

# X19s

16 Relay, 16 Digital Input, 4 Analog Input  
Expansion Module



## USERS MANUAL

Revision 1.0

For models: X-19s

16 Relays • 16 Digital Inputs • 4 Analog Inputs



- ▶ Freezer Doors
- ▶ Light Switches
- ▶ Water Meters
- ▶ Solenoid Valves
- ▶ Lights

**CONTROL** by  
**WEB**™  
www.ControlByWeb.com

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<b>X-19s User Manual Revisions</b>	
<b>Revision</b>	<b>Description</b>
1.0	Initial release

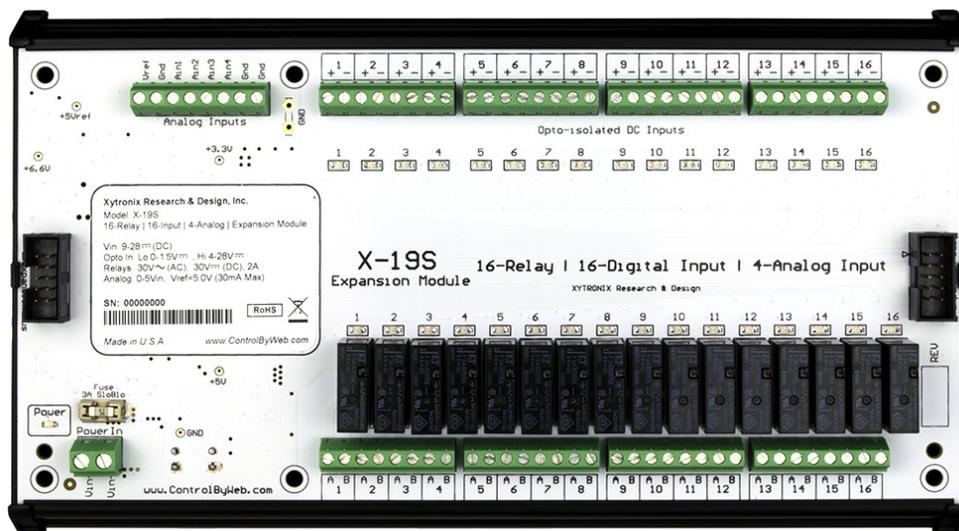
# Section 1: Introduction

The X-19s™ expansion module is used with the X-600M controller. The X-19s has 16 relays, 16 optically isolated digital inputs and 4 analog inputs. Screw terminal strips provide connections to the relays and inputs. One or more X-19s 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 and easy to use and do not require special programming skills.

The X-600M together with expansion modules such as the X-19s provide an easy, flexible and reliable way to monitor and control systems and devices over a network. The X-19s is suitable for use with security systems and industrial controls. It can monitor freezer doors, light switches, and water meters and control moderate loads such as solenoid valves, and lights.

The X-19s' 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 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

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### Relays (16)

The X-19s has sixteen Form A (SPST) relays. The screw terminal connections are wired directly to the relays with no internal fuse or other over current protection. An internal 40V varistor helps protect the relay contacts from arcing. The relays are isolated from all other circuits. For loads greater than 2 Amps, an external interposer relay should be used.

### Digital Inputs (16)

The X-19s has sixteen optically-isolated digital inputs. A 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-19s to be electrically separate. Internally the X-19s has a co-processor which provides enhanced features which include pulse counting and de-bounce timers. Each of the 16-inputs have separate de-bounce and input logic.

### Analog Inputs (4)

The analog inputs have a 0 to 5V range with 12-bit resolution. Control relays or trigger email messages based upon the analog reading.

A precision +5.0V reference terminal is available to power resistance sensing sensors such as potentiometers and bridge sensors. The reference output can provide up to 30ma. When resistance sensors are excited (powered) from the 5.0V reference output, the measurement will be ratio-metric with the reference. With ratio-metric measurements the absolute voltage (and error) of the reference is removed from the measurement accuracy.

### 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-19s 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.

### Power Supply

The X-19s 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-19s 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

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### Input State

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

### 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.

### De-bounce Time

Each of the sixteen 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

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Device	Description	Part Number
X-19s	16-Relay, 16-Input, 4-Analog expansion module	X-19s
Jumper cable	5-inch x 10 conductor ribbon cable (included)	EXPCBL-5in

## Section 2: Installation and Connections

Installation consists of mounting the X-19s and connecting it to an X-600M controller with a 10-conductor ribbon cable. Connect a 9-28VDC power source to the X-19S. Programming and testing is done 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.
- 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.

### 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-19s 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-19s 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

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**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-19s, the equipment to which it is connected, or both.**

Screw terminal connectors are provided for making the relay, input, analog 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-19s, 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-19s 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-19s units. When making connections between the X-19s and the smaller expansion modules, a ribbon cable with multiple connectors can be used. These cables are available from [ControlByWeb.com](http://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-19s, and the smaller modules, purchase a cable with one extra connector to allow the required spacing between the X-19s and the adjacent module. The photo in section 2.2 (above) illustrates how to connect the X-19s. The photo shows an X-600M (on the right) connected to an X-19s module using the ribbon cable that came with the X-19s. To the left of the X-19s are two additional "small" expansion modules (X-12s and X15s). The X-19s is connected to these modules using a multi-connector ribbon cable with four connectors. Due to the height difference between the X-19s 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-19s because it has large number of relays and the ribbon cable cannot reliably provide sufficient DC power. Instead the X-19s 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 allow the X-600M to power X-11s, X-12s etc modules. These power connections flow thru the X-19s from one ribbon cable connector to the other, but are not connected to its internal power supply.

## 2.4 Optically-Isolated Input Connections

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Internally each digital input is connected thru 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 discrete device. To use these inputs, connect a DC control voltage directly to the input, and set up the input function using the 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-19s:

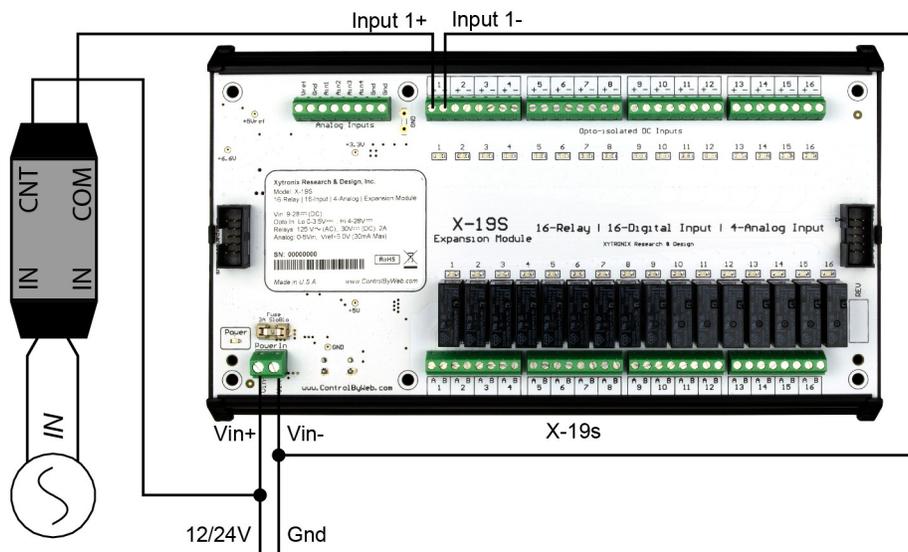
$$R = ((48 - 1.2) / 0.009) - 3000 = 2200 \text{ ohms}$$

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

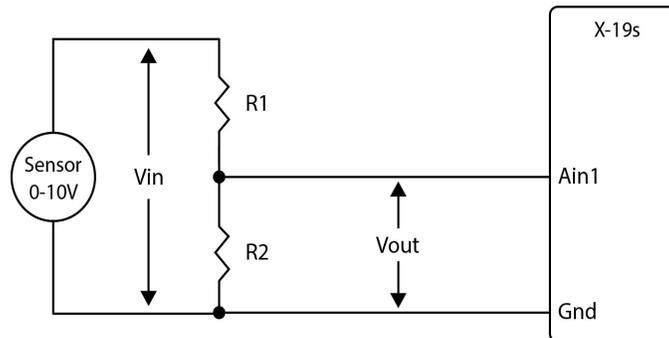
If an AC signal voltage needs to be detected, use a signal conditioner to convert the AC signal to a DC voltage within the input range. An AC signal conditioner can be made using a diode (or bridge rectifier) and a capacitor. Prepackaged signal converters are available as accessories at industrial automation distributors. A simple voltage converter module manufactured by [www.redlion.net](http://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-19s 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-19s as shown in the example below:



## 2.5 Analog Input Connections

The analog inputs must be within the range of 0.0V to 5.0V. Analog sensors that provide an output voltage within the range of 0 to 5 volts can be connected directly to the X-19s module.

For some applications it may be necessary to add external resistors to scale the input to a value compatible with the X-19s. In the case of a sensor whose output levels are higher than 5 volts, a simple voltage divider can be used to scale down the output. The following diagram shows a voltage divider circuit for a 0-10V sensor. In the example resistor values for R1 and R2 are chosen so that Vout will have a 0 to 5 volt range.



Generally, you can choose a 10K Ohm resistor for R2 and then calculate the value of R1 using the following formula.

$$V_{out} = V_{in} * (R2 / (R1 + R2))$$

To determine the proper resistor value to use in the example above, use the maximum output of the sensor (10 VDC) as Vin in the equation, the maximum input value of the X-19s (5 VDC) as Vout, and R2=10K Ohms. Solving for R1 gives R1=10K ohms.

$$R1=10K$$

$$R2=10K$$

As another example, if the maximum output voltage of the sensor is 15VDC, choose R2=10K. Solving for R1 gives R1=20K ohms.

The input bias current of the X-19s is relatively low, such that the X-19s will work with input circuits with an impedance of up to 10K ohms with negligible error.

The slope and offset for the voltage divider must be calculated and entered into the setup pages of the X-600M. The general term for the Slope is:

$$\text{Slope} = (Y2 - Y1) / (X2 - X1)$$

For the 10V input example:

$$\text{Slope} = (10V_{in} - 0V_{in}) / (5V_{out} - 0V_{out}) = 2V/V$$

Once the slope is determined, calculate the offset using the  $Y = mX + b$  linear equation where  $b$  is the offset.

$$0V_{out} = 2V/V * 0V_{in} + \text{Offset}$$

$$\text{Offset} = 0V - (2V/V * 0V) = 0$$

To configure the X-600 with the new *slope* and *offset* values, navigate to the **I/O > Analog Input** screen. Click the *Edit* button of the desired analog input channel. Enter the new Slope, Offset and Units values.

## Analog Input | Configuration

Edit Analog Input.

**Analog Input**

Device:

Device Analog Input Number:

\*Name:

\*Description:

Decimal Places:

Slope:

Offset:

Units:

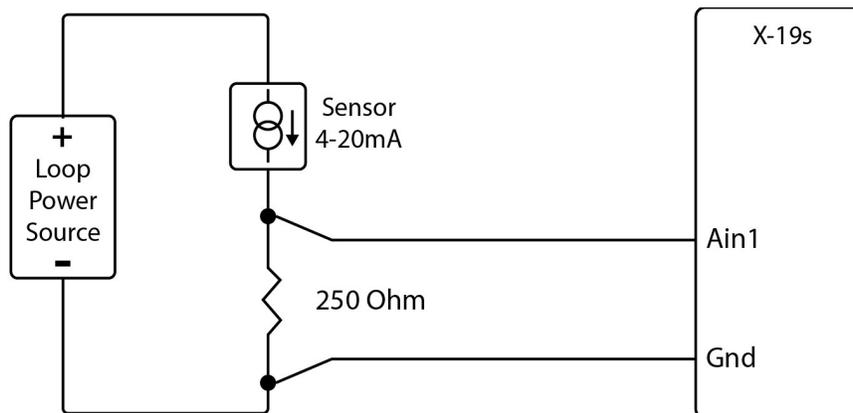
Differential Mode:  On  Off

\*Names are short (20 character max) identifiers that are used in Lua scripts to reference I/O. They may not contain spaces or special characters. The Description (60 character max) appears in Dashboards, Emails, etc.

Click **Update** to submit the changes.

## 2.5.1 Current Sensors

Some sensors generate an output current instead of an output voltage. To use these sensors, a load resistor is connected in the current sensor loop. The load resistor generates a voltage proportional to the sensor current which is in turn sensed by the X-19s. The following diagram shows how to connect a 4 to 20mA sensor to the X-19s.



With a 250-ohm load resistor, a 4 to 20mA sensor will generate a 1.0 to 5.0V output which can be directly connected to the X-19s. A voltage measurement of less than 1.0V indicates the current loop is open or that something is wrong with the sensor. Ensure the resistor wattage is appropriate to handle the power dissipation. A 250-ohm resistor with 20mA flowing thru it will generate 0.1W. The measurement accuracy will be no better than the resistor's accuracy. In general use a 1% or a 0.1% resistor.

When making connections with current sensors it is very important to consider the lead dress. The example above shows the voltage sense connections made with a 4-wire Kelvin connection. This technique uses separate pairs of current-carrying and voltage-sensing wires to make accurate measurements. The goal is to prevent current from flowing in the sense wires and terminals of the X-19s. If current is allowed to flow in the Gnd connections of the X-19s, the current will generate a small offset voltage due to the resistance of the wires and terminals. The offset voltage becomes a source of error. This is especially problematic where the X-19s is used to measure multiple 4-20mA sensors. When connecting more than one 4-20ma sensor consider using a "star" or single point ground topology. If the output current from one sensor changes or affects the measurements of other sensors (crosstalk), you will need to re-consider your connections.

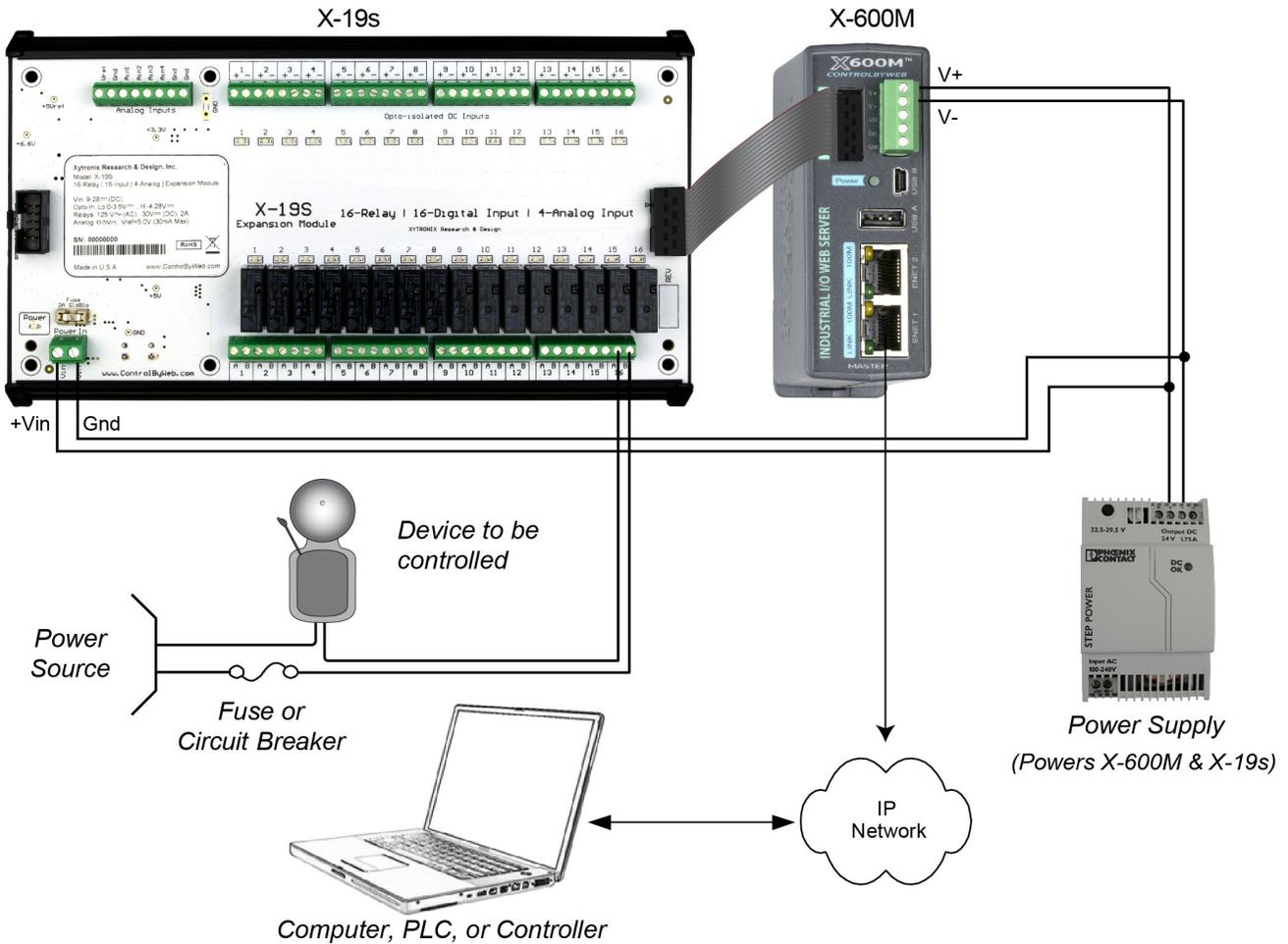
Loop powered current transmitters normally require 7 to 8 Volts across their terminals in order to work properly. With a 250-ohm resistor the load resistor will drop an additional 5-Volts. Allow 2-volts or so for voltage drops across the wiring, especially if the wires are small or long. In this example make certain your loop power source is at least 15-Volts (8+5+2).

# Section 3: Example Applications

## 3.1 Control a device over an IP network

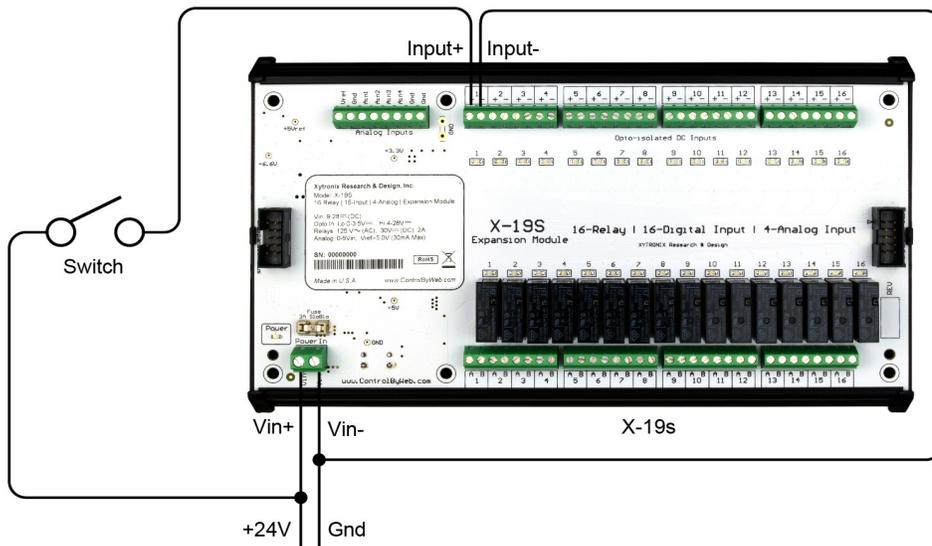
The illustration below shows a simple example of using the X-19s to control a device over an IP network. The device to be controlled is wired in series with the relay contacts.

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



### 3.2 Monitor a switch sensor over an IP network

The illustration below shows an example of using the X-19s to monitor the status of a gate or door over an IP network. The status of the device is detected with a switch. These type of sensors are called “dry contacts” in that the sensor output is a bare switch with no power source. A voltage source for the switch must be provided (this could be via the power supply for the X-600M).



# Section 4: Configuration and Setup

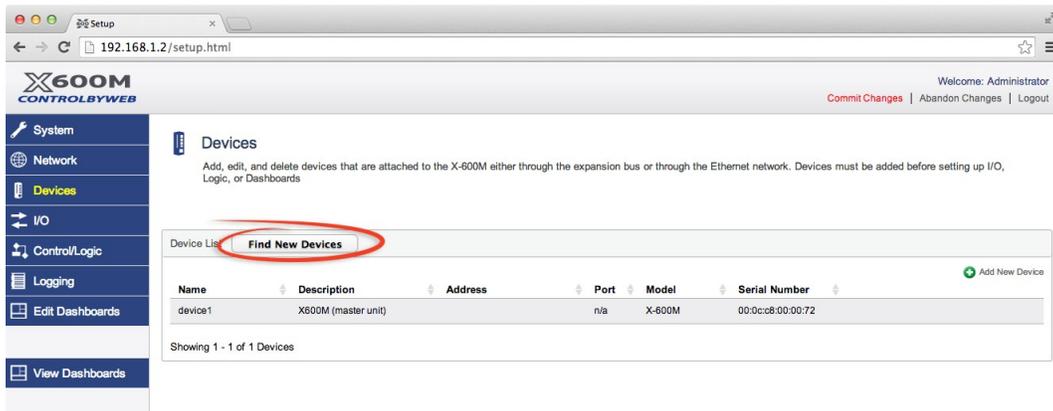
## 4.1 Setup Example

### The Quick Start Demo

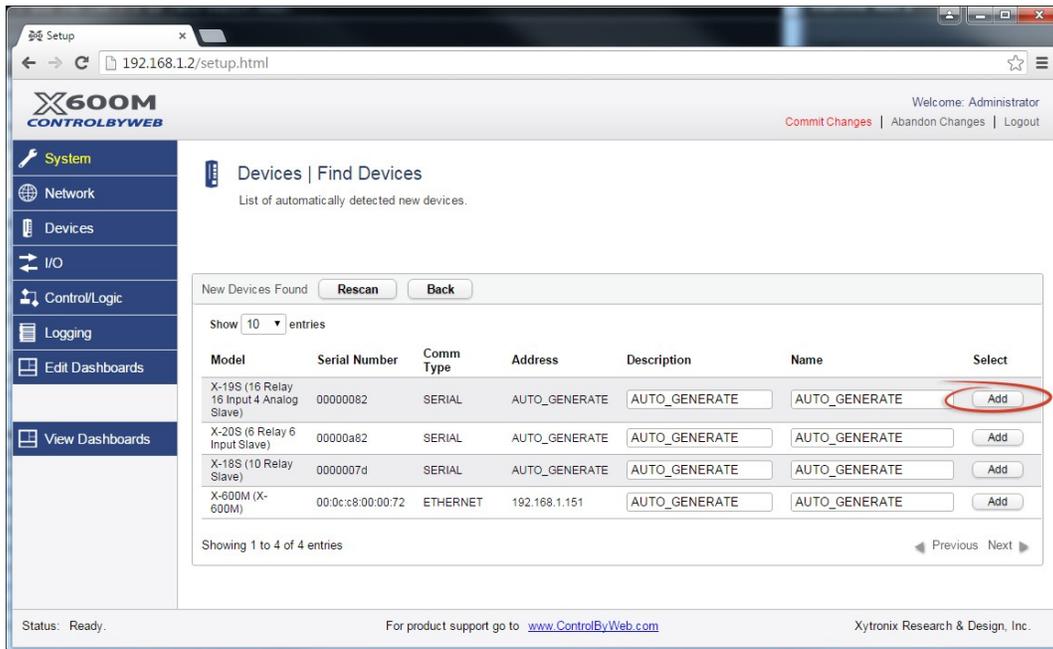
After making the power and Ethernet connections, the X-600M can automatically scan for the presence of any ControlByWeb™ Ethernet devices (on the same sub-net) and also for any expansion modules connected to the X-600M via the ribbon-cable connector. It can automatically create a dashboard web page and populate it with all of the resources (components) supported by the Ethernet devices and expansion modules. 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.

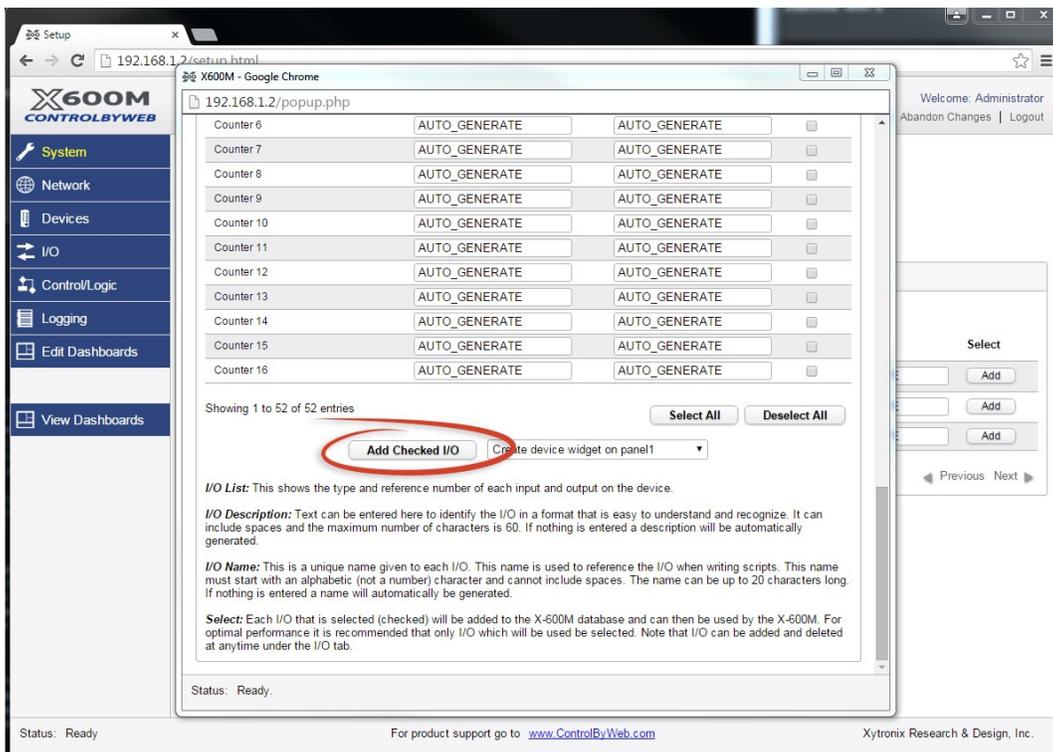


2. In this example we are going to add an X-19s expansion module. Click the **Add** button for the X-19s.

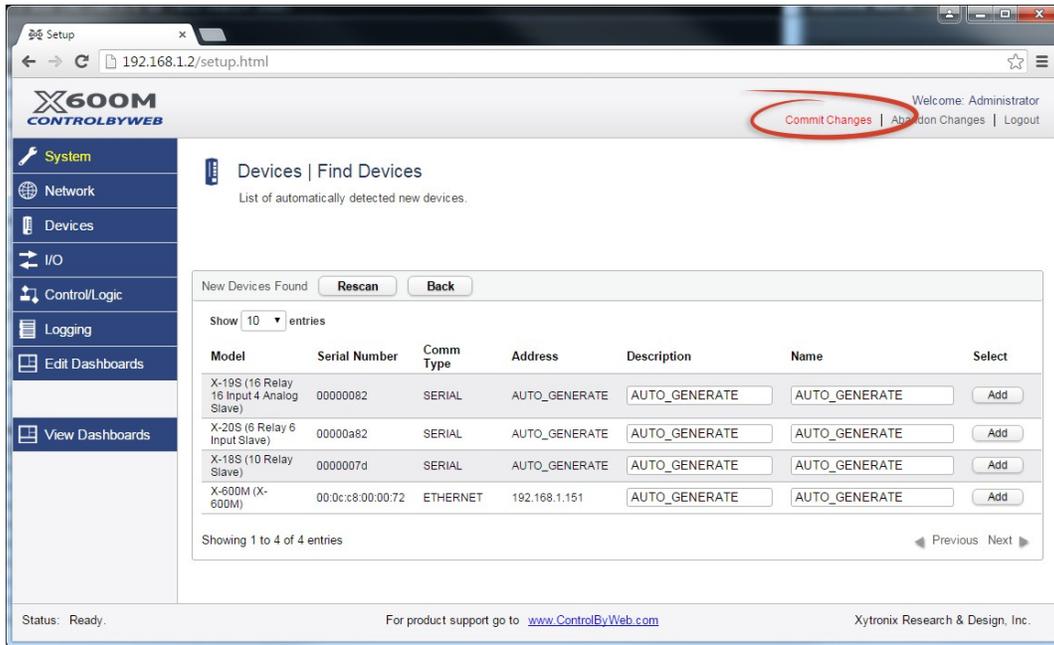


3. In the *Select* column, click the checkboxes of the I/O components you would like to configure and select the **Create Device Widget** option (This will display the status of the I/O on the Dashboard).

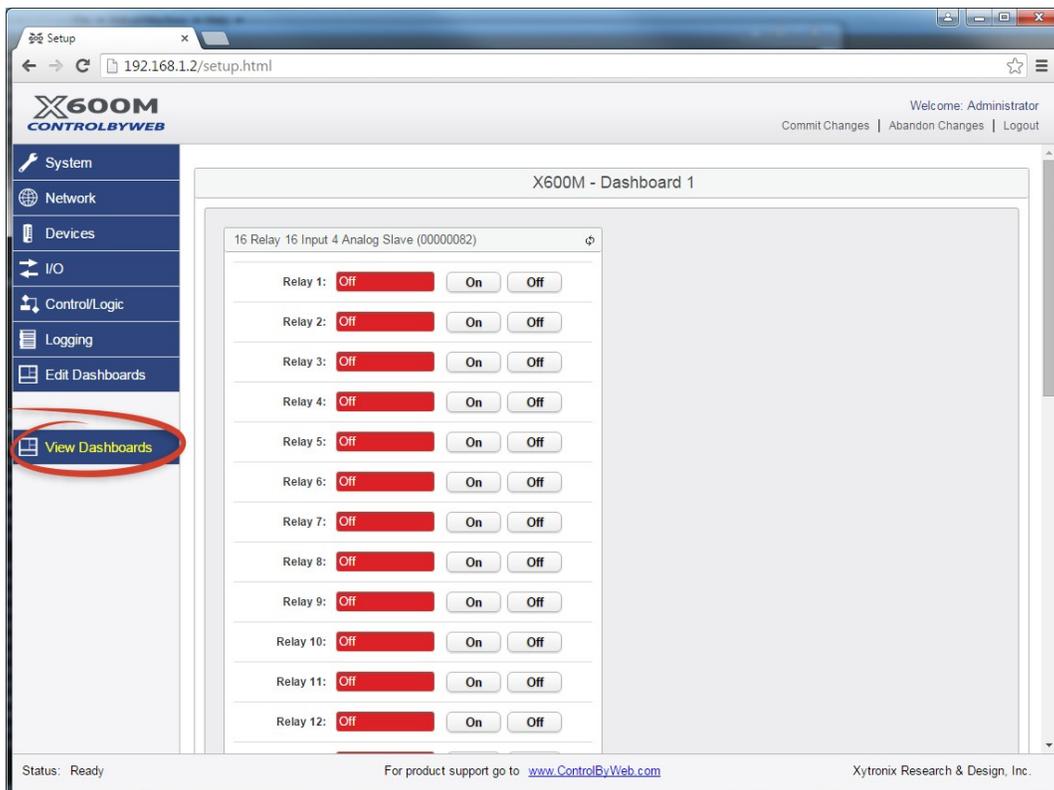
Click **Add Checked I/O** to submit these changes.



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	650 mA
12 VDC	16 mA	490 mA
24 VDC	12 mA	250 mA

### Relays

Number of relays: 16

### Relay Contacts

Load Type: General purpose

Contact Form: SPST (form A)

Contact Material: Silver nickel

Max Voltage: 30 VAC / 30 VDC

Max Current: 2A

Electrical Life: 100K cycles, min @ full rated load (higher with smaller load)

Mechanical Life: 5M cycles, min

Environmental Rating: Over voltage Category II, Pollution Degree 2

Control Options: On/Off or Pulsed

Pulse Timer Duration: 100ms to 86400 Seconds (1-day)

### Terminal Block

Type: PCB terminal block, screw connection, 3.81mm pitch

Wire: Use wire rated for 75°C (min) for connections to the relays

### Digital Inputs

Number of Inputs: 16

Minimum Pulse Time (high or low): 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)

### Measurement Functions

Input State: Asynchronous status of the digital inputs

Count: Total number of transitions (32-bit)

Edge Trigger: Rising, Falling or Both

De-bounce Time: 2mS min, 127 sec max

Max Count Rate: 100Hz

**Analog Inputs**

Type: 4 Single-ended channels  
Input Range: 0-5VDC  
Resolution: 12-bit  
Input Leakage Current: .001uA (Typ.)  
Reference: 5.000V ±.04%, 3ppm, 30mA MAX  
Sampling Rate: 2-sec (via X-600M)

**Expansion Connector:**

Connector: Ribbon cable, 2x5-position, polarized 0.100" pitch  
Communications: RS-485

**LED Indicators**

Green: Power On, Relay 1-16, Input 1-16

**Environmental**

Rating: Indoor use or NEMA-4 protected location  
Altitude: up to 2000m  
Operating Temperature: -40°C to 65.5°C (-40°F to 150°F)  
Storage Temperature: -40°C to 85°C (-40°F to 185°F)  
Humidity: 5-95%, non-condensing

**Mechanical**

Mount: Snaps onto a 35mm by 7.55mm DIN rail  
Size: 8.6" x 4.95" x 1.96" (218.44 x 125.73 x 49.78 mm)  
Weight: 12 oz (342 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**

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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](mailto: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

