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Find the *Acromag BusWorks XT1121-000* at our website: ***Click HERE***

BusWorks® XT Series
10/100MB Industrial Ethernet I/O Modules
USB Programmable, Modbus TCP/IP

Model XT1121-000, 16-Channel Sourcing Digital I/O
16 Active-High Inputs w/ 16 High-Side Switch Outputs

USER'S MANUAL



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IMPORTANT SAFETY CONSIDERATIONS

You must consider the possible negative effects of power, wiring, component, sensor, or software failure in the design of any type of control or monitoring system. This is very important where property loss or human life is involved. It is important that you perform satisfactory overall system design, and it is agreed between you and Acromag, that this is your responsibility.

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GETTING STARTED

DESCRIPTION

Symbols on equipment:



Means “Refer to User’s Manual for additional information”.

The XT1121-000 is a Modbus TCP/IP network control module for interface with up to 16 channels of digital input/output for high-side (sourcing) applications. This unit is setup and configured for network communication via a USB connection to any Windows-based PC (Windows XP and later versions only). The unit provides I/O isolation from network & power.

Key Features

- **CE Approved, UL/Cul Class I, Division 2 Approved.**
- **Designed and Manufactured with High Quality/High Reliability with AS9100 (Aerospace Quality)/ISO9001.**
- **Modbus TCP/IP Protocol Support and w/ i2o Messaging Support.**
- **Conveniently setup and configured w/ Windows software via USB.**
- **High-Density 22.5mm wide package with pluggable, front-facing terminals.**
- **Dual Isolated 10/100Mbps Ethernet ports w/ Auto-Negotiation offers convenient “daisy chain” network connection which saves switch ports.**
- **Operation & Diagnostic LED indicators aide trouble-shooting.**
- **Bus Power Ready for wired or Redundant power connection along DIN Rail.**
- **High 1500VAC Isolation between I/O Channels (as a group), the network (including port-to-port), and power.**
- **I/O, power, excitation, network, & USB ports are all transient protected.**
- **Tandem Input/output channels allow loop-back monitoring of outputs.**
- **Discrete open-source outputs switch up to 32V and 250mA each.**
- **Inputs use TTL thresholds and support up to 32V DC.**
- **I/O channels include 10K ohm pull-downs to Return (RTN).**
- **Outputs have built-in protection for transients, over-current, over/under voltage, loss of ground, reverse excitation, and thermal overload.**
- **Failsafe Mode support w/Watchdog Timeout Control.**
- **Wide-range DC power input from 12-32V.**
- **Wide ambient temperature operation from -40°C to +60°C.**
- **Thoroughly Tested and Hardened for Harsh Environments.**
- **Withstands High Shock (25G) and Vibration (4G).**
- **Model XT-1121-000 is ATEX Certified for Explosive Atmospheres.**
  II 3 G Ex nA IIC T4 Gc -40°C ≤ Ta ≤ +60°C
  DEMKO 15 ATEX 1561X

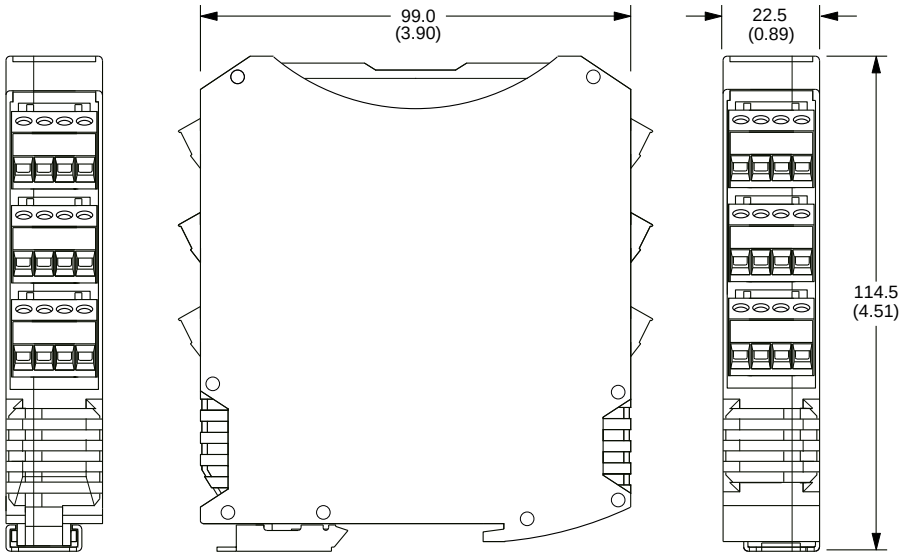
Application

These modules may be mounted side-by-side on 22.5mm centers along T-type DIN rail and units can even plug-together to share power and/or excitation connections along the DIN rail. This model interfaces with any mix of up to 16 digital inputs and/or outputs controlled/monitored via a 10/100Mbps Ethernet interface using the Modbus TCP/IP application protocol. Outputs are open-source high-side switches that switch excitation up to 32V/250mA to the loads. Inputs are TTL and accept up to 32V. The unit is setup and configured for network operation via a USB connection to a host computer running Acromag configuration software. It also supports i2o messaging over the network which can link discrete inputs of one unit to outputs of another over a network connection.

Mechanical Dimensions

Units may be mounted to 35mm "T" type DIN rail (35mm, type EN50022), and side-by-side on 22.5mm (0.9-inch) centers.

WARNING: *IEC Safety Standards may require that this device be mounted within an approved metal enclosure or sub-system, particularly for applications with exposure to voltages greater than or equal to 75VDC or 50VAC.*

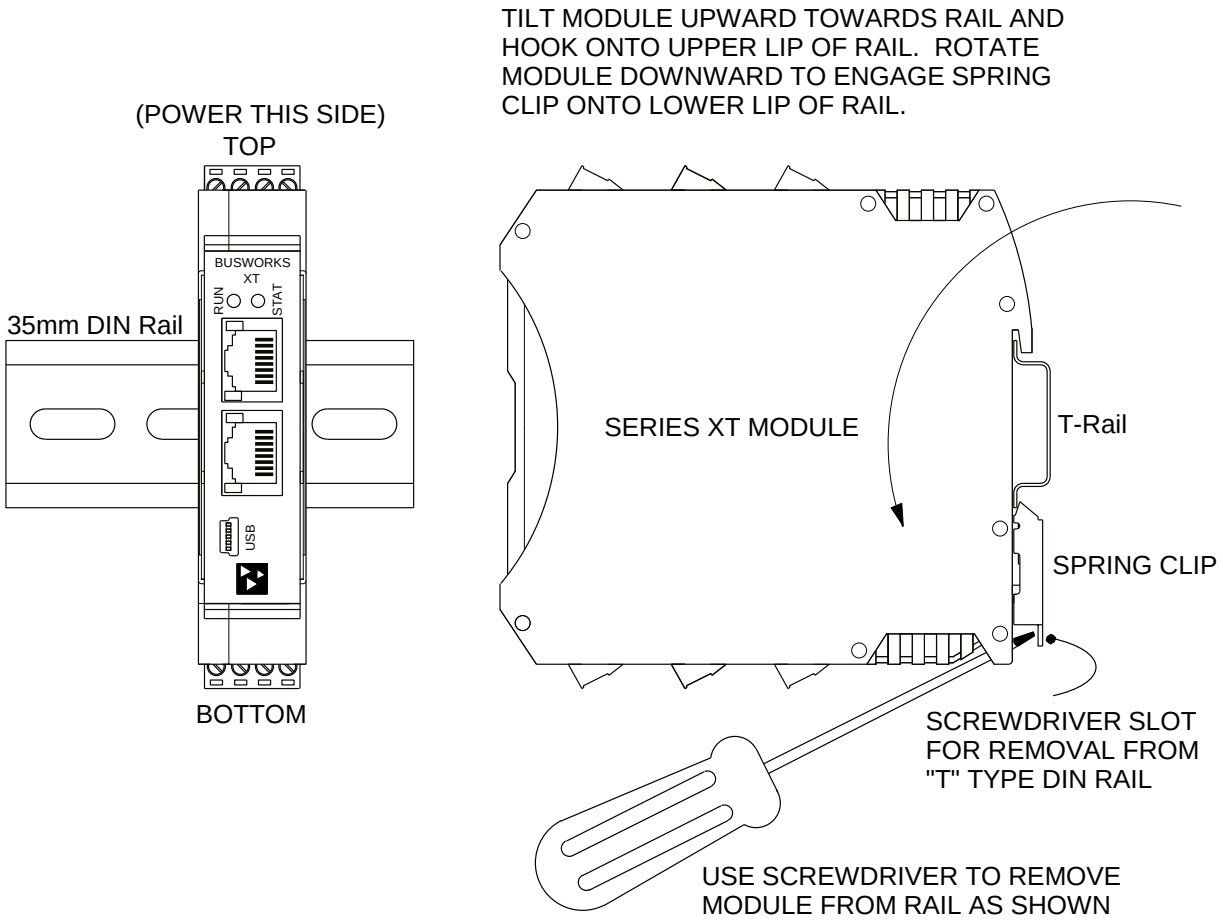


DIMENSIONS ARE IN MILLIMETERS (INCHES)

DIN Rail Mounting & Removal

Refer to the following figure for attaching and removing a unit from the DIN rail. A spring-loaded DIN clip is located on the bottom side. The opposite rounded edge at the bottom of the top side allows you to tilt the unit upward to lift it from the rail while prying the spring clip back with a screwdriver. To attach the module to T-type DIN rail, angle the top of the unit towards the rail and place the top groove of the module over the upper lip of the DIN rail. Firmly push the unit downward towards the rail until it snaps into place. To remove it from the DIN rail, first separate the input terminal blocks from the bottom side of the module to create a clearance to the DIN mounting area. You can use a screwdriver to pry the pluggable terminals out of their sockets. Next, while holding the module in place from above, insert a screwdriver along the bottom side path of the module to the DIN rail clip and use it as a lever to force the DIN rail spring clip down while pulling the bottom of the module outward until it disengages from the rail. Tilt it upward to lift it from the rail.

SERIES XT MODULE DIN RAIL MOUNTING AND REMOVAL



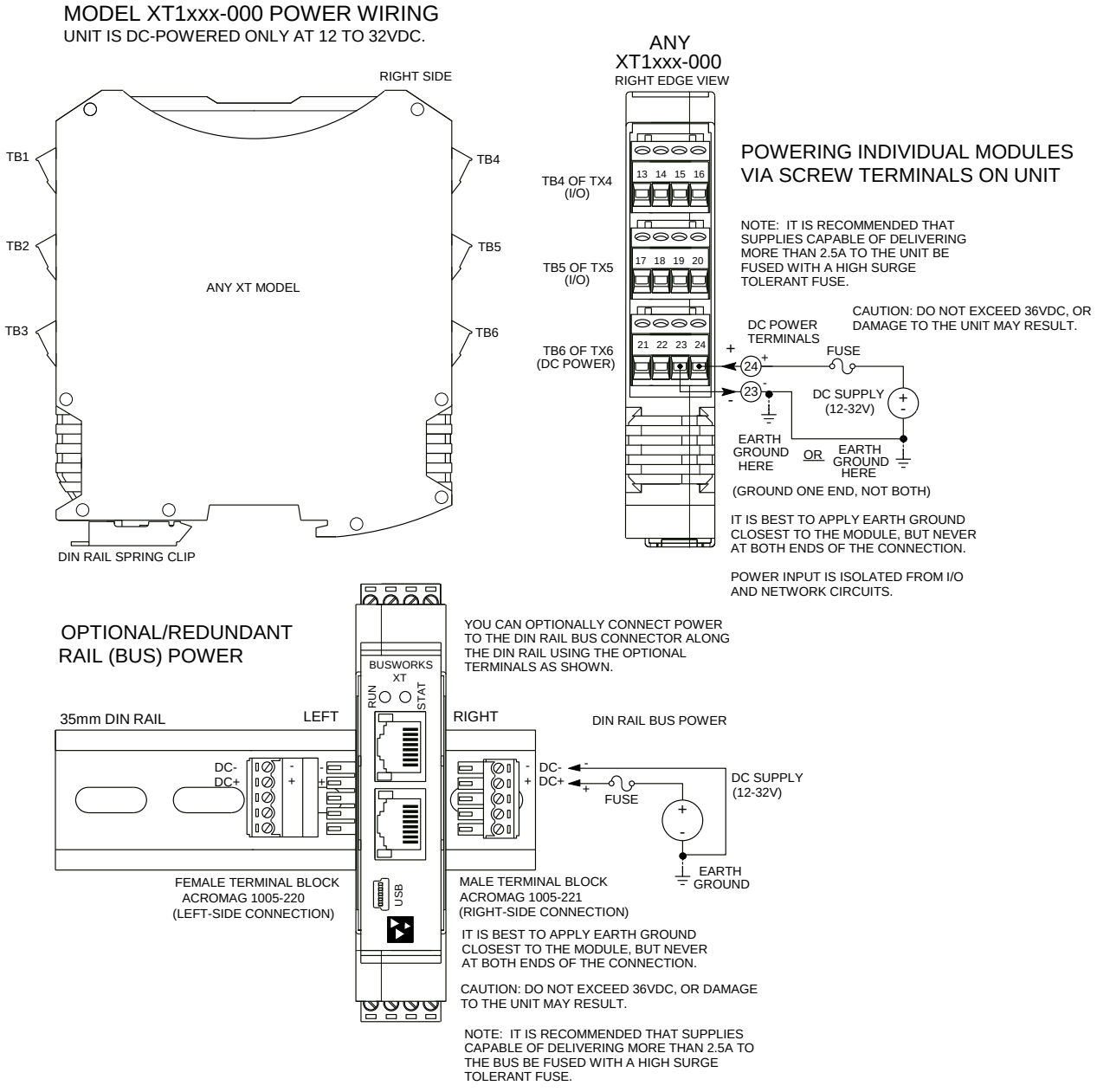
ELECTRICAL CONNECTIONS

WARNING – EXPLOSION HAZARD – Do not disconnect equipment unless power has been removed or the area is known to be non-hazardous.
WARNING – EXPLOSION HAZARD – Substitution of any components may impair suitability for Class I, Division 2.
WARNING – EXPLOSION HAZARD – The area must be known to be non-hazardous before servicing/replacing the unit and before installing.

Wire terminals can accommodate 14–26 AWG (2.08–0.13mm^2) solid or stranded wire with a minimum temperature rating of 85^{o}C. I/O wiring may be shielded or unshielded type. Terminals are pluggable and can be removed from their sockets by prying outward from the top with a flat-head screwdriver blade. Strip back wire insulation 0.25-inch on each lead and insert the wire ends into the cage clamp connector of the terminal block. Use a screwdriver to tighten the screw by turning it in a clockwise direction to secure the wire (use 0.5-0.6Nm torque). Since common mode voltages can exist on I/O wiring, adequate wire insulation and proper wiring practices are recommended. As a rule, I/O wires are normally separated from power and network wiring for safety, as well as for low noise pickup.

Power Connections

Connect a DC power supply from 12-32V as shown in the drawing below. Observe proper polarity (input power is reverse-polarity protected). Optionally, the unit may be powered (or redundantly powered) via its DIN rail connector (optional terminal required, see below). For all supply connections, use 14 AWG wire rated for at least 80°C. Do not exceed 36V DC peak. Be sure to connect earth ground to the DC- terminal, ideally closest to the module, as the other isolated circuits shunt their circuit commons to DC- via high-voltage isolation capacitors.

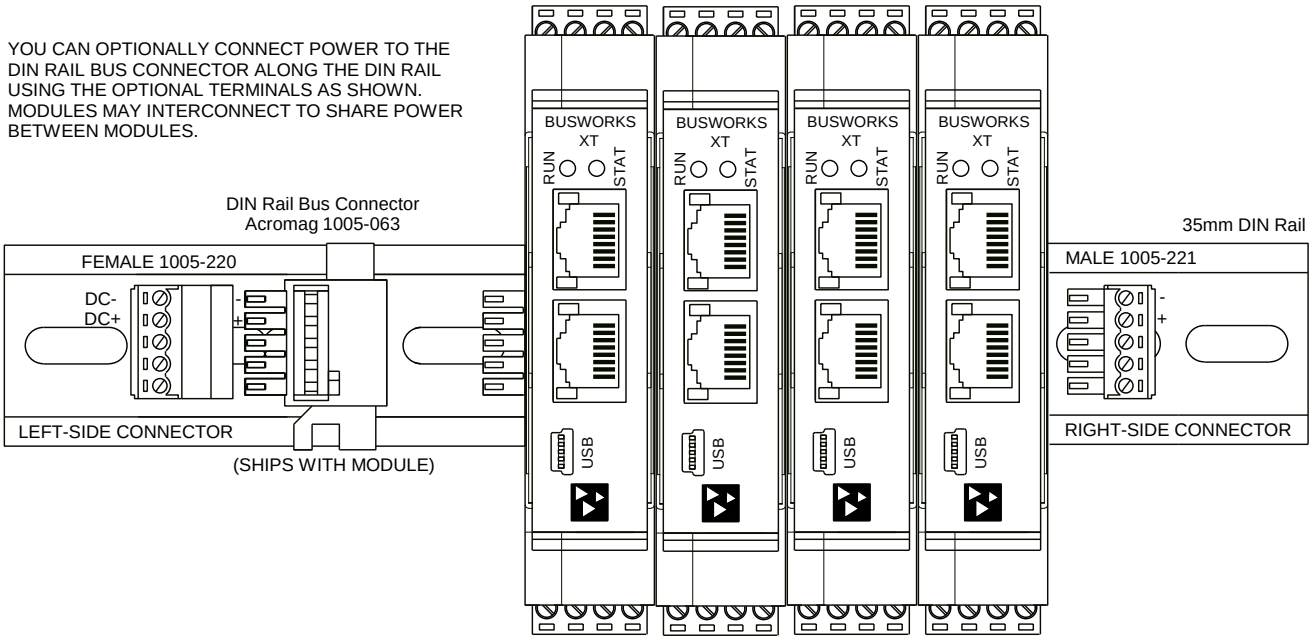


Power Connections…

Note that you can use the bus power connector of the module to interconnect modules by plugging them together and connecting them as a group to a suitable power supply using an optional left or right terminal block, 1005-220 or 1005-221, as shown below.

Important – End Stops: If this module uses the optionally powered (or redundantly powered) via the DIN rail bus for hazardous location installations (Class I, Division 2 or ATEX Zone 2) it must use two end stops (Acromag 1027-222) to secure the terminal block and module (not shown).

XT MODEL OPTIONAL BUS POWER WIRING

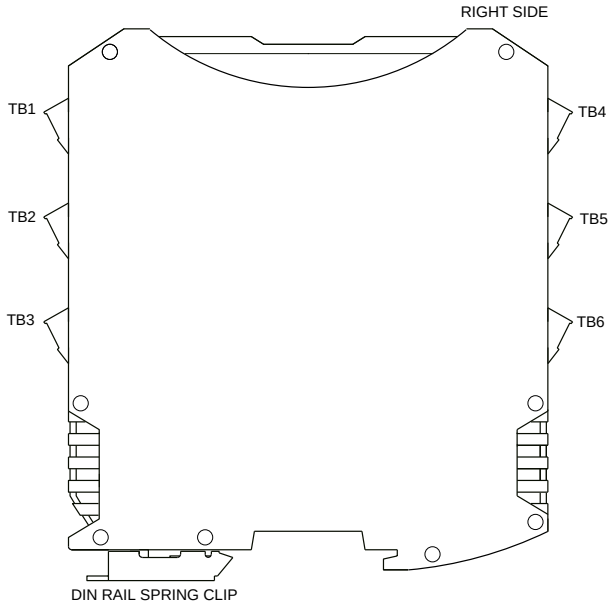


Excitation Connections

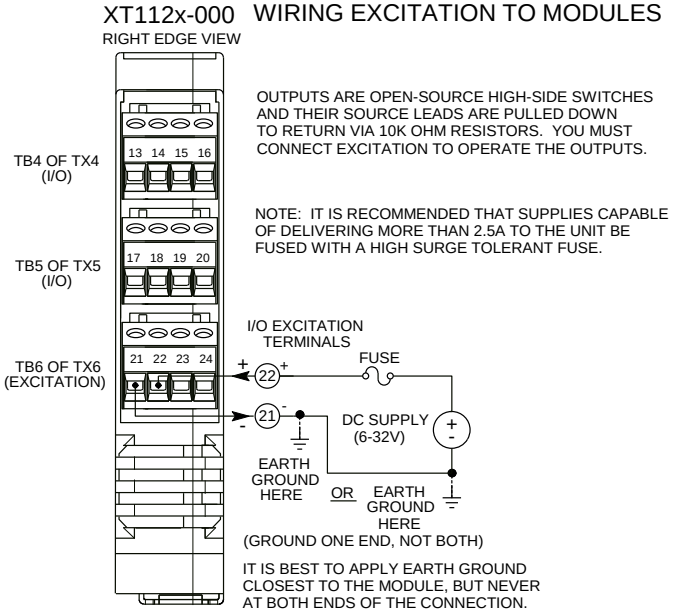
You must connect excitation to operate the outputs of this model. Outputs are the sources of high-side, P-Channel mosfet switches, with their drain leads connected in common to Excitation, and their source leads pulled-down to Return via 10KΩ resistors. Connect DC excitation from 6-32V as shown in the drawing below. Observe proper polarity (excitation is reverse-polarity protected). For excitation connections, use 14 AWG wire rated for at least 80°C. Do not exceed 36V DC peak.

MODEL XT112x-000 EXCITATION WIRING

I/O EXCITATION IS DC ONLY AT 6 TO 32V.



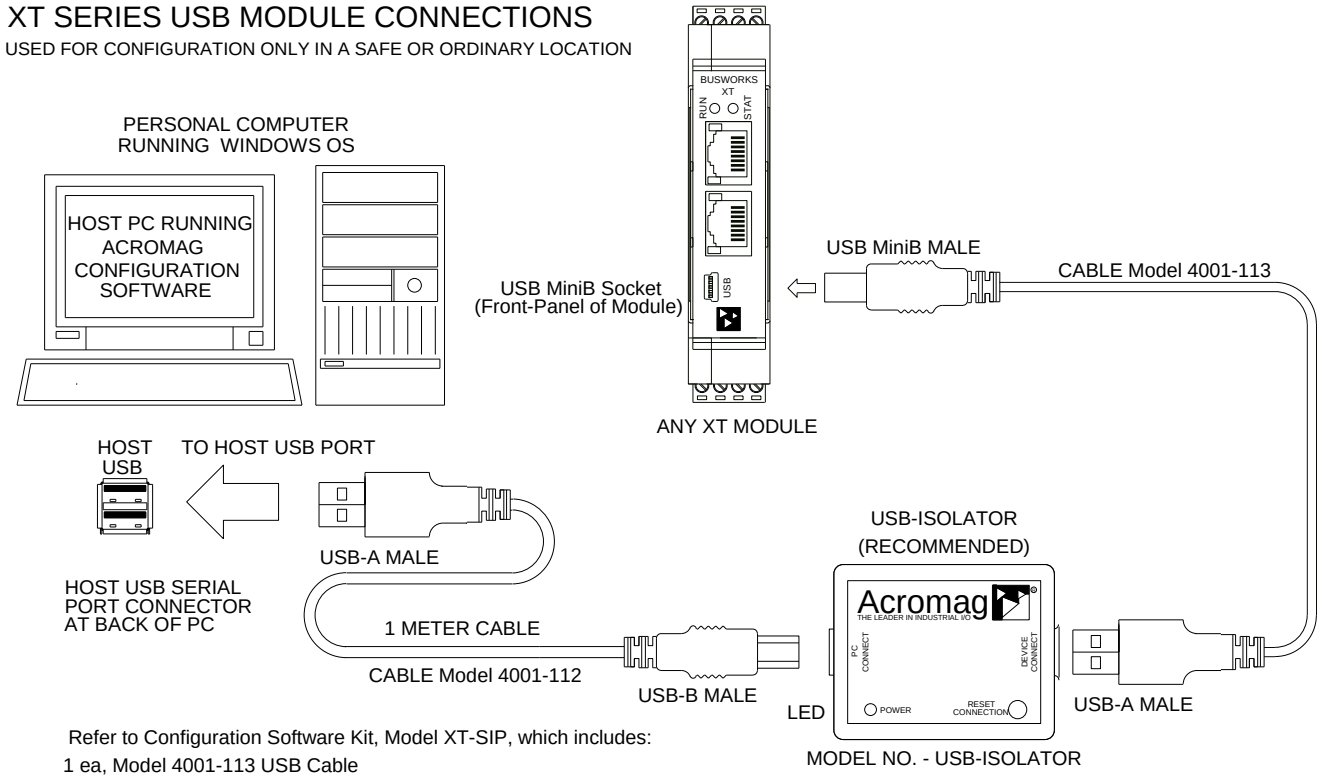
XT112x-000 WIRING EXCITATION TO MODULES



USB Connection

WARNING: The intent of mating USB with this unit is so that it can be conveniently setup and configured in a safe area, then installed in the field which may be in a hazardous area. Do not attempt to connect a PC or laptop to this unit while installed in a hazardous area, as USB energy levels could ignite explosive gases or particles in the air.

- **USB Signal Isolation is Recommended –** You may use Acromag model USB-ISOLATOR to isolate your USB port, or you can optionally use another USB signal isolator that supports USB Full Speed operation (12Mbps).
- **Reconfiguration Does Not Require a Network Connection, as it uses a USB connection**.
- **Connect Unit to Power Before USB**.



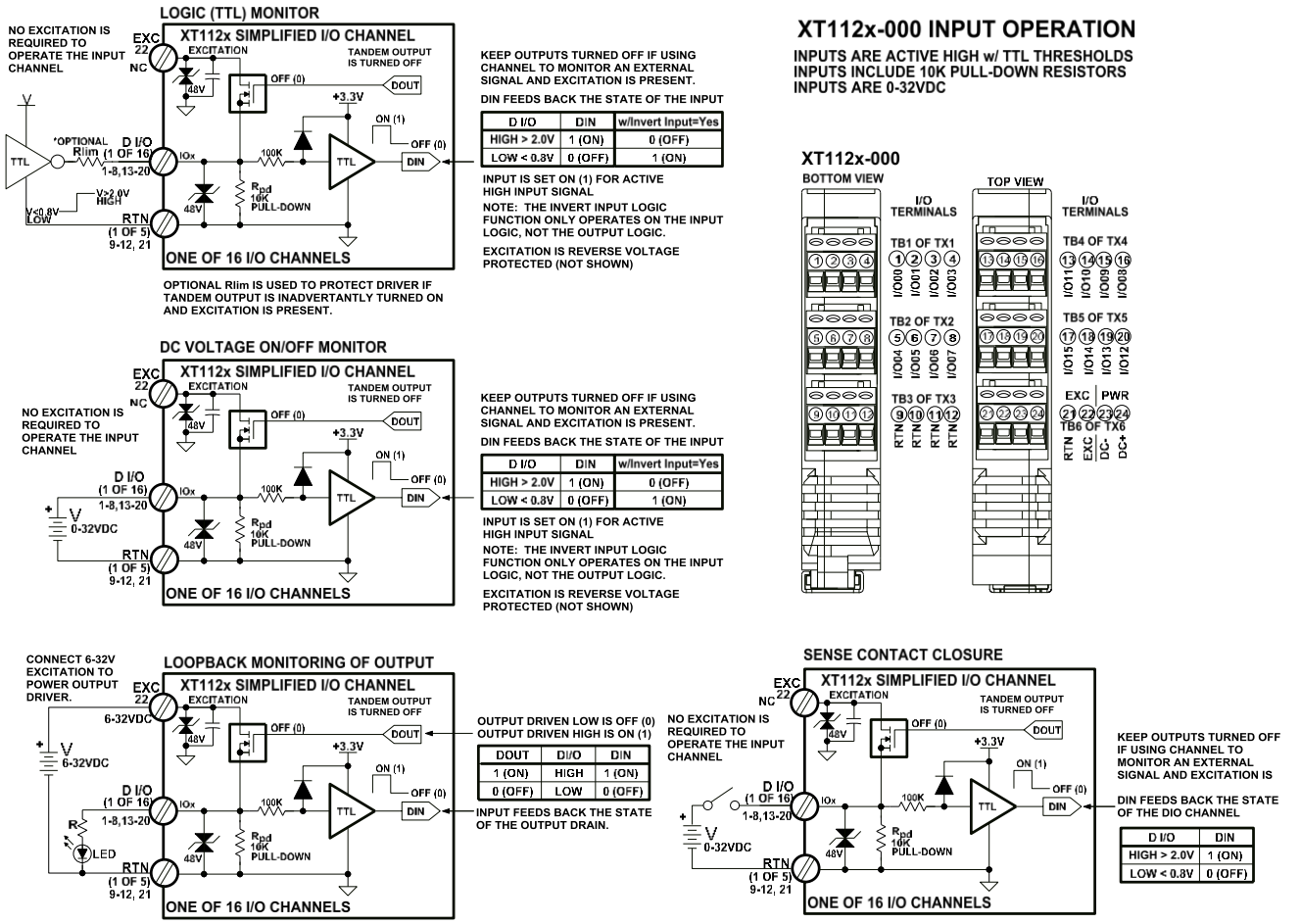
Refer to Configuration Software Kit, Model XT-SIP, which includes:
1 ea, Model 4001-113 USB Cable
1 ea, Model 4001-112 USB Cable
1 ea, Model USB-ISOLATOR
1 ea, Model XT-CONFIG CDROM Software
1 ea, Model 5035-360 Ethernet Cable

Digital Input Connections

16 active-high inputs operate at TTL thresholds and are wired to accomplish loop-back monitoring of the open-source, high-side mosfet switches, or to monitor field input levels with the tandem output switch turned OFF. Inputs include 10K pull-downs to Return (RTN).

Inputs of this model are active-high and accept voltage levels up to 32V and use TTL thresholds for logic transfer. They are pulled down to Return via 10K pull-down resistors installed on the board and never float. Observe proper polarity when making I/O connections. Refer to the following figures to wire inputs to this model.

IMPORTANT: You must keep the tandem output turned off when using the input to sense voltage levels from the field to prevent contention between the field signal and the output channel, which may be turned ON.

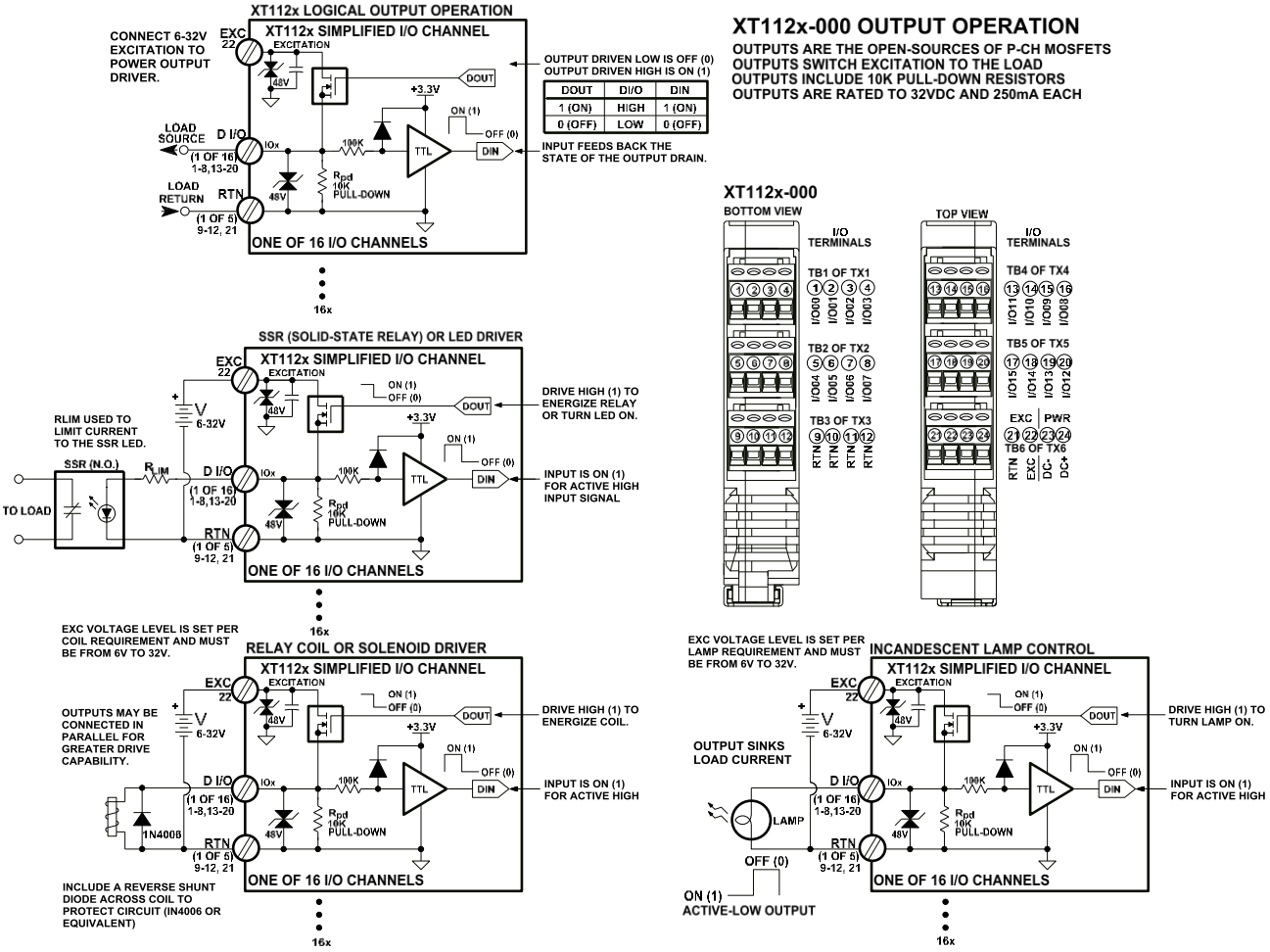


NOTE: If only using inputs to monitor field signals, you do not need to connect excitation. Excitation is only required to operate the outputs.

Digital Output Connections

16 open-source outputs operate as high-side switches between EXC and your load and include 10K pull-downs to Return (RTN).

Outputs will source up to 250mA from the 6-32V excitation to each load. You must connect Excitation to operate the outputs. Observe proper polarity when making I/O connections. Refer to the following figures to wire the outputs of this model.



NOTE: You must connect EXC to a voltage source from 6 to 32VDC to operate the outputs, as the output drivers are powered from the excitation supply.

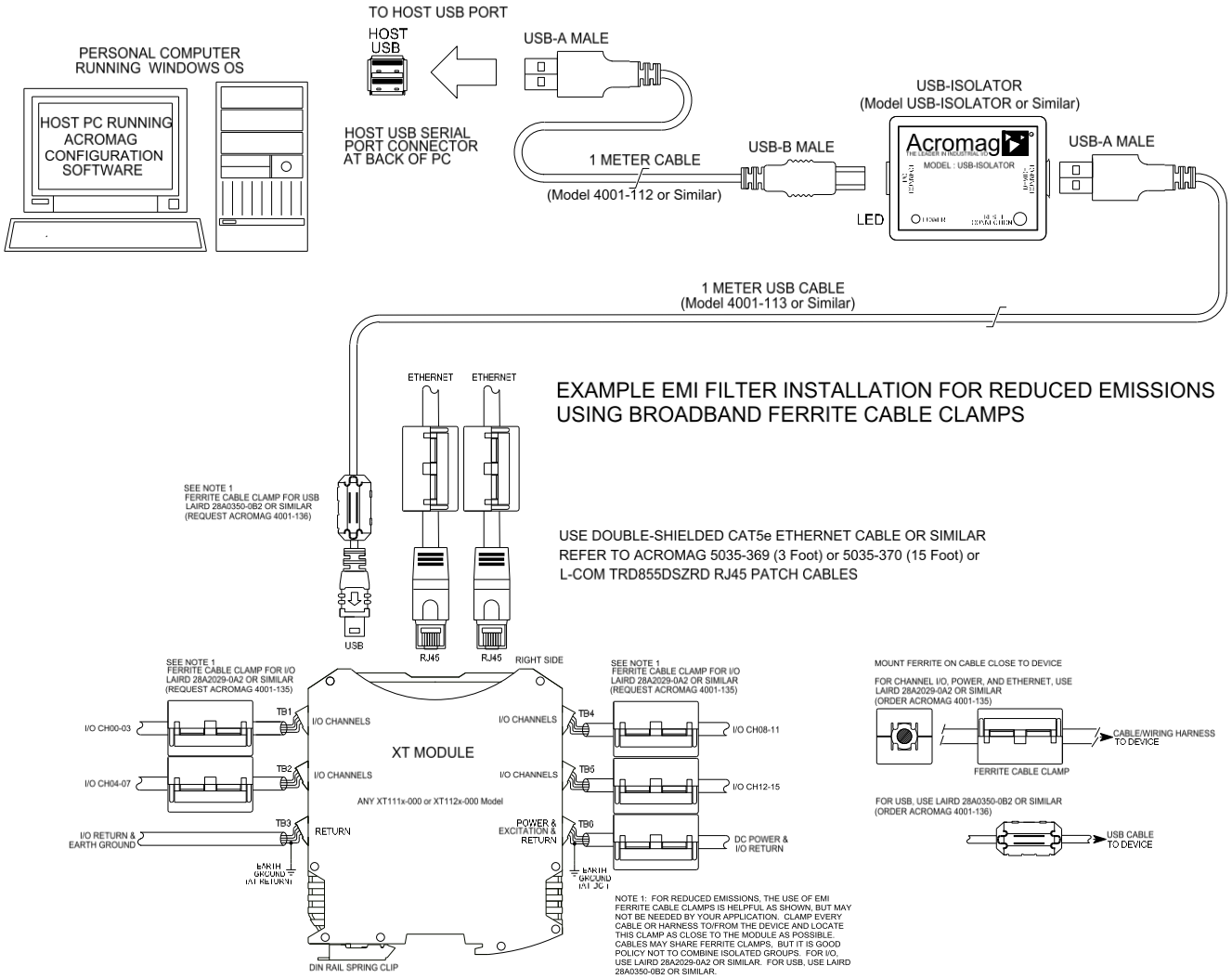
IMPORTANT – Add Protection with Inductive Loads: Outputs do include internal reverse-bias shunt diodes to help protect the output switch from damage due to high reverse-bias voltages generated when switching inductive loads. But you should add external protection near the inductive load to prevent these transients from being sent along the connection wires. Place a diode (1N4006 or equivalent) across an inductive load with the cathode to (+) and the anode to (-).

For greater drive capability or for switching AC loads, it is common to use an appropriately rated interposing relay. Add protection local to the relay as noted above when driving inductive relay coils.

Per UL, when the outputs are used to drive interposing relays for switching AC or DC devices of higher voltage/current, the coil ratings for the interposing relay shall not exceed 24VDC, 100mA.

EMI Filter Installation

For low CE-rated radiated emissions, the use of split snap-on ferrite cores on all cables or harnesses to/from the device as shown in the drawing on the next page is helpful. Use Laird 28A2029-0A2 or similar for I/O, Ethernet, and Power (order Acromag 4001-135) and Laird 28A0350-0B2 or similar for USB cables (Acromag 4001-136). Locate this ferrite by clamping it outside of all input/output cables or wiring harnesses to/from the module (USB, Ethernet, I/O group, DC power), and as close to the module as possible. While the use of these ferrites is helpful to obtaining low CE-rated emissions, it may not be required for your application. Note also that cables may share a ferrite, but it is not good practice to combine isolated circuits inside the same ferrite. Separate isolated circuits for increased safety and greater noise immunity.



Earth Ground Connections

The unit housing is plastic and does not require an earth ground connection to itself. If the module is mounted in a metal housing, an earth ground wire connection to the metal housing's ground terminal (green screw) is usually required using suitable wire per applicable codes.

Circuits wired to power, I/O, and the network should be earth grounded as reflected in the connection diagrams. Note that for I/O, power, and excitation connections, it is always best to apply earth ground closest to the module, but never at both ends of a cable. Keeping this connection close to the module allows any destructive transient energy to be safely shunted to earth ground along a short and local low impedance path, helping to protect the circuit from damage. See the Electrical Connections Drawings for I/O, power, and network ground connections.

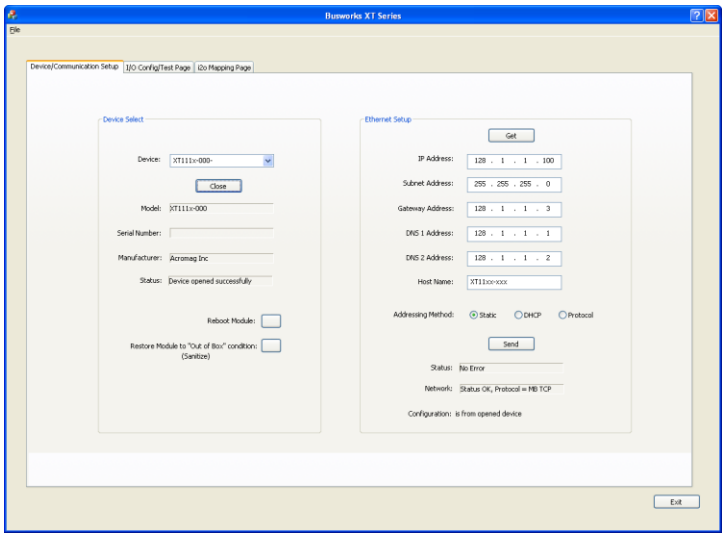
Note: A USB isolator is recommended when connected to a grounded Personal Computer for configuration purposes. This will avoid a potential ground loop that can occur if the I/O signal is already earth grounded, as a PC commonly earth grounds its USB port and this makes contact with the USB signal and shield ground held in common to the input circuit return of this module.

CONFIGURATION SOFTWARE

While this is a Modbus TCP/IP I/O module, it can only be configured and calibrated via its Configuration Software over a USB connection to a Windows-based PC or laptop. USB saves you the trouble of having to already know its set IP address, or having to change the address setting of your network interface card to match its domain to communicate with it. USB software is contained in a zip file that can be downloaded free of charge from our web site at https://www.acromag.com/. Look for the software zip file 9500462 in the Documents and Downloads page for your XT product. Initially, you will have to answer a few questions to open a user account and download this file to your computer. This zip file will extract to an executable file, which installs *modelconfig.exe* executable files in an Acromag subdirectory off the Program Files directory of your PC. Note that you must have administrator rights to download and install this software onto your PC or laptop. Once you have installed the software, be sure to navigate to the *Program Files\Acromag* subdirectory and select the correct *modelconfig.exe* software for your module. This same software is also included on a CDROM bundled with the Configuration Kit XT-SIP (see Accessories) and can be downloaded from the web to ensure that the software is the most up-to-date. The software is compatible with XP or later versions of the Windows operating system. The *modelconfig.exe* software for this unit supports five other model variations—three models with 16 sinking outputs and active-low inputs, and three models with 16 sourcing outputs and active-high inputs.

Quick Overview

After booting the Configuration software for this model, the Device/ Communication Setup page will appear. Once you Select a device and click **"Open"** to connect to an XT1121-000 or XT1111-000 model, your screen will look similar:



For a more detailed configuration procedure, see the Configuration Step-by-Step section of the Technical Reference on page 17 of this manual.

IMPORTANT: Delay clicking [Open] immediately after power-up until it has established its Ethernet connection (wait ~30 seconds after power-up to give it time to initialize), otherwise data transfer or timeout errors may result. If this occurs, turn power off to the unit, close the software, then turn power back on and reboot the software after unit has powered up.

The initial configuration software screen for this model is shown at left. This screen is used to select and identify USB connected units, and to configure the Ethernet parameters necessary to communicate over the network. There are two other screens that can be selected by clicking their tabs, I/O Config/Test, and i2o Mapping. A short description of the controls of this page follows:

Device Select (First Connect to the Unit Here)

- Select from connected modules and Open or Close communication with them.
- Display the Model, Serial Number, and Manufacturer of the connected module and report the status of the connection.
- Reboot a module to force a system reset to the power-up state.
- Restore a module to its initial programmed "out-of-box" state.

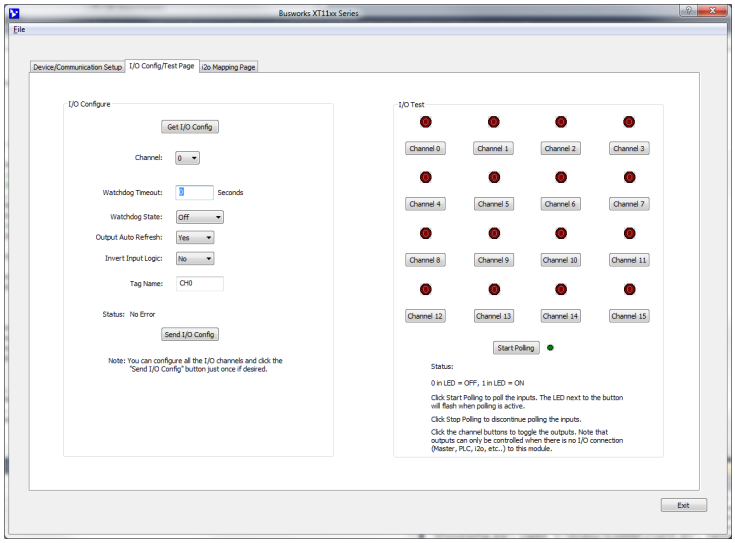
Ethernet Setup (Setup your Network Parameters)

- Retrieve the connected modules current network configuration.
- Set the Network IP address required for Ethernet communication on your network.
- Set the subnet mask, gateway address, and/or domain name server addresses for your network.
- Write parameters to the connected unit and read back the network communication status.

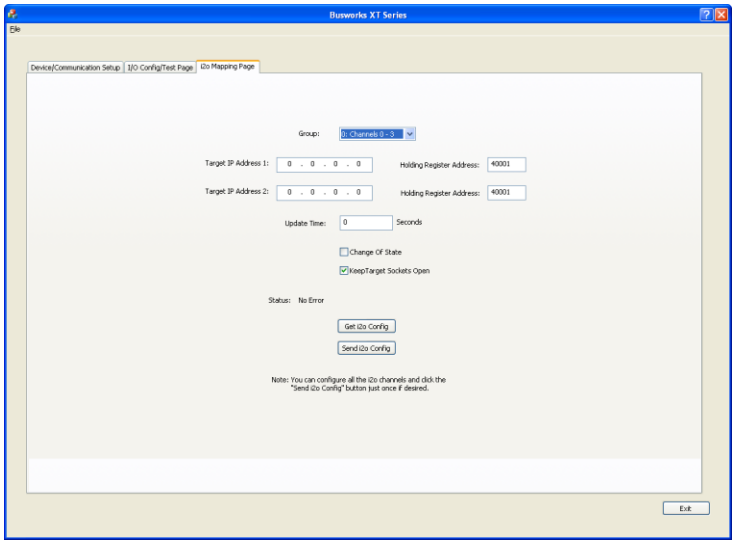
Quick Overview…

HELP – You can press F1 for Help on a selected or highlighted field or control. You can also click the [?] button in the upper-right hand corner of the screen and then click to point to a field or control to get a Help message pertaining to the item you pointed to.

If you click on the I/O Config/Test Page tab, a similar screen to the following will appear:



If you click the i2o Mapping tab, the following screen will appear:



For a more detailed configuration procedure, see the Configuration Step-by-Step section of the Technical Reference on page 17 of this manual.

I/O Configure

- Retrieve the connected modules current channel configuration.
- Configure a watchdog timer for the output channel and a timeout state. Setup auto-refresh for the output to combat digital upset or force a restart following thermal shutdown. You can even choose to invert the logic for the tandem input channel, useful for i2o operation (see below).
- Optionally invert the Input Logic.
- Apply a tag name to the I/O channel for reference purposes.
- Send your channel configuration to the connected unit.

I/O Test

After making I/O configuration changes, you can use the I/O Test controls to verify operation of your I/O.

- Start/Stop polling the input channels.
- Display the current state of the inputs.
- Turn tandem Outputs On/Off.

I2o Mapping

This model includes a special remote messaging function called i2o, for input-to-output communication. This allows it to send its digital input information over the network, to digital outputs on another unit, or compatible unit, without having to hard-wire a connection. The i2o Mapping Page shown at left is used to setup this feature by specifying the IP address of the target output module to send input channel data to, either upon change-of-state, or cyclically at the update time specified.

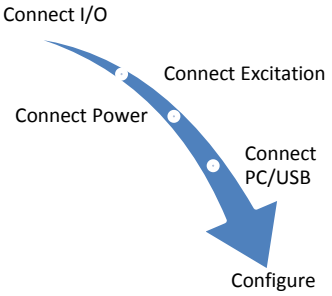
- Set the IP address of one or two target devices to send input data to their output channels.
- Set the Holding Register address to write the input data to at the target.
- Specify to send data upon change of state, or cyclically per an update rate that you specify.
- Retrieve the current i2o configuration from the connected module or send a new configuration to the connected module.

TECHNICAL REFERENCE

CONFIGURATION STEP-BY-STEP

Getting Connected

This section will walk you through the Connection-Configuration process step-by-step. But before you attempt to reconfigure this module, please make the following electrical connections.



1. **Connect I/O:** Refer to Input and Output Connections at the front of this manual and connect your I/O as required for your application.

2. **Connect Excitation (Required for Outputs):** You cannot operate the output channels of this model without connecting excitation across the EXC & RTN terminals on the unit. You do not need to provide excitation if you are only using the digital inputs to monitor field signals. Outputs of this model require excitation from 6-32V (52mA minimum). The actual required current capacity will depend on the loads you are driving and your voltage level, but at full rated load with 16 channels, your excitation supply must be able to deliver up to 4A (See Excitation Connections).

3. **Connect Power:** You need to connect power from 12-32V to power this module. You can choose to connect to Power via terminals on the unit, or via optional terminals that make a connection to the module's bus connector along the DIN rail (See Power Connections). Current required will vary with voltage level (refer to Specifications). Your supply must be cable to drive at least twice the maximum rated current for your voltage level

4. **Connect to PC via USB:** Refer to USB Connections of page 10 and connect the module to your PC or laptop using the USB isolator and cables provided in Configuration Kit XT-SIP.

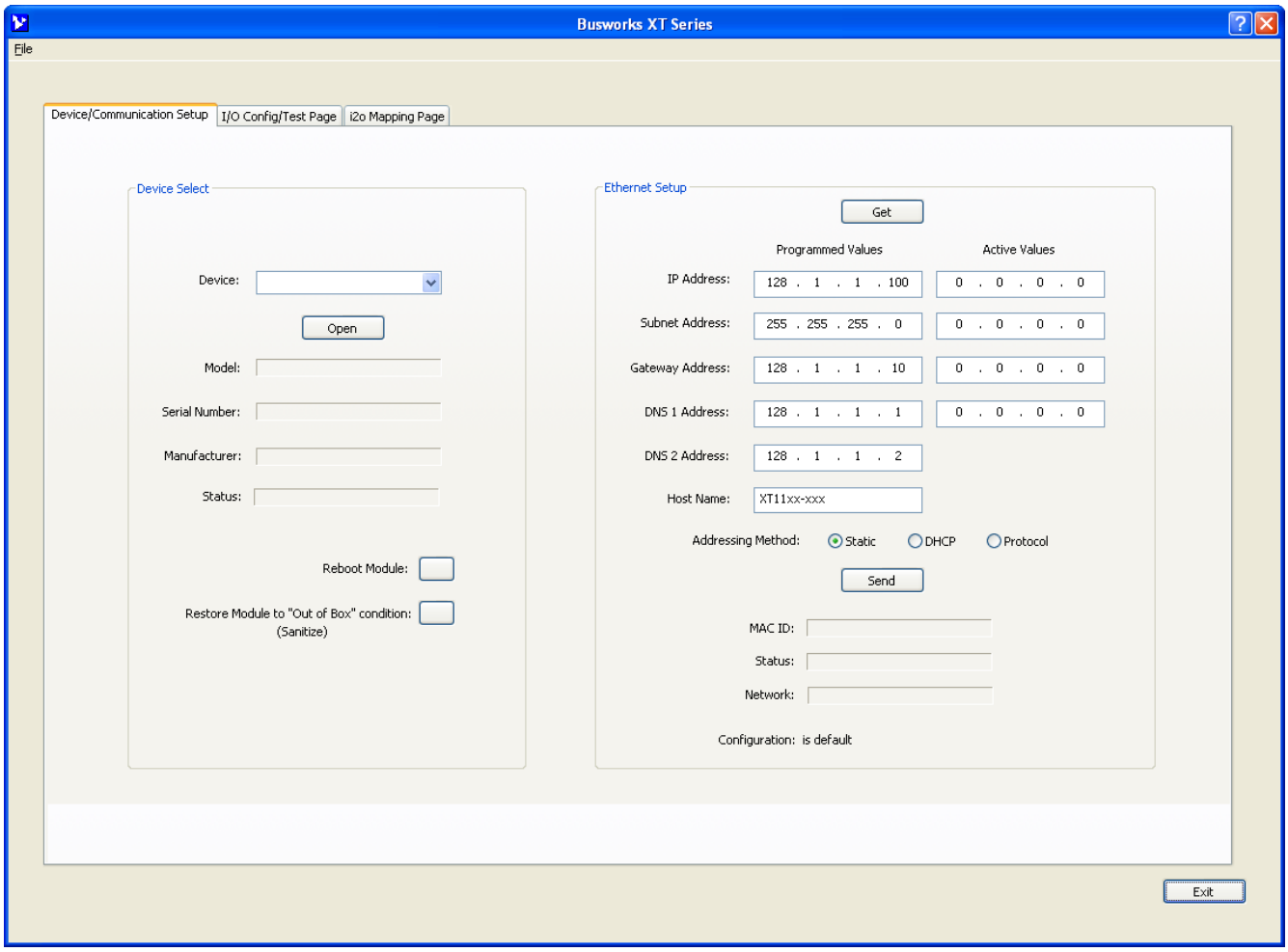
   Now that you have made your connections and applied power, you can execute the XT11xxConfig.exe software to begin configuration of your unit (software is compatible with XP or later versions of the Windows operating system). Note that the same software is used for both DIO models, XT111x-000 (with 16 sinking outputs) and XT112x-000 (with16 sourcing outputs).

   IMPORTANT: Allow the unit to fully power-up and establish its Ethernet connection before attempting to open USB communications with the unit using the XT11xxconfig.exe software (wait ~30 seconds after powering-it up to give it time to initialize).

Note that you do not connect your module to an Ethernet network to configure it. It is instead configured for network operation by initially connecting to USB and a host PC running model-specific configuration software. This has the advantage of not having to know the module's IP address setting or having to change the address setting of your network card to match its subnet address to talk to it.

Device/Communication Setup

After executing the Acromag Configuration software for this model, the screen shown below will appear, if you have not already connected to your module via USB (note Device Select fields are blank under these conditions).



Connect your PC to the unit via USB and its model-serial information will appear in the Device field as shown in the screen on the next page.

Device Select

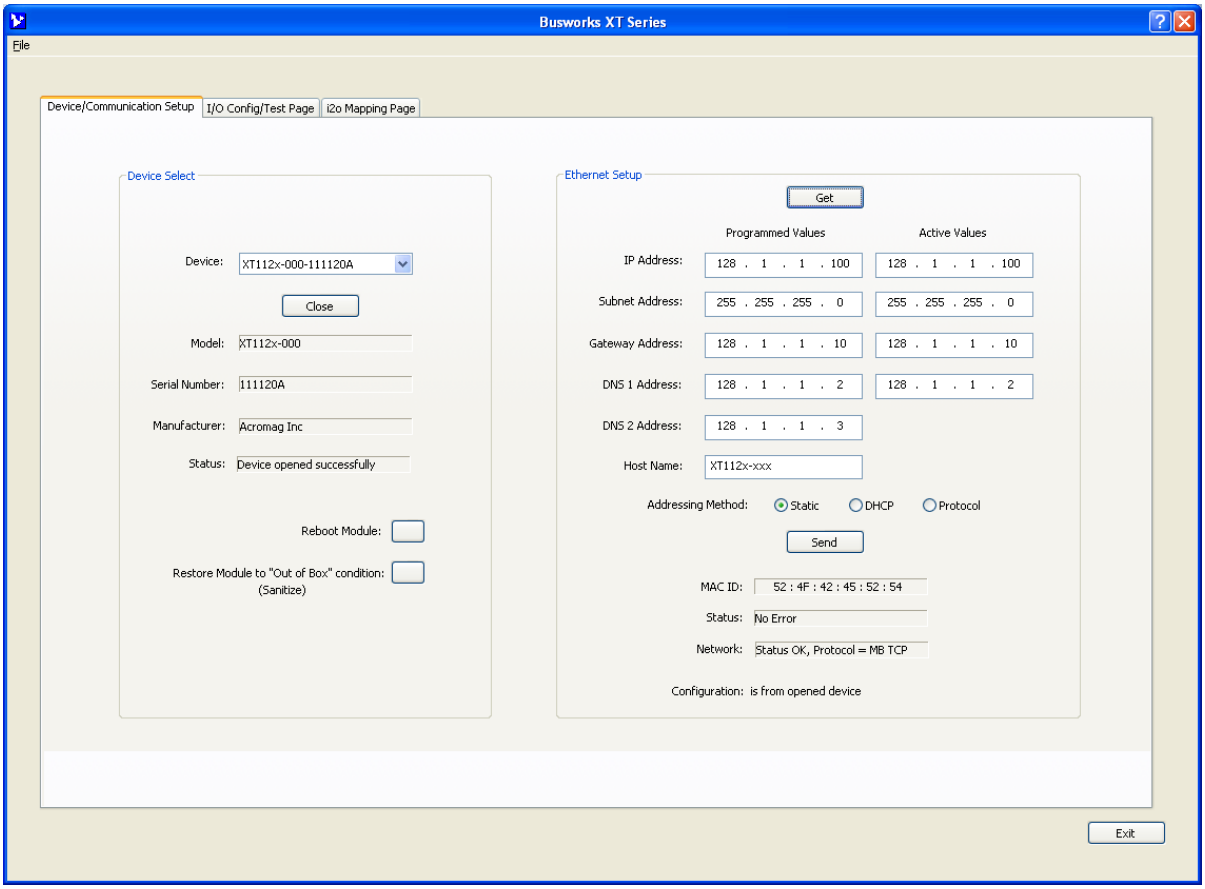
If you are connected to more than one unit via a USB hub, you can use the Device scroll field to select another unit, using the serial information suffix of the Model to discern one unit from another. Be sure to close the connection with a previous unit before connecting to a new unit.

Once you have selected a device, click the **[Open]** button to open communications with the unit.

Note: Click [Open] only after a unit is fully powered-up and has established its network connection (after ~30 seconds following power-up).

After clicking [Open], the selected unit's Model, Serial Number, Manufacturer, and connection status will be displayed as shown on the next page.

Device/Communication Setup…



Device Select

You can use the **[Reboot Module]** button to force a reset of the unit, equivalent to a power-on reset.

You can use the **[Restore Module]** button to restore a module to its initial “out-of-box” configuration.

Ethernet Setup

You can use the **[Get]** button to retrieve the current Ethernet setup of the connected module (sometimes the Active Values fields will indicate zeros and you must click [Get] to retrieve the actual active values).

You use the Ethernet Setup portion of the screen shown above to specify the network communication parameters required to communicate with this module over Ethernet. You may have to consult with your network administrator to complete the contents of this page. The parameters functions are defined below:

An **IP Address** is a unique identification number for any host (this module) on any TCP/IP network (including the internet). The IP address is made up of four octets (8 bits), each octet having a value between 0-255 (00H-FFH). It is expressed here in decimal form, with a period placed between octets.

The **Subnet Mask** is used to subdivide the host portion of the IP address into two or more subnets. The subnet mask will flag the bits of the IP address that belong to the network address, and the remaining bits that correspond to the host portion of the address. The unique subnet to which an IP address refers to is recovered by performing a bitwise AND operation between the IP address and the mask itself, with the result being the sub-network address.

Device/Communication Setup…

Gateway Address refers to the IP Address of the gateway this module is to cross, if your local area network happens to be isolated or segmented by a gateway. Typically, it is assigned the first host address in the subnet address space. If a gateway is not present, then this field should contain an unused address within the host subnet address range.

NOTE: In order to network your PC with an Acromag module, you may have to consult with your network administrator and either temporarily change your TCP/IP configuration (see TCP/IP Properties of Network Configuration in Windows), or create a separate private network using a second network adapter installed in your PC (recommended). The necessary steps will vary with your operating system. Refer to Acromag Application Note 8500-734 to help accomplish this (located on the CDROM shipped with your module or via download from our web site at https://www.acromag.com/).

The **DNS 1 Address** refers to the IP address of the first Domain Name Server used on this network. A DNS server relates symbolic address names to actual numeric IP addresses, while the DHCP server is responsible for dynamically passing out IP addresses.

The **DNS 2 Address** refers to the IP address of the secondary Domain Name Server used on this network. A DNS server relates symbolic address names to actual numeric IP addresses, while the DHCP server is responsible for dynamically passing out IP addresses.

The **Host Name** is the name to be assigned to this host if its address happens to be assigned dynamically using DHCP.

The **Addressing Method** refers to how this network module will obtain its IP address when connected to its network.

Static addressing is exactly as the name implies—it is *static* and represents a unique fixed IP Address that is generally assigned by your service provider or system administrator. The Default static IP address assigned to this module is 192.168.1.100 (refer to product side label), but you can change this address to any address you prefer.

DHCP (Dynamic Host Configuration Protocol) refers to a protocol for assigning dynamic IP addresses to devices on a network. With dynamic addressing, a device can have a different IP address every time it connects to the network. In some systems, it can even change while it is still connected.

This module can support three different network protocols simply by changing its installed firmware (Modbus TCP/IP, Ethernet IP, or ProfiNet). The Protocol addressing method refers to allowing the application protocol specific to this model to set the IP address (Profinet generally requires this).

By default, the module is setup to use **Static IP Addressing and a default Static IP Address of 192.168.1.100**. You can optionally choose to have the IP address assigned dynamically via DHCP, but this will additionally require that you specify a valid Host Name to retrieve the address from. Choosing Protocol gives the application protocol permission to assign the address.

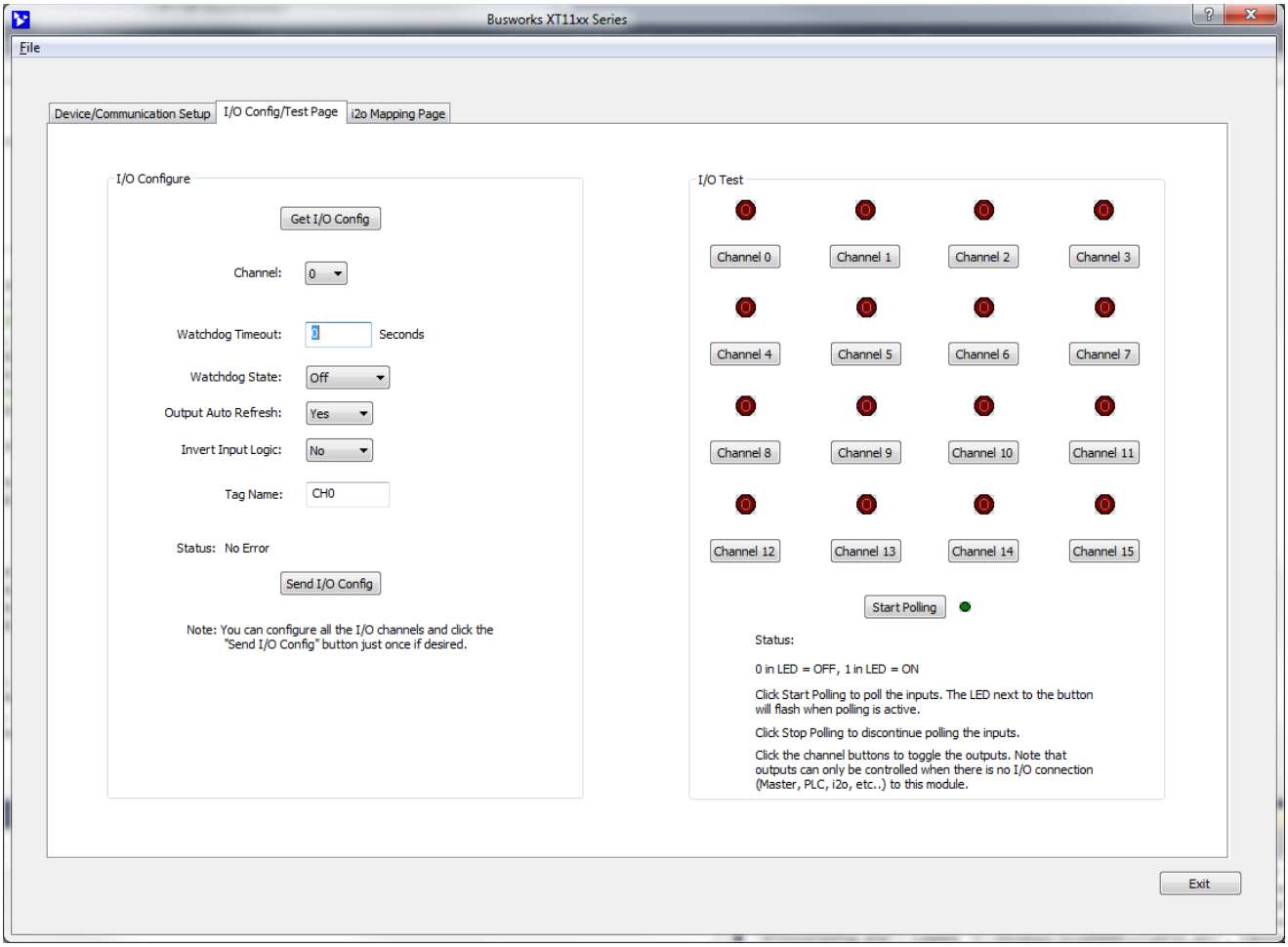
You can click the **[Send]** button to write your Ethernet Setup parameters to the unit once you are done making your selections. This completes any changes made on this page.

The status field will indicate the status of your sent parameters over USB after clicking [Send]. The Network field will indicate the current network connections status as well as the protocol used for this network. The Configuration field will indicate whether the configuration is from an open device, or a default configuration.

You can click the **[Exit]** button in the lower right-hand part of this screen to exit the Configuration Software, or simply click on another tab to access another page before exiting this software.

I/O Configuration & Test Page

Click the "I/O Config/Test Page" tab of the Configuration Software and a similar screen to the following will appear:



This page allows you to configure each channel of the unit, and optionally Test your I/O configuration to verify functionality.

I/O Configure

Get I/O Config Button: Click this button to retrieve the entire I/O configuration of the module.
Channel: Use the channel scroll bar to select the DIO channel you wish to configure. This model has 16 discrete DIO channels and you can configure each individually.
Watchdog Timeout: Specify a time from 5 to 65534 seconds. A time of 0 or 65535 will disable the channel's watchdog timer. If no channel read or write activity occurs during this period, this will trigger a watchdog timeout and the channel will be written to the watchdog state (On or Off) you specify in the next field.
Watchdog State: This is the state that you want the output to go to following a watchdog timeout (see above).
Output Auto-Refresh: You can specify that outputs should be rewritten periodically to ensure they maintain their programmed state following a digital upset, perhaps by some extraordinary transient event. This is also useful to reset an output that may be in a latched thermal shutdown following overload conditions or was set to a specific state by a watchdog timeout that has cleared.

I/O Configure…continued

Invert Input Logic: Note that this model has active-high inputs, but you can choose to apply an inverter to your input channel by selecting "Yes" here. This can be useful for some i2o operations which allow you to control outputs on another "target" module over the network with inputs applied here. For example, if you are sending this unit's input information to the outputs of another unit, or its complimentary active-low XT1111-000 model, and you wish to invert the ON state logic sent to the target device. This only applies to input logic of this model, not its output control logic, as setting an output to "1" always turns it ON for this model regardless of this option setting.
Tag Name (Up to 8 Characters): You can give this I/O channel a name to document its purpose if desired. This is not used by the firmware and just serves as a convenient label for helping to discern its I/O function or application.
Status: This field displays status messages relative to sending and receiving I/O parameters to the module.
Send I/O Config Button: Click this button to send the entire I/O configuration to the device. You can choose to do this one time after you have setup all the I/O channels individually.

Note: A watchdog timeout is triggered if an established client-server relationship to the module is severed by a cable break or power disruption at the client. A client-server network connection to the module is created for the exchange of data between devices, such as that between a Modbus Master and slave, an i2o connection, or that between a networked PLC, HMI, or other client device and its target server module. Thus, a watchdog timeout can only be cleared at the server by first restoring the broken client-server relationship. Clearing a timeout by restoring the client-server connection to the module does not return output(s) to their initial "pre-timeout" state and they remain in their timeout states until otherwise written, or via Output Auto Refresh.

I/O Test

This portion of the screen allows you to selectively turn outputs on or off and read the current state of the tandem inputs. Each channel has a simulated LED lamp that flashes and displays "1" when the corresponding output is ON and is solid red and displays "0" when it is OFF. LED state indication accurately reflects the actual state of the output drain as it utilizes the tandem input channel to read back the drain's state. Optionally, for simple input monitoring of field inputs (with corresponding output OFF), you can click the [Start Polling] button to periodically read the digital input states.

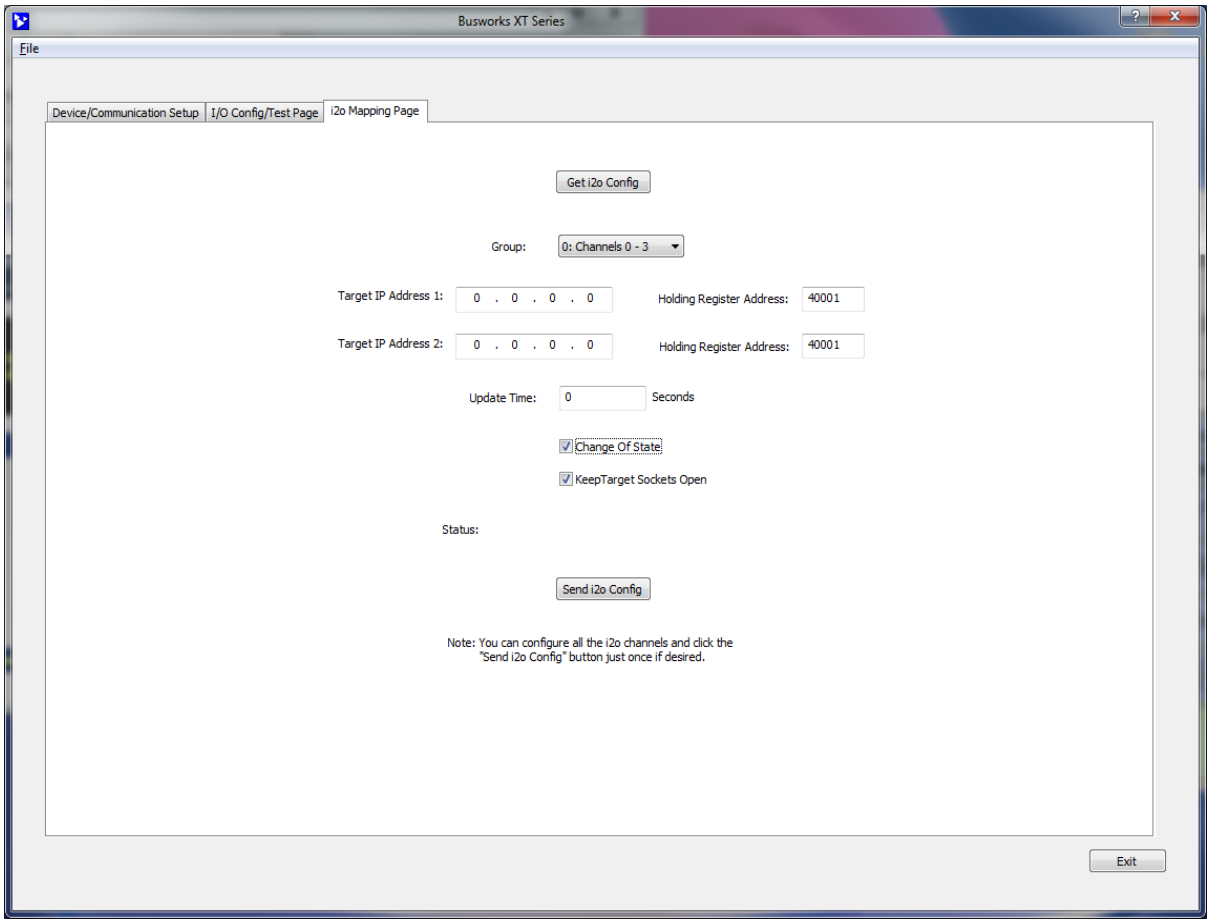
IMPORTANT: The open source outputs of this model include tandem input channels that monitor the state of the source lead. If your intent is to monitor inputs from the field, you must turn the corresponding output OFF, or you may generate contention between the field signal and the channel output when it is ON. Note that all DIO channels have 10KΩ pull-downs to Return and do not float. You must connect I/O Excitation to operate the outputs, as they are powered from Excitation.

Channel Button (Toggle): Click this button to toggle the corresponding DIO channel output ON or OFF.
Start Polling Button (Toggle): Click this button to Start/Stop periodic polling of the DIO input channels. Their states are indicated in the simulated lamp color and the contained "0" indication for OFF, "or 1" indication for ON (if the Invert Input Logic function is set to "No" or disabled).

HELP – You can press **[F1]** for Help on a selected or highlighted field or control.

i2o Mapping Page

Click the "i2o Mapping Page" tab of the Configuration Software and the screen below will be displayed:



This model includes a special remote messaging functionality called i2o, for input-to-output communication. This capability allows it to send its digital input information (or its inverted digital input information) over the network to digital outputs on an identical unit, or another compatible unit (like the XT1111-000). The i2o Mapping Page shown above is used to setup this feature by specifying the IP address of the target module (output) to send input channel data to, either upon change-of-state, and/or cyclically at the update time specified.

IMPORTANT: i2o refers to an Acromag proprietary method of input-to-output communication, done over the network, without other hard-wired connections between inputs and outputs. This is not a Modbus TCP/IP function and the i2o mapping feature of this model may only be configured via this software. As such, there are no Modbus registers for specifying i2o parameters. Under normal operation, this module is designed to function as a Modbus TCP/IP slave/server. By the Modbus standard, Modbus servers are not allowed to initiate messages on their own and may only respond to client/master requests. Thus, the i2o functionality of this unit is a special application that may cause confusion for some other master/client devices linked to the same network. In any case, other master devices on a network should be restricted from attempting to control i2o target devices on the same network to avoid contention.

i2o Mapping…

With i2o, a client-server network connection is established between a sending-module (client) and a target output module (server). This connection refers to an established data path, or socket, between the client input device and server output—it does not refer to just the physical network connection between devices. This is similar with other client-server network connections that are created for the exchange of data between devices, such as that between a Modbus Master and slave, or that between a networked PLC, HMI, or other client device and its target server module.

This model has 16 DIO channels, or four groups of 4 digital I/O channels. Group 1 refers to digital I/O channels 0, 1, 2, and 3. Group 2 refers to digital I/O channels 4, 5, 6, and 7. Group 3 refers to digital I/O channels 8, 9, 10, and 11. Group 4 refers to digital I/O channels 12, 13, 14, and 15. Each group of 4 input channels may be mapped to a corresponding group of 4 output channels on another XT1121-000 unit, or compatible unit (like XT1111-000). The digital input data of this unit may be sent cyclically according to an update time, and/or upon change of state.

You can choose to maintain this connection by enabling Keep Socket Open, or to open and close the connection for each i2o message. If Keep Socket Open is disabled, then you should specify an i2o Update Time at the client that is less than the watchdog time of the server, to ensure that the server's output watchdog does not time-out during the period between i2o updates. Thus, it is generally recommended that you Keep Sockets Open, except perhaps where it costs you money to maintain an open connection, or if infrequent i2o messages might cause your server's watchdog timer to timeout.

The i2o messaging function works best if the target module(s) are already online and ready to receive messages. However, it will still work if the target output module comes online after the input module but may take several minutes to "discover" the network targets and begin transmitting to them. If this input module or the target module(s) go offline, remote i2o messaging will resume on its own when the connection is re-established, but this "healing" function may take several minutes depending on which device(s) went offline, why, and for how long.

It is not recommended to set an i2o update rate greater than 99 seconds while also choosing to "Keep Sockets Open", as increasing bandwidth and shortening response times is not a concern when cyclical messages are spaced farther than 99 seconds apart. But be conservative when setting an update time—shorter intervals than needed may unnecessarily increase network traffic and longer intervals will conserve network bandwidth. Note that digital inputs only map externally to digital outputs of other target modules at different IP addresses, and inputs are mapped in groups of four, to output channels of the target device in groups of four, in the same order. Each i2o message will write at least 4 channels at a time.

To summarize, the behavior of i2o is controlled by the configuration of Update Time, Change-of-State, and Keep Target Sockets Open as illustrated in the following example combinations:

Update Time	Change-of-State	Keep Target Sockets Open	Behavior
0	Disabled	Enabled	i2o is OFF and no i2o messages are sent
0	Disabled	Disabled	i2o is OFF and no i2o messages are sent
0	Enabled	Enabled	Inputs sent every Change-Of-State (COS)
5-99sec	Enabled	Enabled	Inputs sent every COS AND at every interval of time
5-99sec	Disabled	Enabled	Faster throughput w/Inputs sent every interval of update time
0	Enabled	Disabled	Inputs sent only upon a Change-Of-State
5-65535sec	Disabled	Disabled	Inputs sent every interval of Update Time
5-65535sec	Enabled	Disabled	Inputs sent every COS AND at every interval of time
T > 99sec	Disabled	Enabled	Invalid Configuration w/ a long time over an open socket. This will work but it is not recommended to keep the socket open for infrequent i2o updates.

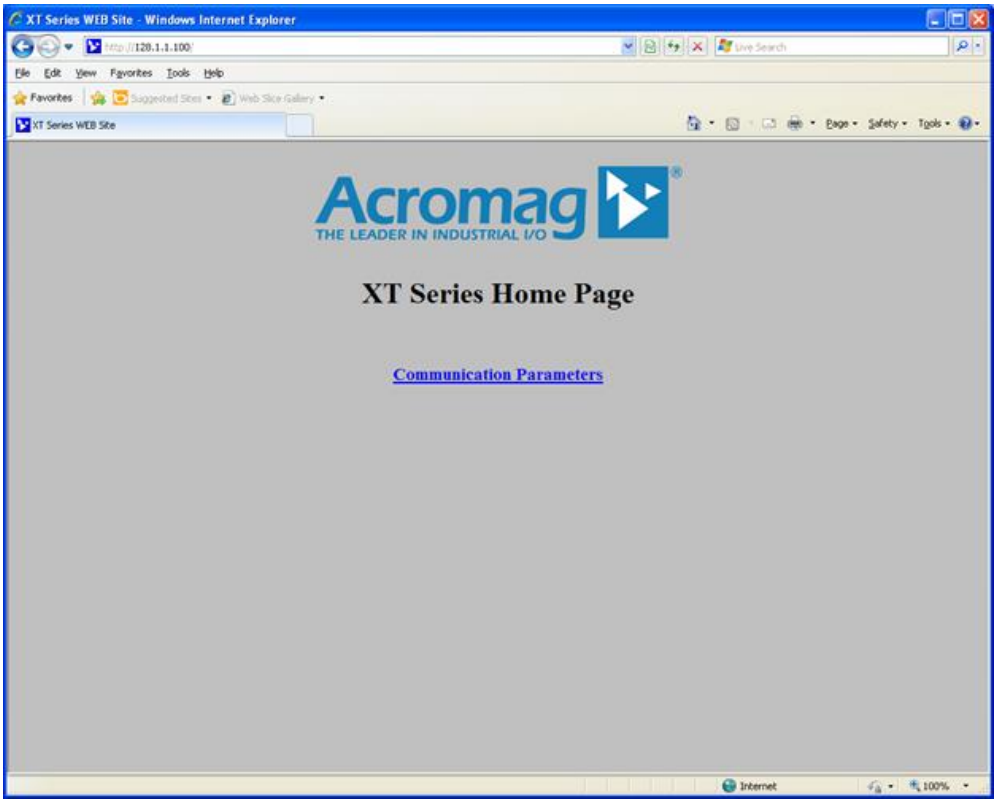
i2o Mapping…

Each input group of this device may be mapped to a channel group of another Acromag XT1121-000 or XT1111-000 digital I/O module at one or two different IP addresses. Subsequent messages will be sent at a periodic rate specified by the update time. Note that the target output port channels may still be controlled independently via the network, but their state will be overwritten by subsequent mapped messages when enabled. It is recommended that you do not control the i2o mapped output ports (target channels) directly, as this could create contention with the i2o control. You cannot use the USB software to control the state of outputs that are i2o targets.

Group Scroll Bar: Select consecutive groups of 4 input channels, each to be mapped to 4 output channels of another unit, in the same order, at the Holding Register address specified. You can configure each group separately.
Target IP Address 1 & Target IP Address 2: This is the IP Address of one or two target output devices (another XT1121-000 or XT1111-000 module on the network). Each digital input group can only be mapped to an output group at one or two target IP addresses.
Holding Register Address 1 & 2: This is the Memory Map address of the output channel group (4 channels) of your i2o target to send this units input data to.
Update Time Field: Specify a time from 5-65534 seconds between messages. Specify 0 or 65535 to turn i2o messaging OFF (cyclical). If change-of-state is enabled and a time greater than or equal to 5 is specified, your message will be sent both upon change of state and at the update time specified.
Change-of-State Checkbox: Set ON to enable output updates on change of input state, and OFF to update cyclically according to the update time.
Keep Target Sockets Open Checkbox: Check this box to keep the communication socket of the target device open after sending i2o data. Keeping the socket open is helpful to obtain a faster i2o throughput time, as the open and close socket messages are not required for each i2o message, allowing an i2o message to be sent immediately along an already open socket. But you should not keep the socket open if you do not require frequent updates, as it does limit the bandwidth somewhat. For wireless/cellular systems, or peer-to-peer applications with long intervals between update messages, you may consider unchecking this box. While still possible, do not Keep Sockets Open and set update intervals greater than 99 seconds (infrequent messaging with long i2o intervals does not need to keep the socket open).
Status Field (USB): Gives the status of your USB i2o configuration message (i.e. returns the status of the write or read of the i2o configuration info only).
Get i2o Config Button: Click this button to retrieve the current i2o configuration from the unit. See the Status field for the status of this operation.
Send i2o Config Button: Click this button to write your i2o configuration to the unit. You may click **[Send i2o Config]** for each group, one at a time, or you can step through all i20 channels and then click the **[Send i2o Config]** button one time to write your entire i2o configuration. See the Status field for the status of this operation.

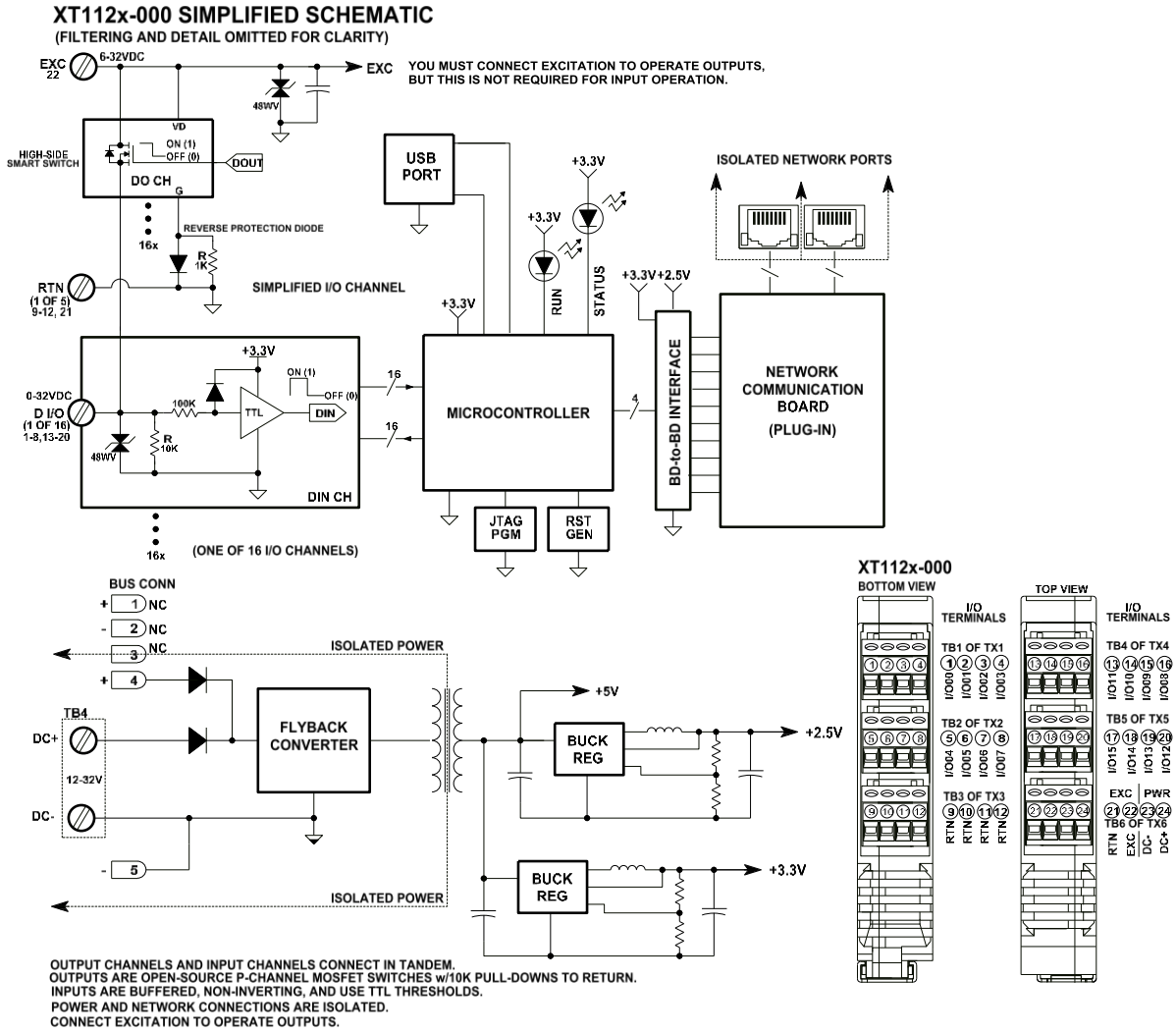
Network Home Page

After you have configured your unit for network communications via its USB connection, you can identify the unit on the Ethernet network using a web browser directed to its IP address (you set this address on the Device/Communication Setup page, the default is 192.168.1.100). This will access the home page of the unit similar to the first screen shown on the following page. You can click the “Communication Parameters” link of the Home Page to access the Ethernet Connection Status page shown in the second screen, useful for verifying your network connection to the unit and its corresponding communication parameter settings.


XT Series WEB Site - Windows Internet Explorer
XT Series WEB Site
Acromag
THE LEADER IN INDUSTRIAL I/O
XT Series Home Page
Communication Parameters


Ethernet Connection Status - Windows Internet Explorer
Acromag
THE LEADER IN INDUSTRIAL I/O
Ethernet Connection Status
PROTOCOL:
Protocol = ModbusTCP
SOFTWARE:
Network Interface firmware version: 3.2.2
Device Software version: 1.1
HARDWARE:
Mac Address: 00:01:c3:00:00:56
IP STATUS:
IP Address: 192.168.1.100
Subnet Mask: 255.255.255.0
Gatway: 192.168.1.10
Primary DNS Server IP address: 192.168.1.2
Secondary DNS Server IP address: 192.168.1.3
[Back]

BLOCK DIAGRAM



How It Works

Key Points of Operation

- Unit is DC Powered
- I/O & USB are Isolated from the network and input power.
- Outputs are connected in tandem with corresponding inputs.
- Inputs use TTL Logic.
- Outputs are Open-Source, P-channel switches.
- I/O channels are individually pulled down to Return.
- I/O circuit return is common to USB ground.

Unit has 16 smart high-side, P-channel power mosfet switches controlled by a 32-bit microcontroller to provide open-source switching of excitation to the load to (sourcing). Inputs are pulled down to Return via 10KΩ pull-down resistors and are also fed back to the controller through series 100KΩ resistors which drive non-inverting input buffers with input diodes clamped to their +3.3V rail, allowing input voltages well above the rail. Input transitions use TTL logic thresholds and feedback the state of the tandem output source, or a field input state when its tandem output is turned OFF. Network communication specific to Modbus TCP/IP is handled by a separate controller on its mating communication board that is serial-UART linked. Power for the I/O and network circuits is provided via an isolated fly-back converter on board that operates from 12-32V. The unit is setup for network operation via a USB connection between a host PC and the I/O board. The host PC runs model specific configuration software designed for the DIO XT models. Refer to the block diagram above to gain a better understanding of how this model works.

How it Works…

The I/O & USB, network, and input power circuits are isolated from each other. The USB port ground is common to the I/O circuit return. The USB port ground of most PC's is also common to the USB cable shield and earth ground. I/O signals could be grounded or ungrounded. For this reason, it is recommended that USB signals be isolated when connected to a PC to prevent a ground loop from occurring between the PC earth ground and a grounded input signal, which could have the negative affect of driving a digital upset for severe ground loop currents.

About Modbus TCP/IP

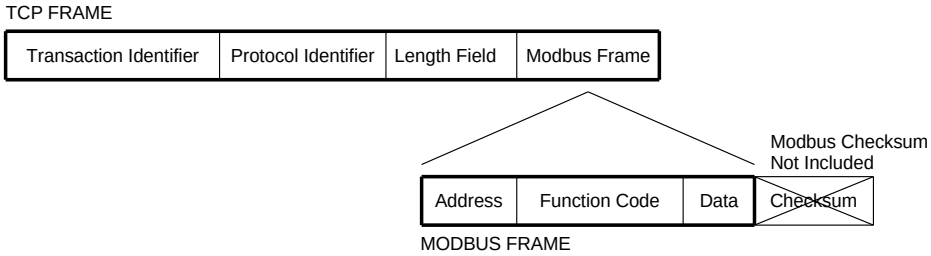
TCP/IP refers to Transmission Control Protocol and Internet Protocol. TCP/IP allows blocks of binary data to be exchanged between computers. TCP/IP is used world-wide and is the foundation for the World Wide Web. The primary function of TCP is to ensure that all packets of data are received correctly, while IP makes sure that messages are correctly addressed and routed. Note that the TCP/IP combination does not define what the data means or how the data is to be interpreted, it is merely a *transport protocol*. Modbus operates on the actual data for this model.

You can find more information on Modbus TCP/IP by visiting our web site and down-loading whitepaper 8500-765, Introduction to Modbus TCP/IP.

Modbus is an *application protocol*. It defines rules for organizing and interpreting data and is essentially a messaging structure that is independent of the underlying physical layer. It is freely available and accessible to anyone, easy to understand, and widely supported by many manufacturers.

Modbus TCP/IP uses TCP/IP and Ethernet to carry the data of the Modbus message structure between devices. That is, Modbus TCP/IP combines a physical network (Ethernet), with a networking standard (TCP/IP), and a standard method of representing data (Modbus). A Modbus TCP/IP message is simply a Modbus communication encapsulated in an Ethernet TCP/IP wrapper.

In practice, Modbus TCP embeds a Modbus data frame into a TCP frame, sans the Modbus checksum, as shown in the following diagram. The Modbus checksum is not used, as the standard Ethernet TCP/IP link layer checksum methods are instead used to guaranty data integrity.



Note that the Modbus address field is referred to as the *Unit Identifier* in Modbus TCP. In a typical slave application, the Unit ID is ignored and just echoed back in the response.

About Modbus TCP/IP…

The operation over Ethernet is essentially transparent to the Modbus register/command structure. If you are already familiar with Modbus or with the Acromag Series 900MB Modbus modules, then you are already familiar with the operation of these modules over Ethernet.

IP Addressing

A *Static IP Address* is as the name implies—static. That is, it is a unique IP Address that is assigned by a service provider and never changes.

A *Dynamic IP Address* is an address that is temporarily assigned to a user by a service provider each time a user connects to the network.

A *Subnet* is a contiguous string of IP addresses. The first IP address in a subnet is used to identify the subnet, while the last IP address in a subnet is always used as a broadcast address. Anything sent to the last IP address of a subnet is sent to every host on that subnet.

Subnets are further broken down into three size classes based on the 4 octets that make up the IP address. A Class A subnet is any subnet that shares the first octet of the IP address. The remaining 3 octets of a Class A subnet will define up to 16,777,214 possible IP addresses ($2^{24} – 2$). A Class B subnet shares the first two octets of an IP address (providing $2^{16} – 2$, or 65534 possible IP addresses). Class C subnets share the first 3 octets of an IP address, giving 254 possible IP addresses. Recall that the first and last IP addresses are always used as a network number and broadcast address respectively and 2 is subtracted from the total possible unique addresses that are defined via the remaining octet(s).

TIP: The first node (0), node 10, and the last node (255 for our example) are typically reserved for servers and may yield poor results if used.
For our example, the default IP address of this module is 192.168.1.100. If we assume that this is a Class C network address (based on a default Class C subnet mask of 255.255.255.0), then the first three numbers represent this Class C network at address 128.1.1.0, the last number identifies a unique host/node on this network (node 100) at address 192.168.1.100.

A *Subnet Mask* is used to determine which subnet an IP address belongs to. The use of a subnet mask allows the network administrator to further divide the host part of this address into two or more subnets. The subnet mask flags the network address portion of the IP address, plus the bits of the host part that are used for identifying the sub-network. By convention, the bits of the mask that correspond to the sub-network address are all set to 1's (it would also work if the bits were set exactly as in the network address). It's called a mask because it can be used to identify the unique subnet to which an IP address belongs to by performing a bitwise AND operation between the mask itself, and the IP address, with the result being the sub-network address, and the remaining bits the host or node address.

IP Addressing…

For our Example, if we wish to further divide this network into 14 subnets, then the first 4 bits of the host address will be required to identify the sub-network (0110), then we would use "11111111.11111111.11111111. 11110000" as our subnet mask. This would effectively subdivide our Class C network into 14 sub-networks of up to 14 possible nodes each.

With respect to the default settings of this module:
Subnet Mask: 255.255.255.0 (11111111.11111111.11111111.00000000)
IP Address: 192.168.1.100 (10000000.00000001.00000001.01100100)
Subnet Address: 128.1.1.0 (1000000.00000001.00000001.00000000)

The sub-network address of 128.1.1.0 has 254 possible unique node addresses (we are using node 100 of 254 possible). Nodes 0, 10, and 255 are typically reserved for servers and may yield poor results if used.

Dynamic Host Configuration Protocol (DHCP)

DHCP refers to Dynamic Host Configuration Protocol and is a method used to assign temporary numeric IP addresses as required. A DHCP server maintains a pool of shared IP addresses which are dynamically assigned and recycled. When a DHCP device wants to use a TCP/IP application, it must request an IP address from the DHCP server. The DHCP server will check the shared supply, and if all addresses are in use, the server will send a busy signal to the client which tells it to try again later. Static IP addresses will ensure a connection every time, but dynamic addresses do not.

Domain Name System (DNS)

DNS refers to the Domain Name System or Domain Name Server and refers to the system used to associate an alphanumeric character string (named addresses) with a numeric IP address. The DNS is a distributed database of domain names and corresponding IP addresses. These servers contain information on some segment of the domain name space and make this information available to clients called *resolvers*. For example, the DNS allows us to use "Acromag.com" as an IP address rather than a complicated number string.

MODBUS REGISTERS

Modbus registers are organized into different reference types identified by the leading number of the reference address:

Reference	Description
0xxxx	Read/Write Discrete Outputs or Coils. A 0x reference address is used to drive output data to a digital output channel.
1xxxx	Read Discrete Inputs. The ON/OFF status of a 1x reference address is controlled by the corresponding digital input channel.
3xxxx	Read Input Registers. A 3x reference register contains a 16-bit number received from an external source—e.g. an analog signal.
4xxxx	Read/Write Output or Holding Registers. A 4x register is used to store 16-bits of numerical data (binary or decimal), or to send the data from the CPU to an output channel.

The "Reference" leading character indicated above is generally implied by the function code and omitted from the address specifier for a given function. The leading character also identifies the I/O data type. The "x" following the leading character represents a four-digit address location in user data memory.

Note: The ON/OFF state of discrete inputs and outputs is represented by a 1 or 0 value assigned to an individual bit in a 16-bit data word. This is sixteen 0x or 1x references per data word. With respect to mapping, the LSB of the word maps to the lowest numbered channel of a group and channel numbers increase sequentially as you move towards the MSB. Unused bit positions are set to zero.

All I/O values are accessed via the 16-bit Input Registers or 16-bit Holding Registers given in the Register Map. Input registers contain information that is read-only. For example, the current input value read from a channel, or the states of a group of digital inputs. Holding registers contain read/write information that may be configuration data or output data. For example, the high limit value of an alarm function operating at an input, or an output value for an output channel.

Register Functions

For detailed information on Modbus, feel free to download our technical reference 8500-648, "Introduction to Modbus", at https://www.acromag.com/. You can also find more information specific to Modbus TCP/IP by down-loading whitepaper 8500-765, "Introduction to Modbus TCP/IP".

Each module has a default factory configuration as noted in the SPECIFICATIONS section. Your application will likely differ from the default configuration and the module will need to be reconfigured for your application. You may only reconfigure this module using a USB connection to it with a host PC running Acromag Configuration Software. There are no Modbus commands to set configuration parameters for this model, as they are only set using a USB connection to a Windows-based host PC.

Below is a small subset of standard Modbus functions supported by this module along with the reference register address group that the function operates on. Use these functions to access these registers as outlined in the Register Map for sending and retrieving data. The following Modbus functions operate on register map registers to monitor and control module I/O:

CODE	FUNCTION	REFERENCE
03 (03H)	Read Holding Registers	4xxxx
04 (04H)	Read Input Registers	3xxxx
06 (06H)	Preset Single Register	4xxxx
16 (10H)	Preset Multiple Registers	4xxxx
17 (11H)	Report Slave ID (See Below)	Hidden Function

If an unsupported function code is sent to a module, exception code 01 (Illegal Function) will be returned in the response. If a holding register is written with an invalid value, exception code 03 (Illegal Data Value) will be returned in the response message. You may refer to the Modbus specification for a complete list of possible error codes.

Note that register mirroring is not supported in the Series XT models.

XT1121-000 Report Slave ID Example Response

FIELD	DESCRIPTION
Unit ID	Echo Unit ID Sent in Query
Function Code	11
Byte Count	30
Slave ID	00
Run Indicator Status	FFH (ON)
Firmware Number String (Additional Data Field)	41 63 72 6F 6D 61 67 2C 58 54 31 31 32 31 2D 78 78 78 2C 39 33 30 30 2D 32 31 37 ("Acromag,XT1121-xxx,9300-217")

Data Types

I/O values for this model are generally indicated by a single bit of a 16-bit word for discrete on/off control or indication, except for watchdog time, which uses an unsigned integer value in range of 0-65535. For discrete I/O, the bit number/position typically corresponds to the discrete channel number for this model. Unless otherwise defined for outputs, a 1 bit means the corresponding output is closed or ON, a 0 bit means the output is open or OFF. For inputs of this model, a value of 1 means the input is ON (Active-high > 2.0V), while a value of 0 specifies the input is OFF or in its low state (asserted low < 0.8V). This assumes that the Input Logic Invert function is set to "No" or disabled.

Register Map

The table at right outlines the register map for the Model XT1121-000 network I/O module. It is very similar to that of its complimentary XT1111-000 network module with 16 active-low, sinking outputs.

Note that the memory map for these models only covers I/O data, as all reconfiguration is done via USB prior to connecting to the network.

Modbus functions operate on these registers using the data types noted above (except for the Report Slave ID functions).

Unless otherwise noted, Holding Register values are not maintained in non-volatile flash memory.

Ref.	Addr.	Description	Data Type/Format
Input Registers (3x References, Read-Only)			
30001	0 (0000)	Input State for Group 0 (Channels 0-3)	Bit 15-4: 0 (Not Used) Bit 3: CH3 Bit 2: CH2 Bit 1: CH1 Bit 0: CH0 1 = ON or High (Active-High Input Asserted > 2.0V) 0 = OFF or Low (Input < 0.8V) A set bit (1) means input is ON or asserted high. A clear bit (0) means input is OFF or asserted low. Unused bits are clear or set to 0. This only applies if the Input Logic Invert function is set to "No" or disabled.
Note: The 30001-30004 registers reflect the actual state of the corresponding input signal, or the source of the tandem p-channel output switch. This signal is active-high.			
30002	0001	Input State for Group 1 (Channels 4-7)	Bit 15-4: 0 (Not Used) Bit 3: CH7 Bit 2: CH6 Bit 1: CH5 Bit 0: CH4 1 = ON or High (Active-High Input Asserted > 2.0V) 0 = OFF or Low (Input < 0.8V) Assumes that the Input Logic Invert function is set to "No" or disabled.
30003	0002	Input State for Group 2 (Channels 8-11)	Bit 15-4: 0 (Not Used) Bit 3: CH11 Bit 2: CH10 Bit 1: CH9 Bit 0: CH8 1 = ON or High (Active-High Input Asserted > 2.0V) 0 = OFF or Low (Input < 0.8V) Assumes that the Input Logic Invert function is set to "No" or disabled.

Register Map…

There are no registers for setting configuration variables, as this model is only configured via USB using its Configuration Software running on a Windows based Personal Computer. Configuration should be done prior to connecting to the network.

It is possible that the input state indicated may not reflect the actual state of the tandem output if the I/O channel is experiencing contention between via a field signal and an output that happens to be turned ON. If monitoring field signals, the corresponding tandem output must be turned OFF to avoid this contention between the output channel and the field signal.

Ref.	Addr.	Description	Data Type/Format
Input Registers (3x References, Read-Only)			
30004	0003	Input State for Group 3 (Channels 12-15)	Bit 15-4: 0 (Not Used) Bit 3: CH15 Bit 2: CH14 Bit 1: CH13 Bit 0: CH12 1 = ON or High (Active-High Input Asserted > 2.0V) 0 = OFF or Low (Input < 0.8V) This assumes that the Input Logic Invert function is set to "No" or disabled.
30005	0004	Heart Beat Register	An integer counter that increments by 1 for every host to network data transfer to help indicate if fresh data is present relative to the last transfer, or if the unit has halted for some reason (i.e. no longer incrementing). This register counts from 0 to 65535 and wraps back around to 0.
Holding Registers (4x References, Read/Write)			
40001	0 (0000)	Set Output State for Group 0 (Channels 0-3)	Bit 15-4: 0 (Not Used) Bit 3: CH3 Bit 2: CH2 Bit 1: CH1 Bit 0: CH0 1 = Turn Output ON (Source Load) 0 = Turn Output OFF (Open) Setting the bit to 1 will drive the corresponding output to source excitation to the load (conducts or sinks load current to return). Clearing the bit to 0 means the output will be switched OFF (open). All input channels are pulled-down to return and will not float. Unused bits are set to 0. The Invert Input Logic function does not affect output logic.
Note: The outputs of this model are the open sources of p-channel mosfet switches with their drain leads held in common to excitation (EXC). Outputs are pulled down to the I/O return (RTN) via 10KΩ resistors. The 40001-40004 registers are used to set/clear the output state of the corresponding output channel and will trigger the gate of the output mosfet to turn ON or OFF as required. Output channels source from output to RTN when turned ON. Failure to provide excitation will render the open-source outputs inoperable.			

Register Map…

Note: *A watchdog timeout is triggered if an established client-server relationship to the module is severed by a cable break or power disruption at the client. A client-server network connection to the module is created for the exchange of data between devices, such as that between a Modbus Master and slave, or that between a networked PLC, HMI, or other client device and its target server module. Thus, a watchdog timeout can only be cleared at the server by first restoring the broken client-server relationship. Clearing a timeout by restoring the client-server connection to the module does not return output(s) to their initial "pre-timeout" state and they remain in their timeout states until otherwise written via the holding registers, or via Output Auto Refresh.*

Note: The holding register signal corresponds to the gate signal of the p-channel output mosfet (the high-side switch between Excitation and the load). The bit position also corresponds to the output channel number (i.e. output 0 uses bit 0 of the 16-bit word at address 0, output 1 uses bit 1 of the 16-bit word at address 1, etc.) A set bit (1) means the output is turned ON (sourcing the load). A clear bit (0) means output is turned OFF (open). Excitation must be provided in order to operate the outputs. A read of this register may not reflect the actual output level at the source lead of the mosfet. You can read the Input Registers to obtain the actual output source state(s) via closed loop feedback (with Invert Input Logic function set to "No" or disabled).

Ref.	Addr.	Description	Data Type/Format
Holding Registers (4x References, Read/Write)			
40002	1 (0001)	Set Output State for Group 1 (Channels 4-7)	Bit 15-4: 0 (Not Used) Bit 3: CH7 Bit 2: CH6 Bit 1: CH5 Bit 0: CH4 1 = Turn Output ON (Source Load) 0 = Turn Output OFF (Open)
40003	2 (0002)	Set Output State for Group 2 (Channels 8-11)	Bit 15-4: 0 (Not Used) Bit 3: CH11 Bit 2: CH10 Bit 1: CH9 Bit 0: CH8 1 = Turn Output ON (Source Load) 0 = Turn Output OFF (Open)
40004	3 (0003)	Set Output State for Group 3 (Channels 12-15)	Bit 15-4: 0 (Not Used) Bit 3: CH15 Bit 2: CH14 Bit 1: CH13 Bit 0: CH12 1 = Turn Output ON (Source Load) 0 = Turn Output OFF (Open)
I/O channels of this model are pulled down to I/O return and will never float. The output logic is not affected by the Invert Input Logic function. After reset, these registers read 0 (outputs OFF) and these registers are not maintained in non-volatile memory.			

TROUBLESHOOTING

Diagnostics Table

Before attempting repair or replacement, be sure that all installation and configuration procedures have been followed and that the unit is wired properly. Verify that 12-32V power is applied to the unit.

If your problem still exists after checking your wiring and reviewing this information, or if other evidence points to another problem with the unit, an effective and convenient fault diagnosis method is to exchange the questionable unit with a known good unit.

Acromag's Application Engineers can provide further technical assistance if required. Repair services are also available from Acromag.

POSSIBLE CAUSE	POSSIBLE FIX
Green RUN LED does not light…	
Internal +3.3V rail has failed.	Return module for repair.
Green RUN LED flashes continuously…	
Internal Firmware Failure	Return module for repair/reprogramming.
Cannot Communicate with Module Over Network…	
Power ON at Module?	*Check power. Is Green Run LED ON?*
Using Wrong IP Address	*You must change either the IP address of the module or your host PC network card so that they match their subnet addresses.*
Cannot Communicate with Module via USB…	
A missing USB Isolator could cause a ground loop between a grounded I/O signal and earth ground at the connected Personal Computer's USB port.	Without a USB isolator, a ground loop is created between a grounded input signal source and earth ground of the PC USB port. For this reason, and for increased safety and noise immunity, it's best to connect to USB via a USB isolator. Use an isolator like the Acromag USB-ISOLATOR. Otherwise, use a battery powered laptop which does not normally earth ground its USB port.
Software Fails to Detect Module…	
Bad USB Connection	Recheck USB Cable Connection
USB has not enumerated the device.	Use the reset button on the Acromag USB isolator to trigger renumeration of the module, or simply unplug and replug the USB cable to the module.
Communication or power was lost while connected to USB with the configuration software running.	Close the current connection with the software, then select and re-open the module for communication (or simply exit the Configuration software and reboot it).
I/O is Erratic, not operational, or Intermittent When Connected to USB…	
Missing USB isolation with grounded I/O signal source.	Even though the I/O is isolated from the network and power, if your input signal is already earth grounded, then connecting USB to the module may drive a ground loop between your input and earth ground at the PC. Use USB signal isolation, or alternatively, you can connect to a battery-powered laptop/PC, which does not earth ground its USB connection.
Outputs Not Working…	*Outputs Not Working…*
Missing EXC connection to power which powers the output drivers.	You must connect an excitation supply from 6-32V to operate the outputs (not required for input-only operation).

Diagnostics Table…

POSSIBLE CAUSE	POSSIBLE FIX
Digital Inputs Appear to Register Incorrect State…	
Contention between the field input and the tandem open-source output if ON, or Invert Input Logic function is enabled.	If you are monitoring a field digital input, you must turn the channel's corresponding output OFF. Check the state of the Invert Input Logic function.
I/O Channels Change States when you connect USB…	
Indicates a ground fault with earth ground at the PC and earth ground applied at the I/O channels if you have not isolated your USB signals.	Only connect to the unit via isolated USB if the I/O signal is already earth grounded. You can connect without USB isolation if the I/O signal is not already grounded.
Many Communication Errors…	
Is Ethernet Cable segment longer than 100M?	The maximum distance between two nodes on an Ethernet network is limited to 100 meters using approved cable.
Correct Cable Type	Shielded CAT-5/5E cable, equivalent or better, is recommended.
Missing Earth Ground Connection?	Connect earth ground to the power minus terminal at TB6-23.
Status field of software screen indicates "Data Transfer Error", "Unknown Protocol" or "Timeout Error"…	
USB connection was opened before unit had completed its power-on initialization and established its network connection.	Wait ~30 seconds after power-up before opening the USB connection with the config software. To remedy, turn power off to the unit, close the USB config software, re-power the unit, then reboot the USB config software, after the unit has completed its initialization and established its network connection.
Continuous blinking yellow status LED…	
Watchdog timer has timed out.	In the absence of a client-server relationship over the network, such as that formed with i2o, or between a Modbus master/client and slave/server, a PLC or HMI and a server module, the watchdog will timeout when enabled. It can also timeout if a client-server relationship has been severed by a network cable break, or power disruption at the client.
Enabled watchdog timer never times out, or only times out initially…	
There is an established client-server connection (socket) over the network with this module.	The timer will only time out if a client-server connection has not been established or has been severed by a cable break.
i2o is not working…	
The upload was corrupted when i2o was written to the module.	Although rare, if you have rechecked your i2o configuration, but it fails to operate, try rebooting the module, or re-writing your i2o configuration (check your address settings, update time, change-of-state, etc).

Service/Repair Assistance

Unit contains solid-state components and requires no maintenance, except for periodic cleaning. Its enclosure is not meant to be opened for access and can be easily damaged if snapped apart. It is recommended that a non-functioning module be returned to Acromag for repair or replacement. Acromag has automated test equipment that thoroughly checks the performance of each module and can restore firmware. Please refer to Acromag's Service Policy and Warranty Bulletins or contact Acromag for complete details on how to obtain repair or replacement.

ACCESSORIES

Software Interface Package



Software Interface Package/Configuration Kit – Order XT-SIP

- USB Signal Isolator
- USB A-B Cable 4001-112
- USB A-mini B Cable 4001-113
- Configuration Software CDROM 5041-094
- Single-shielded Category 5e STP Ethernet Crossover Cable, Green, 5 feet long, with a drain wire and an RJ45 plug at each end

This kit contains all the essential elements for configuring XT family Transmitters. Isolation is recommended for USB port connections to these devices and will block a potential ground loop between your PC, a grounded input, or a grounded current loop. A software CDROM is included that contains the Windows software used to program the transmitter.

USB Isolator



USB Isolator – Order USB-ISOLATOR

- USB Signal Isolator
- USB A-B Cable 4001-112
- Instructions 8500-900

This kit contains a USB isolator and a 1M USB A-B cable for connection to a PC. This isolator and cable are also included in XT-SIP (see above).

USB A-B Cable



USB A-B Cable – Order 4001-112

USB A-B Cable 4001-112

This is a 1 meter, USB A-B replacement cable for connection between your PC and the USB isolator. It is normally included with the XT-SIP Software Interface Package and with the isolator model USB-ISOLATOR.

Note that software for all XT Series models is available free of charge, online at https:www.acromag.com.

USB A-mini B Cable



USB A-mini B Cable – Order 4001-113

- USB A-mini B Cable 4001-113

This is a 1 meter, USB A-mini B replacement cable for connection between a USB isolator and XT/TT/SP/DT transmitters/splitters. It is normally included in XT-SIP.

End Stops

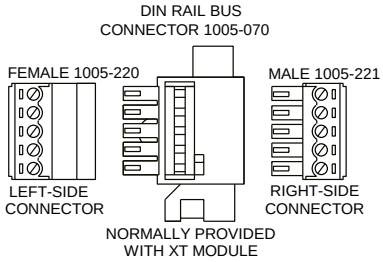


Two End Stops – Order 4001-252

- Two 1027-222 End Stops for 35 mm DIN Rail mounting

For hazardous location installations (Class I, Division 2 or ATEX Zone 2), you can use two end stops (Acromag 1027-222) to help secure modules to 35mm DIN rail (not shown).

DIN Rail Bus Connector Kit



Bus Connector Kit for DIN Rail Bus Connection to Power, Model XTBUS-KIT

- DIN Rail Bus Connector 1005-070 for 22.5mm XT Modules.
- Left Side terminal block, female connector 1005-220.
- Right Side terminal block, male connector 1005-221.
- Two End Stops for 35 mm DIN Rails 1027-222 (not shown).

This module is shipped with the first item included in this kit (DIN Rail Bus Connector 1005-070) and this kit offers a spare. Left and right side terminal blocks mate directly to the bus connector included in this kit and are used to optionally (or redundantly) drive power to Series XT modules via their DIN rail bus connector. They are also used to optionally connect I/O to Excitation along the DIN rail for some XT models (XT111x-000). This allows modules to neatly and conveniently share connections to Power and/or Excitation. Two end stops 1027-222 are used to secure the terminal block and module for hazardous location installations.

Low EMI Double-Shielded Patch Cable



Ethernet Patch Cable, 3 feet long, Model 5035-369
Ethernet Patch Cable, 15 feet long, Model 5035-370

This cable is used to connect a module to your network switch (Acromag 900EN-S005 or equivalent Ethernet switch) and is double-shielded for lower emissions and increased RFI resistance. It has a red, low-smoke, zero halogen jacket and bundles four pairs of 26AWG stranded cable. It uses a 100% foil shield beneath a 60% braided outer shield and includes an RJ45 plug at each end. It is electrically equivalent to L-Com TRD855DSZRD cable and can be obtained in other lengths directly from L-Com (http://www.l-com.com).

Double-shielded CAT5e or better cable is recommended for very noisy environments or in the presence of strong electrical fields. You may obtain shielded CAT-5e cable in other lengths and colors as required for your application from other vendors including L-com Connectivity Products, www.L-com.com, Pro-Link, www.prolink-cables.com, Regal, www.regalusa.com, and Lumberg, www.lumbergusa.com.

SPECIFICATIONS

Model Number

Model XT1121-000

Digital I/O Module
Modbus TCP/IP Support
16 Isolated DC I/O Channels
DC Powered
CE Approved
Includes UL/Cul Class I, Division 2 approvals

The XT1121-000 model denotes a 16-channel digital I/O module with 16 sourcing (high-side) switch outputs with 16 tandem digital inputs for DC voltage applications only. This model operates over Ethernet using Modbus TCP/IP. It is setup and configured using USB. It represents another member of the Acromag DIN-Rail mounted, "Busworks" family, in the XT Series. Refer to Model XT1111-000 for a complimentary version with 16 sinking (low-side) switched outputs. The trailing "-000" model suffix denotes DC powered w/ CE & UL/Cul Class I, Division 2 Approvals.

Individual outputs of this model are each open-source mosfet switches for sourcing common excitation to loads up to 250mA and 32V DC each. Buffered inputs are TTL compatible and accept voltage levels from 0-32V DC. All I/O channels include 10KΩ resistor pull-downs to I/O return and do not float.

Reconfiguration of any XT model will require use of the XT-SIP configuration kit, ordered separately (see Accessories section).

Models are mounted on standard "T" Type DIN rail and include plug-in terminals. Power can be optionally (or redundantly) bussed along the DIN rail (see Power Connections).

Digital Inputs

This model has tandem input and output channels. Always turn outputs OFF if using inputs to monitor field signals.

Sixteen active-high, buffered inputs, with a common return connection (RTN). For DC voltage applications only. Inputs are tied in tandem to the output source leads and provide loopback monitoring of the output state. With the tandem output turned off, they may be used to monitor voltage levels from the field. Inputs include transient suppression and series connected 100KΩ resistors, plus diode over-voltage clamps to the internal +3.3V supply rail. Individual I/O channels are pulled down to the I/O return (RTN terminal) with 10KΩ resistors. External excitation (the source to the load) is required for output operation and is connected between the EXC and RTN terminals of TB6 (terminal numbers 22 and 21 respectively).

Input Signal Voltage Range: 0 to +32VDC with TTL logic threshold (see below).
Input Signal Threshold: TTL compatible w/100Mv of hysteresis, typical. Low-to-High threshold is 1.7VDC, typical, High-to-Low threshold is 1.6VDC, typical. Logic limits are TTL with 0.8VDC Max LOW level, and 2.0VDC Min HIGH level.
Input Current: 280uA at 32VDC, typical. Computed as the max applied input voltage minus 4V (3.3V rail and diode clamp), divided by series 100KΩ input resistance.
Input Resistance: 10KΩ, typical (each input includes a 10KΩ pull-down to return).
Input Hysteresis: 100mVdc typical.
Input Response Time: 10ms typical, not including network time. The actual input response time will vary with network traffic and interrupts.
Input Transient Voltage Suppressor: Installed at every I/O point, the rated working voltage is 38V, breakdown voltage is 47V, and clamping level is 72V.

Digital Outputs

This model has tandem input and output channels.

To control higher voltages and/or currents, or for controlling AC, an interposing relay may be used (see Note).

Sixteen smart open-source, p-channel mosfet switches with a common drain connection to Excitation (EXC) allow this model to high-side switch DC excitation voltage to the load (sourcing). Outputs drive rated current through the load to ground (return). Outputs have tandem inputs which provide true loopback monitoring of the output state. Individual I/O channels are pulled down to Return (connected at RTN terminal) with 10KΩ resistors and do not float. External excitation (6V min) is required for output operation and connected between the EXC and RTN terminals of TB6 (terminal numbers 22 and 21 respectively).

Output "ON" Voltage Range: 6 to 32V DC. Limit voltage to less than 36V peak, or damage to the unit may result. Use protection when switching inductive loads (for example, a reverse shunt diode at the inductive load).
Active Current Limitation: The unit limits load current to a shorted load to 0.6A typical, 0.4A-0.9A range (EXC=13V and 0.01Ω load resistance). This limit works with the latched thermal shutdown to help protect the output channel from damage due to overload.
Thermal Shutdown: Individual outputs will shut down and latch off for thermal overload conditions that drive the junction temperature into the region from 150° to 200°C. In this case, the I/O pin is pulled low and the output must be recycled OFF/ON to reset the output.
Under-voltage Shutdown: Outputs will shut-down if their excitation voltage is less than 6.0V (3V-6V threshold).
Overvoltage Shutdown: Outputs will shut-down if their excitation voltage exceeds 36V minimum.
Ground Loss Protection: The output automatically turns off if the ground lead is disconnected (RTN).
Output "OFF" Leakage Current: 50UA maximum per channel (mosfet only). Does not include the input bias current for the tandem digital input (see Note below).
Note: The 100KΩ series input buffer resistors in combination with the +3.3V voltage diode clamps at the input buffer will tend to increase the off-state current with increasing output voltage (up to 3.5mA at 32V). This is a consequence of the input buffer circuitry being connected in tandem to the output mosfet source lead at every I/O channel, and the presence of a 10KΩ pull-down on the input.
Output "ON" Current Range: 0 to 250mA DC, continuous (up to 4.8A total for all 16 channels combined). No deration is required at elevated ambient. Group one return (RTN) for each group of 4 outputs.
Output R_{ds} ON Resistance: 0.5Ω typical at 0.25A and 25°C, 1.0Ω Maximum.
Output Response Time: 10ms typical. Does not include network time. The actual switch time will vary with network traffic, interrupts, and output load.
Note: Per UL, when the outputs are used to control interposing relays for switching AC and DC devices of higher voltage/current, the coil ratings for the interposing relay shall not exceed 24VDC, 100Ma.

General

Note: *You must connect EXC to operate outputs. Input only operation does not require Excitation.*

Excitation (Required for Output Operation): Excitation is required for output operation and must be from 6-32V (52mA minimum at 32V) and is connected between the I/O EXC and RTN terminals 22 and 21. The excitation path is reverse voltage protected. The capacity of your excitation supply will depend on the loads and number of channels being loaded. For 16 channels at maximum rated load, your excitation supply must be able to source 4A. Outputs will source the excitation voltage to the load when turned ON and are also powered from it (you cannot operate outputs without excitation). The EXC terminal is tied in common to the drains of each output channel switch. The source leads of each switch are pulled down to I/O return via 10KΩ pull-down resistors and drive the output load. Excitation is not required to operate the inputs of this model, only the outputs.

I/O Pull-Downs (Internal): Individual I/O channels have 10KΩ pull-downs to I/O return and will never float. The installed resistor is one element of a four isolated SIP resistor (8 pins) and rated to 0.3W per element up to 70°C (refer to Bourns 4308M-102-103LF parts). If your application requires a stronger pull (lower resistance), you will have to wire it externally in parallel with your load, being careful that you never exceed 250mA of source current per output (load plus pull-down current).

Power

Power Supply (Connect at TB6 terminals 24 & 23, and/or via the DIN Rail Bus): 12-32V DC SELV (Safety Extra Low Voltage). Observe proper polarity. Reverse voltage protection is included. Unit can be redundantly powered by connecting power to both the power terminals on the unit and DIN rail bus (these power inputs are diode-coupled to the same point). Current draw varies with power voltage as follows (current indicated is with all outputs ON).

SUPPLY	XT112x-000 CURRENT
12V	192mA Typical / 211mA Max
15V	151mA Typical / 166mA Max
24V	93mA Typical / 102mA Max
32V	70mA Typical / 77mA Max

CAUTION: Do not exceed 36VDC peak to avoid damage to the unit. Terminal voltage at or above 12V minimum must be maintained to the unit during operation.

Power Supply Effect: Less than ±0.001% of output span effect per volt DC change.

USB Interface



Unit includes a USB socket for temporary connection to a PC or laptop for setup and reconfiguration. USB isolation is recommended when connecting to a unit that may also be connected to grounded I/O signals. The unit does not receive power from USB and must already have DC power connected to it when connecting to USB.
CAUTION: Do not attempt to connect USB in a hazardous environment. Module should be setup and configured in a safe environment only.
Data Rate: USB 2.0 compatible, up to full-speed at 12Mbps.
Transient Protection: Unit adds transient voltage protection to USB power and data lines when connected, but the unit does not use USB power.
Cable Length/Connection Distance: 5.0 meters maximum.
Driver: No special drivers required. Uses the built-in USB Human Interface Device (HID) drivers of the Windows Operating System (Windows XP or later versions only).
USB Connector: USB Mini B-type, 5-pin socket, Hirose UX60-MB-5S8.

PIN	DEFINITION
1	+5V Power (Transient Protected, but Not Used by Module)
2	Differential Data (+)
3	Differential Data (-)
4	NC – Not Connected
5[1]	Power Ground (Connects to Signal Ground via ferrite bead)
SHLD[1]	Signal Ground (Connects directly to Signal Ground)

[1]**Note:** Most Host Personal Computers (except battery powered laptops) will connect earth ground to the USB shield and signal ground.

IMPORTANT – USB Isolation is recommended: The I/O of this module is isolated from each network port and DC power, but its I/O return is common to its USB connection. Most Personal computers (except DC powered laptops) connect their USB signal and shield ground to earth ground. Without a USB isolator, an earth grounded USB connection could drive a ground loop with any earth ground applied at its I/O, which might interfere with operation. For this reason, we recommend that you always use a USB isolator when making a USB connection to prevent a potential ground loop from affecting performance. Otherwise, in the absence of USB isolation, a battery powered laptop could be used to connect to the unit, as the laptop does not normally connect to earth ground.

Ethernet Interface

Connector: Dual, shielded RJ-45 sockets, 8-pin, 10BaseT/100BaseTX. The metal shield circuit of the network connectors are isolated and capacitively coupled to the input power minus terminal via an isolation capacitor.
Network-to-Network Isolation: Network ports are additionally isolated from each other and will withstand HIPOT voltages up to 1500Vrms, or 2250V DC.
Wiring: Unit includes auto-crossover for MDI or MDI-X cables.
Protocol: Modbus TCP/IP w/USB Configuration.
IP Address: Default mode static IP address is 192.168.1.100.
Port: Up to 16 sockets supported, uses port 502 (reserved for Modbus
Data Rate: Auto-sensed, 10Mbps or 100Mbps.
Duplex: Auto-negotiated, Full or Half Duplex.
Compliance: IEEE 802.3, 802.3u, 802.3x.
Modbus TCP/IP Protocol Support: Up to 10 sockets may be selected for Modbus TCP/IP. The unit includes a built-in web page for ID on the network using a standard web-browser, but configuration of the unit is only possible using configuration software running on a Windows PC and connected via USB.
Communication Distance: The distance between two devices on an Ethernet network is generally limited to 100 meters using recommended copper cable. Distances may be extended using hubs, switches, or fiber optic transmission. However, the total round-trip delay time must not exceed 512-bit times for collision detection to work properly.
Port Status Indicator: The yellow LED of the network connector indicates the Ethernet connection is busy and traffic is present.
Address: The module IP address can be preset (static) by the user via USB. At startup, it can be loaded from internal non-volatile memory, or it can be automatically acquired via a network server using DHCP (Dynamic Host Configuration Protocol).

Refer to Acromag Application Note 8500-734 for instructions on how to change the IP address of your PC network interface card to talk to an Acromag Ethernet module.

Enclosure & Physical

General purpose plastic enclosure for mounting on 35mm "T-type" DIN rail.
Dimensions: Width = 22.5mm (0.9 inches), Length = 114.5mm (4.51 inches), Depth = 99.0mm (3.90 inches). Refer to Mechanical Dimensions drawing.
I/O Connectors: Removable plug-in type terminal blocks rated for 12A/250V; AWG #26-12, stranded or solid copper wire.
Program Connector: USB Mini B-type, 5-pin socket, Hirose UX60-MB-5S8.
Case Material: Self-extinguishing polyamide, UL94 V-0 rated, color light gray. General purpose NEMA Type 1 enclosure.
Circuit Board: Military grade fire-retardant epoxy glass per IPC-4101/98.
DIN-Rail Mounting: Unit is normally mounted to 35x15mm, T-type DIN rails. Refer to the DIN Rail Mounting & Removal section for more details.
Shipping Weight: 0.5 pounds (0.22 Kg) packed.

Environmental

These limits represent the minimum requirements of the applicable standard, but this product has typically been tested to comply with higher standards in some cases.

Operating Temperature: -40°C to +60°C (-40°F to +140°F). This data applies to the unit mounted upright on a DIN rail allowing free air flow from the bottom vent through the unit and out the top vent (necessary for operation above 60˚C).
Storage Temperature: -40°C to +85°C (-40°F to +185°F).
Relative Humidity: 5 to 95%, non-condensing.
Isolation: Input/output channels with Excitation and USB (as a group), network (each Ethernet port), and input power circuits are all isolated from each other for common-mode voltages up to 250VAC, or 354V DC off DC power ground, on a continuous basis (will withstand 1500VAC dielectric strength test for one minute without breakdown). This complies with test requirements of ANSI/ISA-82.01-1988 for voltage rating specified.
Installation Category: Suitable for installation in a Pollution Degree 2 environment with an Installation Category (Over-voltage Category) II rating per IEC 1010-1 (1990).
Shock & Vibration Immunity: Conforms to: IEC 60068-2-6: 10-500 Hz, 4G, 2 Hours/axis for sinusoidal vibration; IEC 60068-2-64: 10-500 Hz, 4G-rms, 2 Hours/axis for random vibration, and IEC 60068-2-27: 25G, 11ms half-sine, 18 shocks at 6 orientations, for mechanical shock.

Electromagnetic Compatibility (EMC)

Minimum Immunity per BS EN 61000-6-2:

1) Electrostatic Discharge Immunity (ESD), per IEC 61000-4-2.
2) Radiated Field Immunity (RFI), per IEC 61000-4-4.
3) Electrical Fast Transient Immunity (EFT), per IEC 61000-4-4.
4) Surge Immunity, per IEC 61000-4-5.
5) Conducted RF Immunity (CRFI), per IEC 61000-4-6.

This is a Class A Product with Emissions per BS EN 61000-6-4:

1) Enclosure Port, per CISPR 16.
2) Low Voltage AC Mains Port, per CISPR 16.
3) Telecom / Network Port, per CISPR 22.

WARNING: This is a Class A product. In a domestic environment, this product may cause radio interference in which the user may be required to take adequate measures. Refer to the EMI Filter Installation drawing in the Electrical Connections section of this manual to install ferrite cable clamps that help to reduce radiated emissions. The use of low EMI double-shielded Ethernet cable is also helpful in curbing emissions.

Agency Approvals

Electromagnetic Compatibility (EMC): CE marked, per EMC Directive 2004/108/EC. Consult factory.

Safety Approvals: UL Listed (USA & Canada). Hazardous Locations – Class I, Division 2, Groups A, B, C, D Hazardous Location or Nonhazardous Locations only. These devices are open-type devices that are to be installed in an enclosure suitable for the environment. Consult Factory.

ATEX Certified: Model XT1121-000 is ATEX Certified for Explosive Atmospheres per ATEX Directive 94/9/EC which complies with standards BS EN 60079-0:2012 & BS EN 60079-15:2010.

Ⓔx II 3 G Ex nA IIC T4 Gc -40°C ≤ Ta ≤ +60°C

DEMKO 15 ATEX 1561X

X = Special Conditions

1) The equipment shall only be used in an area of not more than pollution degree 2, as defined in EN 60664-1.
2) The equipment shall be installed in an enclosure that provides a degree of protection not less than IP 54 and only accessible with the use of a tool in accordance with EN 60079-15.
3) Transient protection shall be provided that is set at a level not exceeding 140 % of the peak rated voltage value at the supply terminals to the equipment.

Reliability Prediction

Reliability Prediction

MTBF (Mean Time Between Failure): MTBF in hours using MIL-HDBK-217F, FN2. *Per MIL-HDBK-217, Ground Benign, Controlled, $G_B G_C$*

Temperature	MTBF (Hours)	MTBF (Years)	Failure Rate (FIT)
25°C	498,835 hrs	56.9 years	2,005
40°C	383,981 hrs	43.8 years	2,604

Configuration Controls

Software Configuration Only via USB

Although this module normally operates using Modbus TCP/IP over Ethernet, it can only be setup and configured via USB. Its behavior as a 16-channel digital input/output module is determined via program registers set using a temporary USB connection to a host computer or laptop running a Windows-compatible configuration software program specific to the model. This software provides the framework for digital control of all configuration parameters, and this information is stored in non-volatile memory.

LED Indicators:

RUN (Green) – Located at front panel. Constant ON if power is on, unit is OK, and Ethernet cable is properly plugged in. Flashes ON/OFF during initialization, or if it keeps flashing continuously, then it indicates the network board has not initialized, perhaps because the network cable is unplugged or defective.

ST (Yellow) – Located at front panel. Blinks if a watchdog timeout has occurred.

ACT (Yellow) – Located on RJ45 port connector. Indicates the Ethernet connection is busy with traffic present.

Refer to Configuration Step-by-Step in the Technical Reference section of this manual for detailed information on available software control of this model.

REVISION HISTORY

The following table details the revision history for this document:

Release Date	Version	EGR/DOC	Description of Revision
26-MAR-2013	A	BC/KLK	Initial Acromag release.
19-AUG-2013	B	BC/KLK	CE Approval added.
17-OCT-2013	C	BC/KLK	Corrected typos, screens, & added troubleshooting info.
21-FEB-2014	D	CAP/ARP	Added cULus Mark to this model (removed pending).
31-JUL-2014	E	CAP/ARP	Added UL caution sym /statements.
18-SEP-2014	F	BC/ARP	Updated Digital Output drawing on page 12.
15-OCT-2015	G	CAP/ARP	Added ATEX symbols / statements.
19-AUG-2016	H	CAP/MJO	Corrected “Circuit Board” specification.
13 NOV 2017	J	FJM/ARP	Reference Configuration Software without the revision.
07 SEP 2018	K	BC/MJO	Improved Clarity and Fixed Connection Drawings
05 DEC 2018	L	FJM/ARP	Updated MTBF information.
11 JAN 2019	M	HWW/ARP	Correct the Output Voltage Range in the Specifications section.
03 MAY 2019	N	FJM/ARP	Update Slave ID.

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