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Ethernet Remote I/O Considerations

Remote I/O is most typically found in systems where the controller is located some distance away from the physical inputs and outputs. Some scenarios where you might see or need this is when the device to be controlled has limited space, is located in a high noise (EMI) environment where transmitting analog signals is troublesome, or has been installed previously and just needs some additional I/O that the existing rack/chassis cannot accommodate. Sometimes, you might even be using remote I/O because you aren't even using a controller but instead are just monitoring and/or collecting data. The uses for remote I/O are extremely widespread and unique for almost every application.

When working with Quantum Automation, you've got some great options when it comes to choosing remote I/O. This month's TechCorner has been written to make it easier to select the best option for your application. I'll cover the tradeoffs and also how to do the basics (IP configuration, Modbus addressing) for each system.

Although many people still use serial throughout their control systems, I've decided to focus the discussion only on Ethernet based solutions for two reasons. First, Ethernet use is growing every day and is becoming affordable for both large and small applications. Second, Ethernet is Quantum Automation's preferred communication media for Remote I/O due to its superior speed and EMI tolerance over traditional RS-485/422 or 232 Serial medias.

We'll be focusing on the three main I/O lines that we carry:

1. AutomationDirect's Terminator I/O with T1H-EBC100 (Ethernet communication module)



2. MOXA's ioLogik E1200 series Ethernet Remote I/O



3. Advantech's ADAM Data Acquisition Modules



Considerations when Choosing:

Because there are so many reasons to choose one automation solution over another, we've provided the table below. It's been made to cover what we consider to be the most important specifications when choosing your Remote I/O system.

| Product | User-defined Modbus/TCP addressing | Ethernet Ports | Best Suited Mounting | Wiring | Power Supply Options | Web Based Config. | Protocols | Class 1 Division2 | Operating Temperature Available | Warranty (Years) |
|--------------|------------------------------------|----------------|----------------------|----------------------------------|--------------------------|-------------------|-------------------------------|-------------------|-----------------------------------|---------------------|
| Terminator | NO | 1 | DIN | Downward - Spring or Screw | 120/240 VAC 12/24 VDC | NO | Modbus | YES | 32°F to 131°F (0°C to 55°C) | 1 yr |
| ioLogik 1200 | YES | 2 | DIN | Face, away from backpanel, screw | 12-36 VDC | YES | Modbus, SNMPv1/v2c | YES | -40°F to 167°F (-40°C to 75°C) | 5 yr (2 for relays) |
| ADAM | NO | 1 | PANEL | Top and Bottom, Screw | 10-30 VDC | NO | Modbus, PROFINET, Ethernet/IP | Some Modules | 14°F to 158°F (-10°C to 70°C) | 2 yr |

The Terminator I/O is commonly used because of its rock solid reliability, power supply options, and choice between spring clamps and screw terminals. It's one of the oldest I/O products in our portfolio with hundreds of applications fielded since its introduction. It's also the only remote I/O in this comparison that has both AC and DC power options.

The ioLogik 1200 series' strengths lie in its incredibly easy and flexible web-based configuration, its secondary Ethernet port, and its 5 year warranty. For newer programmers or individuals who

prefer more customization, the MOXA remote I/O line is by far the easiest to figure out. Also, for those who want multiple I/O modules but don't currently have an Ethernet switch, the ioLogik line is great because it has a second unmanaged Ethernet port, designed for easy daisy chaining. It's also the only product in the line to offer a true wide temperature solution.

The Advantech ADAM I/O line is best suited for applications where space is limited and when protocols besides Modbus are needed. Being the smallest in the bunch and having the lowest profile, the ADAM modules are perfect for tight spaces. They can fit in the palm of your hand and still pack similar I/O densities to their competitors. Modules are also available in PROFINET and Ethernet/IP variations, which the AutomationDirect and MOXA offerings lack.

Hopefully the specification table above gives you an idea of what system will work best for you. You should work with your RSM to narrow it down further and compare pricing, if needed.

Setup and configuration:

Now that you've got an idea of what sets the AutomationDirect, MOXA, and Advantech offerings apart, let's shift the focus to how each is configured. What follows is a quick guide to setting up each system and generating Modbus I/O addresses.

Note: When configuring any of the remote I/O discussed below, or any TCP/IP hardware, it is always recommended to disconnect from the internet, disable any anti-virus software, and disable your firewall as these may cause conflicts and prevent access to your device. Disabling the internet will avoid security issues why your system is vulnerable.

E1200 Series

- First, select which module or modules you need based on your I/O requirements:

ioLogik E1200 Series Selection Table

| Models | I/O Combinations | | | | | | | |
|---------------|------------------|-----------------|---------------|----------------|------------|-----------|---------------|-------------------|
| | Digital Inputs | Digital Outputs | Analog Inputs | Analog Outputs | RTD Inputs | TC Inputs | Relay Outputs | Configurable DIOs |
| ioLogik E1210 | 16 | – | – | – | – | – | – | – |
| ioLogik E1211 | – | 16 | – | – | – | – | – | – |
| ioLogik E1212 | 8 | – | – | – | – | – | – | 8 |
| ioLogik E1213 | 8 | 4 | – | – | – | – | – | 4 |
| ioLogik E1214 | 6 | – | – | – | – | – | 6 | – |
| ioLogik E1240 | – | – | 8 | – | – | – | – | – |
| ioLogik E1241 | – | – | – | 4 | – | – | – | – |
| ioLogik E1242 | 4 | – | 4 | – | – | – | – | 4 |
| ioLogik E1260 | – | – | – | – | 6 | – | – | – |
| ioLogik E1262 | – | – | – | – | – | 8 | – | – |

- Then connect your ioLogik to a 12-36VDC power supply and connect it to your computer through an Ethernet switch or directly via a crossover cable. You're now ready to configure the ioLogik via its Web Console.
 - The default IP for the MOXA E1200 series is 192.168.127.254, which is also the default for most of MOXA's products. Set your computer up with an IP in the 192.168.127.XXX subnet then open up Internet Explorer and enter the E1200's IP address.
- Upon entering the web console, you will find a summary page of useful information including a quick reference to the current status of the I/O, the device's MAC address and Firmware Revision.

MOXA ioLogik Remote Ethernet I/O Server www.moxa.com

■ Model - E1211 Ethernet IO Server ■ IP - 192.168.1.254 ■ MAC Address - 00-90-e8-23-30-4e
 ■ Name - ■ Serial No. - 04451 ■ Firmware - V1.4 Build11012820
 ■ Location - ■ System Elapsed Time - 00:33:41

Welcome to ioLogik Series

Ethernet I/O Server

Model Name: E1211
 Serial Number: 04451
 Firmware Version: V1.4 Build11012820
 Ethernet IP Address: 192.168.1.254
 Ethernet MAC Address: 00-90-e8-23-30-4e
 Peer to Peer: Disable

I/O Status

| DO Channel | Mode | Status | Low Width | High Width |
|------------|------|--------|-----------|------------|
| DO-00 | DO | OFF | -- | -- |
| DO-01 | DO | OFF | -- | -- |
| DO-02 | DO | OFF | -- | -- |
| DO-03 | DO | OFF | -- | -- |
| DO-04 | DO | OFF | -- | -- |
| DO-05 | DO | OFF | -- | -- |
| DO-06 | DO | OFF | -- | -- |
| DO-07 | DO | OFF | -- | -- |
| DO-08 | DO | OFF | -- | -- |
| DO-09 | DO | OFF | -- | -- |
| DO-10 | DO | OFF | -- | -- |
| DO-11 | DO | OFF | -- | -- |
| DO-12 | DO | OFF | -- | -- |
| DO-13 | DO | OFF | -- | -- |
| DO-14 | DO | OFF | -- | -- |
| DO-15 | DO | OFF | -- | -- |

- To obtain a pre-define Modbus address map, expand the “User-defined Modbus Addressing” category on the left and find the ‘Default Address’ category, shown below.

The screenshot shows the MOXA ioLogik Remote Ethernet I/O Server web interface. The top navigation bar includes the MOXA logo, the product name "ioLogik Remote Ethernet I/O Server", and the website "www.moxa.com". Below this is a status bar with fields for Model, Name, Location, IP, Serial No., System Elapsed Time, MAC Address, and Firmware. The main content area is titled "Default Modbus Address" and contains a table with the following data:

| No. | Description | User-defined Start Address (DEC) | Function Code | Read/Write | Reference Address (DEC) | Total Channels | Data Type |
|-----|---------------------------------|----------------------------------|---------------------|------------|-------------------------|----------------|-----------|
| 1 | DO Value | 0001 | 01:COIL STATUS | RW | 00001 | 16 | 1 BIT |
| 2 | DO Pulse Status | 0017 | 01:COIL STATUS | RW | 00017 | 16 | 1 BIT |
| 3 | DO Value All Channel (Ch0-Ch15) | 0033 | 03:HOLDING REGISTER | RW | 40033 | 1 | 1 WORD |

The left sidebar shows a navigation menu with "User-defined Modbus Addressing" and "Default Address" highlighted with red boxes.

- To choose your own Modbus Addresses, Click on the entry above ‘Default Address’ and you’ll find the user configurable Modbus settings.
- A second option besides using the web console is to use MOXA’s ioSearch Configuration Utility which is available here: <http://www.moxa.com/support/download.aspx?type=support&id=3405>
This tool is very useful for deploying multiple ioLogik modules, auto discovering devices, and quickly making configuration changes.

The screenshot shows the MOXA ioSearch Configuration Utility window. The title bar reads "MOXA ioSearch". The main window has a menu bar (File, System, Sort, Help) and a toolbar. On the left is a tree view showing a host at 192.168.1.165 with an "ioSearch" folder containing a device at 192.168.1.254 (E1211). The main area displays "Ethernet Remote I/O" and a table of discovered devices:

| # | Server Name | Model | IP Address | MAC Address | Subnet Mask | Gateway | Firmware... | Status |
|---|-------------|-------|---------------|-------------------|---------------|---------|-------------|--------|
| 1 | | E1211 | 192.168.1.254 | 00-90-E8-23-30-4E | 255.255.255.0 | 0.0.0.0 | 1.4 | Unlock |

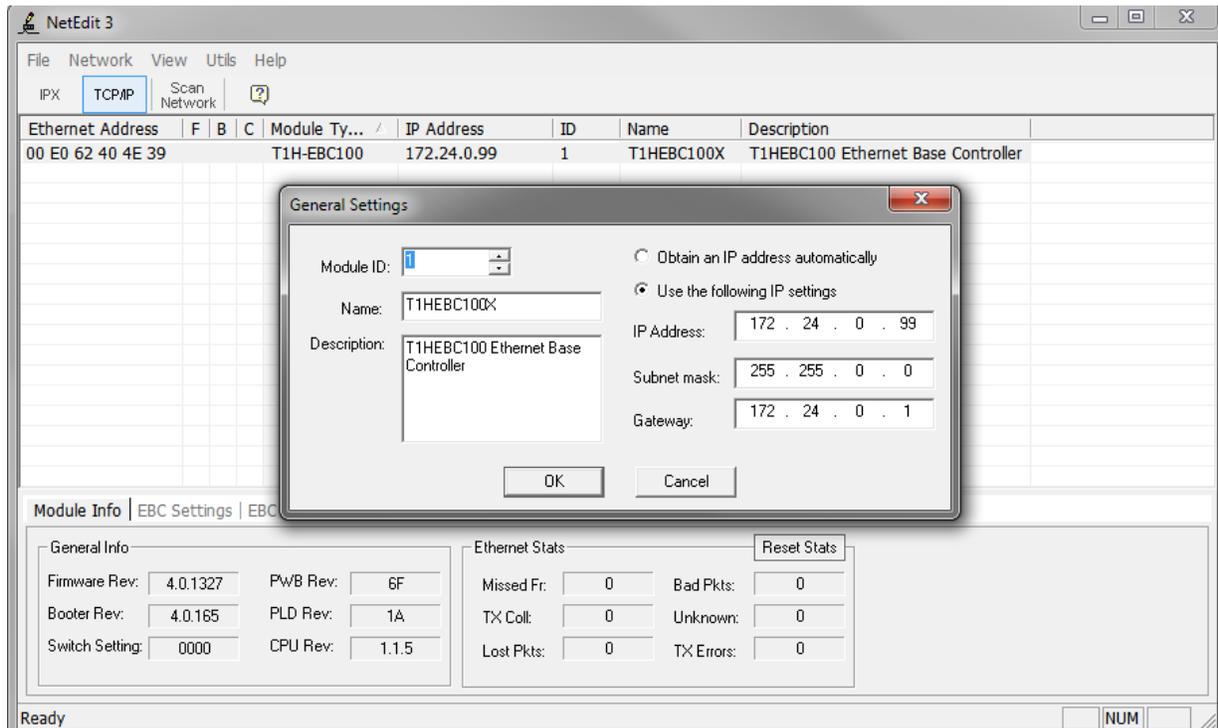
The status bar at the bottom shows "Ready", a timer at "0:00:00:51", and the time "1:48:13 PM".

Terminator I/O

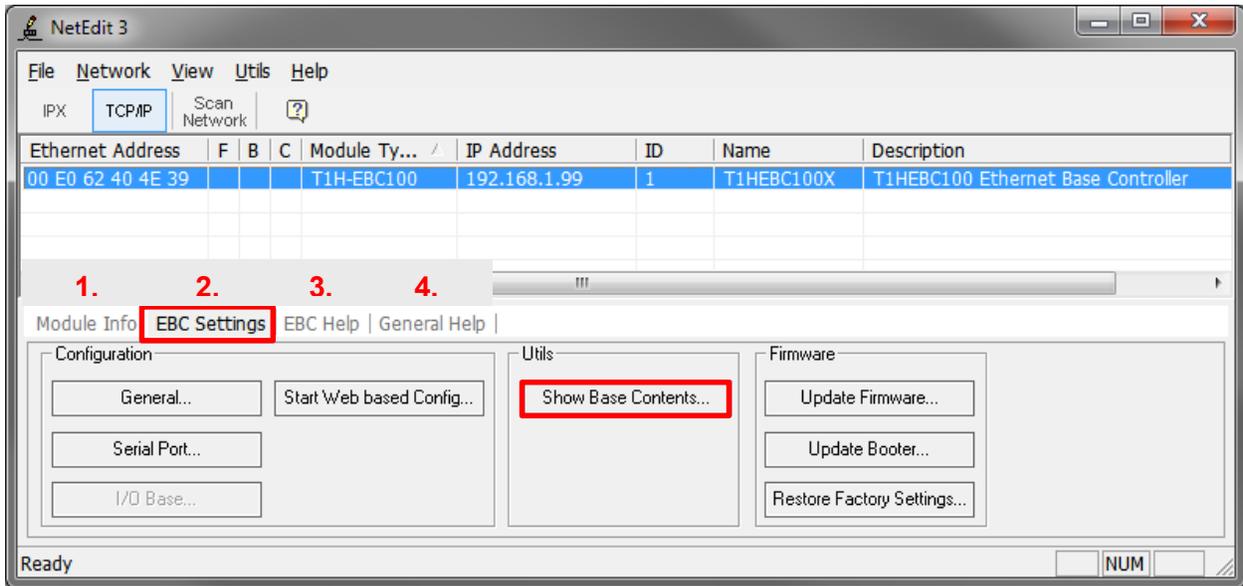
To configure system you must select your power supply, network module (EBC100), I/O modules, mounting bases and calculate your power budget. You can find a full list of modules available here: http://www.automationdirect.com/adc/Shopping/Catalog/Field_I-z-O

Programming via NetEdit3:

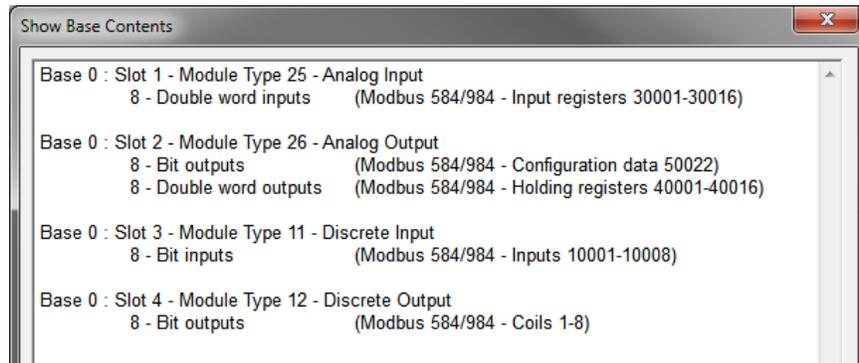
- Launch NetEdit 3, if your T1H-EBC100 communications module does not show up automatically, click on the “Scan Network” button to locate your device. Once it shows up, you can change basic settings like Module ID, IP Address, and Gateway by double clicking anywhere on the selected device.



- Along the bottom of the NetEdit3 window, you’ll see three tabs labeled ‘Module Info’, ‘EBC Settings’, ‘EBC Help’, and ‘General Help.’ The second Tab ‘EBC Settings’ is your access to settings for the serial port on the EBC100, as well as the pre-defined Modbus configuration, and controller firmware tools.

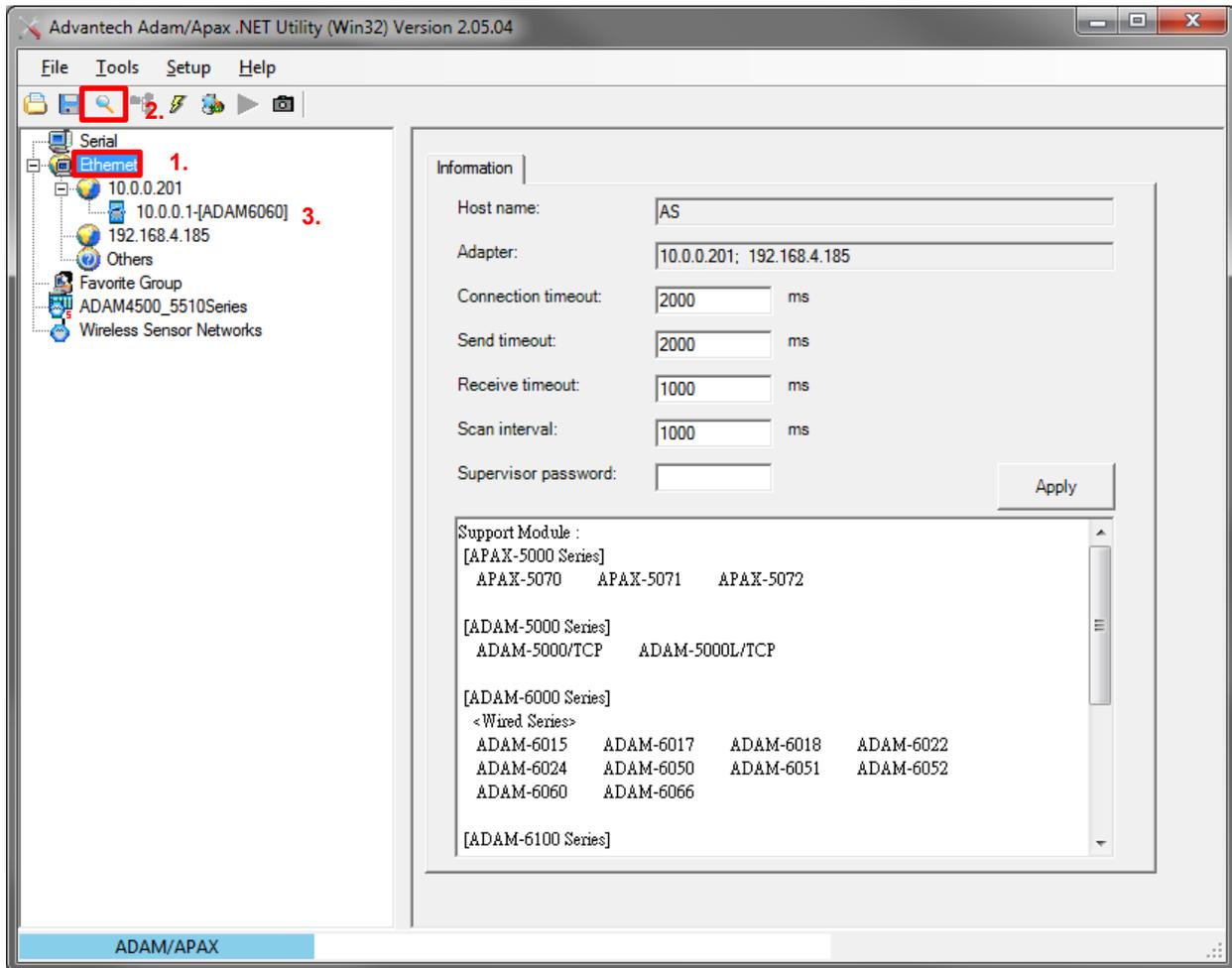


- To access the Modbus configuration, click on 'Show Base Contents'. When you do, a window will pop up that lists your slot-by-slot Terminator I/O configuration and the automatically generated Modbus addresses.

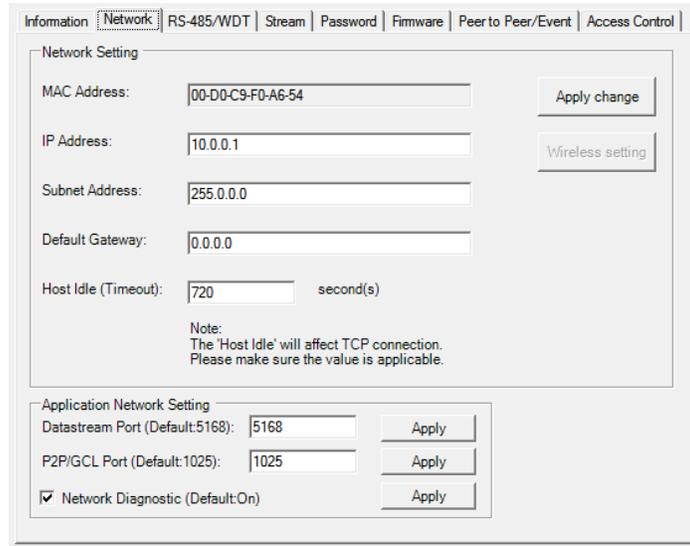


Advantech ADAM I/O

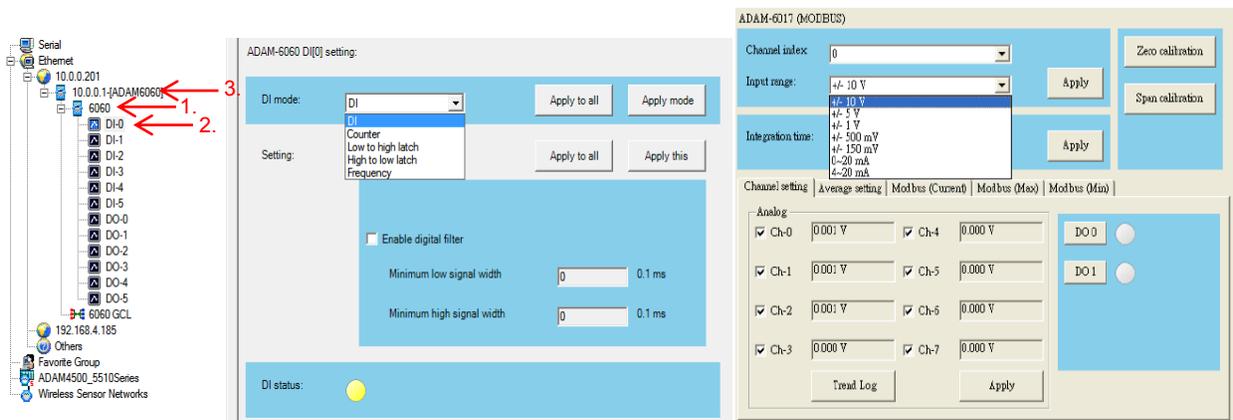
- Start by setting up your computer with an IP on the 10.0.0.XXX Subnet to be compatible with the ADAM's 10.0.0.1 default IP. Connect your hardware via an Ethernet switch or directly via a crossover cable. Install and launch the Advantech .NET utility which can be downloaded here: [Advantech ADAM/APAX .NET Utility](#).
- Once you've launched the software, click on the word 'Ethernet' in the navigation tree on the left. Then click the magnifying glass to search for your I/O module. Your module will show up where the number 3 is marked on the image below.



- Select your module and the right pane will update with tabs containing configuration sheets for the module. If you need to change your IP address, use the second tab labeled 'Network' to make the necessary changes.



- You can change settings for configurable I/O by clicking the module part number (number 2 in image below) listed below your device (number 1 in image below). You may be prompted for a password, by default it's 00000000. You can then click on individual I/O points to change any settings available. For example, the ADAM-6060 module lets you choose whether any or all inputs are typical DI, counters, latching inputs, or high speed frequency inputs. Analog modules may allow you to select their input/output ranges.



- You can locate the Modbus addressing for your particular module two different ways, depending on which module you have. If method 1 doesn't apply, try method 2. The first method is clicking your module part number (1.) and selecting the 'Modbus' tab. The ADAM module may have automatically assigned your addresses, and they can be seen listed here. If not, you can change your addresses by clicking on your device's IP address (3) and locating the Modbus Address tab. The window for method 1 is shown below.

ADAM-6060 6 DI / 6 relay module

Channel setting | Modbus

| Location | Type | Value | Description | Mode |
|----------|------|-------|-------------|------|
| 00001 | Bit | 1 | DI 0 | DI |
| 00002 | Bit | 1 | DI 1 | DI |
| 00003 | Bit | 1 | DI 2 | DI |
| 00004 | Bit | 1 | DI 3 | DI |
| 00005 | Bit | 1 | DI 4 | DI |
| 00006 | Bit | 1 | DI 5 | DI |
| 00017 | Bit | 0 | DO 0 | DO |
| 00018 | Bit | 0 | DO 1 | DO |
| 00019 | Bit | 0 | DO 2 | DO |
| 00020 | Bit | 0 | DO 3 | DO |
| 00021 | Bit | 0 | DO 4 | DO |
| 00022 | Bit | 0 | DO 5 | DO |

- Q: What are the four components do you need to fully assemble a Terminator I/O system
- Q: Name one application where you would use the MOXA ioLogic E1200 series Remote I/O over the Advantech ADAM Remote I/O.

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