EtherStax™ Stackable Industrial I/O Family
Modbus TCP/UDP/IP 10/100MB Ethernet I/O

Model ES2161 & ES2162
32-Ch Differential Analog Current/Voltage Input

USER'S MANUAL

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Symbols on equipment:

Means "Refer to User's Manual (this manual) for additional information".

For additional information, please visit our web site at www.acromag.com and download our whitepaper 8500-765, Introduction To Modbus TCP/IP, or 8500-648, Introduction to Modbus.

IMPORTANT SAFETY CONSIDERATIONS

You must consider the possible negative effects of power, component, wiring, sensor, or software failure in the design of any type of monitoring or control 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.

GETTING STARTED

TECHNICAL REFERENCE

QUICK START

Guide to Quickly Establishing Communication

If you already know the basics of connecting power, connecting a network cable, and using a web-browser, and you only need some help establishing communication, here is a brief outline of what you must do to start communicating with this device right away and where to go for help.

This is an Ethernet device with built-in web capability that allows you to use your web-browser to set it up and configure it. All Ethernet devices have a unique IP address that you are required to know in order to use your web-browser to actually communicate with it.

What if you do not already know the IP address of the unit?

All Acromag Ethernet devices include an alternate default mode of operation with a fixed IP address set to **128.1.1.100**. Additionally, the user-programmable IP address that is used outside of default mode is also initially set to 128.1.1.100 from the factory. If this unit is frsh from the factory, you can talk to it at this address in either mode.

If your unit is not as shipped from the factory and may have another IP address set, then…

You need to place the unit in its Default Mode, which allows you to address it at IP address 128.1.1.100 (**http://128.1.1.100**).

You place this unit into Default Mode by depressing the toggle switch to the position marked "DFT" for about 4 seconds (see front figure at right), just until the yellow STATUS LED (opposite side of unit) starts blinking slowly to indicate the unit is in the Default Mode. Let go of DFT toggle when Status LED starts blinking.

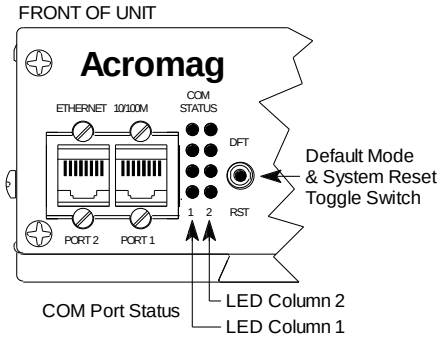
Try browsing the unit with your web browser address at **http://128.1.1.100**. If your unit is in default mode, you should be presented with the home page (and your Status LED should continue to blink).

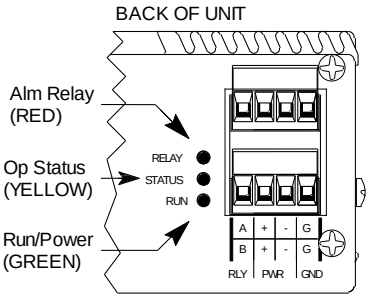
If you are using IP address 128.1.1.100, and you still can't talk to the unit…

You cannot talk to this device at IP address 128.1.1.100 if the Network Interface Card you are using to connect to our device is set to an IP address outside of the address domain established by this default address. You must set the IP address of your network interface to an address like 128.1.1.x, where x is an integer from 1 to 254, except 100 (our default address). This procedure is covered in document 8500-815 shipped with your unit. It is also detailed in Application Note 8500-734, which you can obtain from the CDROM shipped with your unit, or optionally via download from our web site at www.acromag.com.

You managed to browse to the unit's Home Page, but now you need to get to the Network Configuration Page to set your own IP address…

In order to access any of the other web configuration pages, like the Network Configuration Page, you will need to first enter a Username = **User**, and Password = **password** to gain access (these are the default username and password settings for all EtherStax models and these entries are case-sensitive).





QUICK START

Guide to Quickly Establishing Communication

Your unit is not as shipped from the factory and you do not know the Username and Password settings…

If you forget your user name & password, you can always toggle the unit into default mode via the DFT toggle switch at the front of the unit (hold this toggle 4 seconds to invoke default mode). In this mode, the password and username will revert to the original defaults of "User" and "password" (unit assumes an IP address of 128.1.1.100 in its default mode), allowing you to re-invoke the Password Configuration Page and change the username and password settings as required.

If after applying power, your green RUN LED is not solid ON and is blinking continuously, you need to do the following:

Normally on power-up, the green RUN LED will blink for about 22 seconds during initialization, then stay ON. But if it continues to blink, then first check that your network cable is connected to the unit and to your PC. If you powered the unit up without making your network connection, the green RUN LED will continue to blink. If you replace the network cable after powering-up, the RUN LED should stop blinking after about 10 seconds once a network link has been established. Note that once the link is established, and even if you later remove the cable, the green RUN LED should not continue to blink.

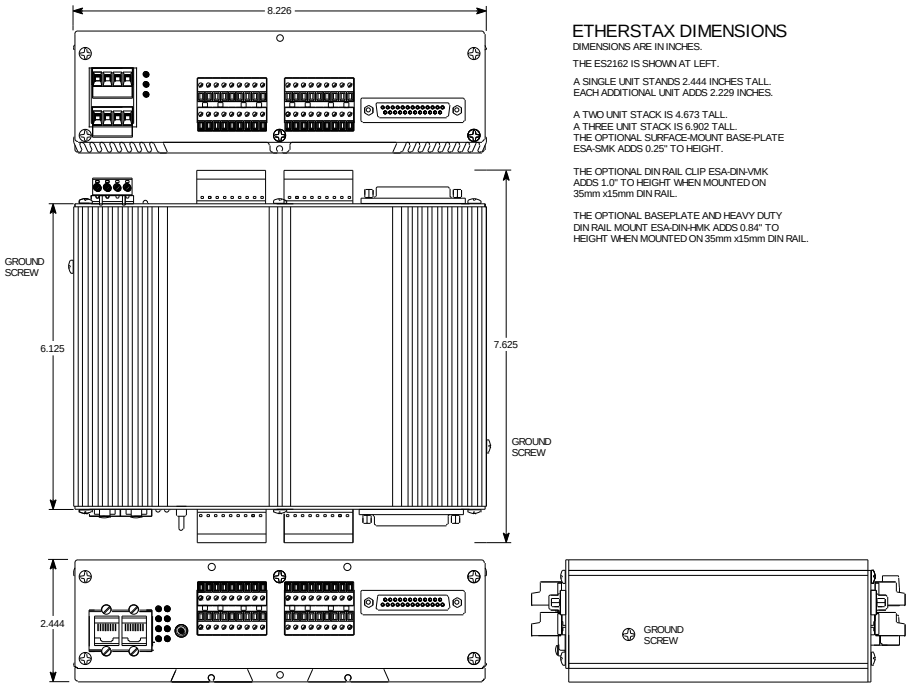
If the green RUN LED continues to blink after checking your network connections, then try resetting the unit by momentarily depressing the DFT/RST toggle switch to the RST position. After five seconds, the green RUN LED should remain ON.

If you have checked your network connections, tried resetting the unit, and the green RUN LED still continues to blink, then you may need to follow the procedure for restoring the EtherStax to its Initial Configuration. This procedure is located at the end of the Trouble-Shooting section of this manual under "Getting Out Of Trouble" on page 53. This is also the procedure used to sanitize the unit for de-commissioning. You should only do this as a last resort, as this procedure restores everything to its default state—all holding registers, network settings, i2o settings, and any calibration you may have performed. If you do use restore and want to return the unit to service, the calibration reference will additionally have to be restored separately via the Restore Factory Voltage Reference Value button of the Input Calibration Page. Inputs will be calibrated automatically, but any manual calibration that you have done to improve accuracy is lost after restore and may need to be rechecked.

At this point, if the green RUN LED continues to blink, then you may need to return the unit for repair.

If you need additional help and you have already reviewed the material in this manual, please contact the factory.

Units are designed to interlock and stack together up to three units high. A stack of units can be bolted to a wall or flat surface, or mounted on deep-channel, "T" type, 35mm x15mm DIN rails (per DIN EN60715 TH35), depending on the optional mounting kit selected. Available mounting kits are shown below.



ETHERSTAX DIMENSIONS

DIMENSIONS ARE IN INCHES.

THE ES2162 IS SHOWN AT LEFT.

A SINGLE UNIT STANDS 2.444 INCHES TALL. EACH ADDITIONAL UNIT ADDS 2.229 INCHES.

A TWO UNIT STACK IS 4.673 TALL. A THREE UNIT STACK IS 6.902 TALL. THE OPTIONAL SURFACE-MOUNT BASE-PLATE ESA-SMK ADDS 0.25" TO HEIGHT.

THE OPTIONAL DIN RAIL CLIP ESA-DIN-VMK ADDS 1.0" TO HEIGHT WHEN MOUNTED ON 35mm x15mm DIN RAIL.

THE OPTIONAL BASEPLATE AND HEAVY DUTY DIN RAIL MOUNT ESA-DIN-HMK ADDS 0.84" TO HEIGHT WHEN MOUNTED ON 35mm x15mm DIN RAIL.

MOUNTING **AND DIMENSIONS**

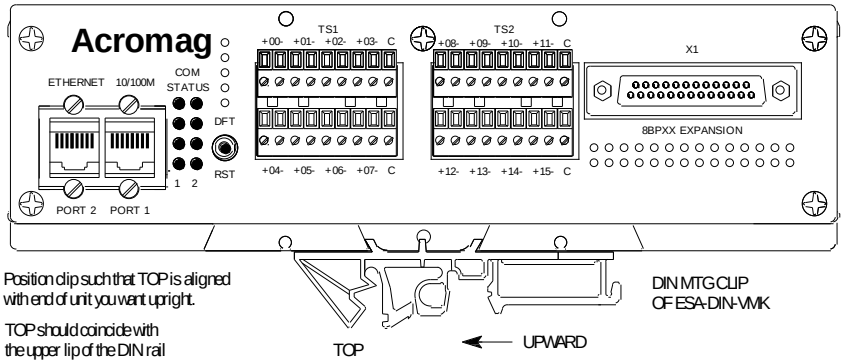
These Models are open-type devices and intended for installation into a suitable enclosure by the end-user.

It is recommended that enclosed units be panel-mounted with the vented endplates positioned at top and bottom for improved cooling. Review the Operating Ambient Temperature specification for more information.

A single unit stands 2.444 inches tall. Each additional unit adds 2.229 inches.

A two-unit stack would be 4.673 inches tall. A three unit stack is 6.902 inches tall. Add any additional height as necessary to account for the mounting plate, DIN clip, and DIN rail, if required.

DIN Rail Vertical Mount Kit ESA-DIN-VMK (One or Two Units): This kit includes two plastic DIN clips (Rose Bopla #77003500) that slide into the dove-tail channel of the bottom of the housing. You can use one clip to mount a single unit, or both for added stability when stacking two units. If stacking more than two units on a DIN rail, see ESA-DIN-HMK.



Position clip such that TOP is aligned with end of unit you want upright.

TOP should coincide with the upper lip of the DIN rail

TOP

This side of clip should align with top of rail

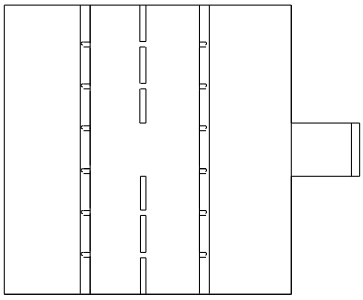
DIN MTG CLIP OF ESA-DIN-VMK

UPWARD

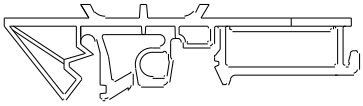
TO HANG: Tilt unit and place TOP of clip over upper lip of DIN rail. Press bottom towards rail to snap in place.

TO REMOVE: Push unit upward and tilt TOP of unit back towards you to disengage it from rail.

ESA-DIN-VMK TOP VIEW



ESA-DIN-VMK SIDE VIEW



NOTE: ESA-DIN-VMK CONTAINS TWO OF THESE PIECES.

MOUNTING AND DIMENSIONS

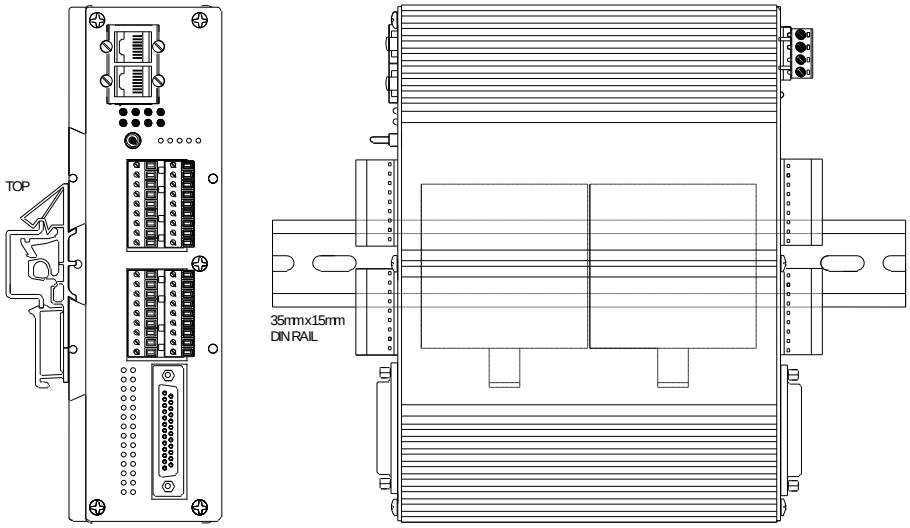
Simply slide the clips of this kit into the dovetail channel at the bottom of the enclosure. You can use one clip, or both (recommended), DIN clips of this kit to mount a single unit. For a stack of two units, both clips must be used. To remove a unit from the DIN rail, you have to lift the assembly upward and tilt the top of the unit back to disengage it from the rail. If you choose to install both DIN clips for added security (recommended), then more pressure will be required to disengage the unit from the rail. To mount a stack of 3 units to a DIN rail, use the heavy-duty DIN kit model ESA-DIN-HMK instead.

The drawing at right shows how to mount a unit with the ESA-DIN-VMK kit.

This kit includes two DIN clips for added stability, or for mounting a stack of two units. Note the orientation of the DIN clips relative to the rail.

To remove a unit from the rail, grip unit on each side and pull/push upward, while tilting the top back to release the unit from the upper lip of the DIN rail.

ETHERSTAX MOUNTING WITH ESA-DIN-VMK

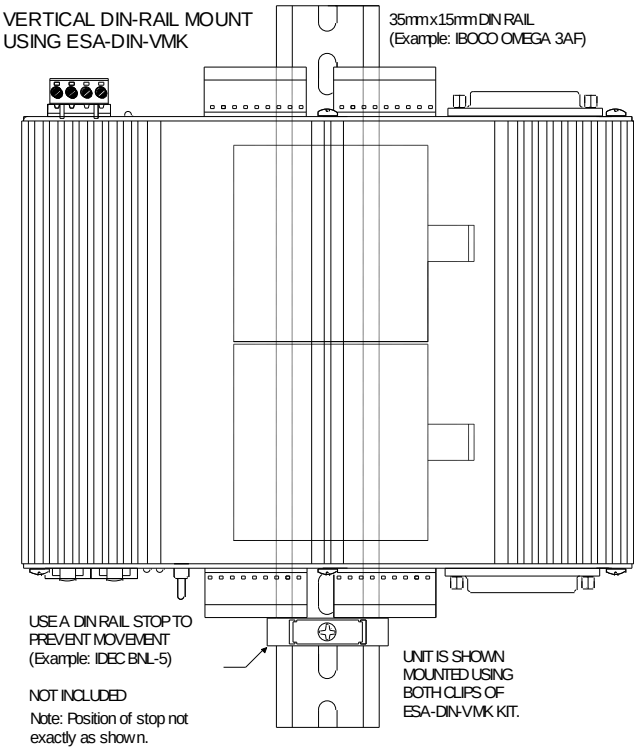


IMPORTANT: Stack no more than 2 units with ESA-DIN-VMK.
Use both clips of this kit with two units stacked together.

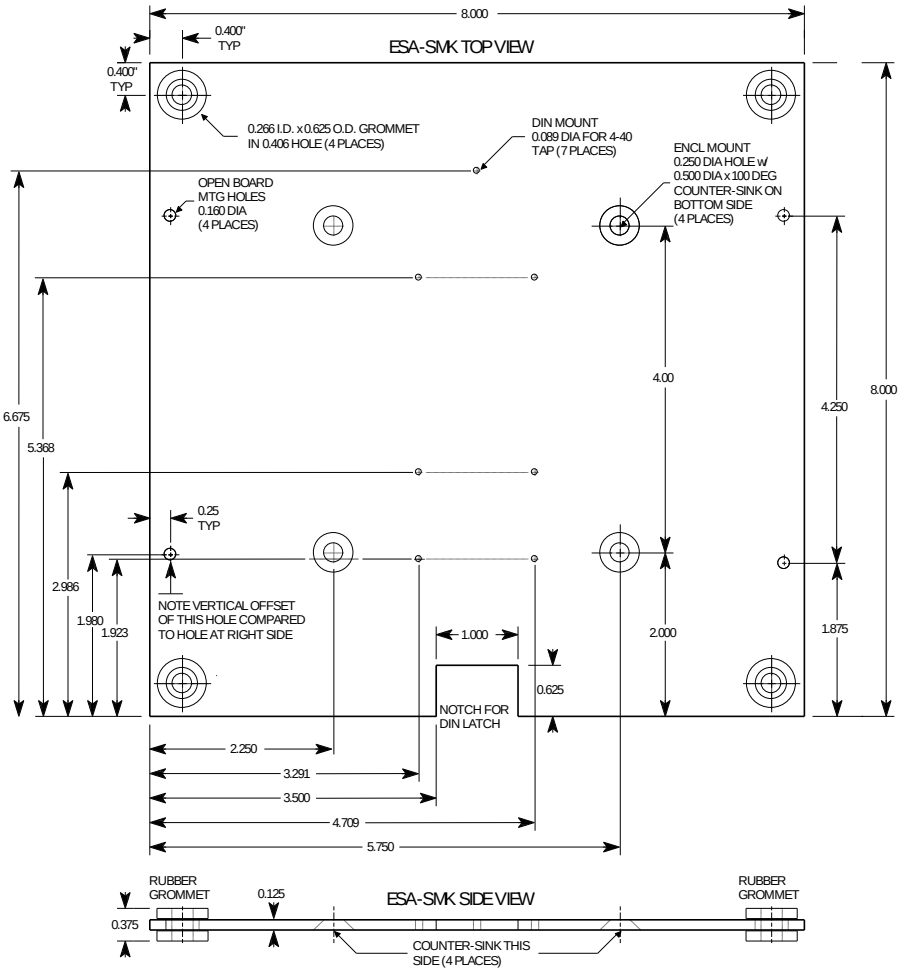
You can use the ESA-DIN-VMK to mount a unit horizontally, or vertically as shown at right. Be sure to use a DIN rail stop to prevent the unit from moving along the rail with vertically mounted DIN rail.

Note that enclosed units oriented as shown at right will have improved cooling ability (see Operating Ambient Temperature).

VERTICAL DIN-RAIL MOUNT
USING ESA-DIN-VMK



Surface-Mount Kit ESA-SMK (One to Three units): This kit includes a shock-mounted aluminum base-plate and bolts that attach to the bottom of the housing. Mounting holes with rubber grommets at each corner support ¼-inch bolts for mounting to flat surfaces. Up to three units may be stacked on this plate.



This plate also includes the four holes necessary for mounting an open-frame circuit board to it (i.e. no enclosure with hardware of ESA-OMK).

ESA-SMK Kit Contents:

1 Pre-Drilled Aluminum Base-Plate, 8 x 8 x 0.125.
4 ¼-20 x 0.375 Flat-Head, 100° Counter-Sink, Phillips
4 Rubber Grommet, 0.625 O.D. x 0.266 I.D.

The ¼-inch bolts and washers (recommended) to attach this assembly to a flat surface or panel are not provided.

For DIN rail mounting of this plate, see ESA-DIN-HMK

MOUNTING AND DIMENSIONS

Insert the four rubber grommets into the holes at each corner of the base-plate.

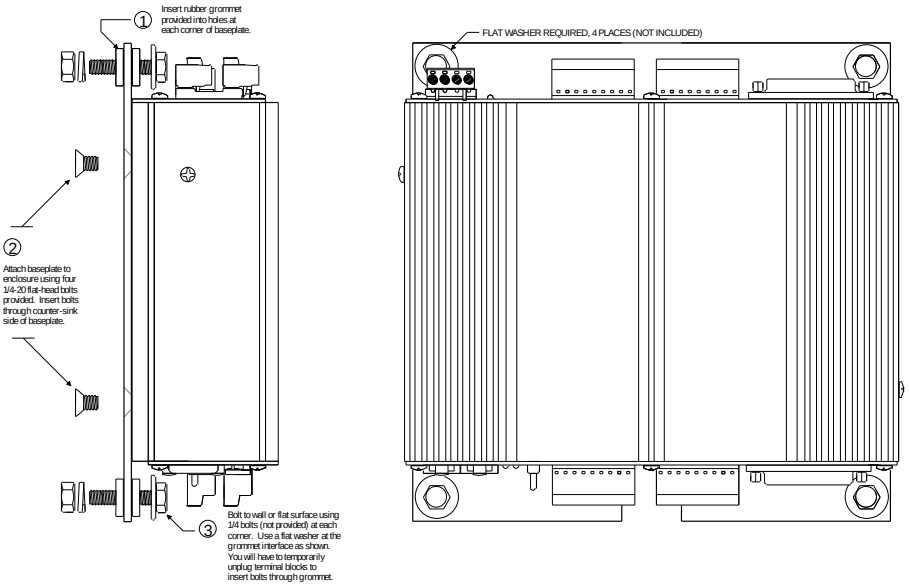
Then use the four ¼-20x0.375, flat head, counter-sink bolts provided to bolt this plate to the bottom of the enclosure. Be sure to insert the bolts from the counter-sink side of the plate.

Add any additional units to your stack–you can safely stack up to three units on this plate.

Use ¼-inch bolts (not provided) to bolt this assembly to a wall or flat surface. It is recommended that flat washers (not provided) be used to protect the rubber grommet.

MOUNTING AND DIMENSIONS

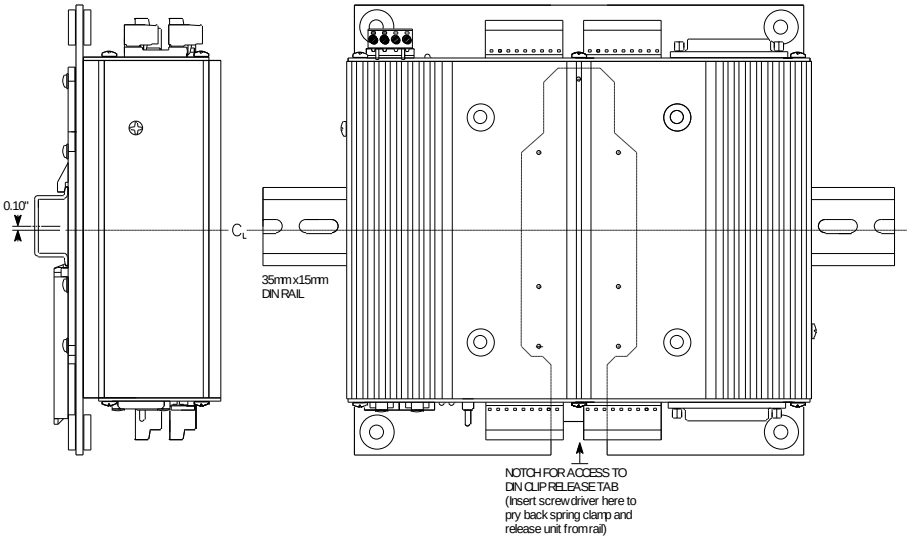
ETHERSTAX SURFACE MOUNTING WITH ESA-SMK



DIN Rail Horizontal Mount Kit ESA-DIN-HMK (one to three units): This kit has the same base-plate as ESA-SMK above, but adds a heavy-duty DIN adapter (Phoenix UTA-159) and screws for mounting to 35x15mm T-type DIN rails. Up to three units may be stacked on this plate and mounted to a DIN rail.

This is the recommended mounting orientation for reducing internal heat generation (see Ambient Operating Temperature at the back of this manual).

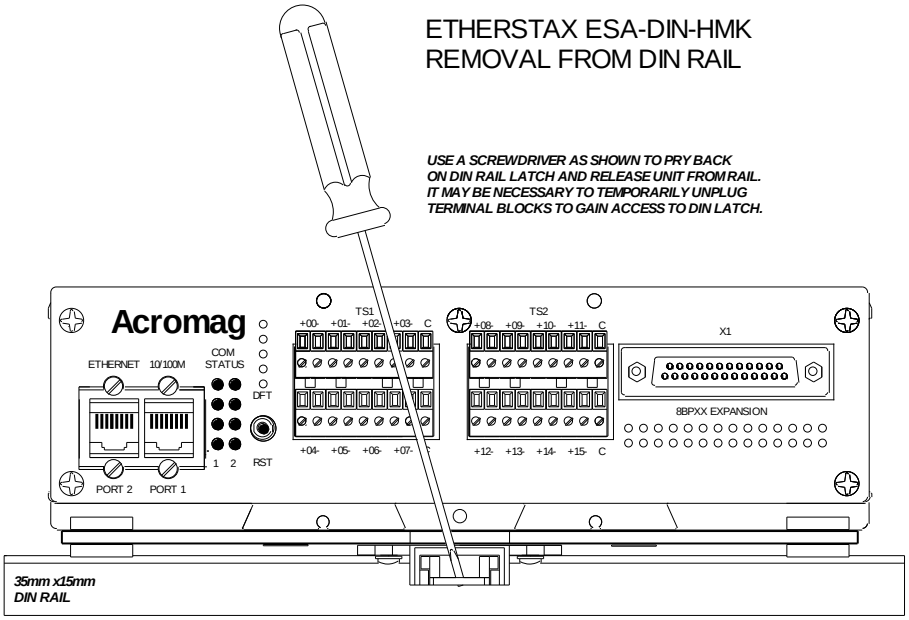
ETHERSTAX MOUNTING WITH ESA-DIN-HMK



ESA-DIN-HMK Kit Contents:

1	Pre-Drilled Aluminum Base-Plate, 8 x 8 x 0.125.
4	¼-20 x 0.375 Flat-Head, 100° Counter-Sink
4	Rubber Grommet, 0.625 O.D. x 0.266 I.D.
1	Heavy-Duty DIN Adaptor (Phoenix UTA-159)
7	4-40 x 0.25 screw with lock-washer

To attach or remove the ESA-DIN-HMK to/from the DIN Rail, use a screwdriver tip inserted into the slot at the end of the DIN clip, in the area of the notch of the base-plate as shown below. Pry back to compress the DIN clip spring, then release it from the rail. You may have to temporarily unplug the terminal blocks in the area of this notch to gain access to the DIN clip.



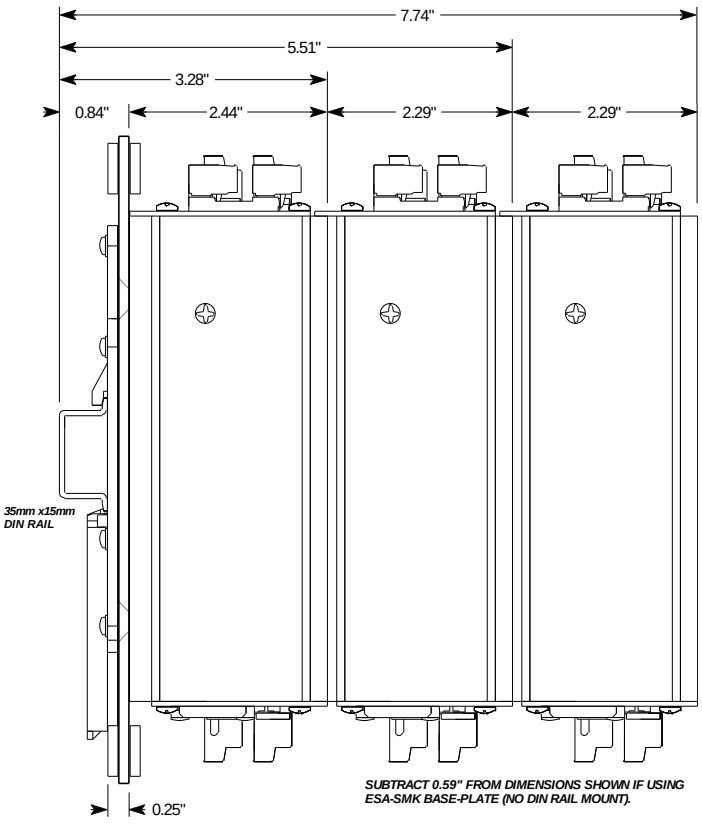
MOUNTING AND DIMENSIONS

IMPORTANT: *Be sure to remove power before attempting to disengage unit from the DIN rail.*

Be sure to grip unit firmly before disengaging unit from rail and avoid dropping it.

ETHERSTAX ESA-DIN-HMK STACKING

UP TO 3 UNITS MAY BE STACKED ON A DIN RAIL USING ESA-DIN-HMK AS SHOWN.



Note that you can stack up to 3 units on the ESA-DIN-HMK or ESA-SMK as shown at left.

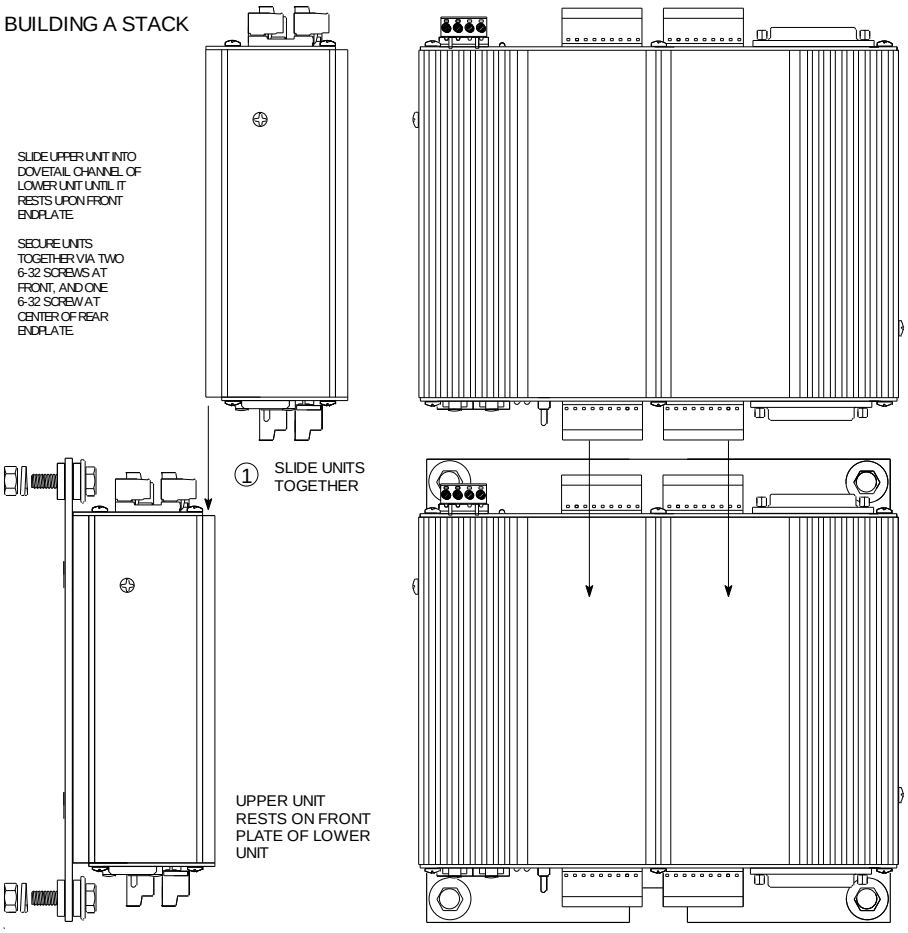
Subtract 0.59 inches from dimensions shown if using ESA-SMK (i.e. no DIN rail mount).

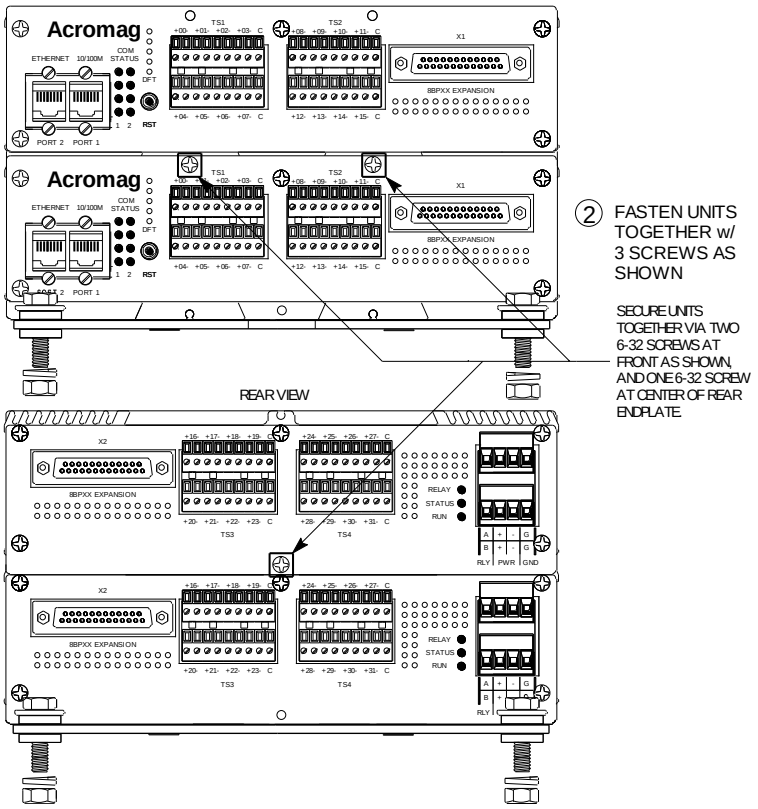
MOUNTING AND DIMENSIONS

The drawing at right shows how to stack units together.

You can stack up to three units together in this manner.

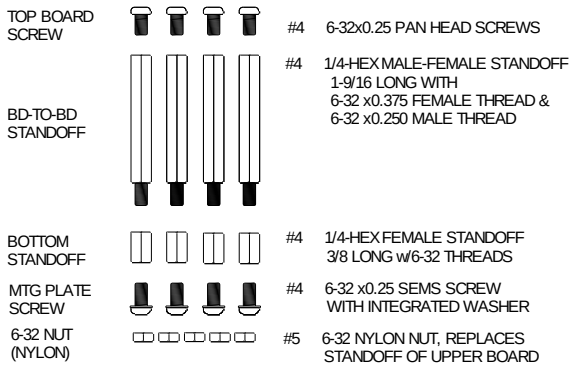
WARNING: *Be sure to grip the edges of unit firmly when stacking units and avoid dropping it.*



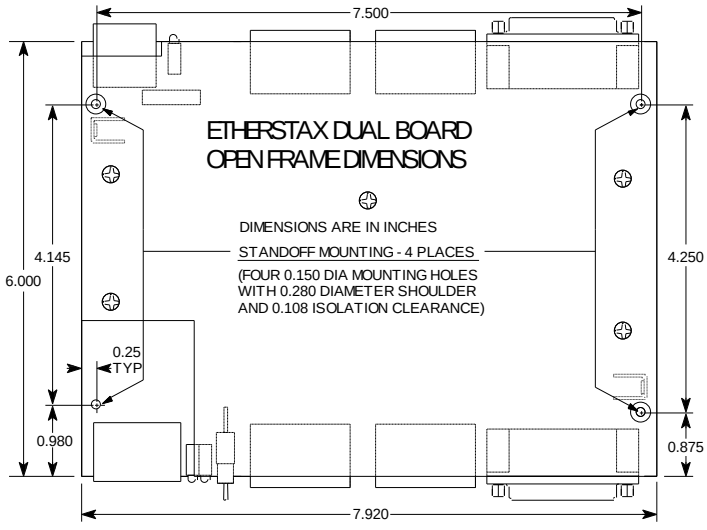


Open-Board Mounting Kit ESA-OMK: EtherStax units can be ordered and mounted without their enclosure. This kit includes the jack-screws, and fasteners necessary to stack two open circuit boards together (or two dual board assemblies), plus the standoffs and screws for mounting this assembly to a flat surface. Note that this is also a replacement kit, as open-frame units already include these items (except for 6-32 nut). Use additional kits as required for stacking more than two boards in this manner.

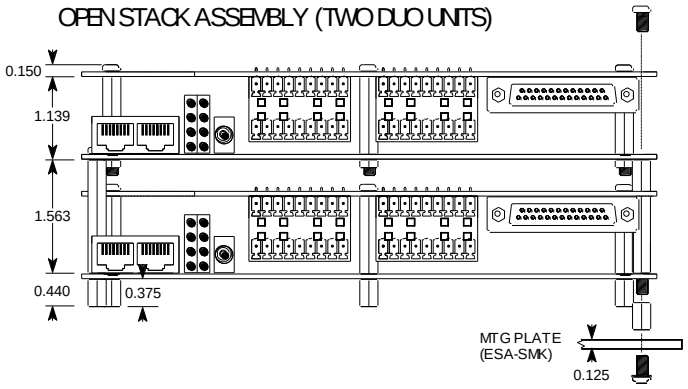
ESA-OMK KIT CONTENTS



ESA-OMK kit items are also included with every open board assembly.



OPEN STACK ASSEMBLY (TWO DUO UNITS)



MOUNTING AND DIMENSIONS

IMPORTANT: *Units ordered without their enclosure do not retain safety agency listing, but are recognized components (see Specifications – Agency Approvals). Open-frame units are also vulnerable with respect to ESD. While the open unit retains all of its built-in transient suppression and filtering, the sensitive electronic circuits are left exposed to ESD damage without the protection of an enclosure.*

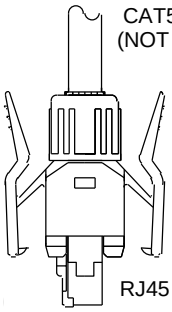
You should take adequate measures to protect open-frame mounted units from dust, debris, and ESD.

Thus, it is recommended that open units be mounted in a protective enclosure or cabinet.

Note: *Open-frame units may also mount to the optional surface-mounted base plate ESA-SMK to facilitate surface or DIN-rail mounting. This plate has mounting holes located as shown to mate with those of the circuit board.*

Be very careful when handling open-frame circuits to avoid ESD damage to the sensitive circuit components.

MOUNTING AND DIMENSIONS



ESA-CTK IP20 CAT5
CABLE TERMINATION KIT

Cable Termination Kit ESA-CTK: The EtherStax enclosure includes a panel mounted frame around the RJ45 network port that accommodates special IP20 clip-type plug connectors that help to secure network connections from shock and vibration. You can still utilize standard RJ45 modular plug connectors, but if you want the added security of this clip frame, then you have to use the compatible cable plug connectors provided by this kit. This kit provides the male plug and sleeve housing for one end of Category 5 Ethernet cable that will mate to this frame. Category 5 cable is not included. You will also require a modular crimping tool for attaching the plug to your cable (most standard RJ45 crimping tools will work).

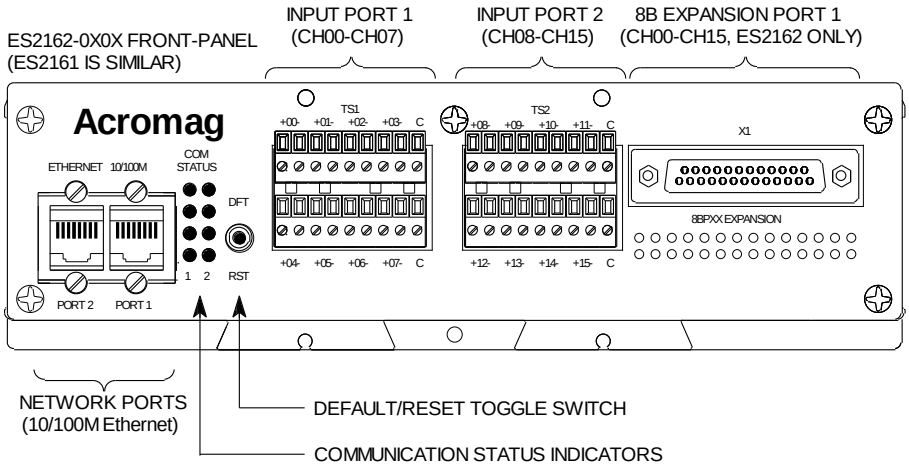
Units ordered without their enclosure cannot utilize this clip.

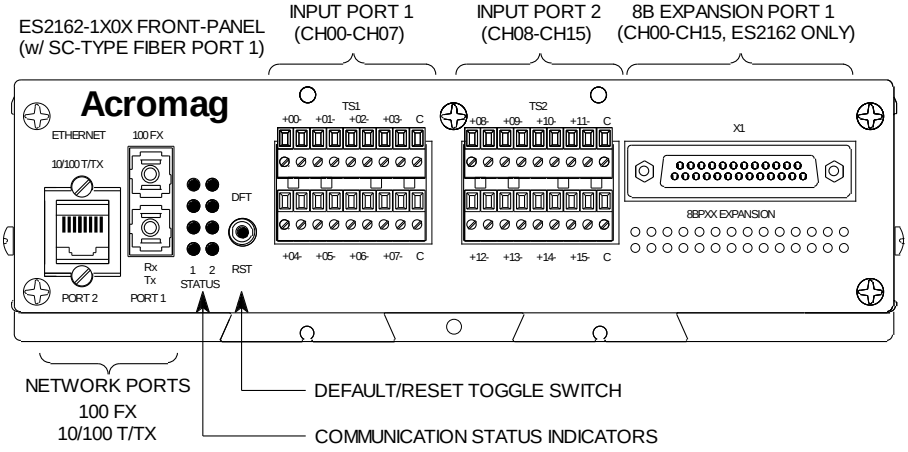
Front Panel

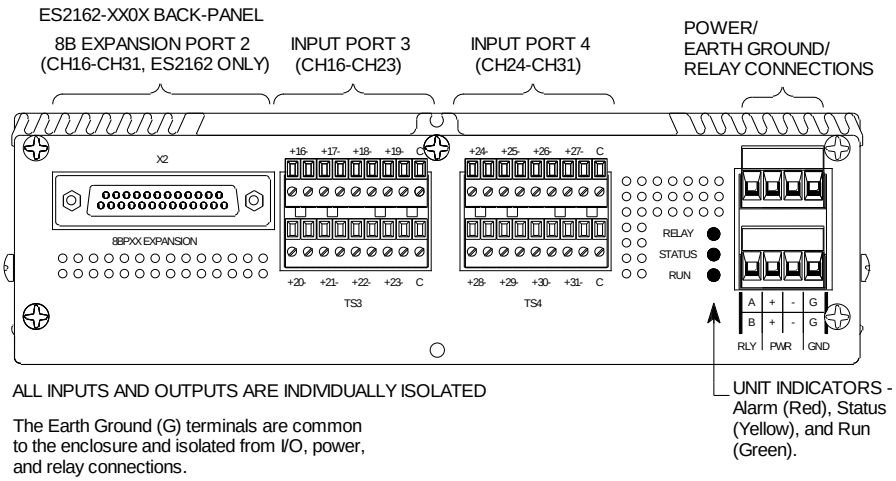
Two columns of status indicators for the network ports are used to indicate different things according to whether the unit is in switch mode, or hub/repeater mode. Refer to Specifications – Controls & Indicators for these definitions.

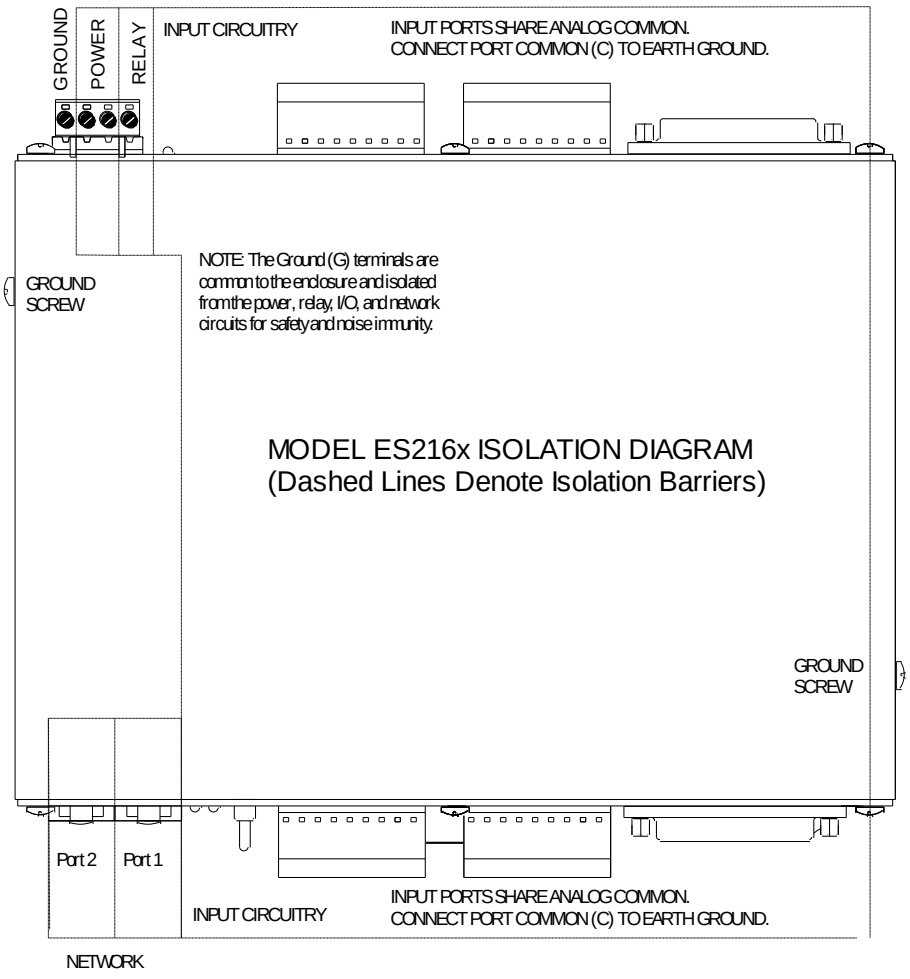
The toggle switch is used to toggle the unit into or out of Default Mode (toggle up & hold 4 seconds), or to reset the unit (toggle down).

In Default Communication Mode, the yellow STATUS LED on the back of the unit will flash slowly and the unit will assume a fixed static IP address of "128.1.1.100", a default subnet mask of "255.255.255.0", a default username of "User", and a default password of "password".









CONTROLS & INDICATORS

Back Panel

The Green RUN LED (bottom) is ON if power is on and will blink in "wink" ID mode.

The Yellow STATUS LED (middle) blinks ON/OFF slowly in default communication mode and blinks rapidly if a watchdog timeout has occurred.

The Red RELAY LED (top) is ON if relay is energized (relay terminals A & B are closed).

ISOLATION BARRIERS

Dashed Lines denote isolation barriers. Additionally, the enclosure is also isolated.

The input circuitry, network ports (each), power circuit, relay, and enclosure (earth ground) are isolated from each other for safety and noise immunity.

Note that the network ports are individually isolated from the rest of the circuit and from each other.

***IMPORTANT:** Transient suppression devices are internally shunted to earth ground, please connect the ground terminal to a suitable earth ground to complete this path and protect the unit. Ground may alternately connect to the ground screw on either side of the unit instead of the ground terminal.*

CONNECTIONS

Network

For 100Base-TX systems, at a minimum, use data grade Unshielded Twisted-Pair (UTP) wiring that has a 100Ω characteristic impedance and meets the EIA/TIA Category 5 wire specifications.

It is recommended that you use a CAT-5 cable to connect this device to your PC.

For 10Base-T systems, you may use Category 3, Category 4, or Category 5/5E UTP/STP cable.

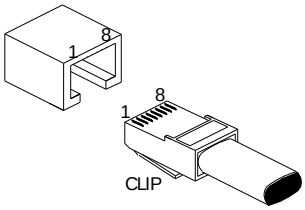
In either case, you are limited to 100 meters between any two devices.

RJ45 MDI AND MDI-X CONNECTIONS

PIN	MDI WIRING	MDI-X WIRING
1	Transmit +	Receive +
2	Transmit -	Receive -
3	Receive +	Transmit +
4	Not Used	Not Used
5	Not Used	Not Used
6	Receive -	Transmit -
7	Not Used	Not Used
8	Not Used	Not Used

Note Crossover Connections

ETHERNET PORT



RJ-45 CONNECTOR

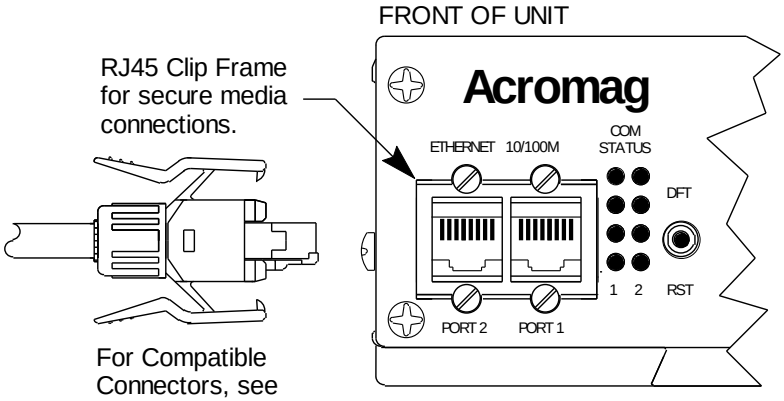
RECOMMENDED CABLE

SPEED	DISTANCE	CABLE
10Base-T	100M	CAT 3, CAT 4, or CAT 5 UTP
100Base-TX	100M	CAT 5/5e UTP/STP

The Ethernet port of this unit is wired MDI-X by default, but includes automatic crossover (the Ethernet port of your PC is typically wired MDI). Thus, you can use either a straight-through or crossover cable to connect this device directly to a PC, Ethernet switch, or another unit.

For compatible male plug connectors, order the Cable Termination Kit, Acromag ESA-CTK.

FRONT OF UNIT



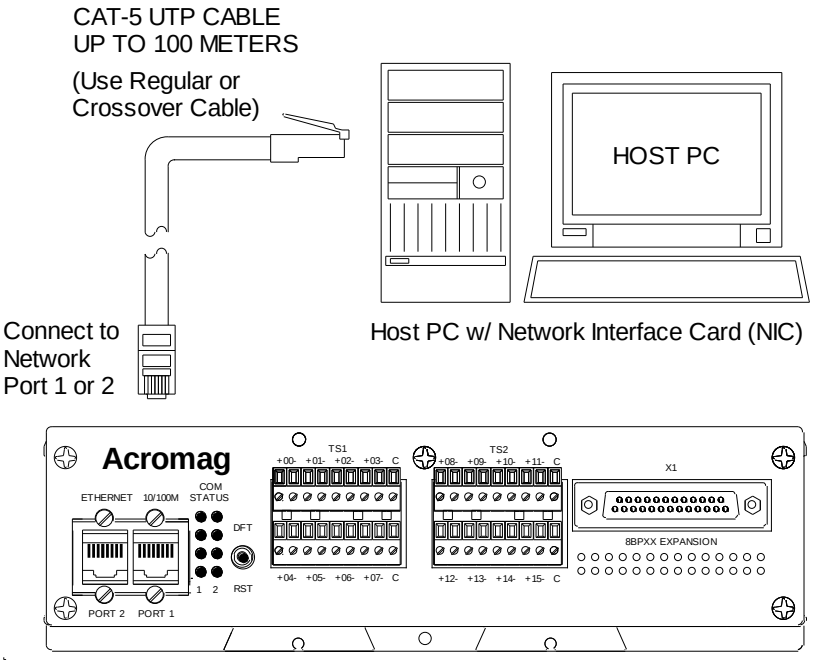
For Compatible Connectors, see ESA-CTK Cable Termination Kit

The RJ45 clip frame mates with the compatible connectors of the ESA-CTK for increased immunity to shock & vibration.

For increased immunity to shock and vibration, the RJ45 network connections include special clip frames that can be used with compatible plug connectors to help secure your network connection from breaking free under shock or vibration. You can still utilize industry standard RJ45 modular plugs, but if you want the extra security provided by this clip frame, then you can order compatible connectors via the Acromag ESA-CTK Cable Termination Kit. This kit includes the male plug and sleeve housing that mate to the RJ45 frame of the enclosure for one end of CAT5 cable (cable not included). You will also need a modular plug crimping tool for attaching the plug provided to your cable.

HOST PC CONNECTED DIRECTLY TO UNIT

Note: This MDI to MDI-X connection does not require a crossover cable.



If your unit is a Model ES2161/2162-1xxx, it includes both a 100FX fiber port and a 10BT/100BTX copper port. To connect directly to the fiber port from your PC, you will need a compatible NIC card installed in your PC, or a media converter. Note that the auto-crossing feature does not apply to fiber connections and the Tx and Rx fiber channels must be mechanically crossed.

Optionally, you may use an external Ethernet switch to connect to your EtherStax unit (recommended). The recommended approach for switched Ethernet is to connect one unit or Ethernet device per switch port. This is the most efficient and deterministic method of communication as it increases network throughput and eliminates data collisions.

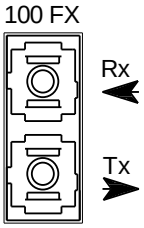
The next section reviews the operation of Ethernet hubs and switches as it relates to the built-in Ethernet switch of this device, which may optionally operate as an Ethernet hub/repeater. You can skip the next two pages if you are already familiar with these terms.

CONNECTIONS

Network – Basic Connections

Your host PC will require that a 10/100M network interface card (NIC) for Ethernet be installed to connect to the EtherStax unit. You may connect to port 1 or port 2 of the EtherStax. The EtherStax unit is auto-crossing, allowing you to use a regular or crossover cable to make connections.

IMPORTANT (Fiber Models): *Some models will substitute an SC-type fiber port connector for port 1. The auto-crossing feature of these units does not apply to the fiber connection and transmit must be manually crossed over to receive, and visa-versa. Facing the front end-plate of the unit, the Transmit (Tx) channel is the bottom half of the SC style connector, while the top half is Receive (Rx).*



COM STATUS		SWITCH MODE LED Column 1 - Port 1 LED Column 2 - Port 2	HUB/REPEATER MODE 1=LED of Column 1 2=LED of Column 2
● ●	GREEN	No Function in Switch Mode.	1=Hub Activity, 2=Hub Collision.
● ●	YELLOW	Link/Activity - ON if Linked/Blinks if Activity.	1=MII/CPU Link/Activity, 2=MII/CPU Error.
● ●	YELLOW	Full-Duplex/Collision - ON for Full-Duplex, Blinks for Half-Duplex Collisions, OFF for Half-Duplex and No Collisions.	1=Port 2 Link/Activity, 2=Error at Port 2.
● ●	YELLOW	Speed - ON for 100Mbps, OFF for 10Mbps.	1=Port 1 Link/Activity, 2=Error at Port 1.
1 2	Refer to Specifications - Controls & Indicators Section for more detail.		

CONNECTIONS

Network – Background

Hubs & Switches

To properly network connect this device, you need to know a little bit about network hubs and switches. Please take a moment to review this material before installing your unit.

Switched Ethernet involves connecting one Ethernet device per switch port. This suppresses CSMA/CD and allows the segment to operate full speed in full duplex. A throughput of 100M at half-duplex effectively doubles with full-duplex. This provides a more reliable and deterministic communication link, as no data collisions are possible.

An Ethernet hub (or repeater) is a device that simply connects Ethernet nodes. Any message at one hub port is repeated on all ports. That is, hubs forward data packets they receive from a single station to all hub ports. As a result, all port devices connected to a single hub will share the same bandwidth. Then as nodes are added to the network hub, they compete for this finite amount of bandwidth (at 10Mbps or 100Mbps). This can cause data collisions to occur and makes network determinism impossible, particularly on busy networks. Determinism is a term that is used to describe the ability to guarantee that a packet is sent or received in a finite and predictable amount of time. In the past, lack of determinism is the main reason that Ethernet has had problems being accepted for use in critical control applications, as most control systems have a defined time requirement for packet transmission, typically less than 100ms.

An Ethernet switch (or switching hub) is an intelligent device that is used to more efficiently connect distributed Ethernet nodes than a hub. Unlike a simple hub, a switch provides *targeted* data transfer, as it will forward a data packet to a specific port or network segment, rather than all ports, thus freeing up bandwidth. The ability to target a packet to a specific port increases network throughput and helps to eliminate the collisions that historically make Ethernet non-deterministic.

- Switches act as intelligent repeaters to increase network distance.
- Switches split networks into separate collision domains at each port.
- Switches provide determinism by reducing collisions.
- Switches increase network bandwidth/throughput.
- Switches can provide supplemental error checking.

With Ethernet, any device can try to send a data frame at any time. The arbitration protocol for carrier transmission access of the Ethernet network is called Carrier Sense Multiple Access with Collision Detect (CSMA/CD). If two devices happen to send a data frame at the same time, then a collision may occur. With CSMA/CD, each device will first sense whether the line is idle and available for use. If it is, the device will begin to transmit its first frame. If another device also tries to send a frame at the same time, then a collision occurs and both frames are discarded. Each device then waits a random amount of time and retries its transmission until it is successfully sent.

Unlike other Ethernet devices, such as an Ethernet host adapter or Network Interface Card (NIC), the port of a switch does not require its own MAC address. During retransmission of a received packet, the switch port will instead look like the originating device by having assumed its source address. This is why the Ethernet collision domain is said to terminate at the switch port. That is, a two-port switch will effectively break a network into two distinct data links or segments (also called *collision domains*). Since all Ethernet nodes are able to recognize the occurrence of a collision, and since the detection of a collision is principal to the way Ethernet arbitrates media access, large domains containing many nodes can become cumbersome.

Thus, using an Ethernet switch to subdivide a large network into separate collision domains will certainly help to increase throughput. Each port of a switch forwards data to another port based on the MAC address contained in the received data packet/frame. In order to know which port to forward a data packet to, the switch will learn and store the MAC addresses of every device it is connected to, along with the associated port number (up to 1024 MAC addresses are stored in high speed SRAM). However, until the switch actually learns the switch port a particular MAC address resides at (after the first packet), it forwards this initial packet traffic to all ports. The switch will use the internal look-up table to quickly determine the location (port) of a node, establish a temporary connection between itself and the node, then terminate the connection once a packet is transferred. In this way, it increases network bandwidth and provides the network determinism required for critical control applications.

Most switches use a *store and forward* algorithm to process Ethernet frames. That is, it first stores the Ethernet frame and examines it for errors before forwarding it to its destination. Although in some case this method may seem to increase the forwarding time (latency) and possibly cause fragmentation, it can also effectively reduce the occurrence of error frames and improve overall throughput for most applications. This is particularly useful where there is heavy network traffic and or greater potential for noise and interference.

The optional hub/repeater mode of this switch provides low-latency network packet transmission that effectively reduces jitter on the network. Ethernet switches have higher inherent latency that varies with packet size due to their store-and-forward behavior. Thus, operation in switch mode adds latency and results in possible latency deviations up to 167us (jitter). In hub-mode, there is a maximum port-to-port latency of only 310ns with a total deviation of only 40ns. This is because hubs immediately repeat the bits arriving on one port at their other ports, rather than storing the entire message first before forwarding it as switches do. This sometimes makes them more useful for transmission of time-critical data, or for reducing latency where there is concentrated link traffic (like the main trunk of cascaded units).

We can also use the hub mode of this switch to implement media redundancy to this device. That is, if you connect the EtherStax to an external switch that happens to support media redundancy via a proprietary ring method, or the Spanning Tree Protocol (STP), or Rapid Spanning Tree Protocol (RSTP), then the EtherStax unit can be placed in "hub mode" and you can connect a cable to both ports. The external redundant switch will sense the redundant path and disable it temporarily. If the primary path should later fail, then the external switch can reactivate the other path, effectively providing media failover protection right to the unit.

Note that Acromag offers several industrial managed and unmanaged Ethernet switch models that can be used to interface to this product (please consult the factory or visit www.acromag.com).

Some examples of various types of network connections using Ethernet switches are included in the following pages.

CONNECTIONS

Network – Background

Hubs & Switches

The current tendency in critical industrial control applications is to connect one Ethernet device per switch port. This will produce the most deterministic mode of operation as the switch can operate full-duplex, with no chance of collisions. This ensures determinism, helping critical control applications to remain predictable and on-time.

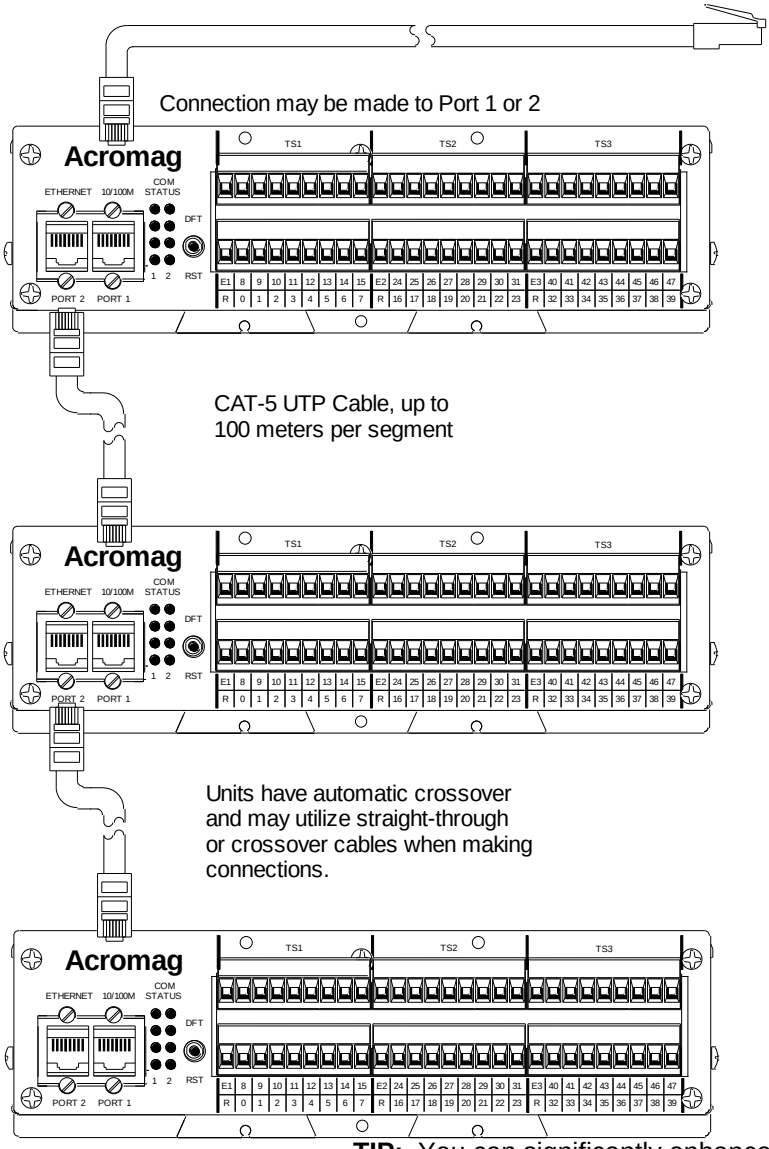
CONNECTIONS

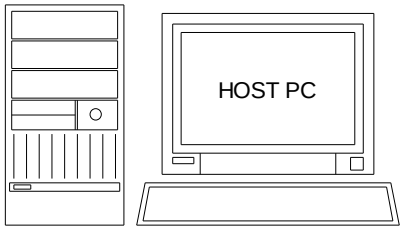
Network

The unit includes two Ethernet ports for convenient cascaded network connections as shown here. This is also useful for extending the network as each segment may extend up to 100 meters.

Note that data collisions are still possible in the first two network segments shown below, as these connections carry the data of more than one unit.

You can isolate each segment and prevent collisions using an external Ethernet switch connected as shown in the diagram of the following page (our recommended approach).





You can connect directly to a Host PC with a NIC installed, or via an Ethernet switch.

CASCADING UNITS

Connections may use Port 1 or Port 2.

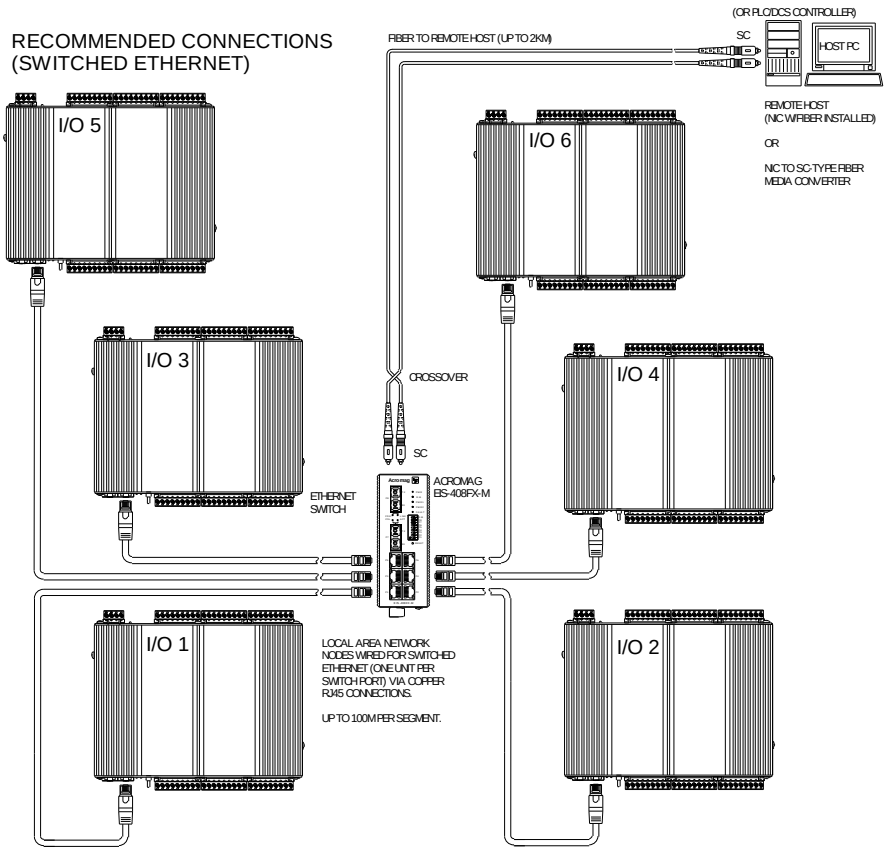
Limit cascaded connections to 4 segments.

Limit cable segments to 100M in length.

You may use straight-through or crossover cables.

TIP: You can significantly enhance the EMI/RFI performance of your network connections by using Category 5E STP cable (Shielded Twisted Pair) cable. The use of shielded cable is strongly recommended for installations in harsh industrial environments and/or in the presence of strong electrical fields. For more information on cable, refer to the Cables & Connectors section at the back of this manual.

You can use an Ethernet switch or switching hub to build a network of EtherStax units, similar to that shown below. The drawing depicts our recommended approach to distributing I/O via switched Ethernet—that is, one EtherStax unit is connected per switch port.



The drawing above shows how to network-connect EtherStax units to an 8-port Ethernet switch (such as Acromag Model EIS-408FX-M). Note that the I/O LAN is distributed locally using copper/RJ45 cable connections (up to 100M per segment), and then connected to a remote (distant) host using fiber cable. The copper connections may use standard or crossover cables, as both the EtherStax unit and the Ethernet switch include automatic crossover, but it is generally not considered good practice to use crossover cables when connecting to an auto-crossing switch.

The switch shown above could be eliminated, if you were connecting to an EtherStax Model ES2161/2162-1000, which includes one fiber port and one standard RJ45 port. For example, you could use the fiber port built into the EtherStax to connect to the distant host using fiber, then add an additional EtherStax locally via its RJ45 port, similar to that shown on the next page. However, the traffic of both units would still be concentrated in the main trunk from the host, and this does not follow the key principle of switched Ethernet, which seeks to suppress CSMA/CD and prevent data collisions by connecting only one device per switch port.

CONNECTIONS

Network

The drawing at left gives our recommended approach to making network connections to the EtherStax via switched Ethernet.

Here we show one EtherStax unit connected per switch port. Thus, each segment is limited to the traffic of only one device and no collisions are possible. This provides the most deterministic method of network communication. Only the segment between the host and the switch carries the traffic of multiple units and collisions are still possible in this segment.

Note that fiber connections must be crossed over, as the auto-crossing feature only applies to copper connections.

***OBSERVATION:** The extra copper port of any of these units can optionally connect to other network devices, but the resulting concentrated traffic in the upstream network segment would violate the goal of switched Ethernet which is to limit the traffic on each segment to the traffic of one device, suppressing CSMA/CD. This is generally not a problem for a small number of cascaded units.*

For many cascaded nodes, it is good practice for the upstream network segment to use a data rate that is 10x the data rate of the downstream nodes, otherwise careful attention must be paid to limiting the number of Ethernet devices that traffic on this segment.

CONNECTIONS

Network

The drawing at right gives an alternate method for connecting to a remote host, while still retaining the benefit of switched Ethernet between two nodes.

This still adheres to the principles of switched Ethernet because the network ports of the EtherStax are provided by an internal 3-port Ethernet switch.

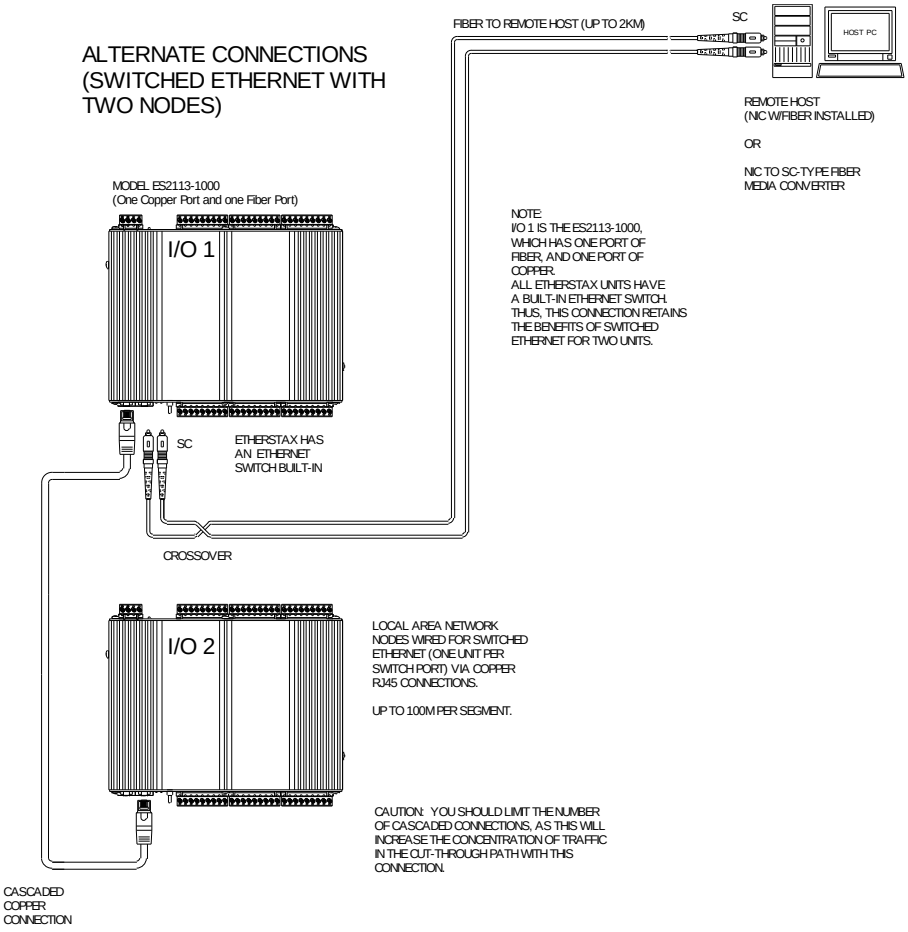
However, note that the fiber connection carries the traffic of both units and this segment is subject to data collisions.

Likewise, if you add a third unit, I/O3, cascaded from I/O 2, then the first copper segment carries the burden of the traffic of I/O 2 and I/O 3. This would not promote the benefit of switched Ethernet in this segment where we attempt to limit the traffic on a switched segment to a single device and suppress the need for CSMA/CD.

***WARNING:** Never use the EtherStax as a bridge device connected in series within your enterprise LAN, as the effect of concentrated traffic in the shared segment could inhibit communication to/from your EtherStax unit.*

Ideally, the shared segment link that carries the concentrated 100Mbps traffic should operate at a higher data rate, like 1Gbps, which this switch does not support

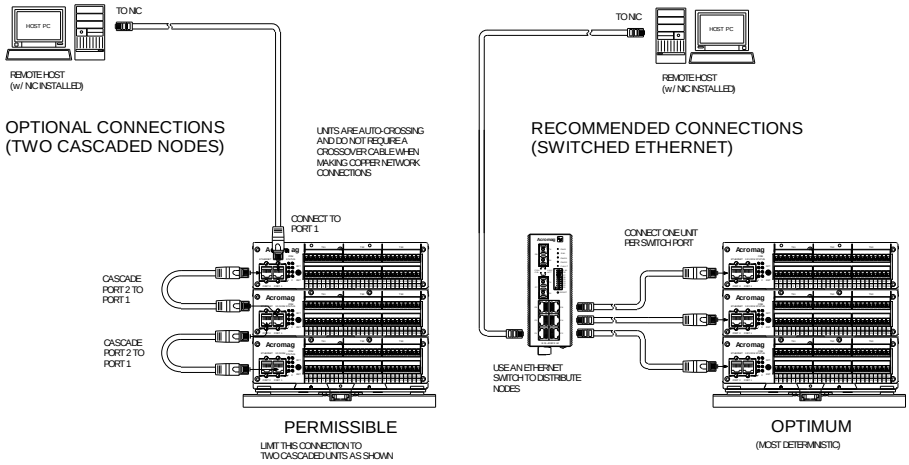
Unfortunately, you cannot avoid concentrated traffic in the main host segment, even with a switch. As such, this aggregate path is usually chosen to operate at a higher data rate than the downstream segments. With the traffic of many Ethernet devices, this would mean that if the main trunk runs at 100MB, then the downstream nodes should operate at 10MB (or 100MB if the main trunk was 1Gbps, which the switch of the EtherStax units does not support). If you cannot easily increase the bandwidth of this segment, then you should be careful to limit the traffic in this shared segment by limiting the total number of Ethernet devices connected downstream.



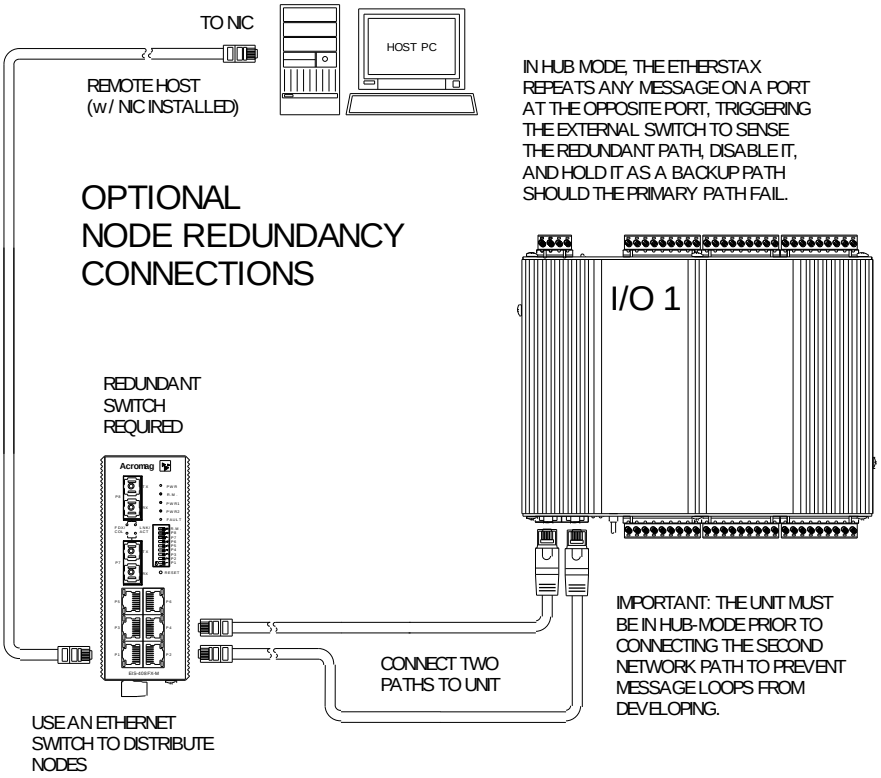
For optimum performance, the ideal recommended approach is to utilize an external Ethernet switch and connect no more than one Ethernet device per switch port—this is what is referred to as switched Ethernet. Connection in this manner avoids the negative effects of concentrated traffic and suppresses the need for collision detection. This effectively allows a segment to operate in full-duplex at the fastest possible speed. Thus, the throughput of 100M at half-duplex, can effectively approach 200MB when operating at full-duplex for switched Ethernet.

Although the connection shown above still retains the benefit of switched Ethernet without utilizing an external switch, it really only applies to the first two nodes. If you wanted to connect more than two nodes, but still retain the benefits of switched Ethernet, you would have to utilize an external Ethernet switch and connect one EtherStax unit per switch port.

Although it may be possible to cascade more than two additional EtherStax units (3 units), it is recommended that the number of units connected in this fashion be limited to 3 total (the recommended physical height of a single stack of EtherStax units), as shown in the following drawing.



Again, for the most deterministic approach, utilize an Ethernet switch and distribute connections as one Ethernet device per switch port as shown in the above right drawing.



Note: The EtherStax fiber port does not operate in hub mode and cannot be used in redundant path applications.

CONNECTIONS

Network

Network – Redundant Media Connections (Optional)

Recommended for High-Reliability Applications

When the EtherStax network port is placed in hub/repeater mode, it can support media redundancy right to the node if connected to a redundant switch as shown at left.

CONNECTIONS

Network –

Redundant Media Connections (Optional)

Recommended for High-Reliability Applications

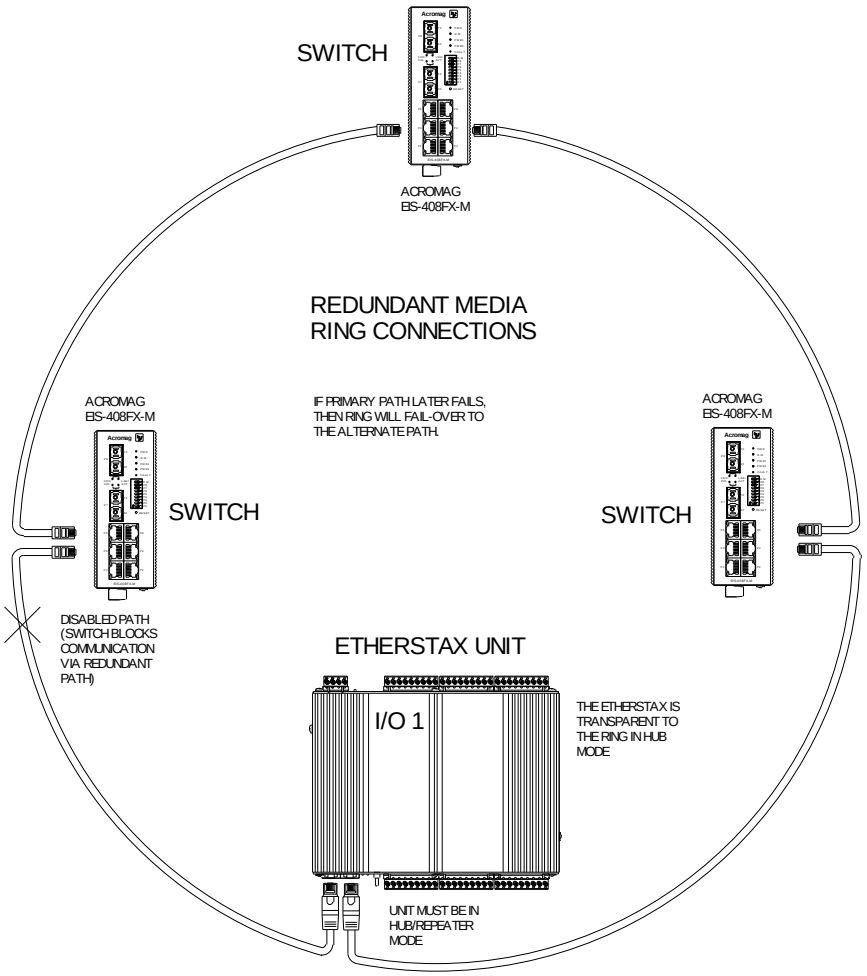
TIP: *If you connect to both ports of this device at the same time from your network, and you notice that the unit is cyclically resetting itself, then this may indicate that your network connections or external network switch(es) are not already setup to handle redundant media connections. Do not connect to both network ports unless your network redundancy status has already been established. Otherwise, message loops may develop that could cause the unit to periodically reset itself.*

Failure to place the EtherStax unit in hub/repeater mode for redundant media connections may prevent the external network switch from detecting the redundant path causing unpredictable results.

Note that all units operate at 100Mbps and half-duplex in hub/repeater mode.

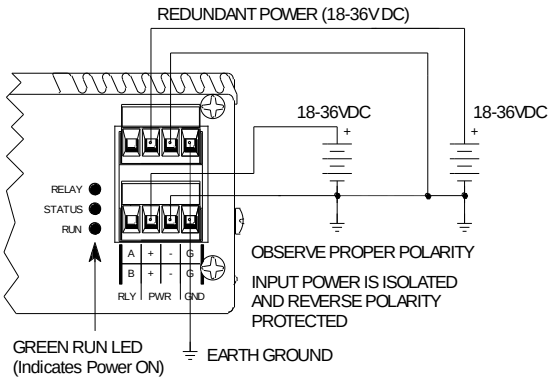
This device has dual Ethernet ports provided by a built-in Ethernet switch. Normally the second port connection provides a convenient cascaded network connection, or is used for extending the network, or to provide media conversion. But this integrated switch also has an alternate operating mode as a hub/repeater. As a hub, anything sent in one port is immediately transmitted out at the other port. This adds much lower latency. Additionally in this mode, if you connect both ports of this device to a redundant switch, or redundant switch network, the external switch will sense the redundant path and automatically disable the second path to this device, holding it as a backup in case of primary path failure. This behavior is completely managed by the redundant switch, making the EtherStax compatible with current proprietary media redundant ring methods, Spanning Tree (STP), or Rapid Spanning Tree (RSTP), but limited to half-duplex operation (hubs are half-duplex devices).

The figure below depicts the EtherStax unit connected to a redundant switch media ring. Here we use an Acromag EIS408FX-M switch to build the ring which supports redundant ring. The EtherStax unit must be placed in hub/repeater mode prior to making these connections. Connected this way, the EtherStax looks just like an Ethernet hub to the ring and operates transparent to the media ring. The redundant path fail-over and recovery are managed entirely by the external switch.



✓ Connect 18-36V DC to the power terminals PWR + and PWR – and observe proper polarity. Optionally connect redundant backup power to the second set of terminals. For supply connections, use No. 14 AWG wires rated for at least 75°C. **CAUTION:** Do not exceed 36VDC peak.

DC POWER CONNECTIONS



Each of the power inputs is series diode-coupled, providing reverse polarity protection and allowing external redundant drive. With redundant power connections, the higher connected voltage will carry the load, and if that supply later fails, the lower voltage supply will carry the load. You cannot use the second set of power terminals to cascade power to other units because of this diode.

CAUTION: Risk of Electric Shock – More than one disconnect switch may be required to de-energize equipment before servicing.

IMPORTANT – External Fuse: If unit is powered from a supply capable of delivering several amps to the unit, it is recommended that current to the unit be limited via a surge tolerant fuse rated for a maximum current of 4A or less (for example, see Bel Fuse MJS series).

Power

Input Power ES216x-0

Voltage	Current
18VDC	234mA Max
24VDC	175mA Max
30VDC	142mA Max
36VDC	121mA Max

Input Power ES216x-1

Voltage	Current
18VDC	303mA Max
24VDC	227mA Max
30VDC	182mA Max
36VDC	153mA Max

Above is maximum power with alarm relay energized.

As a rule, your supply should be capable of providing at least twice the maximum current draw of the unit (for inrush). Your series fuse should also be minimum rated for greater than twice this current also.

Earth Ground

✓ Connect Earth Ground as shown in the connection drawings for best results. Connect the unit's GND terminal (G) to earth ground as shown above (you may alternately utilize the earth ground screw at each side of the enclosure to complete the earth ground path). The input circuit of this unit must also be grounded by connecting earth ground to a port "C" terminal (see Analog Input connections).

In some cases, additional earth grounding is recommended at your I/O (see Analog Input connections). If sensors are already grounded, use caution and avoid adding ground connections which could create ground loops or increase system noise.

The enclosure is common to the ground terminals and isolated from the other circuits. Transient energy is shunted to this ground via isolation capacitors and transient voltage suppressors. You must connect earth ground to complete this path and ensure protection. Additional earth grounding is also recommended at input analog common (see connection drawings).

Warning: *To comply with safety and performance standards, use shielded cable and connect earth ground as noted. Failure to use good wiring and grounding practices may be unsafe and harm performance.*

Alarm Relay

The relay LED indicates the energized state (ON) of these SPST contacts.

You can configure these contacts as failsafe or non-failsafe.

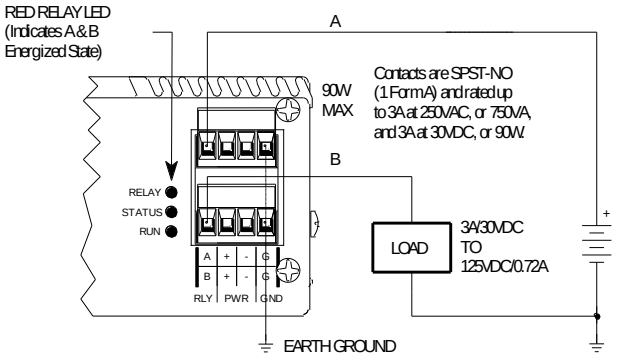
If you select failsafe contacts, then you can also use this relay to signal a power failure (contacts de-energize when power fails).

***IMPORTANT:** External contact protection is required for use with inductive loads. Failure to use adequate protection may reduce the life of the contacts or damage the unit.*

For AC inductive loads, the use of AC-rated capacitors, Metal-Oxide Varistors, or RC-snubbers will help to shunt voltage transients away from relay contacts and extend their life when switching inductive loads. Use a reverse-biased diode at the load for DC inductive loads.

✓ The local alarm relay contacts are located adjacent to power and are labeled A & B. These contacts are switched for conditions of media failure (link loss), watchdog timeout, or power failure (failsafe only). Contacts are normally open type (de-energized), but configurable as failsafe (normally energized), or non-failsafe (normally de-energized)

ALARM RELAY CONNECTIONS - DC LOAD

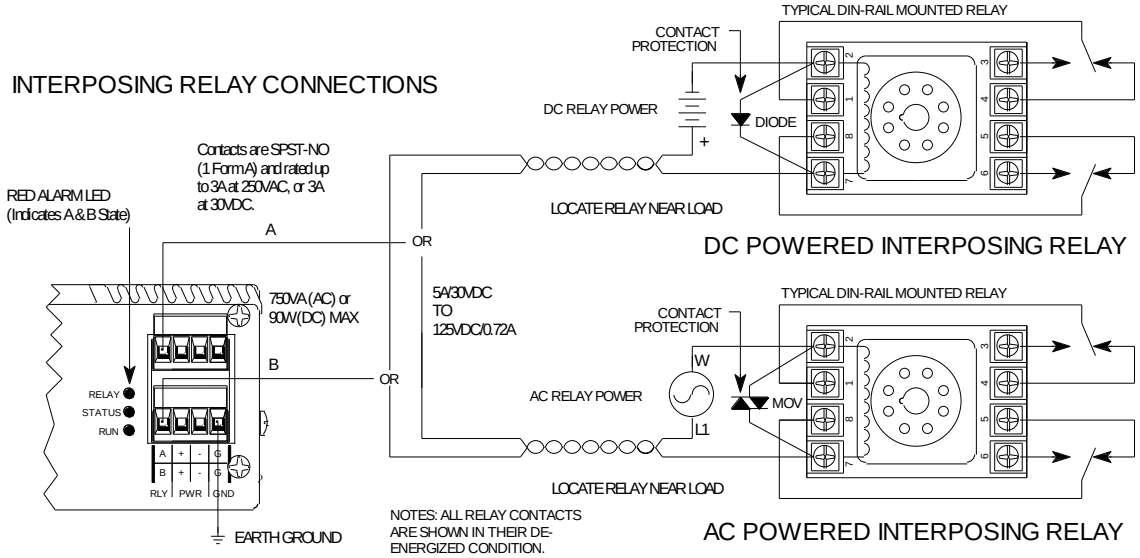


Relay contacts are AC rated to 3A at 250VAC, or 750VA, and DC rated to 3A at 30VDC, or 90W. The maximum switching voltage is 270VAC and 125VDC, and maximum switching current 5A. Your AC application voltage/ current must not exceed 750VA and 250VAC and 5A. Your DC application voltage/current must not exceed 90W and 125VDC and 5A. For control of higher energy devices, use an interposing relay connected as shown below.

IMPORTANT: The relay ratings given apply when switching resistive loads, which are electrically quiet when powered up. For example, an LED lamp is considered a resistive load. On the other hand, inductive loads can be very hard on relay contacts and generally have violent startup voltage and ampere requirements that exceed the steady-state requirements. An electric motor or transformer would be an inductive load.

As such, inductive loads typically require 2-3x the runtime voltage or current when power is first applied to the device. Thus, your switch contact voltage and ampere ratings should be selected 2-3x the nominal steady-state requirements of your load. Choosing a relay that is 2-3x more powerful than your rated application is the best way to extend the life of relay contacts.

INTERPOSING RELAY CONNECTIONS



CONNECTIONS

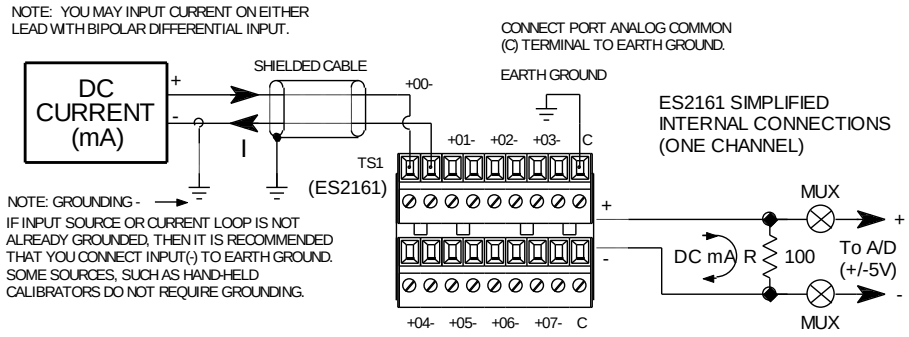
Analog Inputs

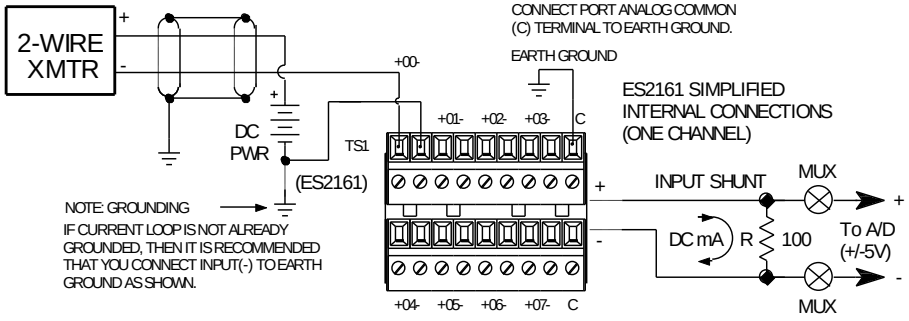
The Common (C) terminal is connected to analog common of the circuit. This is used to reference analog input common to earth ground, and to reference any differential input channels to earth ground if they would otherwise be left floating.

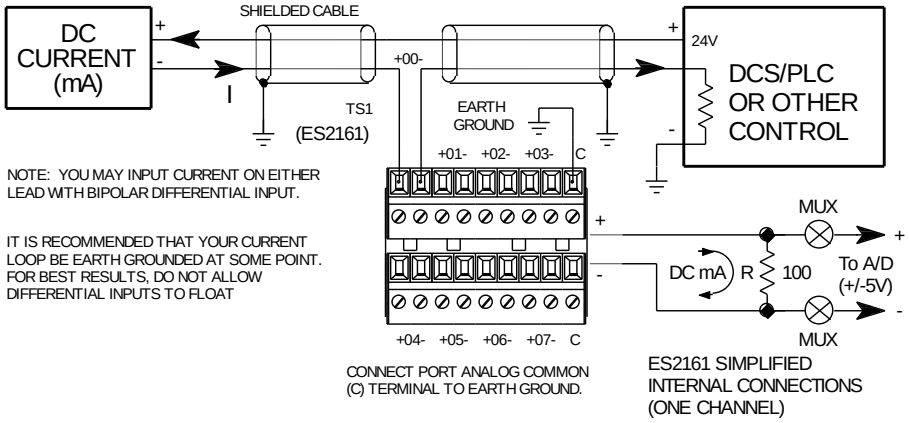
✓ Connect analog current (ES2161), or voltage (ES2162) signals to the input terminals as shown below. Input channels are differential. Each input terminal block (4 channels) includes a Common return (C) that is optionally used to reference input channels to analog common if they would otherwise be left floating. This terminal is also used to reference the input circuit common to earth ground.

Current Inputs (ES2161 Models Only)

Input is bipolar differential, which allows current to be input on either lead, positive or negative. Current (±20mA) is converted to voltage (±2.0V) via precision 100Ω shunt resistors. This drives a 16-bit A/D with an input range of ±5V.







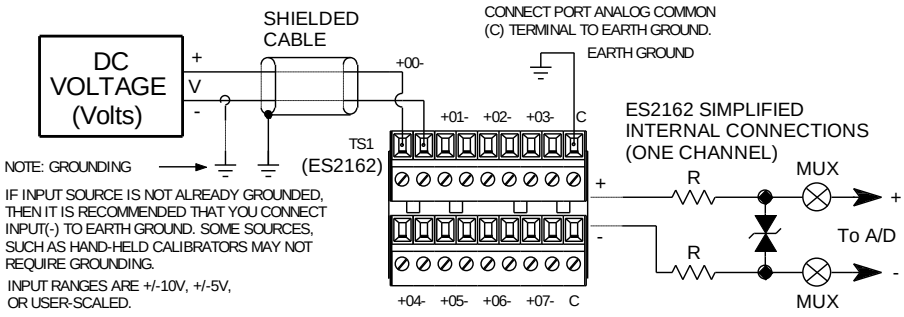
CONNECTIONS

Analog Inputs

Voltage Inputs (ES2162 Models Only)

You can set the channel to accept a fixed voltage input ranges of ±10V, or ±5V. You may also rescale a portion of these native A/D ranges to smaller sub-ranges, down to a minimum span 1/16th of the native span selected in order to maintain minimum 12-bit performance.

Connect input voltage to input positive (+) and negative (-) while observing proper polarity. If the input source is floating, it is recommended that you connect the negative input to the analog common terminal of the port (terminal C). Additionally, analog common (C) should also be connected to earth ground.



CAUTION: You cannot connect to uB or 8B signals and to field inputs on the unit at the same time, or signals will be in contention. Disconnect the uB or 8B interface when you wish to drive the corresponding field inputs on the unit, unless you are being careful to only connect to field inputs that are not being consumed by the uB or 8B panel (mixing field inputs with uB or 8B inputs would only allow field inputs in the second half of the port when connected to APB04 or APB08 back panels).

uB or 8B Module Inputs (ES2162 Models Only)

Optionally, you can drive the voltage inputs via industry-standard uB or 8B signal conditioning modules mounted on 16, 8, or 4 channel back-panels and connected via the DB25 interface connectors X1 and X2. It's always the first channels of the port that are reserved for uB or 8B. For 4 channel back panels, all eight channels of the first port are consumed. Note that the uB or 8B signals are single-ended, not differential.

IMPORTANT: Ground analog common terminal of port, even for uB or 8B inputs. You must connect earth ground to the input common terminal (C) as shown above, even if your input is via an uB or 8B carrier connected to X1 or X2. uB or 8B modules are individually isolated and any ground connections made on the uB or 8B input side does not carry over to the analog input common of the port which must be grounded.

Unused uB or 8B Channels (No Module Installed): It is recommended the output side of any unused uB or 8B channels be shorted on the uB or 8B back-panel to keep the uB or 8B channel from floating. Do not do this for uB or 8B channels that correspond to field channels of the unit that are being driven by field signals when intermixing field inputs of the unit with uB or 8B inputs on panel.

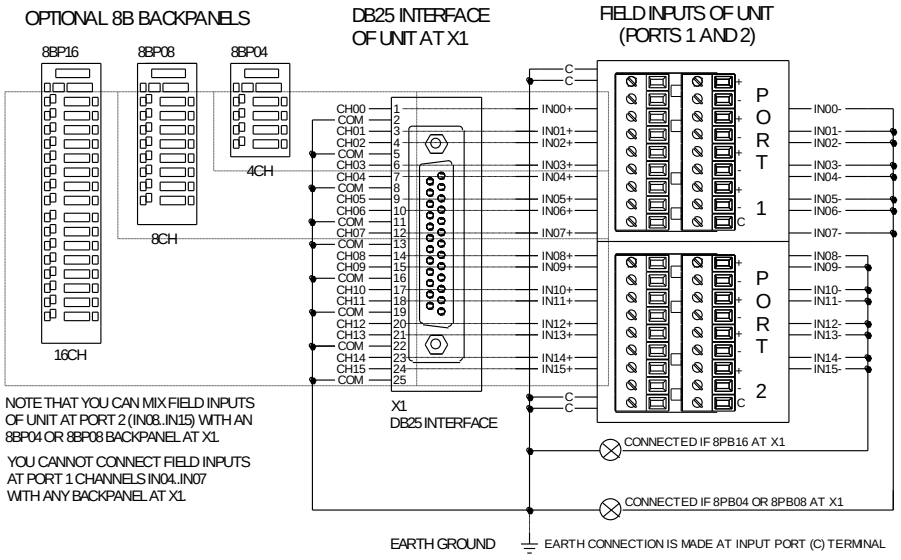
Unused uB or 8B Channels (Module Installed): It is recommended that the input side of any unused uB or 8B module be shorted on the uB or 8B back-panel to keep the inputs from floating.

With the input set to the ±5V A/D range for uB or 8B inputs, the unit does not support any over-range capability of the uB or 8B module. You can optionally select the ±10V input range to capture any over-range capability that may be present on the uB or 8B module, but the effective resolution will be reduced by one half.

CONNECTIONS

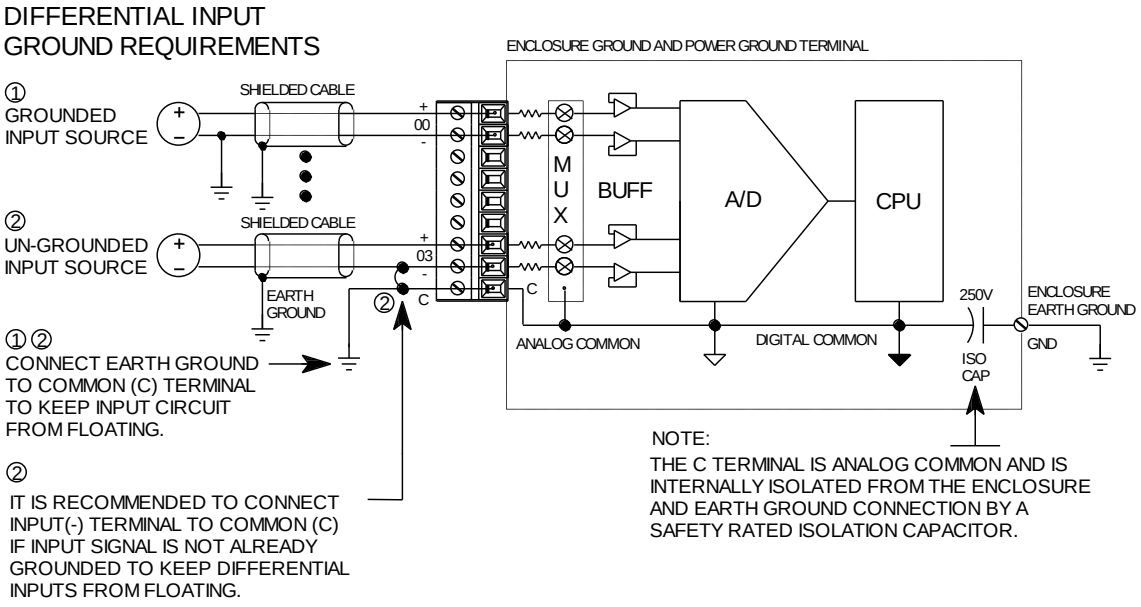
Analog Inputs

Inputs via the uB or 8B interface X1 are mapped to inputs of the unit per the diagram below. Note that uB or 8B inputs via DB25 interface X2 are mapped the same way, except ports 1 & 2 become ports 3 & 4, and unit input channels 16..31 connect to channels 0-15 of the second uB or 8B back-panel.



Analog Common

✓ Each plug-in terminal block (4 channels) includes a common connection at the right-most terminal marked "C". This connects to analog common of the differential input circuit and is provided in order to [1]reference the input circuit to earth ground, and [2]to reference a differential input signal to analog common if it would otherwise be left floating. Check your grounding scheme if inputs are clamped or appear unstable. There are two "C" terminal screws per port for this purpose. You only need to earth ground one of these to earth ground the input circuit, as they are all connected in common.



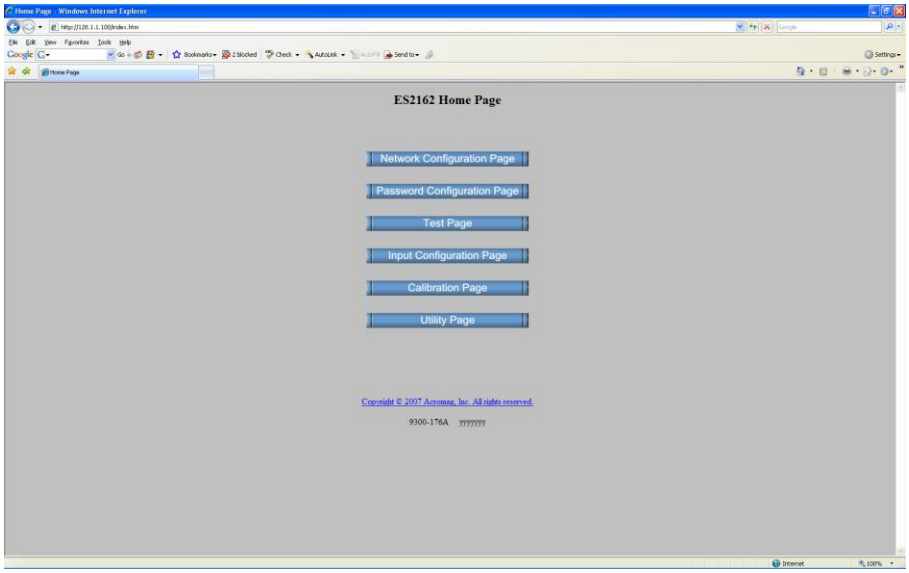
WEB BROWSER

Home Page

This unit supports Modbus over TCP/IP and UDP/IP (a TCP/IP message will get a TCP/IP response, while a UDP/IP message will get a UDP/IP response). You may use your own software to issue Modbus commands to this device (see Modbus Registers), or you may use a standard web browser, as these units have built-in web pages that allow you to setup and control their operation. Simply execute your web browser, type the IP address assigned to your unit in the "Address" window (http://128.1.1.100/ for our example), click [Go], and you will be presented with the Home Page window of the unit similar to that shown below:

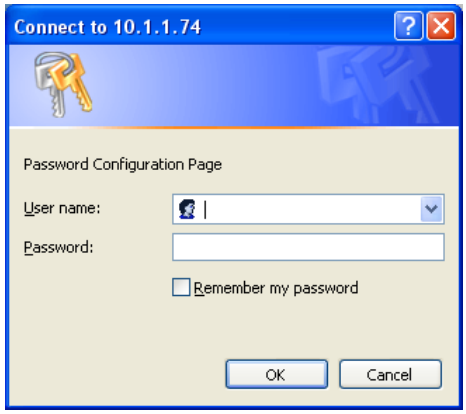
The Home Page provides buttons to access the other web pages of this unit that are used to configure the network parameters, change the user name and password, configure the inputs, calibrate, and operate the unit.

Note that the unit's serial number and firmware number are included at the bottom of the Home Page for reference.

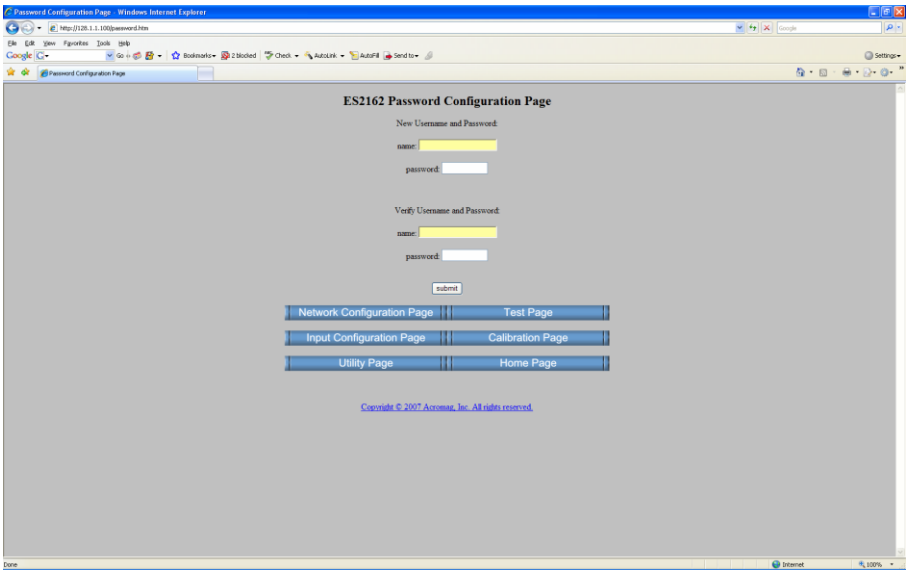


Not all parameters are programmable with Modbus commands issued to Modbus registers. In general, you would still have to use the embedded web pages to complete your configuration (for example, the network configuration parameters do not have Modbus registers). For additional details on various operating modes, please refer to the command descriptions of the Modbus Memory Map.

IMPORTANT: If you forget your user name & password, you can always toggle the unit into default mode via the DFT toggle switch at the front of the unit (hold this toggle 4 seconds to invoke default mode). In this mode, the password and username will revert to the original defaults noted at left (unit assumes IP address 128.1.1.100), allowing you to re-invoke the Password Configuration Page and change the username and password as required.



For each new browser session that accesses the Home Page of this unit, you will be presented with a window prompting you to enter the current User Name and Password as shown at left. This information is required before the program will allow you to make any other selections. **The default user name and password is "User" and "password" respectively.** After entering these defaults, you should invoke the Password Configuration Page to change these parameters to something more meaningful for you.



WEB BROWSER

Password Configuration Page

Note: *Your password is limited to 10 characters. If you exceed 10 characters, your password will only be set to the first 10 characters you typed. This will become apparent to you when you attempt to gain access later.*

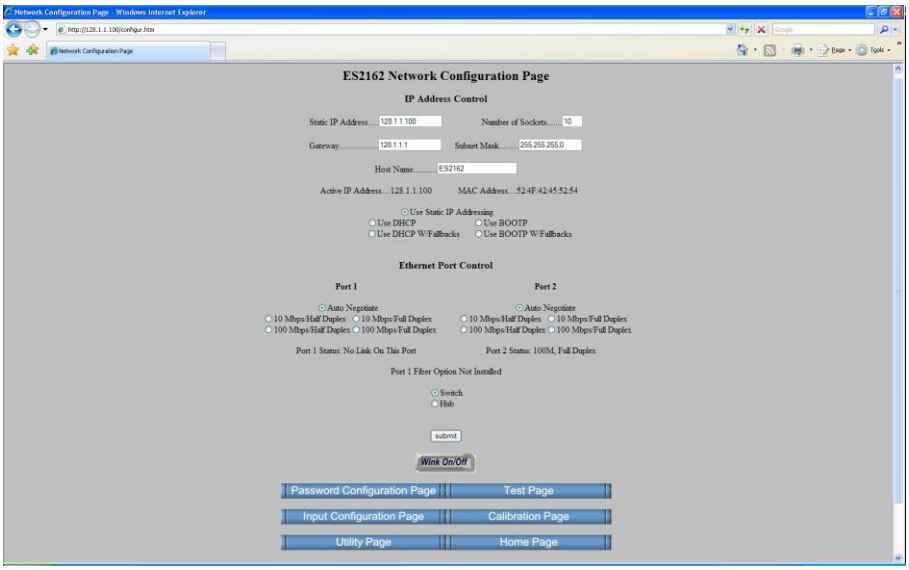
Use up to 20 alphanumeric characters (case sensitive) to specify your username, and 10 alphanumeric characters (case sensitive) to specify a password. You will have to type in these entries twice to help prevent errors.

Click the **submit** button to write your changes to the unit.

After completing your username & password changes, click on the appropriate button at the bottom of the page to select another web page. If you happen to have made changes, you may be prompted again to re-enter your new username and password before being permitted to move to the other web pages. Just be sure to use the new values you just set.

Network Configuration Page

After setting your username and password, you can click the "Network Configuration Page" button and a screen similar to that shown below will appear. Use this screen to set the network configuration parameters for your unit (these parameters cannot be set via Modbus registers). These parameters are described below. You may have to consult your network administrator for help in completing the contents of this page.



WEB BROWSER

Network Configuration Page

Note that Acromag Series ES2100 Ethernet I/O devices may take from 3 to 30 seconds to boot upon power-up, depending on your network configuration and whether a DHCP server is present.

Note that the Number of Sockets limitation does not restrict access via Modbus UDP/IP, only TCP/IP, as UDP is a connectionless protocol.

Static IP Address is as the name implies—*static*, and represents a unique fixed IP Address that is generally assigned by your service provider or system administrator. The Default Mode static IP address assigned to this unit is 128.1.1.100 (refer to the product side label).

An IP Address is a unique identification number for any host (this unit) 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.

Note: If you are in Default Mode when you change the IP address noted, then when you click submit, your unit will leave the default mode and will assume the new IP address. This will look like you lost communication with your web browser, but you simply need to change the web browser address to continue communicating with the unit.

Note: In order to network your PC with an EtherStax unit, you may have to consult with your network administrator and either temporarily change the IP address in 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). This is because your IP address is likely set to an address that is outside of the address domain of the unit's default IP address. The necessary steps for setting up this interface address will vary with your operating system. Refer to Acromag Application Note 8500-734, or document 8500-815, for help accomplishing this (located on the CDROM shipped with your unit or via download from our web site at www.acromag.com).

Number of Sockets is the number (1-10) of Modbus TCP/IP access points to allow for this host via port 502 (a well-known port reserved for Modbus/SCADA applications). You can restrict access by reducing this number.

If this unit is an i2o target device (it has its outputs controlled by another units inputs), then each i2o message sent to this device will require a socket and the Number of Sockets must be increased to allow for this. For example, if each port is being written via i2o, then number of sockets must be set to at least 2, and setting it to 1 would prevent the second port from being written.

A socket is a software mechanism that connects an application to a network protocol (socket is a software object, not a physical object). For example, a Modbus application program can send and receive TCP/IP messages by opening a socket and reading and writing data to and from the socket.

On TCP/IP and UDP networks, a port is an endpoint to a logical connection (a connection port) and the way that a client program specifies a specific server program on a computer network.

For example, a Modbus program will open TCP port 502 to be readable from other Modbus devices on the network (which also use port 502 to establish a connection). A port may have more than one socket active at a time and this server device will allow up to 10 sockets to operate simultaneously over its contact port 502.

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

A gateway is a device which links dissimilar networks and transfers data between them at the application layer level. In this way, Gateways essentially convert messages from one protocol to another.

A **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 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.

The **Host Name** i(up to 20 characters) s the name to be assigned to this host if its address happens to be assigned dynamically using DHCP.

A DNS Server refers to the Domain Name Server used on a network, and is the device that relates symbolic names to actual numeric IP addresses. The DHCP server is responsible for dynamically passing out IP addresses.

The **Active IP Address** refers to the current IP Address being used by this host, as opposed to any new assignments being made via this page.

The **MAC Address** refers to the Media Access Control address that uniquely identifies the MAC hardware of this device. All Ethernet devices have their own MAC address. This is a unique fixed address that was assigned to the MAC at its manufacture. It is not to be confused with the dynamically assigned 32-bit IP Address, commonly denoted as four 8-bit numbers separated by periods (e.g. 128.1.1.100). Every manufacturer producing Ethernet hardware, has by assignment, a series of 48-bit addresses to use. They are restricted to use only the addresses in their series, and only one time, thus ensuring that no two computers in the world will ever have the same network address.

An Ethernet packet will include two 48-bit address fields appended to it that represent the MAC address of the sending computer, and the destination computer. In IEEE 802 networks, the Data Link Control (DLC) layer of the OSI Reference Model is divided into two sub-layers: the Logical Link Control (LLC) layer, and the Media Access Control (MAC) layer. It is the MAC layer that interfaces directly with the network media and where this address distinction is applied (each different type of network media requires a different MAC layer).

Use Static IP Addressing tells this unit to fix the IP address setting to the Static IP Address specified. By default, the unit is set to use Static IP Addressing and a Static IP Address of 128.1.1.100.

You can optionally choose to have the IP address assigned dynamically via DHCP/BOOTP, or DHCP/BOOTP w/Fallbacks. This will also require that you specify a valid Host Name (see above).

If this unit is an i2o target device, you must have a static IP address in order to address it via i2o.

Use DHCP tells the unit its IP address is to be obtained dynamically, and may change each time this device is connected to the network.

Use DHCP w/ Fallbacks works the same way, but will revert to the static IP address specified if your DHCP server cannot be found.

WEB BROWSER

Network Configuration Page

This device can be placed into a default communication mode via the DFT toggle switch at the front of the unit.

Default Mode uses a static IP address of "128.1.1.100", a default subnet mask of "255.255.255.0", a default username "User", and a default password "password".

WEB BROWSER

Network Configuration Page

DHCP refers to Dynamic Host Configuration Protocol and its routine 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, and in some systems, the IP address can even change while it is still connected.

Use BootP tells the unit its IP address is to be obtained from a BootP server.

Use BootP w/ Fallbacks works the same way, but will revert to the static IP address specified if your BootP server cannot be found.

BootP refers to the Bootstrap Protocol which is an internet protocol that enables a diskless workstation to discover its own IP address, the address of a BOOTP server on the network, and a file to be loaded into memory to boot the machine. This enables the workstation or device server to boot without requiring a hard or floppy disk drive. BOOTP works similar to DHCP, but is usually found in older systems. This protocol is defined by RFC 951.

If you are utilizing Hub mode, then speed/duplex will be forced to 100Mbps/half-duplex only.

Ethernet Port Controls, Port 1 and Port 2

These controls allow you to select that speed and duplex be auto-negotiated (recommended), or you may force the speed to 10Mbps or 100Mbps, and the duplex to half or full. The existing port status is displayed just below these controls.

Note that full duplex communication will not be possible unless CSMA/CD is suppressed via a switched Ethernet connection at the port (i.e. only one other device is connected to this port). Connecting one unit per Ethernet switch port will constitute a switched Ethernet connection.

On units that have a fiber-optic SC type connector for port 1, only 100Mbps operation at full-duplex is possible. A message just below the port status will tell you if this unit has the port 1 fiber-optic option installed.

The Default Communication Mode uses a static IP address of "128.1.1.100", a subnet mask of "255.255.255.0", a default username of "User", and a default password of "password".

The unit includes a DFT mode toggle switch to cause the unit to assume a fixed default static IP address (128.1.1.100). This switch is at the front of the unit and used to toggle the unit into, or out of Default Mode. If the unit is already in default mode, then "Default Communications Mode" will be indicated at the bottom of this screen, and the unit's Status LED blinks.

Switch or Hub Selection

Note: *Hub/repeater mode is 100MB at half-duplex only and auto-negotiation does not apply in hub mode.*

Important (ES2xxx-1 units): *Fiber ports are forced to 100MB and auto-negotiation and auto-crossing do not apply. Half or full duplex may still be selected, but operation is restricted to half duplex only in repeater mode.*

For mode control, this unit is set to "Switch" by default, but may optionally be set to "Hub". Hub mode is useful to reduce latency on the network, especially when cascading many devices, or to setup redundant media connections to this device, but is restricted to 100Mbps and half-duplex. You should review the information regarding hubs and switches in the Network Connections section of this manual for help discerning the difference between a switch and a hub, and for information on redundant media connections. Selecting Hub will force speed/duplex to 100Mbps/half-duplex.

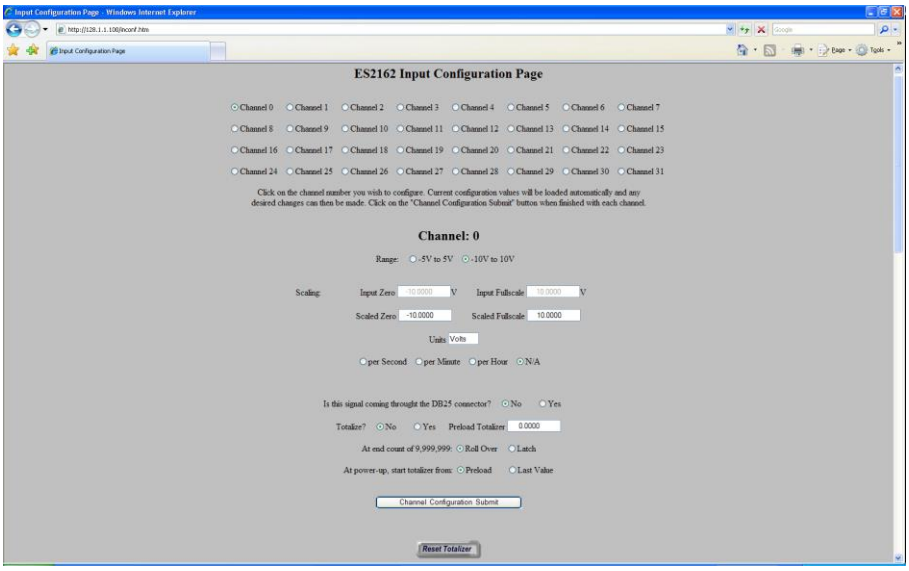
Click the **Submit** button to complete any changes made on this page. Review the port status message to verify your port settings.

Click the **Wink On/Off** button to toggle the unit in/out of "wink" ID mode. In this mode, the unit's green RUN LED will blink to confirm identification and address setting.

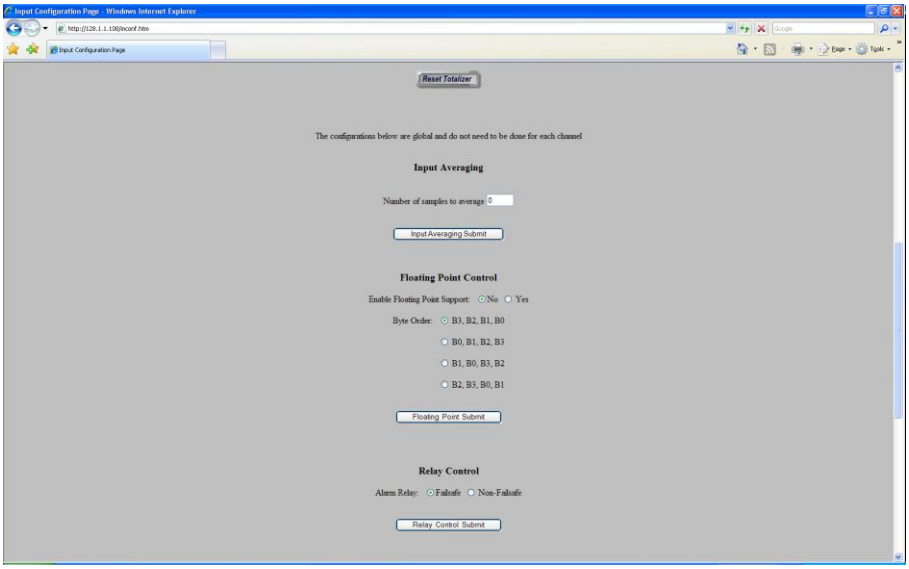
WEB BROWSER

Input Configuration

After completing the username & password assignment, plus the network configuration parameters, use the Input Configuration page to set your input ranges, rescale inputs, setup integration/totalization, enable the uB or 8B interface, setup floating point (required for scaling/integration/ totalization), reset the totalizer, configure local alarm contacts, enable/disable scan groups, and reset the unit.



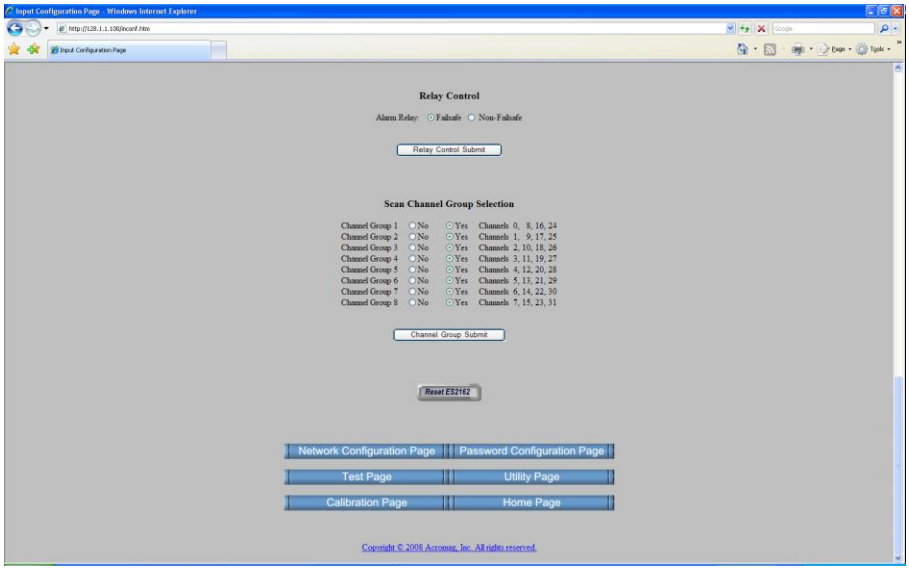
Use the scroll bars on the right to scroll down the page…



WEB BROWSER

Input Configuration

Note: *When you first enter a page that includes interactive controls like the submit button of this page, you may note that your first click on a control is ignored. This is because the first click activates the control.*



This unit has 4 ports of 8 differential input channels each. Each port is 8:1 multiplexed to a separate A/D channel of a four channel 16-bit A/D converter. Channels are scanned sequentially, first by port, then channel order.

Input Configuration (Repeated Per Channel)
You must repeat your reconfiguration for each channel of interest.

Configuration involves first selecting the input channel, its input range, and optionally rescaling the input's zero and full-scale value to your own engineering units. You can also setup an integrator by specifying the scaled input units and its time base in order to totalize the input. Alternately, you may specify if the channel is input through its DB25 interface for Series uB or 8B input modules. You can enable/disable totalization of an input, set its preload and initial value, and you may reset the totalizer. After you have made your channel specific selections, click the Channel Configuration Submit button to apply your selections.

ES2161 Current Input Models

For the ES2161, all current input ranges are sub-ranges of the native ±5V A/D input range and utilize a precision 100Ω input shunt to convert input current to A/D voltage (±20mA into 100Ω yields ±2.0V to A/D).

Note: On ES2161 models, a current input of ±20mA (21.6mA maximum) may be input at the positive or negative input lead, but its sign is relative to current input at the + lead. A precision 100Ω shunt resistor converts ±20mA to ±2.0V at the A/D. The A/D has a native ±5V input range configured (16-bits). Thus, the effective resolution of ±20mA is 14.6 bits (±13107 parts). The ±20mA input is normalized to a count of ±30000 for ±100% (over-range is 2768 counts).
Port Input Range: The current unit utilizes the ±5V A/D input range and is designed for a bipolar current of ±20mA. All input ranges are sub-ranges of the native 16-bit A/D range of ±5V (±20mA into 100Ω is ±2.0V for 14.6 bits of resolution, or 1 part in 13107).
Input Zero (Fixed per Range): Default is same as input range zero (-20mA, 0mA, or 4mA) and this cannot be changed. The indicated value will correspond to 0% of signal and a normalized count of -30000 for ±20mA range, or 0 for the 0-20mA and 4-20mA ranges.

ES2161 Current Input Models…continued

Scaled Zero: Default is same as input zero (-20mA, 0mA, or 4mA), but you can rescale this value as required for your application. Field is limited to a 32-bit number of up to 12 characters and a maximum of 4 decimal places. For each channel 1-32, enter your rescaled full-scale that is to correspond to 0% of input signal. You must also Enable Floating Point Support to accomplish rescaling. If you are using only a portion of this range, you may have to interpolate your scaled zero endpoint.
Input Full-Scale (Fixed per Range): Default is same full-scale as input range (+20mA) and this cannot be changed. The full-scale indicated will correspond to 100% of input signal and a normalized count of +30000.
Scaled Full-Scale: Default is same as input full-scale (+20mA), but you can rescale this value as required for your application. Field is limited to a 32-bit number with up to 12 characters and a maximum of 4 decimal places. For each channel 1-32, enter your rescaled full-scale that is to correspond to 100% of input signal. You must also Enable Floating Point Support to accomplish rescaling. If you are using only a portion of this range, you may have to interpolate your scaled full-scale.
Units (5 characters): Enter the units of measure for your rescaled input zero and full-scale and this is an arbitrary definition used only for reference.

ES2162 Voltage Input Models

Input Range: Select a native 16-bit A/D input range of ±10V, or ±5V. For uB or 8B inputs, it is recommended that you select the ±5V input range for all channels of the input port (i.e. all 8 or 16 channels). Each of these ranges can be rescaled to your own engineering units.
Input Zero (Fixed per Range):: Default is same as input range zero (-5V or -10V) and this cannot be changed. The voltage indicated corresponds to 0% of signal and a normalized count of -30000.
Scaled Zero: Default is same as input zero (-5V or -10V), but you can rescale this value as required for your application.. Field is limited to a 32-bit number with up to 12 characters and a maximum of 4 decimal places. For each channel 1-32, enter your rescaled value in engineering units that is to correspond to 0% of input signal. You must also Enable Floating Point Support to accomplish rescaling. If you are using only a portion of this range, you may have to interpolate your scaled zero endpoint.
Input Full-Scale (Fixed per Range): Default is same as input range full-scale (+5V or +10V) and this cannot be changed. The voltage indicated corresponds to 100% of signal and a normalized count of +30000.
Scaled Full-Scale: Default is same as full-scale (+5V or +10V), but you can rescale this value as required for your application.. Field is limited to a 32-bit number with up to 12 characters and a maximum of 4 decimal places. You must also Enable Floating Point Support to accomplish rescaling. If you are using only a portion of this range, you may have to interpolate your scaled full-scale.
Units (5 characters): Enter the units of measure for your rescaled input zero and full-scale and this is an arbitrary definition used only for reference.
Is this signal coming through the DB25 connector? Select "Yes" if this channel is to be driven by an uB or 8B input module mounted on an external back-panel connected to the DB25 interface connector X1 or X2. Select "No" if the input signal is driving the channel field terminals on the unit.

WEB BROWSER

Input Configuration

NOTE: *If you are rescaling the input signal to a sub-range of the input, you will still have to interpolate the scaled endpoints to align with the fixed input zero and full-scale endpoints indicated.*

IMPORTANT: *Your effective resolution will decrease proportionally as you reduce the nominal signal span through rescaling. For current inputs, multiply input current by 100Ω to get equivalent A/D input voltage.*

Once you have carefully made your selections, click the "Submit" button to activate your reconfiguration (reconfiguration takes effect immediately following clicking "Submit").

WEB BROWSER

Input Configuration

Series uB or 8B Input Consideration (ES2162 Only)

Alternatively for the ES2162 model, input channels may be driven by industry-standard uB or 8B signal conditioning modules mounted on uB or 8BP04 (4 channel), uB or 8BP08 (eight channel), or uB or 8BP16 (16 channel) back panels, and connected via the DB25 interface connectors of the ES2162 model.

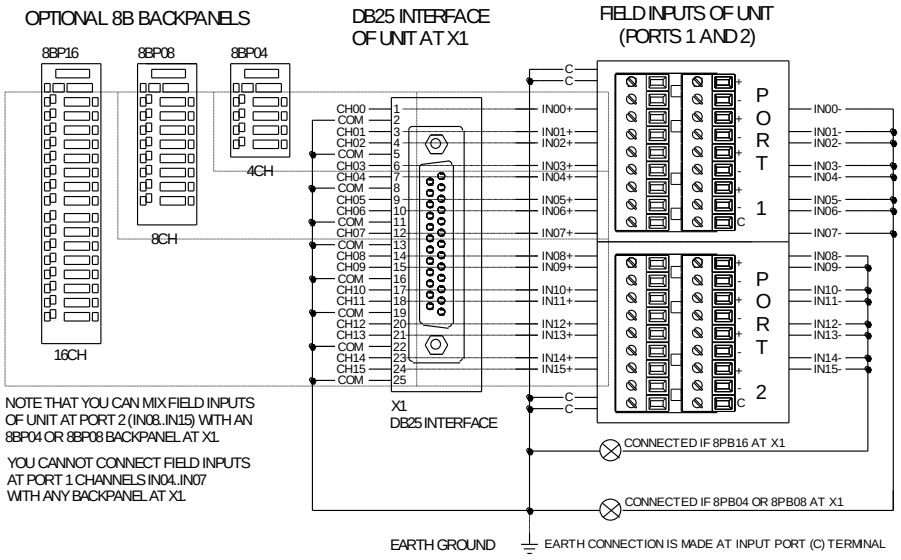
Note that input channels 0-15 comprise ports 1 & 2 and correspond to DB25 connector X1 on the front of the unit. Input channels 16-31 comprise ports 3 & 4 and correspond to DB25 connector X2 on the back-side of the unit. You cannot connect an uB or 8B carrier and also connect field input signals to the same port channels. If you choose "Yes" for the question "Is this signal coming through the DB25 connector", then a single-ended uB or 8B input is assumed and you cannot also input a signal at the field terminals. However, it is possible to connect an 8-channel uB or 8B carrier 8PB08 to X1, and connect field inputs to port 2. Likewise, you can connect an 8PB08 back-panel to X2 and connect field inputs to port 4. If you connect an 8PB16 back-panel to X1 or X2, it will consume both input ports on the same side and you cannot connect field inputs to those input ports. Doing so would cause signal contention between the field inputs and the uB or 8B input module's output signal which may damage the equipment.

Because multiplexing is done on a per port basis (8:1), and because uB or 8B signals are single-ended, while field inputs of the unit are differential, selecting "Yes" for one channel of a port means that you must select "Yes" for the other 7 channels of the same port, even if you do not intend to use all port channels for uB or 8B inputs. For back panels with less than 16 inputs, it's always the first channels of the port that are reserved for uB or 8B. Also, for 4 channel back panels, all eight channels of the first port are consumed.

Series uB or 8B input modules can be divided into 3 groups based on their output voltage: ±5V, 0-5V, or 1-5V (uB or 8B42-02 only). If you are connecting an uB or 8BP back panel to the front or back DB25 interface connector, then you should configure the corresponding input port(s) by selecting an input range of ±5V. If you have an uB or 8B module that outputs 1-5V, you can rescale the native A/D input range as required. The inputs can then be rescaled to your own engineering units as required.

The uB or 8B modules will output either ±5V, 0-5V, or 1-5V (uB or 8B42-02) single-ended signals to the unit. It is recommended that the A/D input range be set to ±5V for uB or 8B inputs. If you need to capture the over-range capability of an uB or 8B module, then you can set the input range to ±10V (this will lower your resolution by about one half). Likewise, if you do intend to connect to uB or 8B I/O panels, then you must set eight or sixteen input channels of the port as required, even if you are only connecting to the four-channel 8PB04 back panel. The EtherStax unit will additionally allow you to rescale the input signal zero and full-scale to your own engineering units. For uB or 8B input modules that output 0-5V or 1-5V, you will have to interpolate the scaled endpoints to align with the input range zero and full-scale values indicated. Additionally, you may refer to the register definitions of the Modbus Memory Map for additional information on re-configuration and other modes of operation.

The following figure shows the channel mapping between input ports 1 & 2 of the ES2162, the DB25 interface connector X1, and the optional uB or 8B back panel accessories that carry the uB or 8B plug-in modules (connections from input ports 3 and 4 to DB25 connector X2 are mapped the same way):



Integration/Totalization (Per Channel)

You can optionally integrate an input signal by totalizing its time-sliced instantaneous value (with integration/totalization enabled at any channel, the instantaneous inputs of this unit are sampled at a slower fixed rate of every 20ms for all channels with no averaging, or 40ms with any input averaging).

Time Base (per Second, per Minute, per Hour, No Application): With integration/totalization enabled, the instantaneous input is sampled at a slower rate of every 20ms (no averaging), or 40ms (with input averaging). You can optionally integrate this signal by totalizing its time sliced instantaneous value. In order for the totalized value to accurately accumulate, you need to specify the time-base units of the input signal to perform the integration over. Select "per Second", "per Minute", "per Hour", or "NA". You must specify a time base other than NA for totalization to occur. Note that if "NA" is selected and Totalize=Yes, then 0.0 is added to the totalized value. Likewise, disabling the totalizer on all channels can be used to raise the throughput from 50Hz/25Hz to a rate between 200Hz and 1298Hz (see Table).

Totalize? & Preload Totalizer: Choose "Yes" for the Totalize? to totalize the input (this will also automatically enable floating point support). You can optionally choose to preload a totalized value on power-up or upon system reset by inserting a number in the Preload Totalizer field. In this way, you can choose that your post-power/reset preload value be taken from the Preload Totalizer field, or from the last totalizer value (before power-up or system reset). During operation, your incremental "time-sliced" measurement will be added to this total every 20ms. Note that in order totalize an input, you MUST also Enable Floating Point Support by selecting "Yes" to that query.

WEB BROWSER

Input Configuration

For unused uB or 8B input channels, it's good practice to short input + and input – terminals to help keep them from floating.

For field inputs, it is also recommended that floating inputs connect to the port common (C) terminal. Connect earth ground to at least one port common terminal as well.

WEB BROWSER

Input Configuration

At the End Count of 9999999 (Rollover or Latch?): When your totalized value reaches the limit of its field, you can click to select Roll Over and continue totalizing from zero, or restart from the the Preload Value, whichever is selected. Optionally, you can latch the totalized value. Note that if the added value exceeds the amount required to reach the limit of 9,999,999.0, the additional amount it is over will be added to the count it rolls over (it assumes a free running counter and rolls over while ignoring the preload value).

Note (Counter Operation): This counter is limited to 7 digits of accuracy/ resolution, starting with 4 places before and after the decimal point (see below). Then, as the count grows beyond least 7 digits, the least significant digit is zeroed as the most significant digit is incremented. For example (note the transitions and digit shift left), the counter starts at 0000.0000 and increments to 0999.9999, then 9999.999 to 99999.99, then 999999.9 to 9,999,999, then it rolls over or latches as specified.

At Power-Up, Start Totalizer From (Preload or Last Value?): When you power-up, reset the unit, or reset the totalizer, you can direct the totalization to start from the Preload value in the Preload Totalizer field, or simply the last totalized value.

Note: A system reset always starts the totalizer from the preload value, or the last value, whichever is selected here. However, Reset Totalizer always restarts from the preload value, even if Last Value is selected here.

Channel Configuration Submit Button: Click this button to write your channel configuration parameters to the selected channel. You must do this separately for each channel being configured.

Reset Totalizer: Click this button to reset the current channel's totalized value to the Preload Totalizer value.

Totalization Calculation Example

During totalization on this model, an instantaneous input sample is gathered every 20ms if no input averaging is being done (see table of page 40). If the instantaneous scaled input value indicates 500, units are gallons, and time base is set to "per Minute". Then (500 gallons/minute)*(1 minute/60 seconds) equals a flow rate of 8.33 gallons/per second. Since a new sample is obtained every 20ms, multiply 8.33gallons/second by 0.020seconds/sample to get an incremental increase in volume of 0.1667gallons/sample, and this amount is added to the totalized value. The maximum possible totalized value is 9,999,999 (7 significant digits).

Input Averaging (Global, Not Per Channel)

You can optionally specify the number of input samples to average together to form your input response. Increasing this number will help to filter the measured response of noisy input signals, but may increase the update time (see table of page 40).

Input Averaging: Enter the number of input samples to average together from 0-500 samples. Selecting 0 is equivalent to selecting 1 and designates that no averaging will be performed. You may increase this number to help filter the measured response of noisy input signals.

WEB BROWSER

Input Configuration

Floating Point Configuration (Global, Not Per Channel)

Floating Point Control - Enable Floating Point Support (No or Yes)?: This is normally set to "No" by default, but must be set to "Yes" if you are rescaling an input, or integrating/totalizing an input. Note that also selecting "Yes" to the Totalize query for any channel will automatically set this to "Yes", but if you later disable floating point, the totalizer will just add 0.0 to the totalized value. Disable IEEE Floating Point if you are not rescaling, integrating, or totalizing the input. Selecting "No" to disable floating point support will reduce the amount of calculations that have to be performed and gives the processor more time to do other tasks besides acquiring data and this is recommended when you are also not rescaling or integrating and totalizing the input. This can help to make critical control network applications more deterministic, particularly over networks with heavy traffic flow. Consider that input data is normally acquired every Xms (see table, no totalization and no averaging), or every 20ms (if totalization is enabled on any/all channels and no averaging is done), or every 40ms (if averaging is done on any channel). Sixty percent of this time is used to convert the data for all 32 channels, leaving only 40% to process all the other tasks required to store this data into Modbus registers, run the web server, and serve this data over the network. You can increase the time devoted to servicing these other tasks by disabling floating point, effectively increasing network determinism. So leave it off if you don't need to rescale or totalize. Note that even with floating point disabled, the measured input value will still indicate a floating point number, but the scaling and totalizing field will indicate "Inactive".

Floating Point Control - Byte Order: Different Modbus systems will use different byte orders for the two 16-bit Modbus registers used to store a 32-bit floating point value. Select the byte order compatible with your system. Note that B0 refers to the Least Significant Byte, and B3 to the Most Significant Byte.
Floating Point Submit Button: Click here to execute your floating point control selections.

Relay Control Configuration (Global, Not Per Channel)

This unit includes a set of isolated SPST contacts at the input power terminal block (labeled A & B). This relay can be triggered upon a link loss condition at the network ports (both ports must be inactive to generate a link-loss error such that no communication is possible).

Relay Control - Alarm Relay (Failsafe or Non-Failsafe): Click to select Failsafe or Non-Failsafe alarm contact. If you select "Failsafe", the contacts will be normally energized (closed), and de-energize (open) upon alarm. If you select "Non-Failsafe", the contacts will be normally de-energized (open), and energize upon alarm (close). If you select "Failsafe", these contacts will also trigger if power is lost to the unit.
Relay Control Submit Button: After making your selection, click here to execute your alarm relay reconfiguration.

TIP: Selecting "Failsafe" will allow the unit to additionally signal a power-loss condition as the contacts will open when power is lost.

Scan Channel Group Selection (Global, Not Per Channel)

Channel data is gathered in groups organized to minimize multiplexer switching delay and optimize throughput. There are 8 scan groups of 4 channels each. If you are not totalizing any inputs, you can realize an increase in throughput by selectively enabling only the scan groups required by your application. This is illustrated in the following tables:

WEB BROWSER

Input Configuration

In the following table, note that the time between samples varies according to the number of scan groups enabled when no totalization and no input averaging is being performed. That is, without totalization and averaging, you can realize an increase in throughput by selectively enabling only the scan groups required by your application.

Input Update Rate per Number of Scan Groups Enabled wo/Filtering

NO TOTALIZATION[2] & NO AVERAGING[3] (Averaging set to 0 or 1)		
SCAN GROUPS	**UPDATE TIME (ms)**	**UPDATE RATE (Hz)**
1	0.77ms	1298Hz
2	1.36ms	735Hz
3	1.97ms	507Hz
4	2.53ms	395Hz
5	3.12ms	320Hz
6	3.73ms	268Hz
7	4.26ms	234Hz
8	5.00ms	200Hz
Totalization Enabled[2]	20ms	50Hz
Input Averaging[3]	40ms	25Hz

[1.] These times apply with floating point and input scaling applied.
[2] The update rate is fixed at 20ms if totalization is enabled for any channel and no input averaging is being performed.
[3] The update rate is fixed at 40ms if any input averaging is enabled at any channel(s).

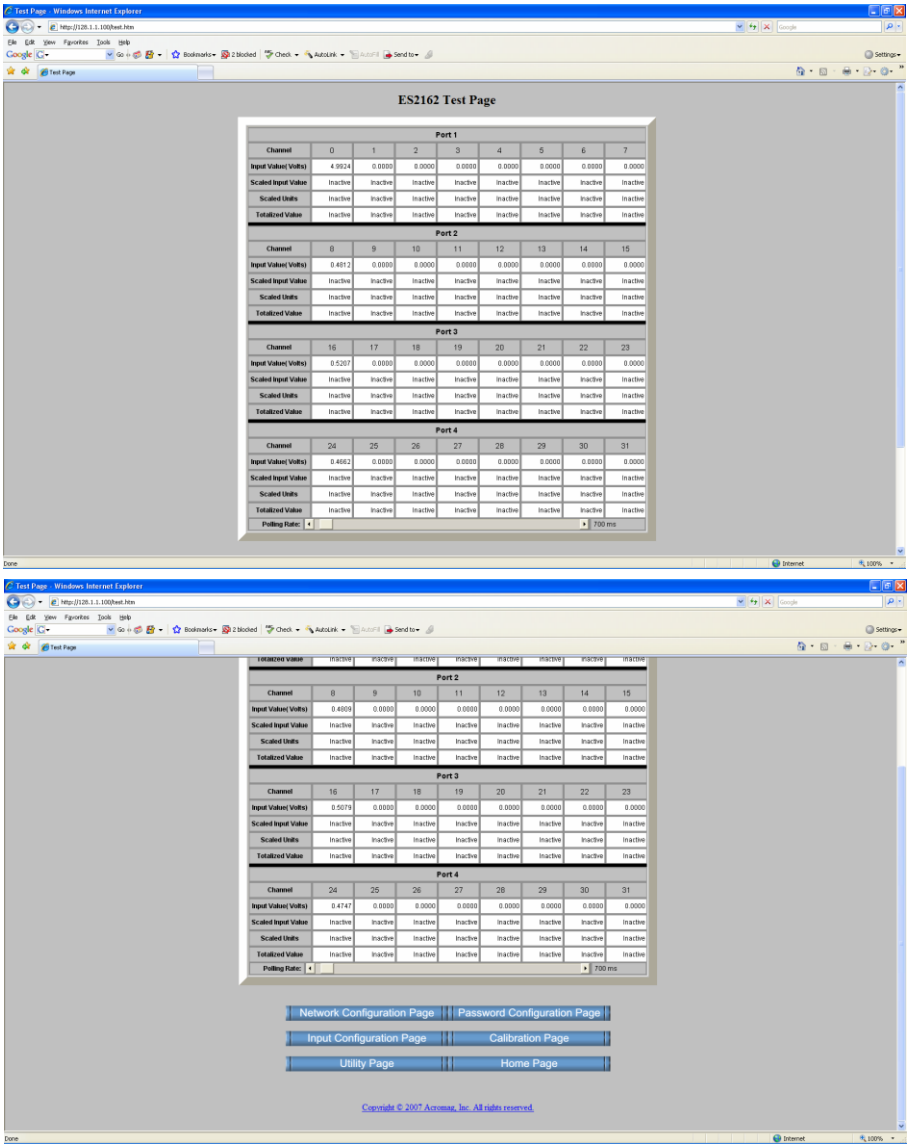
This unit has 4 ports of 8 input channels each. Each port is 8:1 multiplexed to a separate A/D channel of a four channel 16-bit A/D converter. Channels are scanned sequentially, first by port, then channel order. A scan group represents the same channel position of each port and this grouping is indicated at the bottom of the Input Configuration page. If you are using 28 channels or less, and you are not totalizing any input, then you should wire your inputs to maximize throughput. Note that the CPU normally uses 60% of its conversion time converting the channel data, and 40% for everything else. The update times given apply with floating point and scaling applied. Disabling floating point does not reduce the update time, but does increase the portion of this time devoted to "everything else", which can help to increase network determinism. Note that your effective throughput may be less than the update rate because of additional delay in retrieving the updated data over the network.

Scan Group Selection (No or Yes): Click "Yes" next to the channel groups that you are using, and "No" next to unused groups.
Scan Channel Group Submit: Click this button to execute your selected channel scan groups.

Reset Unit Control (System Reset, Not Per Channel)

Reset Button: Click this button to remotely perform a system reset of the unit. This is also equivalent to depressing the reset toggle switch to RST on the unit. Note that resetting a unit will also restart any totalizer channels, and send outputs to their power-up value.

After completing the username/password assignments, plus the network and input configuration parameters, click the Test Page button to access the web-server Test Page and operate your unit. Here you are able to read the input values, scaled values, scaled units, and totalized values of the four input ports of this unit (32 differential input channels). You can even set an input polling rate for the active Test Page at the bottom (use the scroll bar on the right to scroll down the page):



Voltage Inputs & Current Inputs: The 32 input channels of this unit are divided into 4 groups of 8 channels each (ports 1-4). If the channel is not configured for floating point (necessary to accomplish scaling and totalizing), "Inactive" will be indicated for the scaled input and totalized value, and units.

Polling Rate: The input values update continuously at the Polling Rate set via this slide control. Click and drag this control to set the rate at which you wish to read the inputs. The rate is indicated just to the right of this control. Disable input polling by dragging it to the far right.

WEB BROWSER

Test Page

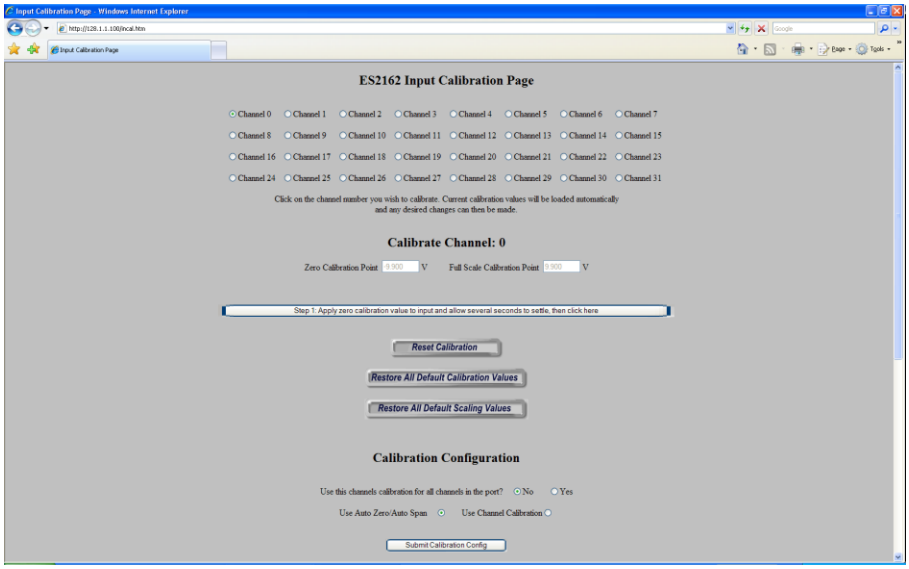
When you first enter a page that includes controls like the polling rate slide of this page, you may note that your first click on the control is ignored. This is because the first click activates the control.

TIP: If you notice that the Input Test Page has stopped scanning I/O or appears to have halted, simply click the refresh button to restart the polling. This may happen if the unit is interrupted for a period of time and it causes the Java applet to time out and stop sending requests for data. Clicking your browser refresh button will restart the Java requests.

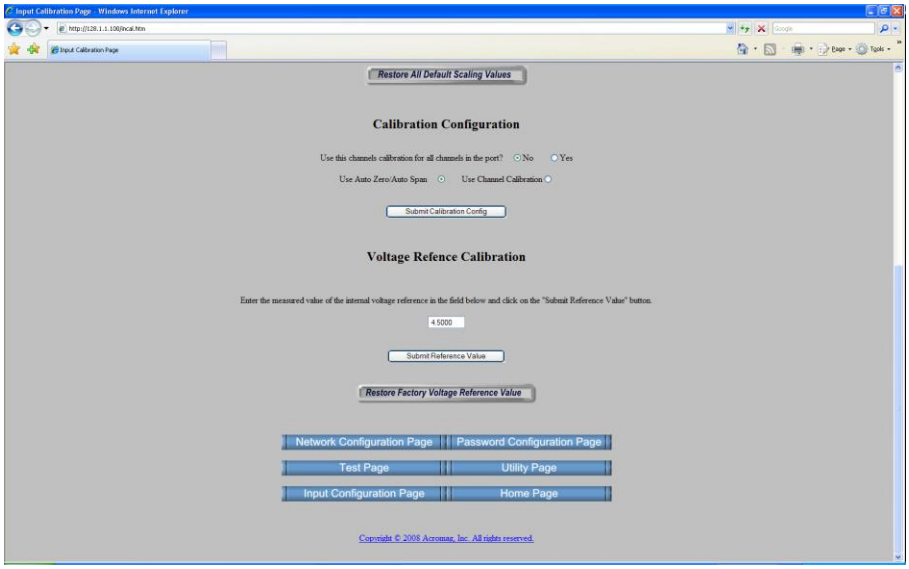
WEB BROWSER

Calibration Page

IMPORTANT: *This module normally performs an automatic calibration of zero and full-scale. Recalibration on a channel-by-channel basis is normally NOT required, except for calibration that must be done to a higher standard. Do not attempt to recalibrate a channel unless absolutely required, or to verify the accuracy of internal calibration, as inadvertent mis-calibration will negatively affect the channel's performance.*



Use the scroll bars to the right to scroll down the page…



In normal operation, this unit automatically re-calibrates its base A/D input ranges every time it scans its 32 input channels by reading its own calibration reference voltage (4.5V ±0.05% ±5ppm/°C) at each A/D channel. This reference has been precisely measured and its value stored inside the unit from the factory. This is sufficient to achieve rated accuracy using automatic calibration. But if you need to calibrate to your own standard, or you want to check the accuracy of the internal calibration, then you can utilize the controls of this page to manually calibrate the inputs instead.

You have 3 options for accomplishing input calibration. The first option is to simply accept the default response of automatic input calibration. The second option will allow you to achieve better accuracy by manually calibrating one channel of each type from each port, and then using that channels response to represent all 8 channels of the port. This effectively calibrates the A/D channel that the port connects to and saves some time while improving accuracy. Your third option is to manually calibrate each input channel separately, using very accurate input signal and measurement equipment to achieve calibration. This would additionally compensate for the small errors contributed by the input filters, buffer amplifiers, and input multiplexers, as well as the initial inaccuracy of the input shunt resistor of current inputs. Which method you choose refers to your Calibration Configuration selected via controls on this page.

While the relative accuracy of calibration can be improved via software calibration facilitated with the controls of this page, or by instead issuing the appropriate Modbus register calibration commands, the Automatic calibration will be sufficient for most applications.

This page additionally allows the internal 4.5V calibration reference that is used to accomplish automatic calibration to be calibrated. An accurate voltage reference measurement is made between P1 header pins 1 and 2. The measured value representing the calibration voltage is recorded and stored inside FRAM memory that resides on the I/O board of the unit. The controls of this page allow a new value to be stored. This has already been done at the factory and should not need to be repeated unless miscalibration is suspected. In order to take this voltage measurement, it requires that the board assembly be carefully removed from the enclosure and this requires handling at an ESD-safe work station. **We do not recommend that you do this in the field as it invites potential damage to sensitive internal circuitry.**

The 16-bit A/D converter used to process the input signals has selectable base ranges of ±5V or ±10V, and four separate differential channels. There are four ports of eight differential channels each that are separately multiplexed to these four A/D channels. ES2161 models utilize the ±5V A/D range and your calibration signal is ±20mA into 100Ω input shunt resistors at the input which drives ±2.0V to the A/D. Thus, the ES2161 calibration endpoints remain ±20mA even if you have selected a different input range.

Once you have selected an input channel to calibrate, and then a calibration configuration, you simply follow the instructions printed on the Calibrate Channel bar as you click the bar, making sure that you apply the zero and full-scale calibration point signals indicated at the appropriate times.

Manual Input Calibration - Voltage Inputs, Current Inputs

These web controls allow you to perform manual calibration on an input channel. Manual calibration is accomplished on a per channel basis, or optionally on a per port basis by calibrating one channel from each port (i.e. each A/D channel).

To begin, at the top of the Input Calibration Page, first select the channel to be calibrated. Next select the Calibration Configuration for the channel before continuing.

WEB BROWSER

Calibration Page

For reference, one LSB of input signal is equivalent to the input full-scale voltage range divided by 65536 ([Full_Scale – Zero]/65536). In general, an uncalibrated A/D input can produce a zero offset error up to ±28LSB, and a full-scale error up to ±0.4%. Each port will match their zeros to within ±10LSB of each other, and their full-scale measurements to within ±15LSB.

WEB BROWSER

Calibration Page

Channel Selector Bullets: Click to bullet the channel you wish to calibrate. Calibration is done on a per channel basis. Optionally, you can pick one channel from each port (group of 8 channels), and use that calibration to represent the port.
Zero Calibration Point Field: This field indicates the low calibration endpoint for the selected input range. This is the input signal that you have to apply to accomplish zero calibration. Your input source must be of an accuracy greater than 0.03% of span to achieve better results than auto-calibration.
Full Scale Calibration Point Field: This field indicates the high calibration endpoint for the selected input range and is the input signal to apply to accomplish full-scale calibration. Your input source must be of an accuracy greater than 0.03% of span to achieve better results than auto-calibration.
Calibration Step Button: You click this button in a sequence of 3 steps to accomplish input calibration via this web page. Specific instructions at each step appear printed on this button
Reset Calibration Button: Click this button if you make a mistake in the calibration sequence and wish to start over from step 1.
Restore All Default Calibration Values Button: Click this if you believe channel calibration has been done in error or you are getting erratic results after recalibrating. This will affect all input channels at one time and the values restored are the ideal values, not the results of an actual calibration. You might choose this option if your calibration was done in error or produced unexpected results.
Restore All Default Scaling Values Button: Click this button if your own scaling produced unexpected results and you wish to return the input scaling values of the selected channel to their default values (typically the input range signal endpoints). Note that this will affect all input scaling values and will restores them to their ideal values.

Calibration Configuration

By default, zero and full-scale are calibrated automatically and this will be sufficient for most applications. You may optionally calibrate each channel separately to obtain the highest possible accuracy. Or to save time, you can calibrate one channel from each port (i.e. one A/D channel) and select an option to allows that channel's calibration to calibrate the response for all 8 channels of the same port.

IMPORTANT: *If you select Yes to "**Use this channel's calibration for all channels in the port?",** note that the channel must be calibrated first, before making this selection.*

Use this channel's calibration for all channels of the port (Yes or No): If you select "Yes", then the manual calibration already done for this channel will apply to all channels of the same port. Each group of 8 channels or individual ports are multiplexed to a separate A/D channel. This selection should be done only after calibrating this channel. This saves additional time by only requiring one manual calibration per port. To distinguish the channels of the same port, each row of the channel selector at the top of this page represents one port. Thus, Port 1 refers to channels 0-7, Port 2 to channels 8-15, Port 3 to channels 16-23, and Port 4 to channels 25-31. When done properly with very accurate signal sources and measurement equipment, this method of calibration is generally better than auto-calibration, but not as accurate as calibrating per channel, as calibrating each channel individually would additionally compensate for the small errors contributed by the input filters, buffer amplifiers, and input multiplexers.

Note: If calibrating one channel per port, the other channel's should have "Use Channel Calibration" selected. Selecting "yes" will automatically select "Use Channel Calibration" for the remaining port channels of the same port and type. You can still override this auto-selection, by subsequently selecting another option for any number of the other port channels.
Use Auto Zero/Auto Span Bullet: Clicking this bullet will use automatic calibration for the selected input channel (default behavior). With automatic calibration, the port utilizes the on-board 4.5V ±0.05% ±5ppm/°C reference signal and ground to calibrate the input. The internal calibration reference was precisely measured at the factory and its voltage value is stored in the unit. Steering circuitry prior to the port input buffer allows each A/D channel to connect to this reference voltage, and alternately to analog common (for zero). In this way, the unit makes a correspondence between it's A/D count and a known voltage to form the linear input response. Only the 0V and +4.5V range points are actually auto-calibrated, while calibration of -5V, and the ±10V range endpoints (ES2162) are coincident (interpolated).
Automatic calibration will be sufficient for most applications. This method of calibrating the inputs is the most convenient and will achieve rated accuracy of ±0.05% for voltage inputs, and ±0.1% for current inputs. It is less accurate for current inputs because it does not compensate for the initial inaccuracy of the input current shunt resistor (100Ω ±0.05% ±10ppm/°C).
Use Channel Calibration Bullet: Clicking this bullet will select manual (per-channel) calibration, which associates the current calibration with only the current channel. It is possible to achieve the greatest accuracy if you calibrate on a per channel basis and you have a precise input signal source and digital voltage meter, but it takes more time to accomplish. Note that internally, ES2161 models only utilize the ±5V A/D range.
Submit Calibration Configuration Button: Select your mode of calibration and click this button to write your selection to the unit. Then you can calibrate the channel as required, repeating it for each of the channels.

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Calibration Page

Voltage Reference Calibration

The on-board calibration reference used for automatic calibration can be separately calibrated by accurately measuring its value and entering it in the field provided in the Voltage Reference Calibration section of this page.

This has already been done at the factory and recalibration of this reference should not normally be required. You should not change the value indicated in this field unless authorized to do so, or performance may be negatively affected.

Voltage Reference Field (4.4968 to 4.5032): The internal calibration reference is precisely measured at the factory and its voltage value stored in the unit and indicated in this field. This reference voltage is 4.5V ±0.05% ±5ppm/°C, and should read between 4.4968 and 4.5032 (4.5V±0.07%). This value is used to make a correspondence between the A/D response (digital count), and the voltage signal itself, in order to calibrate its linear response. You can enter your own measured value in this field if you need to recalibrate it (not recommended).
Note: The internal 4.5V reference voltage can be measured via test points on the backside of the top circuit board (near the left edge) at P1 marked CVREF. This calibration has already been done at the factory in an ambient temperature near 25ºC and should not need to be repeated.

***Reference Voltage Measurement**: This procedure is not normally required and has already been done at the factory. The reference voltage is measured between the pins of header P1, which are marked on the back of the top-side circuit board (do not disassemble mated boards). You will have to remove the front end-plate to pull the assembly from its enclosure to measure this voltage. This should only be performed at a static-safe workstation by qualified personnel, or damage to the unit may result.*

WEB BROWSER

Calibration Page

Submit Reference Value Button: Click this button after you have entered a measured reference voltage in the Voltage Reference field to store your measured value in non-volatile memory.
Restore Factor Voltage Reference Value Button: If you make a mistake and have entered the wrong value for the calibration reference, you can click this button to restore the original value measured from the factory. You would also click this button if you performed a system restore of the unit (see Troubleshooting – Getting Out of Trouble procedure).

A/D Input Calibration

The A/D input voltages, raw counts, and normalized counts are indicated below (before re-scaling) for exactly -5.000V, 0V, and +5.000V, as applicable, for the A/D port channels set to their native ±5V input range.

Zero & Full-Scale A/D Counts for ±5V A/D range & ±0.05% accuracy.

Full-Scale Range	Zero	0V/0mA	Full-Scale
±5V (ES2162)	-5.000V+5mV	0V±5mV	+5.000V-5mV
Raw A/D Count	-32768+33	0±33LSB	+32768-33
Normalized Count	-30000+36	0±36	+30000-36
±20mA (ES2161)[1]	-20mA±20uA	0mA±20uA	+20mA±20uA
Raw A/D Count	-13107±14	0±14LSB	+13107±14
Normalized Count	-30000±32	0±32	+30000±32

[1]The ES2161 utilizes the ±5V native range of the A/D to process ±20mA. A precision 100Ω input shunt resistor (±0.1%, ±10ppm/ºC) is used to convert the input current to the A/D voltage. Thus, all ES2161 input current ranges are actually sub-ranges of the 16-bit ±5V range. A full-scale current of 20mA will present a full-scale voltage of 2.0V to the A/D, yielding an effective resolution of one in 26214 parts for ±20mA (±13107parts), or one in 13107 parts for 0-20mA. For simplification, the raw A/D count for selected input ranges is normalized to a count of ±30000.

If you perform manual calibration via the controls of this page, or you use the Modbus register commands to calibrate the inputs (see below), then this has the added benefit of being able to correct for any negative full-scale offset, as auto calibration only utilizes 0V and +5V to calibrate the bipolar input.

IMPORTANT: Always allow the module to warm up a few minutes prior to calibration.

If you are not satisfied with auto calibration, you can choose to use the web browser calibration page to achieve manual calibration (easier), or via direct Modbus register access as described in Method 2 of the following page.

Method 1 – Channel Calibration Using the Built-In Browser Interface:

1. Bring up the browser interface and select the Input Calibration Page.
2. Allow the module to warm-up a few minutes before continuing.
3. Browse to the bottom of the Input Calibration page and check that the reference field of the Calibration Page indicates a voltage between 4.4968 and 4.5032 (4.5V±0.05%). If you suspect this is inaccurate, this voltage will have to be precisely measured and then typed into this field first. Calibrating the reference requires that the unit be removed from its enclosure and is not recommended. See Optional Reference Calibration above.

Channel Calibration Using the Built-In Browser Interface…continued:

WEB BROWSER

Calibration Page

4. For best results, Zero is always calibrated before full-scale. Note the Zero Calibration Point indicated in its field. You must apply this exact input signal to the input channel being calibrated to proceed. Your signal source should be accurate to better than ±0.05% (auto standard).
   ES2161 Units: The zero input signal is always -20mA. This is equivalent to delivering 20mA to the – terminal and returning it at the + terminal. This produces an A/D calibration voltage of -2.0V.
   ES2162 Units: The zero input cal signal is a negative voltage of -9.9V or -4.95V, according to input configuration. Note that if you do not have a precision negative voltage, just flip the differential positive and negative terminal connections and use a positive reference voltage.
5. After applying the Zero Calibration signal to the channel, simply click the "Step 1…" button to calibrate the zero. If you make a mistake, you can always click the **"Reset Calibration"** button to start over from Calibrate Zero Step 1.
6. Note the Full-Scale Calibration Point indicated in its field. You must apply this exact input signal to the input channel being calibrated. Your signal source should be accurate to better than ±0.05% (auto calibration standard).
   ES2161 Units: The full-scale calibration input signal is always +20mA. This is equivalent to delivering 20mA to the + terminal and returning it at the – terminal. This produces an A/D calibration voltage of +2.0V.
   ES2162 Units: The full-scale calibration signal is a positive voltage of +9.9V or +4.95V, according to your input configuration.
7. After applying the correct Full-Scale Calibration signal to the channel, simply click the "Step 2…" button to calibrate the full-scale cal point. If you make a mistake, you can always click the **"Reset Calibration"** button to start over from Zero calibration Step 1.

   The A/D ±5V or ±10V range is now calibrated for this channel. ES2162 calibration endpoints are determined by your input configuration, while the ES2161 always uses ±20mA into its 100Ω shunt to drive ±2.0V to the ±5V A/D input.

   If your calibration configuration selected "No" for the query "Use this cannel calibration for all channels of this port", then you should repeat this procedure for the other channels. If "Yes" was selected for this query, then you only need to repeat this procedure for 3 other channels, one from each of the other 3 ports, to calibrate the unit completely.

Method 2 – Input Calibration via The Modbus TCP/IP Interface:

1. Write the appropriate Channel Configuration Register to select the input range to be calibrated for the input channel. ES2162 units can select ±5V or ±10V. ES2161 models will always use the ±20mA range to calibrate, even if you select one of the other ranges. This optimizes calibration by using as much of the A/D range as possible and it will drive ±2.0V into the A/D which has a native 16-bit input range of ±5V. This step is effectively not required to calibrate the ES2161 unit.

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Calibration Page

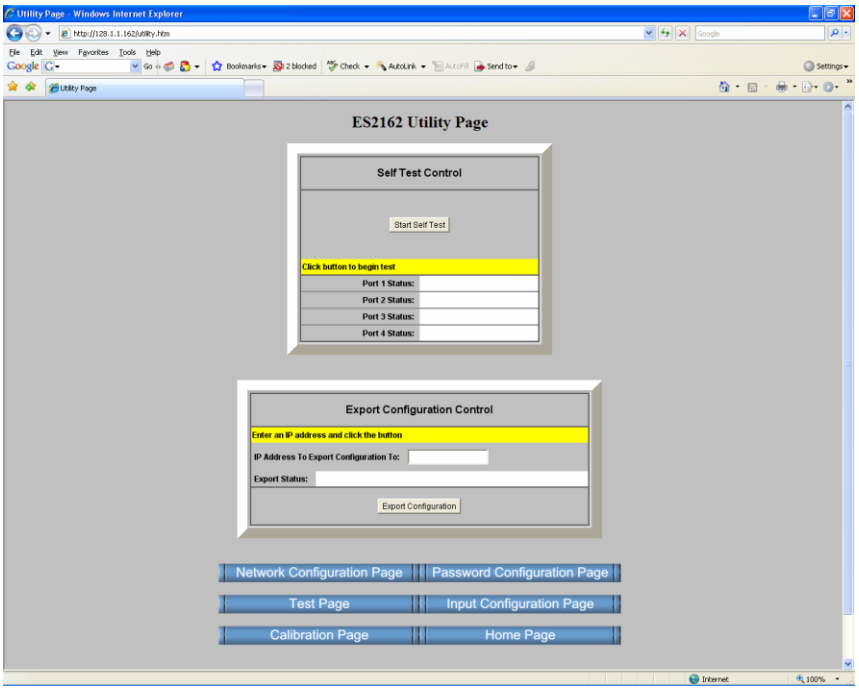
Channel Calibration Using the Modbus TCP/IP Interface…continued:

2. Write a 16-bit word into the Enable Scan Groups register to at least enable the scan group that includes the input channel you wish to calibrate. Note that there are 8 scan groups and bit 0 of this word corresponds to scan group 1, while bit 7 of this word corresponds to scan group 8 (bits 8-15 are 0 and not used). A set bit in a position will enable the corresponding scan group.
3. Write 24106 (5E2AH) into the Calibration Access Register to remove write protection from the calibration registers.
4. For best results, Zero is always calibrated before full-scale. You must apply the exact input zero signal to the input channel being calibrated to proceed. Your signal source should be accurate to better than ±0.05% (auto standard).
   ES2161 Units: The zero input signal is always -20mA. This is equivalent to delivering 20mA to the – terminal and returning it at the + terminal. This produces an A/D calibration voltage of -2.0V.
   ES2162 Units: The zero input cal signal is a negative voltage of -9.9V or -4.95V, according to input configuration. Note that if you do not have a precision negative voltage, just flip the differential positive and negative terminal connections and use a positive reference voltage.
5. Write a 16-bit word into the correct Zero Cal Trigger Register with a set bit in the bit position that corresponds to the channel you wish to calibrate zero at. You would write to the Zero Cal Trigger Low register to address channels 0-15 of ports 1 & 2, or the Zero Cal Trigger High register to address channels 16-31 of ports 3 & 4. A set bit in these registers will trigger the unit to sample the corresponding channel, capture its zero signal, and store the count. The unit will replace calibration coefficients immediately, with no reset required. Note that if you have zero signals at more than one channel, and the corresponding scan groups are enabled, you can effectively calibrate zero for many or all of the channels at once.
6. You must apply the exact input full-scale signal to the input channel being calibrated. Your signal source should be accurate to better than ±0.05% (auto calibration standard).
   ES2161 Units: The full-scale calibration input signal is always +20mA. This is equivalent to delivering 20mA to the + terminal and returning it at the – terminal. This produces an A/D calibration voltage of +2.0V.
   ES2162 Units: The full-scale calibration signal is a positive voltage of +9.9V or +4.95V, according to your input configuration.
7. Write a 16-bit word into the correct Span Cal Trigger Register with a set bit in the bit position that corresponds to the channel you wish to calibrate full-scale at. You would write to the Span Cal Trigger Low register to address channels 0-15 of ports 1 & 2, or the Span Cal Trigger High register to address channels 16-31 of ports 3 & 4. A set bit in these registers will trigger the unit to sample the corresponding channel, capture the full-scale signal, and store the digital count. The unit will replace calibration coefficients immediately, with no reset required. Note that if you have full-scale signals at more than one channel, and the corresponding scan groups are enabled, you can effectively calibrate full-scale for many or all of the channels at once.
8. Repeat these steps for the other input channels to be calibrated.
9. When finished calibrating, write 0x0000 to the Calibration Access Register to replace write protection for the calibration registers and to help prevent potential miscalibration.

WEB BROWSER

Utility Page

You may also access a Utility Page that includes a couple of built-in utilities that allow you to verify input operation without wiring to the inputs (self-test control), and allow you to export your current configuration to another unit (export configuration control). You can select the Utility Page button from the Test Page screen to display a screen similar to that shown here:



When you first enter a page that includes controls like this, you may note that your first click on a control is ignored. This is because the first click only activates the control.

Input Self Test Control

The Self-Test makes use of built-in calibration reference signals to check the operation of input ports. It can serve as a trouble-shooting aide if you are experiencing problems. It does not require that you connect anything to the input, and doing so will not affect the results of this test. Likewise, you do not have to disconnect your input signals to run this test.

Connecting field input signals during self-test will not harm the unit, as the input port multiplexer is disabled during self-test and no signal contention is possible.

Each port of this device (group of 8 channels) is multiplexed to a separate set of input buffers that feed separate A/D channels. The Self Test Control will test the relative accuracy of the input ports by sampling the reference signals. Simply click the "Start Self Test" to begin testing. This triggers the unit to momentarily connect each A/D input channel's buffers (each port channel) to the internal reference signals (0V and 4.5V) and measure the response. If the resultant measurement is within an acceptable level of error with respect to rated accuracy, then the Port status will indicate "Passed". Note that this effectively tests the signal path of each port, but not each port's channel (i.e. it tests the circuit operation beginning from the output side of each input port's 8:1 input multiplexer). Thus, the Self-Test does not test operation of the port input multiplexer, or the integrity of the input filters, as the reference signal is switched to the input buffers of the four A/D channels, after the multiplexer.

Export Configuration Control

Enter the IP address of the destination unit you are trying to replicate this configuration at (the unit must already be connected to the network). Refer to Network Connections for examples of how to network connect units.

WEB BROWSER

Utility Page

The export function is a real time-saver when commissioning multiple units in similar fashion. Simply enter the IP address of the unit you wish to send your I/O configuration to (the unit must already be connected to the network). It is assumed that you have already communicated with the target unit and setup its network parameters. Next, click the Export Configuration button to transmit your I/O configuration.

Referring to the Modbus Memory Map for this device, this function sends the contents of all Holding Registers (4xxxx registers), right up to the wink register, to the IP address indicated (Registers 40001 to 40036). It does not send network configuration parameters which must be preset via the web browser. Likewise, it does not transfer scaled values, scaled units, preload values, nor any floating point information or items that are not represented in a register. The Export Status window will let you know if the configuration was received correctly at the remote station (destination stations may still require their own calibration).

TROUBLE-SHOOTING

Diagnostics Table

Upon power-up, after blinking momentarily the green "Run" LED should remain ON. This indicates the unit is properly powered and operating normally. If RUN continues to blink, then the unit may not be connected to the network or the cable is bad. Otherwise, a continuous blinking RUN LED can indicate unit is in "wink" ID mode, or it may be indicative of a firmware initialization error.

POSSIBLE CAUSE	POSSIBLE FIX
Green RUN LED Does Not Light…	
Bad connections.	Recheck Power Connections
Try a system reset.	Use the RST toggle to reset the unit.
Internal +3.3V power has failed or a fatal processor (firmware) error has occurred.	Return unit for repair.
Continuous Flashing Green RUN LED…	
A network link has not been established.	Check your cable and switch/hub connections. Once a link is established, the green Run LED should not continue to blink but remain ON. If it continues to blink,. then the firmware may be in error.
Unit was not connected to network upon power-up, or network cable is bad.	The RUN LED will continue to blink as the unit hunts for a network link. Connect a network cable to the unit to complete its initialization. This only occurs for initial communication.
Unit in "wink" mode.	Read Status register to verify "wink" status. Write 5555H to Wink Toggle Register to toggle wink mode off/on.
Unit failed to boot firmware.	A continuously flashing green Run LED can signify the unit has failed to initialize and may require repair if you are sure you have a good network connection and proper power voltage.
Repeated System Resets Occur with Redundant Port Connections…	
Your external network or switch is not setup to handle redundant media connections.	Use an external redundant switch to connect to both ports of this device at the same time.
Cannot Communicate…	
Power ON to the unit?	Check if green RUN LED is ON?
Fiber Connections not crossed over.	The auto-crossing feature does not apply to the fiber port. These connections must physically cross transmit to receive and visa-versa.

POSSIBLE CAUSE	POSSIBLE FIX
Cannot Communicate…	
Wrong IP Address	Change IP address of unit or host PC so they match domains. Try the default unit address of 128.1.1.100.
Cannot Communicate Following Restore Procedure…	
Wrong IP Address	IP address has been restored to its default unit address of 128.1.1.100.
Many Communication Errors…	
Is cable segment longer than 100M?	Distance between two Ethernet nodes is limited to 100 meters with approved cable.
Correct Cable?	Shielded CAT-5/5E cable or equivalent is recommended.
Missing earth ground connection.	Connect earth ground to TB6 GND terminal adjacent to power terminal.
Cannot Browse Unit…	
Your browser may be setup to use a proxy server for LAN communications.	Temporarily disable the use of a proxy server by your browser (see procedure of next page).
Redundancy Failover Protection Not Occurring…	
Your unit's network configuration is not in hub/repeater mode.	Set the unit to hub/repeater mode (not switch mode) for redundant media applications.
Cannot Access Web Pages (Unit Won't Accept Username & Password)…	
Have you forgotten your username and password settings?	Return the unit to the Default Mode and use the default username and password to access the Password Configuration Page to reset them to something you can remember.
Fiber Port Not Communicating…	
Is fiber cable crossed over? Have you selected 100MB and Full-Duplex for fiber port 1? Note the Tx channel of the unit is the bottom half of the SC fiber connector, while the Rx channel is the top half (facing front of unit).	The auto-crossing feature does not apply to fiber connections, which must physically crossover the transmit and receive channels. Further, the fiber port communicates at full-duplex and 100M only and auto-negotiation is not possible.
Communication To Unit is Lost…	
Was communication interrupted by severe interference or shock?	Reset the unit via the RST toggle or by cycling power.
Unit Fails to Start-up or Initialize…	
Input power voltage below 18V?	Check your power supply voltage and make sure that it is at least 18V and of sufficient capacity (select a current capacity at least 2x the maximum current draw of the unit).

TROUBLE-SHOOTING

Diagnostics Table

TROUBLE-SHOOTING

Diagnostics Table

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 unit with a known good unit. Acromag's Application Engineers can provide further technical assistance if required. Complete repair services are also available from Acromag.

POSSIBLE CAUSE	POSSIBLE FIX
Adding another unit to network slows web page interaction considerably…	
Does each unit have a unique MAC address? *All units are normally shipped with a unique MAC address assigned from the factory. An error in shipment could release a unit with a default MAC address (52:4F:42:45:52:54).*	Go to the Network Configuration Page and verify that each unit has a unique MAC address installed. This should always be the case. If you have 2 units with same MAC address, this will slow down communications considerably and you must contact the factory for MAC reassignment.
Inputs Appear Noisy or Unstable…	
Have you grounded your inputs? Note that un-grounded inputs and the Port Common terminal both require an earth-ground connection.	Connect the Port Common (C) terminal to earth ground. If input source is not already grounded, then try connecting the IN- lead to the port C terminal (which separately must be connected to earth ground).
Have you tried Input Averaging?	You can use controls on the input configuration page to set the number of samples to average inputs over. Try increasing this number above 1 to minimize noise (up to 500).
Input Polarity is Wrong…	
Are your input terminals reversed?	Observe proper polarity for voltage inputs. Current can be input to the input (+) or input (-) terminals if a non-polarized range is selected.
Unit Fails Input Self Test…	
Internal calibration reference has failed or has been miscalibrated.	Check the reference field of the Calibration Page and make sure a voltage between 4.4978 and 4.5023 (4.5V±0.07%) is indicated. If not, you may attempt to calibrate this yourself, or return the unit to Acromag for calibration, repair, or replacement.
Cannot Calibrate Input Channel…	
Have you also enabled the channel's scan group?	See the Enable Scan Groups Register and/or the Input Config web page to enable input to be sampled.
Current Inputs Have Greater Inaccuracy…	
Auto calibration of current inputs fails to compensate for errors in the current shunt resistor.	Refer to Input Cal Page and perform a manual cal of the input if auto calibration results are not sufficient.

TROUBLE-SHOOTING

Trouble Browsing Your Unit?

Refer to Acromag Application Note 8500-734 for help in setting up network communication with your unit (see CDROM shipped with unit or down-load it from www.acromag.com). This document gives details for changing your PC's TCP/IP configuration in order to communicate with similar hardware to your unit (see TCP/IP Properties of Network Configuration in Windows). If you have carefully followed this procedure and you still cannot browse your unit, you may have the web browser of your laptop or PC setup to use a proxy server when browsing the web. If you are using Internet Explorer, refer to the "Tools" pull-down menu, select "Internet options…", click the "Connections" tab, then click the "LAN Settings" button. Locate the Proxy server information and uncheck the box next to the statement "Use a proxy server for your LAN". Then click [OK] to return to the "Connections" screen, and click [OK] again to save your settings. This should allow you to use Internet Explorer to browse the unit as required. However, to later restore your PC's connection to your company network, you may have to re-enable the use of a proxy server for your LAN.

Getting Out Of Trouble

There is limited error checking to keep you from writing invalid values to a configuration register and operation may become unpredictable if you do this under certain conditions. If resetting the unit fails to restore order, then to regain control of the unit, the unit can either be re-downloaded at the factory, or you can try restoring its initial configuration by following this procedure:

Procedure For Restoring any EtherStax Unit to its Initial Configuration (Also used if you wish to sanitize the unit and return it to original state)

IMPORTANT: Use this only as a last resort, as this procedure will reset everything to its default state--all holding registers, network settings, i2o settings, and calibration (the permanently coded MAC ID does not change). It also restores the IP address to 128.1.1.100.

1. With unit power OFF, press and hold the front-panel toggle switch in the default (DFT upward) position.
2. Holding the toggle switch in the default position and apply power.
3. Note the green RUN LED will turn ON. Continue to hold the toggle at the DFT position for about 10 seconds until the green RUN LED turns OFF. Release the toggle switch at this point and the RUN LED will blink for 1-10 seconds as the unit acquires its address, then remains ON for normal operation. At this point, the unit is not in the default communication mode, but all registers are reset back to their default factory state.
4. If the green RUN LED never turned OFF while you held the DFT toggle during power-up, then reinitializing the unit has failed and you should try it again. This time, make sure that the DFT toggle switch is completely depressed and held until RUN turns OFF while powering the unit. Also make sure that you are holding the DFT toggle in the DFT direction (upward), rather than the RST direction (downward).

So, your EtherStax has apparently "gone wild", and resetting the unit did not correct your problem, then follow this procedure to restore it to its initial configuration and regain control.

If you do use restore and want to return the unit to service, you will also have to separately restore the calibration reference.

TECHNICAL REFERENCE

KEY FEATURES

- **High Density Flexible Industrial I/O** with 32 differential current or voltage channels. ES2162 models support optional connection to industry-standard uB or 8B module carriers for a wider variety of input types.
- **True Differential Wide-Band Input** path is fully differential through to the A/D converter for maximum noise rejection.
- **Web-Browser Reconfiguration** allows a standard web-browser to be used to configure, control, monitor, and calibrated over Ethernet.
- **Achieves End-Node Media Redundancy** to the unit via dual Ethernet ports when also connected to redundant switches that support STP, RSTP, or most other proprietary ring redundancy methods.
- **Fully Isolated** input channels (as a group), alarm relay, network ports, enclosure, and power circuits for safety and increased noise immunity.
- **Wideband Inputs** can process all 32 analog channels in as fast as 5ms (200Hz), or a smaller number of inputs in as fast as 0.77ms (1298Hz).
- **16-bit A/D Converter** for high-accuracy and high-resolution.
- **Built-In Calibration Source** facilitates precise calibration and self-test.
- **Integration and Totalization of Inputs is Possible** via scaling registers and non-volatile memory storage.
- **Optional User-Scaling** allows inputs to rescale to user-defined sub-ranges or other engineering units to facilitate integration/totalization.
- **Field Inputs Can be Mixed with External uB or 8B Module Inputs** on ES2162 models for a wider variety of input signal range types.
- **Safety Agency Approvals** – Enclosed models are CE, & cULus listed, for Class 1; Division 2; Groups A, B, C, D hazardous locations. Open board models are cULus Recognized Components, for Class 1, Division 2, Groups A, B, C, and D hazardous locations.
- **Selectable Modbus TCP/IP or UDP/IP Protocol Support** for up to 10 sockets using Modbus TCP/IP. Also supports UDP/IP.
- **Flexible IP Addressing** supports static, DHCP, or BOOTP.
- **10Base-T and 100Base-TX Support** with auto-negotiated 10/100Mbps, Half or Full Duplex.
- **100BaseFX Support** option for a 100M FX fiber-optic connection at one of two network ports.
- **Dual Ethernet Ports Make Network Connections Easy** using a built-in switch to allow units to be connected in cascaded "daisy-chain" fashion without consuming an external switch port. The second port also allows the network distance to be extended an additional 100 meters (copper), or 2km (fiber).
- **Network Ports with Isolation & Transient Protectioned** are safety-isolated from each other and protected ESD, EFT, and other transients.
- **Auto MDI/MDI-X Crossover** requires no special up/down link port or crossover cables to connect this device to your PC, or an external Ethernet switch, or hub.
- **Nonvolatile Reprogrammable Memory** allows the functionality of this device to be reliably reprogrammed thousands of times.
- **Low-Latency, Cut-Through Repeater Mode** reduces port-to-port latency jitter of switch mode from about 167us, to 40ns in hub mode, useful for time critical applications or concentrated traffic links.
- **Extensive Operating & Diagnostic LED's Aide Troubleshooting** with three LED's to indicate power, operating mode, wink status, and relay state, plus eight communication LED's for per-port activity, communication errors, link status, collision detection, speed, and duplex.

KEY FEATURES
…continued

- **Internal Watchdog** timer is built into the DSP that causes it to initiate a self reset if the controller "locks up" or fails to return from an operation in a timely manner.
- **Convenient "Wink" ID Mode** will blink the green RUN LED as a tool to help identify specific remote units.
- **Local Alarm Function** with a set of SPST-NO relay contacts that can signal link loss and/or power failure (failsafe only).
- **Wide Ambient Operation** from -40°C to +75°C.
- **Hardened For Harsh Environments** and protection from RFI, EMI, ESD, EFT, & surges. Has low radiated emissions per CE requirements.
- **Shock & Vibration Immunity** to 5g random vibration per IEC60068-2-64, to 50g mechanical shock per IEC60068-2-27 (see Specifications).
- **Rugged and Stackable Annodized Aluminum Enclosure** also allows units to be stacked and locked together.
- **"Plug-In" Terminal Block** Make wiring removal, & replacement easy.
- **Enclosure Supports Surface or DIN-Rail Mount** options, even when units are stacked together.
- **Open (No Enclosure) Option** allows units to be purchased without their enclosure and stacked together via threaded standoffs & 6-32 screws.
- **Wide-Range DC-Power w/ Redundant Power Connection** using diode-coupling for use with redundant supplies and/or battery back-up. An extra power terminal is provided for optional standby backup power.

HOW IT WORKS

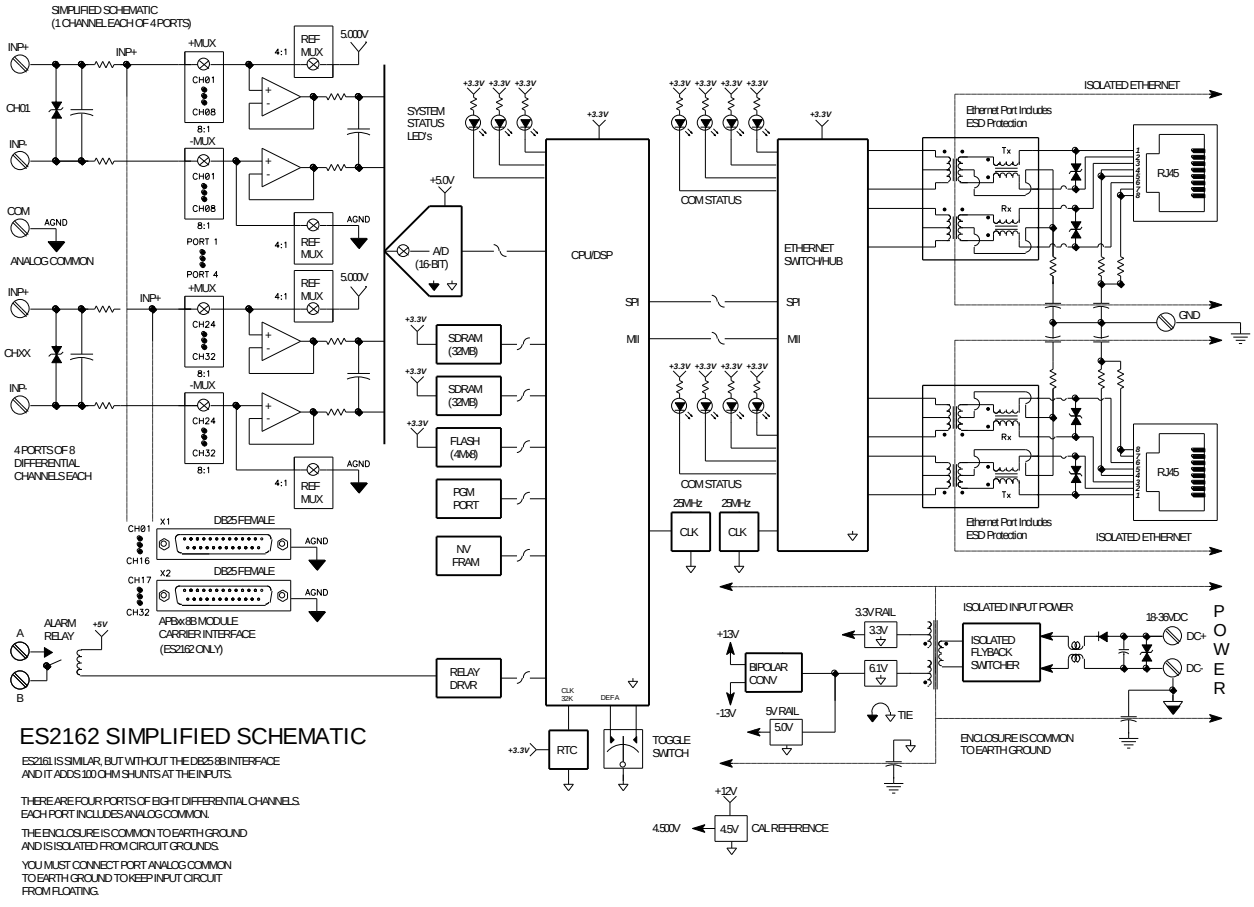
This circuit employs four pairs of fault-tolerant 8:1 analog multiplexers to differentially drive four groups of 8 channels (ports) of current or voltage inputs, to four differential channels of a 16-bit converter. Additional circuitry can optionally connect each A/D input to 0V (zero), or a precision 4.5V reference to help accomplish calibration and self-test. The A/D can be configured for native ranges of ±10V, or ±5V. ES2161 models utilize the ±5V range (a 100Ω shunt resistor converts input current to A/D voltage). Units include an isolated 10/100Mbps Ethernet interface for configuration, monitoring, calibration, and control of the I/O. The ES2162 model adds two female DB25 interface connectors for optional connection to industry-standard uB or 8B input module carriers, which may mix their inputs with the unit's own field inputs on an 8 or 16 channel basis. Embedded configuration parameters are stored in non-volatile memory.

The A/D's internal 4-channel MUX rescales the inputs via a resistor divider network utilizing a series 25KΩ resistor and a 17KΩ divider resistor, additionally coupled to an internal 4.096V A/D reference via a series 10KΩ resistor. The rescaled signals alternately connect to the ADC. The ADC uses a successive approximation algorithm and internal sample & hold circuit to convert the input signal to a 16-bit serial output stream which is transmitted to the CPU via an SPI interface.

The network interface utilizes a dedicated, 3-port, Ethernet switch to provide two external network ports to the internal CPU/MAC (third port). These ports are individually isolated and include transient protection. The embedded switch may also operate as an Ethernet hub, allowing automatic end-node media redundancy when both ports are connected to an external redundant switch (copper only). This also makes the node redundancy compatible with most proprietary ring redundancy methods, Spanning Tree (STP), or Rapid Spanning Tree (RSTP).

HOW IT WORKS

This device is packaged in a rugged aluminum enclosure. The enclosure is common to the earth ground terminal and fully isolated from the internal circuitry for increased safety and noise immunity. The internal transient suppression devices are shunted to earth ground via safety rated isolation capacitors. A wide-input, high-efficiency, switching regulator (isolated flyback converter) provides isolated power to the unit. Refer to the simplified schematic below to help gain a better understanding of circuit operation.



ES2162 SIMPLIFIED SCHEMATIC

ES2161 IS SIMILAR, BUT WITHOUT THE DB25-8B INTERFACE AND IT ADDS 100 OHM SHUNTS AT THE INPUTS.

THERE ARE FOUR PORTS OF EIGHT DIFFERENTIAL CHANNELS. EACH PORT INCLUDES ANALOG COMMON.

THE ENCLOSURE IS COMMON TO EARTH GROUND AND IS ISOLATED FROM CIRCUIT GROUNDS.

YOU MUST CONNECT PORT ANALOG COMMON TO EARTH GROUND TO KEEP INPUT CIRCUIT FROM FLOATING.

Key Observations

- Ethernet ports are individually isolated from power, I/O, and each other, and include transient suppression.
- Input signal path is fully differential right to the A/D for excellent common-mode noise rejection.
- The Input Common terminal is used to reference the analog input circuitry to analog common, and to tie the analog common to earth ground. It must be grounded, even with uB or 8B inputs.
- The input power and external excitation terminals are series-diode coupled for reverse polarity protection, which is also useful to facilitate redundant power connection.
- The aluminum enclosure is common to the earth ground terminal and internal transient suppression devices are shunted to this ground via isolation capacitors, maintaining isolation from earth ground. If an ungrounded enclosure should come in contact with high-voltage, the connected circuits will be isolated from this fault condition (the input port common terminal must be tied to earth ground to keep the input circuit from floating).

MODBUS REGISTERS

Modbus registers are organized into 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 "x" following the leading character represents a four-digit address location in user data memory.

The leading character 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.

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 (port). 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 port and channel numbers increase sequentially as you move towards the msb.

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

Every EtherStax unit has a default factory configuration as noted in the Specifications section. Your application will likely differ from the default configuration and the unit will need to be reconfigured. You may reconfigure most features of this unit by issuing the appropriate Modbus functions to Register Map registers, as required by your application. You may also use a standard web browser to access the built-in web pages of the unit to perform basic I/O, calibration, & reconfiguration.

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

CODE	FUNCTION	REFERENCE
01 (01H)	Read Coil (Output) Status	0xxxx
02 (02H)	Read Input Status	1xxxx
03 (03H)	Read Holding Registers	4xxxx
04 (04H)	Read Input Registers	3xxxx
05 (05H)	Force Single Coil (Output)	0xxxx
06 (06H)	Preset Single Register	4xxxx
15 (0FH)	Force Multiple Coils (Outputs)	0xxxx
16 (10H)	Preset Multiple Registers	4xxxx
17 (11H)	Report Slave ID (See Below)	*Hidden*

MODBUS REGISTERS

If an unsupported function code is sent to a unit, 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. Refer to the Modbus specification for a complete list of possible error codes.

EtherStax ES2161/2162-x0x0 Report Slave ID Example Response[1]

FIELD	DESCRIPTION
Unit ID	Echo Unit ID Sent In Query
Function Code	11
Byte Count	43
Slave ID (Model No.)[1]	04=ES2161-x0x0 (all model variations) 05=ES2162-x0x0 (all model variations)
Run Indicator Status	FFH (ON)
Firmware Number String (Additional Data Field)[1]	41 43 52 4F 4D 41 47 2C 39 33 30 30 2D 31 37 36 41 2C 45 53 32 31 36 32 2D 78 78 78 78 ("ACROMAG,9300-176x,ES216-xxxx,*serial number&rev*,*six-byteMACID*")

[1]**Note:** ES2161 models share slave ID "04" and firmware number 9300-175. ES2162 models share ID "05" and firmware model 9300-176. The firmware number is also indicated on home page of the web browser.

For detailed information on Modbus, feel free to download our technical reference 8500-648, "Introduction to Modbus", at 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". Additional information regarding Ethernet can also be found in our whitepaper 8500-747, "Introduction to Ethernet/IP".*

Register Mirroring

For convenience, the EtherStax mirrors the contents/operation of registers 0xxxx, 1xxxx, & 3xxxx (as applicable) into holding register space for systems and controllers that cannot directly access registers these registers. All Modbus registers can be written to, or read from, using the standard methods described in the Modbus specification, or through mapping (mirroring) to the Holding Registers. Registers are mapped as follows:

0xxxx Coil Registers are mapped to 42xxx Holding Registers
1xxxx Input Status Registers are mapped to 41xxx Holding Registers
3xxxx Input Registers are mapped to 43xxx Holding Registers

For 3xxxx Input Registers, the format of the registers are identical and you only need to offset your address by 43000. For example: if you want to read Input Register 1 through the Holding Registers, you would use the "Read Holding Registers" function with an address of 43001.

For the 1xxxx Input Status Registers, the return data is reformatted to match the Holding Register format. For example: if you request the Input Status for 16 digital inputs, then instead of getting 2 bytes returned with 16 bits representing 16 digital inputs, you get 16 separate words, each set to either 0000H (OFF), or FFFFH (ON).

MODBUS REGISTERS

For the 0xxxx Coil Registers, reads are handled the same as the 1xxxx Input Status Registers. You can also write to coil registers by using the "Preset Single Register" function with an address offset of 42000. Setting the data to 0000H will turn the coil OFF, while setting the data to FF00H will turn the coil ON. Writing to multiple coils is not supported via register mirroring and you must use the "Write Multple Coils" function for that.

Data Types

Summary of Simple Data Types Used By EtherStax Models

Data Types and Description	
Discrete	A single bit of a 16-bit word with the bit number/position typically corresponding to a discrete channel number. Unless otherwise defined, a 1 bit means the corresponding output is closed or ON, or input is ON (active-low, near 0V). A 0 bit means the output is open or OFF, or the input is OFF or in its high state (usually >> 0V).
Analog Data (This Model)	A 16-bit signed integer with a possible range of -32768 to +32767. Analog input ranges of this model are normalized to ±30000, which represents ±100% of the pre-defined range with a resolution of 0.003%/lsb. For example, -100%, 0% and +100% are represented by decimal values –30000, 0, and 30000, respectively. A full possible range is –109% (-32768 decimal) to +109% (+32767 decimal). Thus, a 0-20mA input would be represented by a register count of 0-30000, and have a maximum value near ~21.8mA.
IEEE 754 (This Model)	This is a standard digital format used to represent real numbers on a computer. This unit uses single-precision, 32-bit, IEEE Standard 754 floating point number format for storage of normalized input data, scaled input data, and totalized input data. 32-bit data is stored in two successive 16-bit Modbus registers. For more information see web site at http://standards.ieee.org.
Temperature	A 16-bit signed integer value with resolution of 0.1°C/lsb. For example, a value of 12059 is equivalent to 1205.9°C, a value of –187 equals –18.7°C. The maximum possible temperature range is –3276.8°C to +3276.7°C.

Register Map

Model ES2161
Model ES2162

The following table outlines the register map for all model variations of the EtherStax ES2161 & ES2162 I/O processors. The Modbus functions operate on these registers using the data types noted above (except for the Reset Slave and Report Slave ID functions).

Not all programmable features of this device will include a corresponding Modbus configuration register. Some functionality must be programmed via the built-in web browser interface. For example, parameters related to network communications do not have a Modbus register and are programmed solely through the built-in web interface.

Ref	Addr.	Description	Data Type/Format
Input Registers (3x References, Read-Only)			
Unit Status Register 30001			
30001	0000	Unit Status *Check for fiber-optic option, wink mode, or default mode.*	Bit 15: **Fiber Optic Flag** 1 = Fiber Optic Transceiver Installed 0 = No Fiber (Dual Copper Ports). Bit 14: **Wink Mode** Flag 1 = Wink (Blinks Run LED for ID) (See Wink Unit Register) Bit 13: **Default Mode** Flag 1 = Default Mode Indication 0 = Unit not in Default Mode Bits 12-0: 0 (Not Used)
Channel Status Registers 30002-30033			
30002	0001	CH 00 Status *(Over/Under-range, Input Range)*	Bit 15-4: 0 (Not Used) Bit 3: Over-Range Flag Bit 2: Under-Range Flag b1 b0 | ES2161 | ES2162 0 0 | ±20mA | ±5V DC 0 1 | 0-20mA | ±10 VDC 1 0 | 4-20mA | (Not Used) 1 0 | (Not Used) | (Not Used)
30003	0002	CH 01 Status	See Channel 00 Status
30004	0003	CH 02 Status	See Channel 00 Status
30005	0004	CH 03 Status	See Channel 00 Status
30006	0005	CH 04 Status	See Channel 00 Status
30007	0006	CH 05 Status	See Channel 00 Status
30008	0007	CH 06 Status	See Channel 00 Status
30009	0008	CH 07 Status	See Channel 00 Status
30010	0009	CH 08 Status	See Channel 00 Status
30011	000A	CH 09 Status	See Channel 00 Status
30012	000B	CH 10 Status	See Channel 00 Status
30013	000C	CH 11 Status	See Channel 00 Status
30014	000D	CH 12 Status	See Channel 00 Status
30015	000E	CH 13 Status	See Channel 00 Status
30016	000F	CH 14 Status	See Channel 00 Status
30017	0010	CH 15 Status	See Channel 00 Status
30018	0011	CH 16 Status	See Channel 00 Status
30019	0012	CH 17 Status	See Channel 00 Status
30020	0013	CH 18 Status	See Channel 00 Status
30021	0014	CH 19 Status	See Channel 00 Status

Register Map

Model ES2161
Model ES2162

Ref	Addr.	Description	Data Type/Format
Input Registers (3x References, Read-Only)			
Channel Status Registers 30002-30033			
30022	0015	CH 20 Status	See Channel 00 Status
30023	0016	CH 21 Status	See Channel 00 Status
30024	0017	CH 22 Status	See Channel 00 Status
30025	0018	CH 23 Status	See Channel 00 Status
30026	0019	CH 24 Status	See Channel 00 Status
30027	001A	CH 25 Status	See Channel 00 Status
30028	001B	CH 26 Status	See Channel 00 Status
30029	001C	CH 27 Status	See Channel 00 Status
30030	001D	CH 28 Status	See Channel 00 Status
30031	001E	CH 29 Status	See Channel 00 Status
30032	001F	CH 30 Status	See Channel 00 Status
30033	0020	CH 31 Status	See Channel 00 Status
Normalized Channel Data Registers			
30034	0021	CH 00 Data	16-bit Signed Integer Data
30035	0022	CH 01 Data	16-bit Signed Integer Data
30036	0023	CH 02 Data	16-bit Signed Integer Data
30037	0024	CH 03 Data	16-bit Signed Integer Data
30038	0025	CH 04 Data	16-bit Signed Integer Data
30039	0026	CH 05 Data	16-bit Signed Integer Data
30040	0027	CH 06 Data	16-bit Signed Integer Data
30041	0028	CH 07 Data	16-bit Signed Integer Data
30042	0029	CH 08 Data	16-bit Signed Integer Data
30043	002A	CH 09 Data	16-bit Signed Integer Data
30044	002B	CH 10 Data	16-bit Signed Integer Data
30045	002C	CH 11 Data	16-bit Signed Integer Data
30046	002D	CH 12 Data	16-bit Signed Integer Data
30047	002E	CH 13 Data	16-bit Signed Integer Data
30048	002F	CH 14 Data	16-bit Signed Integer Data
30049	0030	CH 15 Data	16-bit Signed Integer Data
30050	0031	CH 16 Data	16-bit Signed Integer Data
30051	0032	CH 17 Data	16-bit Signed Integer Data
30052	0033	CH 18 Data	16-bit Signed Integer Data
30053	0034	CH 19 Data	16-bit Signed Integer Data
30054	0035	CH 20 Data	16-bit Signed Integer Data
30055	0036	CH 21 Data	16-bit Signed Integer Data
30056	0037	CH 22 Data	16-bit Signed Integer Data
30057	0038	CH 23 Data	16-bit Signed Integer Data
30058	0039	CH 24 Data	16-bit Signed Integer Data
30059	003A	CH 25 Data	16-bit Signed Integer Data
30060	003B	CH 26 Data	16-bit Signed Integer Data
30061	003C	CH 27 Data	16-bit Signed Integer Data
30062	003D	CH 28 Data	16-bit Signed Integer Data
30063	003E	CH 29 Data	16-bit Signed Integer Data
30064	003F	CH 30 Data	16-bit Signed Integer Data
30065	0040	CH 31 Data	16-bit Signed Integer Data

The 16-bit Signed Integer Data stored here refers to the input range A/D count, but after normalizing it to ±30000 for ±100% of the selected input range.

Register Map

Model ES2161
Model ES2162

Ref	Addr.	Description	Data Type/Format
Input Registers (3x References, Read-Only)			
Scaled Channel Low/High Data Words, 32-bit IEEE-754 Floating Point			
30066	0041	CH 00 Data LO	IEEE-754 Floating Point LO Bytes
30067	0042	CH 00 Data HI	IEEE-754 Floating Point HI Bytes
30068	0043	CH 01 Data LO	IEEE-754 Floating Point LO Bytes
30069	0044	CH 01 Data HI	IEEE-754 Floating Point HI Bytes
30070	0045	CH 02 Data LO	IEEE-754 Floating Point LO Bytes
30071	0046	CH 02 Data HI	IEEE-754 Floating Point HI Bytes
30072	0047	CH 03 Data LO	IEEE-754 Floating Point LO Bytes
30073	0048	CH 03 Data HI	IEEE-754 Floating Point HI Bytes
30074	0049	CH 04 Data LO	IEEE-754 Floating Point LO Bytes
30075	004A	CH 04 Data HI	IEEE-754 Floating Point HI Bytes
30076	004B	CH 05 Data LO	IEEE-754 Floating Point LO Bytes
30077	004C	CH 05 Data HI	IEEE-754 Floating Point HI Bytes
30078	004D	CH 06 Data LO	IEEE-754 Floating Point LO Bytes
30079	004E	CH 06 Data HI	IEEE-754 Floating Point HI Bytes
30080	004F	CH 07 Data LO	IEEE-754 Floating Point LO Bytes
30081	0050	CH 07 Data HI	IEEE-754 Floating Point HI Bytes
30082	0051	CH 08 Data LO	IEEE-754 Floating Point LO Bytes
30083	0052	CH 08 Data HI	IEEE-754 Floating Point HI Bytes
30084	0053	CH 09 Data LO	IEEE-754 Floating Point LO Bytes
30085	0054	CH 09 Data HI	IEEE-754 Floating Point HI Bytes
30086	0055	CH 10 Data LO	IEEE-754 Floating Point LO Bytes
30087	0056	CH 10 Data HI	IEEE-754 Floating Point HI Bytes
30088	0057	CH 11 Data LO	IEEE-754 Floating Point LO Bytes
30089	0058	CH 11 Data HI	IEEE-754 Floating Point HI Bytes
30090	0059	CH 12 Data LO	IEEE-754 Floating Point LO Bytes
30091	005A	CH 12 Data HI	IEEE-754 Floating Point HI Bytes
30092	005B	CH 13 Data LO	IEEE-754 Floating Point LO Bytes
30093	005C	CH 13 Data HI	IEEE-754 Floating Point HI Bytes
30094	005D	CH 14 Data LO	IEEE-754 Floating Point LO Bytes
30095	005E	CH 14 Data HI	IEEE-754 Floating Point HI Bytes
30096	005F	CH 15 Data LO	IEEE-754 Floating Point LO Bytes
30097	0060	CH 15 Data HI	IEEE-754 Floating Point HI Bytes
30098	0061	CH 16 Data LO	IEEE-754 Floating Point LO Bytes
30099	0062	CH 16 Data HI	IEEE-754 Floating Point HI Bytes
30100	0063	CH 17 Data LO	IEEE-754 Floating Point LO Bytes
30101	0064	CH 17 Data HI	IEEE-754 Floating Point HI Bytes
30102	0065	CH 18 Data LO	IEEE-754 Floating Point LO Bytes
30103	0066	CH 18 Data HI	IEEE-754 Floating Point HI Bytes
30104	0067	CH 19 Data LO	IEEE-754 Floating Point LO Bytes
30105	0068	CH 19 Data HI	IEEE-754 Floating Point HI Bytes
30106	0069	CH 20 Data LO	IEEE-754 Floating Point LO Bytes
30107	006A	CH 20 Data HI	IEEE-754 Floating Point HI Bytes
30108	006B	CH 21 Data LO	IEEE-754 Floating Point LO Bytes
30109	006C	CH 21 Data HI	IEEE-754 Floating Point HI Bytes
30110	006D	CH 22 Data LO	IEEE-754 Floating Point LO Bytes
30111	006E	CH 22 Data HI	IEEE-754 Floating Point HI Bytes

Register Map

Model ES2161
Model ES2162

Ref	Addr.	Description	Data Type/Format
Input Registers (3x References, Read-Only)			
Scaled Channel Low/High Data Words, 32-bit IEEE-754 Floating Point			
30112	006F	CH 23 Data LO	IEEE-754 Floating Point LO Bytes
30113	0070	CH 23 Data HI	IEEE-754 Floating Point HI Bytes
30114	0071	CH 24 Data LO	IEEE-754 Floating Point LO Bytes
30115	0072	CH 24 Data HI	IEEE-754 Floating Point HI Bytes
30116	0073	CH 25 Data LO	IEEE-754 Floating Point LO Bytes
30117	0074	CH 25 Data HI	IEEE-754 Floating Point HI Bytes
30118	0075	CH 26 Data LO	IEEE-754 Floating Point LO Bytes
30119	0076	CH 26 Data HI	IEEE-754 Floating Point HI Bytes
30120	0077	CH 27 Data LO	IEEE-754 Floating Point LO Bytes
30121	0078	CH 27 Data HI	IEEE-754 Floating Point HI Bytes
30122	0079	CH 28 Data LO	IEEE-754 Floating Point LO Bytes
30123	007A	CH 28 Data HI	IEEE-754 Floating Point HI Bytes
30124	007B	CH 29 Data LO	IEEE-754 Floating Point LO Bytes
30125	007C	CH 29 Data HI	IEEE-754 Floating Point HI Bytes
30126	007D	CH 30 Data LO	IEEE-754 Floating Point LO Bytes
30127	007E	CH 30 Data HI	IEEE-754 Floating Point HI Bytes
30128	007F	CH 31 Data LO	IEEE-754 Floating Point LO Bytes
30129	0080	CH 31 Data HI	IEEE-754 Floating Point HI Bytes
Totalized Chan Low/High Data Words, 32-bit IEEE-754 Floating Point			
30130	0081	CH00 Data LO	IEEE-754 Floating Point LO Bytes
30131	0082	CH00 Data HI	IEEE-754 Floating Point HI Bytes
30132	0083	CH01 Data LO	IEEE-754 Floating Point LO Bytes
30133	0084	CH01 Data HI	IEEE-754 Floating Point HI Bytes
30134	0085	CH02 Data LO	IEEE-754 Floating Point LO Bytes
30135	0086	CH02 Data HI	IEEE-754 Floating Point HI Bytes
30136	0087	CH03 Data LO	IEEE-754 Floating Point LO Bytes
30137	0088	CH03 Data HI	IEEE-754 Floating Point HI Bytes
30138	0089	CH04 Data LO	IEEE-754 Floating Point LO Bytes
30139	008A	CH04 Data HI	IEEE-754 Floating Point HI Bytes
30140	008B	CH05 Data LO	IEEE-754 Floating Point LO Bytes
30141	008C	CH05 Data HI	IEEE-754 Floating Point HI Bytes
30142	008D	CH06 Data LO	IEEE-754 Floating Point LO Bytes
30143	008E	CH06 Data HI	IEEE-754 Floating Point HI Bytes
30144	008F	CH07 Data LO	IEEE-754 Floating Point LO Bytes
30145	0090	CH07 Data HI	IEEE-754 Floating Point HI Bytes
30146	0091	CH08 Data LO	IEEE-754 Floating Point LO Bytes
30147	0092	CH08 Data HI	IEEE-754 Floating Point HI Bytes
30148	0093	CH09 Data LO	IEEE-754 Floating Point LO Bytes
30149	0094	CH09 Data HI	IEEE-754 Floating Point HI Bytes
30150	0095	CH10 Data LO	IEEE-754 Floating Point LO Bytes
30151	0096	CH10 Data HI	IEEE-754 Floating Point HI Bytes
30152	0097	CH11 Data LO	IEEE-754 Floating Point LO Bytes
30153	0098	CH11 Data HI	IEEE-754 Floating Point HI Bytes
30154	0099	CH12 Data LO	IEEE-754 Floating Point LO Bytes
30155	009A	CH12 Data HI	IEEE-754 Floating Point HI Bytes

Register Map

Model ES2161
Model ES2162

Ref	Addr.	Description	Data Type/Format
Input Registers (3x References, Read-Only)			
Totalized Chan Low/High Data Words, 32-bit IEEE-754 Floating Point			
30156	009B	CH13 Data LO	IEEE-754 Floating Point LO Bytes
30157	009C	CH13 Data HI	IEEE-754 Floating Point HI Bytes
30158	009D	CH14 Data LO	IEEE-754 Floating Point LO Bytes
30159	009E	CH14 Data HI	IEEE-754 Floating Point HI Bytes
30160	009F	CH15 Data LO	IEEE-754 Floating Point LO Bytes
30161	00A0	CH15 Data HI	IEEE-754 Floating Point HI Bytes
30162	00A1	CH16 Data LO	IEEE-754 Floating Point LO Bytes
30163	00A2	CH16 Data HI	IEEE-754 Floating Point HI Bytes
30164	00A3	CH17 Data LO	IEEE-754 Floating Point LO Bytes
30165	00A4	CH17 Data HI	IEEE-754 Floating Point HI Bytes
30166	00A5	CH18 Data LO	IEEE-754 Floating Point LO Bytes
30167	00A6	CH18 Data HI	IEEE-754 Floating Point HI Bytes
30168	00A7	CH19 Data LO	IEEE-754 Floating Point LO Bytes
30169	00A8	CH19 Data HI	IEEE-754 Floating Point HI Bytes
30170	00A9	CH20 Data LO	IEEE-754 Floating Point LO Bytes
30171	00AA	CH20 Data HI	IEEE-754 Floating Point HI Bytes
30172	00AB	CH21 Data LO	IEEE-754 Floating Point LO Bytes
30173	00AC	CH21 Data HI	IEEE-754 Floating Point HI Bytes
30174	00AD	CH22 Data LO	IEEE-754 Floating Point LO Bytes
30175	00AE	CH22 Data HI	IEEE-754 Floating Point HI Bytes
30176	00AF	CH23 Data LO	IEEE-754 Floating Point LO Bytes
30177	00B0	CH23 Data HI	IEEE-754 Floating Point HI Bytes
30178	00B1	CH24 Data LO	IEEE-754 Floating Point LO Bytes
30179	00B2	CH24 Data HI	IEEE-754 Floating Point HI Bytes
30180	00B3	CH25 Data LO	IEEE-754 Floating Point LO Bytes
30181	00B4	CH25 Data HI	IEEE-754 Floating Point HI Bytes
30182	00B5	CH26 Data LO	IEEE-754 Floating Point LO Bytes
30183	00B6	CH26 Data HI	IEEE-754 Floating Point HI Bytes
30184	00B7	CH27 Data LO	IEEE-754 Floating Point LO Bytes
30185	00B8	CH27 Data HI	IEEE-754 Floating Point HI Bytes
30186	00B9	CH28 Data LO	IEEE-754 Floating Point LO Bytes
30187	00BA	CH28 Data HI	IEEE-754 Floating Point HI Bytes
30188	00BB	CH29 Data LO	IEEE-754 Floating Point LO Bytes
30189	00BC	CH29 Data HI	IEEE-754 Floating Point HI Bytes
30190	00BD	CH30 Data LO	IEEE-754 Floating Point LO Bytes
30191	00BE	CH30 Data HI	IEEE-754 Floating Point HI Bytes
30192	00BF	CH31 Data LO	IEEE-754 Floating Point LO Bytes
30193	00C0	CH31 Data HI	IEEE-754 Floating Point HI Bytes

Ref	Addr.	Description	Data Type/Format
Holding Registers (4x References, Read/Write)			
Channel Configuration Registers 40001-40032			
40001	0 (0000)	Channel 00 Configuration *(Default is 0019H, see shading)* *Note: Before setting bit 12, be sure to first calibrate the channel before using its calibration to also calibrate its entire port.*	Bit 15: 0 (Not Used) Bit 14: 0=Calibration use AZ/AS 1=Use Manual Calibration Bit 13: 0 (Not Used) Bit 12: 0=Do NOT use this CH Calibration for this port. *(see Note)* 1=Use this CH Cal for Calibrating this port. Bit 11: 0 (Not Used) Bit 10: DB25 Interface Active? 0=Inactive (No uB or 8B) 1=Active (Conn uB or 8B) Bit 9: 0 (Not Used) Bit 8: Totalizer Initial Value 0=Use Preload Value 1=Use Last Value Bit 7: Totalizer Action 0=Rollover 1=Latch Bit 6: Totalizer OFF/ON 0=OFF 1=ON Bit 5: 0 (Not Used) Bits 4,3: Totalizer Time Base 00 Per Second 01 Per Minute 10 Per Hour 11 No Action Bit 2: 0 (Not Used) Bits 1,0: Input Range Selection. ES2161 / ES2162 00 0=±20mA / 0=±5V 01 1=0-20mA / 1=±10V 10 2=4-20mA / *Reserved* 11 *Reserved* / *Reserved*
40002	0001	CH01 Config	*See explanation for channel 00 above.*
40003	0002	CH02 Config	*See explanation for channel 00 above.*
40004	0003	CH03 Config	*See explanation for channel 00 above.*
40005	0004	CH04 Config	*See explanation for channel 00 above.*
40006	0005	CH05 Config	*See explanation for channel 00 above.*
40007	0006	CH06 Config	*See explanation for channel 00 above.*
40008	0007	CH07 Config	*See explanation for channel 00 above.*
40009	0008	CH08 Config	*See explanation for channel 00 above.*
40010	0009	CH09 Config	*See explanation for channel 00 above.*
40011	000A	CH10 Config	*See explanation for channel 00 above.*
40012	000B	CH11 Config	*See explanation for channel 00 above.*
40013	000C	CH12 Config	*See explanation for channel 00 above.*
40014	000D	CH13 Config	*See explanation for channel 00 above.*
40015	000E	CH14 Config	*See explanation for channel 00 above.*

Register Map

Model ES2161
Model ES2162

Totalized inputs are sampled every 20ms (no averaging), or 40ms (with input averaging). Your input signal per time base is multiplied by 20ms per sample to get your incremental increase or decrease of volume that is added to your totalized value. The max totalized value possible is 9,999,999 (7 significant digits).

Note: *You must separately enable floating point if you enable the totalizer here (see Floating Point Enable register).*

IMPORTANT: *If you set bit 12 to use this channel's calibration for the entire port, note that the channel must already be manually calibrated for this to work properly.*

Register Map

Model ES2161
Model ES2162

Note: *You MUST enable floating point in order to scale, integrate, and totalize. Turn it off if you do not need to rescale, integrate, or totalize inputs, as it will help to increase network determinism.*

Scan Group Channels:
Group 1=CH0,8,16,24;
Group 2=CH1,9,17,25;
Group 3=CH2,10,18,26;
Group 4=CH3,11,19,27;
Group 5=CH4,12,20,28;
Group 6=CH5,13,21,29;
Group 7=CH6,14,22,30;
Group 8=CH7,15,23,31.

Ref	Addr.	Description	Data Type/Format
Holding Registers (4x References, Read/Write)			
Channel Configuration Registers 40001-40032			
40016	000F	CH15 Config	*See explanation for channel 00 above.*
40017	0010	CH16 Config	*See explanation for channel 00 above.*
40018	0011	CH17 Config	*See explanation for channel 00 above.*
40019	0012	CH18 Config	*See explanation for channel 00 above.*
40020	0013	CH19 Config	*See explanation for channel 00 above.*
40021	0014	CH20 Config	*See explanation for channel 00 above.*
40022	0015	CH21 Config	*See explanation for channel 00 above.*
40023	0016	CH22 Config	*See explanation for channel 00 above.*
40024	0017	CH23 Config	*See explanation for channel 00 above.*
40025	0018	CH24 Config	*See explanation for channel 00 above.*
40026	0019	CH25 Config	*See explanation for channel 00 above.*
40027	001A	CH26 Config	*See explanation for channel 00 above.*
40028	001B	CH27 Config	*See explanation for channel 00 above.*
40029	001C	CH28 Config	*See explanation for channel 00 above.*
40030	001D	CH29 Config	*See explanation for channel 00 above.*
40031	001E	CH30 Config	*See explanation for channel 00 above.*
40032	001F	CH31 Config	*See explanation for channel 00 above.*
Miscellaneous Unit Configuration Registers 40033-40037			
40033	32 (0020)	Global Floating Point Enable and Byte Order ***(Def = 0000H, disabled)***	Bit 15: 0=OFF 1=ON Bits 14..2 0 (Not Used) Bits 1,0: Data Word Byte Order 00 b3 b2 b1 b0 01 b0 b1 b2 b3 10 b1 b0 b3 b2 11 b2 b3 b0 b1
40034	33 (0021)	Local Relay Failsafe/ Non-Failsafe Selection ***(Def=0000H, Alarm using failsafe relay)***	Bits 15-1: 0 (Not Used) Bit 0: 0=Failsafe 1=Non-Failsafe Relay contacts are used to signal a media failure (link loss), but can also signal a power loss if the relay is set to failsafe.
40035	34 (0022)	Enable Scan Groups ***(Def = 00FFH, all groups enabled)***	Bits 15-8: 0 (Not Used) Bit 7: 0=Disable1=Enable Grp 8 Bit 6: 0=Disable1=Enable Grp 7 Bit 5: 0=Disable1=Enable Grp 6 Bit 4: 0=Disable1=Enable Grp 5 Bit 3: 0=Disable1=Enable Grp 4 Bit 2: 0=Disable1=Enable Grp 3 Bit 1: 0=Disable1=Enable Grp 2 Bit 0: 0=Disable1=Enable Grp 1
40036	35	Input Averaging ***(Def = 0000H, No Averaging)***	Set to 0 or 1 for No Averaging. Set to an integer greater than 1 to specify the number of samples to average (500 samples maximum).

Register Map

Model ES2161
Model ES2162

Ref	Addr.	Description	Data Type/Format
Holding Registers (4x References, Read/Write)			
Miscellaneous Unit Configuration Registers 40033-40037			
40037	36 (0024)	Wink Toggle & Cal Access & Restore Cal & Restore Scaling & System Reset Register	Write **21845 (5555H)** here to cause the unit to "wink" its green Run LED in order to ID the unit. Write the same value a second time to stop "winking". Use the Unit Status Register wink mode flag to determine the wink state. Write **24106 (5E2AH)** to remove write protection from the calibration registers that follow (registers 40233-40236). All other values apply write-protection to the calibration registers. Write **44718 (AEAEH)** to restore the default calibration coefficients. Write **60138 (EAEAH)** to restore the default scaling values. Write **41429 (A1D5H)** to this register to cause a system reset and reboot.
Use Wink to help identify network units. Cal Access allows manual calibration of unit. Reset drives a system reset (there is also a RST switch on the unit). *This register will always read back as 0000H.*			
Channel Calibration Value Registers 40038-40231			
40038	0025	*Reserved*	*Reserved – Do Not Use*
40039	0026	CH00 ±5V Cal HI	16-bit Signed Integer, ±5V Cal HI
40040	0027	CH00 ±5V Cal LO	16-bit Signed Integer, ±5V Cal LO
40041	0028	CH00 ±10V Cal HI	16-bit Signed Integer, ±10V Cal HI
40042	0029	CH00 ±10V Cal LO	16-bit Signed Integer, ±10V Cal HI
40043	002A	*Reserved*	*Reserved – Do Not Use*
40044	002B	*Reserved*	*Reserved – Do Not Use*
40045	002C	CH01 ±5V Cal HI	16-bit Signed Integer, ±5V Cal HI
40046	002D	CH01 ±5V Cal LO	16-bit Signed Integer, ±5V Cal LO
40047	002E	CH01 ±10V Cal HI	16-bit Signed Integer, ±10V Cal HI
40048	002F	CH01 ±10V Cal LO	16-bit Signed Integer, ±10V Cal HI
40049	0030	*Reserved*	*Reserved – Do Not Use*
40050	0031	*Reserved*	*Reserved – Do Not Use*
40051	0032	CH02 ±5V Cal HI	16-bit Signed Integer, ±5V Cal HI
40052	0033	CH02 ±5V Cal LO	16-bit Signed Integer, ±5V Cal LO
40053	0034	CH02 ±10V Cal HI	16-bit Signed Integer, ±10V Cal HI
40054	0035	CH02 ±10V Cal LO	16-bit Signed Integer, ±10V Cal HI
40055	0036	*Reserved*	*Reserved – Do Not Use*
40056	0037	*Reserved*	*Reserved – Do Not Use*
40057	0038	CH03 ±5V Cal HI	16-bit Signed Integer, ±5V Cal HI
40058	0039	CH03 ±5V Cal LO	16-bit Signed Integer, ±5V Cal LO
40059	003A	CH03 ±10V Cal HI	16-bit Signed Integer, ±10V Cal HI
40060	003B	CH03 ±10V Cal LO	16-bit Signed Integer, ±10V Cal HI
40061	003C	*Reserved*	*Reserved – Do Not Use*
40062	003D	*Reserved*	*Reserved – Do Not Use*

Shaded registers from 40038 to 40229 are write-restricted and reserved for internal firmware and factory use (these registers are modified indirectly by the calibration registers 40233-40236). Do not attempt to directly modify the contents of these registers.

Register Map

Model ES2161
Model ES2162

Shaded registers from 40038 to 40229 are write-restricted and reserved for internal firmware and factory use (these registers are modified indirectly by the calibration registers 40233-40236). Do not attempt to directly modify the contents of these registers.

Ref	Addr.	Description	Data Type/Format
Holding Registers (4x References, Read/Write)			
Channel Calibration Value Registers 40038-40231			
40063	003E	CH04 ±5V Cal HI	16-bit Signed Integer, ±5V Cal HI
40064	003F	CH04 ±5V Cal LO	16-bit Signed Integer, ±5V Cal LO
40065	0040	CH04 ±10V Cal HI	16-bit Signed Integer, ±10V Cal HI
40066	0041	CH04 ±10V Cal LO	16-bit Signed Integer, ±10V Cal HI
40067	0042	*Reserved*	*Reserved – Do Not Use*
40068	0043	*Reserved*	*Reserved – Do Not Use*
40069	0044	CH05 ±5V Cal HI	16-bit Signed Integer, ±5V Cal HI
40070	0045	CH05 ±5V Cal LO	16-bit Signed Integer, ±5V Cal LO
40071	0046	CH05 ±10V Cal HI	16-bit Signed Integer, ±10V Cal HI
40072	0047	CH05 ±10V Cal LO	16-bit Signed Integer, ±10V Cal HI
40073	0048	*Reserved*	*Reserved – Do Not Use*
40074	0049	*Reserved*	*Reserved – Do Not Use*
40075	004A	CH06 ±5V Cal HI	16-bit Signed Integer, ±5V Cal HI
40076	004B	CH06 ±5V Cal LO	16-bit Signed Integer, ±5V Cal LO
40077	004C	CH06 ±10V Cal HI	16-bit Signed Integer, ±10V Cal HI
40078	004D	CH06 ±10V Cal LO	16-bit Signed Integer, ±10V Cal HI
40079	004E	*Reserved*	*Reserved – Do Not Use*
40080	004F	*Reserved*	*Reserved – Do Not Use*
40081	0050	CH07 ±5V Cal HI	16-bit Signed Integer, ±5V Cal HI
40082	0051	CH07 ±5V Cal LO	16-bit Signed Integer, ±5V Cal LO
40083	0052	CH07 ±10V Cal HI	16-bit Signed Integer, ±10V Cal HI
40084	0053	CH07 ±10V Cal LO	16-bit Signed Integer, ±10V Cal HI
40085	0054	*Reserved*	*Reserved – Do Not Use*
40086	0055	*Reserved*	*Reserved – Do Not Use*
40087	0056	CH08 ±5V Cal HI	16-bit Signed Integer, ±5V Cal HI
40088	0057	CH08 ±5V Cal LO	16-bit Signed Integer, ±5V Cal LO
40089	0058	CH08 ±10V Cal HI	16-bit Signed Integer, ±10V Cal HI
40090	0059	CH08 ±10V Cal LO	16-bit Signed Integer, ±10V Cal HI
40091	005A	*Reserved*	*Reserved – Do Not Use*
40092	005B	*Reserved*	*Reserved – Do Not Use*
40093	005C	CH09 ±5V Cal HI	16-bit Signed Integer, ±5V Cal HI
40094	005D	CH09 ±5V Cal LO	16-bit Signed Integer, ±5V Cal LO
40095	005E	CH09 ±10V Cal HI	16-bit Signed Integer, ±10V Cal HI
40096	005F	CH09 ±10V Cal LO	16-bit Signed Integer, ±10V Cal HI
40097	0060	*Reserved*	*Reserved – Do Not Use*
40098	0061	*Reserved*	*Reserved – Do Not Use*
40099	0062	CH10 ±5V Cal HI	16-bit Signed Integer, ±5V Cal HI
40100	0063	CH10 ±5V Cal LO	16-bit Signed Integer, ±5V Cal LO
40101	0064	CH10 ±10V Cal HI	16-bit Signed Integer, ±10V Cal HI
40102	0065	CH10 ±10V Cal LO	16-bit Signed Integer, ±10V Cal HI
40103	0066	*Reserved*	*Reserved – Do Not Use*
40104	0067	*Reserved*	*Reserved – Do Not Use*
40105	0068	CH11 ±5V Cal HI	16-bit Signed Integer, ±5V Cal HI
40106	0069	CH11 ±5V Cal LO	16-bit Signed Integer, ±5V Cal LO
40107	006A	CH11 ±10V Cal HI	16-bit Signed Integer, ±10V Cal HI
40108	006B	CH11 ±10V Cal LO	16-bit Signed Integer, ±10V Cal HI
40109	006C	*Reserved*	*Reserved – Do Not Use*

Ref	Addr.	Description	Data Type/Format
Holding Registers (4x References, Read/Write)			
Channel Calibration Value Registers 40038-40231			
40110	006D	*Reserved*	*Reserved – Do Not Use*
40111	006E	CH12 ±5V Cal HI	16-bit Signed Integer, ±5V Cal HI
40112	006F	CH12 ±5V Cal LO	16-bit Signed Integer, ±5V Cal LO
40113	0070	CH12 ±10V Cal HI	16-bit Signed Integer, ±10V Cal HI
40114	0071	CH12 ±10V Cal LO	16-bit Signed Integer, ±10V Cal HI
40115	0072	*Reserved*	*Reserved – Do Not Use*
40116	0073	*Reserved*	*Reserved – Do Not Use*
40117	0074	CH13 ±5V Cal HI	16-bit Signed Integer, ±5V Cal HI
40118	0075	CH13 ±5V Cal LO	16-bit Signed Integer, ±5V Cal LO
40119	0076	CH13 ±10V Cal HI	16-bit Signed Integer, ±10V Cal HI
40120	0077	CH13 ±10V Cal LO	16-bit Signed Integer, ±10V Cal HI
40121	0078	*Reserved*	*Reserved – Do Not Use*
40122	0079	*Reserved*	*Reserved – Do Not Use*
40123	007A	CH14 ±5V Cal HI	16-bit Signed Integer, ±5V Cal HI
40124	007B	CH14 ±5V Cal LO	16-bit Signed Integer, ±5V Cal LO
40125	007C	CH14 ±10V Cal HI	16-bit Signed Integer, ±10V Cal HI
40126	007D	CH14 ±10V Cal LO	16-bit Signed Integer, ±10V Cal HI
40127	007E	*Reserved*	*Reserved – Do Not Use*
40128	007F	*Reserved*	*Reserved – Do Not Use*
40129	0080	CH15 ±5V Cal HI	16-bit Signed Integer, ±5V Cal HI
40130	0081	CH15 ±5V Cal LO	16-bit Signed Integer, ±5V Cal LO
40131	0082	CH15 ±10V Cal HI	16-bit Signed Integer, ±10V Cal HI
40132	0083	CH15 ±10V Cal LO	16-bit Signed Integer, ±10V Cal HI
40133	0084	*Reserved*	*Reserved – Do Not Use*
40134	0085	*Reserved*	*Reserved – Do Not Use*
40135	0086	CH16 ±5V Cal HI	16-bit Signed Integer, ±5V Cal HI
40136	0087	CH16 ±5V Cal LO	16-bit Signed Integer, ±5V Cal LO
40137	0088	CH16 ±10V Cal HI	16-bit Signed Integer, ±10V Cal HI
40138	0089	CH16 ±10V Cal LO	16-bit Signed Integer, ±10V Cal HI
40139	008A	*Reserved*	*Reserved – Do Not Use*
40140	008B	*Reserved*	*Reserved – Do Not Use*
40141	008C	CH17 ±5V Cal HI	16-bit Signed Integer, ±5V Cal HI
40142	008D	CH17 ±5V Cal LO	16-bit Signed Integer, ±5V Cal LO
40143	008E	CH17 ±10V Cal HI	16-bit Signed Integer, ±10V Cal HI
40144	008F	CH17 ±10V Cal LO	16-bit Signed Integer, ±10V Cal HI
40145	0090	*Reserved*	*Reserved – Do Not Use*
40146	0091	*Reserved*	*Reserved – Do Not Use*
40147	0092	CH18 ±5V Cal HI	16-bit Signed Integer, ±5V Cal HI
40148	0093	CH18 ±5V Cal LO	16-bit Signed Integer, ±5V Cal LO
40149	0094	CH18 ±10V Cal HI	16-bit Signed Integer, ±10V Cal HI
40150	0095	CH18 ±10V Cal LO	16-bit Signed Integer, ±10V Cal HI
40151	0096	*Reserved*	*Reserved – Do Not Use*
40152	0097	*Reserved*	*Reserved – Do Not Use*
40153	0098	CH19 ±5V Cal HI	16-bit Signed Integer, ±5V Cal HI
40154	0099	CH19 ±5V Cal LO	16-bit Signed Integer, ±5V Cal LO
40155	009A	CH19 ±10V Cal HI	16-bit Signed Integer, ±10V Cal HI
40156	009B	CH19 ±10V Cal LO	16-bit Signed Integer, ±10V Cal HI

Register Map

Model ES2161
Model ES2162

Shaded registers from 40038 to 40229 are write-restricted and reserved for internal firmware and factory use (these registers are modified indirectly by the calibration registers 40233-40236). Do not attempt to directly modify the contents of these registers.

Register Map

Model ES2161
Model ES2162

Shaded registers from 40038 to 40229 are write-restricted and reserved for internal firmware and factory use (these registers are modified indirectly by the calibration registers 40233-40236). Do not attempt to directly modify the contents of these registers.

Ref	Addr.	Description	Data Type/Format
Holding Registers (4x References, Read/Write)			
Channel Calibration Value Registers 40038-40231			
40157	009C	*Reserved*	*Reserved – Do Not Use*
40158	009D	*Reserved*	*Reserved – Do Not Use*
40159	009E	CH20 ±5V Cal HI	16-bit Signed Integer, ±5V Cal HI
40160	009F	CH20 ±5V Cal LO	16-bit Signed Integer, ±5V Cal LO
40161	00A0	CH20 ±10V Cal HI	16-bit Signed Integer, ±10V Cal HI
40162	00A1	CH20 ±10V Cal LO	16-bit Signed Integer, ±10V Cal HI
40163	00A2	*Reserved*	*Reserved – Do Not Use*
40164	00A3	*Reserved*	*Reserved – Do Not Use*
40165	00A4	CH21 ±5V Cal HI	16-bit Signed Integer, ±5V Cal HI
40166	00A5	CH21 ±5V Cal LO	16-bit Signed Integer, ±5V Cal LO
40167	00A6	CH21 ±10V Cal HI	16-bit Signed Integer, ±10V Cal HI
40168	00A7	CH21 ±10V Cal LO	16-bit Signed Integer, ±10V Cal HI
40169	00A8	*Reserved*	*Reserved – Do Not Use*
40170	00A9	*Reserved*	*Reserved – Do Not Use*
40171	00AA	CH22 ±5V Cal HI	16-bit Signed Integer, ±5V Cal HI
40172	00AB	CH22 ±5V Cal LO	16-bit Signed Integer, ±5V Cal LO
40173	00AC	CH22 ±10V Cal HI	16-bit Signed Integer, ±10V Cal HI
40174	00AD	CH22 ±10V Cal LO	16-bit Signed Integer, ±10V Cal HI
40175	00AE	*Reserved*	*Reserved – Do Not Use*
40176	00AF	*Reserved*	*Reserved – Do Not Use*
40177	00B0	CH23 ±5V Cal HI	16-bit Signed Integer, ±5V Cal HI
40178	00B1	CH23 ±5V Cal LO	16-bit Signed Integer, ±5V Cal LO
40179	00B2	CH23 ±10V Cal HI	16-bit Signed Integer, ±10V Cal HI
40180	00B3	CH23 ±10V Cal LO	16-bit Signed Integer, ±10V Cal HI
40181	00B4	*Reserved*	*Reserved – Do Not Use*
40182	00B5	*Reserved*	*Reserved – Do Not Use*
40183	00B6	CH24 ±5V Cal HI	16-bit Signed Integer, ±5V Cal HI
40184	00B7	CH24 ±5V Cal LO	16-bit Signed Integer, ±5V Cal LO
40185	00B8	CH24 ±10V Cal HI	16-bit Signed Integer, ±10V Cal HI
40186	00B9	CH24 ±10V Cal LO	16-bit Signed Integer, ±10V Cal HI
40187	00BA	*Reserved*	*Reserved – Do Not Use*
40188	00BB	*Reserved*	*Reserved – Do Not Use*
40189	00BC	CH25 ±5V Cal HI	16-bit Signed Integer, ±5V Cal HI
40190	00BD	CH25 ±5V Cal LO	16-bit Signed Integer, ±5V Cal LO
40191	00BE	CH25 ±10V Cal HI	16-bit Signed Integer, ±10V Cal HI
40192	00BF	CH25 ±10V Cal LO	16-bit Signed Integer, ±10V Cal HI
40193	00C0	*Reserved*	*Reserved – Do Not Use*
40194	00C1	*Reserved*	*Reserved – Do Not Use*
40195	00C2	CH26 ±5V Cal HI	16-bit Signed Integer, ±5V Cal HI
40196	00C3	CH26 ±5V Cal LO	16-bit Signed Integer, ±5V Cal LO
40197	00C4	CH26 ±10V Cal HI	16-bit Signed Integer, ±10V Cal HI
40198	00C5	CH26 ±10V Cal LO	16-bit Signed Integer, ±10V Cal HI
40199	00C6	*Reserved*	*Reserved – Do Not Use*
40200	00C7	*Reserved*	*Reserved – Do Not Use*
40201	00C8	CH27 ±5V Cal HI	16-bit Signed Integer, ±5V Cal HI
40202	00C9	CH27 ±5V Cal LO	16-bit Signed Integer, ±5V Cal LO

Ref	Addr.	Description	Data Type/Format
Holding Registers (4x References, Read/Write)			
Channel Calibration Value Registers 40038-40231			
40203	00CA	CH27 ±10V Cal HI	16-bit Signed Integer, ±10V Cal HI
40204	00CB	CH27 ±10V Cal LO	16-bit Signed Integer, ±10V Cal HI
40205	00CC	*Reserved*	*Reserved – Do Not Use*
40206	00CD	*Reserved*	*Reserved – Do Not Use*
40207	00CE	CH28 ±5V Cal HI	16-bit Signed Integer, ±5V Cal HI
40208	00CF	CH28 ±5V Cal LO	16-bit Signed Integer, ±5V Cal LO
40209	00D0	CH28 ±10V Cal HI	16-bit Signed Integer, ±10V Cal HI
40210	00D1	CH28 ±10V Cal LO	16-bit Signed Integer, ±10V Cal HI
40211	00D2	*Reserved*	*Reserved – Do Not Use*
40212	00D3	*Reserved*	*Reserved – Do Not Use*
40213	00D4	CH29 ±5V Cal HI	16-bit Signed Integer, ±5V Cal HI
40214	00D5	CH29 ±5V Cal LO	16-bit Signed Integer, ±5V Cal LO
40215	00D6	CH29 ±10V Cal HI	16-bit Signed Integer, ±10V Cal HI
40216	00D7	CH29 ±10V Cal LO	16-bit Signed Integer, ±10V Cal HI
40217	00D8	*Reserved*	*Reserved – Do Not Use*
40218	00D9	*Reserved*	*Reserved – Do Not Use*
40219	00DA	CH30 ±5V Cal HI	16-bit Signed Integer, ±5V Cal HI
40220	00DB	CH30 ±5V Cal LO	16-bit Signed Integer, ±5V Cal LO
40221	00DC	CH30 ±10V Cal HI	16-bit Signed Integer, ±10V Cal HI
40222	00DD	CH30 ±10V Cal LO	16-bit Signed Integer, ±10V Cal HI
40223	00DE	*Reserved*	*Reserved – Do Not Use*
40224	00DF	*Reserved*	*Reserved – Do Not Use*
40225	00E0	CH31 ±5V Cal HI	16-bit Signed Integer, ±5V Cal HI
40226	00E1	CH31 ±5V Cal LO	16-bit Signed Integer, ±5V Cal LO
40227	00E2	CH31 ±10V Cal HI	16-bit Signed Integer, ±10V Cal HI
40228	00E3	CH31 ±10V Cal LO	16-bit Signed Integer, ±10V Cal HI
40229	00E4	*Reserved*	*Reserved – Do Not Use*
40230	00E5	Reset Totalizer Trigger for Input Channels 15-0 Register always reads back as 0000H	Bit position corresponds to input channel number to reset totalizer at (lsb is lowest numbered channel). 1=Reset Totalizer 0=No Action
40231	00E6	Reset Totalizer Trigger for Input Channels 31-16 Register always reads back as 0000H	Bit position corresponds to input channel number to reset totalizer at (lsb is lowest numbered channel). 1=Reset Totalizer 0=No Action
40232	00E7	*Reserved*	*Reserved – Do Not Use*

Register Map

Model ES2161
Model ES2162

Shaded registers from 40038 to 40229 are write-restricted and reserved for internal firmware and factory use (these registers are modified indirectly by the calibration registers 40233-40236). Do not attempt to directly modify the contents of these registers.

Register Map

Model ES2161
Model ES2162

Ref	Addr.	Description	Data Type/Format
Holding Registers (4x References, Read/Write)			
Calibration Trigger Registers 40233-40236			
40233	0232 (00E8)	Zero Cal Trigger Low Channels (Ch 15-00 of Ports 1 & 2)	Write a set bit to this register to trigger the A/D to sample the corresponding input(s) and store the zero signal (lsb is lowest numbered channel of group). First write 24106 to Calibration Access Register 40037 to remove write-protection from the calibration value registers before triggering..
40234	0233 (00E9)	Zero Cal Trigger High Channels (Ch 31-16 of Ports 3 & 4)	Write a set bit to this register to trigger the A/D to sample the corresponding input(s) and store the zero signal (lsb is lowest numbered channel of group). First write 24106 to Calibration Access Register 40037 to remove write-protection from the calibration value registers before triggering..
40235	0234 (00EA)	Span Cal Trigger Low Channels (Ch 15-00 of Ports 1 & 2)	Write a set bit to this register to trigger the A/D to sample the corresponding input(s) and store the positive calibration signal (lsb is lowest numbered channel of this group). First write 24106 to Calibration Access Register 40037 to remove write-protection from the calibration value registers.
40236	0235 (00EB)	Span Cal Trigger High (Channels (Ch 31-16 of Ports 3 & 4)	Write a set bit to this register to trigger the A/D to sample the corresponding input(s) and store the positive calibration signal (lsb is lowest numbered channel of this group). First write 24106 to Calibration Access Register 40037 to remove write-protection from the calibration value registers.
41001 . . .		This block Mirrors 1xxxx Registers.	*Refer to Register Mirroring. 1xxxx Input Status Registers are mapped to the 41xxx Holding Register space using an address offset of 41000.*
42001 . . .		This block Mirrors 0xxxx Registers.	*Refer to Register Mirroring. 0xxxx Coil Registers are mapped to the 42xxx Holding Register space using an address offset of 42000.*
43001 . . .		This block Mirrors 3xxxx Registers.	*Refer to Register Mirroring. 3xxxx Input Registers are mapped to the 43xxx Holding Register space using an address offset of 43000.*

Register Map

Model ES2161
Model ES2162

Notes (Register Map):

1. The 16-bit A/D range uses an A/D count of ±32768 counts for its native ±5V and ±10V input ranges. All input ranges are normalized to a count of ±30000 by the unit corresponding to ±100% for bipolar ranges, or 0-30000 corresponding to 0-100% for unipolar ranges.
2. ES2161 Models have a fixed A/D range of ±5V, but use a 100Ω input shunt to drive ±2.0V for ±20mA input. All current ranges are normalized to ±30000 by the unit corresponding to ±100%.

Default Register Settings

Here is a summary of the ES2161/2162 default register settings and corresponding default behavior.

ES2161/2162 Default Register Settings

REGISTER	HEX	ACTION
Channel Configuration Registers	0019H	Use Auto-Zero/Span Cal
		Do not use CH Cal for Port
		DB25 uB or 8B Interface Inactive
		Totalizer to use Preload
		Totalizer Action is Rollover
		Totalizer is OFF
		Totalizer Time Base is NA
		Input is ±20mA or ±10V
Digital Filter/Input Averaging	0000H	0, No Input Averaging
Floating Point Enable & Byte Order	0000H	Disable, b3-b2-b1-b0 Order
Relay Failsafe/Non-Failsafe Select	0100H	Enable Failsafe
Enable Scan Groups Register	00FFH	All Scan Groups Enabled
Wink Register	0000H	OFF, Do Not Wink

Configuration Parameters Not Programmable Via Modbus Registers

Use the built-in web interface screens to set these parameters, which are generally required to setup communications.

The web interface is not limited to communication parameters, but will allow you to also exploit other features of the product normally set via Modbus registers.

Not all parameters of this device can be set via Modbus registers. In general, parameters related to I/O will have a Modbus register, while those related to network communication must be set via the web interface. Here is a list of configuration parameters which do not have a Modbus register.

Username & Password
Static IP Address
Number of Modbus Sockets
DNS Server Address
Subnet Mask
Gateway Address
Host Name
Select Static, DHCP/BOOTP, or DHCP/BOOTP w/Fallback Addressing
Wink On/Off
Select Network Port Hub Mode or Switch Mode Operation
Copper Network Port 1 & 2 Forced Speed & Duplex or via Auto-Negotiation
Fiber Port Half or Full Duplex Selection
Self-Test Utility
Export Configuration & Export IP Address

SPECIFICATIONS

A high-density, industrial Ethernet I/O system providing 32 fully differential input channels for current (ES2161), or voltage (ES2162). Units have an isolated 10/100M Ethernet interface for monitoring, calibration, and control via Modbus TCP/IP or UDP/IP. Dual network ports allow units to conveniently cascade with other units, or for implementation of end-node redundancy schemes when connected to Ethernet switches that implement redundancy. Dual network ports also provide a low-latency/ low-jitter hub/repeater mode. The ES2162 model adds two DB25 interface connectors to alternately connect one or two Series uB or 8B expansion panels of 4, 8, or 16 channels each. Unit is DC-powered with redundant power inputs and reverse polarity protection. Field inputs are wide-band, multi-ranging, and fully differential (the uB or 8B interface of ES2162 models is single-ended). Sixteen bit A/D conversion is used and input ranges may be rescaled to sub-ranges or other engineering units to help facilitate integration/totalization. Input channels include transient protection. Input channels (as a group), alarm relay, network ports, and power circuits are isolated from each other, and from earth ground (chassis). Non-volatile reprogrammable memory in the unit stores configuration, calibration, and totalization data.

Model Numbers

Examples:

ES2161-0000 (32 Current Inputs)
ES2161-0010 (wo/Enclosure)
ES2161-1000 (w/Fiber Port)
ES2161-1010 (w/Fiber, wo/Encl.)

ES2162 models are similar, but intended for voltage input and add 2 DB25 interface connectors for connecting to uB or 8BP expansion panels (sold separately).

EtherStax model prefix "ES" denotes the EtherStax Ethernet I/O family. The trailing "21" digits denote the 2100 series. The "61" following "21" denotes a 32 differential current input model. A "62" following "21" denotes a 32 differential voltage input model. The ES2162 model also adds two DB25 connectors for interface to industry standard uB or 8BP expansion panels which support a wide array of input module types. Other options are selected via a hyphenated four digit suffix to the model (-xxxx). The first suffix digit specifies the physical connection (0=Dual 10/100M copper, 1=one 10/100M copper port and one 100BaseFX fiber port). The second suffix digit specifies the protocol (0=Modbus TCP/IP & UDP/IP). The third digit specifies the housing (0=aluminum extrusion, 1=open-frame with no housing). The last digit specifies the input power (0=18-36V DC).

Mounting Options

*Detailed drawings of these items are included in the Mounting and Dimensions section at the front of this manual***.**

Standard units interlock and stack together up to 3 units high. A single unit or stack of units can be bolted to a flat surface, or mounted on deep-channel "T" type DIN rails (35mm x15mm), depending on the mounting kit selected.

ESA-DIN-VMK, DIN Rail Vertical Mount Kit: Includes 2 plastic DIN clips that slide in the bottom dovetail of the housing. Use one clip to mount a single unit, or both clips for added stability and when stacking two units. The "vertical" designation refers to the orientation of unit relative to the DIN rail.

ESA-SMK, Surface-Mount Kit: This kit includes a shock mounted aluminum base plate and four bolts to attach to the bottom of a housing, allowing from one to three units to be bolted to a wall or flat surface.

ESA-DIN-HMK, DIN Rail Horizontal Mount Kit: Includes the same bolt-on aluminum base plate as ESA-SMK above, but adds a heavy-duty DIN clip and screws to mount the base plate onto a DIN rail, allowing up to three units to be stacked together and mounted on the rail. The "horizontal" designation refers to the orientation of unit relative to the DIN rail.

ESA-OMK, Open Mounting Kit: Units can be ordered without their enclosure and already include the threaded standoffs and screws necessary to stack two circuits together, plus the screws and standoffs for mounting the assembly to a flat surface. This kit contains the identical replacement hardware for stacking two open circuits together and/or mounting them to a flat surface. Units may optionally bolt to the surface-mount base plate of ESA-SMK or ESA-DIN-HMK with this hardware.

SPECIFICATIONS

Analog Inputs

Current (ES2161 Model)
or
Voltage (ES2162 Model)

Thirty-two differential input channels organized 8 channels to a port and providing 4 ports of input current (ES2161), or voltage (ES2162). Each port is 8:1 multiplexed to a separate A/D channel. ES2161 input channels use precision 100Ω shunt resistors to convert input current to voltage, such that ±20mA will drive ±2.0V full-scale to the ±5V input channel of a 16-bit A/D. ES2162 input channels drive the A/D directly for ±5V or ±10V. Inputs are wideband (up to 1298Hz) and include transient voltage suppression. Voltage inputs are also fault-tolerant to ±25V.

Unit must be wired and configured for the intended input type and range (see Connections section for details). Input signal is bipolar differential and can be input to either terminal and returned on the opposite terminal. The following paragraphs summarize this model's input types, ranges, and applicable specifications.

DC Input Range: A nominal, bipolar, and differential field range of ±10V or ±5V may be selected on a per channel basis which corresponds to the actual A/D input range. Note that ES2162 units may not be able to achieve the full-scale endpoints exactly. ES2161 units utilize the ±5V A/D range and 100Ω precision shunt resistors (0.125W) at the inputs to convert input current to voltage such that ±20mA DC (±21.6mA Max) drives ±2V full-scale to the A/D. Input sub-ranges of ±20mA, 0-20mA, and 4-20mA may be selected for the ES2161. Inputs may optionally be rescaled to support sub-ranges of nominal ranges, or to accomplish integration and totalization of the input signal. All selectable input ranges are normalized to ±30000 for ±100% of range, or 0-30000 for 0-100% of range (over-range is 2768 or ~9.2%). Positive current or voltage is delivered to the (+) input terminal and returned on the negative (-) input terminal.

Input Resolution: 305.176uV/bit (±10V), or 152.588uV/bit (±5V), or 1.5259uA/bit (ES2161). The internal 16-bit A/D resolution is ±32768 parts for both the ±5V and ±10V ranges, and ±13107 (14.6 bits) for ±20mA (as this drives only ±2V full-scale to the ±5V 16-bit A/D input channel). All input ranges are normalized to ±30000 counts, or 0-30000 counts by the firmware. Your effective resolution will vary with range selection and input scaling.

Normalized Resolution for ES2162 Input Ranges

RANGE	±10V	±5V
Raw A/D	±32768	±32768
Resolution	305.176uV/bit	152.588uV/bit
PPM	15.26ppm	15.26ppm
Normalized	±30000	±30000

Normalized Resolution for ES2161 Input Ranges[1]

RANGE	±20mA	0-20mA	4-20mA
Raw A/D	±13107bits	0-13107bits	2621-13107bits
Resolution	1.5259uA/bit	1.5259uA/bit	1.5259uA/bit
PPM	38.15ppm	76.30ppm	95.36ppm
Normalized	±30000	0-30000	0-30000

[1]Input uses a 100Ω shunt and the ±5V (16-bit) A/D Range. Input ranges are normalized to ±30000 for ±100%, and 0-30000 for 0-100%.

SPECIFICATIONS

Analog Inputs

Current (ES2161 Model)
or
Voltage (ES2162 Model)

Limits to Re-Scaling Nominal Ranges: To achieve a minimum acceptable resolution of 12 bits (±2048 parts), rescaling should not divide the nominal A/D base ranges of ±5V or ±10V by more than 16 (0.0625x). ES2161 input voltage equals input current x100Ω and the ±5V A/D range is used. A peak reading occurs at a normalized count of 32768 (109%) with full-scale corresponding to 30000 counts (100%).

RANGE	±10V (ES2162)	±5V (ES2162)	ES2161 (uses ±5V)
MIN	1.25V or	0.625V or	6.25mA or
SPAN	±0.625V	±0.3125V	±3.125mA

Current Input Reference Test Conditions: ±20mA (ES2161) or ±5V (ES2162) input; ambient temperature = 25°C; 24VDC supply.
Voltage Input Reference Test Conditions: ±5V DC input; ambient temperature = 25°C; 24VDC supply.
Input Over Voltage Protection: Bipolar Transient Voltage Suppressors (TVS), clamp level less than 50V and greater than 18V.
Input Impedance: 4MΩ minimum (ES2162), 100Ω (ES2161).

uB or 8B Expansion Interface DB25 Connector X1/X2 (ES2162 Model Only)

uB or 8B Modules and Accessories can be purchased from Acromag, or from DataForth (consult factory).

Two female DB25 connectors, X1on front, X2 on back, allow you to alternately connect one or two remote uB or 8BP04, uB or 8BP08, or uB or 8BP16 back-panels for installation of up to 32 industry-standard uB or 8B *input* modules (sold separately). There are ninety Series uB or 8B input module types currently compatible with these carriers (see Table). uB or 8B input modules include transient protection and 1500VAC input isolation (240VAC safety rated isolation). All uB or 8B input modules drive an isolated output voltage of ±5V, 1-5V, or 0-5V to the internal A/D channels via the DB25 interface. The unit samples this output voltage at high-speed (up to 1298Hz) using a native ±5V A/D input range. Input module ranges can be rescaled by the unit as required by the application.
Note: Each port of 8 field channels are differentially multiplexed to separate differential input channels of an A/D. It is possible to intermix field channels with uB or 8B channels, but only for 8 channels at a time. You may configure combinations of 16 field channels with sixteen uB or 8B modules, 24 field channels and eight uB or 8B modules, and twenty-four uB or 8B modules with 8 field channels. If you connect to a 4 channel 8PB04 back panel, then an entire port of 8 channels is consumed. This is because ports include 8 differential channels, while uB or 8B back panels drive single-ended output signals, and the port is switched to singled-ended mode for 8 channels at a time.

IMPORTANT: uB or 8B Output Modules are NOT supported (see ES2152 for uB or 8B output support). You cannot intermix uB or 8B output modules with input modules on the same carrier without inducing contention and risking damage to I/O circuitry. Install only uB or 8B input model types on any uB or 8BP carriers connected to the DB25 interface of ES2162 EtherStax models.
You must ground the analog input circuit common (C) terminal of the unit, even if your uB or 8B inputs are grounded, as uB or 8B module inputs are isolated.

Compatible Panels: Industry standard uB or 8B module carriers, uB or 8BP04 (4ch), uB or 8BP08 (8ch), and uB or 8BP16 (16ch). uB or 8B Panels and modules are sold separately. Modules mount in pin sockets on the carriers and are retained via module-captive 4-40 machine screws (one per module). These items can be purchased from Acromag, or directly from Dataforth. Consult factory.

Compatible Modules: See table of following page for input module types. Refer to the Acromag web site for the most up to date listing of modules

Compatible Cable: System interface cable is SCMXCA006-xx (xx is -01, -02, or -07 and refers to the length in meters). This is a DB25 Male to Female interface cable for connecting uB or 8BP04/08/16 back panels to the EtherStax unit, or other host systems.

Input Channels: Up to 32 input channels. Channel configuration registers specify if the input DB25 interface is active. Channels are mapped as shown below. Corresponding input port channels must be set for an input range of ±5V and have their DB25 interface enabled (ES2162).

Input Module Power: uB or 8B back-panels require separate power hookup (+5V or 12-28V DC, according to power configuration).

Input Channel Isolation: uB or 8B input modules safely isolate the input signal for 240VAC continuous. Unit provides 0.108 inches of minimum clearance to maintain the reinforced 240VAC continuous safety isolation rating for each barrier. Inputs pass a 1500Vrms isolation test.

Input Configuration (Per Channel): uB or 8B inputs output a signal of 0-5V, ±5V, or +1V to 5V according to model. Unit has a ±5V A/D input range and it is up to the user to scale the uB or 8B signal per the application.

Input Scaling (Per Channel): Allows input ranges to be rescaled to other engineering units by specifying the 0% & 100% input signal endpoints. This also allows wider-range uB or 8B models to mimic smaller range uB or 8B models. Rescaling should not divide the input range by more than 16 (0.0625x) to maintain minimum 12-bit performance levels of ±204uB or 8Bits.

uB or 8B Channel Mapping (ES2162): Refer to the following table to map input channels to uB or 8B inputs via the DB25 interface connectors X1 & X2.

Port 1 Field Channels								**Port 2 Field Channels**							
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
4CH uB or 8BP04				Not Available				8	9	10	11	12	13	14	15
8CH Backpanel uB or 8BP08								8	9	10	11	12	13	14	15
16CH Back Panel uB or 8BP16															
DB25 X1 Interface Connector Includes 16 channels CH00-CH15-															

Port 3 Field Channels								**Port 4 Field Channels**							
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
4CH uB or 8BP04				Not Available				24	25	26	27	28	29	30	31
8CH Back Panel uB or 8BP08								24	25	26	27	28	29	30	15
16CH Back Panel uB or 8BP16															
DB25 X2 Interface Connector Includes 16 channels CH16-CH31															

SPECIFICATIONS

uB or 8B Expansion Interface DB25 Connector X1/X2 (ES2162 Model Only)

uB or 8B Modules and Accessories can be purchased from Acromag, or from DataForth (consult factory).

Highlighted 8B modules are available in uB Modules (Replace 8B with uB).

***Note:** Dataforth 8B modules and back-panels can use most Acromag uB modules and panels in its place, by changing model 8B with uB typically (consult factory).*

SPECIFICATIONS

Supported uB or 8B Input Modules (Modules Sold Separately)

Two DB25 interface connectors provide support for optional connection of up to two uB or 8B back panels. This allows interface with up to 32 isolated uB or 8B input signal conditioning modules. Currently, there are 90 input model types listed in the table at left that are compatible with this carrier.

Input modules also include 1500VAC input isolation (240VAC safety isolation) and transient protection.

Note that input modules can be divided into 3 groups based on their output signal: ±5V, 0-5V, and 1-5V. This output signal is processed via 16-bit A/D conversion setup for -5V to +5V inputs.

Modules that do not utilize the full A/D range will have a proportionally lower effective resolution (see Table).

IMPORTANT: *You cannot intermix uB or 8B output modules on this backplane, or damage to the unit may result.*

Please refer to the Acromag web site for other input module types that may not be listed here.

uB or 8B Input Modules (Sold Separately)

Model	Input Signal	Output Range	Model	Input Signal	Output Range
8B30-01	±10mV	-5V to +5V	8B41-01	±1V	-5V to +5V
8B30-02	±50mV	-5V to +5V	8B41-02	±5V	-5V to +5V
8B30-03	±100mV	-5V to +5V	8B41-03	±10V	-5V to +5V
8B31-01	±1V	-5V to +5V	8B41-07	±20V	-5V to +5V
8B31-02	±5V	-5V to +5V	8B41-09	±40V	-5V to +5V
8B31-03	±10V	-5V to +5V	8B41-12	±60V	-5V to +5V
8B31-07	±20V	-5V to +5V	8B41-04	±1V	0 to +5V
8B31-09	±40V	-5V to +5V	8B41-05	±5V	0 to +5V
8B31-12	±60V	-5V to +5V	8B41-06	±10V	0 to +5V
8B31-04	±1V	0 to +5V	8B41-08	±20V	0 to +5V
8B31-05	±5V	0 to +5V	8B41-10	±40V	0 to +5V
8B31-06	±10V	0 to +5V	8B41-13	±60V	0 to +5V
8B31-08	±20V	0 to +5V	8B42-01	4-20mA	0 to +5V
8B31-10	±40V	0 to +5V	8B42-02	4-20mA	+1 to +5V
8B31-13	±60V	0 to +5V	8B45-01	0-500Hz	0 to +5V
8B32-01	4-20mA	0 to +5V	8B45-02	0-1KHz	0 to +5V
8B32-02	0-20mA	0 to +5V	8B45-03	0-2.5KHz	0 to +5V
8B34-01	Pt100Ω	0 to +5V	8B45-04	0-5KHz	0 to +5V
8B34-02	Pt100Ω	0 to +5V	8B45-05	0-10KHz	0 to +5V
8B34-03	Pt100Ω	0 to +5V	8B45-06	0-25KHz	0 to +5V
8B34-04	Pt100Ω	0 to +5V	8B45-07	0-50KHz	0 to +5V
8B35-01	Pt100Ω	0 to +5V	8B45-08	0-100KHz	0 to +5V
8B35-02	Pt100Ω	0 to +5V	8B47J-01	TC J	0 to +5V
8B35-03	Pt100Ω	0 to +5V	8B47J-02	TC J	0 to +5V
8B35-04	Pt100Ω	0 to +5V	8B47J-03	TC J	0 to +5V
8B36-01	0-100Ω	0 to +5V	8B47J-12	TC J	0 to +5V
8B36-02	0-500Ω	0 to +5V	8B47K-04	TC K	0 to +5V
8B36-03	0-1KΩ	0 to +5V	8B47K-05	TC K	0 to +5V
8B36-04	0-10KΩ	0 to +5V	8B47K-13	TC K	0 to +5V
8B37J	TC J	0 to +5V	8B47K-14	TC K	0 to +5V
8B37K	TC K	0 to +5V	8B47T-06	TC T	0 to +5V
8B37T	TC T	0 to +5V	8B47T-07	TC T	0 to +5V
8B37R	TC R	0 to +5V	8B50-01	±20mV	-5V to +5V
8B37S	TC S	0 to +5V	8B50-02	±50mV	-5V to +5V
8B38-01	±10mV	-5V to +5V	8B50-03	±100mV	-5V to +5V
8B38-02	±30mV	-5V to +5V	8B51-01	±1V	-5V to +5V
8B38-05	±20mV	-5V to +5V	8B51-02	±5V	-5V to +5V
8B38-31	±10mV	-5V to +5V	8B51-03	±10V	-5V to +5V
8B38-32	±30mV	-5V to +5V	8B51-07	±20V	-5V to +5V
8B38-35	±20mV	-5V to +5V	8B51-09	±40V	-5V to +5V
8B40-01	±10mV	-5V to +5V	8B51-12	±60V	-5V to +5V
8B40-02	±50mV	-5V to +5V	8B51-04	±1V	0 to +5V
8B40-03	±100mV	-5V to +5V	8B51-05	±5V	0 to +5V
			8B51-06	±10V	0 to +5V
			8B51-08	±20V	0 to +5V
			8B51-10	±40V	0 to +5V
			8B51-13	±60V	0 to +5V

Input Scan Groups: This unit gathers input data at high speed utilizing scan groups, which are simply groups of channels organized to minimize multiplexer switching. Each differential input lead is separately switched to one of four differential A/D inputs using fault-tolerant 8:1 multiplexers. Thus, each A/D input represents one group of 8 input channels (one port). There are 8 scan groups of 4 channels each and each channel of a scan group is associated with the same channel of its 8:1 port multiplexer (separate port multiplexers share the same address lines). So scan group 1 is the first channel of each port multiplexer, scan group 2 the second channel of each multiplexer, and so on. All 32 channels are gathered at a rate that is dependent on the number of scan groups enabled (when no totalization or input averaging is being performed). Normally, 60% of this cycle time is used to convert the channel data, while 40% is used to do other tasks. The unit allows scan groups to be individually enabled/disabled to realize faster throughput on a smaller group of channels.

Input Update/Conversion Rate: Varies according to the number of scan groups enabled, whether totalization is being performed, and whether input averaging is being done.

SCAN GROUPS	w/No Totalization and No Input Averaging	
	UPDATE TIME	UPDATE RATE
1	0.77ms	1298Hz
2	1.36ms	735Hz
3	1.97ms	507Hz
4	2.53ms	395Hz
5	3.12ms	320Hz
6	3.73ms	268Hz
7	4.26ms	234Hz
8	5.00ms	200Hz
Totalization ON[2]	20ms	50Hz
Input Averaging[2]	40ms	25Hz

[1.] These times apply with floating point and input scaling applied.

[2] The update rate is fixed at 20ms if totalization is enabled for any channel, except when input averaging. Input averaging at any channel results in a fixed update rate of 40ms (25Hz).

Input Accuracy: Better than ±0.05% of span typical for ES2161, or ±0.03% of span typical for ES2162, for nominal input ranges and reference test conditions. This includes the effects of repeatability, terminal point conformity, and linearization, but does not include sensor error.

Input Calibration: By default, the unit automatically calibrates zero and span every input cycle using precise on-board calibration reference signals sufficient for most applications. Optionally, inputs may be calibrated manually by driving the input channel externally. It is also possible to manually calibrate an entire input port based on the calibration of one channel from that port (a manual calibration time saver). Calibration is automatic, manual per channel or port, and a unit can mix manual and automatic calibration among channels.

Input Measurement Temperature Drift: Better than ±25ppm/°C (±0.0025%/°C).

Input Analog to Digital Converter (A/D): A 16-bit successive-approximation converter, Linear Technology LTC1859IG.

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General Input Specifications

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General Input Specifications

Input Filter: Normal mode filtering fixed per input type.

Input Filter Bandwidth: -3dB at 415KHz, typical. Bandwidth is dominantly restricted to the update rate of 32 channels (see table).

Input Noise Rejection (Common Mode): Better than -72dB @ 60Hz, typical with 100Ω input unbalance.

Input Cable Length: I/O port interface cables should not exceed 30m in length for rated performance.

Floating Point: Unit provides an enable/disable for floating point math. You must enable Floating Point support in order to rescale an input signal, or to accomplish integration/totalization. Disable it if you don't need to rescale or totalize. Like disabling scan groups, disabling floating point support reduces the amount of calculations that have to be performed and gives the processor more time to do other tasks besides acquiring data. This can help to make critical control network applications more deterministic, particularly over networks with heavy traffic flow.

Byte Order: The unit allows you to specify the byte order for 32-bit floating point values. Different Modbus systems will use different byte orders for the two 16-bit registers used to store a 32-bit floating point value. Select the byte order compatible with your system. Note that B0 refers to the Least Significant Byte and B3 to the Most Significant Byte.

Input Integration/Totalization: If totalization is enabled, the instantaneous input is sampled at a slower fixed rate of 20ms with no input averaging, or 40ms with any input averaging. You can choose to integrate this signal by totalizing its time sliced instantaneous value. To totalize, you must separately enable Floating Point Support. You also need to scale the input appropriately and specify the time-base units to perform the integration over ("per Second", "per Minute", "per Hour", or "NA"). You must specify a time base other than NA for totalization to occur. Note that if "NA" is selected and Totalize=Yes, then 0.0 is added to the totalized value. The totalized value is non-volatile and you can even preload a totalized value on power-up, or system reset. Otherwise, it will totalize from the last totalizer value before interrupting power or performing a system reset. During run time, your incremental "time-sliced" measurement value will be added to this total every scan time. The software also gives the capability to reset the current totalized value to zero. For example, if during totalization, we gather an instantaneous input sample every 20ms. Then if your instantaneous scaled input value indicates 500, and units are gallons, and the time base is set to "per Minute". Then (500 gallons/minute)*(1 minute/60 seconds) equals a flow rate of 8.33 gallons/per second. If a new sample is obtained every 20ms, then we multiply 8.33gallons/second by 0.020seconds/sample to get an incremental increase of volume of 0.1666 gallons/sample, and this amount is added to your totalized value. Note that even with floating point disabled, the measured input value will still indicate a floating point number, but the scaling and totalizing fields will indicate "Inactive" with floating point disabled.

Open-Frame Models (ES2161/2162-0010 & ES2161/2162-1010)

These models are UL/cUL Recognized components suitable for use in Hazardous Locations per Class 1, Division 2, Groups A, B, C, and D, where the acceptability of the combination is determined by Underwriters Laboratories. These components have been judged on the basis of required spacing in the standard for Industrial Control Equipment, UL 508, Table 36.1, which would cover the component itself if submitted for unrestricted Listing. As a condition of Acceptability when installed in end-user equipment, consider the following:

1. The device shall be installed in compliance with the enclosure, mounting spacing, casualty (including markings), and segregation requirements of the ultimate application.
2. The accessibility of the live parts through openings in the enclosure, reliable retention of guards or barriers for prevention of risk of electric shock, etc. shall be considered in the end product evaluation.
3. The acceptability of the connection headers shall be determined in the end product.
4. These devices shall be operated within their electrical ratings and in an ambient temperature not exceeding 75°C.
5. When used in end product, programmable controllers must meet requirements for use in Class I, Groups A, B, C, and D, Division 2 or Class I, Zone 2, Group IIC Hazardous Locations.
6. The following temperature code should be noted: "T4A".

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General Input Specifications

Alarm Relay Output

This device includes a set of isolated relay contacts adjacent to power at the A & B terminals. The state of these contacts can be set as normally open (de-energized, non-failsafe), or normally closed (energized, fail-safe). These contacts will transfer states upon media failure (link loss), or power failure (if normally energized/failsafe operation is selected). A red relay LED indicates that the relay contacts are energized (closed).

Type: SPST-NO, 1 Form A, Class I, Division II Approved.
Manufacturer Part: Omron, G6M-1A-DC5.
Maximum Ratings: AC rated to 3A at 250VAC, or 750VA maximum (100K operations minimum). DC rated to 3A at 30VDC, or 90W maximum. Your AC application switching voltage/ current must not exceed 750VA and 250VAC and 5A. Your DC application voltage/current must not exceed 90W and 125VDC and 5A.
Contact Resistance: 100 milliohms, maximum.
Ratings: 5A at 30VDC/250VAC resistive (6K Operations). General Use: 3A at 30VDC/250VAC (100K Operations), 1/8HP at 250VAC/125VAC, and C300 Pilot Duty. UL508 File No. E41515/CSA C22.2 (No. 14) File No. LR31928. Hazardous Location ratings are 2A at 240VAC or 30VDC.
Minimum Permissible Load: 10mA at 5VDC at 120 operations/minute.

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Memory

This unit contains both volatile and non-volatile memory. It does not contain any fixed or removable disk or tape drives, or memory cards. For security or sanitization considerations, review the following:

Flash Memory (Non-Volatile): This 4 Megabyte memory is used for storage register data, communication configuration parameters, and web-page information. It is user-modified via configuration. It is sanitized by holding the default switch while powering up the unit until the green Run LED turns OFF. At this time, the memory reverts to the factory default settings, except for the MAC ID and serial number which are fixed. Refer to "Getting Out of Trouble" section in this manual for more information.

FRAM (Non-Volatile): This 8 Kilobyte memory is resident on the I/O board and is used to store the channel configuration, calibration coefficients, and scaling information for the inputs. It is user-modified via channel setup and calibration. Its contents can be cleared to factory default calibration values by clicking the Restore All Default Calibration Values button of the Input Calibration web page.

SRAM (Volatile): This 132 kilobyte memory is integrated within the central processor and is used as scratchpad memory by the processor during run time. Its contents are cleared at power-down.

SDRAM (Volatile): This 64 Megabyte memory is external to the central processor and used as the run time memory for high-speed execution of this unit's internal program. Its contents are cleared on power-down.

Agency Approvals

Safety Approvals: Enclosed Models, ES2161/2162-0000 & ES2161/2162-1000 are CE marked (EMC Directive 2004/108/EC), and cULus Listed (UL508-Seventeenth Edition, ISA 12.12.01:2007, Canada Standard C22.2, No. 142-M1987 & 213-M1987) for Hazardous Locations, Class 1; Division 2; Groups A, B, C, and D. Open board models ES2161/2162-0010 & ES2161/2162-1010 are cULus Recognized Components for Hazardous Locations, Class 1; Division 2; Groups A, B, C, and D (UL508-Seventeenth Edition, ISA 12.12.01:2007, Canada Standard C22.2, No. 142-M1987 & 213-M1987).

Enclosure & Physical

Dimensions: IP40 rated enclosure, 8.226 inches wide, 2.444 inches tall, and 6.125 inches deep. Enclosed units stack together on 2.175 inch centers. Open frame units are 1.664" tall with 0.375" standoffs. Units will require an optional surface mounting plate and or DIN-rail mount to securely mount the unit (see below). Refer to the Mounting & Dimensions section at the front of this manual for more details.

Surface/Wall-Mounting: Requires optional surface-mounting kit ESA-SMK. This kit includes an 8x8" machined aluminum base-plate and hardware for bolting a stack of 1 to 3 units to a wall or flat surface. See Mounting & Dimensions section for details on this option.

DIN-Rail Mounting: The unit can be mounted to 35x15mm, T-type DIN rails using optional ESA-DIN-VMK, or ESA-DIN-HMK mounting kits. Refer to the Mounting & Dimensions section for more details.

Open-Face (Circuit Board) Mounting/Stacking: Device may be ordered without its enclosure. Enough screws and standoffs for stacking two assemblies are included with every open unit and also in the Acromag ESA-OMK Open Mounting Kit. Individual boards can be stacked using the threaded standoffs and 6-32 jack-screws provided in this kit. Refer to the Mounting & Dimensions section for more details.

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Enclosure & Physical

Input Connectors: Removable plug-in type terminal blocks are rated for 8A/160V; AWG #16-28 stranded or solid copper wire. The torque ratings for field wiring terminals are 0.22-0.25 Nm.

Relay/Power Connectors: Removable plug-in type terminal blocks are rated for 15A/300V; AWG #12-24 stranded or solid copper wire. The torque ratings for field wiring terminals are 0.5-0.6 Nm (5-7 lb-inches).

Enclosure Material: Extruded aluminum, 6063 T6 alloy, silver anodized finish, IP40 minimum rated.

Circuit Boards: Military grade fire-retardant epoxy glass per IPC-4101/98.

Shipping Weight: 3.8 pounds (1.8 Kg) packed (unit w/enclosure is 3.4lbs); 1.5 (0.7Kg) packed (open-frame unit/no enclosure is 1.05lbs).

Network Connectors (Copper): Two 8-pin RJ-45 sockets (ES2161/2162-0xxx), or one 8-pin RJ45 socket (ES2161/2162-1xxx). RJ-45 connections are wired MDI-X by default (like an Ethernet switch, as opposed to MDI), but include automatic MDI/MDI-X crossover. Use CAT-5 or better cable to connect to these ports. Acromag offers an optional Cable Termination Kit (ESA-CTK) that includes the necessary hardware for building one end of your cable for mating to the IP20 clip-frame that surrounds the RJ45 port. This is done for increased immunity to shock & vibration.

RJ-45	Signal	Description (MDI-X)
1	Rx+	Receive Positive
2	Rx-	Receive Negative
3	Tx+	Transmit Positive
4	Not Used	Connects to Pin 5
5	Not Used	Connects to Pin 4
6	Tx-	Transmit Negative
7	Not Used	Connects to Pin 8
8	Not Used	Connects to Pin 7

Network Connector (ES2161/2162-1 w/100FX Fiber): One 8-pin RJ45 socket as wired above (for port 2), plus one 100BaseFX, SC-Type, multi-mode fiber-optic connector (for port 1). The auto-negotiation & auto-crossing features do not apply to the fiber connection and transmit and receive cables must be crossed manually when making fiber cable connections.

Environmental

Operating Ambient Temperature: -40°C to +70°C (-40°F to +158°F), all models.

Storage Temperature: -40°C to +85°C (-40°F to +185°F).

Relative Humidity: 5 to 95%, non-condensing.

Isolation: Input channels (as a group), alarm relay, power, and network circuits (individually) are 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). 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 installation category (over-voltage category) II rating.

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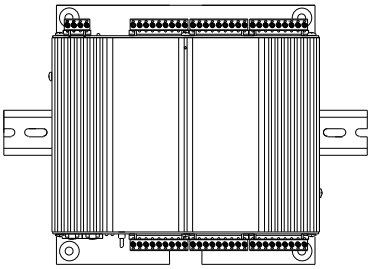
Environmental

IMPORTANT: It is recommended that enclosed units be mounted as shown, with the front-endplate facing down, and the back endplate facing up:



Mounting in this manner allows cool air to flow into the front (bottom), and hot air to pass out the back (top), through the vents provided and the open area around the terminals.

Note that the network ports are safety isolated from each other. The I/O, power, and network ports are also safety isolated from the enclosure.

***TIP:** For critical applications or units subject to severe shock or interference, utilize the built-in watchdog timer and alarm relay to signal an interruption in communication, link loss, or optionally power failure (w/failsafe contacts).*

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.

Power Requirements (Unit Main): 18-36V DC SELV (Safety Extra Low Voltage), 5.5W max (ES2161/2162-1), 4.4W max (ES2161/2162-0). Observe proper polarity. Keep DC power cables less than 10m in length. Divide power by voltage to calculate max current and select a supply that can deliver at least twice this amount. Current noted is with one network port linked and the alarm relay energized.

Power	Model ES2161/2162-0	Model ES2161/2162-1
18V	213mA Typ, 234mA Max	275mA Typ, 303mA Max
24V	159mA Typ, 175mA Max	206mA Typ, 227mA Max
30V	129mA Typ, 142mA Max	165mA Typ, 182mA Max
36V	110mA Typ, 121mA Max	139mA Typ, 153mA Max

***CAUTION:** Do not exceed 36VDC peak to avoid damage to the unit.*
***CAUTION: Risk of Electric Shock** – More than one disconnect switch may be required to de-energize the equipment before servicing.*

Shock & Vibration Immunity: Surface mounted unit with enclosure rated to 5G sinusoidal vibration and 5Grms Random Vibration, 10-500Hz, in 3 axis at 2 hours/axis per IEC60068-2-6 and IEC60068-2-64; Mechanical Shock to 50g, 3ms, with 3 half-sine shock pulses in each direction along 3 axis (18 shocks), and 30g, 11ms, with 3 half-sine shock pulses in each direction along 3 axis (18 shocks), per IEC60068-2-27.

Electromagnetic Interference Immunity (EMI): Inputs/outputs have demonstrated resistance to inadvertent state changes with interference from switching solenoids, commutator motors, and drill motors.

Electromagnetic Compatibility (EMC)

Minimum Immunity Per European Norm EN61000-6-2:2005

Electrostatic Discharge (ESD) Immunity: 4KV direct contact and 8KV air-discharge to the enclosure port per IEC61000-4-2.

Radiated Field Immunity (RFI): 10V/M, 80 to 1000MHz; 3V/m, 1.4 to 2.0 GHz; 1V/m, 2.0 to 2.7 GHz; per IEC61000-4-3.

Electrical Fast Transient Immunity (EFT): 2KV to power, and 1KV to signal I/O per IEC61000-4-4.

Conducted RF Immunity (CRFI): 10Vrms, 150KHz to 80MHz, per IEC61000-4-6.

Surge Immunity: 0.5KV to power per IEC61000-4-5. By the standard, this test is not applicable to DC power input ports intended to be permanently connected to cables less than 10m in length. Further, this test is not applicable to I/O ports that interface via cables whose total length is less than 30m.

Emissions per European Norm EN61000-6-4:2007

Radiated Frequency Emissions: 30 to 1000MHz per CISPR16 Class A

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.

IMPORTANT: Power and I/O wiring must be in accordance with Class I, Division 2 wiring methods of Article 501-4(b) of the National Electrical Code, NFPA 70 for installations in the US, or as specified in section 18-1J2 of the Canadian Electrical Code for installations within Canada and in accordance with the authority having jurisdiction.

SPECIFICATIONS

Environmental

This equipment is suitable for use in Class I, Division 2, Groups A, B, C, and D, or non-hazardous locations only.

WARNING – EXPLOSION HAZARD – Substitution of components may impair suitability for Class I, Division 2.

WARNING – EXPLOSION HAZARD – Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

The maximum surrounding air temperature is 75°C.

The torque ratings for field wiring terminals is 0.5-0.6Nm (4.4-5.3 lb-inches) for power & relay terminals), and 0.22-0.25Nm (1.9-2.2 lb-inches) for the input terminals.

Reference Standard: CNR indicates investigation to Canadian Standard C22.2, No's. 142-M1987 & 213-M1987; USR indicates investigation to United States UL Standards 508 Seventeenth Edition & ISA 12.12.01:2007.

Reliability Prediction

MTBF (Mean Time Between Failure): MTBF in hours using MIL-HDBK-217F, FN2.

Temp	ES2161-00x0	ES2161-100x0	ES2162-00x0	ES2162-10x0
25ºC	479,437 hrs	498,345 hrs	510,264 hrs	496,653 hrs
40ºC	352,568 hrs	358,811 hrs	378,397 hrs	354,916 hrs

Per MIL-HDBK-217, Ground Benign, Controlled, G_BG_C

Ethernet Interface

Unit includes a built-in, 3-port Ethernet switch to interface an internal MII processor, to dual external 10/100M Ethernet ports. This switch has two modes of operation—it may function as a two-port store & forward Ethernet switch (default), or as a low latency hub/repeater. Switch mode is useful to facilitate a cascaded network connection between units for stacking purposes, and may extend network distances another 100 meters per segment, without consuming an additional external Ethernet switch port. Hub/repeater mode is useful to facilitate end-node media redundancy right to this device when connected to external Ethernet switches that happen to support redundancy (proprietary ring, STP, or RSTP). Hub mode is also useful for low-latency cascaded network connections, or where multi-unit network traffic is concentrated. Switch mode is the recommended mode (default), with hub mode preserved for redundant media applications using copper connections, or where low-latency network connections are required.

Note: *10Base-T is not supported in hub/repeater mode. Hubs & repeaters are inherently half-duplex devices, and full-duplex communication will not be possible in hub/ repeater mode. As such, auto-negotiation will not be supported in hub mode.*

Refer to Acromag Application Note 8500-734 for instructions on how to change the IP address of your PC network interface card in order to talk to this unit.

Network Connector (Copper): One (ES216x-1xxx), or two (ES216x-0xxx), 8-pin RJ-45 sockets for 10BaseT/ 100BaseTX connections.

Network Connector (Fiber, ES2161/2162-1xxx Models): One duplex SC-type to multi-mode transceiver for IEEE 802.3u 100Base-FX cable.

Wiring (Copper): Wired MDI-X (Ethernet switch), but unit supports automatic crossover for copper (RJ-45) connections.

Data Rate: Auto-sensed, 10Mbps or 100Mbps on copper connections, fixed to 100Mbps on fiber connection. Data rate is fixed to 100Mbps and auto-negotiation does not apply in hub/repeater mode.

Duplex: Auto-negotiated, Full or Half Duplex. Half-duplex only in hub/ repeater mode (auto-negotiation does not apply). The fiber port cannot operate half duplex in repeater mode.

SPECIFICATIONS

Ethernet Interface

Optionally, port 1 may be selected to interface with fiber-optic cable at 100Mbps. This allows a unit to operate as a local media converter, with a fiber-optic home-run connection, and a local area copper network connection.

Fiber ports are fixed at 100Mbps, half or full duplex, and auto-negotiation and automatic MDI/MDI-X crossing does not apply.

In hub/repeater mode, ports are 100Mbps only at half-duplex and auto-negotiation does not apply.

Response Time: The message turnaround time varies between 2.5ms and 6ms, with an average of 3.8ms. The refers to the typical time measured between a query to the unit and it's completed response for a switched Ethernet connection.

Compliance: IEEE 802.3, 802.3u, 802.3x.

Default IP Address: Default mode static IP address is 128.1.1.100.

Transient Protection: Transient Voltage Suppressors are applied differentially at both the transmit and receive channels of both ports.

Protocol: Modbus TCP/IP or UDP/IP with integrated web-browser reconfiguration. Unit will respond via UDP for messages received via UDP, and via TCP for messages received via TCP. Up to 10 Modbus TCP/IP sockets are supported using port 502 (reserved for Modbus). The number of sockets limit does not apply to messages sent via UDP/IP, as UDP is a connectionless protocol. Unit functionality is configured via memory map registers using Modbus commands & built-in web pages.

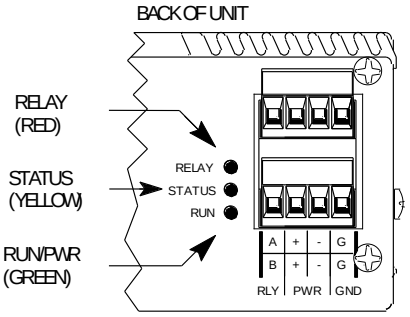
MAC Address Table: 1K MAC Address table.

Password/User-Name Default: Default web-browser password for access is "password" and the user-name is "User".

Network Distance: Distance between two network devices is generally limited to 100 meters using recommended copper cable, and 2Km using multi-mode fiber cable, but may be extended using hubs and switches. However, the total round trip delay time along a network path must never exceed 512 bit times for collision detection to work properly.

IP Address: Can be preset by the user (static) and loaded from internal non-volatile memory, or it can be automatically acquired at startup via a network server using a BOOTP (Bootstrap Protocol), or DHCP (Dynamic Host Configuration Protocol). The unit includes a default mode toggle switch to cause the unit to assume a "known" fixed static IP address of 128.1.1.100, useful for troubleshooting purposes.

Controls & Indicators



LED Indicators (Rear Panel):

Rear System Status Indication (Located next to power terminals)

RELAY (Red) – Indicates energized state of adjacent SPST-NO contacts A & B with ON indicating closed contacts, OFF indicating OPEN contacts. ON by default following power-up indicates a failsafe contact setting (normally energized).

STATUS (Yellow) – Slowly blinks ON/OFF in default mode, blinks rapidly if a watchdog timeout has occurred.

RUN (Green) – Blinks momentarily on power-up and turns constant ON if power is on and unit is OK. Continuous flashing on power-up may indicate that the network cable was not connected or is bad. If you power without a network cable connected, LED will flash until you connect the cable. It will not start flashing if the cable is later disconnected after a link has already been established. Continuous flashing ON/OFF may also indicate unit is in "wink" ID mode.

Controls (Front-Panel):

External (User Access)

Reset/Default Address Toggle: This momentary toggle switch is located on the front panel adjacent to the network LED indicators. It is used to either reset the unit (momentary toggle down), or toggle the unit into, or out of, Default Communication Mode (toggle up, hold for 4 seconds). In Default Mode, the unit assumes the fixed static IP address "128.1.1.100", a default subnet mask "255.255.255.0", a default username of "User", and a default password of "password". This switch can also be used to restore the unit to its initial factory configuration by holding the switch in its default position while powering up the unit (see "Getting Out Of Trouble" in the Troubleshooting section for more information). Reset is useful for trouble-shooting purposes without having to cycle power. If communication with a unit is ever lost, it can typically be restored by simply resetting the unit via this switch, or by cycling power.

Front Network Status Indication Per Port (next to network ports)

These LED's indicate different information when network ports are in switch mode than hub/repeater mode. In switch mode, column 1 corresponds to port 1 status, column 2 corresponds to port 2 status.

Note: Switch Mode is the default mode of communication for this device.

Port SWITCH Mode

Port 1 and Port 2 Indicator Columns 1 & 2, Top to Bottom

3 Green (No Function) – LED (top) has no function in switch mode.

2 Yellow (LINK/ACT) – Constant ON indicates auto-negotiation has successfully established a connection/link. Blinking indicates Ethernet activity on the link (Ethernet connection is busy/traffic is present). OFF indicates no link.

1 Yellow (FDX/COL) – Constant ON indicates full-duplex connection (no collisions possible). Intermittent ON indicates collisions (half-duplex). Constant OFF indicates half-duplex and no collisions.

0 Yellow (SPEED) – This LED (bottom) indicates 100Mbps speed (ON), and 10Mbps speed (OFF).

Port HUB/REPEATER Mode

Indicator Column 2 (Top to Bottom)

3 Green (ACT) – The top LED indicates repeater activity on the link (ON or blinking).

2 Yellow (ERR3) – ON indicates an error has been encountered at internal port 3 (the processor MII port). Error is related to isolation, partition, jabber, or JK error.

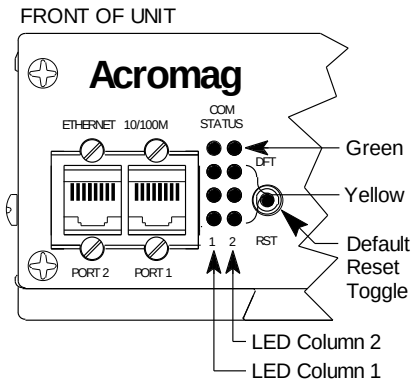
1 Yellow (ERR2) – ON indicates an error has been encountered at network port 2 (the left port). Error is related to isolation, partition, jabber, or JK error.

0 Yellow (ERR1) – ON indicates an error has been encountered at network port 1 (the right port). Error is related to isolation, partition, jabber, or JK error.

Note: Fiber ports are 100Mbps only, half or full duplex. In hub/repeater mode, both ports are 100Mbps only and half-duplex.

SPECIFICATIONS

Controls & Indicators



SWITCH MODE
LED Column 1 - Port 1
LED Column 2 - Port 2

GREEN - No Function in Switch Mode.

YELLOW - Link/Activity: ON if Linked/Blinks if Activity.

YELLOW - Full-Duplex/Collision: ON for FD, Blinks for HD Collisions, OFF for HD and No Collisions.

YELLOW - Speed: ON for 100Mbps, OFF for 10Mbps.

HUB/REPEATER MODE
1=LED of Column 1
2=LED of Column 2

GREEN: 1=Hub Activity, 2=Hub Collision.

YELLOW: 1=MII/CPU Link/Activity, 2=MII/CPU Error.

YELLOW: 1=Port 2 Link/Activity, 2=Error at Port 2.

YELLOW: 1=Port 1 Link/Activity, 2=Error at Port 1.

SPECIFICATIONS

Controls & Indicators

Indicator Column 1 (Top to Bottom)

3 Green (Collision) – The top LED turns ON when a collision occurs.

2 Yellow (Link3/Rx ACT) – Constant ON indicates auto-negotiation has successfully established a connection/link at internal port 3 (the processor MII port). Blinking indicates receive activity on the link (connection is busy/traffic is present). OFF indicates no link.

1 Yellow (Link2/Rx ACT) – Constant ON indicates auto-negotiation has successfully established a connection/link at network port 2 (the left port). Blinking indicates receive activity on the link (connection is busy/traffic is present). OFF indicates no link.

0 Yellow (Link 1/Rx ACT) – Constant ON indicates auto-negotiation has successfully established a connection/link at network port 1 (the right port). Blinking indicates receive activity on the link (connection is busy/traffic is present). OFF indicates no link.

CABLES & CONNECTORS

Copper Connections

The minimum cable required for full operation of this device is Category 5. The term "Category" refers to classifications of UTP (Unshielded Twisted Pair) cables. There are 3 main categories of cable – Category 3, Category 4, and Category 5. The differences in classification is found in their electrical performance and this is documented in the TIA/EIA 568A standard. Category 5 cable includes four twisted wire pairs at eight twists per foot.

This device is designed for use in harsh industrial environments. Acromag recommends the use of shielded cable when wiring to this device. Select STP (Shielded Twisted Pair) cable rather than UTP (Unshielded Twisted Pair). The use of shielded cable will help protect the transmitted data from harmful EMI (Electromagnetic Interference) and RFI (Radio Frequency Interference). It will also help to lower your radiated emissions by keeping the cable from emitting EMI and RFI.

There are two types of cable: solid cable and stranded cable. Stranded cables are more flexible than solid cables. But since attenuation is higher for stranded cables than solid conductor cables, these are generally reserved for short runs and patch applications less than 6 meters.

Currently there are two types of shielding employed in Category 5 STP cable: single-shielded cable and double-shielded cable. Both of these cables have the same core and jacket as UTP cables, but also include a thin foil outer shield that covers all four twisted-wire pairs. Some variations will also include a drain wire that encircles the outer foil. The double-shielded version adds an outer wire screen that wraps around the foil shield and also functions as a drain wire. The drain wire or wire screen typically makes contact at each end of the cable with the metal shield around special shielded RJ45 plug connectors. The metal shield of these connectors then makes contact with the metal shield of shielded RJ45 sockets (the EtherStax units do not have this shield because they are safety isolated from their enclosure/earth ground). The socket shield may make direct contact with earth ground, or it may capacitively couple to earth ground. In addition to minimizing radio frequency and electromagnetic interference, this arrangement also has the added benefit of enhanced protection from ESD (Electro-Static Discharge).

CABLES & CONNECTORS

Copper Connections

Acromag recommends the use of *enhanced* Category 5 cable (CAT-5e). This cable has all the characteristics of Category 5, but includes enhancements that help to minimize crosstalk. It is rated for frequencies up to 200MHz, double the rate of Category 5. Category 5e cable also has a greater number of turns-per-inch in its twisted pairs, making its performance more suitable for applications that make use of all four wire pairs for simultaneous bidirectional data transmission (full-duplex). This cable is defined in TIA/EIA-568A-5 (Addendum 5).

Note that you do not need to use a crossover cable to connect your PC to an EtherStax unit, as it is auto-crossing (copper only). However, the auto-crossing feature is not applicable to the fiber-port. Fiber ports require that transmit be manually crossed over to receive, and visa-versa.

You may obtain cable from other vendors in varied lengths and colors, as required for your application. For example, shielded CAT-5e cable is available from the following vendors:

- L-com Connectivity Products, www.L-com.com
- Pro-Link, www.prolink-cables.com

For very noisy environments or in the presence of strong electrical fields, you can obtain double-shielded CAT-5e cable and shielded RJ45 plugs from the following vendors (the EtherStax does not require shielded plugs as it uses unshielded RJ45 connectors):

- L-com Connectivity Products, www.L-com.com, see cable model TFSC2004 and shielded plug T8P8CSR.
- Regal Electronics, www.regalusa.com, see shielded plug model 1003B-8P8CSR-C5.

Premium double-shielded Category 5e standard and crossover cables in variable lengths can be obtained from Lumberg at www.lumbergusa.com (refer to their EtherMate line). For example, specify RJ45S-RJ45S-656/B/3M for a double-shielded, 3 meter straight cable. Specify RJ45S-RJ45S-656/BX/3M for a double-shielded, 3 meter crossover cable.

Acromag offers a cable termination kit for building cables that take advantage of the special clip-frame provided at the RJ45 socket of the EtherStax unit. These are not required as standard plugs are still supported, but will help to secure network connections for units subject to severe shock and vibration.

Cable Termination Kit ESA-CTK: The EtherStax enclosure includes a panel mounted frame around the RJ45 network port that accommodates special IP20 clip-type plug connectors that help to secure the network connections from shock and vibration. You can still utilize standard RJ45 modular plug connectors, but if you want the added security of this clip frame, then you have to use the compatible cable plug connectors provided by this kit. This kit provides the male plug and sleeve housing for one end of Category 5 Ethernet cable that will mate to this frame. You can purchase these items from us by referencing Acromag ESA-CTK. The Category 5 cable is not included, but readily available from other vendors. You can use a standard modular crimping tool for attaching the RJ45 plug of this kit to your cable (for example, see Phoenix crimping tool CRIMPFOX-LC-RJ45S catalog #1207420). You will need one kit for each EtherStax connection.

CABLES & CONNECTORS

Fiber Connections

Model ES2161/2162-1xxx units include an SC-type fiber-optic port for multi-mode fiber connection.
Note that the standard EtherStax units use SC-type (Stab & Click) fiber connectors. If your application requires ST (Stab & Twist) type fiber connectors, you can request this option from the factory at an additional charge.

You can obtain compatible fiber cable and accessories from a variety of other vendors, and some are listed below:

L-com Connectivity Products (www.L-com.com)
fiber.com (www.fiber.com)
Belkin (www.belkin.com)
CablesToGo (www.cablestogo.com)
CablesPlus (www.cablesplusUSA.com)

Be sure to specify dual or duplex, SC type cables or patch cords. SC cables utilize a snap-in connector that latches with a push-pull motion.

If you wish to build your own cables, you will also need special tools and equipment for cutting, splicing, and polishing the fiber.

With respect to the EtherStax, note that the auto-crossing feature does not apply to the fiber-optic ports, and the transmit and receive channels of these ports must be mechanically crossed over. Likewise, auto-negotiation does not apply to the fiber port, as the speed is fixed at 100MB. Units with a fiber port cannot be placed into hub/repeater mode, as this is a full-duplex fiber connection and hubs/repeaters operate half-duplex.

For reference, when facing the front endplate of the unit, the Transmit (Tx) channel is the bottom half of the SC fiber connector, while the Receive (Rx) is the top half of the fiber connector.

REVISION HISTORY

The following table shows the revision history for this document:

Release Date	Version	EGR/DOC	Description of Revision
JUN 2008	A	BC	Initial Release (Ref ECN 08F000).
AUG 2008	B	BC	Reference ECN 08H011.
DEC 2008	C	BC	Reference ECN 08M007.
AUG 2009	D	BC	Reference ECN 09H005.
JAN 2010	E	BC	Reference ECN 10A001.
14 FEB 2018	F	CAP/ARP	Added uB models to the Accessories.