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

Analog Current & Voltage Output Models

ES2171 16CH 0-20mA/4-20mA Output Model
ES2172 16CH ±10V/±5V Output w/8B Interface

USER'S MANUAL

Target Device

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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.

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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 if you need help.

This is an Ethernet device with built-in web capability. This 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 them.

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 factory fresh, you can talk to it at this address in either mode.

If your unit is not factory fresh 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.

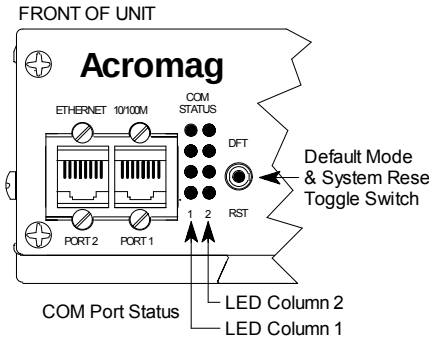
Try browsing the unit with your web browser address at **http://128.1.1.100**. If your unit is in default mode, you should be presented with the home page.

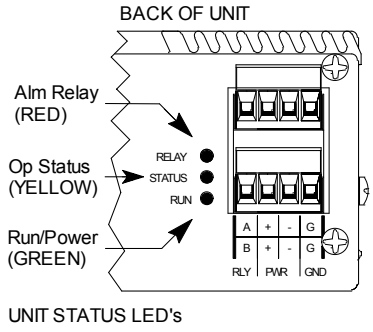
If you are using IP address 128.1.1.100, and you still can't talk to the unit…

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 factory-fresh 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 instead, you need to do the following:

First check that your network cable is connected to the unit and to your PC. If you initially power 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.

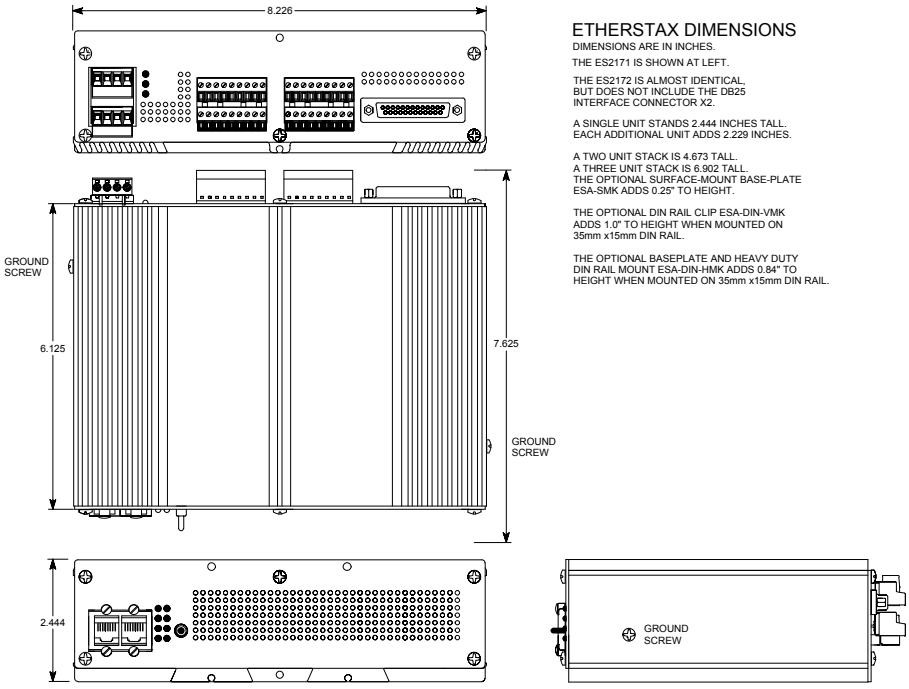
If you have checked your network connections, tried resetting the unit, and the green RUN LED still continues to blink, then you may need to follow the procedure for restoring the EtherStax to its Initial Configuration. This procedure is located at the end of the Trouble-Shooting section of this manual under "Getting Out Of Trouble" on page 45. 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.

Note: If you do use restore and want to return the unit to service, you will have to rewrite your IP address. The calibration reference will additionally have to be restored separately via the Restore Factory Voltage Reference Value button of the Output Calibration Page. Next, be sure to also access the Output Calibration page and perform an Output Self-Calibration. Any manual calibration that you have done 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 or reprogramming.

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 3 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 ES2171 IS SHOWN AT LEFT.

THE ES2172 IS ALMOST IDENTICAL, BUT DOES NOT INCLUDE THE DB25 INTERFACE CONNECTOR X2.

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.

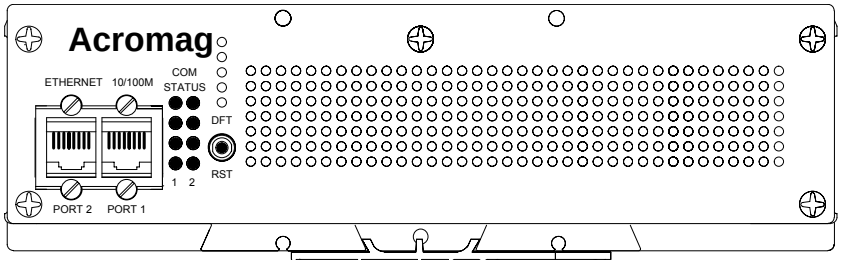
THE OPTIONAL BASEPLATE AND HEAVY DUTY DIN RAIL MOUNT ESA-DIN-HMK ADDS 0.84" TO HEIGHT WHEN MOUNTED ON 35mm x15mm DIN RAIL.

MOUNTING AND DIMENSIONS

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

UPWARD

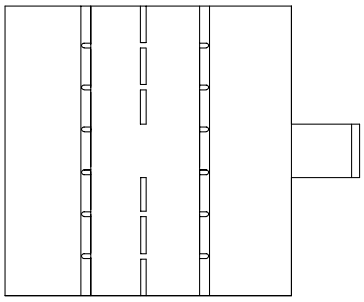
DIN MTG CLIP OF ESA-DIN-VMK

This side of clip should align with top of rail

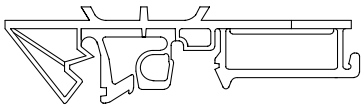
TO HANG: Tilt unit and place TOP of clip over upper lip of DIN rail. Press bottom towards rail to snap in place.

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

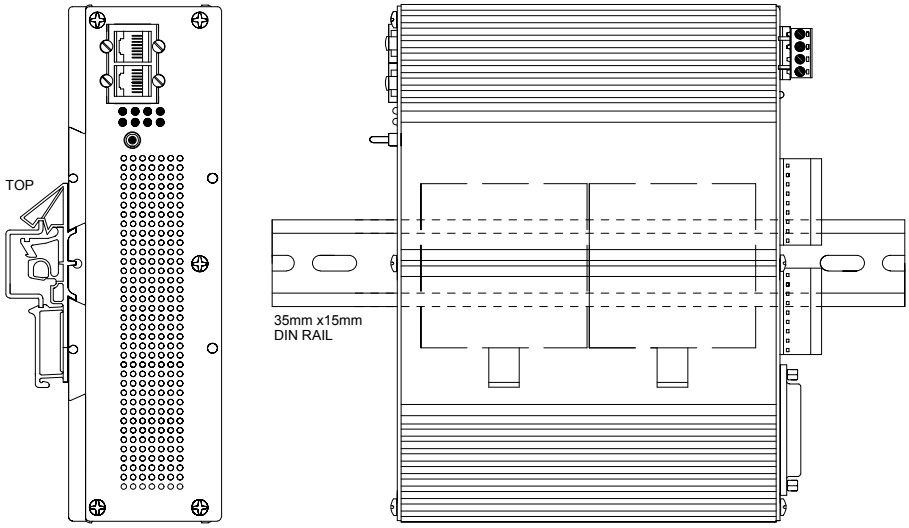
Simply slide the clips of this kit into the dovetail channel at the bottom of the enclosure. You can use one clip, or both (recommended) DIN clips of this kit to mount a single unit. For a stack of two units, both clips must be used. To remove a unit from the DIN rail, you have to lift the assembly upward 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.

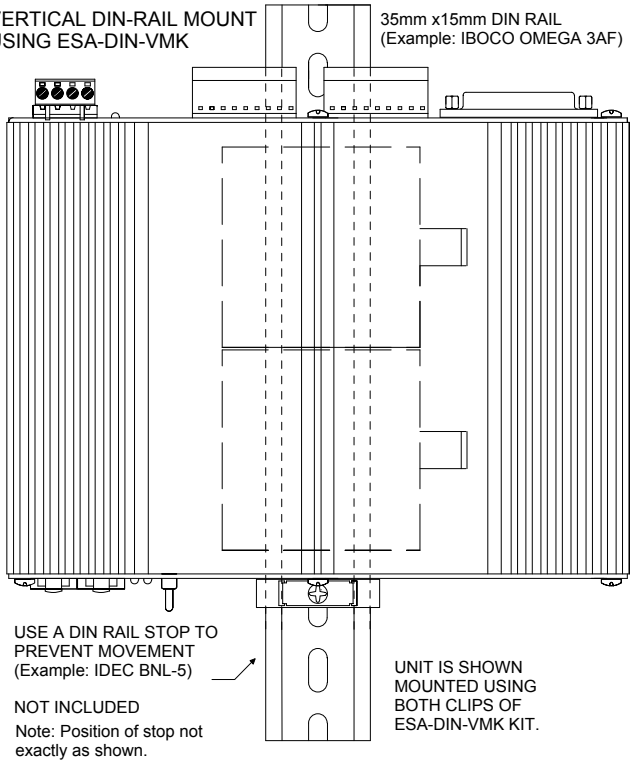
ETHERSTAX MOUNTING WITH ESA-DIN-VMK



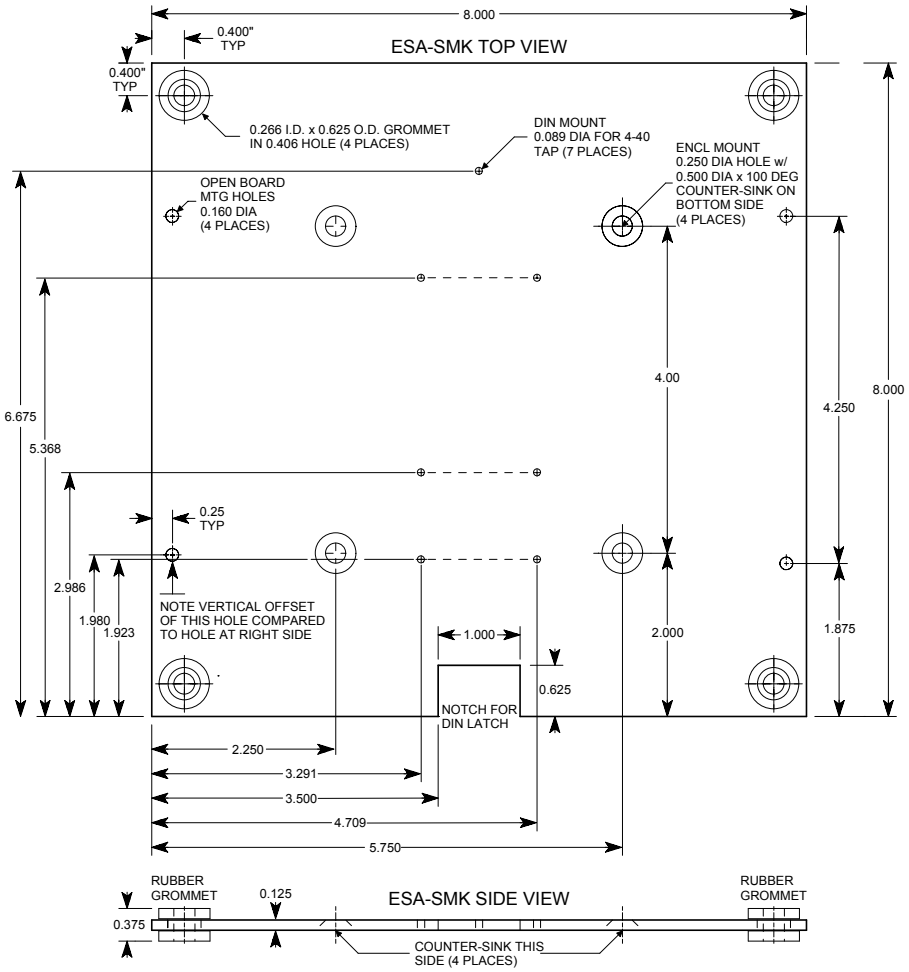
IMPORTANT: Stack no more than 2 units with ESA-DIN-VMK.
Use both clips of this kit with two units stacked together.

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.

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 1/4-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 1/4-20 x 0.375 Flat-Head, 100° Counter-Sink, Phillips
4 Rubber Grommet, 0.625 O.D. x 0.266 I.D

The 1/4-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.

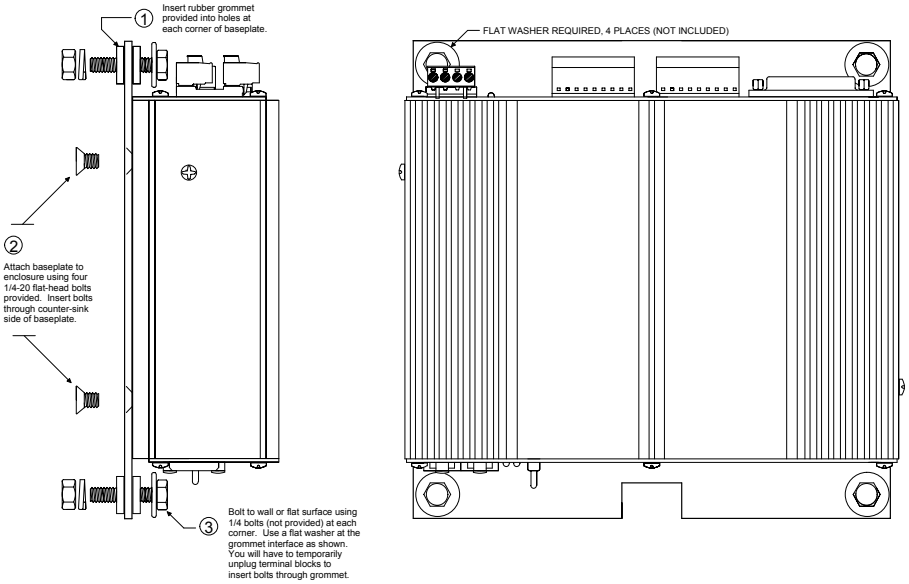
Then use the four 1/4-20x0.375, flat head, counter-sink bolts provided to bolt this plate to the bottom of the enclosure. Be sure to insert the bolts from the counter-sink side of the plate.

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

Use 1/4-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.

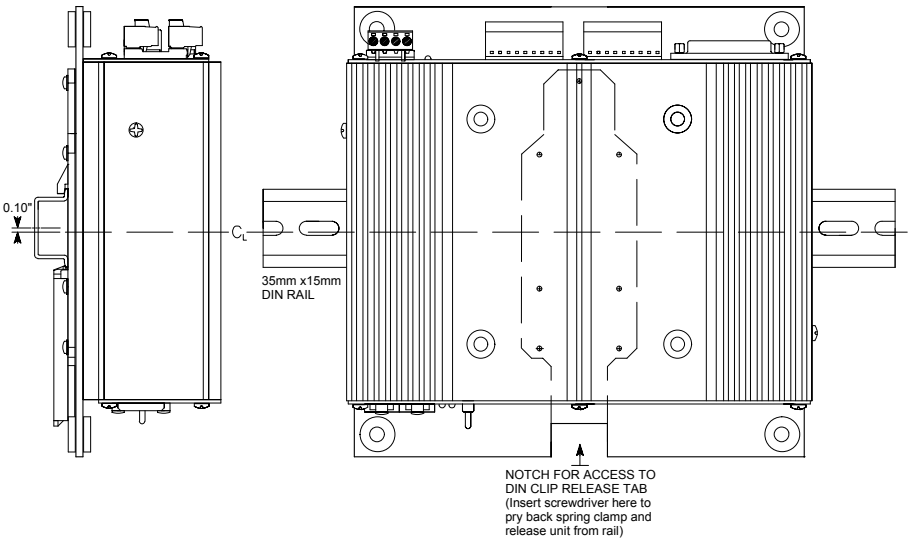
MOUNTING AND DIMENSIONS

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.

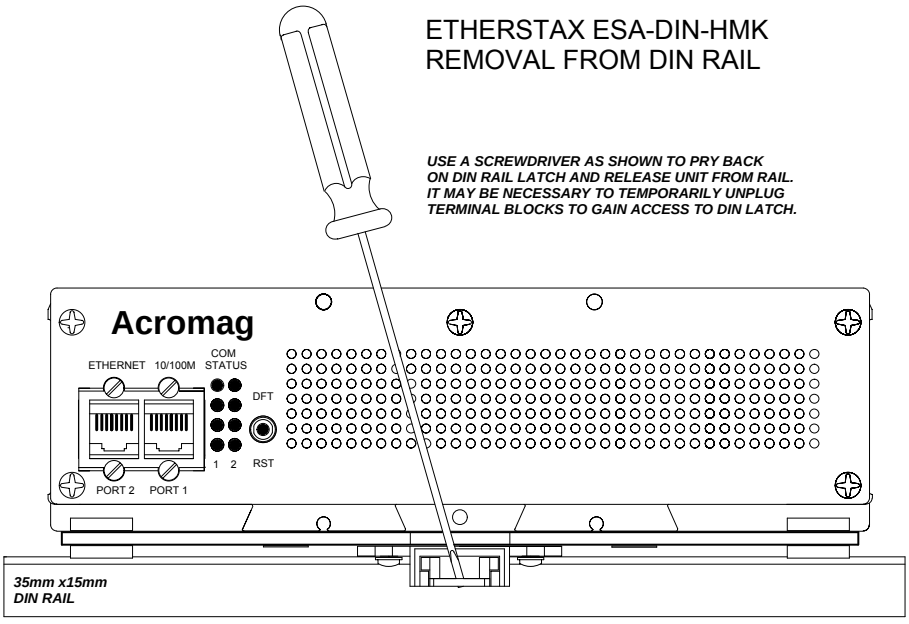
ETHERSTAX MOUNTING WITH ESA-DIN-HMK



ESA-DIN-HMK Kit Contents:

1	Pre-Drilled Aluminum Base-Plate, 8 x 8 x 0.125.
4	1/4-20 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

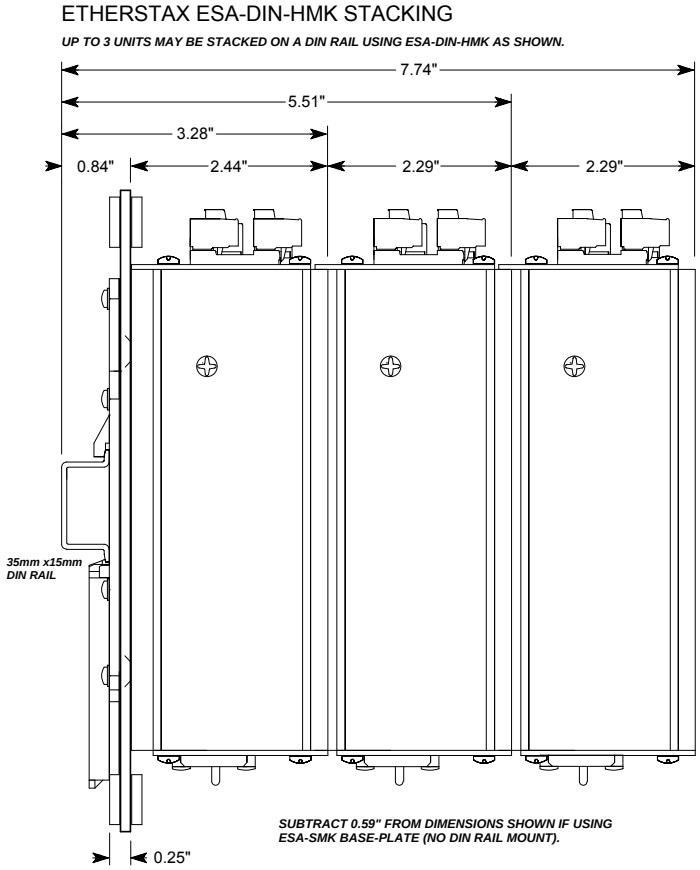
To attach or remove the ESA-DIN-HMK to/from the DIN Rail, use a screwdriver tip inserted into the slot at the end of the DIN clip, in the area of the notch of the base-plate as shown below. Pry back to compress the DIN clip spring and release it from the rail. You may have to temporarily unplug the terminal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



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

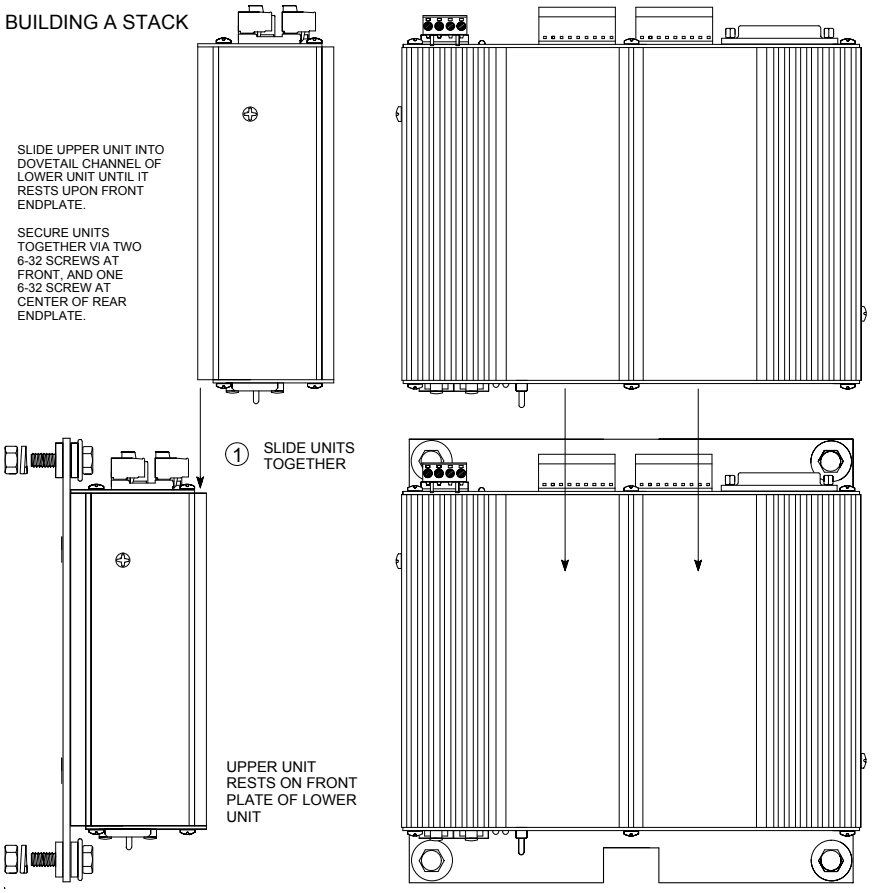
Subtract 0.59 inches from dimensions shown if using ESA-SMK (i.e. no DIN rail mount).

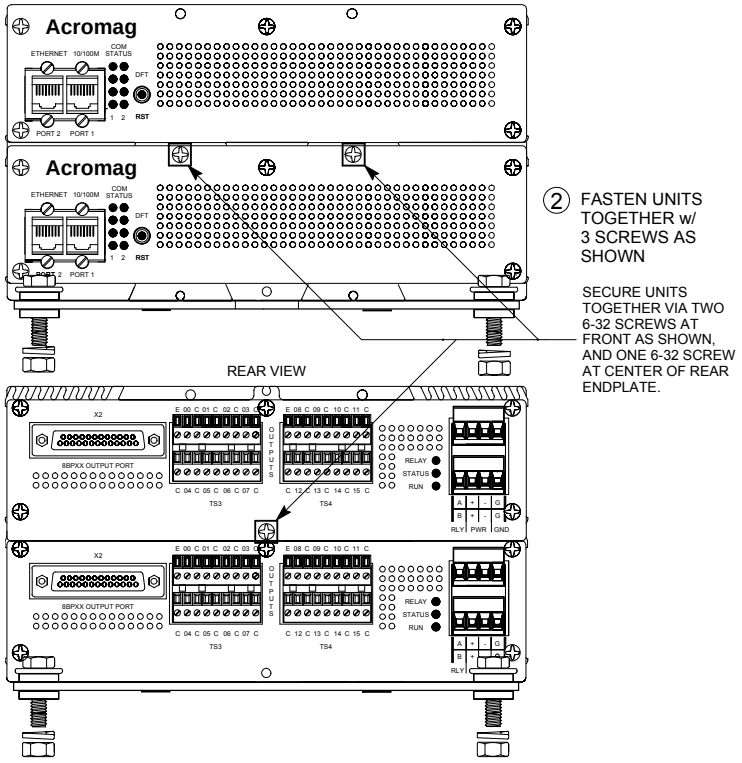
MOUNTING AND DIMENSIONS

The drawing at right shows how to stack units together.

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

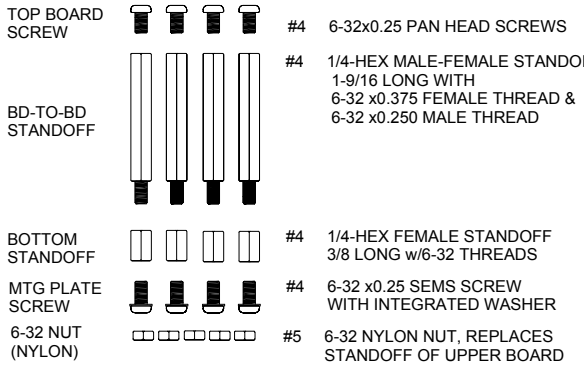
WARNING: *Be sure to grip the edges of unit firmly when stacking units and avoid dropping it.*



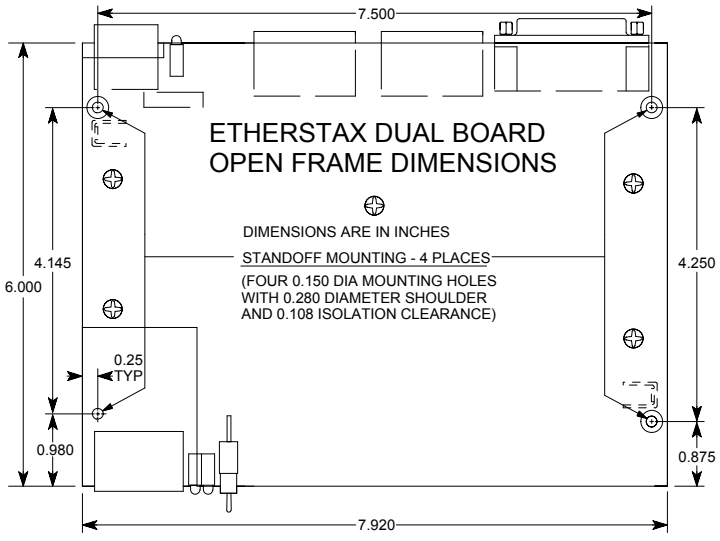


Open-Board Mounting Kit ESA-OMK: EtherStax units can be ordered and mounted without their enclosure. This kit includes the jack-screws, and fasteners necessary to stack two open circuit boards together (or two dual board assemblies like this model), plus the standoffs and screws for mounting this assembly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

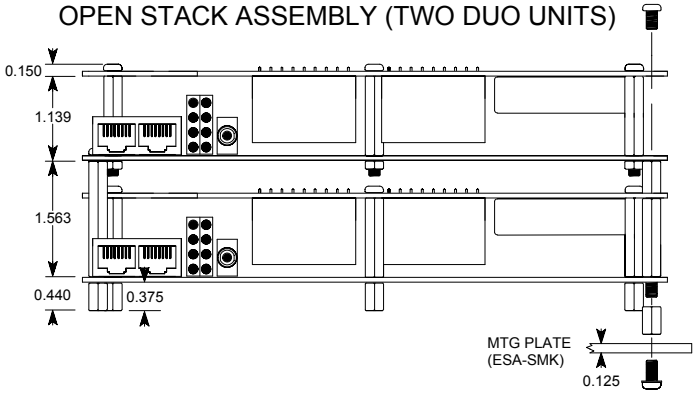
ESA-OMK KIT CONTENTS



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.*

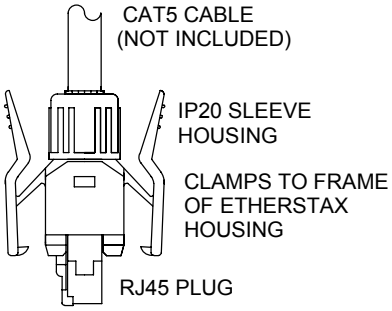
You should take adequate measures to protect open-frame mounted units from dust, debris, and ESD.

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.

CONTROLS & INDICATORS

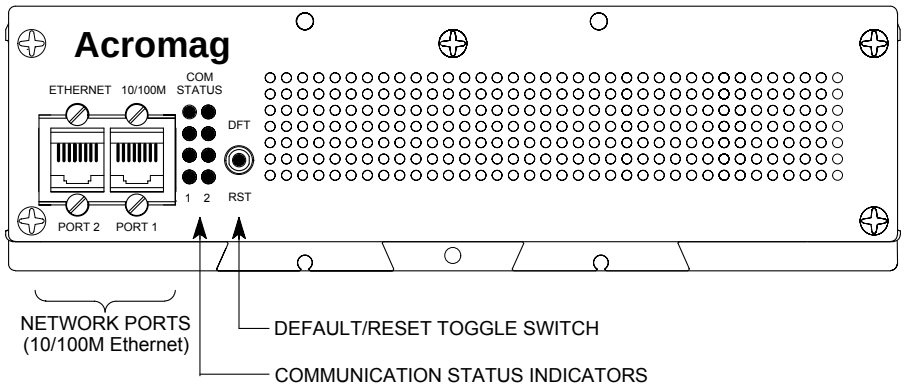
Front Panel

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.

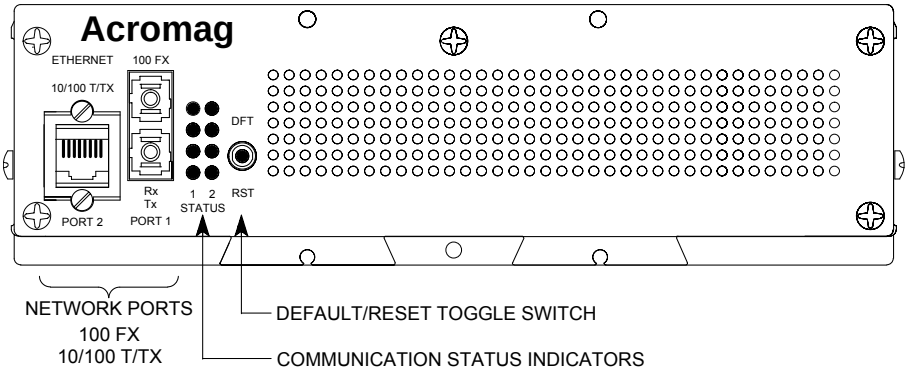
The toggle switch is used to toggle the unit into or out of Default Mode (toggle up & hold 4 seconds), or to reset the unit (toggle down). It can also be used to restore/sanitize the unit by holding it depressed while applying power (see Getting Out of Trouble).

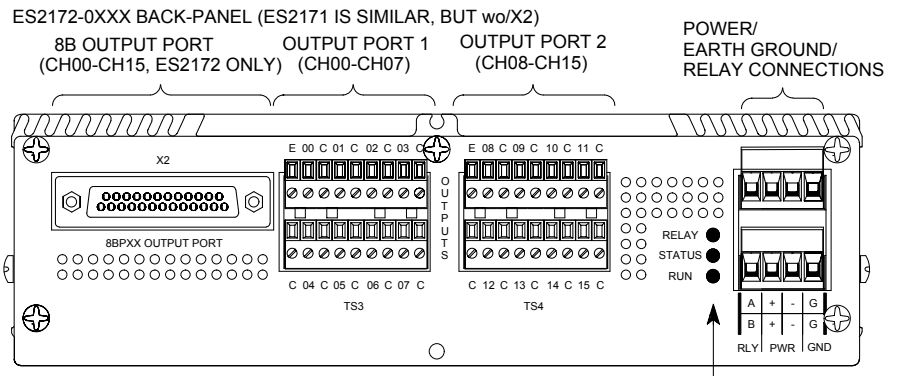
In Default Mode, the yellow STATUS LED on the back of the unit will flash slowly and the unit will assume a fixed static IP address of "128.1.1.100", a default subnet mask of "255.255.255.0", a default username of "User", and a default password of "password".

ES217X-0XXX FRONT-PANEL



ES217X-1XXX FRONT-PANEL
(w/ SC-TYPE FIBER PORT 1)

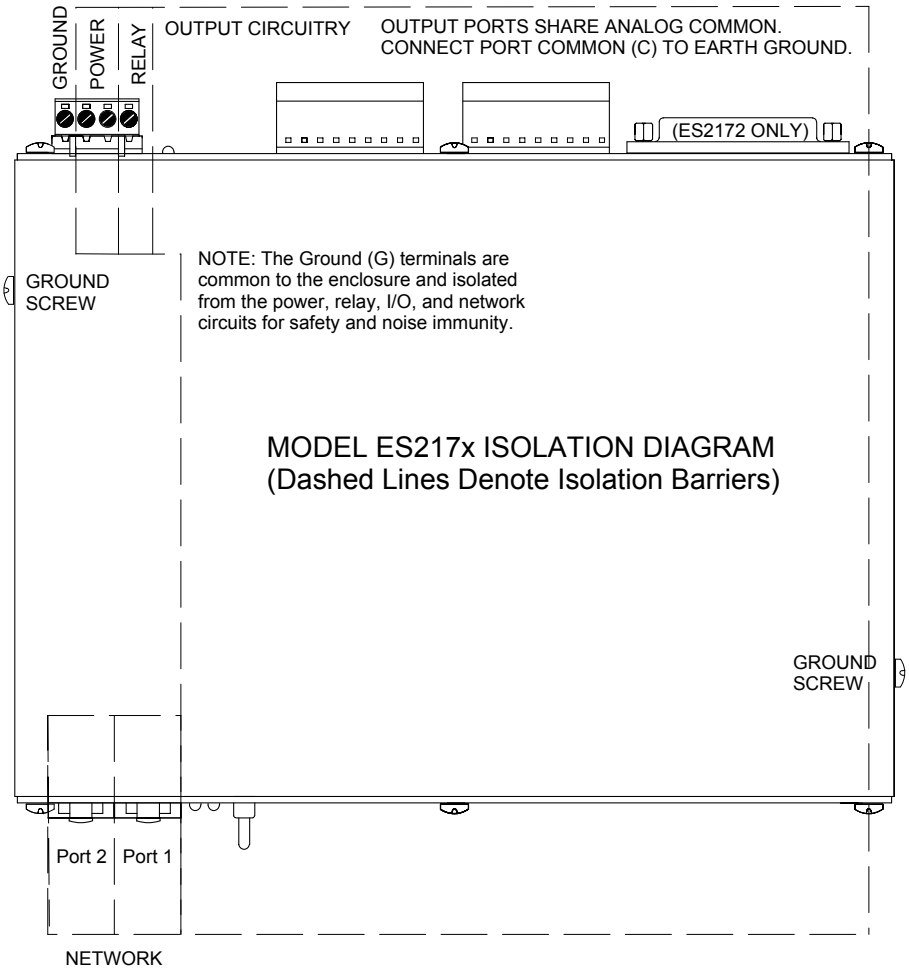




ES2172 OUTPUTS ARE VOLTAGE, ES2171 OUTPUTS ARE CURRENT
ES2171 DOES NOT INCLUDE 8B OUTPUT PORT X2

The Earth Ground (G) terminals are common to the enclosure and isolated from I/O, power, and relay connections.

UNIT INDICATORS - Alarm (Red), Status (Yellow), and Run (Green).



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 I/O 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.

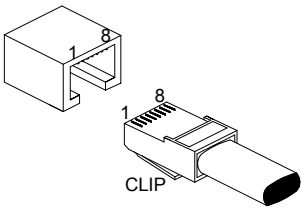
In either case, you are limited to 100 meters between any two devices.

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

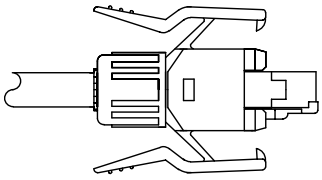
SPEED	DISTANCE	CABLE
10Base-T	100M	CAT 3, CAT 4, or CAT 5 UTP
100Base-TX	100M	CAT 5/5e UTP/STP

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.

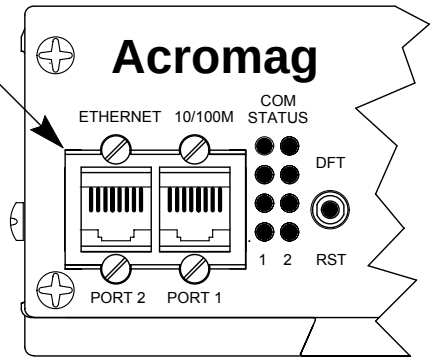
For compatible male plug connectors, order the Cable Termination Kit, Acromag ESA-CTK.

FRONT OF UNIT

RJ45 Clip Frame for secure media connections.



For Compatible Connectors, see ESA-CTK Cable Termination Kit

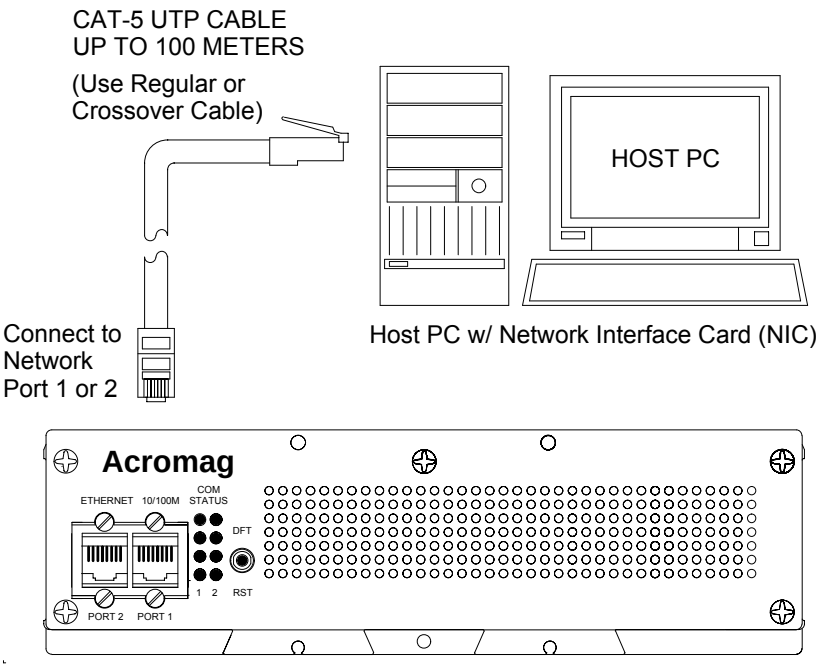


The RJ45 clip frame mates with the compatible connectors of the ESA-CTK for increased immunity to shock & vibration.

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 ES2171/2172-1xxx, 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.

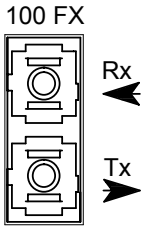
The next section reviews the operation of Ethernet hubs and switches as it relates to the built-in Ethernet switch of this device, which may optionally operate as an Ethernet hub/repeater. You can skip the next two pages if you are already familiar with these terms.

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.

This device has a built-in Ethernet switch that can alternately operate as an Ethernet hub. To understand which mode to use and how to network connect Ethernet devices, you need to review switch operation and the differences between a switch and a hub. If you are already familiar with these terms, skip over this information and review the various network connections outlined in the following pages.

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 provides 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.

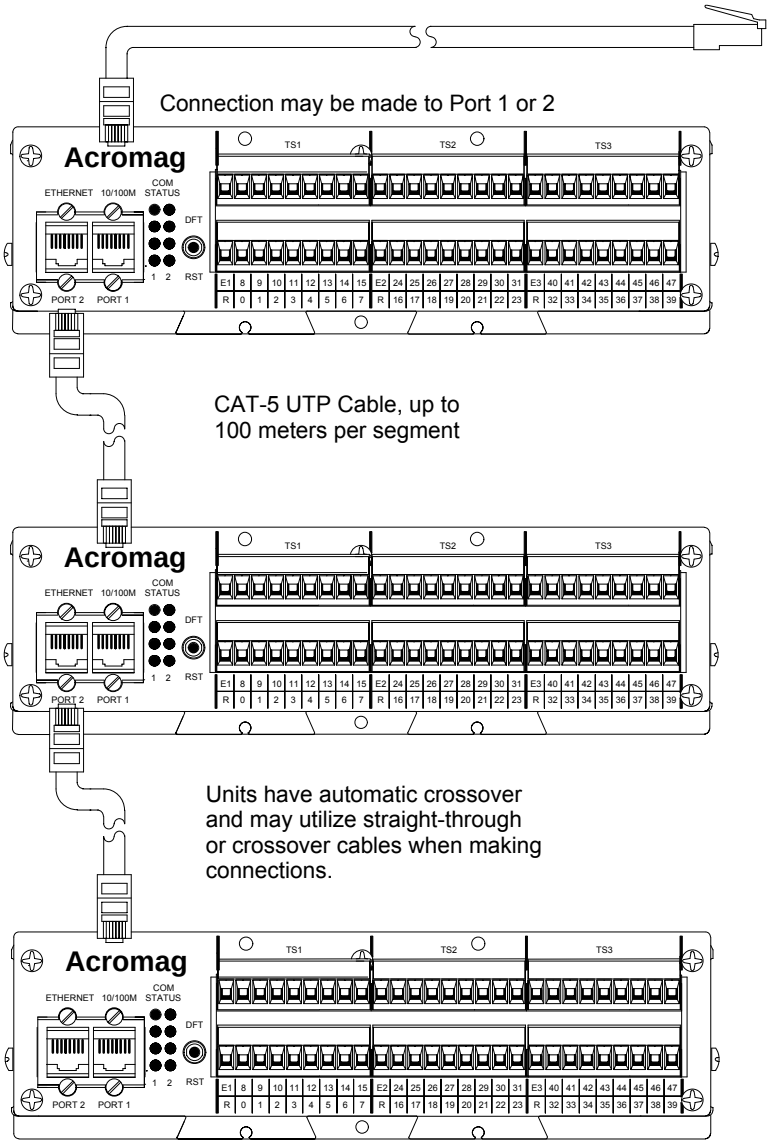
CONNECTIONS

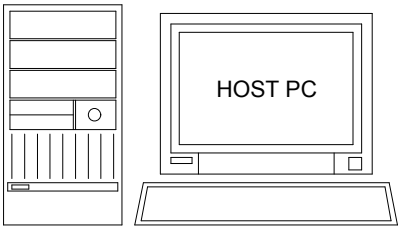
Network

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.

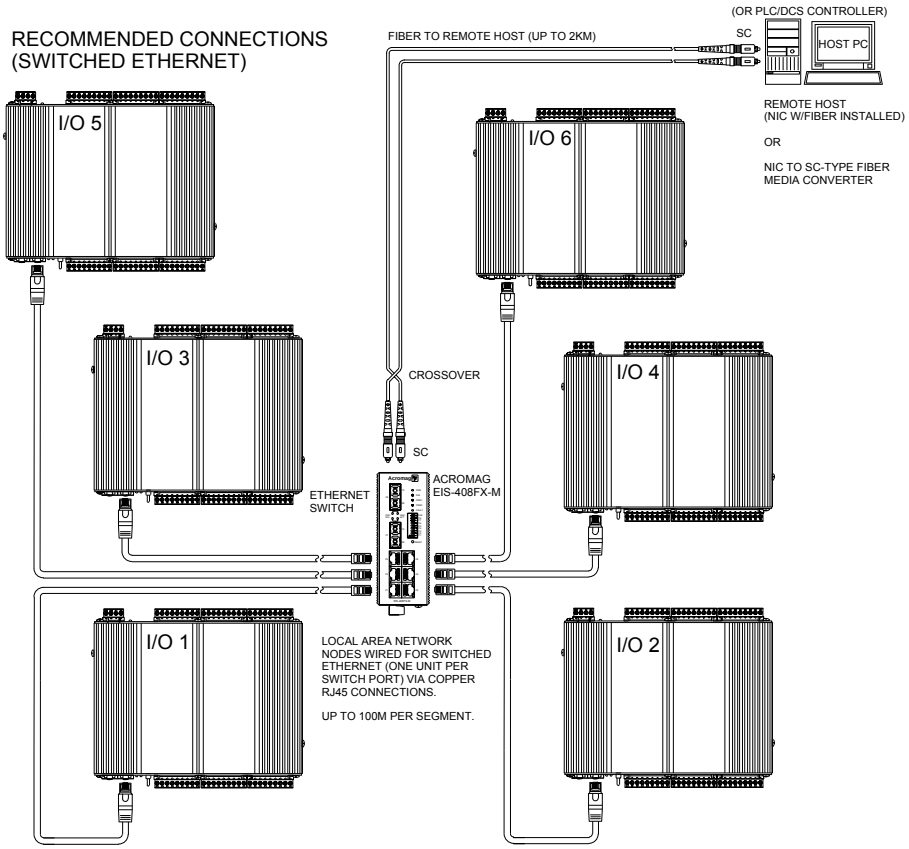
Limit cascaded connections to 4 segments.

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 ES2171/2172-1000, 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, thereby 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.

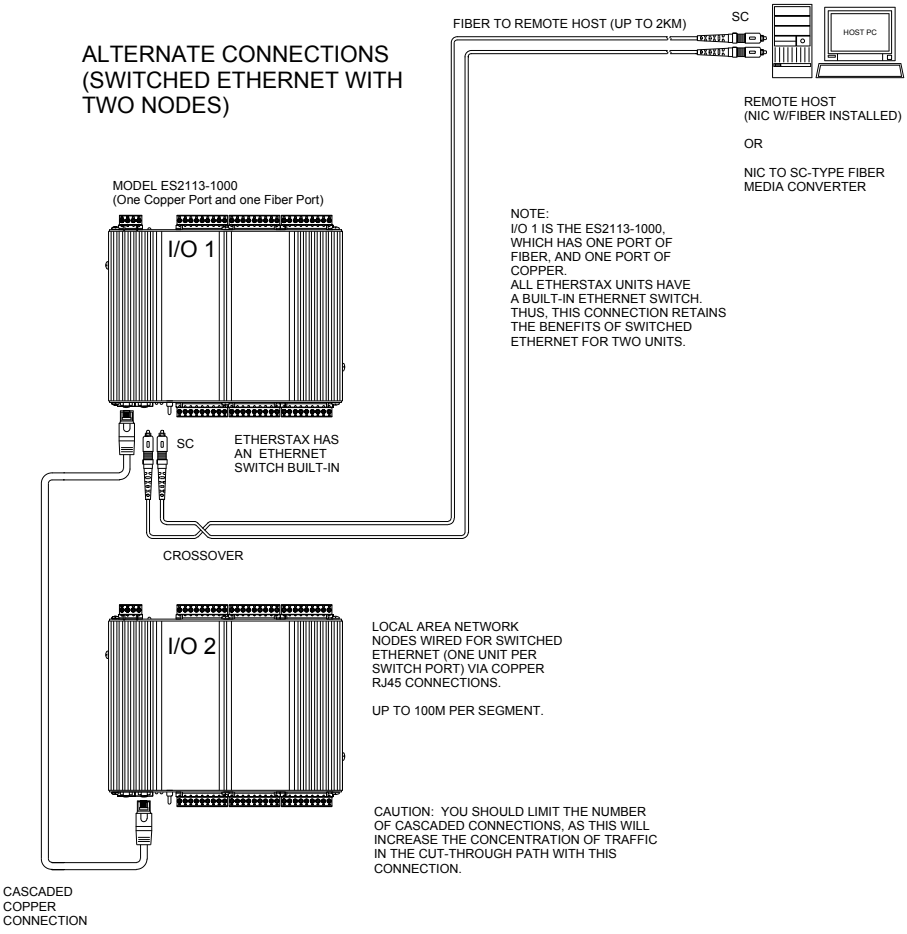
However, note that the fiber connection carries the traffic of both units and this segment is subject to data collisions.

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

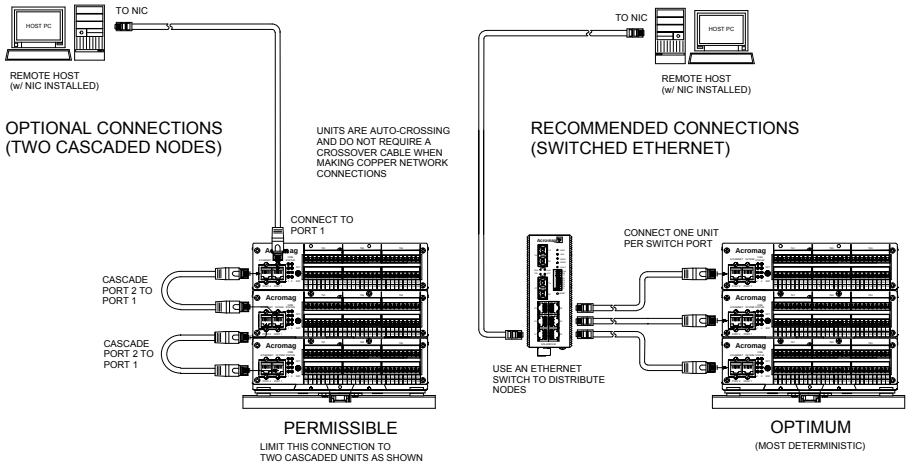
Unfortunately, you cannot avoid concentrated traffic in the main host segment, even with a switch. As such, this aggregate path is usually chosen to operate at a higher data rate than the downstream segments. With the traffic of many Ethernet devices, this would mean that if the main trunk runs at 100MB, 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.



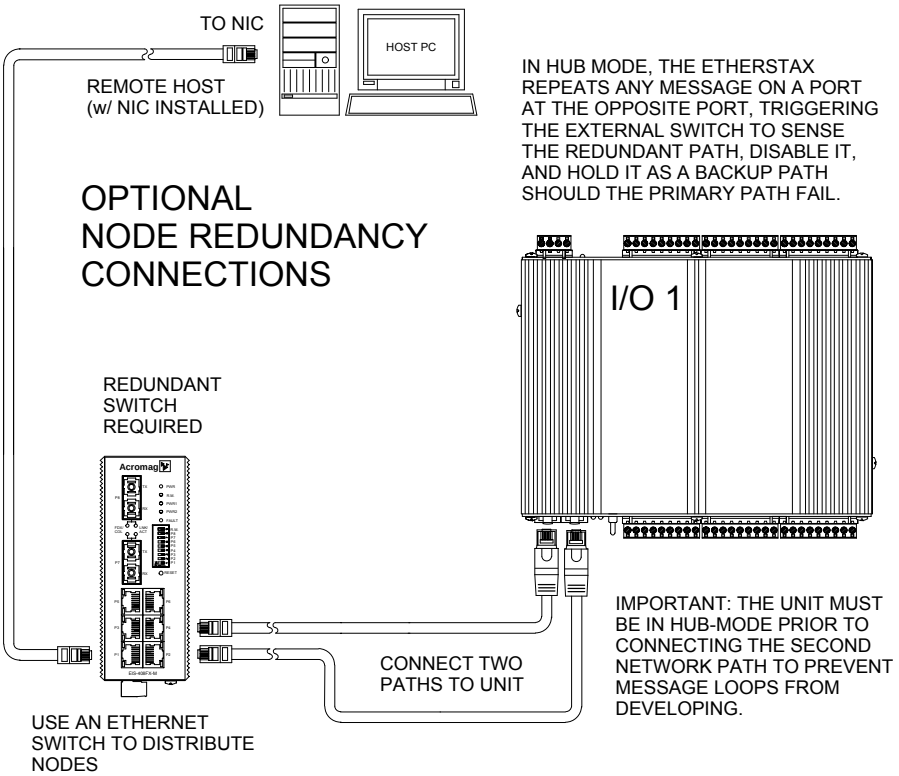
For optimum performance, the ideal recommended approach is to utilize an external Ethernet switch and connect no more than one Ethernet device per switch port—this is what is referred to as switched Ethernet. Connection in this manner avoids the negative effects of concentrated traffic and suppresses 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-Reliabilty Applications

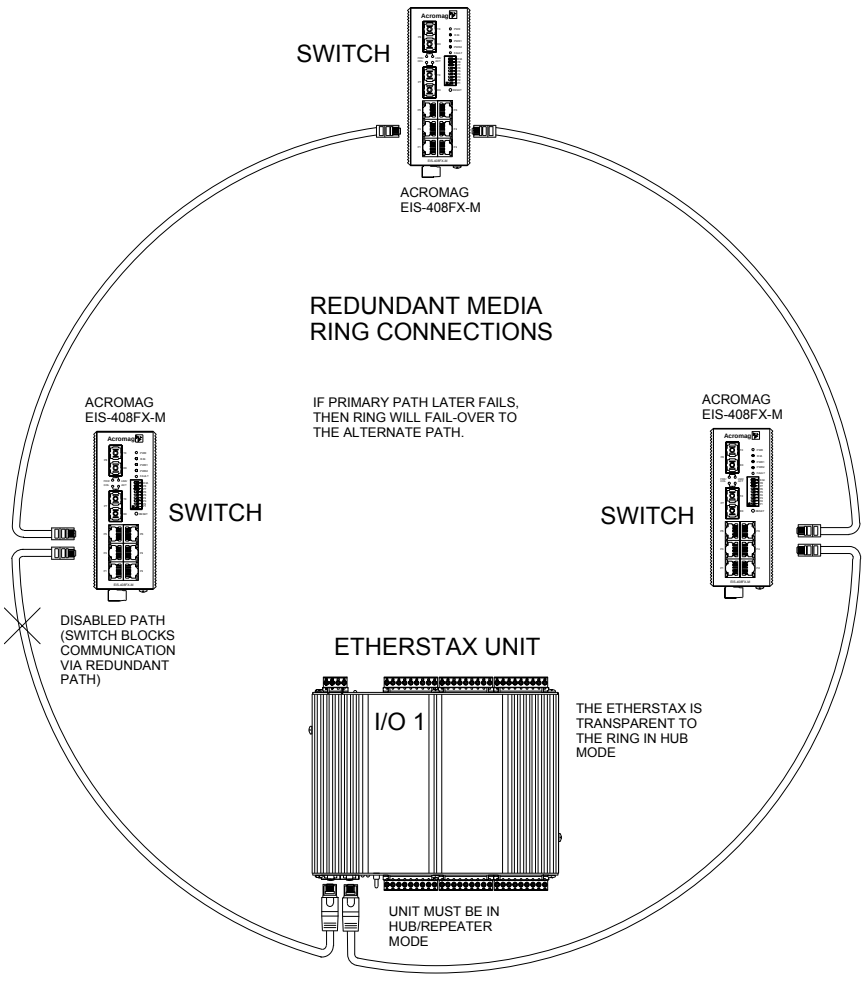
TIP: *If you connect to both ports of this device at the same time from your network, and you notice that the unit is cyclically resetting itself, then this may indicate that your network connections or external network switch(es) are not already setup to handle redundant media connections. Do not connect 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).

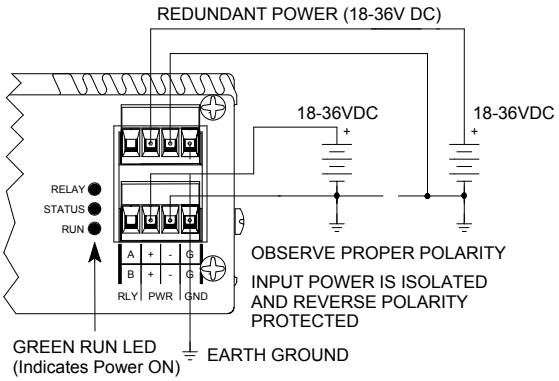
The figure below depicts the EtherStax unit connected to a redundant switch media ring. Here we use an Acromag EIS408FX-M switch to build the ring which supports redundant ring. The EtherStax unit must be placed in hub/repeater mode prior to making these connections. Connected this way, the EtherStax 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.



Power

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

ES2171 Models require an additional power connection between the output excitation (E) and common terminal. There are two E terminals provided and both are series diode-coupled, allowing a second "redundant" excitation supply to be connected for backup. You cannot operate the current outputs without 9-16V of excitation applied.

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

NOTE – External Fuse: If unit is powered from a supply capable of delivering more than 3A to the unit, it is recommended that current to the unit be externally limited via a high surge tolerant fuse rated for a maximum current of 4A or less (for example, see Bel Fuse MJS series).

Inp Power ES217x-0 (3.3W)

Voltage	Current
18VDC	179mA Max
24VDC	133mA Max
36VDC	90mA Max

Inp Power ES217x-1 (4.6W)

Voltage	Current
18VDC	251mA Max
24VDC	186mA Max
36VDC	125mA 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. Additionally, connect the unit's GND terminal (G) to earth ground as shown above. Alternately, you may utilize the earth ground screw at each side of the enclosure to complete the earth ground path.

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

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 grounds may be recommended at the analog common leads (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.

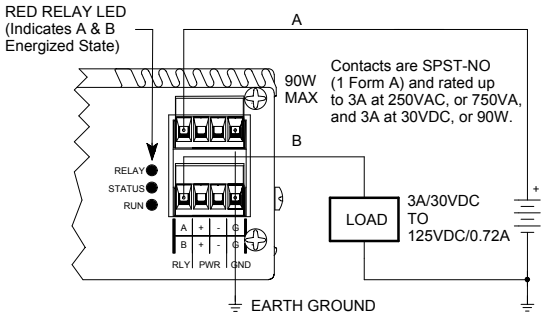
You can configure these contacts as failsafe or non-failsafe.

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.*

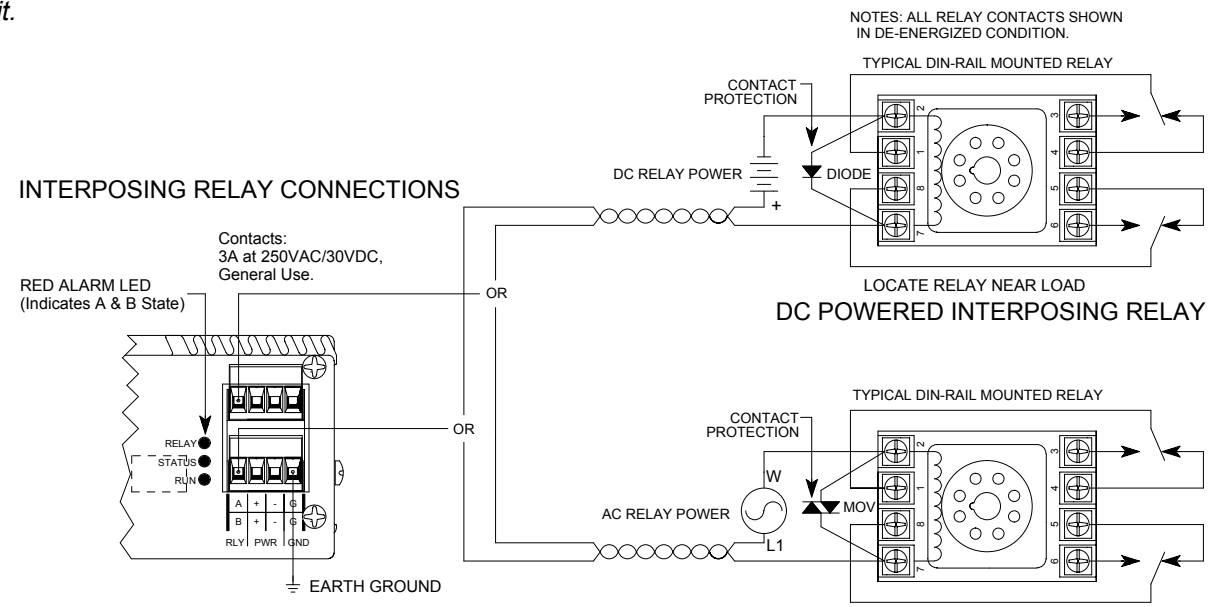
✓ The local alarm relay contacts are located adjacent to power and are labeled A & B. These contacts are switched for conditions of media failure (link loss), watchdog timeout, or power failure (failsafe only). Contacts are normally open type (de-energized), but are configurable as failsafe (normally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

ALARM RELAY CONNECTIONS - DC LOAD



The alarm contacts are rated for general use at 3A and 30VDC/240VAC, 1/8HP at 250VAC/125VAC, and C300 Pilot Duty. For control of higher energy devices, an interposing relay may be used and is connected similar to the following:

INTERPOSING RELAY CONNECTIONS



When switching inductive loads it is good practice to have a contact rating that is 2-3x the steady-state requirements of the load.

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, use AC-rated capacitors, Metal-Oxide Varistors, or RC- snubbers to help shunt potentially high-reverse voltage transients that develop across inductive loads when the output is switched OFF. For DC inductive loads, use a reverse-biased diode to shunt this reverse voltage from the contacts as shown above. This will help protect the relay contacts and extend their life when switching inductive loads.

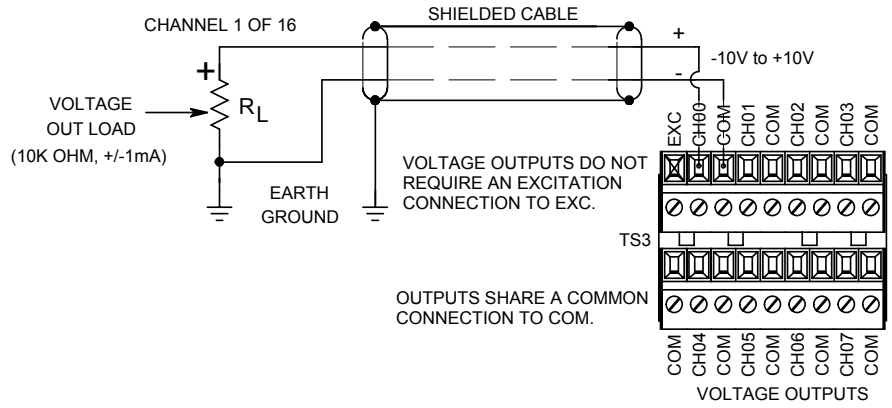
CONNECTIONS

Analog Outputs

The C terminal is connected to analog common of the I/O circuitry. Do not allow input channels to float. You should connect C to earth ground if your signal source is not already earth grounded.

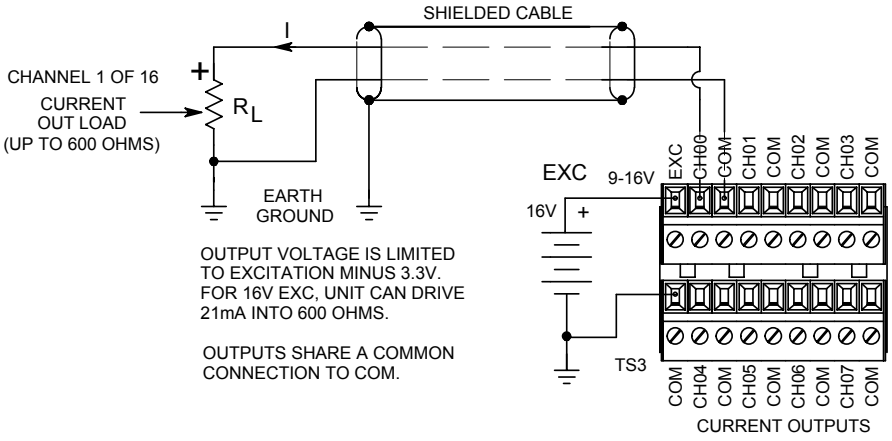
Voltage Outputs (ES2172, No Excitation Required)
This ES2172 model has 16 channels of ±10V outputs (16-bits). External excitation is not required to operate the voltage outputs. Outputs are not isolated channel-to-channel and share a common connection. Voltage outputs deliver up to ±10V into 10KΩ (±1mA maximum).

VOLTAGE OUTPUT CONNECTIONS (ES2172 ONLY)



Current Outputs (ES2171 Only, Requires Additional Excitation)
The ES2171 model has 16 channels of 0-20mA/4-20mA outputs. You must connect external excitation to operate the current outputs (ES2171 models only). Outputs include current limiting. Outputs are not isolated channel-to-channel and share a common connection. The excitation connection EXC is also common to both output ports.

CURRENT OUTPUT CONNECTIONS (ES2171 ONLY)



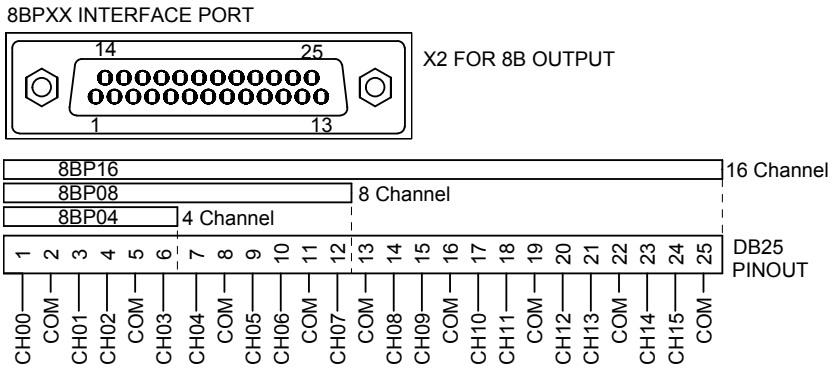
Note that in order to operate the current outputs of the ES2171, you must provide 9-16V of excitation to one of the Excitation terminals as shown above. You can use the second excitation terminals to connect redundant backup excitation if required. The voltage outputs of the ES2172 do not require additional excitation.

CONNECTIONS

Series 8B Analog I/O

Use an SCMXCA006-01, -02, or -07 interface cable to connect an 8BP04, 8BP08, or 8BP16 back-panel to X1. This is simply a DB25 male to DB25 female cable assembly.

ES2172 units include a DB25 interface port that can connect to industry-standard four 8BP04, eight 8BP08, or sixteen channel 8BP16 8B carrier panels, in order to drive 8B output modules. Output modules installed on carrier panels map to voltage output channels of the unit as follows:



The ES2172 model drives 8B **output** modules only. Note that you can intermix field outputs on the unit with 8B outputs on a 4 or 8 channel carrier panel, as long as you do not use corresponding channels (8B panels always consume the first 4, 8, or 16 channels of a port). It is not recommended that you wire to the output channel on the unit while also driving an 8B output module on a connected carrier. Likewise, you cannot intermix 8B inputs and 8B outputs on the same carrier panel.

Separate power is required to be connected to the 8B back-panel. Output modules are driven via 0-5V, 1-5V, and ±5V signals, according to their model. This unit drives ±10V to the module and it is up to the user to set the range endpoints accordingly. Note that you cannot intermix 8B output modules with 8B input modules on the same back-panel. The following table indicates the ideal DAC internal count and relative resolution, plus the ideal (program) count required for the range endpoints control of 8B output modules based on their input signal:

	VOLTAGE OUTPUT	8B OUT w/0-5V INPUT	8B OUT w/ 1-5V INPUT	8B OUT w/ ±5V INPUT
Internal DAC Counts				
- FS	-32767	NA	NA	-16384
ZERO	0	0	+3277	0
+ FS	+32768	+16384	+16384	+16384
Normalized DAC Count (Ideal Program Register Contents)				
- FS	-30000	NA	NA	-30000
ZERO	0	0	0	0
+ FS	+30000	+30000	+30000	+30000

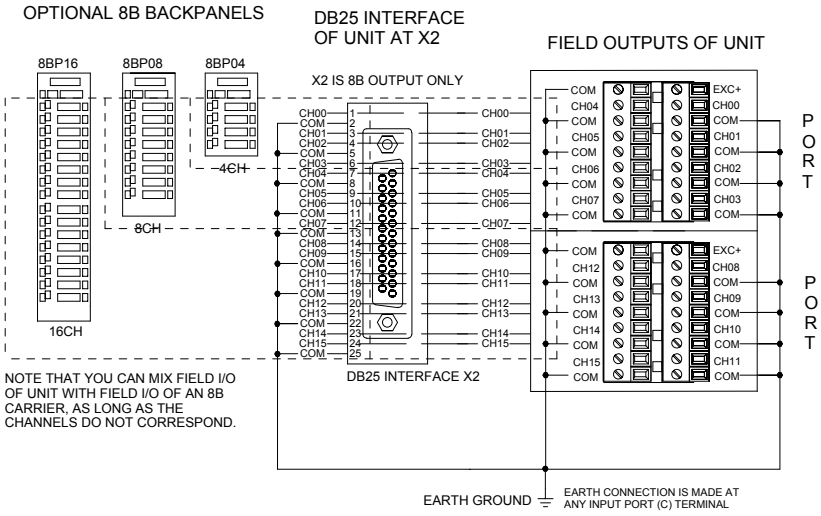
Always ground the analog common terminal (C) of a port, even if connecting to an 8B carrier. 8B modules are individually isolated and any ground connections made on the 8B I/O side of the carrier panel does not carry over to the analog common of the port, and this common must also be grounded.

Unused 8B Output Channels (Module Installed or Not): Do not short the input or output side of these channels.

CONNECTIONS

Series 8B Analog I/O

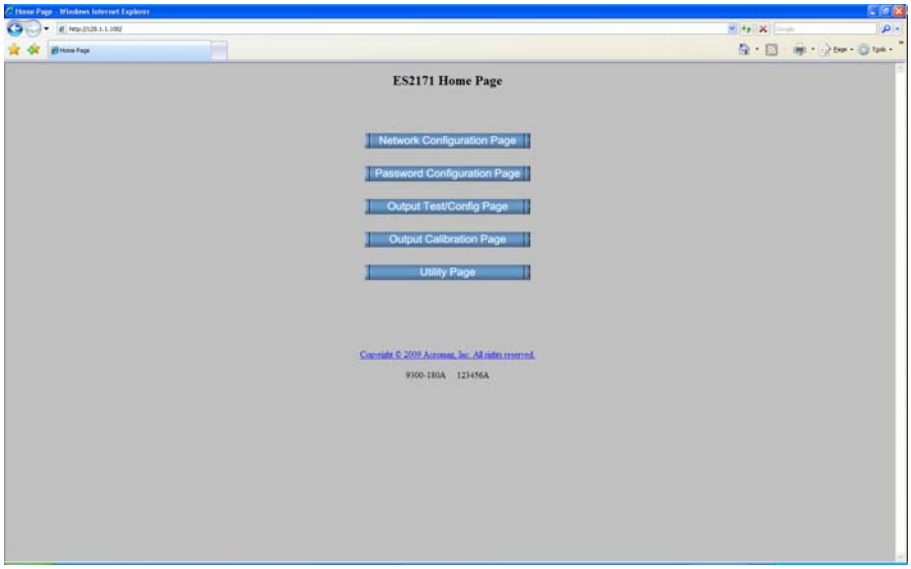
Channels of an 8B back-panel are mapped to outputs of the unit per the following diagram:



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 & test the outputs, calibrate outputs, self-test and export the configuration, 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 provided in the Modbus Memory Map.

WEB BROWSER

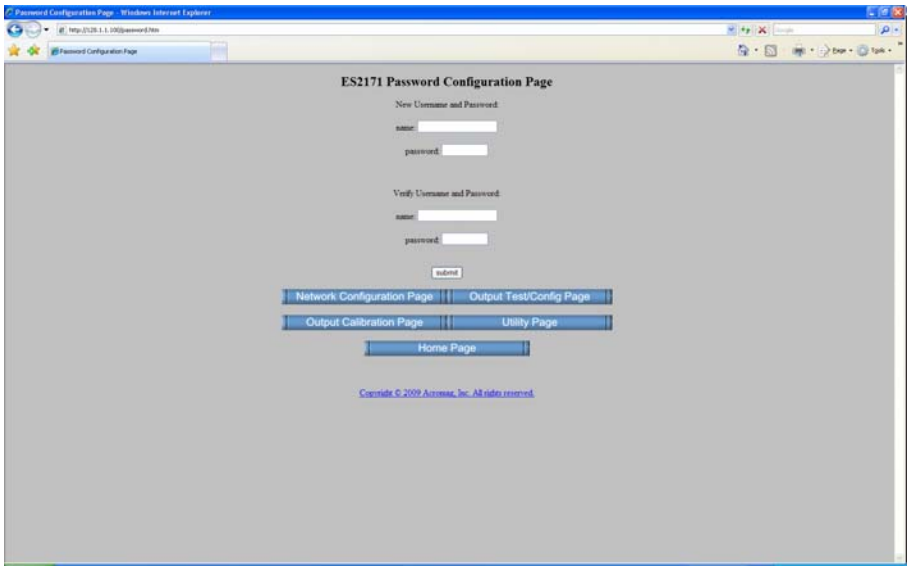
Password Configuration Page

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 painfully apparent to you when you attempt to gain access later.

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--a default IP address of 128.1.1.100, a username "User", and a password "password". This allows you to re-invoke the Password Configuration Page and change the username and password as required, to something you can remember.

TIP: If you do not want to bother with remembering a username and password to access a station, you can submit it blank. Then when it is queried for later, just leave the query fields blank and click OK to gain access.

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.



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 these entries twice to help prevent errors.

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

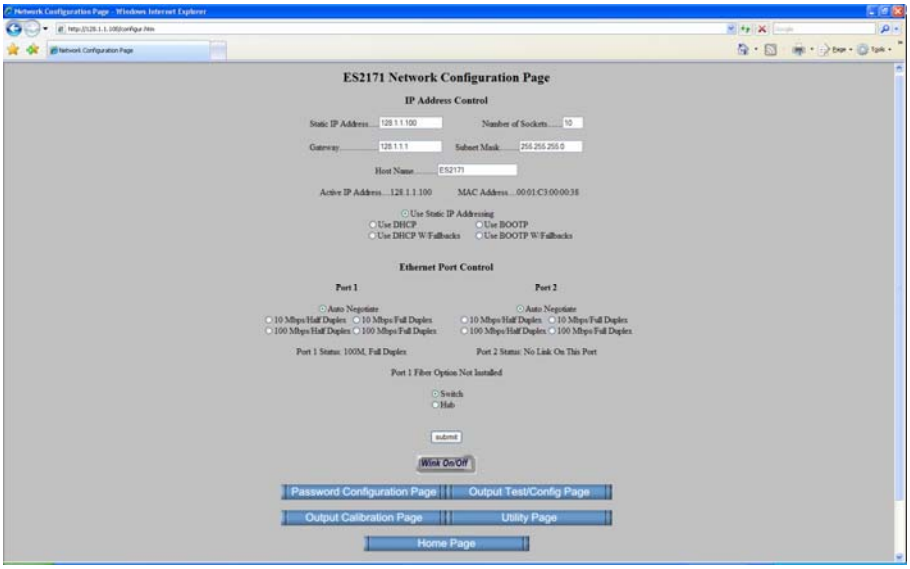
After submitting your username & password changes, you will be prompted to enter your new username and password before being permitted further access to the web pages. Just be sure to use the new values you just set. If you already forgot your settings, then place the unit in the default mode and use the default username and password to access this page again and reset your assignments to something you can remember.

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.

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). Parameters are described below. You may have to consult your network administrator for help in completing the contents of this page.



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).

WEB BROWSER

Network Configuration Page

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

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** (up to 20 characters) is 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.

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.

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

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

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".

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.*

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.

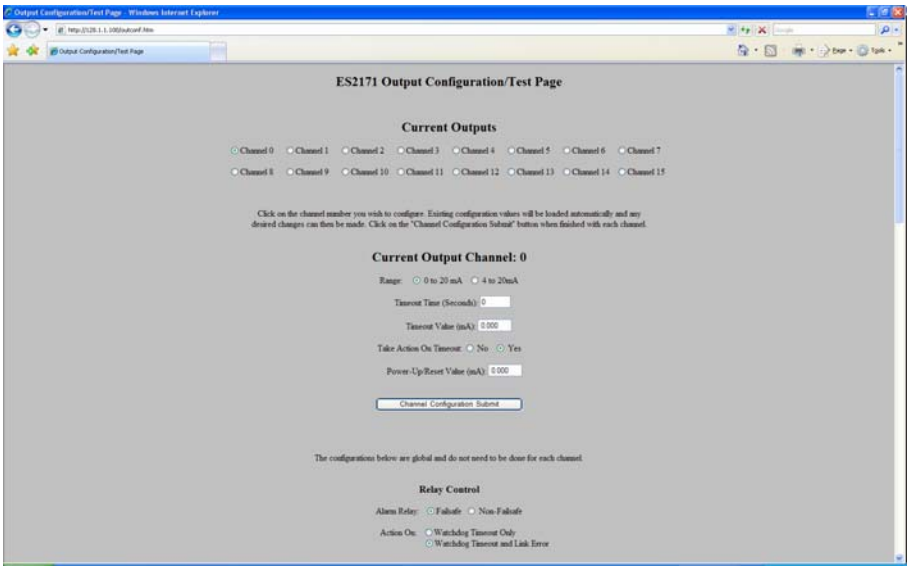
The unit includes a DFT mode toggle switch to cause the unit to assume a fixed default static IP address (128.1.1.100). This switch is at the front of the unit and used to toggle the unit into, or out of Default Mode. If the unit is already in default mode, then "Default Communications Mode" will be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

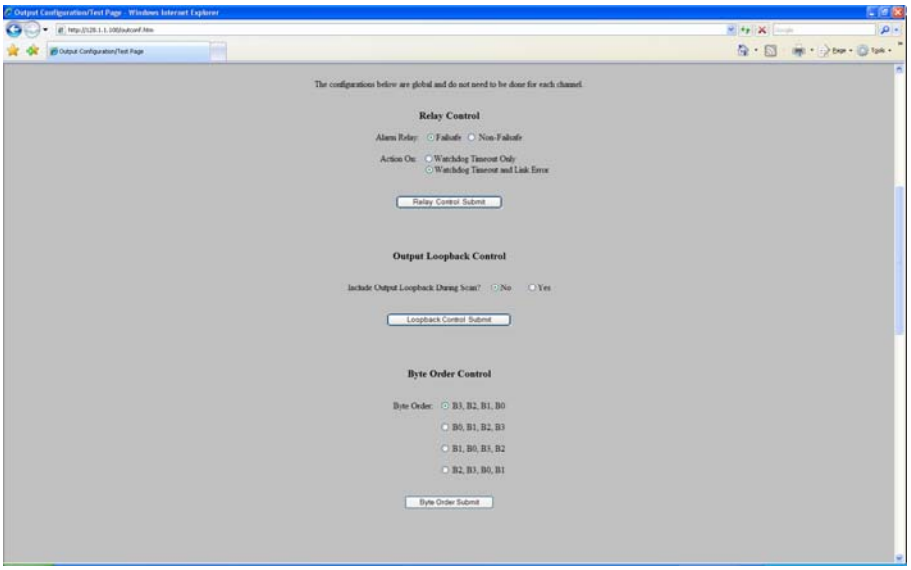
Switch or Hub Selection

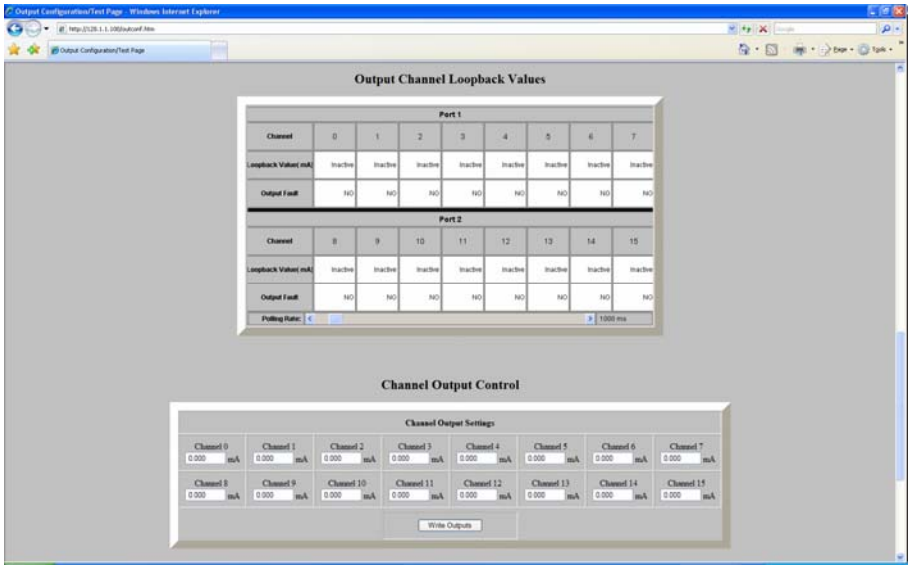
For mode control, this unit is set to "Switch" by default, but may optionally be set to "Hub". Hub mode is useful to reduce latency on the network, especially when cascading many devices, or to setup redundant media connections to this device, but is restricted to 100Mbps and half-duplex. You should 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. This is helpful to identify units when connecting multiple units to the same network.







WEB BROWSER

Output Configuration & Output Test Page

After completing the username/ password assignments, plus the network and input configuration parameters, you can click this page to configure, write, and read the outputs of your unit.

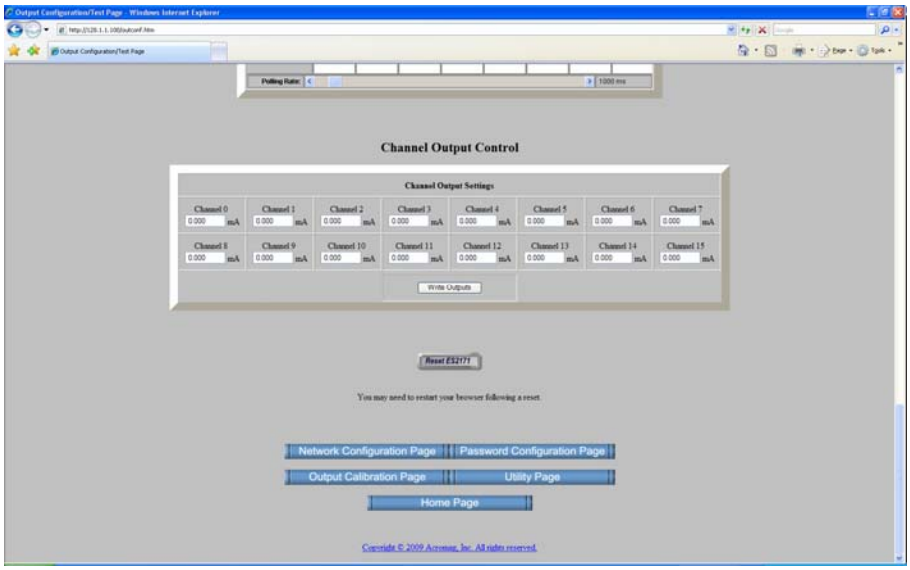
The ES2171 Output Configuration & Test page is shown at left. The ES2172 page is similar, but controls voltage outputs instead of current outputs.

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 Output Test Page has stopped scanning the outputs or appears to have halted, simply click the refresh button to restart the polling. This happens 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

Output Configuration & Output Test Page



For configuration, you click to select the output channel you wish to setup and the channel's current configuration selections will be displayed. You can select the output range, set a watchdog timeout time, a timeout value, the action to take on timeout, and even set an initial power-up value, all on a per channel basis. Simply make your selections and then click the Channel Configuration Submit button to write your configuration. Repeat this for each output channel of interest.

Voltage or Current Output Configuration

Channel Select (Top of Page): Click to bullet the output channel you wish to reconfigure. Configuration is done on a per channel basis, one at a time.
Range: Click to bullet the output range you desire. For ES2172 models, you can select ±5V or ±10V, while approximately ±10.2V represents the full 16-bit dynamic range of the output DAC. You can select a unipolar current range of 0-20mA or 4-20mA for ES2171 models and the DAC uses 0-5V of its ±10V output to drive 0-20mA to the field (14-bits). The 4-20mA outputs can be set to values between 3mA and 21.4mA, while the 0-20mA outputs can be set between 0 and 21.5mA.
Timeout Time (0-65535s): Enter the number of seconds from 0 to 65535 that represents the timeout time, or the time that must pass with no write-activity until a timeout is triggered.
Timeout Value: Enter the signal level the output should assume if a timeout occurs. For ±5V outputs, you can set a value from -5.3V to +5.3V. For ±10V, you can set a value from -10.2 to +10.2V. For 0-20mA, you can set a value from 0 to 21.8mA.
Note: The unit will not assume a new timeout level submitted to it until the original timeout has been cleared via a write to the channel.
Take Action on Timeout: Select "Yes" to enable the output level change on timeout, or "No" to leave the output level the same. This only applies to the rewriting of the output to the Timeout Value, and cannot be used to block the alarm relay from being activated on timeout.
Power-Up Value: Enter the Output Level you want the output to be set to immediately following power-up, or reset. This operates even if watchdog timeout is 0 (disabled), and Take Action on Timeout is "No".

WEB BROWSER

Output Configuration & Output Test Page

Channel Configuration Submit: Click this button to submit your output channel reconfiguration. After this, you would select the next channel to reconfigure and repeat the configuration process, channel by channel.
IMPORTANT – WATCHDOG TIMERS: The unit will not assume a new timeout level submitted to it until the original timeout has been cleared via a write to the channel, or a system reset (which restarts the timeout timer). Even if Take Action on Timeout is set to "No", the alarm relay will still trip on timeout, as "Take Action" only applies to writing the timeout value to the output.

Output Channel Loop Back Values

Output Channel Loop Back Fields: These fields indicate the measured output level read back via separate circuitry through an input A/D (output loop back). "Inactive" will be displayed for the read back values if you did not also choose "Yes" to "Include Output Loopback During Scan?" via the Output Configuration Page. Note that the voltage output swing is slightly greater than the ±10V full-scale A/D range used to read it back (output swing is about ±10.2V). Thus, the loopback indicator will clip near the input range endpoints of ±10V for any output voltages that go beyond these limits. For the ±5V output range, loopback readings clip near ±5.3V. ES2171 current outputs also include fault indication that can detect an open-load/wire break, an output resistance too large for the excitation, or an excitation voltage too low to support the output load (note that excitation must exceed max load voltage by at least 3.3V).
Note: Refer to the Output Loopback Control on this page to include the read back of the unit outputs in the output update sequence. If you elect not to include output read back in the scan sequence, then "Inactive" will be displayed for the Output Channel Read Back Values on this page.
Note: ES2171 current outputs are looped back prior to the last stage (it loops back the DAC voltage that drives the V/I converter). As such, the value indicated may be offset slightly from the actual output current, since it does not include any inaccuracy in the output stage and it is not corrected for any manual output calibration that is done at the output channel.
Polling Rate: The output loop back values update continuously at the rate set via this slide control. Click and drag this control to set the rate at which you wish to update/loopback the outputs. The rate is indicated just to the right of this control. Disable output polling by dragging it to the far right.

Output Control – Testing Your Outputs

Output Control Fields 0-15: Type the output value you wish to set the corresponding output to in these fields.
Write Outputs: Click this button to set the output(s) to the values you have entered into these fields. Note that if this unit is an i2o target device, these fields will auto-load with the values written to these outputs from inputs on another EtherStax via i2o.
Note (Output Loop Back Limitation): While it is possible to program the voltage output to approximately ±10.2V, the internal A/D cannot read values beyond its ±10V limits, and the input reading will remain at its maximum extent for output voltages that equal or exceed this limit near ±10V.

Reset – Click this button to remotely reset the unit. This is equivalent to pressing the RST toggle switch on the unit. Note that it may take up to 30 seconds to re-initialize and restart communication after reset.

WEB BROWSER

Output Configuration & Output Test Page

Note (Loopback of Current Outputs): The value looped back represents the voltage measured at the output terminal of the voltage DAC. For current outputs, it represents a calculated current based on the DAC voltage that drives the last stage, voltage to current converter. Thus, it is one stage removed from the output terminal and may be offset from the actual output current. Likewise, it is possible that the loopback reading can indicate a valid output value, even if the corresponding loop fault indicator flags "Yes", indicating a loop fault (see below). Note that the DAC uses 0-5V of its ±10V output range to drive 0-20mA to the current output.

Note (ES2171 Loop-back Fault Indication): The output loop-back fields include an output fault indicator on current outputs. This is used to detect an open load (wire-break), high load resistance, or an output voltage level approaching the excitation supply. Note that in order to detect a wire break and actually indicate a fault, a non-zero current must be programmed, which prevents it from working at or very near the 0mA endpoint of the 0-20mA range. Likewise, it only works with a valid excitation voltage applied above 8V. This means that low resistance loads below 300Ω may never trigger a fault. It will typically trigger a fault for valid excitation voltage levels less than 3V above the load voltage, indicating that either the load resistance must decrease, or the excitation voltage must increase. Note that it is possible for the loopback current reading to indicate a valid output level with the fault flag set to "Yes", indicating a loop fault (see above).

Important: *You cannot intermix 8B input and output modules on the same back-panel. Further, DB25 interface connector X2 of this unit is restricted for connection to 8B output module carriers.*

Control of 8B Output Modules (ES2172 Models Only)

The bipolar voltage output channels of ES2172 models may alternately drive 8B output modules mounted on a back-panel and connected to DB25 interface connector X2. The outputs of each port are 8:1 multiplexed to separate A/D channels of an eight channel 16-bit A/D converter in order to provide output loop back monitoring of the actual output level. For back panels with less than 16 inputs, it's always the first channels of the port that are reserved for 8B. There is no output pre-scaling done. The output voltage is ±10V and it is up to the user to set the appropriate output voltage level necessary to control the 8B output module. The drive signals required by 8B output modules are ±5V, ±10V, 0-5V, and 0-10V, depending on the model (see Specifications for available models). Any 8B output modules that do not utilize the full ±10V 16-bit dynamic DAC range will have a proportionally lower effective resolution.

DB25 connector X2 maps to field output ports 1 & 2 on the back-side of ES2172 units. The following table outlines the channel mapping between output ports, connector X2, and the 8B back panel that carries 8B plug-in modules:

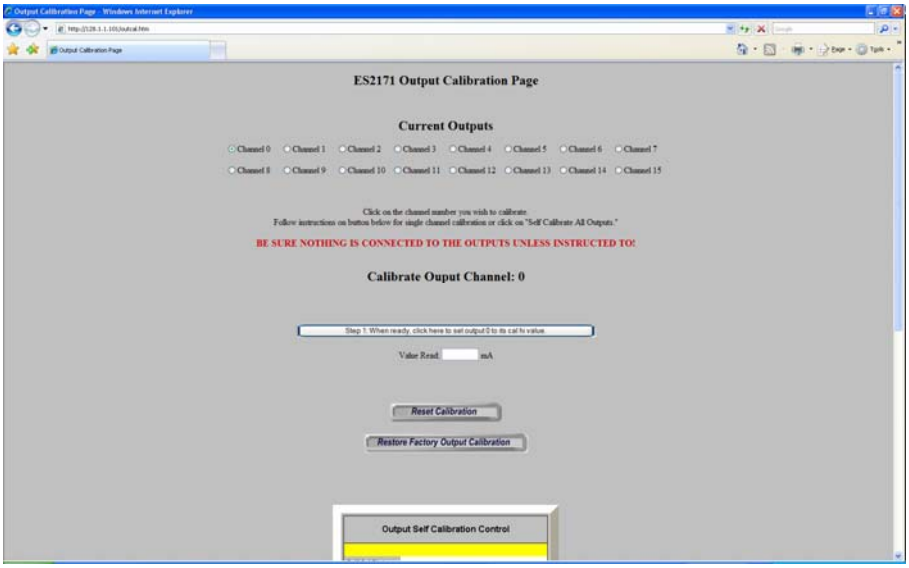
Field Output Channels								**Field Output Channels**							
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
DB25 X2 OUTPUT Interface Connector															
16CH Back Panel 8BP16															
8CH Back Panel 8BP08								8	9	10	11	12	13	14	15
4CH 8BP04				4	5	6	7	8	9	10	11	12	13	14	15

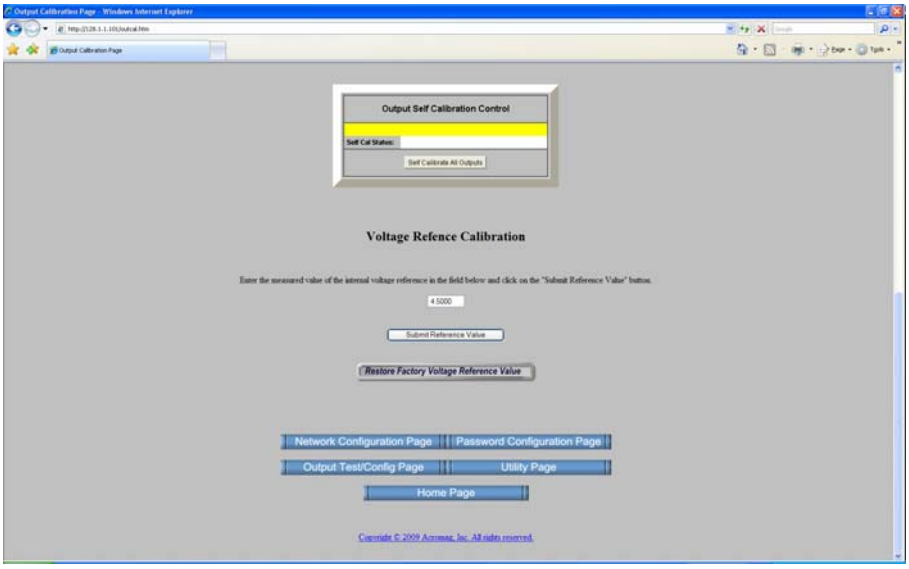
Note that you can intermix field outputs of the unit with 8B outputs on a connected carrier, if you happen to be connected to a 4 or 8 channel carrier (theses carriers will consume the first 4 or 8 channels of the output, leaving the balance for field use on the unit).

When directed to do so, this unit can self-calibrate its analog output DAC by reading a known calibration reference voltage along with each of its DAC output voltages. The calibration reference has been precisely measured at the factory and its value stored inside the unit. Self Calibration controls are included on this page to accomplish this and this calibration is sufficient to achieve rated accuracy. However, if you need to calibrate to your own standard, want to check the accuracy of the internal calibration, or wish to improve the accuracy performance of current output models, then you can utilize other controls of this page to manually calibrate the outputs also. There are also controls on this page to precisely calibrate the calibration reference that is used to auto-calibrate the outputs.

WEB BROWSER

Output Calibration Page





There are controls on this page to precisely calibrate the calibration reference that is used to auto-calibrate the outputs. Do not auto-calibrate the outputs until you are sure that the reference calibration voltage is correct.

ES2172 voltage output units will utilize -9.5V and +9.5V as its calibration endpoints, even with the ±5V range selected.

ES2171 current output units utilize 0mA and 20mA as calibration points to calibrate the 0-20mA and 4-20mA input ranges. Endpoints of -20mA and +20mA are used to calibrate the ±20mA range.

WEB BROWSER

Output Calibration Page

For Output Calibration, if you perform an automatic output cal, it has the effect of replacing any/all manual calibrations that have been done (they share the same calibration coefficient registers and auto-cal is done for all channels at once). On the other hand, if you do an auto-calibration first, then a manual cal of a channel will over-write the auto cal results for that channel, leaving the other output channel calibration intact. Manual cal is meant to supplement an auto-cal, for tweaking only those channels that need it. Automatic calibration will be sufficient for most applications, and it can be used to increase the accuracy of current outputs.

Only self-calibration has been done on units fresh from the factory. You can achieve a higher rated accuracy by doing your own manual calibration.

Output Per-Channel Calibration - Voltage (ES2172) or Current (ES2171)
Manual calibration allows you to use your own DVM to make output signal measurements, store the measured value in the unit, and then use this reference to accurately convert an output. It does this on a channel-by-channel basis and you can achieve very accurate results, but manual per-channel requires more time to complete, as well as very accurate measurement equipment. Units shipped from the factory have only automatic calibration done and per-channel calibration has been performed.

Channel Selector Bullets: Click to bullet the output channel you wish to calibrate. Output calibration is done on a per channel basis. Repeat the calibration process for each output, as required to improve performance.
Calibration Step Button: You click this button in a sequence of 5 steps to accomplish output calibration. Specific instructions at each step are typed on the face of this button. Follow these instructions to proceed.
Value Read Field: Enter the measured output value in this field, at the appropriate step (read Step button instructions for prompting). For voltage outputs, enter your measured voltage, and for current outputs, enter your measured current in milliamps. Unit will use this value to correlate the corresponding DAC count to the output level, to form a linear response.
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 (Global): Click this button if you believe channel calibration has been done in error, or you are getting erratic results after recalibrating. Note that this will affect all output channels at one time. The values restored are the ideal values, not the results of an actual calibration, and may not achieve rated performance. No factory calibration has been done for the output channels, only an Output Self-Calibration. As such, you should only Restore as a last resort for getting out of trouble. You may want to use the Output Self-Calibration Control after invoking Restore Factory Output Calibration to improve performance.

Output Self Calibration Control (Used First Before Manual Calibration)
This control is located in the middle of the page and should be done first, before attempting to manually calibrate an output channel. Invoking this control will over-write existing calibration for all of the output channels.

Self Calibrate All Outputs Button: Click this button to trigger an automatic output calibration of all outputs under program control while using an internal A/D channel to make output signal level measurements.

Self calibration utilizes an A/D channel of the unit, instead of a DVM, to measure each of the programmed output voltages in sequence, plus a known precision reference, all under program control for all output channels at once. It then stores the output response for tailoring the conversion of an output channel. Self calibration will achieve sufficient accuracy for most applications (better than ±0.1% of span for voltage outputs). But for the current outputs of the ES2171 model, it is somewhat less accurate because it only calibrates to the output of the voltage DAC, which is one stage removed from the actual current output. The DAC drives a voltage to current converter for an ES2171 current output. As a result, any inaccuracy in the V/I converter is not compensated for using output self-calibration, and this could add up to an additional ±0.1% of error. Self-calibration of ES2171 current outputs will only achieve results better than ±0.2%. You may use manual channel calibration (described above) to improve calibrated accuracy beyond these figures and as shipped from the factory.

Voltage Reference Calibration
The on-board calibration reference used for output self-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. That value is indicated in this field and is used to make a linear correspondence between the A/D response (digital count), and the voltage signal itself. You can enter your own measured value in this field if you wish to recalibrate it.
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 FRAM 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).

This reference voltage is 4.5V ±0.05% ±5ppm/°C, and the value in this field should read between 4.4968 and 4.5032. 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). The unit utilizes the corresponding raw A/D output count for both zero and the reference voltage to calibrate the input by defining the equation of a straight line used to interpolate the input signal for any given A/D count.

Additional controls of this page provide two different methods to achieve output calibration: automatically for all-channels at once using the internal A/D to make measurements, or manually on a per channel basis using your own DVM to make measurements.

WARNING: Since the Output Self Calibration control calibrates all output channels at once, while manual calibration is done per channel, performing an output self-calibration after a manual per-channel calibration will replace the results of the manual calibration. Thus, you should always auto-calibrate first, then you can apply subsequent manual calibration only on the channels you desire where you may need to improve specific performance.

Normally, you do not require manual calibration for the outputs, as the semi-automatic self-calibration will achieve rated performance. However, in the case of the current output ES2171 models, automatic calibration does not compensate for small errors contributed by the V/I converter that drives the current output. So for ES2171 models, following an automatic calibration with a manual calibration can be used to improve performance. Only semi-automatic self-calibration has been done on units fresh from the factory.

WEB BROWSER

Output Calibration Page

***Reference Measurement**: Reference recalibration 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

Output Calibration Page

Manual Output Calibration Example

While manually calibrating an output, you are required to precisely measure the high and low calibration signals of the selected output channel, and then enter your measured values at the appropriate step (read Step button). This is done separately for each of 16 output channels. The native DAC output is ±10V and output calibration will use calibration endpoints of -9.5 and +9.5, even if you have selected the ±5V output sub-range.

CAUTION: This procedure will change the output signal level. Be sure to disconnect any critical control equipment that may be inadvertently affected by varying the control signal connected to it.

1. Click to bullet the output channel you wish to calibrate.
2. Connect a precision voltmeter in parallel with your load for that channel (or an ammeter in series with your output current for the ES2171).
3. Click the Step 1 button to set the output to its high endpoint cal value.
4. Measure the signal and type your measured value into the "Value Read" field (to 4 decimal places with an accuracy better than 0.0125%). For voltage outputs, enter your measured voltage in volts. For current outputs, enter your measured current in milliamps. Click the Step 2 button to store the high calibration endpoint.
5. Click the Step 3 button to set the output to its low endpoint cal value.
6. Measure the output signal and type the measured value into the "Value Read" field (to 4 decimal places with an accuracy better than 0.0125%). For voltage outputs, enter your measured voltage. For current outputs, enter your measured current in milliamps. Click the step 4 button to store the low calibration endpoint.
7. Calibration of the selected channel is complete. You can click the Step button again, the "Reset Calibration" button, or simply select another channel and repeat steps 1-6 for the remaining channels, one at a time.

If you make a mistake, you can always click the **Reset Calibration** button at any time to return to Step 1 and start over.

Optionally, you can click **Restore All Default Calibration Values** if your calibration was in error, or you get an erratic response after performing calibration. This returns the calibration of the selected channel to its original default (ideal) values and these values may not achieve rated performance. You can use the Output Self-Calibration to improve results, check your performance, and if further improvement is needed, perform a manual per-channel calibration.

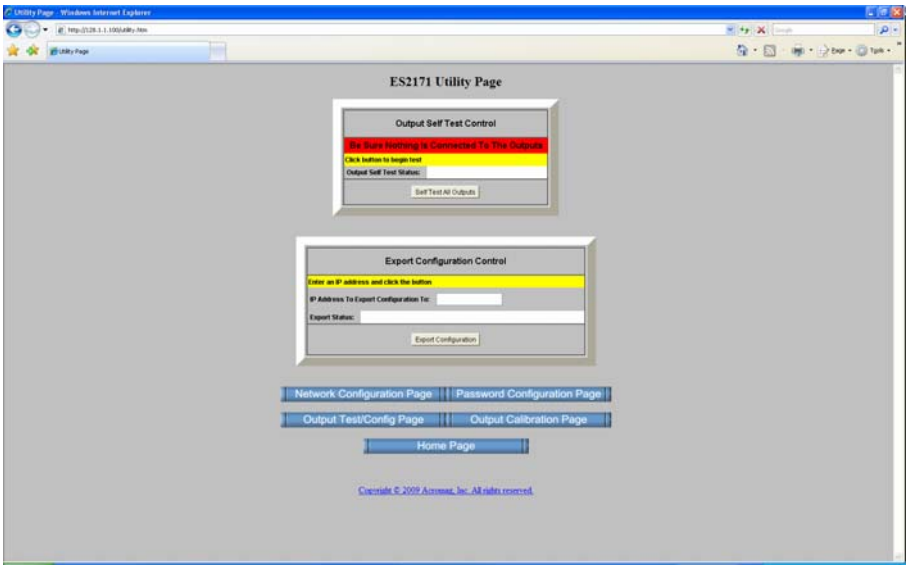
Note (ES2171 Models): If you are manually calibrating an ES2171 current output channel, you may notice increased error in your loopback value indicated on the Output Test Page following calibration. For current outputs, this loopback signal is taken one stage removed from the output terminals, at the output of the voltage DAC. Thus, it does not include, nor compensate for, any error or offset of the last voltage-to-current converter stage (which can be as high as 0.07%). Instead, it interpolates the output current signal based on the DAC voltage and assumes an ideal voltage-to-current output stage. So for current outputs, do not rely on the Test Page loopback signal as an accurate representation of the output. Always use a voltmeter in parallel with an output load resistance, or an ammeter in series with your load to determine the true current output level.

WEB BROWSER

Utility Page

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.

You may also access a Utility Page that includes a couple built-in utilities that allow you to verify output control (via loop back), 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:



Analog Output Self Test Control

The Self-Test makes use of built-in loop-back monitoring of the DAC output signal. For the ES2172, outputs are looped back from the field output terminal (the voltage DAC output). For the ES2171, outputs are looped back from the DAC driving the channel's V/I converter stage, which is one stage removed from the field terminals. This test can serve as a trouble-shooting aide if you are experiencing problems. It does not require that you connect anything to the outputs, and doing so will not affect the results of this test. However, since output self-test changes outputs, you should disconnect critical control wiring to prevent inadvertent control of your application.

Export Configuration Control

The export function is a real time-saver when commissioning multiple identical 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). The unit you are exporting to must be the same model. Further, 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 40102). It does not send network configuration parameters which must be preset via the web browser. Likewise, it does not transfer 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 just remain ON. If it continues to blink,. then the firmware may be in error.
Unit was not initially connected to network upon power-up, or the 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…	
External network or switch is not setup to handle redundant media.	Use an external redundant switch to connect to both ports of this device.
Cannot Communicate Following Restore Procedure…	
Wrong IP Address	IP address has been restored to its default unit address of 128.1.1.100.
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.
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.
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 TS5 GND terminal adjacent to power terminal.

TROUBLE-SHOOTING

Diagnostics Table

POSSIBLE CAUSE	POSSIBLE FIX
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 unit to Default Mode and use the default username and password to gain access to 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).
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 Config 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.
Cannot Write Outputs…	
Have you mapped a local output port to your inputs via the i2o configuration page?	The i2o mapping function will block direct writes to a local output if mapped to its port. Make sure that you have not enabled this feature.
Loop-back Reading of Current Outputs Has Offset Error…	
ES2171 loop-back is based on the DAC voltage that drives the last V/I stage and fails to compensate for last stage offsets. Also, the loop-back value is not corrected for any manual calibration offsets.	Refer to the Output Calibration Page and perform a manual calibration of the outputs to improve performance if auto-cal results are not sufficient. This will not correct the loop-back reading on current outputs though.

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
Unit Fails Output 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 4.4968 and 4.5032 (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 Clear a Watchdog Timeout…	
You can clear a timeout by writing to an output that has timed out, but local i2o mapping to an output port on same unit will prevent you from directly writing to that output?	The i2o mapping function will block direct writes to a local output if mapped to its port, preventing writes from resetting the timeout. Verify that you have not enabled this feature.
Channel Will Not Assume A New Timeout Level…	
If you write a new timeout level to an output while it is timed out, it will not assume the new value until the current timeout has been cleared.	Write an interim value to the timed out output channel to clear its timeout status and assume a the new timeout level.
ES2171 Current Outputs Have Greater Inaccuracy…	
Auto calibration of current outputs fails to compensate for errors in the last stage (voltage to current converter).	Refer to the Output Calibration Page and perform a manual calibration of the outputs to improve performance if auto-cal results are not sufficient.
Cannot Get i2o Source to Write the Output Port On This Unit…	
In your i2o sending unit, have you specified a target starting address that represents 8 valid contiguous output addresses?	This i2o target is returning errors because the sending unit is trying to write beyond its valid output register space. Refer to the i2o Configuration Page and verify that the Map to Holding Register specified addresses eight contiguous register addresses (40351 to 40359 for this model).
Your Configuration Appears to Have Been Corrupted…	
If you have an i2o unit sending messages to this target device, it may have specified the wrong target address and is over-writing configuration registers of this unit.	Check your i2o configuration for other devices on your network and make sure that they have the correct IP address set and output register address specified.

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 hardware similar 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.

Also note that the green run LED of the unit will blink continuously after power-up if you have failed to establish an initial network link with it. However, it does not start blinking later if you break a link that has been established since powering up. If you have verified that your network cable link is solid, then this LED can also blink continuously if the internal firmware has encountered a fatal error (see Getting Out of Trouble below). The third thing that can cause this LED to blink continuously is if the Wink ID function has been triggered (see the Network Configuration page for this toggle control).

TROUBLE-SHOOTING

Trouble Browsing Your Unit?

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

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

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).

If you do restore your unit and you want to return the unit to service later, be sure to set your IP address, restore the calibration reference, and trigger the Output Self-Calibration procedure.

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.

TECHNICAL REFERENCE

KEY FEATURES

- **High Density Flexible Industrial I/O** – These units support up to 16 analog current or voltage outputs according to model. ES2172 models provides a DB25 interface for optional connection to ABPXX back-panels for support of up to sixteen 8B output modules. Series 8B modules and carriers provide support for a variety of output signal types.
- **Field Voltage & Current Outputs Can Mix w/ External 8B Outputs** – These models allow the unit's own field outputs to be mixed with outputs via external 8B module carriers for a wider variety of output signal types and range selection.
- **Output Loop Back** – Allows the unit to read its own outputs via independent multiplexing circuitry. This also helps to facilitate self calibration and self test of the outputs.
- **Built-In Calibration Source** – A very accurate reference signal source is built into the unit to facilitate self-calibration and self-test.
- **Output Self-Calibration –** Unit utilizes output loop back and a precision calibration reference to automatically calibrate the DAC output voltage, and the A/D channel for reading the output voltage.
- **Web-Browser Reconfiguration** - Unit may be configured, controlled, monitored, and calibrated using a standard web browser over Ethernet.
- **Achieves End-Node Redundancy** – Dual network ports can accomplish media redundancy right to the unit, when also connected to redundant switches that support STP, RSTP, or most other proprietary ring redundancy methods.
- **Fully Isolated** – Output channels (as a group), alarm relay, network ports, enclosure, and power are all isolated from each other for safety and increased noise immunity.
- **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 –** Up to 10 sockets of support for Modbus using TCP/IP. Also supports UDP/IP.
- **Flexible IP Addressing** – Supports static, DHCP, or BOOTP.
- **10Base-T and 100Base-TX Support** – Auto-negotiated 10/100Mbps, Half or Full Duplex.
- **100BaseFX Support** – Optional models support a 100M FX fiber-optic connection at one of two ports.
- **Dual Ethernet Ports Make Network Connections Easy** – A built-in switch allows units to be connected in cascaded "daisy-chain" fashion without consuming another (external) switch port. The second port also allows the network distance to be extended an additional 100 meters (copper), or 2km (fiber).
- **Network Ports are Individually Isolated & Transient Protected –** The dual network ports of this device are safety-isolated from each other and have built-in transient protection from ESD, EFT, and other transients.
- **Auto MDI/MDI-X Crossover** – Requires no special up/down link port or crossover cables to connect to a PC, external Ethernet switch, or hub.
- **Low-Latency, Cut-Through Repeater Mode** – Reduces port-to-port latency jitter of switch mode from about 167us, to 40ns, for time critical applications or concentrated traffic links.
- **Nonvolatile Reprogrammable Memory** – Allows the functionality of this device to be reliably reprogrammed thousands of times.

KEY FEATURES
…continued

- **Extensive Operating & Diagnostic LED's Aide Troubleshooting** – Three LED's indicate power, operating mode, wink status, and relay state. Eight communication LED's indicate per-port activity, including: communication errors, link status, collision, speed, and duplex.
- **Internal Watchdog** - A hardware watchdog timer is built into the DSP that causes it to initiate a self reset if the controller ever "locks up" or fails to return from an operation in a timely manner.
- **Convenient "Wink" ID Mode Support** – Blinks green RUN LED in wink mode as a tool to help identify specific remote units.
- **Local Alarm Function** – Unit includes a set of SPST-NO relay contacts that can signal link loss and/or power failure (failsafe only).
- **Wide Ambient Operation** – Reliable operation from -40°C to +75°C.
- **Hardened For Harsh Environments** - For 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 Aluminum Enclosure** – The anodized aluminum enclosure also allows units to be stacked and locked together.
- **"Plug-In" Terminal Blocks -** Make wiring removal, & replacement easy.
- **Enclosure Supports Surface or DIN-Rail Mount** – Optional surface or DIN-rail mounting, even when units are stacked together.
- **Open (No Enclosure) Option** – Units can be purchased without their enclosure and stacked together via threaded standoffs & 6-32 screws.
- **Wide-Range DC-Power w/ Redundant Power Connection -** Diode-coupled for use with redundant supplies and/or battery back-up. An extra power terminal is provided for optional standby backup power.

HOW IT WORKS

These models use the same circuitry as the EtherStax ES2151 & ES2152 models, but do not include analog inputs. They provide 16 current or voltage outputs according to model, and provide an isolated 10/100Mbps Ethernet interface for configuration, monitoring, calibration, and control of the outputs. ES2172 models also include a female DB25 interface for optional connection to industry-standard 8B module carriers, which add up to sixteen 8B output channels. 8B modules may also intermix with voltage outputs of ES2172 units.

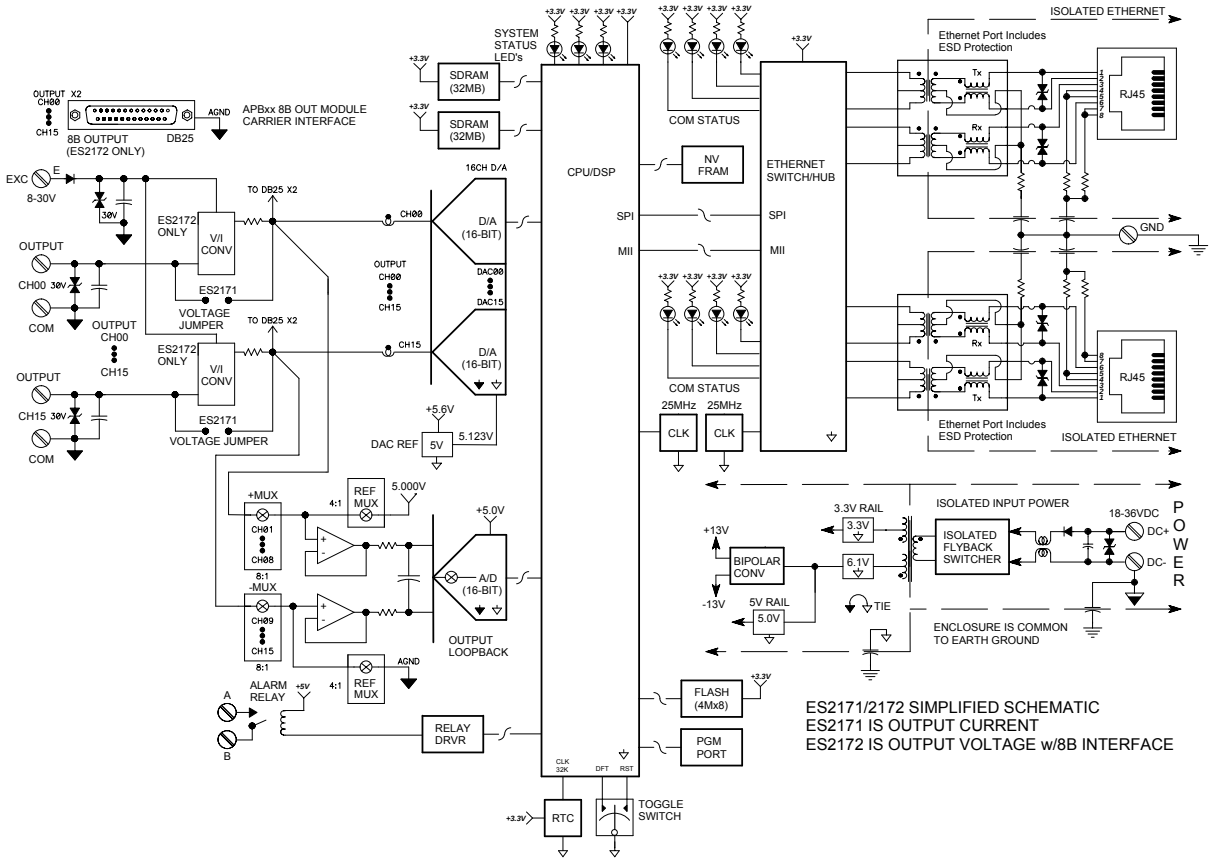
This circuit employs a 16 channel, 16-bit, Digital to Analog Converter (DAC). For the ES2172, the bipolar DAC outputs drive +/-10V to the output terminals. The ES2171 current output unit adds a voltage-to-current converter stage after the DAC that drives 0-22mA to the output. Outputs share common and include transient suppression and filtering. Current outputs add current and thermal limiting, plus fault detection. To operate the current outputs of ES2171 units, you must connect external excitation to the port excitation terminal. Embedded configuration parameters are stored in non-volatile memory.

The network interface utilizes a dedicated, 3-port, Ethernet switch to provide two external network ports to the internal CPU/MAC (third port). Both network ports are fully 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 which 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.



ES2171/2172 SIMPLIFIED SCHEMATIC
ES2171 IS OUTPUT CURRENT
ES2172 IS OUTPUT VOLTAGE w/8B INTERFACE

Key Observations

- Ethernet ports are individually isolated from power, I/O, and each other, and include transient suppression.
- Analog current outputs require external excitation (ES2171 only). Note: The EXC voltage must be 3.3V greater than the load voltage.
- The DB25 X2 interface installed on ES2172 models is for 8B output modules only.
- The input power and external excitation terminals are series-diode coupled for reverse polarity protection, which is also useful to facilitate redundant power connections.
- The aluminum enclosure is common to the earth ground terminal and transient suppression devices are shunted to this ground via isolation capacitors, maintaining isolation from earth ground. If an ungrounded enclosure should contact high-voltage, the connected circuits will be isolated from this fault condition.
- Output port common terminal (C) must be tied to earth ground to keep the output circuits from floating.

MODBUS REGISTERS

Register Functions

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.

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 out data to a digital out 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.

Note: The ON/OFF state of discrete inputs & outputs is represented by a 1 or 0 value assigned to an individual bit of a 16-bit data word (port), with is sixteen 0x or 1x references per word. For channel mapping, the lsb of the word maps to the lowest numbered channel of a port and 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.

Each EtherStax unit has a default factory configuration as noted in the Specifications section. Your application will likely differ from the default configuration provided 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 that the function operates on. Use these functions to access the registers outlined in the Register Map for sending and retrieving data in order 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

Register Functions

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".*

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 message. You may refer to the Modbus specification for a complete list of possible error codes.

EtherStax ES2171/2172-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]	09=ES2171-x0x0 (all 4 model variations) 0A=ES2172-x0x0 (all 4 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 38 30 41 2C 45 53 32 31 37 32 2D 78 78 78 78 ("ACROMAG,9300-180A,ES2172-xxxx,*serial number&rev*,*six-byteMACID*")

[1]**Note:** ES2171 models share slave "09" and firmware number 9300-180. ES2172 models share slave ID "0A" and firmware model 9300-181. The firmware number is also indicated on home page of the web browser.

Register Mirroring

For your 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 0xxxx, 1xxxx, & 3xxxx. All Modbus registers can be written to, or read from, using either the standard methods described in the Modbus specification, or through mapping (mirroring) to the Holding Registers. The registers are mapped as follows and specifics follow the mapping:

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, instead of getting 2 bytes returned with the 16 bits representing the 16 digital inputs, you will get 16 separate words, each set to either 0000H (OFF), or FFFFH (ON).

For the 0xxxx Coil Registers, reads are handled in the same way as the 1xxxx Input Status Registers. You can also write to the 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, you must use the "Write Multple Coils" function for that.

MODBUS REGISTERS

Data Types

I/O values for ES2100 units are represented by the following simple data types for temperature, percentage, and discrete on/off.

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 I/O 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

The following table outlines the register map for all model variations of the EtherStax ES2171 & ES2172 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).

Model ES2171
Model ES2172

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)			
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)

Register Map

Model ES2171
Model ES2172

Ref	Addr.	Description	Data Type/Format
Input Registers (3x References, Read-Only)			
30002	0001	AO Watchdog Status	Bits 15-0 (bit position is AO channel) 1=Watchdog Timeout 0=No Watchdog Timeout
30003	0002	AO ES2151 Fault Status (ES2171 only) *Reserved, Not Used for ES2172 Models*	Bits 15-0 (bit position is AO channel) 1=No Fault Detected at Channel 0=Fault Detected at Channel This flag is cleared for the corresponding channel if the ES2171 output current cannot flow due to a wire break, excessive load resistance, or if the output voltage is approaching the excitation supply voltage (less than 3V of overhead). It will only operate if valid excitation (9-16V) is connected.
30004	0003	*Reserved*	*Reserved – Not Used*
.	.	.	.
.	.	.	.
.	.	.	.
30035	0022	*Reserved*	*Reserved – Not Used*
30036	0023	AO CH 00 Configuration	Bit 15-2: 0 (Not Used) Bit 1-0: Range Per Model:
			b1 b0 / **ES2171** / **ES2172** 0 0 / 0-20mA / ±10V DC 0 1 / 4-20mA / ±5 VDC 1 0 / (Not Used) / (Not Used) 1 1 / (Not Used) / (Not Used)
30037	0024	AO CH 01 Cfg	See AO Channel 00 Configuration
30038	0025	AO CH 02 Cfg	See AO Channel 00 Configuration
30039	0026	AO CH 03 Cfg	See AO Channel 00 Configuration
30040	0027	AO CH 04 Cfg	See AO Channel 00 Configuration
30041	0028	AO CH 05 Cfg	See AO Channel 00 Configuration
30042	0029	AO CH 06 Cfg	See AO Channel 00 Configuration
30043	002A	AO CH 07 Cfg	See AO Channel 00 Configuration
30044	002B	AO CH 08 Cfg	See AO Channel 00 Configuration
30045	002C	AO CH 09 Cfg	See AO Channel 00 Configuration
30046	002D	AO CH 10 Cfg	See AO Channel 00 Configuration
30047	002E	AO CH 11 Cfg	See AO Channel 00 Configuration
30048	002F	AO CH 12 Cfg	See AO Channel 00 Configuration
30049	0030	AO CH 13 Cfg	See AO Channel 00 Configuration
30050	0031	AO CH 14 Cfg	See AO Channel 00 Configuration
30051	0032	AO CH 15 Cfg	See AO Channel 00 Configuration
30052	0033	*Reserved*	*Reserved – Not Used*
.	.	.	.
.	.	.	.
.	.	.	.
30083	0052	*Reserved*	*Reserved – Not Used*

Ref	Addr.	Description	Data Type/Format
Input Registers (3x References, Read-Only)			
30084	0053	AO CH 00 Data	16-bit Signed Int Readback Data
30085	0054	AO CH 01 Data	16-bit Signed Int Readback Data
30086	0055	AO CH 02 Data	16-bit Signed Int Readback Data
30087	0056	AO CH 03 Data	16-bit Signed Int Readback Data
30088	0057	AO CH 04 Data	16-bit Signed Int Readback Data
30089	0058	AO CH 05 Data	16-bit Signed Int Readback Data
30090	0059	AO CH 06 Data	16-bit Signed Int Readback Data
30091	005A	AO CH 07 Data	16-bit Signed Int Readback Data
30092	005B	AO CH 08 Data	16-bit Signed Int Readback Data
30093	005C	AO CH 09 Data	16-bit Signed Int Readback Data
30094	005D	AO CH 10 Data	16-bit Signed Int Readback Data
30095	005E	AO CH 11 Data	16-bit Signed Int Readback Data
30096	005F	AO CH 12 Data	16-bit Signed Int Readback Data
30097	0060	AO CH 13 Data	16-bit Signed Int Readback Data
30098	0061	AO CH 14 Data	16-bit Signed Int Readback Data
30099	0062	AO CH 15 Data	16-bit Signed Int Readback Data
30100	0063	*Reserved*	*Reserved – Not Used*
.	.	.	.
.	.	.	.
.	.	.	.
30163	00A2	*Reserved*	*Reserved – Not Used*
30164	00A3	AO CH00 Rd LO	IEEE-754 Floating Point LO Bytes
30165	00A4	AO CH00 Rd HI	IEEE-754 Floating Point HI Bytes
30166	00A5	AO CH01 Rd LO	IEEE-754 Floating Point LO Bytes
30167	00A6	AO CH01 Rd HI	IEEE-754 Floating Point HI Bytes
30168	00A7	AO CH02 Rd LO	IEEE-754 Floating Point LO Bytes
30169	00A8	AO CH02 Rd HI	IEEE-754 Floating Point HI Bytes
30170	00A9	AO CH03 Rd LO	IEEE-754 Floating Point LO Bytes
30171	00AA	AO CH03 Rd HI	IEEE-754 Floating Point HI Bytes
30172	00AB	AO CH04 Rd LO	IEEE-754 Floating Point LO Bytes
30173	00AC	AO CH04 Rd HI	IEEE-754 Floating Point HI Bytes
30174	00AD	AO CH05 Rd LO	IEEE-754 Floating Point LO Bytes
30175	00AE	AO CH05 Rd HI	IEEE-754 Floating Point HI Bytes
30176	00AF	AO CH06 Rd LO	IEEE-754 Floating Point LO Bytes
30177	00B0	AO CH06 Rd HI	IEEE-754 Floating Point HI Bytes
30178	00B1	AO CH07 Rd LO	IEEE-754 Floating Point LO Bytes
30179	00B2	AO CH07 Rd HI	IEEE-754 Floating Point HI Bytes
30180	00B3	AO CH08 Rd LO	IEEE-754 Floating Point LO Bytes
30181	00B4	AO CH08 Rd HI	IEEE-754 Floating Point HI Bytes
30182	00B5	AO CH09 Rd LO	IEEE-754 Floating Point LO Bytes
30183	00B6	AO CH09 Rd HI	IEEE-754 Floating Point HI Bytes
30184	00B7	AO CH10 Rd LO	IEEE-754 Floating Point LO Bytes
30185	00B8	AO CH10 Rd HI	IEEE-754 Floating Point HI Bytes
30186	00B9	AO CH11 Rd LO	IEEE-754 Floating Point LO Bytes
30187	00BA	AO CH11 Rd HI	IEEE-754 Floating Point HI Bytes
30188	00BB	AO CH12 Rd LO	IEEE-754 Floating Point LO Bytes
30189	00BC	AO CH12 Rd HI	IEEE-754 Floating Point HI Bytes

Register Map

Model ES2171
Model ES2172

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

Register Map

Model ES2171
Model ES2172

Ref	Addr.	Description	Data Type/Format
Input Registers (3x References, Read-Only)			
30190	00BD	AO CH13 Rd LO	IEEE-754 Floating Point LO Bytes
30191	00BE	AO CH13 Rd HI	IEEE-754 Floating Point HI Bytes
30192	00BF	AO CH14 Rd LO	IEEE-754 Floating Pt LO Bytes
30193	00C0	AO CH14 Rd HI	IEEE-754 Floating Pt HI Bytes
30194	00C1	AO CH15 Rd LO	IEEE-754 Floating Pt LO Bytes
30195	00C2	AO CH15 Rd HI	IEEE-754 Floating Pt HI Bytes
30196	00C3	*Reserved*	*Reserved – Not Used*
.	.	.	.
.	.	.	.
.	.	.	.
30259	0102	*Reserved*	*Reserved – Not Used*
Holding Registers (4x References, Read/Write)			
40001	0000	*Reserved*	*Reserved – Not Used*
.	.	.	.
.	.	.	.
.	.	.	.
40032	001F	*Reserved*	*Reserved – Not Used*
40033	0020	AO CH 00 Configuration	Bit 15-2: 0 (Not Used) Bit 1-0: Range Per Model Below
			b1b0 / **ES2171** / **ES2172** 0 0 / 0-20mA / ±10V DC 0 1 / 4-20mA / ±5 VDC 1 0 / (Not Used) / (Not Used) 1 1 / (Not Used) / (Not Used)
40034	0021	AO CH 01 Cfg	See AO Channel 00 Configuration
40035	0022	AO CH 02 Cfg	See AO Channel 00 Configuration
40036	0023	AO CH 03 Cfg	See AO Channel 00 Configuration
40037	0024	AO CH 04 Cfg	See AO Channel 00 Configuration
40038	0025	AO CH 05 Cfg	See AO Channel 00 Configuration
40039	0026	AO CH 06 Cfg	See AO Channel 00 Configuration
40040	0027	AO CH 07 Cfg	See AO Channel 00 Configuration
40041	0028	AO CH 08 Cfg	See AO Channel 00 Configuration
40042	0029	AO CH 09 Cfg	See AO Channel 00 Configuration
40043	002A	AO CH 10 Cfg	See AO Channel 00 Configuration
40044	002B	AO CH 11 Cfg	See AO Channel 00 Configuration
40045	002C	AO CH 12 Cfg	See AO Channel 00 Configuration
40046	002D	AO CH 13 Cfg	See AO Channel 00 Configuration
40047	002E	AO CH 14 Cfg	See AO Channel 00 Configuration
40048	002F	AO CH 15 Cfg	See AO Channel 00 Configuration

Register Map

Model ES2171
Model ES2172

Ref	Addr.	Description	Data Type/Format
Holding Registers (4x References, Read/Write)			
40049	0030	AO CH00 TO Time (Default is 0000H, timer disabled)	AO Channel 00 Timeout Time is a 16-bit unsigned integer from 0-65535 seconds representing the time that must expire before triggering a watchdog timeout if outputs have not been updated. A value of 0 disables the timer.
40050	0031	AO CH01 Time	AO Channel 01 Timeout Time Value
40051	0032	AO CH02 Time	AO Channel 02 Timeout Time Value
40052	0033	AO CH03 Time	AO Channel 03 Timeout Time Value
40053	0034	AO CH04 Time	AO Channel 04 Timeout Time Value
40054	0035	AO CH05 Time	AO Channel 05 Timeout Time Value
40055	0036	AO CH06 Time	AO Channel 06 Timeout Time Value
40056	0037	AO CH07 Time	AO Channel 07 Timeout Time Value
40057	0038	AO CH08 Time	AO Channel 08 Timeout Time Value
40058	0039	AO CH09 Time	AO Channel 09 Timeout Time Value
40059	003A	AO CH10 Time	AO Channel 10 Timeout Time Value
40060	003B	AO CH11 Time	AO Channel 11 Timeout Time Value
40061	003C	AO CH12 Time	AO Channel 12 Timeout Time Value
40062	003D	AO CH13 Time	AO Channel 13 Timeout Time Value
40063	003E	AO CH14 Time	AO Channel 14 Timeout Time Value
40064	003F	AO CH15 Time	AO Channel 15 Timeout Time Value
40065	0040	AO CH00 TO Val **(Default is 0000H, or go to 0% following a timeout)**	AO Channel 00 Post Timeout Level which is the value an output is sent to after a timeout has occurred. This level is expressed as a 16-bit signed integer with a value normalized to ±30000 for ±100% of input range (see Note 1).
40066	0041	AO CH01 TO Val	AO Channel 01 Post Timeout Level
40067	0042	AO CH02 TO Val	AO Channel 02 Post Timeout Level
40068	0043	AO CH03 TO Val	AO Channel 03 Post Timeout Level
40069	0044	AO CH04 TO Val	AO Channel 04 Post Timeout Level
40070	0045	AO CH05 TO Val	AO Channel 05 Post Timeout Level
40071	0046	AO CH06 TO Val	AO Channel 06 Post Timeout Level
40072	0047	AO CH07 TO Val	AO Channel 07 Post Timeout Level
40073	0048	AO CH08 TO Val	AO Channel 08 Post Timeout Level
40074	0049	AO CH09 TO Val	AO Channel 09 Post Timeout Level
40075	004A	AO CH10 TO Val	AO Channel 10 Post Timeout Level
40076	004B	AO CH11 TO Val	AO Channel 11 Post Timeout Level
40077	004C	AO CH12 TO Val	AO Channel 12 Post Timeout Level
40078	004D	AO CH13 TO Val	AO Channel 13 Post Timeout Level
40079	004E	AO CH14 TO Val	AO Channel 14 Post Timeout Level
40080	004F	AO CH15 TO Val	AO Channel 15 Post Timeout Level

Register Map

Model ES2171
Model ES2172

Ref	Addr.	Description	Data Type/Format
Holding Registers (4x References, Read/Write)			
40081	0050	AO CH00 Start **(Default is 0000H, start from 0% of span)**	AO CH00 Initial Startup Value which is the level that the output is initially programmed to. This level is expressed as a 16-bit signed integer with a value normalized to ±30000 for ±100% of input range (Note 1).
40082	0051	AO CH01 Start	AO CH01 Initial Start Val, Signed Int
40083	0052	AO CH02 Start	AO CH02 Initial Start Val, Signed Int
40084	0053	AO CH03 Start	AO CH03 Initial Start Val, Signed Int
40085	0054	AO CH04 Start	AO CH04 Initial Start Val, Signed Int
40086	0055	AO CH05 Start	AO CH05 Initial Start Val, Signed Int
40087	0056	AO CH06 Start	AO CH06 Initial Start Val, Signed Int
40088	0057	AO CH07 Start	AO CH07 Initial Start Val, Signed Int
40089	0058	AO CH08 Start	AO CH08 Initial Start Val, Signed Int
40090	0059	AO CH09 Start	AO CH09 Initial Start Val, Signed Int
40091	005A	AO CH10 Start	AO CH10 Initial Start Val, Signed Int
40092	005B	AO CH11 Start	AO CH11 Initial Start Val, Signed Int
40093	005C	AO CH12 Start	AO CH12 Initial Start Val, Signed Int
40094	005D	AO CH13 Start	AO CH13 Initial Start Val, Signed Int
40095	005E	AO CH14 Start	AO CH14 Initial Start Val, Signed Int
40096	005F	AO CH15 Start	AO CH15 Initial Start Val, Signed Int
40097	0060	AO Watchdog Timeout Action per channel ***(Def = 0000H, No Change)***	Bits 15-0 (bit position is AO channel) 1=Change Output on Timeout 0=Do Not Change Output on Timeout
40098	0061	*Reserved*	*Reserved*
40099	0062	*Reserved*	*Reserved*
40100	0063	*Reserved*	*Reserved*
40101	0064	Global Floating Point Byte Order ***(Def = 0000H)***	Bits 15-2: 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
40102	0065	Local Relay Failsafe/ Non-Failsafe Selection & Alarm Trigger ***(Def=0100H, Alarm for link loss, use failsafe relay)***	Bits 15-9: 0 (Not Used) Bit 8: 0=Alarm on WD Timeout Only (Not Link Error) 1=Alarm on WD Timeout and on Link Error Bits 7-1: 0 (Not Used) Bit 0: 0=Failsafe 1=Non-Failsafe Relay contacts can signal a media failure (link loss). Relay can also signal a power loss if set to failsafe.

Register Map

Model ES2171
Model ES2172

Ref	Addr.	Description	Data Type/Format
Holding Registers (4x References, Read/Write)			
40103	0066	Enable/Disable Output Loopback ***(Def = 0000H, loopbk disabled)***	Bits 15-9: 0 (Not Used) Bit 8: 0=DisLpbk 1=EnaLpbk Bit 7-0: 0 (Not Used)
40104	0067	*Reserved*	*Reserved – Do Not Use*
40105	0068	Wink Toggle & Cal Access & Restore Output Calibration & 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 40345 & 40346). All other values apply write-protection to the calibration registers. Write **43690 (AAAAH)** to restore the factory output cal values. Write **41429 (A1D5H)** to this register to cause a system reset and reboot. *(Write **43981 (ABCDH)** to save factory output calibration-Reserved for factory use only)*
		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.*	
40106	0069	*Reserved*	*Reserved – Do Not Use*
.	.	.	.
.	.	.	.
.	.	.	.
40300	012B	*Reserved*	*Reserved – Do Not Use*
40301	012C	AO CH00 Cal HI	AO CH00 Raw DAC Count HI
40302	012D	AO CH00 Cal LO	AO CH00 Raw DAC Count LO
40303	012E	AO CH01 Cal HI	AO CH01 Raw DAC Count HI
40304	012F	AO CH01 Cal LO	AO CH01 Raw DAC Count LO
40305	0130	AO CH02 Cal HI	AO CH02 Raw DAC Count HI
40306	0131	AO CH02 Cal LO	AO CH02 Raw DAC Count LO
40307	0132	AO CH03 Cal HI	AO CH03 Raw DAC Count HI
40308	0133	AO CH03 Cal LO	AO CH03 Raw DAC Count LO
40309	0134	AO CH04 Cal HI	AO CH04 Raw DAC Count HI
40310	0135	AO CH04 Cal LO	AO CH04 Raw DAC Count LO
40311	0136	AO CH05 Cal HI	AO CH05 Raw DAC Count HI
40312	0137	AO CH05 Cal LO	AO CH05 Raw DAC Count LO
40313	0138	AO CH06 Cal HI	AO CH06 Raw DAC Count HI
40314	0139	AO CH06 Cal LO	AO CH06 Raw DAC Count LO
40315	013A	AO CH07 Cal HI	AO CH07 Raw DAC Count HI
40316	013B	AO CH07 Cal LO	AO CH07 Raw DAC Count LO
40317	013C	AO CH08 Cal HI	AO CH08 Raw DAC Count HI
40318	013D	AO CH08 Cal LO	AO CH08 Raw DAC Count LO

Shaded registers from 40301 to 40332 are write-restricted and reserved for internal firmware and factory use (these registers are modified indirectly by the calibration registers 40345 & 40346). Do not attempt to directly modify the contents of the shaded registers.

Register Map

Model ES2171
Model ES2172

Shaded registers from 40301 to 40332 are write-restricted and reserved for internal firmware and factory use (these registers are modified indirectly by the calibration registers 40345 & 40346). Do not attempt to directly modify the contents of the shaded registers.

Ref	Addr.	Description	Data Type/Format
Holding Registers (4x References, Read/Write)			
40319	013E	AO CH09 Cal HI	AO CH09 Raw DAC Count HI
40320	013F	AO CH09 Cal LO	AO CH09 Raw DAC Count LO
40321	0140	AO CH10 Cal HI	AO CH10 Raw DAC Count HI
40322	0141	AO CH10 Cal LO	AO CH10 Raw DAC Count LO
40323	0142	AO CH11 Cal HI	AO CH11 Raw DAC Count HI
40324	0143	AO CH11 Cal LO	AO CH11 Raw DAC Count LO
40325	0144	AO CH12 Cal HI	AO CH12 Raw DAC Count HI
40326	0145	AO CH12 Cal LO	AO CH12 Raw DAC Count LO
40327	0146	AO CH13 Cal HI	AO CH13 Raw DAC Count HI
40328	0147	AO CH13 Cal LO	AO CH13 Raw DAC Count LO
40329	0148	AO CH14 Cal HI	AO CH14 Raw DAC Count HI
40330	0149	AO CH14 Cal LO	AO CH14 Raw DAC Count LO
40331	014A	AO CH15 Cal HI	AO CH15 Raw DAC Count HI
40332	014B	AO CH15 Cal LO	AO CH15 Raw DAC Count LO
40333	014C	*Reserved*	*Reserved – Do Not Use*
.	.	.	.
.	.	.	.
.	.	.	.
40344	0157	*Reserved*	*Reserved – Do Not Use*
40345	0158	*Output Zero Cal Trigger for Output Ch 15-00 of Ports 1 and 2*	*This register is used to trigger the A/D to write the output(s) and store the measured zero output signal. Write a set bit to cause the corresponding voltage channel to be calibrated (lsb is lowest numbered channel of this group). You must first write 24106 to Calibration Access Register 40105 to remove write-protection from these calibration registers.*
40346	0159	*Output Span Cal Trigger for Output Ch 15-00 of Ports 1 and 2*	*This register is used to trigger the A/D to write the output(s) and store the measured full-scale signal. Write a set bit to cause the corresponding voltage channel to be calibrated (lsb is lowest numbered channel of this group). You must first write 24106 to Calibration Access Register 40105 to remove write-protection from these calibration registers.*
40347	015A	*Reserved*	*Reserved – Do Not Use*
40348	015B	*Reserved*	*Reserved – Do Not Use*
40349	015C	*Reserved*	*Reserved – Do Not Use*
40350	015D	*Reserved*	*Reserved – Do Not Use*

Ref	Addr.	Description	Data Type/Format
Holding Registers (4x References, Read/Write)			
40351	015E	AO CH 00 Value	16-bit Signed Integer Output Value
40352	015F	AO CH 01 Value	16-bit Signed Integer Output Value
40353	0160	AO CH 02 Value	16-bit Signed Integer Output Value
40354	0161	AO CH 03 Value	16-bit Signed Integer Output Value
40355	0162	AO CH 04 Value	16-bit Signed Integer Output Value
40356	0163	AO CH 05 Value	16-bit Signed Integer Output Value
40357	0164	AO CH 06 Value	16-bit Signed Integer Output Value
40358	0165	AO CH 07 Value	16-bit Signed Integer Output Value
40359	0166	AO CH 08 Value	16-bit Signed Integer Output Value
40360	0167	AO CH 09 Value	16-bit Signed Integer Output Value
40361	0168	AO CH 10 Value	16-bit Signed Integer Output Value
40362	0169	AO CH 11 Value	16-bit Signed Integer Output Value
40363	016A	AO CH 12 Value	16-bit Signed Integer Output Value
40364	016B	AO CH 13 Value	16-bit Signed Integer Output Value
40365	016C	AO CH 14 Value	16-bit Signed Integer Output Value
40366	016D	AO CH 15 Value	16-bit Signed Integer Output Value
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.*

Notes (Register Map):

1. The 16-bit D/A ranges use a count of ±32768 for their native ±5V and/or ±10V outputs. All output ranges are normalized to a count of ±30000 by the unit which corresponds to ±100% for bipolar ranges, or 0-30000 corresponding to 0-100% for unipolar ranges. Over-range is 2768.
2. While the ES2172 voltage outputs are directly driven by a 16-bit ±10V DAC with an internal resolution of ±32768. For the ES2171, only a portion of this voltage (0-5V) drives a V/I converter to produce 0-20mA (0-16384 DAC count). All current output ranges (0-20mA and 4-20mA) are unipolar and normalized to a count of 0-30000 corresponding to 0-100% of the range.

Register Map

Model ES2171
Model ES2172

Write to these registers to set the analog output level. The value written is a normalized D/A count with ±100% of output range represented by ±30000 (see Note 1).

The shaded register addresses are those that are suitable i2o target (mapped) register addresses if writing to outputs on this unit via i2o configured on another unit. These represent the starting target addresses of eight contiguous output registers required to write a port via i2o. ***Make sure you enter the correct target address at your i2o generator, or i2o could inadvertently change the configuration of an i2o target device.***

Default Register Settings

Here is a summary of the ES2171/2172 default register settings and corresponding default behavior.

ES2171/2172 Default Register Settings

REGISTER	HEX	ACTION
AO Channel Config Registers	0000H	Output is ±10V or 0-20mA
AO Channel Timeout Time	0000H	0s, Timer is disabled
AO Channel Timeout Value	0000H	0.0000
AO Channel Power-Up/Reset Value	0000H	Set Initial Value to 0%
AO Take Action on Timeout	FFFFH	Do Change on Timeout
Local Relay Failsafe/Non-Failsafe Select and Alarm Trigger	0100H	Enable Failsafe and Alarm for Watchdog Timeout and Link Error.
Wink Register	0000H	OFF, Do Not Wink

Note that all of these parameters are addressed via holding registers 40001 to 40102, and these are the contents that are also exported via the Export Configuration Control of the Utility Web Page. They are also the values restored to via the Restore function (see Getting Out of Trouble procedure).

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
Export Configuration & Export IP Address

SPECIFICATIONS

Description

This high-density, industrial Ethernet I/O system provides 16 analog outputs of voltage (ES2172), or current (ES2171). Output channels employ 16-bit D/A conversion. Units include dual isolated 10/100M Ethernet ports for monitoring, calibration, and control of the outputs via Modbus TCP/IP or UDP/IP. The ES2172 voltage output model adds a DB25 interface connector to optionally connect to a Series 8B expansion panel of 4, 8, or 16 output channels. The unit is DC-powered with redundant power input and reverse polarity protection. Field outputs are wide-band, multi-ranging, and single-ended. Dual network ports allow the unit to be conveniently cascaded with other EtherStax 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. Output channels, the alarm relay, network ports, and the power circuit are isolated from each other, and from earth ground (chassis). Non-volatile reprogrammable memory in the unit stores configuration and calibration information.

Model Numbers

EtherStax model prefix "ES" denotes the EtherStax Ethernet I/O family. The trailing "21" denote the 2100 series. The "71" following "21" denotes a 16 channel voltage output model. A "72" following "21" denotes a 16 channel current output model. The ES2172 has one DB25 interface connector for optional connection to industry standard 8BP expansion panels which support a variety of output 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).

Examples:

ES2171-0000 (16 Current Output)
ES2171-0010 (wo/Enclosure)
ES2171-1000 (w/Fiber Port)
ES2171-1010 (w/Fiber, wo/Encl.)

ES2172 models are similar, but have 16 voltage outputs and add a DB25 interface connector for connecting to 8BP expansion panels for 8B output modules (sold separately).

Mounting Options

Standard units can 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 optional mounting kit selected. These mounting options are listed below. Detailed drawings of these items are included in the Mounting and Dimensions section at the front of this manual.

ESA-DIN-VMK, DIN Rail Vertical Mount Kit: This kit includes two plastic DIN clips that slide into the dovetail channel at the bottom of the housing. You can use one clip to mount a single unit, or both clips for added stability, or when stacking two units. The "vertical" designation refers to the orientation of an EtherStax unit relative to the DIN rail.

ESA-DIN-HMK, DIN Rail Horizontal Mount Kit: This 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 on 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 an EtherStax 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 one to three units to be bolted to a wall or flat surface.

SPECIFICATIONS

Mounting Options

DIN Rail, Surface, or Open-Frame Mounting

ESA-OMK, Open Mounting Kit: EtherStax 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. Units may optionally bolt to the surface-mount base plate of ESA-SMK or ESA-DIN-HMK with this hardware. This kit contains the identical replacement hardware for stacking two open circuits together and/or mounting them to a flat surface.

Analog Voltage Output (ES2172 Only)

16 Voltage Outputs with DB25 8B Interface

Note: This unit can auto-calibrate its DAC output by reading each output with its own A/D along with a known reference voltage (4.5V ±0.05% ±5ppm/°C). This is sufficient to achieve accuracy suitable for most applications. The output accuracy can still be improved by several orders of magnitude by manually calibrating the output. Units shipped from the factory have not been manually calibrated.

Auto-calibrating the current outputs does not compensate for small errors of the last output stage and manual calibration can be used to improve their performance.

Voltage Output Specifications (ES2172 Only):

Output Range: Select ±5V or ±10V, per channel. Outputs are limited to approximately ±5.3V, and ±10.2V typical.
Output Load (of unit, not 8B output): ±1mADC max drive current into 10KΩ or greater (±10V), or 5KΩ or greater (±5V). Optionally, you may use an 8B output module for greater voltage drive capability.
Output Accuracy: Better than ±0.05% (voltage outputs) using auto calibration (as shipped from factory). Output accuracy can be improved to better than ±0.025% by manually calibrating voltage outputs. Units as shipped from the factory have not been manually calibrated.
Output Resolution: ±10V range is 16-bits (±32768), or 1 part in 65536 internal, normalized to ±30000. ±5V range is 15-bits (±16384), or 1 part in 32768 internal, normalized to ±30000. All I/O ranges are normalized to ±30000 (Bipolar, ±100%), or 0-30000 (Unipolar, 0-100%).
Output Maximum Voltage: 10.2V, typical.
Output Impedance: 1Ω maximum.
Output Temperature Drift: Better than ±60ppm/°C (±0.006%/°C).
Output Short Circuit Protection: Included.
Output Update Rate: Output levels are updated when written, and continuously every 5 seconds.
DAC Count (Voltage): All output ranges are normalized to ±30000 which corresponds to ±100% of output range. A normalized count is limited to a 16-bit signed maximum count of 32768, which is approximately 109.2%. In the table, "Internal" refers to the actual D/A count, while "Register" is the ideal program value for the output register (i.e. the normalized value).

Internal DAC Count (Ideal) Versus Voltage Output Range

Range	Range	DAC -100%	DAC 0%	DAC 100%
±5V	Register	-30000	0	+30000
	Internal	-16384	0	+16384
±10V	Register	-30000	0	+30000
	Internal	-32767	0	+32768

8B Output Support: See the **8B Expansion Interface** section that follows this section.

Analog Current Output (ES2171 Only)

16 Process Current Outputs

Current Output Specifications (ES2171 Only):

Output Ranges: Select 0-20mA DC or 4-20mA DC. The 4-20mA range is a sub-range of the 0-20mA range.
Output Accuracy: Output is auto-calibrated from the factory to better than ±0.1% for current outputs. Manual calibration of current outputs can be used to improve output accuracy to better than 0.05%. Units shipped from the factory have not been manually calibrated.
Output Excitation: 9-16V Excitation required for current outputs (see the Power Requirements – Excitation specification).

Note (Current Output Calibration & Loopback): Unit can be triggered to auto-calibrate the outputs. However, for the ES2171, this does not compensate for potential offset in the output V/I stage (up to ±0.07%), as it loops back the DAC voltage driving the V/I converter. Use manual per-channel calibration to calibrate to a higher rated accuracy better than ±0.05%. Manual calibration of the outputs is not done from the factory. Likewise, if current outputs are looped back, the current indicated will not be corrected for any last stage or manual calibration offset.

Output Maximum Current: Limited in firmware to 21.5mA (0-20mA) and 21.4mA (4-20mA). Limits are set by the 16-bit signed integer maximum of 32768, and a normalized DAC count of 0-30000 for 0-100%. This ideally corresponds to 21.84mA for 0-20mA range, and 21.48mA for 4-20mA range.

Output Compliance: 13V (w/16V excitation). See the Power Requirements – Excitation specification.

Output Load Resistance Range: 0-600Ω. Output resistance is a function of excitation voltage as $R_{load\_max} = (V_{exc} - 3.3)/0.0215$. See Power Requirements – Excitation of the Environmental specifications on page 67 for a table of load resistance versus excitation voltage.

Output Update Rate: Output levels are updated when written, and continuously every 5 seconds.

Output Resolution (Current): A 16-bit, ±10V DAC drives a V/I converter such that output current is the DAC voltage divided by 249. With ±32768 representing ±10V, an internal count of 0-16318 yields 0-20mA, and 3264-16318 yields 4-20mA. This is 1.226uA/bit, or 1 part in 16318 for 0-20mA, 1 part in 13054 for 4-20mA. From the programmers perspective, all unipolar output ranges are normalized to 0-30000 for 0-100% of range and the effective resolution is limited by the internal DAC resolution as described. The normalized over-range count is limited to a 16-bit signed integer of 32768, which is 32768/30000, or 109.2%. This yields an ideal over-range value of approximately 21.84mA at 32768 for 0-20mA range, and 21.48mA for 4-20mA range.

IDEAL RANGE LIMITS WRT DAC COUNT

	DAC CT	Voltage	Current	PGM COUNT
0-20mA Range				
0mA	0	0.000V	0.000mA	0
20mA	16318	4.980V	20.000mA	30000
OVR	17824	5.4395V	21.84mA	32768
4-20mA Range				
4mA	3264	0.996V	4.000mA	0
20mA	16318	4.980V	20.000mA	30000
OVR	17523	5.3476V	21.48mA	32768

SPECIFICATIONS

Analog Current Output (ES2171 Only)

16 Process Current Outputs

SPECIFICATIONS

8B Expansion Interface

For Connection to 8B Outputs at X2 of ES2172 Models Only.

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

Modules that do not utilize the full ±10V 16-bit DAC range will have a proportionally lower effective resolution (see Table).

ES2172 models add a female DB25 connector marked X2 on the back of the unit that allows you to connect an 8BP04, 8BP08, or 8BP16 back-panel for installation of industry-standard 8B *output* modules (sold separately).

Sixteen 16-bit, ±10V, voltage output DAC's drive the sixteen output channels of the ES2172 in tandem with pins of the DB25 interface. Installed 8B modules will displace the corresponding field voltage channels of the unit. However, it is possible to intermix field voltage channels on the unit with 8B channels on a connected back-panel, as long as you do not wire to corresponding outputs. Keep in mind that four and eight channel 8B back-panels will always consume the first 4 or 8 output channels of the unit.

8B I/O modules include transient protection and 1500VAC isolation (240VAC safety rated isolation). Likewise, 8B output modules are driven by the 0-5V, ±5V, and ±10V DAC output signals, according to their model.

IMPORTANT: Only 8B **Output** Modules can be driven by ES2172 models at interface connector X2. Install only 8B output model types on any 8B carrier connected to the X2 DB25 interface. You cannot intermix 8B output modules with input modules on the same carrier without introducing contention and risking damage to I/O circuitry

8B Compatible Modules: See the following table for output module types. Modules mount in pin sockets on the carrier circuit board and are retained via module-captive 4-40 machine screws (one per module). Refer to the Acromag web site at www.acromag.com for the most up to date listing of modules

8B Output Modules (Sold Separately)

8B Model	Input Signal[1]	Output Range[2]	8B Model	Input Signal[1]	Output Range[2]
Current Output Modules (100Hz)			**Voltage Output Modules (1KHz)**		
8B39-01	0-5V	4-20mA	8B49-01	0-5V	±5V
8B39-02	±5V	4-20mA	8B49-02	±5V	±5V
8B39-03	0-5V	0-20mA	8B49-03	±5V	0-5V
8B39-04	±5V	0-20mA	8B49-04	0-10V	±10V
8B39-07	±5V	±20mA	8B49-05	±10V	±10V
			8B49-06	±10V	0-10V
			8B49-07	±5V	±10V

[1] The Input Signal refers to the internal signal required to drive the output (i.e. the voltage signal provided by the ES2172).
[2] The Output Range is the isolated field output signal of the module itself.

8B Compatible Panels: Industry standard 8B module carriers 8BP04 (4 channel), 8BP08 (8 channel), and 8BP16 (16 channel). Panels and modules are sold separately. These items can be purchased from Acromag, or directly from Dataforth. Consult factory.

8B 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 8BP04/08/16 back panels to the EtherStax unit, or other host systems.

8B Output Channels: ES2172 models support up to 16 output channels. Channels are mapped as shown below.

8B Output Channel Mapping: Refer to the following tables to map output channels to 8B output modules install on a separate carrier and connected via the DB25 interface connector X2 (ES2172 only).

X2				*ES2172 Only (X2 Interface Not Included on ES2171)*											
Port 1 Voltage Output Channels								**Port 2 Voltage Output Channels**							
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
4CH 8BP04				4	5	6	7	8	9	10	11	12	13	14	15
8CH Back Panel 8BP08								8	9	10	11	12	13	14	15
16CH Back Panel 8BP16															
DB25 X2 Interface Connector Includes 16 output channels CH00-CH15															

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

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

8B Output Scaling: None. Unit output channel voltage is ±10V and it is up to the user to set the appropriate output voltage range to control the 8B output modules. This control range varies with the output module model and this is indicated in the table above.

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.

Agency Rating: 3A at 250VAC or 24VDC (General Use, 100K Operations), or 5A at 250VAC or 24VDC (Resistive Load, 6K Operations). 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.

SPECIFICATIONS

8B Expansion Interface

For Connection to 8B Outputs at X2 of ES2172 Models Only.

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

Modules that do not utilize the full ±10V 16-bit DAC range will have a proportionally lower effective resolution (see Table).

Alarm Relay Output

SPECIFICATIONS

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): 4 Megabytes, used for storage of register data, communication config parameters, and web-page info. User-modified via configuration. Sanitized by holding the default switch while powering the unit until the green Run LED turns OFF. At this time, the memory reverts to the factory default setting, except for fixed MAC ID & serial number. Refer to "Getting Out of Trouble" section for more info.

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.

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.

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.

Agency Approvals

Safety Approvals: Enclosed Models, ES2171/2172-0000 & ES2171/2172-1000 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 ES2171/2172-0010 & ES2171/2172-1010 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).

Open-Frame Models (ES2171-x010 & ES2172-x010)

UL/cUL Recognized Components suitable for use in Hazardous Locations per Class 1, Division 2, Groups A, B, C, & D, where the acceptability of the combination is determined by Underwriters Laboratories. 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 live parts through openings in the enclosure, and reliable retention of guards or barriers for prevention of risk of electric shock, 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".

SPECIFICATIONS

Reliability Prediction

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

Temp	ES2171-00x0	ES2171-100x0	ES2172-00x0	ES2172-10x0
25ºC	416,181 hrs	421,824 hrs	547,718 hrs	557,534 hrs
40ºC	306,845 hrs	304,336 hrs	407,365 hrs	402,953 hrs

Per MIL-HDBK-217, Ground Benign, Controlled, $G_B G_C$

Enclosure & Physical

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.

Dimensions: IP40 rated enclosure, 8.226 inches wide, 2.444 inches tall, 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. 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-Board Mounting/Stacking: For units ordered without an enclosure, enough 6-32 jack-screws and threaded standoffs for stacking two assemblies are included with every open unit and in the Acromag ESA-OMK Open Mounting Kit. Refer to the Mounting & Dimensions section for more details.

I/O 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 is 0.22-0.25 Nm.

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

Network Connector (Copper): One or two 8-pin RJ-45 sockets according to model. Connections are wired MDI-X by default (like an Ethernet switch, as opposed to MDI), and include automatic MDI/MDI-X crossover. Connect using CAT-5 or better cable. For increased immunity to shock & vibration, 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.

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

SPECIFICATIONS

Enclosure & Physical

Network Connector ("-1xxx" Units w/100Base-FX Fiber): An 8-pin RJ45 socket (for port 2), plus a 100BaseFX, SC-Type, multi-mode fiber-optic connector (for port 1). Note that 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.

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).

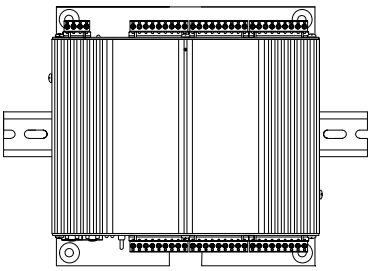
Environmental

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.

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.*

IMPORTANT: Enclosed units should 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.

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: I/O 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.

Power Requirements (Unit Main): 18-36V DC SELV (Safety Extra Low Voltage), 4.6W max (ES2171/2172-1), 3.3W max (ES2171/2172-0). Observe proper polarity. Keep DC power cables less than 10m in length. Divide power by voltage to calculate max current. 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 ES2171/2172-0	Model ES2171/2172-1
18V	163mA Typ, 179mA Max	228mA Typ, 251mA Max
24V	121mA Typ, 133mA Max	169mA Typ, 186mA Max
30V	98mA Typ, 108mA Max	137mA Typ, 151mA Max
36V	82mA Typ, 90mA Max	114mA Typ, 125mA Max

Power Requirements (Excitation, ES2171 Models Only): Connect 9-16V DC between excitation terminal (E) and output common (C) for rated performance. The maximum load resistance will depend on your excitation voltage as follows:

ES2171 EXCITATION	LOAD RESISTANCE RANGE
9V	0-265Ω
10V	0-312Ω
11V	0-358Ω
12V	0-405Ω
13V	0-451Ω
14V	0-498Ω
15V	0-545Ω
16V	0-590Ω
24V[1]	0-600Ω[1]

Notes (ES2171 Excitation Requirements):

1. With 24V excitation, the maximum operating ambient must derate to +35°C (-x000 enclosed models), or +40°C (-x010 open models).
2. The maximum load resistance is calculated from the excitation voltage as follows: $R_{load\_max} = (V_{exc} - 3.3)/0.0215$.

Installation Category: Suitable for installation in a Pollution Degree 2 environment with installation category (over-voltage category) II rating.

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

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 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.

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.

SPECIFICATIONS

Environmental

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

***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).*

SPECIFICATIONS

Ethernet Interface

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

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.

Utilizes 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.

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

Network Connector (Fiber, ES2171/2172-1xxx Models): One duplex SC-type, multi-mode transceiver for IEEE 802.3u 100Base-FX cable connections. Multimode transmission distance is 2Km.

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. In hub/repeater mode, the data rate is fixed to 100Mbps and auto-negotiation does not apply.

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.

Compliance: IEEE 802.3, 802.3u, 802.3x.

IP Address: Default mode static IP address is 128.1.1.100.

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

Protocol: Modbus TCP/IP or UDP/IP with integrated web-browser recon-figuration. 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 devices on an Ethernet network is generally limited to 100 meters using recommended copper cable, and 2Km using multi-mode fiber optic 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.

LED Indicators (Rear Panel):

Rear System Status Indication (Located next to power terminals)

RELAY (Red) – Indicates the energized state of the adjacent SPST-NO relay contacts A & B. ON indicates these contacts are closed. OFF indicates these contacts are open. 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 upon power-up but turns constant ON if power is on and unit is OK. Continuous flashing after power-up may also indicate that the network cable was not connected or was bad on power-up. If you power-up without a network cable connected, this LED will flash until you connect the network cable. It will not start flashing if the cable is disconnected after a link has been established. Continuous flashing ON/OFF may also indicates 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 and 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 according to whether the network ports are in switch mode, or hub/repeater mode. In switch mode, column 1 corresponds to port 1 status and 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.

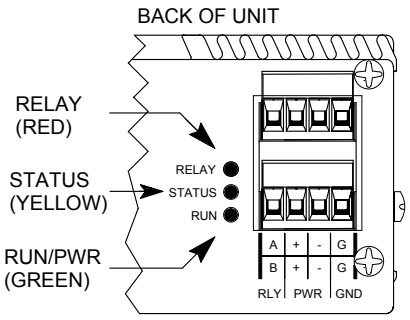
1 Yellow (FDX/COL) – Constant ON indicates full-duplex connection (no collisions possible). Intermittent ON indicates collisions (half-duplex). Constant OFF indicates half-duplex and no collisions.

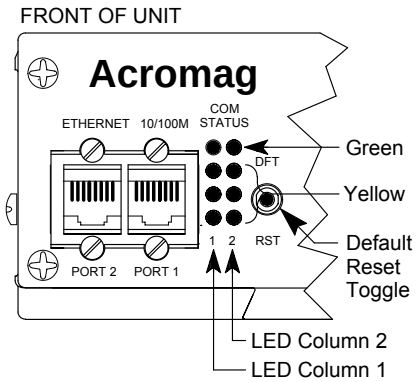
0 Yellow (SPEED) – This LED (bottom) indicates 100Mbps speed (ON), and 10Mbps speed (OFF).

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.

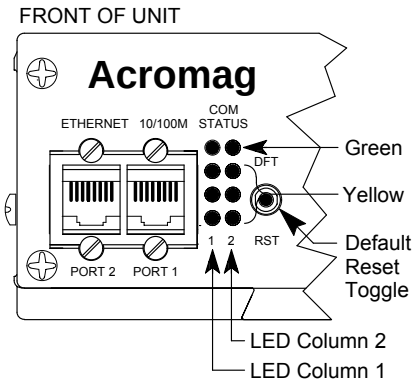
YELLOW - Link/Activity: ON if Linked/Blinks if Activity.

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.

SPECIFICATIONS

Controls & Indicators



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.

Port HUB/REPEATER Mode

Indicator Column 2 (Top to Bottom)

3 Green (ACT, Top) – 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, Bottom) – ON indicates an error has been encountered at network port 1 (the right port). Error is related to isolation, partition, jabber, or JK error.

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).

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.

Complete 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 also offers the following 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.

CABLES & CONNECTORS

Copper Connections

CABLES & CONNECTORS

Copper Connections

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.

Model ES2171/2172-1xxx 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.