



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

**Model ES2163 & ES2164
64-Ch Single-Ended Analog Current/Voltage Input**

USER'S MANUAL



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8500-825-B10A001

TABLE OF CONTENTS

Symbols on equipment:



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

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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.

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IMPORTANT SAFETY CONSIDERATIONS

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

GETTING STARTED

QUICK START.....	3
MOUNTING AND DIMENSIONS.....	5
CONTROLS & INDICATORS.....	12
ISOLATION BARRIERS.....	13
CONNECTIONS.....	14
Network.....	14
Redundant Media Connections.....	21
Power.....	23
Earth Ground.....	23
Alarm Relay.....	24
Analog Inputs.....	25
Analog Common.....	26
WEB BROWSER.....	26
Home Page.....	26
Password Configuration Page.....	27
Network Configuration Page.....	27
Input Configuration Page.....	31
Test Page.....	37
Calibration Page.....	38
Utility Page.....	46
TROUBLESHOOTING.....	47
Diagnostics Table.....	47
Getting Out Of Trouble.....	50

TECHNICAL REFERENCE

KEY FEATURES.....	51
HOW IT WORKS.....	52
Key Observations.....	53
MODBUS REGISTERS.....	54
Register Functions.....	54
Register Mirroring.....	55
Register Map.....	57
SPECIFICATIONS.....	81
Model Numbers.....	81
Mounting Options.....	81
Analog Input Specifications.....	82
General Input Specifications.....	84
Reliability Prediction.....	85
Alarm Relay Output.....	86
Memory.....	86
Agency Approvals.....	86
Enclosure and Physical.....	87
Environmental.....	88
Ethernet Interface.....	89
Controls & Indicators.....	90
CABLES & CONNECTORS.....	92

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

This is a web-enabled Ethernet device that allows you to use your web-browser to set it up and operate it. All Ethernet devices have a unique IP address that you are required to know in order to communicate with them using your web-browser.

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

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

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

You place this unit into Default Mode by depressing the toggle switch to the position marked "DFT" for about 4 seconds (see front figure at right), just until the yellow STATUS LED (opposite side of unit) starts blinking slowly to indicate the unit is in the Default Mode. Let go of DFT toggle when Status LED starts blinking. If you hold it depressed for too long, it will pass back out of 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 (and your Status LED should continue to blink).

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

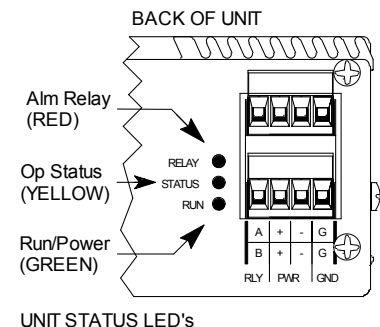
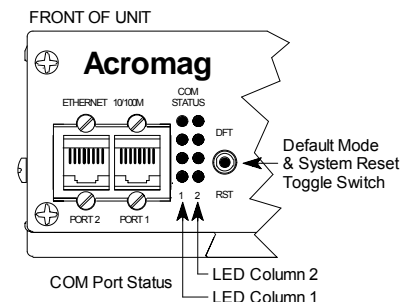
You cannot talk to this device at IP address 128.1.1.100 if the Network Interface Card you are using to connect to this device is set to an IP address outside of the address domain established by this default address. You must set the IP address of your network interface to an address like 128.1.1.x, 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



QUICK START

Guide to Quickly Establishing Communication

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

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

If after applying power, your green RUN LED is not solid ON after 25 seconds and is blinking continuously, you need to do the following:

Normally on power-up, the green RUN LED will blink for about 25 seconds during initialization, then stay ON. But if you powered the unit up without making your network connection, the green RUN LED will continue to blink. If RUN continues to blink, first check that your network cable is connected to the unit and to your PC. If you replaced the network cable after powering-up, the RUN LED should stop blinking after about 10 seconds once a network link has been established. Once the link is established, the green RUN LED should not continue to blink and should stay ON, even if you later remove the cable while still powered up.

If you have checked your network connections and the green RUN LED continues to blink...Reset, Restore, Return:

Reset: Try resetting the unit by momentarily depressing the DFT/RST toggle switch to the RST position. After about 25 seconds, the green RUN LED should remain ON.

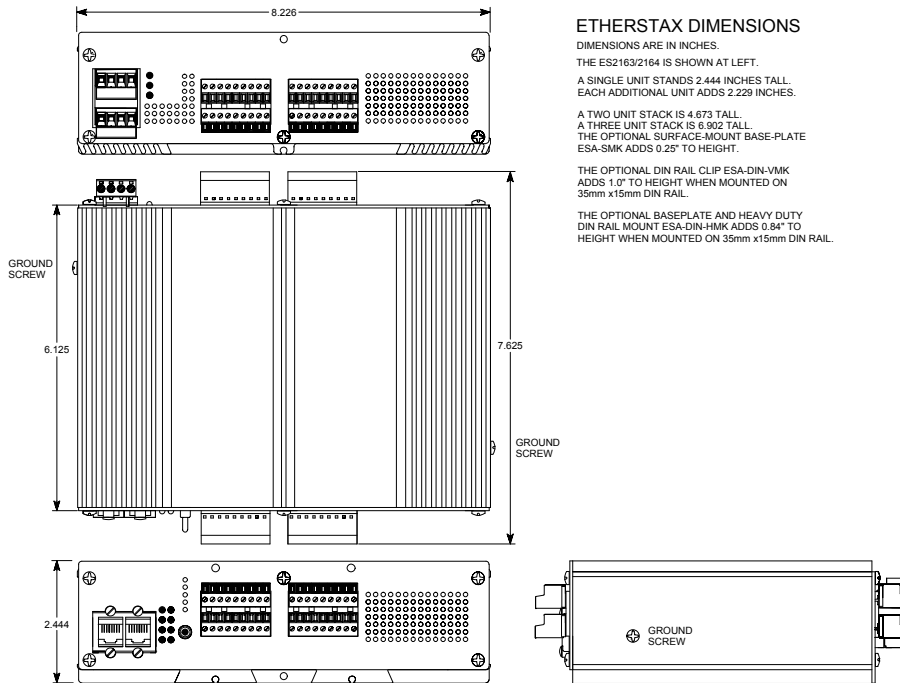
Restore: If you've tried resetting the unit and the green RUN LED still continues to blink, then you may need to follow the procedure for restoring the EtherStax to its initial configuration. This procedure is located at the end of the Trouble-Shooting section of this manual under "Getting Out Of Trouble" on page 50. Note that 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, including any calibration you may have performed.

If you do use restore and want to return the unit to service, the calibration reference will additionally have to be "restored" separately via the Restore Factory Voltage Reference Value button of the Input Calibration Page. Inputs will be calibrated automatically by default, but any manual calibration you may have done to improve accuracy is lost after restore and may need to be rechecked.

Return: At this point, if the green RUN LED continues to blink after resetting and after restoring, then you may need to return the unit for repair.

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

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



MOUNTING AND DIMENSIONS

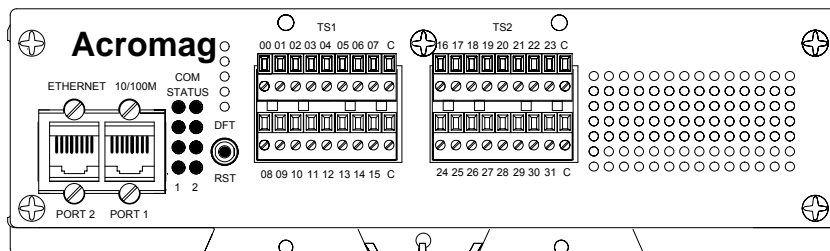
These Models are open-type devices and intended for installation into a suitable enclosure by the end-user.

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

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

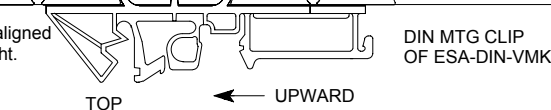
A two-unit stack would be 4.673 inches tall. A three unit stack is 6.902 inches tall. Add any additional height as necessary to account for the mounting plate, DIN clip, and DIN rail, if required.

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



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

TOP should coincide with the upper lip of the DIN rail

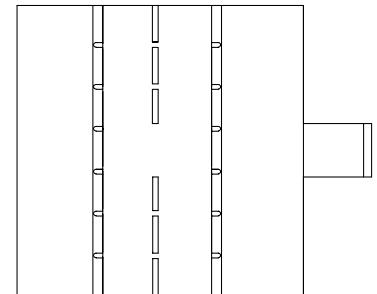


This side of clip should align with top of rail

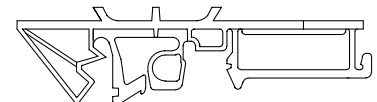
TO HANG: Tilt unit and place TOP of clip over upper lip of DIN rail. Press bottom towards rail to snap in place.

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

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.

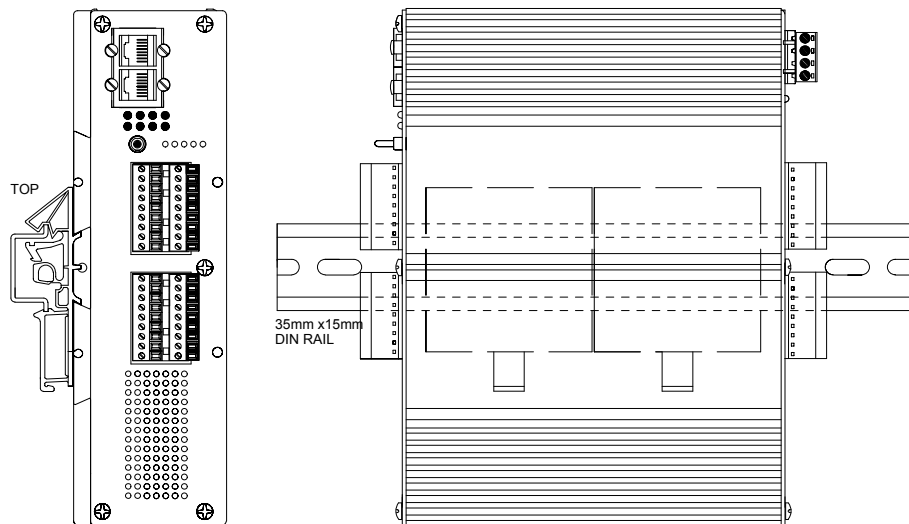
To remove a unit from the rail, grip unit on each side and pull/push upward, while tilting the top back to release the unit from the upper lip of the DIN rail.

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

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

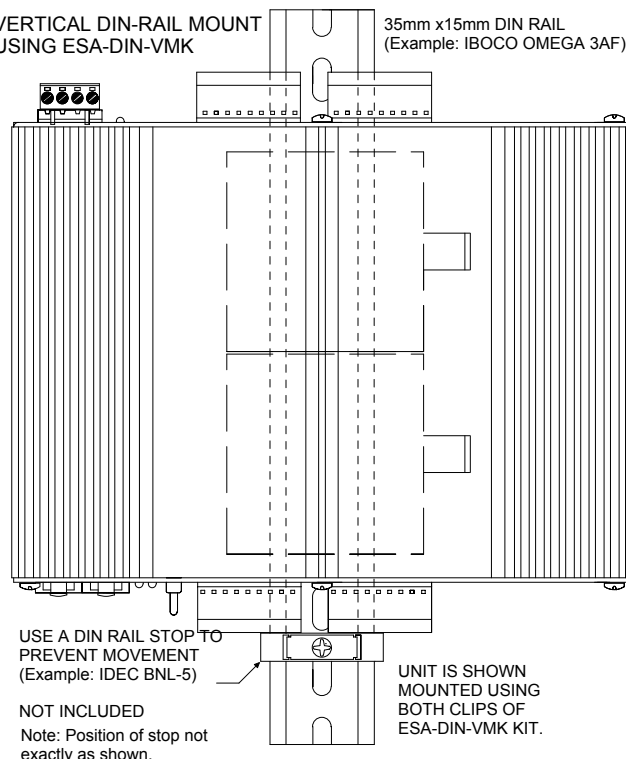
Simply slide the clips of this kit into the dovetail channel at the bottom of the enclosure. You can use one clip, or both (recommended) DIN clips of this kit to mount a single unit. For a stack of two units, both clips must be used. To remove a unit from the DIN rail, you have to lift the assembly upward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

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.

VERTICAL DIN-RAIL MOUNT USING ESA-DIN-VMK 35mm x15mm DIN RAIL (Example: IBOCO OMEGA 3AF)

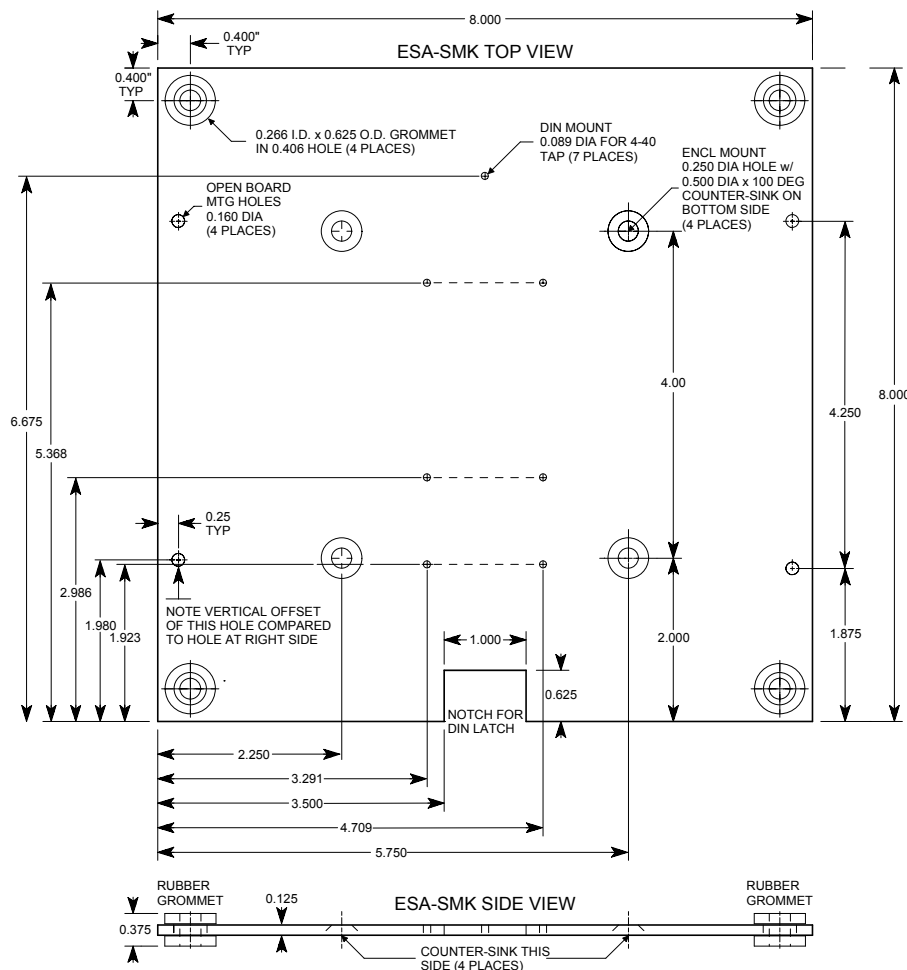


USE A DIN RAIL STOP TO PREVENT MOVEMENT (Example: IDEC BNL-5)

NOT INCLUDED
Note: Position of stop not exactly as shown.

UNIT IS SHOWN MOUNTED USING BOTH CLIPS OF ESA-DIN-VMK KIT.

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



MOUNTING AND DIMENSIONS

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

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

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

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

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

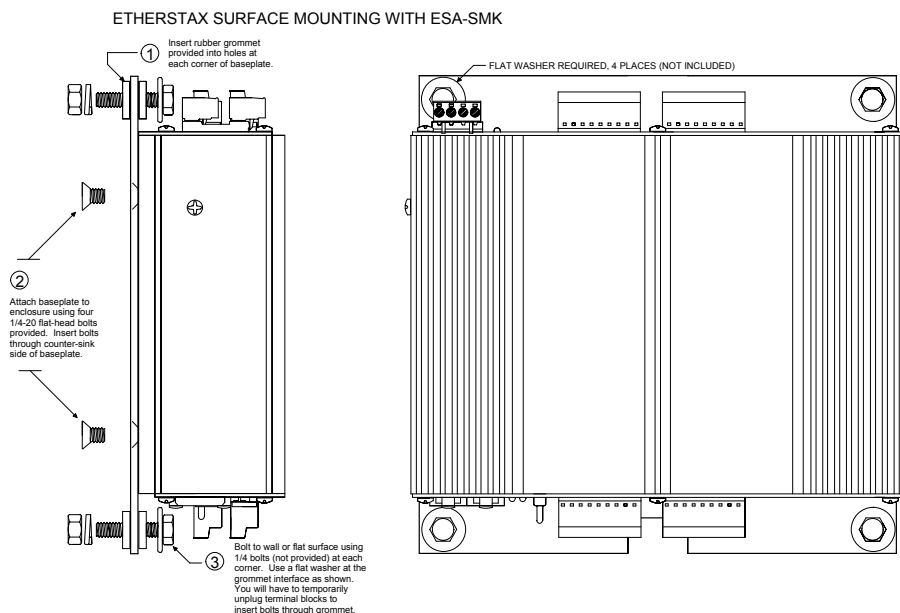
ESA-SMK Kit Contents:

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

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

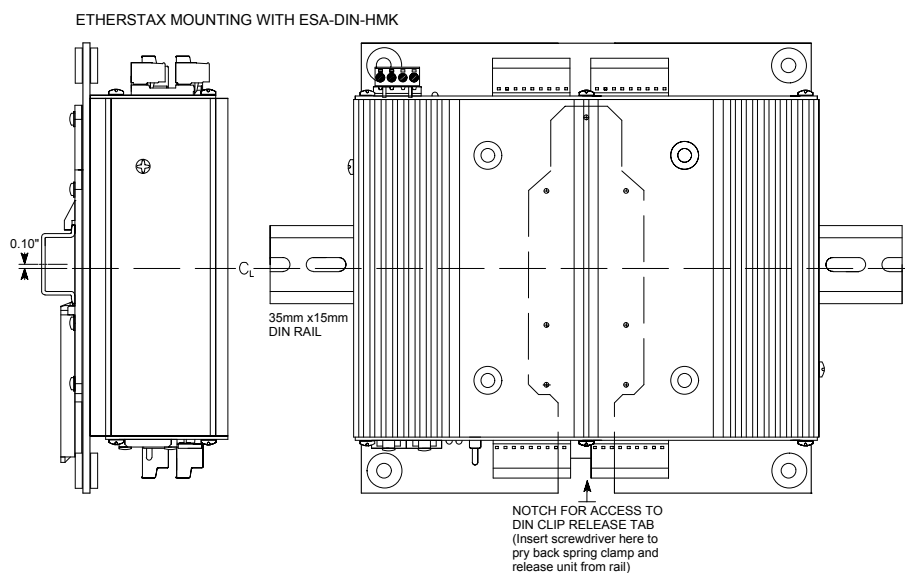
For DIN rail mounting of this plate, see ESA-DIN-HMK

MOUNTING AND DIMENSIONS



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

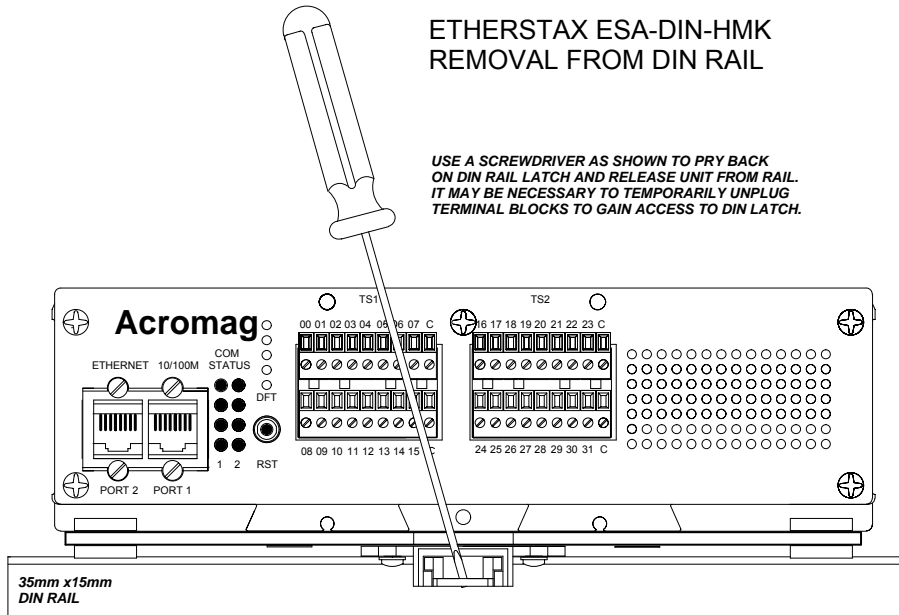
This is the recommended mounting orientation for reducing internal heat generation (see Ambient Operating Temperature at the back of this manual).



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

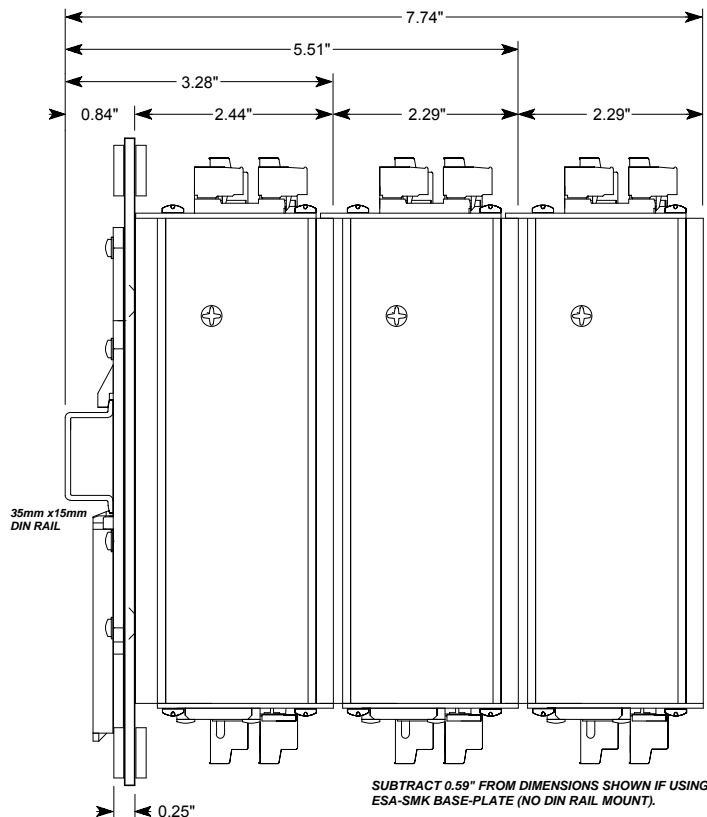
To attach or remove the ESA-DIN-HMK to/from the DIN Rail, use a screwdriver tip inserted into the slot at the end of the DIN clip, in the area of the notch of the base-plate as shown below. Pry back to compress the DIN clip spring, then release it from the rail. You may have to temporarily unplug the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



LOCATE DIN LATCH IN AREA OF NOTCH IN BASE-PLATE

ETHERSTAX ESA-DIN-HMK STACKING

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



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.

BUILDING A STACK

SLIDE UPPER UNIT INTO DOVETAIL CHANNEL OF LOWER UNIT UNTIL IT RESTS UPON FRONT ENDPLATE.

SECURE UNITS TOGETHER VIA TWO 6-32 SCREWS AT FRONT, AND ONE 6-32 SCREW AT CENTER OF REAR ENDPLATE.

① SLIDE UNITS TOGETHER






UPPER UNIT
RESTS ON FRONT
PLATE OF LOWER
UNIT

② FASTEN UNITS TOGETHER w/ 3 SCREWS AS SHOWN

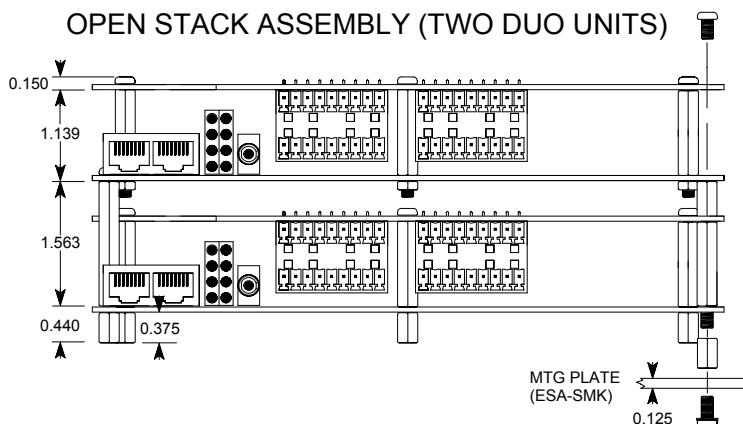
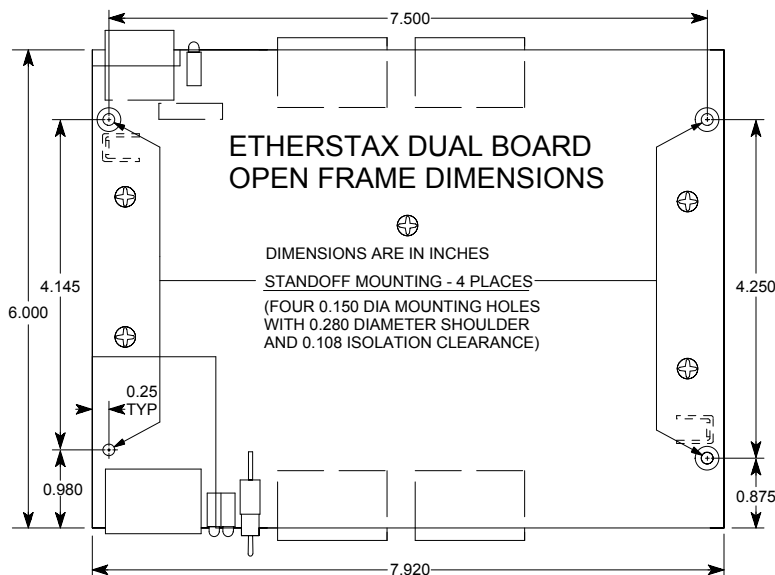
SECURE UNITS
TOGETHER VIA TWO
6-32 SCREWS AT
- FRONT AS SHOWN,
AND ONE 6-32 SCREW
AT CENTER OF REAR
ENDPLATE.

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

ESA-OMK KIT CONTENTS

TOP BOARD SCREW		#4	6-32x0.25 PAN HEAD SCREWS
BD-TO-BD STANDOFF		#4	1/4-HEX MALE-FEMALE STANDOFF 1-9/16 LONG WITH 6-32 x0.375 FEMALE THREAD & 6-32 x0.250 MALE THREAD
BOTTOM STANDOFF		#4	1/4-HEX FEMALE STANDOFF 3/8 LONG w/6-32 THREADS
MTG PLATE SCREW		#4	6-32 x0.25 SEMS SCREW WITH INTEGRATED WASHER
6-32 NUT (NYLON)		#5	6-32 NYLON NUT, REPLACES STANDOFF OF UPPER BOARD

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



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.

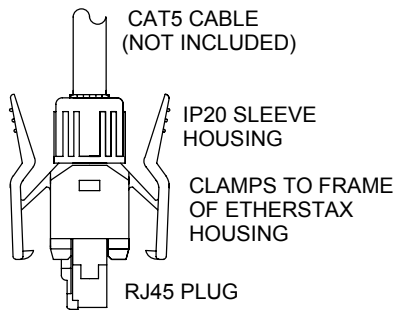
You should take adequate measures to protect open-frame mounted units from dust, debris, and ESD.

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 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.

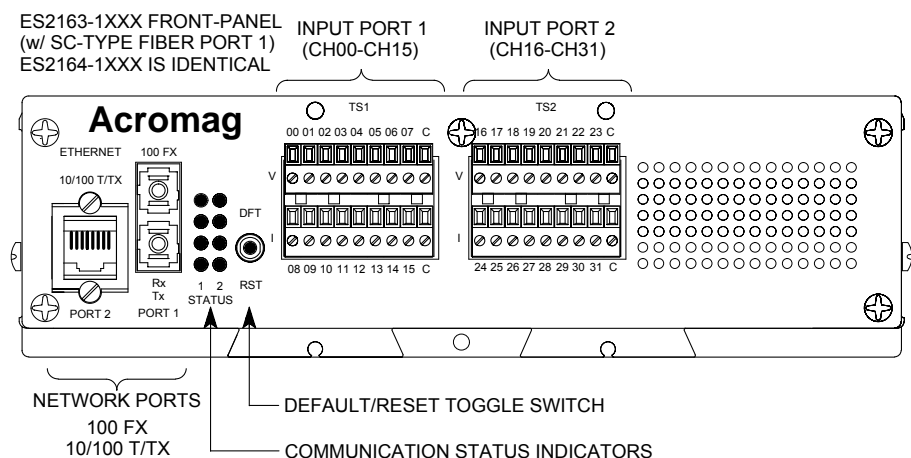
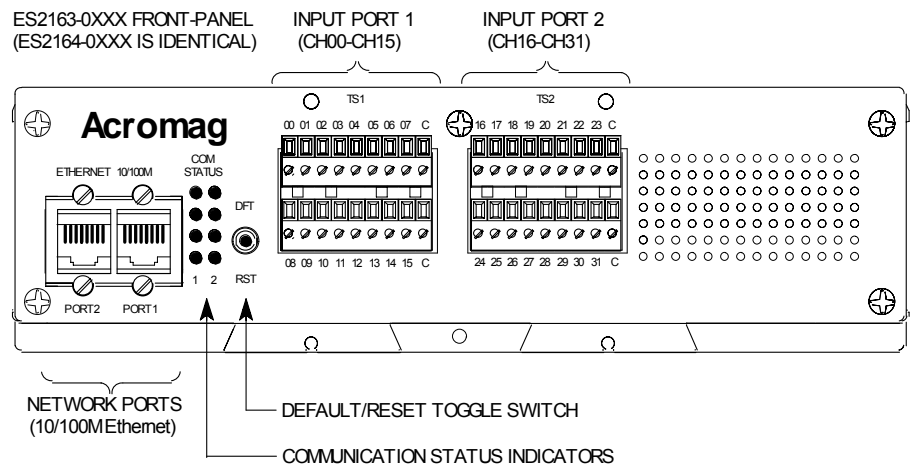
CONTROLS & INDICATORS

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).

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



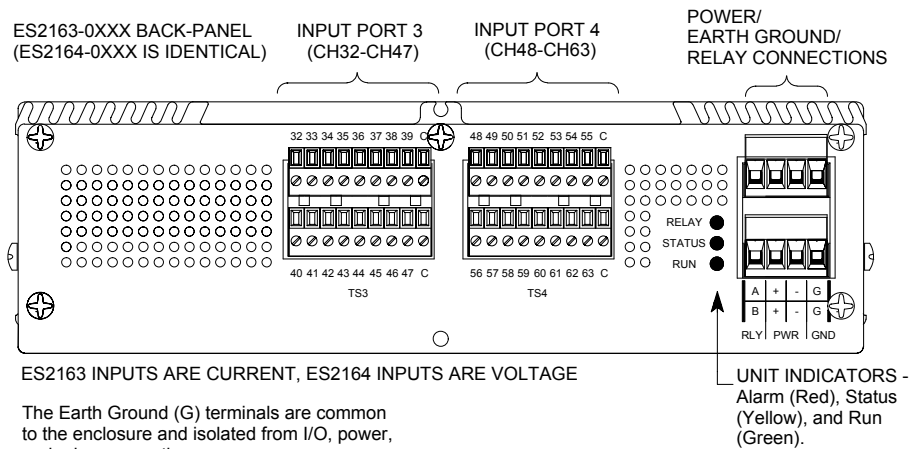
CONTROLS & INDICATORS

Back Panel

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

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

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



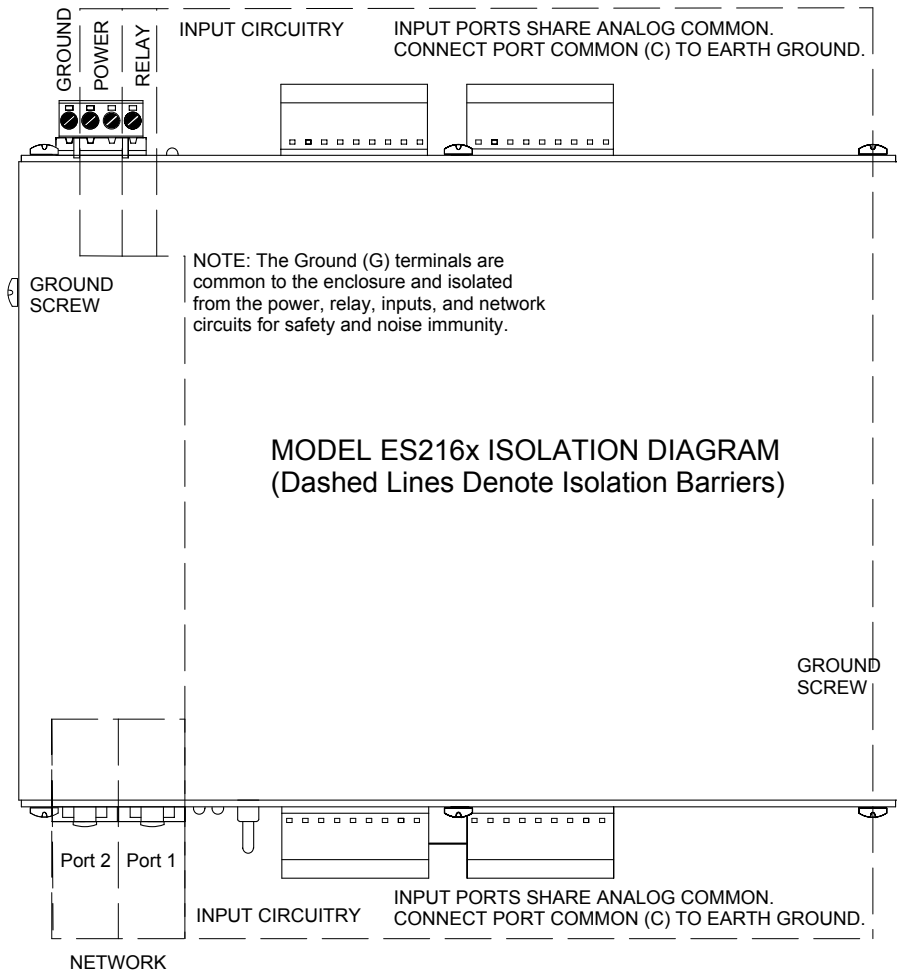
ISOLATION BARRIERS

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

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

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

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



CONNECTIONS

Network

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

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

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

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

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

RJ45 MDI AND MDI-X CONNECTIONS

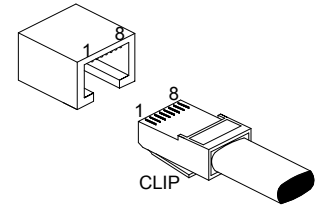
PIN	MDI WIRING	MDI-X WIRING
1	Transmit +	Receive +
2	Transmit -	Receive -
3	Receive +	Transmit +
4	Not Used	Not Used
5	Not Used	Not Used
6	Receive -	Transmit -
7	Not Used	Not Used
8	Not Used	Not Used

Note Crossover Connections

RECOMMENDED CABLE

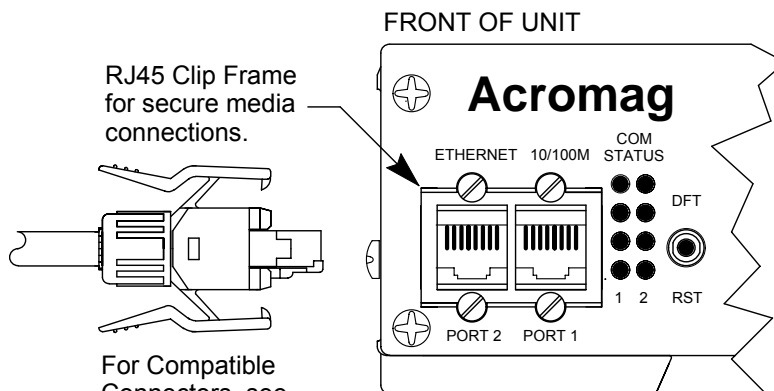
SPEED	DISTANCE	CABLE
10Base-T	100M	CAT 3, CAT 4, or CAT 5 UTP
100Base-TX	100M	CAT 5/5e UTP/STP

ETHERNET PORT



RJ-45 CONNECTOR

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.

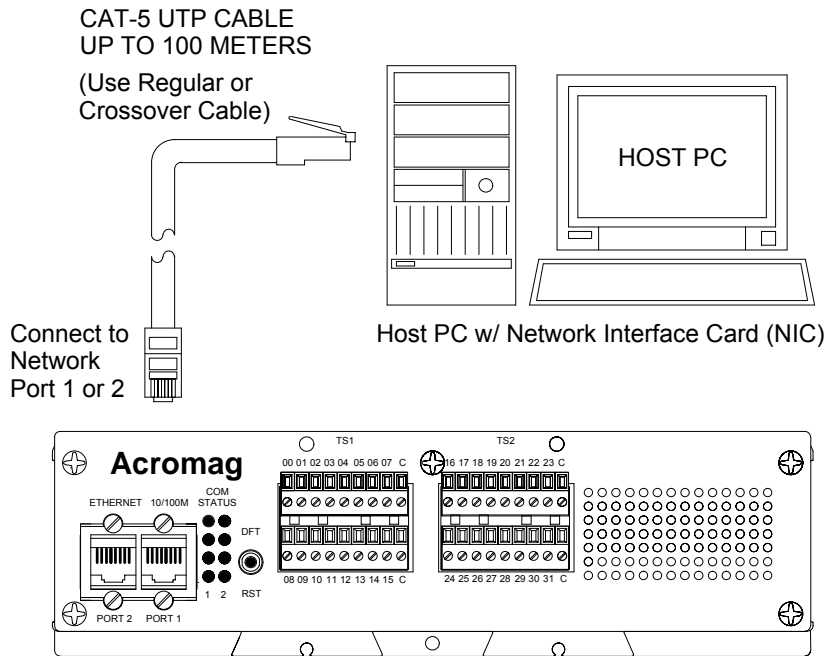


The RJ45 clip frame mates with the compatible connectors of the ESA-CTK for increased immunity to shock & vibration.

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 ES2163/2164-1xxx, 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.

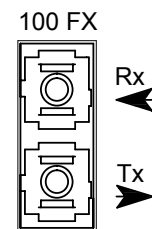
The next section reviews the operation of Ethernet hubs and switches as it relates to the built-in Ethernet switch of this device, which may optionally operate as an Ethernet hub/repeater. You can skip the next two pages if you are already familiar with these terms.

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	HUB/REPEATER MODE
	LED Column 1 - Port 1 LED Column 2 - Port 2	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 examples 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 provide determinism by reducing collisions.
- Switches increase network bandwidth/throughput.
- Switches can provide supplemental error checking.

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

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

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

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

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

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

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

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

CONNECTIONS

Network – Background

Hubs & Switches

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

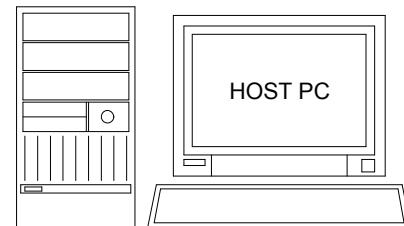
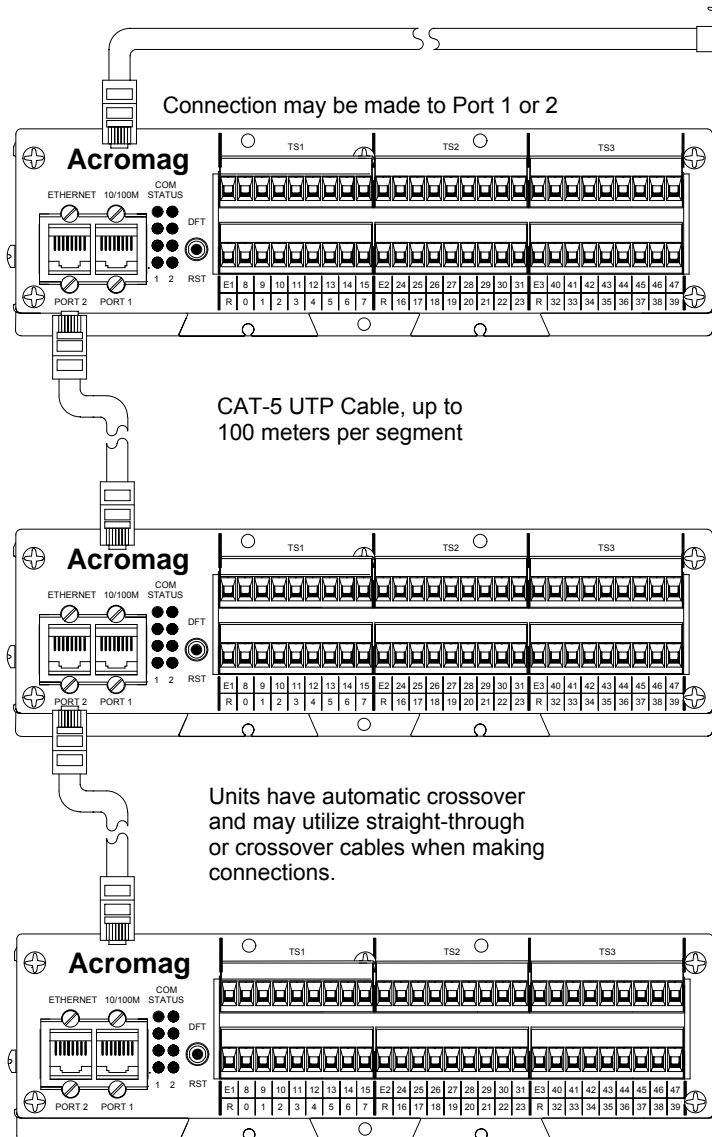
CONNECTIONS

Network

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

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

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



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

CASCADING UNITS

Connections may use Port 1 or Port 2.

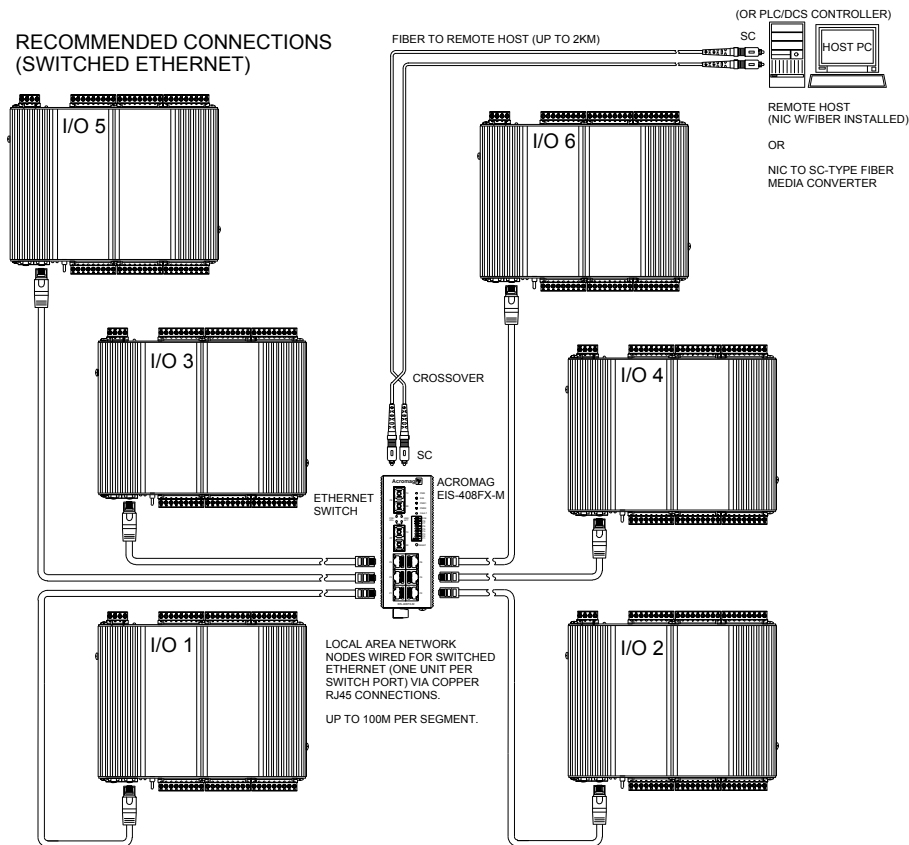
Limit cascaded connections to 4 segments.

Limit cable segments to 100M in length.

You may use straight-through or crossover cables.

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

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



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

The switch shown above could be eliminated, if you were connecting to an EtherStax Model ES2163/2164-1000, which includes one fiber port and one standard RJ45 port. For example, you could use the fiber port built into the EtherStax to connect to the distant host using fiber, then add an additional EtherStax locally via its RJ45 port, similar to that shown on the next page. However, the traffic of both units would still be concentrated in the main trunk from the host, and this does not follow the key principle of switched Ethernet, which seeks to suppress CSMA/CD and prevent data collisions by connecting only one device per switch port.

CONNECTIONS

Network

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

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

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

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

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

CONNECTIONS

Network

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

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

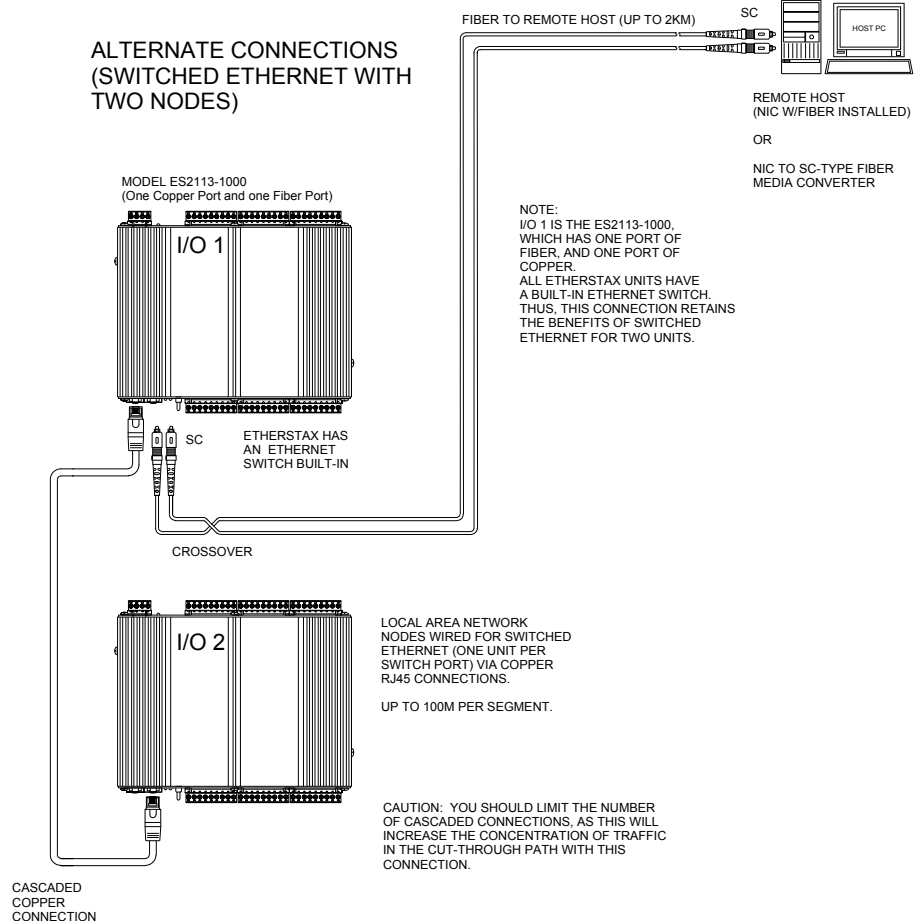
However, note that the fiber connection carries the traffic of both units and this segment is subject to data collisions.

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

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

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

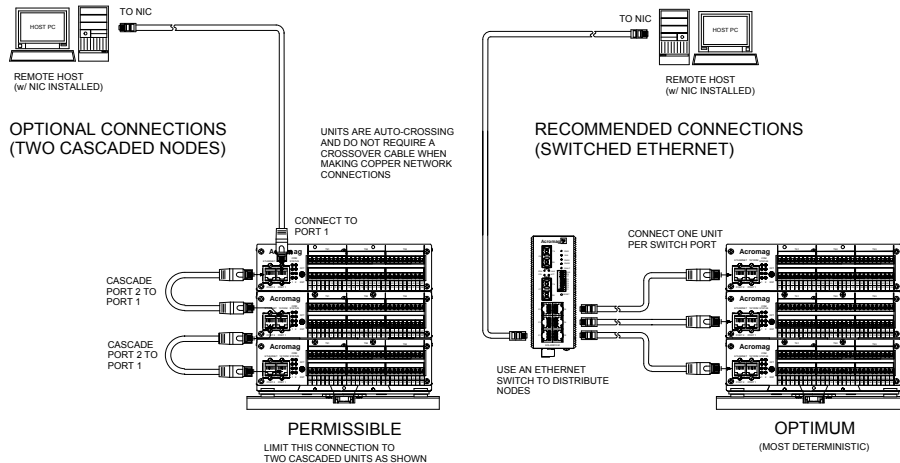
Unfortunately, you cannot avoid concentrated traffic in the main host segment, even with a switch. As such, this aggregate path is usually chosen to operate at a higher data rate than the downstream segments. With the traffic of many Ethernet devices, this would mean that if the main trunk runs at 100MB,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



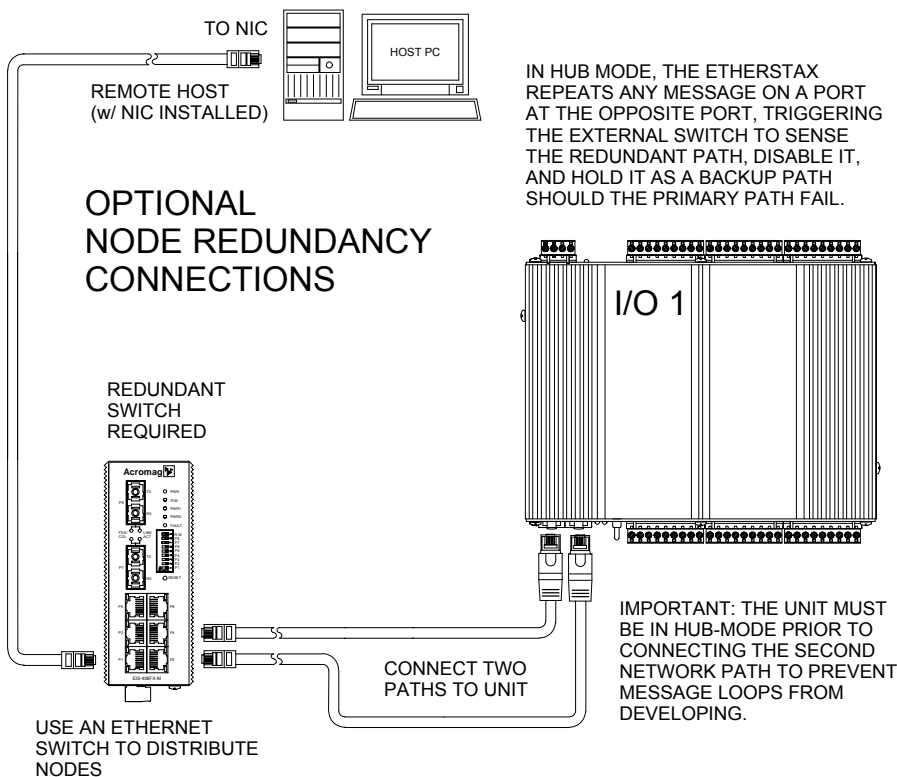
For optimum performance, the ideal recommended approach is to utilize an external Ethernet switch and connect no more than one Ethernet device per switch port—this is what is referred to as switched Ethernet. Connection in this manner avoids the negative effects of concentrated traffic and suppresses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

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

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



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



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

CONNECTIONS

Network

Network – Redundant Media Connections (Optional)

Recommended for High-Reliability Applications

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

CONNECTIONS

Network –

Redundant Media Connections (Optional)

Recommended for High-Reliability Applications

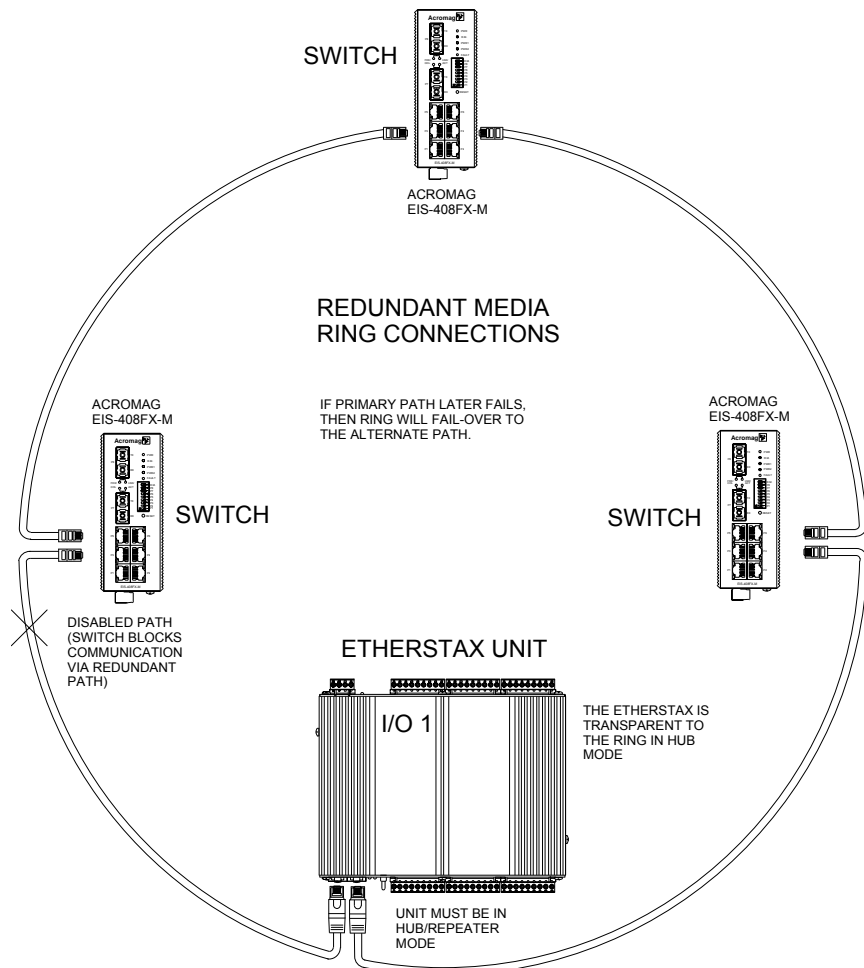
TIP: If you connect to both ports of this device at the same time from your network, and you notice that the unit is cyclically resetting itself, then this may indicate that your network connections or external network switch(es) are not already setup to handle redundant media connections. Do not connect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

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

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

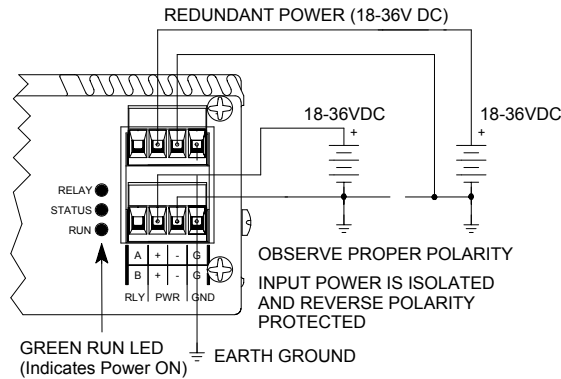
This device has dual Ethernet ports provided by a built-in Ethernet switch. Normally the second port connection provides a convenient cascaded network connection, or is used for extending the network, or to provide media conversion. But this integrated switch also has an alternate operating mode as a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

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



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

DC POWER CONNECTIONS



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

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

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

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

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

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

CONNECTIONS

Power

Input Power ES216x-0

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

Input Power ES216x-1

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

Above is maximum power with alarm relay energized.

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

Earth Ground

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.

CONNECTIONS

Alarm Relay

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

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

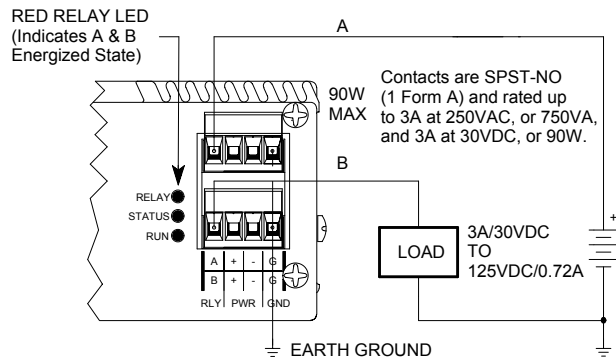
If you select failsafe contacts, then you can also use this relay to signal a power failure (contacts de-energize when power fails).

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

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

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

ALARM RELAY CONNECTIONS - DC LOAD

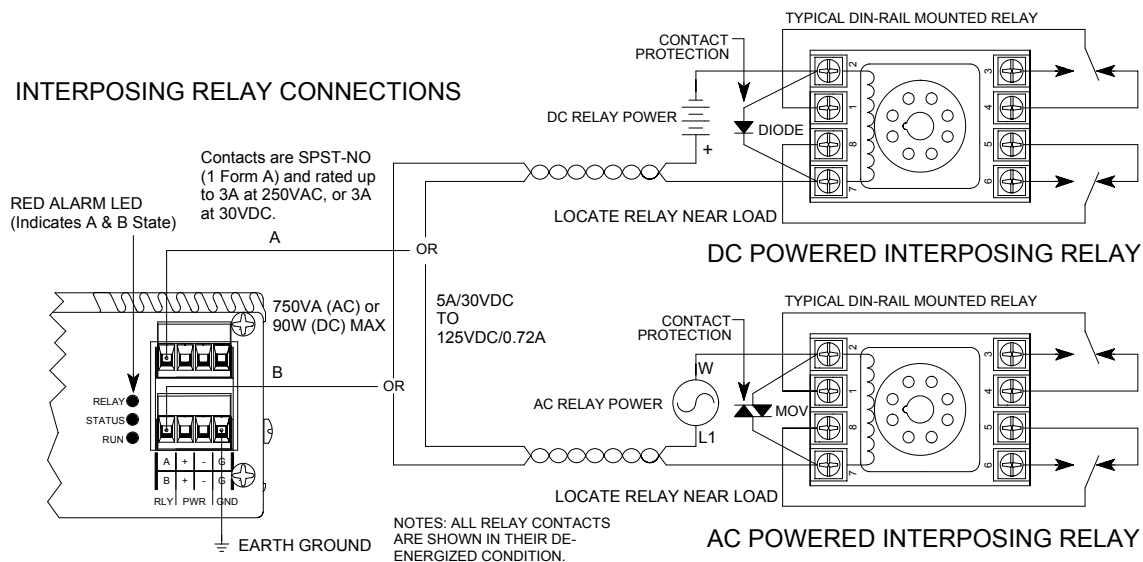


Relay contacts are AC rated to 3A at 250VAC, or 750VA, and DC rated to 3A at 30VDC, or 90W. The maximum switching voltage is 270VAC and 125VDC, and maximum switching current 5A. Your AC application voltage/current must not exceed 750VA and 250VAC and 5A. Your DC application voltage/current must not exceed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

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

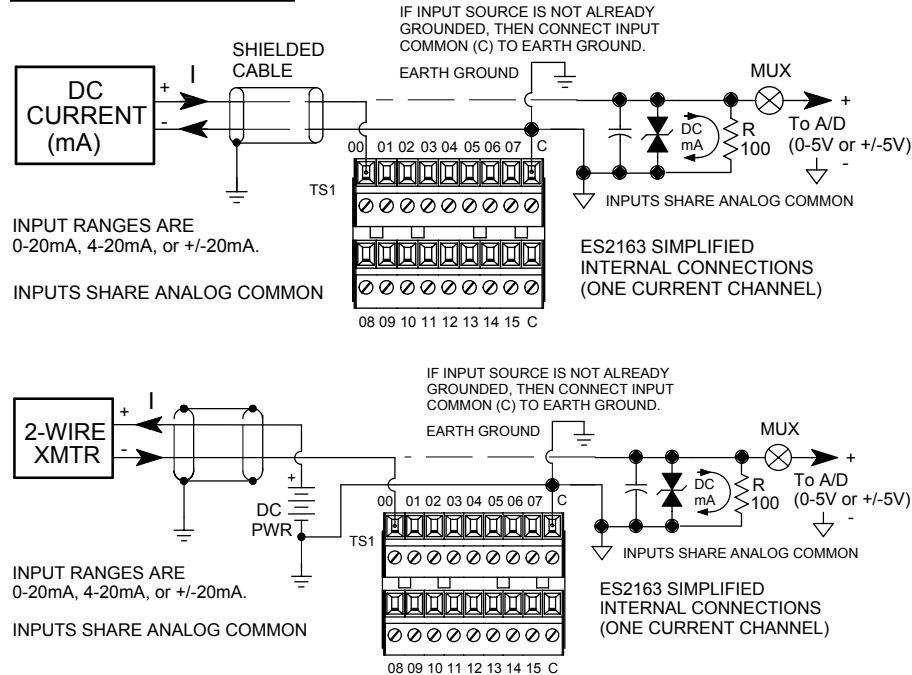
As such, inductive loads typically require 2-3x the runtime voltage or current when power is first applied to the device. Thus, your switch contact voltage and ampere ratings should be selected 2-3x the nominal steady-state requirements of your load. Choosing a relay that is 2-3x more powerful than your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

INTERPOSING RELAY CONNECTIONS

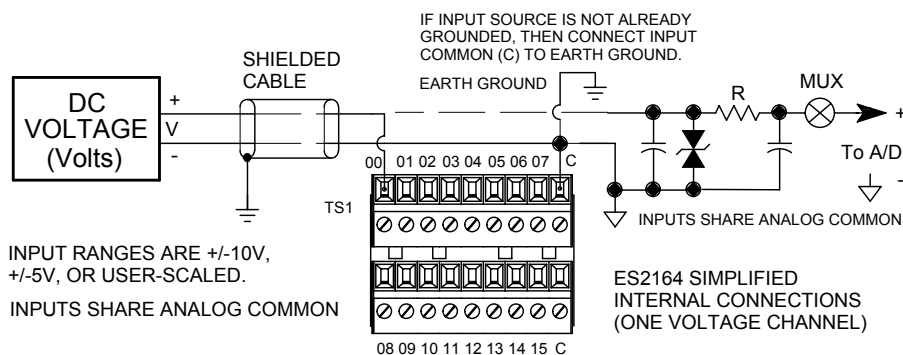


- ✓ Connect analog current (ES2163), or voltage (ES2164) signals to the input terminals as shown below. Input channels are single-ended and share common. Each plug-in terminal block has 9 screws with 8 input channels plus a common connection (C).

ES2163 Current Inputs



ES2164 Voltage Inputs



You can set the voltage channels to accept a fixed input range of $\pm 10V$, or $\pm 5V$. You may also rescale a portion of these native A/D ranges to smaller sub-ranges, down to a minimum span $1/16^{\text{th}}$ of the native span selected in order to maintain minimum 12-bit performance.

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

CONNECTIONS

Analog Inputs

The Common "C" terminal is connected to analog common of the input circuit and should also be connected to earth ground.

ES2163 Current Models:

Current ($\pm 20mA$, 0-20mA, 4-20mA) is converted to voltage ($\pm 2.0V$, 0-2V, 0.4-2.0V) via a precision 100Ω shunt resistor at each input channel. The even and odd channels of a terminal group are multiplexed to separate channels of a 16-bit A/D with an input range of $\pm 5V$ ($\pm 20mA$), or 0-5V (0-20mA & 4-20mA).

ES2164 Voltage Models:

The input voltage drives the A/D input directly through a multiplexer and input buffer, without a voltage divider. That is, the $\pm 5V$ and $\pm 10V$ input ranges directly correspond to the 16-bit input ranges of the A/D converter. As such, the A/D may not be able to achieve the exact range endpoints.

CONNECTIONS

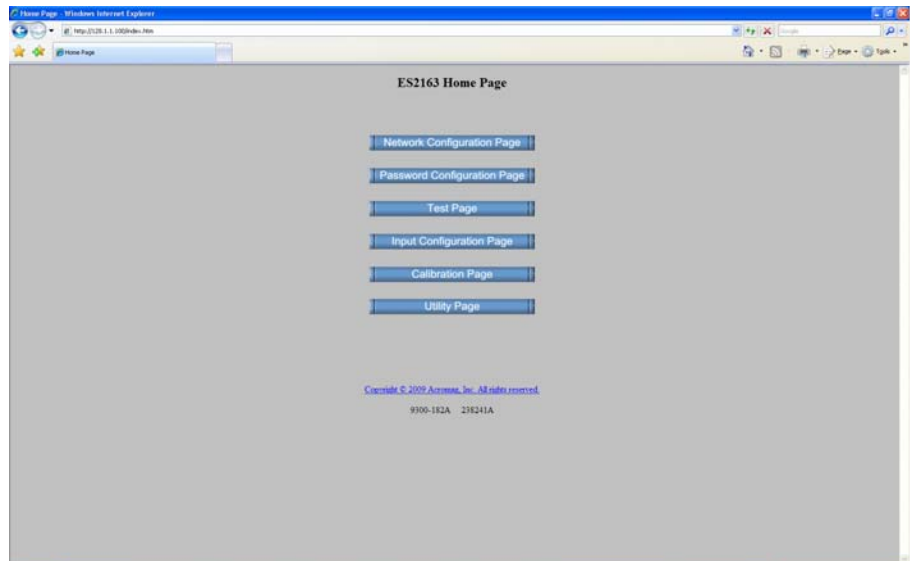
Analog Common

- ✓ Each plug-in terminal block (8 channels) includes a common connection at the right-most terminal marked "C". This connects to analog common of the input circuit and should also connect to earth ground. Check your signal grounding scheme if inputs are clamped or appear unstable, as you may need to add an earth ground connection if your input signals are not already earth grounded. You only need to connect earth ground to one of these common terminals to earth ground the input circuit.

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 at right.



The Home Page provides buttons to access the other web pages of the unit used to configure the network parameters, change the user name and password, configure the inputs, calibrate, and operate the unit. Note that the unit's serial number and firmware number are included at the bottom of the Home Page for reference. Note that not all parameters are programmable with Modbus commands issued to Modbus registers. In general, you still have to use the embedded web pages to complete your configuration (for example, the network configuration parameters do not have Modbus registers). For additional details on various operating modes, please refer to the command descriptions of the Modbus Memory Map.

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



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

WEB BROWSER

Password Configuration Page

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

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

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

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

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

Network Configuration Page

WEB BROWSER

Network Configuration Page

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

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

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

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

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

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

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

If the unit is an i2o target device (it has its outputs controlled by another unit's 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.

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.

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.

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.

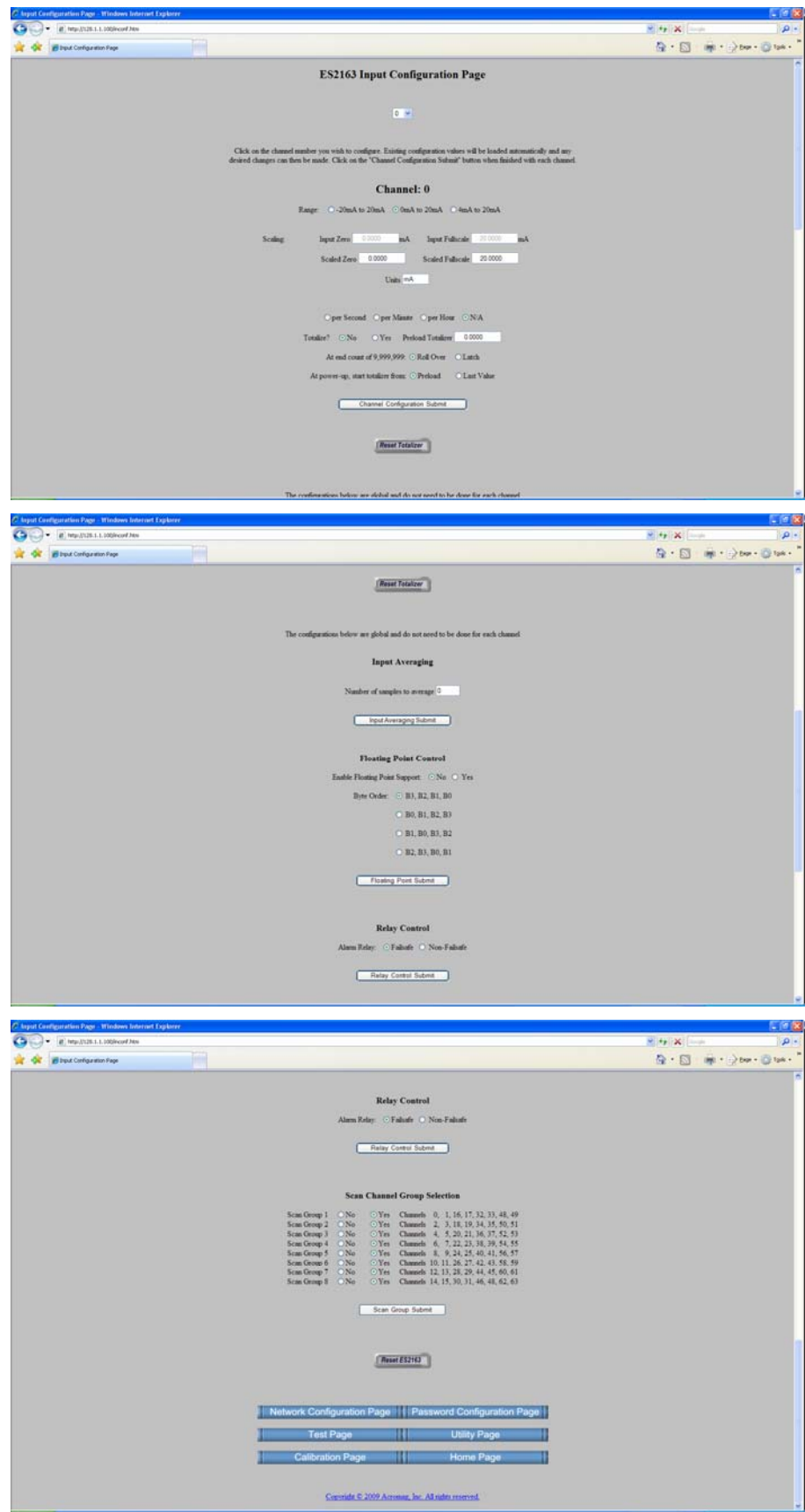
Click the **Submit** button to complete any changes made on this page. Review the port status message to verify your port settings.

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.

WEB BROWSER

Input Configuration

After completing the username & password assignment, plus the network configuration parameters, use the Input Configuration page shown at right to set your input ranges, rescale inputs, setup integration/totalization, setup floating point (required for scaling/integration/totalization). You can also reset the totalizer, set input averaging, configure local alarm contacts, enable/disable scan groups, and reset the unit.



WEB BROWSER

Input Configuration

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

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

IMPORTANT: Your effective resolution will decrease proportionally as you reduce the nominal signal span through rescaling. For current inputs (ES2163), multiply input current by 100Ω to get equivalent A/D input voltage.

This unit has 4 terminal groups of 16 single-ended channels each (TS1-4). Each terminal group has an even and odd channel multiplexer of eight channels each. Each multiplexer connects to one of eight separate A/D channels of a 16-bit A/D converter. Channels are scanned sequentially, first by multiplexer (A/D channel), then by channel order.

Channel configuration begins by first selecting the input channel, its input range, and optionally rescaling the input's zero and full-scale value to your own engineering units. You can also setup an integrator by specifying the scaled input units and its time base in order to totalize the input. You can enable/disable totalization of an input, set its preload and initial value, and you may reset the totalizer. After you have made your channel specific selections, click the Channel Configuration Submit button to apply your selections.

Input Configuration (Repeated Per Channel)

You must repeat your reconfiguration for each channel of interest.

Select: Use this scroll field to select the input channel number to configure. Channels are configured one channel at a time and you can select from input channels 0-63.

Range: Select the input channel range.

Note: Totalizing does not occur for the negative portion of an input range.

Scaling – Input Zero: This field is set by your range selection and cannot be changed independently. It represents your input range zero that will correspond to 0% of signal and a normalized count of -30000 for bipolar input ranges, or a normalized count of 0 for unipolar range selections

Scaling – Input Full-Scale: This field is set by your range selection and cannot be changed independently. It represents your input range full-scale value that will correspond to 100% of signal and a normalized count of +30000 for bipolar input ranges, or a normalized count of 30000 for unipolar range selections.

Scaling - Scaled Zero: Default is normally the same as input zero, but you can rescale this value down to a minimum of -999999.0, as required for your application. That is, a 32-bit floating point value with up to 7 significant digits and a maximum of 4 decimal places. For each channel 0-63, you can enter your rescaled zero that is to correspond to 0% of input signal. If you are using only a portion of your input range, you may have to interpolate your scaled zero endpoint. You must also Enable Floating Point Support to accomplish rescaling.

Scaling - Scaled Full-Scale: Default is normally the same as input full-scale, but you can rescale this value up to +999999.0, as required for your application. That is, a 32-bit floating point value with up to 7 significant digits and a maximum of 4 decimal places. For each channel 0-63, you can enter your rescaled full-scale that is to correspond to 100% of input signal. If you are using only a portion of this range, you may have to interpolate your scaled full-scale. You must also Enable Floating Point Support to accomplish rescaling.

Units (5 characters): Enter the units of measure for your rescaled input zero and full-scale. This is an arbitrary definition used only for reference.

Input Configuration - Integration/Totalization (Per Channel)

You can optionally integrate an input signal by totalizing its time-sliced instantaneous value.

Time Base (per Second, per Minute, per Hour, No Application): You can optionally integrate an input signal by totalizing its time-sliced instantaneous value. In order for the totalized value to accurately accumulate, you need to specify the time-base units of the input signal to perform the integration over. Select "per Second", "per Minute", "per Hour", or "NA". You must specify a time base other than NA (default) for totalization to occur. Note that if "NA" is selected and Totalize=Yes, then 0.0 is added to the totalized value.

Totalize No/Yes? & Preload Totalizer: Choose "Yes" for the Totalize? to totalize the input (this will also automatically enable floating point support). You can optionally choose to preload a totalized value on power-up or upon system reset by inserting a number in the Preload Totalizer field. In this way, you can choose that your post-power/reset preload value be taken from the Preload Totalizer field, or from the last totalizer value (before power-up or system reset). During operation, your incremental "time-sliced" measurement will be added to this total every update. Note that in order to totalize an input, you MUST also Enable Floating Point Support by selecting "Yes" to that query. Note that your maximum possible totalized value is limited to 7 significant digits, including digits after the decimal point.

At the End Count of 9999999 (Rollover or Latch?): When your totalized value reaches the limit of its field (7 significant digits), you can click to select Roll Over and continue totalizing from zero, or restart from the Preload Value, whichever is selected. Optionally, you can latch the totalized value. Note that if the added value exceeds the amount required to reach the limit of 9,999,999.0, any additional amount it is over will be added to the count it rolls over to (it assumes a free running counter and rolls over again while ignoring the preload value).

Note (Counter Operation): This counter is limited to 7 digits of accuracy/resolution, starting with 4 places before and after the decimal point (see below). Then, as the count grows beyond least 7 digits, the least significant digit is zeroed as the most significant digit is incremented. For example (note the transitions and digit shift left), the counter starts at 0000.0000 and increments to 0999.9999, then 9999.9990 to 99999.9900, then 999999.9000 to 9,999,999.0000, then it rolls over or latches as specified. Thus, while the 4 decimal places will remain visible, their importance diminishes beyond 7 significant digits. The max counter value is thus 9,999,999.0.

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

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

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

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

WEB BROWSER**Input Configuration**

Tip: If you are using the web interface to set up totalizers, note that when you click the Submit button, all existing totals will be reset. As such, setup all your totalizers before initiating totalizing.

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

WEB BROWSER

Input Configuration

Totalization Calculation Example

When totalization is enabled at any channel, the scan time of the unit becomes a flat rate of 20ms (for all channels) with no averaging done at any channel, and 80ms with any input averaging set greater than 1. For example, if an instantaneous scaled input value indicates 500, units are gallons, and the time base is set to "per Minute". Then $(500 \text{ gallons/minute}) \times (1 \text{ minute}/60 \text{ seconds})$ will equate to a flow rate of 8.33 gallons/per second. If a new sample is obtained every 20ms (no averaging), then we can multiply 8.33 gallons/second by 0.020 seconds/sample to get an incremental increase in volume of 0.1666 gallons/sample, and this amount is added to the totalized value. The maximum possible totalized value is 9,999,999.0, as it is limited to 7 significant digits.

Note - ES2163 Current Input Models

A current input of $\pm 20\text{mA}$ (22mA maximum) may be input at the positive or common input lead, but its sign is relative to current input at the + lead. Current input ranges are actually sub-ranges of a native $\pm 5\text{V}$ or 0-5V A/D input range and utilize a precision 100 Ω input shunt to convert input current to A/D voltage. That is, $\pm 20\text{mA}$ into 100 Ω yields $\pm 2.0\text{V}$ to the A/D, while 0-20mA drives 0-2.0V to the A/D. The A/D itself has a native $\pm 5\text{V}$ or 0-5V 16-bit input range depending on your range selection. Thus, the effective resolution of $\pm 20\text{mA}$ is 14.6 bits (± 13107 parts). For simplicity, the $\pm 20\text{mA}$ input is normalized to a count of ± 30000 for $\pm 100\%$, and the possible over-range is 2768 counts for the registered 16-bit signed integer.

Note - ES2164 Voltage Input Models

The voltage input ranges drive the 16-bit A/D directly with native input ranges of $\pm 10\text{V}$, or $\pm 5\text{V}$. Because the field input range represents the actual full-scale range of the A/D, it may not be possible to achieve the exact endpoint values and these input ranges will have no over-range.

Input Averaging (Global, Not Per Channel)

You can optionally specify the number of input samples to average together to form your input response. Increasing this number will help to filter the measured response of noisy input signals, but will also increase the update time (see Scan Rate of Specifications for reference table).

Input Averaging: Enter the number of input samples to average together from 0-500 samples. Selecting 0 is equivalent to selecting 1 and designates that no averaging will be performed. You may increase this number to help filter the measured response of noisy input signals. Note that the Test Page does not display the averaged value.

Floating Point Configuration (Global, Not Per Channel)

Floating Point Control — Enable Floating Point Support (No or Yes)?:

This controls the math performed when scaling. This is normally set to "No" by default, but must be set to "Yes" if you are rescaling an input, or integrating/totalizing an input. Note that also selecting "Yes" to the Totalize query for any channel will automatically set this to "Yes", but if you later disable floating point, the totalizer will just add 0.0 to the totalized value. Disable IEEE Floating Point if you are not rescaling, integrating, or totalizing the input. Selecting "No" to disable floating point support will reduce the amount of calculations that have to be performed and gives the processor more time to do other tasks besides acquiring data and this is recommended when you are also not rescaling or integrating and totalizing the input.

Selecting “No” can help to make critical control network applications more deterministic, particularly over networks with heavy traffic flow. Consider that input data is normally acquired at a fixed rate that is dependent on the number of scan groups enabled. Sixty percent of this time is used to actually convert the data for all the channels, leaving only 40% to process the other tasks required to store this data into Modbus registers, run the web server, and serve this data over the network. You can increase the time devoted to servicing these other tasks by disabling floating point, effectively increasing network determinism. Leave it off if you don't need to rescale or totalize. Note that even with floating point disabled, the measured input value will still indicate a floating point number on the Test Page, but the scaling and totalizing field will indicate “Inactive”.

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

Floating Point Submit Button: Click here to execute your floating point control selections.

Relay Control Configuration (Global, Not Per Channel)

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

Relay Control — Alarm Relay (Failsafe or Non-Failsafe): Click to select Failsafe or Non-Failsafe alarm contact. If you select “Failsafe”, the contacts will be normally energized (closed), and de-energize (open) upon alarm. If you select “Non-Failsafe”, the contacts will be normally de-energized (open), and energize upon alarm (close). If you select “Failsafe”, these contacts will also trigger if power is lost to the unit.

Relay Control Submit Button: After making your selection, click here to execute your alarm relay reconfiguration.

WEB BROWSER

Input Configuration

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

Scan Channel Group Selection (Global, Not Per Channel)

Channel data is gathered in groups organized to minimize multiplexer switching delay and optimize throughput. These models have 4 terminal groups of 16 single-ended channels each (TS1-4). Each terminal group utilizes an even channel and an odd channel multiplexer of eight channels each. Each multiplexer connects to one of eight separate 16-bit A/D channels. Channels are scanned sequentially, first by multiplexer (A/D channel), then by channel order. The following table shows which multiplexer and corresponding A/D channel process which channel (horizontally), and which channels belong to which scan group (vertically):

WEB BROWSER

Input Configuration

MULTIPLEXER	CHANNELS OF MULTIPLEXER ¹							
	1	2	3	4	5	6	7	8
1 (TS1 Even CH)	00	02	04	06	08	10	12	14
2 (TS1 Odd CH)	01	03	05	07	09	11	13	15
3 (TS2 Even CH)	16	18	20	22	24	26	28	30
4 (TS2 Odd CH)	17	19	21	23	25	27	29	31
5 (TS3 Even CH)	32	34	36	38	40	42	44	46
6 (TS3 Odd CH)	33	35	37	39	41	43	45	47
7 (TS4 Even CH)	48	50	52	54	56	58	60	62
8 (TS4 Odd CH)	49	51	53	55	57	59	61	63

If you are not totalizing or using input averaging at any channel, you can realize an increase in throughput by selectively enabling only the scan groups required by your application, as illustrated in the following table:

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

SCAN GROUPS	No Averaging (Input Averaging Set to 0 or 1) and No Totalization	Averaging Filter (Input Averaging Set to 500) and No Totalization
	UPDATE TIME/RATE	UPDATE TIME/RATE
1	1.80ms/555Hz	9.40ms/106Hz
2	2.93ms/341Hz	18.20ms/55Hz
3	4.13ms/242Hz	27.00ms/37Hz
4	5.20ms/192Hz	35.83ms/28Hz
5	6.47ms/155Hz	44.50ms/22Hz
6	7.60ms/132Hz	53.33ms/19Hz
7	8.73ms/115Hz	62.17ms/16Hz
8	9.83ms/102Hz	71.00ms/14Hz

¹Rates above apply with totalization on/off, & floating point/scaling applied. If totalization is enabled at any channel, the scan time is a flat rate of 20ms with no averaging at any channel, and 80ms with any input averaging greater than 1.

Scan Group Selection (No or Yes): Click “Yes” next to the input channel groups that you are using in your application, and “No” next to unused groups.

Scan Channel Group Submit: Click this button to execute your selected channel scan groups.

TIP: If you are using less than 57 channels, you should consider wiring your inputs to maximize throughput by disabling the unused scan group(s). When scanning input data, the CPU normally uses 60% of its update time actually converting the channel data, and 40% for everything else. Disabling floating point does not reduce the update time, but does increase the portion of this time devoted to “everything else”, which can help to increase network determinism. Note that your effective throughput may be less than the update rate because of additional delay in retrieving the updated data over the network.

Reset Unit Control (System Reset, Not Per Channel)

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

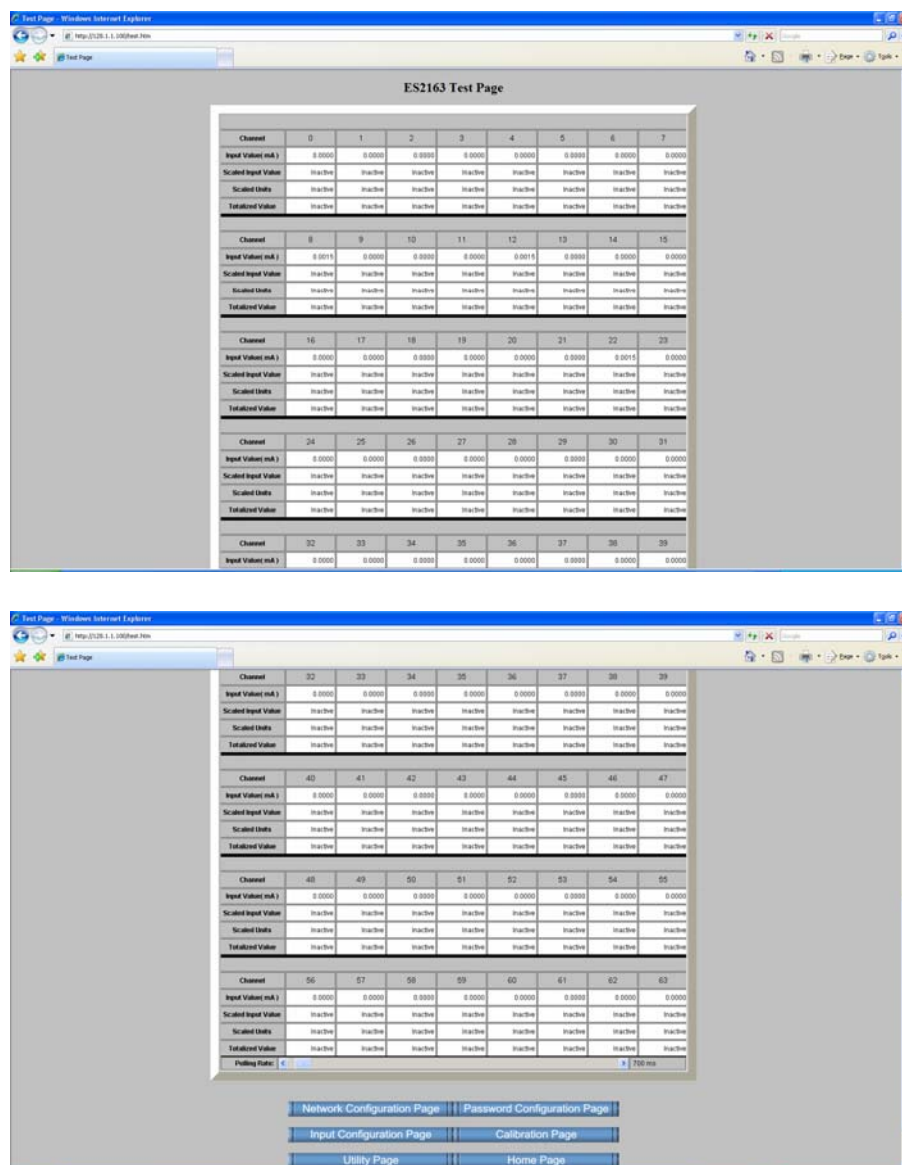
WEB BROWSER

Test Page

After completing username & password assignments, plus the network and input configuration parameters, click the Test Page button to access the web-server Test Page and operate your unit.

Here you are able to read the input values (no averaging), scaled values, scaled units, and totalized values of the 64 single-ended input channels. You can even set an input polling rate for the active Test Page at the bottom of the screen (use the scroll bar on the right to scroll down the page to see the Polling Rate control).

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



Voltage Inputs & Current Inputs: The 64 input channels of this unit are divided into 4 terminal groups of 16 channels each. If the channel is not configured for floating point (necessary to accomplish scaling and totalizing), "Inactive" will be indicated for the scaled input and totalized value, and units.

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

Note: Input averaging does **NOT** apply to the input readings on this page and input readings may appear noisier than expected as a result.

Note: 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.

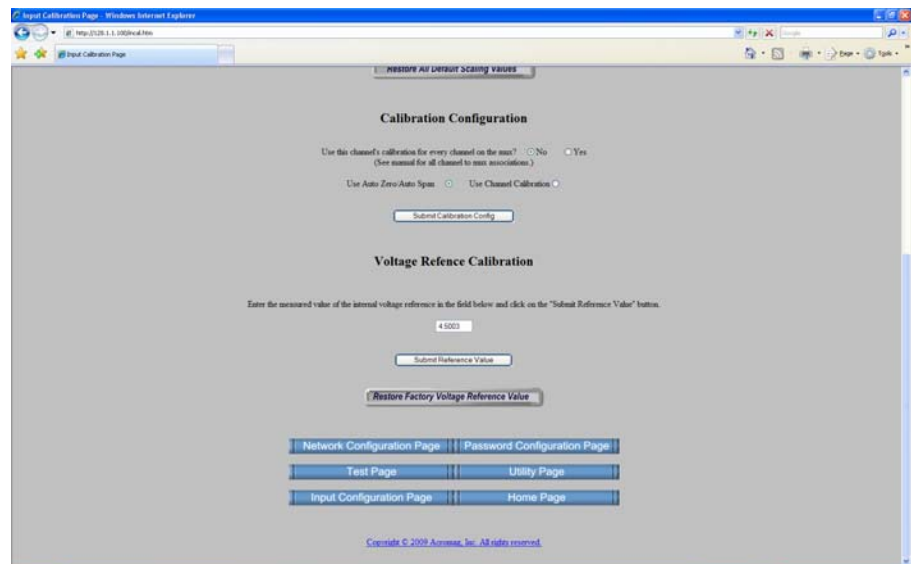
WEB BROWSER

Calibration Page

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



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



In normal operation, this unit automatically re-calibrates a base A/D input range every time it acquires its input channel data by reading its own calibration reference voltage ($4.5V \pm 0.05\% \pm 5ppm/^{\circ}C$) at each A/D channel. It calibrates one input range every acquisition cycle and recycles through each input range for successive acquisition cycles. This reference has been precisely measured and its value stored inside the unit from the factory. This is sufficient to achieve rated accuracy using automatic calibration. But if you need to calibrate to your own standard, improve the accuracy, or you want to check the accuracy of the internal calibration, then you can utilize the controls of this page to manually calibrate the inputs instead.

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

While the relative accuracy of calibration can be improved via software calibration facilitated with the controls of this page, or by instead issuing the appropriate Modbus register calibration commands, the Automatic calibration will be sufficient for most applications. Current inputs gain greater benefit from manual calibration because automatic calibration fails to compensate for the inaccuracy of the current shunt resistor (up to $\pm 0.05\%$).

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

The 16-bit A/D used to process the input signals has selectable base ranges of $\pm 5V$ or $\pm 10V$, and eight separate single-ended channels. There are eight 8:1 multiplexers of single-ended channels, each connected to a separate A/D channel. ES2163 models utilize the $\pm 5V$ and 0-5V A/D ranges for $\pm 20mA$ and 0-20/4-20mA inputs, respectively. Thus, $\pm 20mA$ into 100 Ω input resistors drives $\pm 2.0V$ to the $\pm 5V$ A/D range, while 0-20mA/4-20mA drives 0-2V/0.4-2V to a 0-5V A/D range.

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

WEB BROWSER

Calibration Page

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

During calibration, the unit uses a 100-sample averaged value when sampling the input and making its input response associations.

WEB BROWSER

Calibration Page

Manual Input Calibration — Voltage Inputs, Current Inputs

These web controls allow you to perform manual calibration on an input channel. Manual calibration is accomplished on a per channel basis, or optionally on a per-multiplexer basis by calibrating one channel from each 8:1 input multiplexer (i.e. each A/D channel).

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

Channel Selector: Use this scroll field to select the input channel from 0-63 that you wish to calibrate. Calibration is done on a per channel basis. Optionally, you can pick one channel from each multiplexer group (see table below), and use that calibration to represent the other channels of the group. This saves some time wrt manually calibrating every channel and can achieve slightly better performance than self-calibration, but the greatest performance can be achieved by manually calibrating every input channel separately.

TERMINAL MULTIPLEXER	CHANNELS OF MULTIPLEXER ¹							
	1	2	3	4	5	6	7	8
1 (TS1 Even CH)	00	02	04	06	08	10	12	14
2 (TS1 Odd CH)	01	03	05	07	09	11	13	15
3 (TS2 Even CH)	16	18	20	22	24	26	28	30
4 (TS2 Odd CH)	17	19	21	23	25	27	29	31
5 (TS3 Even CH)	32	34	36	38	40	42	44	46
6 (TS3 Odd CH)	33	35	37	39	41	43	45	47
7 (TS4 Even CH)	48	50	52	54	56	58	60	62
8 (TS4 Odd CH)	49	51	53	55	57	59	61	63

¹Channels listed horizontally belong to the same multiplexer and A/D channel, while channels listed vertically belong to the same scan group.

Zero Calibration Point Field: Indicates the low calibration endpoint for the selected input range. This is the input signal that you have to apply to accomplish zero-end calibration. Your input source must be of an accuracy greater than 0.03% of span to achieve better results than auto-calibration.

Full Scale Calibration Point Field: Indicates the high calibration endpoint for the selected input range and is the input signal to apply to accomplish full-scale calibration. Your input source must be of an accuracy greater than 0.03% of span to achieve better results than auto-calibration.

Calibration Step Button: You click this button in a sequence of 3 steps to accomplish input calibration via this web page. Specific instructions at each step appear printed on this button

Reset Calibration Button: Click this button if you make a mistake in the calibration sequence and wish to start over from step 1.

Restore All Default Calibration Values Button: Click this if you believe channel calibration has been done in error or you are getting erratic results after recalibrating. This will affect all input channels at one time and the values restored are the ideal values, not the results of an actual calibration.

Restore All Default Scaling Values Button: Click this button if your own scaling produced unexpected results and you want to return the input scaling values to default values (typically the input range endpoints). Note that this will affect all input scaling values and will restore them to their ideal values.

Calibration Configuration

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

Use this channel's calibration for all mux channels (Yes or No): If you select "Yes", the manual calibration already done for this channel will apply to all channels of its multiplexer (see following table). The other channels in this group will be automatically set to "Use Channel Calibration" (see below). Note that "Yes" should only be selected after calibrating this channel, and "Yes" should only be selected for one channel in the group. If it is selected for more than one channel in the same group, then the calibration of the highest numbered channel set to "Yes" will be used to represent the group. The selected channel must also be calibrated first, before selecting "Yes", or the other channels of its multiplexer will adopt the wrong calibration coefficients.

MULTIPLEXER	CHANNELS OF MULTIPLEXER ¹							
1 (TS1 Even CH)	00	02	04	06	08	10	12	14
2 (TS1 Odd CH)	01	03	05	07	09	11	13	15
3 (TS2 Even CH)	16	18	20	22	24	26	28	30
4 (TS2 Odd CH)	17	19	21	23	25	27	29	31
5 (TS3 Even CH)	32	34	36	38	40	42	44	46
6 (TS3 Odd CH)	33	35	37	39	41	43	45	47
7 (TS4 Even CH)	48	50	52	54	56	58	60	62
8 (TS4 Odd CH)	49	51	53	55	57	59	61	63

From the table, note that the even and odd channels of a terminal group are 8:1 multiplexed to a separate A/D channel, and there are eight A/D input channels. This option can be a calibration timesaver by allowing you to only manually calibrate one channel from each multiplexer group, and still be able to achieve better results than with automatic calibration. However, this is not recommended for current inputs, as the input shunt resistors at each current input channel are $\pm 0.05\%$ and not matched. Thus, for current inputs, it is better to manually calibrate each channel to minimize this error. When done properly with very accurate signal sources and measurement equipment, this method of calibration is generally better than auto-calibration, but not as accurate as calibrating per channel, as calibrating each channel individually would additionally compensate for the small errors contributed by the input filters, buffer amplifiers, and input multiplexers, and in the case of the current inputs, additionally the inaccuracy of the input shunt resistors.

Use Auto Zero/Auto Span Bullet: Clicking this bullet will use automatic calibration for the selected input channel (default behavior). With automatic calibration, the unit utilizes the on-board $4.5V \pm 0.05\% \pm 5\text{ppm}/^\circ\text{C}$ reference signal and ground to calibrate the input. The internal calibration reference was precisely measured at the factory and its voltage value is stored in the unit.

WEB BROWSER

Calibration Page

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

CAUTION – TRAP: If the channel that you selected "Yes" to represent the calibration of the multiplexer group is later changed to "No", the other 7 channels of the mux group will begin to use their default manual channel calibration, as they were initially automatically switched to "Use Channel Calibration". This will likely produce a less accurate response and may leave you wondering why the other mux channels appear to operate less accurately than before. So if you do change "Yes" to "No", be cognizant of the other multiplexer channels and either manually calibrate them, or simply set them to use automatic channel calibration.

Further, channels of a mux group that have a different input range than the one selected to represent them will be calibrated incorrectly. When you make use of this feature you should configure all channels of the mux group to the same input range.

WEB BROWSER

Calibration Page

Reference Voltage

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

Steering circuitry prior to the input buffer allows each A/D channel to connect to this reference voltage, and alternately to analog common (for zero). In this way, the unit makes a correspondence between its A/D count and a known voltage to form the linear input response. Only the 0V and +4.5V range points are actually auto-calibrated, while calibration of -5V, and the $\pm 10V$ range endpoints (ES2164) are coincident (interpolated). Automatic calibration will be sufficient for most applications. This method of calibrating the inputs is the most convenient and will achieve rated accuracy of $\pm 0.05\%$ for voltage inputs, and $\pm 0.1\%$ for current inputs. It is less accurate for current inputs because it does not compensate for the initial inaccuracy of the input current shunt resistor ($100\Omega \pm 0.05\% \pm 10\text{ppm}/^\circ\text{C}$).

Use Channel Calibration Bullet: Clicking this bullet will select manual (per-channel) calibration, which associates the current calibration with the current channel. Note that no manual calibration is done from the factory and selecting this option without also calibrating the channel will degrade accuracy. It is possible to achieve the greatest accuracy if you calibrate on a per channel basis and you have a precise input signal source and digital voltage meter, but it takes more time to accomplish. Note that internally, ES2163 models only utilize the $\pm 5V$ and $0-5V$ A/D ranges.

Submit Calibration Configuration Button: Select your mode of calibration and click this button to write your selection to the unit. Then you can calibrate the channel as required, repeating it for each of the channels.

Voltage Reference Calibration

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

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

Voltage Reference Field (4.4968 to 4.5032): The internal calibration reference is precisely measured at the factory and its voltage value stored in the unit and indicated in this field. This reference voltage is $4.5V \pm 0.05\% \pm 5\text{ppm}/^\circ\text{C}$, and should read between 4.4968 and 4.5032 ($4.5V \pm 0.07\%$). This value is used to make a correspondence between the A/D response (digital count), and the voltage signal itself, in order to calibrate its linear response. You can enter your own measured value in this field if you need to recalibrate it (not recommended).

Note: The internal 4.5V reference voltage can be measured via test points on the backside of the top circuit board (near the left edge) at P1 marked CVREF. This calibration has already been done at the factory in an ambient temperature near 25°C and should not need to be repeated.

Submit Reference Value Button: Click this button after you have entered a measured reference voltage in the Voltage Reference field to store your measured value in non-volatile memory.

Restore Factor Voltage Reference Value Button: If you make a mistake and have entered the wrong value for the calibration reference, you can click this button to restore the original value measured from the factory. You could also click this button if you performed a system restore of the unit (see Troubleshooting – Getting Out of Trouble procedure).

A/D Input Calibration

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

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

Full-Scale Range	Zero	0V/0mA	Full-Scale
$\pm 5V$ (ES2164)	-5.000V \pm 5mV	0V \pm 5mV	+5.000V \pm 5mV
Raw A/D Count	-32768 \pm 33	0 \pm 33LSB	+32768 \pm 33
Normalized Count	-30000 \pm 36	0 \pm 36	+30000 \pm 36
$\pm 20mA$ (ES2163)¹	-20mA \pm 20uA	0mA \pm 20uA	+20mA \pm 20uA
Raw A/D Count	-13107 \pm 14	0 \pm 14LSB	+13107 \pm 14
Normalized Count	-30000 \pm 32	0 \pm 32	+30000 \pm 32

¹The ES2163 utilizes the $\pm 5V$ native range of the A/D to process $\pm 20mA$. A precision 100 Ω input shunt resistor ($\pm 0.1\%$, $\pm 10ppm/^{\circ}C$) is used to convert the input current to the A/D voltage. Thus, the ES2163 $\pm 20mA$ input range is actually a sub-range of the 16-bit $\pm 5V$ range. A full-scale current of 20mA will present a full-scale voltage of 2.0V to the A/D, yielding an effective resolution of one in 26214 parts for $\pm 20mA$ (i.e. $2/5 * \pm 32768 = \pm 13107$ parts). For the 0-20mA range, a 0-5V A/D input range is used, yielding a resolution of one in 26214 parts ($2/5 * 65536$). Likewise, for the 4-20mA range, we have a resolution of $1.6/5 * 65536$, or 1 part in 20971. For simplification, the raw A/D count for all selected input ranges are normalized to a count of ± 30000 for $\pm 100\%$, or 0-30000 for 0-100%.

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

IMPORTANT – Before You Start: Always allow the module to warm up a few minutes prior to calibration. Make sure that the scan group that includes your input channel is also enabled (Input Configuration Page). At the bottom of the Input Calibration page, verify that the reference field indicates a voltage between 4.4968 and 4.5032 (4.5V \pm 0.07%). If you suspect this voltage is inaccurate, this voltage may have to be precisely measured and then typed into this field first, before calibrating the channel. Calibrating the reference requires that the unit be removed from its enclosure and is not recommended. See Optional Reference Calibration above.

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

1. Bring up the browser interface and use the Input Configuration Page to set the input range to be calibrated. Then scroll down the page to enable the Scan Group that includes the input channel(s) you wish to calibrate.
2. Select the Input Calibration Page. Use the scroll window at the top of this page to select the specific input channel number to calibrate.
3. Note the Zero Calibration Point indicated in its field. You must apply this exact input signal to the input channel being calibrated. Your signal source should be accurate to better than $\pm 0.05\%$ (auto-cal standard).
ES2164 Units: The zero input cal signal is a negative voltage of -9.9V or -4.95V, according to input range.

WEB BROWSER**Calibration Page**

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

WEB BROWSER**Calibration Page****Channel Calibration Using the Built-In Browser Interface...continued:**

ES2163 Units: The zero input signal is -20mA, 0mA, or 4mA according to your input range. Note that -20mA is also equivalent to delivering positive current to the common terminal and returning it at the input terminal. Current is shunted to analog common through a 100Ω resistor such that -20mA produces an A/D calibration voltage of -2.0V.

4. After applying the Zero Calibration signal to the channel, click the "Step 1..." button to calibrate the zero. If you make a mistake, you can always click the "**Reset Calibration**" button to start over from Calibrate Zero Step 1. Note that the unit captures a 100 sample average of the input.
5. Note the Full-Scale Calibration Point indicated in its field. You must apply this exact input signal to the input channel being calibrated. Your signal source should be accurate to better than ±0.05% (auto-calibration standard).

ES2164 Units: The full-scale calibration signal is a positive voltage of +9.9V or +4.95V, according to your input configuration. It does not use the exact input range endpoint, because the A/D may not be able to achieve its endpoint exactly.

ES2163 Units: The full-scale calibration input signal is always +20mA. This is equivalent to delivering 20mA to the input terminal and returning it at the Common terminal. This produces an A/D calibration voltage of +2.0V.

66. After applying the correct Full-Scale Calibration signal to the channel, simply click the "Step 2..." button to calibrate the full-scale cal point. If you make a mistake, you can always click the "**Reset Calibration**" button to start over from Zero calibration Step 1.

Note that manually calibrating the channel automatically sets its Calibration Configuration from "Use Auto-Zero/Auto-Span", to "Use Channel Calibration".

The configured A/D range is now calibrated for this channel. If you intend to setup your calibration configuration such that it uses this calibration for every channel in its multiplexer group, then you only need to repeat this procedure for 7 other channels, one from each of the other 7 multiplexer groups, in order to calibrate the unit completely. Then you would set each of these channel calibration configurations to "Yes" for the query "Use this channel calibration for every channel on the mux" (you do this after actually calibrating the channel). If your calibration configuration is to select "No" for the query "Use this channel calibration for every channel on its mux", then you need to repeat this procedure for all of the other channels of interest.

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

1. Write the Enable Scan Groups register to enable the scan group that includes the input channel(s) you wish to calibrate.
2. Write the individual Channel Configuration Register(s) and select the input range to be calibrated for your input channel(s).
3. Write 24106 (5E2AH) to the Calibration Access Register to remove write protection from the calibration registers.

For best results, calibrate Zero before full-scale.

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

4. Connect the exact input zero signal to the input channel(s) being calibrated. Your signal source should be accurate to better than $\pm 0.05\%$ (auto-calibration standard).

ES2163 Units: The zero input signal is -20mA, 0mA, or 4mA according to input range. Current is shunted to analog common through a 100 Ω resistor such that -20mA will produce an A/D calibration voltage of -2.0V. Note that -20mA is also equivalent to delivering positive current to the common terminal and returning it at the input terminal.

ES2164 Units: The zero input cal signal is a negative voltage of -9.9V or -4.95V, according to your input configuration. The exact input range endpoint is not used because the A/D is being driven directly and may not be able to achieve its range endpoint exactly.

5. Write to the Zero Cal Trigger register for your channel(s) with a set bit in only the bit positions that correspond to the channel(s) you are calibrating zero at. This will trigger the unit to sample (uses a 100 sample average) the corresponding channel(s), capture their zero signals, and store the counts. The unit replaces calibration coefficients immediately, with no reset required. Note that if you have zero signals at more than one channel, and their scan groups are enabled, you can calibrate zero for multiple channels at one time.

6. Connect the exact input full-scale calibration signal to the input channel(s) being calibrated. Your signal source should be accurate to better than $\pm 0.05\%$ (auto-calibration standard).

ES2163 Units: The full-scale calibration input signal is always +20mA. This is equivalent to delivering 20mA to the input terminal and returning it at the analog common terminal. This produces an A/D calibration voltage of +2.0V.

ES2164 Units: The full-scale calibration signal is a positive voltage of +9.9V or +4.95V, according to your input configuration. It does not use the exact input range endpoint, because the A/D is being driven directly and may not be able to achieve its endpoint exactly.

7. Write to the Span Cal Trigger register for your channel(s) with a set bit in the bit position(s) that correspond to the channel(s) you wish to calibrate full-scale at. This will trigger the unit to sample the corresponding channel(s), capture their less-than full-scale signals (100 sample average), and store the counts. The replaces calibration coefficients immediately, with no reset required. Note that if you have near full-scale signals at more than one channel and their scan groups are enabled, you can calibrate full-scale for multiple channels at one time.
8. Repeat these steps for any other input channels to be calibrated.
9. When finished calibrating all the channels, write a zero value to the Calibration Access register to replace write protection for the calibration registers to help prevent potential miscalibration. Note that a system reset will also restore write protection to the calibration registers.

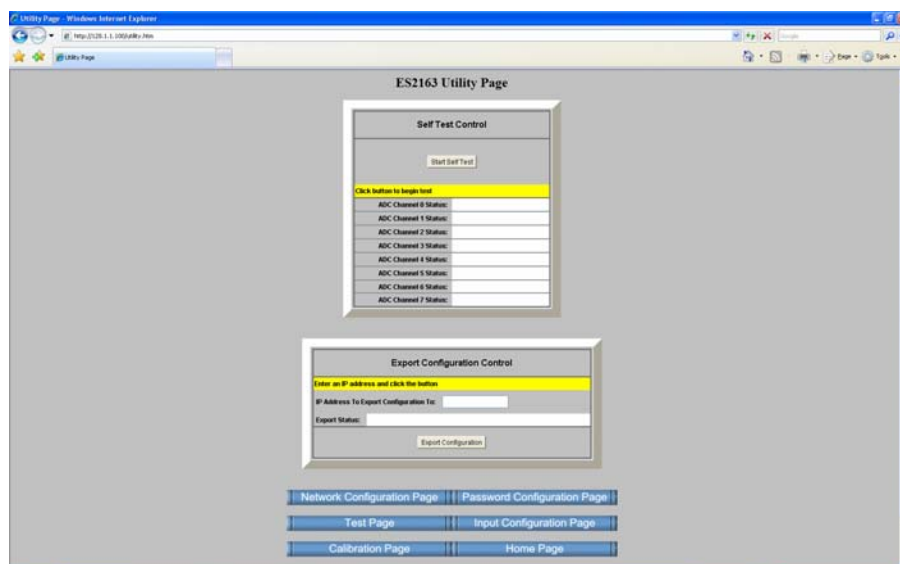
WEB BROWSER**Calibration Page**

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



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

Input Self Test Control

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

There are four 16-channel terminal groups on this unit. The even and odd channels of each terminal group are separately 8:1 multiplexed to eight separate input buffers that drive eight separate A/D channels. The Self Test Control will test the relative accuracy of the A/D input channels by sampling the reference signals. Simply click the "Start Self Test" to begin testing. This triggers the unit to momentarily connect each A/D input channel buffer (representing eight odd or even channels of each terminal group), to the internal reference signals (0V and 4.5V) and measures the response. If the resultant measurement is within an acceptable level of error with respect to rated accuracy, then the mux status will indicate "Passed". Note that this effectively tests the signal path of each channel multiplexer, the input buffer, and the A/D channel it connects to, but not each input channel (i.e. it tests the circuit operation beginning from the output side of each 8:1 input multiplexer). Thus, the Self-Test does not test the operation of the input multiplexer itself, or the integrity of the input filters, as the reference signal is switched to the input buffer of the eight A/D channels, after the 8:1 multiplexer.

Export Configuration Control

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

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

Referring to the Modbus Memory Map for this device, this function sends the contents of all Holding Registers (4xxxx registers), right up to the wink register, to the IP address indicated (Registers 40001 to 40069). It does not send network configuration parameters which must be preset via the web browser. Likewise, it does not transfer scaled values, scaled units, preload values, nor any floating point information or items that are not represented in a register. The Export Status window will let you know if the configuration was received correctly at the remote station (destination stations may still require their own calibration and additional configuration).

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

WEB BROWSER

Utility Page

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.

TROUBLE-SHOOTING

Diagnostics Table

POSSIBLE CAUSE	POSSIBLE FIX
<i>Cannot Communicate...</i>	
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.
<i>Cannot Communicate Following Restore Procedure...</i>	
Wrong IP Address	IP address has been restored to its default unit address of 128.1.1.100.
<i>Many Communication Errors...</i>	
Is cable segment longer than 100M?	Distance between two Ethernet nodes is limited to 100 meters with approved cable.
Correct Cable?	Shielded CAT-5/5E cable or equivalent is recommended.
Missing earth ground connection.	Connect earth ground to TB6 GND terminal adjacent to power terminal.
<i>Cannot Browse Unit...</i>	
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).
<i>Redundancy Failover Protection Not Occurring...</i>	
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.
<i>Cannot Access Web Pages (Unit Won't Accept Username & Password)...</i>	
Have you forgotten your username and password settings?	Return the unit to the Default Mode and use the default username and password to access the Password Configuration Page to reset them to something you can remember.
<i>Fiber Port Not Communicating...</i>	
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.
<i>Communication To Unit is Lost...</i>	
Was communication interrupted by severe interference or shock?	Reset the unit via the RST toggle or by cycling power.
<i>Unit Fails to Start-up or Initialize...</i>	
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).

POSSIBLE CAUSE	POSSIBLE FIX
<i>Adding another unit to network slows web page interaction considerably...</i>	
Does each unit have a unique MAC address? <i>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).</i>	Go to the Network Configuration Page and verify that each unit has a unique MAC address installed. This should always be the case. If you have 2 units with same MAC address, this will slow down communications considerably and you must contact the factory for MAC reassignment.
<i>Inputs Appear Noisy or Unstable...</i>	
Have you grounded your inputs? Un-grounded inputs should be grounded (connect at least one terminal group common terminal to earth ground).	Connect the input Common terminal to earth ground.
Have you tried Input Averaging?	You can use controls on the input configuration page to set the number of samples to average inputs over. Try increasing this number above 1 to minimize noise (up to 500).
<i>Input Polarity is Wrong...</i>	
Are your input terminals reversed?	Observe proper polarity for voltage inputs. Current can be input to the channel input (+), or the input common terminal if a bipolar range is selected.
<i>Unit Fails Input Self Test...</i>	
Internal calibration reference has failed or has been miscalibrated.	Check the reference field of the Calibration Page and make sure a voltage between 4.4978 and 4.5023 (4.5V±0.07%) is indicated. If not, you may attempt to calibrate this yourself, or return the unit to Acromag for calibration, repair, or replacement.
<i>Cannot Calibrate Input Channel...</i>	
Have you also enabled the channel's scan group?	See the Enable Scan Groups Register and/or the Input Config web page to enable input to be sampled.
<i>Current Inputs Have Greater Inaccuracy...</i>	
Auto calibration of current inputs fails to compensate for errors in the current shunt resistor.	Refer to Input Cal Page and perform a manual cal of the input if auto calibration results are not sufficient.

TROUBLE-SHOOTING

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.

TROUBLE-SHOOTING

Trouble Browsing Your Unit?

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

Getting Out Of Trouble



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.

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

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

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

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

If you do use restore and want to return the unit to service, you will have to reconfigure your IP address, and separately restore the calibration reference.

TECHNICAL REFERENCE

- **High Density Analog I/O** with up to 64 single-ended current or voltage input channels according to model number.
- **Web-Browser Reconfiguration** allows a standard web-browser to be used to configure, control, monitor, and calibrate over Ethernet.
- **Achieves End-Node Media Redundancy** to the unit via dual Ethernet ports when also connected to redundant switches that support STP, RSTP, and most other proprietary ring redundancy methods.
- **Fully Isolated** input channels (as a group), alarm relay, individual network ports, enclosure, and power circuits are included for safety and increased noise immunity.
- **Wideband Inputs** can process all 64 analog channels in as fast as 5ms (200Hz), or a smaller number of inputs in as fast as 0.77ms (1298Hz).
- **16-bit A/D Converter** for high-accuracy and high-resolution.
- **Built-In Calibration Source** facilitates precise calibration and self-test.
- **Integration and Totalization of Inputs is Possible** via scaling registers and non-volatile memory storage.
- **Optional User-Scaling** allows inputs to rescale to user-defined sub-ranges or other engineering units to facilitate integration/totalization.
- **Safety Agency Approvals** – Enclosed models are CE, & cULus listed, for Class 1; Division 2; Groups A, B, C, D hazardous locations. Open board models are cULus Recognized Components, for Class 1, Division 2, Groups A, B, C, and D hazardous locations.
- **Selectable Modbus TCP/IP or UDP/IP Protocol Support** for up to 10 sockets using Modbus TCP/IP. Also supports UDP/IP.
- **Flexible IP Addressing** supports static, DHCP, or BOOTP.
- **10Base-T and 100Base-TX Support** with auto-negotiated 10/100Mbps, Half or Full Duplex.
- **100BaseFX Support** option for a 100M FX fiber-optic connection at one of two network ports.
- **Dual Ethernet Ports Make Network Connections Easy** using a built-in switch to allow units to be connected in cascaded “daisy-chain” fashion without consuming another (external) switch port. The second port also allows the network distance to be extended an additional 100 meters over copper, or 2km over fiber.
- **Network Ports with Isolation & Transient Protection** are safety-isolated from each other and include transient protection.
- **Auto MDI/MDI-X Crossover** requires no special up/down link port or crossover cables to connect this device to your PC, or an external Ethernet switch, or hub.
- **Nonvolatile Reprogrammable Memory** allows the functionality of this device to be reliably reprogrammed thousands of times.
- **Low-Latency, Cut-Through Repeater Mode** reduces port-to-port latency jitter of switch mode from about 167us, to 40ns in hub mode, useful for time critical applications or concentrated traffic links.
- **Extensive Operating & Diagnostic LED's Aide Troubleshooting** with three LED's to indicate power, operating mode, wink status, and relay state, plus eight communication LED's for per-port activity, communication errors, link status, collision detection, speed, and duplex.
- **Internal Watchdog** timer is built into the DSP that causes it to initiate a self reset if the controller “locks up” or fails to return from an operation in a timely manner.
- **Wide Ambient Operation** from -40°C to +75°C.

KEY FEATURES

KEY FEATURES

...continued

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

HOW IT WORKS

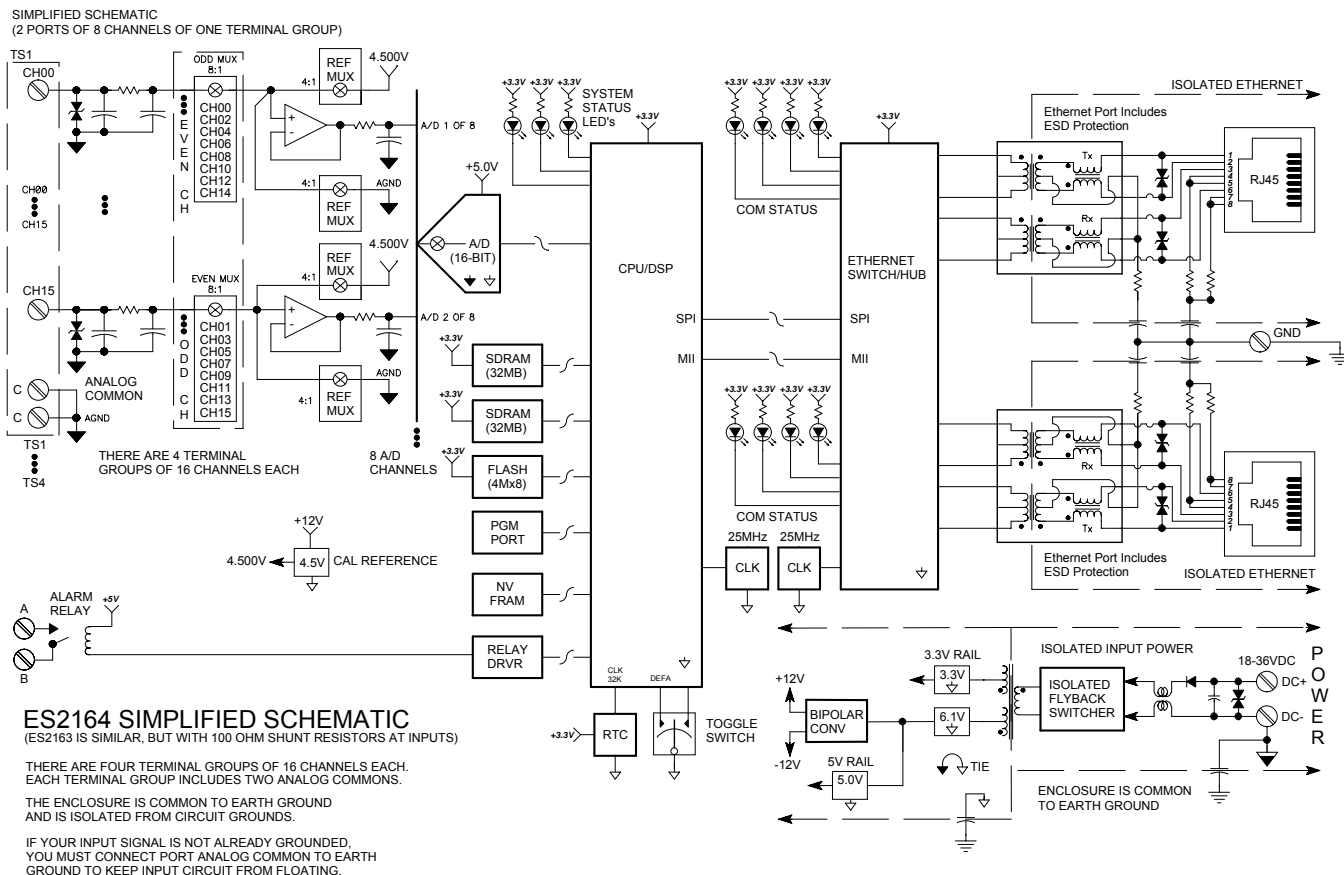
This circuit employs eight fault-tolerant 8:1 analog multiplexers to drive eight groups of 8 channels (ports) of current or voltage inputs, to eight single-ended channels of a 16-bit converter. Additional circuitry can optionally connect each A/D input to 0V (zero), or a precision 4.5V reference to help accomplish calibration and self-test. The A/D can be configured for native ranges of $\pm 10V$, $\pm 5V$, or 0-5V (ES2163). ES2163 models utilize the $\pm 5V$ or 0-5V A/D range (a 100 Ω shunt resistor converts input current to A/D voltage). Units include an isolated 10/100Mbps Ethernet interface for configuration, monitoring, calibration, and control of the I/O. Embedded configuration parameters are stored in non-volatile memory.

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

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

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

HOW IT WORKS



- Each terminal group of 16 channels has its odd numbered channels and even numbered channels separately 8:1 multiplexed to separate A/D channels.
- Ethernet ports are individually isolated from power, I/O, and each other, and include transient suppression.
- The power terminals are series-diode coupled for reverse polarity protection and to facilitate redundant power connection.
- The aluminum enclosure is common to the earth ground terminal and internal transient suppression devices are shunted to this ground via isolation capacitors, maintaining isolation from earth ground. If an ungrounded enclosure should come in contact with high-voltage, the connected circuits will be isolated from this fault condition (the input port common terminal must be tied to earth ground to keep the input circuit from floating).

Key Observations

MODBUS REGISTERS

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	<u>Read/Write Discrete Outputs or Coils</u> . A 0x reference address is used to drive output data to a digital output channel.
1xxxx	<u>Read Discrete Inputs</u> . The ON/OFF status of a 1x reference address is controlled by the corresponding digital input channel.
3xxxx	<u>Read Input Registers</u> . A 3x reference register contains a 16-bit number received from an external source—e.g. an analog signal.
4xxxx	<u>Read/Write Output or Holding Registers</u> . 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 and outputs is represented by a 1 or 0 value assigned to an individual bit in a 16-bit data word (port). This is sixteen 0x or 1x references per data word. With respect to mapping, the lsb of the word maps to the lowest numbered channel of a group and channel numbers increase sequentially as you move towards the msb.

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

Register Functions

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

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

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

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

MODBUS REGISTERS

EtherStax ES2163/2164-x0x0 Report Slave ID Example Response¹

FIELD	DESCRIPTION
Unit ID	Echo Unit ID Sent In Query
Function Code	11
Byte Count	43
Slave ID (Model No.) ¹	0B=ES2163-x0x0 (all current model variations) 0C=ES2164-x0x0 (all voltage 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 32 41 2C 45 53 32 31 36 33 2D 78 78 78 78,... ("ACROMAG,9300-182x,ES2163-xxxx,serial number&rev,six-byteMACID")

¹**Note:** ES2163 models share slave ID "0B" and firmware number 9300-182. ES2164 models share ID "0C" and firmware model 9300-183. The firmware number is also indicated on home page of the web browser.

For detailed information on Modbus, feel free to download our technical reference 8500-648, "Introduction to Modbus", at www.acromag.com. You can also find more information specific to Modbus TCP/IP by down-loading whitepaper 8500-765, "Introduction to Modbus TCP/IP". Additional information regarding Ethernet can also be found in our whitepaper 8500-747, "Introduction to Ethernet/IP".

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

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

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

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

Register Mirroring

MODBUS REGISTERS

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

Data Types

Summary of Simple Data Types Used By EtherStax Models

Data Types and Description	
Discrete	A single bit of a 16-bit word with the bit number/position typically corresponding to a discrete channel number. Unless otherwise defined, a 1 bit means the corresponding output is closed or ON, or input is ON (active-low, near 0V). A 0 bit means the output is open or OFF, or the input is OFF or in its high state (usually >> 0V).
Analog Data (This Model)	A 16-bit signed integer with a possible range of -32768 to +32767. Analog input ranges of this model are normalized to ± 30000 , which represents $\pm 100\%$ 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.

The following table outlines the register map for all model variations of the EtherStax ES2163 & ES2164 I/O processors. The Modbus functions operate on these registers using the data types noted above (except for the Reset Slave and Report Slave ID functions).

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

Register Map

Model ES2163

Model ES2164

Ref	Addr.	Description	Data Type/Format		
Input Registers (3x References, Read-Only)					
Unit Status Register 30001					
30001	0000	Unit Status Check for fiber-optic option, wink mode, or default mode.	Bit 15	Function Fiber-Optic Flag 1=Fiber-optic Transceiver Ins 0=No Fiber Opt (Dual Copper)	
			14	Wink Mode Indicator Flag 1=Winking (Blinks RUN LED) (See Wink Unit Register)	
			13	Default Mode Indicator Flag 1 = Default Mode Indication 0 = Unit not in Default Mode	
			12..0	X (Not Used)	
Channel Status Registers 30002-30065					
30002	0001	CH 00 Status (Over/Under-range, Input Range flags)	Bit 15..4	Function X (Not Used)	
			3	Over-Range Flag 1=Over-range Indication	
			2	Under-Range Flag 1=Under-Range Indication	
			1,0	Input Range Indicator b1b0 ES2163 ES2164 00 ±20mA ±5V DC 01 0-20mA ±10 VDC 10 4-20mA Not Used 11 Not Used Not Used	
30003	0002	CH 01 Status	See Channel 00 Status		
30004	0003	CH 02 Status	See Channel 00 Status		
30005	0004	CH 03 Status	See Channel 00 Status		
30006	0005	CH 04 Status	See Channel 00 Status		
30007	0006	CH 05 Status	See Channel 00 Status		
30008	0007	CH 06 Status	See Channel 00 Status		
30009	0008	CH 07 Status	See Channel 00 Status		
30010	0009	CH 08 Status	See Channel 00 Status		
30011	000A	CH 09 Status	See Channel 00 Status		
30012	000B	CH 10 Status	See Channel 00 Status		
30013	000C	CH 11 Status	See Channel 00 Status		
30014	000D	CH 12 Status	See Channel 00 Status		
30015	000E	CH 13 Status	See Channel 00 Status		

IMPORTANT: There is little or no error checking with respect to writing Modbus registers directly. Writing invalid entries into some fields can result in an unpredictable or unexpected response and may harm performance.

Note that some ES2164 channels may never achieve over or under range indication, as their input ranges correspond to the A/D input range and it may never achieve the endpoint values exactly.

Register Map

Model ES2163

Model ES2164

Ref	Addr.	Description	Data Type/Format
Channel Status Input Registers 30002-30065 (Read-Only)			
30016	000F	CH 14 Status	See Channel 00 Status
30017	0010	CH 15 Status	See Channel 00 Status
30018	0011	CH 16 Status	See Channel 00 Status
30019	0012	CH 17 Status	See Channel 00 Status
30020	0013	CH 18 Status	See Channel 00 Status
30021	0014	CH 19 Status	See Channel 00 Status
30022	0015	CH 20 Status	See Channel 00 Status
30023	0016	CH 21 Status	See Channel 00 Status
30024	0017	CH 22 Status	See Channel 00 Status
30025	0018	CH 23 Status	See Channel 00 Status
30026	0019	CH 24 Status	See Channel 00 Status
30027	001A	CH 25 Status	See Channel 00 Status
30028	001B	CH 26 Status	See Channel 00 Status
30029	001C	CH 27 Status	See Channel 00 Status
30030	001D	CH 28 Status	See Channel 00 Status
30031	001E	CH 29 Status	See Channel 00 Status
30032	001F	CH 30 Status	See Channel 00 Status
30033	0020	CH 31 Status	See Channel 00 Status
30034	0021	CH 32 Status	See Channel 00 Status
30035	0022	CH 33 Status	See Channel 00 Status
30036	0023	CH 34 Status	See Channel 00 Status
30037	0024	CH 35 Status	See Channel 00 Status
30038	0025	CH 36 Status	See Channel 00 Status
30039	0026	CH 37 Status	See Channel 00 Status
30040	0027	CH 38 Status	See Channel 00 Status
30041	0028	CH 39 Status	See Channel 00 Status
30042	0029	CH 40 Status	See Channel 00 Status
30043	002A	CH 41 Status	See Channel 00 Status
30044	002B	CH 42 Status	See Channel 00 Status
30045	002C	CH 43 Status	See Channel 00 Status
30046	002D	CH 44 Status	See Channel 00 Status
30047	002E	CH 45 Status	See Channel 00 Status
30048	002F	CH 46 Status	See Channel 00 Status
30049	0030	CH 47 Status	See Channel 00 Status
30050	0031	CH 48 Status	See Channel 00 Status
30051	0032	CH 49 Status	See Channel 00 Status
30052	0033	CH 50 Status	See Channel 00 Status
30053	0034	CH 51 Status	See Channel 00 Status
30054	0035	CH 52 Status	See Channel 00 Status
30055	0036	CH 53 Status	See Channel 00 Status
30056	0037	CH 54 Status	See Channel 00 Status
30057	0038	CH 55 Status	See Channel 00 Status
30058	0039	CH 56 Status	See Channel 00 Status
30059	003A	CH 57 Status	See Channel 00 Status
30060	003B	CH 58 Status	See Channel 00 Status
30061	003C	CH 59 Status	See Channel 00 Status
30062	003D	CH 60 Status	See Channel 00 Status
30063	003E	CH 61 Status	See Channel 00 Status

Ref	Addr.	Description	Data Type/Format
Channel Status Input Registers 30002-30065 (Read-Only)			
30064	003F	CH 62 Status	See Channel 00 Status
30065	0040	CH 63 Status	See Channel 00 Status
Normalized Channel Data Registers (Read-Only)			
30066	0041	CH 00 Data	16-bit Signed Integer Data
30067	0042	CH 01 Data	16-bit Signed Integer Data
30068	0043	CH 02 Data	16-bit Signed Integer Data
30069	0044	CH 03 Data	16-bit Signed Integer Data
30070	0045	CH 04 Data	16-bit Signed Integer Data
30071	0046	CH 05 Data	16-bit Signed Integer Data
30072	0047	CH 06 Data	16-bit Signed Integer Data
30073	0048	CH 07 Data	16-bit Signed Integer Data
30074	0049	CH 08 Data	16-bit Signed Integer Data
30075	004A	CH 09 Data	16-bit Signed Integer Data
30076	004B	CH 10 Data	16-bit Signed Integer Data
30077	004C	CH 11 Data	16-bit Signed Integer Data
30078	004D	CH 12 Data	16-bit Signed Integer Data
30079	004E	CH 13 Data	16-bit Signed Integer Data
30080	004F	CH 14 Data	16-bit Signed Integer Data
30081	0050	CH 15 Data	16-bit Signed Integer Data
30082	0051	CH 16 Data	16-bit Signed Integer Data
30083	0052	CH 17 Data	16-bit Signed Integer Data
30084	0053	CH 18 Data	16-bit Signed Integer Data
30085	0054	CH 19 Data	16-bit Signed Integer Data
30086	0055	CH 20 Data	16-bit Signed Integer Data
30087	0056	CH 21 Data	16-bit Signed Integer Data
30088	0057	CH 22 Data	16-bit Signed Integer Data
30089	0058	CH 23 Data	16-bit Signed Integer Data
30090	0059	CH 24 Data	16-bit Signed Integer Data
30091	005A	CH 25 Data	16-bit Signed Integer Data
30092	005B	CH 26 Data	16-bit Signed Integer Data
30093	005C	CH 27 Data	16-bit Signed Integer Data
30094	005D	CH 28 Data	16-bit Signed Integer Data
30095	005E	CH 29 Data	16-bit Signed Integer Data
30096	005F	CH 30 Data	16-bit Signed Integer Data
30097	0060	CH 31 Data	16-bit Signed Integer Data
30098	0061	CH 32 Data	16-bit Signed Integer Data
30099	0062	CH 33 Data	16-bit Signed Integer Data
30100	0063	CH 34 Data	16-bit Signed Integer Data
30101	0064	CH 35 Data	16-bit Signed Integer Data
30102	0065	CH 36 Data	16-bit Signed Integer Data
30103	0066	CH 37 Data	16-bit Signed Integer Data
30104	0067	CH 38 Data	16-bit Signed Integer Data
30105	0068	CH 39 Data	16-bit Signed Integer Data
30106	0069	CH 40 Data	16-bit Signed Integer Data
30107	006A	CH 41 Data	16-bit Signed Integer Data
30108	006B	CH 42 Data	16-bit Signed Integer Data
30109	006C	CH 43 Data	16-bit Signed Integer Data
30110	006D	CH 44 Data	16-bit Signed Integer Data

Register Map

Model ES2163

Model ES2164

The 16-bit Signed Integer Data stored here refers to the input range A/D count, but after normalizing it to ± 30000 for $\pm 100\%$ of the selected input range, or 0-30000 for 0-100% of the input range.

Register Map

Model ES2163

Model ES2164

The 16-bit Signed Integer Data stored here refers to the input range A/D count, but after normalizing it to ± 30000 for $\pm 100\%$ of the selected input range, or 0-30000 for 0-100% of the input range.

Ref	Addr.	Description	Data Type/Format
Normalized Channel Data Registers (Read-Only)			
30111	006E	CH 45 Data	16-bit Signed Integer Data
30112	006F	CH 46 Data	16-bit Signed Integer Data
30113	0070	CH 47 Data	16-bit Signed Integer Data
30114	0071	CH 48 Data	16-bit Signed Integer Data
30115	0072	CH 49 Data	16-bit Signed Integer Data
30116	0073	CH 50 Data	16-bit Signed Integer Data
30117	0074	CH 51 Data	16-bit Signed Integer Data
30118	0075	CH 52 Data	16-bit Signed Integer Data
30119	0076	CH 53 Data	16-bit Signed Integer Data
30120	0077	CH 54 Data	16-bit Signed Integer Data
30121	0078	CH 55 Data	16-bit Signed Integer Data
30122	0079	CH 56 Data	16-bit Signed Integer Data
30123	007A	CH 57 Data	16-bit Signed Integer Data
30124	007B	CH 58 Data	16-bit Signed Integer Data
30125	007C	CH 59 Data	16-bit Signed Integer Data
30126	007D	CH 60 Data	16-bit Signed Integer Data
30127	007E	CH 61 Data	16-bit Signed Integer Data
30128	007F	CH 62 Data	16-bit Signed Integer Data
30129	0080	CH 63 Data	16-bit Signed Integer Data
Scaled Channel Low/High Data Words, 32-bit IEEE-754 Floating Point			
30130	0081	CH 00 Data LO	IEEE-754 Floating Point LO Bytes
30131	0082	CH 00 Data HI	IEEE-754 Floating Point HI Bytes
30132	0083	CH 01 Data LO	IEEE-754 Floating Point LO Bytes
30133	0084	CH 01 Data HI	IEEE-754 Floating Point HI Bytes
30134	0085	CH 02 Data LO	IEEE-754 Floating Point LO Bytes
30135	0086	CH 02 Data HI	IEEE-754 Floating Point HI Bytes
30136	0087	CH 03 Data LO	IEEE-754 Floating Point LO Bytes
30137	0088	CH 03 Data HI	IEEE-754 Floating Point HI Bytes
30138	0089	CH 04 Data LO	IEEE-754 Floating Point LO Bytes
30139	008A	CH 04 Data HI	IEEE-754 Floating Point HI Bytes
30140	008B	CH 05 Data LO	IEEE-754 Floating Point LO Bytes
30141	008C	CH 05 Data HI	IEEE-754 Floating Point HI Bytes
30142	008D	CH 06 Data LO	IEEE-754 Floating Point LO Bytes
30143	008E	CH 06 Data HI	IEEE-754 Floating Point HI Bytes
30144	008F	CH 07 Data LO	IEEE-754 Floating Point LO Bytes
30145	0090	CH 07 Data HI	IEEE-754 Floating Point HI Bytes
30146	0091	CH 08 Data LO	IEEE-754 Floating Point LO Bytes
30147	0092	CH 08 Data HI	IEEE-754 Floating Point HI Bytes
30148	0093	CH 09 Data LO	IEEE-754 Floating Point LO Bytes
30149	0094	CH 09 Data HI	IEEE-754 Floating Point HI Bytes
30150	0095	CH 10 Data LO	IEEE-754 Floating Point LO Bytes
30151	0096	CH 10 Data HI	IEEE-754 Floating Point HI Bytes
30152	0097	CH 11 Data LO	IEEE-754 Floating Point LO Bytes
30153	0098	CH 11 Data HI	IEEE-754 Floating Point HI Bytes
30154	0099	CH 12 Data LO	IEEE-754 Floating Point LO Bytes
30155	009A	CH 12 Data HI	IEEE-754 Floating Point HI Bytes
30156	009B	CH 13 Data LO	IEEE-754 Floating Point LO Bytes
30157	009C	CH 13 Data HI	IEEE-754 Floating Point HI Bytes

Ref	Addr.	Description	Data Type/Format
Input Registers (3x References, Read-Only)			
Scaled Channel Low/High Data Words, 32-bit IEEE-754 Floating Point			
30158	009D	CH 14 Data LO	IEEE-754 Floating Point LO Bytes
30159	009E	CH 14 Data HI	IEEE-754 Floating Point HI Bytes
30160	009F	CH 15 Data LO	IEEE-754 Floating Point LO Bytes
30161	00A0	CH 15 Data HI	IEEE-754 Floating Point HI Bytes
30162	00A1	CH 16 Data LO	IEEE-754 Floating Point LO Bytes
30163	00A2	CH 16 Data HI	IEEE-754 Floating Point HI Bytes
30164	00A3	CH 17 Data LO	IEEE-754 Floating Point LO Bytes
30165	00A4	CH 17 Data HI	IEEE-754 Floating Point HI Bytes
30166	00A5	CH 18 Data LO	IEEE-754 Floating Point LO Bytes
30167	00A6	CH 18 Data HI	IEEE-754 Floating Point HI Bytes
30168	00A7	CH 19 Data LO	IEEE-754 Floating Point LO Bytes
30169	00A8	CH 19 Data HI	IEEE-754 Floating Point HI Bytes
30170	00A9	CH 20 Data LO	IEEE-754 Floating Point LO Bytes
30171	00AA	CH 20 Data HI	IEEE-754 Floating Point HI Bytes
30172	00AB	CH 21 Data LO	IEEE-754 Floating Point LO Bytes
30173	00AC	CH 21 Data HI	IEEE-754 Floating Point HI Bytes
30174	00AD	CH 22 Data LO	IEEE-754 Floating Point LO Bytes
30175	00AE	CH 22 Data HI	IEEE-754 Floating Point HI Bytes
30176	00AF	CH 23 Data LO	IEEE-754 Floating Point LO Bytes
30177	00B0	CH 23 Data HI	IEEE-754 Floating Point HI Bytes
30178	00B1	CH 24 Data LO	IEEE-754 Floating Point LO Bytes
30179	00B2	CH 24 Data HI	IEEE-754 Floating Point HI Bytes
30180	00B3	CH 25 Data LO	IEEE-754 Floating Point LO Bytes
30181	00B4	CH 25 Data HI	IEEE-754 Floating Point HI Bytes
30182	00B5	CH 26 Data LO	IEEE-754 Floating Point LO Bytes
30183	00B6	CH 26 Data HI	IEEE-754 Floating Point HI Bytes
30184	00B7	CH 27 Data LO	IEEE-754 Floating Point LO Bytes
30185	00B8	CH 27 Data HI	IEEE-754 Floating Point HI Bytes
30186	00B9	CH 28 Data LO	IEEE-754 Floating Point LO Bytes
30187	00BA	CH 28 Data HI	IEEE-754 Floating Point HI Bytes
30188	00BB	CH 29 Data LO	IEEE-754 Floating Point LO Bytes
30189	00BC	CH 29 Data HI	IEEE-754 Floating Point HI Bytes
30190	00BD	CH 30 Data LO	IEEE-754 Floating Point LO Bytes
30191	00BE	CH 30 Data HI	IEEE-754 Floating Point HI Bytes
30192	00BF	CH 31 Data LO	IEEE-754 Floating Point LO Bytes
30193	00C0	CH 31 Data HI	IEEE-754 Floating Point HI Bytes
30194	00C1	CH 32 Data LO	IEEE-754 Floating Point LO Bytes
30195	00C2	CH 32 Data HI	IEEE-754 Floating Point HI Bytes
30196	00C3	CH 33 Data LO	IEEE-754 Floating Point LO Bytes
30197	00C4	CH 33 Data HI	IEEE-754 Floating Point HI Bytes
30198	00C5	CH 34 Data LO	IEEE-754 Floating Point LO Bytes
30199	00C6	CH 34 Data HI	IEEE-754 Floating Point HI Bytes
30200	00C7	CH 35 Data LO	IEEE-754 Floating Point LO Bytes
30201	00C8	CH 35 Data HI	IEEE-754 Floating Point HI Bytes
30202	00C9	CH 36 Data LO	IEEE-754 Floating Point LO Bytes
30203	00CA	CH 36 Data HI	IEEE-754 Floating Point HI Bytes

Register Map

Model ES2163

Model ES2164

Register Map

Model ES2163

Model ES2164

Ref	Addr.	Description	Data Type/Format
Input Registers (3x References, Read-Only)			
Scaled Channel Low/High Data Words, 32-bit IEEE-754 Floating Point			
30204	00CB	CH 37 Data LO	IEEE-754 Floating Point LO Bytes
30205	00CC	CH 37 Data HI	IEEE-754 Floating Point LO Bytes
30206	00CD	CH 38 Data LO	IEEE-754 Floating Point LO Bytes
30207	00CE	CH 38 Data HI	IEEE-754 Floating Point LO Bytes
30208	00CF	CH 39 Data LO	IEEE-754 Floating Point LO Bytes
30209	00D0	CH 39 Data HI	IEEE-754 Floating Point LO Bytes
30210	00D1	CH 40 Data LO	IEEE-754 Floating Point LO Bytes
30211	00D2	CH 40 Data HI	IEEE-754 Floating Point LO Bytes
30212	00D3	CH 41 Data LO	IEEE-754 Floating Point LO Bytes
30213	00D4	CH 41 Data HI	IEEE-754 Floating Point LO Bytes
30214	00D5	CH 42 Data LO	IEEE-754 Floating Point LO Bytes
30215	00D6	CH 42 Data HI	IEEE-754 Floating Point LO Bytes
30216	00D7	CH 43 Data LO	IEEE-754 Floating Point LO Bytes
30217	00D8	CH 43 Data HI	IEEE-754 Floating Point LO Bytes
30218	00D9	CH 44 Data LO	IEEE-754 Floating Point LO Bytes
30219	00DA	CH 44 Data HI	IEEE-754 Floating Point LO Bytes
30220	00DB	CH 45 Data LO	IEEE-754 Floating Point LO Bytes
30221	00DC	CH 45 Data HI	IEEE-754 Floating Point LO Bytes
30222	00DD	CH 46 Data LO	IEEE-754 Floating Point LO Bytes
30223	00DE	CH 46 Data HI	IEEE-754 Floating Point LO Bytes
30224	00DF	CH 47 Data LO	IEEE-754 Floating Point LO Bytes
30225	00E0	CH 47 Data HI	IEEE-754 Floating Point LO Bytes
30226	00E1	CH 48 Data LO	IEEE-754 Floating Point LO Bytes
30227	00E2	CH 48 Data HI	IEEE-754 Floating Point LO Bytes
30228	00E3	CH 49 Data LO	IEEE-754 Floating Point LO Bytes
30229	00E4	CH 49 Data HI	IEEE-754 Floating Point LO Bytes
30230	00E5	CH 50 Data LO	IEEE-754 Floating Point LO Bytes
30231	00E6	CH 50 Data HI	IEEE-754 Floating Point LO Bytes
30232	00E7	CH 51 Data LO	IEEE-754 Floating Point LO Bytes
30233	00E8	CH 51 Data HI	IEEE-754 Floating Point LO Bytes
30234	00E9	CH 52 Data LO	IEEE-754 Floating Point LO Bytes
30235	00EA	CH 52 Data HI	IEEE-754 Floating Point LO Bytes
30236	00EB	CH 53 Data LO	IEEE-754 Floating Point LO Bytes
30237	00EC	CH 53 Data HI	IEEE-754 Floating Point LO Bytes
30238	00ED	CH 54 Data LO	IEEE-754 Floating Point LO Bytes
30239	00EE	CH 54 Data HI	IEEE-754 Floating Point LO Bytes
30240	00EF	CH 55 Data LO	IEEE-754 Floating Point LO Bytes
30241	00F0	CH 55 Data HI	IEEE-754 Floating Point LO Bytes
30242	00F1	CH 56 Data LO	IEEE-754 Floating Point LO Bytes
30243	00F2	CH 56 Data HI	IEEE-754 Floating Point LO Bytes
30244	00F3	CH 57 Data LO	IEEE-754 Floating Point LO Bytes
30245	00F4	CH 57 Data HI	IEEE-754 Floating Point LO Bytes
30246	00F5	CH 58 Data LO	IEEE-754 Floating Point LO Bytes
30247	00F6	CH 58 Data HI	IEEE-754 Floating Point LO Bytes
30248	00F7	CH 59 Data LO	IEEE-754 Floating Point LO Bytes
30249	00F8	CH 59 Data HI	IEEE-754 Floating Point LO Bytes

Ref	Addr.	Description	Data Type/Format
Input Registers (3x References, Read-Only)			
Scaled Channel Low/High Data Words, 32-bit IEEE-754 Floating Point			
30250	00F9	CH 60 Data LO	IEEE-754 Floating Point LO Bytes
30251	00FA	CH 60 Data HI	IEEE-754 Floating Point LO Bytes
30252	00FB	CH 61 Data LO	IEEE-754 Floating Point LO Bytes
30253	00FC	CH 61 Data HI	IEEE-754 Floating Point LO Bytes
30254	00FD	CH 62 Data LO	IEEE-754 Floating Point LO Bytes
30255	00FE	CH 62 Data HI	IEEE-754 Floating Point LO Bytes
30256	00FF	CH 63 Data LO	IEEE-754 Floating Point LO Bytes
30257	0100	CH 63 Data HI	IEEE-754 Floating Point LO Bytes
Totalized Chan Low/High Data Words, 32-bit IEEE-754 Floating Point			
30258	0101	CH00 Data LO	IEEE-754 Floating Point LO Bytes
30259	0102	CH00 Data HI	IEEE-754 Floating Point HI Bytes
30260	0103	CH01 Data LO	IEEE-754 Floating Point LO Bytes
30261	0104	CH01 Data HI	IEEE-754 Floating Point HI Bytes
30262	0105	CH02 Data LO	IEEE-754 Floating Point LO Bytes
30263	0106	CH02 Data HI	IEEE-754 Floating Point HI Bytes
30264	0107	CH03 Data LO	IEEE-754 Floating Point LO Bytes
30265	0108	CH03 Data HI	IEEE-754 Floating Point HI Bytes
30266	0109	CH04 Data LO	IEEE-754 Floating Point LO Bytes
30267	010A	CH04 Data HI	IEEE-754 Floating Point HI Bytes
30268	010B	CH05 Data LO	IEEE-754 Floating Point LO Bytes
30269	010C	CH05 Data HI	IEEE-754 Floating Point HI Bytes
30270	010D	CH06 Data LO	IEEE-754 Floating Point LO Bytes
30271	010E	CH06 Data HI	IEEE-754 Floating Point HI Bytes
30272	010F	CH07 Data LO	IEEE-754 Floating Point LO Bytes
30273	0110	CH07 Data HI	IEEE-754 Floating Point HI Bytes
30274	0111	CH08 Data LO	IEEE-754 Floating Point LO Bytes
30275	0112	CH08 Data HI	IEEE-754 Floating Point HI Bytes
30276	0113	CH09 Data LO	IEEE-754 Floating Point LO Bytes
30277	0114	CH09 Data HI	IEEE-754 Floating Point HI Bytes
30278	0115	CH10 Data LO	IEEE-754 Floating Point LO Bytes
30279	0116	CH10 Data HI	IEEE-754 Floating Point HI Bytes
30280	0117	CH11 Data LO	IEEE-754 Floating Point LO Bytes
30281	0118	CH11 Data HI	IEEE-754 Floating Point HI Bytes
30282	0119	CH12 Data LO	IEEE-754 Floating Point LO Bytes
30283	011A	CH12 Data HI	IEEE-754 Floating Point HI Bytes
30284	011B	CH13 Data LO	IEEE-754 Floating Point LO Bytes
30285	011C	CH13 Data HI	IEEE-754 Floating Point HI Bytes
30286	011D	CH14 Data LO	IEEE-754 Floating Point LO Bytes
30287	011E	CH14 Data HI	IEEE-754 Floating Point HI Bytes
30288	011F	CH15 Data LO	IEEE-754 Floating Point LO Bytes
30289	0120	CH15 Data HI	IEEE-754 Floating Point HI Bytes
30290	0121	CH16 Data LO	IEEE-754 Floating Point LO Bytes
30291	0122	CH16 Data HI	IEEE-754 Floating Point HI Bytes
30292	0123	CH17 Data LO	IEEE-754 Floating Point LO Bytes
30293	0124	CH17 Data HI	IEEE-754 Floating Point HI Bytes
30294	0125	CH18 Data LO	IEEE-754 Floating Point LO Bytes
30295	0126	CH18 Data HI	IEEE-754 Floating Point HI Bytes

Register Map

Model ES2163

Model ES2164

Register Map

Model ES2163

Model ES2164

Ref	Addr.	Description	Data Type/Format
Input Registers (3x References, Read-Only)			
Totalized Chan Low/High Data Words, 32-bit IEEE-754 Floating Point			
30296	0127	CH19 Data LO	IEEE-754 Floating Point LO Bytes
30297	0128	CH19 Data HI	IEEE-754 Floating Point HI Bytes
30298	0129	CH20 Data LO	IEEE-754 Floating Point LO Bytes
30299	012A	CH20 Data HI	IEEE-754 Floating Point HI Bytes
30300	012B	CH21 Data LO	IEEE-754 Floating Point LO Bytes
30301	012C	CH21 Data HI	IEEE-754 Floating Point HI Bytes
30302	012D	CH22 Data LO	IEEE-754 Floating Point LO Bytes
30303	012E	CH22 Data HI	IEEE-754 Floating Point HI Bytes
30304	012F	CH23 Data LO	IEEE-754 Floating Point LO Bytes
30305	0130	CH23 Data HI	IEEE-754 Floating Point HI Bytes
30306	0131	CH24 Data LO	IEEE-754 Floating Point LO Bytes
30307	0132	CH24 Data HI	IEEE-754 Floating Point HI Bytes
30308	0133	CH25 Data LO	IEEE-754 Floating Point LO Bytes
30309	0134	CH25 Data HI	IEEE-754 Floating Point HI Bytes
30310	0135	CH26 Data LO	IEEE-754 Floating Point LO Bytes
30311	0136	CH26 Data HI	IEEE-754 Floating Point HI Bytes
30312	0137	CH27 Data LO	IEEE-754 Floating Point LO Bytes
30313	0138	CH27 Data HI	IEEE-754 Floating Point HI Bytes
30314	0139	CH28 Data LO	IEEE-754 Floating Point LO Bytes
30315	013A	CH28 Data HI	IEEE-754 Floating Point HI Bytes
30316	013B	CH29 Data LO	IEEE-754 Floating Point LO Bytes
30317	013C	CH29 Data HI	IEEE-754 Floating Point HI Bytes
30318	013D	CH30 Data LO	IEEE-754 Floating Point LO Bytes
30319	013E	CH30 Data HI	IEEE-754 Floating Point HI Bytes
30320	013F	CH31 Data LO	IEEE-754 Floating Point LO Bytes
30321	0140	CH31 Data HI	IEEE-754 Floating Point HI Bytes
30322	0141	CH32 Data LO	IEEE-754 Floating Point LO Bytes
30323	0142	CH32 Data HI	IEEE-754 Floating Point HI Bytes
30324	0143	CH33 Data LO	IEEE-754 Floating Point LO Bytes
30325	0144	CH33 Data HI	IEEE-754 Floating Point HI Bytes
30326	0145	CH34 Data LO	IEEE-754 Floating Point LO Bytes
30327	0146	CH34 Data HI	IEEE-754 Floating Point HI Bytes
30328	0147	CH35 Data LO	IEEE-754 Floating Point LO Bytes
30329	0148	CH35 Data HI	IEEE-754 Floating Point HI Bytes
30330	0149	CH36 Data LO	IEEE-754 Floating Point LO Bytes
30331	014A	CH36 Data HI	IEEE-754 Floating Point HI Bytes
30332	014B	CH37 Data LO	IEEE-754 Floating Point LO Bytes
30333	014C	CH37 Data HI	IEEE-754 Floating Point HI Bytes
30334	014D	CH38 Data LO	IEEE-754 Floating Point LO Bytes
30335	014E	CH38 Data HI	IEEE-754 Floating Point HI Bytes
30336	014F	CH39 Data LO	IEEE-754 Floating Point LO Bytes
30337	0150	CH39 Data HI	IEEE-754 Floating Point HI Bytes
30338	0151	CH40 Data LO	IEEE-754 Floating Point LO Bytes
30339	0152	CH40 Data HI	IEEE-754 Floating Point HI Bytes
30340	0153	CH41 Data LO	IEEE-754 Floating Point LO Bytes
30341	0154	CH41 Data HI	IEEE-754 Floating Point HI Bytes

Ref	Addr.	Description	Data Type/Format
Input Registers (3x References, Read-Only)			
Totalized Chan Low/High Data Words, 32-bit IEEE-754 Floating Point			
30342	0155	CH42 Data LO	IEEE-754 Floating Point LO Bytes
30343	0156	CH42 Data HI	IEEE-754 Floating Point HI Bytes
30344	0157	CH43 Data LO	IEEE-754 Floating Point LO Bytes
30345	0158	CH43 Data HI	IEEE-754 Floating Point HI Bytes
30346	0159	CH44 Data LO	IEEE-754 Floating Point LO Bytes
30347	015A	CH44 Data HI	IEEE-754 Floating Point HI Bytes
30348	015B	CH45 Data LO	IEEE-754 Floating Point LO Bytes
30349	015C	CH45 Data HI	IEEE-754 Floating Point HI Bytes
30350	015D	CH46 Data LO	IEEE-754 Floating Point LO Bytes
30351	015E	CH46 Data HI	IEEE-754 Floating Point HI Bytes
30352	015F	CH47 Data LO	IEEE-754 Floating Point LO Bytes
30353	0160	CH47 Data HI	IEEE-754 Floating Point HI Bytes
30354	0161	CH48 Data LO	IEEE-754 Floating Point LO Bytes
30355	0162	CH48 Data HI	IEEE-754 Floating Point HI Bytes
30356	0163	CH49 Data LO	IEEE-754 Floating Point LO Bytes
30357	0164	CH49 Data HI	IEEE-754 Floating Point HI Bytes
30358	0165	CH50 Data LO	IEEE-754 Floating Point LO Bytes
30359	0166	CH50 Data HI	IEEE-754 Floating Point HI Bytes
30360	0167	CH51 Data LO	IEEE-754 Floating Point LO Bytes
30361	0168	CH51 Data HI	IEEE-754 Floating Point HI Bytes
30362	0169	CH52 Data LO	IEEE-754 Floating Point LO Bytes
30363	016A	CH52 Data HI	IEEE-754 Floating Point HI Bytes
30364	016B	CH53 Data LO	IEEE-754 Floating Point LO Bytes
30365	016C	CH53 Data HI	IEEE-754 Floating Point HI Bytes
30366	016D	CH54 Data LO	IEEE-754 Floating Point LO Bytes
30367	016E	CH54 Data HI	IEEE-754 Floating Point HI Bytes
30368	016F	CH55 Data LO	IEEE-754 Floating Point LO Bytes
30369	0170	CH55 Data HI	IEEE-754 Floating Point HI Bytes
30370	0171	CH56 Data LO	IEEE-754 Floating Point LO Bytes
30371	0172	CH56 Data HI	IEEE-754 Floating Point HI Bytes
30372	0173	CH57 Data LO	IEEE-754 Floating Point LO Bytes
30373	0174	CH57 Data HI	IEEE-754 Floating Point HI Bytes
30374	0175	CH58 Data LO	IEEE-754 Floating Point LO Bytes
30375	0176	CH58 Data HI	IEEE-754 Floating Point HI Bytes
30376	0177	CH59 Data LO	IEEE-754 Floating Point LO Bytes
30377	0178	CH59 Data HI	IEEE-754 Floating Point HI Bytes
30378	0179	CH60 Data LO	IEEE-754 Floating Point LO Bytes
30379	017A	CH60 Data HI	IEEE-754 Floating Point HI Bytes
30380	017B	CH61 Data LO	IEEE-754 Floating Point LO Bytes
30381	017C	CH61 Data HI	IEEE-754 Floating Point HI Bytes
30382	017D	CH62 Data LO	IEEE-754 Floating Point LO Bytes
30383	017E	CH62 Data HI	IEEE-754 Floating Point HI Bytes
30384	017F	CH63 Data LO	IEEE-754 Floating Point LO Bytes
30385	0180	CH63 Data HI	IEEE-754 Floating Point HI Bytes

Register Map

Model ES2163

Model ES2164

Register Map

Model ES2163

Model ES2164

Totalized inputs are sampled every 20ms (or 80ms with averaging). Your input signal per time base is multiplied by 20ms per sample to get the incremental increase or decrease of volume that is added to your totalized value. The max totalized value possible is 9,999,999.9999.

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

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

Ref	Addr.	Description	Data Type/Format											
Holding Registers (4x References, Read/Write)														
Channel Configuration Registers 40001-40032														
40001	0 (0000)	Channel 00 Configuration (Default is 0019H, see shading) Note: Before setting bit 12, be sure to first calibrate the channel before using its calibration to also calibrate its entire multiplexer group of channels.	Bit	Function (Shaded=Default)										
			45	X Not Used										
			14	Cal Config - Channel 0=Calibration use AZ/AS 1=Use Manual Calibration										
			43	X Not Used										
			12	Cal Config - Multiplexer 0=Do NOT use this CH calibration for its mux channels. 1=Use this CH cal for all mux channels (see Note).										
			44	X Not Used										
			40	X Not Used										
			9	X Not Used										
			8	Totalizer Initial Value 0=Use Preload Value 1=Use Last Value										
			7	Totalizer Action 0=Rollover 1=Latch										
			6	Totalizer OFF/ON 0=OFF 1=ON										
			5	X Not Used										
			4,3	Totalizer Time Base 00=per Second 01=per Minute 10=per Hour 11=No Action (NA)										
			2	X Not Used										
			1,0	Input Range Selection <table><tr><td>ES2163</td><td>ES2164</td></tr><tr><td>00=±20mA</td><td>00=±5V</td></tr><tr><td>01=0-20mA</td><td>01=±10V</td></tr><tr><td>10=4-20mA</td><td>10=Reserved</td></tr><tr><td>11=Reserved</td><td>11=Reserved</td></tr></table>	ES2163	ES2164	00=±20mA	00=±5V	01=0-20mA	01=±10V	10=4-20mA	10=Reserved	11=Reserved	11=Reserved
			ES2163	ES2164										
			00=±20mA	00=±5V										
			01=0-20mA	01=±10V										
			10=4-20mA	10=Reserved										
			11=Reserved	11=Reserved										
			40002	0001	CH01 Config	See explanation for channel 00 above.								
40003	0002	CH02 Config	See explanation for channel 00 above.											
40004	0003	CH03 Config	See explanation for channel 00 above.											
40005	0004	CH04 Config	See explanation for channel 00 above.											
40006	0005	CH05 Config	See explanation for channel 00 above.											
40007	0006	CH06 Config	See explanation for channel 00 above.											
40008	0007	CH07 Config	See explanation for channel 00 above.											
40009	0008	CH08 Config	See explanation for channel 00 above.											
40010	0009	CH09 Config	See explanation for channel 00 above.											
40011	000A	CH10 Config	See explanation for channel 00 above.											
40012	000B	CH11 Config	See explanation for channel 00 above.											
40013	000C	CH12 Config	See explanation for channel 00 above.											

Ref	Addr.	Description	Data Type/Format
Holding Registers (4x References, Read/Write)			
Channel Configuration Registers 40001-40032			
40014	000D	CH13 Config	See explanation for channel 00 above.
40015	000E	CH14 Config	See explanation for channel 00 above.
40016	000F	CH15 Config	See explanation for channel 00 above.
40017	0010	CH16 Config	See explanation for channel 00 above.
40018	0011	CH17 Config	See explanation for channel 00 above.
40019	0012	CH18 Config	See explanation for channel 00 above.
40020	0013	CH19 Config	See explanation for channel 00 above.
40021	0014	CH20 Config	See explanation for channel 00 above.
40022	0015	CH21 Config	See explanation for channel 00 above.
40023	0016	CH22 Config	See explanation for channel 00 above.
40024	0017	CH23 Config	See explanation for channel 00 above.
40025	0018	CH24 Config	See explanation for channel 00 above.
40026	0019	CH25 Config	See explanation for channel 00 above.
40027	001A	CH26 Config	See explanation for channel 00 above.
40028	001B	CH27 Config	See explanation for channel 00 above.
40029	001C	CH28 Config	See explanation for channel 00 above.
40030	001D	CH29 Config	See explanation for channel 00 above.
40031	001E	CH30 Config	See explanation for channel 00 above.
40032	001F	CH31 Config	See explanation for channel 00 above.
40033	0020	CH32 Config	See explanation for channel 00 above.
40034	0021	CH33 Config	See explanation for channel 00 above.
40035	0022	CH34 Config	See explanation for channel 00 above.
40036	0023	CH35 Config	See explanation for channel 00 above.
40037	0024	CH36 Config	See explanation for channel 00 above.
40038	0025	CH37 Config	See explanation for channel 00 above.
40039	0026	CH38 Config	See explanation for channel 00 above.
40040	0027	CH39 Config	See explanation for channel 00 above.
40041	0028	CH40 Config	See explanation for channel 00 above.
40042	0029	CH41 Config	See explanation for channel 00 above.
40043	002A	CH42 Config	See explanation for channel 00 above.
40044	002B	CH43 Config	See explanation for channel 00 above.
40045	002C	CH44 Config	See explanation for channel 00 above.
40046	002D	CH45 Config	See explanation for channel 00 above.
40047	002E	CH46 Config	See explanation for channel 00 above.
40048	002F	CH47 Config	See explanation for channel 00 above.
40049	0030	CH48 Config	See explanation for channel 00 above.
40050	0031	CH49 Config	See explanation for channel 00 above.
40051	0032	CH50 Config	See explanation for channel 00 above.
40052	0033	CH51 Config	See explanation for channel 00 above.
40053	0034	CH52 Config	See explanation for channel 00 above.
40054	0035	CH53 Config	See explanation for channel 00 above.
40055	0036	CH54 Config	See explanation for channel 00 above.
40056	0037	CH55 Config	See explanation for channel 00 above.
40057	0038	CH56 Config	See explanation for channel 00 above.
40058	0039	CH57 Config	See explanation for channel 00 above.
40059	003A	CH58 Config	See explanation for channel 00 above.
40060	003B	CH59 Config	See explanation for channel 00 above.

Register Map

Model ES2163

Model ES2164

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

Register Map

Model ES2163

Model ES2164

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

Scan Group Channels:

G8=14,15,30,31,46,48,62,63;
 G7=12,13,28,29,44,45,60,61;
 G6=10,11,26,27,42,43,58,59;
 G5=08,09,24,25,40,41,56,57;
 G4=06,07,22,23,38,39,54,55;
 G3=04,05,20,21,36,37,52,53;
 G2=02,03,18,19,34,35,50,51;
 G1=00,01,16,17,32,33,48,49.

Ref	Addr.	Description	Data Type/Format
Holding Registers (4x References, Read/Write)			
Channel Configuration Registers 40001-40032			
40061	003C	CH60 Config	See explanation for channel 00 above.
40062	003D	CH61 Config	See explanation for channel 00 above.
40063	003E	CH62 Config	See explanation for channel 00 above.
40064	003F	CH63 Config	See explanation for channel 00 above.
Miscellaneous Unit Configuration Registers 40033-40037			
40065	0040	Global Floating Point Enable and Byte Order (Def = 0000H, disabled)	Bit
			Function (Shaded=Default)
			15 Enable Floating Point?
			0=No 1=Yes
			14..2 X (Not Used)
			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
40066	0041	Local Relay Failsafe/ Non-Failsafe Selection (Def=0000H, Alarm using failsafe relay)	Bit
			Function
			15..4 X (Not Used)
			0 Alarm Action
			0=Failsafe 1=Non-Failsafe
			Relay contacts are used to signal a media failure (link loss), but can also signal a power loss if the relay is set to failsafe.
40067	0042	Enable Scan Groups (Def = 00FFH, all groups enabled)	Bit
			Function
			15-8: X (Not Used)
			7..0 Scan Group Enables
			7 0=Disable G8 1=Enable G8
			6 0=Disable G7 1=Enable G7
			5 0=Disable G6 1=Enable G6
			4 0=Disable G5 1=Enable G5
			3 0=Disable G4 1=Enable G4
			2 0=Disable G3 1=Enable G3
			1 0=Disable G2 1=Enable G2
			0 0=Disable G1 1=Enable G1
40068	0043	Input Averaging (Def = 0000H, No Averaging)	Set to 0 or 1 for No Averaging. Set to an integer greater than 1 to specify the number of samples to average (500 samples maximum).

Ref	Addr.	Description	Data Type/Format
Holding Registers (4x References, Read/Write)			
Miscellaneous Unit Configuration Registers 40033-40037			
40069	0044	Wink Toggle & Cal Access & Restore Protect & Restore Cal & Restore Scaling & Reset System Register <i>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.</i>	Multi-Function Write Register <u>Write</u> <u>Function</u> 21845 (5555H) WINK Toggle to ID unit. 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. 24106 (5E2AH) Remove Write Protection Removes write protection from the calibration registers that follow. A system reset or writing zero to this register will restore write-protection to the cal registers. 0 (0000H) Restore write protection to calibration registers. 44718 (AEAEH) Restore default calibration coefficients. 60138 (EAEAH) Restore the default scaling values. 41429 (A1D5H) Cause a system reset and reboot.
Channel Calibration Value Registers 40070-40454			
40070	0045	Reserved	Reserved – Do Not Use
40071	0046	CH00 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40072	0047	CH00 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40073	0048	CH00 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40074	0049	CH00 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40075	004A	CH00 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40076	004B	CH00 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40077	004C	CH01 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40078	004D	CH01 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40079	004E	CH01 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40080	004F	CH01 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40081	0050	CH01 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40082	0051	CH01 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40083	0052	CH02 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40084	0053	CH02 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40085	0054	CH02 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40086	0055	CH02 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40087	0056	CH02 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40088	0057	CH02 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40089	0058	CH03 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI

Register Map

Model ES2163
Model ES2164

Shaded registers from 40070 to 40454 contain the A/D counts corresponding to the channel calibration values for each range and these are write-restricted. They are reserved for internal firmware and factory use and are indirectly modified by the calibration registers 40460-40467. Do not attempt to directly modify the contents of these registers.

Note:

Range 1 = $\pm 20\text{mA}$ (ES2163), or $\pm 5\text{V}$ (ES2164).

Range 2 = $0\text{--}20\text{mA}$ (ES2163), or $\pm 10\text{V}$ (ES2164).

Range 3 = $4\text{--}20\text{mA}$ (ES2163), or Not Used (ES2164).

Register Map

Model ES2163 Model ES2164

Shaded registers from 40070 to 40454 contain the A/D counts corresponding to the channel calibration values for each range and these are write-restricted. They are reserved for internal firmware and factory use and are indirectly modified by the calibration registers 40460-40467. Do not attempt to directly modify the contents of these registers.

Note:

Range 1 = $\pm 20\text{mA}$ (ES2163), or $\pm 5\text{V}$ (ES2164).

Range 2 = $0\text{--}20\text{mA}$ (ES2163), or $\pm 10\text{V}$ (ES2164).

Range 3 = $4\text{--}20\text{mA}$ (ES2163), or Not Used (ES2164).

Ref	Addr.	Description	Data Type/Format
Holding Registers (4x References, Read/Write)			
Channel Calibration Value Registers 40070-40454			
40090	0059	CH03 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40091	005A	CH03 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40092	005B	CH03 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40093	005C	CH03 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40094	005D	CH03 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40095	005E	CH04 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40096	005F	CH04 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40097	0060	CH04 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40098	0061	CH04 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40099	0062	CH04 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40100	0063	CH04 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40101	0064	CH05 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40102	0065	CH05 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40103	0066	CH05 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40104	0067	CH05 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40105	0068	CH05 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40106	0069	CH05 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40107	006A	CH06 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40108	006B	CH06 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40109	006C	CH06 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40110	006D	CH06 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40111	006E	CH06 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40112	006F	CH06 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40113	0070	CH07 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40114	0071	CH07 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40115	0072	CH07 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40116	0073	CH07 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40117	0074	CH07 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40118	0075	CH07 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40119	0076	CH08 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40120	0077	CH08 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40121	0078	CH08 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40122	0079	CH08 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40123	007A	CH08 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40124	007B	CH08 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40125	007C	CH09 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40126	007D	CH09 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40127	007E	CH09 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40128	007F	CH09 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40129	0080	CH09 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40130	0081	CH09 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40131	0082	CH10 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40132	0083	CH10 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40133	0084	CH10 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40134	0085	CH10 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40135	0086	CH10 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40136	0087	CH10 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO

Ref	Addr.	Description	Data Type/Format
Holding Registers (4x References, Read/Write)			
Channel Calibration Value Registers 40070-40454			
40137	0088	CH11 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40138	0089	CH11 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40139	008A	CH11 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40140	008B	CH11 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40141	008C	CH11 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40142	008D	CH11 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40143	008E	CH12 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40144	008F	CH12 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40145	0090	CH12 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40146	0091	CH12 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40147	0092	CH12 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40148	0093	CH12 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40149	0094	CH13 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40150	0095	CH13 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40151	0096	CH13 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40152	0097	CH13 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40153	0098	CH13 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40154	0099	CH13 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40155	009A	CH14 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40156	009B	CH14 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40157	009C	CH14 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40158	009D	CH14 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40159	009E	CH14 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40160	009F	CH14 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40161	00A0	CH15 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40162	00A1	CH15 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40163	00A2	CH15 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40164	00A3	CH15 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40165	00A4	CH15 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40166	00A5	CH15 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40167	00A6	CH16 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40168	00A7	CH16 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40169	00A8	CH16 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40170	00A9	CH16 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40171	00AA	CH16 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40172	00AB	CH16 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40173	00AC	CH17 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40174	00AD	CH17 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40175	00AE	CH17 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40176	00AF	CH17 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40177	00B0	CH17 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40178	00B1	CH17 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40179	00B2	CH18 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40180	00B3	CH18 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40181	00B4	CH18 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40182	00B5	CH18 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40183	00B6	CH18 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI

Register Map

Model ES2163 Model ES2164

Shaded registers from 40070 to 40454 contain the A/D counts corresponding to the channel calibration values for each range and these are write-restricted. They are reserved for internal firmware and factory use and are indirectly modified by the calibration registers 40460-40467. Do not attempt to directly modify the contents of these registers.

Note:

Range 1 = $\pm 20\text{mA}$ (ES2163), or $\pm 5\text{V}$ (ES2164).

Range 2 = $0\text{--}20\text{mA}$ (ES2163), or $\pm 10\text{V}$ (ES2164).

Range 3 = $4\text{--}20\text{mA}$ (ES2163), or Not Used (ES2164).

Register Map

Model ES2163

Model ES2164

Shaded registers from 40070 to 40454 contain the A/D counts corresponding to the channel calibration values for each range and these are write-restricted. They are reserved for internal firmware and factory use and are indirectly modified by the calibration registers 40460-40467. Do not attempt to directly modify the contents of these registers.

Note:

Range 1 = $\pm 20\text{mA}$ (ES2163), or $\pm 5\text{V}$ (ES2164).

Range 2 = $0\text{--}20\text{mA}$ (ES2163), or $\pm 10\text{V}$ (ES2164).

Range 3 = $4\text{--}20\text{mA}$ (ES2163), or Not Used (ES2164).

Ref	Addr.	Description	Data Type/Format
Holding Registers (4x References, Read/Write)			
Channel Calibration Value Registers 40070-40454			
40184	00B7	CH18 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40185	00B8	CH19 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40186	00B9	CH19 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40187	00BA	CH19 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40188	00BB	CH19 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40189	00BC	CH19 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40190	00BD	CH19 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40191	00BE	CH20 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40192	00BF	CH20 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40193	00C0	CH20 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40194	00C1	CH20 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40195	00C2	CH20 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40196	00C3	CH20 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40197	00C4	CH21 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40198	00C5	CH21 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40199	00C6	CH21 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40200	00C7	CH21 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40201	00C8	CH21 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40202	00C9	CH21 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40203	00CA	CH22 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40204	00CB	CH22 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40205	00CC	CH22 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40206	00CD	CH22 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40207	00CE	CH22 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40208	00CF	CH22 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40209	00D0	CH23 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40210	00D1	CH23 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40211	00D2	CH23 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40212	00D3	CH23 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40213	00D4	CH23 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40214	00D5	CH23 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40215	00D6	CH24 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40216	00D7	CH24 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40217	00D8	CH24 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40218	00D9	CH24 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40219	00DA	CH24 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40220	00DB	CH24 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40221	00DC	CH25 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40222	00DD	CH25 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40223	00DE	CH25 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40224	00DF	CH25 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40225	00E0	CH25 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40226	00E1	CH25 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40227	00E2	CH26 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40228	00E3	CH26 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40229	00E4	CH26 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40230	00E5	CH26 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO

Ref	Addr.	Description	Data Type/Format
Holding Registers (4x References, Read/Write)			
Channel Calibration Value Registers 40070-40454			
40231	00E6	CH26 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40232	00E7	CH26 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40233	00E8	CH27 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40234	00E9	CH27 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40235	00EA	CH27 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40236	00EB	CH27 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40237	00EC	CH27 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40238	00ED	CH27 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40239	00EE	CH28 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40240	00EF	CH28 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40241	00F0	CH28 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40242	00F1	CH28 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40243	00F2	CH28 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40244	00F3	CH28 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40245	00F4	CH29 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40246	00F5	CH29 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40247	00F6	CH29 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40248	00F7	CH29 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40249	00F8	CH29 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40250	00F9	CH29 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40251	00FA	CH30 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40252	00FB	CH30 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40253	00FC	CH30 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40254	00FD	CH30 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40255	00FE	CH30 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40256	00FF	CH30 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40257	0100	CH31 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40258	0101	CH31 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40259	0102	CH31 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40260	0103	CH31 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40261	0104	CH31 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40262	0105	CH31 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40263	0106	CH32 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40264	0107	CH32 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40265	0108	CH32 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40266	0109	CH32 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40267	010A	CH32 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40268	010B	CH32 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40269	010C	CH33 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40270	010D	CH33 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40271	010E	CH33 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40272	010F	CH33 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40273	0110	CH33 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40274	0111	CH33 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40275	0112	CH34 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40276	0113	CH34 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40277	0114	CH34 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI

Register Map

Model ES2163 Model ES2164

Shaded registers from 40070 to 40454 contain the A/D counts corresponding to the channel calibration values for each range and these are write-restricted. They are reserved for internal firmware and factory use and are indirectly modified by the calibration registers 40460-40467. Do not attempt to directly modify the contents of these registers.

Note:

Range 1 = $\pm 20\text{mA}$ (ES2163), or $\pm 5\text{V}$ (ES2164).

Range 2 = $0\text{-}20\text{mA}$ (ES2163), or $\pm 10\text{V}$ (ES2164).

Range 3 = $4\text{-}20\text{mA}$ (ES2163), or Not Used (ES2164).

Register Map

Model ES2163

Model ES2164

Shaded registers from 40070 to 40454 contain the A/D counts corresponding to the channel calibration values for each range and these are write-restricted. They are reserved for internal firmware and factory use and are indirectly modified by the calibration registers 40460-40467. Do not attempt to directly modify the contents of these registers.

Note:

Range 1 = $\pm 20\text{mA}$ (ES2163), or $\pm 5\text{V}$ (ES2164).

Range 2 = $0\text{--}20\text{mA}$ (ES2163), or $\pm 10\text{V}$ (ES2164).

Range 3 = $4\text{--}20\text{mA}$ (ES2163), or Not Used (ES2164).

Ref	Addr.	Description	Data Type/Format
Holding Registers (4x References, Read/Write)			
Channel Calibration Value Registers 40070-40454			
40278	0115	CH34 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40279	0116	CH34 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40280	0117	CH34 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40281	0118	CH35 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40282	0119	CH35 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40283	011A	CH35 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40284	011B	CH35 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40285	011C	CH35 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40286	011D	CH35 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40287	011E	CH36 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40288	011F	CH36 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40289	0120	CH36 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40290	0121	CH36 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40291	0122	CH36 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40292	0123	CH36 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40293	0124	CH37 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40294	0125	CH37 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40295	0126	CH37 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40296	0127	CH37 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40297	0128	CH37 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40298	0129	CH37 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40299	012A	CH38 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40300	012B	CH38 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40301	012C	CH38 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40302	012D	CH38 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40303	012E	CH38 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40304	012F	CH38 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40305	0130	CH39 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40306	0131	CH39 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40307	0132	CH39 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40308	0133	CH39 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40309	0134	CH39 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40310	0135	CH39 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40311	0136	CH40 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40312	0137	CH40 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40313	0138	CH40 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40314	0139	CH40 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40315	013A	CH40 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40316	013B	CH40 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40317	013C	CH41 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40318	013D	CH41 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40319	013E	CH41 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40320	013F	CH41 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40321	0140	CH41 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40322	0141	CH41 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40323	0142	CH42 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40324	0143	CH42 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO

Ref	Addr.	Description	Data Type/Format
Holding Registers (4x References, Read/Write)			
Channel Calibration Value Registers 40070-40454			
40325	0144	CH42 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40326	0145	CH42 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40327	0146	CH42 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40328	0147	CH42 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40329	0148	CH43 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40330	0149	CH43 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40331	014A	CH43 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40332	014B	CH43 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40333	014C	CH43 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40334	014D	CH43 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40335	014E	CH44 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40336	014F	CH44 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40337	0150	CH44 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40338	0151	CH44 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40339	0152	CH44 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40340	0153	CH44 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40341	0154	CH45 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40342	0155	CH45 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40343	0156	CH45 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40344	0157	CH45 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40345	0158	CH45 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40346	0159	CH45 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40347	015A	CH46 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40348	015B	CH46 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40349	015C	CH46 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40350	015D	CH46 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40351	015E	CH46 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40352	015F	CH46 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40353	0160	CH47 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40354	0161	CH47 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40355	0162	CH47 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40356	0163	CH47 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40357	0164	CH47 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40358	0165	CH47 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40359	0166	CH48 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40360	0167	CH48 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40361	0168	CH48 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40362	0169	CH48 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40363	016A	CH48 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40364	016B	CH48 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40365	016C	CH49 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40366	016D	CH49 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40367	016E	CH49 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40368	016F	CH49 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40369	0170	CH49 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40370	0171	CH49 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO

Register Map

Model ES2163

Model ES2164

Shaded registers from 40070 to 40454 contain the A/D counts corresponding to the channel calibration values for each range and these are write-restricted. They are reserved for internal firmware and factory use and are indirectly modified by the calibration registers 40460-40467. Do not attempt to directly modify the contents of these registers.

Note:

Range 1 = $\pm 20\text{mA}$ (ES2163), or $\pm 5\text{V}$ (ES2164).

Range 2 = $0\text{--}20\text{mA}$ (ES2163), or $\pm 10\text{V}$ (ES2164).

Range 3 = $4\text{--}20\text{mA}$ (ES2163), or Not Used (ES2164).

Register Map

Model ES2163

Model ES2164

Shaded registers from 40070 to 40454 contain the A/D counts corresponding to the channel calibration values for each range and these are write-restricted. They are reserved for internal firmware and factory use and are indirectly modified by the calibration registers 40460-40467. Do not attempt to directly modify the contents of these registers.

Note:

Range 1 = $\pm 20\text{mA}$ (ES2163), or $\pm 5\text{V}$ (ES2164).

Range 2 = $0\text{--}20\text{mA}$ (ES2163), or $\pm 10\text{V}$ (ES2164).

Range 3 = $4\text{--}20\text{mA}$ (ES2163), or Not Used (ES2164).

Ref	Addr.	Description	Data Type/Format
Holding Registers (4x References, Read/Write)			
Channel Calibration Value Registers 40070-40454			
40371	0172	CH50 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40372	0173	CH50 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40373	0174	CH50 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40374	0175	CH50 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40375	0176	CH50 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40376	0177	CH50 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40377	0178	CH51 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40378	0179	CH51 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40379	017A	CH51 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40380	017B	CH51 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40381	017C	CH51 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40382	017D	CH51 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40383	017E	CH52 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40384	017F	CH52 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40385	0180	CH52 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40386	0181	CH52 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40387	0182	CH52 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40388	0183	CH52 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40389	0184	CH53 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40390	0185	CH53 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40391	0186	CH53 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40392	0187	CH53 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40393	0188	CH53 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40394	0189	CH53 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40395	018A	CH54 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40396	018B	CH54 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40397	018C	CH54 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40398	018D	CH54 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40399	018E	CH54 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40400	018F	CH54 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40401	0190	CH55 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40402	0191	CH55 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40403	0192	CH55 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40404	0193	CH55 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40405	0194	CH55 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40406	0195	CH55 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40407	0196	CH56 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40408	0197	CH56 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40409	0198	CH56 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40410	0199	CH56 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40411	019A	CH56 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40412	019B	CH56 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40413	019C	CH57 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40414	019D	CH57 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40415	019E	CH57 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40416	019F	CH57 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO

Ref	Addr.	Description	Data Type/Format
Holding Registers (4x References, Read/Write)			
Channel Calibration Value Registers 40070-40454			
40417	01A0	CH57 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40418	01A1	CH57 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40419	01A2	CH58 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40420	01A3	CH58 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40421	01A4	CH58 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40422	01A5	CH58 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40423	01A6	CH58 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40424	01A7	CH58 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40425	01A8	CH59 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40426	01A9	CH59 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40427	01AA	CH59 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40428	01AB	CH59 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40429	01AC	CH59 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40430	01AD	CH59 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40431	01AE	CH60 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40432	01AF	CH60 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40433	01B0	CH60 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40434	01B1	CH60 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40435	01B2	CH60 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40436	01B3	CH60 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40437	01B4	CH61 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40438	01B5	CH61 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40439	01B6	CH61 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40440	01B7	CH61 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40441	01B8	CH61 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40442	01B9	CH61 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40443	01BA	CH62 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40444	01BB	CH62 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40445	01BC	CH62 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40446	01BD	CH62 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40447	01BE	CH62 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40448	01BF	CH62 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
40449	01C0	CH63 Rng1 Cal HI	16-bit Signed Int, Rng1 Cal HI
40450	01C1	CH63 Rng1 Cal LO	16-bit Signed Int, Rng1 Cal LO
40451	01C2	CH63 Rng2 Cal HI	16-bit Signed Int, Rng2 Cal HI
40452	01C3	CH63 Rng2 Cal LO	16-bit Signed Int, Rng2 Cal LO
40453	01C4	CH63 Rng3 Cal HI	16-bit Signed Int, Rng3 Cal HI
40454	01C5	CH63 Rng3 Cal LO	16-bit Signed Int, Rng3 Cal LO
Reset Totalizer Registers 40455-40458			
40455	01C6	Reset Totalizer Trigger for Input Channels 15-0 <i>Register always reads as 0000H.</i>	Bit position corresponds to input channel number to reset totalizer (lsb is lowest numbered channel). 1=Reset Totalizer 0=No Action

Register Map

Model ES2163

Model ES2164

Shaded registers from 40070 to 40454 contain the A/D counts corresponding to the channel calibration values for each range and these are write-restricted. They are reserved for internal firmware and factory use and are indirectly modified by the calibration registers 40460-40467. Do not attempt to directly modify the contents of these registers.

Note:

Range 1 = $\pm 20\text{mA}$ (ES2163), or $\pm 5\text{V}$ (ES2164).

Range 2 = $0\text{--}20\text{mA}$ (ES2163), or $\pm 10\text{V}$ (ES2164).

Range 3 = $4\text{--}20\text{mA}$ (ES2163), or Not Used (ES2164).

Register Map

Model ES2163
Model ES2164

Calibration registers 40460-40467 modify the contents of the shaded registers from 40070 to 40454, but only after write-protection has been removed by writing 24106 to the Calibration Access register.

Note that during calibration, a 100 sample average of the input is captured to minimize the negative effects of noise.

Ref	Addr.	Description	Data Type/Format
Holding Registers (4x References, Read/Write)			
40456	01C7	Reset Totalizer Trigger for Input Channels 31-16 <i>Register always reads as 0000H.</i>	Bit position corresponds to input channel number to reset totalizer (lsb is lowest numbered channel). 1=Reset Totalizer 0=No Action
40457	01C8	Reset Totalizer Trigger for Input Channels 47-32 <i>Register always reads as 0000H.</i>	Bit position corresponds to input channel number to reset totalizer (lsb is lowest numbered channel). 1=Reset Totalizer 0=No Action
40458	01C9	Reset Totalizer Trigger for Input Channels 63-48 <i>Register always reads as 0000H.</i>	Bit position corresponds to input channel number to reset totalizer (lsb is lowest numbered channel). 1=Reset Totalizer 0=No Action
40459	01CA	Reserved	Reserved – Do Not Use
Calibration Trigger Registers 40460-40467			
40460	01CB	Zero Cal Trigger Channels 15-00	First write 24106 to Calibration Access Register 40069 to remove write-protection from the calibration value registers before triggering. Write a set bit here to trigger the A/D to sample the corresponding input(s) and store the zero (lsb is lowest number channel of group).
40461	01CC	Zero Cal Trigger Channels 31-16	First write 24106 to Calibration Access Register 40069 to remove write-protection from the calibration value registers before triggering. Write a set bit here to trigger the A/D to sample the corresponding input(s) and store the zero (lsb is lowest number channel of group).
40462	01CD	Zero Cal Trigger Channels 47-32	First write 24106 to Calibration Access Register 40069 to remove write-protection from the calibration value registers before triggering. Write a set bit here to trigger the A/D to sample the corresponding input(s) and store the zero (lsb is lowest number channel of group).
40463	01CE	Zero Cal Trigger Channels 63-48	First write 24106 to Calibration Access Register 40069 to remove write-protection from the calibration value registers before triggering. Write a set bit here to trigger the A/D to sample the corresponding input(s) and store the zero (lsb is lowest number channel of group).

Ref	Addr.	Description	Data Type/Format
Holding Registers (4x References, Read/Write)			
Calibration Trigger Registers 40460-40467			
40464	01CF	Span Cal Trigger Channels 15-00	First write 24106 to Calibration Access Register 40069 to remove write-protection from the calibration value registers before triggering. Write a set bit here to trigger the A/D to sample the corresponding input(s) and store the positive calibration signal (lsb is lowest numbered channel of this group).
40465	01D0	Span Cal Trigger Channels 31-16	First write 24106 to Calibration Access Register 40069 to remove write-protection from the calibration value registers before triggering. Write a set bit here to trigger the A/D to sample the corresponding input(s) and store the positive calibration signal (lsb is lowest numbered channel of this group).
40466	01D1	Span Cal Trigger Channels 47-32	First write 24106 to Calibration Access Register 40069 to remove write-protection from the calibration value registers before triggering. Write a set bit here to trigger the A/D to sample the corresponding input(s) and store the positive calibration signal (lsb is lowest numbered channel of this group).
40467	01D2	Span Cal Trigger Channels 63-48	First write 24106 to Calibration Access Register 40069 to remove write-protection from the calibration value registers before triggering. Write a set bit here to trigger the A/D to sample the corresponding input(s) and store the positive calibration signal (lsb is lowest numbered channel of this group).
41001 . . .		This block Mirrors 1xxxx Registers where applicable.	<i>Refer to Register Mirroring. 1xxxx Input Status Registers are mapped to the 41xxx Holding Register space using an address offset of 41000.</i>
42001 . . .		This block Mirrors 0xxxx Registers where applicable.	<i>Refer to Register Mirroring. 0xxxx Coil Registers are mapped to the 42xxx Holding Register space using an address offset of 42000.</i>
43001 . . .		This block Mirrors 3xxxx Registers where applicable.	<i>Refer to Register Mirroring. 3xxxx Input Registers are mapped to the 43xxx Holding Register space using an address offset of 43000.</i>

Register Map

Model ES2163 Model ES2164

Calibration registers 40460-40467 modify the contents of the shaded registers from 40070 to 40454, but only after write-protection has been removed by writing 24106 to the Calibration Access register.

Note that during calibration, a 100 sample average of the input is captured to minimize the negative effects of noise.

Register Map

Model ES2163 Model ES2164

Notes (Register Map):

1. The 16-bit A/D range uses a signed-integer A/D count of ± 32768 counts for its native $\pm 5V$ and $\pm 10V$ input ranges. All input ranges are normalized to a count of ± 30000 by the unit, which corresponds to $\pm 100\%$ for bipolar ranges, or 0-30000 corresponding to 0-100% for unipolar ranges.
2. ES2163 Models utilize an A/D range of $\pm 5V$ ($\pm 20mA$), or 0-5V (0-20mA, 4-20mA), and include a 100Ω input shunt to drive $\pm 2.0V$ for $\pm 20mA$ to a $\pm 5V$ A/D input, or 0-2V for 0-20mA into a 0-5V A/D input (or 0.4-2V for 4-20mA input into a 0-5V A/D input). Bipolar input ranges are normalized to ± 30000 by the unit corresponding to $\pm 100\%$. Unipolar input ranges normalize to 0-30000 corresponding to 0-100%.

Default Register Settings

Here is a summary of the ES2163/2164 default register settings and corresponding default behavior.

ES2163/2164 Default Register Settings

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

Configuration Parameters Not Programmable Via Modbus Registers

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

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

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

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

A very high-density, industrial Ethernet analog I/O system providing 64 single-ended input channels for current (ES2163), or voltage (ES2164). Units have an isolated 10/100M Ethernet interface for monitoring, calibration, and control via Modbus TCP/IP or UDP/IP. Dual network ports allow units to conveniently cascade with other units, or for implementation of end-node redundancy schemes when connected to Ethernet switches that implement redundancy. Dual network ports also provide a low-latency/low-jitter hub/repeater mode, as well as an optional 100Mbps fiber-optic port. Unit is DC-powered with redundant power inputs and reverse polarity protection. Field inputs are wide-band, multi-ranging, and single-ended (they share common). Sixteen bit A/D conversion is used and input ranges may be rescaled to sub-ranges, or other engineering units to help facilitate integration/totalization. Input channels include transient protection. Input channels (as a group), alarm relay, network ports, and power circuits are isolated from each other, and from earth ground (chassis). Non-volatile reprogrammable memory in the unit stores configuration, calibration, and totalization data.

EtherStax model prefix "ES" denotes the EtherStax Ethernet I/O family. The trailing "21" digits denote the 2100 series. The "63" following "21" denotes a 64 single-ended current input model. A "64" following "21" denotes a 64 single-ended voltage input model. 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).

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

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

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

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

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

SPECIFICATIONS

Model Numbers

Examples:

ES2163-0000 (64 Current Inputs)
ES2163-0010 (wo/Enclosure)
ES2163-1000 (w/Fiber Port)
ES2163-1010 (w/Fiber, wo/Encl.)

ES2164 models are similar, but intended for voltage input.

Mounting Options

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

SPECIFICATIONS

Analog Input Specifications

Current (ES2163 Model)
or

Voltage (ES2164 Model)

Sixty-four single-ended input channels organized with 16 channels to a terminal group for input current (ES2163), or input voltage (ES2164). The odd-numbered and even-numbered channels of a terminal group are 8:1 multiplexed to separate A/D channels. Inputs are fault-tolerant to $\pm 25V$, wideband (up to 1298Hz), and include transient voltage suppression. Unit must be wired and configured for the intended input type and range (see Connections section for details). The following paragraphs summarize this model's input types, ranges, and applicable specifications.

DC Current Input Range (ES2163): Select $\pm 20mA$, 0-20mA, or 4-20mA on a per channel basis. Over-range to $\pm 22mA$. Current units utilize $\pm 5V$ and 0-5V A/D ranges with precision 100 Ω input shunt resistors (0.125W) to convert input current to voltage. Positive current is delivered to the channel input terminal and returned at the common terminal (C) terminal. $\pm 20mA$ DC drives $\pm 2V$ full-scale to the $\pm 5V$ A/D, while 0-20mA and 4-20mA drive 0-2 & 0.4-2 to a 0-5V A/D input. Inputs may be rescaled to support sub-ranges of nominal ranges and as required to accomplish integration and totalization of the input signal. All nominal input ranges are normalized to ± 30000 for $\pm 100\%$ of range, or 0-30000 for 0-100% of range.

DC Voltage Input Range (ES2164): Select $\pm 10V$ or $\pm 5V$ (ES2164) on a per channel basis. Input ranges correspond to the actual full-scale A/D input range. Thus, voltage inputs may not be able to achieve the full-scale endpoints exactly. Inputs may be rescaled to support sub-ranges of nominal ranges and to accomplish integration and totalization of the input signal. Inputs may be rescaled to support sub-ranges of nominal ranges and as required to accomplish integration and totalization of the input signal. All nominal input ranges are normalized to ± 30000 for $\pm 100\%$ of range, or 0-30000 for 0-100% of range.

Input Resolution: Raw resolution is 305.176uV/bit ($\pm 10V$), or 152.588uV/bit ($\pm 5V$), 1.5259uA/bit ($\pm 20mA$ range), and 0.76295uA/bit (0-20mA/4-20mA ranges) based on an internal 16-bit A/D converter. Using signed integers, this is ± 32768 parts for the $\pm 5V$, $\pm 10V$, and 0-5V A/D input ranges. For current inputs, this is ± 13107 (14.6 bits) for $\pm 20mA$, 0-26214 parts for 0-20mA (15.6 bits), and 5242-26214 parts for 4-20mA. All input ranges are subsequently normalized by the firmware to ± 30000 counts, or 0-30000 counts. Your effective resolution will vary with range selection and input scaling.

Normalized Resolution for ES2164 Input Ranges

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

Normalized Resolution for ES2163 Input Ranges¹

RANGE	$\pm 20mA$	0-20mA	4-20mA
Raw A/D	± 13107 bits	0-26214bits	5242-26214bits
Resolution	1.5259uA/bit	0.76295uA/bit	0.76295uA/bit
PPM	38.15ppm	38.15ppm	47.68ppm
Normalized	± 30000	0-30000	0-30000

¹Input uses a 100 Ω shunt and the $\pm 5V$ (16-bit) A/D Range for $\pm 20mA$, or a 0-5V 16-bit A/D range for 0-20mA & 4-20mA. All input ranges are normalized to ± 30000 for $\pm 100\%$, and 0-30000 for 0-100%.

Limits to Re-Scaling Nominal Ranges: To achieve a minimum acceptable resolution of 12 bits (± 2048 parts), rescaling should not divide the nominal A/D base ranges of $\pm 5V$ or $\pm 10V$ by more than 16 ($0.0625\times$). ES2163 input voltage equals input current $\times 100\Omega$ and the $\pm 5V$ and $0-5V$ A/D ranges are used. A peak reading occurs at a normalized count of 32768 (109%) with full-scale corresponding to 30000 counts (100%).

ES2164 RANGE	$\pm 10V$ to A/D	$\pm 5V$ to A/D	
MIN SPAN	1.25V or $\pm 0.625V$	0.625V or $\pm 0.3125V$	
ES2163 RANGE	$\pm 20mA$ (To $\pm 5V$ A/D)	0-20mA (To 0-5V A/D)	4-20mA (To 0-5V A/D)
MIN SPAN	6.25mA/ $\pm 3.125mA$ ($\pm 0.3125V$)	3.125mA, (0.3125V)	3.125mA, (0.3125V)

Input Reference Test Conditions: 0-20mA input (ES2163) or $\pm 5V$ DC input (ES2164); ambient temperature = $25^{\circ}C$; 24VDC supply.

Input Over Voltage Protection: Bipolar Transient Voltage Suppressors (TVS), clamp level less than 50V and greater than 18V.

Input Impedance: 4M Ω minimum (ES2164), 100 Ω (ES2163).

Input Scan Groups & Update Rate: Input data is acquired at high speed utilizing groups of channels organized to minimize multiplexer switching. The unit allows scan groups to be individually enabled/disabled to realize faster throughput on a smaller group of channels when no totalization is being performed. All channels are gathered at a variable rate that is dependent on the number of scan groups enabled and whether input averaging is being performed. If totalization is enabled at any channel, the scan time becomes a flat rate of 20ms without averaging, and 80ms with any input averaging set greater than 1.

SCAN GROUP	CHANNEL NUMBERS
1	0, 1, 16, 17, 32, 33, 48, 49
2	2, 3, 18, 19, 34, 35, 50, 51
3	4, 5, 20, 21, 36, 37, 52, 53
4	6, 7, 22, 23, 38, 39, 54, 55
5	8, 9, 24, 25, 40, 41, 56, 57
6	10, 11, 26, 27, 42, 43, 58, 59
7	12, 13, 28, 29, 44, 45, 60, 61
8	14, 15, 30, 31, 46, 47, 62, 63

¹Channels grouped vertically share same multiplexer & A/D channel.

SCAN GROUPS	No Averaging (Input Averaging Set to 0 or 1) and No Totalization	Averaging Filter (Inp Averaging Set to 500) and No Totalization
	UPDATE TIME/RATE ¹	UPDATE TIME/RATE ¹
1	1.80ms/555Hz	9.40ms/106Hz
2	2.93ms/341Hz	18.20ms/55Hz
3	4.13ms/242Hz	27.00ms/37Hz
4	5.20ms/192Hz	35.83ms/28Hz
5	6.47ms/155Hz	44.50ms/22Hz
6	7.60ms/132Hz	53.33ms/19Hz
7	8.73ms/115Hz	62.17ms/16Hz
8	9.83ms/102Hz	71.00ms/14Hz

¹These times apply with floating point and input scaling applied, and with input totalization OFF at all channels. If totalization is enabled at any channel, the scan time is a flat rate of 20ms with no averaging at any channel, and 80ms with any input averaging greater than 1.

SPECIFICATIONS

Analog Input Specifications

Current (ES2163 Model)
or
Voltage (ES2164 Model)

Each input is separately switched to one of eight single-ended A/D inputs using an 8:1 multiplexer. There are 8 scan groups of 8 channels each, and each channel of a scan group is associated with the same channel of its 8:1 multiplexer. The 8 separate channel multiplexers share the same address lines. Thus, scan group 1 is the first channel of each multiplexer, scan group 2 the second channel of each multiplexer, and so on.

SPECIFICATIONS

General Input Specifications

Input Automatic Calibration (Default): Calibrates zero and span every input cycle using a precise on-board calibration reference signal. This is sufficient for most applications.

Input Manual Calibration (Optional): For improved accuracy, individual inputs may be calibrated manually by driving the input channel with precise signal levels. To save time, it is possible to manually calibrate an entire multiplexer group of channels based on the calibration of one channel from that group. Thus, calibration is automatic, or manual per channel multiplexer, or manual per channel. Units can mix manual per channel and automatic calibration among channels, but not manual per multiplexer group within the same group.

Input Accuracy with Automatic Calibration: Better than $\pm 0.05\%$ of span for voltage inputs (ES2164), or $\pm 0.1\%$ of span (ES2163) for current inputs. This applies for nominal input ranges and reference test conditions and includes the effects of repeatability, terminal point conformity, and linearization, but not sensor error.

Input Accuracy with Manual Calibration: Accuracy can be improved with manual calibration and the response is repeatable to better than 0.025%. Units from the factory do not include any manual calibration.

Input Measurement Temperature Drift: Better than $\pm 25\text{ppm}/^\circ\text{C}$ ($\pm 0.0025\%/^\circ\text{C}$).

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

Input Filter: Normal mode R-C filtering, fixed per input type. Optional input averaging may also be applied.

Input Filter Bandwidth: -3dB at 125KHz, typical. Bandwidth is dominantly restricted to the update rate of 64 Channels (see Update Rate table).

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

Floating Point: Unit provides an enable/disable for floating point math when doing scaling and totalizing. You must enable Floating Point support in order to rescale an input signal, or to accomplish integration & totalization. If you use the web browser to rescale or totalize, floating point will be auto-selected for you. It can be turned off to disable scaling and increase network determinism. Like disabling scan groups, disabling floating point support reduces the amount of calculations that have to be performed and gives the processor more time to do other tasks besides acquiring data. This can help make critical control network applications more deterministic, particularly over networks with heavy traffic flow.

Byte Order: Set for compatibility with different Modbus systems and controls the byte order for 32-bit floating point values. Different systems use different byte orders for the two 16-bit registers used to store a 32-bit floating point value (four bytes).

Input Integration/Totalization: If totalization is enabled at any channel, the scan time is a flat rate of 20ms with no averaging at any channel, and 80ms with any input averaging greater than 1. You can choose to integrate a signal by totalizing its time sliced instantaneous value. To totalize, you must separately enable Floating Point Support. You also need to scale the input appropriately and specify the time-base units to perform the integration over ("per Second", "per Minute", "per Hour", or "NA"). You must specify a time base other than NA (default) for totalization to occur.

Note that if "NA" is selected and Totalize=Yes, then 0.0 is added to the totaled value. This value is non-volatile and you can even preload a totaled value on power-up, or system reset. Otherwise, it will totalize from the last totalizer value before interrupting power or performing a system reset. During run time, your incremental "time-sliced" measurement value will be added to this total every scan time. The software also gives the capability to reset the current totaled value to zero. For example, during totalization, we gather an instantaneous input sample every 20ms (or 80ms if any input averaging being done). If your instantaneous scaled input value indicates 500, units are gallons, and the time base is set "per Minute". Then $(500 \text{ gallons/minute}) \times (1 \text{ minute/60 seconds})$ equals a flow rate of 8.33 gallons/per second. If a new sample is obtained every 20ms (no averaging), multiply 8.3333 gallons/second by 0.020 seconds/sample to get an incremental 0.16667 gallons/sample increase in volume, and this amount is added to your totaled value. Note that even with floating point disabled, the measured input value will still indicate a floating point number, but the scaling and totalizing fields will indicate "Inactive".

SPECIFICATIONS

General Input Specifications

Open-Frame Models (ES2163/2164-0010 & ES2163/2164-1010)

Models are 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. These components have been judged on the basis of required spacing in the standard for Industrial Control Equipment, UL 508, Table 36.1, which would cover the component itself if submitted for unrestricted Listing. As a condition of Acceptability when installed in end-user equipment, consider the following:

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

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

Reliability Prediction

Temp	ES2163-00x0	ES2163-100x0	ES2164-00x0	ES2164-10x0
25°C	479,437 hrs	498,345 hrs	510,264 hrs	496,653 hrs
40°C	352,568 hrs	358,811 hrs	378,397 hrs	354,916 hrs

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

Above values were computed using nearly equivalent ES2161 & ES2162 models which share the same components.

SPECIFICATIONS

Alarm Relay Output

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

Type: SPST-NO, 1 Form A, Class I, Division II Approved.

Manufacturer Part: Omron, G6M-1A-DC5.

Maximum Ratings: AC rated to 3A at 250VAC, or 750VA maximum (100K operations minimum). DC rated to 3A at 30VDC, or 90W maximum. Your AC application switching voltage/ current must not exceed 750VA and 250VAC and 5A. Your DC application voltage/current must not exceed 90W and 125VDC and 5A.

Contact Resistance: 100 milliohms, maximum.

Ratings: 5A at 30VDC/250VAC resistive (6K Operations). General Use: 3A at 30VDC/250VAC (100K Operations), 1/8HP at 250VAC/125VAC, and C300 Pilot Duty. UL508 File No. E41515/CSA C22.2 (No. 14) File No. LR31928. Hazardous Location ratings are 2A at 240VAC or 30VDC.

Minimum Permissible Load: 10mA at 5VDC at 120 operations/minute.

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

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

SRAM (Volatile, 132 Kilobyte): Integrated within the central processor and used as scratchpad memory during run time. Its contents are cleared at power-down.

SDRAM (Volatile, 64 Megabyte): External to the central processor and used as run time memory for high-speed execution of the internal program. Its contents are cleared on power-down.

Agency Approvals

Safety Approvals: Enclosed Models, ES2163/2164-0000 & ES2163/2164-1000 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 ES2163/2164-0010 & ES2163/2164-1010 are cULus Recognized Components for Hazardous Locations, Class 1; Division 2; Groups A, B, C, and D (UL508-Seventeenth Edition, ISA 12.12.01:2007, Canada Standard C22.2, No. 142-M1987 & 213-M1987).

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

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

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

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

Network Connector Port 1: Varies with model. "-00x0" suffixed models have an 8-pin RJ45 socket as wired below. "10x0" suffixed models substitute a 100BaseFX, SC-Type, multi-mode fiber-optic connector. Auto-negotiation & auto-crossing features do not apply to fiber port connections and transmit and receive cables must be crossed manually when making fiber cable connections.

Network Connector Port 2: 8-pin RJ45 socket for copper connection as wired below. Connections are wired MDI-X by default (like an Ethernet switch, as opposed to MDI), but include automatic MDI/MDI-X crossover. Use CAT-5 or better cable to connect to these ports. Acromag offers an optional Cable Termination Kit (ESA-CTK) that includes the necessary hardware for building one end of your cable for mating to the IP20 clip-frame that surrounds the RJ45 port. This is done for increased immunity to shock & vibration.

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

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).

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

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

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

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

SPECIFICATIONS

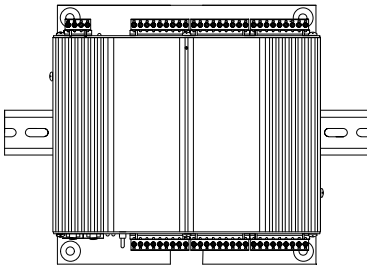
Enclosure & Physical

SPECIFICATIONS

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.

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



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

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

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

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

Isolation: Input channels (as a group), alarm relay, power, and network circuits (individually) are isolated from each other for common-mode voltages up to 250VAC, or 354V DC off DC power ground, on a continuous basis (will withstand 1500VAC dielectric strength test for one minute without breakdown). Complies with test requirements of ANSI/ISA-82.01-1988 for voltage rating specified.

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

Power Requirements (Unit Main): 18-36V DC SELV (Safety Extra Low Voltage), 5.5W max (ES2163/2164-1), 4.4W max (ES2163/2164-0). Observe proper polarity. Keep DC power cables less than 10m in length. Divide power by voltage to calculate max current and select a supply that can deliver at least twice this amount. Current noted is with one network port linked and the alarm relay energized.

Power	Model ES2163/2164-0	Model ES2163/2164-1
18V	213mA Typ, 234mA Max	275mA Typ, 303mA Max
24V	159mA Typ, 175mA Max	206mA Typ, 227mA Max
30V	129mA Typ, 142mA Max	165mA Typ, 182mA Max
36V	110mA Typ, 121mA Max	139mA Typ, 153mA Max

CAUTION: Do not exceed 36VDC peak to avoid damage to the unit.

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

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

Electromagnetic 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.

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

Network Connector (Port 1, Copper or Fiber): 8-pin RJ-45 socket for 10BaseT/ 100BaseTX connections ("-00x0" models), or a full-duplex SC-type to multi-mode transceiver for IEEE 802.3u 100Base-FX cable (-10x0" models). Fiber models do not support hub/repeater mode which is necessary for automatic redundancy failover protection when connected to a redundant media switch. Data rate is fixed to 100Mbps on fiber connection.

Network Connector (Port 2, Copper): 8-pin RJ-45 socket for 10BaseT/ 100BaseTX connections, wired MDI-X (Ethernet switch), but supports automatic crossover for copper (RJ-45) connections.

SPECIFICATIONS

Environmental

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

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

Ethernet Interface

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

SPECIFICATIONS

Ethernet Interface

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.

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

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

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

Compliance: IEEE 802.3, 802.3u, 802.3x.

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

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

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

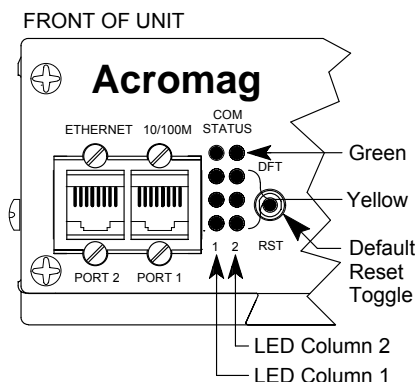
MAC Address Table: 1K MAC address table.

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

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

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

Controls & Indicators



Controls (Front-Panel):

External (User Access)

Reset/Default Address Toggle: This momentary toggle switch is located on the front panel adjacent to the network LED indicators. It is used to either reset the unit (momentary toggle down), or toggle the unit into, or out of, Default Communication Mode (toggle up, hold for 4 seconds). In Default Mode, the unit assumes the fixed static IP address "128.1.1.100", a default subnet mask "255.255.255.0", a default username of "User", and a default password of "password". This switch can also be used to restore the unit to its initial factory configuration by holding the switch in its default position while powering up the unit (see "Getting Out Of Trouble" in the Troubleshooting section for more information). Reset is useful for troubleshooting 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. The DFT position is also used to restore a unit (see "Getting Out Of Trouble" on page 50) by holding it depressed for 10 seconds while powering up.

LED Indicators (Rear Panel):**Rear System Status Indication (Located next to power terminals)**

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

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

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

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

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

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

Port SWITCH Mode**Port 1 and Port 2 Indicator Columns 1 & 2, Top to Bottom**

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

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

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

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

Port HUB/REPEATER Mode**Indicator Column 2 (Top to Bottom)**

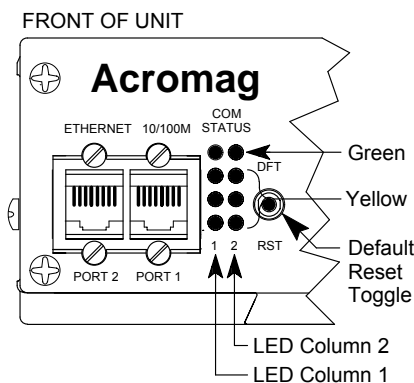
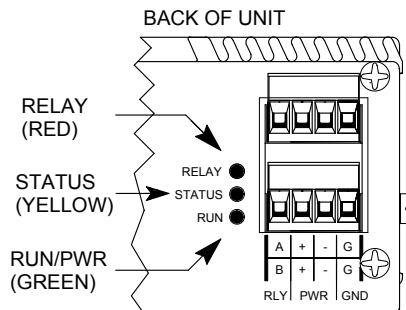
3 Green (ACT, Top LED) – ON or blinking indicates repeater activity on the link.

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

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

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

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

SPECIFICATIONS**Controls & Indicators****SWITCH MODE**

LED Column 1 - Port 1

LED Column 2 - Port 2

GREEN - No Function in Switch Mode.

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

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

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

HUB/REPEATER MODE

1=LED of Column 1

2=LED of Column 2

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

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

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

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

SPECIFICATIONS

Controls & Indicators

Indicator Column 1 (Top to Bottom)

3 Green (Collision, Top LED) – 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.

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

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

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

CABLES & CONNECTORS

Copper Connections

CABLES & CONNECTORS

Fiber Connections

Model ES2163/2164-1xxx 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.