

# Produkt-Datenblatt

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**MEILHAUS**  
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# BusWorks<sup>®</sup> Series Ethernet I/O Modules

Modbus TCP/IP

Ethernet/IP

i2o<sup>®</sup> Peer-to-Peer



Industrial Ethernet  
Analog & Discrete  
I/O Modules

# Answers @ Acromag

## Process Instruments, Signal Conditioners, and Distributed I/O

*Experience counts: especially when selecting an I/O partner. And with 50 years of I/O experience, Acromag can help you improve reliability, increase productivity and reduce your costs.*



### Acromag: The I/O Leader

Acromag is a customer-driven manufacturer focused on developing embedded I/O products that provide the best long term value in the industry. Compare and you'll find that Acromag products offer an unmatched balance of price, performance, and features.

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Acromag has more than 50 years of measurement and control experience. Since 1957, we have delivered nearly a million units to thousands of customers around the globe for manufacturing, power, environmental, transportation, and military applications.

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We take every measure to guarantee you dependable operation and products that perform at or beyond the specifications. State-of-the-art manufacturing and military-grade components add an extra degree of ruggedness. Acromag is also certified for ISO9000/AS9100 quality control management procedures.

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- Custom product development
- Custom calibration
- Source inspections, quality audits
- Special shipping, documentation
- Protective humiseal coating
- Plastic and stainless steel tagging

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Many Acromag products carry globally recognized agency approvals and safety certifications.

- CE
- Ethernet/IP conformance
- UL, cUL
- Modbus conformance
- Atex
- HART conformance
- CSA



ISO9001  
AS9100





# Ethernet I/O: BusWorks® Series



## 900EN Series Compact Ethernet I/O Modules



### ◆ Analog I/O Modules



### ◆ Discrete I/O Modules



### ◆ Combination I/O Modules



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# Ethernet I/O: BusWorks® Series

## 900EN Series Compact Ethernet I/O Modules



### BusWorks 900EN Series Ethernet I/O Modules

The 900EN series is a rugged, high-performance line of networked I/O modules. Modules feature universal input/output ranges and an intelligent microcontroller to provide extreme flexibility and powerful monitoring and control capabilities. Select from a variety of analog and discrete I/O models to meet your application requirements.

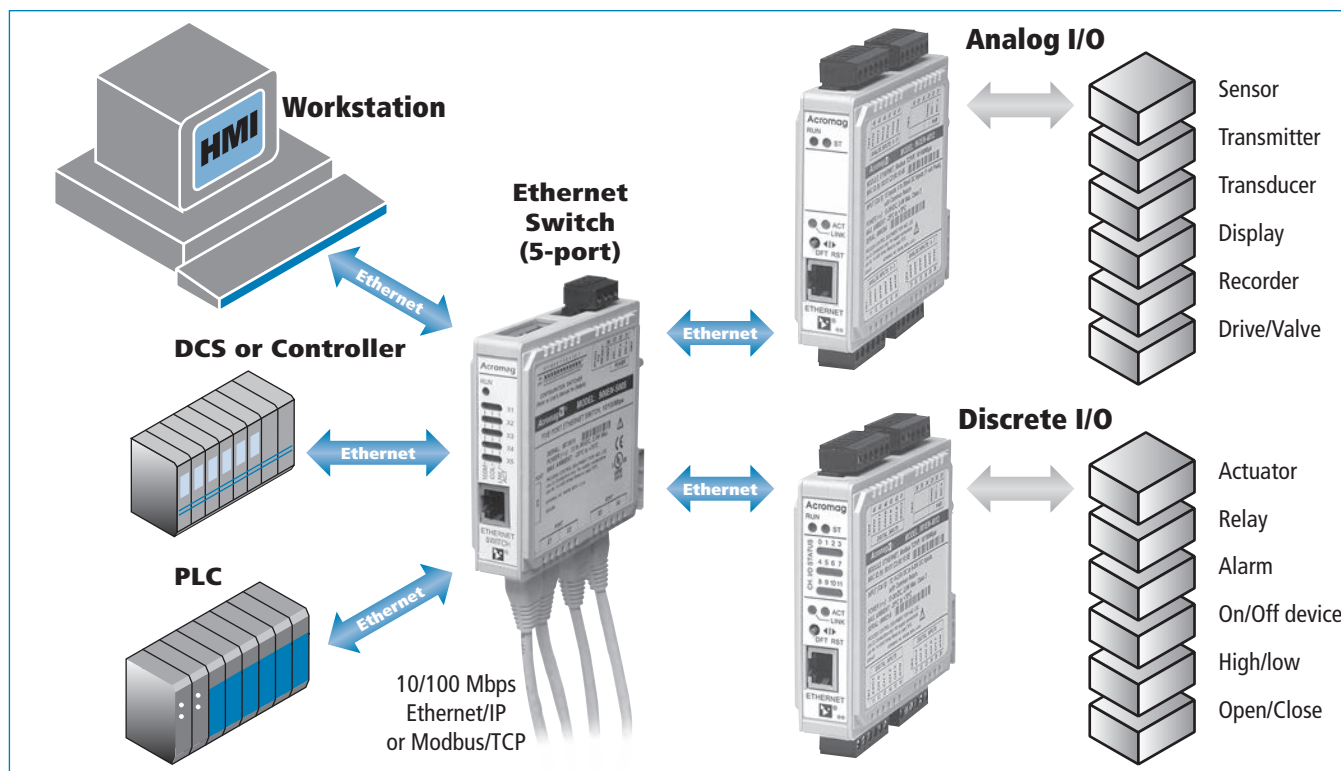
Each inch-wide module has a direct network interface, processes I/O signals on up to twelve channels, and handles power conversion. This space-saving approach is very cost-effective for systems that need to add I/O channels at an existing control site or network to new remote sites. By comparison, many “block I/O” devices would require a large, expensive processor block, an I/O rack, individual plug-in I/O terminal blocks, and a special system power supply.

The I/O modules are easily configured using your standard web browser. Each I/O module has embedded web pages to help you set up and control the unit. These web pages guide you through the steps to configure network settings, calibrate the module, and test operation.

Sophisticated watchdog timers increase system reliability. All I/O modules have a watchdog that monitors the microcontroller for failed operations or a “lock-up” condition and automatically resets the unit. If host communication is lost and a configurable watchdog timer expires, all analog and discrete outputs go to a “fail-safe” condition.

### Key Features & Benefits

- **Web Browser Configuration:**  
Built-in web page enables configuration with a web browser over an Ethernet connection
- **EtherNet/IP™ or Modbus TCP/IP Protocol:**  
Supports 10Base-T and 100Base-TX interface
- **Peer-to-peer Ethernet communication:**  
i2o technology enables module-to-module communication without a controller (Page 14)
- **Direct Network Interface on Each Unit:**  
Each I/O module has a built-in microcontroller for communication. No bus coupler required.
- **Up to 10 Sockets per Module:**  
Multiple masters can talk to one module
- **Automatic Data Flow Control:**  
10/100Mbps and half/full duplex negotiation
- **Fully Isolated:**  
I/O, network, and power circuits isolated from each other for safety and noise immunity
- **Wide Ambient Temperature Range:**  
Provides reliable operation from -40 to 70°C



# Ethernet I/O: BusWorks® Series



## 900EN Series Compact Ethernet I/O Modules

### Discrete I/O Modules

These modules monitor discrete levels of various devices and/or provide on/off control capabilities depending on the model selected. Each module has up to twelve channels to save space and minimize costs. Models are available with input- or output-only, or bidirectional I/O configurations

#### Inputs

- Active-low inputs, 0 to 35V DC

#### Outputs

- Sinking outputs, 0 to 35V DC, up to 500mA

#### Functions

- Monitor discrete state or level
- Control on/off, high/low, open/close switching
- Activate audible or visual alarms
- Count / totalize

### Analog Input Modules

These units monitor a wide variety of industrial machinery and equipment. They accept direct sensor inputs or DC process control signals from transducers, transmitters, and other instruments.

#### Inputs

- DC current
- DC voltage
- DC millivolts
- 8B module inputs (more than 100 signal types)
- Thermocouple
- RTD/resistance
- AC current

#### Functions

- Measure process variables
- Monitor machinery and industrial devices
- Acquire data from non-networked instruments
- Integrate / totalize

### Analog Output Modules

Analog output modules are ideal for controlling a wide variety of devices. The host defines the output of voltage or current signals to control speed, flow, temperature, frequency, level, force, torque, intensity, and many other physical properties.

#### Outputs

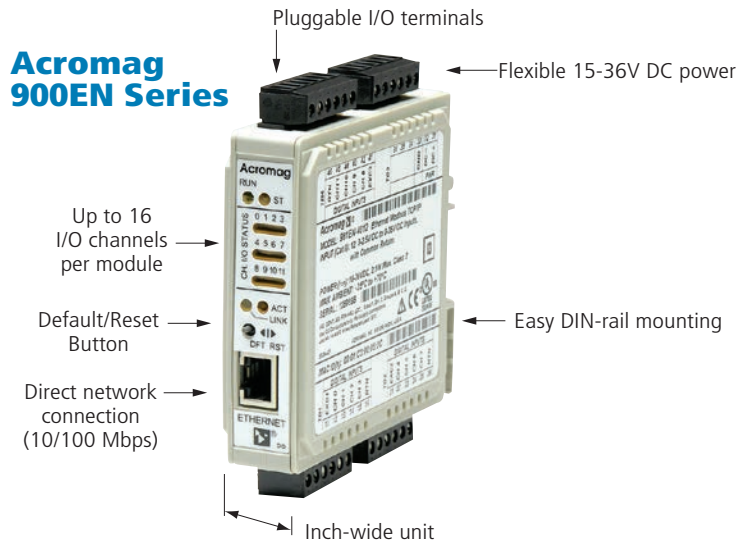
- DC voltage
- DC current

#### Functions

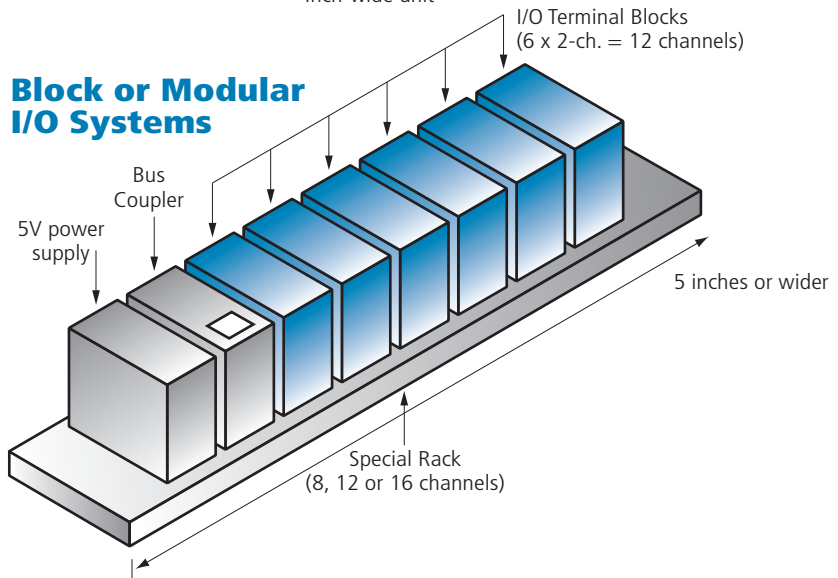
- Write data to local displays or recorders
- Control drives, valves, and positioners

## A Simple Alternative to "Block I/O"

### Acromag 900EN Series



### Block or Modular I/O Systems



### Acromag 900EN Series I/O

Stand-alone I/O modules are very easy to use.

- Configures with standard web browser
- Direct connection to network
- Up to 16 channels on one module
- 1-inch wide for 16 channels
- Flexible 15-36V DC power requirement
- Pluggable terminal blocks on top and bottom

### Block or Modular I/O Systems

Block I/O systems are harder to implement.

- Installation of configuration software required
- Expensive bus coupler required
- Plug-in I/O modules or terminal blocks required
- Five inches wide or more for twelve channels
- Special 5V power supply may be required
- Fixed wiring terminals on front of unit



# Ethernet I/O: BusWorks® Series

## Easy Peer-to-Peer Communication with Acromag i2o®

### i2o input-to-output communication

Acromag's i2o technology provides the easiest way to link your inputs to your outputs without a PLC, PC or master CPU.

With i2o, many BusWorks 900EN I/O modules have the ability to operate like a long-distance transmitter. You can convert your sensor inputs at Point A to process control signals at Point B. Or, monitor a discrete device at one site by reproducing the discrete level with a relay output at another location.

### Use your existing Ethernet lines to save time and wiring expenses

You can connect the input modules to the output modules using your existing copper/fiber infrastructure or with a single new cable. Multiple I/O modules can be multiplexed through a switch or wireless radios.

### No complicated controllers. No software. No programming.

Acromag's Ethernet I/O modules have a built-in web page making it simple to configure using your standard web browser. Just click a few menu settings, enter the IP addresses, and you are done. Fast and easy.



BusWorks 900EN Series I/O Modules

### Up to 12 channels per module and reliable, failsafe communication

Monitor up to a dozen devices with a single pair of I/O modules. Discrete I/O modules have twelve channels that you can set up as inputs or as outputs in four-channel groups. This allows bi-directional communication between two modules. Analog input modules measure up to six current, voltage, thermocouple, or RTD sensor signals. This data is then transmitted to a six-channel analog output module providing DC current or voltage output signals.

### Wire-saving applications

Our i2o technology lets an input module speak directly to an output module. It is ideal for non-critical projects that don't need a PLC or PC master. Reproduce remote signals based on timed or event updates.

- Remote monitoring of process variables (temperature, pressure, level, flow) and discrete devices
- Remote data display, recording, alarms, or control
- Signal splitters
- Analyzer system monitoring
- Power and water utility monitoring
- Tank level, pump, and valve control
- Remote monitoring of motor loads and contactor status
- Remote control switching stations
- Environmental control systems
- Process shutdown, alarming, and annunciator systems
- RFID systems

## Peer-to-Peer Communication

### Analog Inputs

4-20mA, 0-10V DC, thermocouple, RTD/resistance

### Discrete Inputs

on/off, high/low, open/close, momentary push-buttons

### Any Ethernet Media

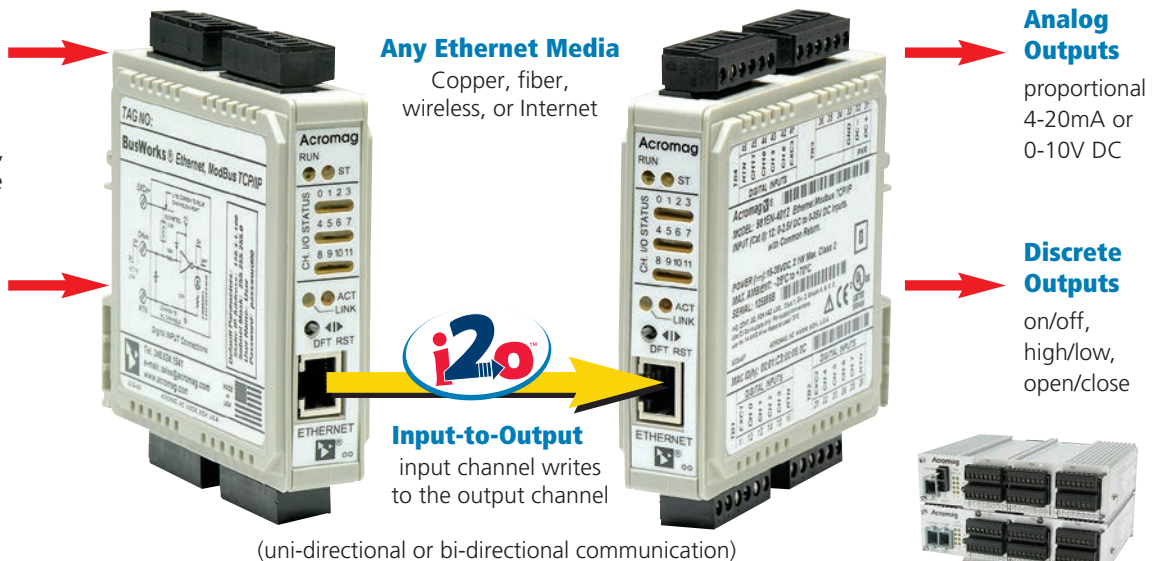
Copper, fiber, wireless, or Internet

### Analog Outputs

proportional 4-20mA or 0-10V DC

### Discrete Outputs

on/off, high/low, open/close



EtherStax I/O® also supports i2o

# Ethernet I/O: BusWorks® Series



## Acromag i2o® Technology for Peer-to-Peer Communication

### 900EN Series Modules with i2o

#### Analog Input Modules

- 961EN / 962EN  
6 differential current/voltage inputs
- 965EN  
6 thermocouple/mV inputs
- 966EN  
6 RTD/resistance inputs
- 967EN / 968EN  
8 differential current/voltage inputs

#### Analog Output Modules

- 972EN  
4 or 6 current outputs
- 973EN  
4 or 6 voltage outputs

#### Discrete I/O Modules

- 982EN  
12 solid-state relay outputs
- 983EN  
12 solid-state input/outputs

#### Combination I/O Modules

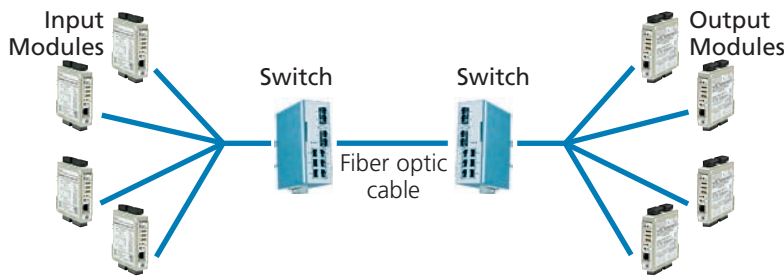
- 951EN  
4 analog current inputs,  
2 analog current outputs, 6 discrete I/O
- 952EN  
4 analog voltage inputs,  
2 analog current outputs, 6 discrete I/O

### Installation #1: Copper Ethernet network

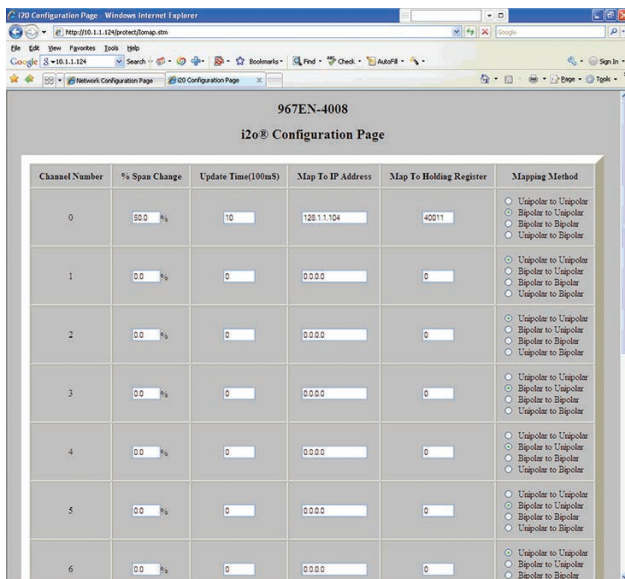
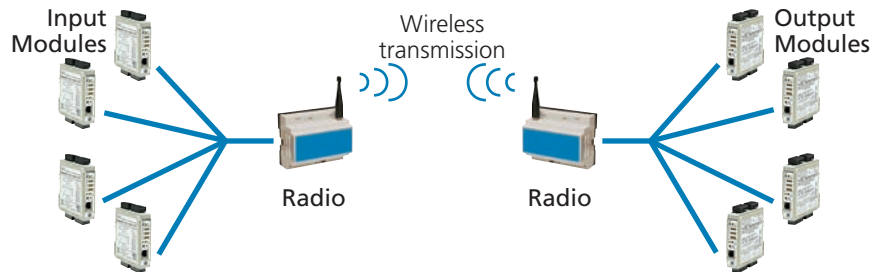


NOTE: Buy modules in pairs. For example:  
AI with AO  
DIO with DO or DIO  
Combo with Combo

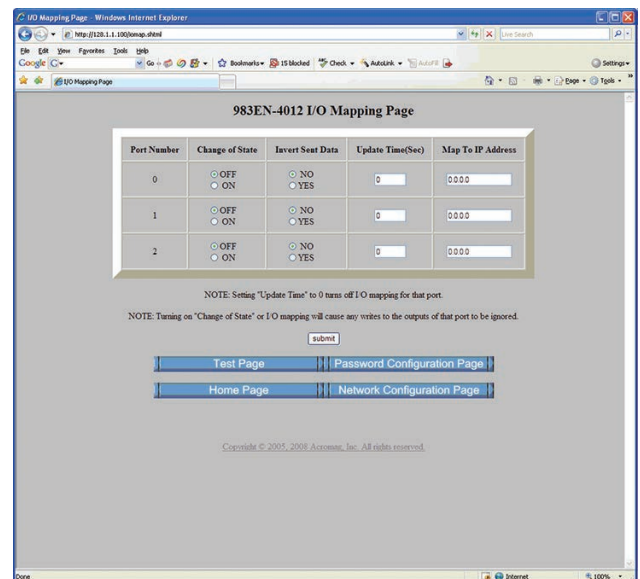
### Installation #2: Fiber optic connection



### Installation #3: Wireless connection (telemetry systems)



Analog input module configuration screen



Discrete I/O module configuration screen



## Module Configuration

### Easy to Configure

Industrial Ethernet networks offer several advantages. They are proven, fast (up to 100Mbps without fiber optic cable) and ideal for transmitting analog or discrete data. I/O devices are also easy to install and maintain. And with Ethernet networks already in place at many facilities, it is a simple task to bring your process data to any networked computer.

Acromag's 900EN I/O modules are easily installed and configured using any standard web browser. No special software is required because each module has a built-in web page for configuration purposes. The startup process is shown below.

### Step 1: Connect the module

Connect the I/O module to your PC with an Ethernet cable. An RJ-45 plug is located right on the front of the I/O module. You can also use an Ethernet switch or switching hub to build a network of Ethernet modules. Acromag offers a 5-port Ethernet switch that includes automatic MDI/MDI-X crossover and accepts straight-through or crossover cable to keep it simple.

### Step 2: Configure the module

You may use your own software to issue commands to this module or you may use a web browser to achieve basic functionality. Each I/O module has built-in web pages that allow you to setup and control the module via a standard web browser. Simply type the IP address assigned to your module in the browser's address window to access the module's home page. Here you can jump to several pages in order to set the desired network settings, password protection security, and operational functions. See Figure 2.

### Step 3: Test/Control the I/O

After completing the network configuration parameters, you can use the test page to operate your module. The test page will allow you to read inputs, turn outputs on and off, configure the watchdog timer, and set watchdog time-out states. After confirming operation, you are ready to add the I/O module to your control system.

### HOST PC CONNECTED DIRECTLY TO A MODULE

Note: This MDI-to-MDI connection requires the use of a crossover cable.

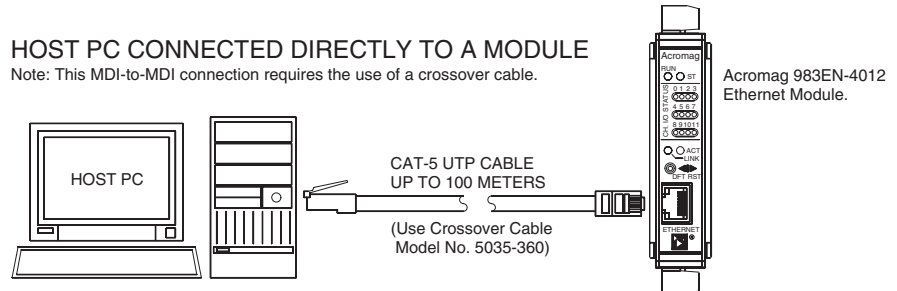


Figure 1: Plug the Ethernet cable from your computer into the I/O module's RJ-45 port to start configuration.

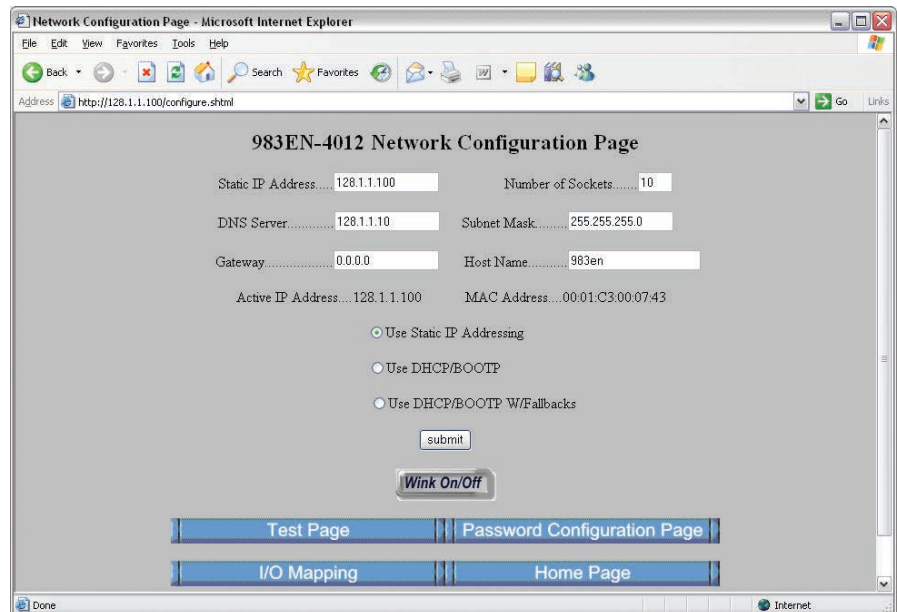


Figure 2: A web page is embedded into each module for easy configuration using a standard web browser.

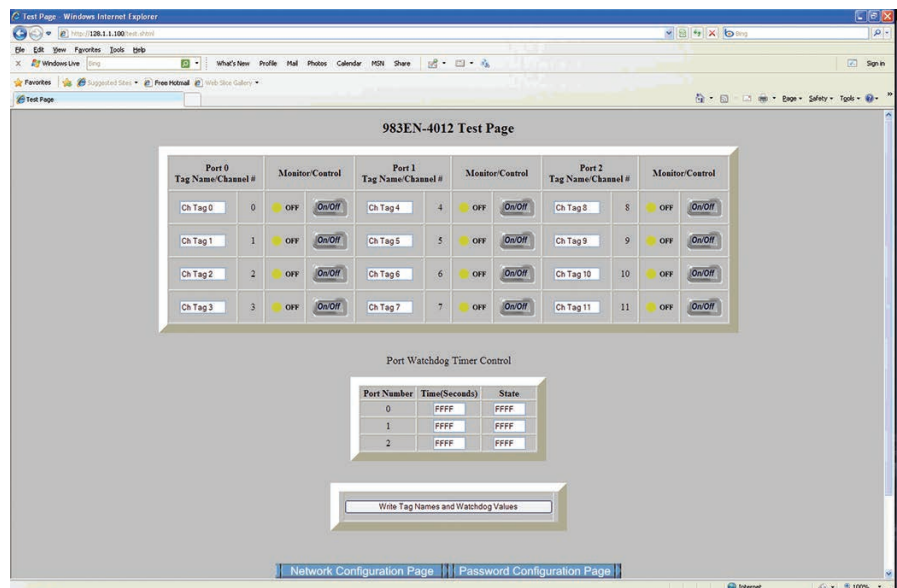


Figure 3: A test page is also accessible with your web browser to confirm proper operation of the I/O module.

# Ethernet I/O: BusWorks® Series



## General Operation and Performance Specifications

The following specifications are common to all 900EN Series I/O modules.

### ◆ Communication

#### Connector

Shielded RJ-45 sockets, 8-pin, 10BaseT/100BaseTX.

#### Wiring

Wired MDI. 9xxEN I/O modules do NOT support auto-crossover. 900EN switch supports auto-crossover.

#### Protocol

EtherNet/IP or Modbus TCP/IP with web browser configuration. EtherNet/IP supports PCCC object for communication with legacy PLCs (e.g. SLC505).

#### IP Address

Default static IP address is 128.1.1.100.

#### Port

Ethernet Modbus TCP/IP models (9xxEN-4xxx):

Up to 10 Modbus TCP/IP sockets supported.

EtherNet/IP models (9xxEN-6xxx):

Up to 10 EtherNet/IP sockets and

1 Modbus TCP/IP socket.

#### Data Rate

Auto-sensed, 10Mbps or 100Mbps.

#### Duplex

Auto-negotiated, full or half-duplex.

### Compliance

IEEE 802.3, 802.3u, 802.3x, Ethernet II.

### Configuration

Web page for configuration and control is built-in with Ethernet access via a standard web browser.

### Communication Distance

Distance between network devices is generally limited to 100 meters using recommended cable. Distances may be extended using hubs and switches.

### Address

IP address is automatically acquired at startup. Unit may be configured to retrieve this address from the network server using BOOTP (Bootstrap Protocol), or via DHCP (Dynamic Configuration Protocol). A static IP address is also user-programmable. A default toggle switch sets the static IP address to the default factory address of 128.1.1.100 for initial configuration.

### ◆ Environmental

#### Isolation

I/O channel, power, and network circuits 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.

### ◆ Electromagnetic Compatibility (EMC)

Immunity per European Norm EN50082-1.

Emissions per European Norm EN50081-1.

Electrostatic Discharge (ESD) Immunity Per EN61000-4-2.

Radiated Field Immunity (RFI)

Per EN61000-4-3 and ENV50204.

Electrical Fast Transient Immunity (EFT)

Per EN61000-4-4.

Conducted RF Immunity (CRFI)

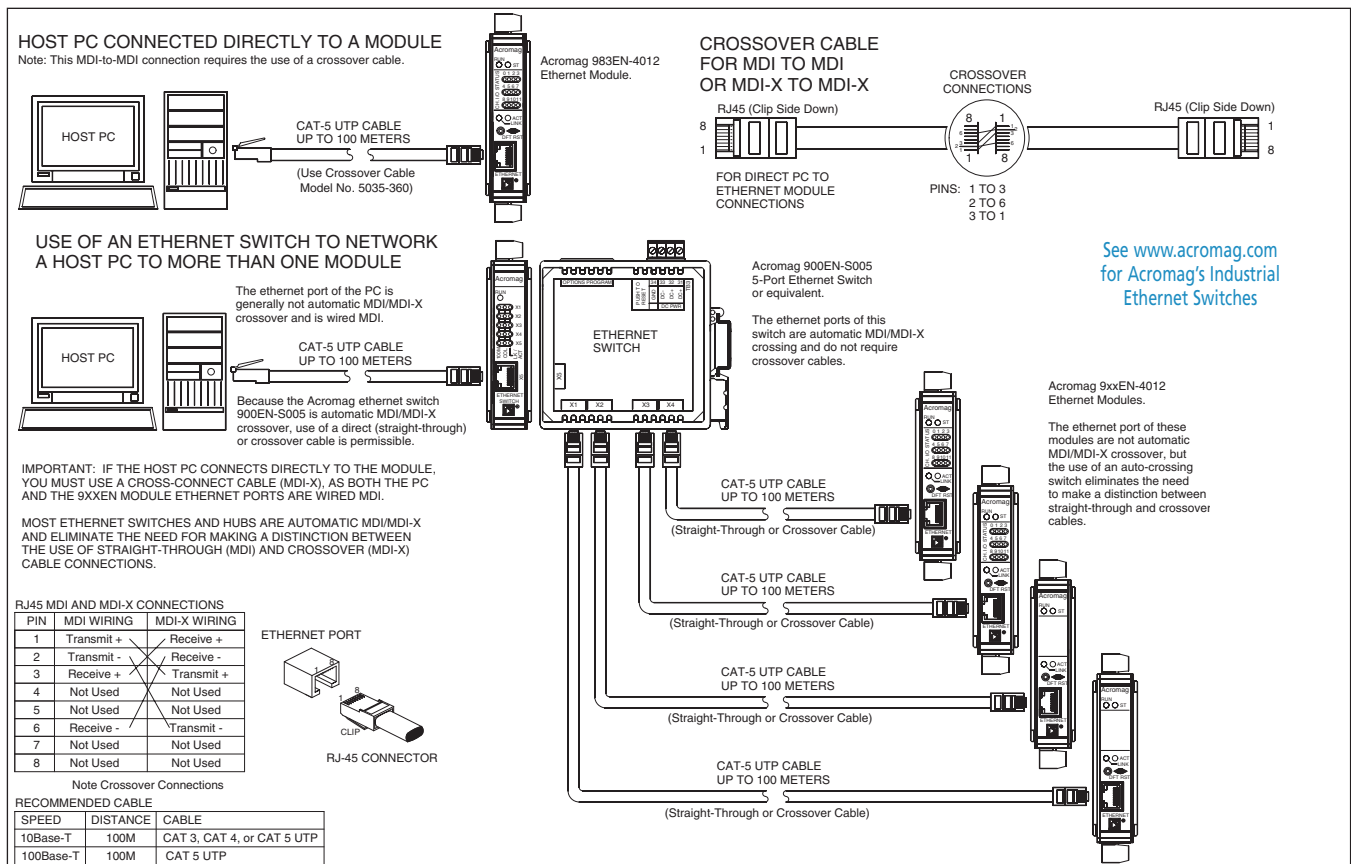
Per EN61000-4-6.

Surge Immunity

Per EN61000-4-5.

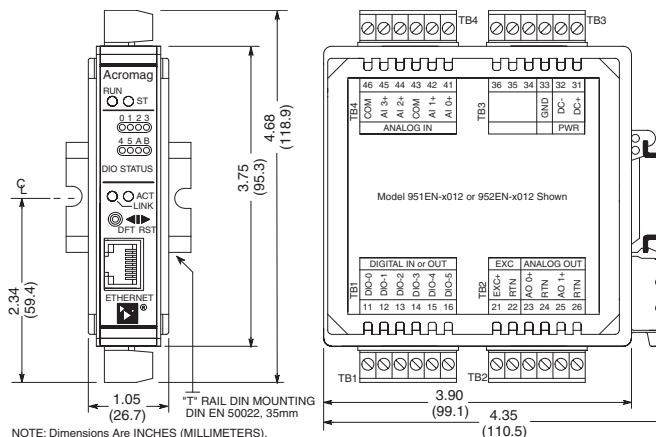
Radiated Frequency Emissions

Per EN5022 Class B.



# Ethernet I/O: BusWorks® Series

951EN, 952EN Ethernet Analog and Discrete I/O Modules



Standard model includes cage clamp terminal blocks. Optional terminals are available (see Page 26).

**EtherNet/IP™**  
conformance tested

**Modbus/TCP**  
conformance tested

4 analog inputs, 2 analog outputs, 6 discrete I/O channels ♦ Ethernet/IP, Modbus TCP/IP, i2o peer-to-peer

## Description

### Models

951EN: Combo module, analog current inputs  
952EN: Combo module, analog voltage inputs

These modules provide an isolated Ethernet network interface for analog and discrete I/O signals. Multi-range analog inputs and outputs support a wide variety of industrial devices. High-resolution, low noise, A/D and D/A converters deliver high accuracy and reliability. 3-way isolation further improves system performance. The discrete I/O provide monitoring and control of on/off, high/low, or open/close industrial devices. Tandem I/O provides output level control and status verification in one unit.

The i2o function lets inputs on one module write directly to outputs on another module.

### Analog Input Ranges

DC Current (user-selectable ranges)  
0 to 1mA, 0 to 11mA, 0 to 20mA, 4 to 20mA  
0 to 20 amps AC (with optional AC sensor)

DC Voltage (user-selectable ranges)  
±1V, ±5V, ±10V DC

### Analog Output Ranges

DC Current (user-selectable ranges)  
0 to 1mA, 0 to 20mA, or 4 to 20mA  
(0 to 625 ohm loads, typical)

### Discrete I/O Range

0 to 35V DC active-high inputs  
Current sourcing (high-side switched) outputs

### Network Communication

EtherNet/IP or Modbus TCP/IP 10/100 network

### Power Requirement

15 to 36V DC supply (3.3 Watts) required

### Approvals

CE/ATEX marked.  
UL, cUL listed, Class I; Div. 2; Groups A, B, C, D.  
EtherNet/IP, Modbus/TCP conformance tested.

## Key Features & Benefits

- Configurable from standard web browser
- EtherNet/IP or Modbus TCP/IP communication with automatic 10/100Mbps negotiation
- i2o technology for peer-to-peer communication without a network controller (see Page 6)
- Multi-function, multi-channel stand-alone module is very economical
- High-resolution 16-bit  $\Sigma$ - $\Delta$  A/D and D/A converters ensure precise measurements
- 0-35V DC solid-state logic interface can monitor or control a wide variety of devices
- Discrete I/O channels are individually configurable as inputs or outputs in any combination
- Bi-directional discrete I/O facilitates read-back monitoring of the output state
- Built-in 5.6K ohm pull-down SIP resistors (socketed)
- Selectable failsafe modes (0%, off, last-state, or pre-defined) help prevent unsafe conditions
- Compact packaging with pluggable terminals saves space and simplifies wiring
- Wide operational temperature range permits installation in extreme environments

**Acromag** <sup>®</sup>  
THE LEADER IN INDUSTRIAL I/O





## Performance Specifications

### ◆ General Specifications

See Page 9 for communication and other specs.

### ◆ Analog Input

#### Configuration

Four input channels. Input range is selectable as a 4-channel group.

#### Accuracy

Better than  $\pm 0.05\%$  of span (0.1% for 0-1mA range), typical. Accuracy near or below 0mA or 0V is degraded if input COM shares AO/DIO RTNs.

#### Analog to Digital Converter (A/D)

16-bit  $\Sigma$ - $\Delta$  converter.

Resolution: 0.005% or 1 part in 20000.

#### Noise Rejection

Normal Mode: Better than 40dB @ 60Hz.

Common Mode: Better than 140dB @ 60Hz.

#### Input Conversion Rate

Less than 50mS per channel.

#### Input Impedance

DC current input (951EN): 49.9 ohms.

DC voltage input (952EN): Greater than 110.5K ohms.

### ◆ Analog Output

#### Configuration

Two output channels. Individually selectable ranges.

#### Accuracy

Better than  $\pm 0.05\%$  of span (0.1% for 0-1mA range), typical.

#### Digital to Analog Converter (D/A)

16-bit converter.

#### Current Output Compliance

12V minimum, 13V typical.

#### Current Output Load Resistance Range

0 to 625 ohms, typical.

### ◆ Discrete Input

#### Input Type

Six independent, active-high, buffered inputs with a common connection. Built-in 5.6K ohm pull-down resistors socketed for 3-channel groups.

#### Input Signal Voltage Range

0 to 35V DC, maximum.

#### Input Impedance

100K ohms, typical.

#### Input Signal Threshold

TTL compatible with 100mV of hysteresis, typical.

### ◆ Discrete Output

#### Output Type

Six independent, open-source, MOSFET switches.

#### Output Voltage and ON Resistance

Up to 35V DC max. (0 to 330mA/ch continuous).

0.15 ohms maximum ON resistance.

### ◆ Environmental

#### Ambient Temperature and Humidity

Operating: -25 to 70°C (-13 to 158°F).

Storage: -40 to 85°C (-40 to 185°F).

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

#### Isolation

1500V AC for 60 seconds or 250V AC continuous.

3-way isolation between I/O, network, and power.

## Ordering Information

*NOTE: i2o function only on Modbus TCP/IP modules*

### ◆ I/O Modules

#### 951EN-4012

Combo module, current inputs, Ethernet Modbus TCP/IP interface, i2o communication

#### 951EN-6012

Combo module, current inputs, EtherNet/IP interface

#### 952EN-4012

Combo module, voltage inputs, Ethernet Modbus TCP/IP interface, i2o communication

#### 952EN-6012

Combo module, voltage inputs, EtherNet/IP interface

### ◆ Accessories

#### Industrial Ethernet Switches

See Page 25.

#### Hardware Accessories and Power Supplies

See Page 26.

#### Software Support

See Page 27.

## i2o™ Input-to-Output Peer-to-Peer Communication

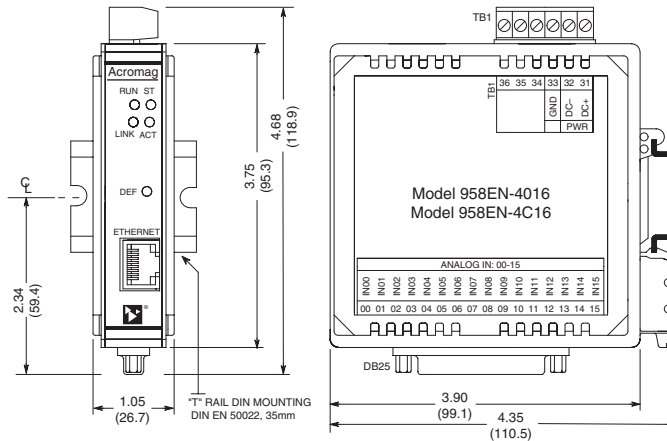


Acromag's i2o technology allows modules to talk directly to another module across any Ethernet media without a PLC, PC, or other controller in between. Input channels on one module can write to output channels on a remote module.



# Ethernet I/O: BusWorks® Series

## 958EN Ethernet 8B Interface Modules (Analog Input)



Standard model includes cage clamp terminal blocks. Optional terminals are available (see Page 26).

**Modbus/TCP**  
conformance tested

16-channel single-ended voltage input ♦ DB25 port for 8B modules ♦ Modbus TCP/IP communication

### Description

#### Models

958EN-4016: Industrial-grade units  
958EN-4C16: Commercial-grade units

These modules interface high-level analog input signals to an Ethernet control network. A high-performance design ensures reliable measurements and dependable operation.

The DB25 port provides a parallel connection to a rack of 8B analog input modules. The 8B modules provide an isolated front-end with signal conditioning of up to 16 sensor signals.

Industrial-grade models add a configurable integrator/totalizer plus superior accuracy and temperature performance compared to the economical commercial-grade version.

#### Input Ranges

±5V DC via DB25 port connection (default) or ±10V DC

#### Ethernet Communication

Modbus TCP/IP, 10/100Base-T(X)

#### Power Requirement

18 to 36V DC, 2.0W

#### Approvals

CE, UL/cUL (industrial-grade units only)  
Zone 2, Class 1, Division 2, ABCD

### Key Features & Benefits

- DB25 port provides an easy connection to a rack of 8B signal conditioning modules (4, 8, or 16 ch panels supported)
- Cables available for input from 8B, 7B, 5B, or 3B signal conditioning modules
- High-resolution 16-bit A/D
- Fast scanning of all channels in 8ms
- 3-way isolation and surge suppression
- Configurable integration/totalization function with non-volatile memory
- Dual-format 16/32-bit data registers
- Scaling registers on all channels
- Configurable sample averaging
- Automatic calibration and self-test
- User-adjustable TCP Ports 1-99,999 for advanced network configuration
- Web browser configuration with copy utility for fast setup

### Performance Specifications

#### Accuracy

958EN-4016: Less than 0.05% of range.  
958EN-4C16: Less than 0.10% of range.

#### Input Impedance

4M ohms.

#### Operating Temperature and Humidity Ranges

958EN-4016: -40 to 70°C (-40 to 158°F).  
958EN-4C16: 0 to 55°C (32 to 131°F).  
Relative humidity: 5 to 95%, non-condensing.

#### Isolation

3-way isolation of I/O, power, network circuits.  
Peak: 1500V AC, ANSI/ISA-82.01-1988.  
Continuous: 250V AC, 354V DC.

### Ordering Information

#### ♦ I/O Modules

958EN-4016 {industrial-grade}  
16-ch voltage input module with integrator

958EN-4C16 {commercial-grade\*}  
16-ch voltage input module

\* CE approval only, no integrator function

#### ♦ Accessories

Industrial Ethernet Switches  
See Page 25.

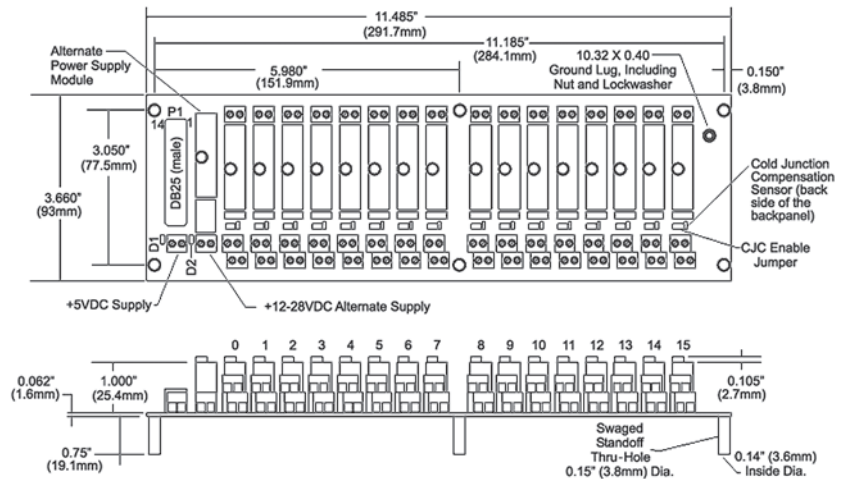
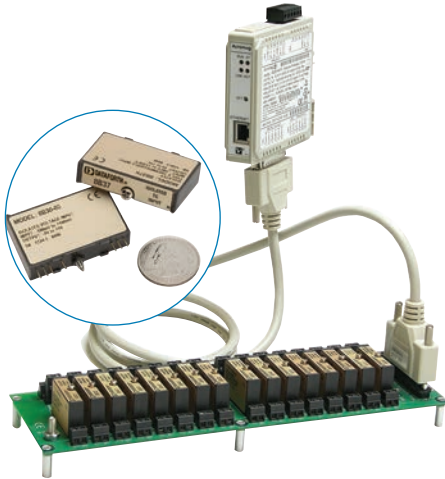
Hardware Accessories and Power Supplies  
See Page 26.

Software Support  
See Page 27.





## 8B Signal Conditioning Modules



High-density isolation amplifiers ♦ Parallel interface connects to 958EN Ethernet Analog Input Modules

### Description

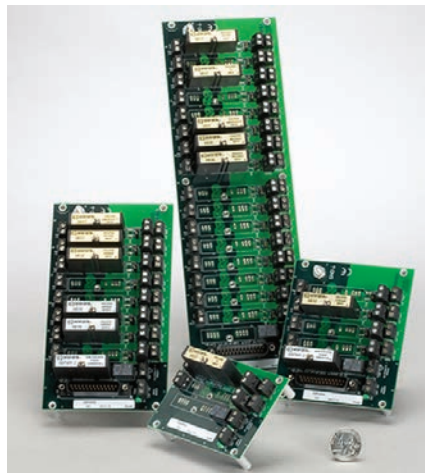
This new line of high-density isolated signal conditioners provides 17 family groups with a total of 102 models that interface to a wide variety of voltage, current, temperature, position, frequency, and strain measuring devices. Housed in a package only one-fifth the size of competing products, the 8B module series offers instrument-class performance with superior specifications for accuracy, linearity, filtering, isolation, output noise and much more.

### Key Features & Benefits

- ±0.05% accuracy
- ±0.02% linearity
- 1500Vrms isolation
- 3- to 5-pole low-pass filter
- 120dB CMR
- ANSI/IEEE C37.90.1 transient protection
- Field I/O protection from 30 to 240V AC continuous
- -40°C to 85° operating temperature range
- CE compliant
- UL/cUL listing pending for Class 1, Division 2

### Applications

- Systems requiring high channel-to-channel isolation, noise rejection, surge suppression, and amplification
- Designed for front-end signal conditioning or embedded applications:
- DCS, PLC, controllers, data acquisition, remote I/O, recorders, etc.
- On-board embedded OEM applications
- Protects equipment, increases accuracy, and installs/expands easily
- Low-cost, high-density amplifier system



### Ordering Information

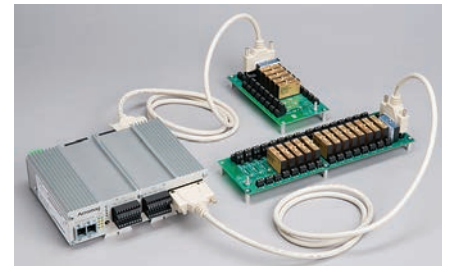
NOTE: Please refer to Acromag Bulletin #8400-479 or visit [www.acromag.com](http://www.acromag.com) for full ordering information.

#### ♦ Input Modules

- Current input
- Voltage input; 1kHz, 20kHz, or narrow bandwidth
- RTD input; linearized; 2-, 3-, or 4-wire RTD
- Thermocouple input; linearized or non-linearized
- Strain gage input; wide or narrow bandwidth
- Potentiometer input
- Frequency input

#### ♦ Accessories

- 2-, 4-, 8-, and 16-position analog I/O backpanels
- Power supplies
- Interface cables
- 19-Inch metal mounting rack



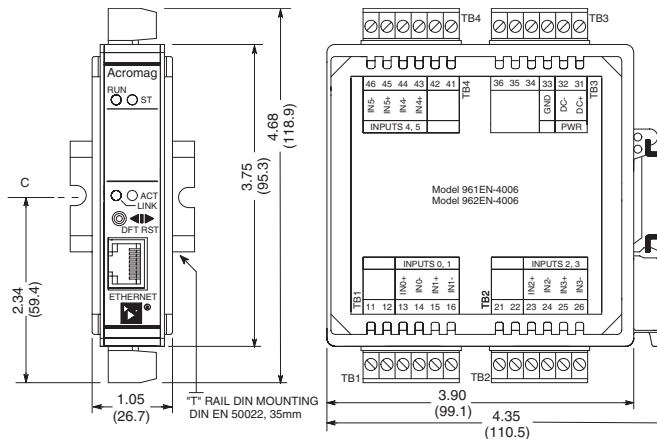
8Bs also connect to EtherStax analog I/O modules (ES2151, ES2152, ES2153, ES2162, ES2172 models)





# Ethernet I/O: BusWorks® Series

## 961EN, 962EN Ethernet Analog Input Modules



Standard model includes cage clamp terminal blocks. Optional terminals are available (see Page 26).

**EtherNet/IP™**  
conformance tested

**Modbus/TCP**  
conformance tested

### 6-channel differential analog current or voltage input ♦ Ethernet/IP, Modbus TCP/IP, i2o peer-to-peer

#### Description

##### Models

961EN: 6 DC current input channels  
962EN: 6 DC voltage input channels

These modules provide an isolated Ethernet network interface for six analog input channels. Differential inputs eliminate ground loops and thus the need for isolators in many applications. Multi-range inputs accept signals from a variety of sensors and devices. High-resolution, low noise, A/D converters deliver high accuracy and reliability.

##### Input Ranges

Ranges are selectable for a 3-channel group.

##### DC Current:

0 to 1mA, 0 to 11mA, 0 to 20mA, 4 to 20mA  
0 to 20 amps AC (with optional AC sensor)

##### DC Voltage:

±78mV to ±10V DC (eight range options)

##### Network Communication

EtherNet/IP or Modbus TCP/IP 10/100Mbps

##### Power Requirement

15 to 36V DC supply (2 Watts) required

##### Approvals

CE/ATEX marked.

UL, cUL listed, Class I; Div. 2; Groups A, B, C, D.

EtherNet/IP, Modbus/TCP conformance tested.

#### Key Features & Benefits

- Configurable from standard web browser
- EtherNet/IP or Modbus TCP/IP communication with auto 10/100Mbps data rate negotiation
- i2o technology for peer-to-peer communication without a network controller (see Page 6)
- 6-input stand-alone module is very economical
- Differential inputs eliminate ground loops
- High-resolution 16-bit  $\Sigma$ - $\Delta$  A/D converters ensure precise, high accuracy measurements
- Wide operational temperature range permits installation in extreme environments

#### Performance Specifications

##### ♦ Input

###### Accuracy

Better than  $\pm 0.05\%$  of span for nominal input ranges.

###### Analog to Digital Converter (A/D)

16-bit  $\Sigma$ - $\Delta$  converter. 0.005% (1/20000) resolution.

###### Noise Rejection

Normal Mode: Better than 40dB @ 60Hz.

Common Mode: Better than 140dB @ 60Hz.

###### Input Filter Bandwidth

-3dB at 3Hz, typical.

###### Input Conversion Rate

80mS per channel.

###### Input Impedance

DC current input: 25 ohms.

DC voltage input: Greater than 110.5K ohms.

#### ♦ Environmental

##### Ambient Temperature and Humidity

Operating: -25 to 70°C (-13 to 158°F).

Storage: -40 to 85°C (-40 to 185°F).

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

##### Isolation

1500V AC for 60 seconds or 250V AC continuous.

3-way isolation between I/O, network, and power.

#### Ordering Information

NOTE: i2o function only on Modbus TCP/IP modules

#### ♦ I/O Modules

##### 961EN-4006

Current input, 6-channel, Ethernet Modbus TCP/IP, i2o communication

##### 961EN-6006

Current input, 6-channel, EtherNet/IP

##### 962EN-4006

Voltage input, 6-channel, Ethernet Modbus TCP/IP, i2o communication

##### 962EN-6006

Voltage input, 6-channel, EtherNet/IP

#### ♦ Accessories

##### Industrial Ethernet Switches

See Page 25.

##### Hardware Accessories and Power Supplies

See Page 26.

##### Software Support

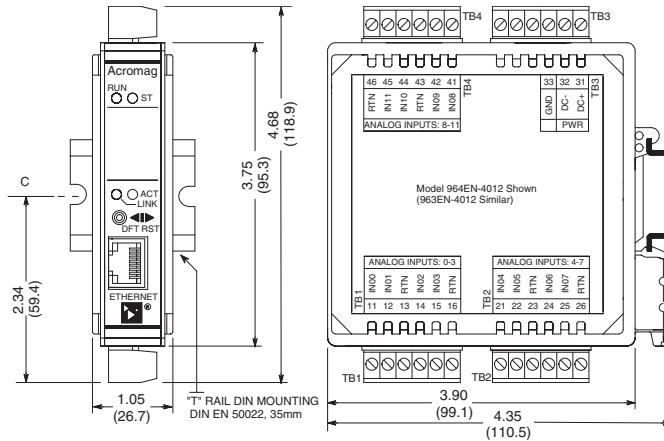
See Page 27.

**Acromag**   
THE LEADER IN INDUSTRIAL I/O

# Ethernet I/O: BusWorks® Series



## 963EN, 964EN Ethernet Analog Input Modules



Standard model includes cage clamp terminal blocks. Optional terminals are available (see Page 26).

**EtherNet/IP™**  
conformance tested

**Modbus/TCP**  
conformance tested

### 12-channel single-ended analog current or voltage input ◆ Ethernet/IP or Modbus TCP/IP communication

#### Description

##### Models

963EN: 12 DC current input channels  
964EN: 12 DC voltage input channels

These modules provide an isolated Ethernet network interface for twelve analog input channels. Compact design saves space and lowers system costs. Multi-range inputs accept signals from a variety of sensors and devices. High-resolution, low noise, A/D converters deliver high accuracy and reliability.

##### Input Ranges

Ranges user-selectable on each terminal block for a group of four input channels (4-channel basis).

##### DC Current:

0 to 1mA, 0 to 11mA, 0 to 20mA, 4 to 20mA  
0 to 20 amps AC (with optional AC sensor)

##### DC Voltage:

±1V, ±5V, or ±10V DC

##### Network Communication

EtherNet/IP or Modbus TCP/IP 10/100Mbps

##### Power Requirement

15 to 36V DC supply (2 Watts) required

##### Approvals

CE/ATEX marked.

UL, cUL listed, Class I; Div. 2; Groups A, B, C, D.

EtherNet/IP, Modbus/TCP conformance tested.

#### Key Features & Benefits

- Configurable from standard web browser
- EtherNet/IP or Modbus TCP/IP communication with auto 10/100Mbps data rate negotiation
- 12-input module has very low cost per channel
- Universal DC inputs support a wide variety of industrial sensors and signals
- High-resolution 16-bit  $\Sigma$ - $\Delta$  A/D converters ensure precise, high accuracy measurements
- Wide operational temperature range permits installation in extreme environments

#### Performance Specifications

##### ◆ Input

##### Accuracy

Better than  $\pm 0.05\%$  of span for nominal input ranges.

##### Analog to Digital Converter (A/D)

16-bit  $\Sigma$ - $\Delta$  converter. 0.005% (1/20000) resolution.

##### Noise Rejection

Normal Mode: Better than 40dB @ 60Hz.

Common Mode: Better than 140dB @ 60Hz.

##### Input Filter Bandwidth

-3dB at 3Hz, typical.

##### Input Conversion Rate

180mS per channel.

##### Input Impedance

DC Current Input: 49.9 ohms.

DC Voltage Input: Greater than 110.5K ohms.

#### ◆ Environmental

##### Ambient Temperature and Humidity

Operating: -25 to 70°C (-13 to 158°F).

Storage: -40 to 85°C (-40 to 185°F).

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

##### Isolation

1500V AC for 60 seconds or 250V AC continuous.

3-way isolation between I/O, network, and power.

Inputs share a common.

#### Ordering Information

##### ◆ I/O Modules

##### 963EN-4012

Current input, 12-channel, Ethernet Modbus TCP/IP

##### 963EN-6012

Current input, 12-channel, EtherNet/IP

##### 964EN-4012

Voltage input, 12-channel, Ethernet Modbus TCP/IP

##### 964EN-6012

Voltage input, 12-channel, EtherNet/IP

##### ◆ Accessories

##### Industrial Ethernet Switches

See Page 25.

##### Hardware Accessories and Power Supplies

See Page 26.

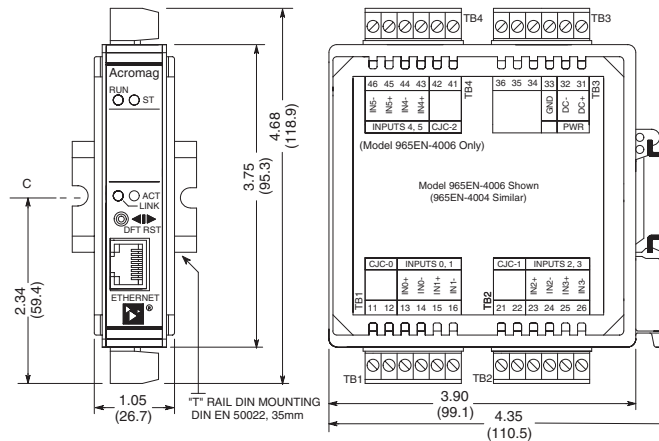
##### Software Support

See Page 27.

**Acromag** <sup>®</sup>  
THE LEADER IN INDUSTRIAL I/O

# Ethernet I/O: BusWorks® Series

## 965EN Ethernet Temperature Input Modules



Standard model includes cage clamp terminal blocks. Optional terminals are available (see Page 26).

**EtherNet/IP™**  
conformance tested

**Modbus/TCP**  
conformance tested

4 or 6-channel thermocouple/millivolt input ◆ Ethernet/IP, Modbus TCP/IP, i2o peer-to-peer messaging

### Description

These modules provide an isolated Ethernet network interface for up to six input channels. Differential inputs eliminate ground noise and each terminal block includes a cold junction compensation (CJC) sensor for more precise temperature measurements. Multi-range inputs accept signals from a variety of sensors and devices. High-resolution, low noise, A/D converters deliver high accuracy and reliability.

### Input Ranges

Ranges are selectable for a 3-channel group.

Thermocouple (user-selectable type)

Type J, K, T, R, S, E, B, or N

DC Millivolts (user-selectable range)

±100mV or ±1V DC

### Network Communication

EtherNet/IP or Modbus TCP/IP 10/100Mbps with automatic data rate negotiation

### Power Requirement

15 to 36V DC supply (2 Watts) required

### Approvals

CE/ATEX marked.

UL, cUL listed, Class I; Div. 2; Groups A, B, C, D.

EtherNet/IP, Modbus/TCP conformance tested.

### Key Features & Benefits

- Configurable from standard web browser
- Universal inputs support a variety of sensors
- Thermocouple break detection (upscale or downscale) identifies sensor wiring failures
- High-resolution 16-bit  $\Sigma$ - $\Delta$  A/D converters ensure precise, high accuracy measurements
- Wide operational temperature range

### Performance Specifications

#### ◆ Input

##### Accuracy

Input	Input Range	Accuracy (typical)
Type J	-210 to 760°C	±0.5°C
Type K	-200 to 1372°C	±0.5°C
Type T	-260 to 400°C	±0.5°C
Type R	-50 to 1768°C	±1.0°C
Type S	-50 to 1768°C	±1.0°C
Type E	-200 to 1000°C	±0.5°C
Type B	260 to 1820°C	±1.0°C
Type N	-230 to -170°C	±1.0°C
Type N	-170 to 1300°C	±0.5°C
Voltage	±100mV or ±1V DC	±0.1% of span

Cold Junction Compensation (CJC) Accuracy: ±0.5°C.

##### Noise Rejection

Normal Mode: Better than 40dB @ 60Hz.

Common Mode: Better than 140dB @ 60Hz.

##### Input Filter Bandwidth

-3dB at 3Hz, typical.

##### Input Conversion Rate

80ms per channel.

### ◆ Environmental

Ambient Temperature and Humidity

Operating: -25 to 70°C (-13 to 158°F).

Storage: -40 to 85°C (-40 to 185°F).

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

##### Isolation

1500V AC for 60 seconds or 250V AC continuous.

3-way isolation between I/O, network, and power.

### Ordering Information

NOTE: i2o function only available on 6-channel Modbus TCP/IP modules

#### ◆ I/O Modules

##### 965EN-4004

4-channel TC/mV input, Ethernet Modbus TCP/IP

##### 965EN-6004

4-channel TC/mV input, EtherNet/IP

##### 965EN-4006

6-channel TC/mV input, Ethernet Modbus TCP/IP, i2o

##### 965EN-6006

6-channel TC/mV input, EtherNet/IP interface

#### ◆ Accessories

##### Industrial Ethernet Switches

See Page 25.

##### Hardware Accessories and Power Supplies

See Page 26.

##### Software Support

See Page 27.

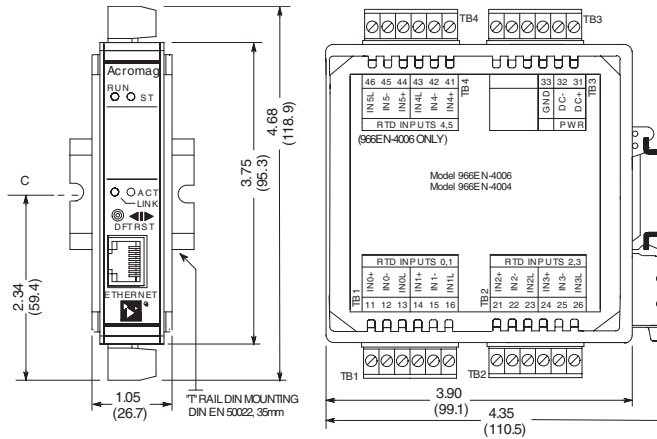




# Ethernet I/O: BusWorks® Series



## 966EN Ethernet Temperature Input Modules



Standard model includes cage clamp terminal blocks. Optional terminals are available (see Page 26).

**EtherNet/IP™**  
conformance tested

**Modbus/TCP**  
conformance tested

### 4 or 6-channel RTD/resistance input ◆ Ethernet/IP, Modbus TCP/IP, i2o peer-to-peer messaging

#### Description

These modules provide an isolated Ethernet network interface for up to six input channels. Multi-range inputs accept signals from a variety of sensors and devices. High-resolution, low noise, A/D converters deliver high accuracy and reliability. 3-way isolation further improves the system performance.

#### Input Ranges

Input ranges are selectable for a 3-channel group.

#### RTD

2-wire and 3-wire RTDs are supported.

Platinum 100 ohm (alpha = 1.3850 or 1.3911)

Nickel 120 ohm

Copper 10 ohm

#### Resistance

0 to 500 ohms

#### Network Communication

EtherNet/IP or Modbus TCP/IP 10/100Mbps with automatic data rate negotiation

#### Power Requirement

15 to 36V DC supply (2 Watts) required

#### Approvals

CE/ATEX marked.

UL, cUL listed, Class I; Div. 2; Groups A, B, C, D.

EtherNet/IP, Modbus/TCP conformance tested.

#### Key Features & Benefits

- Configurable from standard web browser
- 6-input stand-alone module has much lower start-up cost than multi-piece block I/O systems
- Versatile RTD or ohmic inputs support a wide variety of industrial sensors and devices
- RTD break detection (upscale or downscale) identifies sensor wiring failures
- High-resolution 16-bit  $\Sigma$ - $\Delta$  A/D converters ensure precise, high accuracy measurements
- Wide operational temperature range permits installation in extreme environments

#### Performance Specifications

##### ◆ Input

##### Accuracy

Input Type Input Range Accuracy (typical)

Pt 100 ohm -200 to 850°C ±0.25°C

Ni 120 ohm -80 to 320°C ±0.25°C

Cu 10 ohm -200 to 260°C ±1.25°C

Resistance 0 to 500 ohms ±0.05 ohms

##### RTD Break Detection

Upscale or downscale selection applies to all channels.

##### Noise Rejection

Normal Mode: Better than 40dB @ 60Hz.

Common Mode: Better than 130dB @ 60Hz.

##### Input Filter Bandwidth

-3dB at 3Hz, typical.

##### Input Conversion Rate

80mS per channel.

##### Excitation Current

1mA DC typical, all RTD types.

#### ◆ Environmental

##### Ambient Temperature and Humidity

Operating: -25 to 70°C (-13 to 158°F).

Storage: -40 to 85°C (-40 to 185°F).

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

##### Isolation

1500V AC for 60 seconds or 250V AC continuous.

3-way isolation between I/O, network, and power.

Inputs share a common.

#### Ordering Information

NOTE: i2o function only available on 6-channel Modbus TCP/IP modules

#### ◆ I/O Modules

966EN-4004

4-channel RTD input, Ethernet Modbus TCP/IP

966EN-6004

4-channel RTD input, EtherNet/IP interface

966EN-4006

6-channel RTD input, Ethernet Modbus TCP/IP, i2o

966EN-6006

6-channel RTD input, EtherNet/IP interface

#### ◆ Accessories

Industrial Ethernet Switches

See Page 25.

Hardware Accessories and Power Supplies

See Page 26.

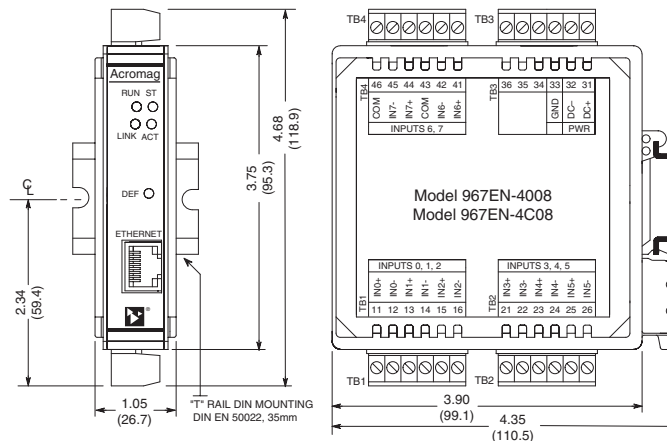
Software Support

See Page 27.

**Acromag**   
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# Ethernet I/O: BusWorks® Series

## 967EN Ethernet Analog Input Modules



Standard model includes cage clamp terminal blocks. Optional terminals are available (see Page 26).

**Modbus/TCP**  
conformance tested

### 8-channel differential current input ♦ Modbus TCP/IP, i2o® peer-to-peer communication

#### Description

##### Models

967EN-4008: Industrial-grade units  
967EN-4C08: Commercial-grade units

These modules interface high-level analog input signals to an Ethernet network. A high-performance design ensures reliable measurements and dependable operation.

Industrial-grade models add a configurable integrator/totalizer plus superior accuracy and temperature performance compared to the economical commercial-grade version.

##### Input Ranges

±20mA, 0-20mA, 4-20mA DC  
(selectable on each channel)

##### Ethernet Communication

Modbus TCP/IP, 10/100Base-T(X),  
i2o peer-to-peer

##### Power Requirement

18 to 36V DC, 2.4W

##### Approvals

CE, UL/cUL (industrial-grade units only)  
Zone 2, Class 1, Division 2, ABCD

#### Key Features & Benefits

- High-resolution 16-bit A/D
- Fast scanning of all channels in 8mS
- 3-way isolation and surge suppression
- Peer-to-peer i2o communication with percent-of-span or timed-based updates
- Configurable integration/totalization function with non-volatile registers
- Dual-format 16/32-bit data registers
- Scaling registers on all channels
- Configurable sample averaging
- Automatic calibration and self-test
- User-adjustable TCP Ports 1-99,999 for advanced network configuration
- Web browser configuration with copy utility for fast setup

#### i2o Peer-to-Peer Messaging

With Acromag's i2o technology, you can map each input channel to any output channel on a 97xEN-400x output unit. Select updates based on time or on a percent of range change (100mS or 0.1% resolution).

#### Performance Specifications

##### Accuracy

967EN-4008: Less than 0.05% of range.  
967EN-4C08: Less than 0.10% of range.

##### Input Impedance

200 ohms.

##### Operating Temperature and Humidity Ranges

967EN-4008: -40 to 70°C (-40 to 158°F).  
967EN-4C08: 0 to 55°C (32 to 131°F).

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

##### Isolation

3-way isolation of I/O, power, network circuits.  
Peak: 1500V AC, ANSI/ISA-82.01-1988.  
Continuous: 250V AC, 354V DC.

#### Ordering Information

##### ♦ I/O Modules

967EN-4008 {industrial-grade}  
8-ch current input module with integrator

967EN-4C08 {commercial-grade\*}  
8-ch current input module

\* CE approval only, no integrator function

##### ♦ Accessories

Industrial Ethernet Switches  
See Page 25.

Hardware Accessories and Power Supplies  
See Page 26.

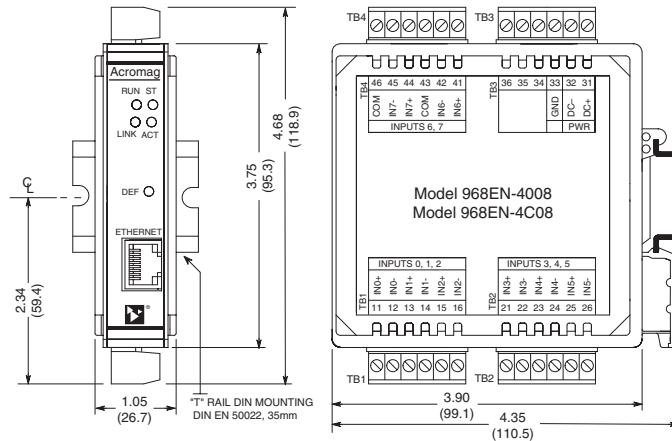
Software Support  
See Page 27.



# Ethernet I/O: BusWorks® Series



## 968EN Ethernet Analog Input Modules



Standard model includes cage clamp terminal blocks. Optional terminals are available (see Page 26).

**Modbus/TCP**  
conformance tested

### 8-channel differential analog voltage input ♦ Modbus TCP/IP, i2o® peer-to-peer communication

#### Description

##### Models

968EN-4008: Industrial-grade units  
968EN-4C08: Commercial-grade units

These modules interface high-level analog input signals to an Ethernet network. A high-performance design ensures reliable measurements and dependable operation.

Industrial-grade models add a configurable integrator/totalizer plus superior accuracy and temperature performance compared to the economical commercial-grade version.

##### Input Ranges

±5V, ±10V DC  
(selectable on each channel)

##### Ethernet Communication

Modbus TCP/IP, 10/100Base-T(X),  
i2o peer-to-peer

##### Power Requirement

18 to 36V DC, 2.4W

##### Approvals

CE, UL/cUL (industrial-grade units only)  
Zone 2, Class 1, Division 2, ABCD

#### Key Features & Benefits

- High-resolution 16-bit A/D
- Fast scanning of all channels in 8mS
- 3-way isolation and surge suppression
- Peer-to-peer i2o communication with percent-of-span or timed-based updates
- Configurable integration/totalization function with non-volatile registers
- Dual-format 16/32-bit data registers
- Scaling registers on all channels
- Configurable sample averaging
- Automatic calibration and self-test
- User-adjustable TCP Ports 1-99,999 for advanced network configuration
- Web browser configuration with copy utility for fast setup

#### i2o Peer-to-Peer Messaging

With Acromag's i2o technology, you can map each input channel to any output channel on a 97xEN-400x output unit. Select updates based on time or on a percent of range change (100mS or 0.1% resolution).

#### Performance Specifications

**Accuracy**  
968EN-4008: Less than 0.05% of range.  
968EN-4C08: Less than 0.10% of range.

**Input Impedance**  
4M ohms.

**Operating Temperature and Humidity Ranges**  
968EN-4008: -40 to 70°C (-40 to 158°F).  
968EN-4C08: 0 to 55°C (32 to 131°F).  
Relative humidity: 5 to 95%, non-condensing.

**Isolation**  
3-way isolation of I/O, power, network circuits.  
Peak: 1500V AC, ANSI/ISA-82.01-1988.  
Continuous: 250V AC, 354V DC.

#### Ordering Information

##### ♦ I/O Modules

968EN-4008 {industrial-grade}  
8-ch voltage input module with integrator

968EN-4C08 {commercial-grade\*}  
8-ch voltage input module

\* CE approval only, no integrator function

##### ♦ Accessories

Industrial Ethernet Switches  
See Page 25.

Hardware Accessories and Power Supplies  
See Page 26.

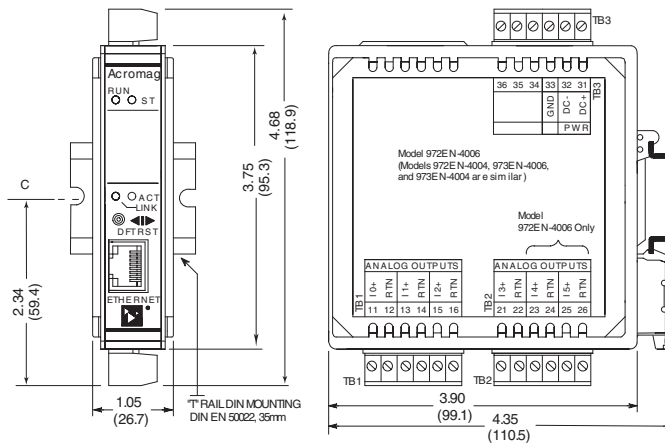
Software Support  
See Page 27.





# Ethernet I/O: BusWorks® Series

## 972EN, 973EN Ethernet Analog Output Modules



Standard model includes cage clamp terminal blocks. Optional terminals are available (see Page 26).

**EtherNet/IP™**  
conformance tested

**Modbus/TCP**  
conformance tested

4 or 6-channel DC current or voltage output ◆ Ethernet/IP, Modbus TCP/IP, i2o peer-to-peer messaging

### Description

#### Models

972EN: DC current output channels  
973EN: DC voltage output channels

These modules provide up to six channels of analog output. Multi-range outputs support a wide variety of industrial devices. They can drive displays and recorders, control drives, or send analog signals to other systems. High-resolution, low noise, D/A converters deliver high accuracy and reliability. 3-way isolation further improves system performance.

#### Output Ranges

Ranges selectable on channel to channel basis.

DC Current (user-selectable ranges)  
0 to 1mA, 0 to 20mA, or 4 to 20mA

DC Voltage (user-selectable ranges)  
0 to 1V, 0 to 5V, or 0 to 10V DC

#### Network Communication

EtherNet/IP or Modbus TCP/IP10/100Mbps with automatic data rate negotiation

#### Power Requirement

15 to 36V DC supply required  
4.6 Watts (972EN) or 2.3 Watts (973EN)

#### Approvals

CE/ATEX marked.  
UL, cUL listed, Class I; Div. 2; Groups A, B, C, D.  
EtherNet/IP, Modbus/TCP conformance tested.

### Key Features & Benefits

- Configurable from standard web browser
- 6-input stand-alone module has much lower start-up cost than multi-piece block I/O systems
- Universal DC outputs support a wide variety of signals and industrial devices
- Three selectable failsafe modes (0%, last-state, or pre-defined) help prevent unsafe conditions
- Wide operational temperature range permits installation in extreme environments

### Performance Specifications

#### ◆ Output

Accuracy  
Better than  $\pm 0.1\%$  of span, typical.  
1.6% for 0 to 1mA range. 0.8% for 0 to 1V range.

Digital to Analog Converter (D/A)  
12-bit converter.

Current Output Compliance  
12V minimum, 13V typical.

Current Output Load Resistance Range  
0 to 625 ohms, typical.

Voltage Output Source Current  
0 to 10mA DC, maximum.

#### ◆ Environmental

Ambient Temperature and Humidity  
Operating:  
972EN models -25 to 60°C (-13 to 140°F).  
973EN models: -25 to 70°C (-13 to 158°F).  
Storage: -40 to 85°C (-40 to 185°F).  
Relative humidity: 5 to 95%, non-condensing.

#### Isolation

1500V AC for 60 seconds or 250V AC continuous.  
3-way isolation between I/O, network, and power.  
Outputs share a common.

### Ordering Information

NOTE: i2o function only on Modbus TCP/IP modules

#### ◆ I/O Modules

- 972EN-4004  
4-ch. current output, Ethernet Modbus TCP/IP, i2o
- 972EN-4006  
6-ch. current output, Ethernet Modbus TCP/IP, i2o
- 972EN-6004  
4-channel current output, EtherNet/IP
- 972EN-6006  
6-channel current output, EtherNet/IP
- 973EN-4004  
4-ch. voltage output, Ethernet Modbus TCP/IP, i2o
- 973EN-4006  
6-ch. voltage output, Ethernet Modbus/TCP, i2o
- 973EN-6004  
4-channel voltage output, EtherNet/IP
- 973EN-6006  
6-channel voltage output, EtherNet/IP

#### ◆ Accessories

Industrial Ethernet Switches  
See Page 25.

Hardware Accessories and Power Supplies  
See Page 26.

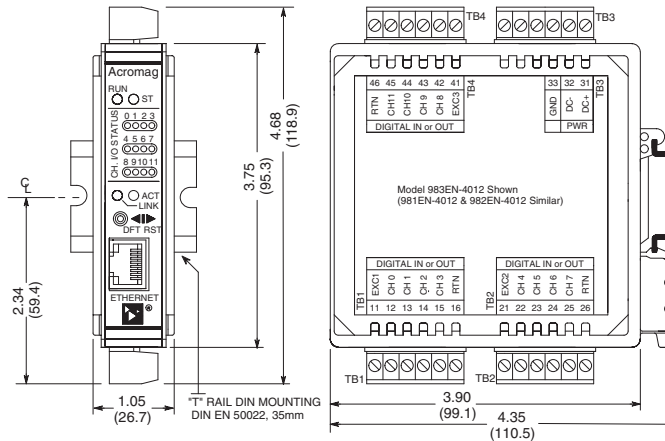
Software Support  
See Page 27.

**Acromag**   
THE LEADER IN INDUSTRIAL I/O

# Ethernet I/O: BusWorks® Series



981EN, 982EN, 983EN Ethernet Discrete I/O Modules



Standard model includes cage clamp terminal blocks. Optional terminals are available (see Page 26).

**EtherNet/IP™**  
conformance tested

**Modbus/TCP**  
conformance tested

12-channel discrete input and/or output ◆ Ethernet/IP, Modbus TCP/IP, i2o peer-to-peer messaging

## Description

### Models

- 981EN: 12 input channels
- 982EN: 12 output channels
- 983EN: 12 input/output channels

These modules provide an isolated Ethernet network interface for twelve discrete input and/or output channels. The outputs provide direct on/off, high/low, or open/close control of industrial devices. The inputs sense the status of motors, pumps, valves and other equipment. The 983EN model with tandem I/O provides output level control and status verification in one unit.

### Input Range

0 to 35V DC

### Output Range

0 to 35V DC

### Network Communication

EtherNet/IP or Modbus TCP/IP 10/100Mbps with automatic data rate negotiation

### Power Requirement

15 to 36V DC supply (2 Watts) required

### Approvals

CE/ATEX marked.  
UL, cUL listed, Class I; Div. 2; Groups A, B, C, D.  
EtherNet/IP, Modbus/TCP conformance tested.

## Key Features & Benefits

- Configurable from standard web browser
- 12-channel stand-alone module has far lower start-up cost than multi-piece block I/O systems
- 0-35V DC solid-state logic interface can monitor or control a wide variety of devices
- Bidirectional I/O models facilitate loopback monitoring of the output state
- Socketed SIP resistors provide input and output 5.6K ohm pull-ups to the excitation supply
- Three selectable failsafe modes (off, last-state, or pre-defined) help prevent unsafe conditions

## Performance Specifications

### ◆ Input (981 & 983 models)

#### Input Type

Twelve active-low, buffered inputs, with a common connection. Built-in 5.6K ohm pullups to excitation terminal socketed for 4-channel groups.

**Input Signal Voltage Range**  
0 to 35V DC, maximum.

**Input Impedance**  
100K ohms, typical.

**Input Signal Threshold**  
TTL compatible with 100mV of hysteresis, typical.

### ◆ Output (982 & 983 models)

#### Output Type

12 independent, open-drain, MOSFET switches.

**Output Voltage and ON Resistance**  
0 to 35V DC max. (0 to 500mA/channel continuous).  
0.28 ohms maximum ON resistance.

## ◆ Environmental

**Ambient Temperature and Humidity**  
Operating: -25 to 70°C (-13 to 158°F).  
Storage: -40 to 85°C (-40 to 185°F).  
Relative Humidity: 5 to 95%, non-condensing.

### Isolation

1500V AC for 60 seconds or 250V AC continuous.  
3-way isolation between I/O, network, and power.

## Ordering Information

NOTE: i2o function only on Modbus TCP/IP modules

### ◆ I/O Modules

**981EN-4012**  
Discrete input, Ethernet Modbus TCP/IP

**981EN-6012**  
Discrete input, EtherNet/IP

**982EN-4012**  
Discrete output, Ethernet Modbus TCP/IP, i2o

**982EN-6012**  
Discrete output, EtherNet/IP

**983EN-4012**  
Discrete input/output, Ethernet Modbus TCP/IP, i2o

**983EN-6012**  
Discrete input/output, EtherNet/IP

### ◆ Accessories

**Industrial Ethernet Switches**  
See Page 25.

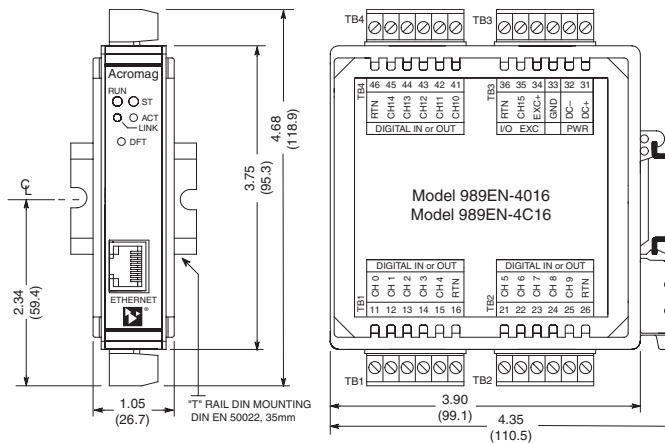
**Hardware Accessories and Power Supplies**  
See Page 26.

**Software Support**  
See Page 27.

**Acromag**   
THE LEADER IN INDUSTRIAL I/O

# Ethernet I/O: BusWorks® Series

## 989EN Ethernet Discrete I/O Modules with Counter/Timers



Standard model includes cage clamp terminal blocks. Optional terminals are available (see Page 26).

**Modbus/TCP**  
conformance tested

### 16-channel discrete I/O ♦ 8 counter/timers ♦ Modbus TCP/IP communication

#### Description

##### Models

989EN-4016: Industrial-grade version  
989EN-4C16: Commercial-grade (no counters)

These modules provide an isolated Ethernet interface for any input/output mix of up to 16 discrete signals. Inputs sense the status of dry contacts, switches, power supplies, and DC logic. Industrial-grade units have eight 32-bit counters with timers, alarms, and non-volatile memory for metering, totalizing, and low-frequency periodic measurement. The outputs control solid-state switching of lamps, horns, and other devices.

##### Input/Output Ranges

Input: 0-28V DC, 31V DC maximum  
Output: 0-28V DC, 0.5A/ch max, 2A total

##### Counter/Timers (Industrial-grade units)

8 up/down counters, 32-bit, 150Hz max  
8 timers, 16-bit, 1mS resolution

##### Ethernet Communication

Modbus TCP/IP, 10/100Base-T(X)

##### Power Requirement

18 to 36V DC (1.33 W)

##### Approvals (industrial-grade only)

CE, UL/cUL  
Zone 2, Class 1, Division 2, ABCD

#### Key Features & Benefits

- 16 solid-state discrete I/O channels (any mix of inputs/outputs)
- 3-way isolation and surge suppression
- Web browser configuration
- Automatic MDI/MDI-X negotiation
- Inputs accept 2- or 3-wire sensors and active logic switches (dry contacts, proximity, namur, 5-28V DC logic)
- Inputs detect level and change of state
- 8 configurable counter/timers
  - 32-bit up/down pulse/event counters (with non-volatile memory)
  - 16-bit periodic timers for "last pulse"
  - Momentary/latch alarms (each counter)
- Programmable debounce (0-65 seconds with 1mS resolution)
- Programmable power-up conditions
- Over-temperature, over-current, and over-voltage output protection
- Ability to "read-back" output states
- Watchdog timer output configurable for fail-safe or hold-last-value operation
- Self-test and auto-copy functions

#### Performance Specifications

##### Environmental

Operating Temperature Range  
989EN-4016: -40 to 65°C (-40 to 149°F)  
989EN-4C16: 0 to 55°C (32 to 131°F)

Storage Temperature Range  
989EN-4016: -40 to 85°C (-40 to 185°F)  
989EN-4C16: 0 to 70°C (32 to 158°F)

Relative Humidity  
5 to 95%, non-condensing.

Isolation  
3-way isolation of I/O, power, network circuits.  
Peak: 1500V AC, ANSI/ISA-82.01-1988.  
Continuous: 250V AC, 354V DC.

#### Ordering Information

##### I/O Modules

989EN-4016  
16 I/O channels with pulse counter/timers  
989EN-4C16  
Commercial-grade, 16 I/O, no counter/timers

##### Accessories

Industrial Ethernet Switches  
See Page 25.  
Hardware Accessories and Power Supplies  
See Page 26.  
Software Support  
See Page 27.

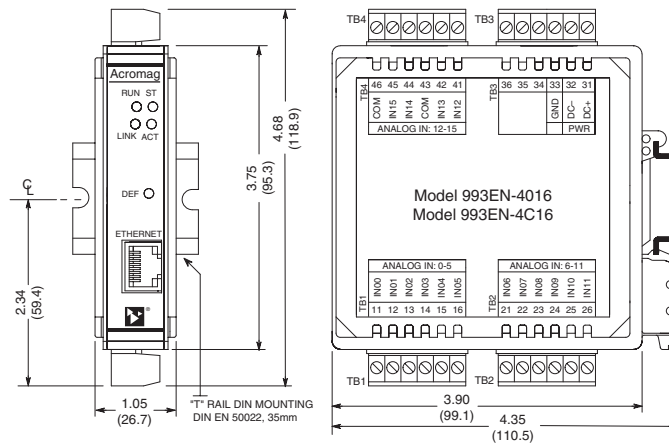




# Ethernet I/O: BusWorks® Series



## 993EN Ethernet Analog Input Modules



Standard model includes cage clamp terminal blocks. Optional terminals are available (see Page 26).

**Modbus/TCP**  
conformance tested

### 16-channel single-ended analog current input ♦ Modbus TCP/IP communication

#### Description

##### Models

993EN-4016: Industrial-grade units  
993EN-4C16: Commercial-grade units

These modules interface high-level analog input signals to an Ethernet control network. A high-performance design ensures reliable measurements and dependable operation.

Industrial-grade models add a configurable integrator/totalizer plus superior accuracy and temperature performance compared to the economical commercial-grade version.

##### Input Ranges

±20mA, 0-20mA, 4-20mA DC  
(selectable on each channel)

##### Ethernet Communication

Modbus TCP/IP, 10/100Base-T(X)

##### Power Requirement

18 to 36V DC, 2.0W

##### Approvals

CE, UL/cUL (industrial-grade units only)  
Zone 2, Class 1, Division 2, ABCD

#### Key Features & Benefits

- High-resolution 16-bit A/D
- Fast scanning of all channels in 8mS
- 3-way isolation and surge suppression
- Configurable integration/totalization function with non-volatile registers
- Dual-format 16/32-bit data registers
- Scaling registers on all channels
- Configurable sample averaging
- Automatic calibration and self-test
- User-adjustable TCP Ports 1-99,999 for advanced network configuration
- Web browser configuration with copy utility for fast setup

#### Performance Specifications

##### Accuracy

993EN-4016: Less than 0.05% of range.  
993EN-4C16: Less than 0.10% of range.

##### Input Impedance

200 ohms.

##### Operating Temperature and Humidity Ranges

993EN-4016: -40 to 70°C (-40 to 158°F).

993EN-4C16: 0 to 55°C (32 to 131°F).

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

##### Isolation

3-way isolation of I/O, power, network circuits.

Peak: 1500V AC, ANSI/ISA-82.01-1988.

Continuous: 250V AC, 354V DC.

#### Ordering Information

##### ♦ I/O Modules

993EN-4016 {industrial-grade}  
16-ch current input module with integrator

993EN-4C16 {commercial-grade\*}  
16-ch current input module

\* CE approval only, no integrator function

##### ♦ Accessories

Industrial Ethernet Switches  
See Page 25.

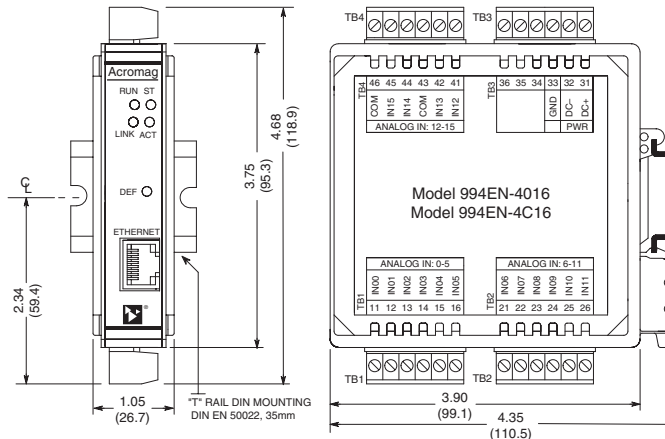
Hardware Accessories and Power Supplies  
See Page 26.

Software Support  
See Page 27.



# Ethernet I/O: BusWorks® Series

## 994EN Ethernet Analog Input Modules



Standard model includes cage clamp terminal blocks. Optional terminals are available (see Page 26).

**Modbus/TCP**  
conformance tested

### 16-channel single-ended analog voltage input ♦ Modbus TCP/IP communication

#### Description

##### Models

994EN-4016: Industrial-grade units  
994EN-4C16: Commercial-grade units

These modules interface high-level analog input signals to an Ethernet control network. A high-performance design ensures reliable measurements and dependable operation.

Industrial-grade models add a configurable integrator/totalizer plus superior accuracy and temperature performance compared to the economical commercial-grade version.

##### Input Ranges

±5V, ±10V DC  
(selectable on each channel)

##### Ethernet Communication

Modbus TCP/IP, 10/100Base-T(X)

##### Power Requirement

18 to 36V DC, 2.0W

##### Approvals

CE, UL/cUL (industrial-grade units only)  
Zone 2, Class 1, Division 2, ABCD

#### Key Features & Benefits

- High-resolution 16-bit A/D
- Fast scanning of all channels in 8mS
- 3-way isolation and surge suppression
- Configurable integration/totalization function with non-volatile registers
- Dual-format 16/32-bit data registers
- Scaling registers on all channels
- Configurable sample averaging
- Automatic calibration and self-test
- User-adjustable TCP Ports 1-99,999 for advanced network configuration
- Web browser configuration with copy utility for fast setup

#### Performance Specifications

##### Accuracy

994EN-4016: Less than 0.05% of range.  
994EN-4C16: Less than 0.10% of range.

##### Input Impedance

4M ohms.

##### Operating Temperature and Humidity Ranges

994EN-4016: -40 to 70°C (-40 to 158°F).  
994EN-4C16: 0 to 55°C (32 to 131°F).  
Relative humidity: 5 to 95%, non-condensing.

##### Isolation

3-way isolation of I/O, power, network circuits.  
Peak: 1500V AC, ANSI/ISA-82.01-1988.  
Continuous: 250V AC, 354V DC.

#### Ordering Information

##### ♦ I/O Modules

994EN-4016 {industrial-grade}  
16-ch voltage input module with integrator

994EN-4C16 {commercial-grade\*}  
16-ch voltage input module

\* CE approval only, no integrator function

##### ♦ Accessories

Industrial Ethernet Switches  
See Page 25.

Hardware Accessories and Power Supplies  
See Page 26.

Software Support  
See Page 27.





## 900EN Series, EIS Series Industrial Ethernet Switches

### ◆ 5-Port Switch, Unmanaged



### 900EN-S005 Ethernet Switches

Acromag's five-port Ethernet switch is designed for use in industrial applications. Rugged construction and a variety of security features ensure reliable operation under demanding conditions. Internal intelligence enables "connect and go" operation for fast and easy network installation with auto-negotiation of data rate, flow control, and crossover signal compatibility. No configuration is necessary when the 900EN-S005 is used as a simple switch with Acromag I/O modules. For advanced users, this switch offers numerous control functions that are easily configured through DIP-switch settings or programmed using your computer.

- Five shielded RJ-45 sockets, 8-pin, 10Base-T / 100Base-TX
- 1500V port-to-port isolation
- Redundant power support
- -25 to 70°C operating range
- CE, ATEX marked. UL, cUL listed, Class I; Div. 2; Groups A, B, C, D.

### ◆ 8-Port Switch, Unmanaged



### EIS Series Ethernet Switches

#### Models

- EIS-358: 8-port (Cu), redundancy, unmanaged
- EIS-408: 8-port (Cu/fiber), redundancy, managed

EIS series switches are designed for harsh environments. They feature a rugged IP30 aluminum case, 300,000 hour MTBF, and power supply redundancy for dependable networking.

#### Managed operation

With web-based setup, managed switches ensure easy installation and maintenance. Managed switches also support many powerful Ethernet features such as port VLAN, Quality of Service (QoS), Internet Group Management Protocol (IGMP) Snooping, and failure alarms.

#### Self-healing redundant ring capability

Some models employ redundancy to provide self-recovery if the primary communication path fails. Redundant ring technology instantly reconfigures to provide an alternate path. The fast recovery time protects mission-critical applications from interruptions and temporary malfunctions.

- Ultra-fast redundant ring technology (<300ms) supports STP, RSTP and proprietary protocols
- -10 to 70°C operating temperature range
- Port-to-port isolation (1200V AC)
- Built-in RFI/EMI and surge/transient protection

### ◆ 8-Port Switch, Managed, FX



### Ordering Information

#### ◆ Switches

For more information please visit [www.acromag.com](http://www.acromag.com).

#### 900EN-S005

Ethernet switch, 5-port Copper

#### EIS-358

Ethernet switch with redundancy, 8-port Copper

#### EIS408FX-M

Ethernet switch with redundancy, 6 Cu / 2 Fiber-optic, multi-mode fiber (up to 2 km).

#### EIS-408FX-S

Ethernet switch with redundancy, 6 Cu / 2 Fiber-optic, single-mode fiber (up to 30 km).

#### ◆ Accessories

Hardware Accessories and Power Supplies

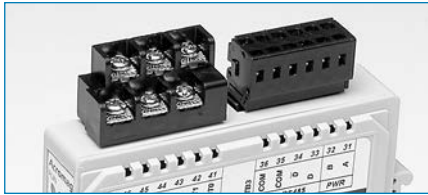
See Page 26.



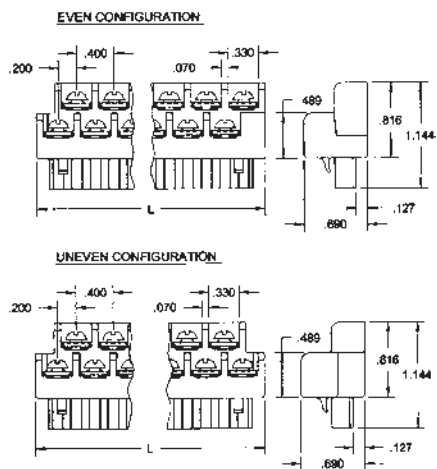
# Ethernet I/O: BusWorks® Series

## Accessories

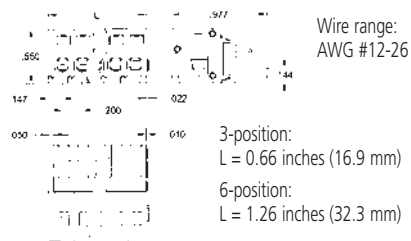
### ◆ Terminal Blocks



#### Barrier Strip Terminal Blocks\*



#### Spring Clamp Terminal Blocks\*



### Ordering Information

\* I/O modules ship with cage clamp terminal blocks. Terminal block kits are for replacement purposes. See I/O module information for compatibility

#### Barrier Strip

- TBK-B01  
Terminal block kit, two 6-position pieces
- TBK-B02  
Terminal block kit, four 6-position pieces
- TBK-B03  
Terminal block kit, one 3-position and three 6-position pieces

#### Spring Clamp

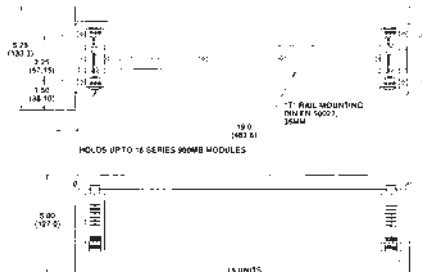
- TBK-S01  
Terminal block kit, two 6-position pieces
- TBK-S02  
Terminal block kit, four 6-position pieces
- TBK-S03  
Terminal block kit, one 3-position and three 6-position pieces

### ◆ Mounting Hardware



#### Din-Rail Mounting

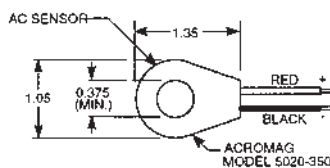
For your convenience, Acromag offers several mounting accessories to simplify your system installation. Our 19" rack-mount kit provides a clean solution for mounting your I/O modules and a power supply. Or you can buy pre-cut DIN rail strips for mounting on any flat surface.



### Ordering Information

- 20RM-16-DIN  
19" rack-mount kit with DIN rail.
- DIN RAIL 3.0  
DIN RAIL 16.7  
DIN rail strip, Type T, 3 inches (75mm) or 16.7 inches (425mm)

### ◆ AC Current Sensor



This external sensor measures a 0-20A AC signal and provides a DC mA output for an Ethernet input module. It enables remote mounting of the I/O module for safe monitoring of the AC signal.

### Ordering Information

- 5020-350  
AC current sensor

### ◆ Power Supplies



#### Universal Slimline Power Supplies

Input Power Requirement  
85 to 264V AC or 105 to 370V DC

Output  
5V DC, 12V DC, or 24V DC  
10W to 240W

### Ordering Information

- PS5R-SB24  
Power supply, 15W, 0.65A at 24V DC
  - PS5R-SD24  
Power supply, 60W, 2.5A at 24V DC
- Visit [www.acromag.com](http://www.acromag.com) for additional models and more information.

### ◆ Cables and Adapters



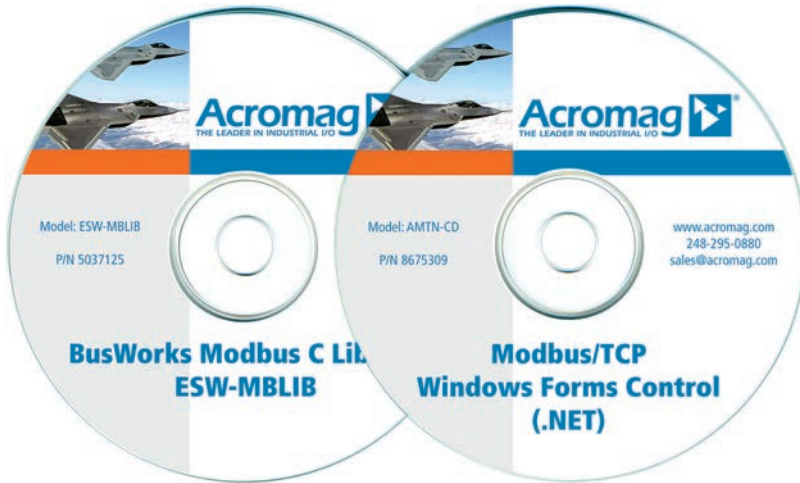
### Ordering Information

- 5035-355  
Ethernet straight cable, CAT5, 3 feet long, shielded
- 5035-360  
Ethernet crossover cable, CAT5E, 5 feet long, shielded
- 4001-096  
USB Ethernet adapter
- 4001-110  
Ribbon cable, 5 feet, DB25 male to 26-pin female IDC connector, interfaces 3B/5B input modules to 958EN





## Software Support Application Development Tools



```

Command Prompt - exmbtcpip

Modbus TCP/IP Example 9500-370A

1. Exit this Program
2. Set IP Address: 10.1.1.161
3. Set Register Address: 0
4. Set Register Count: 4
5. Report Slave I.D.
6. Read Output Status
7. Read Input Status
8. Force Single Coil
9. Force Multiple Coils
10. Read Output Registers
11. Read Input Registers
12. Preset Single Register
13. Preset Multiple Registers

Select: 11
00 0002
01 0000
02 0000
03 0000
    
```

Integrate with HMI and SCADA Software ♦ Supports five operating systems ♦ Demo versions available

### Description

These software development tools help you quickly integrate Acromag Ethernet I/O with your application program.

### OPC DA Server

This low-cost server is exclusively for use with Acromag Modbus TCP/IP Ethernet devices. The OPC Server connects Acromag's I/O modules to your HMI, SCADA or custom-built Visual Basic / C++ applications. Easy CSV import / export capability saves development time for faster deployment.

### .NET / ActiveX Controls

These software controls provide a fast, easy way to communicate with any Modbus/TCP slave devices connected to your PC. Within minutes, your Visual Basic, Visual C, .NET, Excel, or other compatible applications will be talking Modbus protocol.

### Function Libraries with C Source Code

Our C library of function routines speeds framing of Modbus messages. Examples help link your code with provided function calls to configure, read, and write to Acromag I/O modules. Ideal for Windows, Linux, VxWorks, and QNX OS.

### Key Features & Benefits

- High-Speed OPC connectivity to all Acromag Modbus TCP/IP devices
- OPC DA Server supports all OPC-compliant HMI and SCADA applications
- ActiveX and .NET controls enable fast, easy communication with any Modbus TCP/IP or Modbus RTU slave device
- ActiveX and .NET controls support Visual Basic, Visual C++ and Excel applications
- Modbus C Libraries enable use with Linux, VxWorks, QNX, and other OS platforms
- Free evaluation versions



### Ordering Information

See table for model numbers. Software is provided on CD-ROMs except ACMBTCP-OPC which is download only. For more information, visit our website.

[www.acromag.com/software](http://www.acromag.com/software)

Ethernet Software Development Tools			
Model	Description	Program Environment	Operating Systems
ACMBTCP-OPC	Modbus TCP/IP Master OPC DA Server	HMI, SCADA, Visual Basic, C++	Windows XP, Vista, 7, Server
AMTN-CD	Modbus TCP/IP .NET Controls	Visual Basic, C++, C#	Windows XP, Vista, 7
AMTX-CD	Modbus TCP/IP ActiveX Controls	Visual Basic, C++, Excel	Windows XP, Vista, 7
ESW-MBLIB	Modbus C Library of Function Routines	Visual C++	Win, Linux, VxWorks, QNX, OS-9



# Dependable Value.

http://www.acromag.com/ - Windows Internet Explorer

http://www.acromag.com/

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**Ethernet I/O for 8B Inputs**

958EN interfaces 16 high-level analog input signals from 8B signal conditioners. A DB25 port provides a parallel connection to a rack of 8B analog input modules. [Read more...](#)

**Ethernet I/O with 64-channel A/D**

These EtherStax I/O modules provide a rugged, high-density, and high-speed solution to interface a large quantity of analog input signals to SCADA and distributed I/O systems. [Read more...](#)

**I/O Server Industrial PC**

Acromag's Industrial I/O Server is a rugged industrial PC with truly integrated support for user I/O. A built-in carrier card interfaces up to four plug-in I/O modules to the Intel Atom® CPU. [Read more...](#)

**NEWS**

05/10/10  
Acromag Releases ActiveX and .NET Controls  
[READ MORE](#)

05/05/10  
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