

## BusWorks® 900EN Series Ethernet I/O

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	951/952	961/962	963/964	965	966	972/973	981/82/83
<b>DISCRETE INPUTS</b>							
Active low input							X
Active high input	X						
<b>ANALOG INPUTS</b>							
DC current input	X	X	X				
DC voltage input	X	X	X				
DC millivolt input				X			
Thermocouple input				X			
RTD/resistance input					X		
AC current input (requires external sensor)	X	X	X				
<b>DISCRETE OUTPUTS</b>							
Sinking output (low-side switch)							X
Sourcing output (high-side switch)	X						
<b>ANALOG OUTPUTS</b>							
DC current output	X					X	
DC voltage output						X	
<b>POWER REQUIREMENT</b>							
DC-powered	X	X	X	X	X	X	X

## Ethernet Remote I/O Protocols:

1) **EtherNet/IP™**  
conformance tested  
(For Allen-Bradley PLC Systems)

2) **Modbus/TCP**  
conformance tested  
(Ethernet Modbus TCP/IP)

3)   
(Acromag peer-to-peer protocol)



## EtherNet/IP, Modbus TCP/IP



24HR  
5YR

## 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.

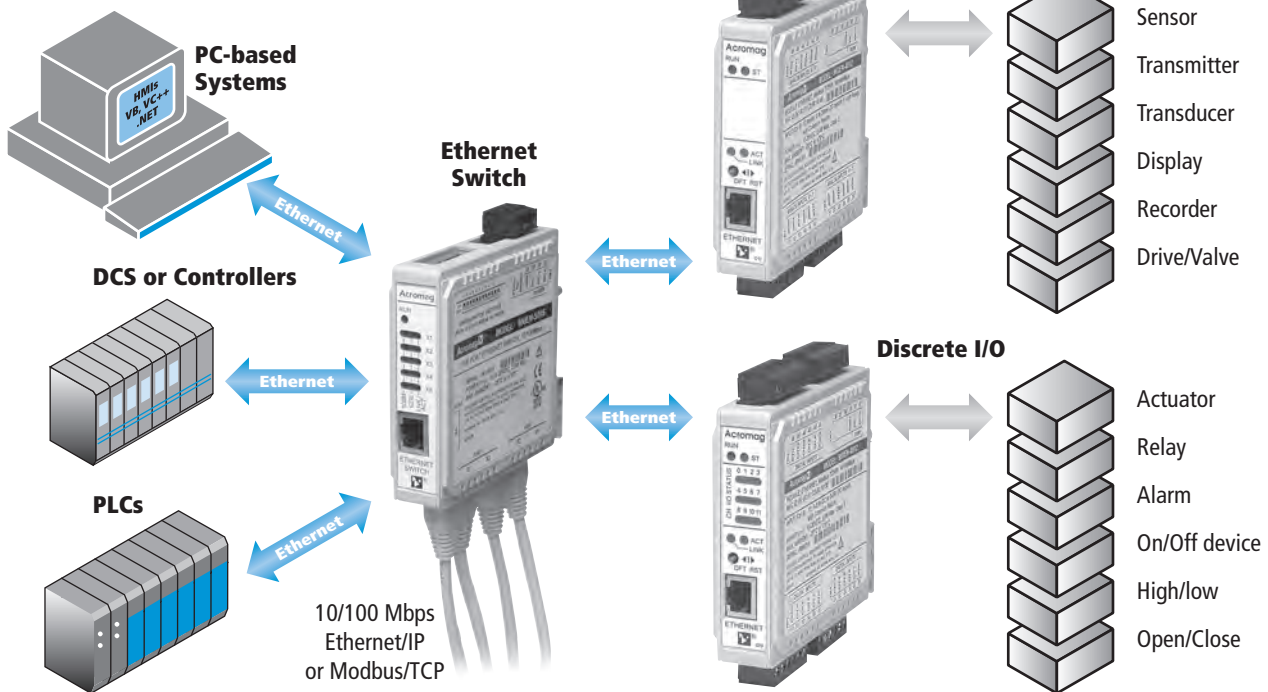
Sophisticated watchdog timers increase system reliability. All I/O modules have a watchdog that monitors the microcontroller for failed operations or a "lock-up" condition and automatically resets the unit. If host communication is lost and a configurable watchdog timer expires, all analog and discrete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

**24HR** Ready to ship within 24-hours from stock.  
**5YR** Backed by a 5-year warranty.

## Special Features

- **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
- **Network Security:**  
Configuration enables password protection
- **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 -25 to 70°C

## Ethernet Remote I/O Architecture





## Discrete I/O

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

## Analog Input

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
- Thermocouple
- RTD/resistance
- AC current

### Functions

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

## Analog Output

Analog output modules are ideal for controlling a wide variety of industrial equipment. 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.

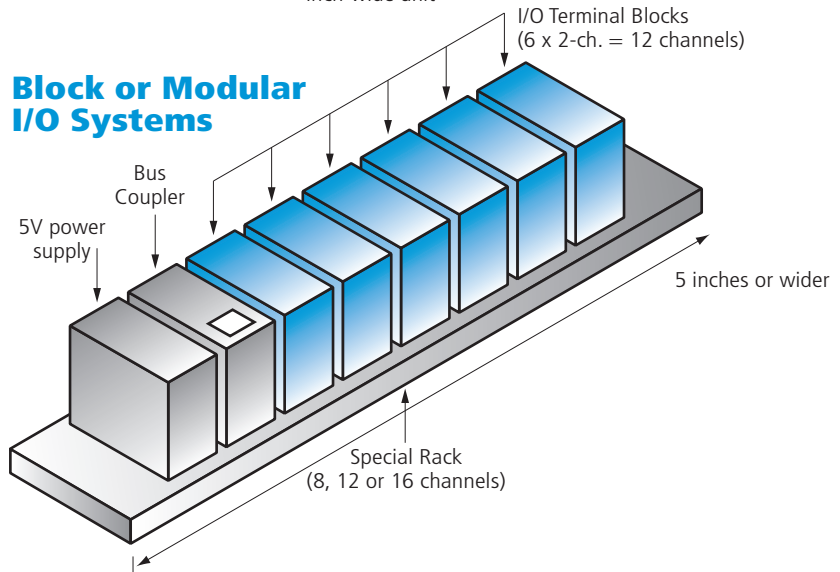
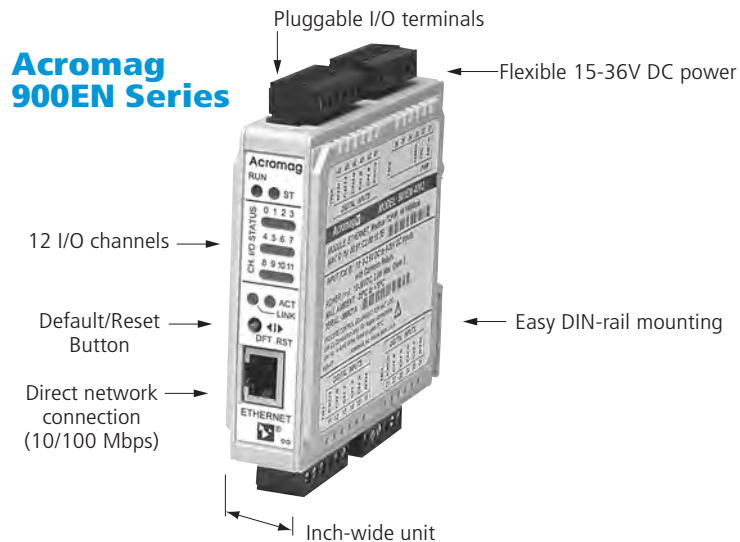
### Outputs

- 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 I/O

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

- Configures with standard web browser
- Direct connection to network
- Up to 12 channels on one module
- One inch wide for twelve 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



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

### i2o input-to-output communication

Acromag's new 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 (6)

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

### Discrete Inputs (12)

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

### Any Ethernet Media

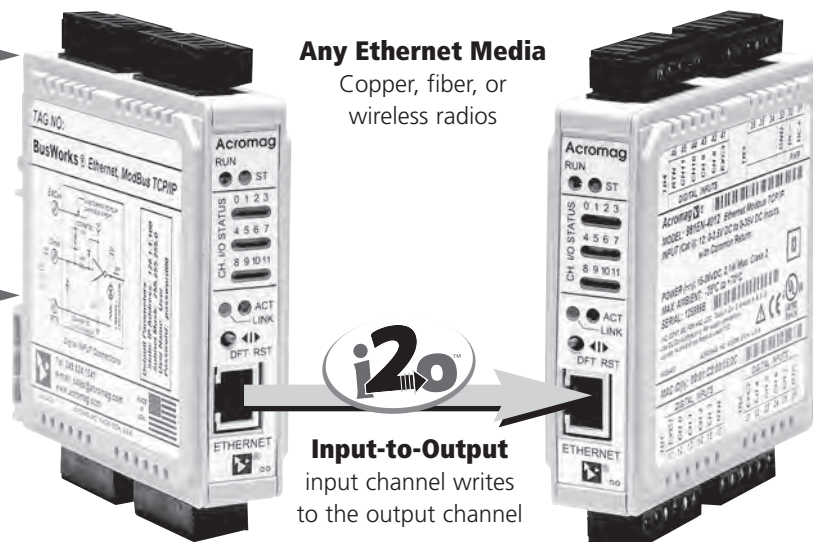
Copper, fiber, or wireless radios

### Analog Outputs (6)

proportional 4-20mA or 0-10V DC

### Discrete Outputs (12)

on/off, high/low, open/close







## 900EN Series Modules with i2o

### Analog Input Modules

- 961EN-4006  
6 differential current inputs
- 962EN-4006  
6 differential voltage inputs
- 965EN-4006  
6 thermocouple/mV inputs
- 966EN-4006  
6 RTD/resistance inputs

### Analog Output Modules

- 972EN-4004  
4 current outputs
- 972EN-4006  
6 current outputs
- 973EN-4004  
4 voltage outputs
- 973EN-4006  
6 voltage outputs

### Discrete I/O Modules

- 982EN-4012  
12 solid-state relay outputs
- 983EN-4012  
12 solid-state input/outputs

### Combo Modules

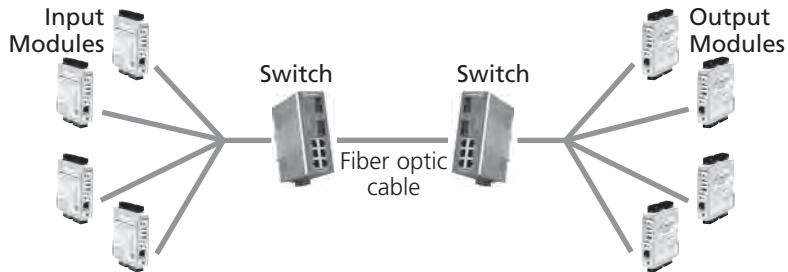
- 951EN-4012  
4 analog inputs, 2 analog outputs, 6 discrete I/O
- 952EN-4012  
4 analog inputs, 2 analog outputs, 6 discrete I/O

### Installation #1: Copper Ethernet network

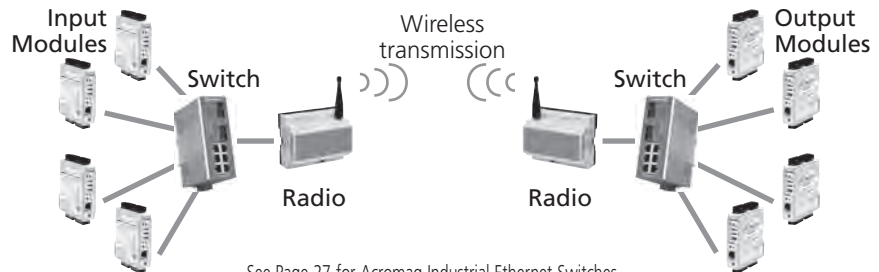


NOTE:  
Buy modules in pairs.  
  
For example:  
AI with AO,  
DIO with DO or DIO  
Combo with Combo

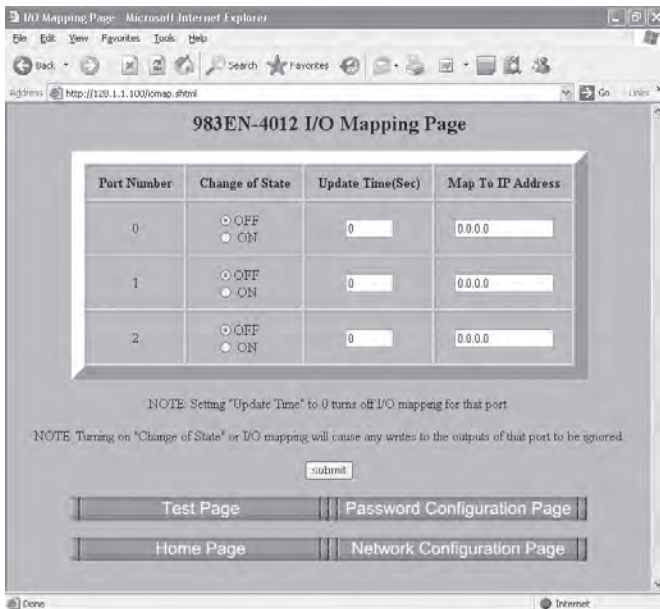
### Installation #2: Fiber optic connection



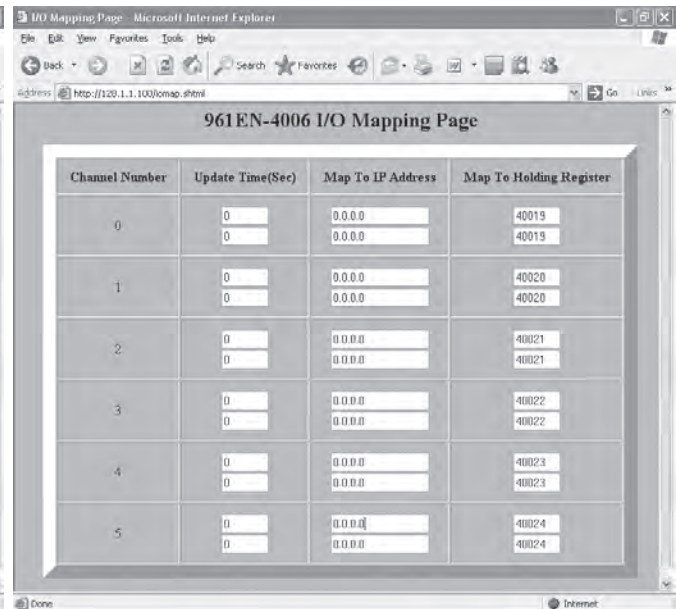
### Installation #3: Wireless connection (telemetry systems)



See Page 27 for Acromag Industrial Ethernet Switches.



Discrete I/O Module configuration screen



Analog Input Module configuration screen



## 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 timeout 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.

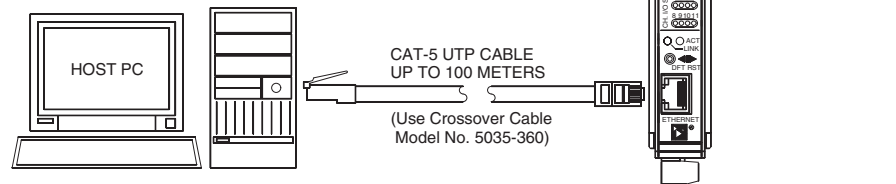


Figure 1: Plug the Ethernet cable from your computer into the I/O module's RJ-45 port to start configuration.

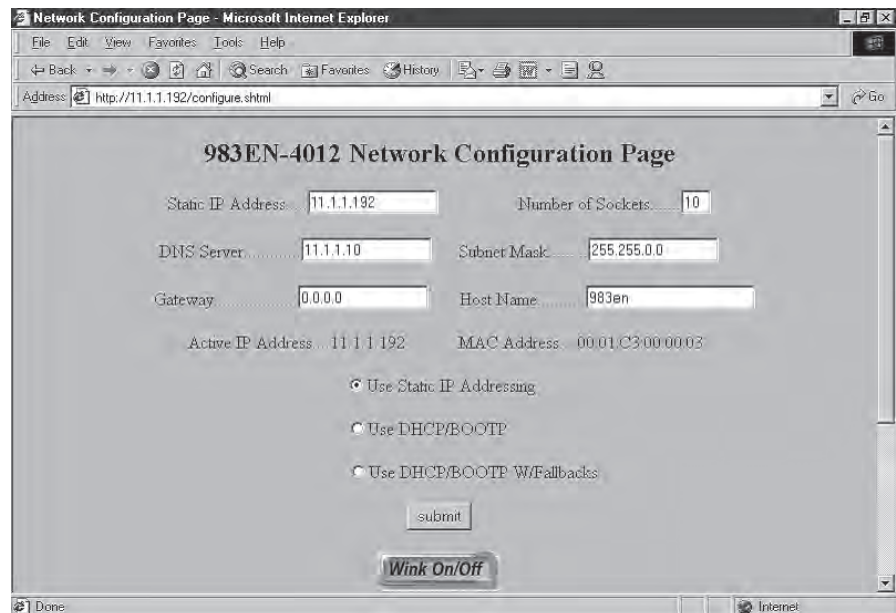


Figure 2: A web page is embedded into each module for easy configuration using a standard web browser.



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



## 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)

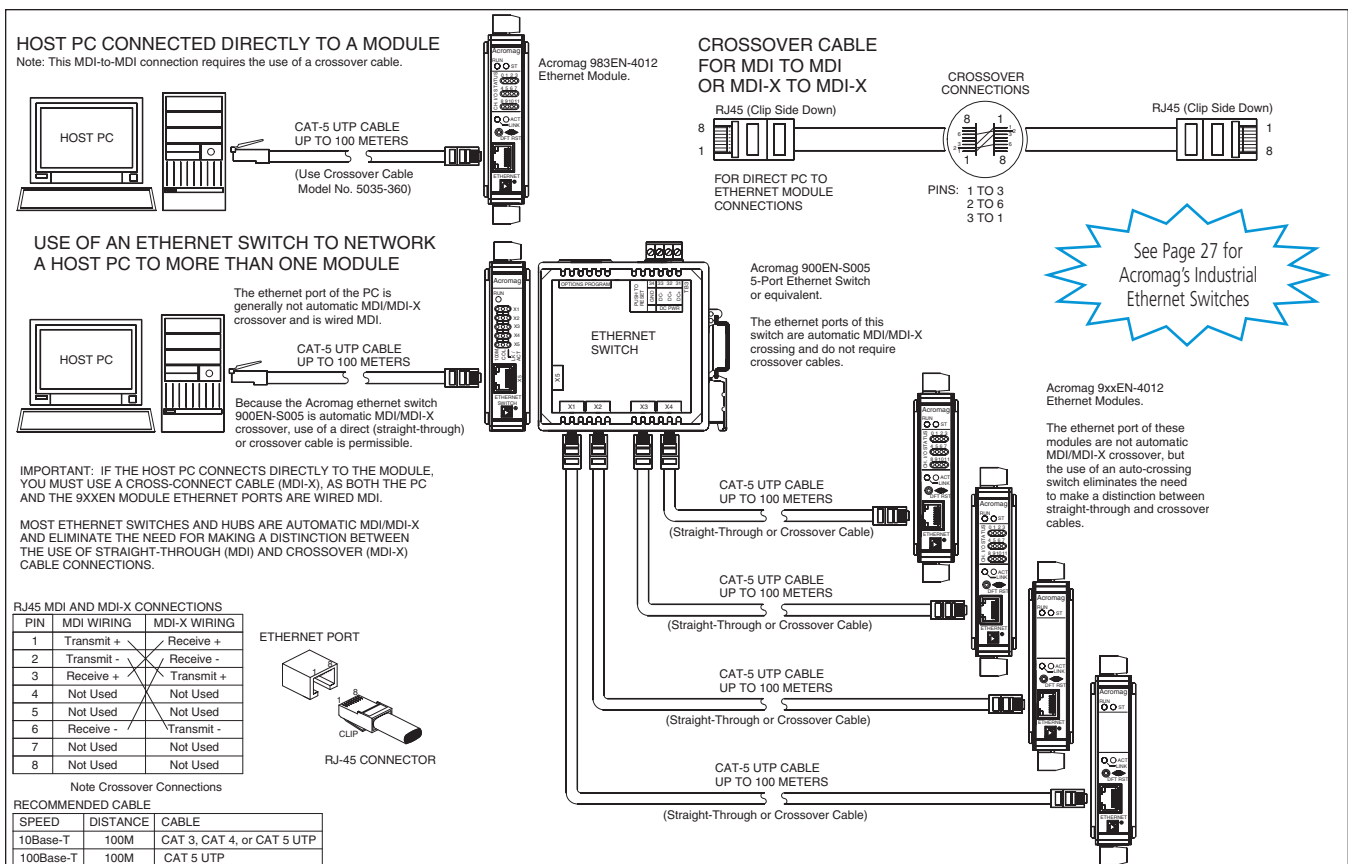
Per EN61000-4-6.

#### Surge Immunity

Per EN61000-4-5.

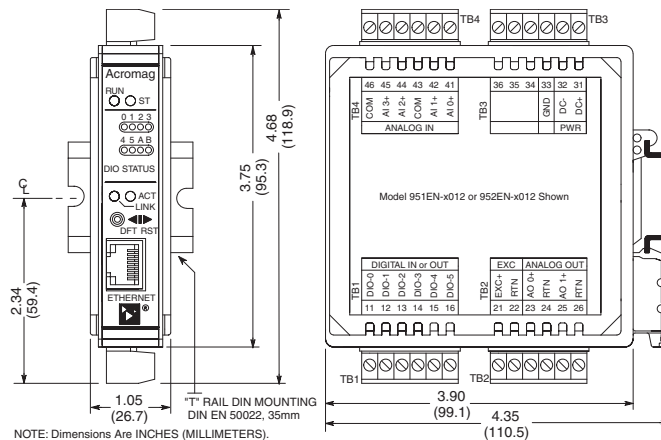
#### Radiated Frequency Emissions

Per EN55022 Class B.





## EtherNet/IP or Modbus TCP/IP



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



**EtherNet/IP™**  
conformance tested

**Modbus/TCP**  
conformance tested

## 951EN, 952EN Combination I/O

**Analog Inputs (4),  
Analog Outputs (2),  
Discrete I/O (6)**

### Models

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

### Description

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

### Special Features

- 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 14)
- Multi-function, multi-channel stand-alone module is very economical
- High-resolution 16-bit  $\Sigma\text{-}\Delta$  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





## ■ Performance

### ■ General Specifications

See Page 17 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 Info

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

### Models

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

See Page 26 for cables, power supplies, mounting hardware, optional terminal blocks and AC sensors.

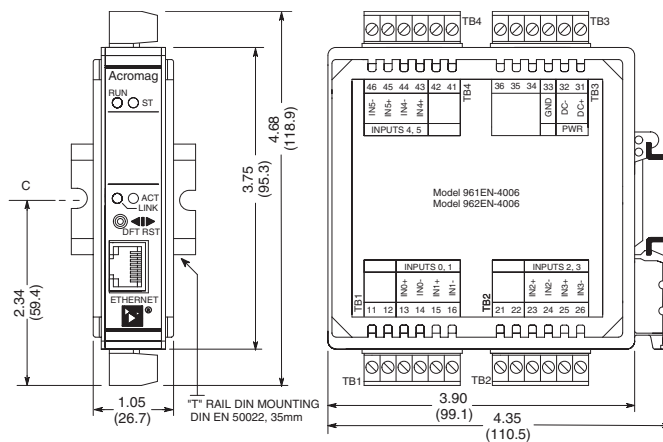
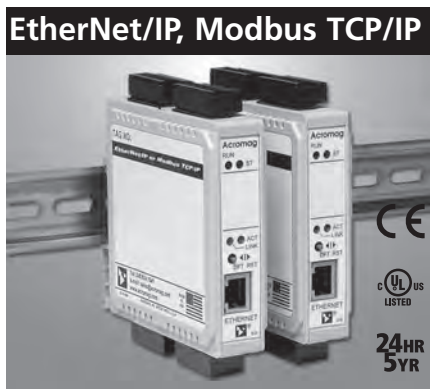
### Industrial Ethernet Switches

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.



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



**EtherNet/IP™**  
conformance tested

**Modbus/TCP**  
conformance tested

## 961EN, 962EN Analog Input

### 6-Channel Differential Input: DC Current or DC Voltage Signals

#### Models

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

#### Description

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

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)

±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 marked. UL, cUL listed.

Class I; Division 2; Groups A, B, C, D.

EtherNet/IP, Modbus TCP/IP conformance tested.

#### Special Features

- 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 14)
- 6-input stand-alone module is very economical
- Differential inputs eliminate ground loops
- Universal inputs support a variety of sensors
- High-resolution 16-bit  $\Sigma$ - $\Delta$  A/D converters ensure precise, high accuracy measurements
- Compact packaging with pluggable terminals saves space and simplifies wiring
- Wide operational temperature range permits installation in extreme environments

#### Performance

##### General Specifications

See Page 17 for communication and other specs.

##### Input Configuration

Input ranges are selectable for a 3-channel group.

##### Accuracy

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

##### 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 Filter Bandwidth

-3dB at 3Hz, typical.

##### Input Conversion Rate

80mS per channel.

##### DC Current Input Impedance

25 ohms.

##### DC Voltage Input Impedance

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 Info

NOTE: i2o function is only available on Ethernet Modbus TCP/IP modules

#### Models

##### 961EN-4006

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

##### 961EN-6006

Current input, 6-channel, EtherNet/IP interface

##### 962EN-4006

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

##### 962EN-6006

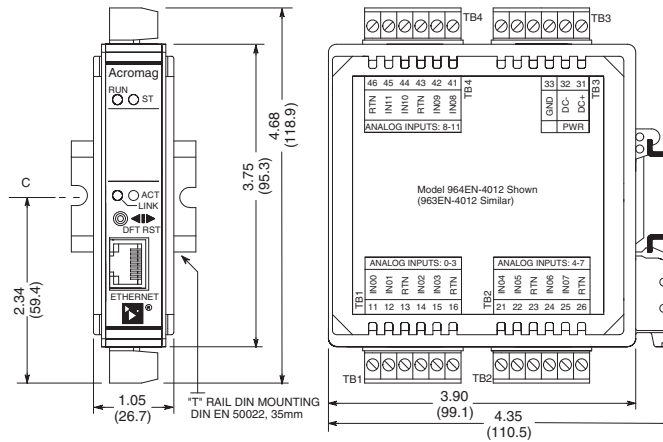
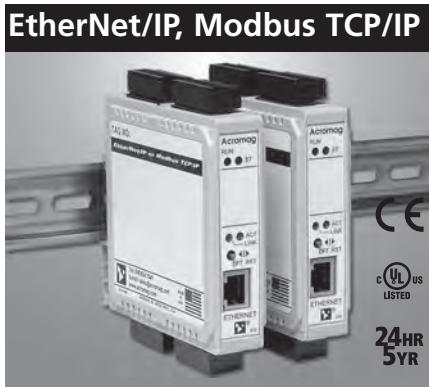
Voltage input, 6-channel, EtherNet/IP interface

#### Accessories

See Page 26 for cables, power supplies, mounting hardware, optional terminal blocks and AC sensors.

#### Industrial Ethernet Switches

See Page 27



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

**EtherNet/IP™**  
conformance tested

**Modbus/TCP**  
conformance tested

## 963/964EN Analog Input

### 12-Channel Single-Ended Input: DC Current or DC Voltage Signals

#### Models

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

#### Description

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

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, 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 marked. UL, cUL listed.

Class I; Division 2; Groups A, B, C, D.

EtherNet/IP, Modbus TCP/IP conformance tested.

#### Special Features

- 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
- Compact packaging with pluggable terminals saves space and simplifies wiring
- Wide operational temperature range permits installation in extreme environments

#### Performance

##### General Specifications

See Page 17 for communication and other specs.

##### Input

###### Configuration

Input ranges are selectable on each terminal block for a group of four input channels (4-channel basis).

###### Accuracy

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

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

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

###### Resolution

0.005% or 1 part in 20000, typical.

###### 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.

DC Current Input Impedance  
49.9 ohms.

DC Voltage Input Impedance  
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 Info

##### Models

963EN-4012

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

963EN-6012

Current input, 12-channel, EtherNet/IP interface

964EN-4012

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

964EN-6012

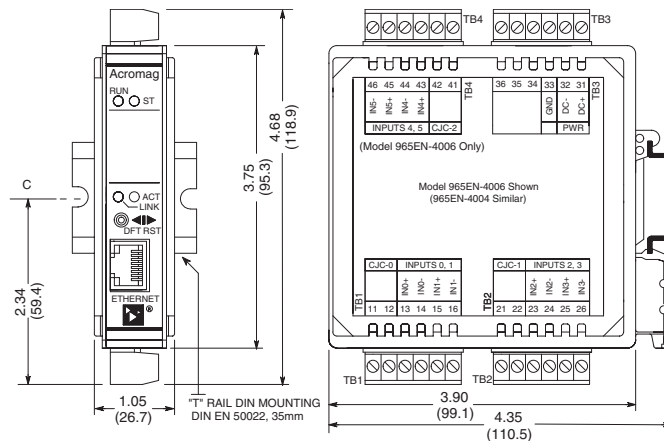
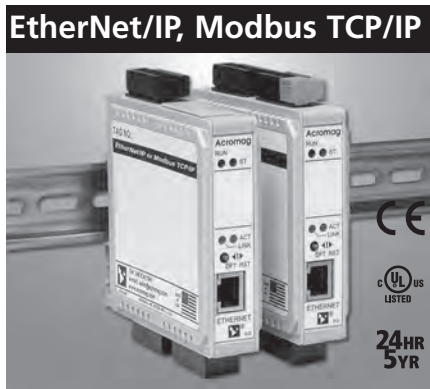
Voltage input, 12-channel, EtherNet/IP interface

##### Accessories

See Page 26 for cables, power supplies, mounting hardware, optional terminal blocks and AC sensors.

##### Industrial Ethernet Switches

See Page 27



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



**EtherNet/IP™**  
conformance tested

**Modbus/TCP**  
conformance tested

## 965EN Analog Input

### 4 or 6-Channel Input: Thermocouple or Millivolt Signals

#### 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

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

#### Power Requirement

15 to 36V DC supply (2 Watts) required

#### Approvals

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

#### Special Features

- Configurable from standard web browser
- EtherNet/IP or Modbus TCP/IP communication with auto 10/100Mbps data rate negotiation
- 6-input stand-alone module is very economical
- Universal inputs support a variety of sensors
- Built-in CJC sensor on each terminal block produces more precise temperature measurements
- Thermocouple break detection (upscale or downscale) identifies sensor wiring failures
- High-resolution 16-bit  $\Sigma$ - $\Delta$  A/D converters ensure precise, high accuracy measurements
- Compact packaging with pluggable terminals
- Wide operational temperature range

#### Performance

##### General Specifications

See Page 17 for communication and other specs.

##### Input Configuration

Input ranges are selectable for a 3-channel group.

##### 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 Info

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

##### Models

###### 965EN-4004

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

###### 965EN-6004

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

###### 965EN-4006

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

###### 965EN-6006

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

##### Accessories

See Page 26 for cables, power supplies, mounting hardware, and optional terminal blocks.

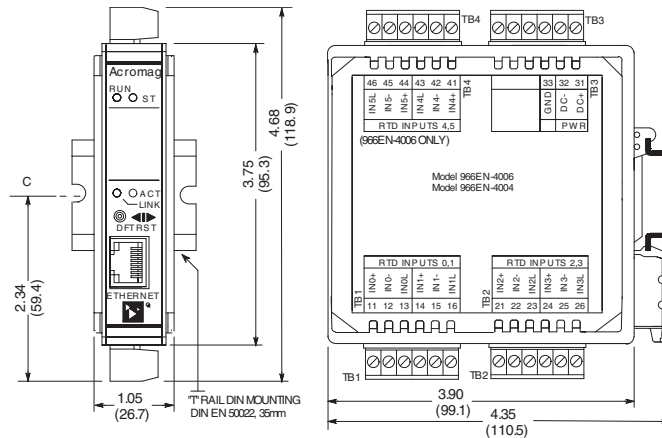
##### Industrial Ethernet Switches

See Page 27





## EtherNet/IP, Modbus TCP/IP



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



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**Modbus/TCP**  
conformance tested

## 966EN Analog Input

### 4 or 6-Channel Input: RTD or Resistance Signals

#### 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

RTD (user-selectable type)

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

#### Power Requirement

15 to 36V DC supply (2 Watts) required

#### Approvals

CE marked. UL, cUL listed.

Class I; Division 2; Groups A, B, C, D.

EtherNet/IP, Modbus TCP/IP conformance tested.

#### Special Features

- Configurable from standard web browser
- EtherNet/IP or Modbus TCP/IP communication with auto 10/100Mbps data rate negotiation
- 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
- Compact packaging with pluggable terminals saves space and simplifies wiring
- Wide operational temperature range permits installation in extreme environments

#### Performance

##### General Specifications

See Page 17 for communication and other specs.

##### Input

##### Configuration

Input ranges are selectable for a 3-channel group.

##### 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 Info

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

#### Models

966EN-4004

4-channel RTD input, Ethernet Modbus TCP/IP interface

966EN-6004

4-channel RTD input, EtherNet/IP interface

966EN-4006

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

i2o communication

966EN-6006

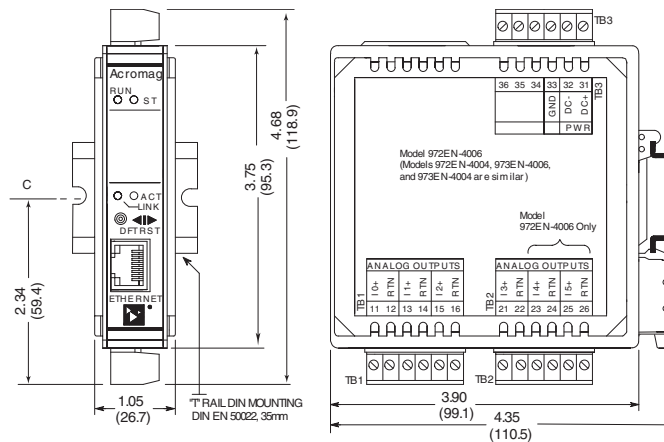
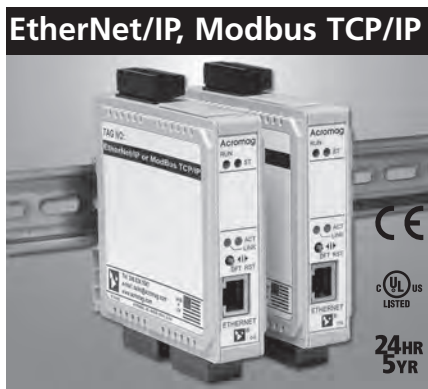
6-channel RTD input, EtherNet/IP interface

#### Accessories

See Page 26 for cables, power supplies, mounting hardware, and optional terminal blocks.

#### Industrial Ethernet Switches

See Page 27



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



**EtherNet/IP™**  
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**Modbus/TCP**  
conformance tested

## 972/973EN Analog Output

### 4 or 6-Channel Output: DC Current or DC Voltage Signals

#### Models

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

#### Description

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

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/IP 10/100Mbps

#### Power Requirement

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

#### Approvals

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

#### Special Features

- Configurable from standard web browser
- EtherNet/IP or Modbus TCP/IP communication with auto 10/100Mbps data rate negotiation
- 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
- Compact packaging with pluggable terminals saves space and simplifies wiring
- Wide operational temperature range permits installation in extreme environments

#### Performance

##### General Specifications

See Page 17 for communication and other specs.

##### Configuration

Output ranges selectable on channel to channel basis.

##### 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 Info

NOTE: i2o function is only available on Ethernet Modbus TCP/IP modules

#### Models

- 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

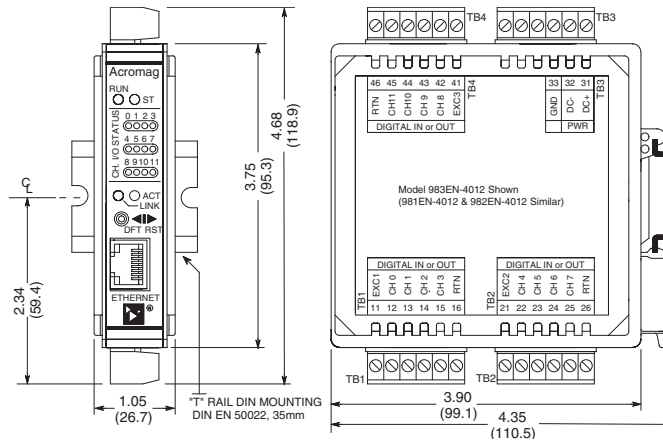
See Page 26 for cables, power supplies, mounting hardware, and optional terminal blocks.

#### Industrial Ethernet Switches

See Page 27



## EtherNet/IP, Modbus TCP/IP



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



**EtherNet/IP™**  
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**Modbus/TCP**  
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## 981/982/983EN Discrete I/O

### 12-Channel I/O: Active-Low Inputs, Sinking Outputs (Low-Side Switching)

#### Models

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

#### Description

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

#### Power Requirement

15 to 36V DC supply (2 Watts) required

#### Approvals

CE marked. UL, cUL listed.

Class I; Division 2; Groups A, B, C, D.

EtherNet/IP, Modbus TCP/IP conformance tested.

#### Special Features

- Configurable from standard web browser
- EtherNet/IP or Modbus TCP/IP communication with auto 10/100Mbps data rate negotiation
- 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
- Compact packaging with pluggable terminals saves space and simplifies wiring
- Wide operational temperature range

#### Performance

##### General Specifications

See Page 17 for communication and other specs.

##### 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 Info

NOTE: i2o function is only available on Ethernet Modbus TCP/IP modules with discrete outputs

##### Models

###### 981EN-4012

Discrete input, Ethernet Modbus TCP/IP

###### 981EN-6012

Discrete input, EtherNet/IP

###### 982EN-4012

Discrete output, Ethernet Modbus TCP/IP,

i2o communication

###### 982EN-6012

Discrete output, EtherNet/IP

###### 983EN-4012

Discrete input/output, Ethernet Modbus TCP/IP,

i2o communication

###### 983EN-6012

Discrete input/output, EtherNet/IP

##### Accessories

See Page 26 for cables, power supplies, mounting hardware, and optional terminal blocks.

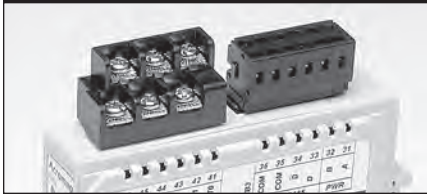
##### Industrial Ethernet Switches

See Page 27



## Accessories

### Terminal Blocks



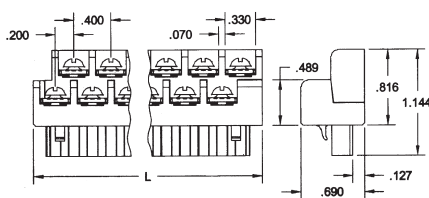
Barrier strip (left) and spring clamp (right).

#### Ordering Information

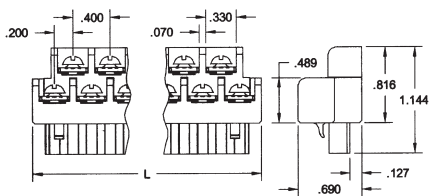
See individual I/O modules for compatibility.

#### Barrier Strip Terminal Blocks\*

##### EVEN CONFIGURATION



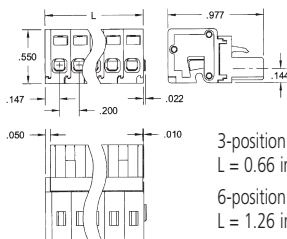
##### UNEVEN CONFIGURATION



**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 Terminal Blocks\*



Wire range:  
AWG #12-26

3-position:  
L = 0.66 inches (16.9 mm)  
6-position:  
L = 1.26 inches (32.3 mm)

**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

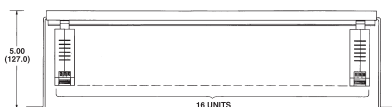
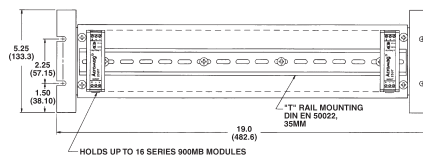


#### DIN-Rail Mounting

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 precut 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)



\* **NOTE:**  
Standard I/O Modules include cage clamp terminal blocks.  
Terminal block kits are for replacement purposes.

### Power Supplies



#### 50W Supply

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

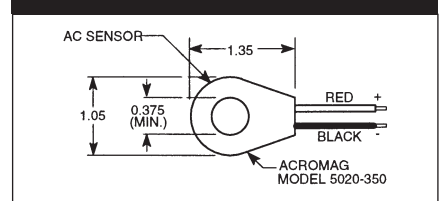
**Output**  
24V DC, 2.1A (50W)

#### Ordering Information

**P55R-D24**  
Universal 50W power supply

See Page 199 for other models and more information.

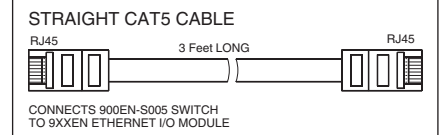
### AC Current Sensor



#### Ordering Information

**5020-350**  
AC current sensor (see Page 205)

### Cables



#### Ordering Information

**5035-355**  
Ethernet straight cable, CAT5, 3 feet long, shielded  
**5035-360**  
Ethernet crossover cable, CAT5E, 5 feet long, shielded  
**5035-365**  
Configuration cable for advanced features, DB-25 PC parallel port to dual row connector, 4 feet long