BusWorks® 900EN Series – Modbus TCP/IP 10/100M Industrial Ethernet I/O Modules

Model 961EN-4006 Six Differential Current Inputs
Model 962EN-4006 Six Differential Voltage Inputs

USER'S MANUAL

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Dynamic Host Configuration Protocol (DHCP)

DHCP refers to Dynamic Host Configuration Protocol and is a method used to dynamically assign temporary numeric IP addresses as required. A DHCP server maintains a pool of shared IP addresses which are recycled. When a DHCP device wants to use a TCP/IP application, it must request an IP address from the DHCP server. The DHCP server will check the shared supply, and if all addresses are in use, the server will send a busy signal to the client which tells it to try again later. Static addresses will ensure a connection every time, but dynamic addresses do not.

Domain Name System (DNS)

DNS refers to the Domain Name System or Domain Name Server and refers to the system used to associate an alphanumeric character string with a numeric IP address. The DNS is actually a distributed database of domain names and corresponding IP addresses. The DNS allows us to use Acromag.com as an IP address rather than a complicated string of numbers. Note that name servers contain information on some segment of the domain name space and make this information available to clients called *resolvers*.

MODBUS REGISTERS

Modbus registers are organized into reference types identified by the leading number of the reference address:

Reference	Description
0xxxx	Read/Write Discrete Outputs or Coils. A 0x reference address is used to drive output data to a digital output channel.
1xxxx	Read Discrete Inputs. The ON/OFF status of a 1x reference address is controlled by the corresponding digital input channel.
3xxxx	Read Input Registers. A 3x reference register contains a 16-bit number received from an external source—e.g. an analog signal.
4xxxx	Read/Write Output or Holding Registers. A 4x register is used to store 16-bits of numerical data (binary or decimal), or to send the data from the CPU to an output channel.

The "x" following the leading character represents a four-digit address location in user data memory.

The leading character is generally implied by the function code and omitted from the address specifier for a given function. The leading character also identifies the I/O data type.

Note: The ON/OFF state of discrete inputs and outputs is represented by a 1 or 0 value assigned to an individual bit in a 16-bit data word. This is sixteen 0x or 1x references per data word. With respect to mapping, the LSB of the word maps to the lowest numbered channel of a group and channel numbers increase sequentially as you move towards the MSB. Unused bit positions are set to zero.

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

Register Functions

Each module has a default factory configuration as noted in the SPECIFICATIONS section. Your application will likely differ from the default configuration and the module will need to be reconfigured. You may reconfigure this module by issuing the appropriate Modbus functions to Register Map registers, as required by your application. You may also use a standard web browser to access the built-in web pages of the module to perform basic operations.

Register Functions

Below is a subset of standard Modbus functions that are supported by this module along with the reference register addresses that the function operates on. Use these functions to access these registers as outlined in the Register Map for sending and retrieving data.

IMPORTANT: *When using your own software to manipulate the module, please note that the maximum query through the Modbus TCP interface is only 50 registers, due to the maximum buffer size limitations of the TCP/IP stack. As such, you can only request data from 50 registers at one time for commands that access multiple registers. For example, the Read Holding Registers command may only retrieve the contents of registers 40001 to 40051 in one read.*

The following Modbus functions operate on register map registers to monitor, configure, and control module I/O:

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

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

961EN-4006 Report Slave ID Example Response[1]

FIELD	DESCRIPTION
Unit ID	Echo Unit ID Sent In Query
Function Code	11
Byte Count	42
Slave ID (Model No.)	00=961EN-4006 (6 Diff Current In w/Modbus) 01=962EN-4006 (6 Diff Voltage In w/Modbus)
Run Indicator Status	FFH (ON)
Firmware Number String (Additional Data Field)	41 43 52 4F 4D 41 47 2C 39 33 30 30 2D **31 32 31** 2C 39 **36 31** 45 4E 2D **34 30 30 36** 2C *30 31 32 33 34 35 41* 2C *30 31 32 33 34 35* ("ACROMAG,9300-**118**,9**61**EN-**4006**,*serial number&rev*,*six-byteMACID*")

[1] **Note:** For Model 962EN-4006, the slave ID is "01" and the firmware number is "9300-119".

For detailed information on Modbus, feel free to download our technical reference "Introduction To Modbus" at www.acromag.com.

Register Mirroring

For your convenience, 9xxEN Ethernet modules mirror the contents and operation of registers 0xxxx, 1xxxx, & 3xxxx (as applicable) into holding register space for systems and controllers that cannot directly access registers 0xxxx, 1xxxx, & 3xxxx.

All Modbus registers of this model can now be written to, or read from, using either the standard methods described in the Modbus specification, or through mapping (mirroring) to the Holding Registers. The registers are mapped as follows and specifics follow the mapping:

Register Mirroring

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

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

For the 1xxxx Input Status Registers (where supported), the return data is reformatted to match the Holding Register format. For example: if you request the Input Status for 12 digital inputs, instead of getting 2 bytes returned with the first 12 bits representing the 12 digital inputs, you will get 12 separate words, each set to either 0000H (OFF), or FFFFH (ON).

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

Note that with respect to Acromag 9xxMB Modbus RTU modules, only 3xxxx Input Registers are mirrored into 4xxxx space, not Coil or Input Status registers as noted here for 9xxEN models.

Data Types

I/O values for Series 900EN modules are represented by the following simple data types for temperature, percentage, and discrete on/off.

Summary Of Data Types Used By 900MB/900EN Modules

Data Types	Description
Normalized Data Count (This Model)	A 16-bit signed integer value is used to represent ±20000 counts for bipolar input ranges and 0-20000 counts for unipolar input ranges. For example, -5V, 0V and +5V are represented by integer values –20000, 0, and 20000 for bipolar devices, respectively.
Temperature	A 16-bit signed integer value with resolution of 0.1°C/lsb represents the range of a TC type measured in degrees C. A 16-bit signed integer value with resolution of 0.1°C/lsb. For example, a value of 12059 is equivalent to 1205.9°C, a value of –187 equals –18.7°C
Discrete	A discrete value is generally indicated by a single bit of a 16-bit word. The bit number/position typically corresponds to the discrete channel number. Unless otherwise defined for outputs, a 1 bit means the corresponding output is closed or ON, a 0 bit means the output is open or OFF. For inputs, a value of 1 means the input is ON (Active low near 0V), while a value of 0 specifies the input is OFF or in its high state (usually >> 0V).

Register Map

Model 961EN-4006
Model 962EN-4006

The following table outlines the register map for the Model 961EN-4006 and 962EN-4006 network input modules. The Modbus functions operate on these registers using the data types noted above (except for the Reset Slave and Report Slave ID functions). Unless otherwise noted, Holding Register values are maintained in flash memory and are non-volatile.

Ref	Addr.	Description	Data Type/Format
Input Registers (3x References, Read-Only)			
30001	0000	Module Status	Bit 15: 0 (Not Used) Bit 14: Wink Mode Flag 1 = Wink Mode (Blinks Run LED for ID) 0 = Normal Operation (See Wink Module Register) Bit 13: Default Mode Flag 1 = Default Mode Indicator 0 = Not Default Mode Bits 12-0: 0 (Not Used)
30002	0001	Input Range (CH 0,1,2)	Bits 15-4: 0 (Not Used) Bits 3,2,1,0: 961EN / 962EN 0000: 0=0-20mA / 0=±10V 0001: 1=4-20mA / 1=±5V 0010: 2=0-11.17mA / 2=±2.5V 0011: 3=0-1mA / 3=±1.25V 0100: *Reserved* / 4=±625mV 0101: *Reserved* / 5=±313mV 0110: *Reserved* / 6=±156mV 0111: *Reserved* / 7=±78mV 1000-1111: *Reserved*
30003	0002	Input Range (CH 3,4,5)	*Format is same as Above.*
30004	0003	CH00 Status	Bits 15-2: 0 (Not Used) Bits 1,0: Input Signal Status 00: In Range 01: Over-Range 10: Under-Range 11: Not Used
30005	0004	CH01 Status	Bits 15-2: 0 (Not Used) Bits 1,0: Input Signal Status 00: In Range 01: Over-Range 10: Under-Range 11: Not Used
30006	0005	CH02 Status	Bits 15-2: 0 (Not Used) Bits 1,0: Input Signal Status 00: In Range 01: Over-Range 10: Under-Range 11: Not Used

Register Map

Model 961EN-4006
Model 962EN-4006

Ref	Addr.	Description	Data Type/Format
Input Registers (3x References, Read-Only)			
30007	0006	CH03 Status	Bits 15-2: 0 (Not Used) Bits 1,0: Input Signal Status 00 In Range 01 Over-Range 10 Under-Range 11 Not Used
30008	0007	CH04 Status	Bits 15-2: 0 (Not Used) Bits 1,0: Input Signal Status 00 In Range 01 Over-Range 10 Under-Range 11 Not Used
30009	0008	CH05 Status	Bits 15-2: 0 (Not Used) Bits 1,0: Input Signal Status 00 In Range 01 Over-Range 10 Under-Range 11 Not Used
30010	0009	CH00 Value	*Count*
30011	000A	CH01 Value	*Count*
30012	000B	CH02 Value	*Count*
30013	000C	CH03 Value	*Count*
30014	000D	CH04 Value	*Count*
30015	000E	CH05 Value	*Count*
30016	000F	CH00 Count	*Raw A/D Count Value*
30017	0010	CH01 Count	*Raw A/D Count Value*
30018	0011	CH02 Count	*Raw A/D Count Value*
30019	0012	CH03 Count	*Raw A/D Count Value*
30020	0013	CH04 Count	*Raw A/D Count Value*
30021	0014	CH05 Count	*Raw A/D Count Value*
Holding Registers (4x References, Read/Write)			
40001	0000	Input Range (CH 0,1,2)	Bits 15-4: 0 (Not Used) Bits 3,2,1,0: 961EN / 962EN 0000 0=0-20mA / 0=±10V 0001 1=4-20mA / 1=±5V 0010 2=0-11.17mA / 2=±2.5V 0011 3=0-1mA / 3=±1.25V 0100 *Reserved* / 4=±625mV 0101 *Reserved* / 5=±313mV 0110 *Reserved* / 6=±156mV 0111 *Reserved* / 7=±78mV 1000-1111 *Reserved*
40002	0001	Input Range (CH 3,4,5)	*Format is same as Above.*

Note: *Changes to Holding Registers take effect immediately.*

Register Map

Model 961EN-4006
Model 962EN-4006

Note: *Changes to Holding Registers take effect immediately.*

Ref	Addr.	Description	Data Type/Format
Holding Registers (4x References, Read/Write)			
40003	0002	*Reserved*	*Do Not Use*
40004	0003	*Reserved*	*Do Not Use*
40005	0004	*Reserved*	*Do Not Use*
40006	0005	*Reserved*	*Do Not Use*
40007	0006	*Reserved*	*Do Not Use*
40008	0007	*Port 0 Scaling Low*	*Reserved For Factory Use - Do Not Use*
40009	0008	*Reserved*	*Do Not Use*
40010	0009	*Port 0 Scaling High*	*Reserved For Factory Use - Do Not Use*
40011	000A	*Reserved*	*Do Not Use*
40012	000B	*Port 1 Scaling Low*	*Reserved For Factory Use - Do Not Use*
40013	000C	*Reserved*	*Do Not Use*
40014	000D	*Port 1 Scaling High*	*Reserved For Factory Use - Do Not Use*
40015	000E	*Reserved*	*Do Not Use*
40016	000F	*Reserved*	*Do Not Use*
40017	0010	*Reserved*	*Do Not Use*
40018	0011	*Reserved*	*Do Not Use*
40019	0012	*Reserved*	*Do Not Use*
40020	0013	*Reserved*	*Do Not Use*
40021	0014	Calibration Access And Wink Mode Toggle And Restore Factory Calibration And **Factory Use Only** *This register is not maintained in flash.*	Writing 24106 (5E2AH) here immediately removes write protection from the calibration registers that follow. All other values apply write protection to the calibration registers (except 21845, 44718, and 43981--See Below). Writing 21845 (5555H) to this register will cause the module to "Wink" its Run LED. Writing this value a second time will stop "Wink" (Toggles Wink ON/OFF). Writing 44718 (AEAEH) will cause the module to restore its factory calibration. This can only be done after "Save Factory Calibration" has been done at the factory. Writing 43981 (ABCDH) is reserved for factory use. **This should not be performed by anyone else or operation will be degraded.** This register always reads back 0. After a reset, this register is set back to 0 (write protection enabled and no wink).

Ref	Addr.	Description	Data Type/Format
Holding Registers (4x References, Read/Write)			
40022	0015	*CH0 Cal Hi Range 0*	*Raw A/D Count Value . 0-20mA (961EN) or ±10V (962EN)*
40023	0016	*CH0 Cal Lo Range 0*	*Raw A/D Count Value . 0-20mA (961EN) or ±10V (962EN)*
40024	0017	*CH0 Cal Hi Range 1*	*Raw A/D Count Value . 4-20mA (961EN) or ±5V (962EN)*
40025	0018	*CH0 Cal Lo Range 1*	*Raw A/D Count Value . 4-20mA (961EN) or ±5V (962EN)*
40026	0019	*CH0 Cal Hi Range 2*	*Raw A/D Count Value . 0-11.17mA (961EN) or ±2.5V (962EN)*
40027	001A	*CH0 Cal Lo Range 2*	*Raw A/D Count Value . 0-11.17mA (961EN) or ±2.5V (962EN)*
40028	001B	*CH0 Cal Hi Range 3*	*Raw A/D Count Value . 0-1mA (961EN) or ±1.25V (962EN)*
40029	001C	*CH0 Cal Lo Range 3*	*Raw A/D Count Value . 0-1mA (961EN) or ±1.25V (962EN)*
40030	001D	*CH0 Cal Hi Range 4*	*Raw A/D Count Value . ±625mV (962EN)*
40031	001E	*CH0 Cal Lo Range 4*	*Raw A/D Count Value . ±625mV (962EN)*
40032	001F	*CH0 Cal Hi Range 5*	*Raw A/D Count Value . ±313mV (962EN)*
40033	0020	*CH0 Cal Lo Range 5*	*Raw A/D Count Value . ±313mV (962EN)*
40034	0021	*CH0 Cal Hi Range 6*	*Raw A/D Count Value . ±156mV (962EN)*
40035	0022	*CH0 Cal Lo Range 6*	*Raw A/D Count Value . ±156mV (962EN)*
40036	0023	*CH0 Cal Hi Range 7*	*Raw A/D Count Value . ±78mV (962EN)*
40037	0024	*CH0 Cal Lo Range 7*	*Raw A/D Count Value . ±78mV (962EN)*
40038	0025	*CH1 Cal Hi Range 0*	*Raw A/D Count Value . 0-20mA (961EN) or ±10V (962EN)*
40039	0026	*CH1 Cal Lo Range 0*	*Raw A/D Count Value . 0-20mA (961EN) or ±10V (962EN)*
40040	0027	*CH1 Cal Hi Range 1*	*Raw A/D Count Value . 4-20mA (961EN) or ±5V (962EN)*
40041	0028	*CH1 Cal Lo Range 1*	*Raw A/D Count Value . 4-20mA (961EN) or ±5V (962EN)*
40042	0029	*CH1 Cal Hi Range 2*	*Raw A/D Count Value . 0-11.17mA (961EN) or ±2.5V (962EN)*
40043	002A	*CH1 Cal Lo Range 2*	*Raw A/D Count Value . 0-11.17mA (961EN) or ±2.5V (962EN)*
40044	002B	*CH1 Cal Hi Range 3*	*Raw A/D Count Value . 0-1mA (961EN) or ±1.25V (962EN)*
40045	002C	*CH1 Cal Lo Range 3*	*Raw A/D Count Value . 0-1mA (961EN) or ±1.25V (962EN)*
40046	002D	*CH1 Cal Hi Range 4*	*Raw A/D Count Value . ±625mV (962EN)*

Register Map

Model 961EN-4006
Model 962EN-4006

Shaded 4xxxx register entries are Read Only

Register Map

Model 961EN-4006
Model 962EN-4006

Shaded 4xxxx register entries are Read-Only.

Ref	Addr.	Description	Data Type/Format
Holding Registers (4x References, Read/Write)			
40047	002E	*CH1 Cal Lo Range 4*	*Raw A/D Count Value . ±625mV (962EN)*
40048	002F	*CH1 Cal Hi Range 5*	*Raw A/D Count Value . ±313mV (962EN)*
40049	0030	*CH1 Cal Lo Range 5*	*Raw A/D Count Value . ±313mV (962EN)*
40050	0031	*CH1 Cal Hi Range 6*	*Raw A/D Count Value . ±156mV (962EN)*
40051	0032	*CH1 Cal Lo Range 6*	*Raw A/D Count Value . ±156mV (962EN)*
40052	0033	*CH1 Cal Hi Range 7*	*Raw A/D Count Value . ±78mV (962EN)*
40053	0034	*CH1 Cal Lo Range 7*	*Raw A/D Count Value . ±78mV (962EN)*
40054	0035	*CH2 Cal Hi Range 0*	*Raw A/D Count Value . 0-20mA (961EN) or ±10V (962EN)*
40055	0036	*CH2 Cal Lo Range 0*	*Raw A/D Count Value . 0-20mA (961EN) or ±10V (962EN)*
40056	0037	*CH2 Cal Hi Range 1*	*Raw A/D Count Value . 4-20mA (961EN) or ±5V (962EN)*
40057	0038	*CH2 Cal Lo Range 1*	*Raw A/D Count Value . 4-20mA (961EN) or ±5V (962EN)*
40058	0039	*CH2 Cal Hi Range 2*	*Raw A/D Count Value . 0-11.17mA (961EN) or ±2.5V (962EN)*
40059	003A	*CH2 Cal Lo Range 2*	*Raw A/D Count Value . 0-11.17mA (961EN) or ±2.5V (962EN)*
40060	003B	*CH2 Cal Hi Range 3*	*Raw A/D Count Value . 0-1mA (961EN) or ±1.25V (962EN)*
40061	003C	*CH2 Cal Lo Range 3*	*Raw A/D Count Value . 0-1mA (961EN) or ±1.25V (962EN)*
40062	003D	*CH2 Cal Hi Range 4*	*Raw A/D Count Value . ±625mV (962EN)*
40063	003E	*CH2 Cal Lo Range 4*	*Raw A/D Count Value . ±625mV (962EN)*
40064	003F	*CH2 Cal Hi Range 5*	*Raw A/D Count Value . ±313mV (962EN)*
40065	0040	*CH2 Cal Lo Range 5*	*Raw A/D Count Value . ±313mV (962EN)*
40066	0041	*CH2 Cal Hi Range 6*	*Raw A/D Count Value . ±156mV (962EN)*
40067	0042	*CH2 Cal Lo Range 6*	*Raw A/D Count Value . ±156mV (962EN)*
40068	0043	*CH2 Cal Hi Range 7*	*Raw A/D Count Value . ±78mV (962EN)*
40069	0044	*CH2 Cal Lo Range 7*	*Raw A/D Count Value . ±78mV (962EN)*
40070	0045	*CH3 Cal Hi Range 0*	*Raw A/D Count Value . 0-20mA (961EN) or ±10V (962EN)*
40071	0046	*CH3 Cal Lo Range 0*	*Raw A/D Count Value . 0-20mA (961EN) or ±10V (962EN)*

Ref	Addr.	Description	Data Type/Format
Holding Registers (4x References, Read/Write)			
40072	0047	*CH3 Cal Hi Range 1*	*Raw A/D Count Value . 4-20mA (961EN) or ±5V (962EN)*
40073	0048	*CH3 Cal Lo Range 1*	*Raw A/D Count Value . 4-20mA (961EN) or ±5V (962EN)*
40074	0049	*CH3 Cal Hi Range 2*	*Raw A/D Count Value . 0-11.17mA (961EN) or ±2.5V (962EN)*
40075	004A	*CH3 Cal Lo Range 2*	*Raw A/D Count Value . 0-11.17mA (961EN) or ±2.5V (962EN)*
40076	004B	*CH3 Cal Hi Range 3*	*Raw A/D Count Value . 0-1mA (961EN) or ±1.25V (962EN)*
40077	004C	*CH3 Cal Lo Range 3*	*Raw A/D Count Value . 0-1mA (961EN) or ±1.25V (962EN)*
40078	004D	*CH3 Cal Hi Range 4*	*Raw A/D Count Value . ±625mV (962EN)*
40079	004E	*CH3 Cal Lo Range 4*	*Raw A/D Count Value . ±625mV (962EN)*
40080	004F	*CH3 Cal Hi Range 5*	*Raw A/D Count Value . ±313mV (962EN)*
40081	0050	*CH3 Cal Lo Range 5*	*Raw A/D Count Value . ±313mV (962EN)*
40082	0051	*CH3 Cal Hi Range 6*	*Raw A/D Count Value . ±156mV (962EN)*
40083	0052	*CH3 Cal Lo Range 6*	*Raw A/D Count Value . ±156mV (962EN)*
40084	0053	*CH3 Cal Hi Range 7*	*Raw A/D Count Value . ±78mV (962EN)*
40085	0054	*CH3 Cal Lo Range 7*	*Raw A/D Count Value . ±78mV (962EN)*
40086	0055	*CH4 Cal Hi Range 0*	*Raw A/D Count Value . 0-20mA (961EN) or ±10V (962EN)*
40087	0056	*CH4 Cal Lo Range 0*	*Raw A/D Count Value . 0-20mA (961EN) or ±10V (962EN)*
40088	0057	*CH4 Cal Hi Range 1*	*Raw A/D Count Value . 4-20mA (961EN) or ±5V (962EN)*
40089	0058	*CH4 Cal Lo Range 1*	*Raw A/D Count Value . 4-20mA (961EN) or ±5V (962EN)*
40090	0059	*CH4 Cal Hi Range 2*	*Raw A/D Count Value . 0-11.17mA (961EN) or ±2.5V (962EN)*
40091	005A	*CH4 Cal Lo Range 2*	*Raw A/D Count Value . 0-11.17mA (961EN) or ±2.5V (962EN)*
40092	005B	*CH4 Cal Hi Range 3*	*Raw A/D Count Value . 0-1mA (961EN) or ±1.25V (962EN)*
40093	005C	*CH4 Cal Lo Range 3*	*Raw A/D Count Value . 0-1mA (961EN) or ±1.25V (962EN)*
40094	005D	*CH4 Cal Hi Range 4*	*Raw A/D Count Value . ±625mV (962EN)*
40095	005E	*CH4 Cal Lo Range 4*	*Raw A/D Count Value . ±625mV (962EN)*

Register Map

Model 961EN-4006
Model 962EN-4006

Shaded 4xxxx register entries are Read-Only.

Register Map

Model 961EN-4006
Model 962EN-4006

Shaded 4xxxx register entries are Read-Only.

Ref	Addr.	Description	Data Type/Format
Holding Registers (4x References, Read/Write)			
40096	005F	*CH4 Cal Hi Range 5*	*Raw A/D Count Value . ±313mV (962EN)*
40097	0060	*CH4 Cal Lo Range 5*	*Raw A/D Count Value . ±313mV (962EN)*
40098	0061	*CH4 Cal Hi Range 6*	*Raw A/D Count Value . ±156mV (962EN)*
40099	0062	*CH4 Cal Lo Range 6*	*Raw A/D Count Value . ±156mV (962EN)*
40100	0063	*CH4 Cal Hi Range 7*	*Raw A/D Count Value . ±78mV (962EN)*
40101	0064	*CH4 Cal Lo Range 7*	*Raw A/D Count Value . ±78mV (962EN)*
40102	0065	*CH5 Cal Hi Range 0*	*Raw A/D Count Value . 0-20mA (961EN) or ±10V (962EN)*
40103	0066	*CH5 Cal Lo Range 0*	*Raw A/D Count Value . 0-20mA (961EN) or ±10V (962EN)*
40104	0067	*CH5 Cal Hi Range 1*	*Raw A/D Count Value . 4-20mA (961EN) or ±5V (962EN)*
40105	0068	*CH5 Cal Lo Range 1*	*Raw A/D Count Value . 4-20mA (961EN) or ±5V (962EN)*
40106	0069	*CH5 Cal Hi Range 2*	*Raw A/D Count Value . 0-11.17mA (961EN) or ±2.5V (962EN)*
40107	006A	*CH5 Cal Lo Range 2*	*Raw A/D Count Value . 0-11.17mA (961EN) or ±2.5V (962EN)*
40108	006B	*CH5 Cal Hi Range 3*	*Raw A/D Count Value . 0-1mA (961EN) or ±1.25V (962EN)*
40109	006C	*CH5 Cal Lo Range 3*	*Raw A/D Count Value . 0-1mA (961EN) or ±1.25V (962EN)*
40110	006D	*CH5 Cal Hi Range 4*	*Raw A/D Count Value . ±625mV (962EN)*
40111	006E	*CH5 Cal Lo Range 4*	*Raw A/D Count Value . ±625mV (962EN)*
40112	006F	*CH5 Cal Hi Range 5*	*Raw A/D Count Value . ±313mV (962EN)*
40113	0070	*CH5 Cal Lo Range 5*	*Raw A/D Count Value . ±313mV (962EN)*
40114	0071	*CH5 Cal Hi Range 6*	*Raw A/D Count Value . ±156mV (962EN)*
40115	0072	*CH5 Cal Lo Range 6*	*Raw A/D Count Value . ±156mV (962EN)*
40116	0073	*CH5 Cal Hi Range 7*	*Raw A/D Count Value . ±78mV (962EN)*
40117	0074	*CH5 Cal Lo Range 7*	*Raw A/D Count Value . ±78mV (962EN)*
40118	0075	*Ideal Range 0 Hi*	*Ideal A/D Count Value . 0-20mA (961EN) or ±10V (962EN)*
40119	0076	*Ideal Range 0 Lo*	*Ideal A/D Count Value . 0-20mA (961EN) or ±10V (962EN)*
40120	0077	*Ideal Range 1 Hi*	*Ideal A/D Count Value . 4-20mA (961EN) or ±5V (962EN)*

Ref	Addr.	Description	Data Type/Format
Holding Registers (4x References, Read/Write)			
40121	0078	*Ideal Range 1 Lo*	*Ideal A/D Count Value . 4-20mA (961EN) or ±5V (962EN)*
40122	0079	*Ideal Range 2 Hi*	*Ideal A/D Count Value . 0-11.17mA (961EN) or ±2.5V (962EN)*
40123	007A	*Ideal Range 2 Lo*	*Ideal A/D Count Value . 0-11.17mA (961EN) or ±2.5V (962EN)*
40124	007B	*Ideal Range 3 Hi*	*Ideal A/D Count Value . 0-1mA (961EN) or ±1.25V (962EN)*
40125	007C	*Ideal Range 3 Lo*	*Ideal A/D Count Value . 0-1mA (961EN) or ±1.25V (962EN)*
40126	007D	*Ideal Range 4 Hi*	*Ideal A/D Count Value . ±625mV (962EN)*
40127	007E	*Ideal Range 4 Lo*	*Ideal A/D Count Value . ±625mV (962EN)*
40128	007F	*Ideal Range 5 Hi*	*Ideal A/D Count Value . ±313mV (962EN)*
40129	0080	*Ideal Range 5 Lo*	*Ideal A/D Count Value . ±313mV (962EN)*
40130	0081	*Ideal Range 6 Hi*	*Ideal A/D Count Value . ±156mV (962EN)*
40131	0082	*Ideal Range 6 Lo*	*Ideal A/D Count Value . ±156mV (962EN)*
40132	0083	*Ideal Range 7 Hi*	*Ideal A/D Count Value . ±78mV (962EN)*
40133	0084	*Ideal Range 7 Lo*	*Ideal A/D Count Value . ±78mV (962EN)*
40134	0085	*Reserved*	*Do Not Use*
40135	0086	*Reserved*	*Do Not Use*
40136	0087	*Span Cal Register*	*A 16-Bit value whose bit position when set indicates the channel to be calibrated for span. For example: to calibrate span of channel 0, write 0001H to this register. To calibrate span of channel 5, write 0020H to this register.* ***IMPORTANT:*** *You must FIRST write 5E2AH into the Calibration Access Register (Register 40021) before attempting calibration.*
40137	0088	*Zero Cal Register*	*A 16-Bit value whose bit position when set indicates the channel to be calibrated for zero. For example: to calibrate zero of channel 0, write 0001H to this register. To calibrate zero of channel 5, write 0020H to this register.* ***IMPORTANT:*** *You must FIRST write 5E2AH into the Calibration Access Register (Register 40021) before attempting calibration.*
43001 . .		*This block Mirrors 3xxxx Registers.*	*Refer to Register Mirroring. 3xxxx Input Registers are mapped to the 43xxx Holding Register space using an address offset of 43000.*

Register Map

Model 961EN-4006
Model 962EN-4006

Shaded 4xxxx registers are Read-Only.

Register Map

Model 961EN-4006
Model 962EN-4006

Notes (Memory Map):

With 16-bit signed integers, a count of 0-7FFFH is a positive number, while 8000-FFFFH is a negative number. The ±1V DC input range values are represented by ±20000 counts. For example when using bipolar voltage devices (962EN), -1V, 0V, & +1V are represented by integer values –20000, 0, & +20000, respectively. Similarly, when connected to a unipolar current device (961EN), integer values from 0-20000 counts represent 0-1mA, excluding negative values.

SPECIFICATIONS

These DIN-rail mount, industrial Ethernet, analog input modules will condition up to six differential DC current (961EN), or voltage (962EN) input signals, and provide an isolated 10/100BaseT Ethernet port for monitoring and control. Units are DC-powered and include reverse polarity protection. Analog inputs (as a group), network, and power are isolated from each other. Non-volatile reprogrammable memory in the module stores configuration and calibration information.

Model Numbers

961EN-4006 (6 DC Current)
962EN-4006 (6 DC Voltage)

The BusWorks model prefix "900" denotes the Series 900 network I/O family. The "EN" suffix denotes EtherNet. Select 961EN for current input, and 962EN for voltage input. The four digit suffix of this model number represents the following options, respectively: "4" = Ethernet; "0" = Default; "06" = 6 Channels.

Analog Inputs

Up to six process current or voltage input channels, according to model number. The unit can be configured to accept one of several input ranges at each group of 3 channels as described below. The unit must be wired and configured for the intended input type and range (see Connections section for details). The following paragraphs summarize this model's input types, ranges, and applicable specifications.

DC Current (961EN Only): Configurable for 0 to 20mA, 4-20mA, 0-11.17mA, and 0-1mA DC nominal input ranges. A precision 24.9Ω current sink resistor converts the input current to a voltage that is processed by the A/D converter. An optional external sensor is required to monitor AC current signals (Acromag Model 5020-350). This sensor generates a DC milliampere signal of 0 to 11.17mA for the module (see Table 1 below for scaling to AC current).
Current Input Reference Test Conditions: 4 to 20mA current input; ambient temperature = 25°C; 24VDC supply.
Input Overvoltage Protection: Bipolar Transient Voltage Suppressers (TVS), 5.2V clamp level typical.

SPECIFICATIONS

Analog Inputs

AC Current Sensor (Model 5020-350, For Use With 961EN): This sensor is a toroidal instrument transformer that converts a sinusoidal 50-60Hz AC current signal into a low level DC milliampere signal of 0 to 11.17mA. The input AC current range is a function of the number of turns placed through the toroid as shown in Table 1 below. This sensor is isolated and requires no calibration or adjustment. When used with a 961EN module, it provides redundant input isolation and may facilitate input-to-input isolation of this six channel unit.

Table 1: AC Current Sensor Turns & Range

AC Current Input Range	Primary Turns	Sensor Output (Red/Black Wires)
0 to 20A AC	1	0 to 11.17mA DC
0 to 10A AC	2	"
0 to 5A AC	4	"
0 to 2A AC	10	"
0 to 1A AC	20	"

The output wires of this sensor are polarized with red as (+) plus and black as (-) minus. Normally these output wires are attached to one end of a user supplied cable while the other end connects to the 961EN's process current input terminals.
Input Burden: A function of the wire gauge resistance used for primary turns (the current carrying wire being monitored).
AC Current Sensor to Transmitter Wiring Distance: 400 feet maximum for 18 gauge wire. Other wire gauges can be used as long as the resistance of both wires is less than 5Ω.
Input Overload: The AC current sensor will withstand overload conditions as follows:

- 20 times full scale for 0.01 seconds.
- 10 times full scale for 0.1 seconds.
- 5 times full scale for 1.0 second.

DC Voltage (962EN Only): A 10:1 input divider is installed at the input (utilizing divider resistor values of 100K and 10.5K). User-configurable for the nominal bipolar DC voltage ranges of ±10V, ±5V, ±2.5V, ±1.25V, ±625mV, ±313mV, ±156mV, and ±78mV DC.
Input Impedance: 110.5KΩ.
Voltage Input Reference Test Conditions: -10 to 10V DC input; ambient temperature = 25°C; 24VDC supply.
Input Overvoltage Protection: Bipolar Transient Voltage Suppressers (TVS), 18V clamp level typical.

General Specifications

Accuracy: Better than ±0.05% of span, typical for nominal input ranges (except 0-1mA). This includes the effects of repeatability, terminal point conformity, and linearization, but does not include sensor error.
Measurement Temperature Drift: Better than ±50ppm/°C (±0.005%/°C).
Analog to Digital Converter (A/D): A 16-bit Σ-Δ converter.
Resolution: 0.005% or 1 part in 20000 (961EN), 0.0025% or 1 part in 40000 (962EN, full bipolar range).