

## Model 353 Controllers Extending I/O Capability with Ethernet

### INTRODUCTION

Ethernet has gained wide acceptance in the industrial process control world as a viable local area network (LAN) solution. Today, Ethernet is also finding use on the sensor and data acquisition side of the controller. Manufacturers have developed I/O devices that put thermocouple, RTD, current, voltage, and discrete I/O signals directly on Ethernet. Ethernet, then, can be used to acquire sensor information from remote locations extending the I/O capability of controllers.

This paper describes the Ethernet I/O that is available from Siemens and provides an overview on the use of this I/O with Siemens' Model 353 Process Automation Controllers. References to detailed information on the various products mentioned are also provided. A detailed discussion of the use of Ethernet, and its use as a peer to peer network with Model 353 controllers, is provided in AD353-113. The current revision of this paper, along with others addressing related topics, can be found on the Siemens Website [www.usa.siemens.com/ia](http://www.usa.siemens.com/ia), then click Process Instrumentation and then Process Controllers and Recorders; for this publication, type AD353-114 in the Site Explorer box and click Search.

### TYPICAL INSTALLATIONS

There are a number of ways Ethernet I/O is used. In a simple implementation, it extends the I/O of a single panelboard controller; see Figure 1. A more advanced application might be to network multiple controllers located in various locations within a plant; see Figure 2. In critical applications, various fault tolerant network configurations can be used to minimize the system affected by a failure of a network component or a network cable; see Figure 3. Refer to the section on Switches for more information.

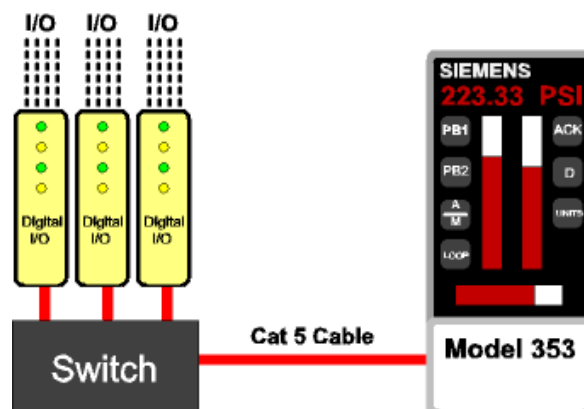


FIGURE 1 Simple Ethernet I/O Example

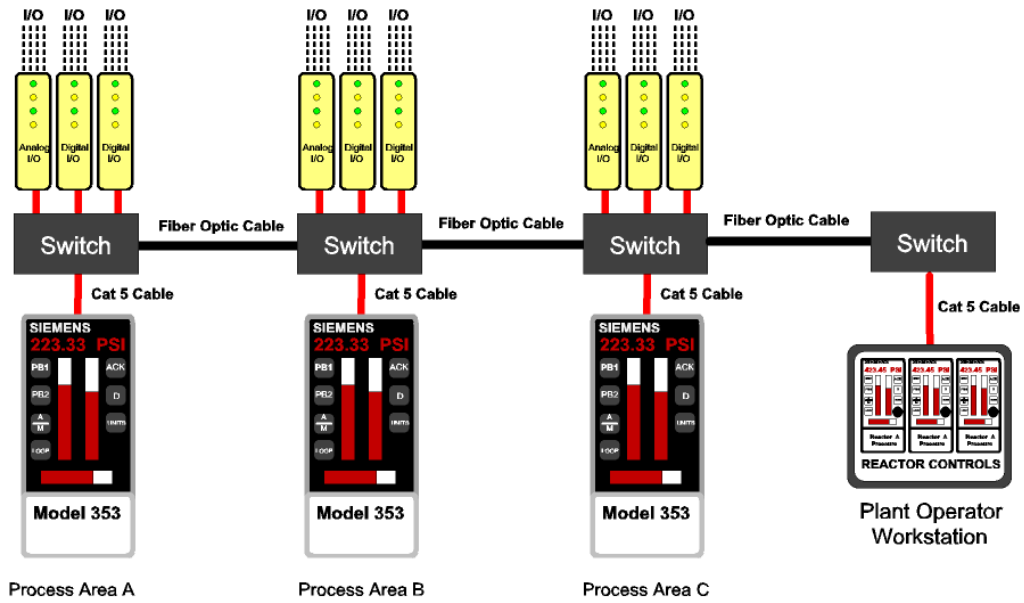


FIGURE 2 Advanced Ethernet I/O Example

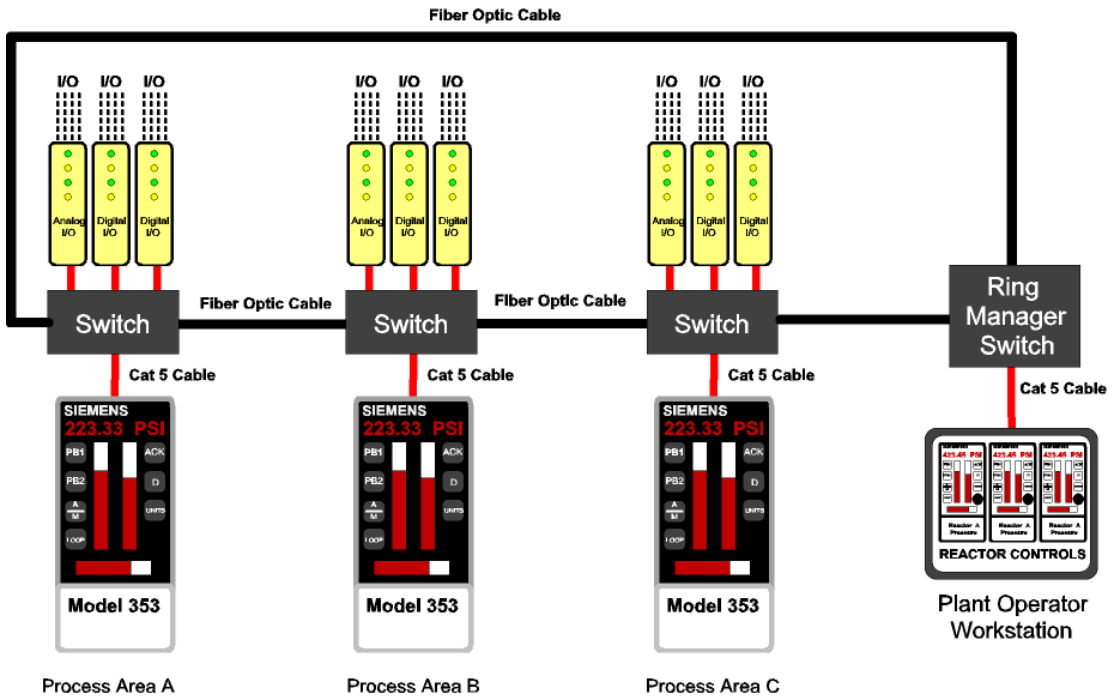


FIGURE 3 Critical Ethernet I/O Example

## CONFIGURE MODULE NETWORK PARAMETERS

An overview of the steps needed to configure an I/O module for use in applications with a Model 353 loop controller follows. Detailed information on Ethernet I/O Modules can be found on the Siemens Website. (At the site given on page 1, type Acromag in the Site Explorer box and click Search.)

1. Connect the module to a PC using either a Cat-5 crossover cable or an Ethernet HUB and standard Cat-5 cable.
2. Open a web browser and enter the default address of the module, <http://128.1.1.100>, in the browser address window.
3. The module Home Page will be displayed; See Figure 4. Select Network Configuration Page; See Figure 5. The default user name and password is “User” and “password00”.
4. Enter the network parameters. A static IP address must be used with the 353 since Ethernet blocks in the 353 will be configured with a fixed address. Check “Use Static Address”. Enter the IP address and the Subnet Mask.
5. Select the “Submit” button to write the configuration into the module.

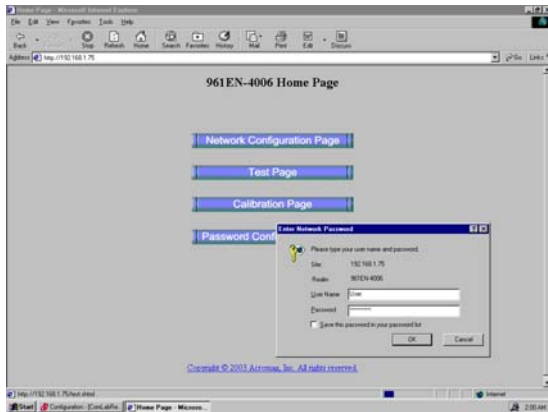


FIGURE 4 Home Page



FIGURE 5 Configuration Page

## CONFIGURE AN ANALOG INPUT MODULE (Models 961EN, 962EN, 963EN, 964EN, 965EN, 966EN)<sup>1</sup>

1. Select “Test Page” from the module Home Page. See Figure 6.



FIGURE 6 Analog Input Module, Test Page

<sup>1</sup> The Acromag, Inc. models listed are examples of Ethernet capable I/O modules from many manufacturers.

2. Select the desired range configuration for the module selected.
  - ❑ Current Inputs (961EN, 963EN): 0-20 mA, 4-20mA, 0-11.17 mA (use with 5020-350 AC current sensor), 0-1 mA.
  - ❑ Voltage Inputs (962EN, 964EN):  $\pm 10\text{V}$ ,  $\pm 5\text{V}$ ,  $\pm 2.5\text{V}$ ,  $\pm 1.25\text{V}$ ,  $\pm 625\text{mV}$ ,  $\pm 313\text{mV}$ ,  $\pm 156\text{mV}$ ,  $\pm 78\text{mV}$
  - ❑ Thermocouple Inputs (965EN): J, K, T, R, S, E, B, N,  $\pm 100\text{mV}$ ,  $\pm 1\text{V}$
  - ❑ RTD (966EN): 3W {Pt 100  $\Omega$  ( $\alpha=1.3850$ ), Pt 100  $\Omega$  ( $\alpha=1.3911$ ), Pt 100  $\Omega$  ( $\alpha=1.3850$ ), Ni 120  $\Omega$ , Cu 10  $\Omega$ , Resistance}, 2W {...}
3. Select the “Submit” button to write the configuration into the module.

### Configuration of the AIE\_<sup>2</sup> Block in 353

The AIE block is used to request a value from an Analog Input module (e.g. 961EN). The configuration example uses the Siemens i|config™ Graphical Configuration software. See Figure 7.

1. Select an AIE\_ block and enter it on the graphical page for the loop.
2. Open the AIE\_ block and enter the configuration parameters.
  - ❑ IP ADRES     xxx.xxx.xxx.xxx (enter IP address of I/O module)
  - ❑ MB ADRES    1
  - ❑ MB REG       xx (enter Modbus register, e.g. 10 for CH00 in Model 961EN-4006)
  - ❑ REG TYPE    INPUT (3xxx Input Registers, e.g. 30010 in this example)
  - ❑ DATA TYPE  SIGNED
  - ❑ UD RATE     Peer2Peer (P2P rate is configured in the Station block)
  - ❑ MIN INT     0 (Zero % of range, e.g. 4 mA)
  - ❑ MAX INT     20000 (Full scale % of range, e.g. 20 mA)
  - ❑ RANGE\*      MANUAL
  - ❑ MINSCALE\*  0 (enter a different value if required by application)
  - ❑ MAXSCALE\*  100 (enter a different value if required by application)
  - ❑ DPP\*        0.00 (enter a different value if required by application)
  - ❑ ENGUNITS\*  PRCT (enter a different value if required by application)

*\*The i|config software may not display these parameters when the DATA TYPE of SIGNED is selected. Therefore, first select UNSIGNED and configure the desired settings of all these parameters. Set the DATA TYPE to SIGNED, then set UD RATE, MIN INT, and MAX INT in order. The \* parameters, even though not visible, are still in the database and will be downloaded to the controller.*

3. Download the configuration to the controller when configuration is complete.

Examples of other Analog Input scaling configurations are listed below.

Module	Range	MIN INT	MAX INT	MINSCALE	MAXSCALE	ENGUNITS
961EN	4-20 mA	0 (4mA)	20000 (20mA)	0.00	100.00	PRCT
961EN	4-20 mA	0 (4mA)	20000 (20mA)	0.0	800.0	degF
961EN	0-11.17mA	0 (0mA)	20000 (11.17mA)	0.00	10.00	AMPS
962EN	$\pm 78\text{mV}$	0 (0mV)	7692 (30mV)	0.00	7.00	pH
965EN	J TC °C	-178 (-17.8°C)	4267 (426.7°C)	0.0	800.0	degF
966EN	PT385 3W	378 (37.8°C)	1489 (148.9°C)	100.0	300.0	degF

<sup>2</sup> The underscore following a function block name indicates a re-useable block; it will be replaced by an incrementing number with each use of the block.

## CONFIGURE AN ANALOG OUTPUT MODULE (Models 972EN, 973EN)

1. Select “Test Page” from the module Home Page.
2. Select the desired range configuration. See Figure 8.
  - ❑ Voltage Inputs (973EN): 0-1 V, 0-5 V, 0-10 V
  - ❑ Current Outputs (972EN): 0-20 mA, 4-20mA, 0-1 mA
3. Select the “write range and ...” button to write the configuration into the module.

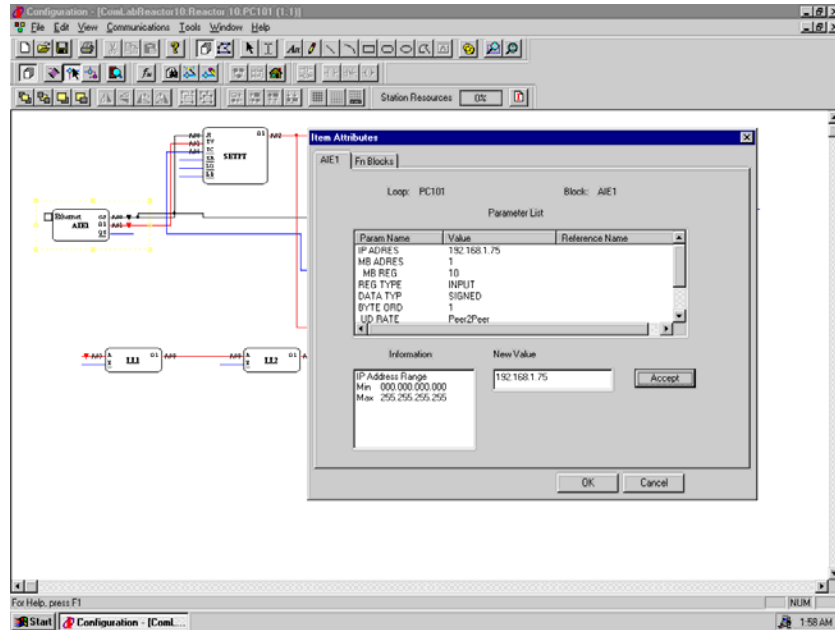


FIGURE 7 AIE Block, Item Attributes Page

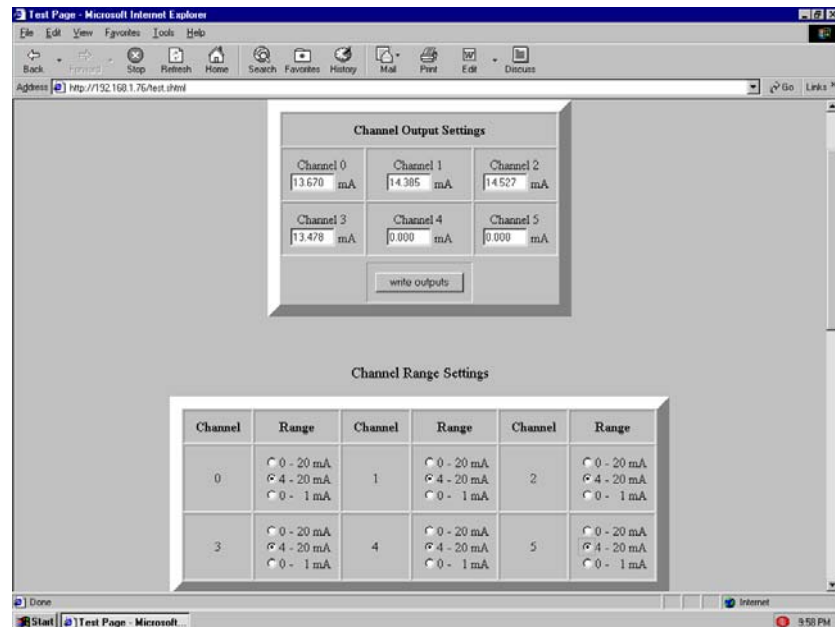


FIGURE 8 Analog Output Modules, Test Page

## Configuration of the AWE\_ Block in 353

The AWE block is used to write a value connected to Input S of the AWE block to an Analog Output module (e.g. 972EN). The configuration example uses the i|config software. See Figure 9.

1. Select an AWE\_ block and enter it on the graphical page for the loop.
2. Open the AWE\_ block and enter the configuration parameters.
  - IP ADRES      xxx.xxx.xxx.xxx (enter IP address of I/O module)
  - RG PTR        loop tag.block tag.output (enter all inputs as required)
  - INPUT S       loop tag.block tag.output (enter all inputs as required)
  - INPUT T       loop tag.block tag.output (enter all inputs as required)
  - MB ADRES      1
  - MB REG        xx (enter Modbus register, e.g. 19 for CH0 in Model 972EN-4006 - R/W Holding register 4xxx which for this example is 40019)
  - DATA TYPE   SIGNED
  - BYTE ORD      1
  - UD RATE       Peer2Peer (P2P rate is configured in the Station block)
  - TRIG DB       0.2
  - MIN INT       0 (Zero % of range, e.g. 100.0 for a range of 100.0-400.0)
  - MAX INT       20000 (Full scale % of range, e.g. 400.0 for a range of 100.0-400.0)
3. Download the configuration to the controller when configuration is complete.

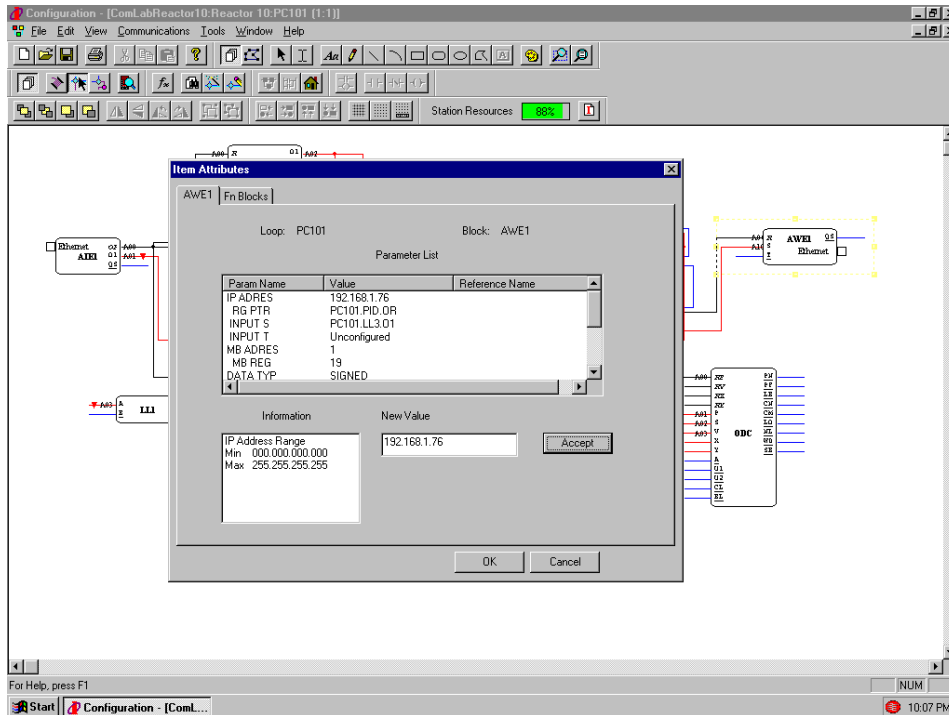


FIGURE 9 AWE Block, Item Attributes Page

## CONFIGURE A DISCRETE INPUT/OUTPUT MODULE

1. Configure the network parameters as previously described.
2. Select the Test Page and test the discrete channels.

### Configuration of the CIE\_ Block in 353

The CIE block is used to request values from a discrete input module (e.g. 981EN, 983EN). The block will request up to 16 contiguous discrete values from a single IP address. The configuration example uses the i|config software.

1. Select a CIE\_ block and enter it on the graphical page for the loop.
2. Open the CIE\_ block and enter the configuration parameters.
  - IP ADRES      xxx.xxx.xxx.xxx (*enter IP address of I/O module*)
  - MB ADRES     1
  - DATA TYPE   INPUT (*Ixxx discrete input, e.g. 10001 in this example*)
  - UD RATE      Peer2Peer (*P2P rate is configured in the Station block*)
  - START CL     1 (*enter starting Modbus register, e.g. 1 in Model 983EN-4012*)
  - NO OF CL     12 (*enter number of discrete values to be requested*)

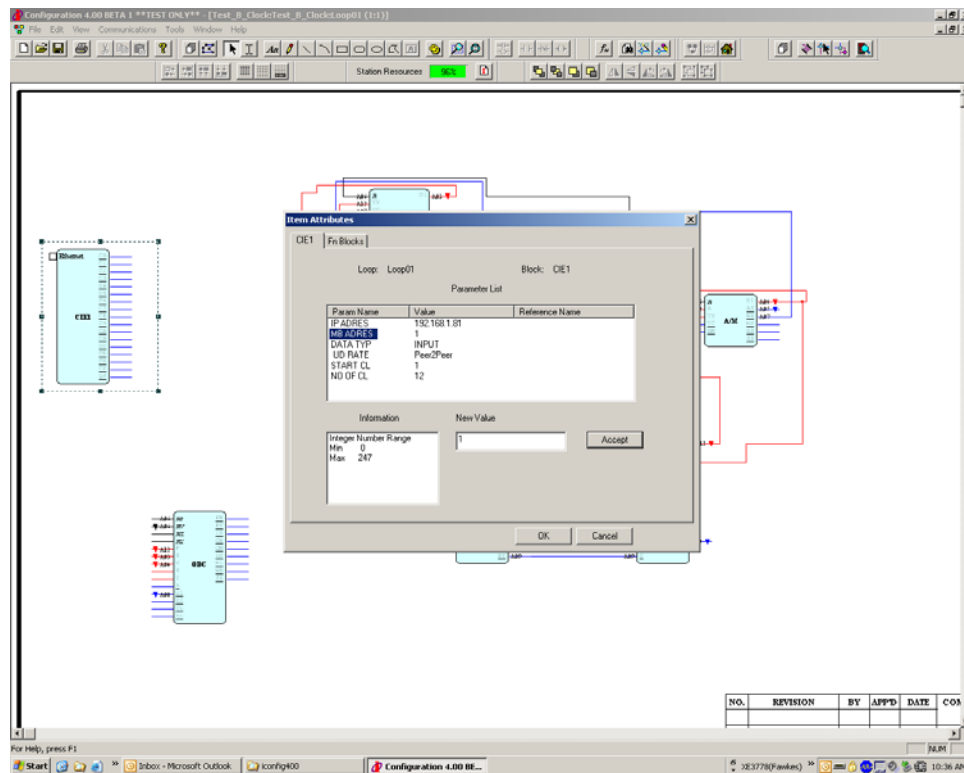
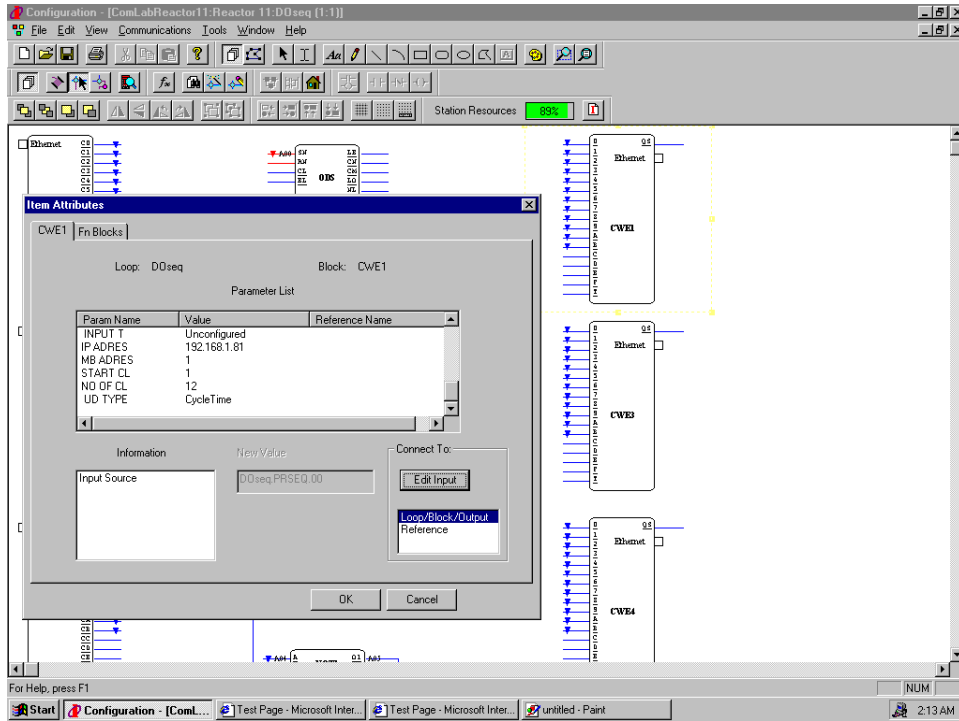


FIGURE 10 CIE Block, Item Attributes Page

### Configuration of the CWE\_ Block in 353

The CWE block is used to write discrete values connected to the various inputs (0, 1, 2, etc) to a discrete output module (e.g. 982EN, 983EN). The block will write up to 16 contiguous discrete values to a single IP address. The discrete values are ON/OFF (1/0) inputs to the block from other blocks within the controller. The configuration example uses the i|config software.

1. Select a CWE\_block and enter it on the graphical page for the loop.
2. Open the CWE\_block and enter the configuration parameters. See Figure 11.
  - ❑ INPUT x            loop tag.block tag.output (enter all inputs as required)
  - ❑ IP ADRES            xxx.xxx.xxx.xxx (enter IP address of I/O module)
  - ❑ MB ADRES            1
  - ❑ START CL            1 (enter starting Modbus register, e.g. 1 in Model 983EN-4012)
  - ❑ NO OF CL            12 (enter number of discrete values to be written)
  - ❑ UD TYPE            Peer2Peer (P2P rate is configured in the Station block)



**FIGURE 11 CWE Block, Item Attributes Page**

## SWITCHES

More information on Ethernet networking components, such as switches, can be found in AD353-113. In the applications described earlier in this paper, the switches used include:

- Figure 1, Simple Ethernet I/O Example: Model 900EN-5005 Ethernet Switch – 5-port. This switch has the same form factor as the I/O modules and can be DIN rail mounted with the modules. For most applications this switch requires no set up. However, detailed technical information can be found in the User Manual.
- Figure 2, Advanced Ethernet I/O Example: N-TRON offers a large variety of switches that include Cat-5 wire and fiber optic media options. More information on these products can be found on the N-TRON web site [n-tron.com](http://n-tron.com).
- Figure 3, Critical Ethernet I/O Example: N-TRON offers a large variety of switches that include Cat-5 and fiber optic media which can be configured in redundant ring topologies for critical applications. More information on these products can be found on the N-TRON web site [n-tron.com](http://n-tron.com).



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**REFERENCES**

- *Model 353 Process Automation Controller User's Manual*, UM353-1, Rev. 9 or higher (Design Level A controllers, discontinued)
- *Model 353 Process Automation Controller User's Manual*, UM353-1B (Design Level B controllers)
- *BusWorks 900EN series Ethernet Modules User Manuals*
- *i/config Graphical Configuration Software Guide*, SG15939-64

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