

EtherNet/IP adapter board W293261

Manual for V1.00



adapter board_(W293261)

Section 1: Specification

1.1 Application

The board may be fitted to the following controls:

- iPAK2: all firmware versions.
- EN7000: Firmware version V1.12 onwards.

Note that both require the use of NetFlash V1.17 or higher.



Fig. 1 The EtherNet/IP adapter board (W293261).

1.2 Functionality

The board provides the control with the following additional functionality:

- Cyclic I/O control using EtherNet/IP implicit messaging (class 1 connection).
- Parameter programming using EtherNet/IP explicit messaging.
- I/O and parameter programming using Modbus TCP/IP.
- A connection for NetFlash software.

These connections are available simultaneously and are in addition to those available through the Ethernet port on the main board.



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1.3 Set up

Users must set the following parameters on the control:

- IP address
- Sub-net mask
- Gateway address

This may be done by using the WSP3, touch-screen or NetFlash.



e	ENTRONK
	SUB: 255.255.255.0 GWY: 192.168.0.254 ID 54:10:EC:9F:76:BB ADAPTER V1.00
l	WSP3

Fig 2. Adapter parameters on WSP3.

A	1		Ethe	met/IP	1	Eth	ernet/IP	〇
Contactor	Clock	>	IP Address[0]	Sub-net mask[0]	~	Gateway[0] 192	MAC 1D 54:10:EC:9F:76:BB	^
COMO	COM1		IP Address[1]	Sub-net mask[1]		Gateway[1] 168	Adapter V1.00	
COM2	COM3	-	IP Address[2]	Sub-net mask[2]		Gateway[2]		
Ethernet/IP 92.168.0.130	Initialise	~	IP Address[3] 130	Sub-net mask[3]	~	Gateway[3]		

Fig 3 Adapter parameters on touch-screen.

		and the second se
span Bechale Methode and a Californic Carlow COBB hermat address sal salamberst address sal salamberst	Californities Carligor 10 Tales (CHerry) (op CAL R5481 (Leine) 400000.4510 (1 Mite Al republi Addess Blactope 2100 (1 Mite Al republi 5100 (1	DP (August) Type Dimension Wo-Co 54 10162 bf 74 880 P Autress 162 1048 102 Shan mark 225 25 25 3. Galway 155 1018 254
COMM Nemat DOBUS TOPHI WERE S SAME AS COMP ADDRESS SAME AS COMP ALL TOP	COND MERTE VERTE	collect Modeluis Tomer Mut 593 Modeluis Tomer
	4	Part 502 COMM Dimension Appr Connel CTED

Fig 4. Adapter parameters on NetFlash.

The hardware address (MAC ID), adapter version code and status can also be read.



In all cases, the control must be restarted before the new settings will take effect.



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1.4 Status

The adapter board has two LEDs which indicate the board status



Fig 5. LEDs on adapter board

On power-up the LEDs perform the following sequence, as defined by the EtherNet/IP specification:

LE1	LE2	Duration s
Green	Off	0.25
Red	Off	0.25
Off	Green	0.25
Off	Red	0.25

After the power-up sequence, the LEDs indicate as follows:

LE1 (left): adapter board status:

GREEN OK RED Fault

LE2 (right): network status:

GRÉEN flashing Ready, no EtherNet/IP connection.GREEN solidEtherNet/IP class 1 connection.RED flashingEtherNet/IP class 1 connection lost.



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1.5 Cyclic I/O via EtherNet/IP (class 1 connection)

To have the EtherNet/IP connection activate the inputs to the welding control, access the control configuration parameters (using WSP3, touch- screen or NetFlash) and select

I/O SOURCE : COM6-E/IP

then restart the control.

The controlling device (usually a plc) must then be set up to initiate the connection. The following screen-shot shows the required parameters:

Originator->Target (0->T) Connection Parameters Connection Point 150 Connection Tag Data Size (bytes) ✓ Run/Idle Header Target->Originator (T->0) Connection Parameters ✓ Connection Point 100 ✓ Connection Tag Data Size (bytes) 48 ✓ Run/Idle Header Redundant Owner Connection Redundant Owner 	Connection Rate 0->T Packet Rate (ms): T->0 Packet Rate (ms): 0->T Production Inhibit T->0 Production Inhibit Connection Type 0->T Tranport Type: T->0 Tranport Type: Transport Trigger: Timeout Multiplier: T->0 Priority:	Timeout (ms): Timeout (ms): Point To Point To Cyclic 1 Schedu	100 100 0 Point 6 led	· ·
COD value 0 ROD value 0 Configuration 0 Configuration Instance: 1 Module Configuration Data - Each byte is a 2 char hex value, separated by a space (i.e. 0a 26 f9).	0->T Priority:	Schedu	led	ctior

Fig 6. I/O connection parameters

As can be seen above, the control accepts 4 bytes of input information and produces 48 bytes of output. This should be interpreted as 2 16-bit words (input) and 24 16-bit words (output) in little-endian format (Isb sent first). The definition of these words can be found in the manual for the control, under 'Modbus mapping' in the Modbus I/O section.



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1.6 Parameter programming via EtherNet/IP

This is achieved through the use of the EtherNet/IP explicit messaging service.

The following services are implemented:

Service	Code
Get attribute single	0E (hex)
Set attribute single	10 (hex)

With each of these services, the following objects are available:

Parameters	Class ID	Instance	Attribute ID	Size
Weld program	96 (hex)	1	0 to FF (hex)	128 bytes
Electrode	97 (hex)	1	0 to 7	128 bytes
Calibration	98 (hex)	1	0 to 7	128 bytes
Configuration	99 (hex)	1	0	128 bytes

Data should be interpreted as 16-bit words, in little-endian format (lsb sent first). The definition of these words can be found in the manual for the control in the 'Programming' section.

For example, to modify a weld parameter in program p (0 to 255)

1. Get the weld program from the control by sending the explicit message:

Service	Class ID	Instance	Attribute ID	Data
0E (hex)	96 (hex)	1	р	none

This returns the 64-word (128 bytes) program structure.

- 2. Modify the parameter(s) as required.
- 3. Send the modified program back to the control with the explicit message:

Service	Class ID	Instance	Attribute ID	Data
10 (hex)	96 (hex)	1	р	128 bytes



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1.7 MODBUS TCP/IP ports

The adapter board also supports MODBUS TCP/IP. There are two simultaneous MODBUS connections:

	Port	Note
COM4	503	Normally used by NetFlash
COM5	502	

1.8 Cyclic I/O via MODBUS TCP/IP

To have the MODBUS connection activate the inputs to the welding control, access the control configuration parameters (using WSP3, touch- screen or NetFlash) and select

I/O SOURCE : COM5

then restart the control.

1.9 Parameter programming via MODBUS TCP/IP

This is identical to the functions available via the Ethernet port on the main board. Please see the control technical manual.



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Section 2: PLC interfacing examples

This section presents two examples showing how to connect an Allen Bradley CompactLogix PLC with an EN7000 control via EtherNet/IP, using Allen Bradley Studio 5000 software. The examples may also be used for an iPAK2 with minor differences. Refer to the iPAK2 Technical Manual for details.

2.1 Exchanging cyclic I/O Data using EtherNet/IP

In this example, the PLC will be used to exchange cyclic I/O information with an EN7000 by using EtherNet/IP Implicit Messages (class 1 connection). The EN7000 must first be added to the PLC project. In Studio 5000, while Offline, right-click on the EtherNet/IP gateway in the I/O configuration and select **New Module**



Select Generic Ethernet Module and click Create

troller Organizer 🗢 🕂 🗙	Catalog Module Discovery Favo	nies			
Controller Fault Handler	generic	Clear F	ilters		Show Filters 🗧
- Ga MainTask	Catalog Number	Description	Vendor	Category	
WainProgram Wincheduled	ETHERNET-BRIDGE ETHERNET-MODULE	Generic EtherNet/IP CIP Bridge Generic Ethernet Module	Allen-Bradley Allen-Bradley	Communication Communication	
Add-On Instructions Data Types Data Types Strings Strings Module-Defined Module-Defined Trends Logical Model Configuration Provide Defined Defined Defined Defined Defined Defined Defined					
- 10 [0] 1769-L16ER-BB1B EN70	2 of 410 Module Types Found				Add to Favorites
111 Embedded Discrete	Close on Create			Create	Close



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In the Module Properties window, enter the information below:

- **Name** for the new Ethernet module. In this example, the module will be named **EN**. This will create EN:C, EN:I, and EN:O Controller Tags in Studio 5000 for use in the program Tasks.
- Select the Comm Format (data type) as Data-INT
- Enter the **IP address** for the module. The IP address of the EN7000 in this example is **192.168.0.100**. Remember to restart the EN7000 after setting its IP address.
- Enter the **Assembly Instance** parameters. For the EN7000, these values should be **Input = 100**, **Output = 150** and **Configuration = 1**.
- Enter the **Size** of the input and output data corresponding to the data sizes configured for the EN7000, in this case **24** words In and **2** words Out. The Size of Configuration is **0**.
- Click on **OK** to confirm the module properties and continue. The EN7000 has now been added to the I/O configuration in Studio 5000.

ew Module					~
Type: Vendor: Parent:	ETHERNET-MODULE Generic Ether Allen-Bradley	net Module			
Name: Description:	EN	Connection Para	Assembly Instance: 100	Size:	 (16-bit) (16-bit)
Comm <u>F</u> orm Address /	at: Data - INT - Host Name	<u>C</u> onfiguration:	1	0	(8-bit)
IP <u>A</u> dd IP <u>A</u> dd Image: Market state	Iress: 192 . 168 . 0 . 100	<u>S</u> tatus Input: S <u>t</u> atus Output:			
🗸 Open Mo	dule Properties	ОК	Can	cel	Help



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- Right click on the EN Ethernet module in the project explorer tree and select **Properties**.
- In the **Module Properties** window, click on the **Connection** tab. Enter the **Requested Packet Interval** (RPI). For this example, **100** (ms) is entered. Check the box **Use Unicast Connection over EtherNet/IP**.
- Click on **OK** to confirm.

General Connection Module Info	0
Requested Packet Interval (RPI):	100.0 🚖 ms (1.0 - 3200.0 ms)
Major Fault On Controller If Con	mection Fails While in Run Mode
Use Unicast Connection over E	EtherNet/IP
Module Fault	
Module Fault	
Module Fault	



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Create three User Defined Data types (UDT). **Right Click** on the **User Defined** folder and select **New Data Type**.

These data types will be used to map the EN7000 I/O to tags in the PLC. Refer to Section 5 – 'MODBUS Mapping' in the EN7000 Technical Manual for the definition of the bits contained in the Input and Output words. These bits will be included in their respective UDT. Each data type should have 16 bits. Any unused bit not dedicated to a specific function should be created as "Reserved" (ResXX).

- UDT EN7000_Read_Outputs_0 Bits described in Read_Outputs_[0] channel, Address %IW0
- UDT EN7000_Write_Inputs_0 Bits described in Write_Inputs_[0] channel, Address %QW0
- UDT EN7000_Write_Inputs_1 Bits described in Write_Inputs_[1] channel, Address %QW2

- Controller EN7000 iPAK2	lame: EN700	0_Read_Outputs_0		Data Type Size: 4 byt
Controller Tags	escription:			
- Tasks	fembers:			
🚊 💱 MainTask	Name	Data Type	Description	
🗄 🍓 MainProgram	EOS	BOOL		
 Parameters and Local MainRoutine 	HAV	BOOL		
- 📓 L.O. Messaging 👘	Fault	BOOL		
- B Read_Program_0	Ready	BOOL		
- 🔛 Unscheduled	Contactor	BOOL		
Motion Groups	Counter	BOOL		
- Add-On Instructions	Stepper	BOOL		
- una rypes	Pre_Warn	BOOL		
Ster-Defined	AV8	BOOL		
- EN7000_Write_Inputs_0	AV7	BOOL		
EN/000_Write_Inputs_1	AV5	BOOL		
Lag Strings	AV5	BOOL		
Git Predefined	AV4	BOOL		
1 GR Module-Defined	AV3	BOOL		
- Trends	AVC	2001		



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Create the three tags described below with their corresponding data types. The meanings of the bits contained in these words are described in the section 'MODBUS I/O' in the control Technical manual.

Tag EN7000_Output_0 EN7000_Input_0 EN7000_Input_1 Data Type EN7000_Read_Outputs_0 EN7000_Write_Inputs_0 EN7000_Write_Inputs_1

Controller Organizer 🔹 4 🗙	Scope: BEN7000_iPAK2 - Sho	w: All Tage
Controller EN7000_iPAK2	Name	그의스 Bas Data Type
Controller Tags	+-EN7000_Analog_Out	INT
Controller Fault Handler		
Take	[+]-EN7000_input_0	EN7000_Write_hputs_0
C S MainTack	F-EN7000_Input_1	EN7000_Write_hputs_1
A MainProgram	ULENTOOD Main Gurant	DINT
Parameters and Local	E-EN7000_Output_0	EN7000_Read_Outputs_0
MainRoutine	CH1000_Coppor_0.000	0002
1.0_Messaging	-EN7000_Output_0.HAV	BOOL
Read_Program_0	EN7000_Output_0.Fault	BOOL
🗑 Send_Program_0	-EN7000_Output_0.Ready	BOOL
🔛 Unscheduled	EN7000_Output_0.Contactor	BOOL
- 😬 Motion Groups	EN7000_Output_0.Counter	BOOL
Ungrouped Axes	EN7000_Output_0.Stepper	BOOL
Add-On Instructions	EN7000_Output_0.Pre_Wam	BOOL
🗃 📇 Data Types	-EN7000_Output_0.AV8	BOOL
🔒 🦏 User-Defined	EN7000_Output_0.AV7	BOOL
M EN7000_Read_Outputs_0	EN7000_Output_0.AV6	BOOL
	EN7000_Output_0.AV5	BOOL
EN/000_Write_Inputs_1	EN7000 Output 0.AV4	BOOL
Strings	-EN7000 Output 0.AV3	BOOL
Add-On-Defined	EN7000 Output 0 AV2	BOOL
Madula Dafinad	-EN7000 Output 0.AV1	BOOL
E - Module - Denned	FLENZ000 Post Heat Ourset	DINT



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Create three copy (COP) instructions. Keep in mind that the Outputs of the EN7000 are Inputs to the PLC and vice versa.

- Rungs 0 and 1 are used to copy the EN7000_Input_0 and EN7000_Input_1 tags to words 0 and 1 of the PLC EIP Output message.
- Rung 2 is used to copy word 0 of the PLC EIP Input message to the EN7000_Output_0 tag.

4 23 23 E		
	Write word 0 of the inputs to the	he EN7000
		Copy File Source EN7000_mput_0 Dest ENIO.Data[0] Length 1
	Write word 1 of the inputs to the	he EN7000 Copy File Source EN7000_input_1 Dest ENC0.Data[1]
	Read word 0 of the control output stat	tus of the EN7000



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The logic below shows how some of the tags created above are used to control the EN7000. Rung 0 is used to enable the Weld On mode from the PLC. Rung 1 shows example Cycle Start logic. The Cycle Start tag is not part of the EN7000. It is shown to represent the user's logic.

Note: the Start, Weld On, and Stop inputs must be linked on connector X3 even if they will be used via the PLC. Refer to Section 4 – 'Discrete I/O' in the EN7000 Technical Manual for details.



Any of the 24 Output words of the Modbus I/O map may be read by the PLC following the method above. The rung below shows how to read the Pre-heat, Main-heat, and Post-heat values of the weld after receiving the End Of Sequence signal.



Note: if using NetFlash software and a PLC simultaneously, the values displayed in NetFlash will need to be read from the EN7000 to get the current value of any parameter modified by the PLC.



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2.2 Exchanging Program Data using EtherNet/IP

This is achieved through the use of the EtherNet/IP explicit messaging service. Explicit messages are sent based on a programmed logic event (e.g. pressing a button on an HMI). As an example, the PLC will be used to send Explicit Messages to the EN7000. This example shows how Program 0 may be modified via an HMI. The HMI code is not described here, only the Explicit message details.

Refer to the 'Parameter Programming via Ethernet/IP' section above and note the following parameters:

- Service Code = Set Attribute Single: 10 (hex) or Get Attribute Single: 0E (hex)
- Class Code = Weld Program: 96 (hex)
- Instance Code = 1
- Attribute Code = Program 0: 00 (hex)

Create the following tags:

- **Get_Program_0_Data**, Data type **INT[64]**, used for 64 words containing Program 0 data read from the EN7000
- Set_Program_0_Data, Data type INT[64], used for 64 words containing Program 0 data sent to the EN7000
- Message_Get_Program_0, Data type Message, tag used in the Message instruction
- Message_Set_Program_0, Data type Message, tag used in the Message instruction
- Sch_0_xx, Data type Bit / Word, xx corresponds to the words or bits as defined in the Weld Program Parameter table of Section 13 'Programming' in the Technical Manual. These tags are used to
 - 1. store the Program 0 parameters read from the EN7000
 - 2. modify their value via an HMI,
 - 3. send them to the EN7000 after editing.



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Create the rung below. The Timer and One Shot Rising instructions prevent the message instruction from executing excessively. Any other user defined logic may be used. After adding the Message instruction, click on the edit box as shown.

TMR Get Sch 0.DN	Timer for enabling Message instruction	OSR
	Timer On Delay Timer TMR_Get_Sch_0 Preset 250 ← (DN)— Accum 137 ←	One Shot Rising Storage Bit OSR_Get_Sch_0 (SB) Output Bit OSR_Get_Sch_0_Ena
OSR_Get_Sch_0_Ena	Read current values of Weld Schedule 0 from the EN700	0 MSG
JL	Message C	ontrol Message_Get_Program_0

The dialog box is displayed. Enter the values shown in the Configuration tab.

Configuratio Message	on Com Type:	munication Tag	c		•			
Service Type:	Get Att	ibute Single		•	Source Element: Source Length:	0		(Bytes)
Service Code: Instance:	e 1	(Hex) Class: Attribute:	96 0	(Hex)	Destination Element:	Get_	Program	_0_Dat 👻
					2	INEV	v lag	J
) Enable	() En	able Waiting	O St	art	O Done	Done Ler	ngth: 0]



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Click on the Communication tab. Click Browse to expand the Ethernet gateway. Click on ETHERNET-MODULE EN to select the message path. Click OK.

Configuration Communication Tag	e parameters in the buffer are replace
Path: EN	Browbe
EN	Message Path Browser
Communication Method	Path: EN
CIP With Source Link: 0 * Destr	
Connected	[0] 1769-L16ER-8818 EN7000_PAK2 Embedded I/O [1] Embedded Discrete_NO Excansion I/O, 0 Modules
Enable O Enable Wating O Start O Don Enror Code:16=0001 Extended Error Code: 16=0000_02 foror Path: EN Tot Concentration follows	Ethernet
OK Can	OK Cancel Help

Click on the Tag tab. Enter the message tag name Message_Get_Program_0. Click OK.

Configuration	Communication	Tag						
Name:	Message_Get_I	^o rogram_0						
Description:					^			
					Ŧ			
Type:	Base							
Data Type:	MESSAGE							
Scope: External Access:	Read/Write	\K2						
Enable	O Enable Waiting	O St	art	O Done	C)one Length:	0	
Error Code: rror Path: EN	16#0001 Exte	nded Error	Code: 16#	0000_0204	E	Timed Out	•	



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Create the rung below. This rung will copy the 64 word array Get_Program_0_Data read from the EN7000 in the previous rung to the Set_Program_0_Data 64 word array.

Copy Weld Schedule 0 to the weld schedule being edited in the following run	gs
	Copy File Source Get_Program_0_Data[0] Dest Set_Program_0_Data[0] Length 64

At this point, any parameter from the HMI may be used to modify Program 0 in the EN7000. Referring to the 'Weld Program Parameters' in the Technical Manual note the parameter, data type, and limits. In the rung below, Sch_0_xx (where $xx = Pre_Squeeze_Time$) may be coppied from the HMI to the Set_Program_0_Data[1] tag. Notice the value from the HMI is contained in the limits of 0 – 99 cycles as described in the Technical Manual. This method may be used for any Program 0 parameter being modified from the HMI.

Limt Test (CIPC)	Conv Etc.
Low Limt 0	Source Sch_0_Pre_Squeeze_Time
Test Sch_0_Pre_Squeeze_Time	Length
High Limit 99	

Once all desired parameters in Set_Program_0_Data have been modified, they may be sent to the EN7000 as shown below. The Timer and One Shot Rising instructions prevent the message instruction from executing excessively. Any other user defined logic may be used. After adding the Message instruction, click on the edit box as shown.

Timer	for enabling Message instruction	
TMR_Set_Sch_0.DN	Timer TMR_Set_Sch_0 Preset 250 + (DN)- Accum 137 +	Ose One Shot Rising Storage Bit OSR_Set_Sch_0 =(SB) Output Bit OSR_Set_Sch_0_Ena =(OB)-
Send the revised weld	schedule parameters to Schedule 0 in th	e EN6001
OSR_Set_Sch_0_Ena] E	Message Message (Control Message_Set_Program_0 (EN)



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The dialog box is displayed. Enter the values shown in the Configuration tab.

onfiguratio	Comm	unication Ta	9				
Message	Type:	CIP Gener	c		-		
Service Type:	Set Attrib	ute Single		٠	Source Element:	Set_Program	_0_Dat 👻
Service Code:	10 (Hex) Class:	96	(Hex)	Source Length: Destination	128 🐺	(Bytes)
Instance:	i	Attribute:	0	(Hex)	Element:	New Tag	
) Enable) Error Co) Enal de:	ble Watting Extende) Sta d Error (art Code:	🕏 Done I	Done Length: 0	



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Click on the Communication tab. Click Browse to expand the Ethernet gateway. Click on ETHERNET-MODULE EN to select the message path. Click OK.

Configuration Communication Tag	ent to the timer
Path: EN	Browpe
EN © Broadcast: *	Message Path Browser
Communication Method	Path:
@ CIP @ DH+ Oramet W Pest	EN
CIP With Source Link: 0 🔄 Dest	O Configuration On Configuration On Configuration
Connected	[0] 1769-L16ER-8B1B EN7000_iPAK2 [1] Embedded I/O [1] Embedded Discrete_NO [2] Expansion I/O, 0 Modules
Enable O Enable Wating O Start O Don	⊟ S Ehemet
Error Code: 16#0001 Extended Error Code: 16#0000_02 fror Path: EN fror Text: Connection failure	ETHERNET-MODULE EN
OK Car	



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Click on the Tag tab. Enter the message tag name Message_Set_Program_0. Click OK.

Configuration	Communication Tag	,			
Name:	Message_Set_Progr	ram_0]	
Description:			*		
			-		
Type:	Base				
Data Type:	MESSAGE				
Scope:	EN7000_iPAK2				
External	Read/Write				
Access.					
) Enable	C Enable Waiting	⊖ Start	Done	Done Length: 0	
Error Code:	Extende	d Error Code:		🔲 Timed Out 🗲	
mor Path: EN					
Error Text:					
		OK	Cancel	Apply	Help

Note: if using NetFlash software and a PLC simultaneously, the values displayed in NetFlash will need to be read from the EN7000 to get the current value of any parameter modified by the PLC.





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