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OCTO24-PN8732
ETHERNET CONTROLLER CARD

INSTALLATION & MAINTENANCE MANUAL

11925 W Carmen Ave Milwaukee, WI 53225 **www.hilmot.com**

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OVERVIEW

The OCTO24 Smart Ethernet Programmable Controller provides networked 24volts Digital I/O for MDR Powered Roller Conveyor systems using the H-20 ZPA cards, as well as general purpose Fast Local/Remote Machine I/O. These Devices are fully programmable for any type of control application, and can act as a programmable master device, or a slaved Remote I/O device. The modules communicate over Ethernet to master or peer devices using Ethernet/IP, Modbus TCP and S3G-Master Slave protocols. For MDR conveyors, interlocking messaging bits e.g., upstream, downstream, merge, divert, etc are handled by the firmware for simplified Ladder Logic Programming.

Operating Specifications	
CPU Input Power	18 – 26V DC. Typical 24V, 60 mA
Digital Output Voltage	18 – 26V DC
Digital I/O Circuit Type	PNP (Sourcing)
Digital Output Max Current	80 mA
Digital Inputs Voltage	18 – 26V
Network	Ethernet 100Mb/s
Ethernet Switch	2 Ports
IP Rating	IP67

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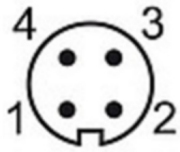
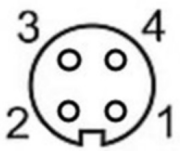
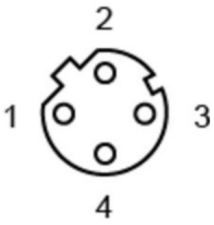
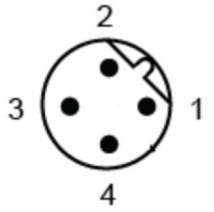
HARDWARE & WIRING

Hardware & Wiring

Label	Connector	Description
1	M12-A Male	Digital Input 1 - Output 1
2	M12-A Female	Digital Input 2 - Output 2
3	M12-A Male	Digital Input 3 - Output 3
4	M12-A Female	Digital Input 4 - Output 4
5	M12-A Male	Digital Input 5 - Output 5
6	M12-A Female	Digital Input 6 - Output 6
7	M12-A Male	Digital Input 7 - Output 7
8	M12-A Female	Digital Input 8 - Output 8
ENET1	M12-D Female	Ethernet Port 1
ENET2	M12-D Female	Ethernet Port 2
RS232	M12-D Female	<RESERVED>
PWR	M12-B Male	CPU and Digital Outputs Power Plug

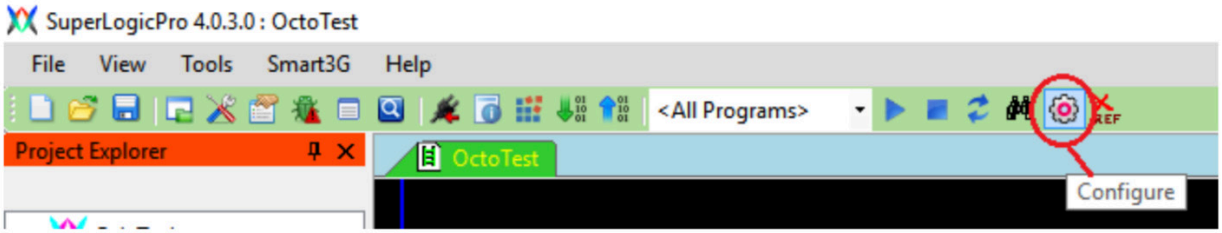
Connector	Connector Type	Pin	Description
	MALE - Used for I/O Plugs 1, 3, 5 & 7	Pin1	Output (+)
		Pin2	Output (-)
		Pin3	Input (+)
		Pin4	Input (-)
	FEMALE - Used for I/O Plugs 2, 3, 6 & 8	Pin1	Input (+)
		Pin2	Input (-)
		Pin3	Output (+)
		Pin4	Output (-)
	M12-D FEMALE - Used for Ethernet Plugs - Auto MDIX Capable	Pin1	Tx (+) | Rx (+)
		Pin2	Rx (+) | Tx (+)
		Pin3	Tx (-) | Rx (-)
		Pin4	Rx (-) | Tx (-)
	M12-B MALE - Used for Power Plug	Pin1	I/O Power 0V/GND
		Pin2	CPU Power 24V
		Pin3	I/O Power 24V
		Pin4	CPU Power 0V/GND

CONFIGURATION & OPERATION

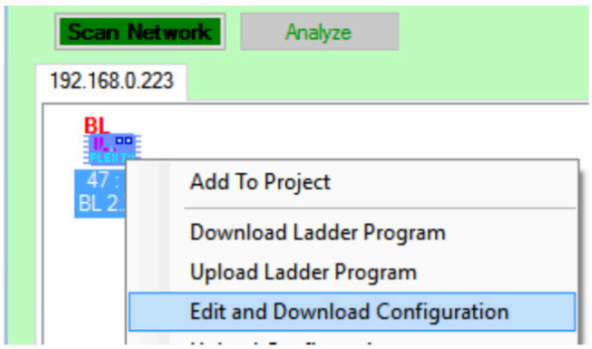
Device Configuration

The OCTO24 device configuration window can be accessed from either the SuperLogicPro, or Deploy3G application.

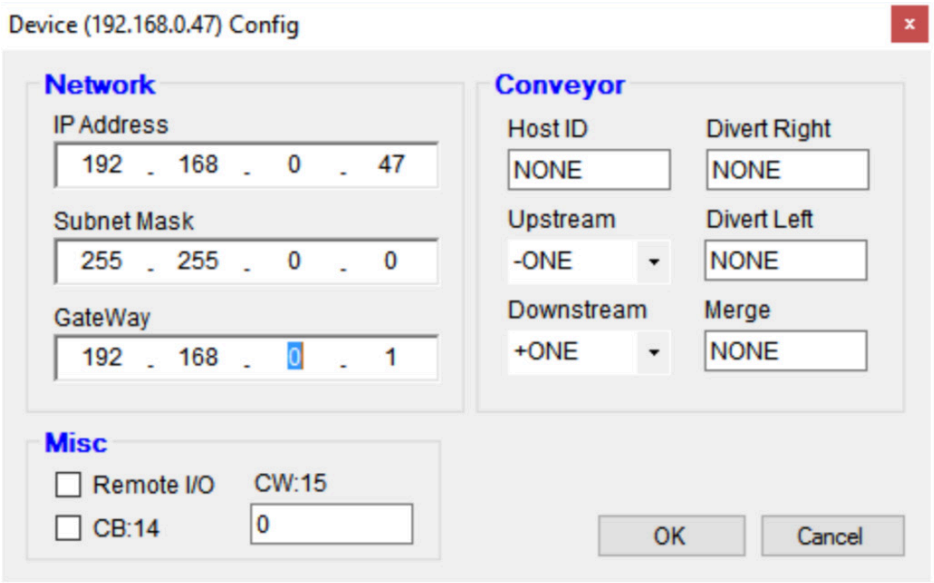
Accessing the device configuration from SuperLogic Pro



Accessing the device configuration from Deploy3G

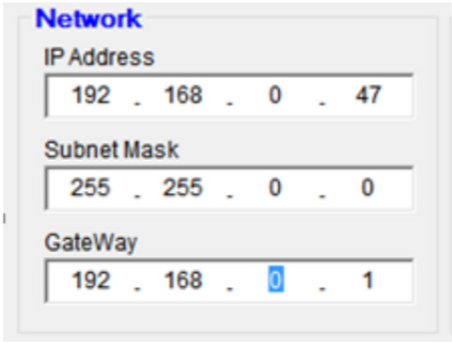


The Device Configuration Window



Network Settings

The below diagram are standard network settings used for communication over an Ethernet network.



IP Address

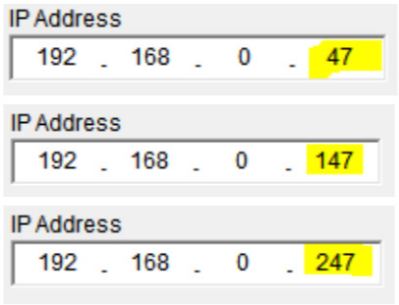
The Device IP address is configured partly by the rotary switches and partly within the device configuration window. The first three bytes of the IP address are configured from the Device Configuration window, while the last byte is configured using the rotary switches. The default IP address is set to **192.168.0.1**.

> ***Note: IP addresses use unsigned byte minimum and maximum values (0 – 255). A value of 255 indicates a broadcast value, and should not be used.***

For semantics, the first 3 bytes of the Device IP Address will be referred to as the **"Device Network"**, while the last byte will be referred to as the **"Device ID"**.

The rotary switches configure the last byte **(Device ID)** of the IP Address (e.g. **0 – 99** for decimal rotary switches, and **0 – 255** for hexadecimal rotary switches).

For decimal rotary switches, the hundreds digit of the last byte can be set by simply inputting the desired value, clicking **OK**, then rebooting the device (e.g. 47, 147, 247). Hexadecimal rotary switches are only available on some OCTO24 models.

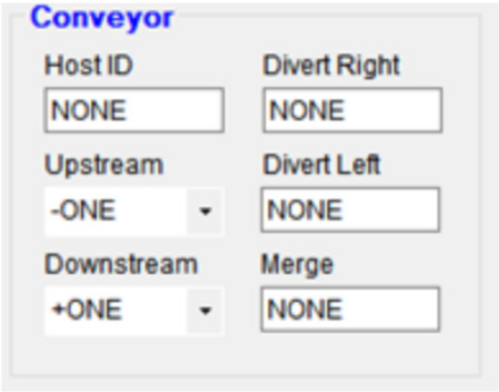


> ***Note: The Device ID can only be set to a value of 1 – 250. Any values beyond this range will result in the device entering an error state due to an invalid IP Address.***

Subnet Mask
The subnet mask of the OCTO24 device which assists in packet routing and is typically used by network routers and switches. This is typically set to a value of **255.255.255.0** for most standard network setups.

Gateway
The default Gateway IP address for the device network which usually indicates the IP address for the network router/switch that routes packets on the Local Area Network. This value is usually obtained by taking the first three bytes of the Device IP Address, and setting the last byte to 1. (Example: if the OCTO24 device is set to an IP address of **192.168.0.20**, then the Gateway should be set to **192.168.0.1**)

Conveyor Settings
The diagram below shows the settings used in OCTO24 device networks to accomplish specialized tasks/behaviors such as those required in conveyor sections:



Host ID
The last byte of the Control PC IP address. This is used by the OCTO24 device as the destination IP address for forwarding received barcode messages via Ethernet/IP. The default value is **“NONE”**, which means that the OCTO24 device will not forward any received messages to a host, and will write the barcode to **CW:61 – 80**.

Upstream
The device ID of the upstream OCTO24 card. The default value is **“-ONE”**, which means the current device ID minus 1. CB:18 is updated by the upstream card to signal that a package is available. CB:12 is used to signal the upstream device that the card is ready and the upstream can send a new package.

Downstream

The device ID of the downstream OCTO24. The default value is **“+ONE”**, which means the current device ID plus 1. CB:19 is updated by the downstream card to signal that it is ready to receive packages. CB:11 is used to signal the downstream device that a package is currently in waiting to be sent downstream.

Divert Right

The device ID of the right divert OCTO24. The default value is **“NONE”**, which means that no right divert path is present. CB:6 is updated by the right divert card to signal that it is ready to receive packages. CB:5 is used to signal the right divert device that a package is currently in waiting to be diverted right.

Divert Left

The device ID of the left divert OCTO24. The default value is **“NONE”**, which means that no left divert path is present. CB:4 is updated by the left divert card to signal that it is ready to receive packages. CB:3 is used to signal the right divert device that a package is currently in waiting to be diverted left.

Merge

The device ID of the OCTO24 controlling an auxiliary merge line. The default value is **“NONE”**, which means that no merge line is present. CB:1 is updated by the merge line card to signal that a package is currently in waiting on the merge line. CB:2 is used to signal the merge line device that a package can be received and merged on the main line.

Miscellaneous Settings

Remote I/O

This setting controls the main operation mode of the OCTO24 device. Enabling this setting will set the device to **Remote I/O Mode**, while disabling it will set the device into **PLC Mode**. See the **Operating Modes Section** for more information **(4.1)**.

CB:14

This setting controls the default value of CB:14. See **CB:14** under the **Control Bits Section** for more information **(8.1)**.

CW:15

The default persistent value for CW:15. CW:15 is a read only value which can only be configured with this setting.

OPERATING MODES

Operating Modes

The OCTO24 device has two main operating modes:

- Remote I/O Device
- Programmable Logic Controller

Remote I/O Controller Mode

Using the **SuperLogic** configuration window, if the **Remote I/O** check box is **ON**, the device allows an external master to control the I/O directly over Ethernet. The controller does not execute any user downloaded ladder logic program. Any of the supported Ethernet communication protocols can be used for I/O manipulation. This is the factory default mode.

The CPU Led blinks in the following two patterns:

- **When a Master Is *Online*:** One second On/Off cycle with **2%** duty cycle. (very short blips)
- **When Master Is *Offline*:** One second On/Off cycle with **50%** duty cycle

Programmable Logic Controller Mode

If the **Remote I/O** check box is **OFF**, the device executes the downloaded user ladder logic program to control the I/O. In this mode, any Master device can still connect to the device, but the outputs will remain in the Ladder Logic program control. The master can write to Control Word file which the device can pick up and take appropriate actions as defined by the user ladder logic program.

In this mode, the CPU Led blinks in the following patterns:

- **Ladder Logic Run Mode**: Heart-beat blink mode *(blip-blip, blip-blip, blip-blip...)*
- **Ladder Logic Stopped**: One second On/Off cycle with **50%** duty cycle.

Control More than 8 In & 8 Out using one ladder program

The ladder logic program controls the local I/O as well as access and control the I/O on remote OCTO24 devices. The remote I/O points appears as local I/O and are accessed the same way as the local I/O, e.g. IN:8, IN:50, OUT:72, etc. Up to eight remote OCTO24 cards can be controlled from a single master OCTO24 device, providing a total of 72 inputs and 72 outputs.
See the **S3G-Master/Slave Protocol Section** for more information to configure the card for expanded I/O **(5.6)**.

CPU Blink Patterns

The CPU LED will display the following blink patterns depending on the current device operation status.

Blink Patterns	Description
Heart Beat (1 blip)	Device is set to Remote I/O mode, and a master is currently controlling the device.
Fast Blink (3 blinks/sec)	Device is set to Remote I/O mode, but is not currently being controlled by a master.
Slow Blink (1/sec)	Programming Mode. Device is not set as remote I/O but is not currently running a ladder program.
Heart Beat (2 blips)	Ladder Logic Run Mode. Device is currently running a ladder program.
Rapid blink (5 blinks/sec) for 1.5 seconds, then OFF for 1.5 seconds.	Duplicate IP address detected on the network. Resolve the duplicate IP issue by changing the IP address of the device. A power cycle is required for a new IP address to take effect.
Rapid Blink (5 blinks/sec)	Rotary switch is set to zero.
Irregular Rapid Blink	Bootloader Mode. Scan for the device in Deploy3G and reprogram the firmware.

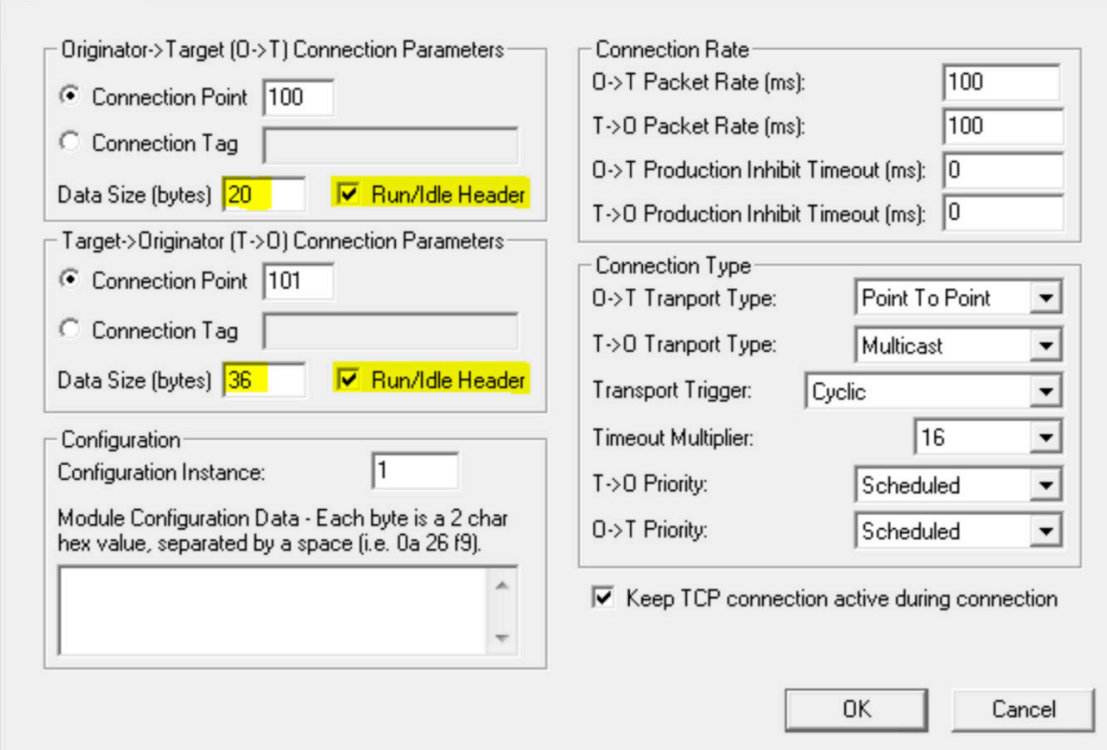
NETWORK COMMUNICATION PROTOCOLS

Network Communication Protocols

Ethernet/IP Protocol

Configuration Parameters	
Device Type	Generic
Name	Any user defined name
Data Format	SINT (byte)
IP Address	Device IP Address
OCTO32 → Master	112, Size 36 Bytes (Input/Produce Data)
Master → OCTO32	111, Size 20 Bytes (Output/Consume Data)
Configuration	113, Size 0

Add Class1 Connection



Input/Produce Message Format

Data to Ethernet/IP Master is read from Control Words 1 through 4, which are 16bit integers.

Byte	Function / Value
0 - 3	Header (byte 0 always set to 1)
4	Status Bits • Bit 0 – Output power • Bit 1 – Remote I/O Enabled • Bit 2 – Ladder Run mode • Bit 3 – Ladder Error
5	Input States, 8 bits
6	Output States, 8 bits
7	S3G Slave I/O online bits (bit0 – slave1, bit1 – slave2, bit2 – slave3, etc.)
8 - 11	System Timer Milliseconds
12 - 13	Contents of Control Word 1 (CW:1)
14 - 15	Contents of Control Word 2 (CW:2)
16 - 17	Contents of Control Word 3 (CW:3)
18 - 19	Contents of Control Word 4 (CW:4)
20 - 21	Digital I/O data for Slave1. (Inputs = bits 0 – 7; Outputs = bits 8 – 15)
22 - 23	Digital I/O data for Slave2. (Inputs = bits 0 – 7; Outputs = bits 8 – 15)
24 - 25	Digital I/O data for Slave3. (Inputs = bits 0 – 7; Outputs = bits 8 – 15)
26 - 27	Digital I/O data for Slave4. (Inputs = bits 0 – 7; Outputs = bits 8 – 15)
28 - 29	Digital I/O data for Slave5. (Inputs = bits 0 – 7; Outputs = bits 8 – 15)
30 - 31	Digital I/O data for Slave6. (Inputs = bits 0 – 7; Outputs = bits 8 – 15)
32 - 33	Digital I/O data for Slave7. (Inputs = bits 0 – 7; Outputs = bits 8 – 15)
34 - 35	Digital I/O data for Slave8. (Inputs = bits 0 – 7; Outputs = bits 8 – 15)

Output/Consume Message Format

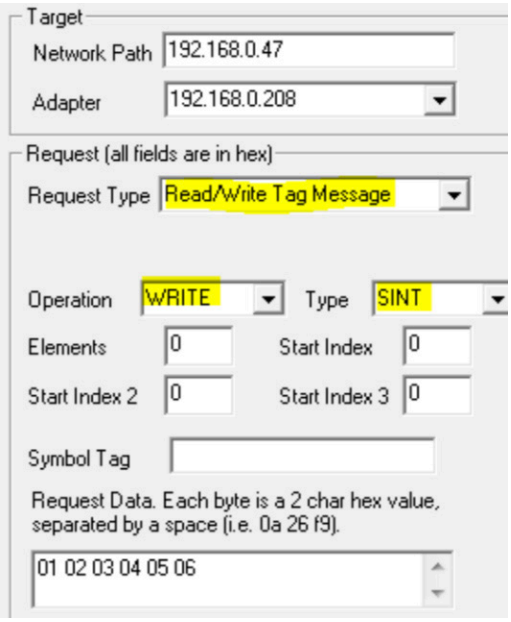
If the OCTO24 device is configured with Remote I/O operation, Byte0 is mapped to outputs for direct master PLC control.

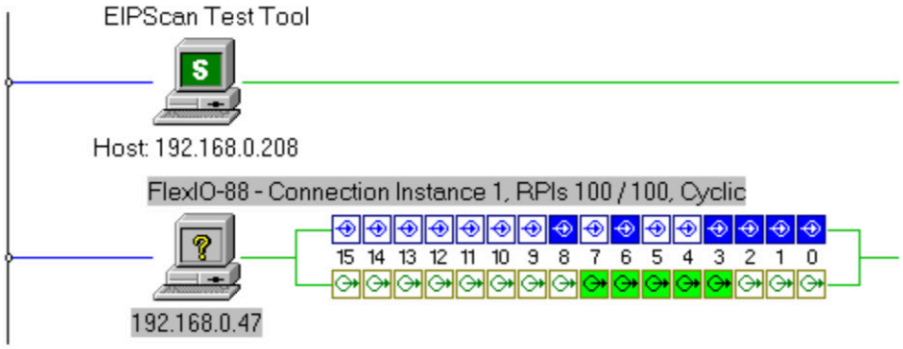
Byte	Function / Value
0 - 1	Control Word 9 (or byte 0 directly to Digital Outputs in Remote I/O mode)
2 - 3	Control Word 10
4 - 5	Control Word 81
6 - 7	Control Word 82
8 - 9	Control Word 83
10 - 11	Control Word 84
12 - 13	Control Word 85
14 - 15	Control Word 86
16 - 17	Control Word 87
18 - 19	Control Word 88

Explicit Requests

Explicit requests can be sent to the OCTO24 device using Ethernet/IP which is useful for barcode scanners. The following message parameters must be used for sending these requests.

Setting	Value
Request Type	Read/Write Tag Message
Operation	Write
Type	SINT (8-bit)





The request data contents will be written to CW:61 – 80, which allows 40 bytes of data to be stored for each request. CB:10 will be activated whenever an explicit request is received and data is written to the control words. If CB:10 is active while a new explicit request is received, CB:15 will be activated to signal a buffer overrun condition.
See the **Control Words (7.1)**, and **Control Bits (8.1) Section** for more information.

Modbus / TCP Protocol

Modus/TCP protocol can read the entire Control Words file CW: 1...54 via **Modbus Holding Registers**. Writes (or Output-Holding) are only allowed to Registers 9, 10, 23 and 24.

Modbus Slave address is ignored.

Reading Modbus Holding Register 1 through 54 will read Control Words 1 thru 54 in the card.

Writing to Modbus Holding Register 9 and 10 will write to Control Words 9 and 10 in the card. Can be used for any general purpose.

The following special condition applies to Register 23 and 24:

Read Holding Reg 23 = Read 8 Inputs (bits 0...7) and new barcode bit (bit 15)
Read Holding Reg 24 = Read 8 Outputs (bits 0...7) and I/O Power State (bit 15)
Write Holding Reg 23 = Write to CW:23
Write Holding Reg 24 = Write to CW:24, or Write to output pins if Remote I/O Checkbox is on

S3G-Master/Slave Protocol

The OCTO24 allows expanding the local I/O by using remote OCTO24 devices (configured as **Remote I/O**). Up to eight slave OCTO24 cards can be scanned by the master, providing a total of 72 inputs and 72 outputs. The ladder logic program controls the local I/O as well as access and control remote I/O of OCTO24 devices using the **S3G-Master/Slave** protocol.

The remote OCTO24 devices must have their **Remote I/O** check box turned **ON**, so they do not run their own ladder program. To enable scanning of remote OCTO24 device(s), enter the device id (last digit of the IP address) in Control Words 41 thru 48 inside the ladder logic program. The default value is 0, which disables the particular slot of the slave scanner.

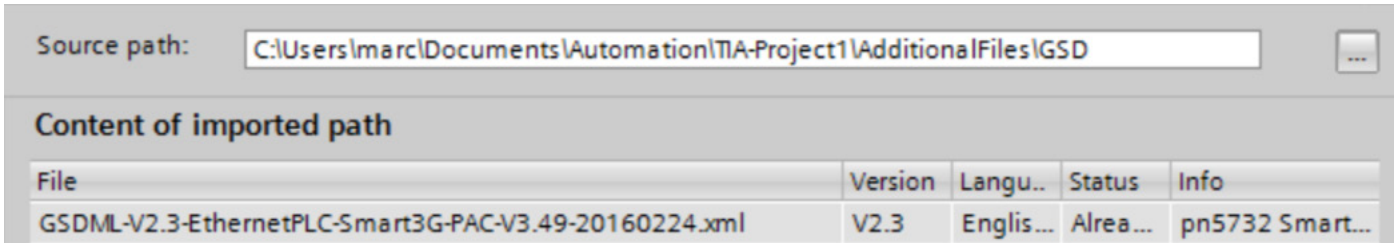
The remote I/O is accessed as follows:

Remote Device	Address Control Word	Input File	Output File
#1	41	IN: 9–16	OUT: 9–16
#2	42	IN: 17–24	OUT: 17–24
#3	43	IN: 25 – 32	OUT: 25 – 32
#4	44	IN: 33 – 40	OUT: 33 – 40
#5	45	IN: 41 – 48	OUT: 41 – 48
#6	46	IN: 49 – 56	OUT: 49 – 56
#7	47	IN: 57 – 64	OUT: 57 – 64
#8	48	IN: 65 – 72	OUT: 65 – 72

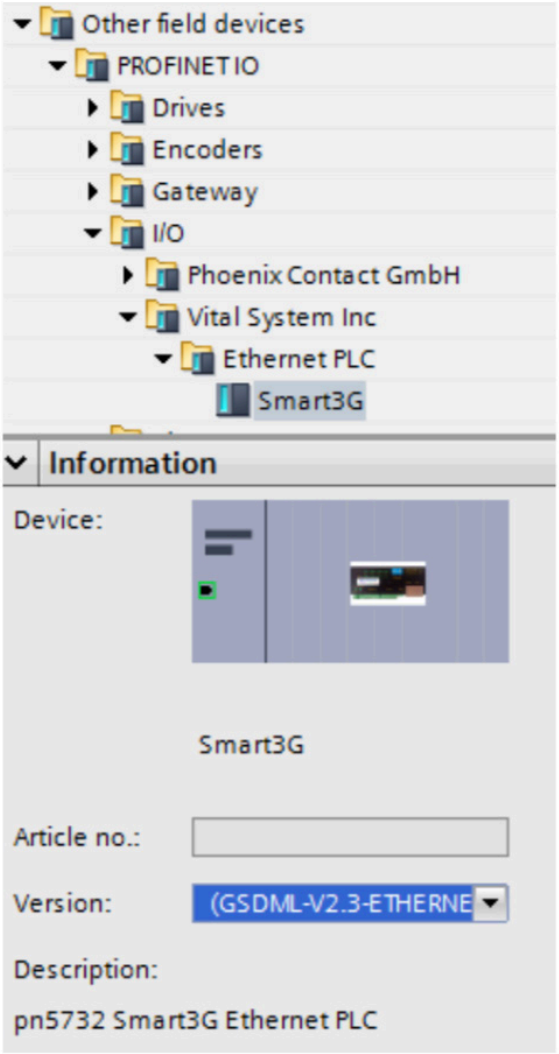
EXAMPLE: to scan device at 192.168.0.88, set CW:41 to a value of 88.
The I/O of device 88 will appear in files IN:9 – 16 and OUT:9 – 16.

Import XML Device Profile

The Smart3G ProfiNET Device Profile can be imported into a ProfiNET project by selecting the XML device profile from Vital System Inc.



After successfully importing the Smart3G device profile, it should then be available in the project's Hardware Catalog.

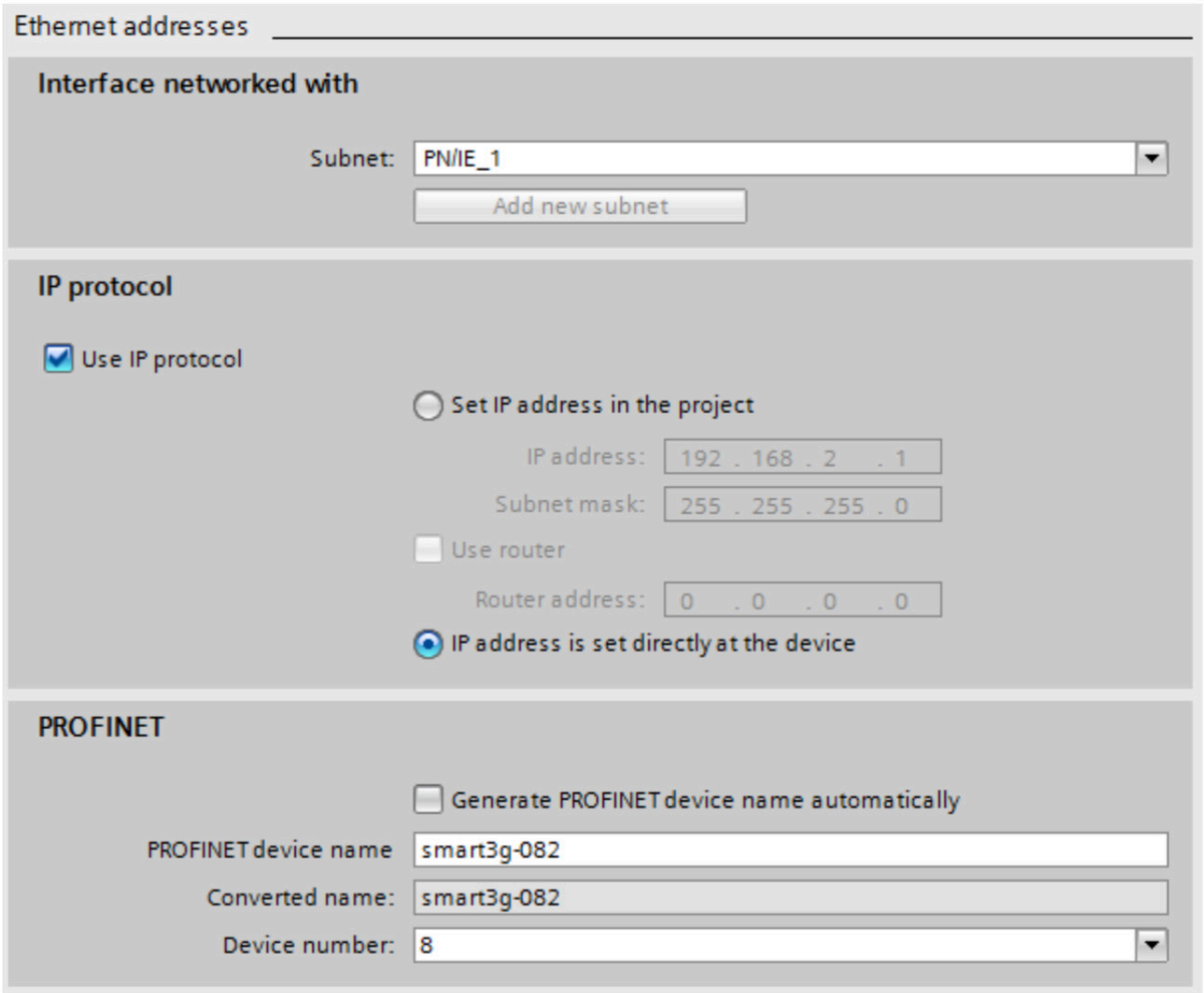


Profinet Ethernet Configuration

The OCTO24 IP address is always specified on the device itself depending on the rotary switch selection.

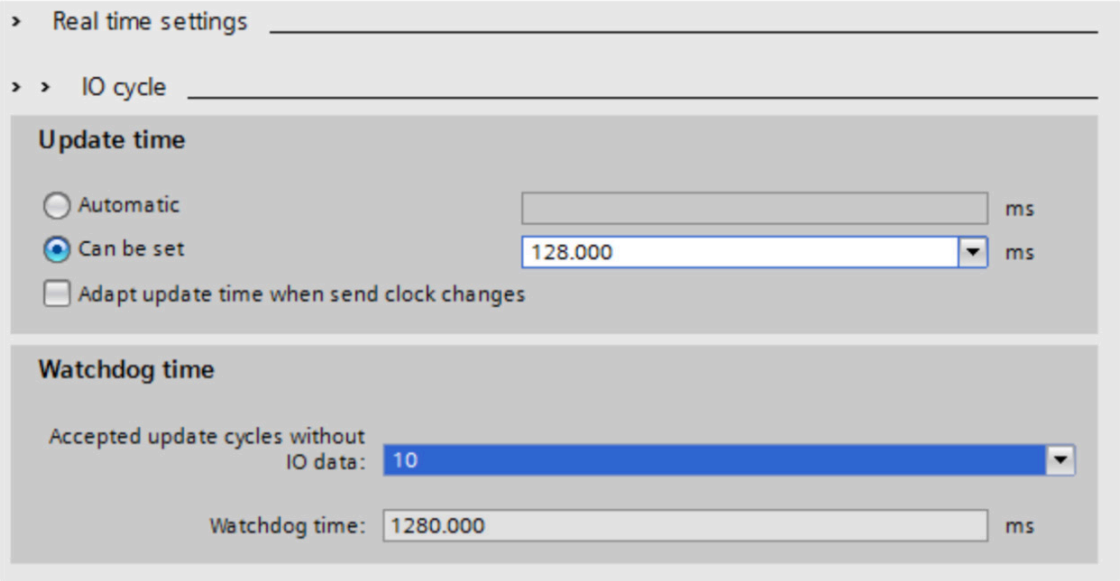
The ProfiNET device name must be set to the text “smart3g-xxx”, where “xxx” is the last octet of the IP Address written in a 3-digit notation. This is also specified by the rotary switch selection.

> ***Note: The IP Address of the device cannot be configured via ProfiNET. It can, however, be configured from the Deploy3G or SuperLogic Pro applications.***



Real Time Settings

These settings control the I/O data polling rate, and the timeout duration.
The polling rate can be set as low as 4 milliseconds.

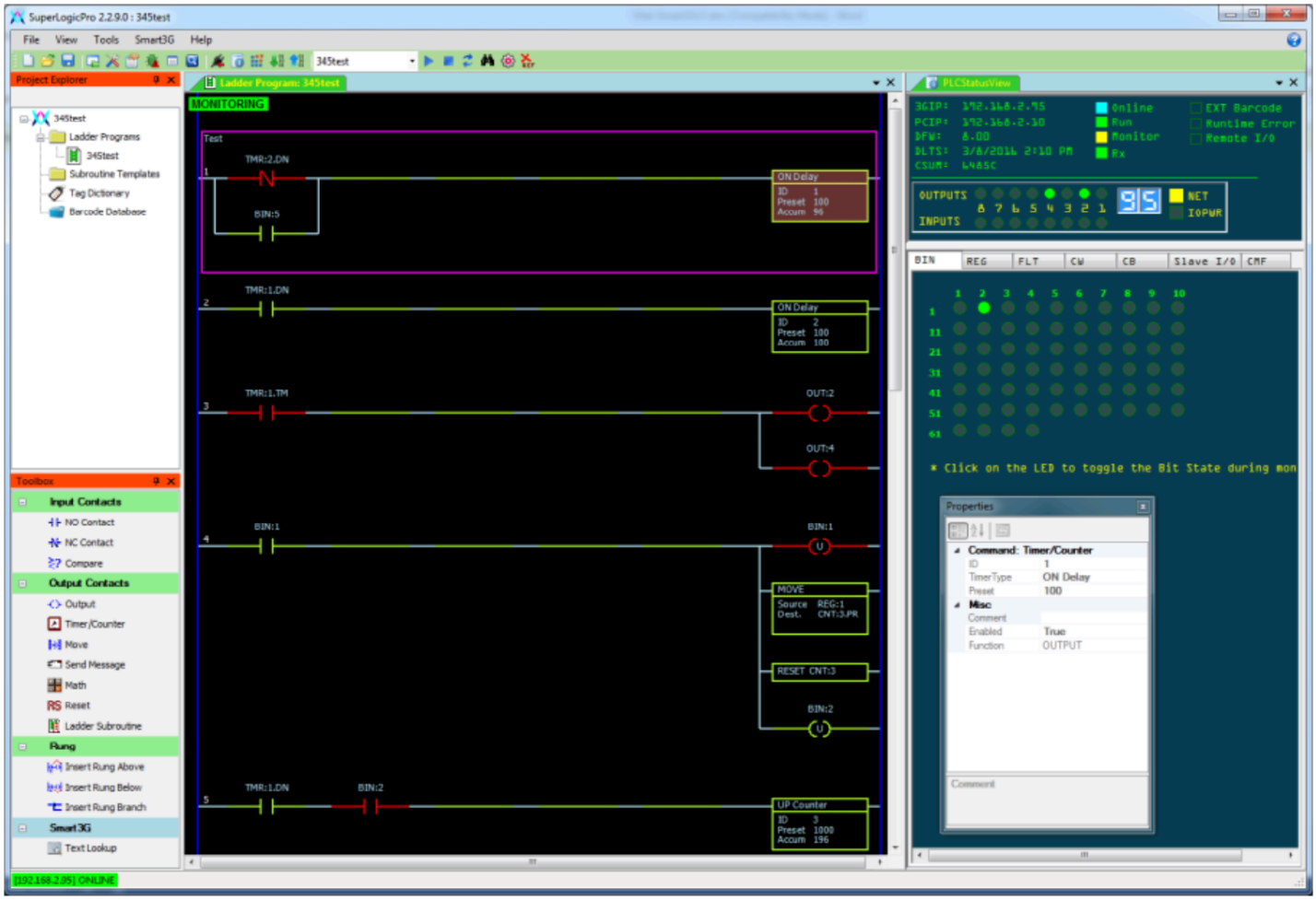


Slot #	Subslot #	Module	Description
1	1001	Digital I/O	Digital Inputs (1-byte or 8-bits) Digital Outputs (1-byte or 8-bits)
	1002	Status Bits	(16-bits); Bit0 = IO Power; Bit1 = RemoteIO; Bit2 = Run Mode;
	1003	Control Bits	(16-bits); CB:1 – 6; 9 – 12; 14 – 15; 18 – 19;
2	1001	CW:01	Read-only Control Word (2-bytes or 16-bits)
	1002	CW:02	Read-only Control Word (2-bytes or 16-bits)
	1003	CW:03	Read-only Control Word (2-bytes or 16-bits)
	1004	CW:04	Read-only Control Word (2-bytes or 16-bits)
	1005	CW:25	Read-only Control Word (2-bytes or 16-bits)
	1006	CW:26	Read-only Control Word (2-bytes or 16-bits)
	1007	CW:27	Read-only Control Word (2-bytes or 16-bits)
3	1001	CW:09	Writable Control Word (2-bytes or 16-bits)
	1002	CW:10	Writable Control Word (2-bytes or 16-bits)
	1003	CW:28	Writable Control Word (2-bytes or 16-bits)
	1004	CW:29	Writable Control Word (2-bytes or 16-bits)
	1005	CW:30	Writable Control Word (2-bytes or 16-bits)

PROGRAMMING & CONFIGURING

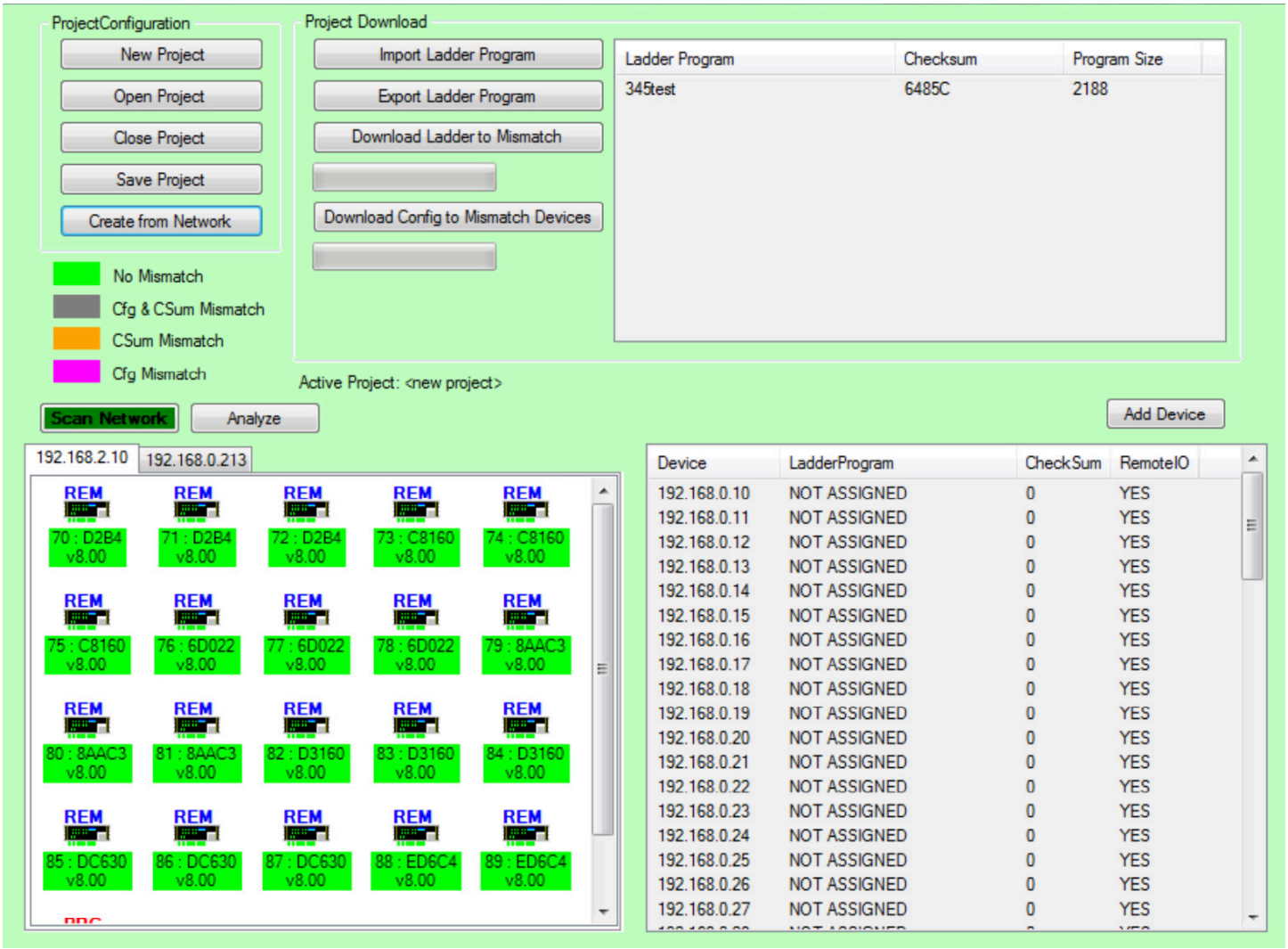
SuperLogic Pro

The Programming and configuration of OCTO24 devices is accomplished by the SuperLogic Pro and Deploy3G PC applications. SuperLogic Pro allows editing, downloading, monitoring/ debugging of the ladder logic program. The configuration window in this program allows editing the IP address and other operation parameters of the device. Please refer to the SuperLogic Pro Software manual for more detail.



Deploy3G

Deploy3G is used to commission large systems that utilize several OCTO24 devices. It maintains a database of ladder programs and device configurations for the entire project.



CONTROL WORDS

Control Words

The Control Word file is a 16-bit integer file. The ladder logic program can read and write Control Words by using the CW:n syntax, although some Control Words are read only as mentioned in the following table. Modbus/TCP can read any control word while writing is only allowed on certain control words. Ethernet/IP and ProfiNET can read/write certain locations only.

File Index	Access	Description
CW:1 – 4	RW	Data that is transmitted to master in Ethernet/IP or ProfiNET polling. This data has no built-in functionality and can be used for any purpose
CW:5	--	RESERVED
CW:6	RO	Merge Device ID
CW:7	RO	Divert 1 Device ID
CW:8	RO	Divert 2 Device ID
CW:9 – 10	RW	Ethernet/IP or Modbus/TCP – Data Write from Master
CW:11	RO	Local Device ID
CW:12	RO	Downstream Device ID
CW:13	RO	Upstream Device ID
CW:14	RO	Master/Slave Protocol Scan List Status. Bits 0 – 7 indicate online status for each device. Bits 8 – 15 indicate Output Power Status on the remote devices
CW:15	RO	User Defined. This value is read from the flash memory at startup
CW:16	RO	Ladder Logic Transmit Message Destination Device ID
CW:17 – 22	RW	Ladder Logic Transmit Message Data. Each control word can have value of 0 thru 255
CW:23 – 24	RW	Special Definition for **Modbus/TCP Holding Regsiters** • Read CW:23 = Read 8 Inputs (Bit 0 – 7) and new serial port data bit (Bit 15) • Read CW:24 = Read 8 Outputs (Bit 0 – 7) and Output Enable Bit (Bit 15) • Write CW:23 = Write to CW:23 • Write CW:24 = Write to CW:24, or write directly to output pins if device is in Remote I/O mode
CW:25 – 30	R	Writable Control Word (2-bytes or 16-bits)
CW:31 – 40	--	Writable Control Word (2-bytes or 16-bits)

File Index	Access	Description
CW:41 – 48	RW	Device IDs for Master/Slave setup. A non-zero value defines the ID of the remote card. A value of 0 disables scanning. Up to 8 cards can be setup as slave
CW:49 – 56	RO	Input / Output data for slave devices. Bits 0 – 7 are input states and bits 8 – 15 are output states. This data is also accessible using the IN/OUT file, (e.g. IN:55, OUT:71 etc). This Data is also sent to the Ethernet/IP Master while the OCTO24 device is running a ladder program
CW:61 – 80	RW	Barcode data received from Ethernet/IP explicit requests
CW:81 – 88	RW	Ethernet/IP or Modbus/TCP – Data Write from Master

CONTROL BIT FILE

Control Bit File

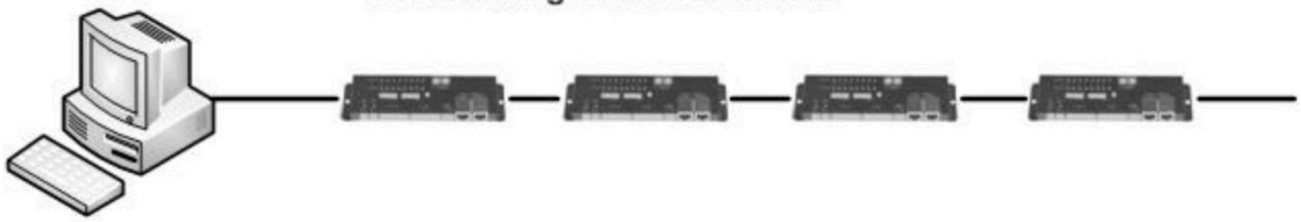
The Control bit file is a binary file. This file is used to pass status and control data between the user ladder logic program and the firmware. Some locations of this file are read only.

File Index	Access	Description
CB:1	RO	Box Available at Merge Branch. (Input from merge line OCTO24 device)
CB:2	RW	Main Line ready to receive from merge branch (Output to merge line OCTO24 device)
CB:3	RW	Package available for Left Divert Branch (Output to Left Divert OCTO24 device)
CB:4	RO	Left Divert Branch is Ready to receive (Input from Left DivertOCTO24 device)
CB:5	RW	Package available for Right Divert Branch (Output to Right Divert OCTO24 device)
CB:6	RO	Right Divert Branch is ready to receive (Input from Right Divert OCTO24 device)
CB:7	--	RESERVED
CB:8	--	RESERVED
CB:9	RO	Output Power On
CB:10	RW	New Barcode Received on CW:61 – 80. This bit is automatically activated when a new barcode is received, but must be manually cleared after the received barcode has been sufficiently processed in the user application, in order to indicate that a new received barcode is free to overwrite the memory
CB:11	RW	Signal to Downstream main line that a package is available (Output to Downstream OCTO24 device)
CB:12	RW	Ready to receive from Upstream main line (Output to Upstream OCTO24 device)
CB:13	--	RESERVED
CB:14	RO	User defined value that can be saved in flash. Data is persistent across power cycles
CB:15	RW	Barcode Overrun. This control bit is active when a new barcode is received while CB:10 is still in the active state. In this case, the newly scanned barcode is ignored. CB:10 must be cleared in order to receive a new barcode scan
CB:16	--	RESERVED
CB:17	--	RESERVED
CB:18	--	Box Available from Upstream main line (Input from Upstream OCTO24 device)
CB:19	--	Downstream main line is ready (Input from Downstream OCTO24 device)
CB:20	--	ProfiNET connection active. This control bit is activated when a ProfiNET connection is currently online and actively sending and receiving I/O data

NETWORK TOPOLOGY EXAMPLES

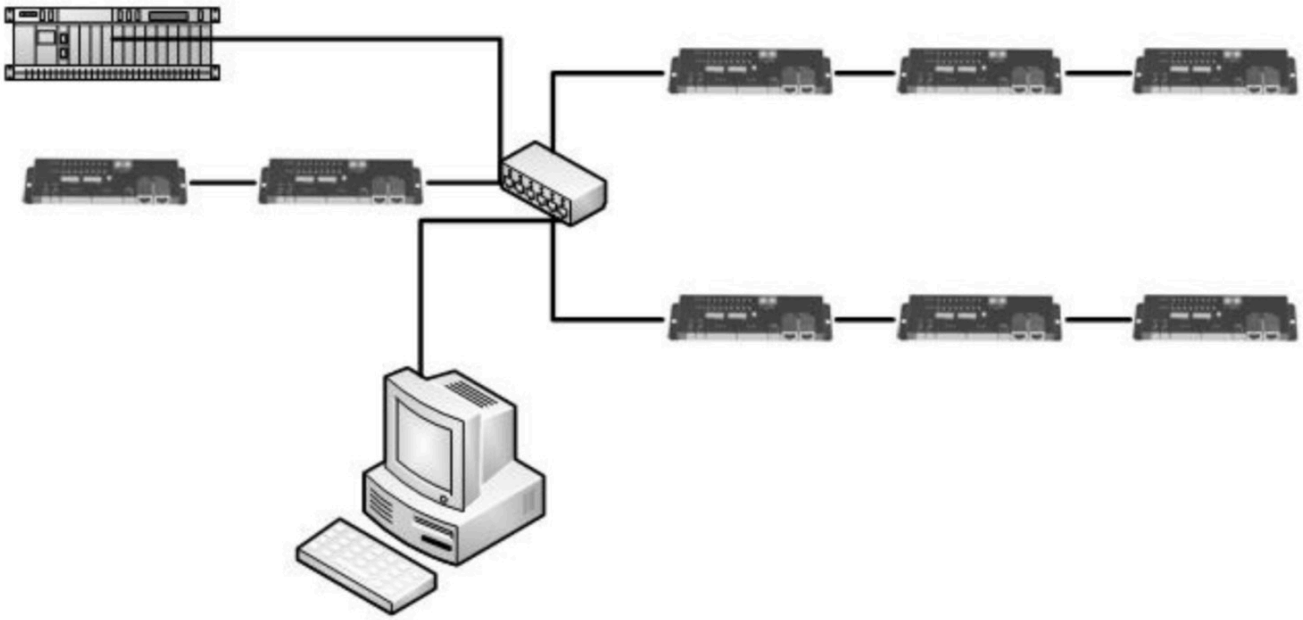
Master PLC Scanning eNetPLC Devices

PC Scanning eNetPLC Devices



Master eNetPLC Scanning Slaved eNetPLC Devices

Multi-Master Scanning eNetPLC Sub Systems



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