iControl® Profibus®, DeviceNet™, and Ethernet/IP™ Gateway

Customer Product Manual
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Contact Us

Nordson Corporation welcomes requests for information, comments, and inquiries about its products. General information about Nordson can be found on the Internet using the following address: http://www.nordson.com.

Address all correspondence to:

Nordson Corporation
Attn: Customer Service
555 Jackson Street
Amherst, OH 44001

Change Record

Revision	Date	Change
A02	09/10	Added P3 network connection detail on page 7 and 30. Added SW4 legend on page 7 and changed SW3, pos-3 to open on page 7. Updated tables on pages 12, 15, 16, and 27.

iControl® Profibus®, DeviceNet™, and Ethernet/IP™ Gateway

Safety

Read and follow these safety instructions. Task- and equipment-specific warnings, cautions, and instructions are included in equipment documentation where appropriate.

Make sure all equipment documentation, including these instructions, is accessible to all persons operating or servicing equipment.

Qualified Personnel

Equipment owners are responsible for making sure that Nordson equipment is installed, operated, and serviced by qualified personnel. Qualified personnel are those employees or contractors who are trained to safely perform their assigned tasks. They are familiar with all relevant safety rules and regulations and are physically capable of performing their assigned tasks.

Intended Use

Use of Nordson equipment in ways other than those described in the documentation supplied with the equipment may result in injury to persons or damage to property.

Some examples of unintended use of equipment include

- using incompatible materials
- making unauthorized modifications
- removing or bypassing safety guards or interlocks
- using incompatible or damaged parts
- using unapproved auxiliary equipment
- operating equipment in excess of maximum ratings

Regulations and Approvals

Make sure all equipment is rated and approved for the environment in which it is used. Any approvals obtained for Nordson equipment will be voided if instructions for installation, operation, and service are not followed.

All phases of equipment installation must comply with all federal, state, and local codes.

Personal Safety

To prevent injury follow these instructions.

- Do not operate or service equipment unless you are qualified.
- Do not operate equipment unless safety guards, doors, or covers are intact and automatic interlocks are operating properly. Do not bypass or disarm any safety devices.
- Keep clear of moving equipment. Before adjusting or servicing any moving equipment, shut off the power supply and wait until the equipment comes to a complete stop. Lock out power and secure the equipment to prevent unexpected movement.
- Relieve (bleed off) hydraulic and pneumatic pressure before adjusting or servicing pressurized systems or components. Disconnect, lock out, and tag switches before servicing electrical equipment.
- Obtain and read Material Safety Data Sheets (MSDS) for all materials used. Follow the manufacturer's instructions for safe handling and use of materials, and use recommended personal protection devices.
- To prevent injury, be aware of less-obvious dangers in the workplace that often cannot be completely eliminated, such as hot surfaces, sharp edges, energized electrical circuits, and moving parts that cannot be enclosed or otherwise guarded for practical reasons.

Fire Safety

To avoid a fire or explosion, follow these instructions.

- Do not smoke, weld, grind, or use open flames where flammable materials are being used or stored.
- Provide adequate ventilation to prevent dangerous concentrations of volatile materials or vapors. Refer to local codes or your material MSDS for guidance.
- Do not disconnect live electrical circuits while working with flammable materials. Shut off power at a disconnect switch first to prevent sparking.
- Know where emergency stop buttons, shutoff valves, and fire extinguishers are located. If a fire starts in a spray booth, immediately shut off the spray system and exhaust fans.
- Clean, maintain, test, and repair equipment according to the instructions in your equipment documentation.
- Use only replacement parts that are designed for use with original equipment. Contact your Nordson representative for parts information and advice.

Grounding

WARNING: Operating faulty electrostatic equipment is hazardous and can cause electrocution, fire, or explosion. Make resistance checks part of your periodic maintenance program. If you receive even a slight electrical shock or notice static sparking or arcing, shut down all electrical or electrostatic equipment immediately. Do not restart the equipment until the problem has been identified and corrected.

Grounding inside and around the booth openings must comply with NFPA requirements for Class II Division 1 or 2 Hazardous Locations. Refer to NFPA 33, NFPA 70 (NEC articles 500, 502, and 516), and NFPA 77, latest conditions.

- All electrically conductive objects in the spray areas shall be electrically connected to ground with a resistance of not more than 1 megohm as measured with an instrument that applies at least 500 volts to the circuit being evaluated.
- Equipment to be grounded includes, but is not limited to, the floor of the spray area, operator platforms, hoppers, photoeye supports, and blow-off nozzles. Personnel working in the spray area must be grounded.
- There is a possible ignition potential from the charged human body. Personnel standing on a painted surface, such as an operator platform, or wearing non-conductive shoes, are not grounded. Personnel must wear shoes with conductive soles or use a ground strap to maintain a connection to ground when working with or around electrostatic equipment.
- Operators must maintain skin-to-handle contact between their hand and the gun handle to prevent shocks while operating manual electrostatic spray guns. If gloves must be worn, cut away the palm or fingers, wear electrically conductive gloves, or wear a grounding strap connected to the gun handle or other true earth ground.
- Shut off electrostatic power supplies and ground gun electrodes before making adjustments or cleaning powder spray guns.
- Connect all disconnected equipment, ground cables, and wires after servicing equipment.

Action in the Event of a Malfunction

If a system or any equipment in a system malfunctions, shut off the system immediately and perform the following steps:

- Disconnect and lock out electrical power. Close pneumatic shutoff valves and relieve pressures.
- Identify the reason for the malfunction and correct it before restarting the equipment.

Disposal

Dispose of equipment and materials used in operation and servicing according to local codes.

Description

The iControl Gateway is the interface between an external controller and a Prodigy® HDLV® pump panel or an iFlow® (Venturi) pump panel.

The Gateway converts standard fieldbus protocol messages and commands (Profibus, DeviceNet, or Ethernet/IP) from an external controller into the proprietary CAN bus messages required to communicate with the modules controlling the spray guns.

See Figure 1. The Gateway is capable of interfacing with up to 32 automatic guns through a single cable to the spray control modules. Additional modules are then connected by daisy chaining this network.

The system is compatible with Tribomatic®, Sure Coat®, Versa-Spray®, PE, and Prodigy guns.

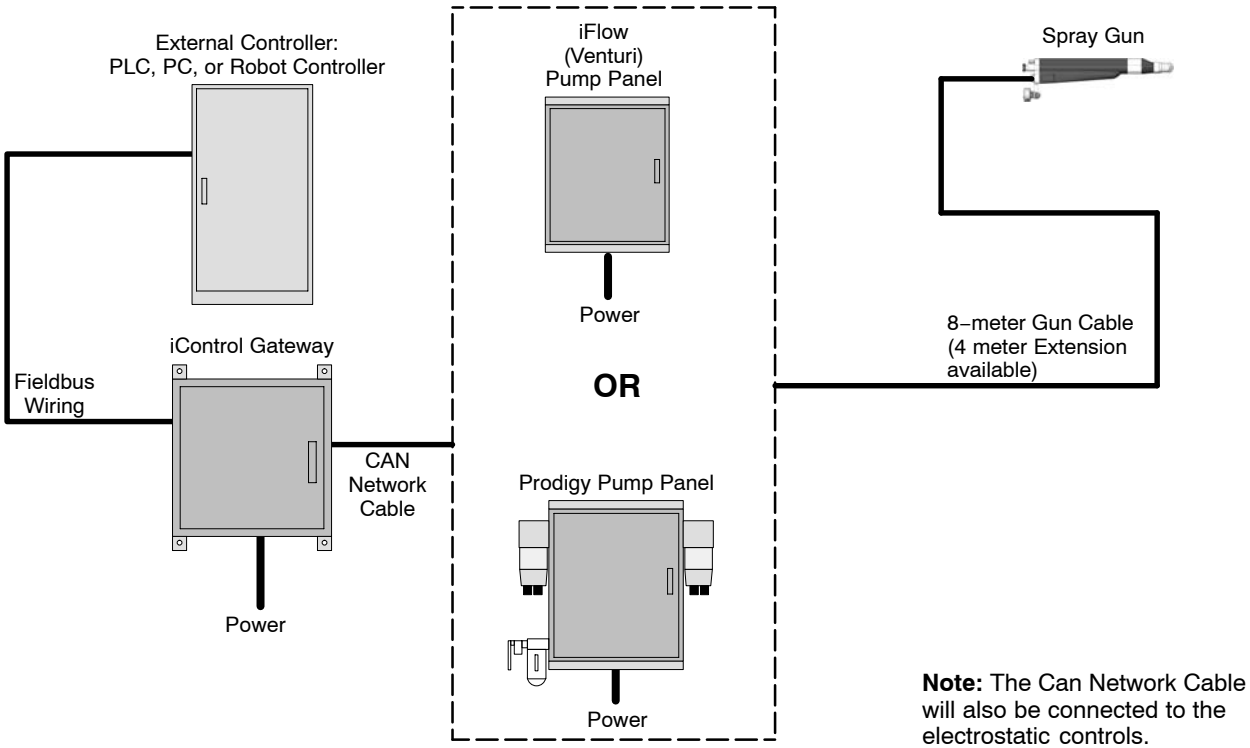


Figure 1 Typical System Diagram

Installation

WARNING: Allow only qualified personnel to perform the following tasks. Follow the safety instructions in this document and all other related documentation.

WARNING: Use dust-tight conduit connectors or strain reliefs to route cables into all electrical enclosures. Installation must be done according to code and care must be taken to maintain the dust-tight integrity of the enclosures.

Enclosure Mounting

See Figure 2. The Gateway may be mounted to any convenient location, provided the network cable lengths do not exceed specification limits.

If mounting on a wall or panel, use the dimensions shown for the enclosure feet. Use M8 fasteners as needed.

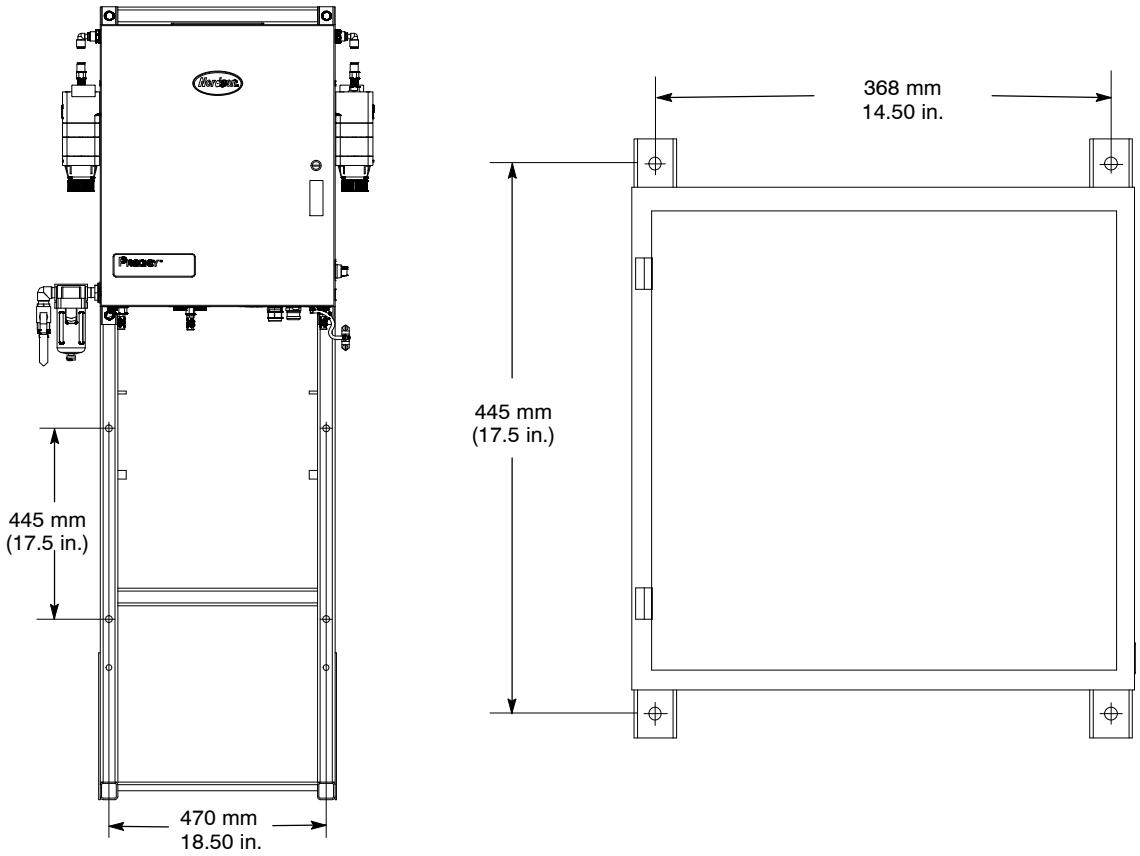


Figure 2 Gateway Mounting to Prodigy II Gun Stand

Electrical Power and Fusing

Refer to the Gateway Enclosure Wiring Diagram on page 30.

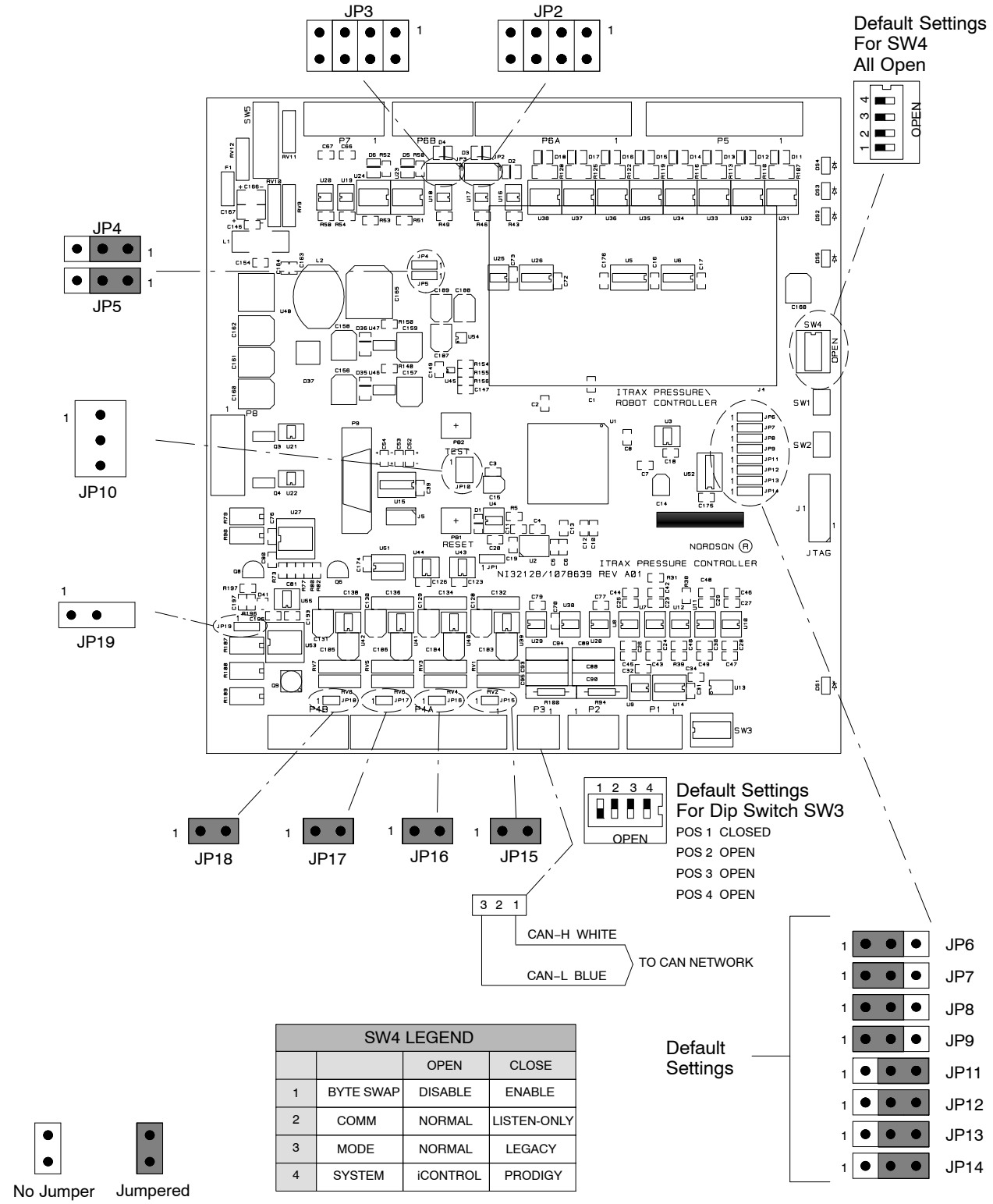
The Gateway requires 85–250 Vac, 50–60 Hz, single phase, 21 VA input power.

Route the AC power leads through a knockout in the bottom of the enclosure and connect them to the L1, L2 and GND terminals on the terminal block as shown in the following wiring diagrams.

Gateway Circuit Board Jumper Settings

Open the Gateway enclosure and verify all jumpers are positioned as shown in Figure 3.

Gateway Circuit Board Jumper Settings *(contd)*



SW4 LEGEND			
		OPEN	CLOSE
1	BYTE SWAP	DISABLE	ENABLE
2	COMM	NORMAL	LISTEN-ONLY
3	MODE	NORMAL	LEGACY
4	SYSTEM	iCONTROL	PRODIGY

Figure 3 Gateway Circuit Board Jumper Settings

Software

Overview

A typical PLC−based powder system utilizing iControl's control modules consists of two basic sub−systems:

- a PLC which controls the triggering of several guns
- a network of several intelligent powder flow (either iFlow or PFCP) and gun KV control modules.

Since the iControl system uses separate intelligent modules (or nodes) for controlling powder flow and gun voltage, the PLC, at times, must have the capability to communicate to 2 nodes for controlling a single gun.

Furthermore, since each flow or KV control node has 2 channels for controlling two guns, each intelligent node must process data and control information for 2 separate guns. All of the control nodes are networked together on a proprietary CAN bus which acts as the channel through which all data and commands to and from the nodes are sent.

Each Gateway is designed to appear as a single slave device to the PLC master, regardless of the number of gun control nodes in the system. Inside the Gateway, the interface between the 2 networks is a dual port memory device which is organized such that all data/commands have a unique address which can be accessed by either network.

This section describes the specifications required to send commands to the flow/gun nodes so that they may perform their intended functions. In particular, the layout of the dual port memory is defined by describing the function and/or range of values which occupy each address location. The method for retrieving process data from the slave nodes, via reading the dual port memory, is also specified.

Throughout this document, the gun flow, gun pump and gun voltage control nodes will be collectively referred to as gun control nodes. For each gun in the system, there is a KV node which controls that gun's electrostatics; and there can be either a gun flow (iFlow) node or a gun pump (PFCP) node, but not both, to control that gun's powder flow.

Hardware Requirements

Figure 4 describes the hardware components which make up the Gateway system. The PLC master only sees a single slave node connected to it. The Gateway consists of 2 circuit boards:

PCA – PLC Gateway Controller

- communicates CAN messages to and from gun control nodes.
- connects up maximum of 32 guns per gateway.
- reads and writes to one side of the dual port memory.

AnyBus® Network Interface Module

- reads and writes data to one side of dual port memory
- specific to PLC protocol (Profibus, DeviceNet, or Ethernet/IP)
- 32 pin header (plug and play – change to any other network interface without software or configuration changes to the gateway)
- 4 diagnostic LEDs
- addressable node ID
- 1 bus termination switch (if applicable)

The AnyBus module communicates with the PCA via the address and data bus and some control signals.

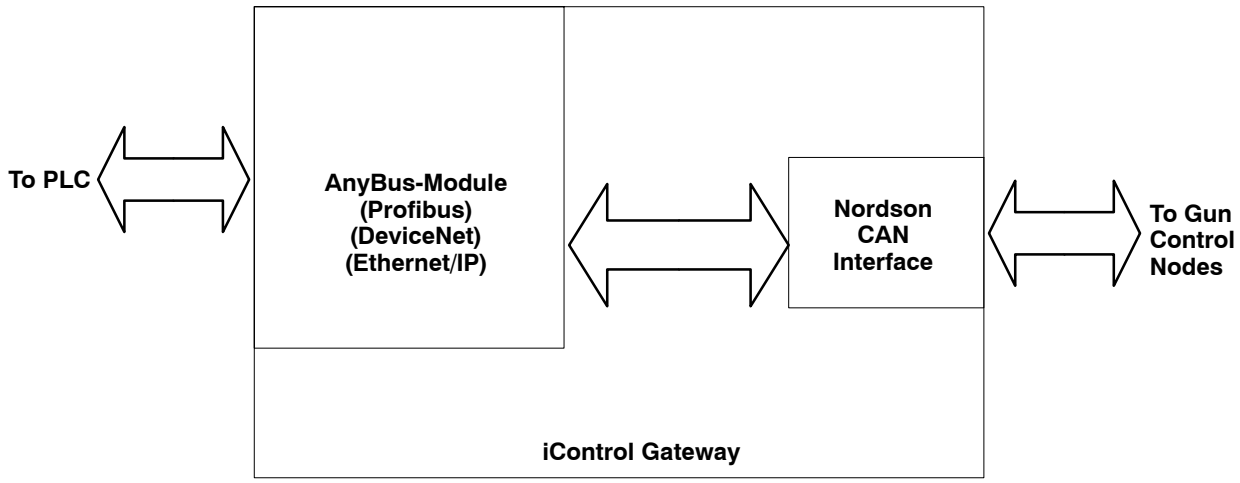


Figure 4 Gateway Hardware

Gateway Software

Figure 5 describes the software architecture of the Gateway. The shaded portion represents the software modules specifically developed for the Gateway. As shown, the Gateway software interfaces to the fieldbus and CAN bus networks using commercially available hardware, thus realizing a gateway function.

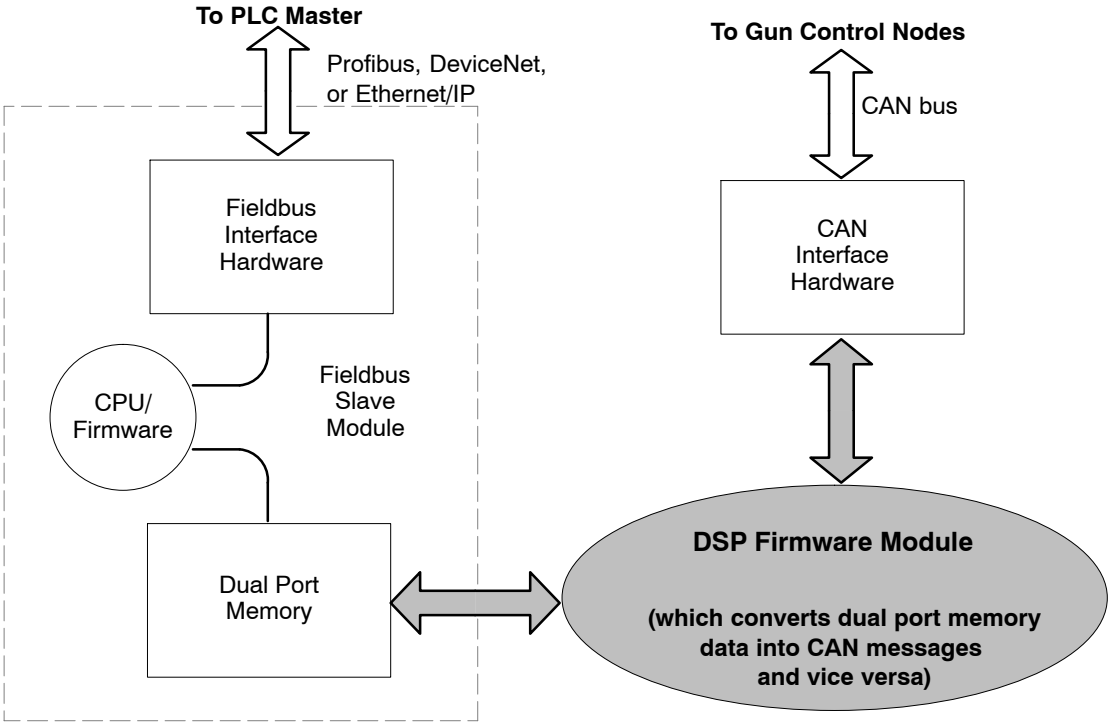


Figure 5 Gateway Software Modules

Addressing Modes

There are three addressing modes which are used for sending and receiving data/commands from the PLC to the gun control nodes addressing modes.

Broadcast Messages

See *Broadcast Messages from the PLC* section on Page 19 for list of all broadcast messages.

- Send messages from the PLC to all the gun control nodes.
- Assigned top priority
- Examples include *Gun Trigger* or *Lockout*

Multicast Messages

See *Multicast Messages from the PLC* section on Page 20 for more information on multicast messages.

- Send commands and data from the PLC group of gun control nodes associated with a single gun
- At this time, multicast addressing only applies to *Change Preset Messages*

NOTE: By default, each physical gun in a system also belongs to a multicast group address (which is equal to the physical gun number). Since each physical gun is connected to two gun control nodes (one for KV control and another for Flow control), it is convenient to have the ability to send certain messages to a given physical gun's KV node/Flow node pair.

Unicast Messages

See *Unicast Messages from the PLC* section on Page 20.

- Sends commands and data from the PLC to an individual gun control node (most commonly *Set Preset Message*)
- Send messages from the gun control nodes to the PLC (includes *Gun Monitor Message* and *System Status Message*)

IO Image Table Configuration

The PLC programmer will have to configure the PLC master so that its IO image table matches that of the slave. The module is from the PLC reference point. The slave is configured at the factory to have the following 14 IO modules:

Table 1 IO Modules

IO Module No.	Module Type	Size (Bytes)	Descriptions	Notes
1	Output	12	Broadcast Message Data	A
2	Output	2	Multicast Message Data	
3	Output	12	Data Table 5 to KV and Flow (Pump)	B
4	Output	1	Gun Bank/Page No. from PLC	
5	Output	4	% Flow Trim Adjust	C
6	Output	1	Heartbeat from PLC	
7	Output	12	General Unicast Message	
8	Output	64	Goto Preset Value (for each gun)	D
9	Output	2	Paged Gun General Information	
10	Input	12	Paged Gun A Monitored Data/Status	
11	Input	12	Paged Gun B Monitored Data/Status	
12	Input	12	Paged Gun C Monitored Data/Status	
13	Input	12	Paged Gun D Monitored Data/Status	
14	Input	8	Global Status and Fault Info	
15	Input	1	Heartbeat from Gateway/Slaves	
16	Input	8	Paged Gun General Information (4 guns)	

NOTE A: The last 3 bytes are never used.

B: The last 2 bytes are never used.

C: The last two bytes are never used.

D: 1 byte for each of the maximum number of guns which may be used in a system. Since there is a maximum of 32 guns in the system, the last 32 bytes are not used.

The details of these IO modules are covered in the following sections.

IO Image Table – Module Definitions

Each IO module serves a specific purpose in transferring data either to or from a gun control node. The terms *output* and *input* image tables are referenced from the perspective of the PLC. The following tables describe the contents of the IO image tables.

Output Image Table

See Table 2.

All of the data contained in the Output Image Table are written by the PLC to its master IO memory space. A general description of how the data of the PLC's output image table flows through the system until it arrives at the gun control nodes follows. The PLC writes the data to the relative addresses shown as "Address Offset" (See Table 2) representing locations in the PLC's output image table. The fieldbus master sends this data to the Gateway's fieldbus slave where the data is written to the dual port memory by the slave's controller. The relative address of the data in the dual port memory is identical to the Address Offset used by the PLC. Finally, the data is read from the dual port memory by the Gateway's DSP controller and processed to create a CAN message. This message is sent to the gun control node(s) on the CAN network.

Module 1
When the Gateway detects a new non-zero value in the first byte of Module 1, it will send a broadcast message to all nodes.

Module 2
When the Gateway detects a change has taken place in Module 2, it will send a multicast message out to the two nodes (KV and Flow/Pump) associated with the specified gun number.

Module 3
When the gateway detects that a change has taken place in the KV parameters of Module 3, it will send a unicast message out to the specified gun's KV node. If the flow parameters in Module 3 changed, then the gateway will send a unicast message to the specified gun's flow (or pump) node. If the gateway detects changes to both KV and flow parameters, it will send two unicast messages out; one to the specified gun's KV node and another to the flow/pump node.

Module 4
This module is a single byte value equal to a Page Number, used by the PLC's Operator Interface. This value, starting with 0, tells the Gateway which group of 4 guns is currently being displayed on the PLC. For example, if this value were equal to 3, then the PLC is currently displaying guns #13 thru #16.

Module 5
This module commands all the flow controls to change its flow rates by a percentage of the setpoint. A detailed description of this module is discussed on page 22 under *Flow % Adjust Message*.

Module 6
This module tells the Gateway that the PLC is active and executing its program. The value in this single byte must change to any new value, at least, every 5 seconds. It is practical for the PLC to change this value every second. If the Gateway does not detect any change in this value for 5 seconds, a broadcast message shutting off all the guns will be sent. To visually verify that the PLC is periodically sending heartbeats, note the green *Status* LED on the KV card. The light will toggle ON and OFF everytime a new value in Module 6 is stored.

Module 7
This module is used to permit the PLC to send any unicast messages while Module 3 is reserved for the efficient handling of Data Table 6 and to quickly send these parameters to their respective nodes. Module 7 is provided primarily to send out other unicast messages.

Module 8
The assignment to each gun is sequential, that is to say, the first byte of Module 8 is assigned to gun #1, the second byte is assigned to gun #2, and so on. The value in these bytes is a new preset number which is to be used by a given gun, and is sent to that gun's KV and Flow node−pair via the Data Table 14 command (using multicast addressing). When the gateway is initialized, it will fill this space with zeros indicating to the gateway there is no change to the current preset (all nodes, by default, start up using preset #1). It is up to the PLC programmer to initialize this space to contain all ones, but it is not necessary. The PLC program may change a gun to a new preset by simply writing to that gun's byte in Module 8. When the gateway detects a change has occurred in any of the bytes in this module, it sends a multicast message out to the node−pair associated with that byte (gun). Therefore, as the gateway polls its way through Module # 8 looking for changes, it is possible for it to send out 32 multicast messages; one for each byte change detected. The last 32 bytes in this module are not used.

Module 9
This module contains 2 bytes. One byte defines which information the Gateway should present to the PLC. The second byte defines which grouping of guns to display. This process is similar to module 4 where 0 equals guns 1−4, 1 equals guns 5−8, and so on. For instance, a 1 in the first byte and a 0 in the second byte will cause the Gateway to pass the gun node maintenance time for guns 1−4 to the PLC.

All of the above IO Modules are discussed in more detail in later sections.

Table 2 Output Image Table

IO Module No.	Address Offset	Size (Bytes)	Description	Range	Comment
1	0	1	Broadcast Msg. No.	0−8	0=WAIT
1	1	1	Data Byte 1	0−255	Guns 1−8
1	2	1	Data Byte 2	0−255	Guns 9−16
1	3	1	Data Byte 3	0−255	Guns 17−24
1	4	1	Data Byte 4	0−255	Guns 25−32
1	5	1	Data Byte 5	0−255	Guns 33−40
1	6	1	Data Byte 6	0−255	Guns 41−48
1	7	1	Data Byte 7	0−255	Guns 49−56
1	8	1	Data Byte 8	0−255	Guns 57−64
1	9−11	3	Not Used		
2	12	1	Gun No.	0−64	0=WAIT
2	13	1	Preset No.	1−255	
3	14	1	Edit Node Preset	0−1	0=WAIT
3	15	1	Gun No.	1−64	
3	16	1	Preset No.	1−255	

IO Module No.	Address Offset	Size (Bytes)	Description	Range	Comment
3	17	1	KV	0–100	
3	18	1	µA	0–100	
3	19	1	AFC	0–1	
3	20	1	Select Charge Mode	0–4	
3	21	1	Flow Value/Powder Setpoint	0–160	Common for Standard and Prodigy
3	22	1	Atomize Value/Pattern Flow Setpoint	0–160	Common for Standard and Prodigy
3	23	1	Assist Air Compensation	-50–+50	Only for Prodigy
3	24	1	Lookup Table	0–3	Prodigy Only
3	25	1	Not Used		
4	26	1	Gun Page No.	0–15	GUI Gun Page No.
5	27	1	%Adjust On/Off	0–1	0=WAIT
5	28	1	%Adjust–Flow	-100–+100	
5	29	1	%Adjust–Atomize	-100–+100	
5	30	1	Not Used		
6	31	1	Heartbeat	0–255	
7	32	1	Send Unicast Msg	0–2	0=WAIT, 1=KV, 2=Flow
7	33	1	Gun Number	1–64	
7	34	1	Data Table No.	1–255	
7	35	1	Parameter Byte 1	0–255	
7	36	1	Parameter Byte 2	0–255	
7	37	1	Parameter Byte 3	0–255	
7	38	1	Parameter Byte 4	0–255	
7	39	1	Parameter Byte 5	0–255	
7	40	1	Parameter Byte 6	0–255	
7	41	1	Parameter Byte 7	0–255	
7	42–43	2	Not Used		
8	44–107	64	Preset Number	1–255	For Data Table 14
9	108	1	General Information Data Type	0–255	0=WAIT, Table 3
9	109	1	Gun Page Number for Gun General Information	0–15	GUI Gun Page Number: associated with next byte only

Table 3 Output Image Table – General Information Data Type

Information Data Number	Information Data Description
0	WAIT
1	Gun Node Maintenance Time
2	Flow Node Maintenance Time
3	Gun Node Maintenance Minutes (low byte of Module 16, high byte will be 0)
4	Flow Node Maintenance Minutes (low byte of Module 16, high byte will be 0)
5	Gun Node Firmware Version
6	Flow Node Firmware Version
7	Prodigy Pump Lookup Table
8	Gateway S/W Version
9	Pump Channel's A Constant
10	Pump Channel's C Constant
11	Pattern Channel's A Constant
12	Pattern Channel's C Constant
13–255	Spare

Input Image Table

See Table 4.

An overview of the Input Image Table modules follows. All of the data contained in the Input Image Table is written into the dual port memory by the DSP controller so that the PLC can read it in its master IO space.

Modules 10 through 13
These four are identical 12 byte modules that contain monitored gun parameter values for four guns. The PLC defines which group of 4 guns is being displayed on the Operator Interface at any given time by writing the *Gun Page No.* into Module 4 of the Output Image Table. The DSP controller processes this value and places the current monitored parameters for the group of 4 guns requested by the PLC.

Module 14
This module contains 8 bytes of global status and fault conditions. These eight bytes provide a quick access to the most important status and alarm conditions of the system. For example, the lockout state of each gun can be examined by reading the last byte of module 10 (or 11, 12, 13); however, if the PLC needs to quickly check if any gun is in lockout, then it can simply read the first byte of module 14. Address Offset 52 is used to determine the communication status between Gateway and the Nodes. This byte is updated every 5 seconds if the Gateway receives any message from any of the Nodes.

Module 15
This module contains a different value every 1 second so that the PLC may know that the Gateway's DSP controller is executing and not locked up.

Module 16

This module contains 8 bytes of information requested through Module 9 as per Table 3. This module contains the monitored gun parameter values for 4 guns as defined by the second byte of Module 9. The PLC defines which group of 4 guns is being displayed on the Operator Interface at any given time by writing the *Gun Page No* into Module 9, byte 2 of the Output Image Table. The DSP controller processes this value and places the current monitored parameters for the group of 4 guns requested by the PLC. If after requesting certain data the PLC program changes to the IO Module 9 byte 1 to 0 (WAIT state), all the data in the Input Image Table IO Module 16 is reset to 0. The PLC program has to request the data again.

Table 4 Input Image Table

IO Module No.	Address Offset	Size (Bytes)	Description	Range	Comment
10	0	1	Paged Gun #1–KV	0–100	KV Monitor
10	1	1	Paged Gun #1–µA	0–140	µA Monitor
10	2	1	Paged Gun #1–Preset	1–255	Current Gun Preset
10	3	1	Paged Gun #1–On/Off	0x00–0x13	Trigger State (KV) AFC State and KV Offline Node State
10	4	1	Paged Gun #1–Type	0–4	Gun Type
10	5	1	Paged Gun #1–Faults	0–255	KV Node Faults
10	6	1	Paged Gun #1–Flow	0–160	Flow Monitor for Standard/Assist Air Monitor for Prodigy
10	7	1	Paged Gun #1–Atom	0–160	Atomize Monitor for Standard/Pattern Air for Prodigy
10	8	1	Paged Gun #1–Preset	1–255	Current Flow Preset
10	9	1	Paged Gun #1–On/Off	0–1	Trigger State (Flow)
10	10	1	Paged Gun #1–Faults	0–255	Flow Node Faults
10	11	1	Paged Gun #1–States	0–255	States
11–13	12–47	36	Paged Gun #2 thru #4		Same Layout as above
14	48	1	Global Status Flags	0–64	Lockout State
14	49	1	Global Status Flags	0–64	Alarm State
14	50	1	Global Status Flags	0–64	Communication Fault
14	51	1	Global Status Flags	0–64	No 24 VDC Fault
14	52	1	Communication Status	0–255	Gateway–Nodes Communication Status
14	53	1	Current Page Number	0–15	Current Parameters
14	54–55	2	Future Use		
15	56	1	Heartbeat	0–255	Heartbeat from Slave
16	57	1	Paged Gun #1– Low Byte	0–255	Low Byte Information
16	58	1	Paged Gun #1– High Byte	0–255	High Byte Information

IO Module No.	Address Offset	Size (Bytes)	Description	Range	Comment
16	59	1	Paged Gun #2– Low Byte	0–255	Low Byte Information
16	60	1	Paged Gun #2– High Byte	0–255	High Byte Information
16	61	1	Paged Gun #3– Low Byte	0–255	Low Byte Information
16	62	1	Paged Gun #3– High Byte	0–255	High Byte Information
16	63	1	Paged Gun #4– Low Byte	0–255	Low Byte Information
16	64	1	Paged Gun #4– High Byte	0–255	High Byte Information

Sending Messages from the PLC

Two general methods can be used to prevent the Gateway from translating a partially constructed message send by the PLC master. The *Single Scan Method* is the most efficient, but if the two conditions cannot be met, then the *Multiple Scan Method* should be used.

See Figure 6 for a diagram of the messages being sent.

Single Scan Method

For most PLCs the single scan method can be done with multiple instructions executed in one scan cycle.

1. Set all bytes in the IO module to be written using one PLC instruction (all data is written in one IO scan).
2. Synchronize the PLC fieldbus master to the IO scan.

Multiple Scan Method

The multiple scan method applies to masters in the PC-based control system or in PLC systems where the fieldbus master scans asynchronously with the PLC IO scans.

1. Set the first byte of the IO module to zero (WAIT) before the rest of the IO module is set-up.
2. The remaining IO bytes of the IO module can be written as the first byte remains at zero.
3. When writing of the remaining bytes is complete, go back and write the first byte from the zero (WAIT) to its correct value.

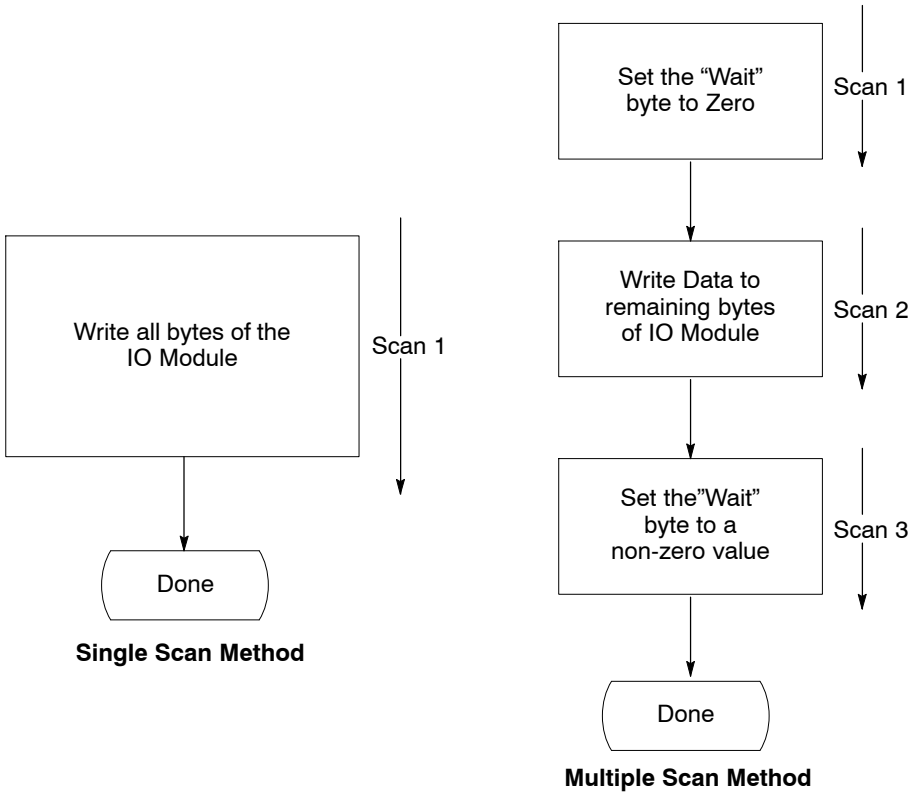


Figure 6 Sending Messages

Broadcast Messages from the PLC (Module 1)

Table 5 List of Some Commonly Used Broadcast Messages from PLC (IO Module 1)

Message No. at Address Offset 0	Description	No. of Data Bytes	Range of Data Values (Address Offsets 1 thru 8)	Notes
1	Trigger Guns	8	Each bit is mapped to a gun	A
2	Lockout All Guns	1	Lockout=1 (in Data Byte #1)	
3	Disabled Alarm Outputs	1	Alarms Disabled=1 (in Data Byte #1)	
6	Reset All Alarms/Faults	8	Each bit is mapped to a gun	A
7	Clear Maintenance Hour	8	Each bit is mapped to a gun	A

NOTE A: Each physical gun number is assigned a bit starting with the LSBit of Data Byte #1. For example, if Message No.1 (Trigger guns) is sent with Data Byte #1 = 0x05, Data Byte #2 = 0xF0, and the remaining data bytes are 0, then guns #1,3,13,14,15,16 will be triggered ON. The remaining gun numbers are triggered OFF.

Multicast Messages from the PLC (Modules 2 and 8)

Using Module 2 of Output Image Table

This is the *Change Preset* command beginning at Address Offset 12. Address Offset 12 contains the physical gun number to where the *Change Preset* command will be sent and Address Offset 13 contains the preset number.

Use Address Offset 12 for WAIT function, if needed for the Multi Scan Method.

Using Module 8 of the Output Image Table

This module has been described on page 12 under *IO Image Table–Address Definitions* and is an alternate method of sending the *Change Preset* command. Each byte beginning with Address Offset 44 is sequentially assigned to a physical gun number. The Gateway will send a multicast message to the gun's KV–Flow node pair whose corresponding byte changed. The Address Offset of the byte that changed is used to compute the destination CAN address of the multicast message.

Unicast Messages from the PLC

Using Module 3 of Output Image Table

Module 3 is used to deliver the *Preset Data* command. Address Offset 14 contains the *Ready* flag which indicates to the Gateway that the data in this module is ready to be sent (when equal to one).

Address Offset 15 contains the physical gun number to where the *Set Preset Data* command will be sent.

Address Offset 16 contains the preset number to which the *Set Preset Data* command's data will be applied. If Multi–Scan Mode is used, then a zero must first be written in Address Offset 14. Use Address Offset 14 as for the WAIT function, if needed for the Multi Scan Method. Table 5 describes the use of Module 3.

Both KV and Flow related parameters are listed in this module. When the Gateway detects a change in this module, it will determine whether the changed parameter is related to a KV or a Flow node. Once the Gateway determines which nodes require unicast messages to be sent, it will send a Table 6 message to the gun's (defined in Address Offset 15) KV node, or to the Flow/Pump node, or messages to both of them. The preset parameters may be changed at any time. A given preset's parameters may be changed while a gun is triggered ON at that preset, so that elaborate flow variations onto a part are possible, if desired.

Table 6 Sending Data Table Messages from the PLC (IO Module 3)

Address Offset	Description of Bytes	Range of Values	Comments
14	Data Ready	0–1	0=WAIT, 1=Ready to Send
15	Gun Number	1–64	Physical Gun Number
16	Preset Number	1–255	Must never be zero
17	KV	0–100	1 count per KV
18	µA	0–100	1 count per µA
19	AFC	0–1	0=AFC OFF, 1=AFC ON
20	Select Charge Number	0–4	0=Standard Mode
21	Flow % Setpoint/Powder Setpoint	0–160	Only 0–100 is used with PFCP node
22	Atomize/Pattern Setpoint	0–160	Atomize or Pattern Setpoint
23	Assist Air Setpoint	-50– +50	Assist Air Setpoint
Note: Negative values are in two's complement form.			

Units of measure for Preset Parameters
On the KV nodes, the units of the KV parameter are KVolts, and the units for uA are Uamps. These values are easily contained in a 1 byte value and require no further scaling.

The Flow parameters are less straight forward. When the flow node is the iFlow module, the Flow and Atomize flow rates (in Address Offsets 21 and 22) are stored in units of counts (which can be stored as a 1–byte integer). The counts have been chosen such that the values can easily be converted to English or Metric Flow units of measure. Since any meaningful flow unit-of-measure requires the use of floating point values, each count represents a unit of flow expressed as a floating point value. Any display of flow rates will require the PC/PLC programmer to convert the counts to the desired units of measure. The conversion is as follows:

- English Units: Counts X 0.025 = SCFM (Std. Cubic Feet per Minute)
- Metric Units: Counts X 0.0425 = SCMH (Std. Cubic Meters per Hour)

When the flow parameters in Module 3 are used with the PFCP nodes, then these values have a different specification. The PFCP Powder Flow setpoint stored at Address Offset 21 is a value from 0 to 100 and it requires no scaling. For a PFCP node, the Pattern Air setpoint stored at Address Offset 22 uses the same scaling factors as mentioned above for the iFlow. The PFCP Assist Air Setpoint stored at Address Offset 23 is a value from –50 to +50.

Using Module 7 of the Output Image Table

This module uses the data in Address Offsets #32 and #33 to determine the CAN address of the destination node/channel which needs to receive the unicast message.

Flow % Adjust Message

Using Module 5

This module relates to the PLC commands that adjust all the flow nodes to operate at some percentage of their setpoint. Separate Flow and Atomizing percentages may be entered.

The percentage value may be from –100% to +100%.

- 0% – Control flow rate at current set point
- –100% – Sets flow rate to zero
- +100% – Doubles the flow rate (limited by saturation)
- negative percent values are expressed in two's complement form.

Use Address Offset 12 for WAIT function, if needed for the Multi Scan Method.

Address Offset 28 contains the % value for the Flow setpoint.

Address Offset #29 contains the % value for the Atomize setpoint.

NOTE: A zero in Address Offset 27 does not indicate that this % Adjust feature is OFF. To turn the feature OFF, or to be sure that the % Adjust is 0% for both Flow and Atomize, it is important to write zeros in Address Offsets 28 and 29. Once it is certain that % Adjust is OFF (i.e. all percentages equal to 0), it is permissible to write a zero into Address Offset 27. If this feature is never used it requires no maintenance. However, if it is (or was) ever used then it is recommended to set Module 5 during system initialization to a known value. This step is important since the flow control nodes store their last %Adjust values in EEPROM. When flow control node power is cycled, they will start up with the last %Adjust value sent to them.

The Gateway sends a broadcast message to each channel of each flow control node every time the PLC sends a Flow % Adjust message.

Reading Data at the PLC – Input Image Table

Since the data contained in the slave's Input Image Table is written by the DSP controller; the data is automatically sent and projected into the PLC's master fieldbus memory space. Therefore, for the PLC to read data it is a simple matter of knowing what data is available at the various addresses of the PLC's input image table. This section defines the contents of IO Modules in the Input Image Table and how it is to be interpreted. Almost all the data stored in the Input Image Table come from the messages collected by the gateway from the gun control nodes. Data from the gun control nodes arrive unsolicited to the gateway by way of the Data Table #4 and Data Table #7 messages. The Gateway stores all of the gun data locally in its own memory space and places only a portion of it (as requested by the PLC) into the dual port memory. The reason the Gateway places only a portion of all the data into the dual port memory is because the PLC master cannot accept more than a total of 244 bytes of input data; the total amount of gun data can require much more than this amount of memory.

Gun Monitored Data

Using Modules 10 – 13

These modules contain monitored gun data for 4 guns, respectively. The group of 4 guns represented in these 4 IO Modules is defined by the Gun Page Number value written by the PLC to Module #4 of the Output Image Table. Use Tables 4 and 7 to identify the correct Address Offsets within the modules for the desired function.

Table 7 Parameters Contained in Modules 9 – 12 and their Corresponding Address Offsets

Parameter Description	Explanation	Page/Gun1 Module 9 Address Offset	Page/Gun2 Module 10 Address Offset	Page/Gun3 Module 11 Address Offset	Page/Gun4 Module 12 Address Offset
KV uA	Actual KV and uA values. When gun is OFF, Gateway updates values every 2 seconds. When gun is ON, Gateway updates every 0.5 seconds.	KV – 0 uA – 1	KV – 12 uA – 13	KV – 24 uA – 25	KV – 36 uA – 37
Preset Number	Displays current preset number in use by the KV and Flow control nodes. They are monitored separately to allow detection of failure of multicast message reaching one of its destination nodes. Under normal conditions, these values are the same.	KV node 2 Flow node 8	KV node 14 Flow node 20	KV node 26 Flow node 32	KV node 38 Flow node 44
KV Node Status Bits Trigger, Communication, and AFC	See Table 8. Gun Triggered OFF Bit 0 (LSB) = 0 Gun Triggered ON Bit 0 (LSB) = 1 KV Node ONLINE Bit 1 = 0 KV Node OFFLINE Bit 1 = 1 AFC OFF Bit 4 = 0 AFC ON Bit 4 = 1	3	15	27	39

Continued...

Parameter Description	Explanation	Page/Gun1 Module 9 Address Offset	Page/Gun2 Module 10 Address Offset	Page/Gun3 Module 11 Address Offset	Page/Gun4 Module 12 Address Offset
Gun Type	Stores the current gun type connected to the physical gun channel. Valid Gun Codes: 0 = No Gun 1 = Tribo 2 = Sure Coat 3 = Versa 4 = PE Gun 5 = HDLV	4	16	28	40
Faults	See Table 9. Contains any fault bits which have been detected by the gun's KV node.	5	17	29	41
Flow Atom (or Pattern)	Contains the actual flow rates. When gun is OFF, Gateway updates values every 2 seconds. When gun is ON, Gateway updates every 0.5 seconds. **Note:** See Page 20 for conversion factors from raw counts to standard units of flow rate.	Flow – 6 Atom – 7	Flow – 18 Atom – 19	Flow – 30 Atom – 31	Flow – 42 Atom – 43
Flow Node Status Bits ON/OFF	Stores the current gun trigger state of the Flow node. Under normal conditions, these values are the same as KV node Trigger states (see above). Flow Triggered OFF Bit 0 (LSB) = 0 Flow Triggered ON Bit 0 (LSB) = 1	9	21	33	45
Faults	Contains any fault bits which have been detected by the gun's Flow node. See Table 10 for fault bit definitions.	10	22	34	46
General Status	Contains the status bits generated by the gun's KV and Flow nodes. The first two bits indicate the state of the KV and Flow nodes regarding their lockout state. When Lockout is ON, the gun cannot be trigger ON. Use Table 11 for bit definitions.	11	23	35	47

Table 8 Trigger, AFC, KV Offline States–Address Offset #3

States	Comment	Bit Number
Trigger State	0=Trigger OFF 1=Trigger ON	0(LSB)
KV Node Offline	0=Online 1=Offline	1
Reserved		2
Reserved		3
AFC State	0=AFC OFF 1=AFC ON	4
Reserved		5
Reserved		6
Reserved		7

Table 9 KV Node Faults–Address Offset #5

Fault	Comment	Bit Number
µA Alarm	0=No Fault 1=Faulted	0
Fold Back	0=No Fault 1=Faulted	1
Feed Back	0=No Fault 1=Faulted	2
Open Circuit	0=No Fault 1=Faulted	3
Short Circuit	0=No Fault 1=Faulted	4
Hardware	0=No Fault 1=Faulted	5
Alarm (Any)	1=Alarm ON	6
No 24V	1=No 24V Supply	7

Table 10 Flow Node Faults–Address Offset #10

Fault	Comment	Bit Number
Communication	1=Heartbeat Lost	0 (LSB)
No 24V	1=No 24V Supply	1
Alarm (Any)	1=Alarm ON	2
Low Flow Fault	1=Faulted	3
Low Atomized Fault	1=Faulted	4
Reserved		5
Valve Detect	1=Atom Valve Fault	6
Valve Detect	1=Flow Valve Fault	7 (MSB)

Table 11 General Node Status–Address Offset #11

Fault	Comment	Bit Number
KV Node Lockout	1=Lockout ON	0 (LSB)
Flow Node Lockout	1=Lockout ON	1
Reserved		2
Reserved		3
Gun Operating Mode	DLL Mode Bit 0	4 (See Note)
Gun Operating Mode	DLL Mode Bit 1	5
Gun Operating Mode	DLL Mode Bit 2	6
Gun Operating Mode	DLL Mode Bit 3	7 (MSB)
Note: The Gun Operating Mode can have the following values: 0=STD 1 thru 9=DLL No. 10=Tribo		

General System Status

Using Module 14

This module allows the PLC to quickly access the most vital fault/status conditions in the system without having to scroll through all of the fault and status bytes of each and every gun (using the Gun Paging mechanism).

Under normal conditions, these four bytes of Module 14 are zero. If a non–zero value is contained in any of these four bytes, the value indicates the first physical gun number which detected a fault.

Address Offset 52 is used to determine the communication status between Gateway and the gun control nodes. PLC can read this byte to determine if the Nodes are powered down. The Gateway will write a new value to the byte every 5 seconds if any message is received from any gun control nodes. It will continuously increment a counter every 5 second from 0 to 255 then rollover back to zero. Table 12 lists the definition of the bytes in Module 14.

Table 12 General Status Bytes–Module 14

Address Offset	Function	Range
48	Guns w/Lockout ON	0–64 (0=None)
49	uns w/Alarm	0–64 (0=None)
50	Guns w/Communication Fault	0–64 (0=None)
51	Guns w/No 24 VDC Fault	0–64 (0=None)
52	Gateway–Node Communication Status	0–255
53	Current Page No.	0–15
54–55	Future Use	

Gateway Heartbeat

Using Module 15

The PLC may periodically read Module 15 to verify that the Gateway is still active and its code is executing. The gateway will write a new value to Module 15 every 1 second. It will continuously increment a counter every second from 0 to 255, then rollover back to zero.

Table 13 Dip Switch (SW4) Settings

NOTE: By default, all positions are OPEN.

Switch	Function	Open	Closed
SW4-1	Byte Swapping	Disabled	Enabled
SW4-2	Communication	Normal	Listen Only
SW4-3	Mode	Normal	Legacy Mode
SW4–4	System	iControl	Prodigy

Table 14 Dip Switch (SW3) Settings

Switch	Function	Open	Closed
SW3-1	Network Term. Resistor	Disabled	Enabled (Default)
SW3-2	RS485	Disabled (Default)	Enabled
SW3-3	Slew Rate	High (Default)	Low
SW3–4	RS232	Disabled (Default)	Enabled

Operation

Power On/Off

Use the slide switch on the PCA board to turn power on and off.

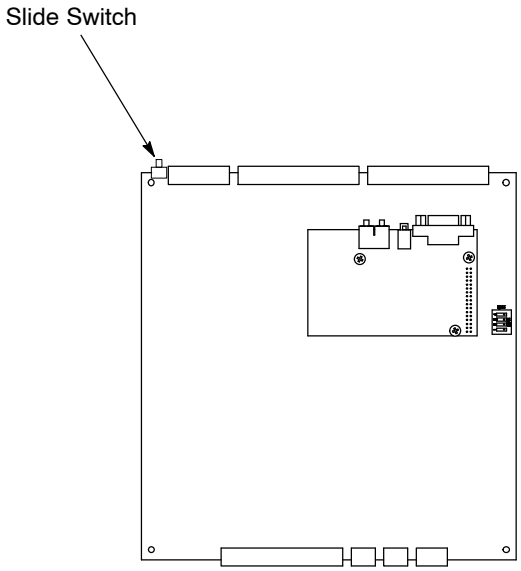


Figure 7 Power Switch Location

Parts

To order parts, call the Nordson Finishing Customer Support Center at (800) 433-9319 or contact your local Nordson representative. For more information, go to http://www.nordson.com on the Internet.

Gateway Replacement Parts

Item	Part	Part	Part	Description	Quantity	Note
–	1092199	–––––––	–––––––	GATEWAY, DeviceNet, iControl	1	
–	–––––––	1092230	–––––––	GATEWAY, Profibus, iControl	1	
–	–––––––	–––––––	1096439	GATEWAY, Ethernet, iControl		
1	1092233	1092235	1096455	• KIT, PCA, iControl, AnyBus, Gateway	1	
1a	–––––––	–––––––	–––––––	• • PCA, AnyBus, Gateway	1	
2	1092231	1092232	1097554	• • KIT, module, AnyBus, Gateway		
3	288807	288807	288807	• FILTER, line, RFI power	1	
4	131477	131477	131477	• FUSE, 2.00, fast-acting, 250 V, 5 x 2	2	
5	288803	288803	288803	• POWER SUPPLY, 24, 5, 12 Vdc, 40 W	1	

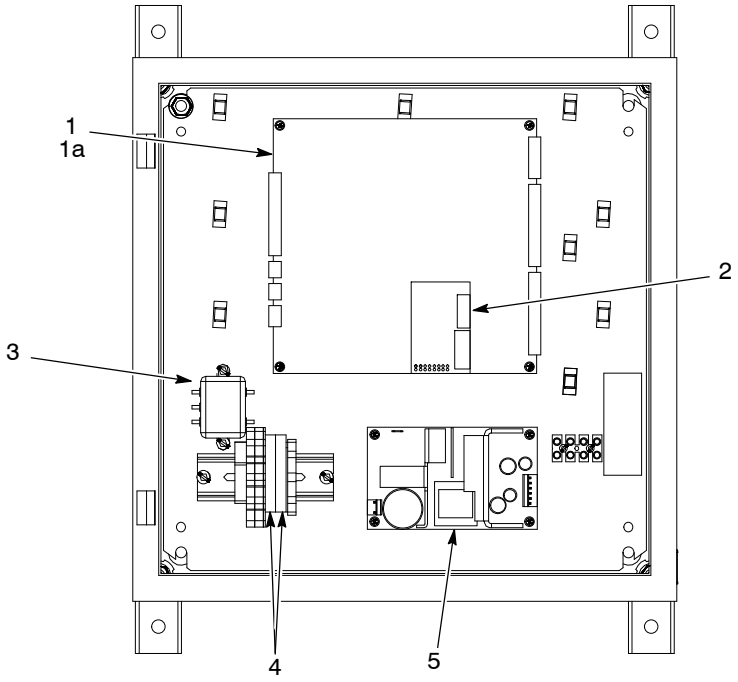


Figure 8 PLC Gateway Parts

Enclosure Wiring Diagram

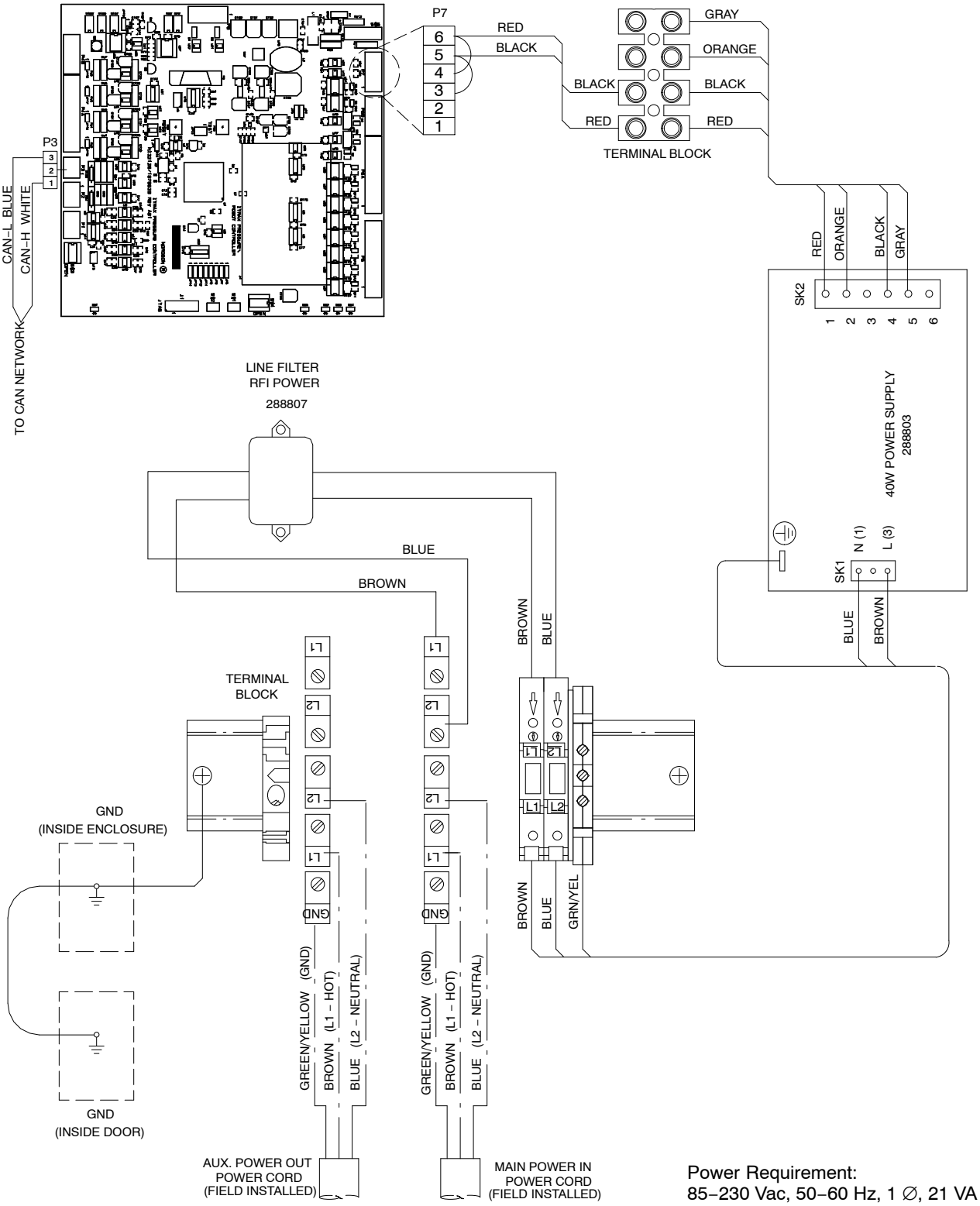


Figure 9 Enclosure Wiring Diagram

DECLARATION of INCORPORATION

Product:: iControl Gateway Controller

(This unit is an interface between an external controller and a powder pump panel controlling powder flow to a powder automatic applicator.)

Applicable Directives:

98/37/EEC (Machinery)

2006/95/EC (Low Voltage Directive)

2004/108/EEC (Electromagnetic Compatibility Directive)

Standards Used for Compliance:

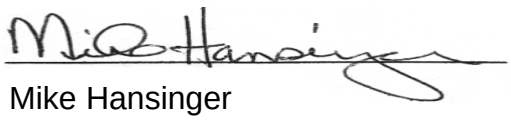
IEC60417	EN55011
EN12100	EN61000-6-2
EN60204	

Principles:

This product has been manufactured according to good engineering practice.
The product specified conforms to the directive and standards described above.

Certificate:

DNV ISO9001



Date: 31 July 2009

Mike Hansinger
Manager Engineering Development
Industrial Coatings

Nordson