Encore® Engage Gateway

Customer Product Manual
Part 1615959–01
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For parts and technical support, call the Finishing Customer Support Center at (800) 433-9319.

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Contact Us

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Change Record

Revision	Date	Change
01	03/19	New Release.
01_Update	03/24	Corrected switches in Gateway heartbeat table.

Encore® Engage 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 Gateway is the interface between a main system controller (usually a PLC) and any of the Engage controllers' dual channel control modules used with automatic powder guns.

The Gateway converts standard fieldbus protocol messages and commands (PROFINET® or EtherNet/IP™) from a main system controller into the proprietary CAN bus messages required to communicate with the pump and electrostatic modules controlling the automatic 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. For a system with the maximum of 32 spray guns, there are 16 KV nodes and 16 flow nodes connected on a CAN network.

The system is compatible with Encore® and Encore HD automatic guns.

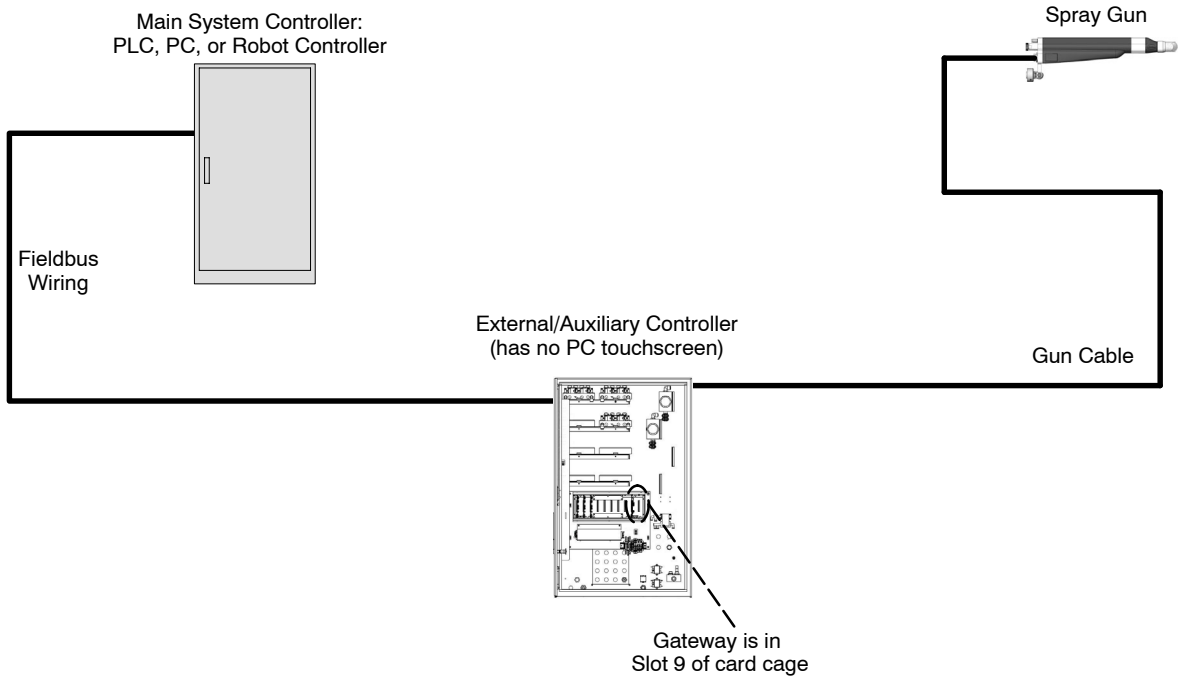

Figure 1 Typical System Diagram

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.

Installing Gateway into External/Auxiliary Controller

See Figure 2. The Gateway may be inserted into Slot 9 of the card cage.

Additional application installation options include:

- A card cage mounted in a custom-built electrical enclosure.
- A Gateway mounted into a single-slot package, mounted in a custom electrical enclosure (see page 40).

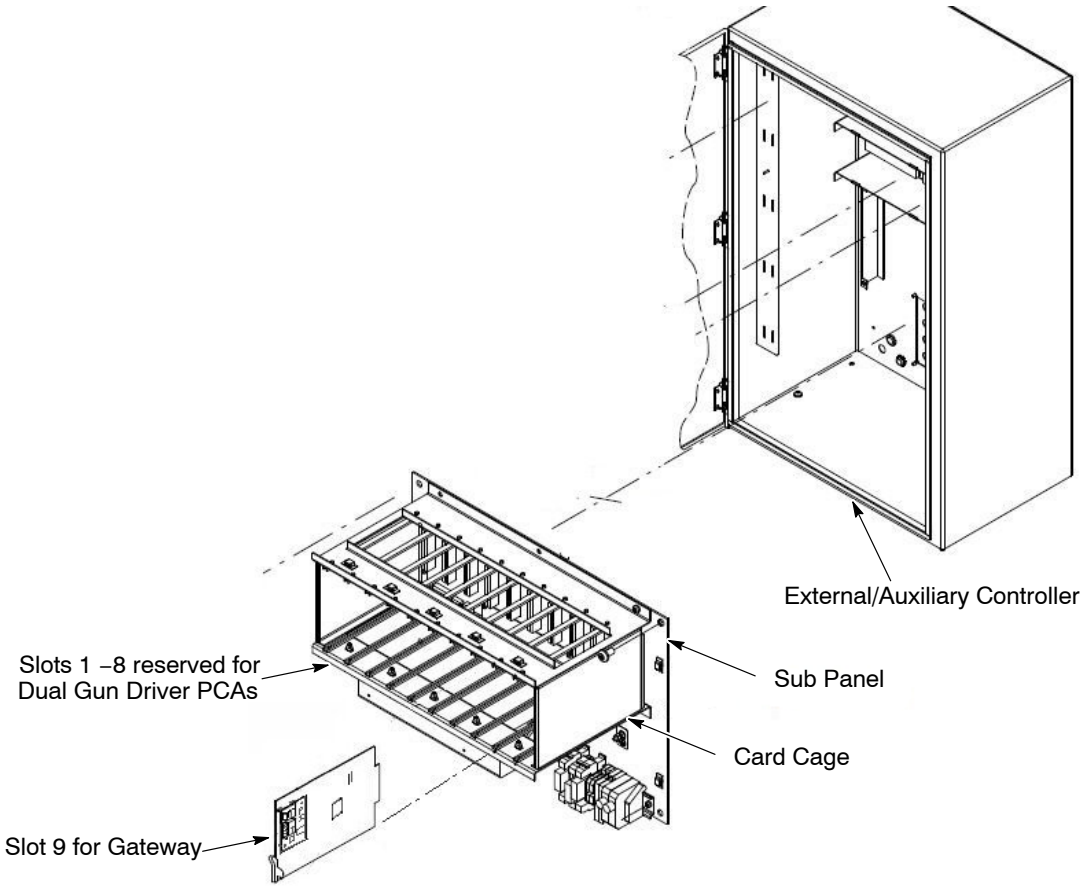

Figure 2 Installing Gateway into External/Auxiliary Controller

Electrical Power

The Gateway requires 24 Vdc @ 100mA (maximum), which is supplied by the card cage backplane.

Fieldbus Connection

The fieldbus connection is made directly to the Anybus® support board, which is mounted to the Gateway board. The customer must provide the appropriate cable for PROFINET or EtherNet/IP networks.

Gateway PCA (Printed Circuit Assembly) Board Jumper Settings

Verify that all jumpers and switch settings on the Gateway are positioned as shown in Figure 3.

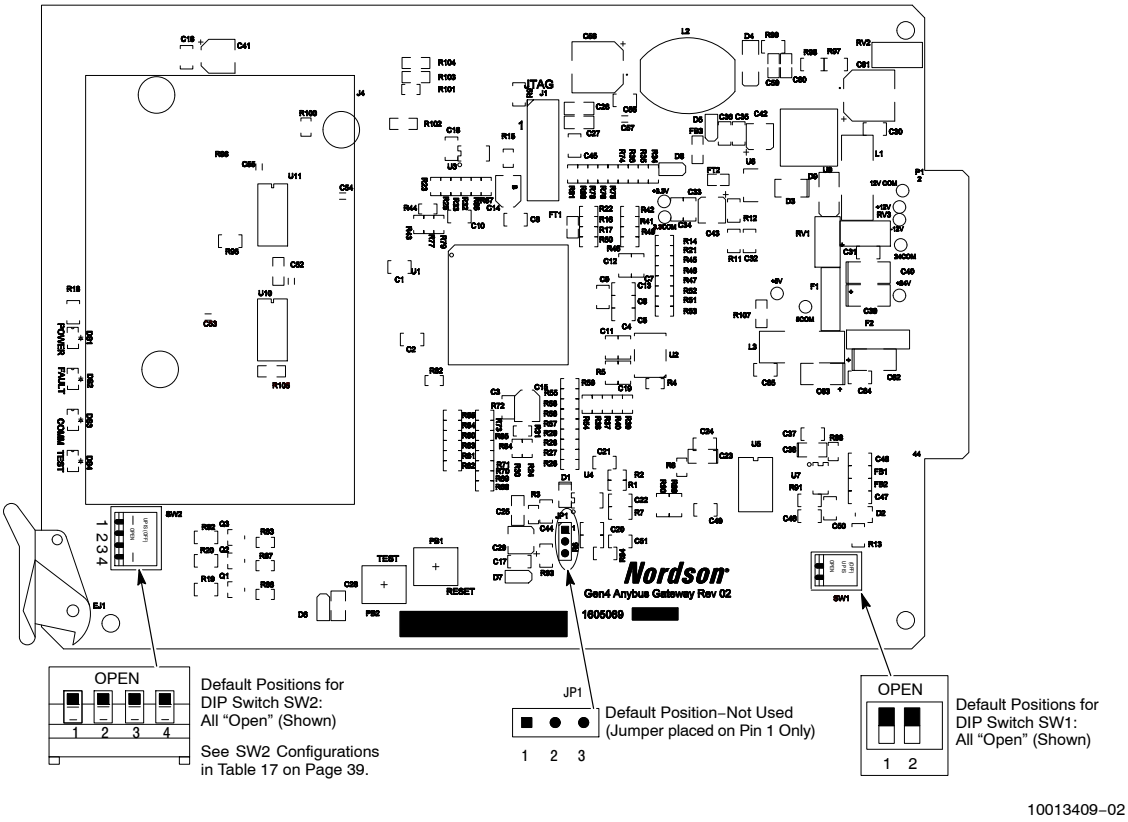

Figure 3 Gateway PCA Board Jumper Settings

Software

Overview

A typical PLC-based powder system utilizing Encore Engage system's control modules consists of two basic sub-systems:

- a PLC which controls the triggering of several guns
- a CAN network of several intelligent powder flow (either HDLV® or Venturi) and gun KV control modules

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

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

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

NOTE: Another example of a main versus a secondary device would be a scanner versus an adapter, respectively.

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 secondary nodes, via reading the dual port memory, is also specified.

Throughout this document, the gun flow 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 is a gun flow node to control that gun's powder flow (HDLV or Venturi).

Hardware Requirements

Figure 4 describes the hardware components which make up the Gateway system. The main PLC only sees a single secondary 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 to 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 (PROFINET 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

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

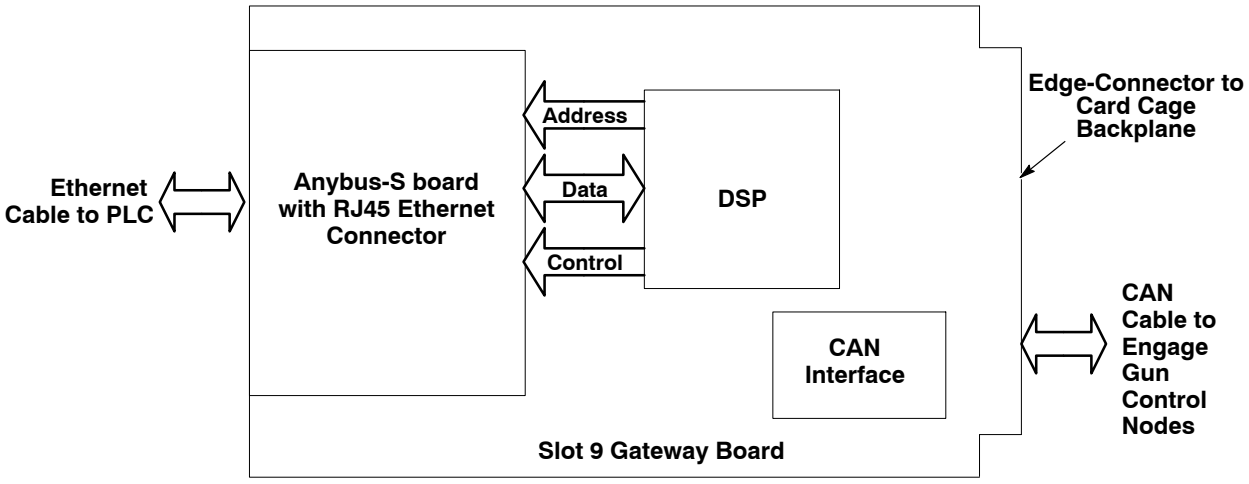

Figure 4 Encore Engage Gateway PCA Diagram

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.

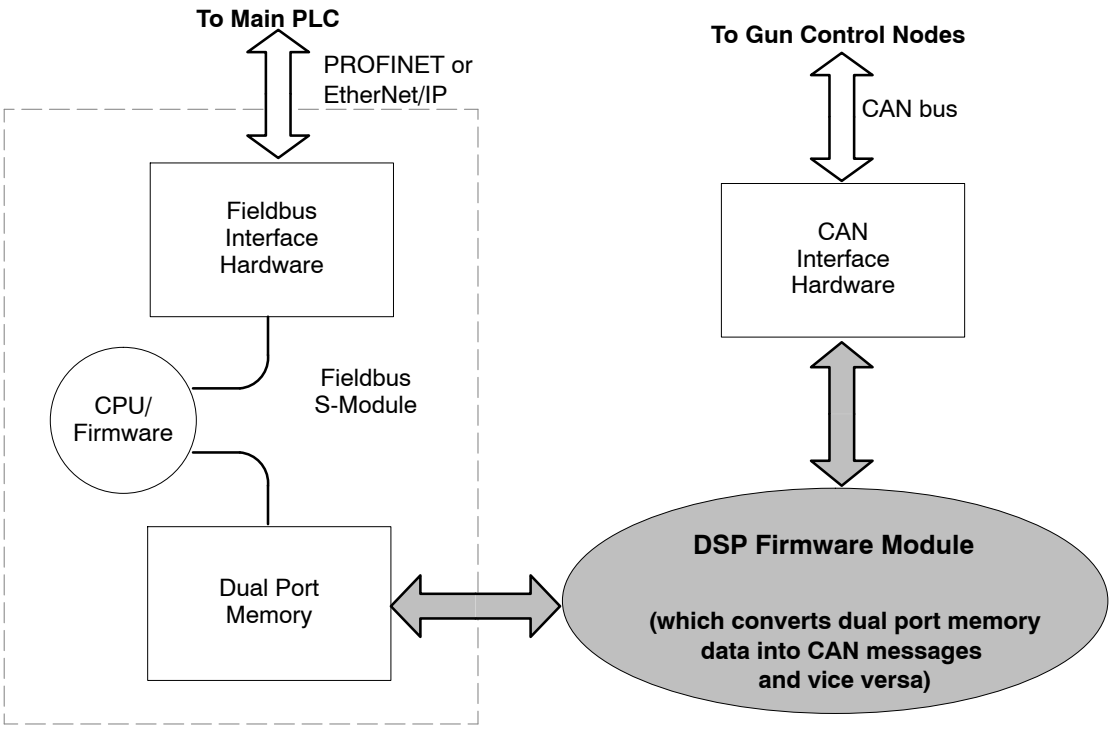

Figure 5 Gateway Software Modules

Software Version

The Gateway software version can be determined by observing the flashing of the *Test, COMM, and Fault* LEDs when power is applied to the Gateway.

See Figure 6 and Table 1 to determine software version. Each LED relates to a position in version number represented by X.YZ. Count the number of flashes to determine the number for that position.

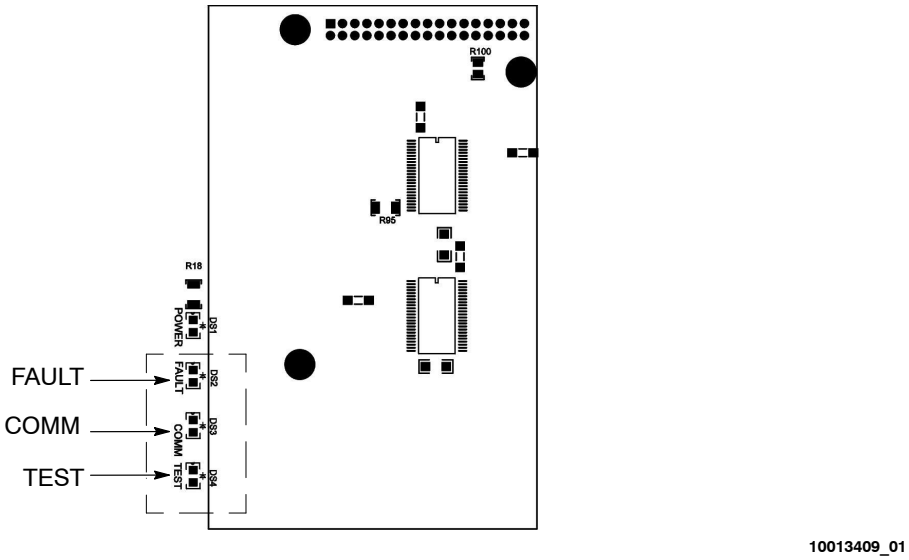

Figure 6 Location of LEDs on Anybus-S Board for Version Verification

Table 1 LEDs to Version Conversion Chart

LED Label	LED Color	Position
TEST	Green	X
COMM	Yellow	Y
FAULT	Red	Z

Addressing Modes

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

Broadcast Messages

See *Broadcast Messages from the PLC* section on Page 26 for a list of common 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 28 for more information on multicast messages.

- Send commands and data from the PLC to a 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 28.

- 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 main PLC so that its IO image table matches that of the secondary.

NOTE: For a successful Gateway setup, the PLC programmer should be familiar with the proprietary Nordson CAN protocol.

The direction of the data (input or output) is from the PLC's reference point. The secondary is configured at the factory to have the following 29 IO modules shown in Table 2.

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

Table 2 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	B
6	Output	1	Heartbeat from PLC	
7	Output	12	General Unicast Message	C
8	Output	32	Goto Preset Value (for each gun)	D
9	Output	2	Paged Gun General Information	
10	Input	12	Paged Gun 1 or 17 Monitored Data/Status	E
11	Input	12	Paged Gun 2 or 18 Monitored Data/Status	E
12	Input	12	Paged Gun 3 or 19 Monitored Data/Status	E
13	Input	12	Paged Gun 4 or 20 Monitored Data/Status	E
14	Input	12	Paged Gun 5 or 21 Monitored Data/Status	E
15	Input	12	Paged Gun 6 or 22 Monitored Data/Status	E
16	Input	12	Paged Gun 7 or 23 Monitored Data/Status	E
17	Input	12	Paged Gun 8 or 24 Monitored Data/Status	E
18	Input	12	Paged Gun 9 or 25 Monitored Data/Status	E
19	Input	12	Paged Gun 10 or 26 Monitored Data/Status	E
20	Input	12	Paged Gun 11 or 27 Monitored Data/Status	E
21	Input	12	Paged Gun 12 or 28 Monitored Data/Status	E
22	Input	12	Paged Gun 13 or 29 Monitored Data/Status	E
23	Input	12	Paged Gun 14 or 30 Monitored Data/Status	E
24	Input	12	Paged Gun 15 or 31 Monitored Data/Status	E
25	Input	12	Paged Gun 16 or 32 Monitored Data/Status	E
26	Input	8	Global Status and Fault Info	
27	Input	1	Heartbeat from Gateway/Secondaries	
28	Input	32	Paged Gun General Information (16 guns)	F
29	Input	4	Node Heartbeat Status	

NOTE A: The last 3 bytes are never used.

B: The last byte is never used.

C: The last 2 bytes are never used.

D: 1 byte for each of the guns in the system (maximum of 32 guns in a system).

E: Gun number displayed depends on page number value in IO Module 4.

F: Page number is defined by the value of the second byte in IO Module 9.

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 3.

All of the data contained in the Output Image Table are written by the PLC to its main 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 3) representing locations in the PLC's output image table. The fieldbus main sends this data to the Gateway's fieldbus secondary where the data is written to the dual port memory by the PC 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.

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

The value in the first byte is the broadcast message number. The next 8 bytes of IO Module 1 contain data specific to that message number.

IO Module 2
When the Gateway detects a change in either of the 2 bytes of IO Module 2 (provided the first byte does not equal 0), it will send a multicast message out to the two nodes (KV and Flow/Pump) associated with the specified gun number.

IO Module 3
When the gateway detects that a change has taken place in the KV parameters of IO Module 3, it will send a unicast message out to the specified gun's KV node. If the flow parameters in IO Module 3 changed, then the gateway will send a unicast message to the specified gun's flow 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.

Before setting new KV or flow parameter values, clear the first byte of IO Module 3 to 0. After new values are written, set the first byte to 1.

IO Module 4
This IO 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 16 guns is currently being displayed on the PLC. For example, if this value were equal to 1, then the PLC is currently displaying guns #17 thru #32.

IO Module 5
This IO Module commands all the flow controls to change its flow rates by a percentage of the setpoint. A detailed description of this IO Module is discussed on page 31 under *Flow % Adjust Message*.

IO Module 6
This IO 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 LED will toggle ON and OFF every time a new value in IO Module 6 is stored.

IO Module 7
This IO Module is used to permit the PLC to send any unicast messages while IO Module 3 is reserved for the efficient handling of Data Table 5 and to quickly send these parameters to their respective nodes. IO Module 7 is provided primarily to send out other Data Tables as unicast messages.

IO Module 8
The assignment to each gun is sequential, that is to say, the first byte of IO 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). Since all gun control nodes always power up using Preset 01, it is recommended that the PLC programmer initialize all of IO Module 8 to contain "1" for every gun number. The PLC program may change a gun to a new preset by simply writing to that gun's byte in IO Module 8. When the gateway detects a change has occurred in any of the bytes in this IO Module, it sends a multicast message out to the node−pair associated with that byte (gun). Therefore, as the Gateway polls its way through IO Module 8 looking for changes, it is possible for it to send out 32 multicast messages; one for each byte change detected.

IO Module 9
This IO Module contains 2 bytes. The first byte defines which information data the Gateway should present to the PLC as defined in Table 4. The second byte defines the page number for the 16 guns for which the information data is contained in IO Module 28. The value of 0 is for Guns 1−16; value of 1 is for Guns 17−32.

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

Table 3 Output Image Table

IO Module No.	Address Offset	Size (Bytes)	Description	Range	Comment
1	0	1	Broadcast Msg. No.	0–39	0=WAIT
1	1	1	Data Byte 1	0–255	Auto Guns 1–8
1	2	1	Data Byte 2	0–255	Auto Guns 9–16
1	3	1	Data Byte 3	0–255	Auto Guns 17–24
1	4	1	Data Byte 4	0–255	Auto Guns 25–32
1	5	1	Data Byte 5	0–255	Manual Guns
1	6	1	Data Byte 6	0–255	
1	7	1	Data Byte 7	0–255	
1	8	1	Data Byte 8	0–255	
1	9–11	3	Not Used		
2	12	1	Gun No.	0–32	0=WAIT
2	13	1	Preset No.	1–255	
3	14	1	Edit Node Preset	0–1	0=WAIT
3	15	1	Gun No.	1–32	
3	16	1	Preset No.	1–255	
3	17	1	KV	0–100	
3	18	1	µA	–99 – +100	(See Note A and B)
3	19	1	AFC	0–1	
3	20	1	Select Charge Mode	0–4	
3	21	1	Flow Value/Powder Setpoint	0–100 (HDLV) 0–160 (Venturi)	For HDLV each count equals a % For Venturi each count equals 0.025 SCFM
3	22	1	Atomize Value/Pattern Flow Setpoint	0–160	Common for Venturi and HDLV
3	23	1	Assist Air Compensation	-50–+50	Only used with HDLV
3	24	1	Lookup Table Number	0–3	Only used with HDLV
3	25	1	Not Used		
4	26	1	Gun Page No.	0–1	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	

NOTE A: The negative number provides better resolution on µA settings. For finer resolution, Charge mode 4 must be selected (I/O Module 3, Btye 22).

B: When NFC is not used, µA is 1 count per µA. If NFC is used and µA setpoint is less than 10 µA , then the value in Address Offset 18 is 1 count per 0.1 µA. This value is entered with no decimal point (an integer) and made a negative number.

Continued...

IO Module No.	Address Offset	Size (Bytes)	Description	Range	Comment
7	32	1	Send Unicast Msg	0–2	0=WAIT, 1=KV, 2=Flow
7	33	1	Gun Number	0–32	
7	34	1	Data Table No.	1–255	This value is in data byte 0
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	44–75	32	Preset Number	0–255	Data Table 14 for each gun
9	76	1	General Information Data Type	0–255	0=WAIT, Table 2–1
9	77	1	General Information Page Number	0–1	

Table 4 Output Image Table – General Information Data

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 IO Module 16, high byte will be 0)
4	Flow Node Maintenance Minutes (low byte of IO Module 16, high byte will be 0)
5	Gun Node Firmware Version
6	Flow Node Firmware Version
7	HDLV Pump Lookup Table
8	Gateway S/W Version
9	Reserved
10	Reserved
11	Reserved
12	Reserved
13	Pump States
14–255	Spare

Input Image Table

See Table 5.

An overview of the Input Image Table IO 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 IO space.

IO Modules 10 through 25
These are 16 identical 12 byte IO modules that contain monitored gun parameter values for 16 guns. The PLC defines which group of 16 guns is being displayed on the Operator Interface at any given time by writing the *Gun Page No.* into IO Module 4 of the Output Image Table. The DSP controller processes this value and places the current monitored parameters for the group of 16 guns requested by the PLC.

IO Module 26
This IO 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 IO Modules 10–25; however, if the PLC needs to quickly check if any gun is in lockout, then it can simply read the first byte of IO Module 26. Address Offset 196 is used to determine the communication status between Gateway and the Nodes. This byte is updated within 5 seconds if the Gateway receives any message from any of the Nodes.

IO Module 27
This IO 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.

IO Module 28
This IO module contains 32 bytes of information requested through IO Module 9 as per Table 3. This IO module contains the information data values for a page of 16 guns. If after requesting information data the PLC program changes to the first byte of IO Module 28 to 0 (WAIT state), all the data in IO Module 28 will reset to 0. The PLC program has to request the information data again to get the updated values.

Table 5 Input Image Table

IO Module No.	Address Offset	Size (Bytes)	Description	Range	Comment
10	0	1	Paged Gun #1 or 17–KV	0–100	KV Monitor
10	1	1	Paged Gun #1 or 17–µA	–99–+140	µA Monitor
10	2	1	Paged Gun #1 or 17–Preset	1–255	Current Gun Preset
10	3	1	Paged Gun #1 or 17–On/Off	0x00–0x13	Trigger State (KV) AFC State and KV Offline Node State
10	4	1	Paged Gun #1 or 17–Type	0–4	Gun Type
10	5	1	Paged Gun #1 or 17–Faults	0–255	KV Node Faults
10	6	1	Paged Gun #1 or 17–Flow	0–160	Flow Monitor for Venturi/Assist Air Monitor for HDLV
10	7	1	Paged Gun #1 or 17–Atom	0–160	Atomize Monitor for Venturi/Pattern Air for HDLV
10	8	1	Paged Gun #1 or 17–Preset	1–255	Current Flow Preset
10	9	1	Paged Gun #1 or 17–On/Off	0–1	Trigger State (Flow)
10	10	1	Paged Gun #1 or 17–Faults	0–255	Flow Node Faults
10	11	1	Paged Gun #1 or 17–States	0–255	States
11–25	12–191	180	Paged Gun #2–16 or #18–32		Same Layout as above
26	192	1	Global Status Flags	0–32	Lockout State
26	193	1	Global Status Flags	0–32	Alarm State
26	194	1	Global Status Flags	0–32	Communication Fault
26	195	1	Global Status Flags	0–32	No 24 Vdc Fault
26	196	1	Communication Status	0–255	Gateway–Nodes Communication Status
26	197	1	Current Page Number	0–1	
26	198–199	2	Future Use		
27	200	1	Heartbeat	0–255	Heartbeat from Secondary

Continued...

IO Module No.	Address Offset	Size (Bytes)	Description	Range	Comment
28	201	1	Gun #1 or 17 Low Byte	0–255	Low Byte Information Data
28	202	1	Gun #1 or 17 High Byte	0–255	High Byte Information Data
28	203	1	Gun #2 or 18 Low Byte	0–255	Low Byte Information Data
28	204	1	Gun #2 or 18 High Byte	0–255	High Byte Information Data
28	205	1	Gun #3 or 19 Low Byte	0–255	Low Byte Information Data
28	206	1	Gun #3 or 19 High Byte	0–255	High Byte Information Data
28	207–231 odd	29	Gun #4–16 or #20–32 Low Byte	0–255	Low Byte Information Data
28	208–232 even	29	Gun #4–16 or #20–32 High Byte	0–255	High Byte Information Data
29	233	1	Gun Nodes 1–8 Heartbeat Status	0–255	Each bit represents a node (2 guns). LSB is node 1
29	234	1	Gun Nodes 9–16 Heartbeat Status	0–255	Each bit represents a node (2 guns). LSB is node 1
29	235	1	Flow nodes 1–8 Heartbeat Status	0–255	Each bit represents a node (2 guns). LSB is node 1
29	236	1	Flow nodes 9–16 Heartbeat Status	0–255	Each bit represents a node (2 guns). LSB is node 1

Sending Messages from the PLC

There are two PLC programming methods which can be used to generate a fieldbus message containing all the data desired in an output IO module. If these methods are not followed, there is risk of generating messages containing only some of the desired data, or the generation of several partially constructed messages (which may flood the CAN side of the Gateway).

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 7 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 main to the IO scan.

Multiple Scan Method

The multiple scan method applies to mains in the PC-based control system or in PLC systems where the fieldbus main 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.

NOTE: The multiple scan method is recommended for output IO Modules 2, 3, 5, and 7.

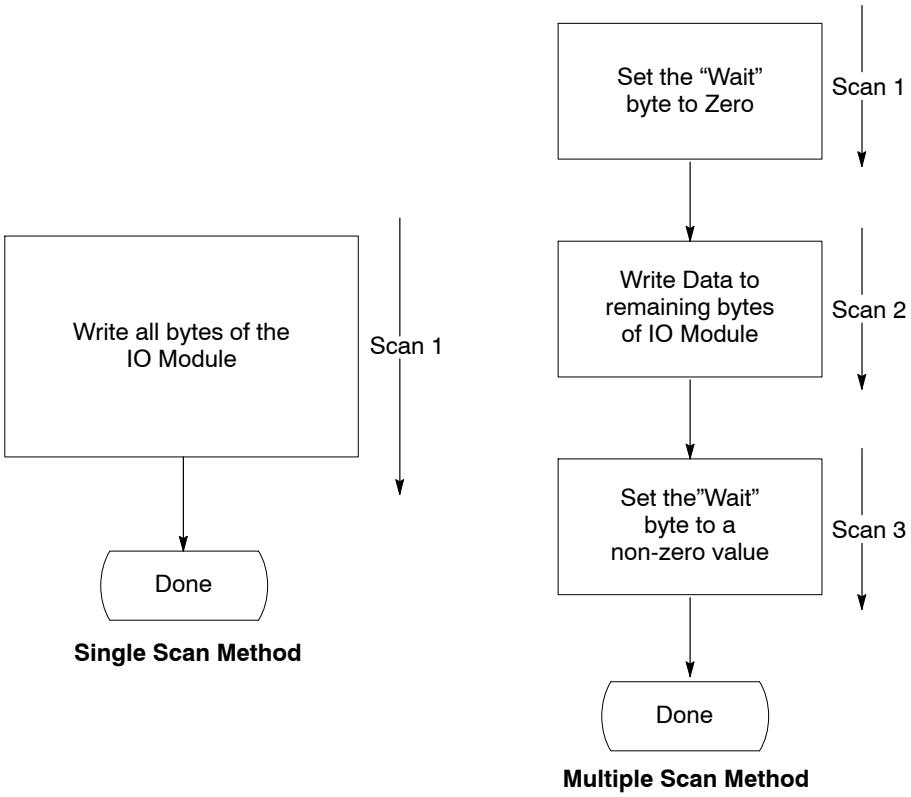

Figure 7 Sending Messages

Broadcast Messages from the PLC (IO Module 1)

Table 6 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
19	Pump Purge Control	8	Each bit is mapped to a gun	A
23	Purge Duration	6	Refer to Table 7	
36	Purge Pump to Gun	8	Each bit is mapped to a gun	A
37	Cycle Release	8	Each bit is mapped to a gun	A
38	Purge Pump to Hopper	8	Each bit is mapped to a gun	A
39	Enable Spectrum HD Cleaning Mode	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.

Table 7 Purge Duration Range of Data Values

Byte Number	Description	Range of Values	Count Meaning (Each Count Represents the Following)
0	Soft Gun Stage	4–40	250 milliseconds
1	Soft Siphon Stage	4–40	250 milliseconds
2	Gun Pulses	1–99	1 pulse
3	Siphon Pulses	2–99	1 pulse
4	Pulse On	2–20	50 milliseconds
5	Pulse Off	2–20	50 milliseconds
6	Siphon Pulse High Nibble	1–15	25 milliseconds
6	Siphon Pulse Low Nibble	1–15	25 milliseconds

Message 19 – Pump Purge Control

This message will trigger the automatic purge cycle. The parameters for this sequence are set by using Broadcast Message 23. Each spray gun can be individually triggered by setting the appropriate bit in the designated byte. Bytes 1–4 control spray guns 1–32. If a manual spray guns are present on the same network, Byte 5 can be used to purge up to four manual guns.

Message 23 – Purge Duration

This message can be used to send the purge parameters to every gun. It should be noted that using this message will send the selected parameters to every gun on the network. Refer to Table 7 for details.

Message 36 – Purge Pump to Gun (Spectrum HD)

After the selected spray gun has been enabled with Broadcast Message 39, this message can be sent to initiate the pump to gun cleaning cycle. The progress of this stage can be monitored by using the Pump State bits. To repeat this stage, first clear the corresponding gun bit, then set the gun bit.

Message 37 – Cycle Release (Spectrum HD)

After the selected spray gun has been enabled with Broadcast Message 39, this message can be sent to initiate the next stage of the cleaning cycle. This stage will turn on the pump air and remain on until the next stage of the cleaning has begun.

Message 38 – Purge Pump to Hopper (Spectrum HD)

After the selected spray gun has been enabled with Broadcast Message 39, this message can be sent to begin the pump to hopper purge stage. After this stage is complete, the pump will be in an idle state. To repeat this stage, first clear the corresponding gun bit, then set the gun bit.

Message 39 – Enable Spectrum HD Cleaning Mode

This message places the specified spray gun in Spectrum HD mode. Spray guns can be individually activated by setting the corresponding bit or they can be deactivated by clearing them.

Multicast Messages from the PLC (IO Modules 2 and 8)

Using IO 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 for the Multi Scan Method.

Using IO Module 8 of the Output Image Table

This IO module has been described on page 15 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 IO Module 3 of Output Image Table

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

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. Use Address Offset 14 as the WAIT function for the Multi Scan Method. Table 5 describes the use of IO Module 3.

Both KV and Flow related parameters are listed in this IO module. When the Gateway detects a change in this IO 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 Data Table 5 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 8 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	1–32	Physical Gun Number
16	Preset Number	1–255	Must never be zero
17	KV	0–100	1 count per KV
18	µA	–99–100	1 count per µA (See Note A)
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 iFlow Engage node
22	Atomize/Pattern Setpoint	0–160	Atomize or Pattern Setpoint
23	Assist Air Setpoint	-50– +50	Only used with iFlow Engage
24	Look-up Table Number	0 – 3	Only used with iFlow Engage

NOTE A: When NFC is not used, µA is 1 count per µA. If NFC is used and µA setpoint is less than 10 µA , then the value in Address Offset 18 is 1 count per 0.1 µA. This value is entered with no decimal point (an integer) and made a negative number.

Sending Messages from the PLC *(contd)*

Units of Measure for Preset Parameters

Engage Dual Gun Drivers

On the KV nodes, the units of the KV parameter are KVolts, and the units for uA are Uamps (microamps) when NFC is not used (default). These values are easily contained in a 1 byte value and require no further scaling.

iFlow Engage Modules

The flow parameters are less straight forward. When the iFlow Engage node is configured for a Venturi pump, 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 IO Module 3 are used with the iFlow Engage nodes configured for HDLV, then these values have a different specification. The HDLV powder flow setpoint stored at Address Offset 21 is a value from 0 to 100 and it requires no scaling. For an HDLV pump, the Pattern Air setpoint stored at Address Offset 22 uses the same scaling factors as mentioned above for the Venturi configuration. The HDLV pump Assist Air Setpoint stored at Address Offset 23 is a value from −50 to +50.

Using IO Module 7 of the Output Image Table

This IO 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 IO Module 5

This IO 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 27 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 IO 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 main 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 main cannot accept more than a total of 512 bytes of input data; the total amount of gun data can require much more than this amount of memory.

Gun Monitored Data

Using IO Modules 10 – 25

These IO modules contain monitored gun data for 16 guns, respectively. The group of 16 guns represented in these 16 IO Modules is defined by the Gun Page Number value written by the PLC to IO Module 4 of the Output Image Table. Use Tables 5, 9, and 10 to identify the correct Address Offsets within the IO modules for the desired function.

Table 9 Parameter Descriptions and Explanations

Byte Number	Parameter Description	Explanation
0	Actual KV	When gun is OFF, Gateway updates values every 2 seconds. When gun is ON, Gateway updates every 0.5 seconds.
1	Actual uA	When gun is OFF, Gateway updates values every 2 seconds. When gun is ON, Gateway updates every 0.5 seconds.
2	Preset – KV	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.
3	KV Status Bits	See Table 11. 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
4	Gun Type	Stores the current gun type connected to the physical gun channel. Valid Gun Codes: 0 = No Gun 6 = Encore and Encore HD
5	KV Faults	See Table 12. Contains any fault bits which have been detected by the gun's KV node.

Continued…

Byte Number	Parameter Description	Explanation
6	Actual Flow/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 28 for conversion factors from raw counts to standard units of flow rate.
7	Actual Atomizing/Assist	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 28 for conversion factors from raw counts to standard units of flow rate.
8	Preset Flow	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.
9	Flow Status Bits	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
10	Flow Faults	Contains any fault bits which have been detected by the gun's Flow node. See Table 13 for fault bit definitions.
11	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 14 for bit definitions.

Gun Monitored Data (contd)

Table 10 Parameters Contained in IO Modules 10 – 25 with Corresponding Address Offsets

Byte Number	Parameter Description	IO Module							
		10	11	12	13	14	15	16	17
		Gun 1 or 17	Gun 2 or 18	Gun 3 or 19	Gun 4 or 20	Gun 5 or 21	Gun 6 or 22	Gun 7 or 23	Gun 8 or 24
0	Actual KV	0	12	24	36	48	60	72	84
1	Actual uA	1	13	25	37	49	61	73	85
2	Preset – KV	2	14	26	38	50	62	74	86
3	KV Status Bits	3	15	27	39	51	63	75	87
4	Gun Type	4	16	28	40	52	64	76	88
5	KV Faults	5	17	29	41	53	65	77	89
6	Actual Flow/Pattern	6	18	30	42	54	66	78	90
7	Actual Atomizing/Assist	7	19	31	43	55	67	79	91
8	Preset Flow	8	20	32	44	56	68	80	92
9	Flow Status Bits	9	21	33	45	57	69	81	93
10	Flow Faults	10	22	34	46	58	70	82	94
11	General Status	11	23	35	47	59	71	83	95
Byte Number	**Parameter Description**	**IO Module**							
		18	**19**	**20**	**21**	**22**	**23**	**24**	**25**
		Gun 9 or 25	**Gun 10 or 26**	**Gun 11 or 27**	**Gun 12 or 28**	**Gun 13 or 29**	**Gun 14 or 30**	**Gun 15 or 31**	**Gun 16 or 32**
0	Actual KV	96	108	120	132	144	156	168	180
1	Actual uA	97	109	121	133	145	157	169	181
2	Preset – KV	98	110	122	134	146	158	170	182
3	KV Status Bits	99	111	123	135	147	159	171	183
4	Gun Type	100	112	124	136	148	160	172	184
5	KV Faults	101	113	125	137	149	161	173	185
6	Actual Flow/Pattern	102	114	126	138	150	162	174	186
7	Actual Atomizing/Assist	103	115	127	139	151	163	175	187
8	Preset Flow	104	116	128	140	152	164	176	188
9	Flow Status Bits	105	117	129	141	153	165	177	189
10	Flow Faults	106	118	130	142	154	166	178	190
11	General Status	107	119	131	143	155	167	179	191

Table 11 Trigger, AFC, KV Offline States–Address Offset #4

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 12 KV Node Faults–Address Offset #6

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

Gun Monitored Data (contd)

Table 13 Flow Node Faults–Address Offset #11

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 14 General Node Status–Address Offset #12

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 IO Module 26

This IO 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 IO Module 26 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 196 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 15 lists the definition of the bytes in IO Module 26.

Table 15 General Status Bytes−IO Module 26

Address Offset	Function	Range
192	Guns w/Lockout ON	0−32 (0=None)
193	uns w/Alarm	0−32 (0=None)
194	Guns w/Communication Fault	0−32 (0=None)
195	Guns w/No 24 VDC Fault	0−32 (0=None)
196	Gateway−Node Communication Status	0−255
197	Current Page No.	0−1
198−199	Future Use	

Gateway Heartbeat

Using IO Module 27

The PLC may periodically read IO Module 27 to verify that the Gateway is still active and its code is executing. The Gateway will write a new value to IO Module 27 every 1 second. It will continuously increment a counter every second from 0 to 255, then rollover back to zero.

Table 16 Dip Switch (SW1) Settings

Switch	Function	Open	Closed
SW1-2	Network Term. Resistor	Disabled (Default)	Enabled
SW1-1	Future Use	Disabled (Default)	Not Applicable

Table 17 Dip Switch (SW2) Settings

NOTE: By default, all positions are OPEN.

Switch	Function	Open	Closed
SW2-4	Byte Swapping	Disabled	Enabled
SW2-3	Communication	Normal	Listen Only
SW2-2	Mode	Engage	Not Used
SW2-1	Pump Type	Venturi	HDLV

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

NOTE: All kits include the host PCA and Anybus-S module.

Part	Description
1616013	KIT, Gateway, Engage, EtherNet IP
1616015	KIT, Gateway, Engage, PROFINET

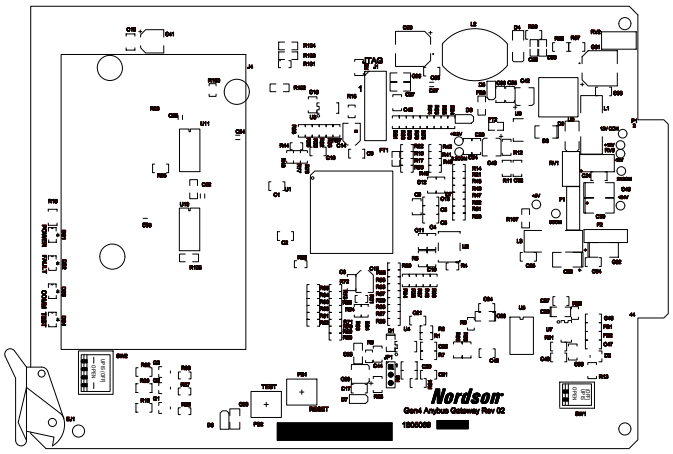

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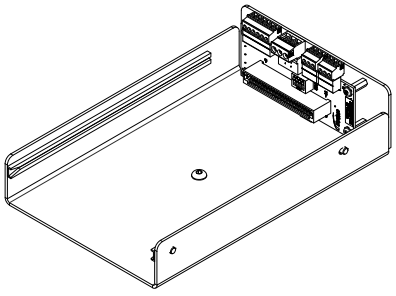
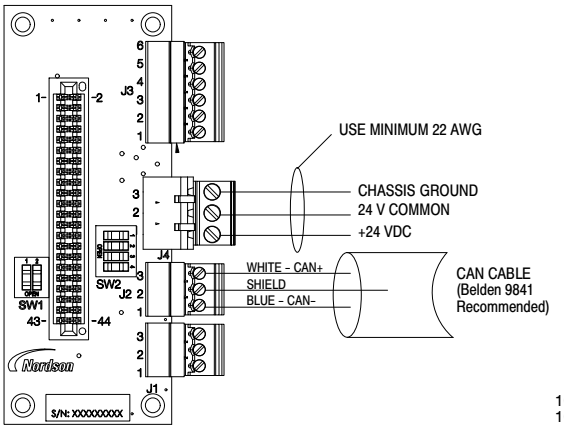
Figure 8 Generation 4 Slot 9 Gateway PCA

Optional Equipment

Part	Description
1611190	CAGE, card, single slot backplane





10016794
10016952

Figure 9 Single Slot Backplane Card Cage