Instructions

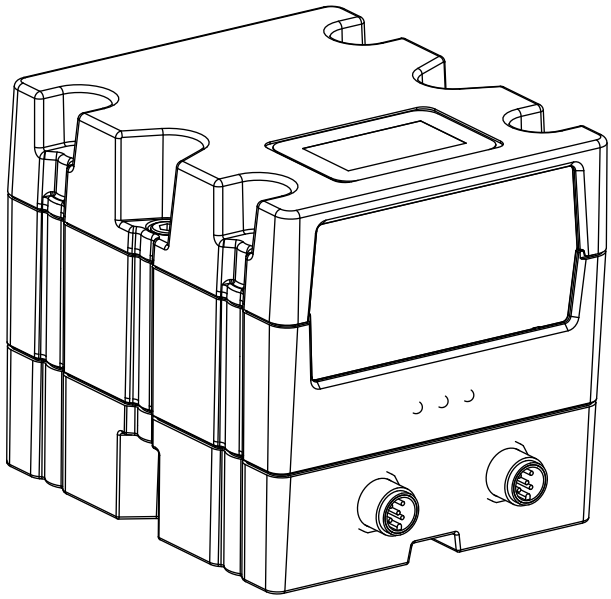
HFR™ Discrete Gateway Module Kits

3A1149K
EN

For external control of the HFR system. For professional use only. Not approved for use in European explosive atmosphere locations.

Single Discrete Gateway Module Kit, 24F843
Dual Discrete Gateway Modules Kit, 24F844
Discrete Gateway Module, 24G830

Important Safety Instructions
Read all warnings and instructions in the HFR operation manual 313997. Save all instructions.



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Contents

Related Manuals

The following manuals are available at www.graco.com.
Manuals are in English.

Part	Description
313997	HFR Operation
313998	HFR Repair-Parts

Overview

This Discrete Gateway Module (DGM) allows the user to control an HFR through an external control device such as a PLC. The DGM will operate in conjunction with the existing Advanced Display Module (ADM) such that both devices can be used to control the machine. Each HFR can be controlled using up to two DGM's which will be referred to as the primary and secondary DGM's.

The primary DGM allows the user to monitor and control general machine functions. This includes the following capabilities:

- Dispensing
- Operating mode selection
- Shot selection
- Fault code monitoring
- Fault acknowledgment
- Pump parking
- Monitoring working pressures of each pump
- Monitoring the combined flow or B (Blue) pump pressure while dispensing
- System Stop button
- Changing the combined flow or B (Blue) pump pressure in operator mode

The secondary DGM is used for monitoring and controlling the temperature conditioning components. These features include:

- Monitoring which conditioning zones are enabled
- Monitoring temperatures of enabled zones
- Turning on or off the enabled zones
- Changing temperature setpoints of enabled zones

NOTE: Changing temperature setpoints is only available on machines with 2nd generation ADMs. 2nd generation ADMs are distinguishable by having only 2 cable connections on the bottom of the ADM. 1st generation ADMs have 4 cable connections.

DGM Presence

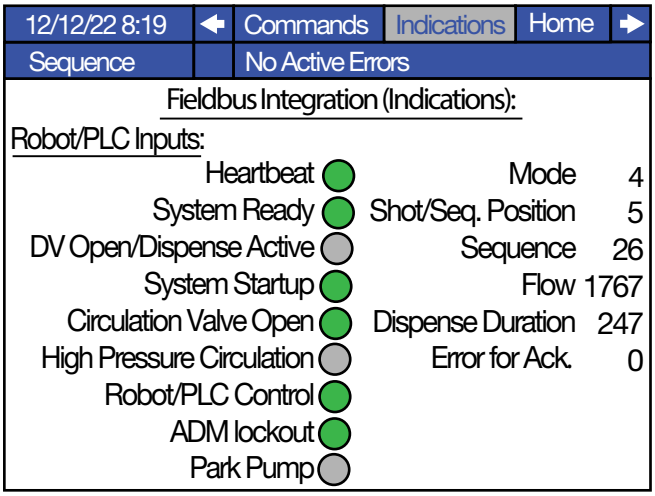
The DGM will broadcast a heartbeat to the HFR every 5 seconds. In the event that the DGM fails to broadcast a heartbeat after 10 seconds, the system will go into disabled mode.

The system can be taken out of disabled mode after acknowledging the alarm on the ADM.

Automation Presence

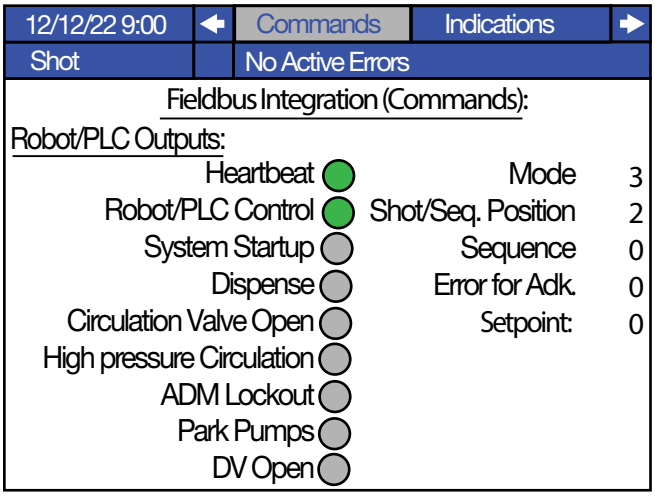
The primary DGM includes a heartbeat monitor. This serves as a verification that the PLC and DGM are communicating. In the event that the PLC becomes unresponsive, the DGM will terminate any active dispenses and set the machine to disabled mode.

If using a HFR DGM module, 16D773 software version 1.05.001 or higher (refer to Advanced #5 setup screen on ADM module for system and module versions), two additional run screens are available to the left of the main "Home" fun screen. Refer to for the additional run screens which provide a graphical representation of the data provided to the PLC ("(Indications)") and commands provided from the PLC to the HFR or NVH system ("(Commands):").



3A1149_screen1

FIG. 1



3A1149_screen2

FIG. 2

Typical Installation

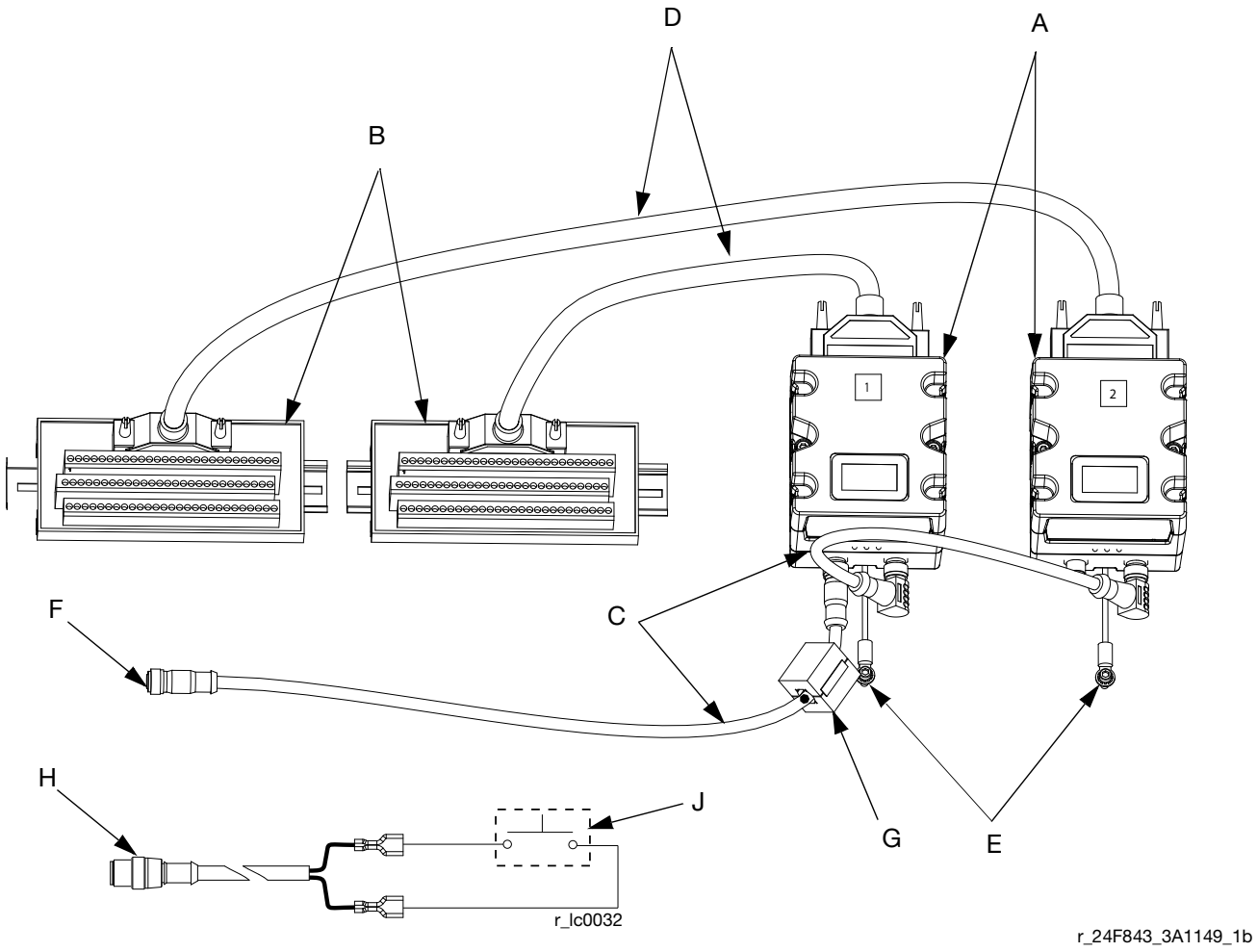


FIG. 3

Key:

A Discrete Gateway Module (DGM)
B Breakout Board
C CAN Cables
D 78 Pin D-Sub Cables (Male to Female)
E Ground screw
F Connects to HFR
G Ferrite Suppressor
H CAN Cable to Motor Control Module (MCM) 2B Port*
J Start Dispense Signal (Customer Supplied)**

* *Cable provided with dispense gun or can be purchased separately. Refer to* ***Accessories*** *for item information.*

** *Connect cable to MCM, port 2B, and a customer provided signal device. The signal device must have isolated, dry contacts.*

Component Identification

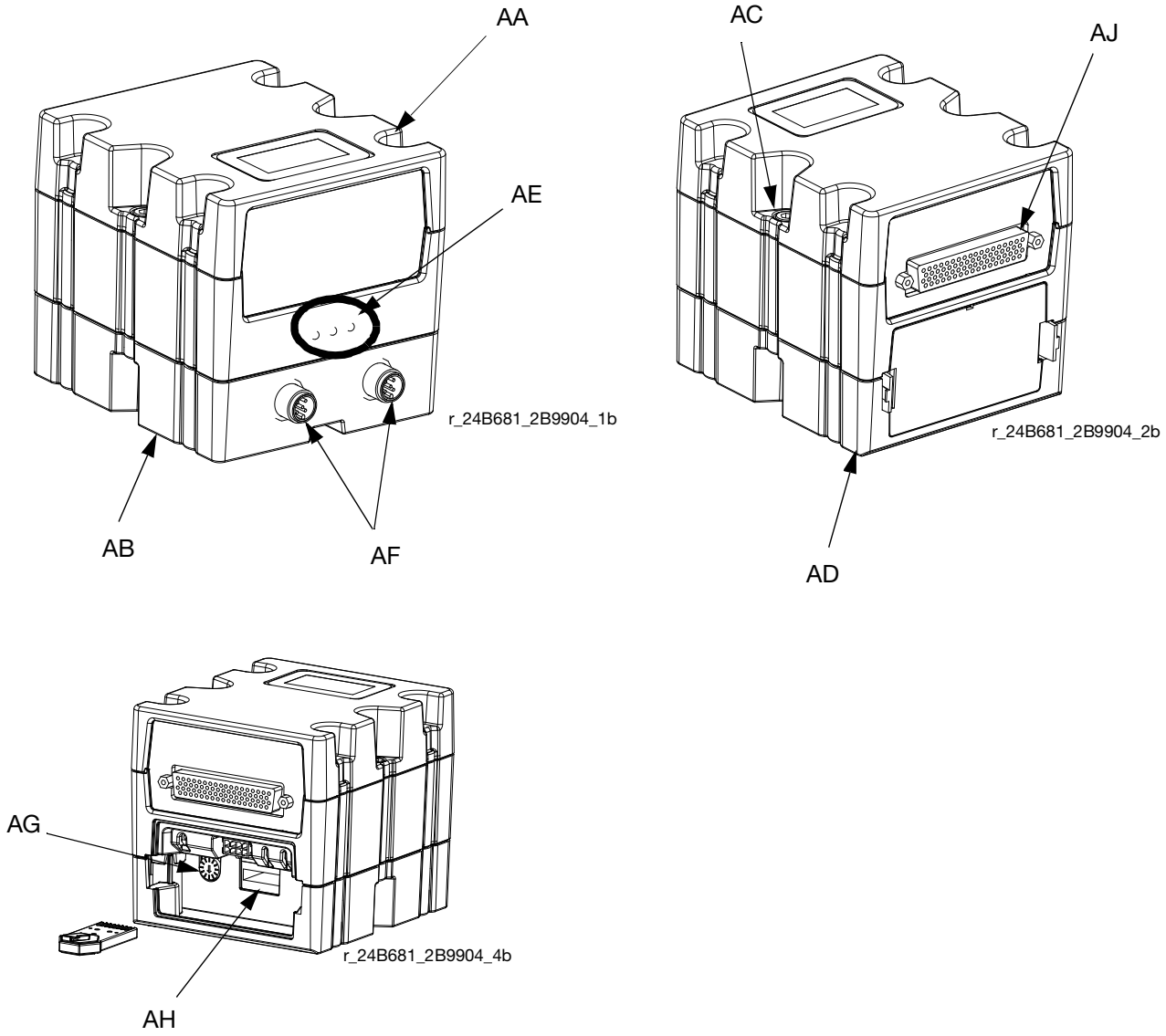


FIG. 4:

Key:

AA Discrete Gateway Module (DGM)
AB Base
AC Module Connection Screws
AD Access Cover
AE Module Status LEDs
AF CAN Connectors
AG Rotary Switch
AH Token Slot
AJ D-Sub Connection

Module Requirements

Each DGM requires a 9-30 VDC NEC Class 2 power supply. This is supplied to the DGM through pins 27, 51, 68, 69 on the D-Sub connection. Ground from this supply should only be connected to pin 70 of the D-Sub connection.

I/O Setup

NOTE: Each DGM is set as the primary or secondary DGM by setting the rotary switch (AG) position. See **Setup** on page 14.

NOTICE
To avoid ground loops and noise immunity issues, do not ground the shield of the D-sub connector cable. The shield is already grounded through the mounting screw on the base of the DGM. If using a breakout board, do not make any connections to the pins with ground symbols.

See the Digital and Analog I/O Overview sections beginning on the following page for I/O setup details. See the **Primary DGM Pin Assignments** and **Secondary DGM Pin Assignments** sections beginning on page 10 for individual pin assignments.

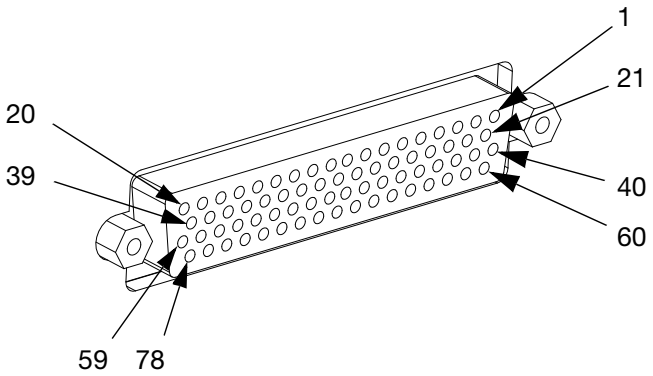
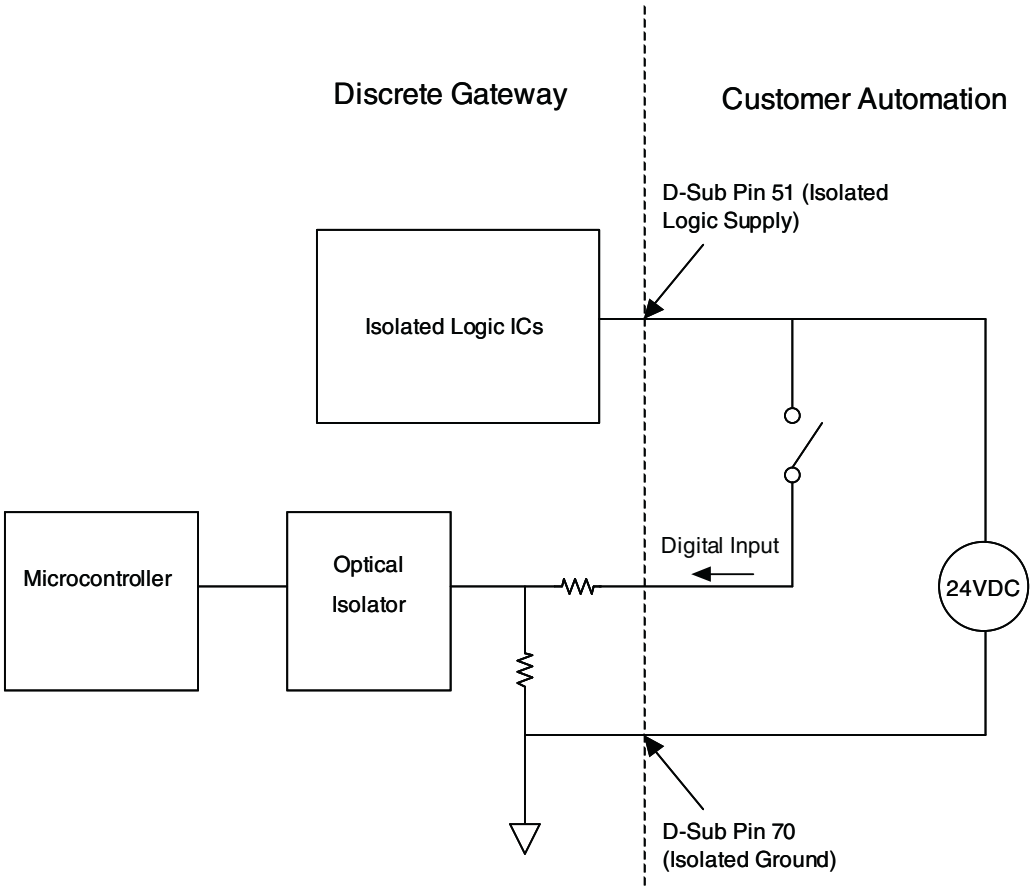


FIG. 5: D-sub Connector - Pin References

DGM Digital Input Overview

The digital inputs function only when power is supplied to pin 51 and there is a ground connection to pin 70. The digital input is rated at 0-30 VDC, and requires an NEC Class 2 power supply connected to pin 51. The DGM provides optical isolation as shown in the following illustration.

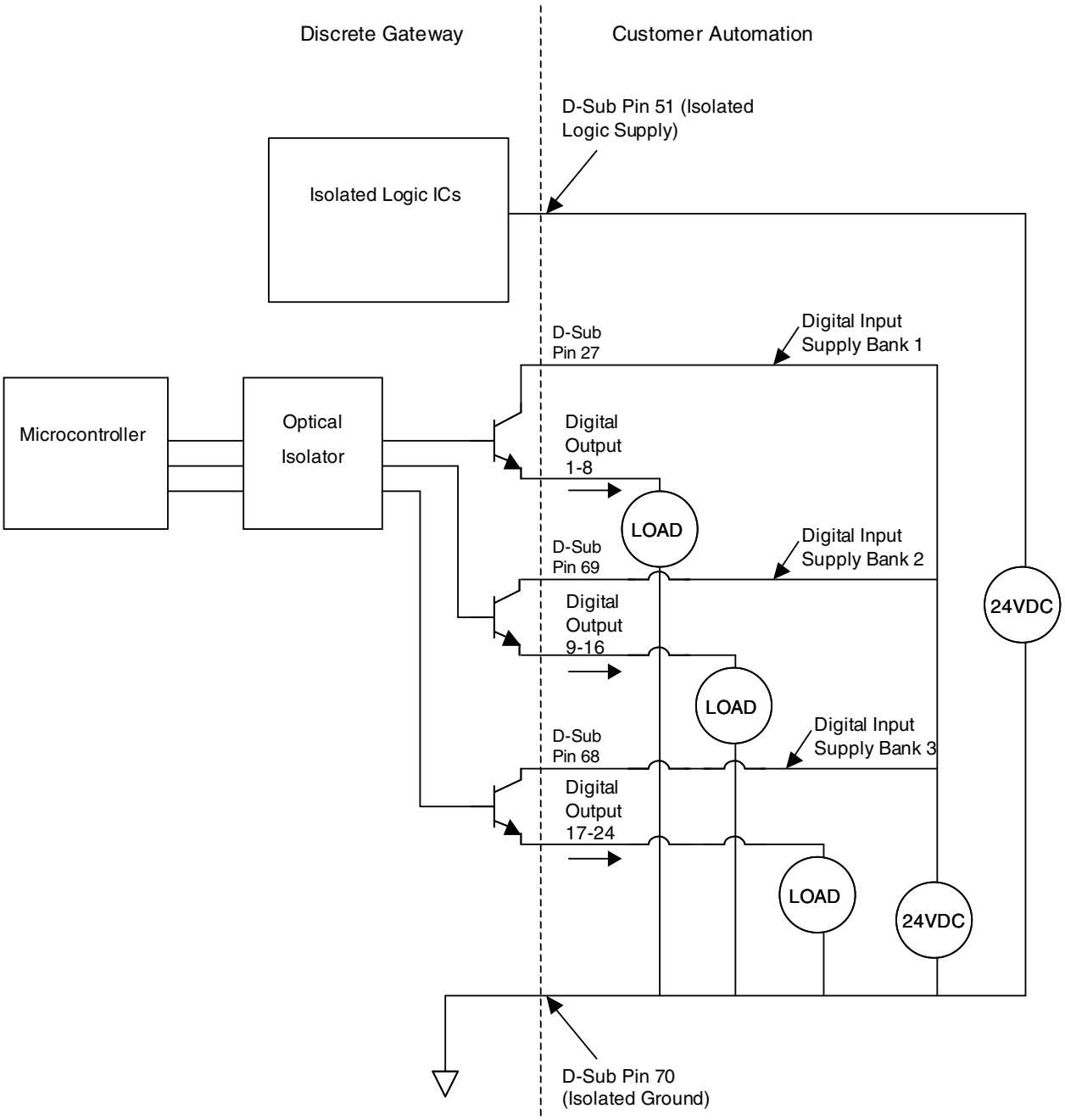
- Pins: 52 – 59, 71-78
- Type: Sinking
- Maximum current draw: 3.6 mA



DGM Digital Outputs Overview

The digital outputs function only when power is supplied to pins 27, 68, and 69 and there is a ground connection to pin 70. The digital output is rated at 0-30 VDC, and requires an NEC Class 2 power supply connected to pin 27 for supply bank 1, pin 69 for supply bank 2, and pin 68 for supply bank 3. The DGM provides optical isolation as shown in the following illustration.

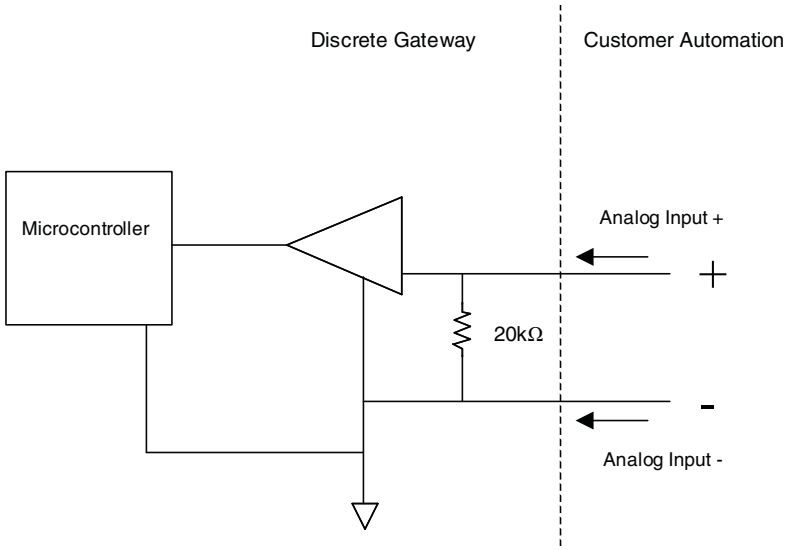
- Pins: 9-20, 28-39
- Type: Sourcing
- Maximum continuous current output: 350 mA (sourced from customer supply)
- Recommended continuous current: 100 mA



DGM Analog Inputs Overview

The analog inputs function only when the DGM is connected to a power supply through the CAN connection; see **Setup**, page 14. Each analog input has a corresponding reference (ground) pin.

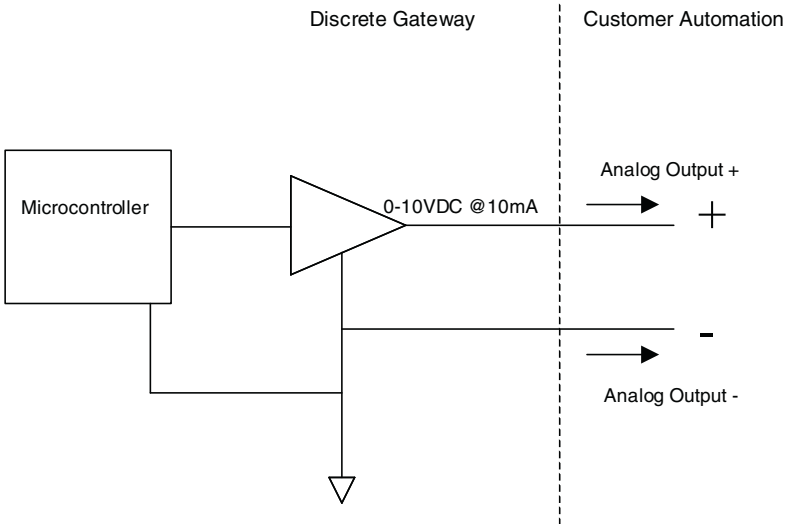
- Type: Sinking
- Voltage Rating: 0-10 Vdc
- Input Impedance: 20 kΩ



DGM Analog Outputs Overview

The analog outputs function only when the DGM is connected to a power supply through the CAN connection; see **Setup** on page 14. Each analog output has a corresponding reference (ground) pin.

- Type: Sourcing
- Voltage Rating: 0-10 Vdc, 10 mA at 10 Vdc



Primary DGM Pin Assignments

Pin Number	DGM Digital Inputs	Functional Description
52	1	PLC to DGM Heartbeat
53	2	Dispense Request / Terminate (Shot, Operator modes), or Start/Stop Recirculation (Standby Mode)
54	3	System Stop
55	4	Acknowledge Active Error
56	5	Set Operating Mode, Bit 2
57	6	Set Operating Mode, Bit 1
58	7	Set Operating Mode, Bit 0
59	8	Accept Operating Mode Change
71	9	Select Shot, Bit 6 (Shot Mode)
72	10	Select Shot, Bit 5 (Shot Mode)
73	11	Select Shot, Bit 4 (Shot Mode)
74	12	Select Shot, Bit 3 (Shot Mode), or Enable Dispensing (Active Low)
75	13	Select Shot, Bit 2 (Shot Mode), or Enable ADM (System in Disabled mode)
76	14	Select Shot, Bit 1 (Shot Mode), or Lock/Unlock the Dispense Valve (Standby Mode)
77	15	Select Shot, Bit 0 (Shot Mode), or Open/Close Dispense Valve (Standby Mode)
78	16	Accepted Selected Shot (Shot Mode), or Accepted Pressure/Flow (Operator Mode), or Park Pump (Standby Mode)

Pin Number	DGM Digital Outputs	Functional Description
9	1	DGM to PLC Heartbeat
10	2	Ready to Dispense
11	3	Dispense in Progress
12	4	Requested Flow Rate/Pressure Setpoint Rejected
13	5	Dispense Mode Selected: Flow (Low) or Pressure (High)
14	6	Error Present
15	7	Fault Code, Bit 7
16	8	Fault Code, Bit 6
17	9	Fault Code, Bit 5
18	10	Fault Code, Bit 4
19	11	Fault Code, Bit 3
20	12	Fault Code, Bit 2
28	13	Fault Code, Bit 1
29	14	Fault Code, Bit 0
30	15	Operating Mode Selected, Bit 2
31	16	Operating Mode Selected, Bit 1
32	17	Operating Mode Selected, Bit 0
33	18	Shot Selected, Bit 6
34	19	Shot Selected, Bit 5
35	20	Shot Selected, Bit 4
36	21	Shot Selected, Bit 3
37	22	Shot Selected, Bit 2 (Shot Mode), or Dispense Valve Locked (Standby Mode)
38	23	Shot Selected, Bit 1 (Shot Mode), or Dispense Valve Open (Standby Mode)
39	24	Shot Selected, Bit 0 (Shot Mode), or Pump Parked (Standby Mode)

Pin Number	DGM Analog Inputs	Functional Description
1	1	Set B (Blue) Pump Dispensing Pressure or Combined Dispensing Flow Rate
2	1 - GND	Grounding Pin for Analog Input 1
3	2	Not Used
4	2 - GND	Not Used
21	3	Not Used
22	3 - GND	Not Used
23	4	Not Used
24	4 - GND	Not Used

Pin Number	DGM Analog Outputs	Functional Description
40	1	B (Blue) Pump Pressure
41	1 - GND	Grounding Pin for Analog Output 1
42	2	A (Red) Pump Pressure
43	2 - GND	Grounding Pin for Analog Output 2
60	3	Combined Flow Rate or B (Blue) Pump Pressure
61	3 - GND	Grounding Pin for Analog Output 3
62	4	Not Used
63	4 - GND	Not Used

Pin Number	Power Supply	Functional Description
27	+	9-30V Power Supply Pins
51		
68		
69		
70	-	Grounding Pin

Secondary DGM Pin Assignments

Pin Number	DGM Digital Inputs	Functional Description
52	1	Set Zone 1 On
53	2	Set Zone 2 On
54	3	Set Zone 3 On
55	4	Set Zone 4 On
56	5	Accept Zone 1 Setpoint Change
57	6	Accept Zone 2 Setpoint Change
58	7	Accept Zone 3 Setpoint Change
59	8	Accept Zone 4 Setpoint Change
71	9	Not Used
72	10	Not Used
73	11	Not Used
74	12	Not Used
75	13	Not Used
76	14	Not Used
77	15	Not Used
78	16	Not Used

Pin Number	DGM Digital Outputs	Functional Description
9	1	Not Used
10	2	Ready To Dispense
11	3	Dispense in Progress
12	4	Zone 1 On
13	5	Zone 2 On
14	6	Zone 3 On
15	7	Zone 4 On
16	8	Zone 1 Temperature Setpoint Rejected
17	9	Zone 2 Temperature Setpoint Rejected
18	10	Zone 3 Temperature Setpoint Rejected
19	11	Zone 4 Temperature Setpoint Rejected
20	12	Tank Heater A (Red) Enabled
28	13	Tank Heater B (Blue) Enabled
29	14	Inline Heater A (Red) Enabled
30	15	Inline Heater B (Blue) Enabled
31	16	Hose Heater A (Red) Enabled
32	17	Hose Heater B (Blue) Enabled
33	18	Chiller A (Red) Enabled
34	19	Chiller B (Blue) Enabled
35	20	Not Used
36	21	Not Used
37	22	Not Used
38	23	Not Used
39	24	Not Used

Pin Number	DGM Analog Inputs	Functional Description
1	1	Set Zone 1 Temperature
2	1 - GND	Grounding Pin for Analog Input 1
3	2	Set Zone 2 Temperature
4	2 - GND	Grounding Pin for Analog Input 2
21	3	Set Zone 3 Temperature
22	3 - GND	Grounding Pin for Analog Input 3
23	4	Set Zone 4 Temperature
24	4 - GND	Grounding Pin for Analog Input 4

Pin Number	DGM Analog Outputs	Functional Description
40	1	Actual Zone 1 Temperature
41	1 - GND	Grounding Pin for Analog Output 1
42	2	Actual Zone 2 Temperature
43	2 - GND	Grounding Pin for Analog Output 2
60	3	Actual Zone 3 Temperature
61	3 - GND	Grounding Pin for Analog Output 3
62	4	Actual Zone 4 Temperature
63	4 - GND	Grounding Pin for Analog Output 4

Pin Number	Power Supply	Functional Description
27	+	9-30V Power Supply Pins
51		
68		
69		
70	-	Grounding Pin

Setup

See **Typical Installation** on page 4 for an assembled view.

1. Install the DGM in the desired location.

   a. Remove access cover (AD).

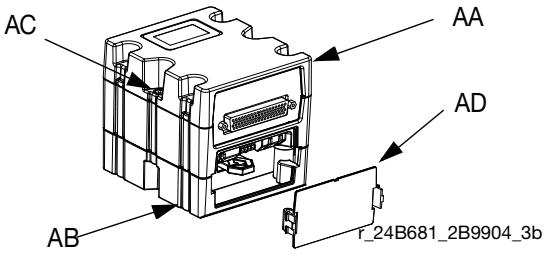
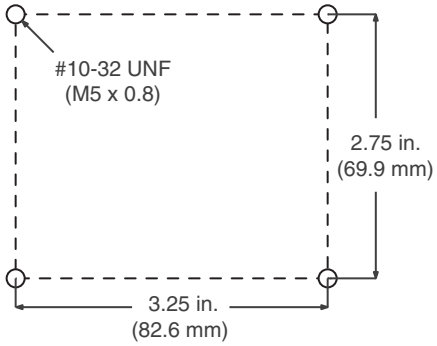


FIG. 6

   b. Loosen two screws (AC) and remove DGM (AA) from base (AB).

   c. Attach ground wire to bottom of base.

   d. Mount base (AB) in desired location with four screws. See the following mounting dimensions.



   e. Insert screws through top of base and tighten.

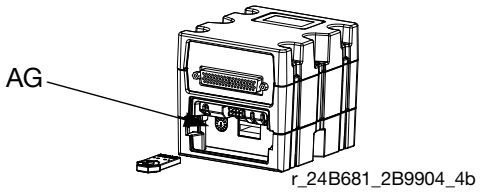
   f. Insert screw through ground wire and tighten.

   g. Mount DGM (AA) on base (AB) with two screws (C).

   h. If applicable, repeat with second DGM.

2. Adjust DGM selector switch (AG) according to the following table.

Setting	Zone
1	Primary DGM
2	Secondary DGM



3. Install access cover (D).

4. Connect CAN and D-Sub cables.

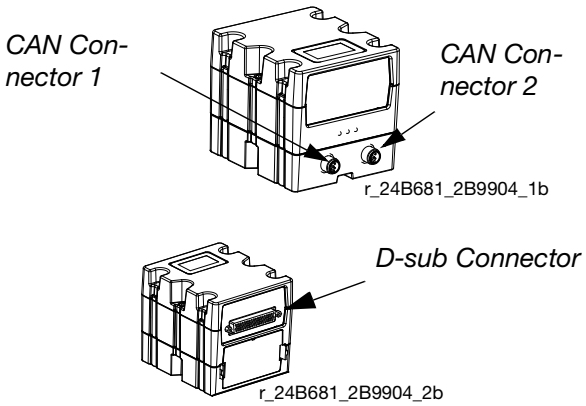


FIG. 7: Cable Connections

   a. Connect CAN cable from Connector 1 on DGM to ADM or any available CAN connection on the machine. Attach the ferrite suppressor to DGM end of the CAN cable.

NOTE: In the previous step if more than one DGM is used the connection can be made with either DGM.

   b. If a second DGM is installed, connect CAN cable from CAN Connector 1 on the second DGM to Connector 2 on the first DGM.

c. Connect D-Sub cable from D-Sub Connector on first DGM to a breakout board or to an external control device.

d. If second DGM is installed, connect D-Sub cable from D-Sub Connector on second DGM to a breakout board or to an external control device.

Operation

Primary DGM Digital Inputs

See DGM Digital Inputs table in the **Primary DGM Pin Assignments** section beginning on page 10 for pin numbers associated with each bit description.

The primary DGM allows the PLC to control and monitor the HFR's dispensing properties.

Digital Input 1: PLC to DGM Heartbeat

The external control device (PLC) and DGM will each have Heartbeat inputs and outputs. The heartbeat serves as a verification that both devices are communicating. The PLC does not need to implement any timers to regulate the period of the heartbeat. To successfully complete a heartbeat, the PLC must match the output state of the DGM heartbeat. This can happen as soon as the PLC detects the change in output state, or within 6 seconds of detecting a change in heartbeat state. If the PLC does not match the output state of the DGM after 6 seconds, the DGM will disable the system. This will only happen once, and the HFR can be reactivated and operated from the ADM. The DGM will not accept any more requests until the heartbeat resumes between the PLC and DGM.

Digital Input Bit 2

The function of this bit is based on the selected operating mode:

NOTE: The Enable Dispensing bit must be pulled low prior to dispensing.

- **Shot Mode:** Toggle this bit high to dispense a single shot. Toggle the bit in the middle of a shot to terminate the dispense.
- **Operator Mode:** The machine will dispense while the bit is pulled high. As soon as the bit falls low, the dispense terminates.
- **Operator Mode with Fusion® Gun:** Toggle this bit to stop/start stalling the system to pressure.
- **Standby Mode:** Toggle this bit high to start/stop recirculation (recirculation systems only).

Digital Input 3: System Stop

Toggle this bit high to place the dispensing system in disabled mode.

Digital Input 4: Acknowledge Active Error

Toggle this bit high to acknowledge any errors detected by the system.

Digital Inputs 5-7: Set Operating Mode Bits

The operating mode is selected through the use of 3 bits. The following table describes the bit pattern to indicate selection of each operating mode. A "1" means the bit is high and a "0" means the bit is low.

Operating Mode Bit Pattern			
Digital Input 5	**Digital Input 6**	**Digital Input 7**	**Operating Mode**
0	0	1	Disabled
0	1	0	Standby
0	1	1	Shot*
1	0	1	Operator
1	1	1	Night**

Digital Input 8: Accept Operating Mode Change

Toggle this bit high while the bit pattern is set to change the operating mode. After toggling this bit, use the analog output bits to verify the operating mode was successfully changed.

* *Shot definitions must be configured through the ADM.*

** *Night mode settings must be configured through the ADM.*

Digital Inputs 9-15: Select Shot Bits

The shot selection bits are used to select one of the 100 different defined shots. The user must use the ADM to define each shot. The DGM will use a 7-bit pattern to select one of the shots.

The machine must be in Shot mode to select a shot.

Shot Selection Bit Pattern							
Digital Input 9	Digital Input 10	Digital Input 11	Digital Input 12	Digital Input 13	Digital Input 14	Digital Input 15	Shot Selected
0	0	0	0	0	0	0	Not Defined
0	0	0	0	0	0	1	Shot 1
0	0	0	0	0	1	0	Shot 2
0	0	0	0	0	1	1	Shot 3
…							
1	1	0	0	1	0	0	Shot 100
1	1	0	0	1	0	1	Not Defined
…							
1	1	1	1	1	1	1	Not Defined

Digital Inputs 12-15 have alternate functionality in Operator, Shot and Standby modes. Below are their alternate functions:

Digital Input 12 becomes:
(used in Operator, Shot, and Standby modes)

- **Enable Dispensing:** Keep this bit low when not selecting a shot. If this bit is high during a dispense request or park pump request, the request will be ignored. If this bit goes high during a dispense the system will go into Disabled mode.

Digital Input 13 becomes:
(used in Disabled mode)

- **Enable ADM:** Toggle this bit to enable the ADM.

Digital Input 14 becomes:
(used in Standby mode)

- **Dispense Valve Open:** While this bit is pulled high the dispense valve will remain open. When it is pulled low the dispense valve will be closed.

Digital Input 15 becomes:
(Standard HFR: Used in Standby mode,
Recirculation HFR: Used in Operator mode)

- *Standard HFR:* **Set/Release Dispense Valve Lock:** Toggle this bit high to lock or unlock the dispense valve in Standby Mode.
- *Recirculation HFR:* **Recirculate or Dispense Selection:** Toggle this bit to select between routing both materials for recirculation or for dispensing.

Digital Input 16

The function of this bit is based on the selected operating mode:

- **Shot Mode:** Sets the shot number. To use, set the Shot Selection Bits to the desired bit pattern then toggle this bit low then high then low to change the shot. After toggling this bit, the PLC programmer should verify that the current shot number matches the request.

- **Operator Mode:** Sets the dispense pressure or flow. To use, set Analog Input 1: Set Pressure/Set Flow to the voltage for the corresponding desire flow or pressure. After 185 mS of settling, toggle this bit to set the new analog value. The PLC programmer should check Digital Output 4 to make sure the setpoint was accepted.

  See the **Primary DGM Analog Inputs** section on page 19 for analog input voltage calculation.

- **Standby Mode:** Hold the bit high to park the pump. Use the Digital Output 24 to verify the pump has successfully parked. Release the bit when the pump is successfully parked.

Primary DGM Digital Outputs

See DGM Digital Outputs table in the **Primary DGM Pin Assignments** section beginning on page 10 for pin numbers associated with each bit description.

Digital Output 1: DGM to PLC Heartbeat

See the DGM to PLC Heartbeat description in the **Primary DGM Digital Inputs** section beginning on page 16.

Digital Output 2: Ready To Dispense

For Fusion® dispense guns: This bit is high when the system is stalled to pressure.

For all other dispense guns: This bit is high when the system is ready to begin dispensing.

Digital Output 3: Dispense In Progress

This bit is high when the machine is dispensing.

Digital Output 4: Flow Rate/Pressure Setpoint Rejected

This bit is high when the requested setpoint change is rejected.

Digital Output 5: Dispense Mode Selected

When this bit is low, the selected Dispense mode is Flow. When this bit is high, the selected Dispense mode is Pressure.

Digital Output 6: Error Present

If an error is generated this output will be high. The PLC programmer should monitor the Fault Code bits to determine if the system is in a healthy state but this will serve as an additional and redundant alert.

Digital Output 7-14: Fault Codes

This 8-bit pattern indicates what error is being displayed. See the **Fault Code Bit Pattern Table** on page 30. The fault code is removed when it is acknowledged. For best results, check the ADM.

Digital Output 15-17: Operating Mode Selected Bits

These bits form a bit pattern to indicate which operating mode is selected. See the operating mode bit patterns table in the **Primary DGM Digital Inputs** section beginning on page 16.

Digital Outputs 18-24: Shot Selected Bits

When in Shot mode, these bits are used to form a bit pattern to indicate which shot is selected. See the shot selection bit patterns table in the **Primary DGM Digital Inputs** section beginning on page 16.

When in Standby mode, Digital Outputs 22-24 each perform a different function:

Digital Output 22:

- **Dispense Valve Locked:** This bit is high when the dispense valve is locked.

Digital Output 23:

- **Dispense Valve Open:** This bit is high when the dispense valve is open.

Digital Output 24:

- **Pump Parked:** This bit is high when the pump is in the parked position.

Primary DGM Analog Inputs

See Analog Inputs table in the **Primary DGM Pin Assignments** section beginning on page 10 for pin numbers associated with each bit description.

The DGM provides 4 analog inputs and 4 analog outputs. Each analog I/O point has a voltage range of 0-10 VDC. Analog Inputs 2, 3, and 4 are not used.

It is the responsibility of the PLC programmer to verify the HFR system and PLC have matching values for pump sizes, material specific gravities, maximum working pressure, and units of measure for pressure. These are verified using the Setup screens in the ADM.

Analog Input 1: Set Combined Flow Rate or B (Blue) Dispensing Pressure

To calculate the input voltage for the desired flow or pressure, use the following formulas.

Volumetric Flow:

$V = (10 \times F_v) / (A_p + B_p)$

Weight Flow:

$V = (10 \times F_w) / (A_p \times A_{sg} + B_p \times B_{sg})$

Pressure:

$V = (10 \times P_d) / (P_{mwp})$

Where:

- V = Voltage
- A_p = A (Red) pump size in cc
- B_p = B (Blue) pump size in cc
- A_{sg} = A (Red) material specific gravity
- B_{sg} = B (Blue) material specific gravity
- F_v = Desired volumetric flow rate in cc per second
- F_w = Desired flow rate in grams per second
- P_d = Desired pressure
- P_{mwp} = Maximum working pressure

For example, if the A (Red) pump is 120 cc, the B (Blue) pump is 160 cc, and the desired flow rate is 180 cc per second then:

$V = (10 \times 180) / (120 + 160)$
$= 6.43$ volts

If the A (Red) pump is 120 cc, the A (Red) specific gravity is 1.09, the B (Blue) pump is 160 cc, the B (Blue) specific gravity is 1.21, and the desired flow rate is 200 grams per second then:

$V = (10 \times 200) / (120 \times 1.09 + 160 \times 1.21)$
$= 6.17$ volts

If the desired pressure is 1500 psi and the maximum working pressure is 2000 psi then:

$P_d = 1250$
$P_{mwp} = 2000$

$V = (10 \times 1500) / (2000)$
$= 7.5$ volts

To set the flow or pressure:

1. Calculate the voltage to use.
2. Set the Analog Input 1 to the calculated voltage and hold.
3. After 185 mS, pull the corresponding Digital Input 16 bit for 185 mS then release Digital Input 16.
4. Check Digital Output 4 to verify the setpoint request was not rejected.

Primary DGM Analog Outputs

See Analog Outputs table in the **Primary DGM Pin Assignments** section beginning on page 10 for pin numbers associated with each function. Each analog I/O point has a voltage range of 0-10 VDC. The primary DGM analog outputs are used to provide feedback regarding operating pressures and flows.

Analog Output 1: B (Blue) Pump Pressure and Analog Output 2: A (Red) Pump Pressure

An analog voltage representation of the pump pressure will be presented at the respective output. The DGM will use the 0-10V range to represent pressures from 0 to 500 psi plus the maximum working pressure. Due to this limit, pressures beyond 500 psi above the maximum working pressure will be represented as 10V.

To calculate the pump pressure based on the output voltage, the maximum working pressure must be known. See the HFR system manual to determine the system maximum working pressure.

When units of measure are psi:

$$P_a = 0.1 \times V \times (P_{mwp} + 500)$$

When units of measure are bar:

$$P_a = 0.1 \times V \times (P_{mwp} + 34.5)$$

When units of measure are MPa:

$$P_a = 0.1 \times V \times (P_{mwp} + 3.45)$$

where,

V = Voltage

P_a = Actual pump pressure

P_{mwp} = Maximum working pressure

For example, if the output voltage is 6 and the maximum working pressure is 2000 psi then:

$$P_a = 0.1 \times 6 \times (2000 + 500)$$
$$= 1500 \text{ psi}$$

Analog Output 3: B (Blue) Pressure or Combined Flow Rate

To use the Analog Output 3 voltage to calculate the B (Blue) pump pressure or combined flow rate, use the following formulas.

Volumetric Flow:

$$F_v = 0.1 \times V \times (A_p + B_p)$$

Weight Flow:

$$F_w = 0.1 \times V \times (A_p \times A_{sg} + B_p \times B_{sg})$$

Pressure:

When units of measure are psi:

$$P_a = 0.1 \times V \times (P_{mwp} + 500)$$

When units of measure are bar:

$$P_a = 0.1 \times V \times (P_{mwp} + 34.5)$$

When units of measure are MPa:

$$P_a = 0.1 \times V \times (P_{mwp} + 3.45)$$

Where:

F_v = Actual volumetric flow rate in cc per second

F_w = Actual flow rate in grams per second

P_a = Actual B (Blue) pump pressure

V = Voltage

A_p = A (Red) pump size in cc

B_p = B (Blue) pump size in cc

A_{sg} = A (Red) material specific gravity

B_{sg} = B (Blue) material specific gravity

P_{mwp} = Maximum working pressure

For example, if the A (Red) pump is 120 cc, the B (Blue) pump is 160 cc, and the output voltage is 2.3 then:

$$F_v = 0.1 \times 2.3 \times (120 + 160)$$
$$= 64.4 \text{ cc/sec}$$

If the A (Red) pump is 120 cc, the A (Red) specific gravity is 1.09, the B (Blue) pump is 240 cc, the B (Blue) specific gravity is 1.21, and the output voltage is 2.3 then:

$$F_w = 0.1 \times 2.3 \times (120 \times 1.09 + 160 \times 1.21)$$
$$= 74.6 \text{ g/sec}$$

If the output voltage is 6 and the maximum working pressure is 2000 psi then:

$$P_a = 0.1 \times 6 \times (2000 + 500)$$
$$= 1500 \text{ psi}$$

Secondary DGM I/O Overview

The secondary DGM is used for controlling and monitoring the status of the heaters and chillers.

NOTE: The HFR has a total of 8 possible conditioning zones that can be implemented in the system. In any given instance, a maximum of 4 conditioning zones can be enabled.

Each temperature conditioning item is assigned a zone number. Most temperature conditioning bits relate to a zone number rather than to a specific temperature conditioning item's name. Knowing the correct zone number is important for desired machine operation. The zone numbers are always assigned in the order shown in the following table. Going down the list, the first enabled item is zone 1, the second is zone 2, the third is zone 3, and the fourth is zone 4.

NOTE: There will be less than four zones if less than four temperature conditioning items are installed or enabled on the ADM.

Order	Temperature Conditioning Item
1	Tank Heater, A (Red)
2	Tank Heater, B (Blue)
3	Inline Heater, A (Red)
4	Inline Heater, B (Blue)
5	Hose Heater, A (Red)
6	Hose Heater, B (Blue)
7	Chiller, A (Red)
8	Chiller, B (Blue)

The following is an example of a system with Tank Heater A (Red), Inline Heater B (Blue), Hose Heater B (Blue), and Chiller A (Red) enabled and shows the assigned zone numbers for each.

Zone	Order	Temperature Conditioning Item
1	1	Tank Heater, A (Red)
	2	Tank Heater, B (Blue)
	3	Inline Heater, A (Red)
2	4	Inline Heater, B (Blue)
	5	Hose Heater, A (Red)
3	6	Hose Heater, B (Blue)
4	7	Chiller, A (Red)
	8	Chiller, B (Blue)

See the **Secondary DGM Digital Outputs** section beginning on page 22 for information about finding out which temperature conditioning components are enabled.

Secondary DGM Digital Inputs

Digital Inputs 1-4: Toggle Zone Conditioning On/Off Bits

Pulling this input high turns the zone on. Pulling it low turns the zone off. It is also possible to control the zones using the ADM.

Digital Inputs 5-8: Accept Zone Setpoint Change Bits

NOTE: This function is only available on 2nd Generation ADM's.

Toggle one of these bits high to tell the DGM to set the new zone setpoint based on the corresponding analog input voltage. See **Secondary DGM Analog Inputs** on page 23 for voltage calculation and procedure for changing the setpoint.

Secondary DGM Digital Outputs

Digital Output 2: Ready To Dispense

The ADM can be configured to prevent dispensing if the conditioning zones are not the correct temperature. If this feature is enabled, this bit will be low when at least one temperature zone is not up to temperature.

NOTE: This bit gets pulled low during a dispense.

Digital Output 3: Dispense in Progress

This bit is high when a dispense is in progress.

Digital Outputs 4-7: Zone Conditioning On

When one of these bits is high, it indicates that the respective heater/chiller in that zone is on.

Digital Outputs 8-11: Zone Temperature Setpoint Rejected

This bit indicates the requested setpoint has been rejected. This occurs when the requested setpoint is too high or low. This bit should be checked after requesting to change a setpoint to verify that the setpoint was accepted.

NOTE: Changing the setpoint on the ADM does not affect this bit.

Digital Outputs 12-19: Temperature Conditioning Component Enabled

When one of these bits is high, the corresponding temperature conditioning component is enabled.

Secondary DGM Analog Inputs

Set Zone Temperature

The external control device interfacing with the DGM can use a varying voltage to specify the desired set-point for the zone. See **Secondary DGM Pin Assignments** on page 12.

To calculate the voltage to use based on the desired temperature in degrees Fahrenheit:

Voltage = 0.074 x °F - 4.074

For example, the voltage for 86°F would be:

Voltage = 0.074 x 86 - 4.074

= 2.29

To calculate the voltage to use based on the desired temperature in degrees Celsius:

Voltage = 0.133 x °C - 1.707

For example, the voltage for 30°C would be:

Voltage = 0.133 x 30 - 1.707

= 2.28

To set the zone temperature:

1. Calculate the voltage to use.
2. Set the desired “Set Zone Temperature” Analog Input to the calculated voltage and hold.
3. After 185 mS, pull high the corresponding “Accept Zone Setpoint Change” Digital Input for 185 mS then release.
4. Check the Zone Temperature Setpoint Rejected bit. If it is asserted, check the ADM.

Secondary DGM Analog Outputs

Actual Zone Temperature

The analog output voltages indicate the actual temperature of the material at the specified zone.

To calculate the temperature in degrees Fahrenheit based on the output voltage:

°F = 13.5 x Voltage + 55

For example, if the output voltage is 2.3 then:

°F = 13.5 x 2.3 +55

= 86°F

To calculate the temperature in degrees Celsius based on the output voltage:

°C = 7.5 x Voltage + 12.8

For example, if the output voltage is 2.3 then:

°C = 7.5 x 2.3 +12.8

= 30°C

Timing Diagrams

Once the last line has been set in any of the following timing diagrams, a 10 mS settle time should be observed to allow the PLC and DGM hardware to reach a steady state.

Heartbeat

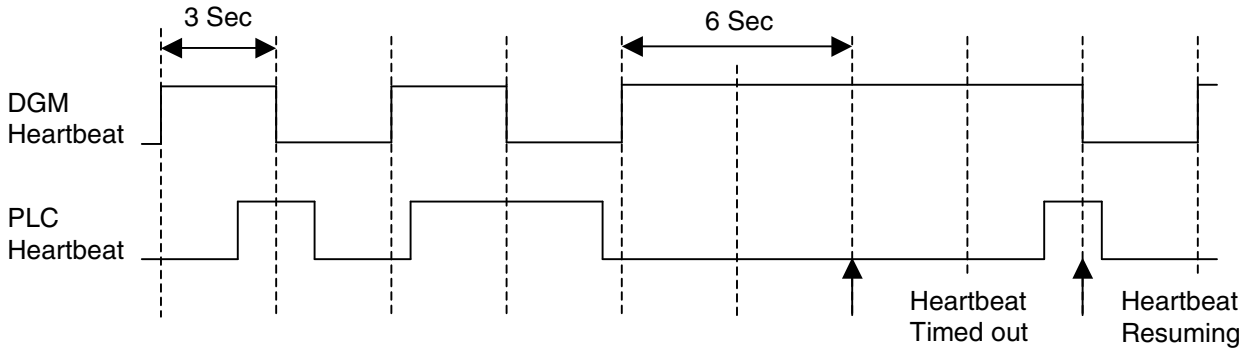


FIG. 8: Heartbeat Timing Diagram

Activate System Stop Button

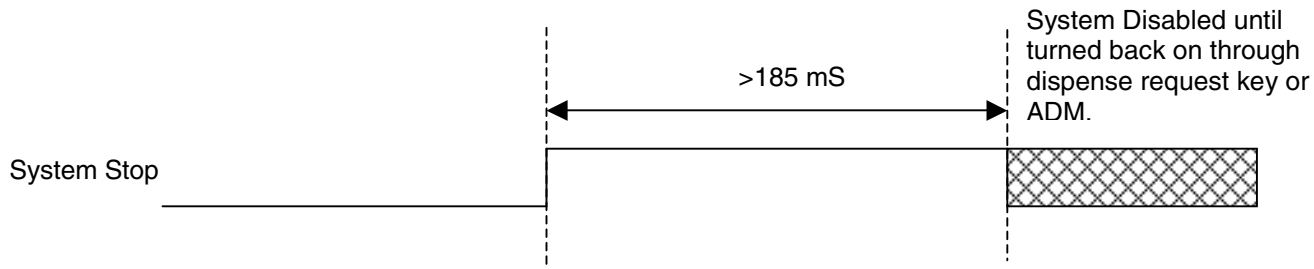


FIG. 9: Activate System Stop Button Timing Diagram

System Requests

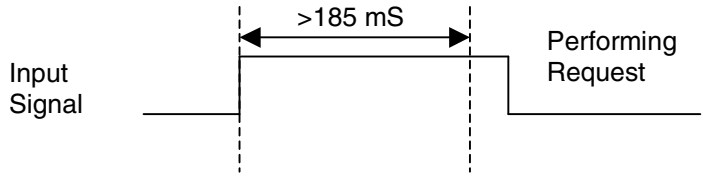


FIG. 10: System Requests Timing Diagram

The following are system requests:

- Enabling the ADM
- Acknowledging Errors
- Parking the pump

Select an Operating Mode or Shot Number

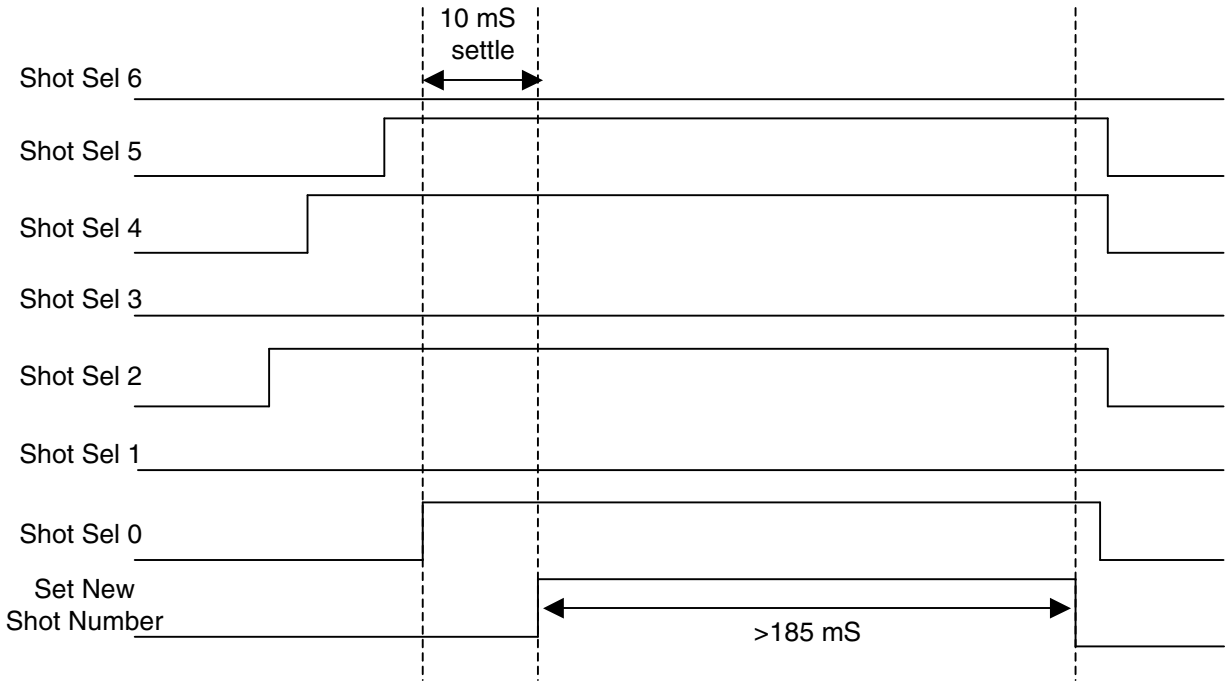


FIG. 11: Select a Shot Number Timing Diagram

The individual lines can change independently in any order.

Change Setpoint

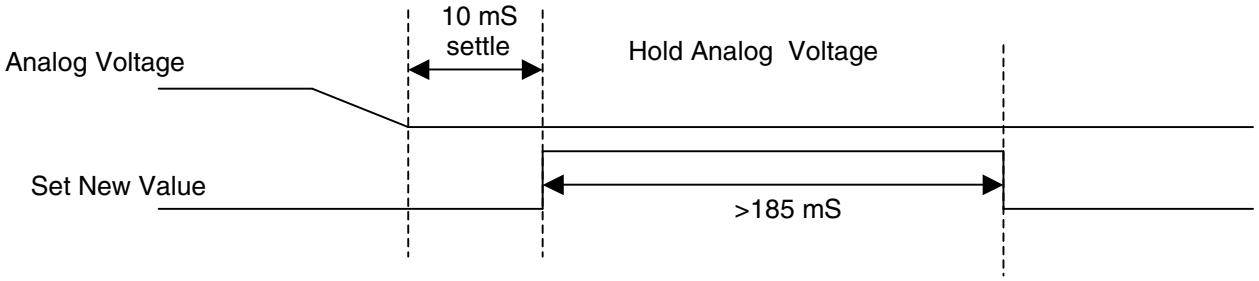


FIG. 12: Change Setpoint Timing Diagram

This procedure applies to the following functions:

- Changing the dispense pressure setpoint
- Changing the material temperature setpoint

Toggle On/Off

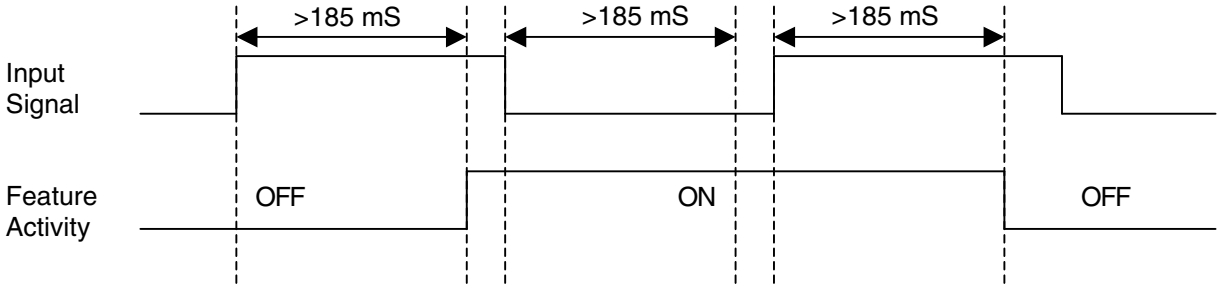


FIG. 13: Toggle On/Off Timing Diagram

This diagram applies to the following functions:

- Open/Close the Dispense Valve
- Lock/Unlock the Dispense Valve
- Activate/Deactivate the Hydraulic Power Pack

Operator Mode Dispense

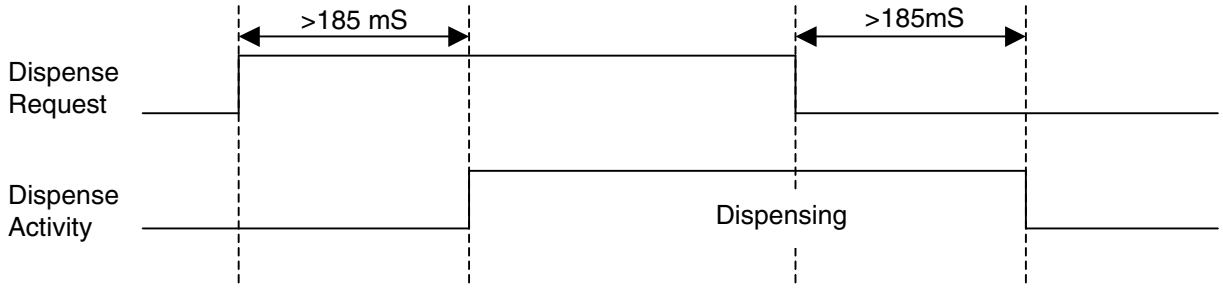


FIG. 14: Operator Mode Dispense Timing Diagram

Maintenance

Install Upgrade Token

Note: The DGM connection to the system is temporarily disabled during the installation of the upgrade token.

To install software upgrades:

1. Use correct software token stated in the table. See Graco Control Architecture™ Module Programming manual for instructions.

NOTE: Upgrade all modules in the system to the software version on the token, even if you are replacing only one or two modules. Different software versions may not be compatible.

All data in the module (System Settings, USB Logs, Recipes, Maintenance Counters) may be reset to factory default settings. Download all settings and user preferences to a USB before the upgrade, for ease of restoring them following the upgrade.

See manuals for locations of specific GCA components.

The software version history for each system can be viewed in the technical support section at www.graco.com.

Token	Application
16H821	**HFR**: - Advanced Display Module - Motor Control Module - High Power Temperature Control Module - Fluid Control Module (AC Power Pack) - Discrete Gateway Module - Communication Gateway Module

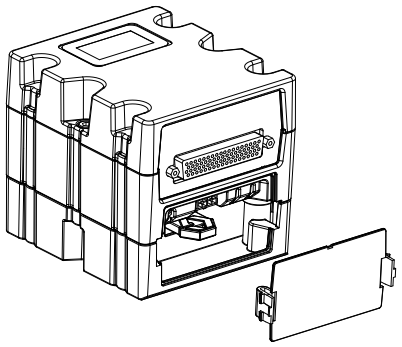


FIG. 15

Check Cable Connections

Ensure all cables are securely connected to DGM connectors.

Troubleshooting

Diagnostic Information

Module Status LED Signal	Diagnosis
Green on	System is powered up
Yellow	Internal communication in progress
Red solid	DGM hardware failure, replace DGM
Red flashing fast	Uploading software
Red flashing slow	Token error, remove token then re-install software token

Fault Code Bit Pattern Table

This is an 8-bit pattern indicating the current error number in the system. The bit pattern is accompanied by the Error Present bit.

If the PLC displays error messages, the PLC programmer should translate the bit pattern to the corresponding descriptive string. See the following table to translate the fault code bit pattern to a descriptive string. The Error Number column is used for reference to aid the PLC programmer in translating from fault code bit pattern to error string.

The table below displays the possible error number outputs from the DGM module and the corresponding error conditions displayed on the ADM. The table does not contain any errors pertaining to possible Chiller heat zones. If the corresponding system contains one or two of these types of conditioning zones, the error generated will be visible on the ADM screen only and can be acknowledged from the ADM screen or the DGM.

NOTE: This manual is available at Graco.com. To prevent having to manually re-type these error codes and strings into your PLC program, go to Graco.com and retrieve the electronic version of this manual then copy the following table from the PDF.

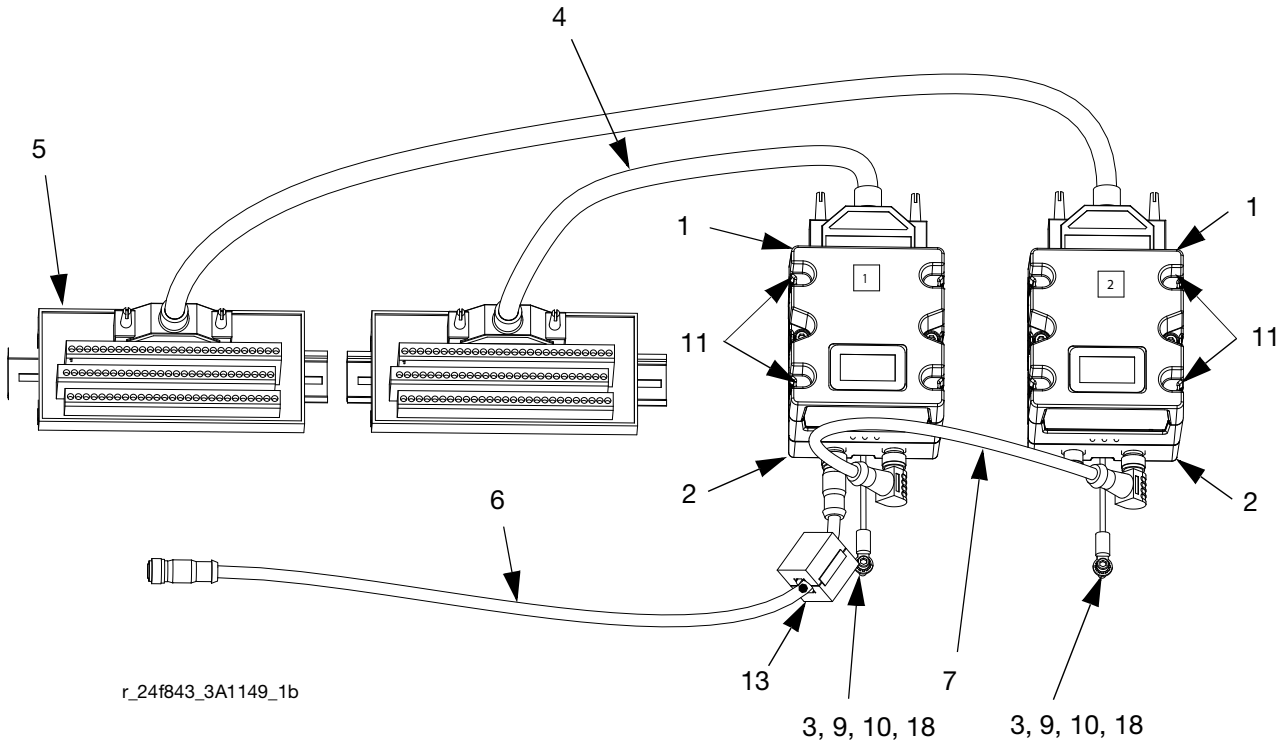
Fault Code Bit Pattern (Bit 7 --> Bit 0)	Error String	Error Number	Error Type	Error Code on the ADM
0	No Active Errors	0		
1	Blue Motor Temp. Shutdown	1	A	T4N1
10	Blue Motor Temp. Cutback	2	V	T3N1
11	Blue MCM Oil Temp. Shutdown	3	A	T4H1
100	Blue MCM Low Oil Level	4	A	MBH1
101	Blue Motor Over Current	5	A	A4H1
110	Blue Motor Over Current	6	A	A4N1
111	Blue Motor Over Current	7	A	A4M1
1000	Blue Motor Over Current	8	A	A9C1
1001	Blue MCM High Temp.	9	A	T4C1
1010	Blue MCM Overvoltage	10	A	V4H0
1011	Blue MCM Undervoltage	11	A	V1H1
1100	Blue Motor Encoder Fault	12	A	WBH1
1101	Blue Motor Controller Fault	13	D	WMH1
1110	Blue Motor Low Performance	14	V	MBN1
1111	Blue Motor High Speed	15	A	WKH1
10000	Blue Pump Failed to Move	16	D	N4A1
10001	Invalid Setpoint Request	17	D	WSC0
10010	Small Shot Request	18	D	B9C0
10011	Pressure Imbalance	19	A	P4D0
10100	Pumps Not Defined	20	A	DSC0
10101	Invalid Learn Mode Data Blue	21	D	D5A1
10110	Blue Position Sensor Fault	22	A	D6A1
10111	Red Pressure Sensor Fault	23	A	P6A1
11000	Blue Pressure Sensor Fault	24	A	P6B2
11001	Blue Setpoint Not Reached	25	D	D1A1
11010	Blue Setpoint Exceeded	26	D	D4A1
11011	Red Pressure Shutdown	27	A	P4A1
11100	Blue Pressure Shutdown	28	A	P4B2
11101	Red Pump Not Parked	29	D	DFB2
11110	Blue Pump Failed to Stall	30	D	F7D1
11111	Invalid Gel Timer Definition	31	D	WSD0
100000	Red Pump Cavitation	32	D	DDA1
100001	Blue Pump Cavitation	33	D	DDB2
100010	M1 Material Extend Fault	34	D	WDF1
100011	M1 Material Extend Fault	35	A	WDF1
100100	Red Blanket Temp. Cutoff	36	A	T9A6
100101	Blue Blanket Temp. Cutoff	37	A	T9B5
100110	Red Inline Temp. Cutoff Temp.	38	A	T9A3
100111	Blue Inline Temp. Cutoff	39	A	T9B1
101000	No Red Blanket Current	40	A	A8A6
101001	No Blue Blanket Current	41	A	A8B5
101010	No Red Inline Current	42	A	A8A3

Fault Code Bit Pattern (Bit 7 --> Bit 0)	Error String	Error Number	Error Type	Error Code on the ADM
101011	No Blue Inline Current	43	A	A8B1
101100	No Red Hose Current	44	A	A8A2
101101	No Blue Hose Current	45	A	A8B4
101110	Red Blanket Overcurrent	46	A	A4A6
101111	Blue Blanket Overcurrent	47	A	A4B5
110000	Red Inline Overcurrent	48	A	A4A3
110001	Blue Inline Overcurrent	49	A	A4B1
110010	Red Hose Overcurrent	50	A	A4A2
110011	Blue Hose Overcurrent	51	A	A4B4
110100	Red Blanket Control Fault	52	A	A7A6
110101	Blue Blanket Control Fault	53	A	A7B5
110110	Red Inline Control Fault	54	A	A7A3
110111	Blue Inline Control Fault	55	A	A7B1
111000	Red Hose Control Fault	56	A	A7A2
111001	Blue Hose Control Fault	57	A	A7B4
111010	Red Blanket Overvoltage	58	A	V4A6
111011	Blue Blanket Overvoltage	59	A	V4B5
111100	Red Inline Overvoltage	60	A	V4A3
111101	Blue Inline Overvoltage	61	A	V4B1
111110	Red Hose Overvoltage	62	A	V4A2
111111	Blue Hose Overvoltage	63	A	V4B4
1000000	Red Blanket Undervoltage	64	A	V4A6
1000001	Blue Blanket Undervoltage	65	A	V4B5
1000010	Red Inline Undervoltage Volt	66	A	V4A3
1000011	Blue Inline Undervoltage Volt	67	A	V4B1
1000100	Red Hose Undervoltage	68	A	V4A2
1000101	Blue Hose Undervoltage	69	A	V4B4
1000110	Red Blanket Ctrl Shutdown	70	A	T9C6
1000111	Blue Blanket Ctrl Shutdown	71	A	T9C5
1001000	Red Inline Ctrl Shutdown	72	A	T9C3
1001001	Blue Inline Ctrl Shutdown	73	A	T9C1
1001010	Red Hose Ctrl Shutdown	74	A	T9C2
1001011	Blue Hose Ctrl Shutdown	75	A	T9C4
1001100	Red Tank Con. Cutback	76	V	WMC6
1001101	Blue Tank Con. Cutback	77	V	WMC5
1001110	Red Inline Con. Cutback	78	V	WMC3
1001111	Blue Inline Con. Cutback	79	V	WMC1
1010000	Red Hose Con. Cutback	80	V	WMC2
1010001	Blue Hose Con. Cutback	81	V	WMC4
1010010	Red Tank High Fluid Temp.	82	A	T4A6
1010011	Blue Tank High Fluid Temp.	83	A	T4B5
1010100	Red Inline High Fluid Temp.	84	A	T4A3
1010101	Blue Inline High Fluid Temp.	85	A	T4B1
1010110	Red Hose High Fluid Temp.	86	A	T4A2
1010111	Blue Hose High Fluid Temp.	87	A	T4B4
1011000	Red Blanket High Temp.	88	A	WMA6
1011001	Blue Blanket High Temp.	89	A	WMB5
1011010	Red Tank Low Fluid Temp.	90	D	T1A6
1011011	Blue Tank Low Fluid Temp.	91	D	T1B5
1011100	Red Inline Low Fluid Temp	92	D	T1A3
1011101	Blue Inline Low Fluid Temp	93	D	T1B1
1011110	Red Hose Low Fluid Temp.	94	D	T1A2
1011111	Blue Hose Low Fluid Temp.	95	D	T1B4
1100000	Red Tank High Fluid Temp.	96	D	T3AE
1100001	Blue Tank High Fluid Temp.	97	D	T3BD
1100010	Red Hose High Fluid Temp.	98	D	T3AA
1100011	Blue Hose High Fluid Temp.	99	D	T3BC

Fault Code Bit Pattern (Bit 7 --> Bit 0)	Error String	Error Number	Error Type	Error Code on the ADM
1100100	Red Tank Low Fluid Temp.	100	D	T2AE
1100101	Blue Tank Low Fluid Temp.	101	D	T2BD
1100110	Red Hose Low Fluid Temp.	102	D	T2AA
1100111	Blue Hose Low Fluid Temp.	103	D	T2BC
1101000	Dispensing Disabled: High Temp.	104	V	T30X
1101001	Dispensing Disabled: Low Temp.	105	V	T20X
1101010	No Heat Red Tank	106	D	T8A6
1101011	No Heat Blue Tank	107	D	T8B5
1101100	No Heat Red Inline	108	D	T8A3
1101101	No Heat Blue Inline	109	D	T8B1
1101110	No Heat Red Hose	110	D	T8A2
1101111	No Heat Blue Hose	111	D	T8B4
1110000	Red Tank RTD Fault	112	A	T6A6
1110001	Blue Tank RTD Fault	113	A	T6B5
1110010	Red Inline RTD Fault	114	A	T6A3
1110011	Blue Inline RTD Fault	115	A	T6B1
1110100	Red Hose FTS Fault	116	A	T6A2
1110101	Blue Hose FTS Fault	117	A	T6B4
1110110	Red Blanket RTD Fault	118	A	T6C6
1110111	Blue Blanket RTD Fault	119	A	T6C5
1111000	Red Tank Con. Fault	120	A	WM06
1111001	Blue Tank Con. Fault	121	A	WM05
1111010	Red Inline Con. Fault	122	A	WM03
1111011	Blue Inline Con. Fault	123	A	WM01
1111100	Red Hose Con. Fault	124	A	WM02
1111101	Blue Hose Con. Fault	125	A	WM04
1111110	Red Tank Con. Fault	126	A	WMC6
1111111	Blue Tank Con. Fault	127	A	WMC5
10000000	Red Inline Con. Fault	128	A	WMC3
10000001	Blue Inline Con. Fault	129	A	WMC1
10000010	Red Hose Con. Fault	130	A	WMC2
10000011	Blue Hose Con. Fault	131	A	WMC4
10000100	High Accumulator Pressure	132	A	P4H3
10000101	Low Accumulator Pressure	133	A	P1H3
10000110	High Mix Head Oil Temp.	134	A	T4H3
10000111	Low Mix Head Oil Level	135	A	MBH3
10001000	Soft Stop Asserted	136	A	DEH3
10001001	Mix Head Motor Overload	137	A	A4H3
10001010	M1 Material Extend Fault	138	A	WDF3
10001011	M1 Cleanout Extend Fault	139	A	WDD3
10001100	M2 Material Extend Fault	140	A	WDF4
10001101	M2 Cleanout Retract Fault	141	A	WDD4
10001110	Red Low Material Level	142	D	L111
10001111	Blue Low Material Level	143	D	L122
10010000	Red High Material Level	144	D	L311
10010001	Blue High Material Level	145	D	L322
10010010	Red Auto Refill Timeout	146	D	L6A1
10010011	Blue Auto Refill Timeout	147	D	L6B2
10010100	Red Fill Sensor Fault	148	D	L8A1
10010101	Blue Fill Sensor Fault	149	D	L8B2
10010110	USB: Logs Full	150	V	MMUX
10010111	High Ratio	151	A	R4D0
10011000	High Ratio	152	D	R3D0
10011001	Low Ratio	153	A	R1D0
10011010	Low Ratio	154	D	R2D0

Fault Code Bit Pattern (Bit 7 --> Bit 0)	Error String	Error Number	Error Type	Error Code on the ADM
10011011	Comm. Error Blue MCM	155	A	CAC2
10011100	Comm. Error Red Tank	156	A	CAC3
10011101	Comm. Error Blue Tank	157	A	CAC4
10011110	Comm. Error Mix Head	158	A	CAC5
10011111	Comm. Error Ratio Monitor	159	A	CAC7
10100000	Comm. Error Red Blanket	160	A	CAA6
10100001	Comm. Error Blue Blanket	161	A	CAB5
10100010	Comm. Error Red Inline	162	A	CAA3
10100011	Comm. Error Blue Inline	163	A	CAB1
10100100	Comm. Error Red Hose	164	A	CAA2
10100101	Comm. Error Blue Hose	165	A	CAB4
10100110	Comm. Error Field Bus	166	A	CACN
10100111	Field Bus Heartbeat Failure	167	A	CUCN
10101000	Comm. Error Discrete I/O	168	A	CACP
10101001	USB Update Failed	169	A	W0U0
10101010	Check Flowmeter Blue	170	D	DR6B
10101011	Check Flowmeter Red	171	D	DR6A
10101100	Tank Stand Software Error	172	A	CVR0
10101101	Red Tank Leak Detected	173	A	L9AX
10101110	Blue Tank Leak Detected	174	A	L9BX
10101111	Prepoly Refresh Time Expired	175	A	L9A0
10110000	High Recirculation Pressure	176	D	P3RX
10110001	Heater(s) are OFF	177	V	T8CX
10110010	Comm. Error Sm. Dispense	178	A	CAC9
10110011	Questionable Shot Recipe Detected	179	V	WMCX
10110100	Mixer Motor Fault	180	D	WBD1
10110101	Comm. Error Mixer	181	A	CAD1
10110110	Accumulator Charges Too Frequently	182	V	P9H1
10110111	Power pack pressure Sensor Fault	183	A	P6H1
10111000	Dispense Valve Open Problem	184	D	WDF3

Parts



Ref	Part	Description	Quantity		
			24F843, Single DGM Kit	24F844, Dual DGM Kit	24G830, DGM only
1	24B681	MODULE, GCA, cube, DGM	1	2	1
2	289697	MODULE, cube, GCA, base	1	2	1
3	24C476	HARNESS, wire, ground, term, 4 in.	1	2	1
4	124638	CABLE, 78 pin, 2.5 ft, D-sub, male to female	1	2	
5	123783	BOARD, DGM, 78 pin break out	1	2	
6	121003	CABLE, CAN, female / female 3.0m	1	1	
7	123762	CABLE, CAN, 90 x 90, female / female, 0.5m		1	
9	114993	SCREW, mach, pan wash head	1	2	1
10	102063	WASHER, lock, ext	1	2	1
11	113003	SCREW, socket head cap, #10-32 x 0.62, stainless steel	5	10	5
12	277674	ENCLOSURE, cube door	1	2	1
13†	121901	SUPPRESSOR, box snap, ferrite	1	1	
17*	16H821	TOKEN, upgrade, software	*	*	*
18	100020	WASHER, lock	1	2	1

* *These kits ship with software loaded. Upgrade token 16H821 is listed for reference only.*

† *The DGM must have a ferrite suppressor attached to the DGM end of the long CAN cable.*

Accessories

Part	Description
124415	CAN Cable Extension, 9.8 ft (3.0 m)
24E898	CAN Cable Extension, 27.9 ft (8.5 m)
24E897	CAN Cable Extension, 52.5 ft (16.0 m)
24K461*	CAN Splitter, 1 male to 2 female
123792	78 pin d-sub cable; 50 ft (15.2 m), male to female
LC0032	Cable, assembly (MCM to start dispense signal)

* *Conditions Requiring a Splitter:*
- *ADM on the system is not part #289701*
- *There are no tank stands or heat zones installed.*

Technical Data

Power Requirements	9-30 VDC NEC Class 2
Weight	14 oz. (0.4 kg)
Dimensions	4.3 x 3.8 x 3.8 in. (109 x 97 x 97 mm)

Graco Standard Warranty

Graco warrants all equipment referenced in this document which is manufactured by Graco and bearing its name to be free from defects in material and workmanship on the date of sale to the original purchaser for use. With the exception of any special, extended, or limited warranty published by Graco, Graco will, for a period of twelve months from the date of sale, repair or replace any part of the equipment determined by Graco to be defective. This warranty applies only when the equipment is installed, operated and maintained in accordance with Graco's written recommendations.

This warranty does not cover, and Graco shall not be liable for general wear and tear, or any malfunction, damage or wear caused by faulty installation, misapplication, abrasion, corrosion, inadequate or improper maintenance, negligence, accident, tampering, or substitution of non-Graco component parts. Nor shall Graco be liable for malfunction, damage or wear caused by the incompatibility of Graco equipment with structures, accessories, equipment or materials not supplied by Graco, or the improper design, manufacture, installation, operation or maintenance of structures, accessories, equipment or materials not supplied by Graco.

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All written and visual data contained in this document reflects the latest product information available at the time of publication.
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Original instructions. *This manual contains English. MM 3A1149*

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