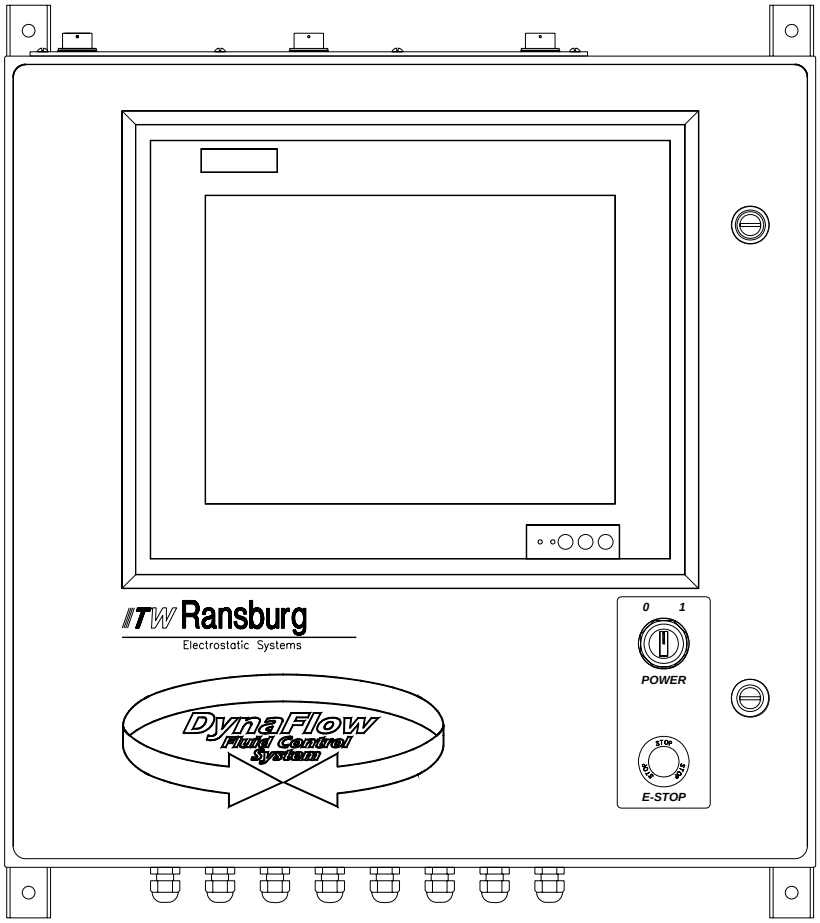
ITW Ransburg

SERVICE MANUAL
LN-9400-00.7
(Replaced LN-9400-00.6)
October - 2008

DYNAFLOW™ USER MANUAL



MODEL: 77376 and A12233

IMPORTANT: Before using this equipment, carefully read SAFETY PRECAUTIONS, starting on page 1, and all instructions in this manual. Keep this Service Manual for future reference.

Service Manual Price: €40.00 (Euro)
$50.00 (U.S.)

NOTE: This manual has been changed from revision **LN-9400-00.6** to revision **LN-9400-00.7** Reasons for this change are noted under “Manual Change Summary” inside the back cover of this manual.

CONTENTS

CONTENTS (Cont.)

SAFETY

SAFETY PRECAUTIONS

Before operating, maintaining or servicing any ITW Ransburg electrostatic coating system, read and understand all of the technical and safety literature for your ITW Ransburg products. This manual contains information that is important for you to know and understand. This information relates to USER SAFETY and PREVENTING EQUIPMENT PROBLEMS. To help you recognize this information, we use the following symbols. Please pay particular attention to these sections.

A WARNING! states information to alert you to a situation that might cause serious injury if instructions are not followed.

A CAUTION! states information that tells how to prevent damage to equipment or how to avoid a situation that might cause minor injury.

A NOTE is information relevant to the procedure in progress.

While this manual lists standard specifications and service procedures, some minor deviations may be found between this literature and your equipment. Differences in local codes and plant requirements, material delivery requirements, etc., make such variations inevitable. Compare this manual with your system installation drawings and appropriate ITW Ransburg equipment manuals to reconcile such differences.

Careful study and continued use of this manual will provide a better understanding of the equipment and process, resulting in more efficient operation, longer trouble-free service and faster, easier troubleshooting. If you do not have the manuals and safety literature for your Ransburg system, contact your local ITW Ransburg representative or ITW Ransburg.

⚠ WARNING

➤ The user **MUST** read and be familiar with the Safety Section in this manual and the ITW Ransburg safety literature therein identified.

➤ This manual **MUST** be read and thoroughly understood by **ALL** personnel who operate, clean or maintain this equipment! Special care should be taken to ensure that the **WARNINGS** and safety requirements for operating and servicing the equipment are followed. The user should be aware of and adhere to **ALL** local building and fire codes and ordinances as well as **NFPA-33 SAFETY STANDARD, LATEST EDITION,** prior to installing, operating, and/or servicing this equipment.

⚠ WARNING

➤ The hazards shown on the following page may occur during the normal use of this equipment. Please read the hazard chart beginning on page 2.

AREA Tells where hazards may occur.	**HAZARD** Tells what the hazard is.	**SAFEGUARDS** Tells how to avoid the hazard.
Spray Area 	Fire Hazard Improper or inadequate opera-tion and maintenance procedures will cause a fire hazard. Protection against inadvertent arcing that is capable of causing fire or explosion is lost if any safety interlocks are disabled during operation. Frequent power supply shutdown indicates a problem in the system requiring correction.	Fire extinguishing equipment must be present in the spray area and tested periodically. Spray areas must be kept clean to prevent the accumulation of combustible residues. Smoking must never be allowed in the spray area. The high voltage supplied to the atomizer must be turned off prior to cleaning, flushing or maintenance. When using solvents for cleaning: Those used for equipment flushing should have flash points equal to or higher than those of the coating material. Those used for general cleaning must have flash points above 100°F (37.8°C). Spray booth ventilation must be kept at the rates required by NFPA-33, OSHA, and local codes. In addition, ventilation must be maintained during cleaning operations using flammable or combustible solvents. Electrostatic arcing must be prevented. Test only in areas free of combustible material. Testing may require high voltage to be on, but only as instructed. Non-factory replacement parts or unauthorized equipment modifications may cause fire or injury. If used, the key switch bypass is intended for use only during setup operations. Production should never be done with safety interlocks disabled. Never use equipment intended for use in waterborne installations to spray solvent based materials. The paint process and equipment should be set up and operated in accordance with NFPA-33, NEC, and OSHA requirements.

AREA Tells where hazards may occur.	**HAZARD** Tells what the hazard is.	**SAFEGUARDS** Tells how to avoid the hazard.
General Use and Maintenance 	Improper operation or maintenance may create a hazard. Personnel must be properly trained in the use of this equipment.	Personnel must be given training in accordance with the requirements of NFPA-33. Instructions and safety precautions must be read and understood prior to using this equipment. Comply with appropriate local, state, and national codes governing ventilation, fire protection, operation maintenance, and housekeeping. Reference OSHA, NFPA-33, and your insurance company requirements.
Electrical Equipment 	High voltage equipment is utilized. Arcing in areas of flammable or combustible materials may occur. Personnel are exposed to high voltage during operation and maintenance. Protection against inadvertent arcing that may cause a fire or explosion is lost if safety circuits are disabled during operation. Frequent power supply shut-down indicates a problem in the system which requires correction. An electrical arc can ignite coating materials and cause a fire or explosion.	The power supply, optional remote control cabinet, and all other electrical equipment must be located outside Class I or II, Division 1 and 2 hazardous areas refer to NFPA-33. Turn the power supply OFF before working on the equipment. Test only in areas free of flammable or combustible material. Testing may require high voltage to be on, but only as instructed. Production should never be done with the safety circuits disabled. Before turning the high voltage on, make sure no objects are within the sparking distance.
Explosion Hazard/ Incompatible Materials 	Halogenated hydrocarbon solvents for example: methylene chloride and 1,1,1,-Trichloroethane are not chemically compatible with the aluminum that might be used in many system components. The chemical reaction caused by these solvents reacting with aluminum can become violent and lead to an equipment explosion.	Aluminum is widely used in other spray application equipment - such as material pumps, regulators, triggering valves, etc. Halogenated hydrocarbon solvents must never be used with aluminum equipment during spraying, flushing, or cleaning. Read the label or data sheet for the material you intend to spray. If in doubt as to whether or not a coating or cleaning material is compatible, contact your material supplier. Any other type of solvent may be used with aluminum equipment.

AREA Tells where hazards may occur.	**HAZARD** Tells what the hazard is.	**SAFEGUARDS** Tells how to avoid the hazard.
Toxic Substances 	Certain material may be harmful if inhaled, or if there is contact with the skin.	Follow the requirements of the Material Safety Data Sheet supplied by coating material manufacturer. Adequate exhaust must be provided to keep the air free of accumulations of toxic materials. Use a mask or respirator whenever there is a chance of inhaling sprayed materials. The mask must be compatible with the material being sprayed and its concentration. Equipment must be as prescribed by an industrial hygienist or safety expert, and be NIOSH approved.

NOTES

INTRODUCTION

FEATURES

- Configurable operating parameters (JOBs) which can be saved and recalled on demand.
- Graphic diagnostics for troubleshooting and for achieving maximum system performance.
- Comprehensive help information easily viewed on the OPERATOR INTERFACE.
- Configurable manual and/or automatic GUN applications.
- Dynamic analog fluid control – the control of flow rate while running a JOB.
- Reverse fluid flow detection provides added protection for system components.

NOTE

➤ This feature requires flow meters that provide reverse flow output.

- Pot-life timer alarms.
- Local and remote monitoring and control.
- Discrete PLC interface capability for remote control.
- Remote I/O (RIO) communications link for direct connection to Allen-Bradley PLCs.
- Process and configuration error and fault detection and reporting.
- USB memory stick, CD-ROM, and floppy disk backup of configuration and operational data.
- Versatile system integration.
- Easy to use.
- Help text and troubleshooting guide available on screens.

DESCRIPTION

The ability to control the delivery of material greatly increases the overall efficiency of the spray operating system and results directly in more uniform and consistent paint finish quality and reduces the amount of material waste. The ability of the fluid flow controller to respond with quick, concise, and repeatable control maximizes finish quality and minimizes material waste.

The ***DynaFlow™ Flow Controller*** design utilizes a form of **distributed processing** similar to many of the industrial network architectures available today. The entire task of fluid flow control is broken up into parts. Each portion of the system is designed for a specific purpose. Since each element of the system is performing specialized functions, and all elements are operating at the same time, overall performance of the system is enhanced. Functionality of the control system components is as follows:

Channel Module

The Channel Module represents the core of the system. Each Channel Module is responsible for:

- Monitoring the CHANNEL specific inputs and supplying the necessary CHANNEL specific outputs for control and status.
- Receiving and processing the flow meter feedback pulses.
- Determining the analog PID output control signal by performing high-speed floating-point math.
- Receiving and interpreting commands from the Interface Module through high speed ITW CAN Bus communication.
- Supplying data and status upon request to and from the Interface Module.

Located on the front panel of the Channel Module are several status indicator lights (LEDs). These are:

1. CPU - Is ON when the microprocessor is operating normally.

2. ACTIVE - Is ON when communication is taking place to the Interface Module.

3. FAULT - Is ON when there is a problem with the module.

Interface Module

The Interface Module performs the following:

- Stores system configuration and data tables.
- Acts as an interpreter for communication with an external Host computer, PLC and/or the local Operator Interface. Communicates through a high speed ITW CAN Bus data link to each Channel Module.
- Responsible for system specific inputs and supplying the necessary system specific outputs for control and status.

Located on the front panel of the Interface Module are several status indicator lights (LEDs). These are:

1. CPU - Is ON when the microprocessor is operating normally.

2. ACTIVE - Is ON when RIO communication is taking place to an Allen-Bradley PLC.

3. FAULT - Is ON when there is a problem with the module.

Local Operator Interface

Supplied as part of the DynaFlow Stand-Alone Control Cabinet, Model# 77376 and A12233.

- Permits total control of the system.
- Displays system configuration and data to the operator.
- Computes and displays text and graphic diagnostic information.
- Organizes, formats, and reports all data and configuration tables.

The DynaFlow fluid flow control system achieves real-time closed loop control through the use of CHANNELs and GUNs. A CHANNEL consists of an electrical-to-pneumatic (E/P) transducer, material regulator and fluid flow meter combination through which a single material is controlled. A GUN represents a single applicator through which one or more materials are delivered. One or more CHANNELs are configured for each GUN. Two-component delivery systems (referred to as 2K systems) have two CHANNELs assigned to a single GUN. The materials are statically mixed before being delivered to the GUN.

Each CHANNEL operates independently of, and simultaneously with all the other CHANNELs. This lets the DynaFlow controller provide accurate dynamic regulation for each CHANNEL, regardless of minor system wear or changes in system variables. With a single-component coating material, the DynaFlow controller detects changes from the programmed flow rate and adjusts the output to correct it. With two-component coatings (where both the resin and catalyst are regulated and monitored), the DynaFlow controller detects any change in the total flow and makes the required adjustments to maintain the programmed flow and ratio. This holds the flow rates of the coating components constant. Deviations from the desired mix ratio are also immediately corrected using this same closed loop process.

A detailed guide on PID control is supplied in this manual to assist you should you want to adjust the control parameters. There are many additional features included in the DynaFlow Fluid Flow Control which reflect on the many years of experience accumulated by ITW Ransburg.

The control rack and OPERATOR INTERFACE panels are consistent with and easily integrated with other ITW Ransburg control products into larger custom system control panels. This optimizes costs, space and functionality for control of multiple applicator spray stations. Spray stations

may also incorporate rotary atomizer speed control, shaping air, high voltage power supplies and more.

The standard stand-alone control cabinet includes control of up to 8 CHANNELs. It incorporates an integrated 10" color LCD, PC based display/ interface sub-panel.

Configurable Operating Parameters

The design of the DynaFlow system allows it to be configured to meet the specific requirements of each application. Any of the 8 available CHANNELs can be linked together, using 1 of 8 GUNs, to control the flow and mixing regulation of two-component materials. The installed channels can be configured to suit the application. If you are using single-component coatings, the DynaFlow controller can support 8 separate single CHANNEL GUNs operating simultaneously. If you are using two-component materials, then 4 separate 2-CHANNEL GUNs operating simultaneously can be supported. For example, you can use 4 CHANNELs assigned to 2 GUNs to spray 2 dual component paints on automatic machines, and 2 CHANNELs assigned to 1 GUN to spray one dual component paint with a manual hand spray GUN.

In addition to the above, a GUN configured for two-component operation can be dynamically changed to operate in a single-component mode by simply setting the ratio JOB parameter to 100. This allows a GUN to operate in either dual or single-component modes by simply changing JOB numbers.

The controlling parameters for each GUN and the CHANNEL(S) assigned to that GUN, are called JOBs. The JOB values define flow characteristics such as Target Flow Rate, Mix Ratio, Flow Tolerance, etc. JOBs include all of the parameters that may be dependent on the material used. This offers the ability to optimize system control as needed per material and then recall the settings each time that material is requested. There are up to 100 JOB #s for each GUN. By saving frequently used JOB #s to memory you can later recall them by loading the number representing that JOB #. All of the JOB #s can be backed-up to, and restored from a 3.5" diskette drive. Reference the "Operator Interface Users Manual" and "Programmers Manual" for details on data transfer operation and available formats.

The flow control unit includes one Interface Module and up to 8 hardware PID control CHANNELs, 2 CHANNELs located on each of the 4 possible Channel Modules. The Interface Module will communicate to a host controller. The host is one of the following:

- PLC using discrete I/O
- PLC using a RS-232C communication port
- Allen-Bradley PLC using RIO
- Local Operator Interface using an RS-232C communication port

3-K Operation

DynaFlow was designed for either single or two-component operation. Three-component operation is possible by configuring two, two-component, guns. The first Gun is set up as follows:

Gun 1 =
  Master Channel =
    Material = Resin
    Flow Controller = Color Change Value (CCV)
    Flow Meter = RF1

  Slave Channel =
    Material = 2nd Component
    Flow Controller = MVR, with appropriate size needle
    Flow Meter = Piston or RF1, depending on min/max flow rates (see Notes 4 and 5)
    Operating Mode = Manual

The output of the first Gun is then fed into the Master Channel input of the second Gun. The second Gun is setup as follows:

Gun 2 =
- Master Channel =
  - Material = Output of Gun 1 (Resin + 2nd Component)
  - Flow Controller = Color Change Value (CCV) (see Notes 1, 2, and 3)
  - Flow Meter = RF1
- Slave Channel =
  - Material = 3rd Component
  - Flow Controller = MVR, with appropriate size needle
  - Flow Meter = Piston or RF1, depending on min/max flow rates (see Notes 4 and 5)
  - Operating Mode = Manual or Auto (see Notes 1, 2, and 3)

NOTES:

1. If the output of Gun 2 supplies one or more hand guns, then Gun 2 should be operated in Manual mode using a CCV for the Master Channel flow controller.

2. If the output of Gun 2 supplies a single applicator, then an MVR should be used for the Master Channel flow controller and Gun 2 should be operated in Auto mode.

3. If the output of Gun 2 supplies multiple applicators other then hand guns, then Gun 2 should be operated in Manual mode using a CCV for the Master Channel flow controller. Additional Guns should be configured for each applicator as shown below to provide automatic flow control for each applicator.

Gun 3 through 6 =
- Master Channel =
  - Material = Output of Gun 2 (Resin + 2nd + 3rd Components)
  - Flow Controller = DR1
  - Flow Meter = RF1
  - Operating Mode = Auto

4. Minimum flow rate for the DynaFlow is determined for each channel by the following formu-la, based on the number of pulses / liter for the flow meter for the channel.

Minimum flow Rate for Channel (cc/min) = 60,000 / Pulses/Liter for Channel.

5. Maximum flow rate for the DynaFlow is 3,276 cc/min per channel.

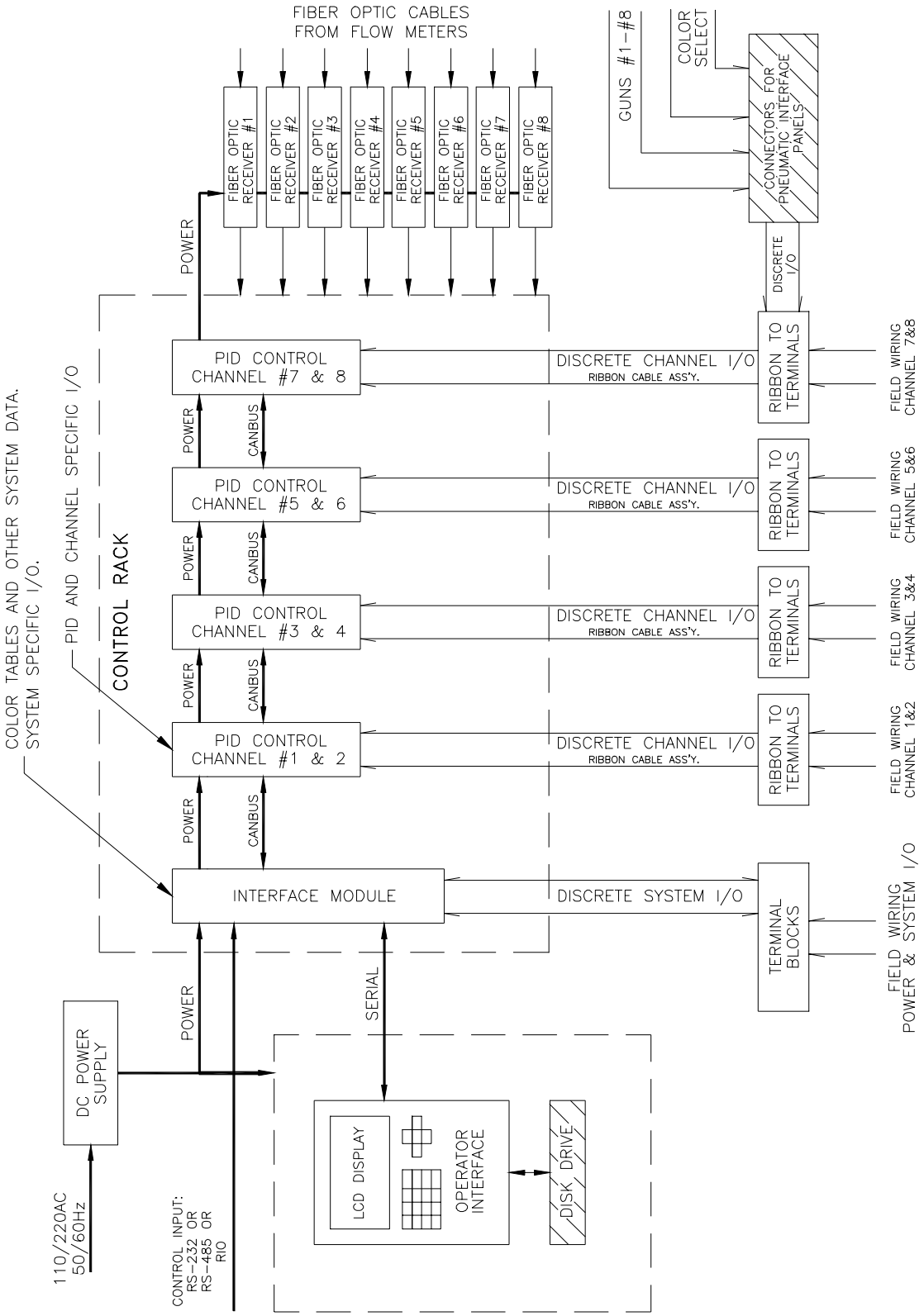


Figure 1: Block Diagram

DYNAFLOW SPECIFICATIONS

Pneumatic Requirements

Transducers: The air supplied to the transducers must be clean and dry and meet the following general specifications:

Filtration: 20 Micron

Supply Pressure: 90 PSIG min. to 150 PSIG max.

Volume: 0.04 to 0.13 Cv

Operating Temperature: 32° to 150° F (0° to 65.5° C)

Control Rack (Up to 8 Channels Per 1/2 of 19" Rack)

Dimensions: 83mm H X 250mm W X 184mm D standard half rack

Power Requirements: 24 VDC at 1 Amp typical, all 8 CHANNELs installed

The following must be followed if the flow control rack and/or Operator Interface is to be integrated into a larger system control panel:

- The 24 VDC Power Supply must be located in the same control panel as the fluid flow control.
- **DO NOT** use a central power supply located else where. The power supplies may be sized for and used for other controls within the same cabinet **WITH THE EXCEPTION OF HIGH VOLTAGE POWER SUPPLY CONTROLLERS**. High voltage power supply controllers MUST have a dedicated power supply.

Interface Module Hardware

General: This Module is responsible for local display/keyboard control and communication to the Host controller. Responsible also for non-volatile storage of all JOB data tables and system configuration parameters.

Dimensions: 3U (130.5 mm) H x 7H (35.2 m) W standard 19" rack module

Interface Module Hardware (Cont.)

Digital Inputs: 24 VDC at 2.3 ma typical per input (optically isolated, source by default, sink selectable)
- JOB Select Strobe
- JOB Select 1 (lower significant BCD digit)
- JOB Select 2
- JOB Select 4
- JOB Select 8
- JOB Select 10 (middle significant BCD digit)
- JOB Select 20
- JOB Select 40
- JOB Select 80
- JOB Select 100 (upper significant BCD digit)
- System Ready/Halt
- Global Gun Enable

Digital Outputs: 24 VDC sourced at 300 ma maximum per output (Solid state relay contacts)

System Pulse: Used as watchdog timer by an external supervisory PLC or computer.

System Fault: Used to activate an alarm and to supply a signal remotely that a System, GUN, or other fault has occurred.

Communications

RS-232C Port #1: Communication with external host PC/PLC or printer.

RS-232C Port #2: Communication with local Operator Interface unit.

RS-485 Port: Intended as multi-drop communication port for external host PC/PLC

Allen-Bradley RIO Port: For direct high-speed communication with Allen-Bradley PLC's.

CAN: Control Area Network (CAN) high speed communication with all channel Modules and with other racks.

Power Requirement: 24 VDC at 100 ma typical

Operating Temperature: 0° to 55° C

Channel Module Hardware Specifications

General: Each Channel Module is responsible for processing channel specific dis crete I/O and performing all of the necessary PID closed loop control functions. Data and control I/O other than discrete is communicated through ITW CAN Bus located on the Motherboard. (See Appendix A for a description of the Channel Module hardware settings.)

Dimensions: 3U (130.5mm) H x 7H (35.2mm) W standard 19" rack module

24 Digital Inputs
(2 Channels): 24 VDC at 2.3 ma typical per input (optically isolated, source by default, sink selectable)

Trigger (level): Automatic mode only - For manual mode, fluid starts with GUN trigger

Halt (edge): Stops current JOB # (no effect on next JOB # in queue)

Clean (edge): Forces regulator full on for cleaning

Run (edge): Gets next JOB # - used in con- junction with JOB # and Toggle select bits

Gun Mask (edge): Used in conjunction with JOB # select bits

Total Reset (edge): Resets all totals

Total Hold (level): Holds present total value regardless of fluid flow

Transparent/PID (level): When active directs the external analog input directly to the transducer output

Analog Hold (level): Freezes PID and holds cur rent analog control output

Load (edge): Loads fluid with controlled mix ratio for GUNs operating in MANUAL Mode

External Fault/ Enable (level): Enable signal input. Must be active for fluid to be delivered by GUN regardless of the operating mode.

Spare: Not used presently

Channel Module Hardware Specifications (Cont.)

12 Digital Outputs
(2 Channels): 24 VDC sourced at 300 ma max- imum per output (Solid state relay contacts)

Ready: Everything is ready for operation, configured correctly and I/O logic OK

Active: CHANNEL is active and controlling Fault has occurred

Pot Life Timer: Pot life timer expired

Clean/Load/Calibrate: Indicates Clean, Load, or Calibrate mode is active

MVR Enable: Used to control trigger valve for CHANNEL in fast trigger applica- tions with Analog Hold enabled

4 Analog Inputs
(2 Channels): Jumper selectable 0-10 VDC (de- fault) or 4-20 ma, op-amp buffered, 10-bit A/D.

Set Point Control #1: Used for external analog control. When used, offset and full scale need to be set. This is accomplished through the MAXIMUM FLOW RATE and MINI- MUM FLOW RATE JOB parameters.

Set Point Control #2: Used for external analog 10-bit A/D control. When used, off- set and full scale need to be set. This is accomplished through the MAXIMUM FLOW RATE and MINIMUM FLOW RATE JOB parameters.

Spare #1: Not used presently

Spare #2: Not used presently

4 Analog Outputs
(2 Channels): Jumper selectable 0-10 VDC (de- fault) or 4-20 ma, op-amp buffered, 12-bit D/A.

Transducer Control #1: Output to proportional E/P 12-bit D/A controller

Transducer Control #2: Output to proportional E/P controller

Flow Rate #1: Flow Rate (scaled between MINI- MUM FLOW RATE and MAXI- MUM FLOW RATE JOB param- eters)

Flow Rate #2: Flow Rate (scaled between MINI MUM FLOW RATE and MAXIMUM FLOW RATE JOB parameters)

Channel Module Hardware Specifications (Cont.)

4 Frequency Inputs: From flow meters (reverse flow capable)

Source Signal #1 & #2: Frequency used to determine flow rate (pulses per volume or weight).

Maximum Frequency = 5 KHz @ ± 0.5%
= 1 KHz @ ± 0.1%
Minimum Frequency = 1 Hz
Minimum CC/min = 60,000 / pulses per liter
Maximum CC/min = 3,267

Phase Signal #1 & #2: State used to determine direction of flow rate, forward or reverse.

PID Control: Closed loop control based on the Kp, Ki, Kd and deadband JOB parameters. 30ms PID up date time (default), each channel.

Communications

CAN: Controller Area Network (CAN) High-speed serial communications to Interface Module.

RS-232C Port: Spare auxiliary communication port.

Power Requirements: 24 VDC at 100 ma typical – each Channel Module

Operating Temperature: 0° to 55° C

Control Enclosure

Dimensions: 610mm H X 610mm W X 410mm D

Weight: 30 Kg

AC Power: 115 VAC, 4A (77376-XXXXØ)
230 VAC, 3A (77376-XXXX1)
50/60 HZ
1 Phase

Temperature: 0° - 40° C

Humidity: 80% to 31° C decreasing to 50% at 40° C non-condensing

INSTALLATION

SYSTEM GUIDELINES

Prints Specific to Your Installation

Installation prints are custom drawn for each site. You should check those prints for information that is specific to your installation. Any deviations from those prints made during or after installation should be recorded for further reference.

Cable Assemblies

Most electrical interconnections between the DynaFlow controller and other system components are made through cable assemblies. The parts list located in the "Appendix" includes standard cable assemblies relating to the flow controller. The cable assemblies are labeled with the part number followed by a “dashed” extension that indicates the length of the cable.

Equipment Grounding

⚠ CAUTION

► The control panel should be grounded in accordance with national and local electrical codes. The location of the main grounding terminal is shown on the installation prints.

Equipment Locations

With the exception of the following restrictions, the installation of the Transducers or Transducer Panel, the Remote Operators Station and Regulator/Flow meter assemblies are application and site dependant. Specific instructions for location and mounting of these assemblies are covered on the site installation drawings.

1. The maximum recommended distance from the Control Panel to each flow meter is 100-ft. as determined by the maximum standard available length of the fiber-optic cable assemblies or intrinsic electrical cable assemblies.

2. The maximum recommended length of air pilot tubing between the electrical-to-pneumatic (E/P) transducer and the material regulator is largely determined by the application. In general, the pilot lines should be kept as short as possible to achieve the best fluid flow response and regulation. See "Pilot Signal Guidelines" chart in this section.

3. The maximum distance between the optional LBAL5001-XX Pneumatic Interface Panel to the Control Console is 40-ft., as determined by the interconnecting electrical cable assembly.

4. The maximum recommended 1/4-inch OD hose length from the LBAL5003, Remote Operator Panel, and the LBAL5001 or A12182, Pneumatic Interface Panel, is 50-ft., however this can be longer depending on the application.

5. The maximum recommended length for the E/P transducer electrical control cable is 95 ft. However, in some cases 175-ft. has been used. Generally, if a GUN number (not atomizers) controls a complete zone of 6 or more atomizers, do not exceed 95-ft. of cable.

Consult ITW Ransburg if longer distances than those shown above are desired.

6. Use the mounting ears supplied with the Control Enclosure to mount the enclosure on a rack, wall, or beam.

7. Use appropriate AWG wire size for incoming AC power.

⚠ WARNING

► If improperly located, certain electrical equipment will become a source of ignition and create a risk of fire or explosion.

The Control Console must be located outside of the Class 1, Division 1 and 2 hazardous locations which are defined for spray finishing of flammable and/or combustible materials. Definitions and requirements for classified areas are found in the National Electrical Code, NFPA-70, Article 516 and the National Fire Protection Association (NFPA-33).

The flow meters and material regulators may be installed and used in the hazardous location only when connected according to ITW Ransburg.

⚠ CAUTION

► Do not locate the Control Panel near or adjacent to heat producing equipment such as ovens, high wattage lamps, steam pipes, etc.

⚠ WARNING

► The Control Enclosure must be located in such a way that acces to the On/Off power switch and Emergency Stop switch is not blocked. The On/Off switch turns off AC power to the PC and 24 VDC supply. The E-stop switch interrupts only the 24 VDC.

PILOT SIGNAL GUIDELINES

			Minimum Length		*Maximum Length*	
Tubing Size OD	**Fluid Regulator Type**	**Typical Application**	**Feet**	**Meters**	**Feet**	**Meters**
1/4"	MVR	Two-component	15	4.6	50	15.3
1/4"	DR1	Single-Component	15	4.6	100	30.5

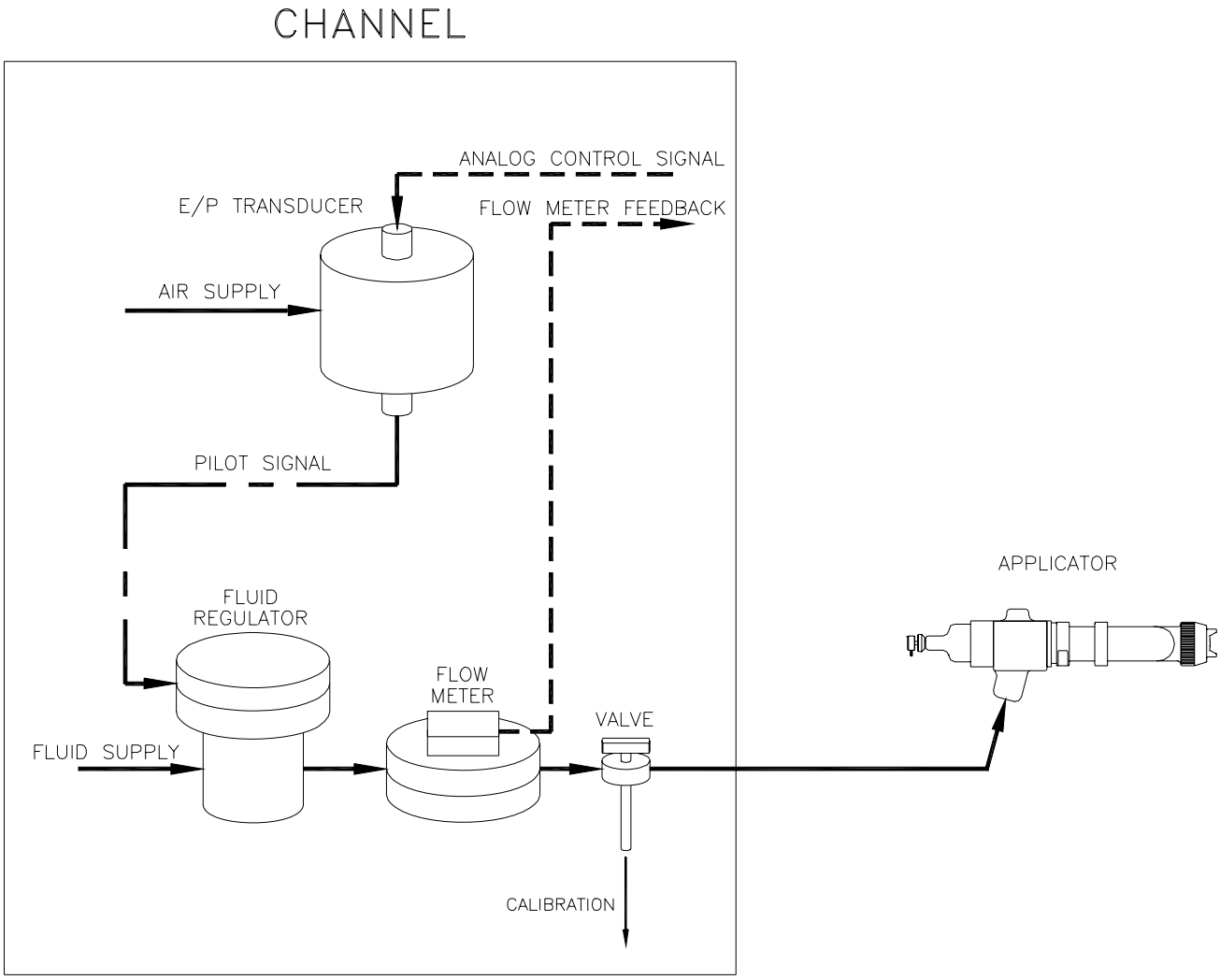


Figure 2: Block Diagram for a Single-Component Gun

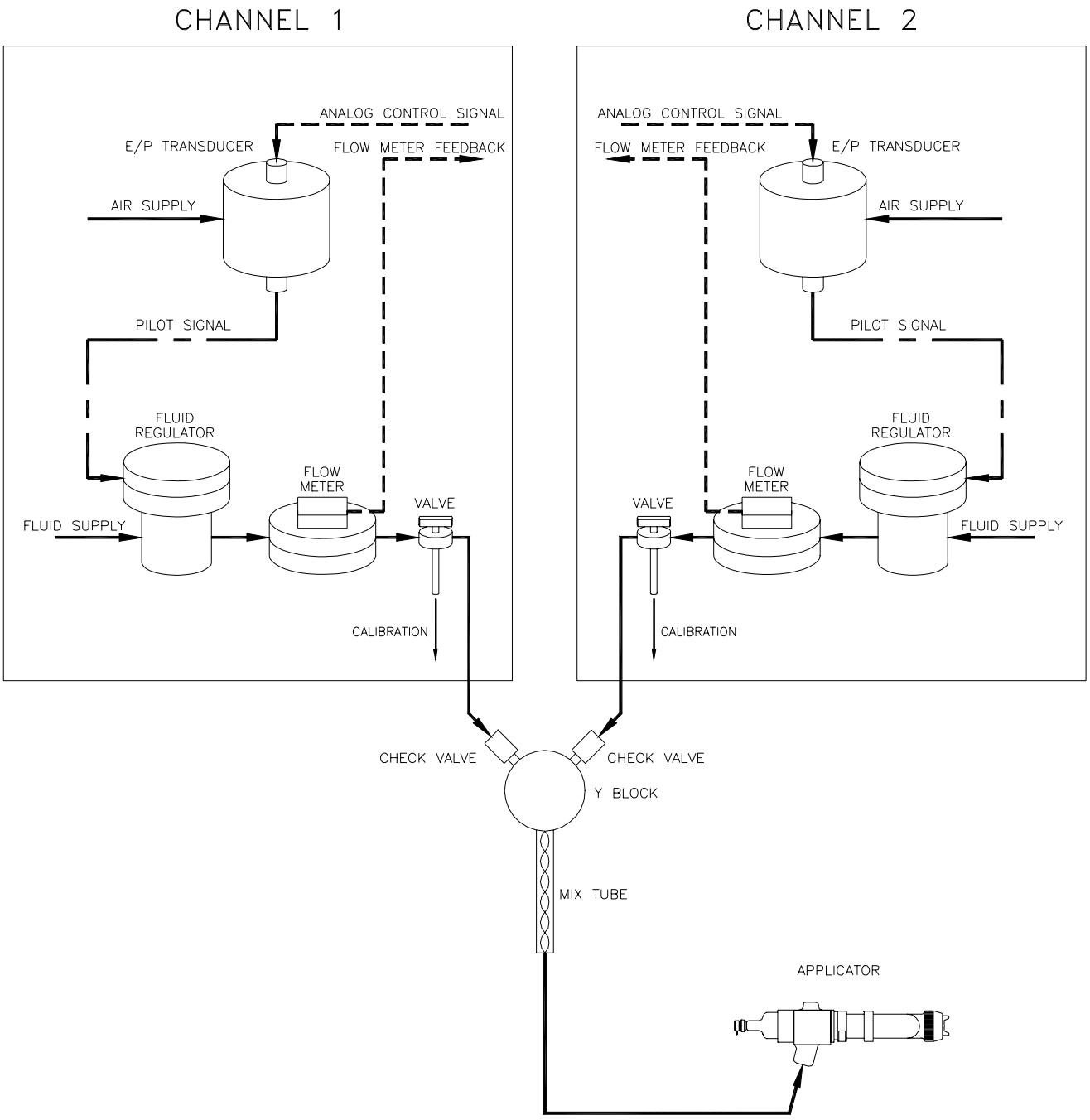


Figure 3a: Block Diagram for a Two-Component Gun

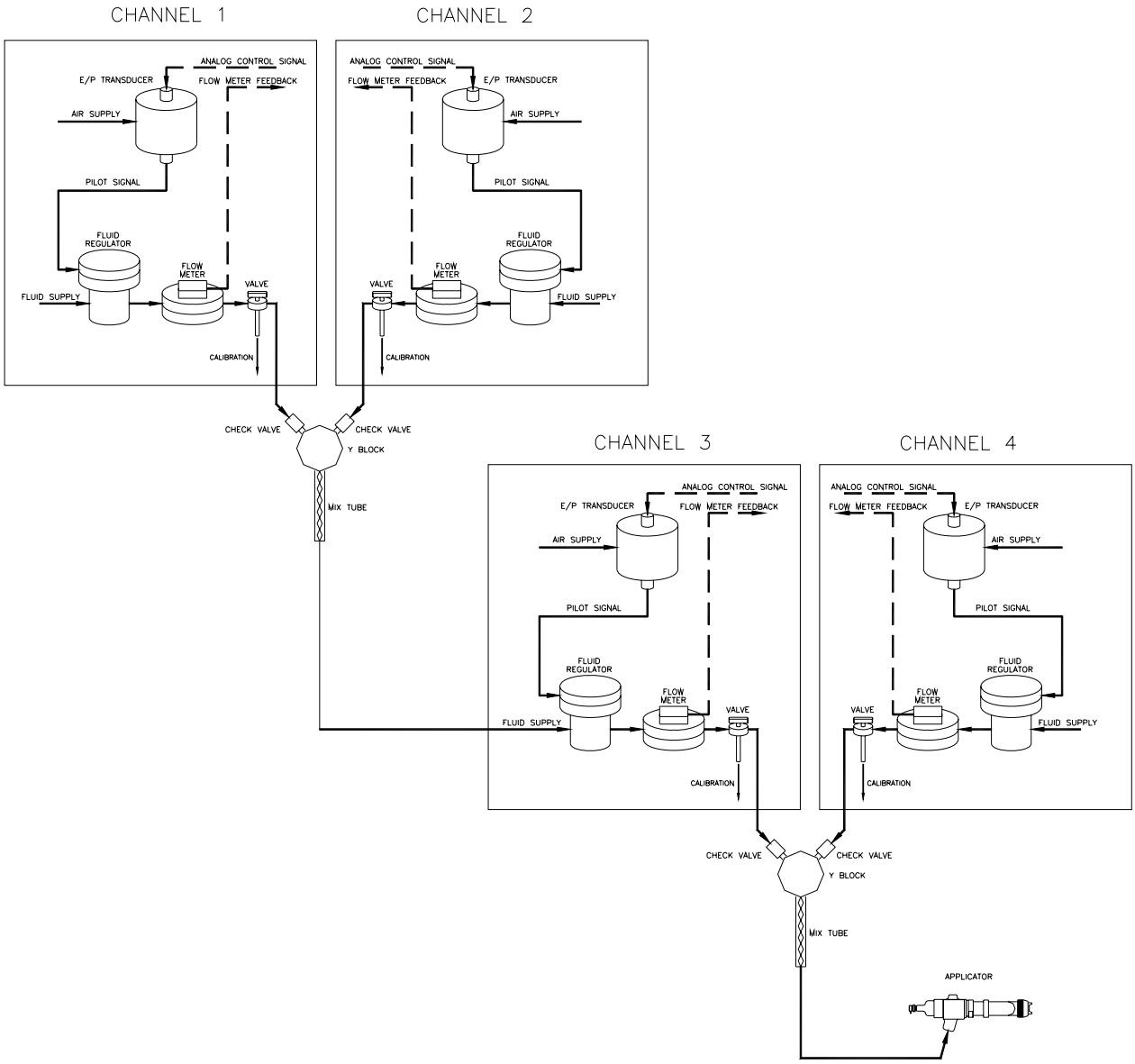


Figure 3b: Block Diagram for a Three-Component Gun

INPUT POWER

Input supply voltage connections should be made from a **FUSED DISCONNECT**. Generally, conduit should be used for the input power wiring with the appropriate connectors into the Control Panel.

If there are large AC line voltage fluctuations or voltage transients such as those typically produced by heavy electric machinery or welding equipment, then a constant voltage transformer (CVT) should be used between the FUSED DISCONNECT and the Control Panel.

⚠ CAUTION

► If a constant voltage transformer (CVT) is to be used on the input to the Control Panel, use a CVT with a Volt-Amp (VA) output rating equal to or greater than the output voltage multiplied by the control panel fuse rating. Also make sure that the CVT input ratings correspond with the voltage and frequency of the source supplied by the FUSED DISCONNECT. The CVT output should be rated for 240 VAC maximum.

⚠ CAUTION

► Before applying power to the control panel, verify that it is set to match the source voltage. There may sometimes be a voltage selection switch (usually located on the DC power supplies) to select between 120 VAC and 240 VAC or different indicator bulbs may be required.

NOTES

INTERFACING TO THE FLOW CONTROLLER

System I/O

SYSTEM INPUTS	
Input Signals	**Description**
JOB Select Inputs	These inputs are used to select a JOB number from the external PLC or other host controller if serial communication is not being used. These inputs represent Binary Coded Decimal (BCD) that translates to 3 digits, each digit represented as a 4-bit binary code. The JOB Select inputs are used in conjunction with the GUN Mask inputs to determine which GUNs will accept the JOB number represented by the total of the active JOB Select Bits. See "Operation" section of this manual for details. The inputs are pulsed signals of at least .25 seconds duration.
JOB Strobe Input	JOB Strobe requires a pulsed signal of at least 0.25 seconds duration. This signal is used in conjunction with the GUN MASK inputs and program select inputs to activate a new JOB # for any or all GUNs. When the controller detects this input, the program select inputs and GUN MASK inputs are read and action taken to load the new JOB # in the JOB # QUEUE. The new program select and GUN MASK inputs must be present before the PROGRAM SET STROBE is activated. Reference "Job Selection Timing Diagram Sample" in the "Operation" section.
System Ready/ Halt Input	System Ready/Halt is a maintained signal that permits activation of any or all GUNs. For the controller to operate, this signal must be maintained in the high state (24 VDC). When this signal is active, the system Ready/Halt output will be held ON. If the signal is lost, ALL GUNs will stop and the READY output is turned OFF. The GUNs must be restarted in the normal manner when this signal is again activated. The JOB # QUEUE for any GUN is not effected by the state of this input.
Global GUN Enable	The Global GUN Enable is a maintained signal that overrides all of the individual External Fault/ Enable GUN inputs. Reference "GUN INPUTS". This is most useful when using RIO, RS-485, or RS-232C control and the discrete GUN I/O is not used through J3, J4, J5, or J6 of the mother board.

SYSTEM OUTPUTS	
Output Signals	**Description**
System Pulse Output	The System Pulse output can be used as a watchdog function by a PLC or other external controller to determine if the flow controller is operating normally. The output is a 50% duty cycle, 0.5 HZ signal (2 pulses per second).
System Fault	A high signal on this output indicates that a system, GUN or other fault has occurred. The type of fault that causes this output to activate is selectable as the Horn Code located in the System Configuration table.
System Spare	Not used presently.

Gun I/O

Discrete GUN I/O provides the input control and output status signals required to interface each GUN with a PLC or similar controller, or other system control components. All GUN I/O can also be controlled or monitored through an external host controller operating through a serial data communications link or the state of each forced active through the local OPERATOR INTERFACE/host controller.

GUN INPUTS	
Input Signal	**Description**
Trigger	For automatic applicators: Starts fluid flow when supplied a 24 VDC signal assuming that the GUN has been put in run mode, is configured properly, and all other conditions are satisfied. For manual GUNs: A Trigger signal is required for the LOAD mode. The Trigger signal can be generated from an atomizing air flow switch. If a Trigger signal is received from the flow switch but no fluid flow is recorded from the catalyst (slaved) CHANNEL, then a FLOW TOO LOW fault is generated. This ensures that both material components are present to the GUN. If the dip switch, Pos #1 on the Channel Card is on, then this input is not used. Fluid flow through the master channel is used to indicate a TRIGGER ON condition.
Halt/Reset	Halt requires a pulsed signal of at least 0.25 seconds duration. It is used to stop the JOB # currently being executed or to stop a CLEAN/PURGE operation. GUN faults are also reset. While in HALT mode, any new JOB # selection using the JOB # Strobe will be entered into the Queue. The GUN will run the JOB # located in the Queue when a RUN signal is again supplied. The faults can still be viewed in the ERROR LOG data table. Halt has no effect on the JOB # in the Queue (Next JOB # to be run).
Clean	Clean requires a pulsed signal of at least 0.25 seconds duration. It forces all of the material regulators controlled by the GUN to the full open position. This permits the fluid system to be cleaned. The removal of the GUN Enable signal or a HALT input signal is required to end the CLEAN operation. Actual cleaning sequencing (PURGE) such as soft air push-out is performed by the PLC, or other external controller. For details, refer to "Clean Mode" in the "Operation" section of this manual.
Run	This input will activate the GUN and start material flow if all other requirements are met. This is identical to pushing the GUN ON switch on the OPERATOR INTERFACE PANELS. Run requires a pulsed signal of at least 0.25 seconds duration. If this signal is reapplied once the JOB # has been started, then it is ignored. When this signal is supplied following a HALT, the JOB # stored in the queue will be activated. If no new JOB # was entered during the previous HALT, then the JOB # located in the queue will not change and will be used again.
Gun Mask	The Gun Mask input specifies whether a JOB # **is** or **is not** toggled into GUN #n queue. This signal is used in conjunction with the system PROGRAM SELECT and PROGRAM STROBE inputs. A 24 VDC signal selects the GUN, a 0 VDC signal masks the GUN as 'not used for the JOB # selected'.
Total Reset	Total Reset requires a pulsed signal of at least 0.25 seconds duration. This signal will reset the daily and JOB totals for the GUN. The non-resettable total will not be effected.

GUN INPUTS (Continued)	
Input Signal	**Description**
Total Hold	This signal will stop all totals for the CHANNEL as long as the signal is supplied, even if the GUN is running and there is fluid flow. The non-resettable total will not be effected. This is most often used during flush or soft air push cycles. It can also be used to account for only that material which is delivered onto parts.
Transparent/ PID	For GUNs configured as single-component, automatic mode only. This input is only acknowledged for run and load modes. This input must be supplied before the clean input or the trigger input if in run mode. This signal will place the CHANNEL in single-component, open loop mode and redirect the Analog Set Point Input directly to the E/P transducer control output. MAXIMUM FLOW RATE, MINIMUM FLOW RATE, MVR HIGH and MVR LOW parameters have no effect while in the transparent mode. The Out of Tolerance, FLOW TOO LOW and FLOW TOO HIGH faults will also be disabled while in the Transparent condition.
Analog Hold	This signal applies only to GUNs configured for single-component automatic mode. This signal will suspend PID control and freeze the analog control output to the E/P transducer to the current value. Normal PID operation will resume when this signal is removed. This would typically be used during flushing operations or for control stability in situations where there are extremely quick trigger cycles or equipment limitations. The Out of Tolerance, Flow Too Low and Flow Too High faults will also be disabled while in the Analog Hold condition.
Load	Load requires a pulsed signal of at least 0.25 seconds duration. The LOAD input places a manual, two-component GUN into LOAD MODE. LOAD MODE is a special way to meter both resin and catalyst to the applicator after the system has been through a CLEAN operation while assuring accurate ratios. A GUN can be placed into the LOAD MODE directly from the RUN MODE. For details, refer to LOAD MODE in the "Operation" section of this manual.
External Fault/ Enable	External Fault will detect a low signal of at least 0.25 seconds duration. This signal must be maintained high for normal operation. **No fluid flow will occur regardless of the operating mode if the Enable input is not active.** This input is supplied as an interlock for other equipment to automatically shut down the fluid flow controller. The system must be reset after the External Fault is returned to the high state. Reference "Recovering From Faults" in the "Operation" section of this manual. A Global Gun Enable system input will override this input.
Spare Digital Input	Not used presently.
Analog Set Point	This is a 0-10 VDC or 4-20 ma input signal (hardware selectable on the Channel Card) which can be used to command flow rate when the applicator is in AUTOMATIC mode. The scaling for input signal vs. flow rate is determined by the GUN JOB # parameters, MAXIMUM FLOW RATE and MINIMUM FLOW RATE. An Analog Set Point signal greater than 0.25 VDC will cause the controller to ignore the SET POINT parameter located in the JOB table.
Spare Analog Input	Not used presently.

GUN OUTPUTS	
Output Signal	**Description**
Ready	This output is 24 VDC when the GUN is configured properly, a valid JOB is loaded.
Active	This output is 24 VDC when the GUN is RUN mode and flowing fluid or prepared to flow fluid.
Fault	This output is 24 VDC if a GUN fault condition occurs.
Pot Life Timer	This output is 24 VDC if the Pot-Life Timer has expired. This may also initiate a horn if set to do so in the Horn Code Configuration, set in the System Configuration.
Clean/Load/ Calibrate	This output is 24 VDC when the GUN is placed in Clean, Load, or Calibrate Mode.
MVR Enable	This output is 24 VDC anytime material should be flowing for the GUN. It is used to control trigger valve(s) installed at the inlet of the MVR valve(s) on fast-trigger JOBs.
Analog Control Output	This is a 0-10 VDC or 4-20 ma output signal (selectable on the Channel Module) which is connected to the E/P transducer for control of the material regulator for the CHANNEL. The output signal is limited through the use of the JOB parameters, MVR HIGH and MVR LOW. Scaling is assumed to be 0 VDC (4 ma) equals 0 PSIG at the output of the E/P transducer and 10 VDC (20 ma) equals 100 PSIG at the output of the E/P transducer. The MVR HIGH and MVR LOW JOB parameters are based on a percentage of the span of 0 to 100 PSIG. This an MVR LOW value of 10% equals 10 PSIG.
Analog Flow Rate Output	This is a 0-10 VDC or 4-20 ma output signal (selectable on the Channel Module) indicating the actual flow rate for the CHANNEL. Scaling of the output signal is accomplished through the use of the JOB parameters MAXIMUM FLOW RATE and MINIMUM FLOW RATE, where 0 VDC (4 ma) equals the MINIMUM FLOW RATE value and 10 VDC (20 ma) equals the MAXIMUM FLOW RATE value. For the Master Channel, if DIP switch 2/2 on the Interface Module is off, the total flow rate for the gun is output and if the switch is on only the flow rate for the Master Channel is output. For the Slave Channel, only the flow rate for the Slave Channel is output.
Fluid Line Flushed Output	On guns configured for dual component operation, the pot-life expired output on the slave (B) channel indicates when the fluid line has been completely flushed. Once mixed material has entered the fluid line, this output is energized and it remains energized until the unit is completely flushed. That is, in order to turn this bit off, the amount of material programmed in for mixed volume must be expended from the applicator while the gun is in clean mode.
User Interface Revision	Displays the current version of the user-interface software running on the user-interface PC.
Language	This allows users to select between English and one Alternate Language. The alternate language text is stored on the flash drive or hard drive of the PC in files named: TEXTMESS_ALT.TXT, PARAMHLP_ALT.TXT, LABELS_ALT.TXT, SOLENOIDVALVES_ALT.TXT, and HELP_ALT.TXT.

Control Rack Wiring

(Reference "Addendum B" in the "Appendix" section for terminal identification.)

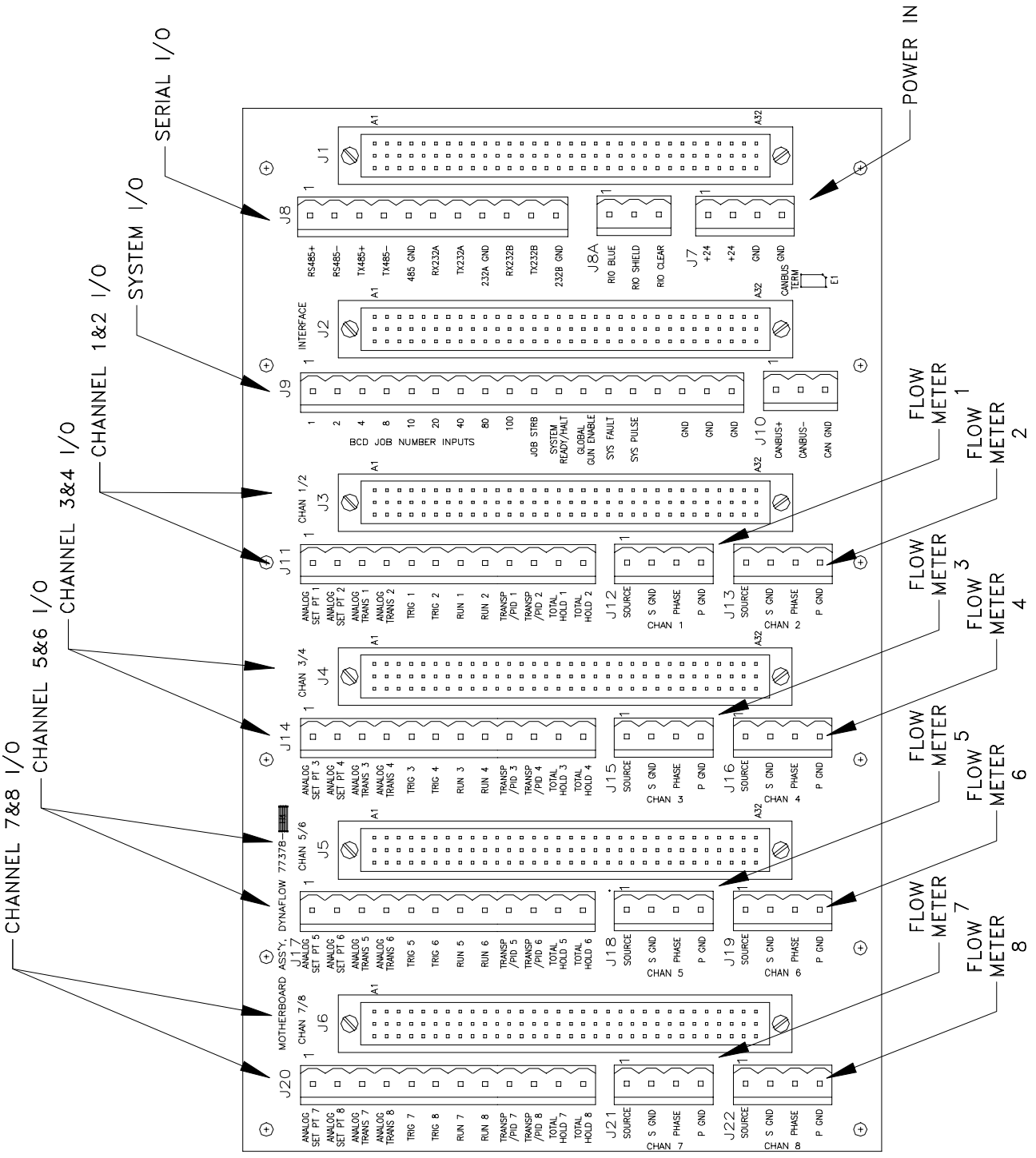


Figure 4: Mother Board Terminals

Hardware Configuration

Reference "Addendum A" in the "Appendix" section for board level hardware settings. For new system installations, all hardware settings should already be in the correct positions. However, if replacing any electronic board assembly, verify that the settings of the new board are identical to those of the board being replaced. In the event that the replacement board is a newer revision and does not appear identical, refer to any documentation that was supplied with the board, or contact your ITW Ransburg representative or contact ITW Ransburg service.

Transducers

The transducers convert electrical control signals from the fluid flow controller to the air pressure signals used to operate the material regulators. The transducers can be either current controlled (4-20 ma) or voltage controlled (0-10 VDC). The transducers can be mounted separately or collectively depending on the installation requirements.

Make sure that the Channel Module jumper settings match the type of transducer being used (refer to "Channel Module Mother Board Jumper Settings Channel 1 I/O and Channel 2 I/O" in the "Appendix" section).

The electrical-to-pneumatic (E/P) transducers are supplied as separate sub-assemblies or as part of a standard transducer panel. The transducer panel offers a convenient way to mount transducers for 2K applications. There are two transducers located in each panel with electrical terminals and an air supply input.

The transducers may also be mounted individually on any air drop **outside** of the Class 1, Division 1 hazardous location if:

1. Tubing and cable lengths do not violate the minimum and maximum lengths specified in the "Installation" section of this manual under Equipment Locations".

2. The air supply meets the specifications as listed in the "Introduction" section of this manual under "Pneumatic Specifications" or those published with the transducer.

A 1:1 volume booster may also be connected directly to the transducer output when; operating a DR-1™ Fluid Regulator, if pilot line lengths are longer than recommended, or of a larger tubing diameter is used other than that recommended.

Keep the distance between the transducer to the material regulator as short as possible, without violating the minimum lengths specified, to avoid system response delays and to achieve the optimum fluid flow characteristics for the system.

Material Regulators and Flow Meters

The location and mounting of the material regulators and flow meters is specific to each installation. The information presented here is intended as a guideline only. Reference should be made to the supplied documentation specific to your installation.

Fluid Supply Requirements

- The fluid supply must be free of pulsation and surges.

- A fluid strainer/filter must be installed immediately before the material regulators. The element size of the strainer should be 100 mesh or per the recommendation of your ITW Ransburg representative.

- For Two-Component (2K) Systems: Selector valves are required for calibration or verifying of the flow meters and should be mounted close to the mixing block. These are supplied as part of the standard fluid panel. Drawings created specifically for your system will provide detailed information about valve type and location. Mount the calibration valves in an easily accessible area close to the mixing block. For most applications the flow meter and material regulator are mounted as an assembly as close as possible to the mixing block and calibration valves.

- For systems with fast trigger cycles, or where dynamic control of fluid flow rates (different flow rate during a JOB), consider installing trigger valves (typically color control valves) immediately upstream of the MVR valves so that the CHANNELs may be placed in Analog

Hold mode without causing the fluid tubes to pressurize to the material supply pressure while the GUN is not triggered.

- For systems with fast trigger cycles or where dynamic control of fluid flow rates (dif ferent flow rates during a JOB), mount the E/P transducer as close to the material regulator as possible. Remember that the transducers MUST be mounted outside of the hazardous location (refer to NFPA-70, NEC). For applications where the requested fluid flow is for the most part consistent, and transitional response time of the system is not as critical, then the E/P transducers may be located in the main control panel.

- Be sure that stainless steel tubing or piping and stainless steel fittings are used for all fluid lines and connections where metal is desired.

- Always mount the flow meter and regulator as close as feasible to the applicator. This reduces paint line pulsation due to applicator reciprocators and reduces the possibility of a paint leak effecting paint delivered to the part.

NOTES

NOTES

OPERATION

OVERVIEW

This section will acquaint you with the general operation of the DynaFlow Fluid Flow Controller. The following information describing CHANNELs, GUNs and PARAMETERS summarize the three main features that form the basis of the fluid flow controller.

CHANNELs

A CHANNEL consists of an electrical-to-pneumatic (E/P) transducer, material regulator and fluid flow meter combination through which a single material is controlled. One or two CHANNELs may be configured for each GUN. Two-component systems (sometimes referred to as 2K systems) have two CHANNELs assigned to a single GUN. Single-component systems (sometimes referred to as 1K systems) have only one CHANNEL assigned to a single GUN.

Each DynaFlow control system has up to 8 CHANNELs available that can be configured to suit the application. For example, you can use 4 CHANNELs assigned to 2 GUNs to spray 2 dual component paints on automatic machines, and 2 CHANNELs assigned to 1 GUN to spray one dual component paint with a manual hand spray GUN.

Please note that most GUN parameters also apply to single-component control as well. The CHANNEL that has the greatest flow rate in two-component systems is typically called the Master CHANNEL. A CHANNEL cannot be assigned to more than one GUN.

GUNs

A GUN represents a single applicator through which one or two materials are delivered.

If you are using single-component coatings, the DynaFlow controller can support 8 separate single CHANNEL GUNs operating simultaneously. If you are using two-component materials, then 4 separate 2-CHANNEL GUNs operating simultaneously can be supported. Any of the 8 available CHANNELs can be linked together, using 1 of 8 GUNs, to control the flow and mixing regulation of two-component materials. A GUN configured for two-component can also operate in single-component control mode by setting the ratio to 99, or higher.

Three Component (3-K) Operation

DynaFlow was designed for either single of two-component operation. Three-component operation is possible by configuring two, two-component, guns. The first Gun is set up as follows:

Gun 1 =
  Master Channel =
    Material = Resin
    Flow Controller = Color Change Value (CCV)
    Flow Meter = RF1

  Slave Channel =
    Material = 2nd Component
    Flow Controller = MVR, with appropriate size needle
    Flow Meter = Piston or RF1, depending on min/max flow rates (see Notes 4 and 5)

Operating Mode = Manual

The output of the first Gun is then fed into the Master Channel input of the second Gun. The second Gun is setup as follows:

Gun 2 =
  Master Channel =
    Material = Output of Gun 1 (Resin + 2nd Component)
    Flow Controller = Color Change Value (CCV) (see Notes 1, 2, and 3)
    Flow Meter = RF1

Slave Channel =
Material = 3rd Component
Flow Controller = MVR, with appropriate size needle
Flow Meter = Piston or RF1, depending on min/max flow rates (see Notes 4 and 5)
Operating Mode = Manual or Auto (see Notes 1, 2, and 3)

NOTES:

1. If the output of Gun 2 supplies one or more hand guns, then Gun 2 should be operated in Manual mode using a CCV for the Master Channel flow controller.

2. If the output of Gun 2 supplies a single applicator, then an MVR should be used for the Master Channel flow controller and Gun 2 should be operated in Auto mode.

3. If the output of Gun 2 supplies multiple applicators other then hand guns, then Gun 2 should be operated in Manual mode using a CCV for the Master Channel flow controller. Additional Guns should be configured for each applicator as shown below to provide automatic flow control for each applicator.

Gun 3 through 6 =
Master Channel =
Material = Output of Gun 2 (Resin + 2nd + 3rd Components)
Flow Controller = DR1
Flow Meter = RF1
Operating Mode = Auto

4. Minimum flow rate for the DynaFlow is determined for each channel by the following formu-la, based on the number of pulses / liter for the flow meter for the channel. Minimum Flow Rate for Channel (cc/min) = 60,000 / Pulses/Liter for Channel.

5. Maximum flow rate for the DynaFlow is 3,276 cc/min per channel.

Parameters

The controlling parameters for each GUN, and for the CHANNELs assigned to that GUN, are called JOBs (also commonly referred to as PSETs, Color Tables or Recipes). The JOB values define flow characteristics such as TARGET FLOW RATE, MIX RATIO, FLOW TOLERANCE, etc. JOBs include all of the parameters that may be dependent on the material used. This offers the ability to optimize system control as needed per material and then recall the settings each time that material is requested. There are up to 100 JOB #s for each GUN. By saving frequently used JOB #s to memory you can later recall them by loading the number representing that JOB #. The parameters are viewed and edited through the local Operator Interface or through a remote host computer.

A set of initial parameter values is included in the controller. The initial (default) values determine the operating conditions of the controller when started for the first time. Some of these will need to be edited during initial setup based on the installation.

PARAMETER DESCRIPTIONS

System Parameters

All system parameters are password protected, unless disabled by setting the password to zero (0). Any time an operator wishes to change any of these parameters, they are prompted for the password. The password only needs to be entered once as long as the time between keystrokes does not exceed the Password Timer as described below. System parameters may be edited at any time regardless of the operating mode if no system errors exist. Any active system errors must be cleared.

NOTE

► Any modifications to the System Parameters screen data are saved only when the operator presses the "Store Data" key (F5), otherwise the modifications will be lost when the screen is exited with the escape (ESC) key.

Blow Off Time

This parameter is used only if the GUN is configured as a manual GUN. The software monitors the trigger signal to identify when the spray GUN is triggered. (Typically this signal comes from an air flow switch located in the atomization air line.) If the software ever detects a GUN trigger signal without pulses from the master channel flow meter after the 'Blow Off' time has elapsed, a No Master Flow fault is issued. This prevents a painter from painting if the flow meter sticks. In some manual applications, painters will only trigger the spray GUN enough to get atomization air to flow without material. They use this air to blow off or feather the part. The software would normally sense this air flow without material flow and then fault the GUN. This parameter allows the painter a preset number of seconds of blow off time before faulting. This parameter is specified in seconds, and the default is 5 seconds. A setting of zero (0) disables the no master flow fault.

Horn Code

This is a coded number that represents when the supervisor would like the System Fault output relay to energize. This output is normally connected to a horn. The options desired are selected.

0 = No horn
1 = Horn when controller faults
2 = Horn when pot-life timer has expired
4 = Horn when external fault is detected

Password

Used in conjunction with the Password Timer parameter. The operator can change the password if the previous password is known. The password is required for editing or setting all data tables and configuration parameters. A password of '0' will disable password operation.

NOTE

► There is an input terminal available for an external fault interlock.

Password Timer

Once a valid password has been entered, this parameter sets the amount of time (in min) which is allowed from the last keystroke until password operation is stopped. Once the timer has expired, the user will be prompted for the password again if password protected settings is to be edited.

RIO Rack Address, Rack Size, Starting Quarter, and Baud Rate

Displays the RIO communication parameters, as decoded from the Interface Module DIP SW1 and SW2 settings.

SIO Baud Rate and COM Port

Displays the SIO communication baud rate, as decoded from the Interface Module DIP SW1 and SW2 settings, and the COM port (COM1 or COM2), as defined in the GO.INI file.

Channel Module Firmware Revision(s)

Displays the firmware revision for the installed Channel Modules.

Interface Module Firmware Revision

Displays the firmware revision for the Interface Module.

User Interface Revision
Displays the current version of the user-interface software running on the user-interface PC.

System Date and Time
Displays the current date and time and permits changing the same.

Language
This allows users to select between English and one Alternate Language. The alternate language text is stored on the flash drive or hard drive of the PC in files named: TEXTMESS_ALT.TXT, PARAMHLP_ALT.TXT, LABELS_ALT.TXT, SOLENOIDVALVES_ALT.TXT, and HELP_ALT.TXT.

Channel Module DIP SW1 Settings
Displays the DIP SW1 settings for each installed Channel Module.

Interface Module DIP SW1 and SW2 Settings
Displays the DIP SW1 and SW2 settings for the Interface Module.

JOB Parameters
JOB parameters may be edited at any time. However, if a JOB is edited while active, the changes made to CHANNEL related parameters will not take effect until the GUN has been halted and requested to be active again. Changes made to GUN related parameters take effect immediately after being saved to the Interface Module.

NOTE

➤ Any modifications to the JOB Parameters screen data are saved only when the operator presses the "Store Data" key (F5), otherwise the modifications will be lost when the screen is exited with the escape (ESC) key.

Flow Setpoint
This parameter has several functions depending on the mode in which the GUN is configured.

- Manual Mode
If the GUN is configured as a manual GUN, this value is the total desired flow rate (cc's/min) when the GUN is put in Load Mode (See "Load Mode" in the "Operation" section of this manual).

- Automatic Mode without Analog Control
If the GUN is configured as an automatic GUN and external analog control of the flow rate is not being used, this is the total flow rate of the mixed material desired at the spray GUN.

- Automatic Mode with Analog Control (Dynamic Control)
If the GUN is configured as an automatic GUN and external analog control of the flow rate is being used, the set point value has no meaning. Analog control is active anytime that the input signal is greater than 0.25 VDC (4.63 ma).

- Automatic Mode with RIO Control (Dynamic Control)
If the GUN is configured as an automatic GUN and RIO control of the flow rate is being used, the set point value has no meaning unless the RIO commanded set point is zero. In that case, the JOB set point is used as the GUN flow rate set point.

NOTE

➤ When operating in 2K mode, this parameter relates to the total mixed material delivered through the GUN.

Ratio
Ratio is expressed as parts of Master CHANNEL to parts of Slaved CHANNEL in the form of XX:1. The Master CHANNEL is typically the resin and the slave CHANNEL is typically the catalyst. If the desired mix ratio is supplied as a percentage of catalyst to the total volume, then refer to the "Ratio Conversion" chart in the "Appendix" to determine the parts setting.

When a GUN is configured for two-component operation and the Ratio is 99.0:1, or greater, the GUN is said to be operating in pseudo single-component mode. In this case, the slave (catalyst)

CHANNEL is NOT set to MVR LOW when the GUN is placed in either Run or Load modes. However, if the slave (catalyst) CHANNEL is specified as a clean CHANNEL, it will be turned on to MVR HIGH in Clean mode.

When a 2K manual GUN is placed in single-component operation, the master (resin) CHANNEL simply turns on to the MVR HIGH output pressure when the GUN is placed in Run mode. All fluid flow is accounted for in the JOB totals.

When a 2K automatic GUN is placed in single-component operation, the master (resin) CHANNEL will control fluid per the set point parameter in the JOB when the GUN is placed in Run mode and a trigger signal is supplied. All fluid flow is accounted for in the JOB totals.

Deadband

This represents a flow rate range divided equally above and below the set point flow rate in which the PID controll is suspended. This keeps the control output from continually changing and produces stability when close to the requested value. For example, if the Deadband is set for 5 cc/min and flow rate set point is set for 100 cc/min, the Deadband would be between 95 and 105 cc/min. The PID controller would therefore be suspended whenever the actual flow rate is within this range. This parameter should normally be set to 1 cc/min.

Kp

The proportional PID controller gain mainly affects the response of the DynaFlow system to disturbances. The DynaFlow system may operate with Kp at zero, however response to material supply and delivery pressure disturbances will be poor. The value of Kp is divided internally by a factor of 1,000 and is used as a multiplier for the flow rate error term. The flow rate error term is the difference between the set point and actual flow rate for the CHANNEL.

The alternate PID algorithm is recommended if the set point is dynamically controlled during Run mode. If the alternate PID algorithm is utilized, Kp is used as a multiplier for the set point of the flow rate. The value of Kp in this mode is divided internally by a factor of 1,000.

Ki

The integral PID controller gain mainly affects the steady-state (non-transitional) response of the DynaFlow system. The DynaFlow system must have a non-zero value for Ki to operate properly. The valve of Ki is divided internally by a factor of 100,000 and is used as a multiplier, along with a factor of 3, for the sum of the error term over the time the trigger has been turned on.

The alternate PID algorithm is recommended if the set point is dynamically controlled during Run mode. The valve of Ki is divided internally by a factor of 10,000 and is used as a multiplier, along with a factor of 3, for the sum of the error term over the time the trigger has been turned on.

Kd

The differential PID controller gain mainly affects the response of the DynaFlow system to disturbances caused by disturbances that are slow in nature. Normally, the DynaFlow system may operate with a Kd value of zero. The value of Kd is divided internally by a factor of 1,000 and is used as a multiplier, along with a factor of 1/3, for the rate of change in the error term.

The alternate PID algorithm is recommended if the set point is dynamically controlled during Run mode. If the alternate PID algorithm is utilized, Kd is divided internally by a factor of 10,000 and is used as a multiplier, along with a factor of 1/3, for the rate of change in the error term.

Pulses Per Liter

The number of pulses sent from the flow meter to the controller for each unit of fluid flow. Each pulse represents a volume of fluid and is dependent on flow meter size. This value can be verified or adjusted during a calibration process to achieve the best accuracy (See "Calibration Mode" in the "Operation" section of this manual). The calibration of all flow meters should be periodically checked. The rheology of some fluids may effect the calibration values, therefore a different value for pulses per liter may be used for each material and is entered into the JOB data tables.

MAXIMUM FLOW RATE

This parameter has 2 possible meanings, dependent upon how the GUN is configured.

- Manual Gun

This parameter is an alarm set point. If the total flow rate of the mixed material to the spray GUN exceeds the amount specified by this parameter, the GUN will shut OFF as the result of a FLOW OUT OF RANGE FAULT.

- Automatic Gun

This parameter is used to scale the flow rate output for the GUN's CHANNEL(s) to specify the desired flow rate when a 10 VDC (or 20 ma) signal is applied to the analog set point input.

MINIMUM FLOW RATE

This parameter has 2 possible meanings, dependent upon how the GUN is configured.

- Manual GUN

This parameter is an alarm set point. If the total flow rate of the mixed material to the spray GUN falls below the amount specified by this parameter, the GUN will shut OFF as the result of a FLOW OUT OF RANGE FAULT. If no alarm is desired, set this parameter to zero (0) and the feature will be disabled.

- Automatic GUN

This parameter is used to scale the flow rate output for the GUN's CHANNEL(s) to specify the desired flow rate when a 0 VDC (or 40 ma) signal is applied to the analog set point input.

Pot-Life Time

The time, in seconds, required for the mixed material being used to set up or harden. This information is obtainable from the manufacturer of the material. The controller will determine if any mixed material is in the paint lines for longer than the Pot-Life Time setting. It is recommended that this time be somewhat less than the actual set up time to allow time to clean the system in the event that the Pot-Life timer expires. If the specified time expires, a Pot-Life alarm is issued, warning the operator that this problem exists. The Pot-Life alarm **does not** shut off the GUN, as this would prevent the operator from triggering and expelling the mixed fluid. The Pot-Life alarm status will remain until the expired material has been purged.

Pot-Life checking may be disabled by entering a value of zero seconds. Since previous versions of the DynaFlow firmware and software used the value 999 minutes to disable Pot-Life checking, the value of 999 seconds is not permitted and will automatically be changed to zero seconds. When upgrading DynaFlow firmware and software, JOBs that specified any value other than 999 minutes must be manually converted to seconds after the upgrade is performed. A Pot-Life alarm may be cleared by entering a Pot-Life Time of zero seconds.

MVR HIGH

This parameter allows the operator to limit the maximum pressure that the transducer is allowed to output to the fluid regulator in any mode.

MVR LOW

This parameter allows the operator to set the low limit on the pressure sent to the fluid regulator while in the Run or Load modes. It can be used to cause a faster response by the transducer/ regulator system. It should be adjusted so that the regulator valve is just short of opening. With a standard MVR valve, this value should never exceed 30 psi. If this value is too high, continuous FLOW TOO HIGH faults will occur.

When a GUN is configured for two-component operation and the Ratio is 99.0:1, or greater, the GUN is said to be operating in pseudo single-component mode. In this case, the slave (catalyst) CHANNEL is NOT set to MVR LOW when the GUN is placed in either Run or Load modes. However, if the slave (catalyst) CHANNEL is specified as a clean CHANNEL, it will be turned on to MVR HIGH in Clean mode.

MVR HIGH AND MVR LOW EFFECT ON PID OPERATION

The PID will only output transducer pressures between MVR LOW and MVR HIGH.

GUN Configuration Parameters

GUN Configuration Parameters should **not** be edited while the GUN is running. This includes all operational modes.

NOTE

► Any modifications to the GUN Configuration Parameters screen data are saved only when the operator presses the "Store Data" key (F5), otherwise the modifications will be lost when the screen is exited with the escape (ESC) key.

Tolerance Volume

This parameter has no effect on single-component GUNs and only effects GUNs configured for two-component operation.

This is the volume over which the ratio accuracy is checked. Every time the volume of Master CHANNEL fluid specified in this parameter has flowed, the ratio is checked. The default value is 150 cc's of the Master CHANNEL. This parameter should never be set so low that less than 10 cc's of the slave channel has flowed. If this value is set too low, nuisance OUT OF TOLERANCE faults will occur.

The first time a gun is triggered after being placed in Run mode, the Tolerance Volume is 150% of the value entered in the job.

Reverse Flow Volume

The amount of fluid which is allowed to flow backwards in the GUN before the controller faults. Reverse flow could cause catalyzed material to backup into either fluid line if a check valve fails. Keep this value small to minimize that possibility. If the GUN is configured for two-component operation, than the Reverse Flow value will apply to each of the CHANNELs assigned to the GUN.

Reverse flow rate is displayed on the main screen of the Local Operator Interface as a flow rate bar colored red, instead of green for normal flow rate.

Mixed Volume

The amount of mixed material present in the mix tube, fluid lines, and spray GUN combined. The fluid in the spray GUN is always the material that has been mixed the longest. The processor keeps track of how long this material has been mixed (Pot-Life Timer), and therefore needs to know the volume from the mix tube to the spray GUN. To determine the amount of mixed material in the system:

1. Measure the volume of the mixing block.
2. Measure the volume of the spray GUN.
3. Measure total hose length and inside diameter.
4. Use the following formula to calculate hose volume.
5. Add 10% to calculated value.

$$\textbf{Volume} = d^2 \times L \times 12.87$$

Volume = Volume in cc's
d = Inside diameter of hose
L = Length of the fluid line from the flow meter to the spray GUN in inches

It is best to over-estimate the amount of mixed material rather than to under-estimate it!

The DynaFlow system uses the Mixed Volume and the Pot-Life Time when it monitors the flow rate of the Gun. Pot-Life is monitored by dividing the Mixed Volume into 40 equal sized 'buckets' of material. When an amount of material has flowed that equals the 'bucket' volume, the 40 'buckets' are time-shifted so the oldest 'bucket' is eliminated, representing the material that has vacated the Mixed Volume tubing at the GUN, and a new 'bucket' is added. If the GUN is in either Run or Load mode, a time value of 1 second is placed in the new 'bucket' to represent mixed material. If the GUN is in Clean mode, a time value of zero is placed in the new 'bucket' representing solvent. Every second, the time values stored in the 'buckets' are incremented if they are non-zero (i.e. contain mixed material vs. solvent). A Pot-Life alarm condition

exists if any of the 40 'buckets' contains a time value greater than the Pot-Life Time (see JOB parameters). A Pot-Life alarm may be cleared by entering a Pot-Life Time of zero seconds.

Flow Rate Tolerance

This is a number (in percent) that indicates how much deviation above and below the set point is acceptable. Increasing this number will reduce nuisance faults, but may lead to inaccurate fluid metering if set too high.

This number is a percent of the specified mix ratio for each of the 2 materials that is allowed to occur before the system faults with an OUT OF TOLERANCE fault. This is only updated after the volume of material, as set by the Tolerance Volume, has passed through the GUN. The accumulated flow volume is reset to 0 upon the application of each RUN command.

Flow Rate Tolerance Time

This parameter specifies how often the Flow Rate Tolerance should be checked. It is adjustable between 0.1 and 10.0 seconds. This parameter should never be set so low that less than 10 cc's of the slave CHANNEL material has flowed in this period of time. If this value is set too low, nuisance FLOW TOO HIGH or FLOW TOO LOW faults will occur.

Trigger OFF Delay

For automatic GUNs only. This parameter has two uses, depending on the position of DIP SW1-2 (or SW1-6) on the Channel Module.

In applications where the trigger off pneumatic action is slow, DIP switch SW1-2 (or SW1-6) on the Channel Module should be turned off so that when the GUN trigger signal is removed, the PID loop for the CHANNEL will continue to control the output of the MVR valve for the CHANNEL based on the measured flow rate until the end of the Trigger OFF Delay.

In applications where the trigger off pneumatic action is fast, DIP switch SW1-2 (or SW1-6) on the Channel Card should be turned on so that when the GUN trigger signal is removed, the PID loop for the CHANNEL holds at the last output value until the end of the Trigger OFF Delay. In this case, it is recommended that a trigger valve (color control valve) be installed at the inlet of the MVR valve. This valve should be driven by a solenoid controlled by the MVR Enable signal for the CHANNEL. In this way, the fluid line will not pressurize to the material supply pressure while the GUN is not triggered and there will be no delay in initiating flow when the trigger is turned on again, since the MVR valve is already at the position last commanded by the PID loop for the CHANNEL. If a trigger valve is not installed at the inlet of the MVR valve, then the Trigger OFF Delay should not be set greater than perhaps 0.5 seconds to avoid pressurization of the fluid line during the Trigger OFF Delay. If the delay is too long in this situation, excessive material may be released when the trigger is turned on again due to the higher pressure in the fluid line.

For 1K applications, DynaFlow supports a Lookup Table that is used to pre-position the MVR valve while the trigger is off. This feature permits fast response when the trigger turns on, since the MVR valve can be pre-positioned at approximately the correct position to obtain the new flow rate. To enable use of the Lookup Table in 1K applications, turn on DIP SW1-3 (or SW1-7) on the Channel Modular.

In either case, the CHANNEL output returns to the MVR LOW value at the end of the Trigger OFF Delay.

Trigger ON Delay

For automatic GUNs only. This parameter allows the user to create a delay between the time when the controller receives a trigger ON signal from a remote device to when it actually starts the flow of material. This parameter should be used only in special situations where pneumatic delays present a problem.

Default JOB#

Sets the JOB# which is loaded at power ON.

CHANNEL Configuration

Sets the current CHANNEL as a Master or Slave and sets the corresponding Master or Slave CHANNEL for two-component operation.

Hardware ID
The channel hardware configuration is stored as this parameter. It is necessary for the controller to know which fluid regulator type is being used so that the proper default PID control parameters can be loaded (Kp, Ki, Kd).

Diagnostic Parameters
The following parameters are available in the Local Operator Interface program as diagnostic parameters.

Force CHANNEL Digital Inputs
Forcing inputs permits debugging and troubleshooting to determine proper operation of the hardware. Each CHANNEL input can be forced ON therefore not requiring a hardware signal for that input to become active. If an external hardware input is present, a forced OFF command will have no effect unless the hardware input is removed.

Force CHANNEL Digital Outputs
Forcing outputs permits debugging and troubleshooting to determine proper operation of the hardware.

Force CHANNEL Analog Outputs
Forcing analog outputs permits debugging and troubleshooting to determine proper operation of the hardware.

Totals
Calendar date/time data is not available from the Interface Module and must be supplied by the Operator Interface or host computer.

Daily Total (For each JOB per CHANNEL)
Records accumulated total of all material through a CHANNEL since last reset. Any time period associated with this total is based on when it is reset. For example, if it is reset after each rack or part, at the end of a shift, end of the day, or end of day.

Yearly Total (For each JOB per CHANNEL)
Records the accumulated total of all material through a CHANNEL since last reset. Any time period associated with this total is based on when it is reset. For example, if it is reset at the end of a shift, end of the day, or end of the year.

Calibration Total (For each JOB per CHANNEL)
Records the accumulated total of all material through a CHANNEL while in CALIBRATION MODE of operation since last reset.

Grand Total (For each JOB per CHANNEL)
Records the accumulated total of all material through a CHANNEL, including while in CALIBRATION MODE of operation, since last reset. Any time period associated with this total is based on when it is reset. For example, if it is reset at the end of a shift, end of the day, or end of the year.

Daily Total (For all JOBs per CHANNEL)
Records the accumulated total of all material for all JOBs through a CHANNEL since last reset. Any time period associated with this total is based on when it is reset. For example, if it is reset after each rack or part, at the end of a shift, end of the day, or end of day.

Yearly Total (For all JOBs per CHANNEL)
Records the accumulated total of all material for all JOBs through a CHANNEL since last reset. Any time period associated with this total is based on when it is reset. For example, if it is reset at the end of a shift, end of the day, or end of the year.

Calibration Total (For all JOBs per CHANNEL)
Records the accumulated total of all material for all JOBs through a CHANNEL while in CALIBRATION MODE of operation since last reset.

Grand Total (For all JOBs per CHANNEL)
Records the accumulated total of all material for all JOBs through a CHANNEL, including while in CALIBRATION MODE of operation, since last reset. Any time period associated with this total

is based on when it is reset. For example, if it is reset at the end of a shift, end of the day, or end of the year.

Clean Total (For all JOBs per CHANNEL)

Records the accumulated total of all material for all JOBs through a CHANNEL, while in CLEAN MODE of operation, since last reset. Any time period associated with this total is based on when it is reset. For example, if it is reset at the end of a shift, end of the day, or end of the year.

Operational Parameters

Flow Rate

- Indicates total flow rate through a GUN.
- If in 2K, sums the total of each CHANNEL attached to the GUN.
- If in 1K, simply indicates the CHANNEL flow rate.

GUN Status

Indicates the current status of the GUN. This can be one of the following:

GUN Active (in run mode)
GUN Halted
CLEAN mode active
LOAD mode active
CALIBRATION mode active
GUN faulted
Transparent mode active
Analog Hold mode active
Pot Life Time Exceeded

JOB Queue

Stores the next JOB to be run. A RUN command following a HALT will load the next JOB # from the Queue. If more than one JOB # is toggled into the Queue before the next RUN command, then the newest JOB # is placed into the Queue and the previous JOB # is lost.

Error Log

- Also See Section on Error Codes

Each ERROR CODE can represent a CHANNEL, GUN or system error. See the Troubleshooting section for list of error codes. It is possible for more than one code to be issued at the same time.

The Interface Module stores ten (10) previous error codes until they are read by the Local Operator Interface program at which time they are automatically purged from its log. The Local Operator Interface program stores one hundred (100) previous error codes until they are manually cleared by the operator. The operator may also save the error codes to a floppy diskette for later analysis.

A PLC may obtain the current error conditions via RIO at any time, but it must maintain its own log.

Calibration Parameters

CHANNEL #

CHANNEL to be calibrated (1-8). Each CHANNEL must be calibrated separately.

Calibration Mode

Sets open-loop manual or closed-loop automatic calibration mode.

- Open-Loop or Manual Calibration Mode

This mode attempts to flow material at the highest flow rate possible by setting the output to the E/P transducer at the MVR HIGH parameter, located in the JOB table, for the selected CHANNEL. No less than 200 cc of material should be dispensed during calibration. Otherwise, the error in calibration will be too large. With 200 cc of material dispensed into a beaker, the error in calibration will be limited to+/- 0.5%, since the measured volume can be determined to only the nearest cc. The operator must open and close the calibration valve, or supply a GUN TRIGGER. The material volume that passed through the GUN is recorded. The measured volume is entered by the operator and a new Pulses/Liter is calculated.

- Closed-Loop or Automatic Calibration Mode
This mode sets the flow rate set point for the selected CHANNEL based on the Total Flow Rate and Ratio for the selected GUN, as stored in the JOB, since calibration should always be performed at the normal flow rate for the CHANNEL. The Calibration Time is also set based on the flow rate so that no less than 200 cc of material will be dispensed during calibration. Otherwise, the error in calibration will be too large. With 200 cc of material dispensed into a beaker, the error in calibration will be limited to +/- 0.5%, since the measured volume can be determined to only the nearest cc. The operator may override both the Calibration Time and Calibration Set Point, if desired. The operator must open and close the calibration valve, or supply a GUN TRIGGER. The material volume that passed through the GUN is recorded. The measured volume is entered by the operator and a new Pulses/Liter is calculated.

Automatic calibration mode may not be selected for the Master channel of a Manual Gun since it normally has no MVR to control flow rate.

Calibration Timer
Sets the time duration for calibration.

Calibration Set Point
Sets the desired flow rate for closed-loop automatic calibration.

Actual Flow Rate
Displays the actual flow rate during calibration. This value is based on the Current Pulses/Liter parameter, so it will be inaccurate if that parameter is inaccurate.

Current Pulses/Liter
Displays the current Pulses/Liter value used by the Channel Module during calibration. If this value is inaccurate at the time, which is why calibration is being performed, the Actual Flow Rate and Calculated Beaker Volume values will also be inaccurate.

Number of Pulses
Displays the actual number of pulses received from the flow meter during calibration.

Calculated Beaker Volume
Displays the calculated volume of material that should be in the beaker when the calibration is stopped. This value is based on the Current Pulses/Liter parameter and the Number of Pulses received, so it will be inaccurate if the Current Pulses/Liter parameter is inaccurate.

Measured Volume
The measured volume (cc's) of material in the calibration beaker. This value is entered by the operator. Once a non-zero value is entered, the operator may not enter a Measured Weight and Specific Gravity.

Measured Weight
The measured weight of material (grams) in the calibration beaker (less the tare weight of the beaker). This value is entered by the operator. The scales used should be accurate to 0.10 gram. This value is entered by the operator. The Measured Weight, along with the Specific Gravity, is used to calculated the Measured Volume. Once a non-zero value is entered, the operator may not enter a Measured Volume.

Specific Gravity
Specific gravity is the ratio of a material's density to the density of water. This can be obtained from the material safety data sheet (MSDS), or directly from the material supplier. This value is entered by the operator. The Specific Gravity, along with the Measured Weight, is used to calculated the Measured Volume. Once a non-zero value is entered, the operator may not enter a Measured Volume.

Calculated Pulses/Liter
This is the new Pulses/Liter value based on the Number of Pulses received from the flow meter during calibration and either the Measured Volume, or the Measured Weight and Specific Gravity. The operator may override the Calculated Pulses/Liter value by entering a Calculated Pulses/Liter value.

AUTOMATIC GUN APPLICATIONS

Automatic applicators use automatic means to vary the fluid flow through the use of transducers and material regulators. When used with single-component materials and an automatic spray applicator, the DynaFlow controller regulates total material flow.

When used with two-component materials, the DynaFlow controller regulates both the total fluid flow rates to the applicator and the mixing ratios. Each CHANNEL of the two-component material is programmed with predetermined values.

The following conditions must be met in order for the GUN to allow fluid flow:

1. There must be no system faults or GUN faults active.

2. There must be valid GUN configurations.

3. The proper inputs must be supplied.

When a GUN is placed in the RUN MODE, the controller sends a signal to the transducer to open to the MVR LOW setting (default = 0 VDC). On the first receipt of a trigger signal, the master channel immediately starts its closed loop (PID) control and updates the information to the transducer at a rate determined by the PID Update Time (default = 30ms) to adjust the actual flow rate to match the target flow.

At the same time, in a two-component system, the slave channel (catalyst) also closes its PID control loop and matches the actual flow rate to the target flow rate as determined by the requested flow rate ratio of the Master CHANNEL (resin) and slaved CHANNEL (catalyst).

Both channels run closed loop, independently of each other. If either CHANNEL is not able to achieve the required target flow rate, a FLOW TOO LOW or FLOW TOO HIGH fault will be issued by the controller for the offending channel.

After an amount of material has passed through the Master CHANNEL (set by the TOLERANCE VOLUME parameter), the DynaFlow controller compares that volume with the volume of the catalyst that flowed during that volume interval. If the ratio is outside of the tolerance as set by the FLOW TOLERANCE parameter, the DynaFlow controller will issue an OUT OF TOLERANCE fault for the offending GUN.

Dynamic Flow Rate Set Point Control

Dynamic Flow Rate Set Point Control is useful for changing flow rates of a material to achieve different coating thickness over different areas of the same part. Several examples are shown in the "Analog Control Settings chart" in this section. In automatic GUN applications, the total flow rate set point for the GUN may be varied in real time using either of two methods; Remote I/O (RIO) or Analog Input. If the RIO Set Point is zero and Analog Input Set Point is less than 0.25 volts, the Total Flow Rate set point comes from the JOB.

RIO Set Point

The Total Flow Rate set point for a GUN may also be input via Remote I/O (RIO). No scaling is required, since the Total Flow Rate value is sent in cc's/minute. RIO control is initiated when the value sent is non-zero, regardless if an Analog Input Set Point greater than 0.25 volts is presented to the Master CHANNEL.

Analog Input Set Point

The Total Flow Rate set point for a GUN may be input via an external analog signal (0-10 VDC or 4-20 ma) presented to the Master CHANNEL via the Channel Module. The Maximum Flow Rate and Minimum Flow Rate for the JOB determine the scaling applied to this analog input. Analog control is initiated when the input signal is greater than 0.25 volts and the RIO Set Point is zero. Note: When configured for current loop input, the minimum 0.25 volts is achieved since 4 ma produces 2.00 volts at the input due to the 500 ohm shunt resistor used in current loop mode.

ANALOG CONTROL SETTINGS					
Minimum Flow Rate CC's/Min	Maximum Flow Rate CC's/Min	Minimum Voltage or Current	Maximum Voltage or Current	CC's/Volt	CC's/Ma
0	100	0 volts or 4 ma	10 volts or 20 ma	10.00	6.25
100	300	0 volts or 4 ma	10 volts or 20 ma	20.00	12.50

Load Mode

LOAD MODE is similar to RUN MODE. However, in LOAD MODE, up to 10 faults are permitted before the gun will leave LOAD MODE and enter the FAULT MODE. All eleven (11) faults will appear in the Error Log screen. The GUN will automatically leave LOAD MODE and return to the READY MODE after a volume greater than or equal to the Mixed Volume has flowed since the last fault.

To Place A GUN In LOAD MODE:

1. The external GUN enable input must be supplied to the Master CHANNEL. No system or GUN faults can be active and the GUN configuration and JOB tables should be properly set.

2. The GUN Trigger input is required for automatic GUNS.

3. A signal must be supplied to the Master CHANNEL LOAD input or a LOAD command issued from the Operator Interface Panel or the host controller.

4. Flow will begin when the Trigger signal is supplied.

To Exit LOAD MODE:

1. Simply remove the LOAD input and apply the HALT input or issue a command from the Operator Interface Panel.

MANUAL HAND GUN APPLICATIONS

The DynaFlow controller can provide closed loop regulation for manual hand GUN application of two-component materials. When used with hand spray GUNs, the painter regulates the total fluid flow with the spray GUN trigger. Regulation of two-component materials is based on pre-set ratios located in the JOB tables.

When the GUN is placed in RUN MODE and a trigger signal has been received, the master channel (resin) goes full open, or to the setting specified for that channel as MVR HIGH, and stays at that value. The slave channel goes to the pressure setting specified for that channel by MVR LOW. The controller determines the flow rate of the master channel and calculates the set point of the slaved (catalyst) CHANNEL based on the ratio setting for the GUN. The first time that the control loop is activated after a new JOB has been loaded, 40 psi is output to the Slave CHANNEL for a short interval. This is done to assist the control loop initialization. The detection of a Trigger OFF signal or the lack of Master CHANNEL flow meter pulses will cause the controller to output the MVR LOW setting to the Slave CHANNEL. In addition, the PID control loop is frozen and the last control output stored. Upon reapplication of a Trigger signal, or the detection of Master CHANNEL flow meter pulses depending on the dip switch setting on the Channel Module, the stored Slave CHANNEL control signal is output for a short delay time and then the PID control loop is again initiated. This results in stable control loop operation regardless of the duration or quickness of trigger signals.

The flow rate of the master CHANNEL will be continuously monitored during operation and the slaved CHANNEL set point adjusted accordingly.

If the slaved CHANNEL cannot achieve the proper flow rate, the software issues a FLOW TOO LOW or FLOW TOO HIGH fault.

Additionally, the software verifies ratio after each TOLERANCE VOLUME has flowed through the master channel flow meter by comparing the two volumes that flowed during that time period and calculates a "ratio error". If that error is greater than the FLOW TOLERANCE parameter, the software issues an OUT OF TOLERANCE fault.

When the GUN is given a HALT command, both fluid regulators are set to 0 psi.

Load Mode

LOAD MODE is similar to RUN MODE. However, in LOAD MODE, up to 10 faults are permitted before the gun will leave LOAD MODE and enter the FAULT MODE. All eleven (11) faults will appear in the Error Log screen. The GUN will automatically leave LOAD MODE and return to the READY MODE after a volume greater than or equal to the Mixed Volume has flowed since the last fault.

To Place A GUN In LOAD MODE:

1. The external GUN Enable input must be supplied to the Master CHANNEL. No system or GUN faults can be active and the GUN configuration and JOB tables should be properly set.

2. The GUN Trigger input is not required for manual GUNS.

3. A signal must be supplied to the Master CHANNEL LOAD input or a LOAD command issued from the Operator Interface Panel or other host controller.

4. Flow will begin immediately.

To Exit LOAD MODE:

1. Simply remove the LOAD input and apply the HALT input, or issue a command from the Operator Interface Panel (host controller).

GENERAL

The following are common to both AUTOMATIC and MANUAL GUN operation.

Pulsed and Maintained Inputs

Pulsed inputs detect the transition in voltage, either up or down. This form of input is comparable to a momentary push-button. Pulsed inputs are timing sensitive, e.g. the pulse MUST be present at the input at the proper time in relation to other input signals. The duration of the pulse is also critical. Pulsed inputs should be supplied for at least 0.25 seconds in duration. The input signal is ignored after detection by the controller and can be removed at any time after the minimum 0.25 seconds.

Maintained inputs require the voltage to be held at a level, either low or high in order to perform the intended function.

System Inputs and Outputs

System I/O applies to all GUNs in the system. They provide system status, input for JOB numbers, and all system commands.

JOB Select Inputs

These inputs are used to select a JOB number from the external PLC or other host controller if serial communication is not being used. These inputs represent Binary Coded Decimal (BCD) that translates to 3 digits, each digit represented as a 4-bit binary code. The system inputs shown in Figure 6 are used to select and enter a JOB number. The JOB Select inputs are used in conjunction with the GUN Mask inputs to determine which GUNs will accept the JOB number represented by the total of the active JOB Select Bits. The inputs are pulsed signals of at least 0.25 seconds duration.

Mode changes require the previous signal to be removed for 0.25 seconds before the new mode signal is asserted. Therefore, the best practice is to turn on only one mode signal at a time for no less than 0.25 seconds and wait no less than 0.25 seconds before asserting another mode signal. The HALT signal is an exception. The HALT signal may be asserted at any time, for no less than 0.25 seconds, and is recognized over all other signals.

JOB SELECT INPUTS

Discrete System Inputs	Toggles (enters) the Selected Values	Value
JOB Select #1	Selects BCD Bit #1	1
JOB Select #2	Selects BCD Bit #2	2
JOB Select #4	Selects BCD Bit #4	4
JOB Select #8	Selects BCD Bit #8	8
JOB Select #10	Selects BCD Bit #10	10
JOB Select #20	Selects BCD Bit #20	20
JOB Select #40	Selects BCD Bit #40	40
JOB Select #80	Selects BCD Bit #80	80
JOB Select #100	Selects BCD Bit #100	100

Example: *JOB #25 is Requested*

Decimal Number = 25
Most Significant Digit (100's) = 0 = binary 0000
Most Significant Digit (10's) = 2 = binary 0010
Least Significant Digit (1's) = 5 = binary 0101

JOB numbers can be entered into the JOB Queue at any time regardless of the operating mode.

These signals are used in conjunction with the GUN MASK inputs to determine which GUN(S) will receive the JOB # as input by the program select inputs. The JOB SELECT inputs must be present at the time that the JOB SELECT STROBE signal is activated.

The basic sequence for selecting and entering JOB numbers is:

1. Select and hold high the appropriate JOB SELECT input bits.

2. Select and hold high the appropriate GUN MASK input(s). This can be performed simultaneously with the JOB SELECT input bits.

3. Select and hold high the JOB SELECT STROBE input.

4. Return all inputs to the low state (0 VDC).

Figure 5 gives a graphic representation of the timing required for selecting a JOB #. Normally, the JOB SELECT inputs and GUN MASK inputs are held high for a slightly longer duration than the JOB SELECT STROBE. This ensures that the new JOB SELECT and GUN MASK inputs are correct before strobing the information into the controller.

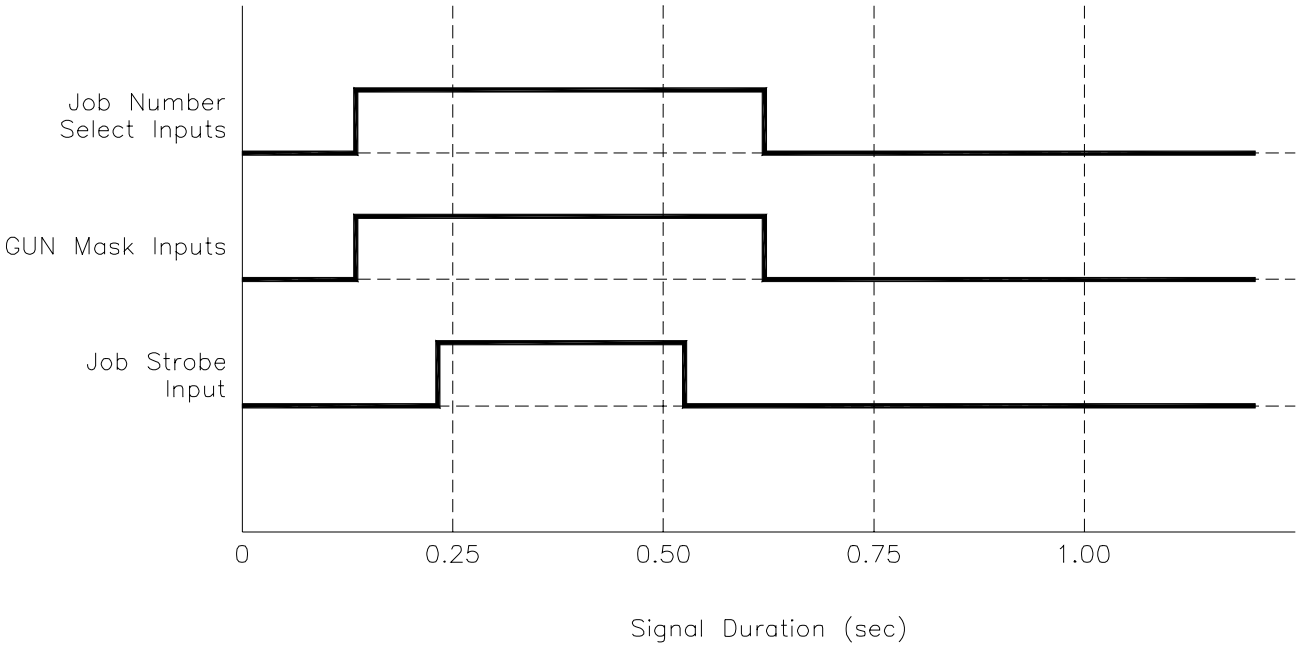


Figure 5: JOB Select Timing Diagram

Figure 6 shows 4 Toggle Signals. By following the dashed line down you can determine the states of the various signals for each example. Maintained inputs that are high are “active”. Pulsed signals that go high at that instance are also active. The list below will help explain what JOB number is selected, and to which of the 8 GUN queues the JOB is entered into.

Toggle 1		***Toggle 3***	
JOB number selected:	69	JOB number selected:	63
GUNs Masked to accept JOB #69:	1,3	GUNs Masked to accept JOB #63:	NONE
Toggle 2		***Toggle 4***	
JOB number selected:	26	JOB number selected:	22
GUNs Masked to accept JOB #26:	2,5,8	GUNs Masked to accept JOB #22:	4

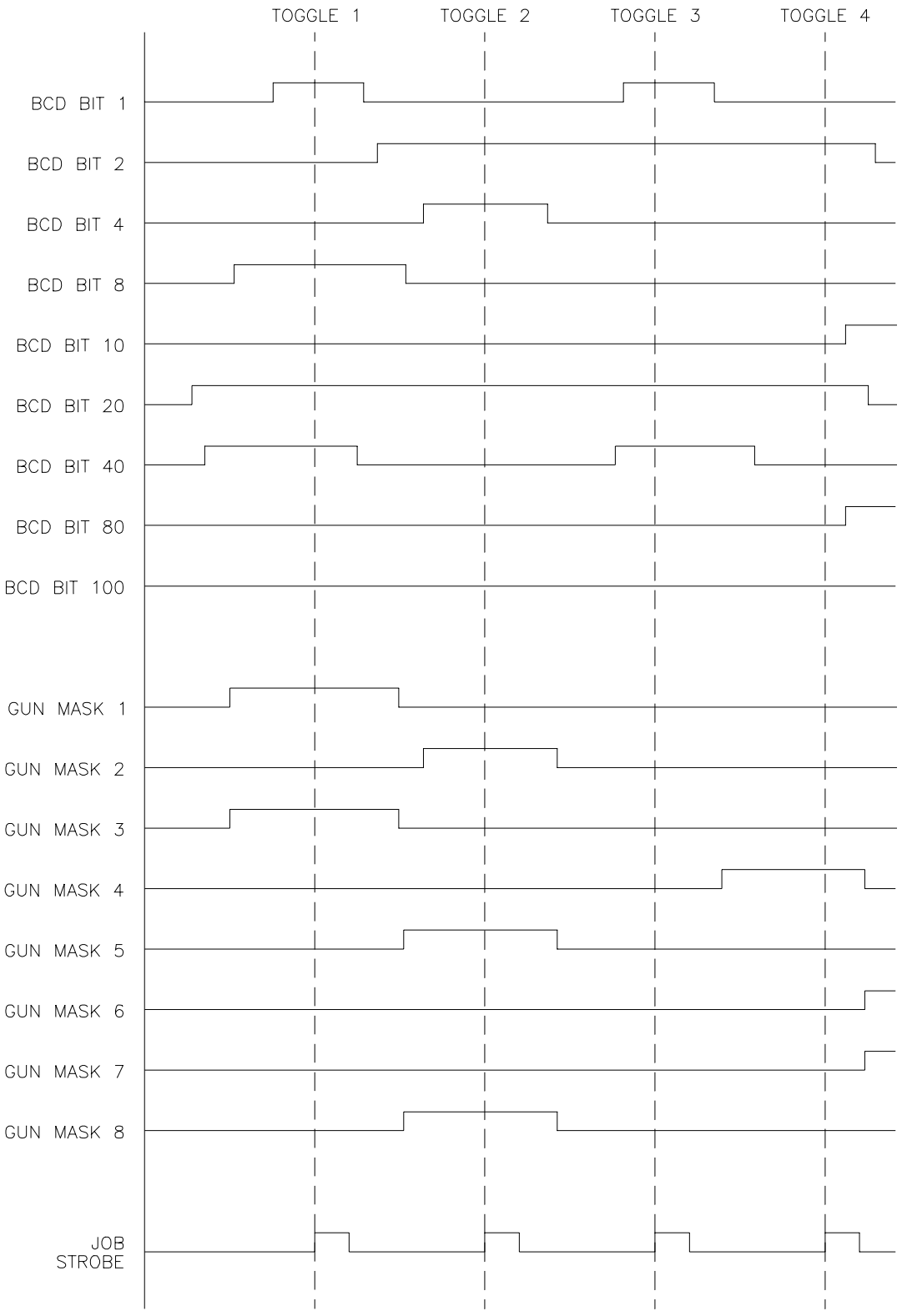


Figure 6: JOB Selection Timing Diagram Sample

JOB Queue

The JOB Queue is an input buffer for each of the 8 possible GUNs in the system. JOBs are loaded into the Queue only if the GUN is already operating a JOB in the RUN, LOAD, CLEAN, CALIBRATE modes. Each of the 8 GUNs has a JOB Queue with a fixed length of 1 (JOB). This permits the next JOB number for GUN #n to be stored before the current JOB has been halted. After the current JOB has been halted the next RUN input signal will initiate the next JOB number located in the queue.

NOTE

► If another JOB number is loaded into the Queue before it is emptied, the queue contents will be replaced with the second entry. See the following examples.

JOB Number is Loaded into the Queue Before it is Emptied

1. GUN #3 is running JOB #32 and has NOT been halted.

2. JOB #47 is in the Queue for GUN #3.

3. JOB #54 is now entered into GUN #3's Queue.

4. This will result in JOB #54 replacing JOB #47 for GUN #3.

JOB #47 became "lost" and was not processed by GUN #3.

The Correct Sequencing Should Be:

1. GUN #3 is running JOB #32 and has NOT finished. (Current JOB #)

2. JOB #47 is in the Queue for GUN #3. (Next JOB #)

3. GUN #3 is halted.

4. The Run input signal is pulsed. (The Trigger input does not effect the JOB queue)

5. JOB #47 moves up and the Queue empties. JOB #47 becomes the current JOB #.

6. JOB #54 is entered into GUN #3's Queue. JOB #54 is now the next JOB for GUN #3.

JOB Queue Defaults

If no JOB is entered into the Queue (the Queue is empty) the current JOB number reverts to the last JOB number entered if the GUN Run signal is made active.

1. A Halt signal input will halt the current JOB.

2. Pressing Run will restart the GUN with the old JOB number.

3. Entering a new JOB number and selecting Run will restart the GUN with the new JOB number.

Reverse Flow Detection

For two-component systems, both forward and reverse fluid flow is detected through the flow meter. Reverse flow detection can help prevent mixed two-component material from backing up into the fluid supply system due to check valve failure. When the controller detects reverse fluid flow in excess of the programmed REVERSE FLOW LIMIT, it will immediately shut OFF the fluid regulator valves and prohibit mixed material from contaminating the fluid supply.

Reverse flow rate is displayed on the main screen of the Local Operator Interface as a flow rate bar colored red, instead of green for normal flow rate.

Pot-Life Fault

Each of the GUNs configured as two-component has an associated Pot Life Time located in the JOB Parameters. These timers are used for materials that can harden or setup after a specific time. Hardening material in fluid lines or the spray applicator can cause costly downtime and maintenance to correct. The output of the POT-LIFE TIMER alarm can be connected directly to an external PLC for automatic initiation of the cleaning cycle, or to an alarm to alert the operator. The Horn Code, located in the System configuration table, determines if a Pot-Life Fault activates the horn. A

Pot-Life Fault can only be reset by eliminating the expired material from the fluid lines, or by setting the Pot Life Time to zero in the JOB Parameters. The horn will be turned off, however by issuing a Clear Faults command. A Pot-Life Fault **does not** turn off the GUN.

The DynaFlow system uses the Mixed Volume and the Pot-Life Time when it monitors the flow rate of the Gun. Pot-Life is monitored by dividing the Mixed Volume into 40 equal sized "buckets" of material. When an amount of material has flowed that equals the "bucket" volume, the 40 "'buckets" are time-shifted so the oldest "bucket" is eliminated, representing the material that has vacated the Mixed Volume tubing at the GUN, and a new 'bucket' is added. If the GUN is in either Run or Load mode, a time value of 1 second is placed in the new "bucket" to represent mixed material. If the GUN is in Clean mode, a time value of zero is placed in the new "bucket" representing solvent. Every second, the time values stored in the "buckets" are incremented if they are nonzero (i.e. contain mixed material vs. solvent). A Pot-Life alarm condition exists if any of the 40 "buckets" contains a time value greater than the Pot-Life Time (see JOB parameters). A Pot-Life alarm may be cleared by entering a Pot-Life Time of zero seconds.

Calibration Mode

The first time that the system is operated after installation or when using new fluids, calibration is recommended for the flow meters (CHANNELs). There are several procedures that can be used for calibration (see the Calibration Mode Section). Flow meters can be calibrated by fluid weight or by fluid volume. All calibration measurements are metric, such as weight is measured in grams and volume in cubic centimeters (cc).

Procedure 1 (Manual)

1. Place the controller in Calibration Mode - select manual procedure.

2. Place a graduated container beneath the calibration valve or applicator paint feed tube/ nozzle.

3. Start fluid flow. Open the calibration valve or trigger the GUN.

4. Collect fluid manually into the graduated container for a specific time.

5. Stop fluid flow.

6. Select "Stop Cal".

7. Measure the amount of fluid collected.

8. Enter the measured volume of fluid.

9. Accept or reject the new Pulses Per Liter number that the controller calculated. The flow meter calibration will automatically be updated.

Required:

- Specific gravity of material
- Digital scale, accurate to 0.10 grams

1. Weigh the empty beaker and record the tare weight for later calculations.

2. Enter the calibration mode for the desired CHANNEL.

3. Perform the desired collection procedure above.

4. Weigh the fluid in the beaker and subtract the beaker tare weight to get the net weight of the fluid collected.

5. Entered the measured weight.

Procedure 2 (Automatic)

1. Place the controller in Calibration Mode - select automatic procedure.

2. Set the desired flow rate. The pre-set flow rate set point for the selected CHANNEL is based on the Total Flow Rate and Ratio for the GUN, as stored in the JOB, since calibration should always be performed at the normal flow rate for the CHANNEL. The operator may override this value, if desired.

3. Set the desired time to collect fluid. The pre-set time for the selected CHANNEL is based on the desired flow rate for the CHANNEL so that 200 cc of material will be dispensed. The operator may override this value, if desired.

4. Make sure that the applicator is triggered OFF and any calibration valves are closed. Also make sure that the fluid has been loaded up to the point at which the fluid sample is to be taken (GUN output or calibration valve).

5. Place a graduated container at the place of fluid collection (GUN or calibration valve).

6. Trigger the GUN ON (manually or automatic) or open the calibration valve.

7. Select "Start Cal".

8. Collect and measure the fluid. Fluid flow will stop once the timer has expired.

NOTE

► It is not important that fluid be flowing, or triggered ON, for the entire calibration time. The calibration procedure is based only on the volume of fluid that was registered. Automatic mode simply supplies a convenient means to calibrate at a specific flow rate and for an approximate amount of time.

9. Enter the measured amount.

10. Accept or reject the new Pulses Per Liter number that the controller calculated. The flow meter calibration will automatically be updated.

Calibration by Weight

If calibrated by volume, it is not necessary to calibrate by weight.

Required:

- Specific gravity of material
- Digital scale, accurate to 0.10 grams

1. Weigh the empty beaker and record the tare weight for later calculations.

2. Enter the calibration mode for the desired CHANNEL.

3. Perform the desired collection procedure above.

4. Weigh the fluid in the beaker and subtract the beaker tare weight to get the net weight of the fluid collected.

5. Entered the measured weight.

NOTE

► An unassigned CHANNEL cannot be calibrated. The CHANNEL must be assigned to a Gun and the Gun must be configured.

► If the weight method is used, the specific gravity of the material must be entered.

► The new value for pulses per liter will be automatically calculated and updated.

► Repeating the calibration procedure is highly recommended to ensure it was performed satisfactorily.

Clean

Any CHANNEL or Gun can be placed into a CLEAN mode by an external command or through the Host controller. The Clean mode forces the material regulator fully open until turned OFF. The GUN Enable and CLEAN inputs must be active and all system or GUN faults cleared. To properly exit the CLEAN MODE, the GUN Clean input should be removed followed by a GUN Halt signal, or a command issued from the Operator Interface Panel (host controller). Each CHANNEL must be set as a "clean" CHANNEL in the Clean CHANNEL parameter located in the Gun Configuration table.

Full Error Detection

The DynaFlow controller will detect certain error conditions and indicate the cause of the error with a code. The code indicates the faulted Gun and CHANNEL, as well as giving you a text error message. All errors are categorized by CHANNEL, Gun or System depending on the type of error. The error codes and conditions are listed in the appendix and include:

- Tolerance errors in fluid flow rates for each material
- Tolerance errors in fluid flow ratios for each material
- Reverse fluid flow
- Low material flow
- High material flow
- Pot-life timers expired
- Memory errors
- Backup disk errors
- Configuration errors
- System errors

PROCEDURES

First-Time System Start-Up

This section is intended for skilled trades personnel. Always be aware of safety guidelines while operating equipment.

Before power is supplied to the DynaFlow Fluid Flow Control, take time to familiarize yourself with the controls. Unexpected actions can occur during initial power-up sequences and you should know which controls shut down the controller. The following information serves as a guide for initial system testing and start-up. Operational problems will be avoided if time is taken to follow the steps outlined below. Read through the entire sequence first before performing any actions.

- Verify that the Channel Module dip switch settings are correct. Reference Channel Card Settings in the HARDWARE SETTINGS section.
- Visually inspect the entire system. Review the "Installation" section of this manual and any related manuals such as the flow meter and material regulator. Verify that all air and fluid lines are routed properly and fittings are secure.
- Make sure that the required fluid filtration is installed. Fluid lines should be flushed out manually before installation of the flow meters to ensure that any large particles or contamination located from the fluid filter to the flow meter connection are removed.
- Make sure that the required air filtration for the E/P transducer(s) is installed.
- If rotary applicators are used, remove the front shroud and bell cup to expose the paint feed tube. If GUNs are being used, point the applicator(s) downward if possible. This will prevent the possibility of material from contaminating the applicator and provide additional safety for any personnel working near the system.
- Turn ON the main power disconnect to the fluid flow control panel.
- Turn ON the power switch located on the flow control panel.
- Verify that the local Operator Interface is working properly and that no errors are being reported. Refer to the "Operator Interface" manual for additional information.
- Turn ON the system host controller (PLC or PC) and verify proper operation. Configure the flow controller. This is usually performed at the local Operator Interface panel, but can be through the system controller depending on the installation. Refer to the "Operator Interface" manual for additional information.
- Turn ON the factory air supply to the E/P transducer(s) and adjust the regulator to 90 psi minimum, 110 psi maximum.

- Turn ON the fluid supply pressure to the material regulator.
- Inspect the air and fluid system for any leaks and fix before continuing. Fluid should NOT be flowing through the system at this point.
- Perform a system flush, one GUN at a time.
- Load paint.
- Perform a calibration check of each CHANNEL.
- Verify operation of any safety or system interlocks.
- Perform and verify remaining system operation. This includes any automatic operations such as a color change sequence.
- Observe the fluid flow response of each GUN. Refer to "Operator Interface" manual and related sections of this manual.

Normal Start-Up Procedure

Before attempting start-up:

- Inspect the entire system and make sure that all air and fluid hoses are in place and secure, and that all other system components are in good condition.
- Review and perform any required preventive maintenance procedures.
- Inform personnel in the immediate area that the system is being started.
- Observe the operation of the system as it is started and be ready to shut it down in the event of a problem.

The following procedure assumes that the system was running normally when previously operating. This is only a recommended procedure. Variance from this procedure is dependent on the installation, operation and protocols.

1. Turn on the main power disconnect to the fluid control panel.

2. Turn ON the panel power switch.

3. Verify that the Operator Interface is operating normally and that there are no errors.

4. Turn ON the factory air supply to the E/P transducers and any other pneumatic control circuits.

5. Supply fluid pressure to the system.

6. Turn ON any auxiliary equipment that may be interlocked with the fluid flow controller such as the booth exhaust.

7. Perform a system flush of each GUN.

8. LOAD the material to be sprayed. This may be controlled automatically or manually depending on the system.

9. A "dummy" JOB can be run to verify the operation of the entire coating system before spraying production parts. In general, the longer a system is shutdown, the more that importance should be placed on the start-up procedure.

Normal Shutdown Procedure

The shutdown procedure should be basically opposite of the start-up procedure. The degree or level to which the system is shutdown depends on how long the shutdown is to last. The following are considerations when shutting down the system.

1. Place the system in a safe mode when personnel will not be present for extended periods of time.

2. It is recommended to keep fluid loaded in the flow meters to prevent the gears from sticking during start-up. Generally this is the flushing solvent.

3. Total system shutdown, including AC power, air and fluid pressure is recommended if the system is to be shutdown for more than one shift.

Clean Mode

CLEAN mode can only be initiated if the GUN has been given a Halt input and is enabled and no faults are active. Each CHANNEL can be independently configured to accept the CLEAN command. For two-component GUNs, it may not

be desirable to clean both the resin and catalyst at the same time, therefore each CHANNEL can be configured as a “clean” CHANNEL independently by setting the Clean CHANNELs parameter in the GUN configuration table.

The CLEAN operation can be started one of several ways. The first method is to simply supply the GUN CLEAN input. The second method is to initiate the CLEAN mode through the OPERATOR INTERFACE or host controller (refer to the appropriate manual). Actual cleaning time and sequences, including soft air push-out (purge) is performed by the system controller or the pneumatic interface panel, and not directly by the fluid flow controller.

The CLEAN mode is terminated when deactivated from the Operator Interface or when a HALT signal is supplied.

Calibrate Mode

CALIBRATE mode can only be initiated if the GUN is enabled and no faults are active. The CALIBRATE operation is initiated and controlled through the OPERATOR INTERFACE or host controller (refer to the appropriate Operator Interface or Programming manual).

The CALIBRATE mode is terminated when deactivated from the Operator Interface or if the Enable input is removed.

Recovering From Faults

This section:

- Identify and record the fault
- Evaluate action(s) to be taken
- Perform corrective action(s)
- Reset and run

PID CONTROL

The ITW Ransburg DynaFlow Fluid Flow Controller incorporates a form of a Proportional-Integral-Derivative (PID) algorithm with additional functions or modifications which are specific to the efficient control and delivery of materials in paint spray applications. PID is the most widely used method for closed loop controllers in all areas of industrial control.

The PID control algorithm develops a control signal composed of three elements. The proportional element is simply proportional to the difference between the current fluid flow and the desired fluid flow, referred to as the error. The integral element of the control output is proportional to the integral of the error signal, and the derivative element is proportional to the derivative of the error signal. These are explained in more detail below. A general understanding of how a PID controller works will be beneficial in producing the best overall fluid flow response from the fluid delivery system. This can lead directly to reduced paint usage and higher quality of finish.

Largely the air and fluid control components and their placement with respect to each other determine limitations on general fluid flow response. This includes the following:

- Type of fluid regulator and needle or diaphragm ratio (pilot pressure vs. fluid pressure).
- Rheology of the fluid(s) such as viscosity, and shear.
- Length and diameter (volume) of the air pilot lines from the V/P or I/P transducer to the fluid regulator.
- Back pressures created by fluid control devices such as the applicator fluid passage restrictions.

Error

The difference between the requested (set point) value and the actual process being controlled.

Deadband

This represents a flow range above and below the set point value in which the PID control is suspended. This keeps the control output from continually changing and produces stability when close to the requested value.

Proportional Action (Kp)

Proportional action simply means that the controller output changes in proportion to the error between the set point and the actual flow. It is also commonly referred to as gain, proportional gain and proportional band to name a few. If the proportional gain is set too high, the system will oscillate. If set too low, the fluid flow will "wonder" due to a lack of responsiveness.

Integral Action (Ki)

The Integral element of the PID controller forces the actual output (flow) to match the desired by utilizing the sum of the error in flow rate.

Integral action is proportional to the sum of the error. This term is needed to remove long term, or steady-state error that cannot be removed by the proportional term.

Integral action is the most important factor governing control near the set point. The integral term changes the control output as a result of a continuing error between set point and actual. The integral term will continue to shift the output until the actual flow rate falls within the Deadband value.

Integral action will also effect transition response times. The greater the change in requested flow rate, the more the integral action will effect the response time.

The integral gain, Ki, must be chosen such that oscillations do not occur. Increased integral gain will cause faster response times, but can lead to process instability and uncontrolled oscillations.

Derivative Action (Kd)

Derivative action is proportional to the rate of change of the error. The derivative term dampens, or slows down process overshoot and improves the response to changes in the process being controlled. Another way to view this term is that it "anticipates" or leads what is happening with the actual flow.

Derivative action provides a sudden shift in the control output as a result of a quick change in the actual flow (transient) or set point. If the actual flow drops quickly, the derivative term will provide a large change in the output in an attempt to correct the perturbation before it goes too far.

Derivative action should be associated more with transient response control and less with overshoot inhibition such as during start-up, or trigger ON.

Oscillation due to derivative action is typically a cyclic "wander" away from the set point.

Putting It All Together

The optimum PID controller settings are determined based on the application. Types of applications that will effect PID considerations are:

- Dynamic control of flow rate while spraying parts - robot mounted,
- Short GUN trigger times
- Long trigger times - constant flow rate requested during entire part
- Precise 2K mixing ratio required at all times
- Low flow rate applications
- Applicators mounted on oscillators or reciprocators that may produce cyclic back pressures within the fluid lines
- Systems with piston pump type supplies
- Long pilot line lengths from fluid regulator to transducer

General Guidelines

1. The type of fluid regulator represents the largest overall impact on system response. The following table lists control settings for various fluid regulators that should result in stable control. The determination of these parameters was based upon worst case conditions and therefore

constitutes "conservative" control response. It is recommended to start with these values and confirm stable response before trying to achieve faster response from the system. Generally, when adjusting the Proportional (Kp) and Integral (Ki) gain parameters, adjust both up or down proportional to themselves. In other words, if faster response is desired and the system is currently operating stable, assume the starting Kp value is 500 and the starting Ki value is 2000. You would adjust the Kp value to 550 (10% increase) and the Ki value to 2200 (also a 10% increase). The deadband parameter should be kept to 1 and the differential gain (Kd) at 0.

Quick triggering applications: For applications requiring multiple, short trigger cycles, more stable response can typically be obtained by adjusting the Kp down to approximately 75-100, while adjusting the Ki to approximately 1000-2500.

2. The Integral gain is probably the most important setting and has the greatest overall impact on response behavior associated with the fluid flow control system. This parameter can also be adjusted through a relatively large range without creating instability.

3. The Proportional gain can improve system response, especially for large set point changes, but care should be taken not to increase by more than approximately 25% of the default setting. The system can easily become unstable and go into oscillation if adjusted to high.

DEFAULT CONTROL PARAMETERS

Fluid Regulator	Kp	Ki
MVR #2	10	1200
MVR #3	15	1000
MVR #4	20	800
DR1, 1:1	50	1000
DR1, 1:2	45	1200
DR1, 1:3	40	1400
DR1, 1:4	35	1600
DR1, 1:6	30	1800
DR1, 1:8	25	2000
DR1, 1:10	20	2200

TYPICAL RANGES FOR CONTROL PARAMETERS

Fluid Regulator	Kp Typical Range	Ki Typical Range
MVR #2	0-500	600-2400
MVR #3	0-500	500-2000
MVR #4	0-500	400-1600
DR1, 1:1	0-500	500-2000
DR1, 1:2	0-500	600-2400
DR1, 1:3	0-500	700-2800
DR1, 1:4	0-500	800-3200
DR1, 1:6	0-500	900-3600
DR1, 1:8	0-500	1000-4000
DR1, 1:10	0-500	1100-4400

4. The differential gain has the least effect on system performance and should be left at the default setting of zero (0).

5. Response times will be limited by changes in the fluid mechanics of the system. It will take longer to achieve requested flow rate as fluid viscosity increases or fluid supply pressure decreases. In other words, the same response cannot be achieved for a 50 sec, Zahn #2 material as for a 20 sec, Zahn #2 material given the same fluid supply pressure and fluid control components. This is important to understand, especially for 2K systems. It may be an advantage to purposely slow down the response of the quicker reacting (thinner) fluid such that it will remain closer to that of the thicker fluid in 2K systems during triggers or changes in the set point. Other options are to decrease the supply pressure for the thinner fluid or increase pressure for the thicker fluid.

6. "Reset Windup" condition. Reference "Troubleshooting" in the "Maintenance" section. Reset windup is a condition when the controller does not have enough strength to reduce the error back to zero. This occurs due to unusual restrictions in the fluid control devices or fluid lines and indicates that the system is not tuned properly or there is a problem. If the actual fluid flow is less than the requested flow (minus the dead band value), the controller will continue to increase the output until it reaches the maximum allowable fluid regulator pressure. This is due to the Integral term of the PID control. If the restriction causing the low

flow condition is removed suddenly while a large control output signal exist, then a relatively long amount of time is required for the Integral term of the PID to reduce the control output back to a normal range since the Integral term is proportional to time and also due to the inherent response of the system. If fluid flow response has changed significantly with the same setup that previously produced good response, then inspect the system for component failure and check the fluid type and viscosity.

Alternate PID Equation

The normal PID equation is based on the error between the desired set point and the actual flow rate for the CHANNEL. If the set point is varied dynamically by a PLC via RIO or by a robot via Analog Input, it may be desirable to implement an alternate form of the equation. The alternate form of the equation uses the set point for the proportional term of the equation. The Integral and Derivative terms are the same, but slightly different scale factors are used.

To enable the alternate PID equation, turn on DIP SW1-4 (or SW1-8) on the Channel Module for each CHANNEL of the GUN.

PID Tuning Methods - Standard PID

1. Select the nominal flow rate for the GUN.

2. Set Kp and Kd parameters to zero. Do this for both CHANNELS if this is a two-component GUN.

3. Set Ki for the Slave CHANNEL to zero (assuming this is a two-component GUN).

4. Set Ki for the Master CHANNEL to the default value shown in "Default Control Parameters" chart and "Typical Ranges for Control Parameters" chart in this section.

5. Cycle the GUN from READY to RUN so the new parameters are sent to the Channel Module(s).

6. Trigger the GUN. If the flow rate does not oscillate, or the oscillations decrease in amplitude in a few seconds, increase Ki by 100 and repeat from step 5. If the flow rate oscillates with increasing amplitude, decrease Ki by 50 and repeat from step 5. 8If the flow rate oscillates with a constant amplitude, proceed to step 7.

7. Set Ki to one-half the present value.

8. Set Kp to the default value shown in the "Default Control Parameters chart" and Typical Ranges for Control Parameters chart" in this section.

9. Cycle the GUN from READY to RUN so the new parameters are sent to the Channel Module(s).

10. Trigger the GUN. If the flow rate does not oscillate, or the oscillations decrease in amplitude in a few seconds, increase Kp by 30 and repeat from step 9. If the flow rate oscillates with increasing amplitude, decrease Kp by 15 and repeat from step 9. If the flow rate oscillates with a constant amplitude, proceed to step 11.

11. Set Kp to one-third the present value.

12. Cycle the GUN from READY to RUN so the new parameters are sent to the Channel Module(s).

13. Trigger the GUN. If the flow rate does not oscillate, proceed to step 14. If the flow rate is oscillating, reduce Ki by 50 and/or reduce Kp by 15 and repeat from step 12.

14. At this point, the tuning procedure is completed for most flow control applications. However, if there is a great amount of lag time from the point of sensing the flow rate to where the material volume regulator is located, the derivative term of the PID equation may be required. In that case, set Kd to the default value shown in "Default Control Parameters" chart and "Typical Ranges for Control Parameters" chart in this section.

15. Cycle the GUN from READY to RUN so the new parameters are sent to the Channel Module(s).

16. Trigger the GUN. If the flow rate does not oscillate, or the oscillations decrease in amplitude in a few seconds, increase Kd by 30 and repeat from step 15. If the flow rate oscillates with increasing amplitude, decrease Kd by 15 and repeat from step 15. If the flow rate oscillates with a constant amplitude, proceed to step 17.

17. Set Kd to one-eighth the present value.

18. Cycle the GUN from READY to RUN so the new parameters are sent to the Channel Module(s).

19. At this point, the tuning procedure is completed. The resulting Kp, Ki, and Kd parameters should produce the fastest response with minimal overshoot and/or oscillation. If oscillation does occur with these PID parameters, consider reducing each value by the same percentage. This will lower the overall gain resulting in a slightly longer time to achieve the desired set point and a slower response to disturbances, such as paint pumps.

20. For two-component GUNs, repeat steps 4 through 19 for the Slave CHANNEL.

PID Tuning Methods - Alternate PID

1. Set the maximum set point for the GUN.

2. Set Ki and Kd parameters to zero. Do this for both CHANNELS if this is a two-component GUN.

3. Set Kp for the Master CHANNEL based on the following formula:

$$Kp = \frac{(8.0 - \text{MVR LOW}) * 25{,}500}{\dfrac{10}{\dfrac{(\text{Max. Gun Set Point} * \text{Ratio})}{(\text{Ratio} + 1)}}}$$

For example:
Max. Gun Set Point = 400 cc/min.
MVR LOW = 15 PSIG
Ratio = 3:1

$$Kp = \frac{(8.0 - 15) * 25{,}500}{\dfrac{10}{\dfrac{(400 * 3)}{(4)}}}$$

$$= \frac{6.5 * 25{,}500}{300}$$

$$= 552.5$$

$$= 550$$

4. Set Kp for the Slave CHANNEL based on the following formula:

$$Kp = \frac{(8.0 - \text{MVR LOW}) * 25{,}500}{\dfrac{10}{(\text{Max. Gun Set Point})}}$$
$$(\text{Ratio} + 1)$$

For example:
Max. Gun Set Point = 400 cc/min.
MVR LOW = 15 PSIG
Ratio = 3:1

$$Kp = \frac{(8.0 - 15) * 25{,}500}{\dfrac{10}{\dfrac{(400)}{(4)}}}$$

$$= \frac{6.5 * 25{,}500}{100}$$

$$= 1657.5$$

$$= 1660$$

5. Cycle the GUN from READY to RUN so the new parameters are sent to the Channel Module(s).

6. Trigger the GUN. If the flow rates do not achieve their individual CHANNEL set points, adjust the upstream fluid pressures until they both are on target.

NOTE: This may require repeated triggers and fault resetting. Once the proper fluid pressures are set, the maximum set point for the gun will be flowing, ratioed properly between the CHANNELS, with the MVR pressures at 80 PSIG.

7. Set the Ki parameters for both channels to a value between 50 and 500 in order to bring each CHANNEL to its exact set point. Be sure to cycle the GUN between READY and RUN to send the Ki values to the Channel Modules.

8. Normally, Kd may remain at zero. Set Kd to a value between 50 and 500 if there appears to be a delay in the response.

NOTES

MAINTENANCE

TROUBLESHOOTING

Error Codes

The following is a complete list of error codes. Some of these codes may not apply depending on the specific control system configuration. The corrective actions listed in the table are discussed in more detail later in this section and also included in the "HELP" screens located on the operator interface.

Example Error Code: XXXX

1st Digit:
- 2 = GUN Alert
- 4 = DISK Error
- 9 = CHANNEL Fault
- A = GUN Fault
- B = SYSTEM Alert or Fault

2nd and 3rd Digit:
- No specific meaning

4th Digit:
- If a GUN error, the number indicates which GUN (1-8)
- If a CHANNEL error, the number indicates which CHANNEL (1-8)

ERROR CODES

Code	Displayed Text	Fault Cause	Corrective Action
2021 2022 2023 2024 2025 2026 2027 2028	Pot-Life Timer Expired - GUN #<>	Pot-Life Timer has expired for GUN indicated. Last digit indicates **CHANNEL #**.	Verify the following: 1. Correct value for Pot-Life time. 2. Correct value for Mixed Volume. If the above values are correct, then fluid must be flushed from the GUN immediately.
2061 2062 2063 2064 2065 2066 2067 2068	Gun Not Ready - GUN #<>	Indicated GUN # is not ready. This means that the GUN # has been given a RUN command without being enabled, or the GUN has faulted. Last digit indicates **CHANNEL #**.	Verify that the GUN is enabled and not faulted. Each GUN must have the Ext. Fault/Enable Input active, or the Global Gun Enable active.
9011 9012 9013 9014 9015 9016 9017 9018	Out Of Tolerance - CHANNEL #<>	The indicated CHANNEL is outside it's maximum tolerance limit as specified by the FLOW TOLERANCE parameter. Last digit indicates **CHANNEL #**.	Check the following: 1. Kp, Ki, and Kd gains set wrong which may cause unstable fluid regulation. 2. Running the wrong JOB # which may include the wrong Kp, Ki, and Kd values.

ERROR CODES (Cont.)

Code	Displayed Text	Fault Cause	Corrective Action
9021 9022 9023 9024 9025 9026 9027 9028	Reverse Flow Limit - CHANNEL #<>	The amount of reverse flow for the indicated CHANNEL has ex-ceeded the maximum allowable amount as defined in the CHAN-NEL parameter set. Last digit indicates **CHANNEL #**.	Check the following: 1. That the Reverse Flow value entered in the JOB # is correct. 2. Flow meter fiber-optic cables are properly connected and not reversed. 3. Fluid pressures are properly set and stable. 4. All check valves are operating correctly. 5. All fluid lines filled and all valves open. 6. Flow meter is operating properly.
9031 9032 9033 9034 9035 9036 9037 9038	Flow Too Low - CHANNEL #<>	The flow rate for the indicated CHANNEL # is too low. Based on the transducer output. Not issued for a manual GUN, master CHANNEL. Last digit indicates **CHANNEL #**.	Check the following: 1. There is fluid in the fluid lines for the indicated CHANNEL. 2. Fluid pressures are properly set and stable. 3. The pilot air line to the fluid regulator is not damaged or leaking. 4. Fluid viscosity is correct for the CHANNEL pressure and pipe size. 5. The pressure transducer and regulator are operating properly. 6. Transducer air supply is at least 90 psi. 7. Kp, Ki, and Kd Gains are set correctly for the indicated CHANNEL.
9041 9042 9043 9044 9045 9046 9047 9048	Flow Too High	The flow rate for the indicated CHANNEL # is too high. Based on the transducer output. Not issued for a manual GUN, master CHANNEL. Last digit indicates **CHANNEL #**.	Check the following: 1. Fluid regulators - sticking or faulty. 2. Control parameters - gains possibly set too high. 3. MVR low setting too high.
9071 9072 9073 9074 9075 9076 9077 9078	No Master Flow	Manual mode only. A trigger signal was received and no fluid flow was detected through the master chan-nel after the Blowoff timer had elapsed (if used).	Check the following: 1. There is fluid in the fluid lines for the indicated CHANNEL. 2. Fluid pressure is OK. 3. The flow meter, pressure trans-ducer, and regulator are operating properly.

ERROR CODES (Cont.)

Code	Displayed Text	Fault Cause	Corrective Action
9081 9082 9083 9084 9085 9086 9087 9088	External GUN ENABLE Input Not Detected	24 VDC must be supplied to the external GUN ENABLE input before the GUN can be placed in an active state. This is typically used as an interlock with other equipment or hard-wired directly to 24 VDC.	Check for 24 VDC on the external GUN ENABLE input.
9091 9093 9095 9097	Channels Not Present	Channel Module is not installed or has failed.	1. Insert Channel Module or change GUN configuration. 2. Reboot system and check again. 3. Replace Channel Module.
9111 9112 9113 9114 9115 9116 9117 9118	Out of Tolerance - Catalyst Too High CHANNEL #<>	The indicated slave (catalyst) CHANNEL is above it's maximum tolerance limit as specified by the FLOW TOLERANCE parameter.	Check the following: 1. Kp or Ki gains set too high. 2. Running the wrong JOB #, which may include the wrong gain values. 3. Fluid pressures. Either reduce the catalyst supply pressure or increase the resin pressure. Try to maintain normal operating pilot pressures to the fluid regulators, between 30-60 psi. 4. The MVR LOW JOB parameter for the catalyst is set too high (above the regulator cracking pressure). 5. Air bubbles or cavitation. Last digit indicates **CHANNEL #**.
9211 9212 9213 9214 9215 9216 9217 9218	Out of Tolerance - Catalyst Too Low CHANNEL #<>	The indicated slave (catalyst) CHANNEL is below it's minimum tolerance limit as specified by the FLOW TOLERANCE parameter.	Check the following: 1. Kp or Ki gains set too low. 2. Running the wrong JOB #, which may include the wrong gain values. 3. Fluid pressures. Either increase the catalyst supply pressure or decrease the resin pressure. Try to maintain normal operating pilot pressures to the fluid regulators, between 30-60 psi. 4. Requested flow rate exceeds capability of the catalyst channel at the given fluid supply pressure. Reduce total flow rate or increase catalyst supply pressure. 5. Air bubbles or cavitation. Last digit indicates **CHANNEL #**.

ERROR CODES (Cont.)

Code	Displayed Text	Fault Cause	Corrective Action
A011 A012 A013 A014 A015 A016 A017 A018	Non-Existent Program - GUN #<>	JOB # number entered for the indicated GUN does not exist. JOB # number defaulted to 00. Last digit indicates **CHANNEL #**.	Verify the following: 1. The JOB # has been saved in memory for the indicated GUN. 2. The correct JOB # is being requested. 3. For discrete hard-wired JOB # select, PROGRAM TOGGLE and JOB # inputs have been asserted correctly by the PLC or host computer.
A021 A022 A023 A024 A025 A026 A027 A028	GUN Flow Out of Range	The total flow rate for GUN # has exceeded the MAXIMUM FLOW RATE JOB parameter or fallen below the MINIMUM FLOW RATE JOB parameter. For Manual GUNs only.	See "Flow Too Low" and "Flow Too High" faults.
B001	System Halted	System Ready/Halt input is inactive.	This input is typically used as an interlock to other control equipment or it is simply hard-wired to 24 VDC. Supply 24 VDC to the System Ready/Halt input.
B010	RIO - Communications Error	PLC and DynaFlow are not set to the same: - baud rate - rack address - rack size - rack starting quarter RIO cable is not connected to the proper terminals at either end.	Check with the PLC programmer to determine the correct values for baud rate, rack address, rack size, and rack starting quarter and then set the DynaFlow Interface Module DIP SW1 and SW2 to the appropriate settings per "Interface Module DIP SW2 Settings" and "Mother Board Signal ID (J3, J4, J5, J6 Channel Cards" respectively in this section.

ERROR CODES (Cont.)			
Code	**Displayed Text**	**Fault Cause**	**Corrective Action**
(Cont.)	RIO - Communi-cations Error (Cont.)	RIO cable is not properly terminated at each end.	Check cable connections per Figure 25 of this manual. Check each end of the cable to de-termine if the terminating resistor is installed at each end. The DynaFlow system may not be the last rack on the RIO cable. The value of the terminating resistor is based on cable length, baud rate, and if Extended Node Capability is enabled at the PLC. If Extended Node Capability is enabled, the terminating resistors should always be 82 ohms. Otherwise, the term-inating resistors should be 150 ohms for 57.6 and 115.2 Kbaud and 82 ohms for 230.4 Kbaud. In any case, use 1/2 watt resistors.
B020	RIO - Invalid BTW Type	The PLC has issured a BTW with an invalid BTW data type in the first word offset.	Have the PLC programmer reference the "DynaFlow Programmer" manual for the correct BTW data types.
B030	RIO - Invalid BTR Type	The PLC has issued a BTW with an invalid BTR data type in the second word offset.	Have the PLC programmer reference the "DynaFlow Programmer" manual for the correct BTR data types.
B040	Gun/Channel Number	The PLC has issued a BTW with an invalid gun or channel number in the third word offset.	Have the PLC programmer ensure gun and channel numbers are between 1 and 8, or 0 if not required for the particular data type.
B050	RIO - Invalid BTR Job Number	The PLC has issued a BTW with an invalid job number in the fourth word offset.	Have the PLC programmer ensure job numbers are between 1 and 100, or 0 if not required for the particular data type.
B060	RIO - Invalid BTW Length	The PLC has issued a BTW with an invalid message length (word count).	Have the PLC programmer reference the "DynaFlow Programmer" manual for the correct BTW message lengths.

Flow Too Low -or- Flow Too High

Explanation: These are CHANNEL specific faults.

FLOW TOO HIGH and FLOW TOO LOW faults are issued if the requested fluid flow cannot be obtained. This typically means that there is a setup problem, maintenance issue, or mechanical failure.

These types of faults can be caused by numerous problems. Most of the more common causes are listed below. Keep in mind that the controller senses that either too little or too much material is getting to the applicator and that this is based on JOB parameter settings and fluid flow feedback from the flow meters. This troubleshooting section assumes that the system was previously operating successfully and then a problem developed. The following is not meant for initial system setup, however, many of the troubleshooting procedures described can be used in either case.

1. Material Supply Pressure
   - Has the material supply pressure changed?
   - What was the supply pressure when the system was operating properly?
   - Is the pressure gauge accurate or reliable?
   - Has the fluid delivery system been changed?
   - Are there any air leaks in the fluid regulator pilot line?
   - Are there any leaks in the fluid lines?

The controller can compensate for small changes in supply pressure, but changes such as seen with piston pumps without surge chambers or pressure drop regulators can be a definite problem.

2. Material Viscosity
   - Has the material properties such as viscosity or temperature changed?

Changes in viscosity alter the way in which it passes through the fluid metering and control components (regulator, flow meter, check valves, Y-Block, spiral mix tube, etc.). Typically, an increased viscosity will require more pressure to achieve the same flow rate. However, in some cases, as with thixotropic materials, the viscosity will actually change as the pressure varies or as the material passes through the fluid regulator or flow meter. Additionally, the material may be broken down into smaller particles as it passes through the fluid delivery system which can also cause some materials to change their properties as they flow.

The temperature of the fluid can also greatly impact the flow properties. Make sure that the fluid heaters are functioning correctly if temperature control is being used. If temperature control is not being used, then evaluate how ambient temperature may effect the fluid, as it is stored including the paint kitchen. Also, consider the length of the recalculating system and how long the material takes to travel to the applicators.

The amount in which the control response is effected by changes in fluid properties is also determined by how aggressive the control parameters are set (Kp, Ki, Kd). The fluid flow response can be observed as discussed in the "Operator Interface" manual. Also, refer to the "PID Control" in the "Operation" section of this manual under

3. Fluid Line Restriction
   - Has a restriction formed somewhere in the fluid line?

This could be a pinched paint tube, contamination in the fluid regulator, spiral mix tube blockage, a sticking check valve, or a Y block blockage to name a few.

Corrective Action:

An easy way to verify that the system is capable of flowing at the desired rate is to place the GUN in CLEAN MODE and trigger the applicator. The CLEAN MODE supplies maximum control pressure to the fluid regulator. Watch the flow rate. If the desired flow rate cannot be achieved or surpassed in CLEAN MODE, it is obvious that it will not be achievable in control mode. This tests all fluid lines from the material supply to the applicator. If calibration ports (valves) are available, such as on 2K fluid panels, try operating the controller with the calibration valves open. Place containers under the calibration ports and put the controller in RUN mode. If operating in AUTOMATIC MODE, the TRIGGER signal has to be

forced ON. If the desired flow is achieved while in this mode of operation, the fluid restriction is located further downstream to the applicator.

4. Flow Meter Feedback
   - Is flow being indicated on the controller?

If it is obvious that material is flowing through the system (from the GUN or calibration ports if used), but the controller indicates no flow, then this indicates that the controller is not detecting flow meter pulses. This could be caused by one of the following:

- Flow meter gear stuck
- Bad flow meter sensor
- Disconnected or damaged fiber-optic cable
- Bad fiber-optic receiver
- Bad input on the CHANNEL MODULE
- Fiber-optic flow meter transmitter battery has expired. Life expectancy is two years minimum.

Corrective Action:

Flow Meter: Disassemble, clean, and inspect the flow meter. Refer to instructions supplied with the meter.

Try connecting the flow meter in question to a fiber-optic cable from a properly functioning CHANNEL. If fluid flow is now observed, then the flow meter and pickup sensor are functioning properly.

Fiber-Optic Cable: Simply shine a light into one end of the cable and have someone observe the opposite end. If light is visible through the cable then it is probably good, although it is possible that the cable is damaged and will not conduct enough light to operate properly.

Fiber-Optic Detector: With fluid flowing, observe the LED located on the fiber-optic receiver. The LED is an indication that fluid is flowing and pulses are being received from the flow meter. If the LED is not ON, then replace or swap the fiber-optic receiver and try again.

If everything checks good but no fluid flow is displayed, replace the CHANNEL MODULE. Make sure that the hardware settings located on the module are configured identically to the one being replaced.

5. Transducer Failure

Corrective Action:

Perform the following with the GUN OFF and calibration valves closed. Place a pressure gage (if one does not already exist) in the pilot line between the transducer and the fluid regulator. Make sure that the air supply pressure to the transducer is at least 100 psi. Go to the FORCE I/O menu for the CHANNEL in question. Force Control Output voltage (or 4-20 ma) to several different values and observe the pressure gauge. Reference "Analog Sealing" chart in this section for correct values.

If the transducer does not produce the proper pressures, check for air leaks in the air pilot tube, transducer and fluid regulator. The transducers are very low volume devices and are designed for non-flow, or dead-headed operation. Also, observe the pressure gauge for oscillation and listen to the transducer for fluttering sounds. These are other indications that there may be air leaks in the system.

Another method for isolating small air leaks is to spray or dab a small amount of a soap and water solution around the fittings or valves and look for the continuous formation of air bubbles.

ANALOG SEALING		
0 - 10 VDC	4-20 mA	Pressure (PSIG)
0	4	0
1	5.6	10
2	7.2	20
3	8.8	30
4	10.4	40
5	12.0	50
6	13.6	60
7	15.2	70
8	16.8	80
9	18.4	90
10	20.0	100

Gun Flow Out of Range

Explanation: (Manual Guns Only) This fault indicates that the total flow rate through a GUN has exceeded the MAXIMUM FLOW RATE JOB parameter value or dropped below the MINIMUM FLOW RATE JOB parameter.

Out of Tolerance Faults

Explanation: "OUT OF TOLERANCE" faults are generated in the following manner. Every time a specific volume of fluid passes through the GUN (specified by the TOLERANCE VOLUME parameter), the controller determines the amount of resin and catalyst material that flowed. The controller then calculates the actual ratio and determines if it is within the limits as set by the FLOW TOLERANCE setting.

Reference the "Error Codes" table (Figure 16). Typical causes for OUT OF TOLERANCE faults are:

1. Kp, Ki, or Kd gains not set correctly.

2. Sticking or faulty fluid regulator.

3. Sticking or faulty flow meter.

4. Running the wrong JOB #, which may include the wrong gain values.

5. Fluid supply pressures not adjusted properly.

6. The MVR LOW JOB parameter set too high (above the regulator cracking pressure).

7. Air bubbles or cavitation in the fluid.

8. Unstable fluid supply pressures to the fluid regulators. This can be seen with pump supply systems.

Corrective Action:

The cause is the material supply pressure in almost every case when this fault is observed. Obviously, if FLOW TOO LOW or FLOW TOO HIGH faults are not occurring, the flow rates are operating within the range of the fluid regulators. Over an extended period of time, however, the volumes used are not within the appropriate tolerance band. Observe the ratio for both the resin and catalyst channels that are producing faults while they are operating or immediately after the controller faults (before resetting it). If the actual ratio of the catalyst is below target, adjust the supply pressure to the catalyst regulator up approximately 5 psi, or adjust the resin supply down by approximately 5 psi and try to run again. Keep adjusting these pressures until the actual ratio locks in on the target. Keep in mind that higher is not always better. Many times it is better to lower the pressure of the opposite channel, rather than raise a channel that is operating low in ratio.

The Kp and Ki gain settings located in the JOB tables may also be used to eliminate OUT OF TOLERANCE faults. For example, if an OUT OF TOLERANCE - CATALYST TOO HIGH fault occurs, adjust the gain settings for the catalyst channel down and vice-versa for a OUT OF TOLERANCE - CATALYST TOO LOW fault. The resin channel also needs to be taken into account for GUNs configured as automatic.

Gun Not Ready

Explanation: This is not a fault condition and does not prevent the GUN from operating. This error occurs if a GUN has not been configured, is not enabled, or no JOB #s have yet been saved and the GUN is placed in the RUN mode. This can be caused by trying to place a GUN in RUN mode either from local display/interface or from an external control device such as a PLC or host PC.

Corrective Action:
Simply save a JOB # for the indicated GUN making sure the parameters are correct. The Gun can be placed in RUN mode without generating the GUN NOT READY error.

System Errors

System errors are not associated with any CHANNEL or GUN. System errors are typically related to the disk drive, file I/O operations or communications.

Reverse Flow Limits

Explanation: The controller has sensed that material has flowed backwards through a flow meter and exceeded the preset REVERSE FLOW LIMIT value for that CHANNEL. There are several possible causes for this.

1. The check valve for one of the CHANNELs has failed in the open condition and the opposite CHANNEL material is at a higher pressure causing the material to back up into the other paint line.

Corrective Action:
The system must be flushed immediately and the faulty check valve replaced.

2. Sometimes this error can be generated after a GUN has been flushed and left unused for a period of time, such as at the end of the day or end of a shift. This is probably due to pressure trapped in the line between the fluid regulator and the applicator. This pressure could eventually back up through the flow meter and through the weep port if using a weeping type MVR valve, or through a small leak in the system.

Corrective Action:
Make sure that the applicator stays triggered ON for several seconds after it has been taken out of a CLEAN mode in order to relieve the pressure.

3. If operating the GUN for the first time, the feedback signals could be reversed from the flow meter.

Corrective Action:
Verify that the source and gate signals are routed correctly. This includes the fiber-optic cable connections at both the flow meter and receiver and wiring connections from the receiver to the control rack mother board.

4. If using a single phase flow meter that is not capable of reverse flow detection, then the "phase" signal input must be connected to +24 VDC. Reference the "Mother Board Signal Identification" in the "Appendix" section of this Manual.

No Master Flow

Explanation: This fault will only occur on GUNs configured for MANUAL operation. For a GUN configured for MANUAL operation, as soon as the GUN is placed in RUN mode, the master CHANNEL fluid regulator opens to the MVR HIGH set point (usually 100 psi). This is typically full open. In this way, operators can demand as much fluid as they wish with only the slaved (typically catalyst) CHANNEL being controlled to the desired ratio. It is possible, however, for the master CHANNEL flow meter gears to stick, and still allow fluid to pass through the flow meter. When this happens, the applicator continues to flow resin (master CHANNEL) but the controller is unaware that material is flowing and therefore does not command any catalyst (slaved CHANNEL) material to flow. To prevent this from happening, an air flow switch placed in the atomizing air line can send a trigger signal to the controller. When the controller receives a trigger signal, it immediately determines if the master CHANNEL flow meter is sending pulses. If it is not, the controller issues a NO MASTER FLOW fault.

In many cases, however, operators use their GUNs to blow dust and water off of the parts before spraying. They do this by pulling the trigger on the GUN back just far enough to get atomization air but no paint. When this happens, the controller receives a trigger signal and no paint flow, which would cause a fault. To allow for this "blow off" , a parameter called BLOW OFF TIME is used (system configuration parameter). The default value of 32 seconds. With the default value of 32 seconds the operator is allowed to blow off parts for a total of 32 seconds without faulting. As soon as the controller

senses flow from the master CHANNEL, the timer is reset and will start once again the next time a trigger signal is received with no master CHANNEL flow.

Corrective Action:
In most cases, this fault is generated by the master CHANNEL flow meter gears not turning (usually stuck). Try flushing the system and watch the flow rate or flow volume on the operator interface. If there still is no flow, disassemble and clean the flow meter. If this still does not correct the problem, see the section in this manual on FLOW TOO LOW FAULTS. If this fault occurs while the operator was not trying to spray, then the air flow switch may be defective. This can be verified by the GUN status on the operator interface.

SYSTEM PREVENTIVE MAINTENANCE INSTRUCTIONS

Control Panels

There is no maintenance schedule for control panels other than good housekeeping practices. These include.

- Keeping the door closed at all times. This will maintain the dust-tight environment required by the electronic printed circuit boards.
- Plug all unused access holes into the cabinet in order to keep contamination out.
- Use the following guidelines for cleaning the Operator Interface:

  Use cleaning solution specifically formulated for computer monitors, a mild window cleaner, or isopropyl alcohol. **DO NOT** use solvents. Most importantly, use a clean, soft paper towel or tissue and use very light force.

Fluid Control Components

It is recommended to record system settings such as fluid supply and air supply pressures, etc.

Reference the appropriate service literature for maintenance instructions.

SYSTEM COMPONENTS AND PARTS IDENTIFICATION

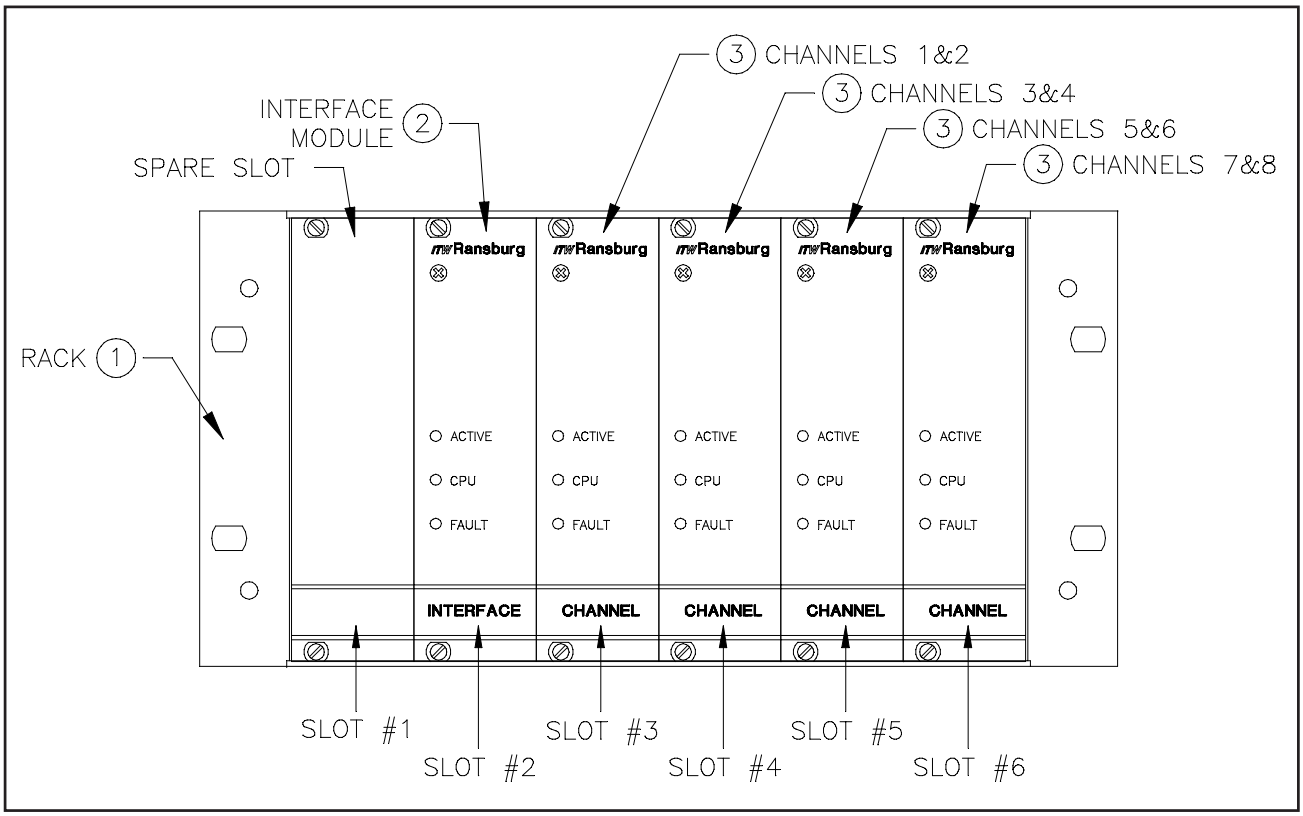


Figure 7: Card Rack Assembly

DYNAFLOW SYSTEM COMPONENTS AND PARTS IDENTIFICATION (Figure 7)

Item #	Part #	Description
1	77383-01	Rack Assembly, Empty, 1/2 Rack, 1 Mother Board
	77383-02	Rack Assembly, Empty, Full Rack, 1 Mother Board
	77383-03	Rack Assembly, Empty, Full Rack, 2 Mother Boards
2	77377-02	Interface Module Assembly, With RIO
3	A10946-01	Channel Module for use with 0-10VDC transducers and for the flow rate indication output
	A10946-02	Channel Module for use with 0-10VDC or 4-20mA transducers and for the flow rate indication output
	77378-00	Mother Board Assembly
	LBAL0021-00	Interface Cable Assembly, Interface Panel to Control Panel, 40 ft.
	LBAL5001-00	Interface Panel, Standard Two Component
	LBAL5001-01	Interface Panel, GUN 1
	LBAL5001-02	Interface Panel, GUN 2
	A12182	Interface Panel W/Color Change
	LPNE5002-00	Pneumatic Color Change Panel
	LBAL5003-00	Pneumatic Operator Panel

Note: Refer to the "DynaFlow Operator Interface" manual for parts that are specific to the 77376 and A12233 Stand-Alone Control Panel.

RECOMMENDED SPARE PARTS

Recommended spare parts list for the DynaFlow rack components only.

SPARE PARTS FOR DYNAFLOW RACK COMPONENTS					
Part #	**Description**	**Total # of Interface Modules in System**			**Notes**
		1-4	**4-10**	**>10**	
77377-02	DynaFlow Interface Module	1	2	3	77377-02 RIO Compatible
77378-00	DynaFlow Mother Board	0	1	1	
Part #	**Description**	**Total # of Channel Cards in System**			**Notes**
		1-8	**9-16**	**>16**	
A10946-01/-02	DynaFlow Channel Module	1	2	3	

The following DynaFlow recommended spare parts lists **do not** include auxiliary fluid control/monitoring equipment such as pneumatic interface panels, fluid panels, transducer panels, etc. The recommended spare parts list for the auxiliary equipment should be derived from previous fluid control lists since their usage and requirements are the same.

SPARE PARTS FOR 77376 AND A12233 CONSOLE UNIT

Part #	Description	Total # of Consoles			Notes
		1-2	3-4	5+	
77377-02	DynaFlow Interface Module	1	2	2	
A10946-01/-02	DynaFlow Channel Module	1	2	3	
77378-00	Mother Board	0	0	1	
A11224-00	Power Supply Assy., 24 VDC	1	1	1	
73837-08	Intrinsic Safety Barrier	1	1	2	For 77376-XXX1X Only
77454-00	Fiber-Optic Flow Meter Receiver	1	1	2	For 77376-XXX0X Only
77382-00	Ribbon Cable Adaptor	0	1	1	
74300-00	Bulb, 130 VAC	1	2	2	
4131-11	Fuse, 3 AG, 3 AMP	1	2	2	
77384-00	Emergency Stop Switch, Red Mushroom Head	1	1	1	Included with all stand-alone systems
A11375-00	Stop Switch, Yellow Mushroom Head	1	1	1	Alternate stop switch, available special order only, for integrated systems when only one emergency stop switch is permitted in the control room area.
A10577-00		1	1	1	For 77376-XXXX0 Only
A10577-01	Power Line Filter (115 VAC) Power Line Filter (230 VAC)	1	1	1	For 77376-XXXX1 Only

NOTES

WARRANTY POLICIES

LIMITED WARRANTY

ITW Ransburg will replace or repair without charge any part and/or equipment that falls within the specified time (see below) because of faulty workmanship or material, provided that the equipment has been used and maintained in accordance with ITW Ransburg's written safety and operating instructions, and has been used under normal operating conditions. Normal wear items are excluded.

THE USE OF OTHER THAN ITW RANSBURG APPROVED PARTS, VOID ALL WARRANTIES.

SPARE PARTS: One hundred and eighty (180) days from date of purchase, except for rebuilt parts (any part number ending in "R") for which the warranty period is ninety (90) days.

EQUIPMENT: When purchased as a complete unit, (i.e., GUNs, power supplies, control units, etc.), is one (1) year from date of purchase. **WRAPPING THE APPLICATOR, ASSOCIATED VALVES AND TUBING, AND SUPPORTING HARDWARE IN PLASTIC, SHRINK-WRAP, OR ANY OTHER NON-APPROVED COVERING, WILL VOID THIS WARRANTY.**

ITW RANSBURG'S ONLY OBLIGATION UNDER THIS WARRANTY IS TO REPLACE PARTS THAT HAVE FAILED BECAUSE OF FAULTY WORKMANSHIP OR MATERIALS. THERE ARE NO IMPLIED WARRANTIES NOR WARRANTIES OF EITHER MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. ITW RANSBURG ASSUMES NO LIABILITY FOR INJURY, DAMAGE TO PROPERTY OR FOR CONSEQUENTIAL DAMAGES FOR LOSS OF GOODWILL OR PRODUCTION OR INCOME, WHICH RESULT FROM USE OR MISUSE OF THE EQUIPMENT BY PURCHASER OR OTHERS.

EXCLUSIONS:
If, in ITW Ransburg's opinion the warranty item in question, or other items damaged by this part was improperly installed, operated or maintained, ITW Ransburg will assume no responsibility for repair or replacement of the item or items. The purchaser, therefore will assume all responsibility for any cost of repair or replacement and service related costs if applicable.

APPENDIX

ADDENDUM A:

Obsolescence of the 77206-01 8-bit Channel Card, the 77206-12 10-bit Channel Card and the A10946-00 12-bit Channel Card.

In 2004, the 77206-01 DynaFlow 8-bit Channel Card was replaced by the 77206-12 10-bit Channel Card to improve the resolution of the analog outputs on this card. Then in 2006, the 77206-12 10-bit Channel Card was replaced by a totally redesigned 12-bit Channel Card and it was assigned a part number of A10946-00. Lastly, in 2007, the A10946-00 board was obsoleted and replaced by 2 boards, the A10946-01 and the A10946-02. The reasons for this final change are explained below: (This information is also contained in Service Note AF-111307.)

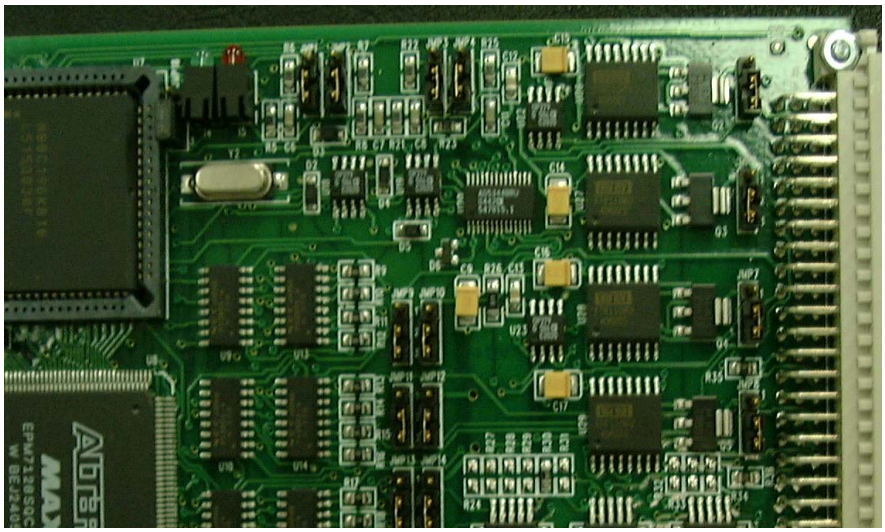
The IC chip used on the A10946-00 DynaFlow Channel Card that produces the 4-20 mA output for flow rate and pressure control is becoming extremely expensive and is currently experiencing very long lead times. We have decided to produce two versions of the DynaFlow Channel Card. One version will be built as the boards are now. The other version will not have the 4-20 mA converter IC on the board, which will effectively eliminate the capability of the board to output 4-20 mA signals for these two outputs. (Our sales history shows very few users make use of these two output signals.) The 0-10 VDC outputs for these two signals will still function normally.

In order to ensure that the proper boards are selected, the following changes have been made to the part numbers: The A10946-00 part number has been obsoleted. The A10946-01 board is the new board without the 4-20 mA IC's and is the board that will be used in all future builds unless the customer specifically requests 4-20 mA outputs for these two signals. The A10946-01 board can be modified by our manufacturing facility to become an A10946-02, when necessary, if this option is required. (Because of the high cost and limited availability of these IC's, there will be an additional cost for this option.)

If you currently use the obsoleted A10946-00 boards, our technical support personnel will need to know if you are using the 4-20 mA option for either the flow rate output or the pressure control output to be able to determine which of the two new boards to send. This can be done by examining the jumpers on the boards you are now using. If jumpers any of the following jumpers: JMP5, JMP6, JMP7, or JMP8 are connected between pins 1 to 2, this most likely indicates that you are using the 4-20 mA option and will require the A10946-02 board. (Unless that channel or output signal is not being used and the jumpers were changed from the factory defaults for some reason.) In all other cases, the A10946-01 board should be used. (See picture on next page. Note that pin #1 is toward the top of the board.)

Since this is a totally redesigned board from that of the 77206 series boards, we have also included jumper and dip switch setting information with this addendum. The dip switch settings for SW1 have not changed. Refer to page 78 of the DynaFlow User Manual (LN-9400-00) for these settings.

ADDENDUM A (Cont.):



JUMPER TABLE

	JUMPER	DESCRIPTION	TYPE	PIN 1–2	PIN 2–3	F.S.
ANALOG INPUTS	JMP1	FLOW RATE SETPOINT, CH. A	0–10 VDC	OPEN	CLOSED	✓
			4–20mA	CLOSED	OPEN	
	JMP2	SPARE INPUT, CH. A	0–10 VDC	OPEN	CLOSED	✓
			4–20mA	CLOSED	OPEN	
	JMP3	FLOW RATE SETPOINT, CH. B	0–10 VDC	OPEN	CLOSED	✓
			4–20mA	CLOSED	OPEN	
	JMP4	SPARE INPUT, CH. B	0–10 VDC	OPEN	CLOSED	✓
			4–20mA	CLOSED	OPEN	
ANALOG OUTPUTS	JMP5	CONTROL PRESSURE, CH. A	0–10 VDC	OPEN	CLOSED	✓
			4–20mA	CLOSED	OPEN	
	JMP6	ACTUAL FLOW, CH. A	0–10 VDC	OPEN	CLOSED	✓
			4–20mA	CLOSED	OPEN	
	JMP7	CONTROL PRESSURE, CH. B	0–10 VDC	OPEN	CLOSED	✓
			4–20mA	CLOSED	OPEN	
	JMP8	ACTUAL FLOW, CH. B	0–10 VDC	OPEN	CLOSED	✓
			4–20mA	CLOSED	OPEN	
DIGITAL INPUTS	JMP9	TRIGGER, CH. A RUN MODE, CH. A TRANSPARENT MODE, CH. A TOTAL HOLD, CH. A	SOURCE	OPEN	CLOSED	✓
			SINK	CLOSED	OPEN	
	JMP10	GUN MASK, CH. A HALT, CH. A TOTAL RESET, CH. A CLEAN MODE, CH. A	SOURCE	OPEN	CLOSED	✓
			SINK	CLOSED	OPEN	
	JMP11	LOAD MODE, CH. A ANALOG HOLD, CH. A EXTERNAL FAULT, CH. A SPARE INPUT, CH. A	SOURCE	OPEN	CLOSED	✓
			SINK	CLOSED	OPEN	
	JMP12	TRIGGER, CH. B RUN MODE, CH. B TRANSPARENT MODE, CH. B TOTAL HOLD, CH. B	SOURCE	OPEN	CLOSED	✓
			SINK	CLOSED	OPEN	
	JMP13	GUN MASK, CH. B HALT, CH. B TOTAL RESET, CH. B CLEAN MODE, CH. B	SOURCE	OPEN	CLOSED	✓
			SINK	CLOSED	OPEN	
	JMP14	LOAD MODE, CH. B ANALOG HOLD, CH. B EXTERNAL FAULT, CH. B SPARE INPUT, CH. B	SOURCE	OPEN	CLOSED	✓
			SINK	CLOSED	OPEN	
	JMP15	FLOW RATE FREQUENCY INPUT, CHANNELS A AND B	SOURCE	OPEN	CLOSED	✓
			SINK	CLOSED	OPEN	
MEMORY/PROC. SETTINGS	JMP16	UVEPROM SIZE	256 KB	CLOSED	OPEN	
			512 KB	OPEN	CLOSED	✓
			1024 KB	OPEN	CLOSED	
	JMP17	RAM SIZE	8Kx8	OPEN	CLOSED	
			16Kx8	CLOSED	OPEN	
			32Kx8	CLOSED	OPEN	✓
	JMP18	PROCESSOR PIN EA	RUN	OPEN	CLOSED	✓
			PROGRAM	CLOSED	OPEN	

ADDENDUM B:

Color Change Sequencer

The redesigned DynaFlow includes an optional color change sequencer that controls the flush, load, and color change sequences for each gun. Each time a job number is loaded into a gun, the flush and load sequences are downloaded to this controller. (A color change sequence is simply a flush sequence followed by a load sequence.)

F9: COLOR CHANGE –

An optional color change sequencer may have been included with the controller. If it was included, the F9 key will indicate as such. If the F9 key is blank, your system does not have this option.

When this function is selected, the operator is first prompted for the gun number they wish to view or edit the sequence for, they are then prompted for which Job Number they wish to view and/or edit the sequences of, and last, they are asked if they want to view/edit the sequence for flushing or filling. (There is a separate flush sequence and load sequence stored for every Job Number and for every gun.)

Once the operator responds to the above prompts, a screen similar to the following appears:

ADDENDUM B (Cont.):

This chart displays a simple 6 step sequencer where the user defines how long they wish each step to take and which valves or signals should be energized at each one of those steps. There are 6 steps for the flush cycle and 6 steps for the load cycle. When a color change is desired, the sequencer automatically runs the flush sequence followed by the load sequence.

The following solenoid valves can be controlled by the sequencer:

Resin/Solvent Air Chop
Resin Solvent
Resin Air
Paint
Dump Valve
Resin Fluid Override
Trigger Solenoid
Catalyst #1
Catalyst #2
Catalyst #3
Catalyst Solvent
Catalyst Override

The following DynaFlow inputs can be controlled by the sequencer:

DynaFlow Run
DynaFlow Halt
DynaFlow Trigger
DynaFlow Load
DynaFlow Clean
Catalyst Disable

Note that there are too many valves and signals to be displayed on one screen. Therefore, the operator must scroll down to see the bottom five items.

Program the time for each step by touching the step duration box under the step to be modified and then push F1 (Modify) to change it. Then toggle any of the signal or valve boxes at each step that you wish to have on during that step and then push the Modify button. The steps will toggle between Off and On as you continuously hit the Modify button.

The Hold step is the final step in the sequence (for both flush and fill). When the sequence completes, the signals and valves will be held in the condition selected in the hold step. Keep in mind that when changing from one color to another, the system performs a flush sequence followed by a fill sequence so the hold step in the flush sequence will only occur momentarily.

There are 8 function keys defined while editing flush, load, and color change sequences:

F1: Modify – This button brings up a numeric keypad if cursor is on one of the step duration cells. If cursor is on one of the valve condition cells, that cell is toggled from off to on or on to off.

F2: Chop Air Time – This button allows the user to program how long the air valve remains on for each step of the solvent/air chop timer.

F3: Chop Solvent Time - This button allows the user to program how long the solvent valve remains on for each step of the solvent/air chop timer.

F4: Edit Fill/Flush – This button opens the screen that allows viewing and editing of the flush or the fill sequences (the button changes to fill if the flush sequence is displayed and to flush if the fill sequence is displayed).

F5: Send to PLC – This button allows the operator to immediately send the edited sequence to the sequencer (located in the motor amplifier panel). Note that the sequences are automatically sent to the sequencer every time a new Job Number is loaded.

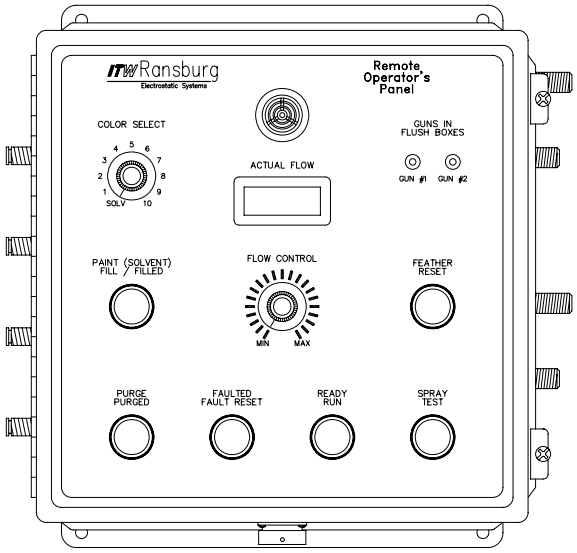
F8: Copy Sequence – This button allows the operator to copy sequences from one job to another.

F9: Read In File – This button allows the operator to load flush and load sequences from the flash drive of the touchscreen, a USB memory stick, or to a floppy diskette.

F10: Save To File – This button allows the operator to save flush and load sequences to the flash drive of the touchscreen, a USB memory stick, or to a floppy diskette. All flush and load sequences for all guns are saved in a file named: *ColorChg.par.*

ADDENDUM C:

Remote Operator's Panel



If the Model A12233 control console and Model A12182 Interface Panel is used, the optional Remote Operator Panel (P/N: A11095) can be used. this Remote Operator's Panel (shown above) operates in the following manner:

Color Select - This is an eleven position selector switch that allows the operator to select the next color to be loaded. If the most counter-clockwise position is selected (Solv) and the Paint (Solvent) Fill button is pushed, the normal load sequence occurs and solvent is loaded into the fluid sytem as if it was a color.

Paint (Solvent) Fill/Filled - This is a green illuminated push-button. When pushed, the paint load sequence runs (as programmed from the "Load" user interface screen). The green indicator lamp flashes as the sequence is occurring and stays lit solid when the sequence has completed, indicating to the operator that the system is ready.

If there is already a color loaded (i.e., one of the color valve outputs is already on) when this button is pushed, the system will execute a flush sequence, followed by a load sequence.

Purge/Purged - This is an amber illuminated push-button. When pushed, a purge sequence is initiated (as programmed from the "Purge" user interface screen). While the purge sequence is occurring, this indicator lamp flashes. It remains on solid when the purge sequence is complete, indicating to the operator that the purge is complete. This indicator will be turned off if a "Paint (Solvent) Fill" sequence has been initiated or a color is loaded.

NOTE: If both the green Paint (Solvent) Fill/Filled lamp and the amber Purge/Purged lamps are flashing simultaneously, this indicates that no sequence has been downloaded to the color change sequencer since the last time power was applied to the system. This can be corrected by loading a job from the user interface screen.

Horn - In the top center of the panel is a horn that indicates when the controller has turned on the "Fault" output from the gun.

Total Flow - This is an LCD display that indictes the current flow rate out of the applicator (or applicators, if multiple applicators are fed from one fluid panel). It operates from an analog output signal from the controller with 0 VDC being 0 cc'min. and 10 VEC scaled to 2000 cc/min.

Flow Control - This is a potentiometer that varies the analog flow control voltage into the channel card from 0 volts DC to 10 volts DC. Users can program what flow rate they want for both extremes by using the Minimum Flow and Maximum Flow parameters under the edit gun screen.

Faulted/Fault Reset - This is a red illuminated push-button. The lamp will be illuminated anytime a fault occurs. Pushing this button resets any fault that has caused the fault. After resetting a fault, the user must then push the Ready Run push-button to put the gun back into run mode to resume spraying.

Ready/Run - This is a green illuminated push-button. Pushing this button puts a gun into run mode. When in run mode, the green lamp is illuminated. It is extinguished in either a halted or faulted state.

Guns in Flush Box - These are two LED's that indicate when up to two spray guns are in their respective flush boxes. A flush or load sequence will not be allowed to start until both of these indicators are illuminated. These LED's are connected to four pressure switches, which are actuated by the two flush boxes. The signal from these pressure switches also feed the Paint Fill and Purge push-buttons to prevent color changes and purges from occurring unless the guns are in their flush boxes and the boxes are closed. These pressure switches should be jumpered if gun flush boxes are not to be used. There are jumpers on the PC board inside the panel to bypass these pressure switches.

Feather Reset - This push-button is not functional when used in a DynaFlow system.

Spray Test - This is a simple push-button that sends a trigger signal back to the controller and also turns on the trigger solenoid to allow operators to verify and test flow, etc. Note that this button is only functional if fluid has been loaded (i.e., the green Paint Filled indicator lamp is illuminated).

HARDWARE SETTINGS

Channel Module Settings

CHANNEL MODULE MOTHER BOARD JUMPER BOARD SETTINGS (CHANNEL 1 I/O)				
Jumper	**Default Setting**		**Description**	**Comments**
E1	512K 1024K	2-3	ROM size select. 1-2 = 256K, 27256 device 2-3 = 512K or 1024K, 27512 or 27010 devices	Factory set. Do not change unless instructed to do so.
E5	0-10 VDC	2-3	Selects 0-10 VDC or 4-20 ma operation for the analog control output #1. 2-3 = 0-10 VDC 1-2 = 4-20 mA	To the E/P transducer #1
E6	0-10 VDC	2-3	Selects 0-10 VDC or 4-20 ma operation for the spare analog output #1. 2-3 = 0-10 VDC 1-2 = 4-20 mA	Actual flow rate for CHANNEL #2, scaled by Maximum and Minimum Flow Rate parameters
E8	Source	2-3	Selects 24 VDC source control or grounded sink control for digital inputs 8-11. 2-3 = 24 VDC source 1-2 = grounded sink	Inputs effected: Load Mode #1 Analog Hold #1 External Fault #1 MVR Enable #1
E10	Source	2-3	Selects 24 VDC source control or grounded sink control for digital inputs 4-7. 2-3 = 24 VDC source 1-2 = grounded sink	Inputs effected: Run #1 Halt #1 Total Reset #1 Clean #1
E9	Source	2-3	Selects 24 VDC source control or grounded sink control for digital inputs 0-3. 2-3 = 24 VDC source 1-2 = grounded sink	Inputs effected: Trigger #1 Gun Mask #1 Transparent/PID #1 Total Hold #1
E4	0-10 VDC	2-3	Selects 0-10 VDC or 4-20 ma operation for the analog set point input #1. 2-3 = 0-10 VDC 1-2 = 4-20 mA	Scaled by Maximum and Minimum Flow Rate parameters
E3	0-10 VDC	2-3	Selects 0-10 VDC or 4-20 ma operation for the spare analog input #1. 2-3 = 0-10 VDC 1-2 = 4-20 mA	

CHANNEL MODULE DAUGHTER BOARD JUMPER SETTINGS (CHANNEL 2 I/O)

Jumper	Default Setting		Description	Comments
E3	Source	2-3	Selects 24 VDC source control or grounded sink control for digital inputs 12-15. 2-3 = 24 VDC source 1-2 = grounded sink	Inputs effected: Trigger #2 Gun Mask #2 Transparent/PID #2 Total Hold #1
E1	Source	2-3	Selects 24 VDC source control or grounded sink control for digital inputs 20-23. 2-3 = 24 VDC source 1-2 = grounded sink	Inputs effected: Load Mode #2 Analog Hold #2 External Fault #2 MVR Enable #2
E2	Source	2-3	Selects 24 VDC source control or grounded sink control for digital inputs 16-19. 2-3 = 24 VDC source 1-2 = grounded sink	Inputs effected: Run #2 Halt #2 Total Reset #2 Clean #2
E6	0-10 VDC	2-3	Selects 0-10 VDC or 4-20 ma operation for the analog control output #2. 2-3 = 0-10 VDC 1-2 = 4-20 mA	To the E/P transducer #2
E7	0-10 VDC	2-3	Selects 0-10 VDC or 4-20 ma operation for the analog output #2. 2-3 = 0-10 VDC 1-2 = 4-20 mA	Actual flow rate for CHANNEL #2, scaled by Maximum and Minimum Flow Rate parameters
E5	0-10 VDC	2-3	Selects 0-10 VDC or 4-20 ma operation for the analog set point input #2. 2-3 = 0-10 VDC 1-2 = 4-20 mA	Scaled by Maximum and Minimum Flow Rate parameters
E4	0-10 VDC	2-3	Selects 0-10 VDC or 4-20 ma operation for the spare analog input #2. 2-3 = 0-10 VDC 1-2 = 4-20 mA	

CHANNEL MODULE DIP SWITCH SW1 SETTINGS		
Position	**Default Setting**	**Description**
1 / 5	OFF	Trigger Detection Method This switch setting effects only GUNs configured as dual-component, Manual mode. OFF = GUN trigger input signal required. ON = GUN trigger input signal not required. Fluid flow through Master CHANNEL initiates PID on Slave CHANNEL. Master CHANNEL flow rate is determined by a manual flow rate adjustment located on the GUN.
2 / 6	OFF	Analog Hold Mode OFF = When the GUN trigger is removed, the E/P transducer pressure immediately returns to MVR LOW. ON = If the Trigger OFF Delay is zero, when the GUN trigger is removed, the E/P transducer pressure immediately returns to MVR LOW. If the Trigger OFF Delay is non-zero, the E/P transducer pressure remains at the last output value from the PID loop until the Trigger OFF Delay expires.
3 / 7	OFF	Lookup Table Enabled This switch setting applies only to single-component GUNS. OFF = The Lookup Table is updated while in Run mode, but it is not used to determine the flow rate set point when the GUN is triggered. ON = The Lookup Table is updated while in Run mode and is used to determine the flow rate set point when the GUN is triggered, or when the flow rate set point is changed by more than 10% of the range in flow rate (Maximum Flow Rate minus Minimum Flow Rate). In addition, if the GUN has been placed in Transparent mode and a PLC or robot sends a flow rate set point via RIO or Analog Input, the value is assumed to be a flow rate, rather than a pressure value.
4 / 8	OFF	Alternate PID Equation The Alternate PID Equation should be used whenever the set point for the flow rate is dynamically changed during Run mode. OFF = The PID Proportional term is based on the error term, which is the difference between the desired flow rate (set point) and actual flow rate. ON = The PID Proportional term is based on the setpoint.

ITW CAN Bus Address

Communication between the Interface Module and Channel Cards.

The Control Area Network (CAN) address of the Interface is automatically determined by hardware based on the physical slot location in the rack.

Interface Module Settings

INTERFACE MODULE JUMPER SETTINGS				
Jumper	**Default Setting**		**Description**	**Comments**
E4	512K 1024K	2-3	ROM size select. 1-2 = 256K, 27256 device 2-3 = 512K or 1024K, 27512 or 27010 devices	Factory set. Do not change unless instructed to do so.
E5	RS-232C	2-3	RS-232C/RS-485 select	
E10	*	Out	RS-485 termination resistor	
E2	**	In	ITW CAN Bus termination resistor	
E3	Source	In	Circuit common to earth ground connection.	
E6	Source	2-3	Selects 24 VDC source control or grounded sink control for digital inputs 12-15. 2-3 = 24 VDC source 1-2 = grounded sink	
E7	Source	2-3	Selects 24 VDC source control or grounded sink control for digital inputs 8-11. 2-3 = 24 VDC source 1-2 = grounded sink	
E8	Source	2-3	Selects 24 VDC source control or grounded sink control for digital inputs 4-7. 2-3 = 24 VDC source 1-2 = grounded sink	
E9		2-3	Selects 24 VDC source control or grounded sink control for digital inputs 0-3. 2-3 = 24 VDC source 1-2 = grounded sink	

* Inserting this jumper adds a 120 Ohm termination resistor across the RS-485 RX+ and RX- lines.

** Inserting this jumper adds a 120 Ohm termination resistor across the ITW CAN Bus.

INTERFACE MODULE DIP SW1 SETTINGS

Position	Default Setting	Description	Comments
1-6	OFF Address = 00	RIO Rack address position 1 = most significant bit (MSB) position 6 = least significant bit (LSB)	0 - 63 Decimal 0 - 77 Octal 0 - 3F Hex
7-8	OFF	RIO Starting Quarter position 7 8 Quarters OFF OFF = 0 OFF ON = 1/4 ON OFF = 1/2 ON ON = 3/4	Number of Channel Cards: 1 to 4 1 to 4 1 to 3 1

INTERFACE MODULE DIP SW2 SETTINGS

Position	Default Setting	Description	Comments
1	OFF	ON = NVRAM Erased & Reset OFF = NVRAM Maintained	All data will be lost when set to ON position.
2	OFF	ON = Master Channel outputs Master Chanel flow rate on secondary analog output. OFF = Master Channel outputs GUN flow rate on secondary analog output.	
3-4	OFF	RIO Baud rate position 3 4 Baud Rate OFF OFF = 57.6 KB OFF ON = 115.2 KB ON OFF = 230.4 KB ON ON = 230.4 KB	
5-6	OFF	SIO Baud rate position 5 6 Baud Rate OFF OFF = 19.2 KB OFF ON = 4.8 KB ON OFF = 9.6 KB ON ON = 38.4 KB	
7-8	OFF	RIO Rack Size position 7 8 Size OFF OFF = 1/4 Rack OFF ON = 1/2 Rack ON OFF = 3/4 Rack ON ON = Full Rack	Number Of Channel Modules: 1 1 to 3 1 to 4 1 to 4

CONTROL RACK TERMINAL IDENTIFICATION

MOTHER BOARD SIGNAL IDENTIFICATION			
J3, 4, 5, 6 CHANNEL MODULES		J3, 4, 5, 6 CHANNEL MODULES	
Pin #	**Description**	**Pin #**	**Description**
1A	Analog Set Point Input #1	1B	
2A	Spare Analog Input #1	2B	
3A	Analog Input GND	3B	
4A	Analog Transducer Control #1	4B	
5A	Analog Flow Rate Output #1	5B	
6A	Analog Output GND	6B	
7A	Trigger Input #1	7B	
8A	Run Input #1	8B	
9A	Transparent/PID Input #1	9B	
10A	Total Hold Input #1	10B	
11A	Digital Input GND	11B	
12A	Gun Mask Input #1	12B	
13A	Halt Input #1	13B	
14A	Total Reset Input #1	14B	
15A	Clean Input #1	15B	
16A	Digital Input GND	16B	
17A	Load Input #1	17B	
18A	Analog Hold Input #1	18B	
19A	External Fault Input #1	19B	
20A	Spare Input #1	20B	Flow Meter Input #1A
21A	Digital Input GND	21B	Flow Meter #1A GND
22A	Ready Output #1	22B	Flow Meter Input #1B
23A	Active Output #1	23B	Flow Meter #1B GND
24A	Fault Output #1	24B	Flow Meter Input #2A
25A	Pot Life Timer Output #1	25B	Flow Meter #2A GND
26A	Clean/Load/Calibrate Output #1	26B	Flow Meter Input #2B
27A	MVR Enable Output #1	27B	Flow Meter #2B GND
28A	Digital Output GND	28B	ITW CAN BUS+
29A	Console Rx232	29B	ITW CAN BUS-
30A	Console GND	30B	ITW CAN BUS GND
31A	+24 VDC	31B	+24 VDC
32A	PWR GND	32B	PWR GND

Mother Board Signal Identification (Continued)

MOTHER BOARD SIGNAL IDENTIFICATION			
J3, 4, 5, 6 CHANNEL MODULES		J2 INTERFACE MODULE	
Pin #	**Description**	**Pin #**	**Description**
1C	Analog Set Point Input #2	1A	Digital Input GND
2C	Spare Analog Input #2	2A	Digital Input GND
3C	Analog Input GND	3A	Digital Input GND
4C	Analog Transducer Control #2	4A	Digital Input GND
5C	Analog Flow Rate Output #2	5A	Digital Input GND
6C	Analog Output GND	6A	Digital Input GND
7C	Trigger Input #2	7A	Digital Input GND
8C	Run Input #2	8A	Digital Input GND
9C	Transparent/PID Input #2	9A	Digital Input GND
10C	Total Hold Input #2	10A	Digital Input GND
11C	Digital Input GND	11A	Digital Input GND
12C	Gun Mask Input #2	12A	Digital Input GND
13C	Halt Input #2	13A	Digital Input GND
14C	Total Reset Input #2	14A	Digital Input GND
15C	Clean Input #2	15A	Digital Input GND
16C	Digital Input GND	16A	Digital Input GND
17C	Load Input #2	17A	
18C	Analog Hold Input #2	18A	
19C	External Fault Input #2	19A	
20C	Spare Input #2	20A	
21C	Digital Input GND	21A	Digital Input GND
22C	Ready Output #2	22A	Digital Input GND
23C	Active Output #2	23A	Digital Input GND
24C	Fault Output #2	24A	Digital Input GND
25C	Fluid Line Flushed	25A	Digital Input GND
26C	Clean/Load/Calibrate Output #2	26A	Digital Input GND
27C	MVR Enable Output #2	27A	
28C	Digital Output GND	28A	
29C	Console Tx232	29A	
30C	Console GND	30A	
31C	+24 VDC	31A	+24 VDC
32C	PWR GND	32A	PWR GND

MOTHER BOARD SIGNAL IDENTIFICATION			
J2 INTERFACE MODULE		J2 INTERFACE MODULE	
Pin #	**Description**	**Pin #**	**Description**
1B	SIO Rx485+	1C	JOB Select Bit 1, LSD
2B	SIO Rx485-	2C	JOB Select Bit 2, LSD
3B	SIO Tx485+	3C	JOB Select Bit 4, LSD
4B	SIO Tx485-	4C	JOB Select Bit 8, LSD
5B	SIO 485 GND	5C	JOB Select Bit 1, MSD
6B		6C	JOB Select Bit 2, MSD
7B	Console Rx232A	7C	JOB Select Bit 4, MSD
8B		8C	JOB Select Bit 8, MSD
9B	Console Tx232A	9C	Spare Digital Input
10B		10C	JOB Select Strobe Input
11B	Console GND	11C	System Ready/Halt Input
12B		12C	Spare Input
13B	SIO Rx232B	13C	Spare Input
14B		14C	Spare Input
15B	SIO Tx232B	15C	Spare Input
16B		16C	Spare Input
17B	SIO GND	17C	
18B		18C	
19B		19C	
20B		20C	
21B		21C	System Fault Output
22B		22C	System Pulse Output
23B		23C	Spare Output
24B		24C	Spare Output
25B		25C	Spare Output
26B		26C	Spare Output
27B		27C	
28B	ITW CAN BUS+ITW CAN BUS-	28C	
29B	ITW CAN BUS-	29C	
30B	ITW CAN BUS GND	30C	
31B	+24 VDC	31C	+24 VDC
32B	PWR GND	32C	PWR GND

MOTHER BOARD SIGNAL IDENTIFICATION

J7 POWER INPUT

Terminal	Description
J7-1	+24 VDC
J7-2	+24 VDC
J7-3	PWR GND
J7-4	PWR GND

J8 SERIAL I/O

Terminal	Description
J8-1	SIO Rx485+
J8-2	SIO Rx485-
J8-3	SIO Tx485+
J8-4	SIO Tx485-
J8-5	SIO 485 GND
J8-6	Console Rx232A
J8-7	Console Tx232A
J8-8	Console GND
J8-9	SIO Rx232B
J8-10	SIO Tx232B
J8-11	SIO GND
J8-12 or J8A-1	RIO Blue
J8-13 or J8A-2	RIO Shield
J8-14 or J8A-3	RIO Clear

J9 SYSTEM I/O

Terminal	Description
J9-1	JOB Select BCD, Units 1 Input
J9-2	JOB Select BCD, Units 2 Input
J9-3	JOB Select BCD, Units 4 Input
J9-4	JOB Select BCD, Units 8 Input
J9-5	JOB Select BCD, Tens 1 Input
J9-6	JOB Select BCD, Tens 2 Input
J9-7	JOB Select BCD, Tens 4 Input
J9-8	JOB Select BCD, Tens 8 Input
J9-9	JOB Select BCD, Hundreds 1 Input
J9-10	JOB Select Strobe Input
J9-11	System Ready/Halt Input
J9-12	Spare Input
J9-13	System Fault Output
J9-14	System Pulse Output
J9-15	Spare Output
J9-16	GND
J9-17	GND
J9-18	GND

J10 AUXILIARY CAN BUS PORT

Terminal	Description
J10-1	ITW CAN BUS+
J10-2	ITW CAN BUS-
J10-3	ITW CAN BUS GND

J11 = Channels 1 & 2
J14 = Channels 3 & 4
J17 = Channels 5 & 6
J20 = Channels 7 & 8

J11, 14, 17, 20 CHANNEL I/O

Terminal	Description
Jn-1	Analog Set Point #1
Jn-2	Analog Set Point #2
Jn-3	Analog Transducer Signal #1
Jn-4	Analog Transducer Signal #2
Jn-5	Trigger Input #1
Jn-6	Trigger Input #2
Jn-7	Run #1
Jn-8	Run #2
Jn-9	Transparent/PID Input #1
Jn-10	Transparent/PID Input #2
Jn-11	Total Hold #1
Jn-12	Total Hold #2

J12 = Channel #1 Flow Meter
J13 = Channel #2 Flow Meter
J15 = Channel #3 Flow Meter
J16 = Channel #4 Flow Meter
J18 = Channel #5 Flow Meter
J19 = Channel #6 Flow Meter
J21 = Channel #7 Flow Meter
J22 = Channel #8 Flow Meter

J12, 13, 15, 16, 18, 19, 21, 22 FLOW METER INPUTS

Terminal	Description
Jn-1	Source Signal
Jn-2	Source GND
*Jn-3	Phase Signal
Jn-4	Phase GND

* Used for flow meters with reverse flow detection capabilities only. This input must be connected to +24 VDC if a single direction flow meter is used.

SERIAL COMMUNICATION PROTOCOLS

NOTE

► Reference the "DynaFlow Programmers's Manual" for more information.

Allen-Bradley RIO

The Interface Module allows for direct communication from an Allen-Bradley PLC Remote Input/Output (RIO) port to the DynaFlow Fluid Flow Control system. The RIO interface portion of the Interface Module contains some Allen-Bradley components that are licensed to ITW Ransburg. These are designed specifically to communicate with the proprietary protocol of the RIO serial link. The central component being an application specific IC (ASIC) which is capable of formatting the RIO information for use by the central processor (CPU).

Up to four Channel Modules (8 flow control CHANNELs) can be controlled with the Interface Module. The Interface Module and four Channel Modules constitute half of a standard 19" rack. In terms of RIO rack size, a full rack consists of 8 I/O groups. The Interface Module is one I/O group, but only uses the high byte of the group. Each Channel Module is one I/O group with the first CHANNEL in the low byte and the second CHANNEL in the high byte. A RIO 1/4 rack is 2 I/O groups, which consists of the Interface Module and only one (1) Channel Module. A RIO 1/2 rack is 4 I/O groups, which may consist of the Interface Module and from one (1) to three (3) Channel Modules. A RIO 3/4 rack is 6 I/O groups, which may consist of the Interface Module and from one (1) to four (4) Channel Modules. A RIO full rack is 8 I/O groups, which may consist of the Interface Module and from one (1) to four (4) Channel Modules.

The Interface Module accepts both hard-wired discrete I/O and RIO discrete and RIO block transfers from a PLC.

NOTES

RATIO CONVERSION CHART	
% of Catalyst to Total Volume	**Parts of Resin to 1 Part Catalyst**
1	99
2	49
3	32.33
4	24
4.76	20
5	19
6.25	15
9.09	10
10	9
11.11	8
12.5	7
14.28	6
15	5.67
16.67	5
20	4
25	3
30	2.33
33.33	2
35	1.86
40	1.5
45	1.22
50	1

Formula for converting percentage of catalyst to parts of resin:

$$\frac{100\%}{\%\ \text{of Catalyst}} - 1 = \text{Parts Resin to 1 Part Catalyst}$$

Example: 5% catalyst is specified

$$\frac{100\%}{5\%} - 1 = 19\ \text{Parts Resin to 1 Part Catalyst}$$

Formula for converting "parts" to percentage:

$$\frac{100\%}{(\text{Parts Resin} + 1)} = \%\ \text{of Catalyst}$$

Example: If a ratio setting is 13 (13 parts resin to 1 part catalyst), and I want to know what percentage of the total mixed material is resin and what percentage is catalyst.

$$\frac{100\%}{(13 + 1)} = 7.14\%\ \text{Catalyst}$$

100% - 7.14% = 92.86% Resin

ITW Ransburg

MANUAL CHANGE SUMMARY

This manual was published to supercede Service Manual ***LN-9400-00.6, DynaFlow User Manual,*** to make the following changes:

1. Added "Service Manual Price: €40.00 (Euro") to the "Front and Back Covers".

2. Added "Model #A12233 Pneumatic Interface" throughout the service manual.

3. Added "Interfacing to the Flow Controller - Gun I/O - Gun Outputs - Output Signal - Fluid Line Flushed Out, User Interface Revision, and Language" in the "Installation" section.

4. Added "Dynaflow System Components and Parts Identification - Item 3 - A12182 - Interface Panel W/Color Change" in the "Maintenance" section.

5. Added "A12233 to Spare Parts for 77376 Console Unit" in the "Maintenance" section.

6. Removed "Paint and Solvent Specifications", "Viscosity Conversion" charts, and "Volumetric Content of Hose or Tube (English and Metric Units)" in the "Appendix" section. See "IL-307, Technical Supplement for All Products".

7. Added "Addendum A - Obsolence of the 77206-01 8-bit Channel Card, the 77206-12 10-bit Channel Card, and the A10946-00 12-bit Channel Card" in the "Appendix" section.

8. Added "Addendum B - Color Change Sequencer" in the "Appendix" section.

9. Added "Addendum C - Remote Operator's Panel" in the "Appendix" section.

10. Revised "DynaFlow Channel Module - Part #10946-01" in the "Appendix" section.

Service Manual Price: €40.00 (Euro)
$50.00 (U.S.)

Manufacturing
1910 North Wayne Street
Angola, Indiana 46703-9100
Telephone: 260/665-8800
Fax: 260/665-8516
www.itwransburg.com

Technical/Service Assistance Telephone: 800/ 626-3565 Fax: 419/ 470-2040
Telephone: 800/ 233-3366 Fax: 419/ 470-2071

Technical Support Representative will direct you to the appropriate telephone number for ordering Spare Parts.

ISO 9001 Quality Systems

ENVIRONMENTALLY CONCERNED

Form No. LN-9400-00.7
Litho in U.S.A.
10/08