Quantum™

Operation Manual

UNIST
Environmentally Friendly Lubrication

unist.com/qtman
Ly!3kC3

Questions or part orders:

1-800-253-5462 (US & Canada)
1-616-949-0853 (International)

Quantum™ Operation Manual

05/07/2019 V1.5

Important Operator Information

Consult this documentation in all cases where this caution symbol appears. This symbol is used to inform you of any potential HAZARD or actions that require your attention.

Use of this equipment in a manner other than that specified by Unist, Incorporated may compromise design integrity and become unsafe.

WARNING: This equipment is not intended for use in explosive environments.

ADVERTENCIA: Este equipo no está diseñado para uso en atmósferas explosivas.

AVVERTIMENTO: Questa apparecchiatura non è inteso per l'uso in ambienti esplosivi

WARNUNG: Das Ausrüstung darf in einer explosiven Umgebung NICHT verwendet werden.

AVERTISSEMENT: Cet équipement n'est pas prévu pour une utilisation dans des environnements explosifs

---

WARNING: This product can expose you to chemicals, including lead, which is known to the State of California to cause cancer, birth defects, or other reproductive harm. For more information go to www.p65warnings.ca.gov.

ADVERTENCIA: Este producto puede exponerlo a productos químicos, incluido el plomo, que el estado de California sabe que causan cáncer, defectos de nacimiento u otros daños reproductivos. Para obtener más información, vaya a www.p65warnings.ca.gov.

AVVERTIMENTO: Questo prodotto può esporre a sostanze chimiche, incluso il piombo, che è noto allo Stato della California come causa di cancro, difetti alla nascita o altri danni riproduttivi. Per ulteriori informazioni, visitare www.p65warnings.ca.gov.

WARNUNG: Dieses Produkt kann Sie Chemikalien, einschließlich Blei, aussetzen, von denen der Staat Kalifornien weiß, dass sie Krebs, Geburtsfehler oder andere Fortpflanzungsschäden verursachen. Weitere Informationen finden Sie unter www.p65warnings.ca.gov.

AVERTISSEMENT: Ce produit peut vous exposer à des produits chimiques, y compris le plomb, qui est connu par l'État de Californie pour causer le cancer, des malformations congénitales ou d'autres problèmes de reproduction. Pour plus d'informations, visitez www.p65warnings.ca.gov.

Quantum Operating Environment

Usage:	Indoor only
Altitude:	2000 m
Pollution degree:	2
Overvoltage:	Category II

Federal Communications Commission Notice

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Industry Canada Statement

This ISM equipment complies with Canadian ICES-001.
Cet équipement ISM est conforme à la norme NMB-001 du Canada.

CAN ICES-1/NMB-1

Quantum CE Declaration

Manufacturer:	Unist, Inc.
Address:	4134 36th Street S.E. Grand Rapids, MI 49512-1991 USA
Telephone:	(616) 949 0853
Responsible person	BIJUR DELIMON INTERNATIONAL
Address:	9 Avenue du Québec B.P50 ZIND de Courtaboeuf Villebon sur Yvette F-91942 COURTABOEUF Cedex
Telephone:	+33(0)1 69 29 85 85

- Council Directive 2014/30/EC - Electromagnetic Compatibility
  - EN61326-1:2006 Electrical equipment for measurement, control and laboratory use
    - EN55011/CISPR11:2009+A1:2010 Conducted and Radiated Emissions
    - IEC/EN 61000-3-2:2006+A2:2009 Harmonic Current Emissions
    - IEC/EN61000-3-3:2008 Voltage Fluctuations and Flicker
    - IEC/EN61000-4-2: 2008 ESD
    - IEC/EN 61000-4-3:2006+A1:2007+A2:2010 Radiated Immunity
    - IEC/EN 61000-4-4:2004+A1:2010 - EFT
    - IEC/EN 61000-4-5:2005 - Surges
    - IEC/EN 61000-4-6:2008 Conducted Susceptibility
    - IEC/EN 61000-4-11:2004 Voltage Dips and Interrupts

- Council Directive 2014/35/EC - Low Voltage Equipment Safety
  - IEC/EN 61010-1: 2010 3rd Edition Safety requirements for measurement, control, and laboratory use.

Warning: This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

Identifying Symbols

Caution - ISO 7000-0434B

Table Of Contents

Table Of Contents

Table Of Contents

Table Of Contents

Introduction

Thank You

Thank you for your purchase of the Unist Quantum™ system. The Quantum™ system is a programmable Minimum Quantity Lubrication (MQL) system designed to interface with various automated industrial machines such as CNC machining centers, dedicated machining cells, tube bending machines, saws, metal forming cells, and any other industrial process that requires precise lubrication application. The system has been designed for maximum flexibility while still maintaining simplicity in its controls and programming. Please take the time to read and review this operating manual to take full advantage of all that the Quantum™ has to offer.

Figure 1: Quantum™ system

System Introduction

The Quantum™ is designed to control a variety of configurations of MQL application outputs. These outputs range between MQL (oil mist) outputs with manually adjusted atomization air flow or programmable air flow, oil-only outputs, and air blow-off outputs. These outputs can be configured to meet the demands of almost any machining operation.

The Quantum™ also incorporates several performance monitoring systems to ensure proper operation. Pump output, incoming air pressure, and reservoir fluid level can all be monitored to ensure optimal system performance. The Quantum™ incorporates an alarm relay output that can be integrated as an interlock to stop critical processes when a problem is detected.

The Quantum™ interfaces with a machine in two ways. The first is through the use of discrete input signals. These are simply on or off switches that can be used to trigger the outputs of the Quantum™. The second is through the use of serial commands. This is a string of commands that the Quantum™ listens to and executes as they are sent.

Unist designed the Quantum™ with maximum flexibility to ensure successful implementation. Because of this, it is important to note that the examples provided in this manual are meant to be illustrations of the system's capabilities and are not an exhaustive list of all implementations.

Capabilities

As previously mentioned, the Quantum™ system is designed to give end users maximum flexibility in configuring their system to application requirements. The following sections define the types of outputs, control methods, and process monitoring capabilities that a Quantum™ system may be equipped with.

Output Types

MQL

The first output type for a Quantum™ is an MQL output. An MQL output consists of an oil and air mixture that is to be delivered to the work interface. In the Quantum™ system, the oil is delivered via a pneumatically actuated positive displacement metering pump. The nominal output of the metering pumps is either 1 or 2 drops (0.033 or 0.067 mL) per pump stroke. The pump output per stroke can also be manually adjusted with the manual pump output adjustment knob. The nominal output of your pumps can be determined by the color band on the pump adjustment knob. A green band indicates a 1-drop output pump. A red band indicates a 2-drop output pump.

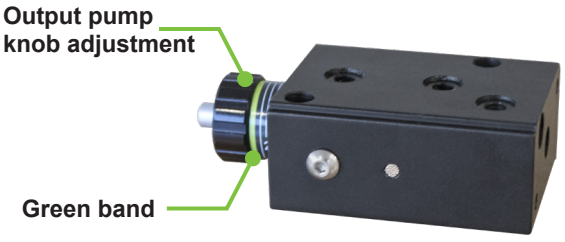


Figure 2: 1-drop Quantum™ pump

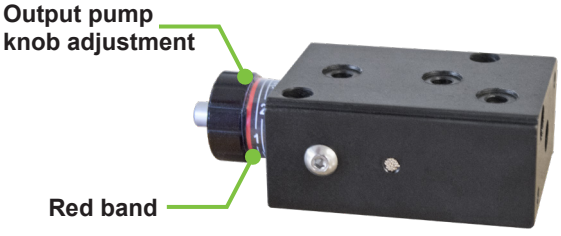


Figure 3: 2-drop Quantum™ pump

MQL outputs on the Quantum™ system can either have manual or electronic atomization air flow control. Pumps with manually adjusted air flow have metering screws that allow users to increase or decrease the air flow by adjusting the position of the metering screw. Electronically adjusted air flow pumps incorporate proportional solenoid valves so that the users can specify the air flow rates via the user interface or with a serial command.

MQL outputs with manually adjusted air flow can also be “linked” together. This indicates that the outputs are turned on and off as a group. The fluid flow settings are the same for each output that is part of a linked output group.

Through-Spindle MQL

The second type of output for a Quantum™ is an MQL output specifically designed for use with through-spindle MQL applications. This is very similar to MQL outputs but in addition to the fluid pump and atomization air control, it incorporates a fluid valve control feature. This feature optimizes the system response time for through-spindle MQL applications by retaining pressure on the fluid line when the system is off.

Air Blow-Off

The next type of output available on the Quantum™ system is an air blow-off output. An air blow-off output is most commonly used to assist in the removal of chips from the machining zone during operation. Air blow-off outputs can be a continuous air blast, or a pulsed air blast.

Figure 4: Air blow-off option

Introduction

Air blow-offs on the Quantum™ system can be implemented as either external or integrated air blow-offs. An external air blow-off indicates that the physical output will exit the system enclosure with its own independent nozzle and hose connection. An integrated air blow-off output exits the enclosure as part of an MQL output as it is integrated into the MQL output hose and nozzle. Integrated air blow-off outputs utilize special nozzle couplers to minimize excess misting while performing air blow-off operations out of the MQL nozzle. Additionally, integrated air blow-off outputs can supply air to MQL applications that require additional air flow such as through spindle MQL applications.

Oil Only

The last output type from the Quantum™ system is an oil-only output. Oil-only outputs consist of the same pneumatically actuated positive displacement pumps as MQL outputs, but they do not deliver atomization air. These pumps can be used to deliver oil to an MQL application zone independently of atomization air. Oil-only outputs can also be linked together for common actuation and flow rate.

Control Interface

The Quantum™ system can be controlled with two control mechanisms: serial control and discrete inputs. Serial control enables a CNC machine or PLC controlled machine to directly control the Quantum™ via a prescribed set of serial control commands. Alternatively, discrete input signals can be used to start Jobs that have been set up by the user to control system outputs. Serial commands give the user the most flexibility in programming the Quantum™ but for some applications, discrete inputs are more than sufficient.

Performance Monitoring

The Quantum™ system can include multiple activity monitoring systems that ensure optimal system performance. Flow sensors on the positive displacement pumps ensure that fluid is moved with each pump stroke. A level switch inside the fluid reservoir can be used to alert users that the fluid level is low. This can also be used to automatically refill the reservoir if connected to a central fluid supply. An integrated pressure sensor monitors the input supply air pressure to ensure the optimal operation conditions are met. The Quantum™ system also has an alarm relay output which can be used as an interlock between the Quantum™ and end use machine to ensure operation is halted if there is an error.

Lockout

The Quantum's™ user interface can be configured to be passcode protected from unauthorized users. This includes setting two levels of access codes: user and admin. Different functions on the system can be protected with different levels of security at the discretion of the end user.

System Layout

Enclosure

The Quantum™ system features a rugged industrial enclosure that houses the system controller and all mechanical components. Key enclosure features are pointed out on the illustrations below.

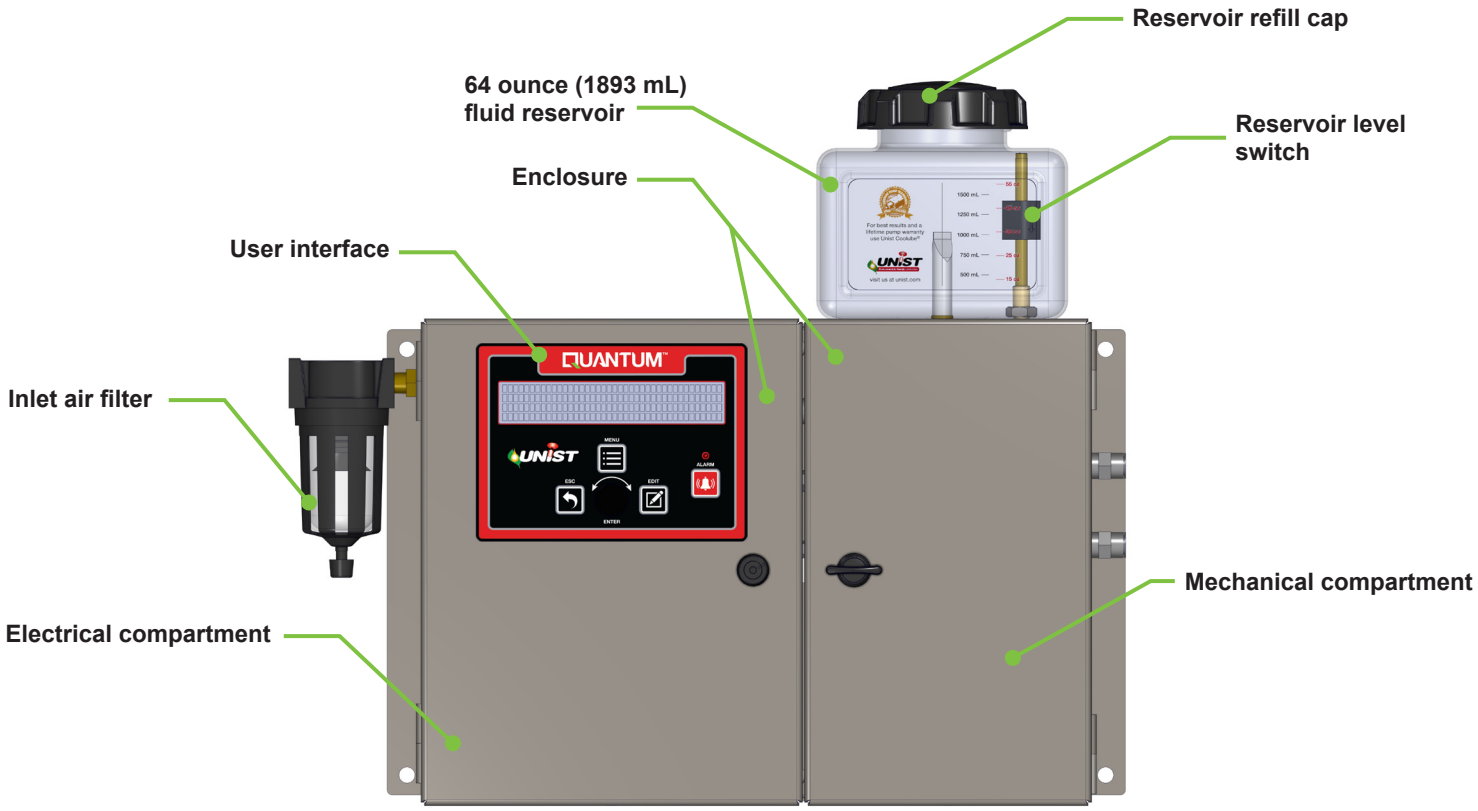


Figure 5: System layout front view

Pump Stack

The pump stack on a Quantum™ system is made up of various blocks. These blocks can be a top block, manifold block, metering pump, air blow-off block, or bottom block. Metering pumps can have various output blocks depending on what type of output they are. Together the blocks stack up to create the pump stack. Refer to your system drawings for the specific blocks that compose your pump stack. Blocks in a pump stack are referred to by their position in the pump stack, starting with block one at the top.

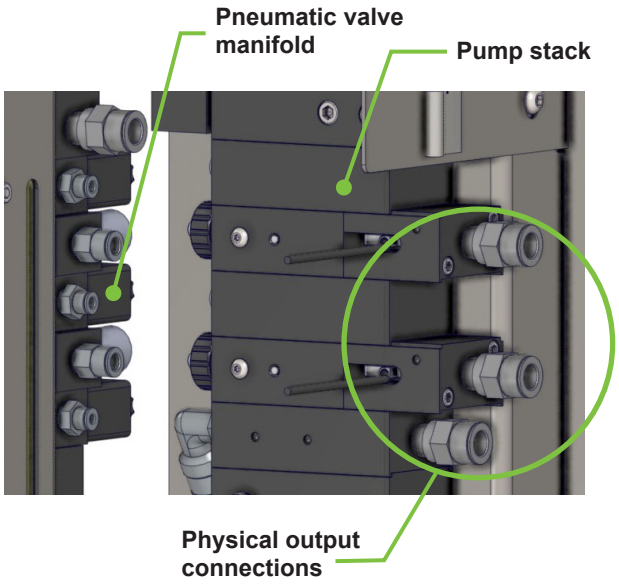


Figure 6: Pump & valve stacks

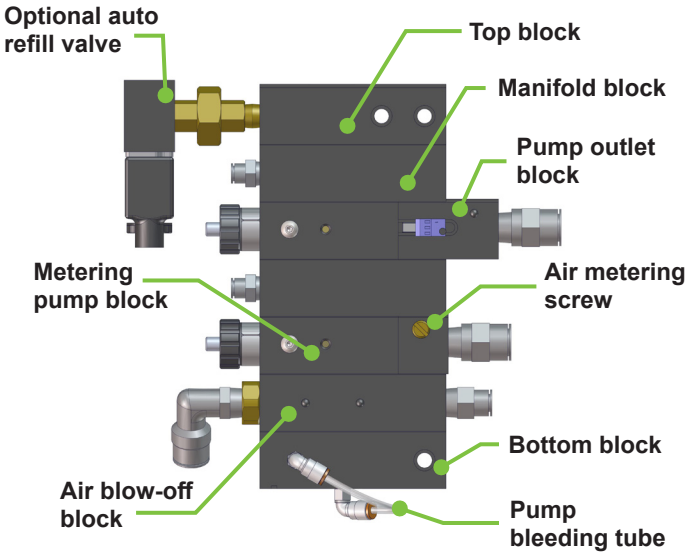


Figure 7: Pump stack view

Pneumatic Valve Manifold

The pneumatic valve manifold on a Quantum™ system controls the pump stack. Valves in this stack can be an on off valve, used to control the stroking of a pump, pulsing of an air blow-off, and manually adjusted atomization air. Valves can also be a proportional type valve used to control the electronically adjusted atomization air. Valves are referred to by their numbered position in the stack, starting at the top with valve number 1. Refer to your system drawings for the specific valves in your valve stack.

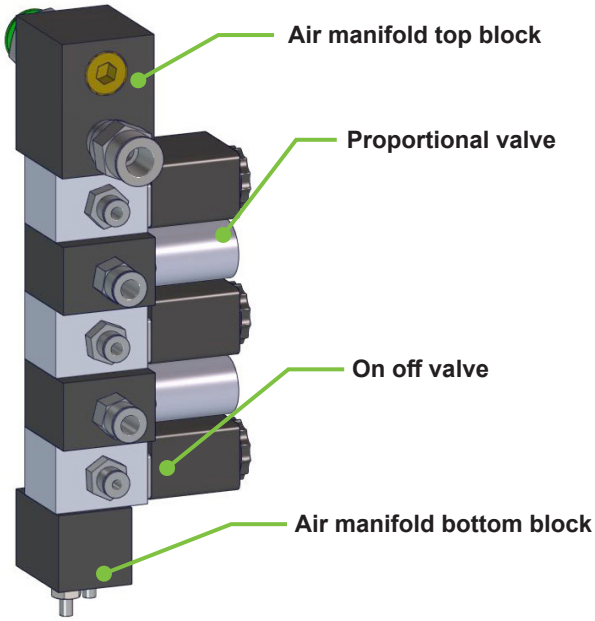


Figure 8: Pneumatic valve stack

Optional Remote Display

As an option for more flexible installation, the Quantum™ is available with a remote display option. The remote display interface can be mounted at a location that is convenient to the operator, and the controller and mechanical portion of the system can be mounted elsewhere.

Figure 9: Optional remote display

Physical Outputs & Output Control ID's

A Quantum™ system can contain numerous outputs. A physical output is determined by a hose connection coming out of the outlet side of the control enclosure. Physical outputs are referred to by their position in the pump stack, starting with output 1 at the top.

Physical outputs are differentiated from output control ID's by the controller's capability to operate some outputs independently of others. A unique output control ID is given to each output or group of outputs that can be controlled independently. It is the output control ID that is used in programming the Quantum™ system with jobs and serial commands.

Output control ID's of the Quantum™ system are labeled alpha numerically. The number associated with each output control ID indicates the output's physical location on the pump stack, starting with number 1 at the top. An output control ID with an "A" suffix indicates that it is controlling an air blow-off type output. As previously mentioned, air blow-off outputs can be of either the integrated or external type. For this reason, an integrated air blow-off output can share the same output number as an MQL output, but since it can be controlled independently of the MQL output, it is differentiated with the "A" suffix.

For example, a system has two MQL outputs with two integrated air blow-offs. The physical outputs on this system are 1 and 2. However, this system has output control ID's of 1, 1A, 2, and 2A. This is because output control ID 1A shares the same physical hose connection as output control ID 1 and output control ID 2A shares the same connection as output control ID 2. Since each of these can be controlled independently of one another we have the output control ID's of 1, 1A, 2, 2A.

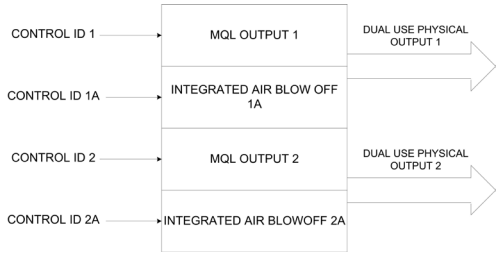


Figure 10: Integrated air blow-off control ID's

It was previously mentioned that some MQL and oil-only outputs can "linked" in that they cannot be controlled independently of one another. Each physical output (hose connection) gets its own physical output number, however in programming jobs and serial commands, they must be called by their output control ID which is the grouping of the linked pumps.

For example, a system has two groups of two linked MQL outputs. The physical output numbers of the system are 1 and 2 in the first group and 3 and 4 in the second group. The output control ID's for use with the controller are 1-2 and 3-4, as the settings for physical outputs within these groups cannot be controlled independently.

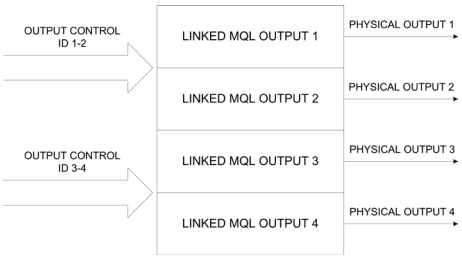


Figure 11: Linked output control ID's

Determining the physical outputs and output control ID's on your system is simple. Navigate through the Main menu to the View Outputs option. Click enter at this option and you will be directed to the View Outputs display. This display will list all output control ID's configured on your system in the output column and also the type of output they control. Scroll through the list to see what outputs are available on your system.

```
*****************MENU*****************
  BLOWOFF SETTINGS
 >VIEW OUTPUTS
  SYSTEM ID
```

```
*************VIEW OUTPUTS*************
  OUTPUT      TYPE
 >1           PROGRAMMABLE AIR PUMP
  1A          INTEGRATED AIR BLOW OFF
  2           MANUAL AIR PUMP
  3-4         MANUAL AIR PUMP, LINKED
  5           OIL ONLY PUMP
  6A          EXTERNAL AIR BLOW OFF
```

Control Knob

Scrolling

When navigating within menus, rotating the control knob will move the cursor (>) among menu options. Rotating the knob clockwise will move the cursor down. Rotating the knob counterclockwise will move the cursor up.

Enter

Clicking or pushing the control knob will select the item that the cursor is next to. This will either bring the user to the next menu level, or will allow the user to edit a field.

Editing

When a field that is editable is selected, the cursor will flash between the cursor symbol (>) and a solid square (■). Rotating the control knob when the field is selected will rotate the user through the valid list of selections. To increase numeric entries, rotate the knob clockwise. To decrease numeric entries, rotate the knob counterclockwise. To confirm the new value, click enter and this will save the value and move the cursor back to navigating.

Menu Button

Pushing the MENU button returns the user to the top of the Main menu.

Alarm Button

Pushing the ALARM button brings the user to the Alarm menu where past and active alarms are viewed.

Edit Button

Pushing the EDIT button brings the user to the Edit Job menu.

Escape Button

Pushing the ESCAPE button will bring the user back one menu level. If editing a field, pushing the ESCAPE button will exit the field without saving the new value.

Display

The 4 Line By 40 Character display is the main user interface.

Alarm LED

The alarm LED illuminates when an alarm condition exists.

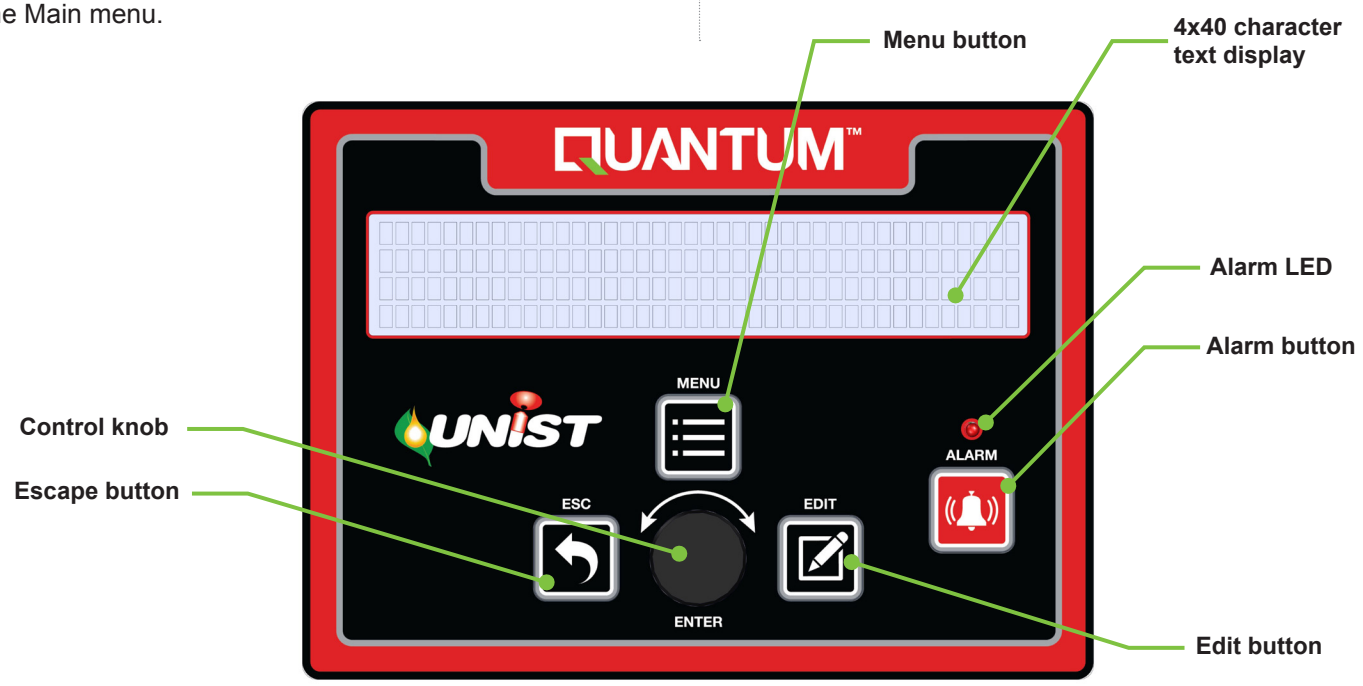


Figure 12: User interface

System Specifications

Power Supply

• 24 VDC, 60 W MAX

Control Inputs

• Dry contact (switch closure)
• 24 VDC PNP/NPN

Serial Input

• RS232
• Baud rate: 9600, 14.4k, 19.2k, 38.4k, 57.6k, 115.2k, 230.4k
• Parity: odd, even, zero
• Flow control: None, XON / XOFF
• ASCII
• Stop bits: 1 or 2
• Data bits: 8
• End of block character: Carriage return

Supply Air Pressure

• Clean, dry compressed air, 80 to 100 psi [5.5 to 6.9 bar], 25 SCFM minimum [708 Lpm]

Alarm Relay Output

• Isolated, non-fused single pole, double throw
• 2 amp load maximum

Output Ranges

MQL Oil Flow Rate**

• 1-drop metering pumps → 0 to 200 drops/minute [0 to 400 mL/hr]
• 2-drop metering pumps → 0 to 400 drops/minute [0 to 800 mL/hr]

MQL Air Flow Rate**

• 0 to 4 SCFM [0 to 113 Lpm]

Air Blow-Off Air Flow**

• 8 SCFM [226 Lpm]

Air Blow-Off Frequency

• 1 to 255 cycles/minute

Air Blow-Off Pulse Length

• 0.100 seconds to continuous

Pump Viscosity Range

• 1-drop pump: 30 – 1300 SUS
• 2-drop pump: 30 – 500 SUS

Flow Sensor Minimum Viscosity

• 50 SUS**

Operating Temperature Range

• 32° to 122°F [0° to 50°C]

Storage Temperature Range

• -4° to 158°F [-20° to 70°C]

Flow Sensor Inputs

• NPN sensor, 10-30 VDC

Fluid Reservoir Capacity

• 64 oz [1892.7 mL]

Remote Display Cable Maximum Distance

• 20 ft [6.1 m]**

RS232 Serial Cable Max Length

• 10 ft [3.0 m]**

Fluid Supply For Auto Refill

• Clean, filtered fluid, 20 psi MAX [138 kPa MAX]

Typical expected values. Exact limits may vary depending on particular installation.

System Installation & Mounting

Mount the system where it is convenient to the operator using the four mounting holes on the steel enclosure. If equipped with a Remote display, mount the display in a convenient location and the main unit in a position convenient for output routing. The back plate of the Remote display enclosure can be removed and installed and then the remainder of the Remote display can be mounted to the back plate. Ensure that the control cable between the Remote display box and main unit is no longer than 20 feet. See the drawings below for mounting dimensions.

Attention: *The Quantum™ must be securely mounted to a suitable mounting surface for safe operation. Use 3/8" diameter fasteners in all four mounting positions. Failure to do so could lead to unsafe operation and personal injury.*

Attention: *Always use two people while securing the Quantum™ system to it's mounting surface. Failure to do so could cause personal injury.*

Mounting Dimensions

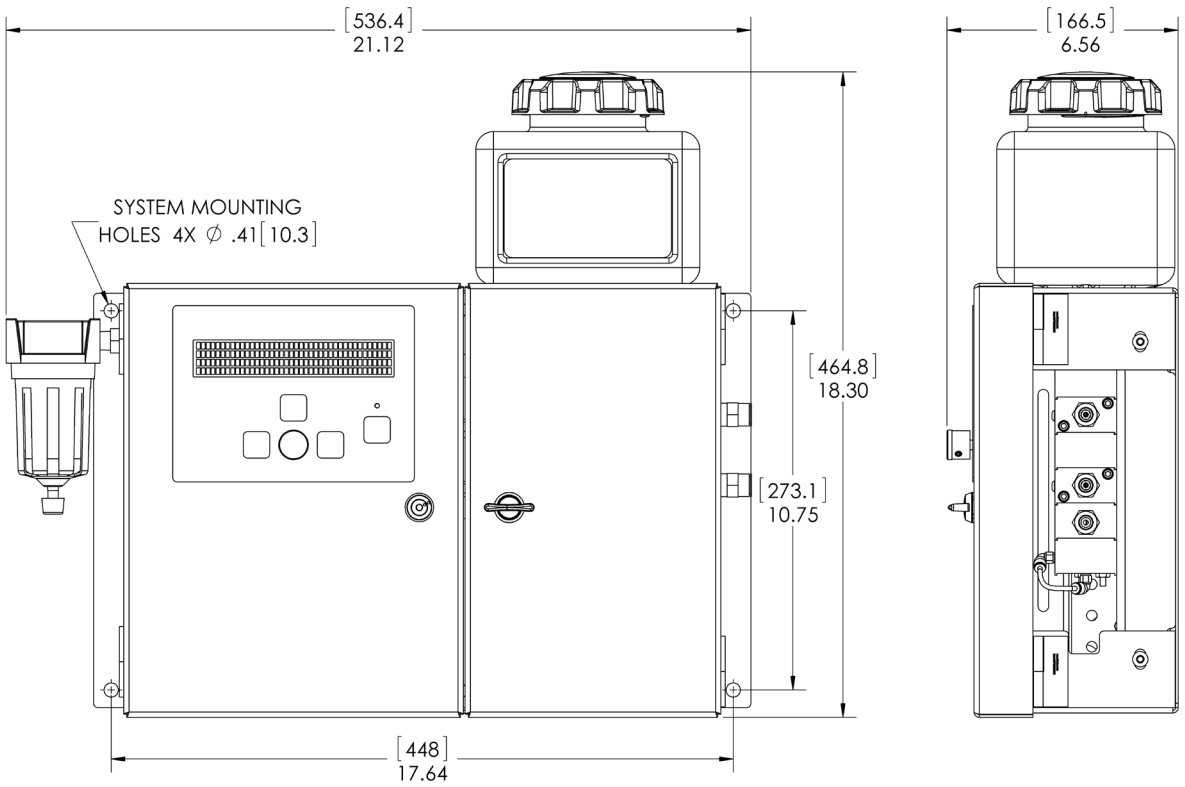


Figure 13: Standard enclosure mounting dimensions

Remote Display

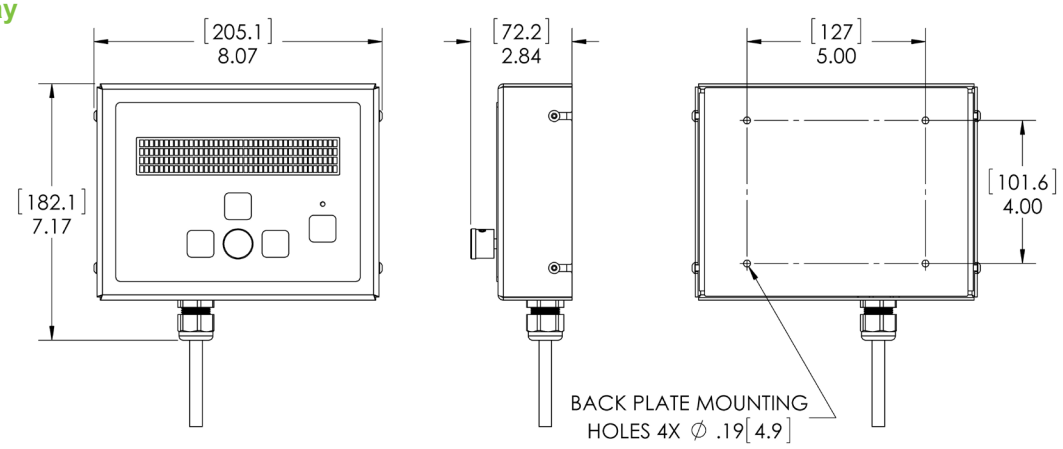


Figure 14: Remote display box mounting dimensions

Large Enclosure

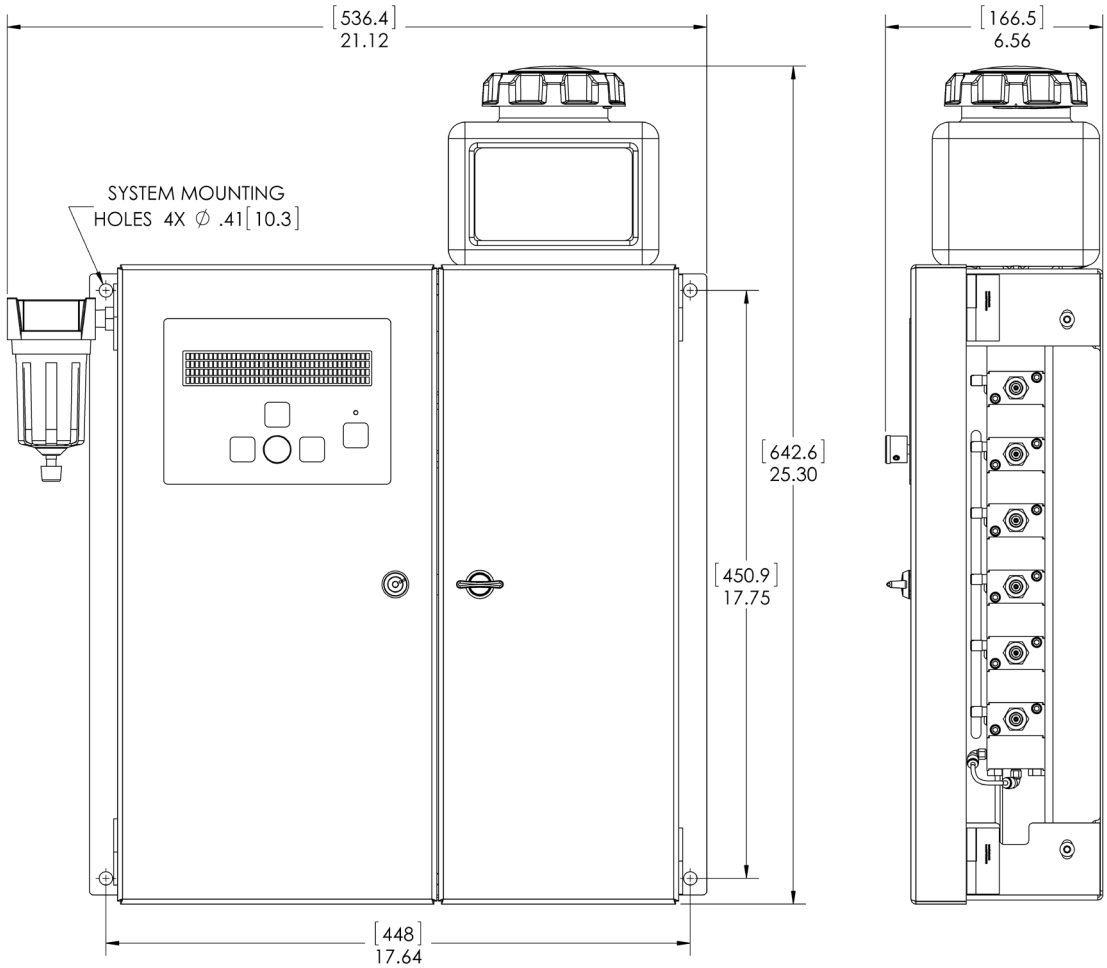


Figure 15: Large system mounting dimensions

System Connections

Power

The system requires 24 VDC supply power. This must be connected to the supply power connector on the main system circuit board. Unist can supply a power transformer if 24 VDC power is not readily available at your installation site. Refer to the Wiring Schematic shown in section 19.1 Wiring Diagram for more details.

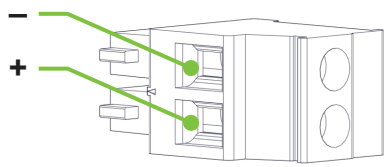


Figure 16: Power connection 24 VDC

Attention: *Use caution when making electrical connections. Only qualified individuals should attempt to connect input power and control signals to the Quantum™. Failure to do so safely could cause damage to property and personal injury.*

When power is applied to the system, a splash screen will appear for a few seconds as the software loads. The splash screen indicates the current version of the software running.

```
**************************************
          UNIST   QUANTUM
           VERSION: X.XX
**************************************
```

Compressed Air

Connect the compressed air source to the 1/4” female NPT compressed air inlet. It is recommended that the inlet air pressure be regulated between 80 and 100 psi [5.5 and 6.9 bar].

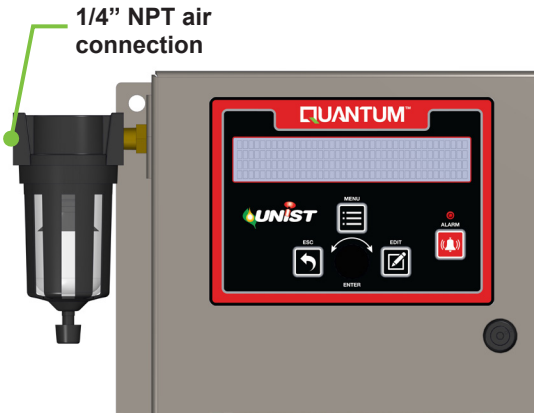


Figure 17: 1/4” NPT air connection

Attention: *Use caution when connecting the Quantum™ to a compressed air source. Only qualified individuals should make this connection. Failure to do so safely could cause damage to property and personal injury.*

Input Signals

If using discrete input signals to control the Quantum™ system, connect them to the circuit board using the supplied connectors. These can be an M-code, dry contact relay, or a PNP or NPN sensor. *Do not connect any external voltage to an input*. For more details on connecting the wires to the circuit board, refer to the System Wiring Diagrams found in 19.1 Wiring Diagram.

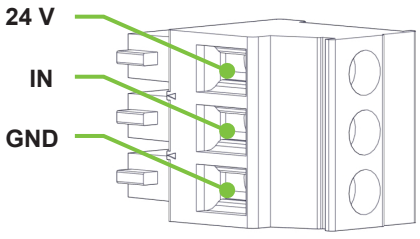


Figure 18: Discrete input connectors

For connections to dry contact, use the circuit pictured below.

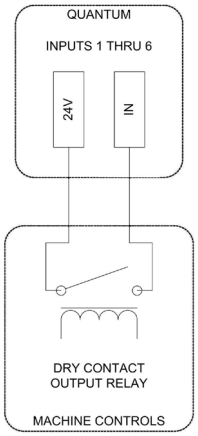


Figure 19: Dry contact connection schematic

Attention: *Do not connect any external voltage to a Quantum™ input. Doing so could cause personal injury or property damage.*

For connections to an NPN or PNP sensor, use the circuit pictured below.

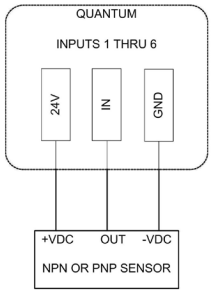


Figure 20: Sensor input wiring

Attention: *Ensure that power is not applied to the Quantum™ while connecting control signal as this could cause personal injury or property damage.*

Serial Input

If using serial commands to control the Quantum™ system, connect the serial port of your machine to the Quantum™ with the supplied cable. Refer to the System Wiring Diagram for detail about exact terminations found in 19.1 Wiring Diagram. For more information on typical serial connection styles, please refer to the Advanced Serial Command Set Document.

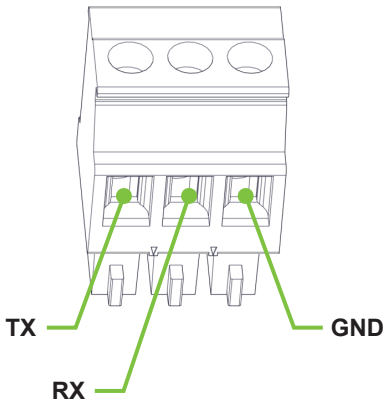


Figure 21: Serial connector

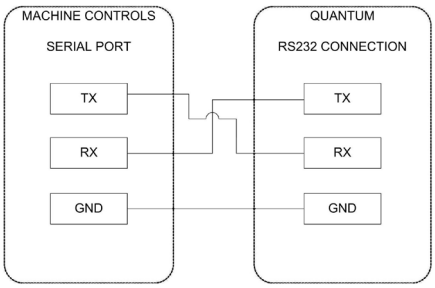


Figure 22: Serial connection schematic

Attention: *Ensure that power is not applied to the Quantum™ while connecting serial control signals as this could cause personal injury or property damage.*

Alarm Relay Connection

The system is equipped with an alarm relay connection that can be used as an interlock with a machine or used with an external annunciating device to detect when an alarm condition has occurred during operation. A supply voltage connection can be made to the common (COM) terminal and then to either the normally open (N/O) or normally closed (N/C) terminal. The N/O alarm provides an open circuit when the Quantum™ is powered up and no alarm is present. The N/C alarm provides a closed circuit when the Quantum™ is powered up and no alarm is present. Unist recommends using the N/C alarm connection for broken wire detection.

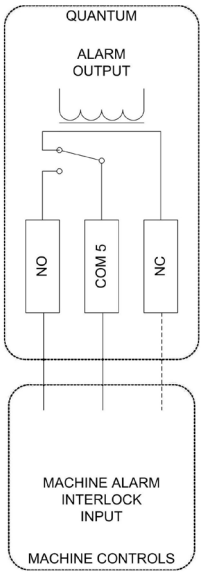


Figure 23: Alarm connection schematic

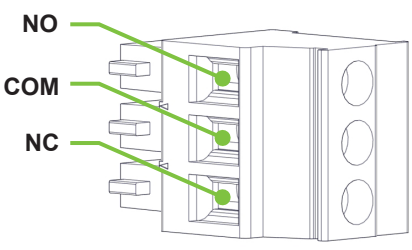


Figure 24: Alarm connection

Attention: *Ensure that power is not applied to the Quantum™ while connecting the alarm relay signal as this could cause personal injury or property damage.*

Attention: *Proper installation of the alarm relay interlock is essential for safe operation. The interlock will prevent the machine from running should an error occur with the Quantum™.*

NO: Open circuit when powered up and no alarm
NC: Closed circuit when powered up and no alarm

Output Connections

If not already connected, you can connect the fluid output tubes and nozzles to the outputs of the pump stack. Refer to your system drawing for the specific output nozzles and connections.

Remote Display Connection

If you ordered a system with remote display, the remote display cable must be connected to the main unit with the supplied cabling. Refer to the System Wiring Diagram for more detailed information about the required terminations.

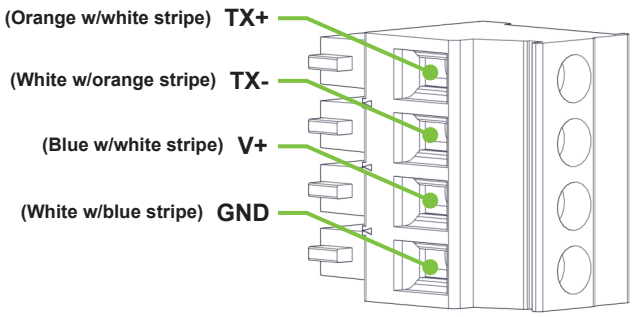


Figure 25: Display connection

Attention: *Ensure that power is not applied to the Quantum™ while connecting the remote display connection as this could cause personal injury or property damage.*

Reservoir Auto Refill

If equipped with the reservoir automatic refill mechanism, the pressurized central fluid supply connection can be made to the Quantum™. Connect this fluid source to the 1/8” NPT fluid connection on the refill valve.

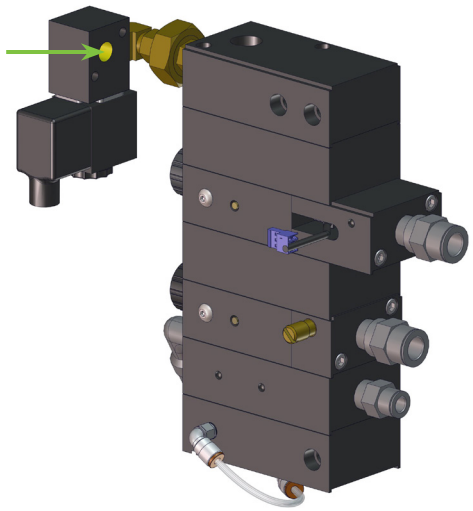


Figure 26: Fluid inlet connection

Attention: *Use caution while connecting to a pressurized fluid source. Fluid leaks could cause hazardous slippery conditions. Only qualified individuals should attempt to make this connection.*

Fluid Valve Connection

If your system is equipped with a through-spindle MQL output, the connection for the fluid control valve must be made at the system circuit board. The board output designated for the fluid control valve can be found by navigating through the menu to Configuration/Factory Settings/View Valve Configuration. The fluid control valve will be called out as shown below. Take note of the BOARD category, as this is the board output that the fluid control valve will need to connect into.

```
********VIEW VALVE CONFIGURATION********
  BOARD    VALVE    FUNCTION
 >02       02       AIR PUMP 1
  03       03       FLUID CONTROL 1
```

If you purchased the through-spindle valve assembly from Unist, this will come with a control wire with the connector attached. Plug the control wire for the fluid control valve into the valve output previously indicated and route the cable out of the enclosure up to where the fluid valve is installed.

User Interface Display Tree

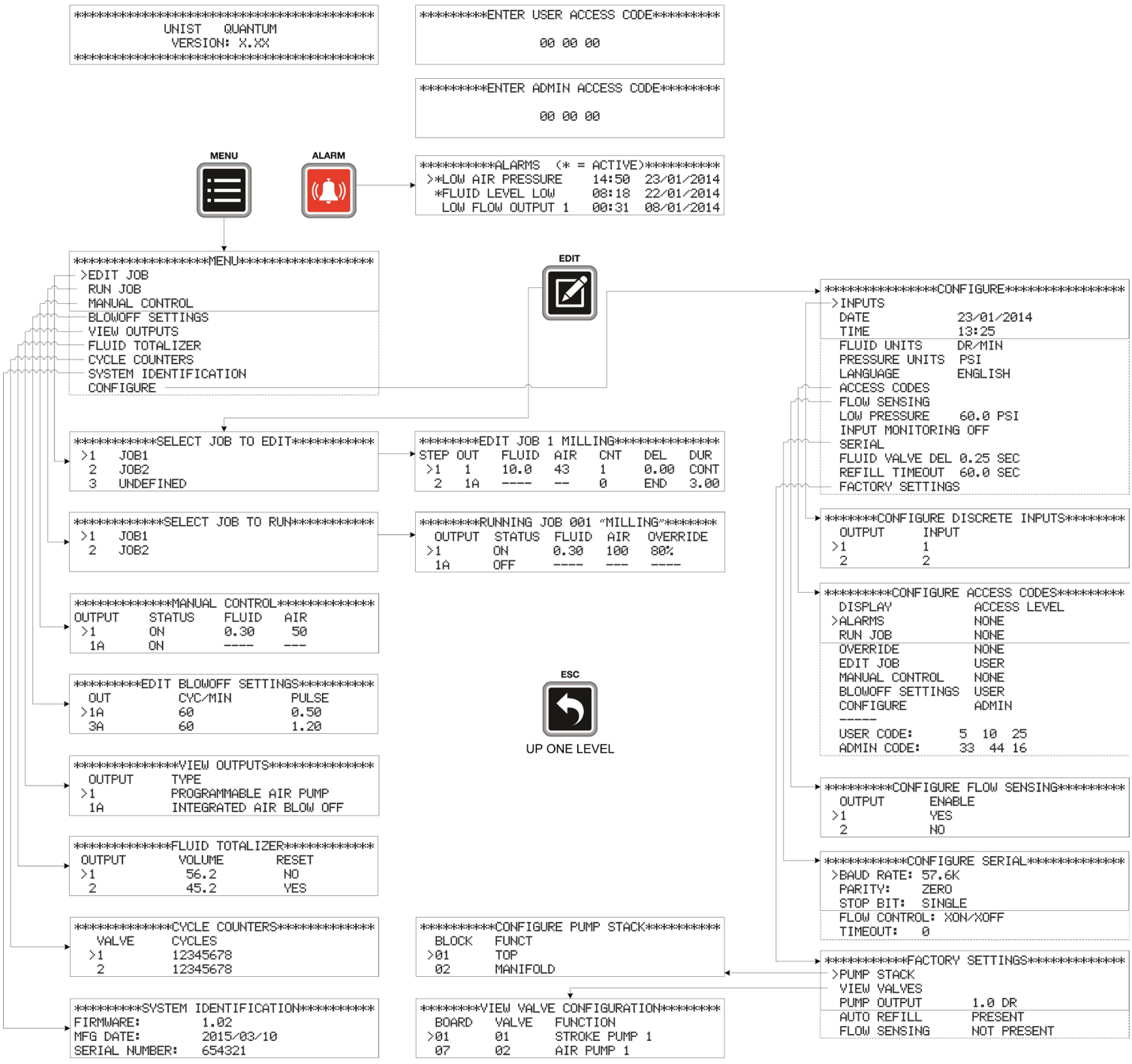


Figure 27: User interface display tree

Bleeding The Pump Stack

The metering pumps come pre-primed from the factory. In case the system reservoir must be emptied or the system is serviced and the pumps lose their prime, they can easily be re-primed.

The pump stack has a clear bleeder tube protruding from the bottom of the pump stack connected to a push-in fitting on the side of the bottom pump stack block. With the reservoir filled, the metering pump stack can be bled. A small container will be required to catch the small amount of fluid that will flow out of the bleeder tube. With the container placed under the push-in fitting on the side of the pump bottom block, push the release ring on the push-in fitting and release the bleeder tube from the fitting. Fluid will flow out of the bleeder tube as it fills the internal pump cavities. When a clean line of fluid is flowing from the bleeder tube and no more bubbles are present, the internal metering pump fluid cavities will be full. Insert the bleeder tube back into the push-in fitting.

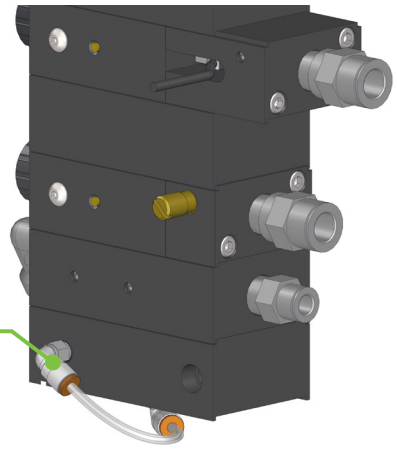


Figure 28: Bleeder tube

Note: only a small amount of fluid (less than 1 oz) will need to flow from the bleeder to properly fill the metering pump fluid cavities.

Attention: *Be careful to not spill any oil during the pump stack bleeding process. Clean up any spilled oil immediately as spilled oil can cause hazardous slippery conditions.*

Once the fluid cavity has been filled, the pump should be able to start pumping fluid. Depending on the length of the output lines, the pump may need to be cycled multiple times before the fluid reaches the end of the output line without air bubbles.

Using Manual Control

After installing the system and connecting outputs, the user may wish to use the Manual Control function to set up initial flow rates for air and oil and to properly position nozzles. To access the Manual Control feature, navigate through the Main menu to Manual Control. On the Manual Control display you will see a list of the system outputs, their status, fluid, and air settings. Not all outputs have fluid and air settings. For instance, outputs with manually controlled atomization air flow and oil-only outputs do not have an air setting. Also, air blow-off outputs do not have fluid or air settings.

```
*****************MENU*****************
 >MANUAL CONTROL
  BLOWOFF SETTINGS
  VIEW OUTPUTS
```

To manually turn on an output, scroll to the line with the output you desire to turn on and click the control knob to select the line. Scroll over to the fluid and air settings and adjust them as desired and then click the status field and rotate the control knob to turn on the output. While the output is on, you can adjust the fluid and air settings until you are satisfied with the results. The output status can then be changed to off to turn off the output. Exiting the manual control display will return all set points to zero and will turn off any outputs that were turned on.

```
************MANUAL CONTROL************
OUTPUT     STATUS     FLUID    AIR
 >1        ON         0.30      50
  1A       ON         ----     ---
  2        OFF        0.50     ---
  3-4      OFF        0.80     ---
  5A       ON         ----     ---
```

Attention: *Ensure all people are clear from the area of the system output nozzles when operating the outputs manually. Failure to do so could result in personal injury.*

Setting Pump Stroke

The volumetric output of each metering pump is set to the nominal pump output from the factory (1-drop or 2 drops depending on pump type). This value is also stored in the memory of the system controller for calculating fluid flow rates. Unist recommends operating the pumps at their nominal output volume. If it is deemed necessary, the pump output per stroke can be adjusted by turning the pump adjustment knobs. To decrease metering pump output, turn the adjustment knob clockwise. To increase metering pump output, turn the adjustment knob counterclockwise.

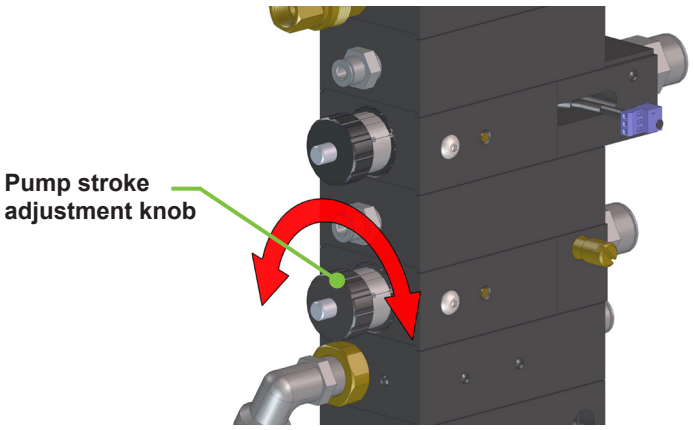


Figure 29: Pump stroke adjustment

Each pump in the pump stack must be set to the same volumetric output. After making an adjustment to a pump, you must measure what the new pump output per stroke is, ensuring that each pump is the same. To do this, disconnect the output nozzle or tube and stroke the pump into a container. Count the number of pump strokes it takes to dispense a known volume of fluid. Divide the known volume by the number of strokes to find the volume per stroke. Again, ensure that each pump is set to the same output per stroke.

After adjusting the pump output and measuring the output, the controller must then be told what the new volumetric output of the pumps is set to. This value must entered into the controller via the user interface. The pump output setting is found in the factory settings menu. Navigate to this menu and scroll down to the pump output option. Click enter to select the pump output line and scroll to change the pump output to the correct value. Please note the current fluid unit system in use at time of adjustment.

```
**********FACTORY SETTINGS**********
  PUMP STACK
  VIEW VALVES
 >PUMP OUTPUT        1.0 DR
```

Note: An improperly calibrated pump output will not provide accurate fluid output rates which can cause inferior system performance.

Setting Air Flow

For outputs with electronically controlled atomization air flow, the air flow is electronically set with a value from 0 to 100. See the chart below for air flow settings and approximate air flow rates. The manual control function can be used to actuate an output and adjust the air to the desired flow rate. Remember the value used as this is what will be entered when programming the system to run jobs or serial commands.

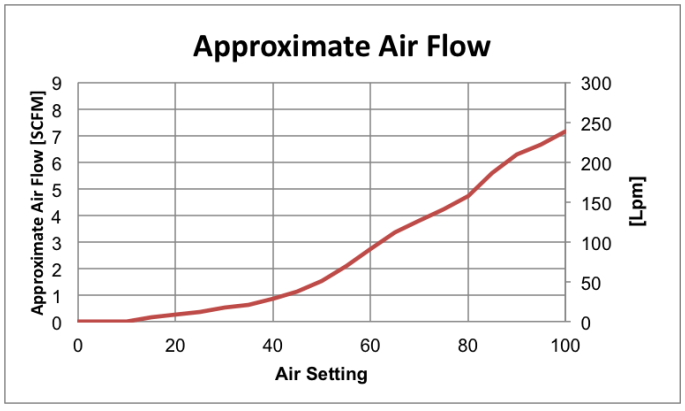


Figure 30: Approximate air flow chart

```
**********MANUAL CONTROL**********
OUTPUT    STATUS    FLUID   AIR
  1       ON        0.30    >50
  1A      ON        ----    ---
```

For outputs that have manually controlled atomization air flow, the air flow must be set with the air metering screw. Use the Manual Control function to turn on the output and adjust the air flow as desired. Turning the metering screw clockwise will reduce the amount of air flow, turning it counter clockwise will increase the amount of air flow. Air flow can be shut off by turning the screw completely clockwise. Adjust the air flow so that there is a nice mist spray pattern coming from the nozzle. Excessive air flow will lead to fogging and insufficient air flow will lead to spitting.

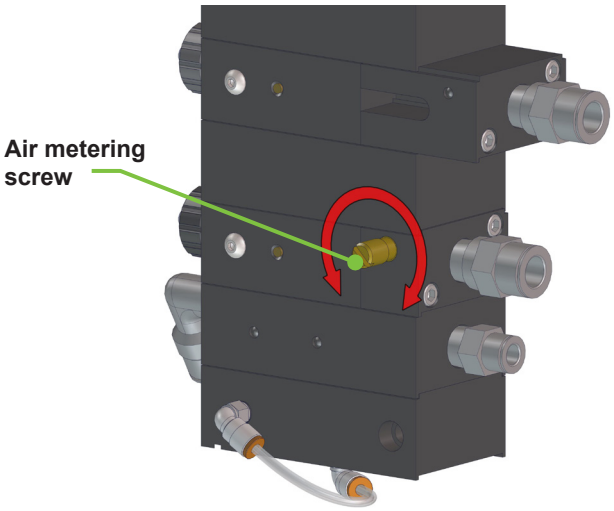


Figure 31: Metering screw adjustment

Configuring Options

Other optional system features to configure at system startup are the air blow-off settings, flow sensing, and automatic reservoir refill timer.

Air Blow-Off Settings

If your system is equipped with air blow-off outputs, they have the ability to operate as a continuous air blast, or as a pulsed output when turned on. The settings for each air blow-off output can be set on the Configure Blow-off Settings menu. Navigate to this menu by going to the Main menu and scrolling down to and selecting blow-off settings.

```
**********MENU**********
  MANUAL CONTROL
 >BLOWOFF SETTINGS
  VIEW OUTPUTS
```

For each air blow-off output, there will be a frequency setting (cyc/min) and pulse setting. The frequency dictates the frequency of the pulsed output, in pulses per minute, and the pulse setting sets the duration of each pulse. For example a frequency of 60 and a pulse of 0.50 will pulse the air for 0.5 seconds, once every second. To set up and air blow-off output to be a continuous air blast, set the pulse length longer than the value of 60 divided by frequency. This yields a continuous blast because the pulse length is longer than the period of the oscillation. An example of this is shown in output 3A in the display shot below. Use the control knob to navigate between options and make changes as desired.

```
*********EDIT BLOWOFF SETTINGS*********
  OUT          CYC/MIN         PULSE
 >1A           60              0.50
  3A           60              1.20
```

The air blow-off settings can be tested by returning to the Manual Control menu and turning on the air blow-off outputs. The settings indicated on the Configure Air Blow-off menu will be used any time the air blow-off output is turned on with a job or serial command.

Unist recommends setting integrated air blow-offs up to be either a continuous air blast, or a slow long pulsing blast (no more than 60 pulses per minute, duration of 0.8 seconds per pulse or greater). This will help to minimize excess fogging due to running the air blast through an MQL nozzle.

Flow Sensing

The Flow Sensor option monitors the output of each metering pump to ensure that it is pumping fluid each time it strokes. If the system is ordered from the factory with the Flow Sensing option, the flow sensors will be calibrated properly for use with Coolube® Fluid. Fluids of different viscosities may need slight adjustment of the flow sensor to ensure proper operation. Please refer to the System Specifications for fluids used with flow sensors as fluids with very low viscosities will not properly activate the flow sensor. Also, please avoid setting the pump output below half of the nominal pump output, as this can also cause issues with flow sensing.

To calibrate the flow sensors, locate the flow sensor on the side of each metering pump outlet block. Begin the calibration process by loosening the small flathead flow sensor locking screw and moving the flow sensor all the way to the right. Using a non-ferrous material (brass, aluminum, plastic, etc.) slowly move the flow sensor to the left until the red LED on the sensor illuminates. Next, move the sensor very slowly back to the right just until the sensor LED goes out. Tighten down the flow sensor locking screw. Use the Manual Control feature to turn on the output and cycle the pump. Observe the output and the flow sensor to ensure that fluid is being pumped and the flow sensor flashes once with each pump stroke.

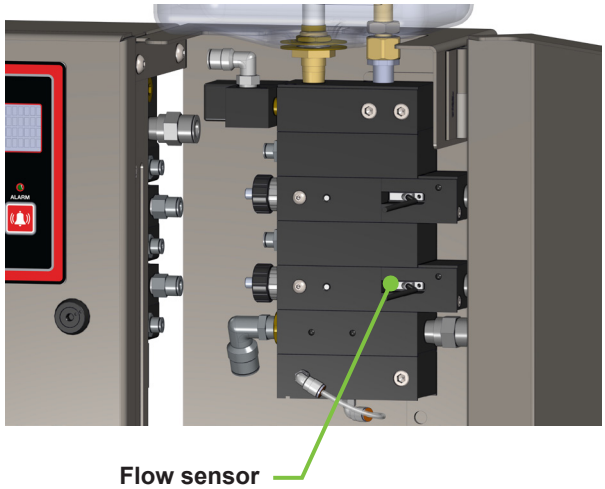


Figure 32: Flow sensor calibration

If the controller detects no fluid output from one of the pumps, it will create an alarm. Refer the section on Alarms for determining the cause of the alarm. Flow sensing can be enabled or disabled for each output if required for an application where the flow sensors do not work. This can be done on the Configure Flow Sensing menu. The user can navigate to this menu from the Configure menu.

```
**************CONFIGURE***************
  ACCESS CODES
 >FLOW SENSING
  LOW PRESSURE     60.0 PSI
```

This menu shows each output and an enable option for flow sensing. If flow sensing is disabled on an output, the controller will ignore the flow sensing input for that output. To disable flow sensing on an output, scroll down the list to the desired output and then click enter to select it. Use the control knob to select between yes and no and click enter again to confirm the choice.

```
*********CONFIGURE FLOW SENSING*********
  OUTPUT       ENABLE
 >1            YES
  2            NO
  3            YES
  4            YES
```

Auto Refill Timeout

If your system is equipped with the Auto Refill option, there is a setting for a refill timeout value that is used to detect issues with the auto refill mechanism. This setting is a measure of how long it should take to refill an empty reservoir. If it takes longer than the time set here, the system activates a refill timeout alarm. After connecting to the auto refill fluid line, use a stopwatch to measure how long it takes for the reservoir to fill with fluid. Add 10% to this measured time and enter this via the Configure menu into the refill timeout value. The value is entered in seconds and can range from 0.00 to 255. To enter the value, scroll down the Configure menu until you reach the Refill Timeout option. Click enter to select the line and then use the control knob to enter the desired value. Click enter to confirm the entry.

```
**************CONFIGURE***************
  SERIAL
 >REFILL TIMEOUT    60.0 SEC
  FACTORY SETTINGS
```

Configuring Other System Settings

Users may wish to configure the following system settings during system startup according to their preferences.

Access Codes

The Quantum's™ user interface can utilize access codes to protect against access from unauthorized users. This includes setting two levels of access codes: user and admin. Different functions on the system can be protected with different levels of security at the end user's discretion. The access codes are configured via the Configure Access Codes menu selection.

```
**************CONFIGURE***************
 >ACCESS CODES
  FLOW SENSING
  LOW PRESSURE    60.0 PSI
```

This menu displays a list of the displays of the user interface and their respective access levels. Options available are none, user, or admin. The access codes themselves are also set on the bottom two lines of this display. The pass code is a set of 3, 2 digit numbers; for example 05, 10, 25. These can be configured at the user's discretion. Remember to record the access codes for future reference.

```
*********CONFIGURE ACCESS CODES*********
  DISPLAY            ACCESS LEVEL
 >ALARMS             NONE
  RUN JOB            NONE
  OVERRIDE           NONE
  EDIT JOB           USER
  MANUAL CONTROL     NONE
  BLOWOFF SETTINGS   USER
  CONFIGURE          ADMIN
  -----
  USER CODE:       5  10  25
  ADMIN CODE:      33  44 16
```

Record your Access Code settings below.

User access code:_____

Admin access code:_____

Display	**Access code protects against:**
Alarms	Viewing list of active and past alarms
Run job	Selecting a job to run
Override eters	Adjusting the override param- while running a job
Edit job	Editing a job
Manual control	Using manual control to actuate outputs
Blowoff settings	Adjusting the air blow-off output settings
Configure	Changing anything under the configure menu

Upon trying to access one of the menus that has been access code protected, the user will be confronted with the Enter User or Admin Access Code display. The correct code must be entered before being allowed to proceed. Rotate the control knob to set and click enter to enter each two digit value and to move on to the next set. Pressing escape will move the user back to the previous set of two digits. A correct entry will allow the user to go through to the next display; an incorrect entry will return the user to the previous menu.

```
*********ENTER USER ACCESS CODE*********
                00 00 00
```

```
*********ENTER ADMIN ACCESS CODE********
                00 00 00
```

Fluid Units

The fluid unit setting indicates the unit system in which fluid flow rates are entered. The valid selections for the fluid units are DR/MIN (drops/minute) and ML/HR. Unist's standard MQL flow rate system is drops per minute where one drop is defined as 1/30 of a milliliter. To change the fluid units used, scroll down the System Configuration menu until the cursor is on the line labeled fluid units. Click enter to select the line and then scroll between the options. Click enter to select the desired unit system.

```
**************CONFIGURE***************
 >FLUID UNITS     DR/MIN
  PRESSURE UNITS  PSI
  LANGUAGE        ENGLISH
```

If you need to convert between fluid flow rate units, please use the equations below for conversion factors.

DR/MIN	X	2	=	ML/HR
ML/HR	X	0.5	=	DR/MIN

Pressure Units

The pressure units indicate the unit system that the value for the low pressure alarm set point is entered in. These can be set to match the user's preference. The valid selections for the fluid units are PSI, KPA, and BAR. To change the pressure units used, scroll down the System Configuration menu until the cursor is on the line labeled pressure units. Click enter to select the line and then scroll between the options. Click enter to select the desired unit system.

```
**************CONFIGURE***************
  FLUID UNITS     DR/MIN
 >PRESSURE UNITS  PSI
  LANGUAGE        ENGLISH
```

Language

The display language can be changed with the language setting under the System Configuration menu. To select a language, use the control knob to move the cursor down the Configure menu. Click enter to select the language option and use the control knob to choose between available options. Click enter again to select your choice.

```
**************CONFIGURE***************
  FLUID UNITS     DR/MIN
  PRESSURE UNITS  PSI
 >LANGUAGE        ENGLISH
```

Date

To set the system date, scroll down the System Configuration menu until the cursor is on the line labeled system date. Click enter to select the line and notice that the cursor moves next to the year field and starts flashing. Rotate the control knob to select the correct date and click enter to confirm. The cursor will then move to the month field and then on to the date field. Use the knob to change and then click enter to confirm the change. Please note that the systems tracks date under the DD/MM/YYYY format.

```
**************CONFIGURE***************
  INPUTS
 >DATE            23/01/2014
  TIME            13:25
```

Time

To set the system time, scroll down the System Configuration menu until the cursor is on the line labeled system time. Click enter to select the line. Rotate the control knob to select the correct time. Please note that the systems tracks time in the HH:MM, 24 hour format.

```
**************CONFIGURE***************
  INPUTS
  DATE            23/01/2014
 >TIME            13:25
```

Serial

Settings specific to the serial communication of the system are set on the Configure Serial menu. The setting here must match the settings on the end use machine for successful communication. The Quantum™ allows the user to select the BAUD rate, parity, number of stop bits, and flow control method used for the serial communication.

```
**************CONFIGURE**************
 >SERIAL
  REFILL TIMEOUT    60.0 SEC
  FACTORY SETTINGS
```

```
**********CONFIGURE SERIAL**********
 >BAUD RATE:     57.6K
  PARITY:        ZERO
  STOP BIT:      SINGLE
  FLOW CONTROL:  XON/XOFF
  TIMEOUT:       255
```

Available settings for baud rate are 9600, 14.4K, 19.2K, 38.4K, 57.6K, 115.2K, and 230.4K. The parity can be set to Zero, Even, or Odd. Stop bits can be set to either Single or Double. Flow control can be set to either NONE or XON/XOFF for software flow control. The settings here must match the settings on the machine desired to interface serially with the Quantum™ system.

Low Air Pressure Set Point

The low air pressure set point is the point at which the system will give a low air pressure alarm. From the factory this value is set at 60.0 psi [4.14 bar] as this is the minimum pressure required to properly operate the metering pumps. This value can be adjusted on the Configure menu. To change the set point, navigate to the low pressure set point on the Configure menu and click enter to select it. Rotate the control knob to select the desired value and click enter to confirm the entry. A setting of 0.0 psi will tell the system to ignore the low air pressure alarm if for some reason the sensor is malfunctioning.

```
**************CONFIGURE**************
  FLOW SENSING
 >LOW PRESSURE     60.0 PSI
  SERIAL
```

Input Monitor

The Quantum™ system has input monitoring for monitoring the discrete inputs while running a job to ensure that job steps will not overlap. This feature can be turned off by navigating to the input monitor item on the Configure menu and selecting either ON or OFF.

```
**************CONFIGURE**************
  FLOW SENSING
  LOW PRESSURE     60.0 PSI
 >INPUT MONITOR    ON
```

Fluid Valve Delay

If your system is equipped with a through-spindle MQL output, the fluid valve delay timer must be configured. This timer is a selectable amount of time between 0.00 and 9.99 seconds, that indicates the amount of time required between when an output is commanded on and the fluid control valve opens. This amount of time should be set slightly longer than the amount of time required for the machine spindle and air supply lines to fill with air pressure after the MQL is commanded on. As a general rule of thumb, this should be set to .20 seconds; however this will vary with specific installation cases.

```
**************CONFIGURE**************
 >SERIAL
  FLUID VALVE DEL 0.25 SEC
  REFILL TIMEOUT  60.0 SEC
```

Programming Introduction

The Quantum™ can run in two modes, either Job or Serial. The information provided in this manual is intended to be used as a brief introduction to the Quantum™ programming modes. If more information is desired, please contact Unist or look to our "Quantum™ Advanced Job Setup Guide" or "Quantum™ Serial Interface" documents.

Jobs

A job is a set of steps that defines the Quantum's™ reactions to discrete inputs. These steps are configured through the user interface by going to the Edit Job display. When running a job, the Quantum™ will carry out the currently running job as discrete inputs are given.

Discrete Inputs

The Quantum™ system has 6 discrete inputs. Each output on the system can be assigned to one input at the users choosing. Any input can be used to control one or more outputs. The first step to setting up a job is to have the relationship between inputs and outputs configured. This is done via the Configure Inputs display.
The Configure Inputs display is found via the Configure display. Navigate to the Configure display and select Configure Inputs.

```
**************CONFIGURE**************
 >INPUTS
  DATE              23/01/2015
  TIME              13:25
```

The Configure Inputs display will show a list of the outputs control ID's (OUTPUT) on the system. Use the control knob to navigate the list. Select a control ID by clicking the control knob and then scroll through the list of inputs 1 through 6 and click to select the input that is desired to control the selected output control ID. The input assigned to an output control ID is the input that the system will monitor as the controlling signal for starting job steps for that output control ID.

```
*******CONFIGURE DISCRETE INPUTS********
  OUTPUT      INPUT
 >1           1
  2           2
  3A          3
```

System Operating Principles

Jobs consist of a series of steps. A step is set of parameters that define one operation of an output from the Quantum™. Steps can be assigned for any output on the system. Steps for the same output will run sequentially as the job is active. A job can have up to 15 steps.

```
********EDIT JOB 1 MILLING*************
STEP OUT   FLUID  AIR   CNT   DEL   DUR
 >1   1    10.0   43    1     0.00  5.00
  2   1    0.50   50    0     2.50  10.0
```

For each job step, there can be up to six parameters to set.

OUT

The OUT or output value selects the output control ID that will be active in the job step. Valid values are any output control ID available on the system.

FLUID

The FLUID setting is the set point for the fluid flow rate of the output. This value is entered in the units setup on the Configure display for fluid units. Setting this value is valid for any MQL and oil-only outputs. The valid range is from 0.00 to 500. For an air blow-off output, this value will be blank (---).

AIR

The AIR setting is the air flow set point for the atomization air of an MQL output. This is only valid on MQL outputs with electronically controlled air flow. The valid range is from 0 to 100. For oil only, manually controlled atomization air MQL, and air blow-off outputs, this value will be blank (---).

CNT

The CNT, or count, value represents the number of inputs signals (of the input assigned to the particular output control ID in the job step) required to activate the job step. The valid range is from 0 to 255. If a job step has a count of 0, it will start immediately after the previous job step that contains the same output control ID finishes.

DEL

The DEL, or delay, value indicates the amount of time to elapse between when the required count value has been reached and when the output actually turns on. Valid values are between 0.00 and 255 and are entered in seconds. Also, this value can be set to END (scroll past 255) to indicate that the output turns on after an input turns on and then off. The END option is useful for operations where a sustained input signal is used during the process and the user wishes for the output to turn on after the process is done.

DUR

The DUR, or duration, value sets the length of time for which the output is on. Valid values are between 0.00 and 255 and are entered in seconds. The DUR value can also be set to CONT (scroll past 255), or continuous. The CONT option is useful for operations where a sustained input signal is given during the process and the user wishes for the output to remain on during the entire process, and the time length of the process varies.

Job Step Examples

The following are examples of job steps and descriptions of their end result.

```
********EDIT JOB 1 MILLING************
STEP OUT   FLUID  AIR   CNT   DEL   DUR
 >1   1    10.0   43    1     0.00  5.00
```

Step 1 → after one input signal is received (CNT = 1) on the input assigned to output 1 (OUT = 1), output 1 will immediately (DEL = 0.00) turn on at a fluid rate of 10.0 (FLUID = 10.0) and air rate of 43 (AIR = 43) for 5.00 seconds (DUR = 5.00).

```
********EDIT JOB 1 MILLING************
STEP OUT   FLUID  AIR   CNT   DEL   DUR
 >1   1    10.0   43    2     5.00  5.00
```

Step 1 → after two input signals are received (CNT = 2) on the input assigned to output 1 (OUT = 1), 5.00 seconds will pass (DEL = 5.00) and then output 1 will turn on at a fluid rate of 10.0 (FLUID = 10.0) and air rate of 43 (AIR = 43) for 5.00 seconds (DUR = 5.00).

```
********EDIT JOB 1 MILLING************
STEP OUT   FLUID  AIR   CNT   DEL   DUR
 >1   1    10.0   43    1     0.00  5.00
  2   1    15.0   53    0     0.00  10.0
```

Step 1→ after one input signal is received (CNT = 1) on the input assigned to output 1 (OUT = 1), output one will turn on immediately (DEL= 0.00) at a fluid rate of 10.0 (FLUID = 10.0) and an air rate of 43 (AIR = 43) for 5.00 seconds (DUR = 5.00).

Step 2 → output one (OUT = 1) will then remain on (CNT = 0) (DEL = 0.00) at a fluid rate of 15.0 (FLUID = 15.0) and an air rate of 53 (AIR = 53) for an additional 10.0 seconds (DUR = 10.0).

```
********EDIT JOB 1 MILLING************
STEP OUT   FLUID  AIR   CNT   DEL   DUR
 >1   1    10.0   43    1     0.00  CONT
  2   1A   ----   --    0     END   3.00
```

Step 1 → When the input signal assigned to output 1 (OUT = 1) turns on (CNT = 1), output 1 will immediately (DEL = 0.00) turn on at a fluid rate of 10.0 (FLUID = 10.0) and an air rate of 43 (AIR = 43) for as long as the inputs signal remains on (DUR = CONT).

Step 2 → assuming output 1A (OUT = 1A) is assigned to the same input signal as output 1, output 1A will immediately turn on (DEL = 0.00) for 3.00 seconds (DUR = 3.00) after the input signal turns off (DEL = END).

Editing A Job

Jobs are edited through the Edit Job display. This is found as the first option on the Menu display. Selecting the Edit Job menu option will bring the user to the Select Job To Edit display. Previously defined jobs are listed along with jobs that are listed as "UNDEFINED". An "UNDEFINED" job is simply a job that has not been configured and is empty. Use the control knob to select the job that you wish to edit. It is possible to create and save up to 250 jobs.

```
**********MENU**********
 >EDIT JOB
  RUN JOB
  MANUAL CONTROL
```

```
*******SELECT JOB TO EDIT*******
 >1   JOB1
  2   JOB2
  3   UNDEFINED
```

Upon entering the Edit Job display, the cursor will first scroll by job steps. To edit a particular job step, click enter and then the cursor will scroll between the OUT, FLUID, AIR, CNT, DEL, and DUR options. Use the control knob to set the fields to the desired values and then press escape to return to scrolling between job steps.

```
*******EDIT JOB 1: MILLING*******
STEP OUT   FLUID  AIR   CNT   DEL    DUR
 >1   1    0.30   100    1    0.00  5.00
  2   1    0.50    50    0    2.50  CONT
  3   1A   -----  ---    1    END   2.00
  4   1A   -----  ---    0    0.00  0.00
  5   2    0.50   ---    1    7.50  CONT
  6   2    0.00   ---    1    0.00  0.00
  7  3-4   0.80   ---    1    0.00  5.00
  8  3-4   1.00   ---    1    0.00  5.00
```

Job steps can be added by the "ADD NEW STEP" option at the bottom of the Job display. This will append a job step to the job.

```
*******EDIT JOB 1: MILLING*******
STEP OUT   FLUID  AIR   CNT   DEL    DUR
  7   1    0.30   100    1    0.00  5.00
  >   ADD STEP
```

Job steps can also be added by pressing and holding the control knob to bring up the insert and delete step options. Insert step will insert a step below the job step that the cursor is currently on. Delete step will delete the step the cursor is currently on.

```
*******EDIT JOB 1: MILLING*******
 >INSERT STEP
  DELETE STEP
  CANCEL
```

A job name can be edited on the Edit Job display by moving the cursor up to the top of the display and selecting the job name. Users can move though letter by letter editing the name as desired. Hit escape to move the cursor back to the job steps.

```
*******EDIT JOB 1:>MILLING*******
STEP OUT   FLUID  AIR   CNT   DEL    DUR
  1   1    0.30   100    1    0.00  5.00
  2   1    0.50    50    0    2.50  CONT
```

Selecting A Job To Run

Jobs are run by selecting them from the Run Job menu option. Selecting the Run Job option will bring the user to a list of defined jobs. Use the control knob to select the desired job and it will then become the active job.

```
*******SELECT JOB TO RUN*******
 >1   JOB1
  2   JOB2
```

Upon selection, the user will be brought to the running job display. This display shows the current job name, all job steps, the fluid and air settings for the step, and the step status: on or off. Also available on this display is the override function. The override function allows someone to quickly increase or decrease the fluid flow rate for a particular job step. The override can range from 50% to 200%. An override value of 100% produces the same output as what is present in the job step, 50% override cuts the flow rate in half, and 200% override doubles the flow rate.

```
********RUNNING JOB 001 "MILLING"********
  OUTPUT  STATUS  FLUID  AIR  OVERRIDE
  1       ON      0.30   100  >80%
  1A      OFF     ----   ---  ----
```

Pressing the escape key from the Running Job display will bring the user back to the Select Job To Run display. Pressing escape again will return the user to the menu. If a user wishes to return to the Running Job display, simply press escape from the Main menu and if a job is currently active, the user will be directed back to the Running Job display.

Serial Interface

Serial refers to the Quantum's™ capability to listen and react to a specific serial command language. Users can program their machine to send the Quantum™ commands in real time that the Quantum™ will carry out.

The serial command interface utilizes a special syntax of commands and variables that allow users to send text based commands to the Quantum™ system. The Quantum™ can also respond to the device with information about its current status. Many system configuration items can be carried out across the serial interface, however the most basic commands are used to turn system outputs on and off at specific rates in real time. Using serial commands to control the outputs on your system will give the maximum amount of flexibility in control.

Serial commands can be sent to the quantum using a terminal program from a PC, through the use of the DPRNT command from a CNC controller, or ASCII commands from a PLC. Serial commands consist of the command string followed by the command's variables, separated by white space.

Consult your machines documentation for instructions on how to configure the serial port settings to match those on the Quantum™ setting. A good connection must be established and proven before serial commands can be used.

Once the system is fully configured, outputs can be turned on and off using the "SET-FLUID-OUTPUT-STATE" command. The syntax for this command is as follows.

"SET-FLUID-OUTPUT-STATE OUTPUT-CONTROL-ID FLUID-RATE AIR-RATE"

OUTPUT-CONTROL-ID Indicates the control ID of the output you wish to turn on. Valid values for this are any output control ID currently on the system as listed on the View Outputs display.

FLUID-RATE Indicates the fluid rate of the output you wish to turn on. The valid values for this variable are 0.00 to 500.00. Please note that values sent must include both digits after the decimal point. To turn on an air blow-off output (output control ID with an A suffix), the fluid rate must be set to 1. To turn an output off, set the fluid rate to 0.

AIR-RATE Indicates the air-flow rate of the output you wish to turn on. The valid values for this variable are 0 to 100. This is only used on MQL outputs with electronically controlled air flow. To turn an output off, set the air rate to 0.

There must be a space between the command, and each variable.

Serial Command Examples:

“SET-FLUID-OUTPUT-STATE 1 10.00 56”
Turns on output 1 at a fluid rate of 10.00 and air-flow rate of 56.

“SET-FLUID-OUTPUT-STATE 1 0.00 0”
Turns off output 1 (fluid rate set to 0.00 and air rate set to 0).

“SET-FLUID-OUTPUT-STATE 2-4 10.00”
Turns on outputs 2-4 (linked outputs) at a fluid rate of 10.00.

“SET-FLUID-OUTPUT-STATE 2-4 0.00”
Turns off outputs 2-4 (fluid rate set to 0.00).

“SET-FLUID-OUTPUT-STATE 1A 1”
Turns on air blow-off output 1A.

“SET-FLUID-OUTPUT-STATE 1A 0”
Turns off air blow-off output 1A.

When using the serial commands to control outputs, the current output status can be found on the Running display. From the menu, simply hit escape to view this display. This display will list all system outputs and their current statuses.

```
********RUNNING SERIAL CONTROL**********
  OUTPUT  STATUS  FLUID  AIR   OVERRIDE
 >1       ON      12.0   44    80%
  1A      OFF     ----   ---   ----
```

Each machine tool will likely have its own nuances about using the serial port. Keep in mind that CNC processors often look ahead while operating so the DPRNT command might need some extra lines with the end of block symbol before it to ensure the command is executed at the desired time. Also, remember that most CNC controllers will not output a “space” when entered, but rather the “*” character must be used to indicate a space between variables in the command string sent to the Quantum™ system.

Users who write their CNC programs offline will greatly benefit from editing their CAM system post processor to incorporate the DPRNT commands while starting programs and exiting tool changes. This will help to maximize the flexibility and application success of the Quantum™ system.

Program Interrupt Outputs Shut Off

When the system is running under either a job or under serial control, the user can interrupt operation to either hold, or pause, the system or stop and reset the system. While running, simply press and hold the escape key for a few seconds to bring up the user interrupt display.

```
**********USER INTERRUPT**********
 >HOLD
  STOP ALL AND RESET
  CANCEL
```

Selecting cancel or pressing the escape key again will return the user to the Running display. Selecting HOLD will turn off all outputs. The display will then change to offer a resume option. Selecting resume will turn on all outputs that were on at the time of the hold at the rates at which they were previously running at.

```
**********USER INTERRUPT**********
 >RESUME
```

Selecting STOP ALL AND RESET will turn off all outputs. It will then require either another discrete input signal or a new serial command to turn the outputs on again.

Serial Control Kill Switch Input

When running the Quantum™ system under serial control, it is sometimes useful to be able to turn off all outputs with a discrete signal coming from a machine PLC. An example of where this might be appropriate is when a machine's CNC controller has sent serial commands to turn the Quantum™ on, but there was a machine fault for something monitored by the machine's PLC. Allowing the PLC to send a discrete signal to the Quantum™ when a fault occurs is easier to accomplish than having the CNC controller send serial commands to turn off the Quantum™ outputs.

For firmware versions 1.28 and later, discrete input #6 on the Quantum™ circuit board can be used as the serial control kill switch input. When input number 6 registers a high level for more than 10 milliseconds, all outputs that are currently running on serial control will be turned off. See the following wiring diagram depicting how to connect the kill switch circuit. It will then require another serial command to turn the outputs on again.

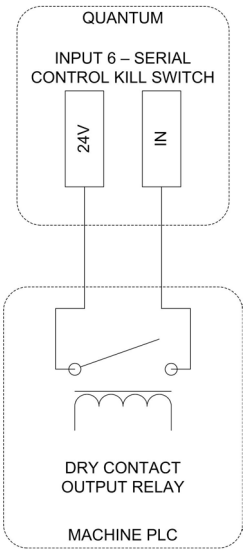


Figure 33: Serial control kill switch input

Factory Settings

The Quantum™ system menu structure allows access to a number of software settings that are set at the factory to coincide with how the system was configured when ordered. These settings are specific to the physical configuration of the system and changing them can cause numerous issues with the functionality of your system and is not recommended.

```
**********FACTORY SETTINGS**********
 >PUMP STACK
  VIEW VALVES
  PUMP OUTPUT        .033 ML
  AUTO REFILL        PRESENT
  FLOW SENSING       NOT PRESENT
```

View Outputs

The View Outputs display allows the user to see what outputs are available on the system. This is useful for using as a reference when configuring the system. The display shows the output number and what type of output that it is. The View Outputs display is found on the Main menu. Upon selecting this option, the user will be directed to a display that lists all system outputs and what type they are.

```
**************VIEW OUTPUTS**************
  OUTPUT      TYPE
 >1           PROGRAMMABLE AIR PUMP
  1A          INTEGRATED AIR BLOW OFF
  2           MANUAL AIR PUMP
  3-4         MANUAL AIR PUMP, LINKED
  5           OIL ONLY PUMP
  6A          EXTERNAL AIR BLOW OFF
```

System Identification

The System Identification display shows the user the firmware version loaded into the control panel, the system's date of manufacture, and also the system serial number.

```
*********SYSTEM IDENTIFICATION**********
FIRMWARE:          1.02
MFG DATE:          2015/03/10
SERIAL NUMBER:     654321
```

Pump Stack

The settings in the Pump Stack display in the software are the specific components that make up your Quantum™ system. Each block in the system can have a specific function. These include Top, Manifold, Metering Screw Pump, Proportional Air Pump, Oil-only Pump, Integrated Air Blow-off, External Air Blow-off, TS Pump, Prop TS Pump and Bottom.

View Valves

The View Valves factory settings option allows users to see what pneumatic valves are incorporated into the system. For each valve in the system, a board position, valve number, and function are indicated. These refer to where the valve is connected to the control board, what position it is in the physical valve stack, and what its function is.

Pump Output

As mentioned in the System Startup section, the system controller must be told what the pump output is set to on the system. This is to ensure accurate fluid flow rates. The adjustable stroke on the pumps gives more operational flexibility, however care should be taken to ensure that the setting is accurate.

Auto Refill

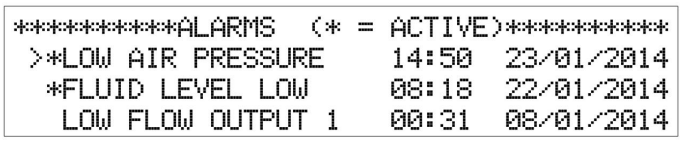
If the system was ordered with the optional auto refill feature, this is enabled in the factory settings.

Flow Sensing

If the system was ordered with the optional flow sensing feature, this is enabled in the factory settings.

Alarms

During system operation, the Quantum is monitoring critical operating parameters. If the system detects an issue, the alarm feature will activate. A red led light on the user interface indicate that there is an alarm condition. The alarm condition also triggers an alarm relay that can be used as a machine interlock or can be connected to an external annunciating device.



A list of 20 active and past alarms can be accessed by pressing the ALARM button on the user interface. This display lists the most recent alarms along with a time and date stamp of when they occurred. An asterisk (*) next to the alarm, indicates that the alarm is still active and has not yet been corrected. A list of possible alarm conditions along with their possible causes and fixes is shown below. When an alarm condition exists, the user must acknowledge the alarm by pressing the ALARM button, even if the problem causing the alarm has been resolved. Acknowledging the alarm will turn off the LED and restore the alarm relay output if the alarm is no longer active.

Attention: *An alarm message could indicate a condition that could create an unsafe situation. Consult the specific alarm message and its definition in this manual for more information.*

Fluid Level Low

A Low Fluid alarm is triggered when the fluid level in the reservoir gets low. To resolve this issue, carefully refill the lubricant reservoir. Once the fluid level in the reservoir is above the low level switch float, the alarm will cease to be active.

Refill Timeout

A Refill Timeout alarm occurs on systems equipped with optional automatic refill when it takes too long to refill the reservoir with fluid. When this alarm happens, check to ensure that the fluid supply system is working properly, and that the refill timeout value is set appropriately. Refer to the system startup section for information on how to adjust this value. Once the reservoir is full, the alarm will cease to be active.

Low Air Pressure

The Low Air Pressure alarm indicates that the incoming air pressure to the Quantum™ system is insufficient for proper operation. Check to ensure that the air pressure supply is working properly, and that the low pressure alarm set point is properly configured. Refer to the system startup section for instructions on how to adjust this value. Once the proper air pressure is restored, the alarm will cease to be active.

Low Flow Output XX

A Low Flow alarm can occur on systems equipped with optional flow sensing on MQL or oil-only outputs. The Low Flow alarm indicates that there was not a change in the flow sensor signal when the respective metering pump was cycled. When one of these alarms occurs, ensure that the fluid reservoir is properly filled, the pump stack is fully primed, and that the flow sensor is properly calibrated. If fluid is visually observed to be flowing from the pump when it strokes, you may need to calibrate the flow sensor's position. Refer to the System Startup section for instructions on calibrating flow sensors. Also, please note that fluids with low viscosities and reduced pump outputs can impact the flow sensor's ability to detect pump flow. Once the controller sees a change in state of the flow sensor for the output, the alarm will cease to be active.

No FS Board Present

On systems equipped with optional flow sensing, a No FS Board Present alarm indicates that the flow sensing expansion board is not present, or is not properly communicating with the main circuit board. If this happens, ensure that the flow sensing board is properly installed.

Input Timeout X

If input monitoring is turned on, the Quantum™ system will monitor inputs to ensure that job steps do not overlap. An Input Timeout alarm indicates that a job step for a particular output was not finished before that output's next job step received the inputs required to start. This indicates an issue with coordination between process controls and the Quantum's™ job settings. Edit the job to ensure this does not happen. The X in the alarm message indicates which discrete input the alarm was associated with. An input time out alarm clears when another input is received that does not cause an overlap.

Attention: *While troubleshooting it may be necessary to access the electrical enclosure of the Quantum™. Only qualified individuals should perform such work and control power to the Quantum™ should be turned off when accessing this enclosure.*

Low fluid level alarm will not turn off

Verify reservoir has sufficient fluid to raise the fluid level float. If fluid reservoir has sufficient fluid make sure the fluid level float is not stuck in the down position. Verify that the fluid level sensor connector on the circuit board is properly connected. See the System Wiring Diagram for proper connections. Verify that the fluid level sensor connector on the level sensor on the bottom of the tank is properly connected. Check fluid level sensor wires for continuity to the plug. Verify a change in state of continuity between the low level wire and the common wire by probing the circuit board connector while manually manipulating the float in the tank.

Low fluid level alarm will not turn on

Verify that the float is not stuck in the up position. Verify a change in state of continuity between the low level wire and the common wire by probing the circuit board connector while manually manipulating the float in the tank.

Low flow alarm will not turn off

Verify that the fluid reservoir has adequate fluid. Verify that the fluid output line for the respective pump is clear and not blocked, kinked, or otherwise restricted in any way. Verify that there is fluid output from the pump at the end of the fluid line for the respective pump. Verify that the flow sensor connector on the circuit board is properly connected. See the System Wiring Diagram for proper connections. Observe that the flow sensor (located on the side of the pump outlet block) has a change in state when the pump strokes. A change in state is indicated by a red LED on the flow sensor itself when the pump strokes and then the LED turns off. If the red LED on the flow sensor does not light up for each pump stroke or stays on all the time it may need to be recalibrated. See the system startup section on flow sensing for instructions on calibrating the flow sensor. If the flow sensor is not able to be calibrated it may be due to using fluid with too low a viscosity or the flow sensor may be defective and in need of replacement.

User display is blank

Verify the LCD screen contrast is properly adjusted. (small blue box on upper left of circuit board adjustable by Phillips head screwdriver from top) Verify that the system is connected to a working power source of 24 VDC. Verify that the power connector on the circuit board is properly connected. Check the connections between the display board and the main circuit board for continuity. See the System Wiring for proper connections. Test for 24 VDC at the power connector on the circuit board. If the LCD is still blank after checking all of the items above, the circuit board may be defective Contact Unist to arrange for repair or replacement of the circuit board.

Pump does not stroke

Verify that the output is called to be on by viewing either the Run Job display or the Run Serial Control menu. Verify that the output in question operates with the Manual Control feature. If using a job to control system outputs, verify that the inputs are properly configured to an output. Do so by checking the settings on the Configure Inputs display. Verify that the inputs are correctly wired. Verify that the valve is getting a signal to turn on by sending the system an M-code and observing the main screen to see if the appropriate output is turning on. Check the pump cycle rate in the appropriate output configuration screen is not set to 0 and/or that enough time has elapsed for a pump cycle to occur per the programmed settings. Verify that the injector pump cycle valve connector on the circuit board is properly connected (See the System Wiring Diagram in Appendix E on page 39 for proper connections). Verify that the system is getting proper air pressure (Unist recommends 80-100 psi [5.5-6.9 bar] in a static state).

Air blow-off output does not turn on

Verify that the air blow-off output in question has been properly configured. Do so by navigating to the Blow-off Settings display. Check to ensure that the output turns on with the manual control function. Verify that the input to control the air blow-off output is properly configured. Verify that the air blow-off valve connector on the circuit board is properly connected (See the System Wiring Diagram for proper connections).

Serial communication does not work

For serial communications to work, both the Quantum™ and the controlling device must have the same serial port settings. Verify that all connections are correct, and that all settings for serial communications are the same between devices. Using a PC with terminal program, one can trouble shoot communications and verify serial port settings. Please refer to machine documentation to learn how to configure and use serial port communications.

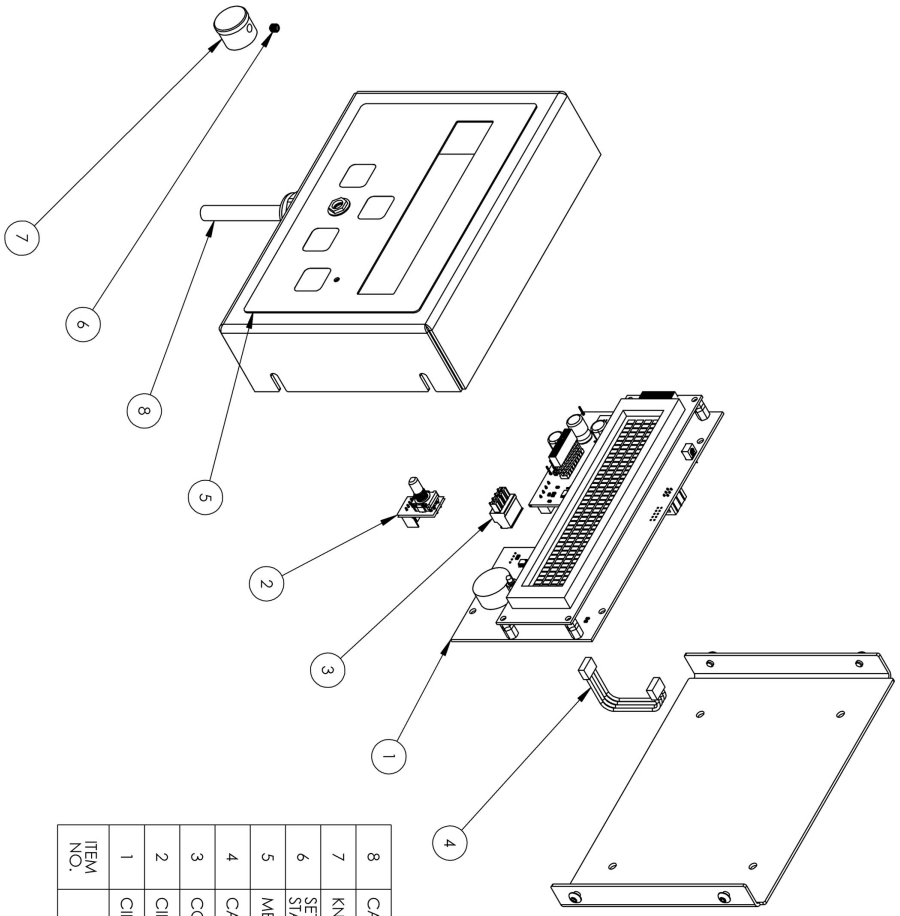
Input signal does not start job step

Verify that the job you wish to run is selected and running. The display should read “Running Job XX”. Verify that the inputs are properly configured to outputs on the Configure Inputs display. Verify that either a dry contact or NPN or PNP sensor is connected to the appropriate input. No external voltage should be connected to an input on the Quantum circuit board. Ensure that the job steps are set up appropriately with correct values in each field.

Appendix A: FAQ's

- ***What can be used for an input?***
  The most common type of input used with a Quantum™ is a dry contact, switch closure input. This is simply a switch that is controlled by the interfacing machine that closes when an input is to be sent to the Quantum™. Most often this takes the form of a relay or a manual switch. Occasionally, someone might use an NPN or PNP style proximity sensor as an input. It is important to note that no external voltage can be connected to an Input on the Quantum™.
- ***How do you wire up an input?***
  By referring to the system wiring diagram and system installation sections of this manual, one can see how to connect an input. For a dry contact input, voltage is taken from the Quantum™ board, sent through a customer controlled switch, and then brought back to a Quantum™ input.
- ***How do you wire up a serial connection?***
  Using the pinouts and schematics provided in this manual, one can connect the serial port on their machine to the RS232 serial input connection on the Quantum™ main circuit board. The transmit connection from the machine must be connected to the receive connection on the Quantum™. For two way communications, the transmit connection from the Quantum™ must be connected to the receive connection at the machine. The user must also note the type of flow control supported by the machine. The Quantum™ supports no flow control, and software flow control (XON/XOFF). For machines that do not support no flow control nor XON/XOFF, hardware flow control can be used by jumping the CTS and RTS (clear to send and request to send) connections from the machine.
- ***How do I send a serial command?***
  Serial commands are generally sent from a CNC machine using the DPRNT command. Consult your machine documentation for implementing this command. Using this requires most machines to have macros available. The DPRNT command can be implemented throughout a G-code program, and used to turn the Quantum™ On and Off as desired.
- ***What are the limitations of flow sensors?***
  The optional flow sensors on a Quantum™ system can be used to detect the flow of fluid from the metering pumps. They are limited, however, in that very low viscosity fluids and very low pump stroke volumes can inhibit the functionality of the flow sensors. Consult the system specifications for the specifications of the liquid flow sensor.
- ***Is there a battery in the panel?***
  Yes, there is a battery in the panel. The battery is simply there to retain the time and date settings when the system is not powered. All configuration and job data will be stored when the board is powered down, separate from the function of the battery.
- ***What happens if power is interrupted?***
  If power is interrupted while the system is running, the system will start back up when power comes back on. The system will default to the main menu and the user must select the job to run again. A new serial command will be required to restart the outputs if the system was running serial commands prior to the power down.

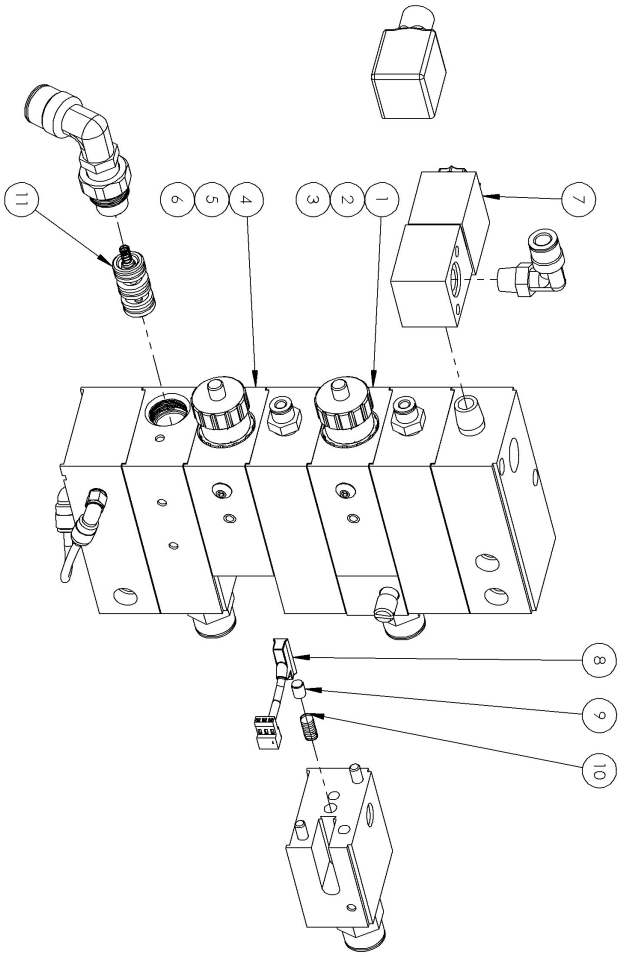
Appendix B: Spare Parts Drawing (User Interface)



ITEM NO.	DESCRIPTION	PART NUMBER
8	CABLE, 4 CONDUCTOR, TWISTED PAIR, PER FOOT	302589
7	KNOB, CONTROL, QUANTUM USER INTERFACE	303053
6	SET SCREW, 10-32 X .1875, CUP POINT, HEX DRIVE, STAINLESS STEEL	301615
5	MEMBRANE SWITCH, QUANTUM	302551
4	CABLE, JUMPER, DISPLAY TO ENCODER, QUANTUM	303117
3	CONNECTOR, SCREW TERMINAL, 4 POSITION	302557
2	CIRCUIT BOARD, ROTARY ENCODER, QUANTUM	302564
1	CIRCUIT BOARD, DISPLAY, QUANTUM	302556

Figure 34: Spare parts drawing (user interface)

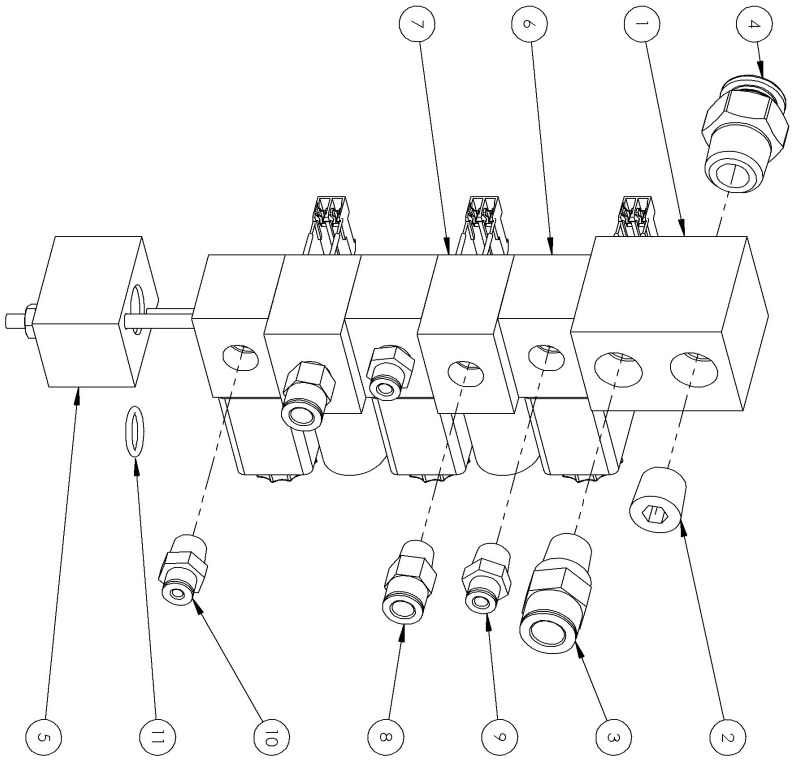
Appendix B: Spare Parts Drawing (Pump Stack)



ITEM NO.	DESCRIPTION	PART NUMBER
1	METERING PUMP, NO OUTLET, 1 DROP, QUANTUM	302575
2	SEAL KIT, QUANTUM, 1 DROP-PUMP	302864
3	REBUILD KIT, QUANTUM, 1-DROP PUMP	302865
4	METERING PUMP, NO OUTLET, 2 DROP, QUANTUM	302576
5	SEAL KIT, QUANTUM, 2-DROP PUMP	302866
6	REBUILD KIT, QUANTUM, 2-DROP PUMP	302867
7	SOLENOID VALVE, 24 VDC	4016-20
8	FLOW SENSOR, REED SWITCH S/A, W/CONNECTOR	302595
9	MAGNET	1502
10	SPRING, FLOW SENSOR, PISTON RETURN	4084
11	VALVE, CARTRIDGE, AIR PILOT, 0.125 ORIFICE	302573

Figure 35: Spare parts drawing (pump stack)

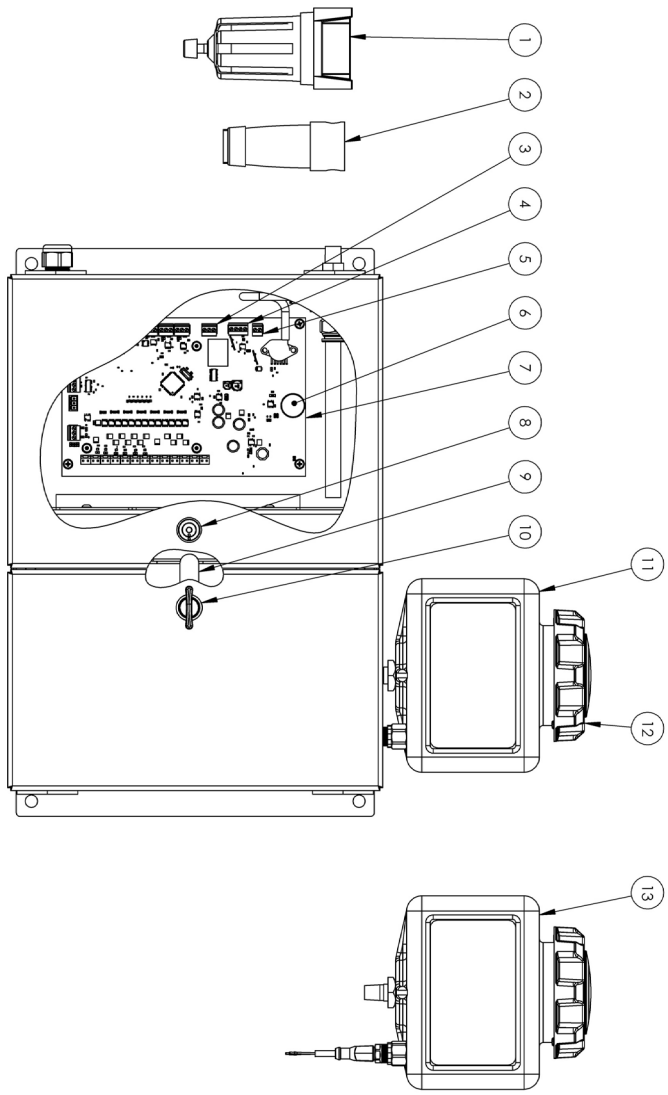
Appendix B: Spare Parts Drawing (Valve Stack)



ITEM NO.	DESCRIPTION	PART NUMBER
1	BLOCK, VALVE STACK MANIFOLD, QUANTUM	302530
2	PLUG, ALLEN, BRASS, 1/4 NPT	9303-019
3	PUSH-IN FITTING, 3/8 OD, 1/4 NPT	9704-01
4	FITTING, PUSH IN, 1/2 OD, 3/8 NPT	302577
5	BLOCK, BOTTOM, VALVE STACK, QUANTUM	302532
6	VALVE S/A, 3-WAY, STACKABLE, W/CONNECTOR	302594
7	VALVE, 2 WAY, PROPORTIONAL, STACKABLE	302570
8	PUSH-IN FITTING, 1/4 OD, 1/8 NPT	9303-029
9	PUSH-IN FITTING, 5/32 OD, 1/8 NPT	9412-01
10	PUSH-IN FITTING, 1/8 OD, 1/8 NPT	9303-016
11	O-RING, 013, BUNA	2-013

Figure 36: Spare parts drawing (valve stack)

Appendix B: Spare Parts Drawing (Enclosure)



ITEM NO.	DESCRIPTION	PART NUMBER
1	AIR FILTER, 1/4 NPT	F60-2
2	AIR FILTER, 1/4 NPT	69-459
3	CONNECTOR, SCREW TERMINAL, 3 POSITION	302558
4	CONNECTOR, SCREW TERMINAL, 4 POSITION	302557
5	CONNECTOR, SCREW TERMINAL, 2 POSITION	302565
6	BATTERY, CR2032	302566
7	CIRCUIT BOARD, MAIN, QUANTUM	302562
8	LATCH ASSEMBLY	E3-56-15
9	CAM LATCH, QUANTUM	302572
10	LATCH, CYLINDER, WING DRIVE	301186
11	RESERVOIR ASSEMBLY, QUANTUM, W/LOW LEVEL SENSOR	302596
12	CAP, RESERVOIR, VENTED	301294
13	RESERVOIR ASSEMBLY, QUANTUM, W/ HIGH-LOW LEVEL SENSOR	302597

Figure 37: Spare parts drawing (enclosure)

Appendix C: Standard System Part Number Key

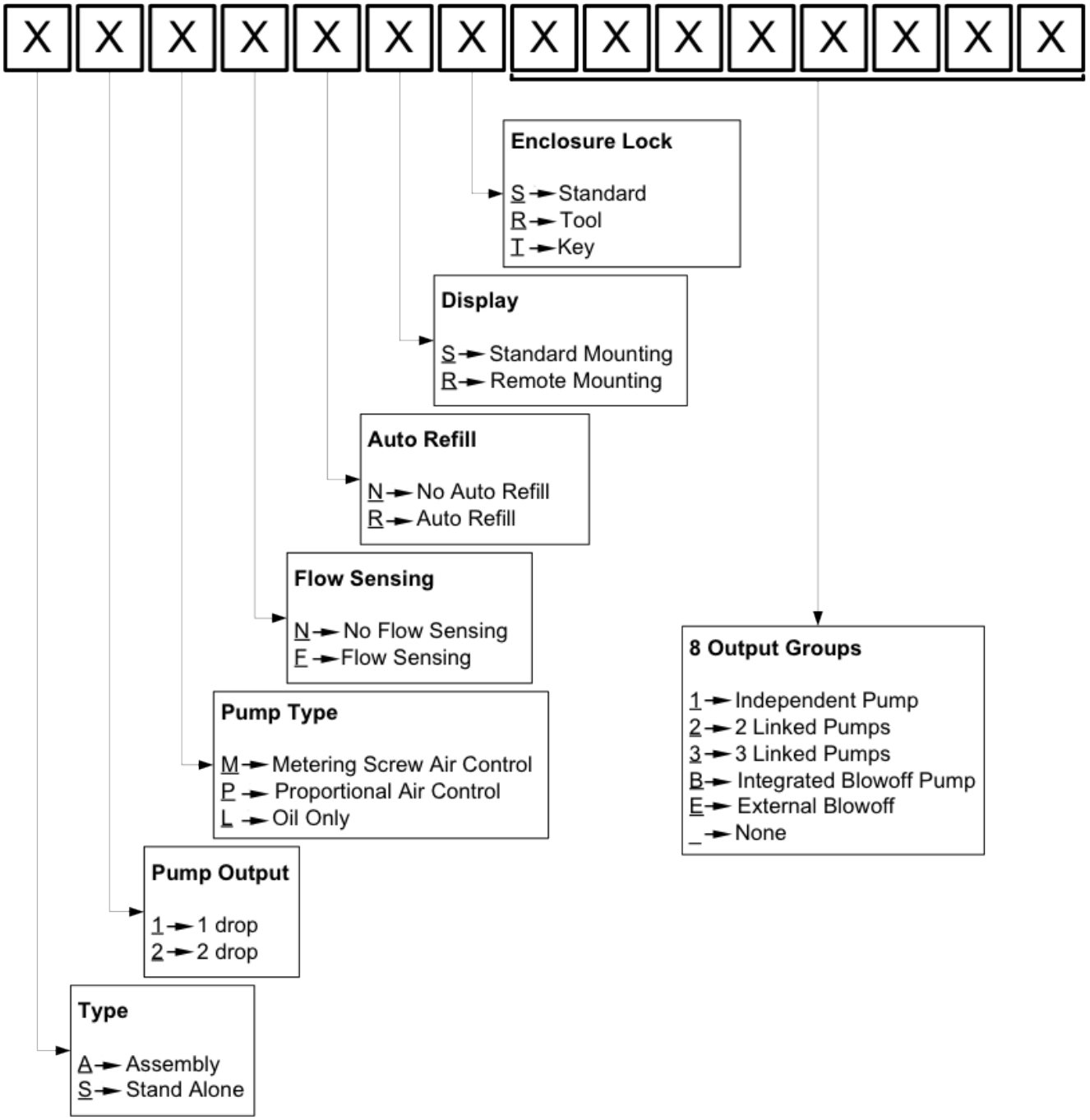


Figure 38: Standard system part number key

Appendix D: Wiring Diagram

Attention: *Ensure that control power is turned off from the Quantum™ before accessing the electrical enclosure and circuit boards.*

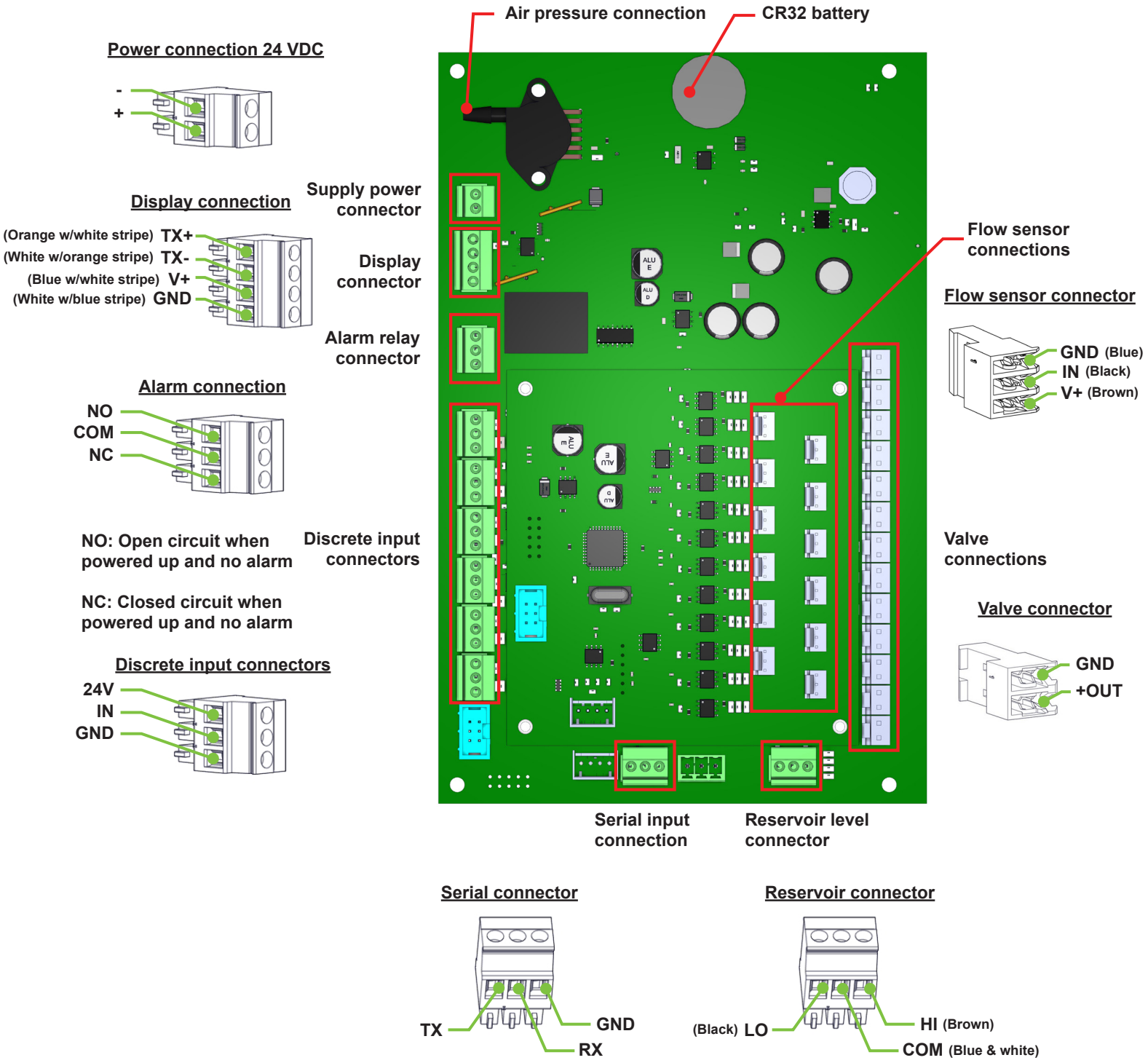


Figure 39: Installation wiring diagram

Appendix E: Serial Connectors

RS232 DB9

Pin 2	Receive (RX)
Pin 3	Transfer (TX)
Pin 5	Signal ground (GND)
Pin 7	Request to send (RTS)
Pin 8	Clear to send (CTS)

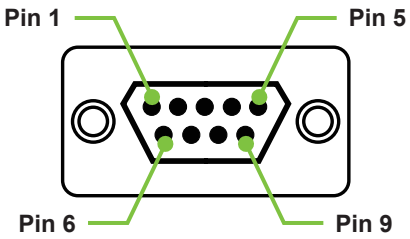


Figure 40: Typical male DB 9 connector

RS232 DB25

Pin 2	Transfer (TX)
Pin 3	Receive (RX)
Pin 4	Request to send (RTS)
Pin 5	Clear to send (CTS)
Pin 7	Signal ground (GND)

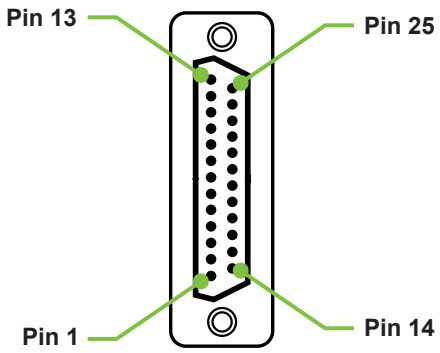


Figure 41: Typical male DB 25 connector

Notes

Notes

Unist, Inc.
4134 36th Street SE
Grand Rapids, MI 49512 USA
U.S. & Canada: 800.253.5462
International: 616.949.0853
Email: salessupport@unist.com