



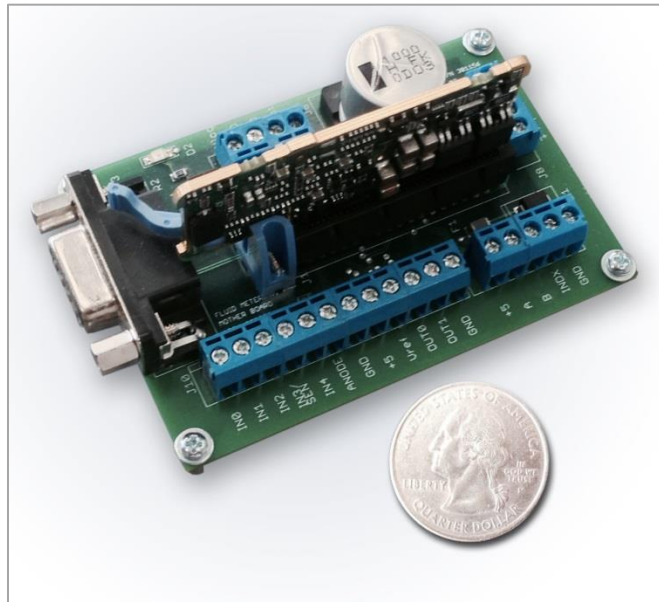
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ICST02-02 & ICST02-04

Intelligent Stepper Motor Controllers

User Instructions Rev 495



Introduction

The **ICST02** Intelligent Stepper Controller provides the means to control all of Fluid Metering's pumps including the FENYX, FDD, STF, and STFQ. By properly configuring Fluid Metering's ICST02 controller one can increase the performance efficiency of a connected pump over a wide range of speeds. This document will describe the individual connections on the controller, their electrical specifications, and their functions. For mechanical details refer to outline drawing 600298 Rev B.

This document will also introduce a software application "[FMI Configuration Tool](#)" that can be used to manage settings within the controller. This application will help to determine the optimal settings for the operation of the pump.

Overview of Functionality

I/O Connector (J10)

IN0 (J10.1): RUN/STOP - Connection to ground initiates a run.

- In Dispense mode a momentary connection is required. When momentarily connected to ground the pump will run at a set number of revolutions (1 to 20) based on the voltage input "Vdisp". See "Vdisp" table 1 for required voltage.
- The number of revolutions can also be set using the GUI software that comes with the controller.
- In continuous mode a connection to ground will keep the pump running. Removing the connection to ground stops the pump.

IN1 (J10.2): DIRECTION - Connection to ground to run pump in reverse (motor counter-clockwise). Leave open to run pump forward (motor clockwise).

IN2 (J10.3): DISPENSE/METER – Connection to ground enables dispense. Leave open to enable metering.

IN3 (J10.4): SENSOR OUTPUT – This input line uses the sensors output to home the pump on power up. The pump will home halfway on the intake. The position is direction dependent.

VDISP (J10.5): CYCLES – Two options are available on how to set the number of cycles the pump will rotate.

- Input accept a voltage from 0 to 5 VDC. The value determines the number of cycles the pump will rotate.
- The number of cycles can also be set using the GUI software that comes with the controller.

Anode (J10.6): SENSOR ANODE – This output provides the voltage source for the LED of the sensor. It is important to connect the sensor anode here and NOT +5. Sensor anode current limiting resistor is installed on this pin to protect sensor anode from damage.

GND (J10.7): GND – Logic ground

+5 (J10.8): VCC – 5 VDC output 250 mA max.

V_{REF} (J10.9): SPEED (RPM) – Voltage input from 0 to 5 VDC. Minimum speed is 10 RPM and maximum is 2000. $V_{REF} \text{ (VDC)} = 2.4543 \text{ mV (mVDC/RPM)} \times \text{SPEED (RPM)}$.

- The speed can also be set using the GUI software that comes with the controller.

OUT0 (J10.10): MOTION COMPLETE – This output is “HIGH” when pump is in motion and “LOW” when pump motion is complete.

OUT1 (J10.11): ERROR – General error. “HIGH” = no error. “LOW” = error. Power down to reset.

GND (J10.12): GND – Logic ground

Table 1- Voltage applied to Vdisp to achieve the listed number of dispenses

Vdisp (VDC nom)	Dispense (cycles)
4.875	1
4.625	2
4.375	3
4.125	4
3.875	5
3.625	6
3.375	7
3.125	8
2.875	9
2.625	10
2.375	11
2.125	12
1.875	13
1.625	14
1.375	15
1.125	16
0.875	17
0.625	18
0.375	19
0.125	20

Connections

Encoder Connector (J9 – not implemented at this time)

+5 (J9.1): VCC – +5 VDC output 250 mA max.

A (J9.2): Encoder A (For pumps supplied with encoder)

B (J9.3): Encoder B (For pumps supplied with encoder)

I (J9.4): Encoder Index (For pumps supplied with encoder)

GND (J9.5): GND – Logic ground

Motor Connector (J8)

A+ (J8.1): Motor phase A+

A- (J8.2): Motor phase A-

B+ (J8.3): Motor phase B+

B- (J8.4): Motor phase B-

Power Supply Connector (J6)

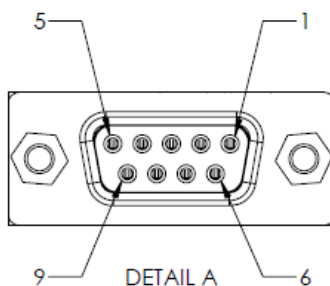
V_{MOT} (J6.1): Motor power supply input

GND: (J6.2): Motor power supply and logic power supply ground

GND: (J6.3): Motor power supply and logic power supply ground

V_{LOG}: (J6.4): Logic power supply input

RS232 Connector (J3)



J3 TERMINAL WIRING		
PIN	SIGNAL	CONTROL DESCRIPTION
J3.2	RS232-TX	TRANSMIT
J3.3	RS232-RX	RECIEVE
J3.5	GND	GROUND

Table 2- Sensor Connections (FMI 110569 Sensor)

Sensor Signal	Wire Color	Controller Pin
Output	Blue	J10.4 IN3/SENSE
V _{cc}	White	J9.1 +5
Ground	Green	J9.5 GND
Cathode	Black	J9.5 GND
Anode	Red	J10.6

FMI Configuration Tool

Is a windows based application that makes it possible to examine different motion settings against ICST02 controllers. It also makes it possible to save values related to desired motion parameters into an ICST02 controller. This application can be used to manage controllers that connect to both the new line of Variable Dispense pumps, and also the ICST02 controllers. The following sections will provide the steps necessary for proper installation and operation of this application.

Installation

To install this application, double click on the setup.exe located in its installation folder. This application requires .NET FrameWork 4.5 to be present for its proper operation. As soon as installation is complete, FMI Configuration tool will start, and connection screen will be displayed. You can also start the application from “Start” menu in windows 10 or “program files” menu in windows 7. Next section will explain all the parameters and settings that must be in place for the FMI Configuration tool to successfully connect to an ICST02 controller.

Connecting to the Controller

First connect the FMI Configuration tool to the ICST02 controller using the USB to serial converter (**Future Technology Devices International (FTDI) US232R-10, RS232 to USB serial converter is recommended**). Next power on the controller using proper 24 VDC power supply. When the Configuration tool is started it will automatically scan to find the COM port that ICST02 controller is connected to. If COM port is detected successfully its value will be displayed on the connection screen. To connect to the controller, make sure channel type is set to “RS 232”, and select the baud rate (see **Error! Reference**

source not found.). After selecting communication port values, click on “Open Port”. If connection fails, application will display an error message (see **Error! Reference source not found.**)

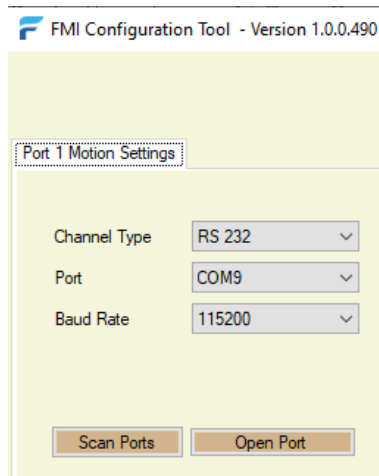


Figure 1 - Connection Dialog

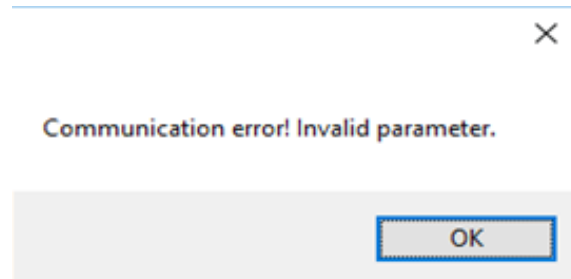


Figure 2 - Failed connection message

If connection succeeds FMI Configuration tool will display main Configuration screen which is populated using values from its previous execution (if one is available).

Following section will discuss elements that make up the Configuration screen.

Configuration Screen

Is made up of 4 main sections, **Motion Settings**, **Pump Control**, **Menu Strip**, and the **general information area** on the left (See **Error! Reference source not found.**).

Motion Settings

Include parameters whose values affect the motion of the pump. Motion Settings are made up of the following rows: Speed, Strokes, Acceleration, Run Current, Standby Current, Flow Direction, and Flow Method (see **Error! Reference source not found.**).

Each row displays values from four different sources: **Factory Default**, **User Input**, **Analog Input**, and **Controller**.

- **Factory Default:** Values that are recommended by Fluid Metering for optimal operation of the pump. These values cannot be modified.

- **User Input:** Values that are entered by user. These values can be modified by the user.
- **Analog Input:** These values are read from the ICST02 controller's input ports. As values change on the input ports, they get updated into their respective fields on the screen. These values cannot be modified by the user.
- **Controller:** Values that are currently stored in the controller. These values cannot be modified by the user.

A checkbox is displayed below each of the value fields. On any given row only one checkbox can be in checked state. When a box is checked its related value field will be used to operate the pump. Value fields that will be used to operate the pump are highlighted in yellow to help the user to identify them visually.

FMI ICST02 Configuration Tool - Version 1.0.0.490

Configuration File Settings Tools Help

Port 1 Motion Settings Custom Program Settings


www.fluidmetering.com

Model: ICST02-2

App ID: 301273-0000-B14

Flag Present? Yes

Close Port



Iterations (1-1,000): 1

Dwell (1-10,000 sec): 1

Degrees Per Step: 1.8

Motion Settings		Factory Default	User Input	Analog Input	Controller
Speed (1 - 1250 RPM)	<input type="checkbox"/>	300	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Speed Source	<input type="checkbox"/>				
Strokes (1-5,000 Cycles)	<input type="checkbox"/>	10	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Strokes Source	<input type="checkbox"/>		Cycles		
Accel (1 - 10,000 rad/sec^2)	<input type="checkbox"/>	300	<input checked="" type="checkbox"/>		<input type="checkbox"/>
Accel Source	<input type="checkbox"/>				
Run Current (Amps Peak)	<input type="checkbox"/>	1.00	<input checked="" type="checkbox"/>		<input type="checkbox"/>
Run Current Source	<input type="checkbox"/>				
Standby Current (Amps Peak)	<input type="checkbox"/>	0.16	<input checked="" type="checkbox"/>		<input type="checkbox"/>
Standby Current Source	<input type="checkbox"/>				
Flow Direction			Dispense (CW)	Dispense (CW)	
Flow Direction Source	<input checked="" type="checkbox"/>				
Flow Method			Dispense	Meter	
Flow Method Source	<input checked="" type="checkbox"/>				

Pump Control

Start Home Park Reset Fault Reset Controller

Save selected parameters into controller

☒ Start/Stop using FMI Configuration Tool

Figure 3 – Main Configuration Screen

Configuration File
Settings
Tools
Help

Rotary Motor
Custom Program Settings
Port 2 Motion Settings
Data Collection


www.fluidmetering.com

Model
VariableDispense

App ID
301273-0000-VDRP14

Flag Present?
Yes

Close Port



ICST Sensor
☐ Blocked
☒ Un-Blocked

Iterations (1-1,000):
1

Dwell (1-10,000 sec):
1

Degrees Per Step
1.8

Motion Settings

	Factory Default	User Input	Analog Input	Controller
Speed (1 - 2000 RPM)	300	400		75
Speed Source	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Strokes (1-5,000 Cycles)	10	10		2
Strokes Source	<input type="checkbox"/>	<input checked="" type="checkbox"/> Cycles	<input type="checkbox"/>	<input type="checkbox"/>
Accel (1 - 10,000 rad/sec ²)	300	300		75
Accel Source	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Run Current (Amps Peak)	1.00	1.00		1
Run Current Source	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Standby Current (Amps Peak)	0.5	0.50		0.5
Standby Current Source	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Flow Direction		Dispense (CW)		
Flow Direction Source	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Flow Method		Dispense		
Flow Method Source	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

Pump Control

Start
Home
Park
Reset Fault
Reset Controller

Save selected parameters into controller

Figure 4 – Main Configuration Screen for a Variable Dispense Pump

Display of some of the parameters on the configuration screen depends on the controller configuration tool connects to. If configuration tool connects to a variable dispense pump controller, an extra tab will be displayed to accommodate management of the rotary motor, and, the actuator (using a Linear Motor) and also a custom program setting that will be discussed in later sections.

Following is a brief description of the Motion Parameters:

- **Speed** – Is used to vary the flow rate (flow rate based on pump calibration). Refer to Fluid Metering's calibration data sheet that shipped with the pump.
- **Strokes** – Is used to set the number of strokes (cycles, steps, or micro-steps) that pump will complete when in dispense mode.

- **Acceleration** – Sets acceleration of the motor
- **Run Current** (Amps Peak) – Is used to set the amount of current (In Amps) that the controller provides to the motor when it is running.
- **Standby Current** (Amps Peak) – Is used to set the amount of current (In Amps) that the controller provides to the motor when it is in standby mode (not rotating).
- **Flow Method** – Allows the user to toggle between continuous flow (**Meter**) or a set number of strokes (**Dispense**). When Meter is selected, all parameters related to Strokes will disappear. Value of Flow Method displayed in the **Analog Input** column is read only and represents the value that is read from respective ICST02 controller's input port.
- **Flow Direction** – Allows the user to set the direction that the pump will rotate in. Flow Direction displayed in the **Analog Input** column is read only and represents the value that is read from respective ICST02 controller's input port.

Pump Control

Elements in Pump Control group are used to send motion or administrative commands to the controller. Following is a brief description of each of these commands:

- **Start** – This command instructs the controller to move the pump using selected motion parameters. When pump starts its movement, only parameters that influence its motion will be displayed in the Motion Settings area.
- **Stop** – This command instructs the controller to stop the pump from moving. After pump comes to complete stop, all Motion Parameters will be displayed, and user input will be accepted.
- **Home** – This command moves the pump to its "Home" position (A position where the flat of the piston is facing the inlet port).
- **Park** – This command moves the pump to its Parked position where Piston will be nearest to the bottom (smallest gap) "TDC" - Top Dead Center
- **Reset Controller** – Resets the controller and requires it be reinitialized completely. Cycling power will also reset controller's fault condition. Reset is required when controller enters into a state that prevents it from continuing its operation unless it is completely recycled.

- **Reset Fault** – Resets a controller fault condition. A fault condition can occur when controller fails to execute an internal command. By resetting the fault condition, the pump can proceed with the rest of its operation without any need to reinitialize or recycle the power on the controller.

Menu Items

Menu items located on top of the Configuration screen provide access to functionalities that are not directly related to the operation of the pump. The following sections will provide more detail on each of these menu items:

Configuration File – When selected, it displays two commands: **Save** and **Open**.

- **Save** - Allows the user to save current context of the FMI Configuration Tool. All Parameter settings that are on the current view will be stored into a file. User will be able to choose location and name of the file.
- **Open** – Allows the user to restore FMI Configuration Tool's context from a file created using the Save command. An error message will be displayed if contents of the file are not compatible with running the FMI Configuration Tool.

Settings – Provides access to “Turn TOP Most On” and “Turn Top Most Off”. By turning Top Most On, the FMI Configuration tool window becomes the top most window on the desktop.

Tools – Provides access to **Program** menu item. This option will make it possible to update the firmware in ICST02 controller. First, a window will be displayed to help locate the file (with “sw” extension) that will be uploaded into the controller. A prompt will be displayed if an attempt is made to upload an older version of the firmware into the controller. If user chooses to move forward with an upload, upload starts, and mouse cursor changes to an hour glass. The upload normally lasts around 30 seconds depending on the speed of the communication channel. Upon successful upload of the firmware, controller will be recycled (Reset) by the FMI Configuration Tool. The FMI Configuration tool will connect to the controller automatically after it is recycled. At this point controller should be running the newly uploaded firmware.

After a successful connection to the controller, its **model** and **App ID** (Application ID) will be retrieved by the FMI Configuration Tool. These values

will be displayed at the upper left hand corner of the configuration screen (see **Error! Reference source not found.**).

Aside from Model and App ID, “**Flag Present?**” is displayed. Flag Present allows the user to enable/disable the sensor used to detect the flag. Display of Home and Park buttons in the Pump Control is managed by the value of Flag Present setting. If Flag Present is set to “No”, both Home and Park buttons will disappear.

By pressing “**Save selected parameters into controller**”, the configuration tool will attempt to save all the selected motion parameters into the controller. This way when controller is operated manually, values that are stored in the controller will be used to drive the pump.

To allow manual operation of the pump, while configuration tool is connected to the controller, you must uncheck “**Start/Stop using FMI Configuration Tool**” located at the lower right hand side of the screen (see *Figure 5*). When unchecked, all Pump Control elements on the user interface such as Start, Stop, and Park will be disabled, otherwise these elements will be enabled to allow control of the pump through the configuration tool.

If last set of values that were selected during operation of the pump were the ones displayed on the Analog Input column, user should be able to operate the pump using digital I/O lines provided on the ICST02 motherboard. To the same token, if last set of values that were used before unchecking “**Start/Stop using FMI Configuration Tool**”, the user can operate the pump using values stored in the controller (displayed on the controller column). In this mode of operation, the user can also adjust Flow Method and Flow Direction using their respective digital I/O lines.

FMI ICST02 Configuration Tool - Version 1.0.0.490

Configuration File Settings Tools Help

Port 1 Motion Settings Custom Program Settings


www.fluidmetering.com

Model: ICST02-2

App ID: 301273-0000-B14

Flag Present? Yes

Close Port



Iterations (1-1,000): 1

Dwell (1-10,000 sec): 1

Degrees Per Step: 1.8

Motion Settings		Factory Default	User Input	Analog Input	Controller
Speed (1 - 1250 RPM)	Speed Source	300	400	2	300
Strokes (1-5,000 Cycles)	Strokes Source	10	10	20	2000
Accel (1 - 10,000 rad/sec ²)	Accel Source	300	300		300
Run Current (Amps Peak)	Run Current Source	1.00	1.00		1
Standby Current (Amps Peak)	Standby Current Source	0.16	0.50		0.5
Flow Direction		Dispense (CW)		Dispense (CW)	
Flow Direction Source		<input checked="" type="checkbox"/>		<input type="checkbox"/>	
Flow Method		Dispense		Meter	
Flow Method Source		<input checked="" type="checkbox"/>		<input type="checkbox"/>	

Pump Control

Start Home Park Reset Fault Reset Controller

Save selected parameters into controller

☒ Start/Stop using FMI Configuration Tool

Figure 5 – Placing Controller in Manual Operation Mode

Custom Program Settings

Settings in this tab (See Figure 6) facilitate defining motion profiles using up to 10 phases of customized motor operations. This should assist in creating complex scenarios that may be required when operating an attached pump.

FMI Configuration Tool (Variable Dispense Pump) - Version 1.0.0.490

Configuration File Settings Tools Help

Rotary Motor Custom Program Settings Port 2 Motion Settings Data Collection

Phase 1

☒ Enabled

Speed

Strokes

Cycles

Accel

Dir

Iterations

Apply to:

☐ Home Pump

Phase 2

☒ Enabled

Speed

Strokes

Cycles

Accel

Dir

Iterations

Apply to:

☐ Home Pump

Phase 3

☒ Enabled

Speed

Strokes

Cycles

Accel

Dir

Iterations

Apply to:

☐ Home Pump

Phase 4

☒ Enabled

Speed

Strokes

Cycles

Accel

Dir

Iterations

Apply to:

☐ Home Pump

Phase 5

☒ Enabled

Speed

Strokes

Cycles

Accel

Dir

Iterations

Apply to:

☐ Home Pump

☐ Run Phase 1 and Phase 2 in sequence when number of Phase 1 iterations is higher than 1

☐ Continuously repeats phases until stopped

Delay before repeating the phases seconds

Phase 6

☒ Enabled

Speed

Strokes

Cycles

Accel

Dir

Iterations

Apply to:

☐ Home Pump

Phase 7

☒ Enabled

Speed

Strokes

Cycles

Accel

Dir

Iterations

Apply to:

☐ Home Pump

Phase 8

☒ Enabled

Speed

Strokes

Cycles

Accel

Dir

Iterations

Apply to:

☐ Home Pump

Phase 9

☒ Enabled

Speed

Strokes

Cycles

Accel

Dir

Iterations

Apply to:

☐ Home Pump

Phase 10

☒ Enabled

Speed

Strokes

Cycles

Accel

Dir

Iterations

Apply to:

☐ Home Pump

Run Custom Program

Figure 6 – Custom Program Settings

User can choose to operate a specific phase or all selected phases up to 10 phases of operation. In each phase user can define motion parameters of interest, and if the pump should be Homed before selected phase starts. Also, user is allowed to force all selected phases to cycle indefinitely until stopped, as well as, configure a delay period that takes effect before next cycle starts.

FMI Configuration Tool automatically restores all Custom Program Settings that was used in previous execution of the application. Using “Load Custom Settings Parameters” and “Save Custom Settings Parameters” (See Figure 7), Configured Program Settings can be stored and restored for future use.

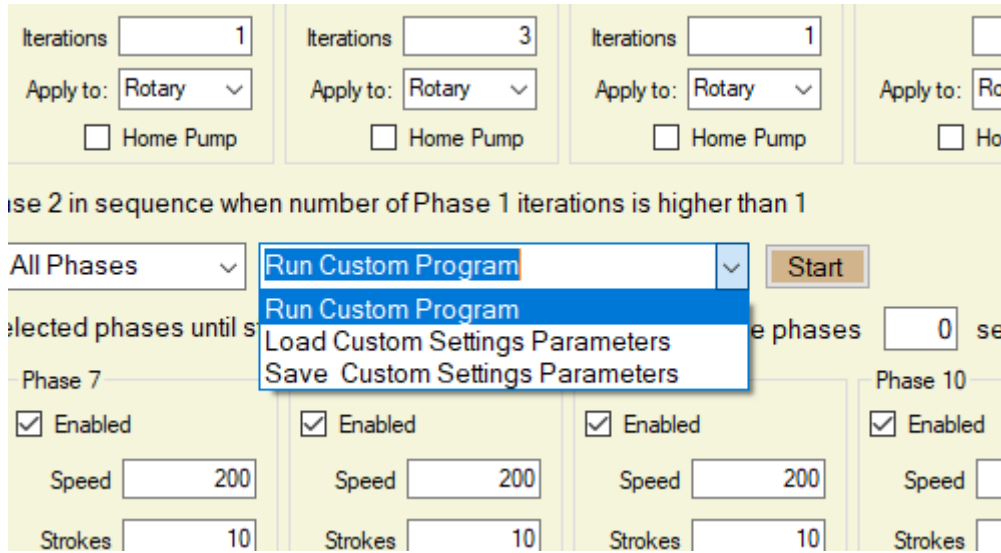
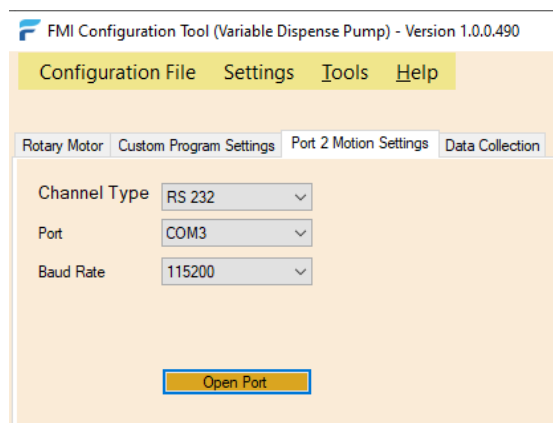


Figure 7 – Loading and Storing Custom Program Settings

Operating Linear Pump

If serial connection to rotary motor has already been opened, by switching to **Port 2 Motion Settings**, communication parameters necessary for connecting to linear pump's motor can be selected. click on **Open Port** to connect to the Linear Pump's controller.



After successful connection, name of the tab will be changed to Linear Motor, and motion parameters that can be used to operate against the Linear Pump's motor will be displayed.

FMI Configuration Tool (Variable Dispense Pump) - Version 1.0.0.490

Configuration File Settings Tools Help

Rotary Motor Custom Program Settings Linear Motor Data Collection

Model: VariableDispense

App ID: 301273-0000-VOLP14

Flag Present?: Yes

Close Port

Current position: 0

Motion Settings		Factory Default	User Input	Analog Input	Controller
Speed (1 - 750 RPM)	<input type="checkbox"/>	300	<input checked="" type="checkbox"/> 300		<input type="checkbox"/> 300
Speed Source	<input type="checkbox"/>		<input checked="" type="checkbox"/>		<input type="checkbox"/>
Steps (1 to 5000 Steps)	<input type="checkbox"/>	10	<input checked="" type="checkbox"/> 10		<input type="checkbox"/> 2000
Steps Source	<input type="checkbox"/>		<input checked="" type="checkbox"/> Steps		<input type="checkbox"/>
Accel (1 - 10,000 rad/sec ²)	<input type="checkbox"/>	300	<input checked="" type="checkbox"/> 300		<input type="checkbox"/> 300
Accel Source	<input type="checkbox"/>		<input checked="" type="checkbox"/>		<input type="checkbox"/>
Run Current (Amps Peak)	<input type="checkbox"/>	0.45	<input checked="" type="checkbox"/> 0.45		<input type="checkbox"/> 0.45
Run Current Source	<input type="checkbox"/>		<input checked="" type="checkbox"/>		<input type="checkbox"/>
Standby Current (Amps Peak)	<input type="checkbox"/>	0.1	<input checked="" type="checkbox"/> 0.10		<input type="checkbox"/> 0.5
Standby Current Source	<input type="checkbox"/>		<input checked="" type="checkbox"/>		<input type="checkbox"/>
Flow Direction	<input type="checkbox"/> Dispense (CW)				
Flow Direction Source	<input checked="" type="checkbox"/>				
Flow Method	<input type="checkbox"/> Dispense				
Flow Method Source	<input checked="" type="checkbox"/>				

Pump Control

Start Home Park Reset Fault Reset Controller

Save selected parameters into controller

Instructions provided in section **Pump Control** can also be used to operate the Linear pump. By adjusting **Steps** and **Direction** motion parameters, one can increase the dispense angle of the linear actuator, by setting the direction to “Dispense”, input the desired steps, and press the “Start” button. Conversely, to decrease the dispense angle of the linear actuator, set the direction to “Aspirate”, input the desired steps, and press the “Start” button. Please note, the dispense angle can be decreased (set to “Aspirate”) from the Home position up to 1000 steps.

Specifications

Electrical Specifications

Table 2 - Motor Supply Input (+VMOT)

		Min.	Typ.	Max.	Units
Supply voltage	Nominal values	7		36	V _{DC}
	Absolute maximum values, drive operating but outside guaranteed parameters	4.9		42	V _{DC}
	Absolute maximum values, surge (duration ≤ 10ms) [†]	-1		+45	V
Supply current	+V _{LOG} = 7V		125	300	mA
	+V _{LOG} = 12V		80	200	
	+V _{LOG} = 24V		50	125	
	+V _{LOG} = 40V		40	100	

Table 3 - Logic Supply Input (+VLOG)

		Min.	Typ.	Max.	Units
Supply voltage	Nominal values	9		36	V _{DC}
	Absolute maximum values, drive operating but outside guaranteed parameters	8.5		40	V _{DC}
	Absolute maximum values, surge (duration ≤ 10ms) [†]	-1		+45	V

Table 4 - Analog Inputs 0...5V (VREF & VDISP)

		Min.	Typ.	Max.	Units
Input voltage	Operational range	0		4.95	V
	Absolute maximum values, continuous	-12		+18	
	Absolute maximum, surge (duration ≤ 1S) [†]			±36	
Input impedance	To GND		30		KΩ
Resolution		12			bits
Integral linearity				±2	bits
Offset error			±2	±10	bits
Gain error			±1%	±3%	% FS [†]
Bandwidth (-3dB)	Depending on software settings	0		1	KHz
ESD protection	Human body model	±5			KV

Table 5 - Digital Inputs (IN0, IN1, IN2, IN3)

		Min.	Typ.	Max.	Units
Mode compliance		TTL / CMOS / LVTTTL (3.3V) / Open-collector / NPN / 24V outputs			
Default state	Input floating (wiring disconnected)	Logic HIGH			
Input voltage	Logic "LOW"		0	0.8	V
	Logic "HIGH"	2	5+24		
	Floating voltage (not connected)		3		
	Absolute maximum, continuous	-10		+30	
	Absolute maximum, surge (duration $\leq 1\text{S}$) [†]	-20		+40	
Input current	Logic "LOW"; Pulled to GND		0.6	1	mA
	Logic "HIGH"; Internal 4.7K Ω pull-up to +3.3	0	0	0	
	Logic "HIGH"; Pulled to +5V		0.15	0.2	
	Logic "HIGH"; Pulled to +24V		2	2.5	
Input frequency		0		150	KHz
Minimum pulse width		3.3			μS
ESD protection	Human body model	± 5			KV

- Pump acceleration/deceleration is 100 rot/sec².
- Dwell time for dispense after completing cycles (time from when pump stops to pump starts) when leaving IN0 (start input) connected to ground is approximately 41.8 milliseconds.

Table 6 - Digital Outputs (OUT0 & OUT1)

		Min.	Typ.	Max.	Units
Mode compliance	All outputs (OUT0, OUT1, OUT2/Error, OUT3/Ready)	TTL / CMOS / Open-collector / NPN 24V			
	Ready, Error	Same as above + LVTTTL (3.3V)			
Default state	Not supplied (+V _{Lo} floating or to GND)		High-Z (floating)		
	Immediately after power-up	OUT0, OUT1		Logic "HIGH"	
		OUT2/Error, OUT3/ Ready		Logic "LOW"	
	Normal operation	OUT0, OUT1, OUT2/Error		Logic "HIGH"	
		OUT3/Ready		Logic "LOW"	
Output voltage	Logic "LOW"; output current = 0.5A		0.2	0.8	V
	Logic "HIGH"; output current = 0, no load	OUT2/Error, OUT3/ Ready		2.9	
		OUT0, OUT1		4	
	Logic "HIGH", external load to +V _{Lo}		V _{Lo}		
	Absolute maximum, continuous		-0.5	V _{Lo} +0.5	
	Absolute maximum, surge (duration $\leq 1\text{S}$) [†]		-1	V _{Lo} +1	

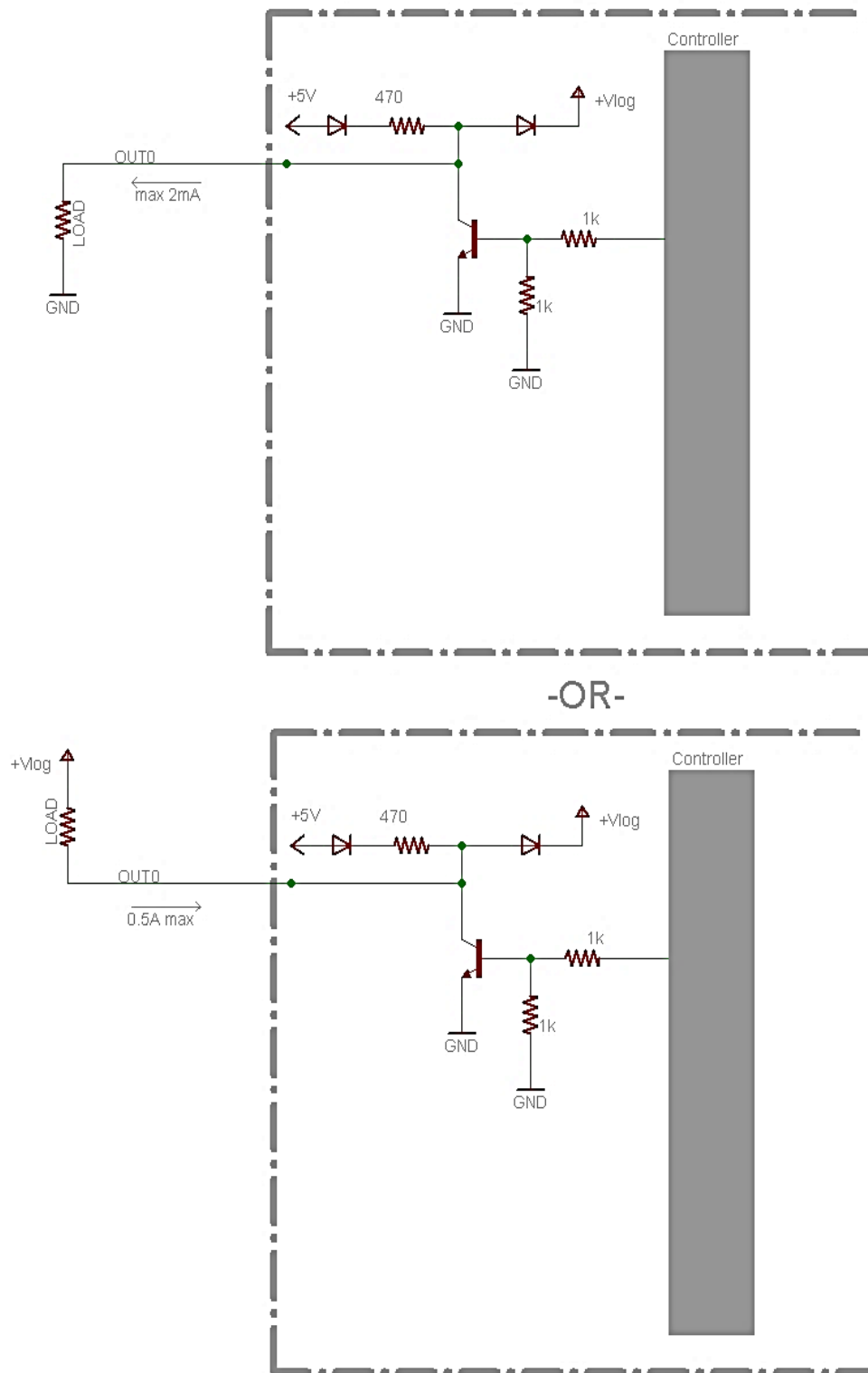


Figure 8 – Output Diagram

Operating Conditions		Min.	Typ.	Max.	Units
Ambient temperature ¹		0		+40	°C
Ambient humidity	Non-condensing	0		90	%Rh
Altitude / pressure	Altitude (vs. sea level)	-0.1	0 ÷ 2.5		Km
	Ambient Pressure	0 ²	0.75 ÷ 1	10.0	atm

Storage Conditions		Min.	Typ.	Max.	Units
Ambient temperature		-40		+85	°C
Ambient humidity	Non-condensing	0		100	%Rh
Ambient Pressure		0		10.0	atm
ESD capability (Human body model)	Not powered; applies to any accessible part			±0.5	kV
	Original packaging			±15	kV

Technical Support

Please Contact:

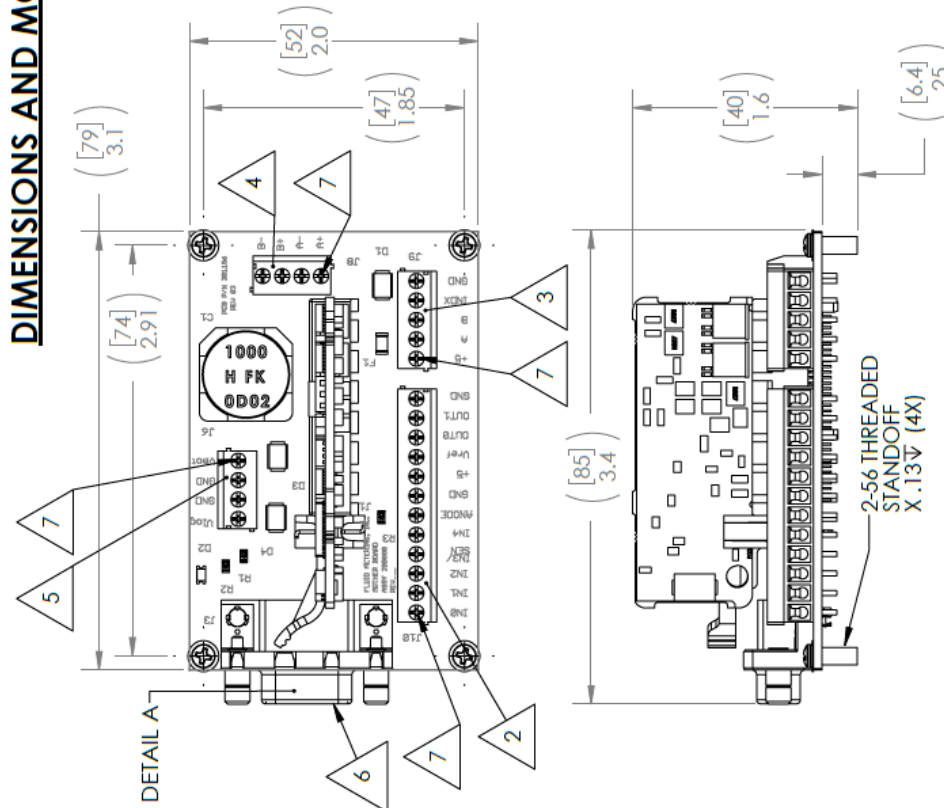
Fluid Metering
5 Aerial Way, Ste. 500
Syosset, NY 11791

Tel: 800-223-3388 or 516-922-6050
Email: pumps@fluidmetering.com

Appendix A – Intelligent Stepper Control, 4 AMP

P/N ICST02-4

DIMENSIONS AND MOUNTING



NOTES:

1. SEE SHEET 2 AND 3 FOR CONNECTOR/SIGNAL INFO.
2. J10 TERMINAL STRIP FOR I/O.
3. J9 TERMINAL STRIP FOR ENCODER.
4. J8 TERMINAL STRIP FOR MOTOR.
5. J6 TERMINAL STRIP FOR MOTOR AND LOGIC VOLTAGE.
6. DB9F CONNECTOR FOR SOFTWARE INTERFACE.
7. PIN 1 ON TERMINAL.
8. ALL TERMINAL STRIPS ACCEPT 18-28 AWG WIRE.
9. THIS PRODUCT IS ROHS COMPLIANT.

FMI P/N ICST02-4

TOLERANCES UNLESS OTHERWISE SPECIFIED X = ±.08 [1.5] .XX = ±.02 [0.5] XXX = ±.01 [0.25]		UNITS ARE IN INCHES [millimeters]		DATE 07/31/24	
DRAWN BY	CR	CHECKED BY	DT	APPROVED BY	RH
INTELLIGENT STEPPER CONTROL, 4 AMP (W/O POWER SUPPLY)		DATE 07/31/24		DATE 08/01/24	
DWG NO. 600298		REV B		SHT NO 1 of 3	

Fluid metering
5 Aerial Way, Suite 500, Syosset, NY 11791
800.323.3358 P. 516.562.6050 F. 516.564.6501 www.fluidmetering.com

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TABLE 1: J3 TERMINAL WIRING

PIN	SIGNAL	CONTROL DESCRIPTION
J3.2	RS232-TX	TRANSMIT
J3.3	RS232-RX	RECEIVE
J3.5	GND	GROUND

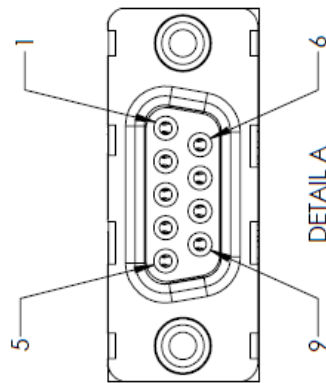


TABLE 2: J6 TERMINAL WIRING

PIN	SIGNAL	CONTROL DESCRIPTION
J6.1	VMOT	MOTOR VOLTAGE (9 TO 36 VDC)
J6.2	GND	GROUND
J6.3	GND	GROUND
J6.4	VLOG	LOGIC VOLTAGE (7 TO 36 VDC)

TABLE 3: J8 TERMINAL WIRING

PIN	SIGNAL	CONTROL DESCRIPTION
J8.1	MOTOR PHASE A+	MOTOR DRIVE OUTPUT A+
J8.2	MOTOR PHASE A-	MOTOR DRIVE OUTPUT A-
J8.3	MOTOR PHASE B+	MOTOR DRIVE OUTPUT B+
J8.4	MOTOR PHASE B-	MOTOR DRIVE OUTPUT B-

TABLE 4: J9 TERMINAL WIRING

PIN	SIGNAL	CONTROL DESCRIPTION
J9.1	+5 VDC	OUTPUT
J9.2	ENCODER A	ENCODER PHASE A (ONLY FUNCTIONAL FOR PUMPS WITH ENCODER)
J9.3	ENCODER B	ENCODER PHASE B (ONLY FUNCTIONAL FOR PUMPS WITH ENCODER)
J9.4	INDX	ENCODER INDEX (ONLY FUNCTIONAL FOR PUMPS WITH ENCODER)
J9.5	GND	GENERAL DIGITAL GROUND

FMI P/N ICST02-4

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		<p>Fluid metering</p> <p>5 Aerial Way, Suite 500, Syosset, NY 11791 800.223.1388 P. 516.922.6050 F. 516.624.6261 www.fluidmetering.com</p>	<p>TITLE INTELLIGENT STEPPER CONTROL, 4 AMP (W/O POWER SUPPLY)</p>	<p>DWG NO. 600298</p>	<p>APPVD BY RH</p>	<p>CHECKED BY DT</p>	<p>DATE 08/01/24</p>	<p>REV B</p>	<p>SHT NO 2 of 3</p>

TABLE 5: J10 TERMINAL WIRING

PIN	SIGNAL	CONTROL DESCRIPTION
J10.1	IN0	DRY CONTACT START INPUT (METERING: CONNECT TO GROUND AND OPEN TO STOP -- DISPENSE: MOMENTARILY CONNECT TO GROUND TO START)
J10.2	IN1	DIRECTION (CW - LEAVE DISCONNECTED; CCW - CONNECT TO GROUND)
J10.3	IN2	METERING/DISPENSE (METERING - LEAVE DISCONNECTED; DISPENSE - CONNECT TO GROUND)
J10.4	IN3/SEN	SENSOR OUTPUT (BLUE WIRE)
J10.5	Vdisp	0 - 5 VDC INPUT TO SET NUMBER OF DISPENSE CYCLES (1 TO 20 REVOLUTIONS)
J10.6	ANODE	SENSOR ANODE (RED WIRE)
J10.7	GND	SENSOR CATHODE (BLACK WIRE)
J10.8	+5 VDC	OUTPUT (250 mA MAX)
J10.9	Vref	0 - 5 VDC INPUT TO SET SPEED IN RPM (10.25 TO 2005 RPM)
J10.10	OUT0	MOTION COMPLETE ("0" = MOTION COMPLETE; "1" = MOTION NOT COMPLETE)
J10.11	OUT1	ERROR GENERAL DRIVE ERROR - ("0" = ERROR; "1" = NO ERROR)
J10.12	GND	GENERAL DIGITAL GROUND



NOTES:

1. DIRECTION BASED ON VIEW FACING PUMP HEAD SIDE.

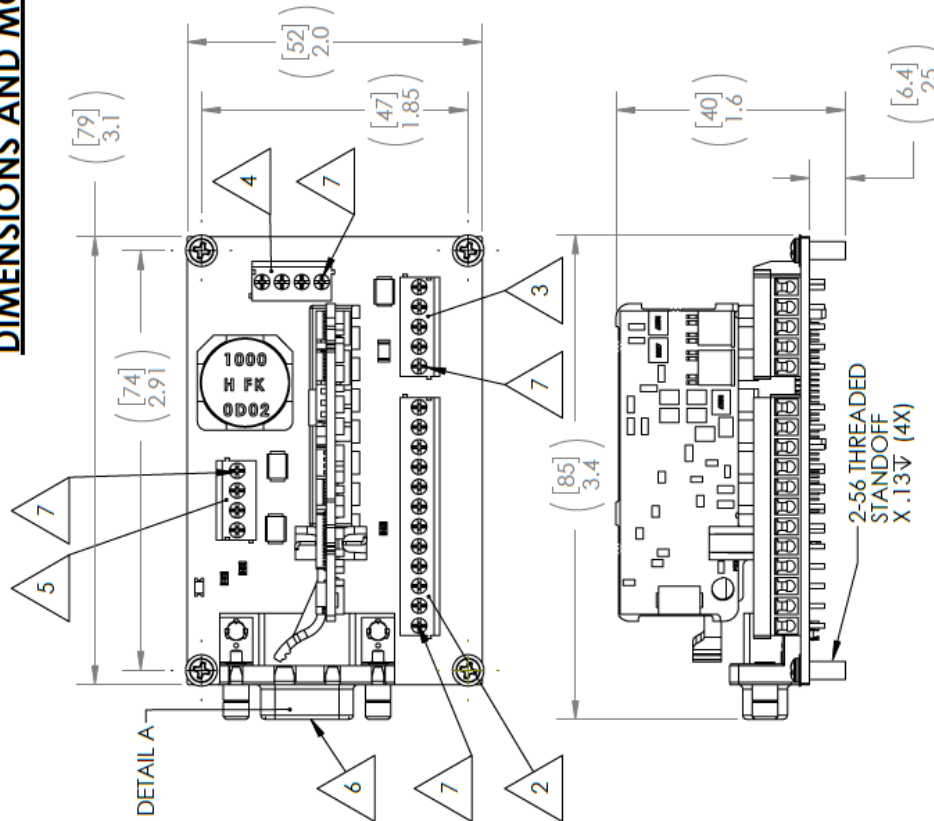
FMI P/N ICST02-4

Fluid metering 5 Aerial Way, Suite 500, Syosset, NY 11791 (800) 223.3388 P. 516.922.6050 F. 516.624.8261 www.fluidmetering.com		TOLERANCES UNLESS OTHERWISE SPECIFIED .X = ±.06 [1.5] .XX = ±.02 [0.5] .XXX = ±.01 [0.25]	UNITS ARE IN INCHES [millimeters]	DATE 07/31/24	TITLE INTELLIGENT STEPPER CONTROL, 4 AMP (W/O POWER SUPPLY)
		DRAWN BY CR	CHECKED BY DT	DATE 07/31/24	REV B
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Appendix B – Intelligent Stepper Control, 2 AMP

P/N ICST02-2

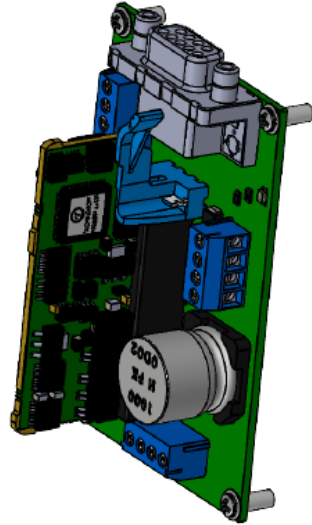
DIMENSIONS AND MOUNTING



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NOTES:

1. SEE SHEET 2 AND 3 FOR CONNECTOR/SIGNAL INFO.
2. J10 TERMINAL STRIP FOR I/O.
3. J9 TERMINAL STRIP FOR ENCODER.
4. J8 TERMINAL STRIP FOR MOTOR.
5. J6 TERMINAL STRIP FOR MOTOR AND LOGIC VOLTAGE.
6. DB9F CONNECTOR FOR SOFTWARE INTERFACE.
7. PIN 1 ON TERMINAL.
8. ALL TERMINAL STRIPS ACCEPT 18-28 AWG WIRE.
9. THIS PRODUCT IS ROHS COMPLIANT.



FMI P/N ICST02-2

TOLERANCES UNLESS OTHERWISE SPECIFIED	X = ±.08 (1.5) .XX = ±.02 (0.5) .XXX = ±.01 (0.25)	UNITS ARE IN INCHES (millimeters)	DATE 07/3/24	CR	DRAWN BY	DATE 07/3/24	DT	CHECKED BY	DATE 08/01/24	RH	APPROVED BY	DWG NO. 600299	REV C	SHT NO 1 of 3
Fluid metering 5 Aerial Way, Suite 500, Suquet, NY 11791 800.223.3388 P. 516.822.6050 F. 516.824.8261 www.fluidmetering.com														
TITLE INTELLIGENT STEPPER CONTROL, 2 AMP (W/O POWER SUPPLY)														

TABLE 1: J3 TERMINAL WIRING

PIN	SIGNAL	CONTROL DESCRIPTION
J3.2	RS232-TX	TRANSMIT
J3.3	RS232-RX	RECEIVE
J3.5	GND	GROUND

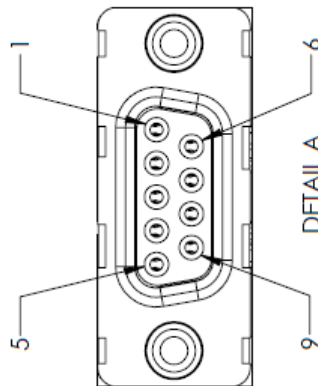


TABLE 2: J6 TERMINAL WIRING

PIN	SIGNAL	CONTROL DESCRIPTION
J6.1	VMOT	MOTOR VOLTAGE (9 TO 36 VDC)
J6.2	GND	GROUND
J6.3	GND	GROUND
J6.4	VLOG	LOGIC VOLTAGE (7 TO 36 VDC)

TABLE 3: J8 TERMINAL WIRING

PIN	SIGNAL	CONTROL DESCRIPTION
J8.1	MOTOR PHASE A+	MOTOR DRIVE OUTPUT A+
J8.2	MOTOR PHASE A-	MOTOR DRIVE OUTPUT A-
J8.3	MOTOR PHASE B+	MOTOR DRIVE OUTPUT B+
J8.4	MOTOR PHASE B-	MOTOR DRIVE OUTPUT B-

TABLE 4: J9 TERMINAL WIRING

PIN	SIGNAL	CONTROL DESCRIPTION
J9.1	+5 VDC	OUTPUT
J9.2	ENCODER A	ENCODER PHASE A (ONLY FUNCTIONAL FOR PUMPS WITH ENCODER)
J9.3	ENCODER B	ENCODER PHASE B (ONLY FUNCTIONAL FOR PUMPS WITH ENCODER)
J9.4	INDX	ENCODER INDEX (ONLY FUNCTIONAL FOR PUMPS WITH ENCODER)
J9.5	GND	GENERAL DIGITAL GROUND

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DRAWN BY	CR	DATE 07/31/24
CHECKED BY	DT	DATE 07/31/24
APPROVED BY	RH	DATE 08/01/24
DWG NO	600299	REV C
TITLE INTELLIGENT STEPPER CONTROL, 2 AMP (W/O POWER SUPPLY)		SHT NO 2 of 3

TABLE 5: J10 TERMINAL WIRING

PIN	SIGNAL	CONTROL DESCRIPTION
J10.1	IN0	DRY CONTACT START INPUT (METERING: CONNECT TO GROUND AND OPEN TO STOP -- DISPENSE: MOMENTARILY CONNECT TO GROUND TO START)
J10.2	IN1	DIRECTION (CW - LEAVE DISCONNECTED; CCW - CONNECT TO GROUND)
J10.3	IN2	METERING/DISPENSE (METERING - LEAVE DISCONNECTED; DISPENSE - CONNECT TO GROUND)
J10.4	IN3/SEN	SENSOR OUTPUT (BLUE WIRE)
J10.5	Vdisp	0 - 5 VDC INPUT TO SET NUMBER OF DISPENSE CYCLES (1 TO 20 REVOLUTIONS)
J10.6	ANODE	SENSOR ANODE (RED WIRE)
J10.7	GND	SENSOR CATHODE (BLACK WIRE)
J10.8	+5 VDC	OUTPUT (250 mA MAX)
J10.9	Vref	0 - 5 VDC INPUT TO SET SPEED IN RPM (10.25 TO 2005 RPM)
J10.10	OUT0	MOTION COMPLETE ("0" = MOTION COMPLETE; "1" = NO MOTION NOT COMPLETE)
J10.11	OUT1	ERROR GENERAL DRIVE ERROR - ("0" = ERROR; "1" = NO ERROR)
J10.12	GND	GENERAL DIGITAL GROUND



NOTES:

1. DIRECTION BASED ON VIEW FACING PUMP HEAD SIDE.

FMI P/N ICST02-2

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		<p>Fluid metering</p> <p>5 Aerial Way, Suite 500, Syosset, NY 11791</p> <p>800.223.3388 P. 516.624.8261 F. 516.624.8261 www.fluidmetering.com</p>	<p>TITLE INTELLIGENT STEPPER CONTROL, 2 AMP (W/O POWER SUPPLY)</p>												

FMI Configuration Tool Release Notes

Revision 495:

Made improvements to Custom Settings Tab by further validating input values such as number of iterations before allowing the custom program to run.

When connected to a variable dispense pump, user can upgrade the ICST02 firmware to provide updated motion parameters from external digital I/O (using firmware with Application ID: 301273-0000-VDLP15 for linear and Application ID: 301273-0000-VDRP15 for rotary pumps).

Latest configuration settings are updated into the controller when communication port is reopened.