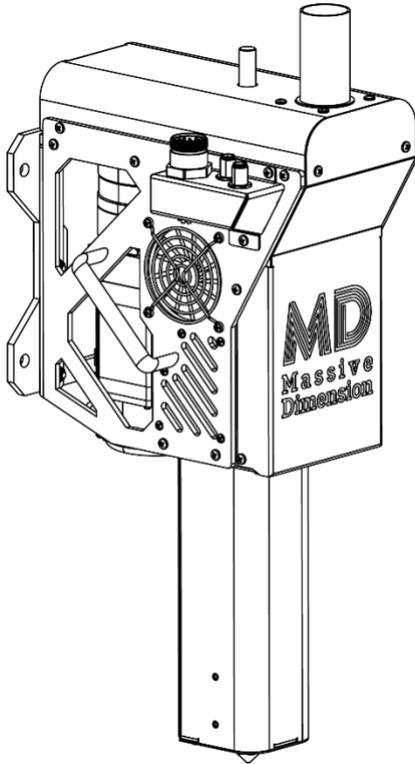# Massive Dimension MDPE10 Extruder

Operation's Manual

This manual applies to the Massive Dimension MDPE10.

Triex LLC, Barre, VT 05641, USA

Table of Contents

Document Revision

02/16/2021 – Revision 1: Initial Release

12/29/2021 – Revision 2: Adding Servo Drive wiring and setup instructions

1/25/2022 – Revision 3: Nozzle Quantity Update, General Updates

CAUTION! Read Carefully

- **RISK OF ELECTROCUTION** Customer is responsible for proper machine implementation, controls enclosure, grounding, safety fuses, and wiring. Improper wiring could cause injury or death. Consult a local electrician if unfamiliar with AC wiring.

- **HOT MATERIALS & SURFACES** Use gloves and eye protection while operating the MDPE10 Extruder. The barrel and nozzle are HOT and melted plastic can stick to the skin and cause serious burns and injury.

- **HIGH-PRESSURE EXPLOSION** Air trapped inside the barrel becomes highly pressurized during operation and can cause small explosions from the nozzle which eject molten plastic in all directions.

- **TOXIC FUMES** Some plastics can produce dangerously toxic fumes when they are heated. Always carefully review the MSDS of any material before using it in the MDPE10 to avoid dangers to your health. Always use the MDPE10 in a well-ventilated area. Always follow material manufacturers processing guidelines.

- **In Case of Emergency** ALWAYS include accessible emergency power shut-offs as part of implementing the MDPE10.

- Only use the MDPE10 to extrude thermoplastic polymers. No other use has been tested or approved by Massive Dimension.

- Always STOP the extruder before clearing the feed port or removing the screw. Never stick anything into the feed port while the screw is turning as this could damage your system.

- The MDPE10 is designed for indoor use only. Operate in a clean, dry area.

- Only use the specified input voltage to operate the MDPE10 or damage to the components could occur.

Contact Massive Dimension with any questions
1-802-505-6772
contact@massivedimension.com

General Specifications

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Thermal Power Input: 208~240VAC-4.8A 50/60Hz 1-Phase
1000W MAX - varies with settings

Weight: 13.8kg (30.5 lbs) - With Servo & Gearbox
7.85kg (17.3 lbs) - Without Servo and Gearbox

Dimensions: 27.8cm D x 20.3cm W x 54.2cm H
(10.9in L x 8.0in W x 21.3in H)
Refer to "MDPE10_Public_Dimensions" for
detailed dimensions. 3D files available on
Massivedimension.com &
Massivedimension.com

Temperature Control: 3 PID Controlled Barrel Heat Zones
(aluminum blocks with dual 150W heaters)
1 PID Controlled Feed Throat Heat Zone
2 24VDC Feed Zone Fans
Max Recommended Run Temp: 660°F (350°C)

Servo Drive: SureServo servo drive 1 kW 230 VAC
1 and 3-phase, (1) RS-232/RS-485/RS-422
(IEEE1394) port Modbus. For use with 750W
and 1 kW servos

Drive Motor: SureServo low inertia AC brushless servo motor
750W, 3-phase input, 2500 lines/10000 ppr
encoder

Gearbox: SureGear high-precision planetary gearbox,
10:1 ratio, inline, 22mm diameter output shaft,
nominal output torque 50 N-m (443 lb-in), 1-
stage, 90mm frame

Screw: Part # EX6-625
16mm (5/8") Diameter
1/2" Pitch
24 L/D Ratio
17-4 PH Stainless Steel Con. H900
2:1 Compression

Nozzle: 1.5mm MD Nozzle (7/8"-14 Thread)

Parts Included

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Parts Included cont.

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1. EX6-625 Extrusion Screw 5/8" OD 2:1 Comp
2. Brass Bristle Tube Cleaner
3. Tube Cleaner Extension Rod
4. High-Temperature Resistant Terry Cloth Gloves
5. Copper Gauze
6. Brass Bristle Wheel
7. (2x) MD Nozzle 1.5mm
8. Magnetic Screw Retainer Rod
9. 1-1/8" Mini-change 9-pole cord set 12' long (AMX10E0010)
10. M12 Female 8-pole shielded thermocouple signal cable 16' (AMX10E0009)
11. M12 Female 4-pole shielded auxiliary signal cable 16'
12. ZL-SVC-CBL50 ZIPLink servo cable 50-pin connector to 50-pin connector
13. SVC-PFL-020 SureServo power cable 20'
14. SVC-EFL-020 SureServo encoder feedback cable 20'
15. ZL-RTB50 ZIPLink feedthrough module, 50-pole, DIN rail mount
16. SVC-PCCFG-CBL SureServo programming cable 9-pin D-sub 6'
17. SVA-2100 SureServo servo drive, 1 kW, 230 VAC, 1 and 3-phase
18. (4x) SLB4848-V0 SOLO single-loop temperature controller, 1/16 DIN
19. (4x) AD-SSR810-DC-28R Solid state relay 35mm DIN rail mount
20. 2x 1lb Bags of Extruder Purge Compound

Tools Required:
Non-marring bench vice (with V-block) for holding screw while cleaning
Powered Drill with a chuck that can receive a 5/16" or larger shank
3/4" Wrench (for nozzles)
Automotive grade wheel bearing grease (small amount)
Never-Seize/Anti-Seize thread lubricant (450ºC rated or higher)

Recommended:
Compressed air & air blower/duster gun
Heat gun or propane torch
Shop Vacuum Cleaner

Call 1-802-505-6772 or visit massivedimension.com for additional or
replacement parts

Thermal Control Components

Refer to "MDPE10 Wiring Diagram" for thermal control wiring

Temperature Control PIDs

Automation Direct Part # SLB4848-V0

Mount these PIDs in a controls enclosure with 1/16 DIN panel cutouts.

Run the auto-tuning function (page 5-2 of the PID manual) at the set temperature you plan to operate the machine at.

To ensure the PID controllers perform at their highest accuracy, we recommend re-tuning whenever operating at a temperature more than 30°C higher or lower than the temperature the previous tune was set at.

PID Manual Link:

https://cdn.automationdirect.com/static/manuals/solobasic/solobasicmanual.pdf

Temperature Control Relays

Automation Direct Part # AD-SSR810-DC-28R

Mount these relays on a 35mm DIN rail in an enclosure.

Relay Specifications Link:

https://cdn.automationdirect.com/static/specs/ssclass8relays.pdf

Servo Motor & Servo Drive Components

Servo Drive

Automation Direct Part # SVA-2100

Refer to the SureServo manual to set up the drive parameters for your implementation:

https://cdn.automationdirect.com/static/manuals/sureservomanual/sureservomanual.html

A serial programming cable is provided (AD Part # SVC-PCCFG-CBL). Connect the drive to a PC's 9-pin D-sub serial port to set and load drive parameters using the SureServo PRO Software which can be downloaded here:

https://support.automationdirect.com/products/sureservo.html

The servo drive I/O is broken out by the ZIPLink feedthrough module (AD Part # ZL-RTB50). Refer to the ZIPLink manual for pinout details:

https://cdn.automationdirect.com/static/manuals/ziplinks/specsheets/ZL-RTB50.pdf

Servo Motor

Automation Direct Part # SVL-207

Servo motor manual:

https://cdn.automationdirect.com/static/manuals/sureservomanual/sureservomanual.html

Servo Gearbox

Automation Direct Part # PGA090-10A3

Servo gearbox specifications:

https://cdn.automationdirect.com/static/specs/suregearservogb-il.pdf

Installing the Screw

1. Apply a very thin layer of grease to all 5 flat surfaces of the square tang on the back of the screw. Be careful not to leave excess grease on the edges of the tang to minimize grease getting on the barrel walls while inserting the screw. Check that there is a thin layer of grease on the square tang at every screw change.

2. Insert the magnetic screw retainer rod into the small hole near the feed port on the top of the machine.

3. Insert the screw, square end first, into the end of the barrel. Push the screw into the barrel until it stops and is retained by the magnet on the end of the retainer rod. The tip of the screw should be recessed about 0.44" from the end of the barrel when the screw is fully inserted. If the screw does not easily insert to the full depth DO NOT install the nozzle or try to force the screw in. Pull the screw back out partially, turn it slightly and try again until it seats in the square coupler.
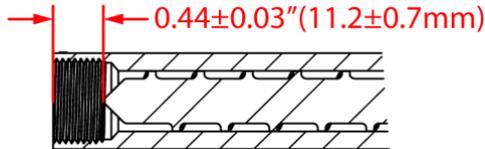
It should take minimal force to insert the screw fully. DO NOT tap the screw in as this could jam the screw in the barrel. There could be debris in the barrel or in the square socket that is stopping the screw. See "Cleaning" for more information.

CAUTION! The barrel gets **HOT!** To prevent burns, always use gloves when working with the screw and nozzles.

4. Apply a thin layer of anti-seize lubricant to the nozzle threads and screw the nozzle into the end of the barrel. The nozzle should be snug but not tight, approximately 200 in-lbs (230 kg-cm).

Wiring Instructions

NOTE: These wiring instructions are not a replacement of the manufacture's guide for the Servo Driver, only a starting point for quickly getting the system set up.

Please read through and refer to the Servo Driver's system User's Manual for more detailed instructions for setup and wiring: https://cdn.automationdirect.com/static/manuals/sureservomanual/sureservomanual.html

Warning: before starting the wiring of the system, make sure all power is disconnected from the system.
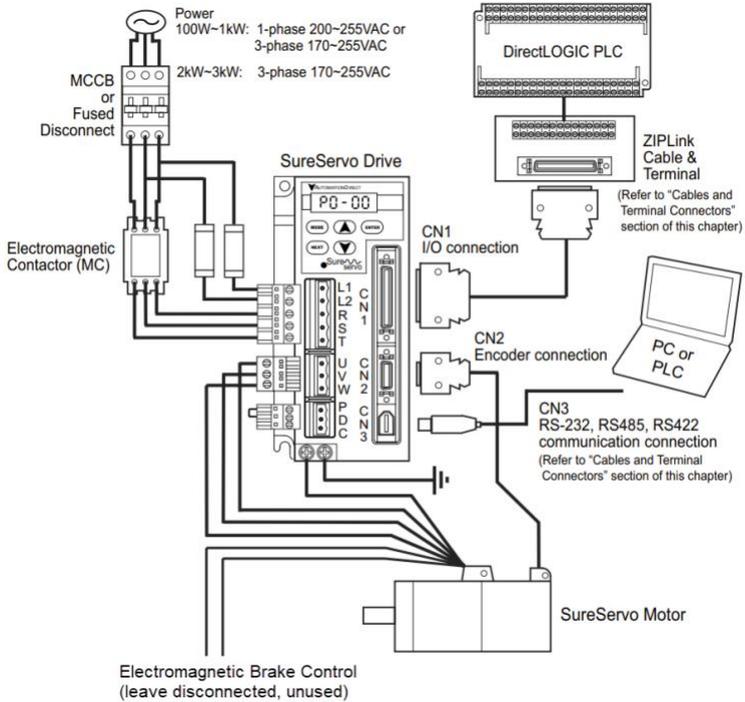
Servo System Connection Overview

Figure 1: Servo Driver Connection Overview

Servo Motor & Driver Cable Connections

Note: Servo Motor Power and Encoder connector cables poke out on the right side of the extruder.

Servo Power Cable

Install the removable connectors that are included with the Servo Driver onto Servo Power Cable (SVC-PFL-020). The Motor Output Power connector is a 3-pin connector that has the corresponding 'U', 'V' and 'W' motor phase labels on it. Connect the 3-pin connector to the corresponding wire colors on the harness, as identified in table 1.

Figure 2: Servo Power Cable

Table 1: Servo Motor Power Cable Pinout

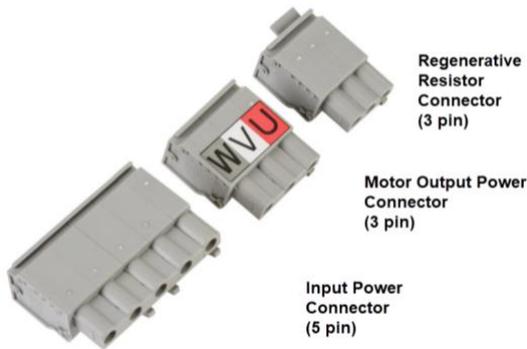| Wire	Pin	Color
U	A1	Red
V	A2	White
W	A3	Black
GND	B1	Green Or Green with Yellow Stripes
BRAKE1	B2	Yellow (Unused)
BRAKE2	B3	Orange (Unused)

After connecting the Servo Power Cable wires to the removable connector, plug the connector into the Servo Driver. The motor phase markings on the connector should correlate to the markings on the Servo Driver.

Connect the green wire from the Servo Power cable to one of the ground studs on the bottom left corner of the Servo Driver. The second ground stud on the Servo Driver should be connected to the ground/chassis of the system.
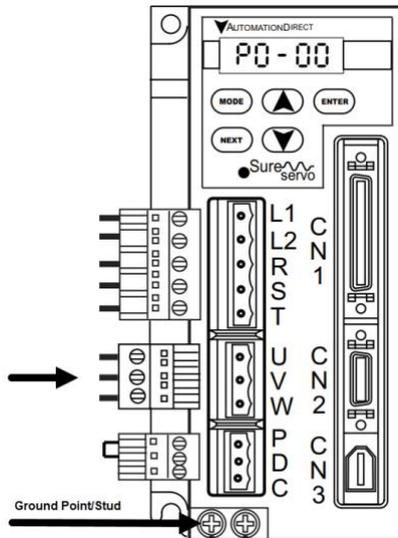

Figure 4: Servo Power Connector

Connect the other end of the Servo Power Cable to the corresponding connector on the extruder Servo Motor Cable.

Servo Encoder Cable

Connect the one side of the Servo Encoder Feedback cable (SVC-EFL-020) to the CN2 connector on the Servo Driver and the other side of the cable to the corresponding connector on the extruders' Servo Motor cable.

Figure 5: Servo Encoder Feedback Cable

Regenerative Resistor Connection

Install the 3-pin Regenerative Resistor Connector onto the Servo Driver connection labeled "PDC". The connector should have a reinstalled jumper between pins P and D. This will allow the Servo Driver to use the internal resistor for dissipating power during breaking.
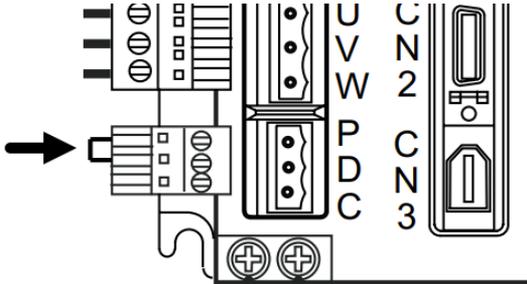

Figure 6: Regenerative Resistor Jumper Connection

Power Input Connections

The SVA-2100 Servo Driver has two power input options: 200-255VAC Single-Phase power and Three-Phase 170-255VAC power (not needed for this application). The diagrams shown below are only for reference. Refer to the SVA-2100 Servo Driver User's Guide for more details about connecting power to the driver for your specific application. Power

connections may include additional safety components such as contactors, fusing, and other items.
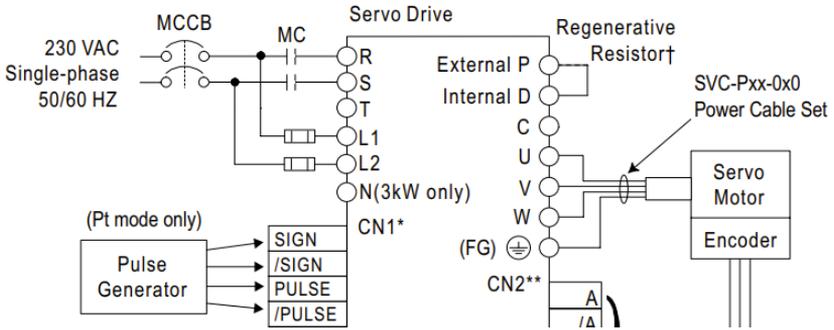

Figure 7: Single-Phase Power Connection Overview (see manual Ch. 2-20 for more details)

ZIPLink connection

Connect the ZIPLink 50-pin cable (ZL-SVC-CBL50) from CN1 on the Servo Driver to the ZIPLink Feedthrough Breakout module (ZL-RTB50).
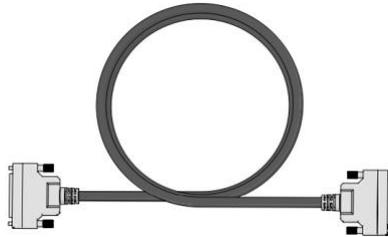

Figure 8: ZIPLink 50-pin Cable

Connecting Servo Driver ZIPLink to a Controller

For this wiring guide a Duet 2 Controller board will be used, but any other controller can be used with the proper I/O and setup.

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WARNING: OBSERVE PRECAUTIONS FOR HANDLING ELECTROSTATIC SENSITIVE DEVICES

During assembly and wiring of the Duet 2 controller, make sure to follow proper product handling techniques and ESD precautions to prevent electrostatic discharge and damage to the board. Assembly should be done on a grounded ESD safe workstation or by grounding yourself and the product together to a common point.

The SVA-2100 Servo Driver also supports multiple drive control modes such as Position Mode (Pt & Pr Mode), Velocity Mode, and Torque Mode. This guide will only be detailing the Position Control Mode (Pt) using external Step and Direction signals.
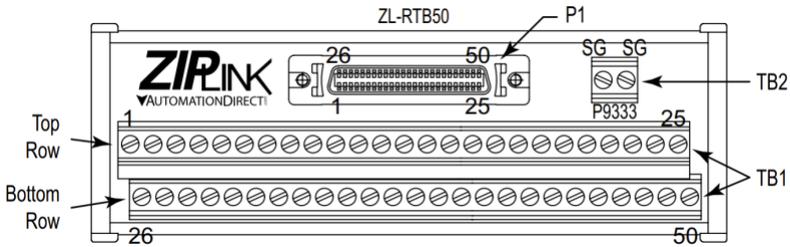
Figure 9: ZIPLink Breakout Module

Table 2: ZL-RTB50 Pin-out – TB1

Top Row			Bottom Row		
Pin #	Signal	Description	Pin #	Signal	Description
1	DO4+	Digital Output	26	DO4-	Digital Output
2	DO3-	Digital Output	27	DO5-	Digital Output
3	DO3+	Digital Output	28	DO5+	Digital Output
4	DO2-	Digital Output	29	NC	No Connection
5	DO2+	Digital Output	30	DI8	Digital Input
6	DO1-	Digital Output	31	DI7	Digital Input
7	DO1+	Digital Output	32	DI6	Digital Input
8	DI4	Digital Input	33	DI5	Digital Input
9	DI1	Digital Input	34	DI3	Digital Input
10	DI2	Digital Input	35	PULL HI	Position Pulse Input
11	COM+	Power Common DI & DO	36	/SIGN	Position Pulse Input

12	GND	Power VCC Ground AI	37	SIGN	Position Pulse Input
13	GND	Power VCC Ground AI	38	NC	No Connection
14	NC	No Connection	39	NC	No Connection
15	MON2	Analog Monitor Output 2	40	NC	No Connection
16	MON1	Analog Monitor Output 1	41	PULSE	Position Pulse Input
17	VDD	Power 24V Source	42	V_REF	Analog Velocity Input
18	T_REF	Analog Torque Input	43	/PULSE	Position Pulse Input
19	GND	Power VCC Ground AI	44	GND	Power VCC Ground AI
20	VCC	Power 12V Source	45	COM-	Power VDD Ground DI & DO
21	OA	Position Pulse A Output	46	NC	No Connection
22	/OA	Position Pulse A Output	47	COM-	Power VDD Ground DI & DO
23	/OB	Position Pulse B Output	48	OCZ	Encoder Z Pulse Open Collector Output
24	/OZ	Position Pulse Z Output	49	COM-	Power VDD Ground DI & DO
25	OB	Position Pulse B Output	50	OZ	Encoder Z Pulse Line Driver Output

Table 3: ZL-RTB50 Pin-out – TB2

Pin #	Signal	Description
1	SG	Shield Ground
2	SG	Shield Ground

The ZIPLink manual states: "TB2 is internally connected to the shield drain wire and should be field connected to earth ground". **Connect** a wire from either of the pins to the chassis of the system.

Figure 9 shows the input connections of the ZIPLink Breakout module. For the position control (Pt) mode, pins 36 (/SIGN), 37 (SIGN), 43 (/PULSE), 41 (PULSE), and 45 (COM-) will be used.
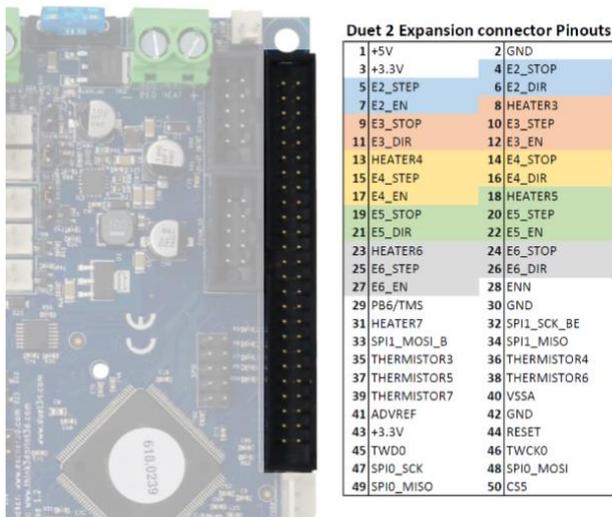
Figure 10: Duet 2 Controller Expansion Pinout

For this example, we will be using the Duet 2 Controller board for controlling the extruder Servo Driver, but any other controller boards that have similar output control signals can be used. The E5 (drive 8) Step and Direction control signals will be accessed through the Duet 2's expansion connector.

Connect the Duet 2 signal lines to the ZIPLink Breakout module as detailed in Table 4. A Molex 22552502 or similar connector can be used to interface with the Duet 2 Expansion connector with a custom wire harness. Use the associated crimps for this connector to match the wire gauge being used.

Table 5: Wiring Table for Duet-to-ZIPLink Connections

Duet 2 Expansion Connector			ZIPLink Breakout Terminal Module		
Pin #	Signal Net	Description	Pin #	Signal Net	Description
21	E5_DIR	Direction Signal	36	/SIGN	Direction In (+)
30	GND	Ground	37	SIGN	Direction In (-)
20	E5_STEP	Step Signal	43	/PULSE	Position Pulse In (+)
30	GND	Ground	41	PULSE	Position Pulse In (-)
2	GND	Ground	45	COM-	Ground

For best EMC and noise performance twist the SIGN and /SIGN signal pair wires together between the two modules to create a twisted pair. Do the same for the PULSE and /PULSE wires.

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Servo Drive Parameter Setup

This guide will help you get the Servo Driver setup and spinning for use with the extruder. If more control or tuning is desired, see the SVA-2100 detailed User Manual for additional information.

1) **Apply power to the Servo Driver**

2) **Reset the Servo Driver to factory defaults:**
   Set Parameter P2-08 to 10. "Press MODE, then press NEXT until P2-00 appears. Press ARROW-UP until P2-08 appears. Press ENTER. Press ARROW-UP until you enter a value of 10. Press ENTER to accept." See detailed Servo Driver manual for additional help on navigating the device's menu and keypad.

P2-08	Password (and Factory Default)
10	Reset Drive to Factory Defaults

3) **Set Motor Code:**
   Navigate and verify/set Parameter P1-31 to '20', this sets the type of motor being used with the Servo Driver. The Servo Motor used in the MDPE10 extruder is the SLV-207 motor (750W) which is also the default setting for the SVA-2100 drive. See the "Servo Drive Parameters" chapter for more details.

P1-31	Motor Code
20	Motor: SVL-207(B)
(= 750W)	Default setting for the SVA-2100 drive

4) **Disable Digital Input 8 (DI8 = Fault Stop) (for testing purposes)**
   Navigate to P2-17 and set the parameter to '0'. This will disable the Fault Stop input temporarily, allowing testing of the motor without the Fault Stop signal interfering with it (it will be re-enabled later in step 10 if needed).

P2-17	Digital Input 8 (DI8) – Fault Stop
0	Disables Digital Input 8

5) **Cycle Power to the Drive**

6) Servo Drive Enable Override

Navigate to P2-30 and set the parameter to '1'. Setting this parameter temporarily overrides Servo Enable, CW Limit, and CCW Limit inputs for testing. This will be reset this once setup is completed.

P2-30	Auxiliary Function
1	Force Servo to be Enable (regardless of input status)

7) Jogging the Motor

Navigate to parameter P4-05 Jog Operation and press ENTER. This will set the jog speed of the Servo Motor in rpm. Enter 100 and press NEXT which will move the cursor to the left. Press ENTER, the LED display will show "JOG". Use the UP-ARROW or DOWN-ARROW to jog the motor forward or reverse. Press the MODE button to exit the jog operation menu.

P4-05	JOG Operation
100	Jog the motor at 100 rpm when the JOG signal is active

If the run, stop, and direction operation of the motor does not work as expected, check the motor power cable connections and wiring table. Refer to the "Servo Power Cable" section of this manual or reference the SVA-2100 Servo Driver User Manual for more details.

8) Cycle Power to the Drive

This resets the P2-30 parameter set earlier and re-enables the inputs.

9) Set Pulse Type and Control Mode:

Navigate to Parameter P1-00 and set it to '002' (Pulse + Direction). This will set the type of pulse signal coming into the Servo Driver. Then navigate to Parameter P1-01 and set it to '0100' (the Drive accepts Position Control via external pulse inputs with CCW direction). This will set the control mode and output direction.

P1-00	External Input Pulse Type (See Chapter 2 and Appendix B for encoder wiring details.)
000	Quadrature Input – A, /A, B, /B (typical encoder input signals)
001	CW + CCW pulse input
002	Pulse + Direction

P1-01	Control Mode and Output Direction
0000	Drive accepts Position Control via external pulse inputs with CW direction.
0100	Drive accepts Position Control via external pulse inputs with CCW direction.

10) Configure Digital Inputs:

Enable the digital inputs your specific system requires. These additional digital inputs are not required for the extruder operation but may be used as needed for your application. Please refer to the Servo Driver's User's Manual chapter 2-22 for more detail on driving the Enable or any other of the digital inputs.

P2-10 Through P2-17		Digital Input Definition	
P2-10	101	DI1 = Servo Enable	Normally Open
P2-14	102	DI5 = Alarm Reset	Normally Open
P2-15	022	DI6 = Reverse Overtravel (set to 000 to disable this input)	Normally Closed
P2-16	023	DI7 = Forward Overtravel (set to 000 to disable this input)	Normally Closed
P2-17	121	DI8 = Fault Stop	Normally Open

11) Rotate Servo Motor in Software:

To wrap up and test the setup, the extruder should be spun using the PC to verify control and/or prime the extruder. Two methods can be used to do this: Controller board's provided software utility or running a simple G-code snippet.
G-code example:

```
;Run Extruder
G91
G1 E100000 F1500
G90
```

G91 and G90 switch the machine between absolute and incremental positioning modes, line G1 E100000 F1500 commands the extruder an amount to extrude (E100000) and a speed at which to do it (F1500).

Note: Depending on your machine settings, you may also have to first enter M302 - this command allows "cold extrusion" and will allow you to spin the screw without the heaters on.

Caution: To prevent damage avoid running the extruder dry without any polymer for more than a few minutes at a time.

Cleaning

Caution! Parts of the extruder get **hot!** Wear gloves and eye protection! It is recommended to thoroughly clean the extruder after use, or right before the next use, for the most consistent extrusion. Polymer melt on the screw due to heat creep after shutdown can cause issues when restarting the extruder. Leave the extruder temperature zones on during cleaning.

1. Either run the extruder until the feed port is empty or use a vacuum cleaner to remove the remaining pellets. Continue running the extruder until polymer stops extruding from the nozzle.

2. If you are using a filter nozzle, stop the extruder, remove it, and replace it with a standard nozzle with a minimum hole size of 1.5mm. Purge damages the filter. Fill the steel angled feed tube approximately halfway with extruder purge compound while running the extruder at approximately 20RPM. Do not change the temperatures from the polymer that was run to run purge. **NOTE:** *Use high temp purge for temps over 300°C. It is possible to remove and clean the screw without using purge material, but the process can be significantly more difficult and is not recommended.*

3. Continue running the extruder until purge stops extruding from the nozzle, or add more if the residual polymer is still visible in the purge. **NOTE:** *Running the extruder "dry" with no polymer in the feed will cause excess wear on the screw over time. Avoid running the extruder while empty for more than a few minutes at a time.*

4. After all the purge has been extruded, stop the extruder and remove the nozzle.

5. Remove the magnetic screw retainer rod and insert the tube cleaner extension rod to push the screw forward and out from the end of the barrel.
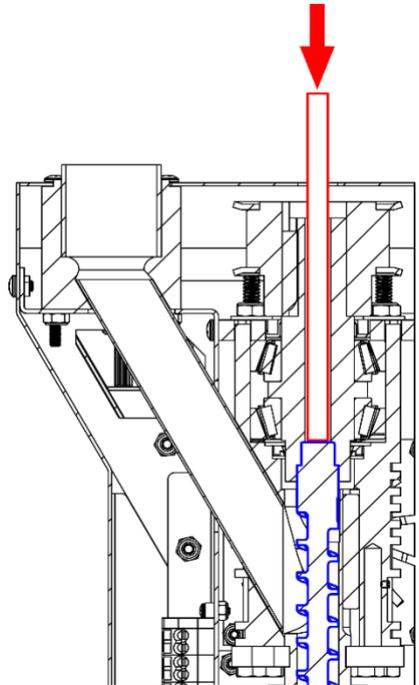
Cleaning – Continued

6. Pull the screw the rest of the way out of the barrel using gloves, then clamp the back of the screw in a non-marring vice with a v-block for cleaning. **NOTE:** *Clean the screw while it is still hot.*

   Always use a smooth, non-marring vice and v-block to secure the screw. *Damage to the screw from the use of an improper vice could cause wear issues or prevent the screw from fitting in the barrel.*
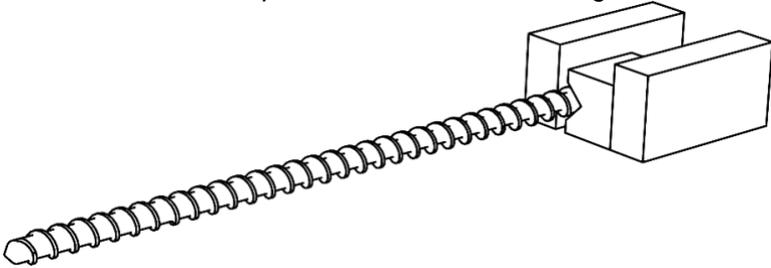
7. Clean the remaining material from the screw using a power drill with the brass bristle wheel. If present, large pieces of material may need to be scraped off first. **NOTE:** *Always use soft metal tools (brass, aluminum, etc.) to remove material from the screw to prevent marring of the surface which can decrease the life of the screw and cause extrusion issues. Use a heat gun or propane torch if the screw cools and cleaning becomes difficult.*

8. Screw the brass bristle tube cleaner onto the tube cleaner extension rod and wrap two layers of copper gauze around the brass bristle tube cleaner. Wrap the gauze counter-clockwise with the extension rod pointing toward you.

9. Secure the end of the extension rod in the power drill chuck and make sure the drill is turning clockwise.

10. Insert the brass bristle tube cleaner into the end of the barrel, while spinning, and continue until it reaches the feed port. While still spinning, remove the tube cleaner, and repeat 2~3 times.

11. Use compressed air in the feed tube to blow any remaining debris out the end of the barrel. Check if the barrel is clean by shining a light in the feed port and looking into the end of the barrel.

Refer to our online resources at massivedimension.com for cleaning demos.