Basic 3-Stage Control

Applications & Reference

RJG, Inc.

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Basic 3-Stage Control Applications

Requirements

Use of the Basic 3-Stage Control tool requires the following:

- Constant Velocity Pack valve

  This valve will provide a conventional 2-stage machine with an independent pack stage. Select the GPM rating that best matches your machine (Contact RJG Customer Support for assistance).

  - CVP-300-LX (119 GPM) or
  - VM-520-LX (59 GPM)

- 3-Stage Valve Interface box (3ST/LX-INT)

  The 3ST/LX-INT is the main interface between the *eDART*® and the CVP-300-LX or VM-520LX valve. The *eDART* sends a control signal to the 3ST/LX-INT, which in turn sends power to actuate the CVP-300-LX valve. Since the 3ST/LX-INT identifies itself automatically in the Sensor Locations tool, no software setup for this device is required.

- Stroke/Velocity Encoder (LE-R-30)

  The Stroke sensor enables you to control injection fill by position and is required for Fill (V1) to Pack (V2) transfer by volume on the CVP-300-LX.

- Hydraulic Pressure Sensor (LS-H-1/4NPT-3K)

  The Hydraulic Pressure sensor is used to monitor the machine injection pressure.

- Sequence Input Module (ID7-D-SEQ)

  The Sequence Module provides inputs from the machine to the software.

  - “Injection Forward” (required)
  - “Screw Run” (required)
  - “First Stage” (recommended)

- Dual Relay Output Module (OR2-D)

  Use of the Basic 3-Stage Control tool requires one OR2-D module to get the necessary contact closures. These contact closures are wired into the machine through auxiliary relays.

  - “Control Output, V -> P Transfer” output (required)
  - “Control Output, Inject Enable” output, if using Injection Enable buttons (required)

- Cavity Pressure Sensorsa

  If using cavity pressure control, you will need a cavity pressure sensor with a suitable location in the mold for this purpose.

- Basic 3-Stage Control Software

  If the software is not already installed, you will need a disc to install. Contact RJG Customer Support at (231) 947-3111.

Installation

Hydraulic

Install the CVP-300-LX Valve

Refer to Figure 1 on the next page for installation description.

1. Insert the CVP-300-LX in line with the hose that goes to the injection cylinder of the press.

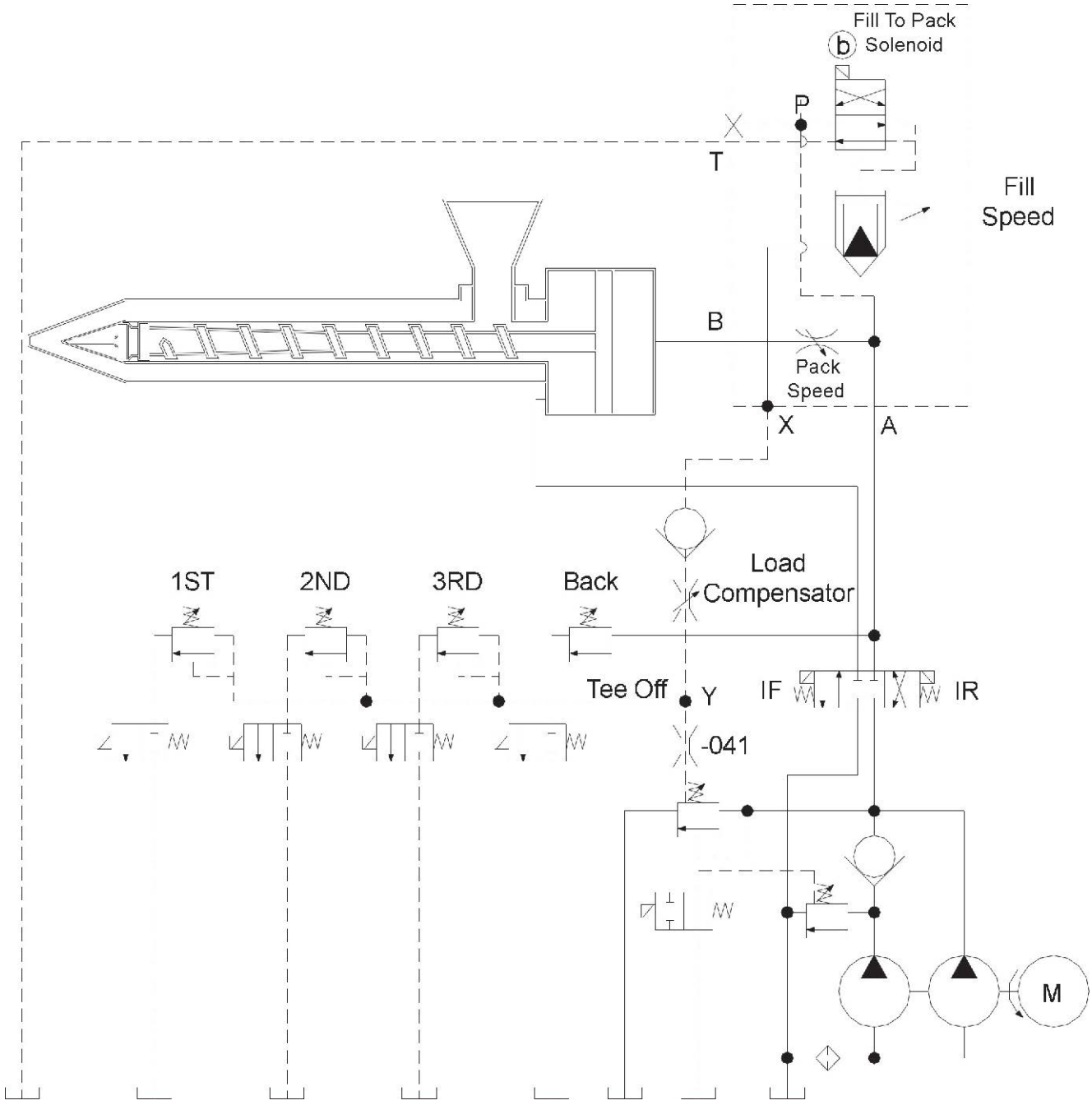
   WARNING: *Install the valve downstream of the pump's main relief valve. Improper installation in-line before the main relief valve could cause failure of the safety function of dumping oil to the tank, resulting in possible personal injury or equipment damage.*

2. Plumb port "B" on the injection cylinder side and port "A" on the pump side so that oil flow during injection goes from "A" to "B".

3. Connect port "T" of the valve block to the tank.

4. When the directional valve is energized in the sequence from Fill to Pack control, the cartridge valve will be shut down, disabling the flow of oil through port "A" to "B". A lower flow rate of oil will occur through the pack valve flow control located on the side of the CVP valve. This will give the molder a separate pack flow control to adjust the pack velocity of the job. The fill flow control of the valve utilizes a micrometer adjustment for setting the fill speed. All other types of flow or speed control valves originally on the press that are normally used to control injection speed should be disabled or set to default flow control to the CVP-300-LX.

5. Port "X" of the CVP-300-LX valve should plumb into RJG's LCK Load Compensation circuit. See Appendix A for details.



* The VM-520-LX valve does not use a load compensator

***Figure 1**: CVP-300-LX Valve Hydraulic Schematic*

NOTE: *This is a generic hydraulic schematic to be used as a guideline. Your machine may not be identical to the one shown. For further installation information specific to your machine, please contact RJG Customer Support at (231) 947-3111.*

Electric

Connect the Interface

1. Mount the 3-Stage Valve Interface box.

   CAUTION: *Make sure that the box is bound firmly to the machine and that the machine is properly grounded. Also, make sure that all cables are wired away from any sources of static such as material feeds lines.*

2. Connect the CVP Valve to the 3-Stage Valve Interface box using the supplied cable (C-3ST/LX-4M).
3. Wire 120 VAC to the pigtail end of the 3-pin power cable.
4. Connect the power cable to the 3-Stage Valve Interface box.
5. Connect a Lynx cable (CL-LX5-4M) between the *eDART*® and the 3-Stage Valve Interface box.

   CAUTION: *Make sure that the Lynx communication cables do not lay on the machine solenoid, C-3ST/LX-4M cable, or on the CVP valve.*

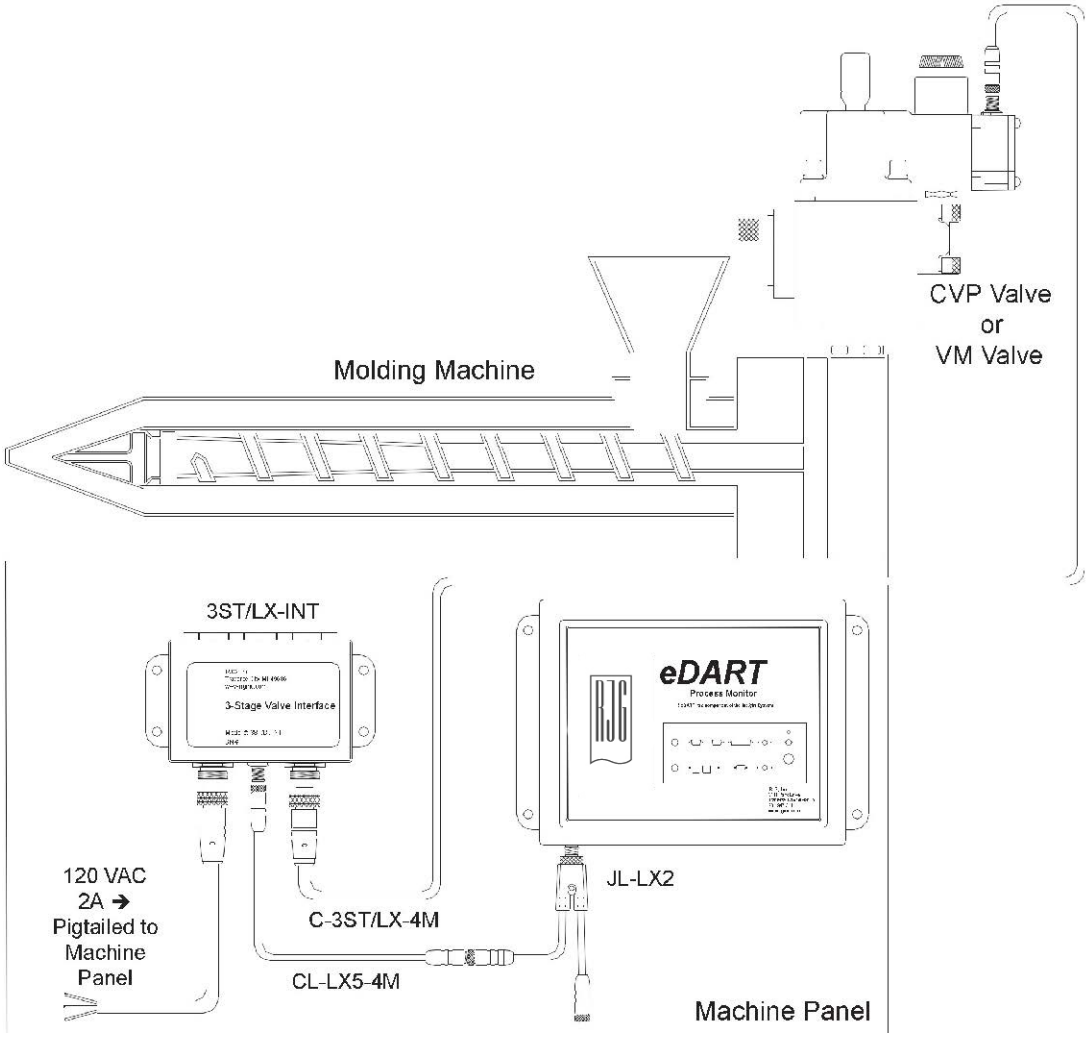


Figure 2: *3-Stage Valve Interface Layout*

Wiring - Machine Interface Inputs/Outputs

The Basic 3-Stage Control tool requires a Sequence Input Module (ID7-D-SEQ) and one Dual Relay Output Module (OR2-D) mounted in the machine and interfaced to the machine controller.

The Sequence Input Module and Dual Relay Output Module are designed to be mounted on standard 35mm DIN rail often found in machine panels. The DIN rail can be mounted anywhere that is convenient. Once mounted, connectors allow the unit to be interfaced with other Lynx DIN rail modules and the *eDART*® System.

Sequence Input Module

In order to do important computations relevant to the operation and safety of the Basic 3-Stage Control tool, the *eDART* needs certain signals from the machine controller wired to the Sequence Module (signals listed to the right). For more detailed wiring information, refer to Appendix C.

INJ Forward	Required
Screw Run	Required
1st Stage	Recommended

Dual Relay Output Module

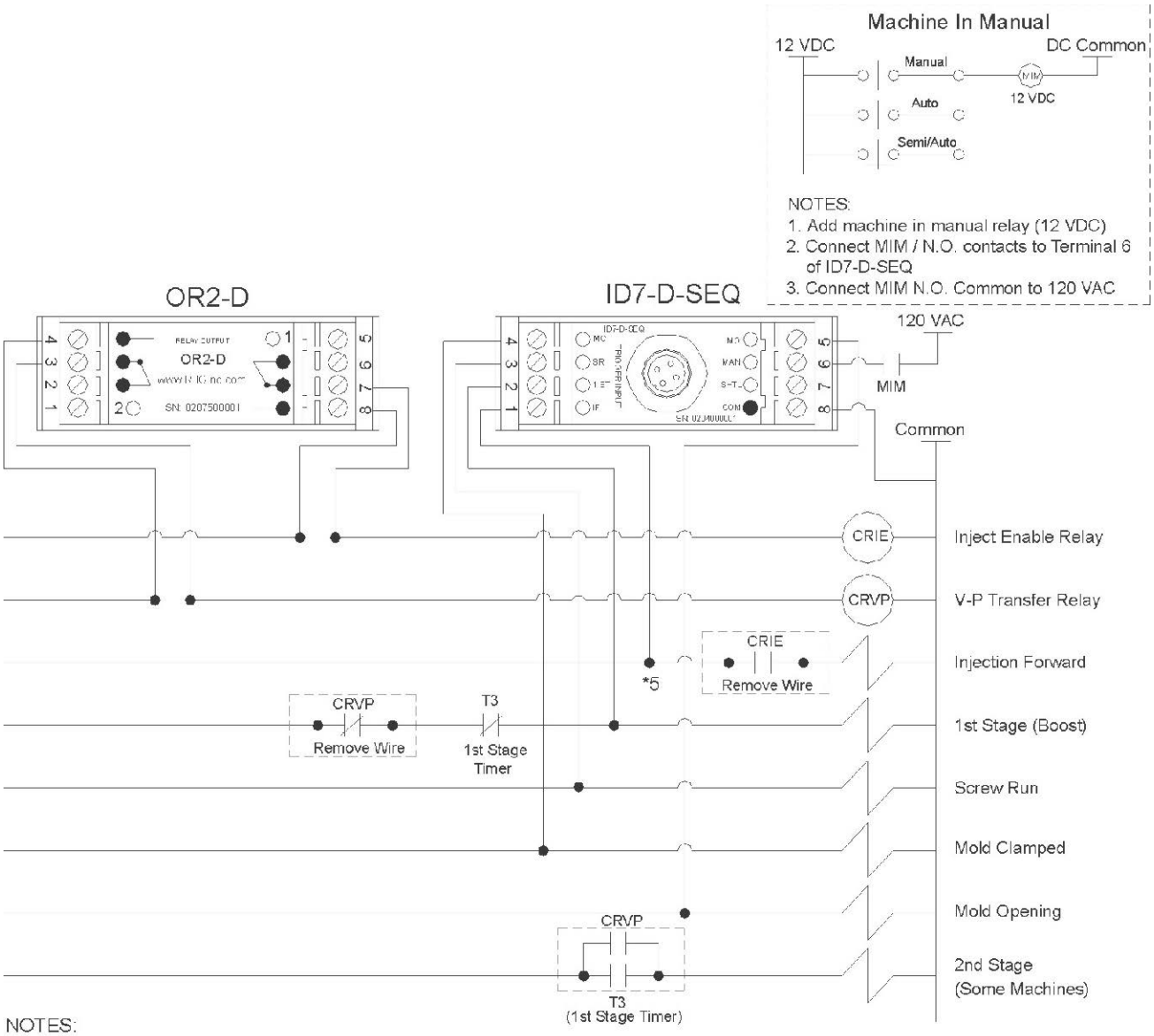
The Basic 3-Stage Control tool requires one OR2-D in the machine panel for Inject Enable and V -> P Transfer.

1. Inject Enable
   The Inject Enable relay contact allows the Basic 3-Stage Control to interrupt injection during default conditions such as loss of power to the *eDART* or loss of communication to a critical sensor. This requires that the normally open output on an OR2-D is wired to an auxiliary relay, which, in turn is wired inline of the Injection Forward solenoid or relay (See Figure 3). On the Sensor Locations tool, this contact is called “Control Output, Inject Enable” (See Figure 4).

2. V -> P Transfer
   The V -> P Transfer relay contact signals the machine to transfer from 1st to 2nd stage (on cavity pressure, injection volume, injection pressure, or time). The V -> P transfer wiring will vary depending on the design of the molding machine (See Appendix D for machine specific examples). On some machines, the controller will automatically shut off 1st stage. Other machines require an additional set of contacts to turn off 1st stage (An auxiliary relay is needed in either case). On the Sensor Locations tool, these contacts are called “Control Output, V -> PTransfer” (See Figure 4).

   Whether you use the “normally open” or the “normally closed” set of contacts depends on how the timer interrupt relays on the machine are wired. If your timer interrupt relays are “normally open”, you will wire the auxiliary relay contacts in parallel. If they are “normally closed”, you must run them in series. Both wiring schemes are shown in Figure 3.

The diagram below illustrates a general machine wiring scheme. Appendix D contains machine specific wiring diagrams.



NOTES:
1. Add Fast Horse Power Rated Double Pull Double Throw relays for Inject Enable and Velocity to Pressure Transfer.
2. Wire CRIE N.O. contacts (Held Closed) in series with Inj Fwd solenoid.
3. Wire CRVP N.C. contacts in series with T3 N.C. contacts and 1st Stage solenoid.
4. Wire CRVP N.O. contacts in parellel with T3 N.O. contacts.
5. Connection must be on Logic side of Inject Enable contacts.

***Figure 3**: General Machine Wiring Diagram*

Software Setup

When the machine sensors are configured using the Sensor Locations tool, one contact closure (from an OR2-D) must be configured as “Control Output, V -> PTransfer”. Another must be configured as “Control Output, Inject Enable”. A “Control Output, CVPValve Slow” should appear, but no configuration is necessary. Make sure all other sensors are configured correctly and click the *Accept* button.

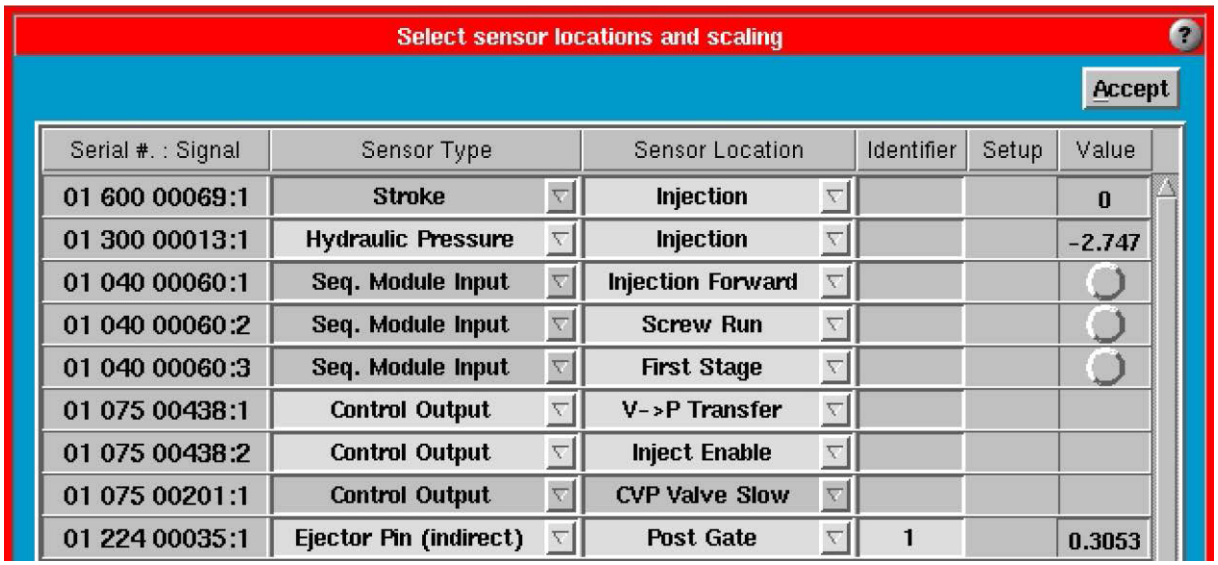


***Figure 4**: Sensor Locations tool*

CAUTION: *When programming your machine to accept an RJG cavity pressure transfer control input, you must utilize any time, pressure, or stroke overrides in the machine control algorithm. If a setpoint is set incorrectly or a sensor is removed from the mold, the cavity pressure may not reach a transfer setpoint so there must be a backup to keep from flashing or damaging a tool.*

CAUTION: *You MUST have a reliable Injection Forward Sequence Module input (on at cycle start, off at end of hold) from the machine or the V -> P transfer control may not activate, causing flash or mold damage.*

To open the Basic 3-Stage Control tool, bring up the Architect from the Main Menu. Select the “Current” tab at the left side of the Architect and click the large Machine button below it. From the “Controls” pull down menu on the right side of the Architect, choose the Basic 3-Stage Control tool by clicking and holding down your left mouse button and dragging the tool onto the blue work area. The Basic 3-Stage Control tool will now be available as a button on the bottom of your screen. Click the button to open the tool.

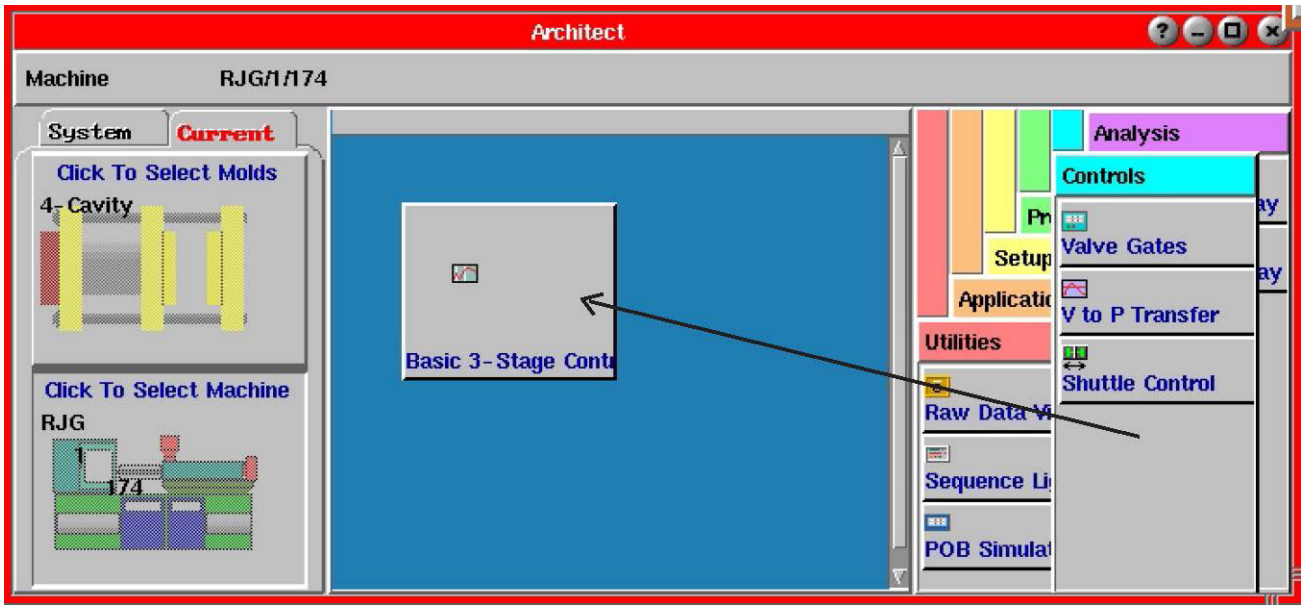


***Figure 5**: Opening the Basic 3-Stage Control from the Architect (saved to the machine)*

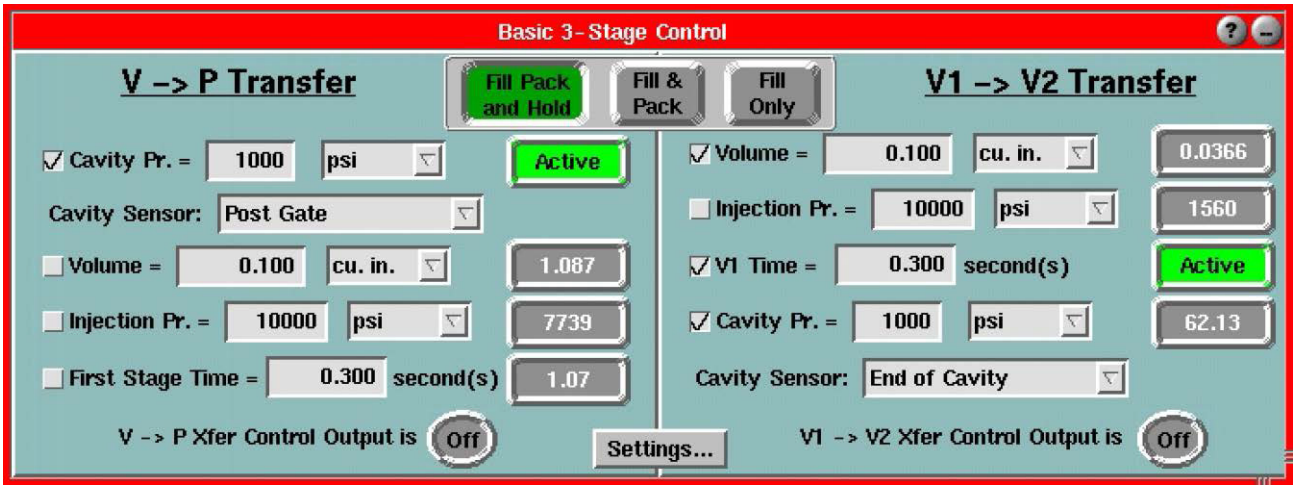


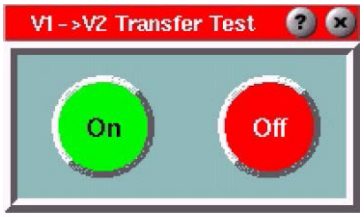
***Figure 6**: Basic 3-Stage Control Tool*

CAUTION: *The Basic 3-Stage Control tool must be running before you start a cycle on the injection molding machine. You may damage your mold if the machine is cycled before you see the Basic 3-Stage Control tool or its button on the toolbar.*

Test the Outputs

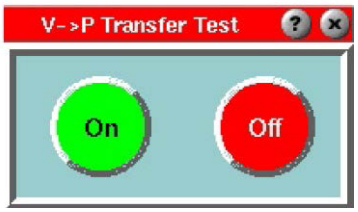
On the Basic 3-Stage Control tool, click the Settings button and from the menu choose V1 -> V2 or V -> P Xfer Output Test. Here you can determine whether the machine is receiving the control signal correctly.

V1 -> V2 Transfer Test



Click either the *On* or *Off* button to test the CVP Valve Slow Control Output. When either button is clicked, you should hear the valve solenoid operating.

V -> P



Click the *On* button to force the V->P Transfer Control Output contacts on (closed) for the selected output.

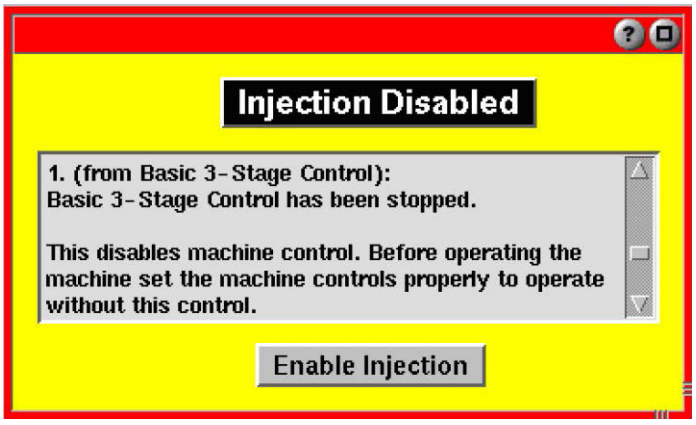
Click the *Off* button to force the V->P Control Output contacts off (open) for the selected output.

Inject Enable

To test the functionality of the Inject Enable signal, follow the steps below:

1. Stop the job (select Stop Job from the Main Menu).

   A yellow warning screen should appear. Do NOT click the Enable button.



2. Try to inject.

   The machine should not inject.

3. Manually inject if you feel safe without control.

   The machine should inject.

4. Restart the job on the *eDART*®.

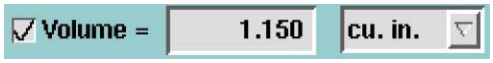
Setting up the Process

Here, you will set up a 3-stage DECOUPLED MOLDING® process using Volume and Cavity Pressure as primary transfer methods. Other transfer methods are available as backups (or primary if necessary).

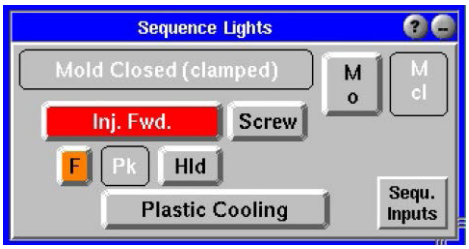
1. **Make a Fill-only Part**

To begin setting up a 3-stage decoupled process, bring up the Basic 3-Stage Control tool and click the Fill Only Injection Enable button.

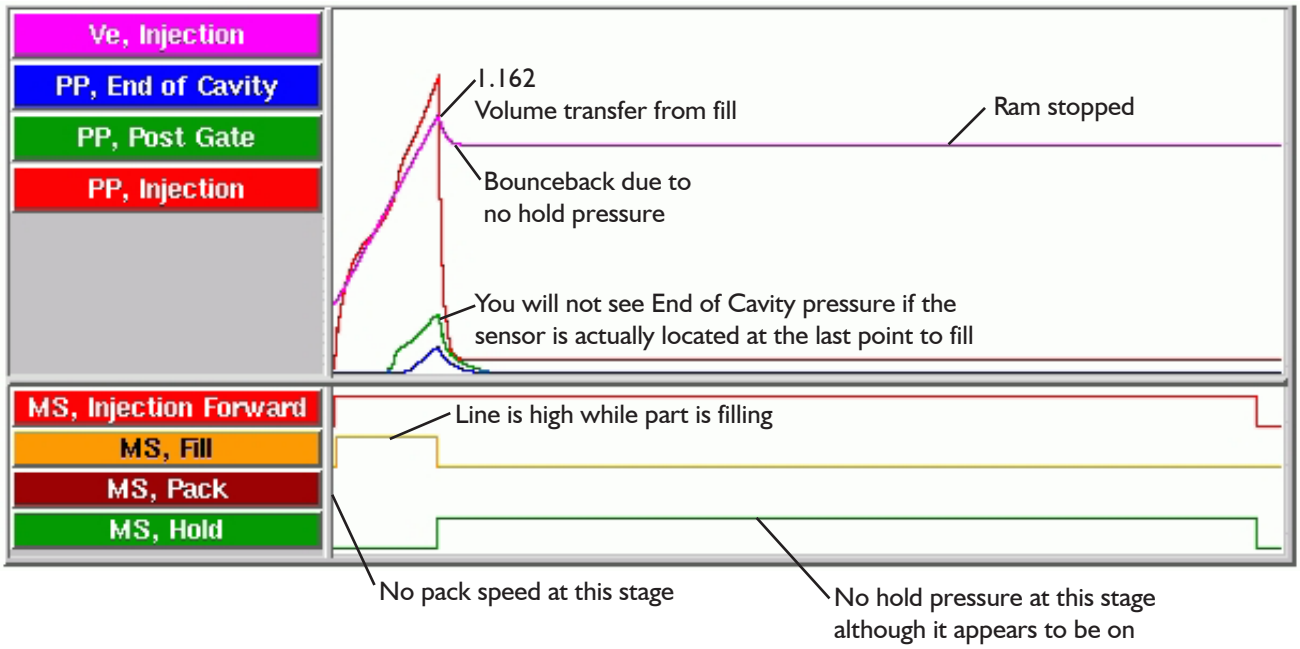
Adjust the fill fast knob on the CVP valve to about 1/2 full speed to start. On the V1 -> V2 Transfer side of the tool, click the Volume checkbox to transfer from fill on volume. Enter a transfer setpoint and units. Adjust this setpoint until you get a 90% full fill-only part. Note that the actual transfer point will vary slightly from the setpoint entered (See the cycle graph below).



Watch the Sequence Lights tool to see when the Fill (F) Machine Sequence goes on and off. The fill light will come on and stay on during the fill portion of the cycle. (The pack (Pk) light should not come on. The hold (Hld) light will come on even though there is no hold pressure set at this time).



Bring up the Cycle Graph and add “Machine Sequence, Fill” to the bottom of the graph. Watch the graph to see when the Fill (F) Machine Sequence goes on (line goes high) and off (line goes low). (“Machine Sequence, Pack” and ‘Hold” can also be added at this time although not yet used).

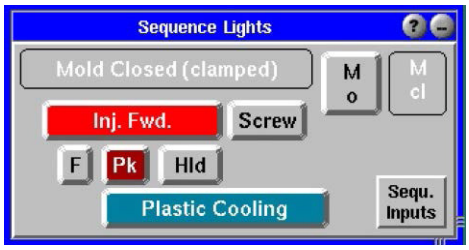


2. **Add Pack Speed**

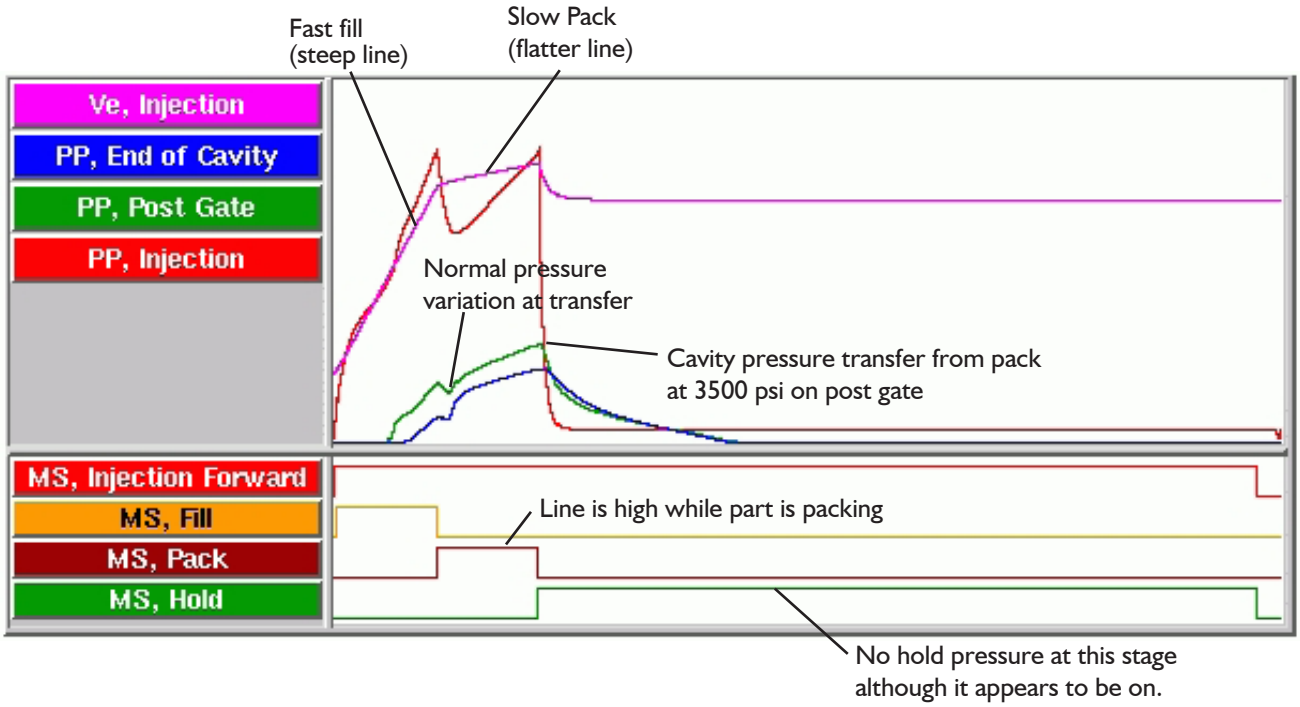
Click the *Fill & Pack* Injection Enable button.

On the machine, crack the 2nd stage velocity from closed to slightly open. More speed may be dialed in later if needed. On the V -> P Transfer side of the tool, make sure the Cavity Pr. box is checked to transfer from pack on cavity pressure. Enter a transfer setpoint and units. Adjust this setpoint and the 2nd stage velocity until you get a full part without sinks, voids, flash, etc.

Watch the Sequence Lights tool to see when the Fill (F) and Pack (Pk) Machine Sequences go on and off. The pack light will come on when fill ends (by reaching the volume setpoint entered in Step 1) and packing begins. (The hold (Hld) light will come on even though there is no hold pressure set at this time).



Add "Machine Sequence, Pack" to the bottom of the Cycle Graph. Watch the graph to see when the Fill and Pack Machine Sequences go on (line goes high) and off (line goes low).



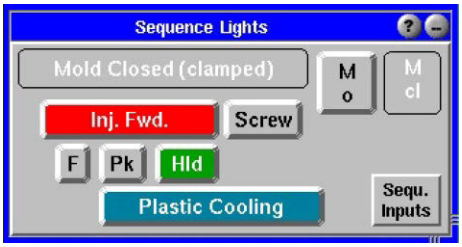
Cycle the machine until you see the Pack Machine Sequence on the bottom of the cycle graph go on and off as shown above.

3. **Add Hold Time and Pressure**

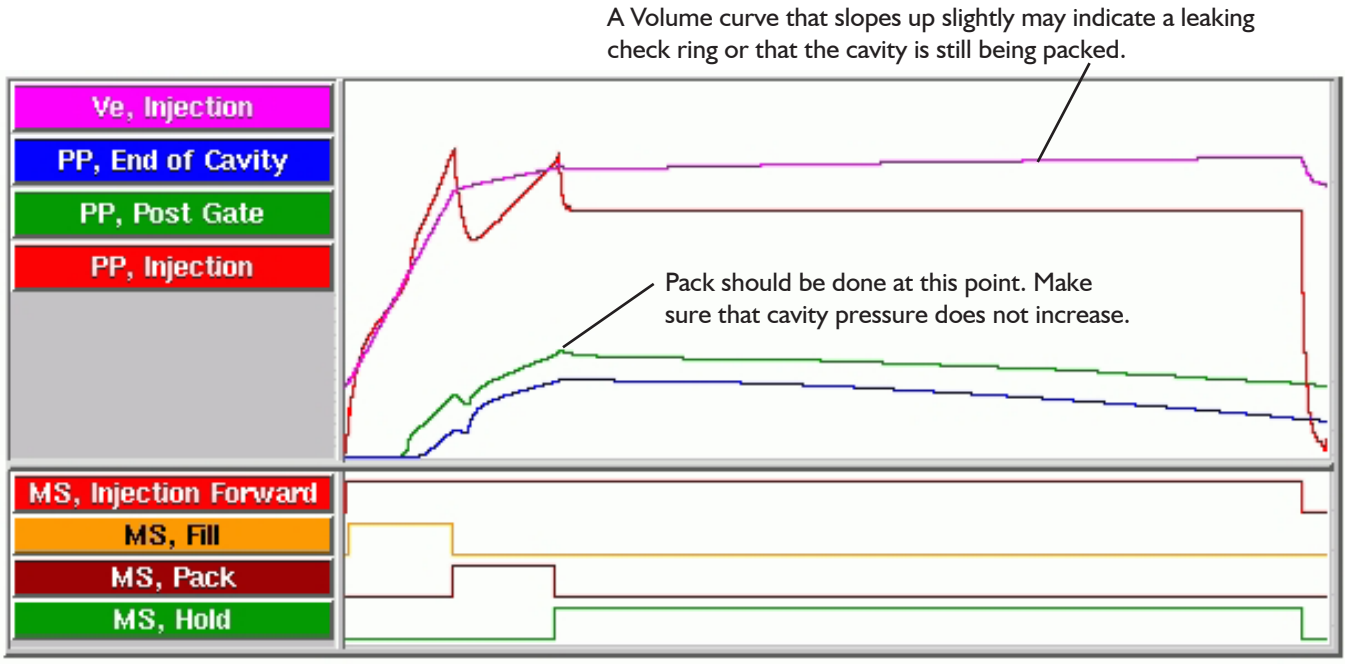
Click the *Fill Pack & Hold* Injection Enable button.

Set the hold time and pressure on the machine. Hold time is determined by whether or not the gate is sealed. Set the hold pressure to approximately 25-50% of the injection pressure used.

Watch the Sequence Lights tool to see when the Fill (F), Pack (Pk), and Hold (Hld) Machine Sequences go on and off. The hold light will come on when pack ends (by reaching the cavity pressure setpoint entered in Step 2) and holding begins. Watch the Cycle Graph to make sure that the pack phase is actually ending when hold begins.



Add "Machine Sequence, Hold" to the bottom of the Cycle Graph. Watch the graph to see when the Fill (F), Pack (Pk), and Hold (Hld) Machine Sequences go on (line goes high) and off (line goes low).



Basic 3-Stage Control Tool Reference

There are four main components to this tool:

- V1 -> V2 Transfer Settings
- Injection Enable Buttons
- V -> P Transfer Settings
- Other Settings

V1 -> V2 Transfer Settings

This component controls the transfer from high velocity fill to low velocity pack. This is usually done using injection volume as the primary means of transfer, with other methods available as backups.

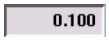
NOTE: *You can choose to enable one or more transfer methods (cavity pressure, position, etc.). Usually one transfer method is chosen as the "primary transfer" and the other methods are set as backup or secondary transfers. When more than one transfer method is chosen, the first to reach its setpoint will activate the transfer.*

CAUTION: *If you disable all of the possible pack transfer controls on this tool, you MUST be sure that your mold can withstand high-speed fill until the machine transfers. If it cannot, you may flash the mold and cause damage to it.*

Transfer on Injection Volume

Injection Volume Pack Enable

Check this box to enable transfer to slow speed pack (V2) when the injection volume reaches the setpoint entered. This is the usual method used in 3-stage DECOUPLED MOLDING®.



Volume Setpoint

In 3-stage DECOUPLED MOLDING, you typically set this value to make a short shot about 90% full with pack and hold turned off. You can use the *Fill Only* Injection Enable button to run a fill-only shot and determine whether the volume setpoint is set correctly.

Volume Units

Choose the units you wish to enter the volume setpoint. If you switch units, the program will change the value in the setpoint box to represent the same level with the new units.

Volume Transfer Active Light

If this light is on, the last fill -> pack transfer occurred because the volume reached the volume setpoint.

If another V1 -> V2 transfer method transfers first, from something other than shot volume, this light shows the value of the shot volume when the transfer occurred.

Transfer on Injection Pressure

Injection Pressure Enable

This is a backup transfer in case the volume setpoint for fill -> pack (V1 -> V2) transfer is disabled or not reached. If the injection pressure reaches the pressure set here before any other transfers occur, this will activate the V1 -> V2 transfer.

Injection Pressure Setpoint

Be careful to set this value high enough to allow for viscosity variations which can raise by 10% or more the dynamic fill pressures required from the machine.

Injection Pressure Units

Choose the units you wish to enter the injection pressure. If you switch units, the program will change the value in the setpoint box to represent the same level with the new units.

Injection Pressure Transfer Active Light

If this light is on, the last fill -> pack transfer occurred because the injection pressure reached its setpoint. This means that volume transfer is NOT in control of the pack portion of your process (as it typically is in 3-stage DECOUPLED MOLDING®).

When the V1 -> V2 transfer occurs first, from something other than injection pressure, this light shows the value of the injection pressure when the transfer occurred.

Transfer on V1 (Fill Time)

V1 (Fill Time) Enable

This is usually a last resort fill -> pack (V1 -> V2) control. The time begins at the start of injection. We recommend that you set this to an initial estimated fill time when you first set up a process. That way, you will not slam the end of the mold even if your volume or cavity pressure settings are not correct.

If you set this time too short, the machine will transfer to pack before the cavity if filled enough. You may not then be able to pack the part out at slow speed (V2). Also, if your speed control is not stable (load compensated) or the decompress distance varies, transferring on time will not make a consistent 90% filled part.

V1 Time Transfer Active Light

If this light is on, the last fill -> pack transfer occurred because the fill time (from start of injection) exceeded the maximum set at left.

Whether the light is on or off, it shows the actual time at which the fill -> pack (V1 -> V2) transfer occurred. You can use this to determine how much time you may want to set as a backup V1 time once you have the process set up. This means that cavity pressure is NOT in control of the pack portion of your process.

When this light is off, it shows the time at which the last V1 -> V2 switch over occurred.

Transfer on Cavity Pressure

Cavity Pressure Enable

Check this box to enable fill -> pack (V1 -> V2) on cavity pressure. This can be used in high-speed thin wall molding to get a consistent flow front position on transfer to pack. Here, an end of cavity sensor placed at about 90% of a full cavity should be used.
Cavity pressure fill -> pack transfer can also be used as a backup when setting up a process. You can use sensors other than end of cavity and enter a setpoint, which will prevent mold damage.

Cavity Pressure Setpoint

Set this value to the plastic pressure in the cavity at which you want the machine to transfer from fill (high velocity) to pack (low velocity).

If you have an end of cavity sensor placed at about 90% of a full cavity, you can enter a very low setpoint (e.g. 200 psi). This will cause the transfer tool to switch to a slow speed pack at a consistent flow front position.

NOTE: *If your end of cavity sensor is at the very end (last point to fill), then transfer from high speed on cavity pressure will be too late and should not be used as a primary transfer.*

Cavity Pressure Units

Choose the units you wish to enter the cavity pressure setpoint. If you switch units, the program will change the value in the setpoint box to represent the same level with the new units.

Sensor

This is the sensor used to transfer from fill (V1) to pack (V2). When used as a primary transfer, an end of cavity sensor placed at the point when you want the transfer to occur (about 90% full for DECOUPLED MOLDING®) should be used.
For multi-cavity applications, see help on the pack -> hold (V -> P) transfer cavity pressure setpoint box.

CAUTION: *If you switch to a nonoperating sensor and all of the other possible transfer controls are disabled, you MUST have backups set on your machine. If you do not, you may flash the mold and cause damage to it.*

The sensor name is saved with the "process" which is the mold, material, and cavity setup.

Cavity Pressure Active Light

When this light is on (green with the word "Active") it means that the last fill -> pack transfer was controlled by cavity pressure. The pressure in the cavity reached the setpoint before any other of the backup settings reached their setpoints.

When the V1 -> V2 transfer occurs first from something other than cavity pressure, this light shows the value of the cavity pressure when the transfer occurred.

V -> P Transfer Settings

This component controls the transfer from velocity control (fill & pack) to 2nd stage pressure (hold).

NOTE: *You can choose to enable one or more transfer methods (cavity pressure, position, etc.). Usually one transfer method is chosen as the "primary transfer" and the other methods are set as backup or secondary transfers. When more than one transfer method is chosen, the first to reach its setpoint will activate the transfer.*

Transfer on Cavity Pressure

Cavity Pressure Enable

Check this box to enable transfer to hold on cavity pressure. This is usually the primary transfer method (also known as cavity pressure control). You can disable it if you wish.

Cavity Pressure Setpoint

Set this value to the plastic pressure in the cavity at which you want the machine to transfer from pack (low velocity) to hold (pressure control).

Cavity Pressure Units

Choose the units you wish to enter the cavity pressure setpoint. If you switch units, the program will change the value in the setpoint box to represent the same level with the new units.

Sensor

This is the control sensor for cavity pressure transfer to hold. You may select any cavity including the average ("#Avg"), high or low generated by the Multi Cavity Mixer.

In multi-cavity applications, the system generates some "combined" pressure sensors for each location in the cavity. These appear as three more distinct cavities: "High", "Low", and "Avg" (as in "Post Gate #High"). Each of these "phantom" sensors is the high, low, or average value of all sensors at that location at each instant throughout the cycle. These can be used for control as well.

Transfer on:

- High if you want no cavity pressure to exceed the value.
- Low if you want all cavity pressures to reach the value.
- Avg to balance out pressure over all cavities. This can be helpful on hot runner tools where cavity balance is not consistent from shot to shot.

CAUTION: *If you switch to a nonoperating sensor and all of the other possible transfer controls are disabled, you MUST have backups set on your machine.*

Cavity Pressure Active Light

When this light is on (green with the word “Active”) it means that the last transfer to hold (2nd or pressure stage) was controlled by cavity pressure. In other words, the pressure in the cavity reached the setpoint before any other transfer methods reached their setpoints.

This means that the process is controlled by cavity pressure. It does not mean it is “decoupled”. For further details, see “Building a Decoupled Process” in the Insight System™ Helpviewer.

When the V -> P transfer occurs first, from something other than cavity pressure, this light shows the value of the cavity pressure when the transfer occurred.

Transfer on Injection Volume

Injection Volume Transfer Enable

Check this box to enable transfer to hold (pressure) when the injection volume reaches the setpoint entered.

Be careful that the setpoint you enter on volume is larger than the typical volume at the point of transfer on cavity pressure. Otherwise, the process may not be controlled by cavity pressure, but by shot volume (stroke) instead.

Volume Setpoint

If you enable volume transfer, set this value to the maximum volume you would expect at the end of pack (plus some extra to account for normal process variation). Observe the “Active” light to the right. If it comes on, the cavity pressure no longer controls transfer from pack (low velocity) to hold (2nd Stage, pressure control).

Volume Units

Choose the units you wish to enter the volume setpoint. If you switch units, the program will change the value in the setpoint box to represent the same level with the new units.

Volume Transfer Active Light

If this light is on, the last pack -> hold transfer occurred because the volume reached the volume setpoint. This means that cavity pressure is NOT in control of the pack portion of your process.

When the V -> P transfer occurs first, from something other than shot volume, this light shows the value of the shot volume when the transfer occurred.

Transfer on Injection Pressure

Injection Pressure Transfer Enable

This is a further backup transfer in case the cavity pressure does not reach the setpoint entered for it. If the injection pressure falls when the machine reaches its fill volume, this tool waits for injection pressure to fall below the setpoint before activating the transfer on the next pass up through the setpoint.

If the injection pressure continues to rise after the end of fill, this tool immediately begins looking for injection pressure above the setpoint and transfers the next time that occurs.

Odd Case:

If the injection pressure at fill -> pack transfer is below the setpoint because the fill volume is set too early, the pack -> hold (velocity -> pressure) transfer will occur the instant the pressure rises above the setpoint.

Injection Pressure Setpoint

If no other setpoint is reached first, this tool will transfer the machine from low speed pack (1st Stage) to hold (2nd Stage) when the injection pressure reaches this level. However, if the injection pressure at the end of the “Machine Sequence, Fill” signal is greater than the injection setpoint, the control waits for it to fall below the setpoint value and then to rise back above it again before transferring the machine. This is done because typically it can take more pressure to fill the mold at high speed than you might want to use as a pressure safety during pack.

Injection Pressure Units

Choose the units you wish to enter the injection pressure. If you switch units, the program will change the value in the setpoint box to represent the same level with the new units.

Injection Pressure Transfer Active Light

If the light is on, the last pack -> hold transfer occurred because the injection pressure reached its setpoint. This means that cavity pressure is NOT in control of the pack portion of your process.

When the V -> P transfer occurs first from something other than injection pressure, this light shows the value of the injection pressure when the transfer occurred.

First Stage Time Transfer Enable

This is usually a last resort transfer control. The time begins at the start of injection. When the time start exceeds the duration you have entered for first stage time, the transfer output will close to transfer the machine to hold.

We recommend that when you are setting up a process for the first time, you always use this backup to prevent mold damage. Set the time to an estimated value which will include time to use up decompress stroke, fill time, and pack time.

If you set this time too short, the machine will transfer to hold before the cavity pressure reaches the setpoint. In that case, the system is no longer running decoupled pack.

Pack Time Transfer Active Light

If this light is one, the last pack -> hold transfer occurred because the pack time (from end of fill) exceeded the maximum set at left. This means that cavity pressure is NOT in control of the pack portion of your process.

When the light is off, it shows the actual time at which the pack -> hold (V -> P) transfer occurred. You can use this to determine how much time you may want to set as a backup first stage time once you have the process set up.

Injection Enable Buttons

These buttons provide a quick, easy way to make “fill only” and “fill and pack” parts (used to verify proper setpoints), and then return to the normal process. To enable the buttons, an “Inject Enable” contact closure wired into the machine’s primary injection circuit is required.

Fill, Pack, and Hold

In this mode, the controller runs all three stages of the cycle (i.e. It transfers from fill to pack using the settings in the right panel and pack to hold using the settings in the left panel). Also, the cycle is never aborted.

This is the normal mode of operation and the only mode if you do not have the “Control Output, Inject Enable” signal wired into the machine to stop injection (and hold) when that signal drops out.

Fill and Pack

In this mode, the controller runs only two stages of the cycle (i.e. It transfers from fill to pack using the settings in the right panel and pack to hold using the settings in the left panel). As soon as pack is complete (left panel), the controller drops the “Inject Enable” signal, aborting injection so that there is no hold phase. This makes a part that is full and packed but not held (usually plastic discharges from the gate).

This is useful in setting a proper V -> P setpoint, ensuring packing of the part without flashing.

You can only use this mode of operation if you have the “Control Output, Inject Enable” signal wired into the machine so that it stops injection (and hold) when that signal drops out.

Fill Only

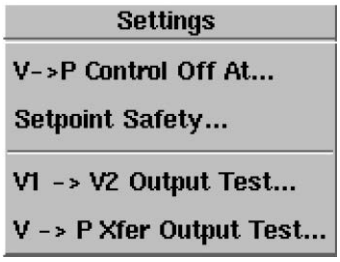
In this mode, the controller runs only the fill stage of the cycle (i.e. It transfers from fill to pack using the settings in the right panel). As soon as this happens, the controller drops the “Inject Enable” signal, aborting injection so that there is no hold phase. This makes a “fill only” part. When setting up the process, you usually start with a “fill only” part and adjust shot volume to get the part to about 90% full (a short shot) before turning on fill and pack.

You can only use this mode of operation if you have the “Control Output, Inject Enable” signal wired into the machine so that it stops injection (and hold) when that signal drops out.

Other Settings

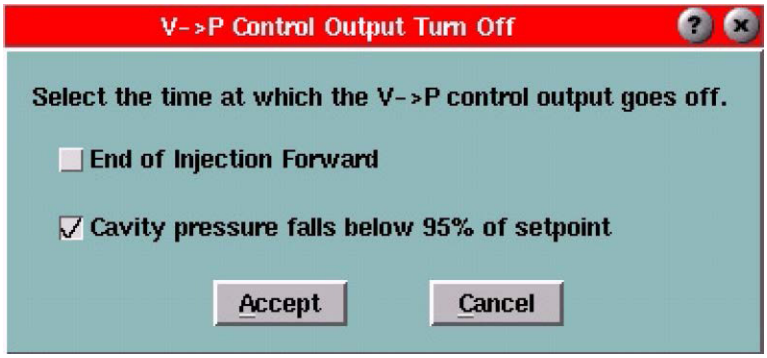
These options are used to adjust general settings and to test the control outputs.

Settings... **Settings Menu**



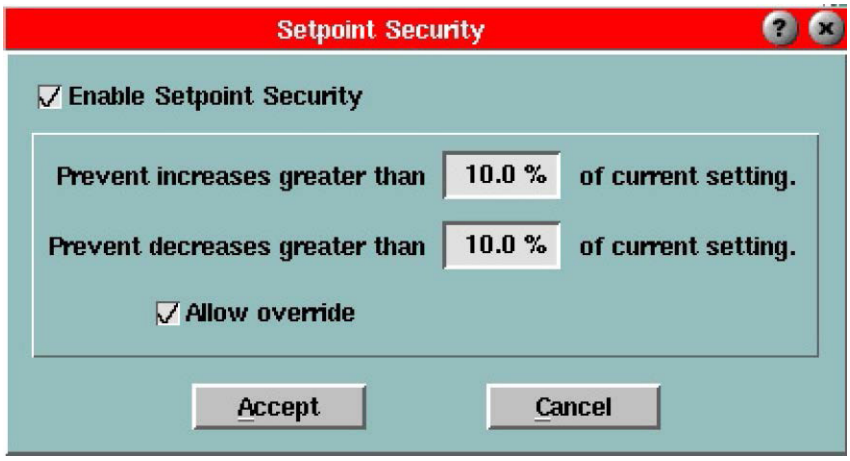
From the Settings menu, you can choose when to turn the V -> P control off, secure the entered setpoints, or test the V -> P/V1 -> V2 outputs.

V -> P Control Output Turn Off



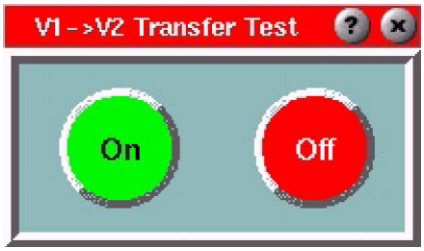
Here, you can select the time at which you would like the V -> P control output to go off. This can be either at the end of Injection Forward or when the cavity pressure falls below 95% of the setpoint.

Setpoint Safety



Here, you can enable setpoint security, which blocks users from changing setpoints in the Basic 3-Stage Control tool. When you check “Enable Setpoint Security”, security is enabled and you can set the percentage of setpoint change allowed.

V -> P & V1 -> V2 Transfer Test



This tool is useful to determine whether the machine is receiving its control signals correctly (See page 9 for further details).

Appendix A: Load Compensation Kit

Load Compensation Objective

The machine upgrade consists of relatively minor modifications to machine hydraulics and the addition of key variable digital displays on the *eDART*® to allow precise, accurate and repeatable control of machine injection rates. This upgrade is based on fundamental hydraulic concepts in conjunction with good engineering practices utilizing load compensation circuits which are properly installed and tuned to achieve repeat abilities of injection rates comparable to new injection molding machines.

Load compensation, which is sometimes called load sensing, uses a form of hydraulic feedback, which allows the injection main relief valve to respond to changes in viscosity of plastic which normally causes changes in injection speed on a standard molding machine. Load sensing, which is used on many of the new molding machines, allows the machine's injection speed to be controlled solely by the injection speed control. Thus, it is possible to inject into the mold and to purge into the air and have the same injection speed!

What does this mean with respect to process capability? It means that a machine can absorb variations in incoming material instead of amplifying them. If the viscosity of material goes down (becomes easier to flow), the pressure in the injection cylinder needed to push the plastic at the set injection speed is reduced. It is reflected back into the pilot circuit and the pump pressure, thus reducing the supplied pressure, keeping the pressure difference across the flow control constant and thus injection speed constant.

If the viscosity of material increases, the pressure in the injection cylinder necessary to flow the material at the set flow rate increases. This increase is reflected back into the pilot circuit, which raises the pump pressure via the main relief valve to provide a fixed pressure drop across the flow control. This keeps the material flowing at a constant controlled speed.

Load compensation does not give the machine the capability of injection profile or changing injection speed during fill, sometimes called programmed injection. However, if molds can make good parts on conventional machines, programmed injection is not necessary. What is needed is consistency of injection and the ability to set it.

An integral part of the machine upgrade includes monitoring fill times consistently with the *eDART*. Due to non-Newtonian characteristics, plastic viscosities change dramatically with even small changes in injection speed. This makes it essential for processes to be repeated that the injection fill times be controlled to within 100ths of a second.

Another essential part of the *eDART* is its ability to monitor hydraulic pressure. Hydraulic pressure during 1st stage only builds up to the pressure required to push the plastic at the set injection speed. It is therefore important to be able to detect peak hydraulic pressure during 1st stage. This incidentally also gives a true measure of viscosity of plastic when multiplied times the fill time. The *eDART* also allows very accurate and repeatable settings of 2nd stage and back pressure adjustments. Machines of different injection unit ratios can be normalized using nonstandard calibration using the *eDART*.

Another large benefit of load compensation is in power savings and machine wear. You will notice with the load compensator installed that the machine sounds different. Load compensation makes the pump work only hard enough to achieve the flow rate. It therefore relieves excess oil back to the tank at a much lower pressure than when using a normal machine. This makes the machine run cooler and saves tremendous amounts of power. It has been estimated by users of load compensation that as much as 30% of the power of the molding machine is wasted during injection and thus can be recouped by the use of this technique. Much of the savings depend on how you are molding currently, however in all cases, machine power consumption during injection is optimized.

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Installation

Hydraulics

Compensator Circuit

RJG's Model CVP-300-LX cartridge injection speed flow control is installed in place of the flow control originally installed in the machine as described on page 2. Figure 1 shows the in-line location of the compensator circuit for proper operation. Port "X" on the CVP-300-LX has a 1/8" NPTF tapped hole used to plumb in the compensator components. Figure 7 shows the compensator circuit with a directional valve. The directional valve turns the compensator on only during 1st stage injection. Though not necessary in many machines, those that require the directional valve have other metering functions that will be interfered with if the compensator is not turned off. The compensator should only do its job during 1st stage injection.

Ports X and Y in Figure 7 are identified again on a hand-marked copy of your hydraulic circuit print to show installation. Figure 7 shows a generic installation of these points where "A" is flow in, "B" is out, "Y" is tee'd into the pilot line, and "X" is where the compensator tuning orifice is plumbed into the CVP-300-LX block.

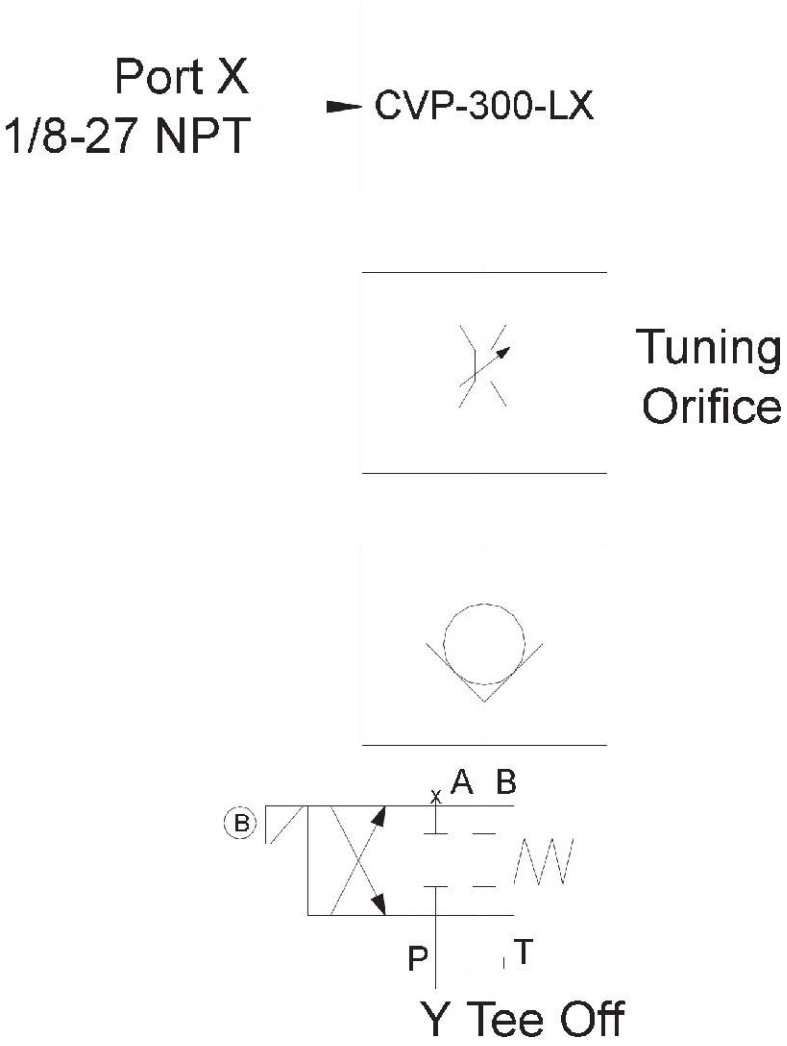
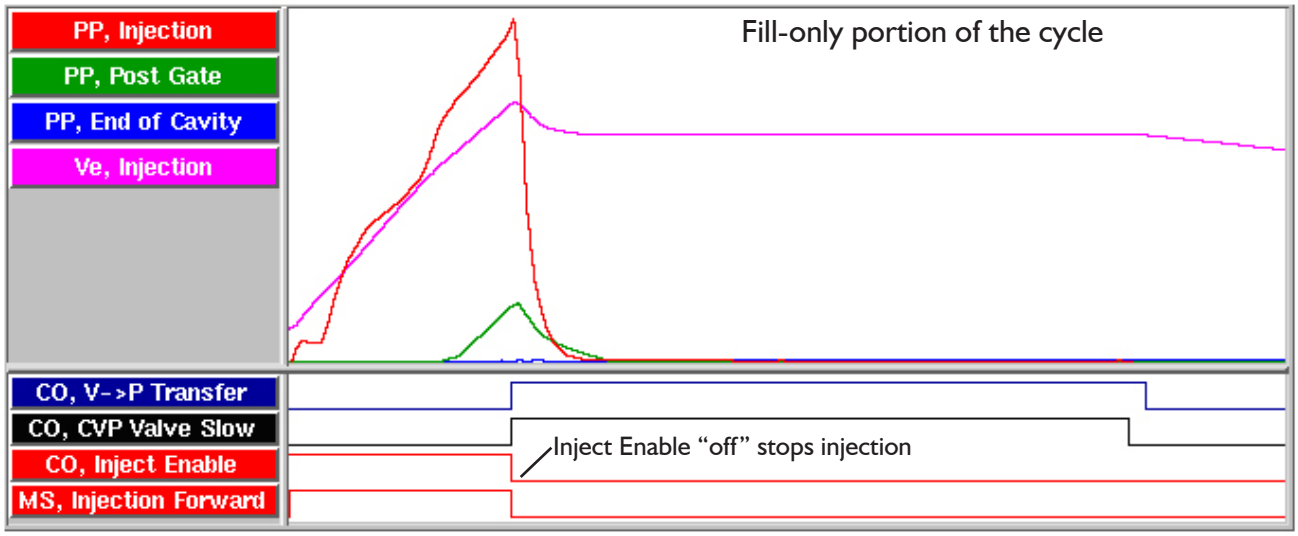
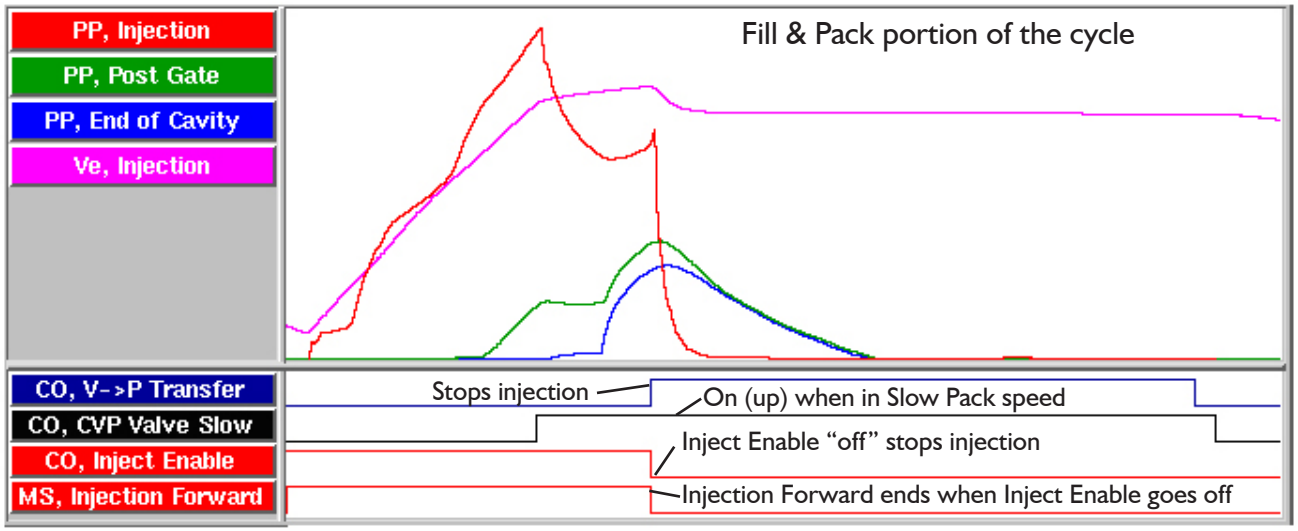


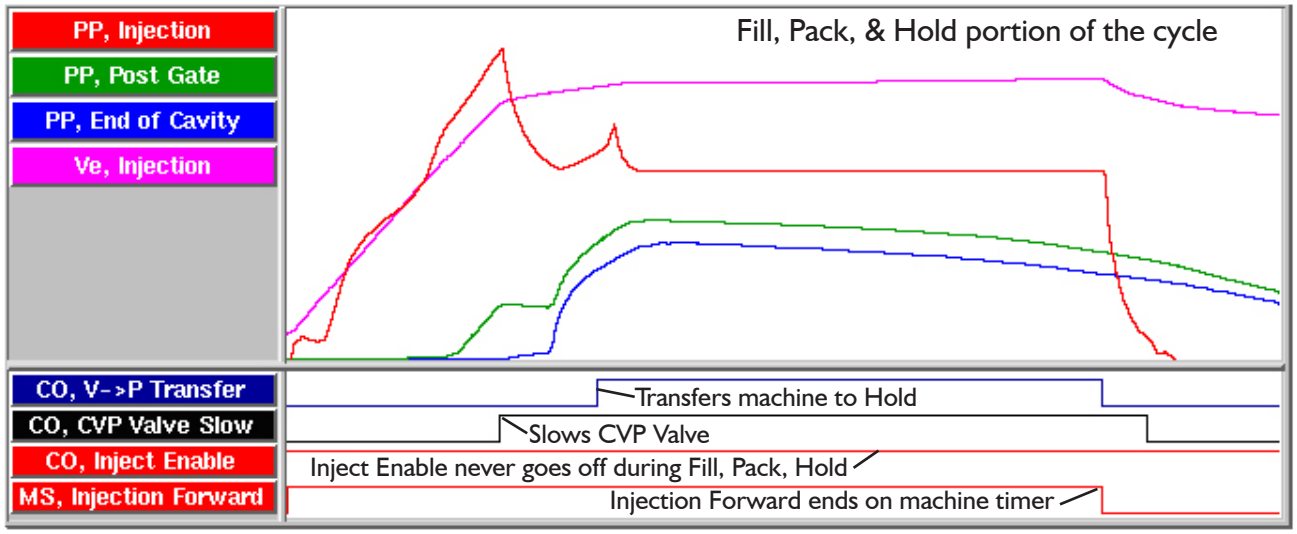
***Figure** 7: Compensator Circuit*

Appendix B: Monitoring Output Signals

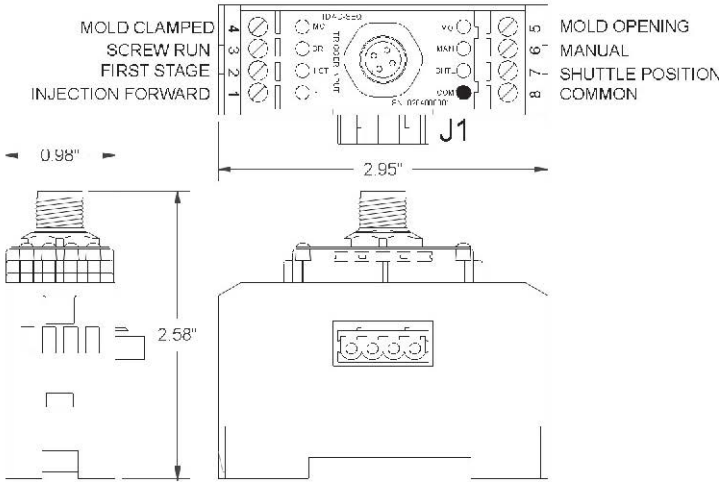
The ouput signals wired to the OR2-D and 3-Stage Valve Interface can be viewed on the cycle graph. Watch the traces to see when the signals go on and off.







Appendix C: Sequence Module Wiring



The ID7-D-SEQ is a DIN rail mountable Sequence Input Module that acts as an interface between machine operations and the *eDART*® System. With the Sequence Module, it is unnecessary to wire all of the inputs from the machine. The *eDART* software takes what is easily available from the machine and derives the rest. This is important when implementing a network or installing on a portable basis because many times the inputs are not readily available.

The Sequence Module is designed to be mounted on standard 35mm DIN rail often found in machine panels. Once mounted, connectors allow the unit to be interfaced with other Lynx DIN rail modules and the *eDART* System.

The digital inputs are connected to the Sequence Module through the eight terminal connectors (see the figure and table to the below). The inputs themselves are connected to terminals 1-7 and common for these inputs is wired to terminal 8. These inputs can be taken directly from the valve solenoids or from the machine controller and can operate at 24VDC or 120-240VAC.

Connection	Function
Terminal 1	INJ Forward
Terminal 2	1st Stage
Terminal 3	Screw Run
Terminal 4	Mold Clamped
Terminal 5	Mold Opening
Terminal 6	Manual
Terminal 7	Shuttle Position
Terminal 8	Input Common

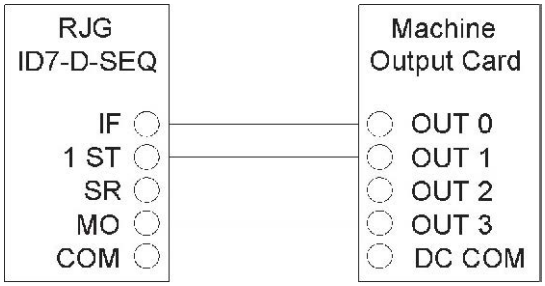
Technical Specifications	
Power (supplied by the *eDART*®)	12VDC
Current Draw	45mA
Maximum Input Voltage	36VDC
Absolute Minimum Trigger on Voltage	18VDC

Sequence Module Inputs

In order to do important computations relevant to the injection molding process, the *eDART*® needs certain inputs from the machine controller. These inputs indicate to the *eDART* when important events happen during the machine cycle and help synchronize signals from the hydraulic and mold pressure sensors to the actions of the machine for display in the software. The table below details these inputs in order of importance to the software. If none of these inputs is available, contact RJG for alternatives.

Terminal	Input Name	Input Description
SR	Screw Run	Input should be on during the time the screw is rotating and building the shot
IF	Injection Forward	Input comes ON at the start of injection and remains ON during Fill, Pack, and Hold
MC	Mold Clamped	Input should come on as the mold is closing
MO	Mold Opening	Input should come on as the mold is opening
1 ST	First Stage	Input is ON only when the part is filling and then it goes OFF. Typically, Fill ends when the cavity is 95 - 99% full
MAN	Manual	Input should be on while the machine is in manual mode
SHTL	Shuttle Position	If using a mold with two (2) halves, this input should be on when the B half is in position

The Sequence Module can be interfaced with a machine output card as shown in the figure below. See the Technical Specifications table for voltage ranges. Alternatively these voltage signals can be taken directly from the valve solenoids. The Sequence Module inputs these voltage signals using an optoisolated circuit to ensure full isolation from the machine controller or solenoids.

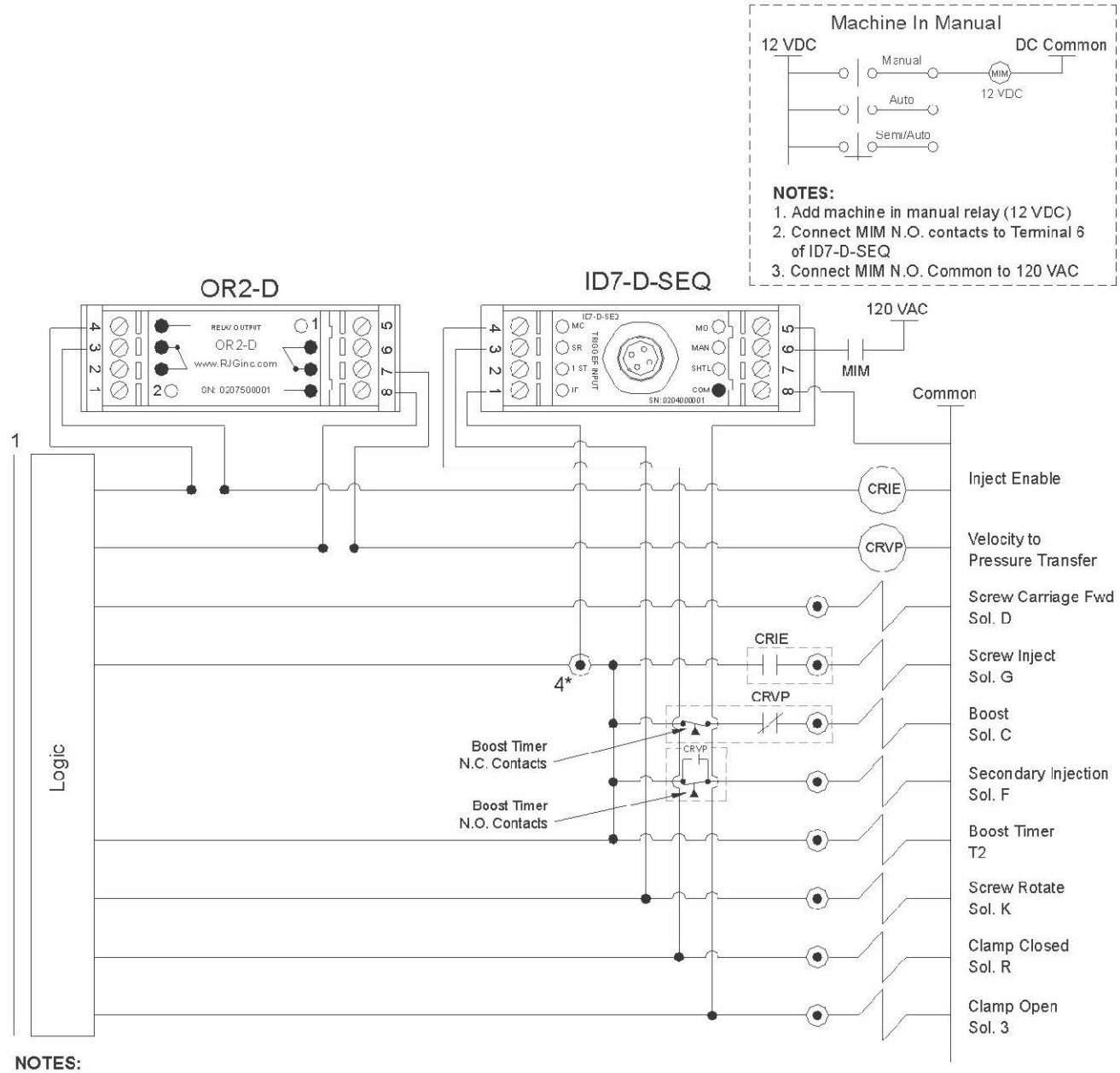


CAUTION

Always power down before working on any equipment

Appendix D: Machine Specific Wiring Diagrams

3-Stage Electrical Diagram Based on Van Dorn Model



NOTES:

1. Add Fast Horse Power Rated Double Throw Double Pull relays for Inject Enable and Velocity to Pressure Transfer.
   a. Remove Screw Inject wire from Terminal 2. Wire Inject Enable relay contacts in series with Screw Inject solenoid.
   b. Connect Inject Enable N.O. Common to Screw Inject wire.
   c. Connect Inject Enable N.O. to Screw Inject solenoid.
2. Wire Velocity to Pressure relay N.C. contacts in series with Boost Timer N.C. contact.
   a. Break wire between Boost Timer contacts and Boost solenoid.
   b. Connect CRVP N.C. Common to wire from Boost Timer N.C. contacts.
   c. Connect CRVP Common to wire from Boost solenoid.
3. Wire Velocity to Pressure relay N.O. contacts in parellel with Boost Timer N.O. contact.
   a. Connect CRVP N.O. Common to Logic side of Boost Timer N.O. contacts.
   b. Connect CRVP N.O. to Secondary Injection solenoid side of Boost Timer N.O. contact.
4. Connection must be on the Logic side of Inject Enable contacts.

***Figure 8**: Van Dorn Wiring Diagram*

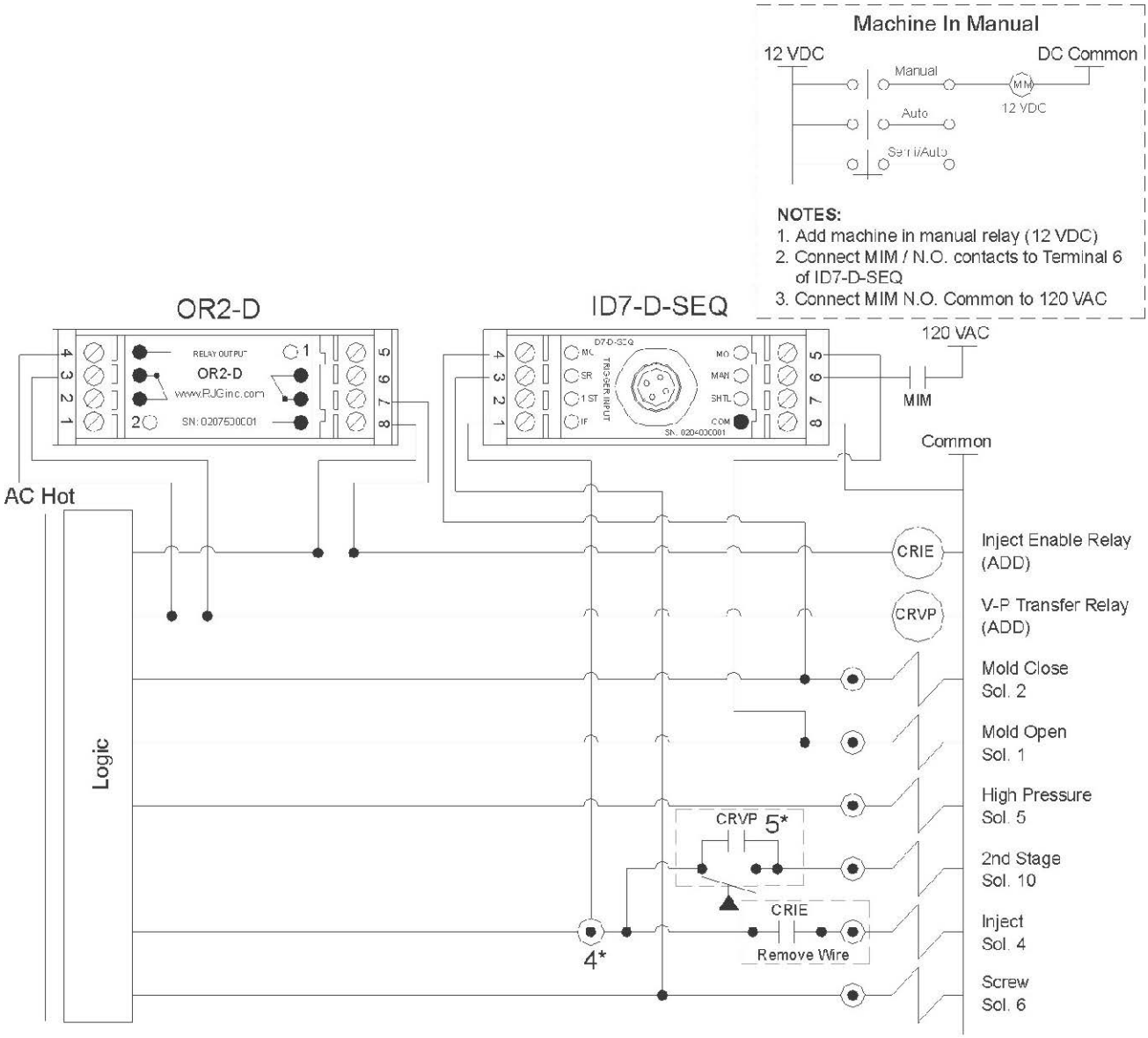


***Figure 9**: Boston Mathews Wiring Diagram*