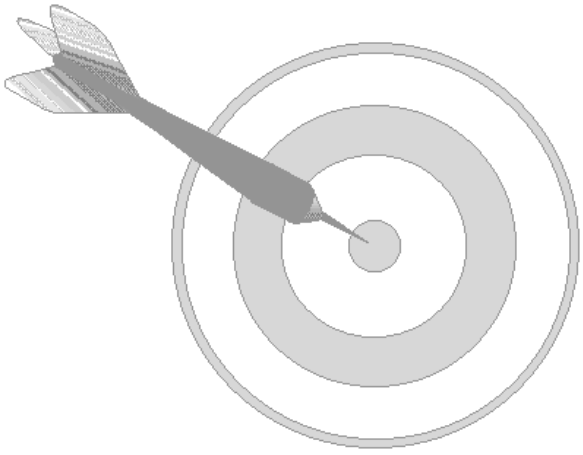
Cavity Pressure Process Control Kit

CPC-110-C
Operating Instructions



"We Make Molding Simple"

Rev $_{5.4}$ 01/99

by Janice A Walters

Filename: K:\Cavity Control\Current\Manual\CPC-110-C.wpd

Table of Contents

List Of Illustrations

CPC-110-C Description

RJG, Inc. CPC-110-C Kit gives molders a simple means of converting any conventional injection molding machine into a machine having process control capability for cavity pressure. The kit allows mold pressure transducer signals to initiate machine transfer from 1st Stage to 2nd Stage injection pressure for better compensation to plastic viscosity variations. The kit is also adaptable to hydraulic pressure transducers as an alternative control input. The simple-to-install modular make-up of the kit allows for portability from machine to machine.

As an option, the CPC-110-C kit can be configured to initiate machine transfer from multiple cavity pressure signals. the special option Model CPC-210 uses two Model 3015 Signal Conditioners to provide set-point logic and initiate control of the molding machine. The two signal conditioners transfer commands are "ORED" together, so that the first signal conditioner to reach it's set-point transfers the machine.

Mechanical Installation

The CPC-110-C kit comes with the Model 3015 Signal Conditioner mounted to a precision machined faceplate for easy flush mounting to a machine panel. Modify your machine panel with a 2.25" height x 8" width opening and place the machined faceplate over the opening. Drill mounting holes for fastening into place. The DC Power Supply and Interface Relay board are mounted to a separate plate that can be mounted in the molding machine panel.

Components

Model 3015 Pressure Transducer Signal Conditioner

The Model 3015 module supplies power to the pressure transducers and allows for the pressure signals to be calibrated for accurate results.

The Model 3015 transforms the mold pressure transducer signal into calibrated units of pressure, accurately and repeatable, then triggers the hydraulic sequencing for machine transfer control. On the Model 3015, set-point logic circuitry allows packing out a part to a user-defined mold pressure and staging the machine from pack-to-hold.

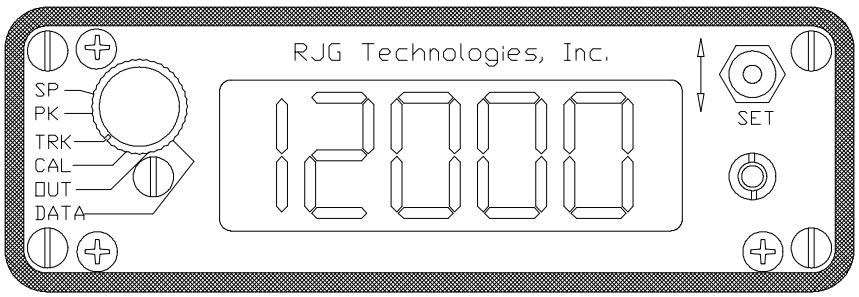


Figure 1

Model 3015 Front Panel Components

Figure 1 shows the front panel components of the Model 3015 Signal Conditioner. The description for each of these components is as follows:

Digital Readout

This panel meter continuously displays plastic or hydraulic pressure in psi (or kg/cm^2). The peak pressure displayed during the cycle will be shown and automatically reset every cycle as determined by the set-point.

Set Toggle Switch

The Momentary toggle switch located on the right side of the front panel is used for setting digits on the display after the Mode Select switch has been selected. All changes are stored when switching out of the Mode Select position. To prevent accidental changing of the numbers, there is a security sequence which must be followed to activate toggling only when in the OUT mode. The security sequence is outlined below. There are two primary uses for the switch: Zeroing and Number Changing.

Zeroing (Security Sequence Not Required)

With no pressure on the transducer, and with the Mode Select switch in the Track (TRK position,) toggle the Set switch down once to zero the display. The gage is ready to be used after zeroing. Move the Mode Select switch to the Peak (PK position) to read peaks if so desired, or leave the Mode Select switch in the Track (TRK position,) and apply pressure.

Number Changing (Prior Security Sequence Required For OUT)

In the Mode Select switch positions SP, CAL, and OUT, the user may need to set different numbers for differing uses. After entering the security sequence (this applies to OUT only), the flashing digit is the one active for changing by momentarily toggling the Set switch UP <▲> or DOWN <▼>. To move the flashing digit to another position, toggle and hold the Set switch down and after about 1 second the flashing digit will scroll across the display. Release the Set switch when the flashing digit is at the appropriate position for the required number change.

Security Sequence Activation

In the OUT Mode Select switch position, the Set Toggle switch must be activated by a security sequence to allow changing of the numbers on the display. This prevents accidental changing of the numbers while the gage is in use. The security sequence is as follows: Press and hold the Set Toggle switch up for about 5 seconds, release, then press and hold the same switch down for about 3 seconds and release. The display will show a flashing digit to indicate the security has been passed, and the Set Toggle switch can now be used for changing the numbers.

Mode Select Switch

This is the rotary switch (knob located on left hand side of faceplate) which defines the function to be displayed on the readout. There are six features available from

which to choose, as described below:

SP (Set-Point)

This is the threshold level of pressure the unit will measure in order to trip a set-point. The letter "L" appears on the left hand side of the display indicating "level". The set-point is used to select the pressure desired which the Model 3015 will send out a signal to control the machine. The set-point is also used to select a level where the peak/hold reading on the display will automatically reset each cycle. When the incoming pressure drops below the set-point, the peak is reset, and the display will track the incoming pressure. Figure 2 shows an example of using the set-point as a peak reset function in an injection molding application.

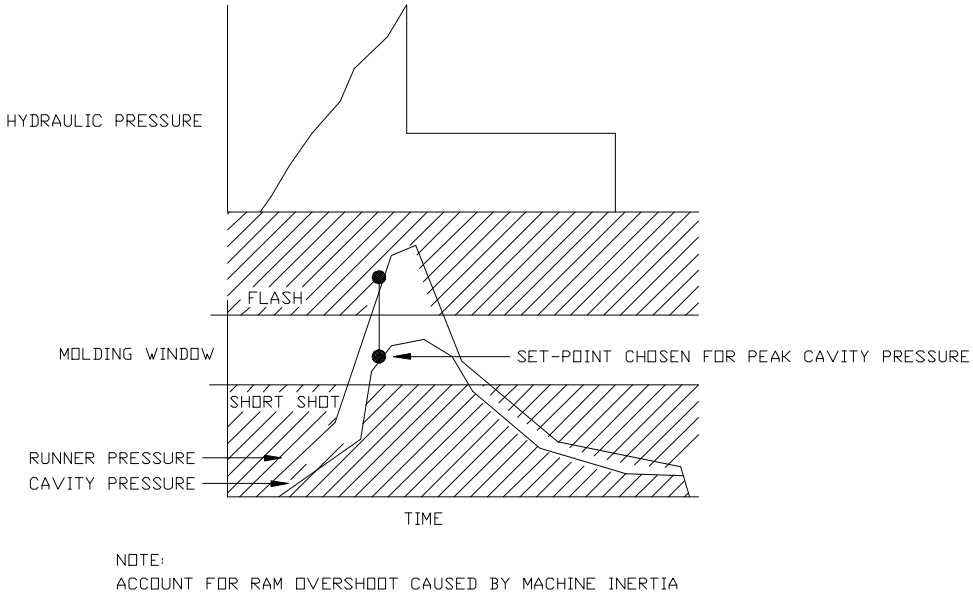


Figure 2

Set-Point (Peak Reset)

Note: If the Set-point Is Set at Zero, the Signal Conditioner Will Hold the Peak Value until an Autozero Signal Is Applied or the Set Switch on the Front Panel Is Pressed. Negative [-] Values Entered for a Set-point Value Will Default to Zero.

PK (Peak)

In this position, the display holds the peak detected for a cycle based on the duration of time the incoming pressure is above the selected set-point. The letter "P" appears on the left hand side of the display indicating peak. When the incoming pressure is below the set-point, the display tracks the pressure, and the symbol "+-" appears on the left hand side of the display.

TRK (Track)

This displays the incoming pressure by tracking or following it as it goes up or down over time.

CAL (Calibration)

The CAL position is used for setting a calibration number corresponding to a hydraulic pressure transducer or a mold pressure transducer under varying sized ejector pins.

When the Model 3015 is used with a hydraulic pressure transducer, reference the CAL number identified on the transducer label. The calibration can be changed to satisfy particular applications. For example, by installing the transducer on the injection cylinder of a molding machine, the Model 3015 can be calibrated to readout in the representative plastic pressure in front of the ram at the nozzle. By considering the injection ram intensification ratio and multiplying it by the calibration number on the gage, the gage will readout in plastic pressure even though it senses hydraulic pressure.

a) **Determine the injection unit ram intensification ratio from the following formula:**

Intensification Ratio = $\frac{D_C^2}{D_S^2}$ **Where D_C is the diameter of the cylinder and D_S is the diameter of the screw.**

b) **Multiply the ratio by the calibration number on the hydraulic transducer being used to find the new calibration number.**

c) **In the TRK mode, zero the Model 3015 with no pressure applied to the transducer.**

d) **Switch to the CAL position and adjust to the new calibration number.**

e) **Switch back to TRK to observe nozzle pressure.**

The CAL number can be changed to have the display readout in engineering units other than PSI.

NOTE: Changing the CAL number will only be recognized if the change is made when there is no pressure being applied to the gage, and the gage has first been zeroed.

When switching from the CAL position back to the TRK position, a small "c" will appear in the upper left corner of the display indicating that the Model 3015 has accepted the calibration number. The "c" will stay on the display about 1 second and disappear. If a "c" is not observed, repeat the calibration procedure.

OUT (Analog Output)

This position allows the user to set the analog output voltage to correspond to the full scale number on the display. This feature is pre-set at the factory for either a 0-2, 5, or 10 volt output signal corresponding to the pressure reading on the display.

The output voltage can be changed to correspond to any selected display reading. There are a combination of two optional steps to resetting this feature. When the Mode Select switch is initially set in the OUT position, the symbol "F" appears on the left hand side of the display to represent the full scale reading which when reached will output the full scale analog voltage. It can be changed to any value, using the Set Toggle switch and the security sequence previously described. The value will then correspond to the full scale voltage setting.

To change the full scale voltage setting, rotate the Mode Select switch back and forth from the CAL position to the OUT position until a "t" or "P" symbol appears on the left hand side of the display. A "t" indicates that the output voltage will be following the display value in the Track position. A "P" symbol indicates that the output voltage will follow the display value in the Peak position. The voltage level for the selected full scale value on the display can be set to 2, 5 or 10 volts. For typical control and monitoring installations, a setting of "t 2", "t 5", or "t 10" is used.

DATA

This switch position is for internal use by RJG at the factory for electronics alignment and calibration.

Zeroing The Model 3015

Zeroing the Model 3015 is the means of adjusting the output so that the meter reads zero (0) when no pressure is applied to the transducer. To zero the system, the transducer must be connected to the input connector with no pressure applied. (If possible, this should be done with the transducer out of the mold.) With the Meter Select switch in Track, press the Set switch down to achieve a 000 $\pm$ 1 count indication on the digital meter. If the zero reading changes when the transducer is installed in the mold, check sensor mold modifications against RJG transducer installation instructions.

Since the machine's *Mold Closed Sequence Signal* is being used to enable Autozero, Manual Zero should only be required once for the duration of the machine operation. The Model 3015 automatically re-zeros at the beginning of each machine cycle, initiated from the *Mold Closed Sequence Signal*.

NOTE: The Set switch should not be depressed during a cycle when pressure is present in the mold or this pressure will be zeroed out causing a low reading error.

Calibrating The Model 3015

Calibration of the transducer to the Model 3015 is necessary to insure that true psi readings are obtained on the meter. The sensitivity of some non-standard mold pressure sensors varies, and the calibration adjustment is necessary to normalize all sensors to correctly read pounds per square inch (or kg/cm^2). Calibration also adjusts for the size of the ejector pin being used to detect mold pressure. Normally, if RJG transducers are used they can be interchanged without re-calibration unless the size of the ejector pin used for sensing changes.

Calibration Procedure

The CAL setting is used to calibrate the instrument for the transducer and ejector pin size used, as shown in Table 1 below. To get an accurate readout in psi, adjust the CAL number for the transducer model and pin size used. Use the Set switch when setting the CAL number.

NOTE: The Model 3015 must be zeroed before adjusting the CAL setting.

Ejector Pin	Transducer	CAL # (psi)	CAL # (kg/cm^2)
1/16"	T-410/T-414	8,905	626
3/32"	T-410/T-414	3,958	278
1/16"	T-405/T-412/T-425	3,562*	2,504
3/32"	T-405/T-412/T-425	15,831	1,113
1/8"	T-405/T-412/T-425	8,905	626
5/32"	T-405/T-412/T-425	5,699	401
3/16"	T-405/T-412/T-425	3,958	278
1/4"	T-405/T-412/T-425	2,226	157
3/16"	T-405/T-412/T-425	15,831	1,113
1/4"	T-405/T-412/T-425	8,905	626
5/16"	T-405/T-412/T-425	5,699	401
3/8"	T-405/T-412/T-425	3,958	278
1/2"	T-405/T-412/T-425	2,226	157
	T-406/T-413/T-426		
	T-406/T-413/T-426		
	T-406/T-413/T-426		
	T-406/T-413/T-426		
	T-406/T-413/T-426		
3/8"	T-445	7916	556
7/16"	T-445	5816	409
1/2"	T-445	4453	313
9/16"	T-445	3518	247
5/8"	T-445	2850	200
3/4"	T-445	1979	139
--	T-6153	5,828	416
--	T-6157	4,996	351
--	T-6159	10,229	719
2 mm	T-410/T-414	5,610	395
3 mm	T-410/T-414	2,494	175

2 mm	T-405/T-412/T-425	22,442	1,578
3 mm	T-405/T-412/T-425	9,974	701
4 mm	T-405/T-412/T-425	5,610	395
5 mm	T-405/T-412/T-425	14,363	1,010
6 mm	T-405/T-412/T-425	9,974	701
7 mm	T-406/T-413/T-426	7,328	515
8 mm	T-406/T-413/T-426	5,610	395
9 mm	T-406/T-413/T-426	4,433	312
10 mm	T-406/T-413/T-426	3,591	252
12 mm	T-406/T-413/T-426	2,494	175
12 mm	T-445	4988	351
14 mm	T-445	3665	258
16 mm	T-445	2805	197
18 mm	T-445	2216	156
--	T-6153	5,828	416
--	T-6157	4,996	351
--	T-6159	10,229	719
N/A	T-2000	437†	31
N/A	T-3000	655†	46
N/A	T-5000	1092†	77

Table 1 **- Ejector Pin & Calibration**

*** Display will read psi/10.**
† Full Scale Output setup is required for Hydraulic Pressure Transducers. Contact RJG for more details.

Calibration For Unlisted Ejector Pin Sizes

To measure pressures using unlisted pin sizes, a new calibration number must be determined. Once the new calibration number is calculated, the only adjustment required is to switch to the CAL mode and enter the new calibration number.

Determining New Calibration Number

1. **Calculate a new calibration number for the unlisted pin size using the following equation:**

New Calibration Number = $\frac{D_1^2}{D_2^2}$ **x CAL number on sensor ID label (8,905 for all RJG transducers).**

D_1 = Diameter listed on sensor identification label or calibration sheet
D_1 = 1/16" for Model T-410
D_1 = 1/8" for Model T-405
D_1 = 1/4" for Model T-406

D_1 = 1/8" for Model T-412
D_1 = 1/4" for Model T-413
D_2 = Diameter of unlisted pin

2. **If new "CAL" number is higher than 32,000 psi, divide new "CAL" number by two (2) and use this value as the calibration setting. The digital meter will now read one-half (1/2) the actual pressure in the cavity.**

Example 1

Use a 9/32" pin with a Model T-406 transducer. The calibration number on the sensor identification label for 1/4" diameter pin size is 8,905 psi.

D_1 = 1/4"
D_2 = 9/32"

$$\frac{D_1^2}{D_2^2} = 0.7901$$

New CAL number = 0.7901 x 8905 = 7,036

Example 2

Use a Model T-405 to measure pressure from a 0.075 diameter pin. The calibration number on the sensor identification label is 8,905 psi for a 1/8" diameter pin.

New CAL Number = $(0.125)^2/(0.075)^2$ x 8,905 = 2.77 x 8,905
New CAL number = 24,736 psi

Interface Relay Board

The Interface Relay board provides the electrical connection between the Model 3015 Signal Conditioner, input triggers from the machine and a relay for controlling machine transfer.

Machine Logic Connections

The CPC-110-C it requires AC Power for the 15 VDC power supply, and a *Clamp Closed* **signal for autozero. The kit provides a set of control contacts for transferring the machine. These Machine Logic connections are described below.**

Clamp Closed

The *Clamp Closed* **signal initiates the autozeroing of the signal conditioner (Model 3015) to remove any offset or pre-load on the mold pressure transducer that may be present before injection. The** *Clamp Closed* **signal can be a 24 VDC or 120 VAC signal. Alternatively, an** *Injection Start* **signal can substitute for** *Clamp Closed* **to accomplish autozero.**

Contact Closure Output

This method of *Control Output* **is applied to machines which have no capability within the factory-installed machine controller to select control transfer set-points and ejector pin sizes being used with the mold pressure transducers. Channel 2 in this case will be used for energizing the control contacts available on the trigger connector on Pins 12 and 15. Selecting the set-point is accomplished in the DART***Net* **/ DART***Win*™ **software.**

Maximum Switching Power	3 VA
Maximum Switching Voltage	100 VDC OR PEAK AC
Maximum Switching Current	0.25 A
Maximum Carry Current	0.40 A

Table 2 - **Contact Closure Rating**

When Channel 2 pressure reaches the set-point set in the software, a relay inside the CPC-110-C box is energized which closes a set of contacts. The contacts can be input to the machine's controller for transferring the machine.

Control Signals

Option 1: Ladder Logic Sequence

For the control function of the CPC kit to work properly, it must perform the same control function of the *Machine Ladder Logic* **as the 1st Stage injection high (booster) timer. Molding hydraulic injection circuits normally work in one of two ways to shift from 1st to 2nd Stage pressures and volumes. One method of changing from 1st to 2nd Stage hydraulic pressure is where an input to the** *Ladder Logic Sequence* **is disabled to subsequently de-energize the normally energized 1st Stage circuit or solenoid. This is known as the** *Series Mode Hook-up***. A more common installation is the method of obtaining 2nd Stage pressure and volume by enabling the appropriate** *Ladder Logic Sequence* **input to subsequently energize the booster control relay or solenoid when holding is to occur. This Control mode is known as the** *Parallel Mode Hook-up***. Both of these modes are shown in Figure 5.**

Option 2: Amplified Transducer Signal Output

There is an output from the MP1 Signal Conditioner which must be wired to the machine's controller. This option assumes the factory installed machine controller has the capability to let the operator select through its user-interface software the control transfer set-point and the size of the ejector pin being used with the mold pressure transducer.

The MP1 Output Level has a 0 - 10 VDC (or 0 - 5 VDC on some models) signal output corresponding to 0 - 20,000 psi full scale plastic pressure in the mold. Of course when using a mold pressure transducer which is installed under an ejector pin for sensing pressure, the full scale is based on a standard pin size reference. For RJG's Model T-405, the reference pin size used is ⅛" and for the Model T-406, the reference pin size used is ¼". This information is very important from a calibration point of view for maintaining the standard 20,000 psi full scale in the mold. The MP1 CAL number should be set to 8905 regardless of changing molds

and pressure transducers in the machine (see *Appendix A - Mold Pressure Transducer* **for CAL information for Model 3015 [MP1].) This assures the 10 VDC signal will be sent from MP1 when 20,000 psi exists in the cavity. When different size pins are used, the corresponding pin size should be selected in the machine's controller software setting, and not changed by setting a new CAL number on MP1. The machine's controller will scale the signal input to consider the pin size change and keep the pressure readings accurate.**

NOTE: The contacts on TB3 Pins 4, 5 and 10 are not horse power rated and should not be used to switch the machine's relay coils or solenoids directly. You must interface Pin 4 and 5 (or Pins 4 and 10) with an added relay for switching the appropriate solenoid on the machine, as shown in Figure 4.

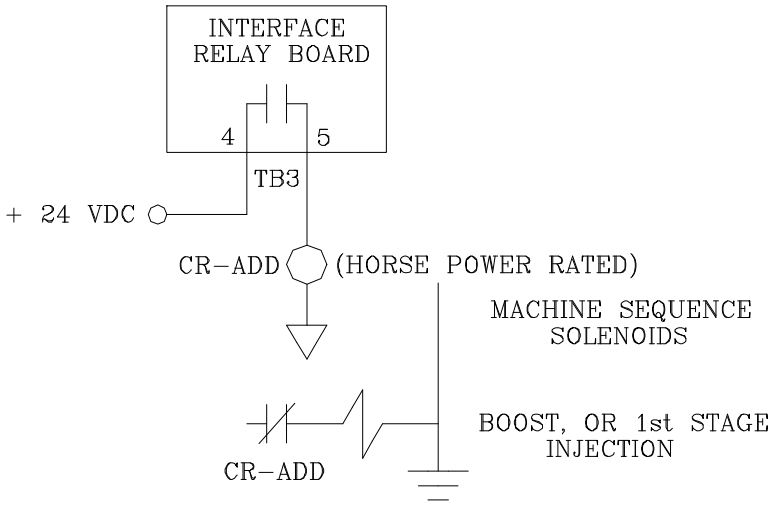
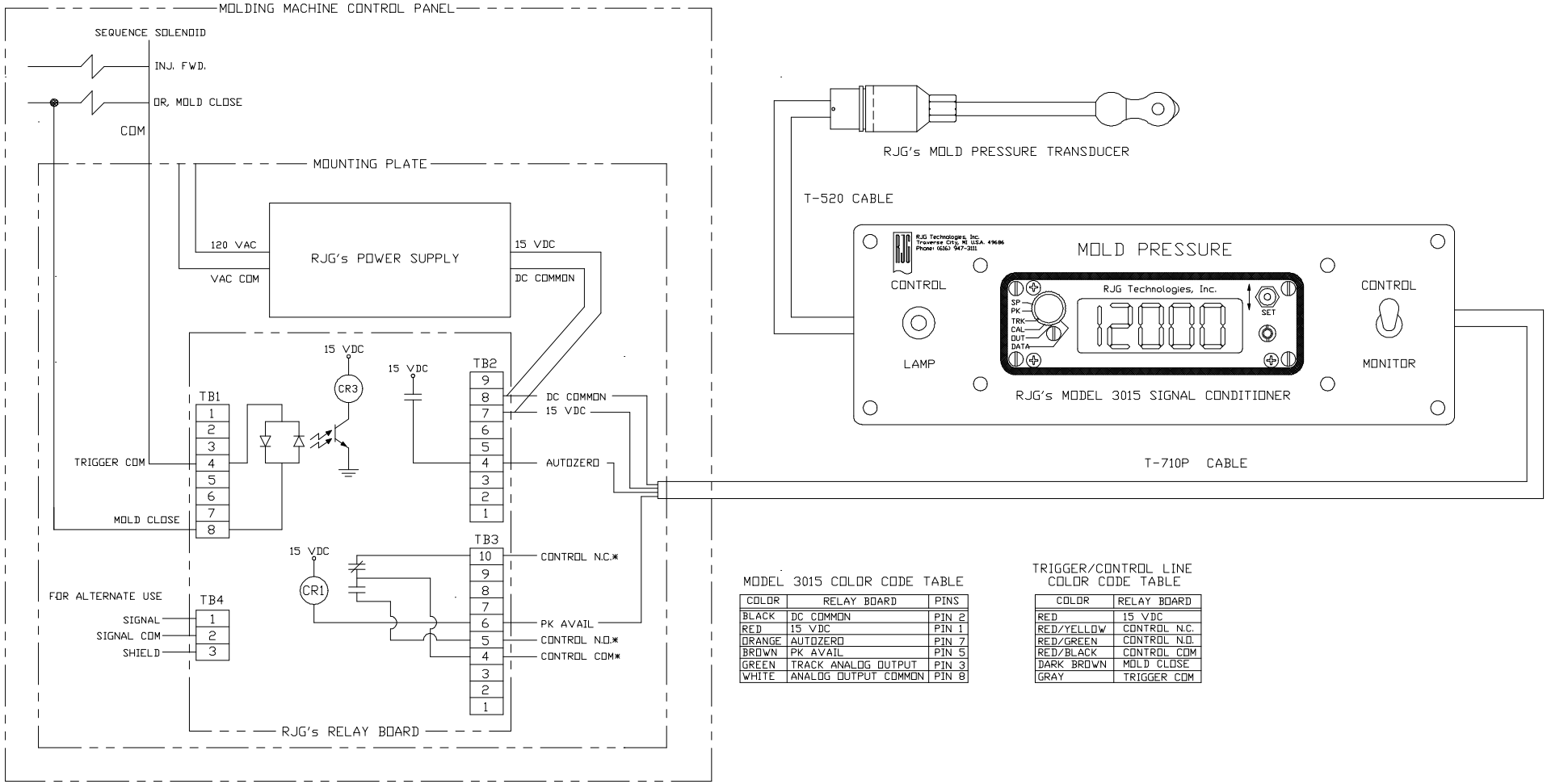


Figure 3

Interfacing to a Machine to Directly Switch Relay Coil, or Solenoid Logic

NOTE: When Cr-add Is Energized Due to Pins 4 and 5 Closing, 1st Stage Is Cut-off.

The Control/Monitor switch (shown in Figure 4) allows the disabling of the process control by not allowing the Control relay to turn ON even though cavity pressure is reached. The easiest way to determine how to wire the system into the machine logic panel is to observe the 1st Stage timer contacts as shown on the machine electrical drawings. The signals must perform the same function as the booster timer contacts.



MODEL 3015 COLOR CODE TABLE

COLOR	RELAY BOARD	PINS
BLACK	DC COMMON	PIN 2
RED	15 VDC	PIN 1
ORANGE	AUTOZERO	PIN 7
BROWN	PK AVAIL	PIN 5
GREEN	TRACK ANALOG OUTPUT	PIN 3
WHITE	ANALOG OUTPUT COMMON	PIN 8

TRIGGER/CONTROL LINE COLOR CODE TABLE

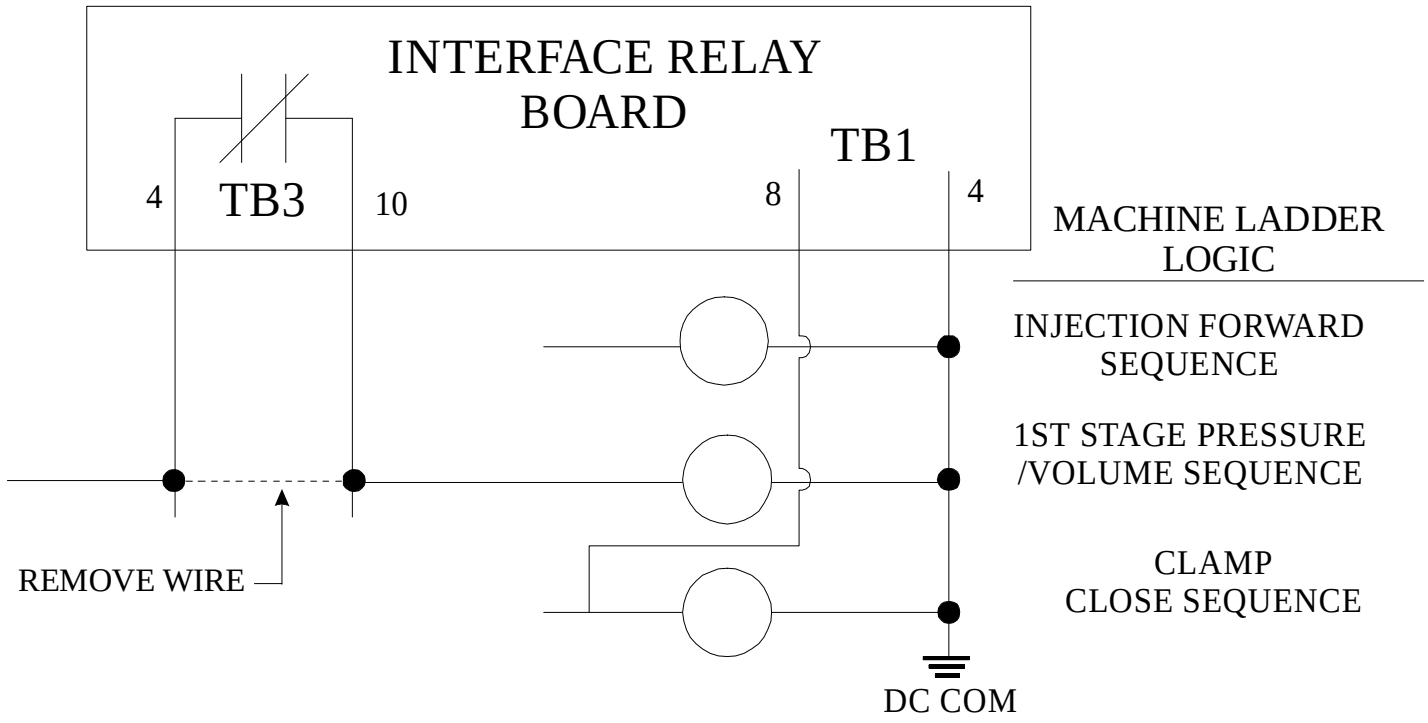
COLOR	RELAY BOARD
RED	15 VDC
RED/YELLOW	CONTROL N.C.
RED/GREEN	CONTROL N.O.
RED/BLACK	CONTROL COM
DARK BROWN	MOLD CLOSE
GRAY	TRIGGER COM

Figure 4

CPC-110-C Kit Components

*** NOTE:** The Contacts on TB3 Pins 4, 5 and 10 Are **Not** Horse Power Rated and Should Not Be Used to Switch the Machines's Relay Coils or Solenoids Directly.

SERIES MODE



PARALLEL MODE

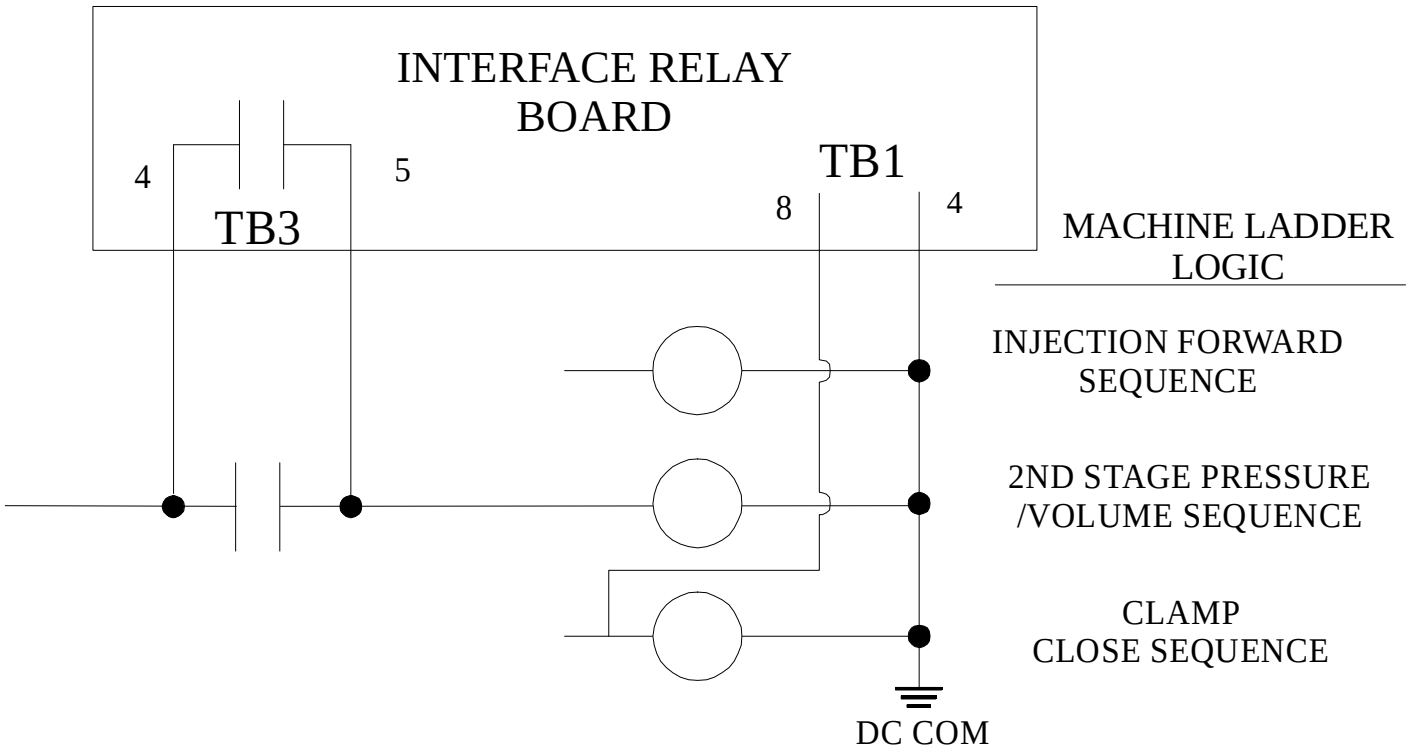


Figure 5

Interfacing to a Machine with a Programmable Logic Controller

NOTE: See Figure 3 For Directly Switching Machine Solenoids Or Relay Coils.

Operation

Theory

With a conventional molding machine (without cavity control capability) the traditional molding practice is to mold with just enough pressure on the 1st Stage or high volume pump to fill and pack the mold cavity. 1st Stage pressure is initiated at the start of the injection cycle and is maintained by the 1st Stage timer. This timer is manually set with enough time available so that the mold can be completely filled and packed before the timer has completed its cycle. When this timer completes its cycle, the machine switches from first stage (high volume) pressure to 2nd Stage (low volume) pressure. 2nd Stage pressure is set to hold the material in the cavity until the plastic solidifies. To use this approach properly, a cushion of material ahead of the screw must be used. This cushion allows pressure in the injection cylinder to be transferred to the mold cavity, thus allowing the packing and the holding portions of the injection cycle to occur.

The major weakness of this traditional method of molding arises when using 1st Stage pressure of the molding cycle with only enough pressure used to fill and pack the cavity. When the 1st Stage hydraulic pressure is set by this method, variations of plastic viscosity (plastic temperature, mold temperature or fill rate) cause greater or lesser pressure losses across the runner, gates, and cavities. This in turn causes variations in mold cavity pressure, which in turn cause flash, short shot and dimensional inconsistencies of parts. In injection molding, cavity pressure variations are the greatest single cause of molded part variations. It is this type of process variation which the controller kit eliminates.

When using cavity pressure control, it is necessary to use more than enough 1st Stage pressure to fill the part, then only pack the part on 2nd Stage. RJG refers to this separation of fill from pack as DECOUPLED MOLDING℠. This higher than normal 1st Stage pressure allows the machine to fill the mold quickly and overcome increases in viscosity of the plastic when it occurs.

Having provided excess 1st Stage pressure for injection, it is only necessary now to know when to transfer to 2nd Stage in order to ensure the integrity of the part. This point that initiates transfer is called the cavity pressure set-point. It is this mold pressure setting which, when reached, causes the machine to switch from the boost pressure to holding pressure automatically. Cavity pressure continues to rise after this point until a peak pressure is reached. This continued rise in pressure above the set-point is referred to as the "overshoot" of the system. This overshoot is caused by two factors. The first factor is the response of the molding system. This is the time lag between the point where the signal is sensed by the control unit and the time when the machine is actually switched to lower pressure. This portion of the overshoot is generally small and consistent from shot to shot, thus it does not present a concern.

The second factor, which affects the overshoot, is the rate of ram speed when the set-point is reached. If the screw or plunger is moving at a high rate of speed when the boost pressure is inhibited, the cavity pressure will continue to rise after the screw decelerates. The amount of overshoot is a variable which depends primarily upon fill rate; therefore, the molder must readjust the set-point when fill

rate changes are made. This is an important factor to remember when setting up a machine for cavity pressure control.

Procedure For Using 1st Stage Cut-Off On Mold Pressure Control For Increased Process Capability

Overall Objective:

The overall objective of using injection 1st Stage cutoff control by cavity pressure rather than stroke or time, as in traditional molding, is to improve the consistency and the overall capability of the injection process. This will give more consistent dimensions and molded in stresses and result in fewer short shots and other rejects.

The primary reason that this technique works better than traditional molding is because injection fill rates are more consistent. It also allows the mold to be filled quicker without overpacking. On molds where fill must be done slowly, this technique provides more consistent slow fills such as on imbalanced tools or molds that tend to be easily flashed if filled too rapidly. Finally, staging the machine from the mold minimizes the effect of viscosity variations and non-return valve inconsistencies. No other means of control can achieve this. So, on any mold, there should be more consistency and a greater molding latitude using this technique.

The technique, however, does necessitate using procedures which may seem unnerving for those who have used only traditional molding techniques, employing only enough 1st Stage pressure to fill and pack the mold. **A fundamental necessity for this technique to work properly is to always have an excess amount of 1st Stage pressure available to fill and pack the mold.** It is this abundance of 1st Stage pressure which allows the pressure compensating flow control valve to do its job of controlling injection rate and fill time.

In order to use an abundance of 1st Stage pressure it is **very important** that a technique be utilized which will not allow overpacking of the mold with this 1st Stage pressure. It is also important to realize that you do not control speed anymore by lowering 1st Stage pressure. Controlling injection speed, or injection rate, is done only by adjusting the flow control setting. Generally, if flashing occurs during filling it is caused by too much or too little injection speed, rather than too much pressure. In the past, pressure adjustments have been made to change this condition, however, what was really being changed was the rate of injection, not the actual pressure that the plastic sees during fill.

Initial Mold Setup Using Mold Pressure Cut-Off For 2nd Stage DECOUPLED MOLDING℠

The objective is to fill the mold quickly on initial shots at high 1st Stage pressure under controlled flow rates without overpacking and on successive shots fill out the mold until a slight short shot exists. Then the mold can be packed using 2nd Stage for a sufficient time to allow gate sealing when appropriate.

1. With press stopped, set the 1st Stage pressure at about 1900 psi, and 2nd Stage at 0.

2. Set the mold pressure control set-point <SP> at 500 psi for a minimal shot.

3. Set the injection speed for start up by purging and observing speed of injection and then adjusting the flow control setting until the proper speed is observed.

4. Set the screw back setting or limit switch at a position where you are sure the mold will not be filled out.

5. Set the 1st Stage time higher than will be needed. It can be the same as injection total.

6. Make sure that the rest of the timers are set where you want to run them. Then purge the barrel and retract the screw ready to run.

7. Make a shot. The fullness of the parts will tell you how well you made the set up. If you did not have the cavity pressure control on, chip out the flash.

8. Slowly increase the screw back position setting until 1/2" to 1" cushion exists.

9. Inspect the parts for signs of flash. If flash exists, slow down the injection speed gradually and keep checking the parts. Do not let the 1st Stage timer get in the way of the cut-off.

10. When the flash is acceptable, adjust the mold pressure set-point to make the parts just short. Lock down the injection speed control.

11. Turn up the 2nd Stage pressure to properly pack the part.

12. You may be able to reduce the 2nd Stage time if freeze-off is before the timer times out. (This can be determined by running shots at various injection total times (2nd Stage) and determine where the part weight changes. Too short will make parts lighter due to discharging of plastic from gates. **NOTE: On most hot runner molds, gates never seal so this test may not be proper.**

Take Over Approach

When using the takeover approach the idea is to mold good parts in the conventional fashion of filling and packing under the influence of 1st Stage. Then, gradually but systematically, take over using the new 1st Stage cut off technique using mold pressure. This will be done while keeping the molding conditions the same, from the plastics point of view.

1. With the molding machine running on cycle, record 2nd Stage pressure and reduce to zero.(0). Observe whether or not the mold is being filled on 1st or 2nd Stage (are the parts still full, but not packed out, or are they short).

2. The next objective is to only fill the mold on 1st Stage. This will be done by adjusting the mold pressure set-point so that 1st Stage cut off is being

accomplished by mold pressure. Adjusting the mold pressure setting to a lower number on successive shots will eventually result in reduced fill and a short shot because there will be no 2nd Stage pressure available to pack the mold.

3. Continue to adjust the setting until a substantial short shot exists. This will insure that the mold will not be filled and packed on 1st Stage as a result of any increase in injection rate during set up.

4. Note the fill time on the fill time clock and record it for future reference.

5. Reduce the flow control valve setting on successive shots until the fill time gets longer. This insures that the flow control valve is set such that it will control the injection velocity.

6. Adjust the flow control until the fill time increases approximately 10%. This will insure that when the 1st Stage pressure is increased, the increased injection rate will not cause too short a fill time, and thus overpack or flash the mold.

7. Now, raise the 1st Stage pressure slowly on successive shots and watch the fill time clock reading. Initially, it will get lower, indicating that there has not been sufficient pressure to allow the Flow Control valve to control flow rate. At some point, the fill time will stop decreasing. The 1st Stage hydraulic pressure at which this occurs should be noted. This is the minimum hydraulic pressure necessary for adequate injection speed or fill time control.

8. The injection pressure should now be increased approximately 200 PSI above this point. This will insure that there is enough energy available for fill time control even with wide changes in plastic viscosity during material changes or temperature changes, or during start up and shut downs.

9. If fill time seems too slow or too fast, based either on experience or on the data from the initial set up, adjust the fill time using the Flow Control valve.

10. During all this time, the parts should be short. Once the desired fill time is set using the flow control, adjust the mold pressure set-point to fill the mold as far as possible without flashing or excessively overpacking it. Note, there will still be sink marks, because there is no 2nd Stage pressure. The object here would be to fill the entire mold without flashing it. However, on severely imbalanced tools this may not be possible. It may be necessary to go back and forth on the fill time and the cut off position to achieve an essentially full part without flashing. On imbalanced molds, this technique can be used, but will not change the balance. It will only help run the part more consistently once set up. Note that when you change the 1st Stage cut off pressure set-point, the fill time will change because the distance the ram has to travel before cutting off 1st Stage pressure and the fill time clock has changed.

11. When the proper amount of filling on 1st Stage is achieved, then note the

new fill time reading and record. Also record the shot weight. This will allow resetting the fill position and fill time accurately on another setup, **even on another machine. 2nd Stage should be increased on successive cycles to hold plastic in the mold. It should generally be approximately what it was before the 1st Stage cut off on stroke technique was used.**

12. With this set up complete, note the peak hydraulic pressure at transfer on a digital peak reading gage (if used). This is the amount of pressure used to fill the mold. 1st Stage pressure must be set at least 200 psi above this reading.

13. Note the cut off pressure, the flow control valve setting (for start up purposes only), the 1st Stage setting and the 2nd Stage setting, as well as all other normal set up information. This will allow systematic start up using this technique on future set ups.

NOTE: 1st Stage pressure setting can only be determined by bottoming the screw under 1st Stage pressure.

Restarting The Tool

Once the initial set up using mold pressure cut off is used, it should only be necessary to dial in the proper settings and make minor adjustments. It is important to realize that if some cavities are blocked or if the injection unit is different on the machine then the set up will have minor differences, namely in the screw back position. This is not as significant when mold pressure cut off is used.

1. If in doubt, start with a 1st Stage cut off pressure lower than normal. This means a mold pressure set-point as low as 500 psi.

2. Start up with no 2nd Stage pressure so that no packing will be done on 2nd Stage. The amount of fill can be observed on initial shots.

3. Dial in the excess 1st Stage pressure, and the flow control settings from the set up sheet of previous runs. Start molding. A short shot should be produced.

4. If the cut off pressure settings are identical to those previously used and the screw back position allows sufficient material to make the shot, it should only be necessary to add 2nd Stage pressure back to its original setting and the set up should be complete.

5. Fine tune the fill time to the previous setup fill time by adjusting the flow control valve setting. The Fill Time, not the Flow Control valve setting is the primary variable to duplicate.

Troubleshooting

Problem I: Machine Does Not Transfer From 1st Stage Pressure To 2nd Stage Pressure.

1. Verify the hook-up for Series mode or Parallel mode, is the correct version for your machine.

2. Set the Fill Timer for a short fill time so as to not stick the part (possibly 0.5 seconds). After the start of injection the cutoff should occur at the time you've set (0.5 seconds).

Problem II: Cavity Pressure Does Not Seem To Be Initiating 1st Stage Cut-Off

1. Adjust the set-point <SP> knob on the Model 3015 on successive shots down to a lower number where you know cavity pressure has to pass through that level and take control. At 100 psi, for example, cut off should occur when cavity pressure reaches 100 psi and the part should be significantly short, and the Fill Time clock should display a very short fill time compared to a higher set-point. If this works, go back and be sure to set backup boost timers longer than the time it takes to reach the cavity pressure you're going to use for cutoff.

Problem III: Model 3015 Will Not Zero

1. The Model 3015 is designed to zero transducer signals in the range -5.0% to +100% of full scale. While in the Track mode, if an "F" appears at the left of the display, a fault has occurred in the transducer installation. This condition could be due to the following:

Pre-load On The Transducer:

This can be checked by removing the transducers from the mold and attempting to re-zero the Model 3015. Refer to *Appendix A - Mold Pressure Transducer* for installation instructions.

Broken Or Shorted Wires Between The Transducer And The Connector:

Check the resistance at the transducer connector. Refer to Table 1.

Transducer Imbalance:

Unhook the transducer from the Model 3015 and plug in a star bridge or reference bridge. Zero the Model 3015 with the Toggle switch, and set the CAL number to 8900. Remove the star bridge or reference bridge and plug in the transducer in question. **NOTE: The transducer must be removed from the mold.** If the reading is out of the range of -2300 to 32000, the imbalance cannot be zeroed by the Model 3015. Contact RJG for assistance.

Appendix A: Model 3015 Signal Conditioner Additional Information

Block Diagram

Description Of Operation

A block diagram of the readout is shown in Figure 6. The millivolt signal from the transducer is input into a differential instrumentation amplifier where it is amplified and output to a scaling amplifier where variable gain is used to scale or calibrate the signal. The calibrated signal is then simultaneously presented to the meter display switch, the set-point comparator and the peak detector circuit. The comparator compares it to a set level. If the signal is higher than the level set the comparator sends a signal through logic to activate the peak detector and simultaneously switch the open collector output to the "conduct" state for a control or alarm output. The meter display switch allows the user to read the set-point, track and peak. Autozero samples the amplified transducer signal error and feeds back a correction voltage to null out that error.

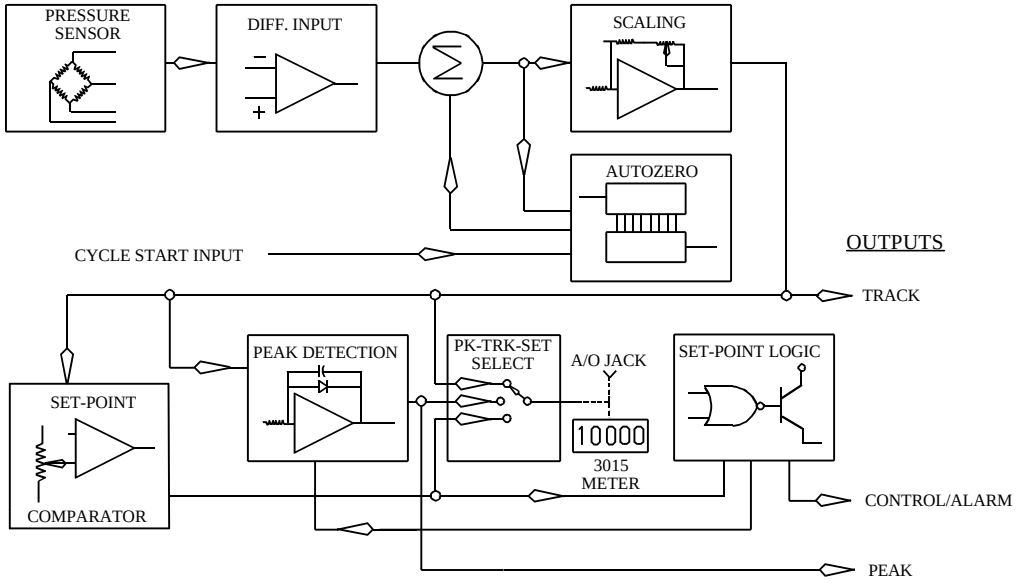


Figure 6

BLOCK DIAGRAM OF READOUT

Package And Multi-Channel Configuration

The Model 3015 is encased in a metal package with flip-top cover for environmental protection when package code W is specified.

Grounding When Connecting The Unit To Other Devices

One precaution to observe deals with the possibility of ground loops when connecting a recorder, data logger or other external instrument to the analog

output of the Model 3015. A ground loop can be generated if the signal return current should follow more than one path such as through the shield wire of the connecting cable or earth ground as a result of a voltage differential between two or more uncommon grounds of the Model 3015 and the external instrument. See Figure 8. This may cause some instability in the Model 3015 display or excessive noise on the analog output signal or in the external instrument function. This situation can be avoided by assuring that the system has only one common ground point to provide a single return path. For example in Figure 7, all ground points have been lifted with the exception of the external instrument ground. RJG Signal Conditioners are built standard with no connection from Circuit Common to Case Ground.

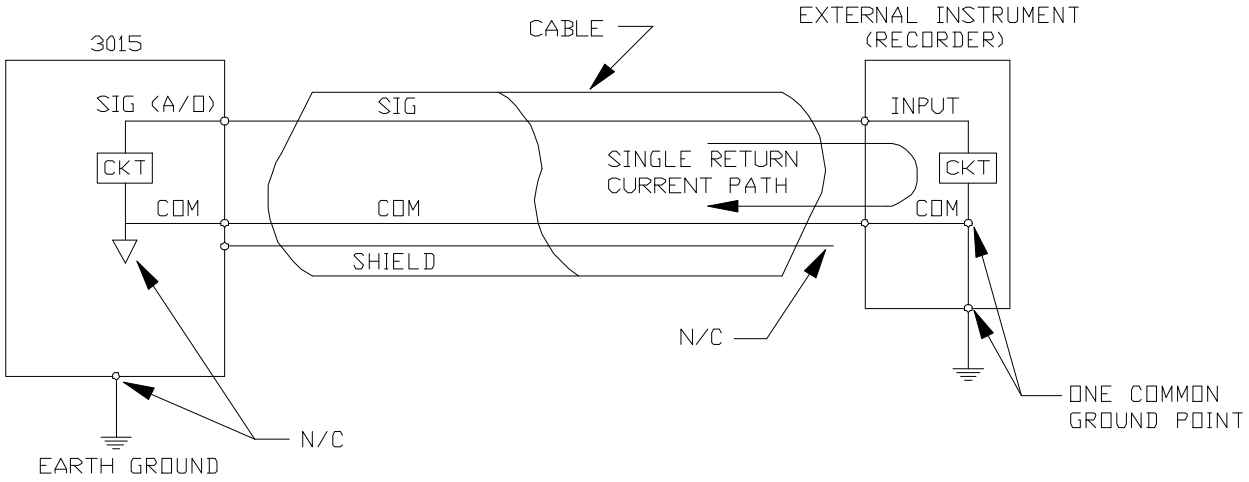


Figure 7

Single Return Current Pathways with One Common Ground Port

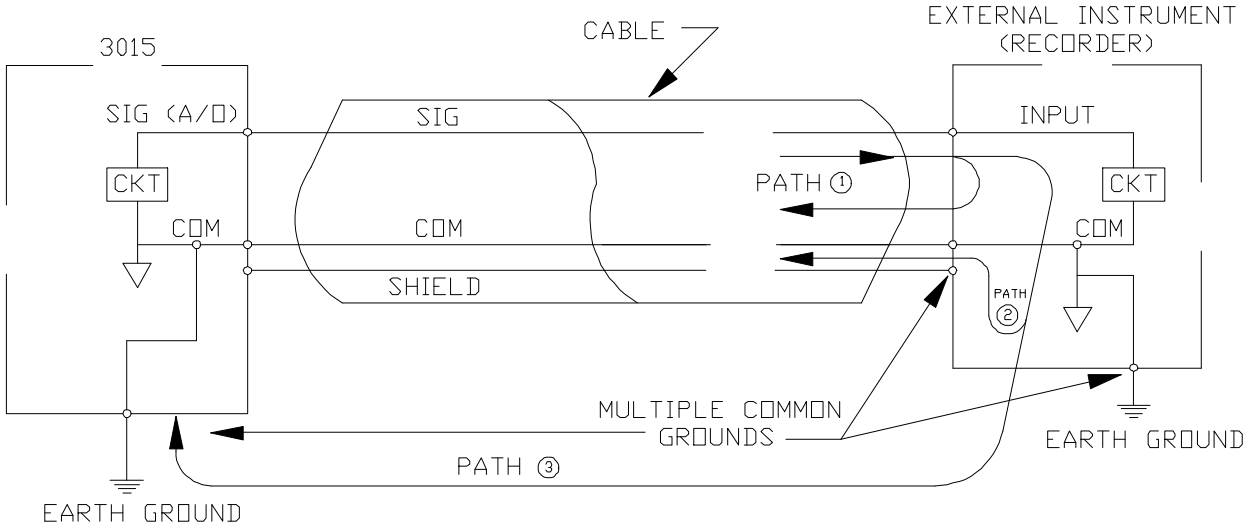


Figure 8

Single Return Current Pathways with Multiple Common Grounds

Quick Reference Guide For The 30 Series Signal Conditioners

Normal Operation Rev. 3.3

Switch	Function	Operation
TRK	A Zero Display	Press SET down once.
	B Calibrate to known input	1. Transducer in un-loaded. 2. Press SET once to zero. 3. Apply known input. 4. SET up 5 down, up 3 seconds. 5. Set **A** value to known input. 6. Switch to PK or CAL.
	C Return to Re-calibrate using Shunt.	1. SET up 5 sec, down 3 sec. 2. Set **A** value to 00000. 3. Switch to CAL. 4. Calibrate as below.
PK	D Release Peak	If display shows a **P**, press SET down. If below Peak, the display returns to tracking.
SP	E Set Peak Threshold	Set the **L** value to the threshold above which peaks are held.
CAL	F Calibrate using Shunt CAL	1. Transducer is un-loaded. 2. Set **C** value to transducer number. 3. Switch to TRK. Display shows **c** if CAL is OK.
	G Change from Shunt CAL to Scale Number	1. Change CAL number from given value to C00000. 2. Switch to TRK. 3. Switch back to CAL. 4. Set **c** Scale Number.
	H Set Scale Factor (Intensification Ratio)	1. Enter Scale mode with functions **B** or **G** above. 2. Set **c** Scale Number.
OUT	I Set Output Full Scale Voltage and Function	1. Switch to OUT once or twice to get **t** or **P** display. 2. SET down 5 sec, up 3 sec. 3. Press SET up or down to select type & Full Scale volts.
	J Set Full Scale Output @ Level	1. Switch to OUT once or twice to get **F** display. 2. SET up 5 sec, down 3 sec. 3. Set F number to TRK or Peak value for volts in 1.
DATA	K Normalize Integral	1. Allow machine to stabilize. 2. When 1 is displayed, press SET one or more times to normalize to 100-10,000.
	L View Version	Press SET up once to see the internal software revision number.
	M Un-Zero the Input	1. Press SET up once for version (Security for **h/P/t**.) 2. Press SET down once to un-zero the input.

Table 3 **- Digital Signal Conditioner Quick Reference**

3015/3016 Quick Reference V 3.3

TRK: Track mode

- Shows value in eng. Units (F=> fail)
- Press SET ▼ to zero.

CAL: CAL Number mode

- **C**: View and set Shunt CAL.†
- **c**: View and set multiplier.†
- **U-----:** means unstable input.
- **F-----:** means over/under range.
- ^{c}:(in TRK) indicates CAL is accepted.**

PK: Peak Display mode

- Shows **P** when holding Peak.
- Shows ┌┘ when moving up.
- Press SET ▼ to remove Peak.
- If level = 0, Peak holds till zero or autozero in.

SP: Set-Point

- Shows L for level.
- Set level above which Peak and Integral to Peak operate.†

** Feature added to V3.0 & above

† **Number Set (When digit is blinking):**

- SET switch ▲ or ▼ to change blinking digit value ± 1.
- Hold for ½ second for next digit.

OUT: Analog Output Settings

- First switch to: **F** for Full Scale.
- Second: **t** = Track Volts, **P** = Peak Volts.
- Output is voltage shown in engineering units selected at **F**.
- To allow setting, hold SET ▲ for 5 seconds, then ▼ for 3 seconds.

DATA: Fill Time, Integral to Peak etc.

- Shows Fill Time. SET ▲ for Integral to Peak.**
- Shows Relative Integral to Peak above set-point level.
- Shows n when integrating, **i** when complete.
- Press SET ▼ (at **i**) to normalize to 1000, 10000 or 100.
- ▲ for Version, then ▼ to un-zero.
- Or to set Fill Time mode, press SET ▲ for 5 seconds, then ▼ for 3 seconds. Then SET ▼ for Time to Peak (**h**), Time to SP (**P**) or Trig. Time (**t**).

RJG, Inc.
3111 Park Drive
Traverse City MI 49686
(616) 947-3111

Table 4 **- Quick Reference Guide**