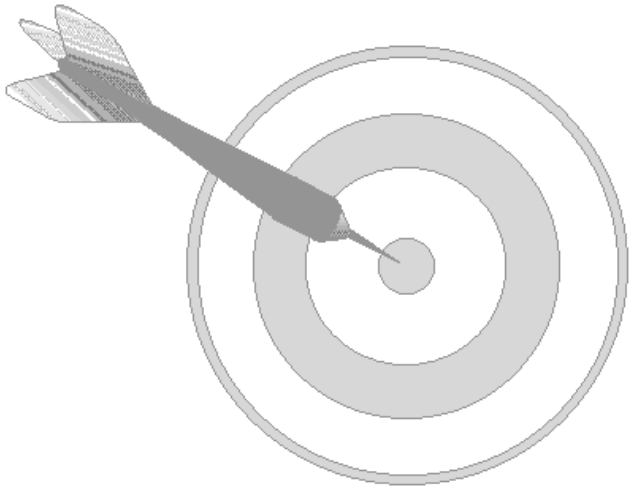
Model 3015

Digital Strain Gage Signal Conditioner
Operating Instructions



"We Make Molding Simple!"

Rev $_{3.4}$ 01/99

by Janice A. Walters

Filename: K:\Signal Conditioner\Current\Manual\3015 Manual.wpd

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Introduction

The Model 3015 Digital Strain Gage Signal Conditioner is used with pressure transducers for sensing pressure directly from a hydraulic, water, air or a gas source and displaying the reading digitally. Generally, in an injection molding application the unit is installed to sense pressure at the injection cylinder of the machine. The display will track or follow the pressure or will catch and hold the peak. A level detector set-point can be adjusted to automatically reset the peak each cycle. Also, the set-point option can be used as an output to activate an external device, such as a conveyor or robot, for high alarming. The 5 digit display enables readings of up to 32,000 psi in 1 psi increments. The unit also has an analog output signal available which is user-selectable to a full scale level of 2, 5, or 10 Volts.

Model 3015 Technical Specifications

Input Range	0.5 to 2 mV/V
Operating Temperature	32° to 150°F
Accuracy (Nl, H, R)	0.5 F.S.
Repeatability	0.1 F.S.
Resolution	1 Part in 4096
Sample Rate	250 Samples per Second
Zero Adjustment Range	-5% to +100% F.S.
Input Power	See Model Number Designation above

Table 1: Technical Specifications

Model 3015 Front Panel Description

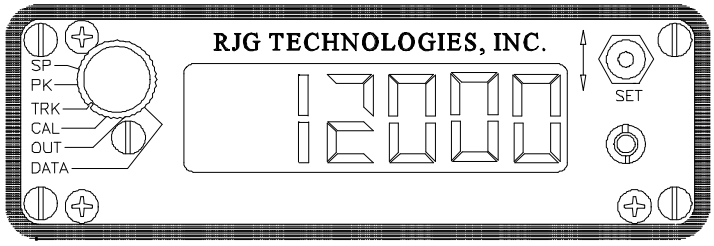


Figure 1

Model 3015 Front Panel

Refer to Figure 1 for the following description of the front panel controls:

Mode Select Switch

A rotary switch located on the left hand side of faceplate defines the function being displayed on the readout. There are six (6) features available to choose from, as described below:

SP (Set-Point)

The set-point is the threshold level of pressure the unit will use to change the logic state at the set-point output (Pin 5 of the Power Input connector). 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 as a signal to control a machine, turn on a light, or trigger a parts flipper or robot. 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.

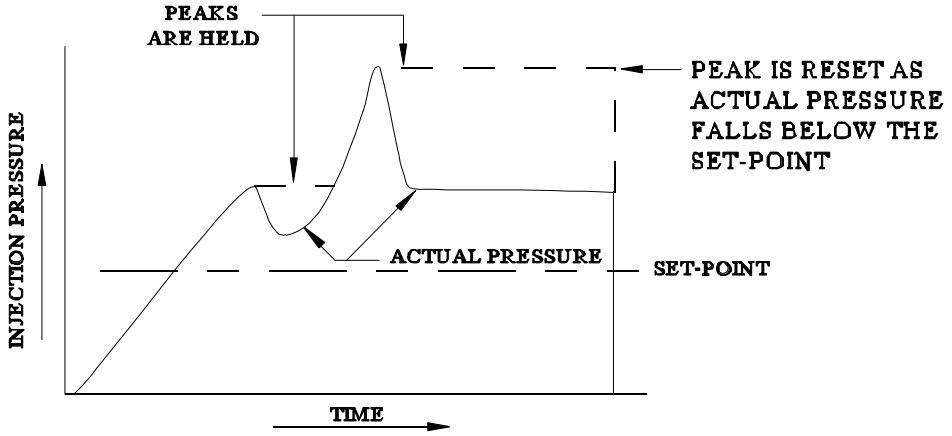


Figure 2

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 Toggle Switch on the Front Panel Is Pressed. Negative Values Entered for a Set-point Value Will Default to Zero.

PK (Peak)

The PK setting displays and 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)

The TRK 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, as outlined in the *Zeroing The Instrument* section

To assure accurate calibration, a provision is made to assure signal stability before accepting a new CAL number change. See *Calibration - Calibrating the Instrument With A Mold Or Hydraulic Pressure Transducer Input* section.

OUT (Analog Output)

The OUT position allows setting of the analog output voltage to correspond to the full scale number on the display. This feature is preset at the factory for either a 0-2, 5, or 10 Volt output signal.

The output voltage can be changed to correspond to any selected display reading. There are two possible ways to reset this feature. Option I allows the output voltage to be kept the same and the full scale to be changed. 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. Typically, the display will read "F 2000" for mold pressure sensors. It can be changed to any value by entering the security code (outlined in the *Model 3015 Front Panel Description - Set Toggle switch - Security Sequence Activation* section), and using the Set switch. The value will then correspond to the full scale voltage setting.

Option II allows the output voltage to be changed, but the full scale to be kept the same. 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" symbol appears on the left hand side of the display to represent the full scale output voltage of the track signal display. It can be changed to 2, 5, or 10 Volts F/S by entering the security code (outlined in the *Model 3015 Front Panel Description - Set Toggle switch - Security Sequence Activation* section), and using the Set switch. The full scale voltage setting can also be changed for the Peak <PK> output. Rotate the Mode Select switch back and forth from CAL to OUT until a "P" appears on the left hand side of the display. In the Track Output mode, the analog output follows or tracks the TRK display. In the Peak Output mode, the output follows the PK display and holds peaks when the set-point is reached.

DATA

The DATA position displays a time reading measured from the start of the hardwired input trigger (autozero) to when the pressure reaches the selected set-point. Switching the Mode Select switch into the DATA position will display a "F" symbol on the left to indicate this configuration. Optionally, the unit can be configured to display time measured from the start of the trigger to when the peak is reached, or the time duration the trigger is "ON" (see the *Fill Time Clock* section for more details.)

The DATA position also serves as a reference to identify the version of the program chip being used internal to the unit. Toggling the Set switch UP [▲] until the symbol "+" appears on the left selects the version number.

Set Toggle Switch

The Set switch is an UP [▲] and DOWN [▼] toggle switch (located on right hand side of front panel) utilized for changing each numerical digit on the display after the Mode Select switch has been selected. All changes are only registered when switching out of the Mode Select position of interest. 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 (2) primary uses for the switch: Zeroing and Number Changing.

Zeroing (Security Sequence Not Required)

With no pressure applied and with the Mode Select switch in the Track <TRK> position, toggle the Set switch DOWN [▼] once to zero the display. The signal conditioner 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 incrementing or decrementing by momentarily toggling the Set switch UP [▲] and DOWN [▼], respectively. 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 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 signal conditioner is in use. The security sequence is as follows: Press and hold the Set 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 switch can now be used for changing the numbers.

Model Number Designation

The following tables identify options for particular models of the 5 digit display 3015X-XX.

3015D-XX

C D	15-24 VDC 115 VAC	100mA Power Requirements 60Hz, 20 Watts (Version Includes Model T-1115 Wall Plug-In Power Supply

Table 2: Power Requirements

3015D-02

00	No Analog Output
02	2 V A/O JACK (Standard)
05	5 V A/O Jack
10	10 V A/O Jack

Table 3: Analog Output Full Scale

3015D-02-WO

W	With case and flip-top cover
WO	Without case (faceplate only)

Table 4: Packaging

Connector Pin Assignments

Power Input Connector Pin Assignments

The Model 3015 is encased in a metal package with flip-top cover for environmental protection when package code W is specified. Figure 3 shows the outline drawings.

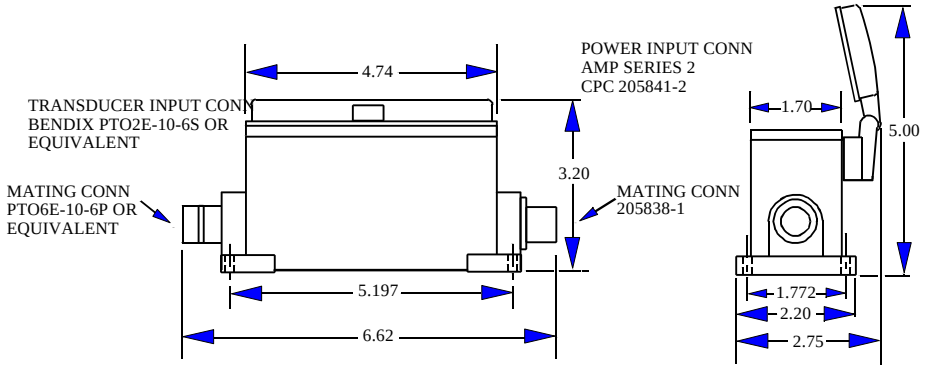


Figure 3

Model 3015 with Flip-top Cover

Pin	Color	Signal
1	Red	+ Power
2	Black	Power Common
3	Green	Track Analog Output
4	--	N/C
5	Brown	Set-point Output (Open Collector Transistor)
6	--	N/C
7	Orange	Trigger In (Autozero)
8	White	Analog Output Common

Table 5: Power Input Connector Pin Assignments

Receptacle

AMP CPC-205841-2 Mating Plug: AMP CPC-205838-1

Pin	Color	Signal
A	Red	+ Excitation
B	Black	- Excitation
C	Green	+ Signal
D	White	- Signal
E	--	Shield
F	--	N/C

Table 6: Transducer Input Connector Pin Assignments

Receptacle

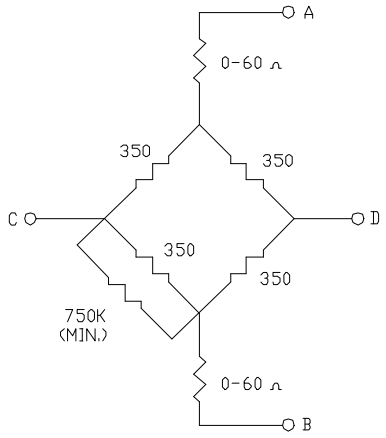
Bendix PT02E-10-6S Mating Connector: PT06E-10-6P

Transducer Compatibility

The transducer is the information gathering portion of the system. It changes pressure into an electrical signal which is then amplified into a usable process signal. The transducer signal is usually in the 0-20 millivolt range. Therefore, it cannot be measured by conventional test meters. This small signal must be carefully isolated and shielded from sources of interference. RJG cables are shielded for this precaution. The most common causes of transducer failures are short circuits or broken wires. The following approximate resistances can be measured to determine if a transducer is good:

Pin A to Pin C	260Ω to 325Ω
Pin B to Pin D	260Ω to 325Ω
Pin B to Pin C	260Ω to 325Ω
Pin A to Pin B	350Ω to 470Ω
Pin A to Pin D	260Ω to 325Ω
Pin C to Pin D	350Ω ± 5Ω

Table 7: Resistance Table



A shorted sensor can also cause amplifier failure in the unit. Transducers should be thoroughly checked if the possibility of failure exists. The best way to eliminate the transducer as a possible source of trouble is to replace it with one known to be good.

Zeroing The Instrument

Zeroing the instrument is the means of adjusting the output so that the meter reads zero 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, or the hydraulic transducer off the machine.) With the Mode Select switch in Track <TRK>, momentarily press the Set switch once to achieve a 000 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.

The Model 3015 is equipped with an Autozero configuration which if wired to the machine does not require manual zeroing. If the machine is being used to enable Autozero, manual zero should only be required once for the duration of the machine operation. It automatically re-zeros at the beginning of each machine cycle which is initiated from the cycle start input.

Autozero Procedure

As shown in Figure 4, wire the Model 3015 to the machine by interfacing with a relay. Connect the relay dry N.O. contacts to Pins 7 and 1 so the contact closure

will enable, or trigger, Autozero. The relay coil should be wired to a sequence signal from the machine at the start of the cycle, such as Mold Closing, or Injection Forward, on an injection molding machine.

After powering up the instrument, allow the display to stabilize, and with the transducer hooked up, enable the Autozero once with a machine cycle start input, or press the Set switch. The display will read 000 ±1 counts. Autozero is now activated and does not need to be readjusted for the duration of the machine operating time. The initial zeroing will be done automatically on the first cycle of the injection unit.

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

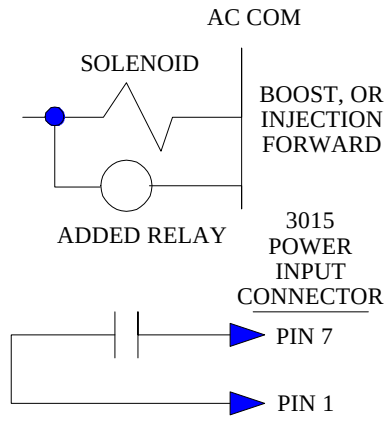


Figure 4

Hardwiring Schematic

Calibration

Calibrating The Instrument With A Mold Or Hydraulic Pressure Transducer Input

Calibration of the transducer to the instrument is necessary to insure that true psi readings are obtained on the meter. The sensitivity of some non-standard hydraulic and 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 Mode Select switch position is used to calibrate the instrument for the transducer and ejector pin size used, as shown in Table 8 below. All that is necessary to get an actual readout in psi from any of the transducers listed is to adjust the Set switch so that the number in the table corresponding to the pin size and/or transducer used is displayed **after first zeroing the instrument.** A check of the calibration accuracy can be done by first momentarily pressing the Set switch while in the Track <TRK> mode to zero the display, and then switching to the CAL mode. The CAL number shown in Table 8 should be displayed on the meter when in the CAL mode. If a new CAL number is desired, wait about 2 ½ seconds after switching into the CAL mode, until the last digit on the display begins flashing. The Set switch can now be used (as outlined in *Model 3015 Front Panel Description* -

Set Toggle Switch - Number Changing (Prior Security Sequence Required For OUT section)) to select the new CAL number. The meter displays units of pressure in 1 psi increments. Once the meter is calibrated it is normally unnecessary to re-calibrate unless the transducer is changed. The table also shows the analog output voltage of 2 volts for a 20,000 psi full scale for each CAL number. A CAL of 8905 on the display is represented by a voltage of .8905 on the A/O for a 0 to 2 V full scale, 2.22 V (.8905 x 2.5) for a 0 to 5V full scale, or 4.45 V (.8905 x 5) for a 10V full scale instrument.

To assure accurate calibration, a provision is made to assure signal stability before the unit accepts a new CAL number change. When attempting to calibrate, the display may show "U----" or "F----" at times. This represents an unstable condition or a problem with the cable or transducer, respectively. The operator may need to attempt the CAL procedure again in order for the new CAL number to be accepted.

If 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 applying it to the CAL of the gage, the gage will readout in plastic pressure even though it senses hydraulic pressure.

1. Determine the injection unit ram intensification ratio from the following formula:

$$\text{RATIO} = \frac{D_C^2}{D_S^2}$$

Where D_C is the diameter of the cylinder and D_S is the diameter of the screw.

2. Multiply the ratio by the calibration number on the hydraulic transducer being used to find the new calibration number.

2. In the Track <TRK> mode, zero the Model 3015 with no pressure applied to the transducer.

3. Switch to the CAL position and adjust to the new calibration number.

4. 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.

Ejector Pin	Transducer	CAL# (PSI)	A/O (2V F/S)	A/O (5V F/S)	A/O (10V F/S)
1/16"	T-410/T-414	8905	0.890	2.226	4.452
3/32"	T-410/T-414	3858	0.396	0.989	1.979
1/16"	T-405/T-412	3562*	0.56	0.891	1.791
3/32"	T-405/T-412	15831	1.583	3.958	7.915
1/8"	T-405/T-412	8905	0.890	2.226	4.452
5/32"	T-405/T-412	5699	0.570	1.425	2.850
3/16"	T-405/T-412	3958	0.396	0.989	1.979
1/4"	T-405/T-412	2226	0.223	0.557	1.113
3/16"	T-406/T-413	15831	1.583	3.958	7.915
1/4"	T-406/T-413	8905	0.890	2.226	4.452
5/16"	T-406/T-413	5699	0.570	1.425	2.850
3/8"	T-406/T-413	3958	0.396	0.989	1.979
1/2"	T-406/T-413	2226	0.223	0.557	1.113
N/A	T-2000	437	0.437	1.093	2.185
N/A	T-3000	655	0.655	1.638	3.275
N/A	T-5000	1092	1.092	2.730	5.460

* = Display will read PSI/10.

Table 8: Ejector Pin & Transducer Calibration Table

Calibration For Unlisted Ejector Pin Sizes

To measure pressures using unlisted pin sizes (i.e. not shown on the pin size chart), 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 CAL number.

Determining New Calibration Number

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

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

D_1 = Diameter listed on sensor calibration sheet (or identification label)
D_1 = 1/8" for Model T-405
D_1 = 1/4" for Model T-406
D_1 = 1/16" for Model T-410
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 (i.e., multiply the meter reading by two (2) to find the actual cavity pressure). Readout in psi/2.

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"

$$\frac{D_1^2}{D_2^2} = .7901$$

New CAL number = .7901 x 8,905 = 7,036

Example 2

Use a Model T-405 to measure pressure from a .075 dia. pin. The calibration number on the sensor identification label is 8,905 psi for a 1/8" dia. pin.

New CAL = $(.125)^2/(.075)^2$ x 8,905 = 2.77 x 8,905

New CAL number = 24,736 psi

Fill Time Clock

If an Autozero Trigger Input is being applied to the Model 3015, then Fill Time can be monitored on the display. When switching to the DATA position on the Mode Select switch, the letter "F" will appear on the left of the display to signify Fill Time. The Fill Timer starts when an Autozero Input is applied, and is stopped by one of three (3) methods:

Reaching The Set-Point Value

This method is appropriate if the Model 3015 is being used in conjunction with a mold pressure sensor. This is the default configuration set up at the factory.

Reaching A Peak

This method is generally used when making measurements of hydraulic pressure where the peak pressure occurs at transfer from 1st stage to 2nd stage on the machine.

Autozero Input "OFF"

In this mode, the timer will run for the duration that the Autozero signal stays on.

To determine which mode the Fill Timer is in, or to change the Fill Timer mode, perform the following:

1. From the DATA position of the Mode Select switch, toggle the Set switch UP [▲] twice to show the Model 3015 program version number.

2. With the version number displayed, enter the security code (5 seconds UP [▲], 3 seconds DOWN [▼]) with the Set switch. The display will show a "P," "h," or "t" to the left, and a zero to the right. (The zero has no meaning.)

3. Press the Set switch DOWN [▼] to change between "P" (Time to Set-Point), "h" (Time to Peak), and "t" (Autozero on Time).

4. Switch the Mode Select switch out of the DATA position to "save" the selected mode.

Appendix A - Universal High/Low Level Inputs

Input Signal Level

The Model 3015 is able to accept both low and high level signals as inputs. Low level signals such as signals from a strain gauge transducer must come into the Model 3015 through Pins "C" and "D" on the 6 Pin Bendix connector. High level (0 to 10 volts) will be expected between Pins "C" and "B."

The Model 3015 must be set up to accept the input signal for the particular application. There are three (3) options:

Low Level Only:

Used for strain gage or similar full bridge inputs. Pins "A" and "B" provide 10 VDC excitation. Pins "C" and "D" are used for positive [+] and negative [-] signal.

High Level Only:

Used with potentiometer based transducers, or other high level 0-10 Volt signals.

Externally Controlled Input Level:

The input will be taken from the low level input (Pins "C" and "D") if no connection is made to the control pin (Pin "F") on the Model 3015. If Pin "F" is grounded, a high level input will be accepted on Pins "C" and "B."

The externally controlled input will allow the user to specially configured a jumper in a cable connector, or an external switch, to automatically indicate the type of input to the Model 3015. The Level mode can also be changed internal to the Model 3015, without the use of a special cable.

To view or change this mode internally, perform the following:

1. From the DATA position on the Mode Select switch, move the Set switch UP [▲] twice to get the Model 3015 revision number.

2. With the version number displayed, enter the security code to get to the Fill Time Mode Select as described in the *Fill Time Clock* section. The letter "P," "h," or "t" will appear on the left of the display.

3. Enter the security code a second time. The display will show a letter "L" (for Low Level), "H" (for High Level), or "C" (for Externally Controlled Level) on the left of the display. For the "C" display, a "1" or "2" will be displayed on the right indicating Low or High Level input status based on the special cable input connection described above.

4. Move the Set switch DOWN [▼] again to change between the "L" (Low Level Input), "H" (High Level Input), and "C" (Externally Controlled Input).

5. Switch the Mode Select switch out of the DATA position to "save" the change.

When changing the Input Signal Level, the calibration procedure will apply as follows:

1. When switching from **High** Level Inputs to Low Level Inputs, the display will read in units of PSI. Enter the proper calibration number for the transducer type and pin size being used.

2. When switching from **Low** Level Inputs to High Level Inputs, the CAL Mode Select display position will require setting to the corresponding psi units for a 10.0 VDC input. Generally, this is 20,000 psi for 10.0 VDC input.

Figure 5 shows an example of a wiring configuration that uses the externally controlled input feature of the Model 3015.

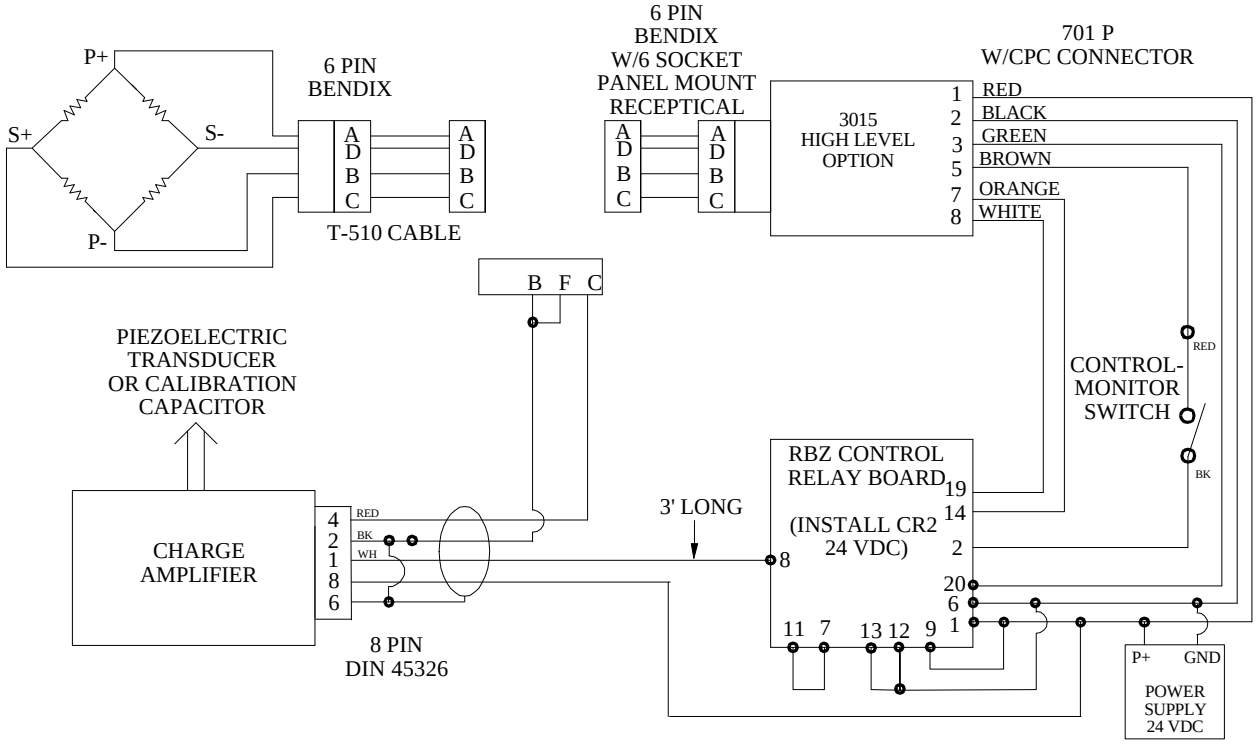


Figure 5

Universal Configuration Wiring Diagram

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