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# INSTALLATION & OPERATING INSTRUCTIONS
## Model 5082-0001, "Smart" Board (Ver.2.0)

## INTRODUCTION.

Kinematics, Model 5082-0001 (Ver. 2.0) "Smart" Board is a low-power, microprocessor based, four-channel, liquid level control board.

It is designed:

1. To provide multiplexed, pulse-modulated, D.C. power for up to four (4) Kinematics' optoelectronic, discrete point, liquid level sensors.

2. To receive their return signals as inputs.

3. And, to provide appropriate output signals, and fault indication to the "outside world" in accordance with the selected mode of operation.

## SPECIFICATIONS.

Microprocessor ....."Signetics" 87C752 or Equiv.
Board Size (With Snap-Track) ..... 4"W. X 6"L. X 1-1/2"H.
Mounting ..... 4"W. Snap-Track, or (4).156" Dia. Mounting Holes.
Input Voltage..... 12-28 VDC.
Outputs .....Open Collector Transistors, Sinking, 150 ma. Max., ea.
Power Consumption ..... 30 ma. (Min.), 55 ma. (Max.)
Operating Temperature Range ..... (-)20°C To (+)80°C.

## FEATURES.

• **Push-Button Calibration**. All sensors are calibrated simultaneously and instantly with the push of a button. In addition, there are two terminal block positions provided for adding an additional remote push-button "calibrate" switch in parallel with the on-board push button.

• **User Selectable Options**. The user selectable options include selection of operating "Mode", [i.e., "Independent", "Flip-Flop" (Pump "up"/ Pump "down") or "Combination"]; Sensor normally "Wet" or normally "Dry"; Length of time delay; Delay "enable/disable" and Sensor "enable/disable".

• **Ambient Light Immunity**. The Ver.2.0 "Smart" board provides a multiplexed, pulse-modulated input and filtered and amplified output to each sensor, for virtual immunity to false triggering by incident ambient light.

• **Continuous Fault Monitoring**. A fault monitoring algorithm in conjunction with the "learned" calibration data determines and signals the faulty condition of any non-functional sensor.

• **Common Outputs**. A common "SIGNAL" output transistor provides secondary signaling when any enabled sensor deviates from its "Normal" condition. A common "FAULT" output transistor provides secondary signaling if any of the enabled sensors is faulty. Mode of these common outputs is not user selectable. These outputs are both "HIGH" (Open) in their "NORMAL" states, and "LOW' (Grounded) in either their "SIGNAL" or "FAULT" states.

• **Watchdog Timer**. Prevents the processor from losing control of the program during momentary power losses or "glitches".

• **L.E.D. Indicators**. On-board L.E.D.'s provide visual indication of "Power ON/OFF", and of "SIGNAL" and "FAULT" conditions. "SIGNAL" and "FAULT" L.E.D.'s are "OFF" under "NORMAL" operating conditions. A steadily "ON" L.E.D. indicates a change in state (SIGNAL) from the sensor's "NORMAL" condition. A blinking L.E.D. indicates a sensor "FAULT".

• **Unpluggable Terminal Blocks**. The board has two, sixteen-position terminal blocks for I/O. In the event that the board has to be swapped-out for any reason, the wiring is quickly disconnected from the board simply by unplugging these terminal blocks. The board is also shipped with a small bag of red, plastic "polarizing lugs". These may be inserted in any unique pattern between the halves of each of the terminal blocks to assure correct reconnection of the wiring to the board after any disassembly. The fork-shaped pieces are inserted into the notches at the top of the board mounted receptacle. The flat pieces are inserted into the thin grooves at the rear of the removable plug.

## USER SELECTABLE OPTIONS.

• **Time Delay**. The user may select an operating time delay of from 0 to 15 seconds. This time delay is the interval between the moment the sensor sees a change in its "wet-to-dry" or "dry-to-wet" state, and the moment the board gives its output signal. It is often useful to program in a short time delay whenever there is turbulence or sloshing in the tank. Only one value for time delay may be selected. It will be the same for all channels where the time delay feature is enabled. If "zero" delay is desired on all channels, it is a good practice to disable the delay feature on all channels rather than setting the time delay to binary "zero". See the following section for a discussion of this feature.

The time delay interval is programmed by the 8-position DIP switch "SW2", positions 1, 2, 3 and 4. It is programmed as a pure binary number. The #1 position is the least significant bit. The #4 position is the most significant bit. The "ON" position of the switch is binary "0". The "OFF" switch position is binary "1". **Refer to Table 3., "Setting DIP Switch SW2 For Time Delay", on page 10 as an aid for correctly setting this time delay.**

• **Delay Enable/Disable**. Users may selectively enable or disable the time delay feature on each channel. Time delay will be "zero" on all channels where the delay feature is disabled. It will be equal to the selected time delay on all channels which have been enabled.

The delay enable/disable feature for sensor channels L1, L2, L3, and L4 is implemented on DIP switch "SW2", at positions 5, 6, 7 and 8 respectively. The time delay feature for a particular channel is enabled when that switch is in the "ON" position. Conversely, it is disabled when it is in the "OFF" position. **Refer to Table 1., "Summary Table of User Programmable Functions", on page 9 for further clarification.**

• **Sensor Enable/Disable**. The user may totally enable or disable any or all of the four sensor channels. This is useful in temporarily silencing alarms from faulty sensors, or in preventing such alarms in cases where all of the channels are not being utilized. Whenever a channel is not being used, it must be disabled to prevent a constant fault condition from being reported.

The sensor enable/disable feature for sensor channels L1, L2, L3 and L4 is selected on DIP switch "SW1", at positions 5, 6, 7, and 8 respectively. Again, as with the time delay enable/disable, a sensor channel is enabled when its corresponding switch is in the "ON" position. It is disabled when it is in the "OFF" position.

**Refer to Table 1.,"Summary Table of User Programmable Functions", on page 9 for further clarification.**

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• **Modes of Operation**. The user may select one (1) of three (3) Modes of operation for the board. They are the "INDEPENDENT" mode, the "FLIP-FLOP" (Pump "up" / Pump "down") mode and the "COMBINATION" mode. They are explained as follows.

1. INDEPENDENT MODE.

   The "Independent" mode of operation is chosen when it is desired to have the output transistors respond independently and directly to changes in the Wet/Dry state at each of the sensors. The microprocessor performs no "logic" functions in this mode. The output for each channel is "HIGH"(Open) in the "normal" state and "LOW" (Grounded) in the switched state. The four sensors may all be in one tank, or may be divided as required into any possible number of tanks up to four. Common "SIGNAL" and "FAULT" outputs are functionally active in this mode, and go "LOW" if any one of the four sensors changes state or experiences a failure.

2. FLIP-FLOP (Pump "UP" / Pump "DOWN") MODE.

   The "Flip-Flop" mode of operation is chosen when it is required to maintain a liquid level between two points in either a "pump-up" or "pump-down" system. The smart board allows this mode of level control in up to two tanks simultaneously. In this mode, the first and second sensor channels (L1 & L2) are paired together by the microprocessor. The third and fourth sensor channels (L3 & L4) also operate as a pair. The microprocessor only switches the transistor outputs when both sensors of a pair are wet, or when both are dry. The transistor outputs at terminal block positions (17) and (19) are complimentary outputs for the first sensor pair (L1,L2). The transistor outputs at terminal block positions (21) and (23) are complimentary outputs for the second sensor pair (L3,L4).

   In the "Flip-Flop" mode, the common "SIGNAL" output (25) is inactive (HIGH). However, both the individual "FAULT" outputs (18,20,22,24) and the common "FAULT" output (26) remain functional, and will go "LOW" when any one of the sensors experiences a failure or a fault.

3. COMBINATION MODE.

   The "Combination" mode is used when a pair of single point sensors, or a single dual-level sensor is to be used in the "Flip-Flop" mode, and one or two more are to be used in the "Independent" mode at the same time. A good example of this, would be when it is necessary to maintain a constant level between two points in a tank, and to have independent "HIGH" and "LOW" level alarm signals as well. Whenever this mode is selected, the input from the first sensor (L1) and the second sensor (L2) are paired together by the microprocessor and operate the (17) and (19) outputs in a complimentary manner as described in the "Flip-Flop" mode above. The third (L3) and fourth sensor (L4) act independently with their outputs at (21) and (23) respectively.

   Discrete "FAULT" outputs (18,20,22,24) act normally to signal faulty sensors individually. The common "SIGNAL" output at (25) acts only on the switching action of either of the two independently acting sensors. The common "FAULT" output at (26) will signal upon fault detection in any sensor.

The MODE OF OPERATION of the board is selected at DIP switch "SW3", positions 1 and 2. It is programmed as a "pure" binary number. The #1 position is the least significant bit. The #2 position is the most significant bit. The "ON" position of the switch is binary "0". The "OFF" switch position is binary "1". Positions 3-8 of SW3 are unused!

**Refer to Table 2., "Setting DIP Switch SW3 For Mode Selection", on page 10 as an aid for correctly setting the desired operating mode.**

• **Normally WET/DRY**. Users may select either Normally "WET" (Signal when dry), or Normally "DRY" (Signal when wet), mode of operation for each of the four sensor channels. This is particularly useful where the board is used to drive power consuming control devices such as relays or solenoid valves directly. In these cases, good design practice always dictates that the user select the mode that will keep output power "OFF" during the greater portion of the wet/dry cycle. This rule is also important, although of less significance, when the board's outputs are used as inputs to P.L.C.'s or computers, where, as a rule, signals are more low-powered, and may be inverted in software.

The "Normal" state for each sensor channel is selected at positions 1, 2, 3 and 4 of DIP switch "SW1". The switch position numbers correspond to the sensor channel numbers L1, L2, L3 & L4 directly. The "ON" position of each switch selects a "Normally Wet" (Signal when dry) mode. The "Normally Dry" (Signal when wet) mode is selected when any of these switches is toggled "OFF". **Refer to Table 1., "Summary Table of User Programmable Functions", on page 9 for further clarification.**

## INSTALLATION PROCEDURE.

Refer to the diagrams and tables referenced in each paragraph below, and follow these simple steps for quick and easy installation.

1. **Fasten the board in place**. It is recommended that the the snap-track provided with the board be used. This will allow easy removal and replacement of the board if it becomes necessary at any time in the future. If this is not convenient or desirable, there are four (4) .156" Dia. mounting holes for standoffs provided on the board, just inboard of the terminal blocks.

2. **Connect the sensors** to the terminal block at positions 1-16. Sometimes all of the terminal block positions are not used. Refer to the sensor outline and connection diagrams on pages 16-21 for the correct wiring scheme required for the particular sensor purchased.

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**Caution! Double check all sensor connections before applying power to the board. Improper connection will damage or destroy the sensors. Never connect or disconnect sensors while there is power applied to the board.**

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3. **Connect outputs.** Connect each of the required transistor outputs to its respective output device or P.L.C. Refer to the output connection diagrams on pages 22 & 23 of these instructions for the correct output wiring scheme. The ten outputs are at positions 17-26 of the sixteen-position terminal block.

4. **Connect power.** Connect t the board to a D.C. power supply of between 12 and 28 V.D.C. This is done at terminal block positions 31 & 32. Terminal block position 31 is the + VDC. input. Position 32 is ground.

5. **Program.** Select user programmable options as outlined on pages 4, 5 & 6, and summarized in the table on page 9.

6. **Calibrate.** Immerse all of the sensors in the working fluid. Apply power and press the on board "Calibrate" push button. All sensors will be calibrated simultaneously and instantly. Terminal block positions 27 & 28 may be used to connect an additional, normally open "calibrate" push button switch at a remote location such as a control panel. The board may be recalibrated in the same maner at any time.

7. **Your installation is now complete**!

## TABLES.

### Table 1.

**SUMMARY TABLE OF USER PROGRAMMABLE FUNCTIONS**

| DIP SWITCH | POSITION | SENSOR CHANNEL | BINARY | SENSOR FUNCTION | "ON" POSITION | "OFF" POSITION |
|---|---|---|---|---|---|---|
| SW1 | 1 | L1 | - | NORMALLY "WET" OR "DRY" | NORMALLY "WET" | NORMALLY "DRY" |
| | 2 | L2 | - | | | |
| | 3 | L3 | - | | | |
| | 4 | L4 | - | | | |
| | 5 | L1 | - | SENSOR ENABLE/ DISABLE | ENABLE | DISABLE |
| | 6 | L2 | - | | | |
| | 7 | L3 | - | | | |
| | 8 | L4 | - | | | |
| SW2 | 1 | ALL | 1 | SET TIME DELAY | BINARY "0" | BINARY "1" |
| | 2 | | 2 | | | |
| | 3 | | 4 | | | |
| | 4 | | 8 | | | |
| | 5 | L1 | - | DELAY ENABLE/ DISABLE | ENABLE | DISABLE |
| | 6 | L2 | - | | | |
| | 7 | L3 | - | | | |
| | 8 | L4 | - | | | |
| SW3 | 1 | ALL | 1 | SELECT MODE | BINARY "0" | BINARY "1" |
| | 2 | | 2 | | | |
| | 3 | UNUSED | | | | |
| | 4 | | | | | |
| | 5 | | | | | |
| | 6 | | | | | |
| | 7 | | | | | |
| | 8 | | | | | |

**Table 2. Setting DIP Switch "SW3" For Mode Selection.**

| BINARY | MODE | POS 2 | POS 1 |
|---|---|---|---|
| 01 | INDEPENDENT | ON | OFF |
| 10 | FLIP-FLOP | OFF | ON |
| 11 | COMBINATION | OFF | OFF |

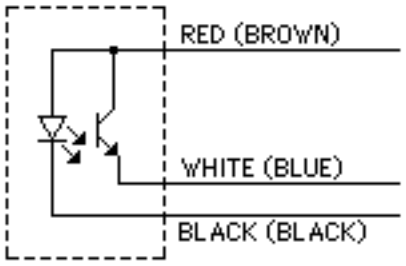
**Table 3. Setting DIP Switch "SW2" For Time Delay**

| TIME DELAY (SEC.) | DIP SWITCH (SW2) | | | |
|---|---|---|---|---|
| | POS 4 | POS 3 | POS 2 | POS 1 |
| 0 | ON | ON | ON | ON |
| 1 | ON | ON | ON | OFF |
| 2 | ON | ON | OFF | ON |
| 3 | ON | ON | OFF | OFF |
| 4 | ON | OFF | ON | ON |
| 5 | ON | OFF | ON | OFF |
| 6 | ON | OFF | OFF | ON |
| 7 | ON | OFF | OFF | OFF |
| 8 | OFF | ON | ON | ON |
| 9 | OFF | ON | ON | OFF |
| 10 | OFF | ON | OFF | ON |
| 11 | OFF | ON | OFF | OFF |
| 12 | OFF | OFF | ON | ON |
| 13 | OFF | OFF | ON | OFF |
| 14 | OFF | OFF | OFF | ON |
| 15 | OFF | OFF | OFF | OFF |

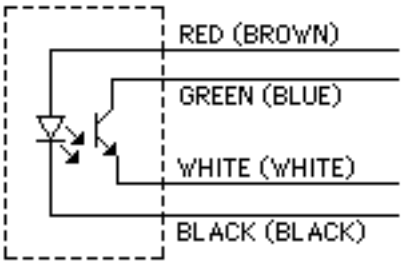
## SENSOR STYLES.

The following diagrams illustrate the various styles of Kinematics' liquid level sensors that will function with this version of the Smart Board. The diagrams on pages 15-21 in the following section illustrate how these different sensors are connected to the board. Note that some sensor styles have alternate color schemes for the wiring.

**STYLE "A"**
**SINGLE LEVEL SENSOR**
**(3-WIRE)**




**STYLE "B"**
**SINGLE LEVEL SENSOR**
**(4-WIRE)**



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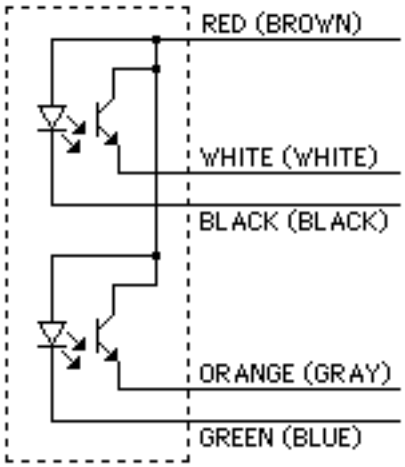
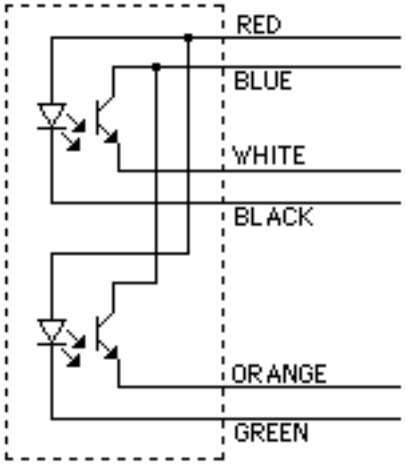
## STYLE "C"
## DUAL LEVEL SENSOR
## (5-WIRE, PARALLEL)




## STYLE "D"
## DUAL LEVEL SENSOR
## (6-WIRE)



## INSTALLATION & OPERATING INSTRUCTIONS
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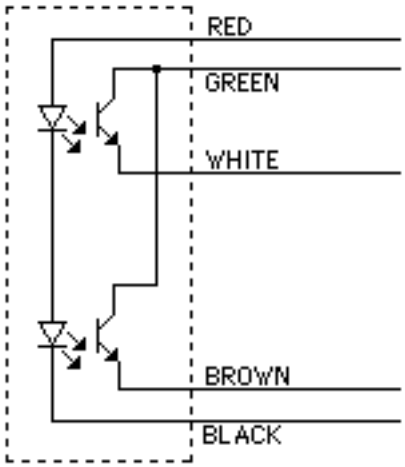
### STYLE "E"
### DUAL LEVEL SENSOR
### (5-WIRE, SERIES)



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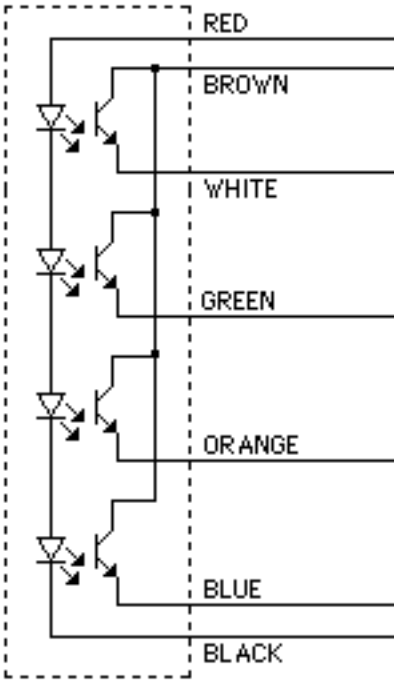
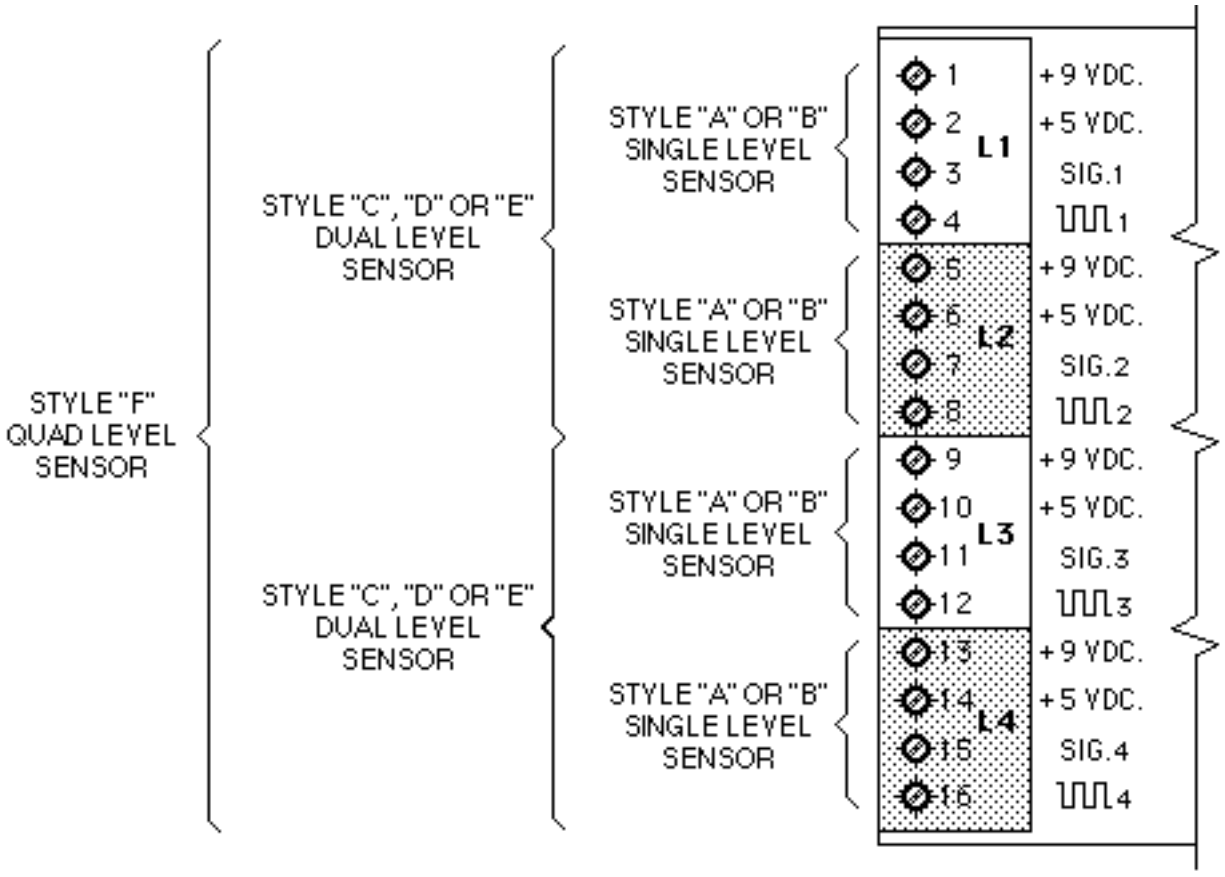
## STYLE "F"
## QUAD LEVEL SENSOR
## (7-WIRE)



## SENSOR CONNECTIONS.

All styles of Kinematics' optoelectronic liquid level sensors are connected to the Smart Board at terminal block positions 1 thru 16. Single level sensors, Styles "A" and "B", may be connected at L1(1, 2, 3, & 4), L2(5, 6, 7, & 8), L3(9, 10, 11, & 12) or L4(13, 14, 15, & 16). Dual level sensors, styles "C", "D" or "E", are connected at terminal block positions (1 thru 8) or (9 thru16). Quad level sensors, style "F", utilize the entire block, although not all positions, 1 thru 16. Different styles may be mixed and matched on the board. **It is important** to remember, however, that when the "COMBINATION MODE" has been selected, the sensors which are to act in the Flip-Flop mode must be connected to the board at positions 1-8, and the independently acting sensors must be connected at positions (9-12) and/or (13-16). Refer to the general connection scheme below, and to the specific connection diagrams for each sensor type on pages 16-21. Always "Disable" any sensor channel not being utilized to avoid any false signaling.

### General Connection Scheme



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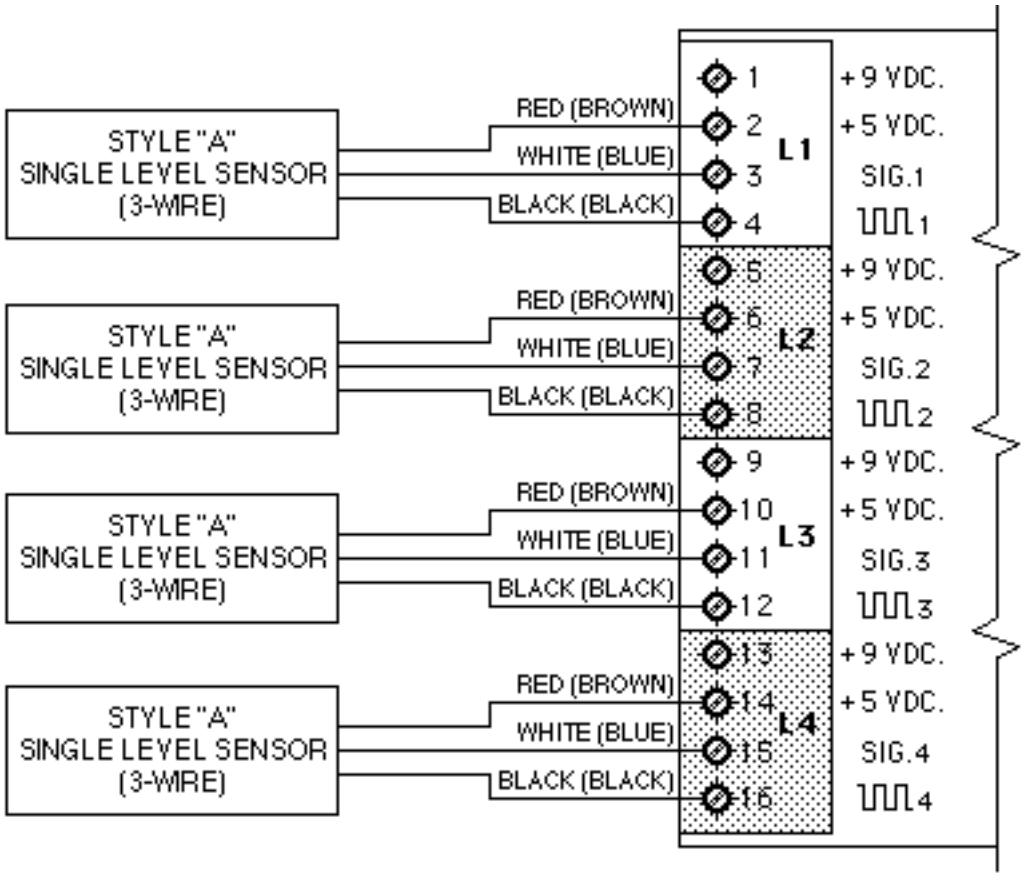
## Connecting Style "A" Sensors



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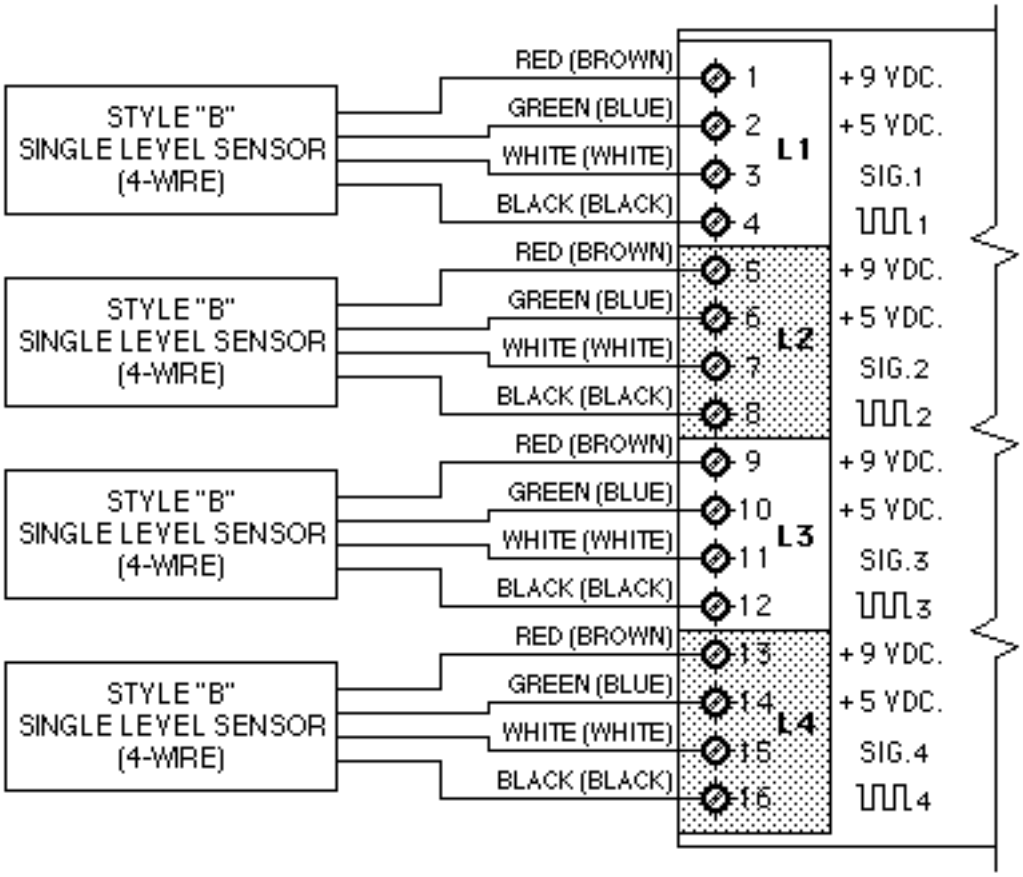
## Connecting Style "B" Sensors



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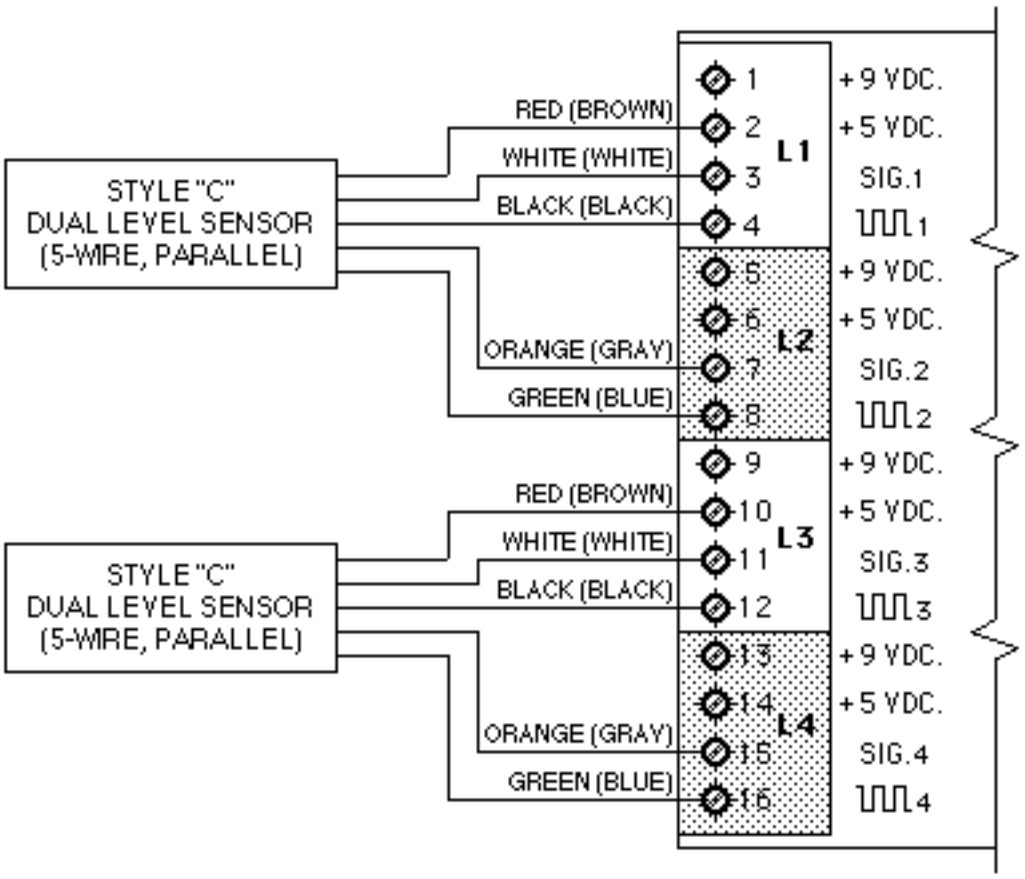
## Connecting Style "C" Sensors



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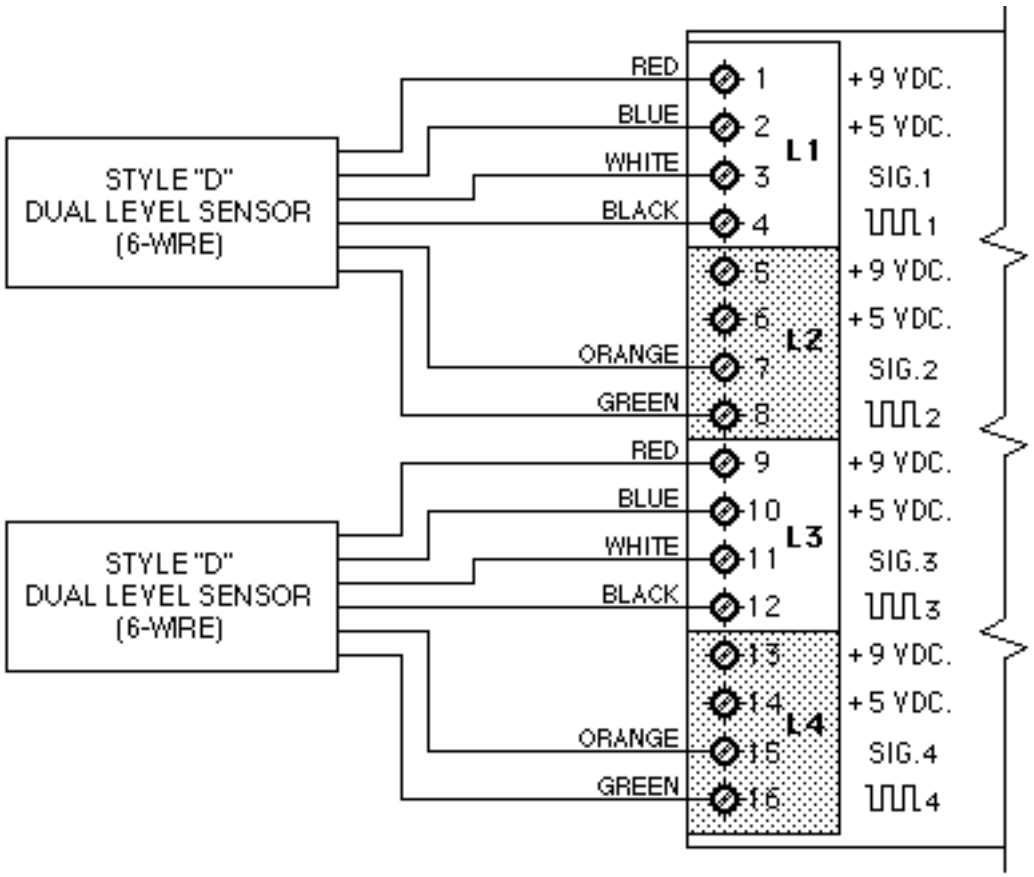
## Connecting Style "D" Sensors



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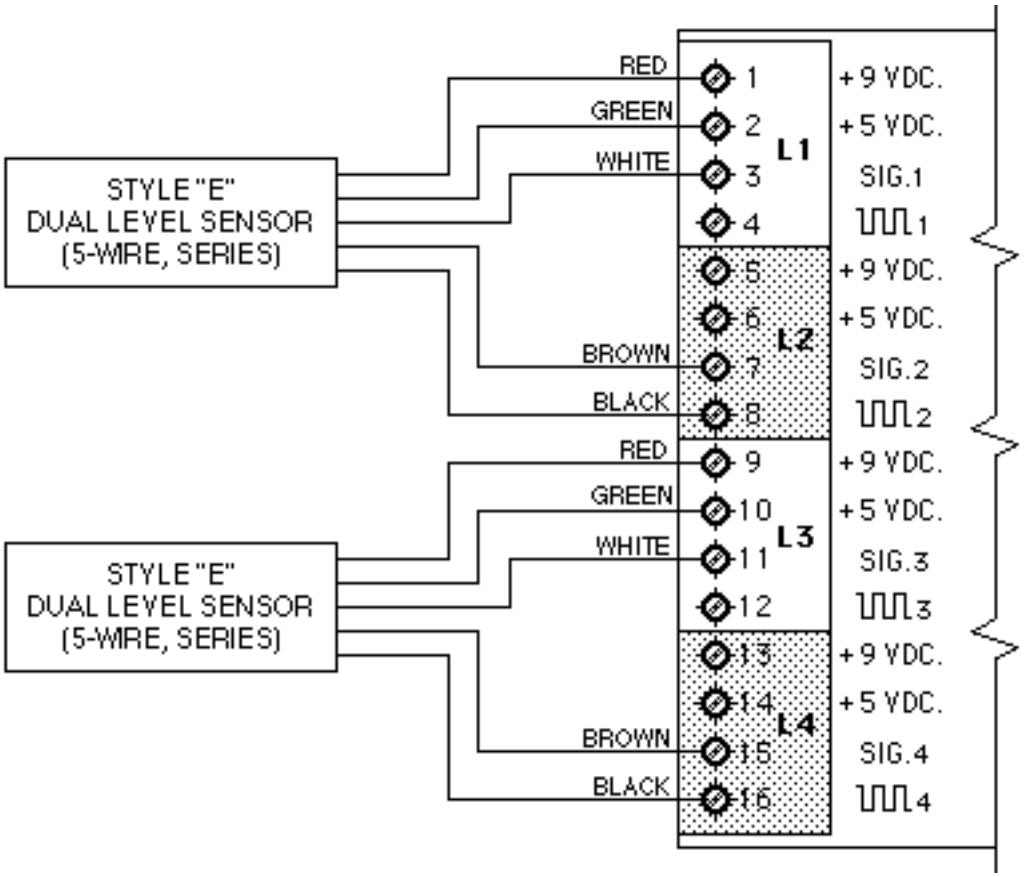
## Connecting Style "E" Sensors



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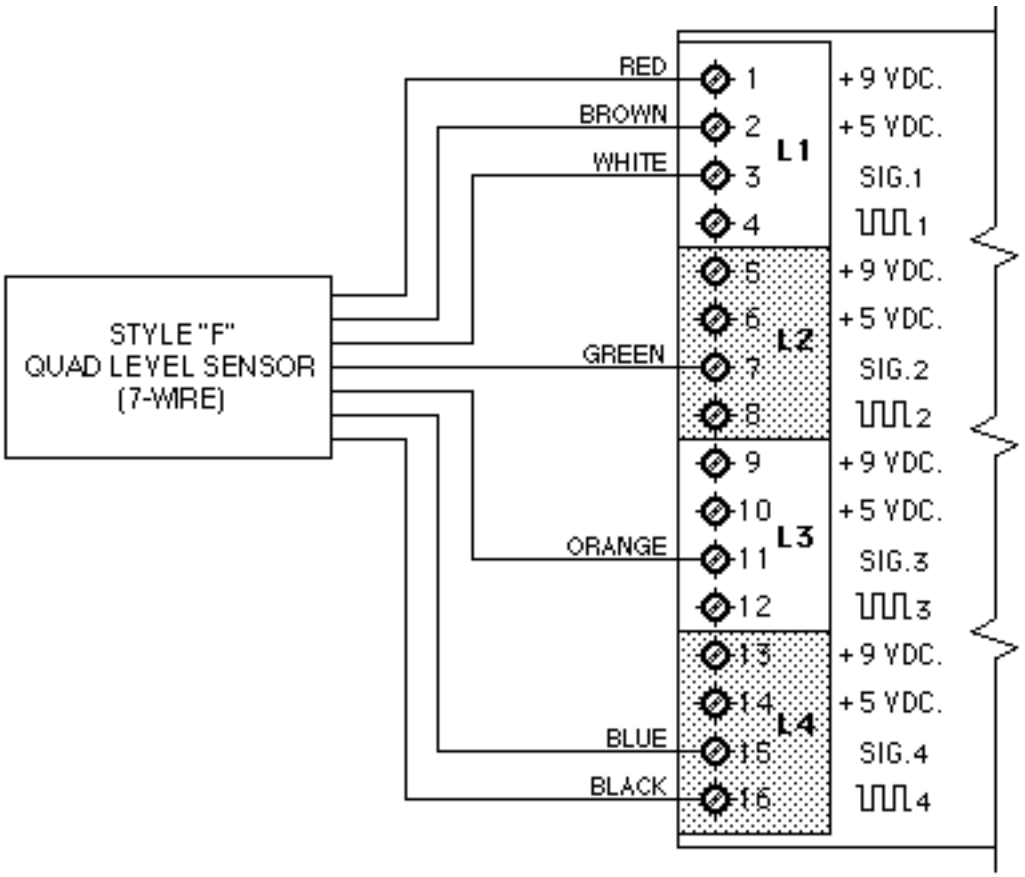
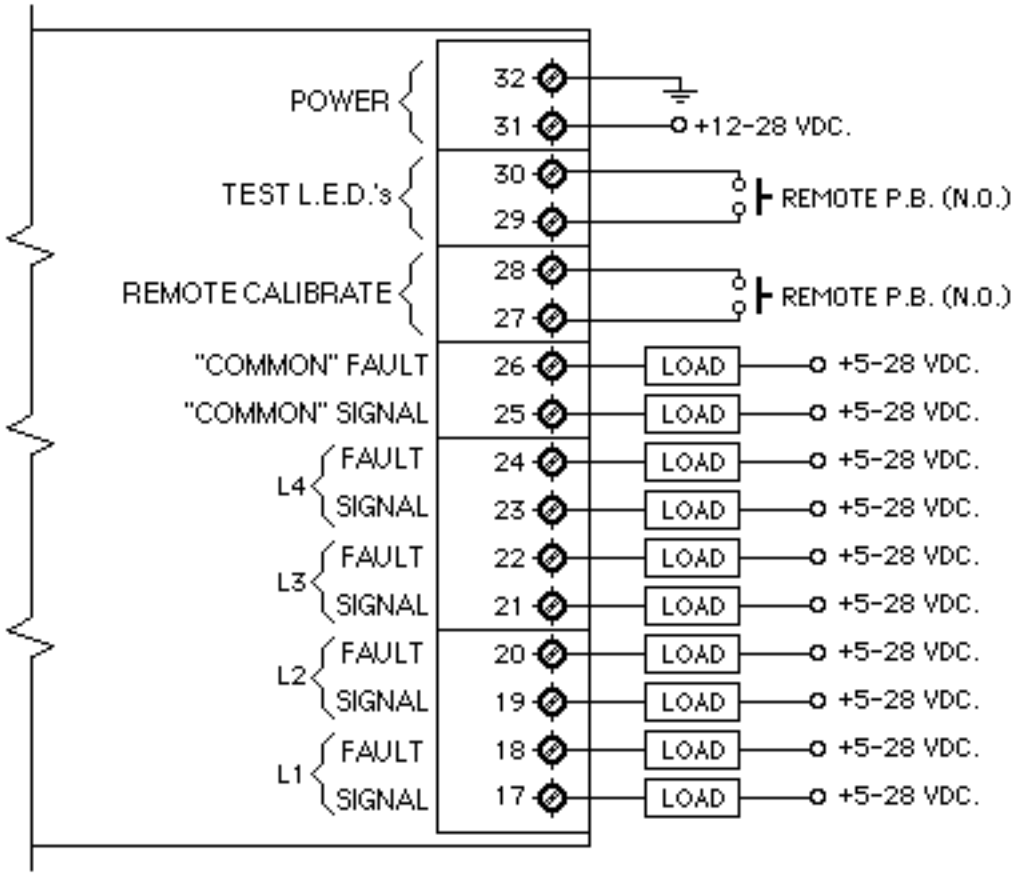
## Connecting Style "F" Sensors



## OUTPUT CONNECTIONS.

There are ten (10) open-collector transistor outputs on the board at terminal positions 17-26. Connect these points to the appropriate output device as shown in the diagrams below and on page 23. The state of each particular level sensor may be observed on the output L.E.D.'s, "D3" for channel (L1), "D4" for channel (L2), "D5" for channel (L3) and "D6" for channel (L4). The common outputs are observed at L.E.D. "D7".
"SIGNAL" and "FAULT" L.E.D.'s are "OFF" under "NORMAL" operating conditions. A steadily "ON" L.E.D. indicates a change in state (SIGNAL) from the sensor's "NORMAL" condition. A blinking L.E.D. indicates a sensor "FAULT". Power On/Off indication is observed at L.E.D., "D2".




**Typical Output Connection**

## INSTALLATION & OPERATING INSTRUCTIONS
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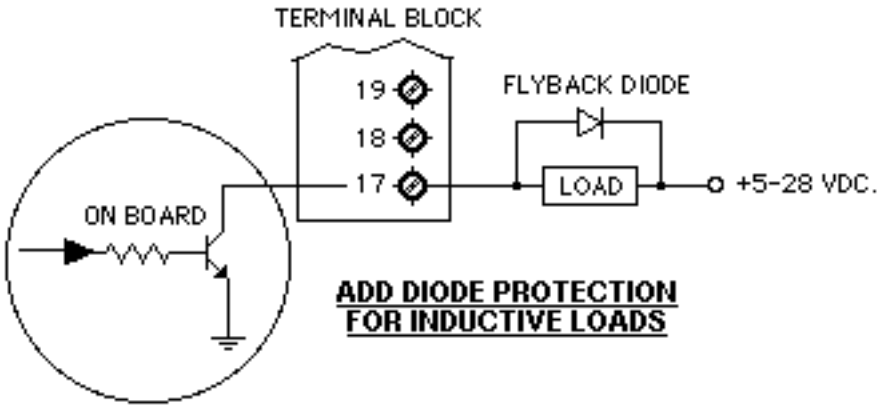


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**Warning!!! When driving inductive loads such as relay coils, with open collector transistor outputs, a flyback diode must always be provided across the load as shown above.**

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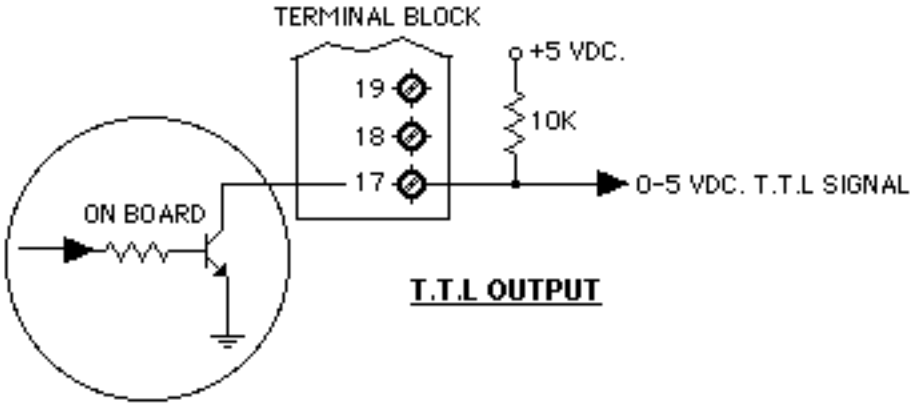
### Add 10K Pull-Up Resistor For 0-5 VDC. Output



## SUPPORT.

**Kinematics & Controls Corporation** provides full technical support for its products. If you need assistance with any problem, please call us **Toll-Free** at **1-800-833-8103.** Ask for technical support. Within N.Y. State, please call 516-595-1803.

## WARRANTY.

All equipment described herein is warranted to the original purchaser for one year from the date of purchase to be free from defects in material and workmanship, but not against damages caused by misuse, negligence, accident or faulty installation. When the equipment is installed and operated in accordance with factory recommendations and instructions, Kinematics & Controls Corporation will repair or replace free of charge any part of the equipment found to be defective, upon prepaid return of the part to the factory during the warranty period. In no event shall any liability or obligation of Kinematics arising from this warranty exceed the purchase price of the equipment.

All other warranties, whether expressed, implied or statutory such as warranties of merchantability or fitness for a particular purpose, are hereby excluded and disclaimed to the extent that they exceed the warranties expressly granted in this clause. In no event shall Kinematics be liable for consequential or incidental damages.

## IMPORTANT NOTICE TO THE PURCHASER.

All statements, technical information and recommendations are based on tests we believe to be reliable, but the absolute accuracy or completeness thereof is not guaranteed, and the following is made in lieu of all warranties expressed or implied.

Seller's and manufacturer's only obligation shall be to replace such quality of the product proved to be defective. Neither seller nor manufacturer shall be liable for any injury, loss or damage, direct or consequential arising out of the use or the inability to use the product. Before using, user shall determine the suitability of the product for his intended use, and user assumes all risk and liability whatsoever in connection therewith.

No statement or recommendation shall have any force or effect unless in an agreement signed by officers of seller and manufacturer.