Flo-Way Liquid Integrator

The ***Flow-Way*** Liquid Integrator, used in conjunction with ***Belt-Way*** Conveyor Belt Scales or ***Flow-Way*** Solids Impact Flow Meters, automates blending of liquid additives.

For example:
To blend a controlled amount of water, simply calculate the weight of the liquid per ton –
8 lb. per gallon / 2,000 = .004 (tons per gallon)

If your water meter outputs 1 pulse per gallon, then one pulse = .004 tons.

If your water meter outputs 100 pulses per gallon, then one pulse = .00004 tons.

The output from your liquid meter must be a TTL compatible square wave from 0-5 vdc. (It connects to the input marked Speed Sensor on the ***Flo-Way*** Liquid Integrator's Terminal Strip.)

The ***Flo-Way*** liquid Integrator connects to other ***Belt-Way*** products using a high speed NETWORK. RG62 A/U 93 ohm coaxial cable with solder-on BNC Connectors and Terminators required.

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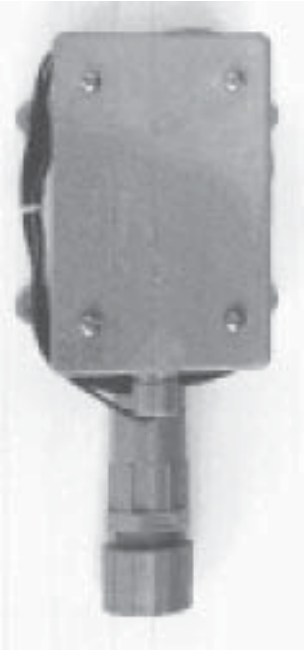
Control Parts

Control Box

Power Supply



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Electrical Installation

If you are using a **generator** for power install a **switch** in the 120 volt AC line to the power supply. To prevent possible loss of data at startup turn the generator on first and then the control. At shutdown turn the control off first and then the generator.

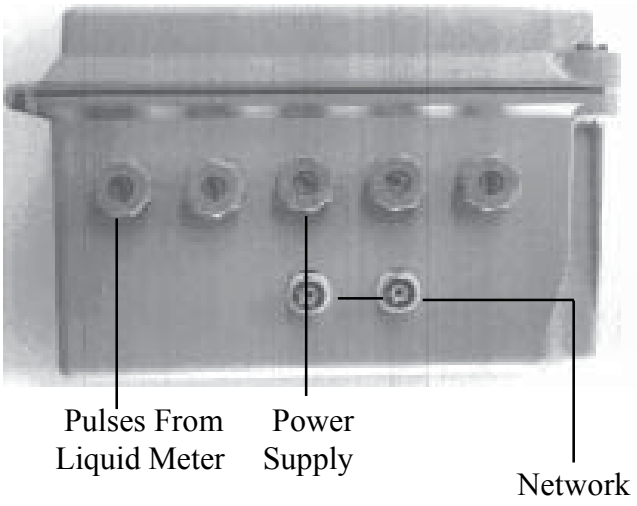
1. Open the door on the control box by loosening the two screws in the front of the door. The terminal strips are made in two pieces so you can disconnect each cable for testing by pulling the connector out of its socket. This allows you to remove a connector without disconnecting the individual wires.

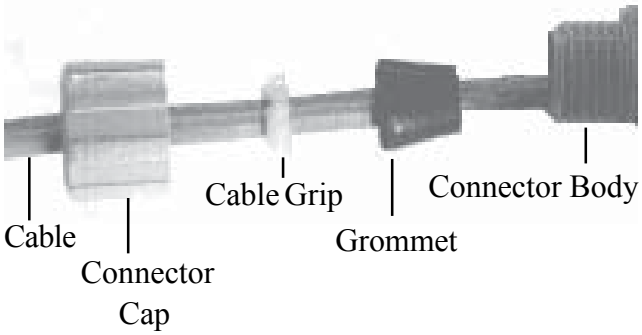
2. Leave a short cable in the cable grips which are not used so the cable grips will remain waterproof. Leave the jumper installed between SIG and A-GND on the connector marked ANGLE SENSOR. If you use the optional remote start / stop station remove this jumper when you connect the cable to the start / stop station.

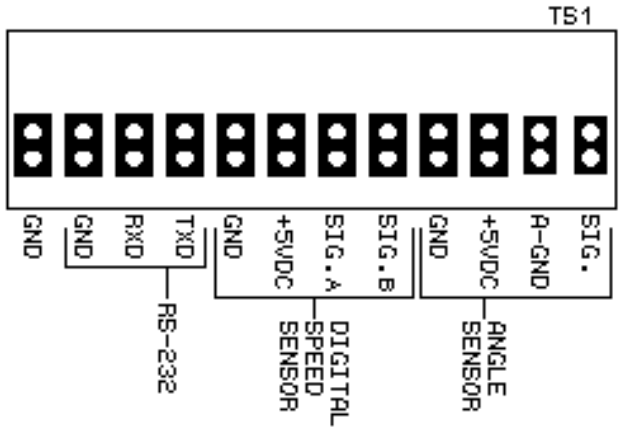
3. Connect the output from your liquid flowmeter to the input marked digital speed sensor. This signal must be a 0 to 5VDC TTL signal. Connect the +5VDC output and ground from the control box to the corresponding inputs on the liquid meter. Connect the signal output from the liquid meter to the SIG A input in the flowmeter control box. If your liquid meter does not supply a TTL compatible output additional electrical hardware must be used to convert your output signal to a TTL output. SIG B is not used.

4. If you are using the RS-232 serial port connect your RS-232 cable to TxD and GND using a 3 conductor terminal. There is no connection to RxD or to the INT-1 terminal.

Wiring TS1

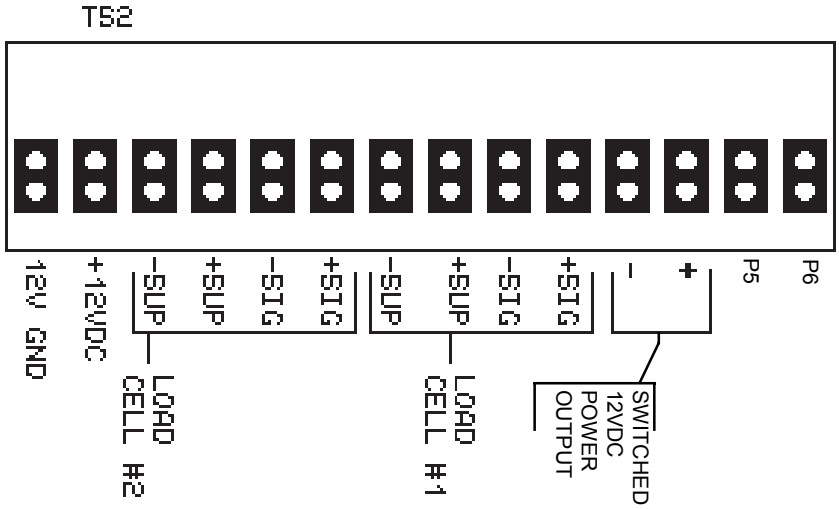






Electrical Installation

Wiring TS2



4. Next connect the cables to terminal strip TS2. First route the cable from the power transformer through the third cable grip from the left. IMPORTANT ... be absolutely certain to connect the 12 volt ground wire to the terminal marked 12V GND. Connect the wire marked + to the terminal marked +12VDC. The positive lead will be identified by a colored stripe or rib or by a tag. If these wires are connected backwards the control will not work. Do not connect the 120 volt AC power to the transformer yet.

5. There are no connections to the terminals marked LOAD CELL #1 and LOAD CELL #2.

6. The terminals marked - and + are switched 12VDC power output used to power the I/O option board. Note that on circuit boards prior to PB-8 these terminals are used for G1 and G2 jumpers for the load cells. Beginning with boards marked PB-8 these terminals are used to power the I/O board.

DO NOT PUT A JUMPER BETWEEN THESE TERMINALS OR YOU WILL SHORT OUT THE 12 VOLTS DC POWER AND BLOW A FUSE.

7. The terminals marked P5 and P6 are not used.

Electrical Installation

8. The terminals marked BNC 1 and BNC 2 have BNC connectors that extend through the bottom of the box. The connectors may have vinyl caps over them to protect them. If you have purchased the network option you must connect the network using coaxial cable type RG62A/U. BNC connectors are available in several styles. Some solder on to the cable. Some crimp on to the cable. Others simply twist on to the cable. It is important to use a high quality connector. Most network problems can be traced to poor connections between the cable and the connector. We provide a high quality cable capable of being buried in the ground. We recommend using a connector that solders on to obtain the best connection. See the drawing at the end of the manual.

9. The network is an industry standard network. There are 3 possible cable configurations. The simplest and least costly is called a bus configuration. The total length of cable in one bus is 1000 feet. You can connect up to 8 stations on one bus. If your layout meets these requirements the simplest way to connect the controls is run the cable from one device to the next. It does not matter which connector you use for the cable coming in and the cable going out. At one end of the cable the last control will have a cable going in but none going out. You must connect a 93 ohm terminator to the last connector. This is simply a BNC connector with a terminating resistor in it. At the other end of the cable will be the main PC which may be in an office or trailer. It must be connected with a BNC "TEE" connector and a 93 ohm terminator. Remember the maximum cable length is 1000 feet and the maximum number of devices is 8.

10. The second configuration is called a star. It uses a central hub which is not used in a bus configuration. Assume the hub is an 8 port active hub. You can have 8 devices connected. One device connects to each port. You can run the cable 2000 feet for each device. You can connect more than 8 devices by making one of the devices another active hub.

11. The third configuration mixes both the star and the bus. You may have five or six flow meters within 1000 feet of each other. You may want to put the PC in an office some distance away. You can connect the flow meters in a bus configuration and have the last device on the bus be an active hub. You can then run 2000 feet of cable from the hub to the office. If the office is farther than 2000 feet you can use additional active hubs every 2000 feet. The total length of the network cannot exceed 4 miles. The active hubs will require 120 volt AC power.

12. After all cables are connected you can connect the 120 volt AC power to the transformer. The transformer is housed in a small waterproof electrical box. The transformer is a wall plug unit connected to a socket. Connect your 120 volt AC wiring to the socket provided. The 12 volt cable exits the box through a waterproof cord grip. The 120 volt wiring enters the box through a separate cord grip. Replace the cover on the plastic box and tighten the screws.

Configuration

1. On the inside of the control box door is the display circuit board. It contains SW1 which is a 9 position slide or rocker switch used to configure the control. The positions are marked 1 through 8 and are described below. Position 9 controls the backlight.

2. If you turn on position 1 the entire keypad is enabled except the **CLEAR** key. You can view and change all data. This position has no effect on the **CLEAR** key for clearing total weight.

3. If you turn on position 2 the **CLEAR** key is enabled to clear total weight. You can set the total weight back to zero by pressing the **CLEAR** key twice within 2 seconds if you are viewing the weight and rate. If position 2 is off you can not set the total weight back to zero.

4. Position 3 enables the **CLEAR** key to clear master totals. If position 2 is on and position 3 is off you can clear scale totals but not master totals.

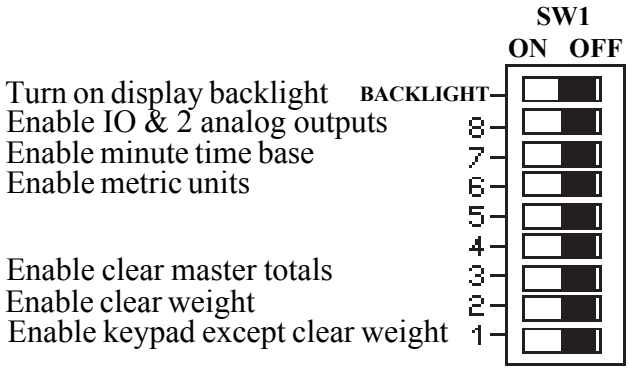
5. Position 4 is not used.

6. Position 5 is not used.

7. Position 6 selects English or metric units. If it is off the weight will be displayed in tons and the rate will be in tons per hour or per minute. If position 6 is on the weight will be displayed in metric tons and the rate will be in metric tons per hour or per minute.

8. Position 7 determines the time base for the rate display. If position 7 is off the rate will be per hour. If position 7 is on the rate will be per minute. Set this switch before entering set rate, maxrate, or log rate.

9. Position 8 enables the IO option board and first two analog outputs. This is an option that allows you to connect the flow meter to a chart recorder which accepts a 4 to 20 mA. signal. If you have this option installed position 8 must be on to enable the outputs. If you do not have this option installed position 8 must be off. If position 8 is on but you do not have the option installed your keypad and display will not function. If you have this option see the section describing the use of function key F2.



Configuration

1. Again on the inside of the control box door is another 9 position switch SW2. It is also used to configure the control as described.

2. Position 1 is not used.

3. Position 2 enables the optional two additional analog outputs. You must have the IO option board installed and must have the additional two outputs installed before you turn on this switch. If you turn on this switch without having the correct hardware installed the keypad and display will not function.

4. Position 3 enables the control serial port to work with a COLOR BRITE large character display.

5. Position 4 disables changing the load weights.

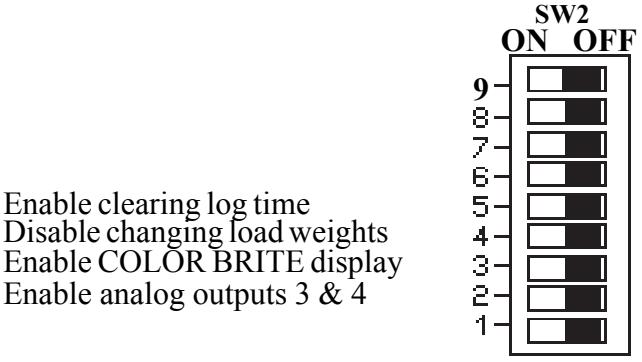
6. Position 5 enables clearing log time.

NOTE:

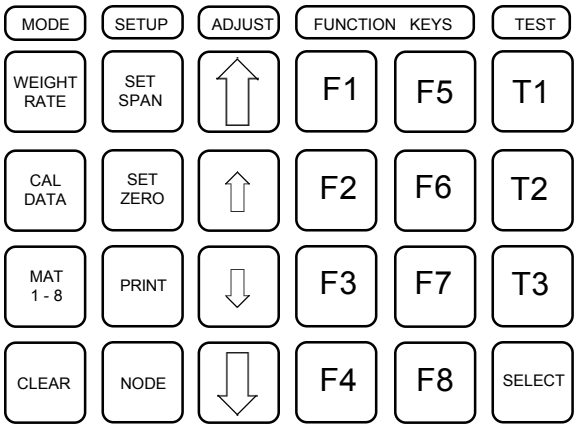
Some controls have slide switches for SW1-SW4. SW1 and SW2 are located on the door. Sliding these switches away from the door hinge turns them on. SW3 (GAIN) and SW4 (ZERO) are located on the circuit board inside the body of the control box. Sliding these switches toward the word GAIN or ZERO turns them on.

Some controls have rocker switches for SW1-SW4. SW1 and SW2 are located on the door. Pushing down on the rocker on the side of the switch away from the door hinge turns them on. SW3 (GAIN) and SW4 (ZERO) are located on the circuit board inside the body of the control box. Pushing down on the rocker on the side of the switch closest to the word GAIN or ZERO turns them on.

Some switches may be labeled OFF and ON but some may be labeled OPEN. Open means off.



The Keypad



Mode Keys

1. The mode keys run from top to bottom in the first column. The top key is the normal mode. It is the **WEIGHT RATE** mode. The display shows the accumulated weight, the current rate, the number of pulses per second coming from the liquid meter, and the scale node number. The control will be in this mode when it is turned on.

2. The next key down is the **CAL DATA** key which shows calibration data. The display shows the current rate and the tons per pulse to calibrate the flowmeter to your liquid meter. You can use the **SELECT** key to select coarse, medium, and fine adjust and then use the arrow adjust keys to enter the value for each pulse from your liquid meter.

3. The next key down is the **MAT 1-8** key. It displays a screen showing PID SHIFT, RESET I, and MIN RATE. These are used in conjunction with the PID loop if it is used. PID SHIFT is a method of making the PID loop more sensitive with light loads. RESET I will reset the "I" term. MIN RATE will turn on output PWM0 when the rate is above MIN RATE.

4. The lower key in the first column is the **CLEAR** key. It is used to clear several items. If you are looking at the normal display seen by pressing the **WEIGHT RATE** key, then the **CLEAR** key will set the total weight back to 0. Switch SW1 position 2 must be on and you must press the key twice within 2 seconds to clear the total weight.

If you press the **CAL DATA** key you can use the select key to select coarse, medium, or fine adjust and set the tons per pulse to 0 using the **CLEAR** key. Switch SW1 position 1 must be on. In a similar manner, you can select node and set it to 1 using the key.

If you press the F2 key you can use the **SELECT** key to select any of the setpoints and use the **CLEAR** key to set them to 0. No configuration switches need to be on so you can always change your formula without accidentally changing calibration.

You can also set any of the maxrate values to 0 using the **CLEAR** key but switch SW1 position 1 must be on. Once you set the correct maxrate values you would not want them changed accidentally.

The Keypad

If you press the F3 key you can use the **SELECT** key to choose log rate or log time and set either to 0 using the **CLEAR** key. Switch SW1 position 1 must be on to clear log rate. SW2 position 5 must be on to clear log time.

If you press the F4 key to view the master total you can press the **CLEAR** key twice within two seconds to clear the master total. Switch SW1 position 3 must be on. You can also use the select key to select hours, minutes, seconds, month, date, or year and set each to 0 using the **CLEAR** key. To do this switch SW1 position 1 must be on.

If you press the F5 key you can use the **SELECT** key to choose load weight or cutoff weight. You can set either to 0 any time using the **CLEAR** key. No configuration switches need to be on. This allows you to change your load size and still prevent accidental changes to the scale calibration.

If you press the F7 key you can use the **SELECT** key to choose log data and turn it off using the **CLEAR** key. You can also select any of the 12 special codes and use the **CLEAR** key to set each to 00. Switch SW1 position 1 must be on.

Setup Keys

1. The top key in column 2 is the **SET SPAN** key. It is used not used in the liquid control.

2. The next key down is the **SET ZERO** key. It is not used in the liquid control.

3. Next is the **PRINT** key. It is used to print a ticket if you have a serial printer connected to the control.

4. The bottom key is the **NODE** key. It is used to set the scale node number for use on the network.

Adjust Keys

The adjust keys change the item you have chosen using the select key. Depending on what screen you are viewing the select key will cause a small arrow to appear next to the items you will be able to adjust.

1. The **LARGE UP ARROW** increases most items by 256. It increases load weight and cutoff weight by .200. On items limited to 256 possibilities or items where you select from a few options the large up arrow key increases the item by 1 just as the small up arrow key does.

2. The **SMALL UP ARROW** increases the item by 1.

3. The **SMALL DOWN ARROW** decreases the item by 1.

4. The **LARGE DOWN ARROW** decreases most items by 256. It decreases load weight and cutoff weight by .200. On items limited to 256 possibilities or items where you select from a few options the large down arrow key decreases the item by 1 just as the small down arrow key does.

The Keypad

Pressing any of the arrow keys will cause the described action to occur. Holding any of the arrow keys down will cause the key to repeat until you release the key.

The arrow keys are disabled if switch SW1 position 1 is turned off except you can still adjust the setpoints for analog outputs, load weights, and cutoff weights. This allows you to prevent someone from accidentally changing your calibration but you can change your formula if you are using the analog output and you can change your batch size and cutoff weight if you are loading trucks.

Function Keys

Each function key is described on a separate page later in this manual.

Test Keys

The test keys are used to view data to diagnose any problems that might occur. They are described later in this manual.

Select Key

The **SELECT** key is used to select various item which you can program. When you press the **SELECT** key a small arrow will appear after the item you can program. Some items can be set to zero using the **CLEAR** key. Use the arrow adjust keys to program the item you have selected.

Network Station Address

If you are using the network to collect data in a PC or you are using a remote display you must set each control box to a unique station address. Address 0 is not allowed. Address 255 is reserved for the central PC. Valid addresses you can use are 1 to 254. We suggest using address 1 for scale 1, address 2 for scale 2, etc.

To set the network station address press the node key. Then press the select key and a small arrow will appear after the word NODE. Use the arrow keys to set the node for this scale. Be sure no two scales are set to the same address. If any two scales have the same address the network will not work.

When you press the node key the display appears as shown below.

NETWORK NODE	**1**
CONFIG	**56**
DIAGNOSTICS	**114**
STATUS	**119**

You can only change the network node. The other data is for troubleshooting the network if there are problems. The normal data will be 56 for config. Diagnostics will be 114 if the PC was on before the scale was turned on, or 122 if the scale is turned on before the PC. Status normally will be 119. If the scale is not connected to any other network device diagnostics will alternate between 34 and 162. Status will be 116.

Calibration

1. Press the **CAL DATA** key. The display will appear as shown below.

RATE TPH	**12.345**
TONS PER PULSE	
.00000000000	
ADJUST DISABLED	

2. Switch SW1 position 1 on the door must be turned on to enable the keypad.

3. Press the **SELECT** key. The bottom line will change to show COARSE ADJUST. The large up and down arrow keys will adjust the tons per pulse in increments of .001. The small arrow keys will adjust in increments of .00001.

4. Press the **SELECT** key again. The bottom line will change to show MEDIUM ADJUST. The large arrow keys will now adjust in increments of .000001. The small arrow keys will adjust in increments of .00000001.

5. Press the **SELECT** key again. The bottom line will change to show FINE ADJUST. The large arrow keys will now adjust in increments of .000000001. The small arrow keys will adjust in increments of .00000000001.

By following the above procedure you can set the exact value in tons per pulse for your meter. For example, water weighs about 8 pounds per gallon. Divide the 8 pounds by 2000 to convert to tons per gallon. Dividing 8 by 2000 equals .004 tons per gallon. If your meter outputs one pulse per gallon then one pulse equals .004 tons so that is what you program for tons per pulse. If your meter outputs 100 pulses per gallon then you must divide the .004 by 100 which equals .00004 tons per pulse.

If your meter pulse value is based on so many pulses per gallon, you must know the weight of your liquid in pounds per gallon. Then divide that weight by 2000 to convert to tons per gallon. Then divide the result by the number of pulses per gallon that your meter outputs. The final result is the tons per pulse value to enter.

If you do not know the weight of one gallon of your liquid press the T1 key. The top line is a pulse counter. Press the **CLEAR** key to set it to zero. Now weigh an empty bucket. Run some liquid into the bucket. Weigh the liquid and subtract the weight of the empty bucket. Assuming your weight is in pounds, divide the result by 2000 to convert it to tons. Now divide the result by the number of pulses shown on line 1 of the T1 display. This is the number of pulses counted for the amount of liquid you just ran into the bucket. The result is the tons per pulse value to enter in the **CAL DATA** display.

6. When adjust is not disabled the clear key will set the tons per pulse value to .00000000000. You can use this feature to clear any value before programming the correct value.

7. Press the select key again. The bottom line will now show ADJUST DISABLED. Be sure to turn off switch SW1 position 1 on the door when you are finished.

Print Key

Printing a Ticket

The print key is used to print a ticket if you have set the RS-232 port to printing tickets. When you want to print a ticket simply press the **PRINT** key.

You can also print a ticket using the remote print input located on the optional IO board. It is input P4.5. Of course you must have the optional IO board installed.

In this discussion of the RS-232 port STX means start of transmission. It's value is 2. CR means carriage return. It's value is 13. LF means line feed. It's value is 10.

If you are using the 12 special codes to send control codes to your printer you will need to refer to your printer manual to tell you what the codes are. The codes you will program use the hexadecimal number system. You may also need to refer to an ASCII chart to find the hexadecimal values of letters used in the control codes. All the information you need should be in your printer manual.

Function Key F1

Test Weight

If you do not have an I/O option board the F1 key is not used. If you do have an I/O option board press the F1 function key. The display will appear as shown below.

```
LOW PULSE ALARM
PULSES/SEC        123
```

Press the **SELECT** key one time. A small arrow will appear after the word ALARM. You can use the arrow keys to change from low speed alarm to speed interlock. Press the **SELECT** key again. The arrow appears after PULSES/SEC. You can use the arrow keys to set the value of the pulses per second you want to use for the low pulse alarm or pulse interlock. If you have chosen low pulse alarm whenever the pulses per second coming from your liquid meter is below the programmed pulses/sec value then output P4.3 will be on. When the pulses per second coming from your liquid meter is above the programmed pulses/sec value then output P4.3 will be off. If you selected pulse interlock output P4.3 will be off when the pulses per second coming from your liquid meter is below the programmed value. Output P4.3 will be on if the pulses per second from your liquid meter is above the programmed value.

Press the **SELECT** key again and the small arrow will disappear. Press the **WEIGHT RATE** key to return to the normal display.

Function Key F2

Analog Outputs

1. The F2 function key is used to control the meter analog outputs. You must have the IO option board installed in the flow meter and switch SW1 position 8 must be turned on. Otherwise if you press the F2 key the display will say KEY DISABLED on line 4 of the current display. You may also have the optional additional two outputs installed. If you do then switch SW2 position 2 must also be turned on.

If you do not have the IO option board installed and you turn on switch SW1 position 8 the keypad and the display will lock up. If you do not have the additional two outputs installed and you turn on switch SW2 position 2 the keypad and display will lock up. If this happens turn the meter off. Turn off the switch that is causing the problem. Turn the flow meter on again. The keypad and display will function.

The following assumes you have the IO option board installed with the two additional outputs. Switch SW1 position 8 and switch SW2 position 2 are turned on. If you do not have the additional two outputs lines 3 and 4 on the display will be blank.

Press the F2 function key. The display will appear as show below. No configuration switches need to be on to program setpoints.

#1 SETPOINT	**100.00%**
#2 SETPOINT	**10.00%**
#3 SETPOINT	**5.50%**
#4 SETPOINT	**2.25%**

Press the SELECT key. A small arrow will appear after the word SETPOINT on line 1. This means you can use the adjust keys to enter your setpoint for analog output 1. Press the SELECT key again. the small arrow appears on line 2. Each time you press SELECT the arrow moves to the next line. If the arrow is on the last line the next time you press SELECT the arrow will disappear. Program the setpoint for each output. See the examples that follow for a guide.

2. Press the F2 function key a second time. The display will appear as shown below.

#1 MAXRATE	**500.00**
#2 MAXRATE	**10.00**
#3 MAXRATE	**7.50**
#4 MAXRATE	**4.25**

Press the SELECT key. A small arrow appears after the word MAXRATE on line 1. Use the adjust keys to enter the desired maximum rate for output 1. Press the SELECT key again and the small arrow appears on line 2. Repeat for lines 3 and 4. Maxrate is normally in tons per hour. Enter values for each output installed. Switch SW1 position 1 must be on.

3. Press the F2 function key a third time. The display will appear as shown below.

#1 OUTPUT 4 TO 20 MA
#2 OUTPUT 0 TO 20 MA
#3 OUTPUT 4 TO 20 MA
#4 OUTPUT 4 TO 20 MA

Press the SELECT key. A small arrow appears after the word OUTPUT on line 1. Press either up arrow key to select 0 to 20 MA. Press either down arrow key to select 4 to 20 MA. Repeat for all outputs. Switch SW1 position 1 must be on.

Function Key F2

Analog Outputs

4. Press the F2 key a fourth time. The display will appear as shown below.

PID CHANNEL	**OFF**

Press the **SELECT** key. A small arrow appears after the word CHANNEL. If you want to use one of the IO channels as a PID loop control use either up arrow key to change the word OFF to the channel you want to use as a PID loop. For example, if you want to use channel 1 press either up arrow key once. The display will now appear as shown below.

PID CHANNEL	**1**
PID ACTION	**REVERSE**
PID SETPOINT	**LOCAL**
P = 10 I = 100	**D = 3**

After you have selected the desired channel press the **SELECT** key again. The small arrow will appear after the word ACTION. Press either down arrow to select reverse action. Press either up arrow to select forward action. Forward and reverse action are described later.

Press the **SELECT** key again. The small arrow will appear after the word SETPOINT. Press either down arrow to select local setpoint. Press either up arrow to select remote setpoint. Local and remote setpoints are described later.

Press the **SELECT** key again. The small arrow will replace the = after the P. Use the adjust keys to enter the P value. Press the **SELECT** key again. The small arrow will replace the = after the I. Use the adjust keys to enter the I value. Press the **SELECT** key again. The small arrow will replace the = after the D. Use the adjust keys to enter the D value. The large arrow keys will change P, I, and D by 50. The small arrow keys will change P, I, and D by 1. The action of P, I, and D are described below.

USING THE PID LOOP CONTROL

You can use the built in PID loop control to control the rate material is running through the flow meter. The first step is to select the channel you want to use as described above. If you have a two channel IO board you can select channel 1 or 2. If you have a four channel IO board you can select channel 1,2,3, or 4. The other channels can be used for their standard functions.

Next you must select the PID action. Most applications will use reverse action. This means that if the rate goes up above the programmed rate the output will go down to slow down the feeder to reduce the rate back to the programmed rate. The electrical output goes in the reverse direction from the rate error. If the rate is too high the electrical output will go down. If the rate is too low the electrical output will go up. You may find a situation where increasing the electrical output will decrease the rate. An example would be a system controlled by air pressure and more air pressure reduces the feed rate. In this case if the rate goes above the set rate the electrical signal must also go up to reduce the feed rate. Since the electrical signal goes in the same direction as the rate the action is called forward action.

Function Key F2

Analog Outputs

Next you must select local or remote setpoint. Normally you will select local setpoint. This means you will program the rate through this flow meter in this control box. First you will press the **WEIGHT RATE** key. Line 3 will show PULSES/SEC. Press the **WEIGHT RATE** key again. Line 3 will change to show SET RATE .00. Press the **SELECT** key and the small arrow will appear after the word RATE. Use the adjust keys to enter the rate you want in tons per hour. If you are using metric units the rate will be in metric tons per hour. If you have turned on switch SW1 position 7 to display your rate in tons per minute then your set rate will also be in tons per minute.

If you have two or more ***FLO-WAY*** meters you can program one to be the master and several others to be slaves. The master can either be a wild flow or you can use the PID loop on the master to control the rate using the local setpoint. You then set up each slave as a remote setpoint. Next you program the setpoint percent using the F2 key for each slave. Enter the percent you want to add of the slave ingredient compared to the material flowing through the master flow meter. Be sure to enter the percent for the channel you have selected to be the PID channel.

You must connect the network using RG62A/U coaxial cable between the master and all slave controls. The order that the controls are connected together does not matter. Put a 93 ohm terminator on the two control boxes at opposite ends of the cable. In other words, if you have one master and one slave, each will have a terminator. If you have a master and two slaves, two of the three controls will have 93 ohm terminators. See the wiring diagrams and drawings at the end of the manual.

If you are using the PID loop as a local setpoint then the setpoint percent and maxrate for that channel are not used. You program the desired set rate on line three of the weight rate display. If line three is blank press the **WEIGHT RATE** key again to display set rate. If you are using the PID loop as a remote setpoint then the setpoint percent for that channel is programmed to the percent you want to add in relation to the rate flowing through the master. The maxrate for that channel is not used. If you are using any controls as remote setpoints then you must program the master control to send its rate to the controls with remote setpoints. See the section on the F3 key for details.

If there is any problem with the network the alarm output P4.3 will turn on. If the master control is using the PID loop and the output is at its maximum the alarm output P4.3 will turn on. If a control is set up as a master and any of the slaves are at maximum output the master will turn on alarm output P4.3. If there is a problem with the network the master and all slaves will run a setpoint of 0.00 and turn off.

Function Key F2

Analog Outputs

You can use input P4.7 to tell the PID loop to run at a setpoint of 0.0 which will stop the feeder. If the control is set up as a master all slaves will also stop. **Important**...if you stop the system in this manner any motors still have power applied and could start up unexpectedly. Before attempting to work on any of the feeders in the system be sure to disconnect power so the feeder cannot start up unexpectedly.

Now you must select the values for P, I, and D. The PID loop stands for proportional, integral, and derivative. Mathematically, the control equation looks like this:

Output =
(P * (setpoint rate - actual rate)) +
(I * (theoretical weight total - actual weight total))
-
(D* (present rate - last rate))

The control works something like your car. The output is the gas pedal and the instruments are the speedometer and odometer. You look at your speedometer and see how fast you are going and compare that to how fast you want to go. If there is a large difference, you press hard on the gas. If there is a little difference, you press a little bit. This is the P term in your car control equation. You also look at your odometer and check to see how many miles you have traveled and compare that to how many miles you should have gone had you been going fast enough. This is the I term in your car equation. You also do not want to accelerate and decelerate too fast and be real jerky in your driving. The D term looks at your change of speed or acceleration rate such as when you are going down hill. This helps to restrain you from accelerating too fast. If you are going uphill it lets you give it more gas to keep from slowing down too much. It has a kind of damper action and keeps you smooth.

Any or all of these control terms can be too aggressive or too lax in their application to your control. If they are too aggressive, you can get wild oscillations and jerky control like pushing hard on the gas and then backing off, back and forth like the teenage hot rodder. If they are too lax, you will be like the 90 year old that takes forever to get up to speed. You want to tune your PID control to give you a responsive yet smooth control. Also, an important point to remember is that once you are up to speed, the P term and the D term will basically be zero and do no controlling. The I term will be doing the work with very small changes coming from the P and D terms.

We recommend starting with P = 10, I = 100, and D = 3. Increasing the value of P will cause the feeder to start out faster when it is first turned on but it may start so fast that it overshoots the desired set rate and then slows down too much to compensate and continues to oscillate. If that happens the value of P is probably too large. The I term works on the difference of where you are versus where you should be. The D term acts as a brake. If either is too large the response time may be too fast and again the control may begin oscillating. If the set rate is very low you may need to make all three terms larger to increase the response time. If you are running very high set rates you may need to make all three terms smaller. A value of 0 will disable that term. The maximum number is 255. The PID loop will work using only an I term. Never set I = 0.

Function Key F2

Analog Outputs

5. Press function key F2 a fifth time. The display will appear as shown below.

#1 OUTPUT	**149**
#2 OUTPUT	**220**
#3 OUTPUT	**75**
#4 OUTPUT	**92**

This display shows the digital value of each analog output. If the output is 4 to 20 mA then this number will be from 51 which is 4 mA to 255 which is 20 mA. If the output is 0 to 20 mA then this number will be from 0 which is 0 mA to 255 which is 20 mA. The **SELECT** key is not used with this display since there is nothing to program on this screen.

EXAMPLES

1. A CHART RECORDER

Assume you want to control a chart recorder on output #1 using a 4 to 20 mA signal. First set your setpoint for output 1 to 100.00%. Next assume the maximum rate you will run will be about 475 tons per hour. Set your maxrate for output 1 to 500 tons per hour. This will cause your chart pen to be near 100 % of full scale when you are running near 500 tons per hour. If you set your maxrate to 1000 tons per hour then at 500 tons per hour your pen would be at 50 % of full scale and it would never use the upper 50 % of the chart paper. This makes your chart harder to read because it is compressed. That is the reason you want to set maxrate to slightly more than you normally will be running at full load.

Select 4 to 20 mA for the desired output and connect the wires to the chart recorder as shown on the wiring diagram at the end of the book.

2. CONTROLLING A FEEDER (OPEN LOOP)

Assume you have a feeder that is controlled by a 4 to 20 mA signal. At 20 mA the feeder has a maximum rate of 5.00 tons per hour. You want the feeder to add 10 % additive to the material flowing through the flow meter, using analog output 2. First set your setpoint for output 2 to 10.00%. Next set your maxrate for output 2 to 5.00 tons per hour. Finally select 4 to 20 mA for your output. Connect the feeder as shown on the wiring diagram at the end of the book.

3. USING VOLTAGE OUTPUT

Assume the feeder in example 2 uses 0 - 5 volts DC instead of 4 to 20 mA as the control signal. Program the setpoint and maxrate the same as example 2. Select 0 to 20 mA for the output. Connect the feeder as shown on the wiring diagram at the end of the book. Note that when you connect the output as a voltage you must add a resistor which determines the output voltage. The connections are different than they are for current outputs.

Current loops and voltage outputs **ARE NOT ISOLATED** and reference or use a common ground. The negative current loop terminal will vary in voltage above ground from .5VDC at 4 mA to 2.5VDC at 20 mA. The voltage at the positive current loop terminal is dependent on the external resistance of the device it is tied to. If the device you use is also not isolated but has the same ground as the scale, then use the voltage configuration instead of a current loop. If the flow meter and external device have different ground potentials you must purchase a separate isolation unit to properly isolate the flow meter and the external device.

Function Key F2

Analog Outputs

4. USING THE PID LOOP (CLOSED LOOP)
Assume you have one flow meter and you want to control the feed rate to maintain some rate through the meter. First press the F2 key and set up the PID loop. Select the desired channel, reverse (or forward) action, and local setpoint. Begin with P = 10, I = 100, and D = 3. Next press the **WEIGHT RATE** key. If line 3 is blank press the **WEIGHT RATE** key again to display set rate. Then press the **SELECT** key and use the arrow keys to enter the desired set rate. If you intend to change the time base from tons per hour or tons per minute by turning switch SW1 position 7 on or off you must set the switch before entering your set rate.

You can use input P4.7 to make the feeder stop but remember that there is still power on the feeder motor and the feeder could start unexpectedly.

If the control is at maximum output alarm output P4.3 will turn on. This can be used in conjunction with a solid state relay to turn on an alarm horn.

5. CONTROLLING ADDITIVES WITH THE PID LOOP (SLAVE OUTPUTS)
Assume you have two meters. The first one is set up to weigh the main product. The second meter is going to be used to add 15% of another ingredient. You can set the first scale to use its PID loop to control the feed rate of the main material as described above or you can simply use the meter to measure the main flow. Assume you have used the **NODE** key to make the first meter node 1 and the second meter node 2. You must press the F3 key and set the first meter to send rate to nodes from 2 to 2. Now set the PID loop for the second meter to remote setpoint. This tells the second meter that it is going to get the rate from a master meter over the network. It will then multiply the rate from the master by the setpoint percent you enter into the second meter. Assume the second meter is set to use channel 2 for the PID loop. Press F2 to display the setpoint percents and enter 15% for setpoint #2. Connect the two meters using RG62A/U coaxial cable. Install a 93 ohm terminator on the unused BNC connector of each meter.

PID NOTES

1. You can have several meters set up as slaves to one master which will allow you to blend materials. You must set the nodes for the slaves so they are in consecutive order. For example, you could have three slaves at nodes 4,5, and 6. You could not have the three slaves to one master at nodes 4,5, and 7 because you have to tell the master to send rate to nodes from some value to some value. You can enter from 4 to 6 but if you enter 4 to 7 the master will detect no meter at node 6 and shut down all the feeders.

2. You can have one master and several slaves and then have another master with its own slaves on the same network cable. They will be completely independent and one will not be aware of the existence of the other.

3. You can also continue the cable to a personal computer and do data collection from the masters and all slaves as well as from other meters not using the PID loop. You can also network Sauk Valley Systems ***BELT-WAY*** belt scales as masters or slaves with ***FLO-WAY*** solids impact flow meters.

Function Key F2

Analog Outputs

4. If you are using two or more controls in a master slave setup there are two conditions when the alarm output may turn on. First if any of the controls using the PID loop is running at maximum output the alarm output will turn on in that control box and also in the master control. Next if there is a network problem the slave that does not receive a message from the master will turn off by itself. The master will detect the problem and force the rest of the slaves to turn off. If the master is running the PID loop then the master feeder will also turn off. However, if the master is not running the PID loop but is simply measuring rate then the control cannot shut off the master feeder. In this case you can use the batching output to interlock the master feeder motor starter. First press the F5 key and press the **SELECT** key to position the small arrow after the words LOAD WT. Press the **CLEAR WEIGHT** key to set the load weight to .000. Then press the small down arrow key to set the load weight to 9999999.999. Now the batching output P4.0 will turn on and stay on. If there is a network failure the batching output will turn off until the problem is resolved. You can use this output and a solid state relay to interlock your master feeder motor starter. Now if there is a network problem the master not running the PID loop and all slaves will turn off.

You can also use the batching output to actually run a specific amount of material through the flow meter. When the master flow meter reaches the load weight minus the cutoff the batching output will turn off. This will shut off the master feeder so the rate will drop to zero. This will cause all the slaves to drop to zero as well.

5. If you are running two or more controls as master and slaves you must set them all to display rate in tons per hour or tons per minute. They must all be in the same units. Switch SW1 position 7 is used to select the time base.

Function Key F3

Log Rate and Send Rate

Press function key F3. The display appears as shown below.

LOG RATE	**350.00**
LOG TIME	**12H 45M**
SEND RATE TO NODES	
IS TURNED OFF	

Press the SELECT key. A small arrow appears after the word RATE. You can use the CLEAR key to set the log rate to .00 or use the adjust keys to enter your desired log rate. Switch SW1 position 1 must be on to change log rate. Be sure to turn switch SW1 position 1 off when you are done setting log rate so nobody can accidentally change your meter calibration. The control will keep track of the hours and minutes that the meter is running at a rate equal to or higher than the log rate you enter. In other words, if you enter a log rate of 300 tons per hour the log time will show you how many hours and minutes your production was at or above 300 tons per hour. If you want to have your rate displayed in tons per minute instead of tons per hour you must turn on switch SW1 position 7 before you enter your log rate. Otherwise your log time will be incorrect.

Press the SELECT key again. Now the arrow appears after the word TIME. You can use the CLEAR key to set the log time to 0H 0M. In order to be able to clear log time switch SW2 position 5 must be turned on.

Press the select key again. The small arrow appears after the word OFF or after the word FROM if send rates to nodes is turned on. If the word OFF appears then the control is not sending its rate to any other controls. This is the normal mode and this feature must be OFF unless you have one or more additional controls set up as slaves to the master control and the network is connected. Assume you do have one additional control set up as a slave and this control is the master. Assume that the slave control is programmed to be node 4. Using the SELECT key position the small arrow after the word OFF. Then use either up arrow key change the word OFF to FROM 4. Press the SELECT key again. The arrow appears after the word TO. Use either up arrow key to enter 4. Now this control is set up as a master and node 4 must be set up as a slave to this master. Any control set up as a slave or set up as a stand alone control must have the feature send rates to nodes turned off. Only a master should have this feature turned on and then it must be set up to send rate to nodes from and to the slaves you have connected. Assume you have three slaves set up as nodes 4, 5, and 6. You would program the master to send rate to nodes from 4 to 6. The display would appear as shown below.

LOG RATE	**350.00**
LOG TIME	**12H 45M**
SEND RATE TO NODES	
FROM 4 TO	**6**

Function Key F4

Master Total, Time, and Date

Press function key F4. The display appears as shown below.

```
MASTER TOTAL IS
      1234.567
TIME 11:08:24
DATE 07/28/94
```

Every time you clear the flow meter total weight the total is added to the master total before it is cleared. If you want to clear the master total you must have switch SW1 position 3 turned on. Then if you press the **CLEAR** key twice within two seconds while you are looking at the master total it will be set to zero. You can prevent someone from clearing the master total by keeping switch SW1 position 3 turned off. You do not need to press the **SELECT** key to clear the master total.

If you press the **SELECT** key a small arrow will replace the : after the hours. At this time you can set the hour to 0 using the **CLEAR** key or you can use the adjust keys to set the hours to the correct time. Each time you press the **SELECT** key the arrow will move to minutes, seconds, month, date, and finally year. In this manner you can set the time and date.

Time and date are only used if you are printing tickets or are logging data.

Beginning with version 6.08, if you have the RS-232 port set up to print tickets, you can print the master total. Simply press function key F4 so you are looking at the master total. Then press the **PRINT** key to print a ticket. The ticket will be similar to a normal ticket but line 4 will say MASTER TOTAL and the master total amount will be printed. See the instructions for function key F7 to set the scale up to print tickets.

Function Key F5

Loading Trucks, Barges, and Rail Cars

Function key F5 is used if you want to use the flow meter for loading trucks, barges, or rail cars. You must have the optional IO board installed in order to use this feature. If you do not have the optional IO board you can still program this screen but the output will not function.

Press the F5 function key. The display appears as shown below. If switch SW1 position 5 is off line 3 will be blank.

LOAD WT	**25.000**
WEIGHT	**12.345**
CUTOFF	**.000**

Press the **SELECT** key. A small arrow appears after the WT. The arrow means you can set your load weight using the adjust keys. After setting the correct load weight press the **SELECT** key again. The arrow will appear on line 4 after CUTOFF.

Use the adjust keys to set your cutoff. You may need to experiment with the cutoff to find the correct value. The cutoff is used to shut off the feeder early to allow for material already flowing to reach the flow meter.

You may change the values of the load weight and cutoff weight any time. You do not need to have switch SW1 position 1 turned on. This allows you to change load size and cutoff while preventing someone from accidentally changing the scale calibration. If you do not want your operators to be able to change the load weight turn on switch SW2 position 4. This will disable the adjust keys so the load cannot be changed and selecting one of eight preset load weights will also be disabled.

The load weight is the amount you want to put in the truck. In this example it is 25.000 tons. The cutoff weight allows the feeder to turn off before all the material has reached the flow meter. Otherwise each load might be over weight.

Press the **SELECT** key again. The display will appear as shown below.

LOAD #1	**.000**
LOAD #2	**.000**
LOAD #3	**.000**
LOAD #4	**.000**

Function Key F5

Loading Trucks, Barges, and Rail Cars

The small arrow will appear after #1. Use the adjust keys to program load 1. Press the **SELECT** key and continue to program loads 2, 3, and 4. When you press the **SELECT** key after the arrow is on #4 the display will change to show loads 5,6,7, and 8. In this manner you can program eight different load weights. Switch SW1 position 1 must be on to program the eight preset load weights. Be sure to turn off switch SW1 position 1 when you are done to prevent somebody from accidentally changing your calibration or preset load weights.

Once you have pressed function key F5 the eight function keys are used to select preset load weights 1 - 8. To escape from this feature so that you can use the other function keys to perform their normal functions press the **WEIGHT RATE** key. Now when you press any function key other than F5 they will perform their normal function. Once you press F5 the eight function keys again will select preset load weight 1 - 8. F1 will select load preset 1, F2 will select load preset 2, etc.

The angle sensor input can be used to connect a selector switch which will allow your operators to select preset load weights 1 - 8. Sauk Valley Systems has available a remote start / stop station which will allow your drivers to load their trucks without ever touching the flow meter control keypad. You can also select your preset load using the function keys F1 - F8. You may want to write down the load weight for presets 1-8 and perhaps laminate it to keep it weatherproof.

Material going into the truck must pass through the flow meter. The batching output P4.0 should be connected to a feeder which feeds material to the flow meter.

Whenever the flow meter weight total is less than the load weight minus the cutoff weight the batching output will be on. When the flow meter weight total is equal to or greater than the load weight minus the cutoff weight the batching output will be off.

The batching output must be connected to an optional start / stop station. See the wiring diagram in the section of wiring diagrams for details on how to connect the batching output. You can purchase a start / stop station from Sauk Valley Systems or make your own. The start / stop station should be mounted next to the flow meter control box.

HOW TO BATCH IN GENERAL

1. Program your eight spans for materials 1 - 8 if you have enabled selecting different materials. Use the **MAT 1-8** key, **SELECT** key, and adjust keys.
2. Press function key F5 to enter the load mode.
3. Program your cutoff using the **SELECT** and adjust keys.
4. Select material 1 - 8 using the **SELECT** and adjust keys if this feature is enabled.
5. Program your load weight using the **SELECT** and adjust keys or select from load 1-8 using the function keys F1 - F8 or remote start / stop station.
6. Clear the flow meter total using the keypad **CLEAR** key or remote clear button on the start / stop station connected to P4.4. The total will be added to the master total.
7. As soon as you clear the total the batching output will turn on. The feeder will not turn on until you press start on the start / stop station.
8. Press start on the start / stop station when you are ready. If you need to stop the feeder before the load is complete press the stop button.

Function Key F5

Loading Trucks, Barges, and Rail Cars

9. When the flow meter total reaches the load weight minus the cutoff the batching output will turn off.
10. If you are printing tickets press the remote print button connected to P4.5 or press the **PRINT** key.
11. Repeat the sequence from step 4 for each new load.

HOW TO USE THE START / STOP STATION

1. Press function key F5 to enter the load mode.
2. If enabled select material 1 - 8 using the **SELECT** and adjust keys on the control keypad. You can not select different materials using the remote station.
3. Use the rotary selector switch to select 1 of 8 preset load weights.
4. Press the enter load pushbutton. The selected preset load weight will appear on the control display line 1. If the load weight is not correct repeat 3-4.
4. Press the clear pushbutton on the start / stop station. The flow meter weight total will go to .000 and the ready light will turn on.
5. Press the start pushbutton. The run light will turn on and the feeder will start running.
6. If you need to stop the feeder for any reason before the load is complete press the stop pushbutton. The feeder will stop and the run light will turn off. The ready light will stay on. Press the start pushbutton to continue loading the truck.
7. When the weight on the flow meter reaches the load weight minus the cutoff weight the feeder will turn off automatically. The run light and the ready light will turn off.
8. If you have a printer connected to the scale you would have already set the control up to print tickets following the instructions for the F7 key. Simply press the print pushbutton to print a ticket.

Function Key F6

Pulsed Output and Auto Zero

Press function key F6. The display appears as shown below.

TONS PER PULSE	**OFF**
PULSE ON TIME	**50%**

Press the **SELECT** key. A small arrow appears after the word PULSE. You can now use the adjust keys to select from the following options:

TONS PER PULSE OFF .01 .10 1.0 10

If you select OFF the pulse output will be disabled. Any other selection requires the optional IO board. If you select .01 you will get a pulse every time the weight increases .01 tons. This will work up to about 150 tons per hour. If you select a pulse every .10 tons this will work up to about 1500 tons per hour.

Press the **SELECT** key again. A small arrow appears after the word TIME. You can now use the adjust keys to select from the following options:

PULSE ON TIME 50% 10 MS --- 500 MS

If you select 50% you will have a true quadrature wave output on P4.1 and P4.2. This will drive a remote display with quadrature input or a PLC. The advantage of using quadrature waveform is that if the flow meter is losing weight the remote counter or PLC will detect this and maintain the correct weight. See the wiring diagram in the wiring section for details.

If you select pulse on times from 10 to 500 milliseconds use either output P4.1 or P4.2. The pulse will remain on for the programmed time. You will not have a true quadrature waveform so do not select pulse on times other than 50% if you are connecting the pulsed output to a device with a quadrature input.

Function Key F7

RS-232 Serial Output

Function key F7 is used to control the RS-232 output to a printer, a remote display terminal, a remote scoreboard display, or a PLC at 1200 baud, 8 data bits, no parity, 1 stop bit, no handshake. Press the F7 key. The display appears as shown below.

RS-232	**OFF**

Press the **SELECT** key. A small arrow appears after the word RS-232. You can use the adjust keys to select from the following options:

RS-232 OFF TICKETS WEIGHT RATE or
WEIGHT&RATE

Press either of the up arrow keys. The display appears as shown below.

RS-232	**TICKETS**
USE	**0 LINE FEEDS**

Press the select key again. Now the small arrow appears after the word USE. You can use the adjust keys to select from the following options:

USE 0 - 10 LINE FEEDS or
USE 1 FORM FEED or
USE 1 - 12 SPECIAL CODES

If you select 1 - 12 SPECIAL CODES the following two lines will appear on lines 3 and 4 of the display.

00	**12**	**54**	**7A**	**F3**	**DE**
FA	**03**	**1B**	**45**	**A0**	**FF**

In this section of the instructions you are programming the RS-232 output to print tickets. The ticket can be used for loading trucks. Your ticket printer may need a few line feeds or a form feed to advance the ticket out of the printer. You can select from 0 to 10 line feeds to follow the ticket or you can select one form feed. If you have unusual conditions you can select up to 12 characters to be sent to the printer after the ticket. For example, one printer uses the following codes to advance the paper and cut the ticket off.

ESCAPE "a" n will advance the paper n lines
ESCAPE "d" 0 will cut the paper off

To program the flow meter to send these codes select 6 special codes. Then use the select key to move the small arrow to follow each of the first 6 codes and use the adjust keys to make them be as follows:

1B 61 8 1B 64 00

This will cause the printer to advance 8 lines and cut the ticket off. The ticket printed appears below.

SCALE # 1
TIME 09:25:42
DATE 07/28/94
WEIGHT 797.504

The scale number will be the node you programmed the flow meter. To print the ticket press the **PRINT** key or connect a pushbutton to the remote print input P4.5. You can use the **CLEAR** key to set any of the special codes to 00 after using the select key to select the code. You cannot use FF for a special code since it is the end of message marker.

Function Key F7

RS-232 Serial Output

Again press the select key until the small arrow is back on line 1. Use either of the up arrow keys to change the word TICKETS to WEIGHT. Now the display appears as shown below.

RS-232 WEIGHT
FORM STX WT CR
LF AFTER CR OFF
LOG DATA OFF

Use the **SELECT** key to move the small arrow to line 2 after the word FORM. You can now select from the following options:

FORM STX WT CR or WT CR

This allows you to send an STX if the data is going to a PLC or disable STX if the data is going to some type of display.

Use the select key to move the small arrow to line 3 after the word CR. You can now use the adjust keys to select from the following options:

LF AFTER CR OFF YES BOTH

If you select off no line feed will follow the carriage return. If you select yes a line feed will follow the carriage return at the end of the message. If you select both a line feed will follow each carriage return if you have selected weight and rate.

The above discussion shows you how to send the scale weight out the RS-232 port once each second. You can use the select key to move the small arrow back to line 1 and select RATE instead of WEIGHT. If you do select RATE then once each second the current rate will be sent out the serial port. You can also use the adjust keys to select WEIGHT&RATE. If you do then the weight will be sent followed by the rate, once each second. If you select WEIGHT&RATE then you have the following options for the format of the message.

STX WEIGHT RATE CR
WEIGHT RATE CR
STX WEIGHT CR RATE CR
WEIGHT CR RATE CR

Again, on line 3 LF AFTER CR allows you to select sending no line feed after the carriage return by selecting OFF. You can send one line feed after the final CR by selecting YES. Or you can send a line feed after each CR by selecting BOTH.

Use the select key to move the small arrow to line 4 after the word DATA. If you select OFF then either weight, rate, or weight and rate, depending on what you have selected, will be transmitted once each second. You have the option of using the adjust keys to change LOG DATA from OFF to from 1 to 255 MIN. In that case data will be transmitted once every X minutes where X is the number you have programmed. In addition to the normal message time and date are added. The format of a data log is

WEIGHT RATE TIME DATE

if you selected sending both weight and rate. Logging data allows you to collect data from the scale in a time frame you can select yourself.

Function Key F7

RS-232 Serial Output

If you press the F7 key a second time the display will appear as shown below.

```
BAUD  1200
COLOR RED
```

If you have not turned on switch SW2 position 3 the second line will be blank. Press the SELECT key and a small arrow appears after the word BAUD. You can use the arrow keys to select 1200, 2400, 4800, or 9600 baud. Keep in mind there is no handshake so characters may be lost if you select a high baud rate.

This version of the scale control supports a low cost large display called a COLOR BRITE sign Model SW-214CR. This display is made up of red and green light emitting diodes. You can select the color you want from red, green, and orange. The characters are two inches high. You can display either the total weight that has crossed the scale or the current rate crossing the scale. The display is updated once each second. This display is designed to be used indoors. It is not waterproof or weather proof so it must be protected by mounting it in a suitable housing. The display is very bright indoors but in direct sunlight you cannot read it. If you use it outdoors you must shield it from direct sunlight. In spite of its limitations it will allow you to read the scale from at least 25 feet away and it is very low cost. If you are using this option you must turn on switch SW2 position 3. This switch is on the door. It must be off if you are not using the sign since the message format is special.

You may contact Sauk Valley Systems for information on where to purchase this display. You will need a special cable to connect the display to the control. One end has a telephone style connector to plug into the display. The other end connects to terminals in the control box labeled TXD and GND. You can purchase a cable from Sauk Valley Systems.You must set the baud rate to 2400 to match the COLOR BRITE display.

Function Key F8

Function key F8 is not currently used.

Test Keys T1 T2 T3

1. Press test key T1. The display appears as shown below.

PULSES	**12345**

This display is a pulse counter which counts each pulse from your liquid meter as it occurs. This display can be used to calculate the correct tons per pulse value for your liquid and your liquid meter. Its use is explained on the calibration page.

2. Press test key T2. The display appears as shown below.

SWITCH SW2	**0**
SWITCH SW1	**3**
VERSION	**6.06**

This display shows what configuration switches are turned on and also the version of the software.

3. Test key T3 is not used.

Display Summary

Weight Rate Key (Normal Display)

WEIGHT	**3248.962**
RATE TPH	**350.451**
PULSES/SEC	**542**
NODE 1	

Cal Data Key (Calibration Data)

RATE TPH	**350.451**
TONS PER PULSE	
.00004000000	
ADJUST DISABLED	

Node Key

NETWORK NODE	**1**
CONFIG	**56**
DIAGNOSTICS	**114**
STATUS	**119**

Function Key F1

LOW PULSE ALARM	
PULSES/SEC	**550**

Display Summary

Function Key F2 (First Press)

#1 SETPOINT	100.00%
#2 SETPOINT	10.00%
#3 SETPOINT	5.50%
#4 SETPOINT	2.25%

Function Key F2 (Second Press)

#1 MAXRATE	500.00
#2 MAXRATE	10.00
#3 MAXRATE	7.50
#4 MAXRATE	4.25

Function Key F2 (Third Press)

#1 OUTPUT 4 TO 20 MA
#2 OUTPUT 0 TO 20 MA
#3 OUTPUT 4 TO 20 MA
#4 OUTPUT 4 TO 20 MA

Function Key F2 (Fourth Press)

PID CHANNEL	OFF

Function Key F2 (Fourth Press)

PID CHANNEL		1
PID ACTION		REVERSE
PID SETPOINT		LOCAL
P = 10	I = 100	D = 3

Function Key F2 (Fifth Press)

#1 OUTPUT	149
#2 OUTPUT	220
#3 OUTPUT	75
#4 OUTPUT	92

Function Key F3

LOG RATE	350.00
LOG TIME	12H 45M
SEND RATE TO NODES	
FROM 4	TO 6

Function Key F4

MASTER TOTAL IS
1234.567
TIME 11:08:24
DATE 07/28/94

Function Key F5

LOAD WT	25.000
WEIGHT	12.345
CUTOFF	.000

Function Key F5

LOAD #5	.000
LOAD #6	.000
LOAD #7	.000
LOAD #8	.000

Display Summary

Function Key F6

```
TONS PER PULSE      OFF
PULSE ON TIME       50%
```

Function Key F7

```
RS-232              OFF
```

Function Key F7

```
RS-232       TICKETS
USE       0 LINE FEEDS
```

Function Key F7

```
RS-232       TICKETS
USE  6  SPECIAL CODES
 00   12   54   7A   F3   DE
 FA   03   1B   45   A0   FF
```

Function Key F7

```
RS-232       WEIGHT
FORM   STX  WT  CR
LF  AFTER  CR    OFF
LOG DATA         OFF
```

Function Key F7

```
RS-232       RATE
FORM   STX  RT  CR
LF  AFTER  CR    OFF
LOG DATA         OFF
```

Function Key F7

```
RS-232  WEIGHT & RATE
 FORM   STX  WT  RT  CR
 LF  AFTER  CR    OFF
 LOG DATA         OFF
```

Test Key T1

```
PULSES              12345
```

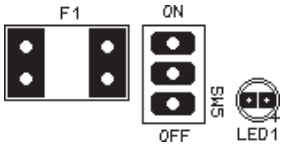
Test Key T2

```
SWITCH SW2       0
SWITCH SW1       3

VERSION        6.06
```

Maintenance

Electrical



Check the wiring terminals periodically to be sure the screws are still tight. If your flow meter fails to operate the following steps may help determine the problem.

1. Is the red light emitting diode LED 1 on? If not, there is a problem with the 12 volt power. Make sure there is 120 volts AC at the socket for the transformer. Make sure the power switch SW5 is turned on. Make sure the fuse F1 is not blown. If it is, replace it with a 1 amp 2AG fuse. This fuse is difficult to find locally. On circuit boards marked PB-9 or higher the fuse is a 5x20 mm 1 amp slow blow fuse. Use Littlefuse number 2180001 or Radio Shack 270-1063. If there is power coming in to the transformer, the fuse is good, and the switch is turned on, but the red light still is not on, there is a problem with the transformer. It should be replaced.

If the red power on light is on but there is nothing displayed on the computer liquid crystal display, then there is a problem with the computer. The fastest way to repair it is to replace the two circuit boards in the control. A replacement set is available with instructions. You will receive credit for the old boards if you return them.

2. If the display does work then the computer is working. If you are not recording weight as product passes through the flow meter the problem is most likely the load cell.

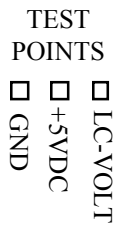
To check the load cells, press the **WEIGHT RATE** key. The display shows the load cell signal as load percent. As you press down on the load cells the number should change. The number should be somewhere near 7.5% with no material flowing since that is how you calibrated the flow meter. The number should go up as you press down on the impact plate connected to the load cells.

If the load cell signal does not respond as described above you may have one or two defective load cells. You can check each cell separately. Unplug one of the cells. Turn all the zero switches off. Remove the resistor connected with load cell #1. You are now testing the cell still plugged in. It may show a 0 at all times or some number that does not change when you press on the impact plate. Then unplug that cell and plug in the other cell. Compare the two results. If one of the load cells appears defective it can be replaced. Make sure there are no broken, loose, or disconnected wires at the terminal strip.

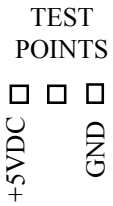
Maintenance

Test Points

Processor Board



Display Board



The processor board is located in the control box. It has test points marked as shown above on the left. If you have a voltmeter you can check the +5 volt and LC-VOLT power supplies using these test points. The test point marked LC-VOLT is the load cell supply voltage. It should be about 9.5 volts DC.

The display board is located on the control box door. It also has test points as shown above on the right. You can check to see if there is +5 volts on this circuit board.

USING A MODEM TO COLLECT DATA

Beginning with version 6.02 the liquid control can be used to collect data using the internal memory. This data can be downloaded into a personal computer using a modem from anywhere in the world or you can use a serial cable and a portable computer to collect the data locally.

1. Press the **NODE** key. If you only have one scale at this location you can set the node to 1. If you have several scales at this location you should set each to a different node number. Press the **SELECT** key once to move the programming arrow to the word node. Switch SW1 position 1 must be on to program the node number.

2. Press the **SELECT** key again to move the programming arrow to plant. If you are collecting data from several plants enter a unique number to identify this plant. Switch SW1 position 1 must be on to program the plant number.

3. Press the **SELECT** key again to move the programming arrow to product. If you want to identify each different product crossing this scale enter a unique number to identify this product. Switch SW1 position 1 does NOT need to be on to program the product number. This allows your operator to change the product number when the actual product changes without opening the door on the control. If you do use the product number to identify your different products it is up to your operator to have the correct product number entered for the product being weighed.

4. Press the **SELECT** key again to move the programming arrow to modem time. Enter the time interval you wish to record data. The standard scale will store 120 records. If you set the modem time to 1 minute increments you can store 120 minutes or 2 hours of data. After 2 hours older data will be replaced with new data. If you set your modem time to 6 minutes (.1 hour) you can store 12 hours of data before older data will be replaced. This is because you will be storing 10 records per hour. Dividing 120 records by 10 records per hour is 12 hours.

The data is in the following format:

001,002,003,00007543.142,08:48:01,03/26/97crlf
where the scale number is 1, the plant number is 2, the product number is 3, the weight is 7543.142, the time is 08:48:01, and the date is 03/26/97. The cr lf at the end of the line is carriage return line feed. The format of this data should be able to be imported into any spread sheet or data base program. The data is in ASCII format. Leading zeroes will be suppressed by being replaced with spaces.

Once the data is collected in the scale integrator you must use the RS-232 port to download the data to a personal computer. First press the F7 key twice and set the baud rate to 9600 for the fastest transmission. If you are using a modem it must be programmed to use 9600 baud between the scale integrator and the modem. Let the modem auto detect the speed between the two modems. Program the baud rate from your personal computer to your office modem for as fast as possible. It must be faster than 9600 baud or you may lose characters. If you lose characters you may have to slow down the baud rate at the integrator.

The scale integrator RS-232 port is a simple 3 wire interface. It does not support handshaking signals like RTS, CTS, DCD, etc. Connect our transmit data pin TxD to the modem receive data. Connect our receive data RxD to the modem transmit data. Connect our ground to the modem signal ground. You must connect the modem that will be used with the scale integrator to a personal computer to program the modem. It must be set to the correct baud rate, usually 9600, 8 data bits, 1 stop bit, no parity, using your terminal program. You must program the modem to auto answer, send numeric response, send only short form messages, disable flow control, and DTR assumed on. See the example

USING A MODEM TO COLLECT DATA

at the end of this manual. This data must be written into the modem memory as shown in the example.

If you do not use a modem you can connect a personal computer directly to your scale integrator using a 3 wire cable. The scale transmit data TxD must be connected to the computer receive data. The scale receive data RxD must be connected to the computer transmit data. The scale ground must be connected to the computer signal ground.

When you use a modem set to auto answer it will send the scale the number 1 to indicate the modem has connected. The scale sees the 1 and waits 5 seconds and then sends the modem menu. This is why your modem must be set for numeric responses and short form messages. Once you see the menu simply enter the letter of the function you want download. Your responses MUST be LOWER CASE. If you enter c for current data the data will include the current rate. Before you enter b for download the 120 record buffer you want to set your terminal program to store the buffer data on your hard drive.

Once you have the data on your hard drive you will want to import it into your spread sheet or data base program. Some of the data may be a repeat of data you downloaded last time. This depends on your modem time and how often you actually download the data. You should remove duplicate records from your data base.

If you are not using a modem but instead are using a direct cable connection enter a lower case letter a to bring up the menu. If you enter the number 1 the menu will appear after about 5 seconds. Once you see the menu simply enter the lower case command for the function you want to perform.

Warranty

Belt-Way Scales, Inc. ("Belt-Way"), warrants its products ***only*** on the terms contained herein. No one has the right or authority to assume or create any obligation or responsibility, express or implied, on behalf of or in the name of Belt-Way Scales, Inc., or to bind Belt-Way Scales, Inc., in any manner whatsoever. Products manufactured by Belt-Way are warranted to be free of manufacturing defects for a one year period after the original date of purchase. Belt-Way's liability hereunder is conditioned on dealer, or in the event of a direct sale to a first-end user (then on first-end user) giving notice in writing to Belt-Way of any alleged defect. Such notice must be given immediately upon the discovery of such alleged defect. If, within the warranty period, any machinery or parts shall be proved to the satisfaction of Belt-Way to be defective, the defective item shall be replaced or, at Belt-Way's option, repaired at Belt-Way's factory. The right to have defective machinery or parts, repaired or replaced as set forth above, shall constitute the dealer or first-end user's sole and exclusive remedy. No warranty shall apply to machinery, parts or accessories which have been furnished, repaired or altered by others so as (in the opinion of Belt-Way) to have affected the same adversely. Belt-Way cannot and does not warrant or represent that machinery or parts furnished by it will handle specific materials or will produce specific results from such materials.

This warranty does not include damage to the product resulting from accident, misuse, improper installation or operation. If a component should become defective within the warranty period, we will repair or replace it free of charge at our option. Defective components must be returned freight prepaid to Belt-Way or to an authorized Belt-Way service center.

Complete products included with our system that are not manufactured by Belt-Way such as computers, printers, chart recorders, active hubs for network expansion, etc. are warranted to the extent that they are warranted to us.

The customer's sole remedy shall be such repair or replacement as is expressly provided above, and we shall in no event be liable for any incidental or consequential damages arising out of the use or inability to use this product for any purpose whatsoever.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific legal rights. You may also have other rights which vary from state to state.

For products purchased outside the United States, see your distributor for warranty.

Warranty

This product is not designed or sold as a legal for trade device.
This warranty is in lieu of any and all other warranties, express or implied.

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Wiring Diagrams and Drawings

The following pages contain wiring diagrams for the IO option board and the remote start / stop station used for loading trucks. Use these diagrams in conjunction with the description in the manual to connect the wiring for these options. Also included are drawings showing the hole layout for mounting the scale.

CURRENT LOOP #1 - OUTPUT

CURRENT LOOP #1 + OUTPUT

CURRENT LOOP #2 _ OUTPUT

CURRENT LOOP #2 + OUTPUT

CURRENT LOOP #3 - OUTPUT — OPTIONAL

CURRENT LOOP #3 + OUTPUT

CURRENT LOOP #4 - OUTPUT — OPTIONAL

CURRENT LOOP #4 + OUTPUT

12VDC RETURN FOR +12VDC POWER SUPPLY

+12VDC POWER SUPPLY TO IO-4 BOARD

INPUT #4 SET "PID" LOOP TO ZERO RATE

INPUT #3 SELECT LOAD

INPUT #2 EXTERNAL PRINT

INPUT #1 EXTERNAL CLEAR WEIGHT

COMMON RETURN FOR INPUTS

+ SUPPLY FOR OUTPUTS

OUTPUT #1 BATCHING/LOADOUT

OUTPUT #2 EXTERNAL COUNTER (CHANNEL A)

OUTPUT #3 EXTERNAL COUNTER (CHANNEL B)

OUTPUT #4 LOW BELT SPEED ALARM/SPEED INT

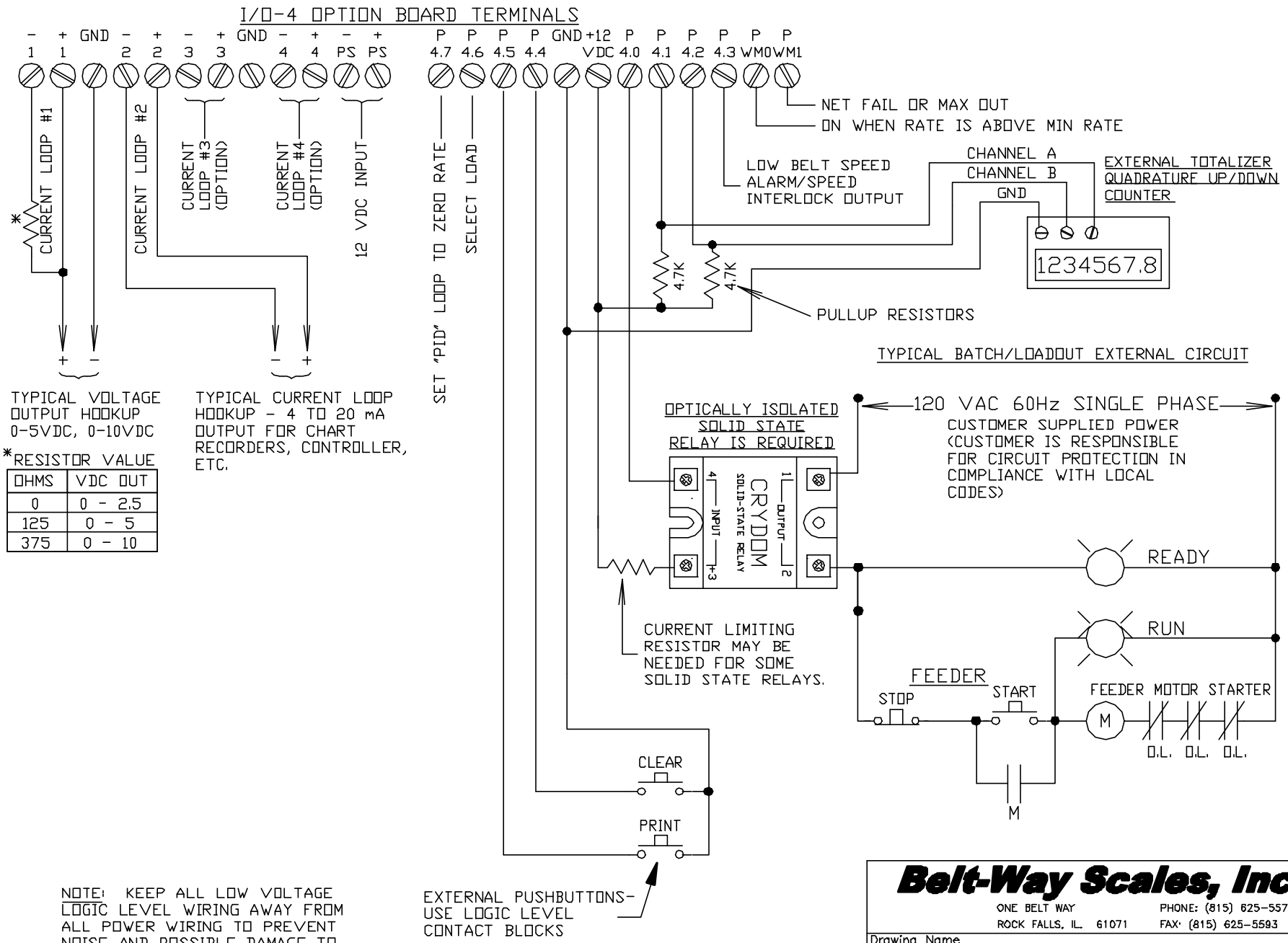
ON WHEN RATE IS ABOVE MIN RATE

NET FAIL OR MAX OUT

Belt-Way Scales, Inc.
ONE BELT WAY
ROCK FALLS, IL 61071
PHONE: (815) 625-5573
FAX: (815) 625-5593

Drawing Name	REV
I/O-4 Option Board Terminals	1.2

Scale	Drawn By	Date	DWG NO.
1.00		07/10/02	IO4.dwg



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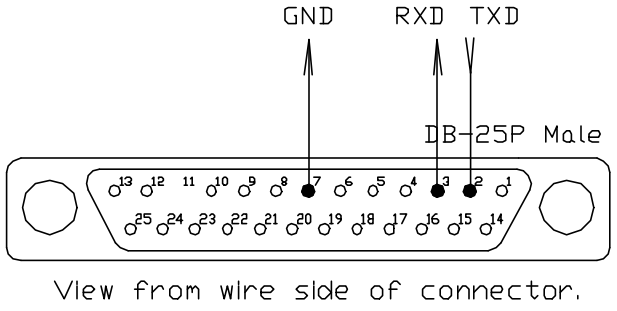
ROCK FALLS, IL 61071
PHONE: (815) 625-5573
FAX: (815) 625-5593

Drawing Name	REV
IO-4 Board Wiring	1.2

Scale	Drawn By	Date	DWG NO.
1.00		07/10/02	IOWIRING.dwg

Control Box
to Modem Cable



View from wire side of connector.

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ONE BELT WAY
ROCK FALLS, IL. 61071
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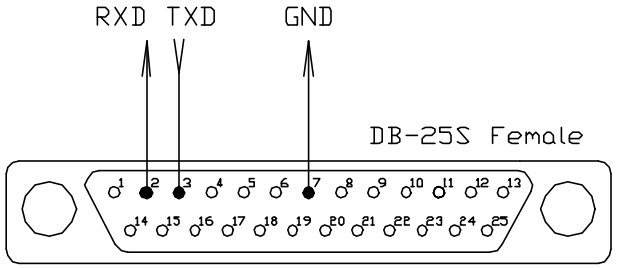
FAX. (815) 625-5593

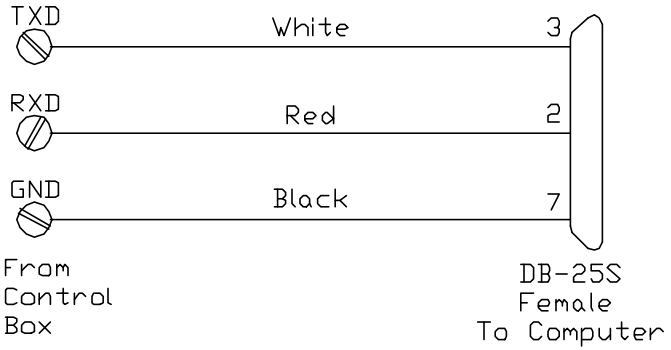
Drawing Name				REV
Control Box to Modem Cable				2.1
Scale	Drawn By	Date	DWG NO.	
	TjM	07/10/02	modem to box	

Control Box to Computer

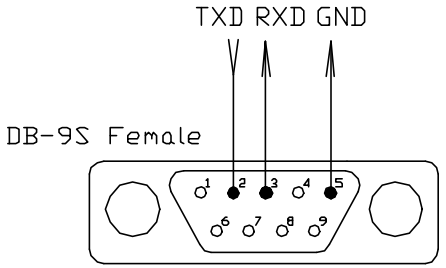
25- Pin Serial Port



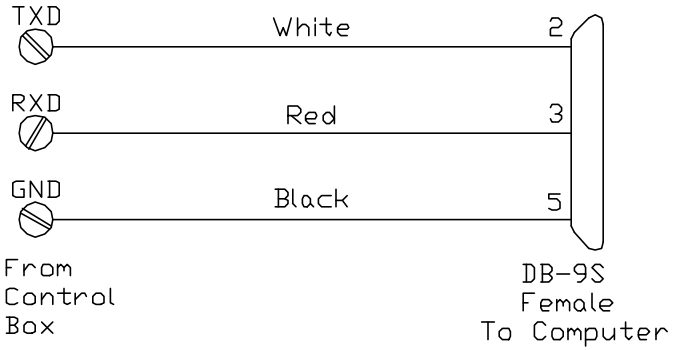
View from wire side of connector.



9-Pin Serial Port



View from wire side of connector.



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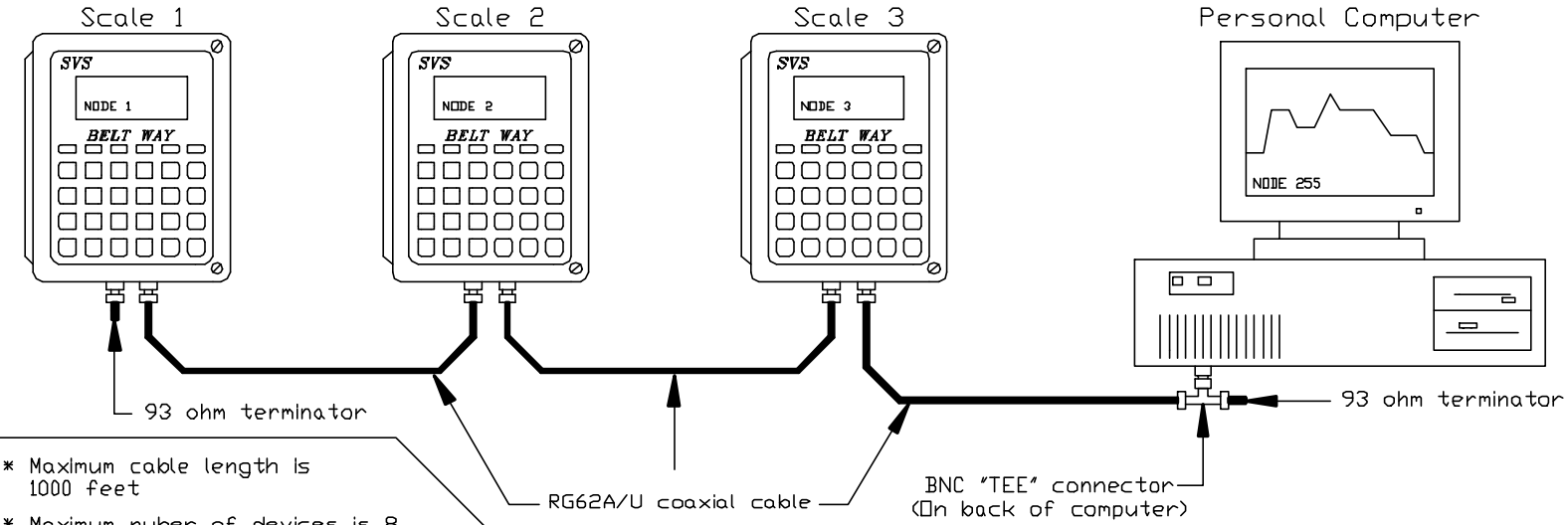
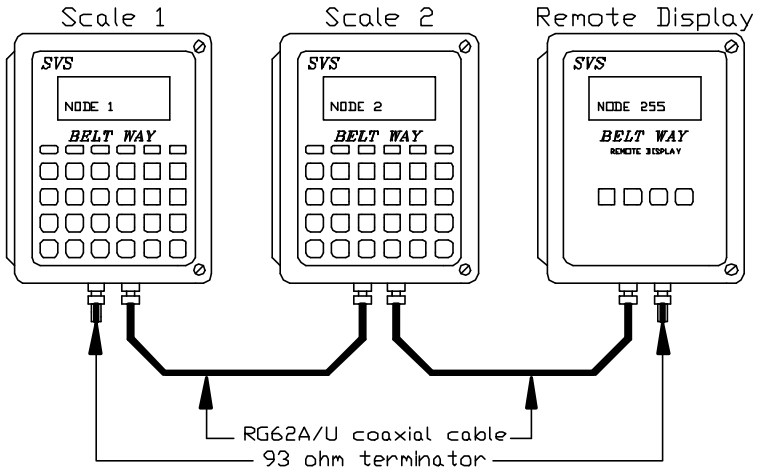
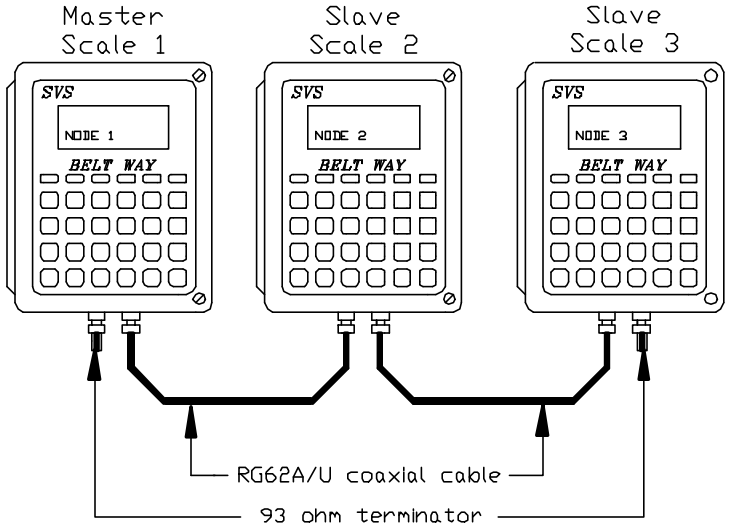
Drawing Name				REV
Control Box to Computer Cable				2.1
Scale	Drawn By	Date	DWG NO.	
	TjM	07/10/02	computer to box	



* Maximum cable length is 1000 feet
* Maximum nuber of devices is 8
* For more than 1000 feet or 8 devices an active hub is required.





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Drawing Name				REV
Bus Configurations				X.X
Scale	Drawn By	Date	DWG NO.	
		07/10/02	network1.dwg	

Table of Contents

Electrical Installation

If you are using a **generator** for power install a **switch** in the 120 volt AC line to the power supply. To prevent possible loss of data at startup turn the generator on first and then the control. At shutdown turn the control off first and then the generator.

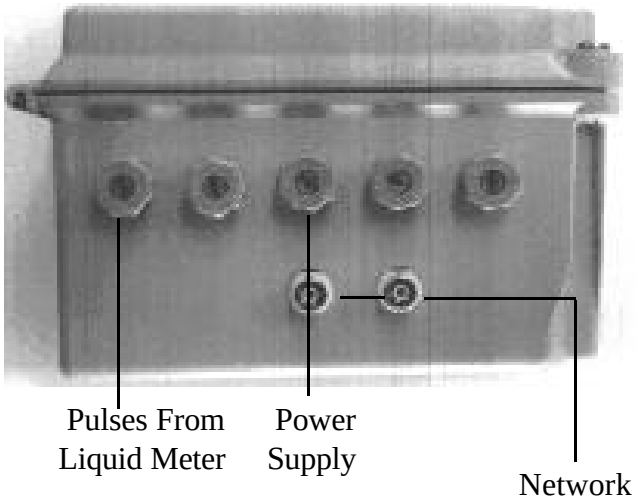
1. Open the door on the control box by loosening the two screws in the front of the door. The terminal strips are made in two pieces so you can disconnect each cable for testing by pulling the connector out of its socket. This allows you to remove a connector without disconnecting the individual wires.

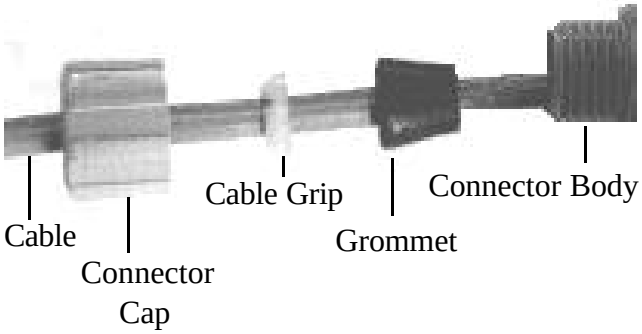
2. Leave a short cable in the cable grips which are not used so the cable grips will remain waterproof. Leave the jumper installed between SIG and A-GND on the connector marked ANGLE SENSOR. If you use the optional remote start / stop station remove this jumper when you connect the cable to the start / stop station.

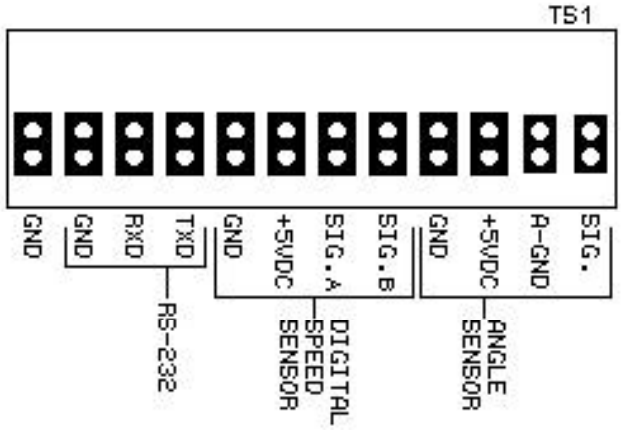
3. Connect the output from your liquid flowmeter to the input marked digital speed sensor. This signal must be a 0 to 5VDC TTL signal. Connect the +5VDC output and ground from the control box to the corresponding inputs on the liquid meter. Connect the signal output from the liquid meter to the SIG A input in the flowmeter control box. If your liquid meter does not supply a TTL compatible output additional electrical hardware must be used to convert your output signal to a TTL output. SIG B is not used.

4. If you are using the RS-232 serial port connect your RS-232 cable to TxD and GND using a 3 conductor terminal. There is no connection to RxD or to the INT-1 terminal.

Wiring TS1

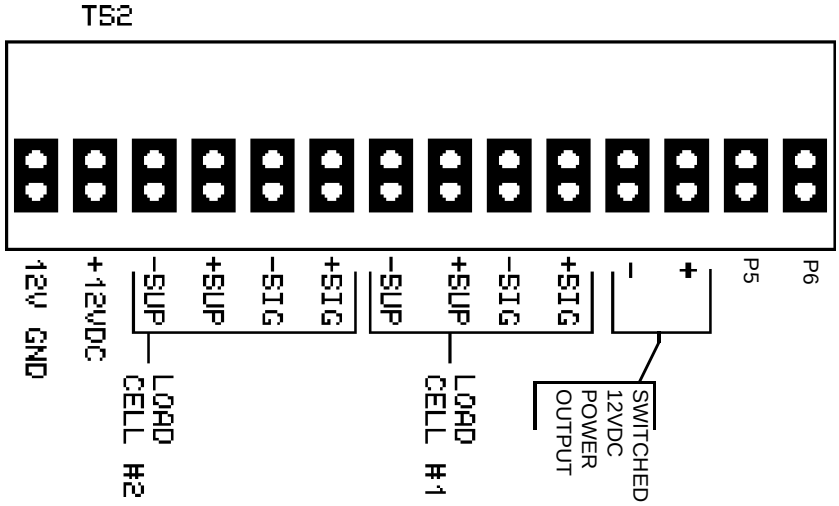






Electrical Installation

Wiring TS2



4. Next connect the cables to terminal strip TS2. First route the cable from the power transformer through the third cable grip from the left. IMPORTANT ... be absolutely certain to connect the 12 volt ground wire to the terminal marked 12V GND. Connect the wire marked + to the terminal marked +12VDC. The positive lead will be identified by a colored stripe or rib or by a tag. If these wires are connected backwards the control will not work. Do not connect the 120 volt AC power to the transformer yet.

5. There are no connections to the terminals marked LOAD CELL #1 and LOAD CELL #2.

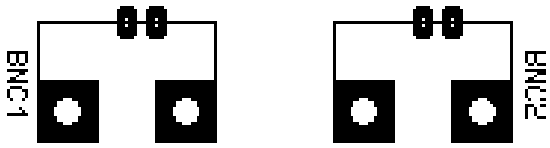
6. The terminals marked - and + are switched 12VDC power output used to power the I/O option board. Note that on circuit boards prior to PB-8 these terminals are used for G1 and G2 jumpers for the load cells. Beginning with boards marked PB-8 these terminals are used to power the I/O board. **DO NOT PUT A JUMPER BETWEEN THESE TERMINALS OR YOU WILL SHORT OUT THE 12 VOLTS DC POWER AND BLOW A FUSE.**

7. The terminals marked P5 and P6 are not used.

Electrical Installation

8. The terminals marked BNC 1 and BNC 2 have BNC connectors that extend through the bottom of the box. The connectors may have vinyl caps over them to protect them. If you have purchased the network option you must connect the network using coaxial cable type RG62A/U. BNC connectors are available in several styles. Some solder on to the cable. Some crimp on to the cable. Others simply twist on to the cable. It is important to use a high quality connector. Most network problems can be traced to poor connections between the cable and the connector. We provide a high quality cable capable of being buried in the ground. We recommend using a connector that solders on to obtain the best connection. See the drawing at the end of the manual.

9. The network is an industry standard network. There are 3 possible cable configurations. The simplest and least costly is called a bus configuration. The total length of cable in one bus is 1000 feet. You can connect up to 8 stations on one bus. If your layout meets these requirements the simplest way to connect the controls is run the cable from one device to the next. It does not matter which connector you use for the cable coming in and the cable going out. At one end of the cable the last control will have a cable going in but none going out. You must connect a 93 ohm terminator to the last connector. This is simply a BNC connector with a terminating resistor in it. At the other end of the cable will be the main PC which may be in an office or trailer. It must be connected with a BNC "TEE" connector and a 93 ohm terminator. Remember the maximum cable length is 1000 feet and the maximum number of devices is 8.



10. The second configuration is called a star. It uses a central hub which is not used in a bus configuration. Assume the hub is an 8 port active hub. You can have 8 devices connected. One device connects to each port. You can run the cable 2000 feet for each device. You can connect more than 8 devices by making one of the devices another active hub.

11. The third configuration mixes both the star and the bus. You may have five or six flow meters within 1000 feet of each other. You may want to put the PC in an office some distance away. You can connect the flow meters in a bus configuration and have the last device on the bus be an active hub. You can then run 2000 feet of cable from the hub to the office. If the office is farther than 2000 feet you can use additional active hubs every 2000 feet. The total length of the network cannot exceed 4 miles. The active hubs will require 120 volt AC power.

12. After all cables are connected you can connect the 120 volt AC power to the transformer. The transformer is housed in a small waterproof electrical box. The transformer is a wall plug unit connected to a socket. Connect your 120 volt AC wiring to the socket provided. The 12 volt cable exits the box through a waterproof cord grip. The 120 volt wiring enters the box through a separate cord grip. Replace the cover on the plastic box and tighten the screws.

Configuration

1. On the inside of the control box door is the display circuit board. It contains SW1 which is a 9 position slide or rocker switch used to configure the control. The positions are marked 1 through 8 and are described below. Position 9 controls the backlight.

2. If you turn on position 1 the entire keypad is enabled except the **CLEAR** key. You can view and change all data. This position has no effect on the **CLEAR** key for clearing total weight.

3. If you turn on position 2 the **CLEAR** key is enabled to clear total weight. You can set the total weight back to zero by pressing the **CLEAR** key twice within 2 seconds if you are viewing the weight and rate. If position 2 is off you can not set the total weight back to zero.

4. Position 3 enables the **CLEAR** key to clear master totals. If position 2 is on and position 3 is off you can clear scale totals but not master totals.

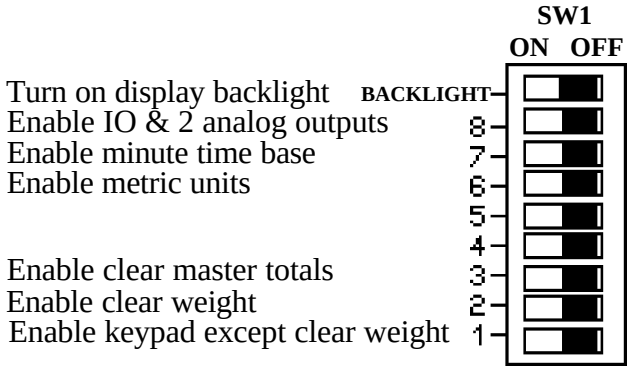
5. Position 4 is not used.

6. Position 5 is not used.

7. Position 6 selects English or metric units. If it is off the weight will be displayed in tons and the rate will be in tons per hour or per minute. If position 6 is on the weight will be displayed in metric tons and the rate will be in metric tons per hour or per minute.

8. Position 7 determines the time base for the rate display. If position 7 is off the rate will be per hour. If position 7 is on the rate will be per minute. Set this switch before entering set rate, maxrate, or log rate.

9. Position 8 enables the IO option board and first two analog outputs. This is an option that allows you to connect the flow meter to a chart recorder which accepts a 4 to 20 mA. signal. If you have this option installed position 8 must be on to enable the outputs. If you do not have this option installed position 8 must be off. If position 8 is on but you do not have the option installed your keypad and display will not function. If you have this option see the section describing the use of function key F2.



Configuration

1. Again on the inside of the control box door is another 9 position switch SW2. It is also used to configure the control as described.

2. Position 1 is not used.

3. Position 2 enables the optional two additional analog outputs. You must have the IO option board installed and must have the additional two outputs installed before you turn on this switch. If you turn on this switch without having the correct hardware installed the keypad and display will not function.

4. Position 3 enables the control serial port to work with a COLOR BRITE large character display.

5. Position 4 disables changing the load weights.

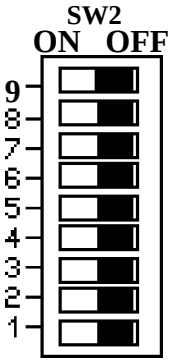
6. Position 5 enables clearing log time.

NOTE:

Some controls have slide switches for SW1-SW4. SW1 and SW2 are located on the door. Sliding these switches away from the door hinge turns them on. SW3 (GAIN) and SW4 (ZERO) are located on the circuit board inside the body of the control box. Sliding these switches toward the word GAIN or ZERO turns them on.

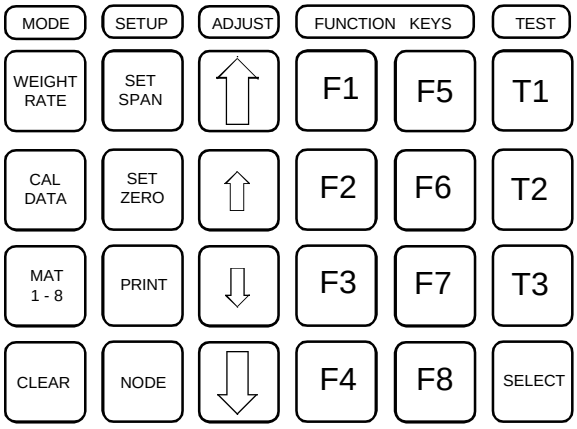
Some controls have rocker switches for SW1-SW4. SW1 and SW2 are located on the door. Pushing down on the rocker on the side of the switch away from the door hinge turns them on. SW3 (GAIN) and SW4 (ZERO) are located on the circuit board inside the body of the control box. Pushing down on the rocker on the side of the switch closest to the word GAIN or ZERO turns them on.

Some switches may be labeled OFF and ON but some may be labeled OPEN. Open means off.



Enable clearing log time
Disable changing load weights
Enable COLOR BRITE display
Enable analog outputs 3 & 4

The Keypad



Mode Keys

1. The mode keys run from top to bottom in the first column. The top key is the normal mode. It is the **WEIGHT RATE** mode. The display shows the accumulated weight, the current rate, the number of pulses per second coming from the liquid meter, and the scale node number. The control will be in this mode when it is turned on.

2. The next key down is the **CAL DATA** key which shows calibration data. The display shows the current rate and the tons per pulse to calibrate the flowmeter to your liquid meter. You can use the **SELECT** key to select coarse, medium, and fine adjust and then use the arrow adjust keys to enter the value for each pulse from your liquid meter.

3. The next key down is the **MAT 1-8** key. It is not used in the liquid controller.

4. The lower key in the first column is the **CLEAR** key. It is used to clear several items. If you are looking at the normal display seen by pressing the **WEIGHT RATE** key, then the **CLEAR** key will set the total weight back to 0. Switch SW1 position 2 must be on and you must press the key twice within 2 seconds to clear the total weight.

If you press the **CAL DATA** key you can use the select key to select coarse, medium, or fine adjust and set the tons per pulse to 0 using the **CLEAR** key. Switch SW1 position 1 must be on. In a similar manner, you can select node and set it to 1 using the key.

If you press the F2 key you can use the **SELECT** key to select any of the setpoints and use the **CLEAR** key to set them to 0. No configuration switches need to be on so you can always change your formula without accidentally changing calibration.

You can also set any of the maxrate values to 0 using the **CLEAR** key but switch SW1 position 1 must be on. Once you set the correct maxrate values you would not want them changed accidentally.

The Keypad

If you press the F3 key you can use the **SELECT** key to choose log rate or log time and set either to 0 using the **CLEAR** key. Switch SW1 position 1 must be on to clear log rate. SW2 position 5 must be on to clear log time.

If you press the F4 key to view the master total you can press the **CLEAR** key twice within two seconds to clear the master total. Switch SW1 position 3 must be on. You can also use the select key to select hours, minutes, seconds, month, date, or year and set each to 0 using the **CLEAR** key. To do this switch SW1 position 1 must be on.

If you press the F5 key you can use the **SELECT** key to choose load weight or cutoff weight. You can set either to 0 any time using the **CLEAR** key. No configuration switches need to be on. This allows you to change your load size and still prevent accidental changes to the scale calibration.

If you press the F7 key you can use the **SELECT** key to choose log data and turn it off using the **CLEAR** key. You can also select any of the 12 special codes and use the **CLEAR** key to set each to 00. Switch SW1 position 1 must be on.

Setup Keys

1. The top key in column 2 is the **SET SPAN** key. It is used not used in the liquid control.

2. The next key down is the **SET ZERO** key. It is not used in the liquid control.

3. Next is the **PRINT** key. It is used to print a ticket if you have a serial printer connected to the control.

4. The bottom key is the **NODE** key. It is used to set the scale node number for use on the network.

Adjust Keys

The adjust keys change the item you have chosen using the select key. Depending on what screen you are viewing the select key will cause a small arrow to appear next to the items you will be able to adjust.

1. The **LARGE UP ARROW** increases most items by 256. It increases load weight and cutoff weight by .200. On items limited to 256 possibilities or items where you select from a few options the large up arrow key increases the item by 1 just as the small up arrow key does.

2. The **SMALL UP ARROW** increases the item by 1.

3. The **SMALL DOWN ARROW** decreases the item by 1.

4. The **LARGE DOWN ARROW** decreases most items by 256. It decreases load weight and cutoff weight by .200. On items limited to 256 possibilities or items where you select from a few options the large down arrow key decreases the item by 1 just as the small down arrow key does.

The Keypad

Pressing any of the arrow keys will cause the described action to occur. Holding any of the arrow keys down will cause the key to repeat until you release the key.

The arrow keys are disabled if switch SW1 position 1 is turned off except you can still adjust the setpoints for analog outputs, load weights, and cutoff weights. This allows you to prevent someone from accidentally changing your calibration but you can change your formula if you are using the analog output and you can change your batch size and cutoff weight if you are loading trucks.

Function Keys

Each function key is described on a separate page later in this manual.

Test Keys

The test keys are used to view data to diagnose any problems that might occur. They are described later in this manual.

Select Key

The **SELECT** key is used to select various item which you can program. When you press the **SELECT** key a small arrow will appear after the item you can program. Some items can be set to zero using the **CLEAR** key. Use the arrow adjust keys to program the item you have selected.

Network Station Address

If you are using the network to collect data in a PC or you are using a remote display you must set each control box to a unique station address. Address 0 is not allowed. Address 255 is reserved for the central PC. Valid addresses you can use are 1 to 254. We suggest using address 1 for scale 1, address 2 for scale 2, etc.

To set the network station address press the node key. Then press the select key and a small arrow will appear after the word NODE. Use the arrow keys to set the node for this scale. Be sure no two scales are set to the same address. If any two scales have the same address the network will not work.

When you press the node key the display appears as shown below.

NETWORK NODE	**1**
CONFIG	**56**
DIAGNOSTICS	**114**
STATUS	**119**

You can only change the network node. The other data is for troubleshooting the network if there are problems. The normal data will be 56 for config. Diagnostics will be 114 if the PC was on before the scale was turned on, or 122 if the scale is turned on before the PC. Status normally will be 119. If the scale is not connected to any other network device diagnostics will alternate between 34 and 162. Status will be 116.

Calibration

1. Press the **CAL DATA** key. The display will appear as shown below.

RATE TPH	**12.345**
TONS PER PULSE	
.00000000000	
ADJUST DISABLED	

2. Switch SW1 position 1 on the door must be turned on to enable the keypad.

3. Press the **SELECT** key. The bottom line will change to show COARSE ADJUST. The large up and down arrow keys will adjust the tons per pulse in increments of .001. The small arrow keys will adjust in increments of .00001.

4. Press the **SELECT** key again. The bottom line will change to show MEDIUM ADJUST. The large arrow keys will now adjust in increments of .000001. The small arrow keys will adjust in increments of .00000001.

5. Press the **SELECT** key again. The bottom line will change to show FINE ADJUST. The large arrow keys will now adjust in increments of .000000001. The small arrow keys will adjust in increments of .00000000001.

By following the above procedure you can set the exact value in tons per pulse for your meter. For example, water weighs about 8 pounds per gallon. Divide the 8 pounds by 2000 to convert to tons per gallon. Dividing 8 by 2000 equals .004 tons per gallon. If your meter outputs one pulse per gallon then one pulse equals .004 tons so that is what you program for tons per pulse. If your meter outputs 100 pulses per gallon then you must divide the .004 by 100 which equals .00004 tons per pulse.

If your meter pulse value is based on so many pulses per gallon, you must know the weight of your liquid in pounds per gallon. Then divide that weight by 2000 to convert to tons per gallon. Then divide the result by the number of pulses per gallon that your meter outputs. The final result is the tons per pulse value to enter.

If you do not know the weight of one gallon of your liquid press the T1 key. The top line is a pulse counter. Press the **CLEAR** key to set it to zero. Now weigh an empty bucket. Run some liquid into the bucket. Weigh the liquid and subtract the weight of the empty bucket. Assuming your weight is in pounds, divide the result by 2000 to convert it to tons. Now divide the result by the number of pulses shown on line 1 of the T1 display. This is the number of pulses counted for the amount of liquid you just ran into the bucket. The result is the tons per pulse value to enter in the **CAL DATA** display.

6. When adjust is not disabled the clear key will set the tons per pulse value to .00000000000. You can use this feature to clear any value before programming the correct value.

7. Press the select key again. The bottom line will now show ADJUST DISABLED. Be sure to turn off switch SW1 position 1 on the door when you are finished.

Print Key

Printing a Ticket

The print key is used to print a ticket if you have set the RS-232 port to printing tickets. When you want to print a ticket simply press the **PRINT** key.

You can also print a ticket using the remote print input located on the optional IO board. It is input P4.5. Of course you must have the optional IO board installed.

In this discussion of the RS-232 port STX means start of transmission. It's value is 2. CR means carriage return. It's value is 13. LF means line feed. It's value is 10.

If you are using the 12 special codes to send control codes to your printer you will need to refer to your printer manual to tell you what the codes are. The codes you will program use the hexadecimal number system. You may also need to refer to an ASCII chart to find the hexadecimal values of letters used in the control codes. All the information you need should be in your printer manual.

Function Key F1

Test Weight

If you do not have an I/O option board the F1 key is not used. If you do have an I/O option board press the F1 function key. The display will appear as shown below.

```
LOW PULSE ALARM
PULSES/SEC        123
```

Press the **SELECT** key one time. A small arrow will appear after the word ALARM. You can use the arrow keys to change from low speed alarm to speed interlock. Press the **SELECT** key again. The arrow appears after PULSES/SEC. You can use the arrow keys to set the value of the pulses per second you want to use for the low pulse alarm or pulse interlock. If you have chosen low pulse alarm whenever the pulses per second coming from your liquid meter is below the programmed pulses/sec value then output P4.3 will be on. When the pulses per second coming from your liquid meter is above the programmed pulses/sec value then output P4.3 will be off. If you selected pulse interlock output P4.3 will be off when the pulses per second coming from your liquid meter is below the programmed value. Output P4.3 will be on if the pulses per second from your liquid meter is above the programmed value.

Press the **SELECT** key again and the small arrow will disappear. Press the **WEIGHT RATE** key to return to the normal display.

Function Key F2

Analog Outputs

1. The F2 function key is used to control the meter analog outputs. You must have the IO option board installed in the flow meter and switch SW1 position 8 must be turned on. Otherwise if you press the F2 key the display will say KEY DISABLED on line 4 of the current display. You may also have the optional additional two outputs installed. If you do then switch SW2 position 2 must also be turned on.

If you do not have the IO option board installed and you turn on switch SW1 position 8 the keypad and the display will lock up. If you do not have the additional two outputs installed and you turn on switch SW2 position 2 the keypad and display will lock up. If this happens turn the meter off. Turn off the switch that is causing the problem. Turn the flow meter on again. The keypad and display will function.

The following assumes you have the IO option board installed with the two additional outputs. Switch SW1 position 8 and switch SW2 position 2 are turned on. If you do not have the additional two outputs lines 3 and 4 on the display will be blank.

Press the F2 function key. The display will appear as show below. No configuration switches need to be on to program setpoints.

#1 SETPOINT	**100.00%**
#2 SETPOINT	**10.00%**
#3 SETPOINT	**5.50%**
#4 SETPOINT	**2.25%**

Press the SELECT key. A small arrow will appear after the word SETPOINT on line 1. This means you can use the adjust keys to enter your setpoint for analog output 1. Press the SELECT key again. the small arrow appears on line 2. Each time you press SELECT the arrow moves to the next line. If the arrow is on the last line the next time you press SELECT the arrow will disappear. Program the setpoint for each output. See the examples that follow for a guide.

2. Press the F2 function key a second time. The display will appear as shown below.

#1 MAXRATE	**500.00**
#2 MAXRATE	**10.00**
#3 MAXRATE	**7.50**
#4 MAXRATE	**4.25**

Press the SELECT key. A small arrow appears after the word MAXRATE on line 1. Use the adjust keys to enter the desired maximum rate for output 1. Press the SELECT key again and the small arrow appears on line 2. Repeat for lines 3 and 4. Maxrate is normally in tons per hour. Enter values for each output installed. Switch SW1 position 1 must be on.

3. Press the F2 function key a third time. The display will appear as shown below.

#1 OUTPUT 4 TO 20 MA
#2 OUTPUT 0 TO 20 MA
#3 OUTPUT 4 TO 20 MA
#4 OUTPUT 4 TO 20 MA

Press the SELECT key. A small arrow appears after the word OUTPUT on line 1. Press either up arrow key to select 0 to 20 MA. Press either down arrow key to select 4 to 20 MA. Repeat for all outputs. Switch SW1 position 1 must be on.

Function Key F2

Analog Outputs

4. Press the F2 key a fourth time. The display will appear as shown below.

PID CHANNEL	**OFF**

Press the **SELECT** key. A small arrow appears after the word CHANNEL. If you want to use one of the IO channels as a PID loop control use either up arrow key to change the word OFF to the channel you want to use as a PID loop. For example, if you want to use channel 1 press either up arrow key once. The display will now appear as shown below.

PID CHANNEL	**1**
PID ACTION	**REVERSE**
PID SETPOINT	**LOCAL**
P = 10 I = 100	**D = 3**

After you have selected the desired channel press the **SELECT** key again. The small arrow will appear after the word ACTION. Press either down arrow to select reverse action. Press either up arrow to select forward action. Forward and reverse action are described later.

Press the **SELECT** key again. The small arrow will appear after the word SETPOINT. Press either down arrow to select local setpoint. Press either up arrow to select remote setpoint. Local and remote setpoints are described later.

Press the **SELECT** key again. The small arrow will replace the = after the P. Use the adjust keys to enter the P value. Press the **SELECT** key again. The small arrow will replace the = after the I. Use the adjust keys to enter the I value. Press the **SELECT** key again. The small arrow will replace the = after the D. Use the adjust keys to enter the D value. The large arrow keys will change P, I, and D by 50. The small arrow keys will change P, I, and D by 1. The action of P, I, and D are described below.

USING THE PID LOOP CONTROL

You can use the built in PID loop control to control the rate material is running through the flow meter. The first step is to select the channel you want to use as described above. If you have a two channel IO board you can select channel 1 or 2. If you have a four channel IO board you can select channel 1,2,3, or 4. The other channels can be used for their standard functions.

Next you must select the PID action. Most applications will use reverse action. This means that if the rate goes up above the programmed rate the output will go down to slow down the feeder to reduce the rate back to the programmed rate. The electrical output goes in the reverse direction from the rate error. If the rate is too high the electrical output will go down. If the rate is too low the electrical output will go up. You may find a situation where increasing the electrical output will decrease the rate. An example would be a system controlled by air pressure and more air pressure reduces the feed rate. In this case if the rate goes above the set rate the electrical signal must also go up to reduce the feed rate. Since the electrical signal goes in the same direction as the rate the action is called forward action.

Function Key F2

Analog Outputs

Next you must select local or remote setpoint. Normally you will select local setpoint. This means you will program the rate through this flow meter in this control box. First you will press the **WEIGHT RATE** key. Line 3 will show PULSES/SEC. Press the **WEIGHT RATE** key again. Line 3 will change to show SET RATE .00. Press the **SELECT** key and the small arrow will appear after the word RATE. Use the adjust keys to enter the rate you want in tons per hour. If you are using metric units the rate will be in metric tons per hour. If you have turned on switch SW1 position 7 to display your rate in tons per minute then your set rate will also be in tons per minute.

If you have two or more ***FLO-WAY*** meters you can program one to be the master and several others to be slaves. The master can either be a wild flow or you can use the PID loop on the master to control the rate using the local setpoint. You then set up each slave as a remote setpoint. Next you program the setpoint percent using the F2 key for each slave. Enter the percent you want to add of the slave ingredient compared to the material flowing through the master flow meter. Be sure to enter the percent for the channel you have selected to be the PID channel.

You must connect the network using RG62A/U coaxial cable between the master and all slave controls. The order that the controls are connected together does not matter. Put a 93 ohm terminator on the two control boxes at opposite ends of the cable. In other words, if you have one master and one slave, each will have a terminator. If you have a master and two slaves, two of the three controls will have 93 ohm terminators. See the wiring diagrams and drawings at the end of the manual.

If you are using the PID loop as a local setpoint then the setpoint percent and maxrate for that channel are not used. You program the desired set rate on line three of the weight rate display. If line three is blank press the **WEIGHT RATE** key again to display set rate. If you are using the PID loop as a remote setpoint then the setpoint percent for that channel is programmed to the percent you want to add in relation to the rate flowing through the master. The maxrate for that channel is not used. If you are using any controls as remote setpoints then you must program the master control to send its rate to the controls with remote setpoints. See the section on the F3 key for details.

If there is any problem with the network the alarm output P4.3 will turn on. If the master control is using the PID loop and the output is at its maximum the alarm output P4.3 will turn on. If a control is set up as a master and any of the slaves are at maximum output the master will turn on alarm output P4.3. If there is a problem with the network the master and all slaves will run a setpoint of 0.00 and turn off.

Function Key F2

Analog Outputs

You can use input P4.7 to tell the PID loop to run at a setpoint of 0.0 which will stop the feeder. If the control is set up as a master all slaves will also stop. **Important**...if you stop the system in this manner any motors still have power applied and could start up unexpectedly. Before attempting to work on any of the feeders in the system be sure to disconnect power so the feeder cannot start up unexpectedly.

Now you must select the values for P, I, and D. The PID loop stands for proportional, integral, and derivative. Mathematically, the control equation looks like this:

Output =
(P * (setpoint rate - actual rate)) +
(I * (theoretical weight total-actual weight total)) -
(D* (present rate - last rate))

The control works something like your car. The output is the gas pedal and the instruments are the speedometer and odometer. You look at your speedometer and see how fast you are going and compare that to how fast you want to go. If there is a large difference, you press hard on the gas. If there is a little difference, you press a little bit. This is the P term in your car control equation. You also look at your odometer and check to see how many miles you have traveled and compare that to how many miles you should have gone had you been going fast enough. This is the I term in your car equation. You also do not want to accelerate and decelerate too fast and be real jerky in your driving. The D term looks at your change of speed or acceleration rate such as when you are going down hill. This helps to restrain you from accelerating too fast. If you are going uphill it lets you give it more gas to keep from slowing down too much. It has a kind of damper action and keeps you smooth.

Any or all of these control terms can be too aggressive or too lax in their application to your control. If they are too aggressive, you can get wild oscillations and jerky control like pushing hard on the gas and then backing off, back and forth like the teenage hot rodder. If they are too lax, you will be like the 90 year old that takes forever to get up to speed. You want to tune your PID control to give you a responsive yet smooth control. Also, an important point to remember is that once you are up to speed, the P term and the D term will basically be zero and do no controlling. The I term will be doing the work with very small changes coming from the P and D terms.

We recommend starting with P = 10, I = 100, and D = 3. Increasing the value of P will cause the feeder to start out faster when it is first turned on but it may start so fast that it overshoots the desired set rate and then slows down too much to compensate and continues to oscillate. If that happens the value of P is probably too large. The I term works on the difference of where you are versus where you should be. The D term acts as a brake. If either is too large the response time may be too fast and again the control may begin oscillating. If the set rate is very low you may need to make all three terms larger to increase the response time. If you are running very high set rates you may need to make all three terms smaller. A value of 0 will disable that term. The maximum number is 255. The PID loop will work using only an I term. Never set I = 0.

Function Key F2

Analog Outputs

5. Press function key F2 a fifth time. The display will appear as shown below.

#1 OUTPUT	**149**
#2 OUTPUT	**220**
#3 OUTPUT	**75**
#4 OUTPUT	**92**

This display shows the digital value of each analog output. If the output is 4 to 20 mA then this number will be from 51 which is 4 mA to 255 which is 20 mA. If the output is 0 to 20 mA then this number will be from 0 which is 0 mA to 255 which is 20 mA.The **SELECT** key is not used with this display since there is nothing to program on this screen.

EXAMPLES

1. A CHART RECORDER

Assume you want to control a chart recorder on output #1 using a 4 to 20 mA signal. First set your setpoint for output 1 to 100.00%. Next assume the maximum rate you will run will be about 475 tons per hour. Set your maxrate for output 1 to 500 tons per hour. This will cause your chart pen to be near 100 % of full scale when you are running near 500 tons per hour. If you set your maxrate to 1000 tons per hour then at 500 tons per hour your pen would be at 50 % of full scale and it would never use the upper 50 % of the chart paper. This makes your chart harder to read because it is compressed. That is the reason you want to set maxrate to slightly more than you normally will be running at full load.

Select 4 to 20 mA for the desired output and connect the wires to the chart recorder as shown on the wiring diagram at the end of the book.

2. CONTROLLING A FEEDER (OPEN LOOP)

Assume you have a feeder that is controlled by a 4 to 20 mA signal. At 20 mA the feeder has a maximum rate of 5.00 tons per hour. You want the feeder to add 10 % additive to the material flowing through the flow meter, using analog output 2. First set your setpoint for output 2 to 10.00%. Next set your maxrate for output 2 to 5.00 tons per hour. Finally select 4 to 20 mA for your output. Connect the feeder as shown on the wiring diagram at the end of the book.

3. USING VOLTAGE OUTPUT

Assume the feeder in example 2 uses 0 - 5 volts DC instead of 4 to 20 mA as the control signal. Program the setpoint and maxrate the same as example 2. Select 0 to 20 mA for the output. Connect the feeder as shown on the wiring diagram at the end of the book. Note that when you connect the output as a voltage you must add a resistor which determines the output voltage. The connections are different than they are for current outputs.

Current loops and voltage outputs **ARE NOT ISOLATED** and reference or use a common ground. The negative current loop terminal will vary in voltage above ground from .5VDC at 4 mA to 2.5VDC at 20 mA. The voltage at the positive current loop terminal is dependent on the external resistance of the device it is tied to. If the device you use is also not isolated but has the same ground as the scale, then use the voltage configuration instead of a current loop. If the flow meter and external device have different ground potentials you must purchase a separate isolation unit to properly isolate the flow meter and the external device.

Function Key F2

Analog Outputs

4. USING THE PID LOOP (CLOSED LOOP)
Assume you have one flow meter and you want to control the feed rate to maintain some rate through the meter. First press the F2 key and set up the PID loop. Select the desired channel, reverse (or forward) action, and local setpoint. Begin with P = 10, I = 100, and D = 3. Next press the **WEIGHT RATE** key. If line 3 is blank press the **WEIGHT RATE** key again to display set rate. Then press the **SELECT** key and use the arrow keys to enter the desired set rate. If you intend to change the time base from tons per hour or tons per minute by turning switch SW1 position 7 on or off you must set the switch before entering your set rate.

You can use input P4.7 to make the feeder stop but remember that there is still power on the feeder motor and the feeder could start unexpectedly.

If the control is at maximum output alarm output P4.3 will turn on. This can be used in conjunction with a solid state relay to turn on an alarm horn.

5. CONTROLLING ADDITIVES WITH THE PID LOOP (SLAVE OUTPUTS)
Assume you have two meters. The first one is set up to weigh the main product. The second meter is going to be used to add 15% of another ingredient. You can set the first scale to use its PID loop to control the feed rate of the main material as described above or you can simply use the meter to measure the main flow. Assume you have used the **NODE** key to make the first meter node 1 and the second meter node 2. You must press the F3 key and set the first meter to send rate to nodes from 2 to 2. Now set the PID loop for the second meter to remote setpoint. This tells the second meter that it is going to get the rate from a master meter over the network. It will then multiply the rate from the master by the setpoint percent you enter into the second meter. Assume the second meter is set to use channel 2 for the PID loop. Press F2 to display the setpoint percents and enter 15% for setpoint #2. Connect the two meters using RG62A/U coaxial cable. Install a 93 ohm terminator on the unused BNC connector of each meter.

PID NOTES

1. You can have several meters set up as slaves to one master which will allow you to blend materials. You must set the nodes for the slaves so they are in consecutive order. For example, you could have three slaves at nodes 4,5, and 6. You could not have the three slaves to one master at nodes 4,5, and 7 because you have to tell the master to send rate to nodes from some value to some value. You can enter from 4 to 6 but if you enter 4 to 7 the master will detect no meter at node 6 and shut down all the feeders.

2. You can have one master and several slaves and then have another master with its own slaves on the same network cable. They will be completely independent and one will not be aware of the existence of the other.

3. You can also continue the cable to a personal computer and do data collection from the masters and all slaves as well as from other meters not using the PID loop. You can also network Sauk Valley Systems ***BELT-WAY*** belt scales as masters or slaves with ***FLO-WAY*** solids impact flow meters.

Function Key F2

Analog Outputs

4. If you are using two or more controls in a master slave setup there are two conditions when the alarm output may turn on. First if any of the controls using the PID loop is running at maximum output the alarm output will turn on in that control box and also in the master control. Next if there is a network problem the slave that does not receive a message from the master will turn off by itself. The master will detect the problem and force the rest of the slaves to turn off. If the master is running the PID loop then the master feeder will also turn off. However, if the master is not running the PID loop but is simply measuring rate then the control cannot shut off the master feeder. In this case you can use the batching output to interlock the master feeder motor starter. First press the F5 key and press the **SELECT** key to position the small arrow after the words LOAD WT. Press the **CLEAR WEIGHT** key to set the load weight to .000. Then press the small down arrow key to set the load weight to 9999999.999. Now the batching output P4.0 will turn on and stay on. If there is a network failure the batching output will turn off until the problem is resolved. You can use this output and a solid state relay to interlock your master feeder motor starter. Now if there is a network problem the master not running the PID loop and all slaves will turn off.

You can also use the batching output to actually run a specific amount of material through the flow meter. When the master flow meter reaches the load weight minus the cutoff the batching output will turn off. This will shut off the master feeder so the rate will drop to zero. This will cause all the slaves to drop to zero as well.

5. If you are running two or more controls as master and slaves you must set them all to display rate in tons per hour or tons per minute. They must all be in the same units. Switch SW1 position 7 is used to select the time base.

Function Key F3

Log Rate and Send Rate

Press function key F3. The display appears as shown below.

LOG RATE	**350.00**
LOG TIME	**12H 45M**
SEND RATE TO NODES	
IS TURNED OFF	

Press the **SELECT** key. A small arrow appears after the word RATE. You can use the **CLEAR** key to set the log rate to .00 or use the adjust keys to enter your desired log rate. Switch SW1 position 1 must be on to change log rate. Be sure to turn switch SW1 position 1 off when you are done setting log rate so nobody can accidentally change your meter calibration. The control will keep track of the hours and minutes that the meter is running at a rate equal to or higher than the log rate you enter. In other words, if you enter a log rate of 300 tons per hour the log time will show you how many hours and minutes your production was at or above 300 tons per hour. If you want to have your rate displayed in tons per minute instead of tons per hour you must turn on switch SW1 position 7 before you enter your log rate. Otherwise your log time will be incorrect.

Press the **SELECT** key again. Now the arrow appears after the word TIME. You can use the **CLEAR** key to set the log time to 0H 0M. In order to be able to clear log time switch SW2 position 5 must be turned on.

Press the select key again. The small arrow appears after the word OFF or after the word FROM if send rates to nodes is turned on. If the word OFF appears then the control is not sending its rate to any other controls. This is the normal mode and this feature must be OFF unless you have one or more additional controls set up as slaves to the master control and the network is connected. Assume you do have one additional control set up as a slave and this control is the master. Assume that the slave control is programmed to be node 4. Using the **SELECT** key position the small arrow after the word OFF. Then use either up arrow key change the word OFF to FROM 4. Press the **SELECT** key again. The arrow appears after the word TO. Use either up arrow key to enter 4. Now this control is set up as a master and node 4 must be set up as a slave to this master. Any control set up as a slave or set up as a stand alone control must have the feature send rates to nodes turned off. Only a master should have this feature turned on and then it must be set up to send rate to nodes from and to the slaves you have connected. Assume you have three slaves set up as nodes 4, 5, and 6. You would program the master to send rate to nodes from 4 to 6. The display would appear as shown below.

LOG RATE	**350.00**
LOG TIME	**12H 45M**
SEND RATE TO NODES	
FROM 4 TO	**6**

Function Key F4

Master Total, Time, and Date

Press function key F4. The display appears as shown below.

```
MASTER TOTAL IS
      1234.567
TIME 11:08:24
DATE 07/28/94
```

Every time you clear the flow meter total weight the total is added to the master total before it is cleared. If you want to clear the master total you must have switch SW1 position 3 turned on. Then if you press the **CLEAR** key twice within two seconds while you are looking at the master total it will be set to zero. You can prevent someone from clearing the master total by keeping switch SW1 position 3 turned off. You do not need to press the **SELECT** key to clear the master total.

If you press the **SELECT** key a small arrow will replace the : after the hours. At this time you can set the hour to 0 using the **CLEAR** key or you can use the adjust keys to set the hours to the correct time. Each time you press the **SELECT** key the arrow will move to minutes, seconds, month, date, and finally year. In this manner you can set the time and date.

Time and date are only used if you are printing tickets or are logging data.

Beginning with version 6.08, if you have the RS-232 port set up to print tickets, you can print the master total. Simply press function key F4 so you are looking at the master total. Then press the **PRINT** key to print a ticket. The ticket will be similar to a normal ticket but line 4 will say MASTER TOTAL and the master total amount will be printed. See the instructions for function key F7 to set the scale up to print tickets.

Function Key F5

Loading Trucks, Barges, and Rail Cars

Function key F5 is used if you want to use the flow meter for loading trucks, barges, or rail cars. You must have the optional IO board installed in order to use this feature. If you do not have the optional IO board you can still program this screen but the output will not function.

Press the F5 function key. The display appears as shown below. If switch SW1 position 5 is off line 3 will be blank.

LOAD WT	**25.000**
WEIGHT	**12.345**
CUTOFF	**.000**

Press the SELECT key. A small arrow appears after the WT. The arrow means you can set your load weight using the adjust keys. After setting the correct load weight press the SELECT key again. The arrow will appear on line 4 after CUTOFF.

Use the adjust keys to set your cutoff. You may need to experiment with the cutoff to find the correct value. The cutoff is used to shut off the feeder early to allow for material already flowing to reach the flow meter.

You may change the values of the load weight and cutoff weight any time. You do not need to have switch SW1 position 1 turned on. This allows you to change load size and cutoff while preventing someone from accidentally changing the scale calibration. If you do not want your operators to be able to change the load weight turn on switch SW2 position 4. This will disable the adjust keys so the load cannot be changed and selecting one of eight preset load weights will also be disabled.

The load weight is the amount you want to put in the truck. In this example it is 25.000 tons. The cutoff weight allows the feeder to turn off before all the material has reached the flow meter. Otherwise each load might be over weight.

Press the SELECT key again. The display will appear as shown below.

LOAD #1	**.000**
LOAD #2	**.000**
LOAD #3	**.000**
LOAD #4	**.000**

Function Key F5

Loading Trucks, Barges, and Rail Cars

The small arrow will appear after #1. Use the adjust keys to program load 1. Press the **SELECT** key and continue to program loads 2, 3, and 4. When you press the **SELECT** key after the arrow is on #4 the display will change to show loads 5,6,7, and 8. In this manner you can program eight different load weights. Switch SW1 position 1 must be on to program the eight preset load weights. Be sure to turn off switch SW1 position 1 when you are done to prevent somebody from accidentally changing your calibration or preset load weights.

Once you have pressed function key F5 the eight function keys are used to select preset load weights 1 - 8. To escape from this feature so that you can use the other function keys to perform their normal functions press the **WEIGHT RATE** key. Now when you press any function key other than F5 they will perform their normal function. Once you press F5 the eight function keys again will select preset load weight 1 - 8. F1 will select load preset 1, F2 will select load preset 2, etc.

The angle sensor input can be used to connect a selector switch which will allow your operators to select preset load weights 1 - 8. Sauk Valley Systems has available a remote start / stop station which will allow your drivers to load their trucks without ever touching the flow meter control keypad. You can also select your preset load using the function keys F1 - F8. You may want to write down the load weight for presets 1-8 and perhaps laminate it to keep it weatherproof.

Material going into the truck must pass through the flow meter. The batching output P4.0 should be connected to a feeder which feeds material to the flow meter.

Whenever the flow meter weight total is less than the load weight minus the cutoff weight the batching output will be on. When the flow meter weight total is equal to or greater than the load weight minus the cutoff weight the batching output will be off.

The batching output must be connected to an optional start / stop station. See the wiring diagram in the section of wiring diagrams for details on how to connect the batching output. You can purchase a start / stop station from Sauk Valley Systems or make your own. The start / stop station should be mounted next to the flow meter control box.

HOW TO BATCH IN GENERAL

1. Program your eight spans for materials 1 - 8 if you have enabled selecting different materials. Use the **MAT 1-8** key, **SELECT** key, and adjust keys.
2. Press function key F5 to enter the load mode.
3. Program your cutoff using the **SELECT** and adjust keys.
4. Select material 1 - 8 using the **SELECT** and adjust keys if this feature is enabled.
5. Program your load weight using the **SELECT** and adjust keys or select from load 1-8 using the function keys F1 - F8 or remote start / stop station.
6. Clear the flow meter total using the keypad **CLEAR** key or remote clear button on the start / stop station connected to P4.4. The total will be added to the master total.
7. As soon as you clear the total the batching output will turn on. The feeder will not turn on until you press start on the start / stop station.
8. Press start on the start / stop station when you are ready. If you need to stop the feeder before the load is complete press the stop button.

Function Key F5

Loading Trucks, Barges, and Rail Cars

9. When the flow meter total reaches the load weight minus the cutoff the batching output will turn off.
10. If you are printing tickets press the remote print button connected to P4.5 or press the **PRINT** key.
11. Repeat the sequence from step 4 for each new load.

HOW TO USE THE START / STOP STATION

1. Press function key F5 to enter the load mode.
2. If enabled select material 1 - 8 using the **SELECT** and adjust keys on the control keypad. You can not select different materials using the remote station.
3. Use the rotary selector switch to select 1 of 8 preset load weights.
4. Press the enter load pushbutton. The selected preset load weight will appear on the control display line 1. If the load weight is not correct repeat 3-4.
4. Press the clear pushbutton on the start / stop station. The flow meter weight total will go to .000 and the ready light will turn on.
5. Press the start pushbutton. The run light will turn on and the feeder will start running.
6. If you need to stop the feeder for any reason before the load is complete press the stop pushbutton. The feeder will stop and the run light will turn off. The ready light will stay on. Press the start pushbutton to continue loading the truck.
7. When the weight on the flow meter reaches the load weight minus the cutoff weight the feeder will turn off automatically. The run light and the ready light will turn off.
8. If you have a printer connected to the scale you would have already set the control up to print tickets following the instructions for the F7 key. Simply press the print pushbutton to print a ticket.

Function Key F6

Pulsed Output and Auto Zero

Press function key F6. The display appears as shown below.

TONS PER PULSE	**OFF**
PULSE ON TIME	**50%**

Press the **SELECT** key. A small arrow appears after the word PULSE. You can now use the adjust keys to select from the following options:

TONS PER PULSE OFF .01 .10 1.0 10

If you select OFF the pulse output will be disabled. Any other selection requires the optional IO board. If you select .01 you will get a pulse every time the weight increases .01 tons. This will work up to about 150 tons per hour. If you select a pulse every .10 tons this will work up to about 1500 tons per hour.

Press the **SELECT** key again. A small arrow appears after the word TIME. You can now use the adjust keys to select from the following options:

PULSE ON TIME 50% 10 MS --- 500 MS

If you select 50% you will have a true quadrature wave output on P4.1 and P4.2. This will drive a remote display with quadrature input or a PLC. The advantage of using quadrature waveform is that if the flow meter is losing weight the remote counter or PLC will detect this and maintain the correct weight. See the wiring diagram in the wiring section for details.

If you select pulse on times from 10 to 500 milliseconds use either output P4.1 or P4.2. The pulse will remain on for the programmed time. You will not have a true quadrature waveform so do not select pulse on times other than 50% if you are connecting the pulsed output to a device with a quadrature input.

Function Key F7

RS-232 Serial Output

Function key F7 is used to control the RS-232 output to a printer, a remote display terminal, a remote scoreboard display, or a PLC at 1200 baud, 8 data bits, no parity, 1 stop bit, no handshake. Press the F7 key. The display appears as shown below.

RS-232	**OFF**

Press the **SELECT** key. A small arrow appears after the word RS-232. You can use the adjust keys to select from the following options:

RS-232 OFF TICKETS WEIGHT RATE or
WEIGHT&RATE

Press either of the up arrow keys. The display appears as shown below.

RS-232	**TICKETS**
USE	**0 LINE FEEDS**

Press the select key again. Now the small arrow appears after the word USE. You can use the adjust keys to select from the following options:

USE 0 - 10 LINE FEEDS or
USE 1 FORM FEED or
USE 1 - 12 SPECIAL CODES

If you select 1 - 12 SPECIAL CODES the following two lines will appear on lines 3 and 4 of the display.

00	**12**	**54**	**7A**	**F3**	**DE**
FA	**03**	**1B**	**45**	**A0**	**FF**

In this section of the instructions you are programming the RS-232 output to print tickets. The ticket can be used for loading trucks. Your ticket printer may need a few line feeds or a form feed to advance the ticket out of the printer. You can select from 0 to 10 line feeds to follow the ticket you can select one form feed. If you have unusual conditions you can select up to 12 characters to be sent to the printer after the ticket. For example, one printer uses the following codes to advance the paper and cut the ticket off.

ESCAPE "a" n will advance the paper n lines
ESCAPE "d" 0 will cut the paper off

To program the flow meter to send these codes select 6 special codes. Then use the select key to move the small arrow to follow each of the first 6 codes and use the adjust keys to make them be as follows:

1B 61 8 1B 64 00

This will cause the printer to advance 8 lines and cut the ticket off. The ticket printed appears below.

SCALE # 1
TIME 09:25:42
DATE 07/28/94
WEIGHT 797.504

The scale number will be the node you programmed the flow meter. To print the ticket press the **PRINT** key or connect a pushbutton to the remote print input P4.5. You can use the **CLEAR** key to set any of the special codes to 00 after using the select key to select the code. You cannot use FF for a special code since it is the end of message marker.

Function Key F7

RS-232 Serial Output

Again press the select key until the small arrow is back on line 1. Use either of the up arrow keys to change the word TICKETS to WEIGHT. Now the display appears as shown below.

RS-232 WEIGHT
FORM STX WT CR
LF AFTER CR OFF
LOG DATA OFF

Use the **SELECT** key to move the small arrow to line 2 after the word FORM. You can now select from the following options:

FORM STX WT CR or WT CR

This allows you to send an STX if the data is going to a PLC or disable STX if the data is going to some type of display.

Use the select key to move the small arrow to line 3 after the word CR. You can now use the adjust keys to select from the following options:

LF AFTER CR OFF YES BOTH

If you select off no line feed will follow the carriage return. If you select yes a line feed will follow the carriage return at the end of the message. If you select both a line feed will follow each carriage return if you have selected weight and rate.

The above discussion shows you how to send the scale weight out the RS-232 port once each second. You can use the select key to move the small arrow back to line 1 and select RATE instead of WEIGHT. If you do select RATE then once each second the current rate will be sent out the serial port. You can also use the adjust keys to select WEIGHT&RATE. If you do then the weight will be sent followed by the rate, once each second. If you select WEIGHT&RATE then you have the following options for the format of the message.

STX WEIGHT RATE CR
WEIGHT RATE CR
STX WEIGHT CR RATE CR
WEIGHT CR RATE CR

Again, on line 3 LF AFTER CR allows you to select sending no line feed after the carriage return by selecting OFF. You can send one line feed after the final CR by selecting YES. Or you can send a line feed after each CR by selecting BOTH.

Use the select key to move the small arrow to line 4 after the word DATA. If you select OFF then either weight, rate, or weight and rate, depending on what you have selected, will be transmitted once each second. You have the option of using the adjust keys to change LOG DATA from OFF to from 1 to 255 MIN. In that case data will be transmitted once every X minutes where X is the number you have programmed. In addition to the normal message time and date are added. The format of a data log is

WEIGHT RATE TIME DATE

if you selected sending both weight and rate. Logging data allows you to collect data from the scale in a time frame you can select yourself.

Function Key F7

RS-232 Serial Output

If you press the F7 key a second time the display will appear as shown below.

```
BAUD  1200
COLOR  RED
```

If you have not turned on switch SW2 position 3 the second line will be blank. Press the SELECT key and a small arrow appears after the word BAUD. You can use the arrow keys to select 1200, 2400, 4800, or 9600 baud. Keep in mind there is no handshake so characters may be lost if you select a high baud rate.

This version of the scale control supports a low cost large display called a COLOR BRITE sign Model SW-214CR. This display is made up of red and green light emitting diodes. You can select the color you want from red, green, and orange. The characters are two inches high. You can display either the total weight that has crossed the scale or the current rate crossing the scale. The display is updated once each second. This display is designed to be used indoors. It is not waterproof or weather proof so it must be protected by mounting it in a suitable housing. The display is very bright indoors but in direct sunlight you cannot read it. If you use it outdoors you must shield it from direct sunlight. In spite of its limitations it will allow you to read the scale from at least 25 feet away and it is very low cost. If you are using this option you must turn on switch SW2 position 3. This switch is on the door. It must be off if you are not using the sign since the message format is special.

You may contact Sauk Valley Systems for information on where to purchase this display. You will need a special cable to connect the display to the control. One end has a telephone style connector to plug into the display. The other end connects to terminals in the control box labeled TXD and GND. You can purchase a cable from Sauk Valley Systems.You must set the baud rate to 2400 to match the COLOR BRITE display.

Function Key F8

Function key F8 is not currently used.

Test Keys T1 T2 T3

1. Press test key T1. The display appears as shown below.

PULSES	**12345**

This display is a pulse counter which counts each pulse from your liquid meter as it occurs. This display can be used to calculate the correct tons per pulse value for your liquid and your liquid meter. Its use is explained on the calibration page.

2. Press test key T2. The display appears as shown below.

SWITCH SW2	**0**
SWITCH SW1	**3**
VERSION	**6.06**

This display shows what configuration switches are turned on and also the version of the software.

3. Test key T3 is not used.

Display Summary

Weight Rate Key (Normal Display)

WEIGHT	**3248.962**
RATE TPH	**350.451**
PULSES/SEC	**542**
NODE 1	

Cal Data Key (Calibration Data)

RATE TPH	**350.451**
TONS PER PULSE	
.00004000000	
ADJUST DISABLED	

Node Key

NETWORK NODE	**1**
CONFIG	**56**
DIAGNOSTICS	**114**
STATUS	**119**

Function Key F1

LOW PULSE ALARM	
PULSES/SEC	**550**

Display Summary

Function Key F2 (First Press)

#1 SETPOINT	**100.00%**
#2 SETPOINT	**10.00%**
#3 SETPOINT	**5.50%**
#4 SETPOINT	**2.25%**

Function Key F2 (Second Press)

#1 MAXRATE	**500.00**
#2 MAXRATE	**10.00**
#3 MAXRATE	**7.50**
#4 MAXRATE	**4.25**

Function Key F2 (Third Press)

#1 OUTPUT 4 TO 20 MA
#2 OUTPUT 0 TO 20 MA
#3 OUTPUT 4 TO 20 MA
#4 OUTPUT 4 TO 20 MA

Function Key F2 (Fourth Press)

PID CHANNEL	**OFF**

Function Key F2 (Fourth Press)

PID CHANNEL		**1**
PID ACTION		**REVERSE**
PID SETPOINT		**LOCAL**
P = 10	**I = 100**	**D = 3**

Function Key F2 (Fifth Press)

#1 OUTPUT	**149**
#2 OUTPUT	**220**
#3 OUTPUT	**75**
#4 OUTPUT	**92**

Function Key F3

LOG RATE	**350.00**
LOG TIME	**12H 45M**
SEND RATE TO NODES	
FROM 4	**TO 6**

Function Key F4

MASTER TOTAL IS
1234.567
TIME 11:08:24
DATE 07/28/94

Function Key F5

LOAD WT	**25.000**
WEIGHT	**12.345**
CUTOFF	**.000**

Function Key F5

LOAD #5	**.000**
LOAD #6	**.000**
LOAD #7	**.000**
LOAD #8	**.000**

Display Summary

Function Key F6

```
TONS PER PULSE      OFF
PULSE ON TIME       50%
```

Function Key F7

```
RS-232              OFF
```

Function Key F7

```
RS-232       TICKETS
USE        0 LINE FEEDS
```

Function Key F7

```
RS-232       TICKETS
USE  6  SPECIAL CODES
 00   12   54   7A   F3   DE
 FA   03   1B   45   A0   FF
```

Function Key F7

```
RS-232       WEIGHT
FORM   STX  WT  CR
LF  AFTER  CR    OFF
LOG DATA         OFF
```

Function Key F7

```
RS-232       RATE
FORM   STX  RT  CR
LF  AFTER  CR    OFF
LOG DATA         OFF
```

Function Key F7

```
RS-232  WEIGHT & RATE
 FORM   STX  WT  RT  CR
 LF  AFTER  CR    OFF
 LOG DATA         OFF
```

Test Key T1

```
PULSES              12345
```

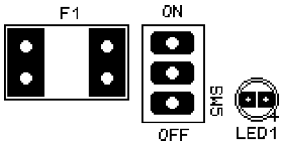
Test Key T2

```
SWITCH SW2       0
SWITCH SW1       3

VERSION        6.06
```

Maintenance

Electrical



Check the wiring terminals periodically to be sure the screws are still tight. If your flow meter fails to operate the following steps may help determine the problem.

1. Is the red light emitting diode LED 1 on? If not, there is a problem with the 12 volt power. Make sure there is 120 volts AC at the socket for the transformer. Make sure the power switch SW5 is turned on. Make sure the fuse F1 is not blown. If it is, replace it with a 1 amp 2AG fuse. This fuse is difficult to find locally. On circuit boards marked PB-9 or higher the fuse is a 5x20 mm 1 amp slow blow fuse. Use Littlefuse number 2180001 or Radio Shack 270-1063. If there is power coming in to the transformer, the fuse is good, and the switch is turned on, but the red light still is not on, there is a problem with the transformer. It should be replaced.

If the red power on light is on but there is nothing displayed on the computer liquid crystal display, then there is a problem with the computer. The fastest way to repair it is to replace the two circuit boards in the control. A replacement set is available with instructions. You will receive credit for the old boards if you return them.

2. If the display does work then the computer is working. If you are not recording weight as product passes through the flow meter the problem is most likely the load cell.

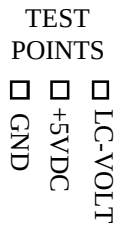
To check the load cells, press the **WEIGHT RATE** key. The display shows the load cell signal as load percent. As you press down on the load cells the number should change. The number should be somewhere near 7.5% with no material flowing since that is how you calibrated the flow meter. The number should go up as you press down on the impact plate connected to the load cells.

If the load cell signal does not respond as described above you may have one or two defective load cells. You can check each cell separately. Unplug one of the cells. Turn all the zero switches off. Remove the resistor connected with load cell #1. You are now testing the cell still plugged in. It may show a 0 at all times or some number that does not change when you press on the impact plate. Then unplug that cell and plug in the other cell. Compare the two results. If one of the load cells appears defective it can be replaced. Make sure there are no broken, loose, or disconnected wires at the terminal strip.

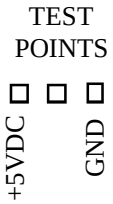
Maintenance

Test Points

Processor Board



Display Board



The processor board is located in the control box. It has test points marked as shown above on the left. If you have a voltmeter you can check the +5 volt and LC-VOLT power supplies using these test points. The test point marked LC-VOLT is the load cell supply voltage. It should be about 9.5 volts DC.

The display board is located on the control box door. It also has test points as shown above on the right. You can check to see if there is +5 volts on this circuit board.

USING A MODEM TO COLLECT DATA

Beginning with version 6.02 the liquid control can be used to collect data using the internal memory. This data can be downloaded into a personal computer using a modem from anywhere in the world or you can use a serial cable and a portable computer to collect the data locally.

1. Press the **NODE** key. If you only have one scale at this location you can set the node to 1. If you have several scales at this location you should set each to a different node number. Press the **SELECT** key once to move the programming arrow to the word node. Switch SW1 position 1 must be on to program the node number.

2. Press the **SELECT** key again to move the programming arrow to plant. If you are collecting data from several plants enter a unique number to identify this plant. Switch SW1 position 1 must be on to program the plant number.

3. Press the **SELECT** key again to move the programming arrow to product. If you want to identify each different product crossing this scale enter a unique number to identify this product. Switch SW1 position 1 does NOT need to be on to program the product number. This allows your operator to change the product number when the actual product changes without opening the door on the control. If you do use the product number to identify your different products it is up to your operator to have the correct product number entered for the product being weighed.

4. Press the **SELECT** key again to move the programming arrow to modem time. Enter the time interval you wish to record data. The standard scale will store 120 records. If you set the modem time to 1 minute increments you can store 120 minutes or 2 hours of data. After 2 hours older data will be replaced with new data. If you set your modem time to 6 minutes (.1 hour) you can store 12 hours of data before older data will be replaced. This is because you will be storing 10 records per hour. Dividing 120 records by 10 records per hour is 12 hours.

The data is in the following format:

001,002,003,00007543.142,08:48:01,03/26/97crlf
where the scale number is 1, the plant number is 2, the product number is 3, the weight is 7543.142, the time is 08:48:01, and the date is 03/26/97. The cr lf at the end of the line is carriage return line feed. The format of this data should be able to be imported into any spread sheet or data base program. The data is in ASCII format. Leading zeroes will be suppressed by being replaced with spaces.

Once the data is collected in the scale integrator you must use the RS-232 port to download the data to a personal computer. First press the F7 key twice and set the baud rate to 9600 for the fastest transmission. If you are using a modem it must be programmed to use 9600 baud between the scale integrator and the modem. Let the modem auto detect the speed between the two modems. Program the baud rate from your personal computer to your office modem for as fast as possible. It must be faster than 9600 baud or you may lose characters. If you lose characters you may have to slow down the baud rate at the integrator.

The scale integrator RS-232 port is a simple 3 wire interface. It does not support handshaking signals like RTS, CTS, DCD, etc. Connect our transmit data pin TxD to the modem receive data. Connect our receive data RxD to the modem transmit data. Connect our ground to the modem signal ground. You must connect the modem that will be used with the scale integrator to a personal computer to program the modem. It must be set to the correct baud rate, usually 9600, 8 data bits, 1 stop bit, no parity, using your terminal program. You must program the modem to auto answer, send numeric response, send only short form messages, disable flow control, and DTR assumed on. See the example

USING A MODEM TO COLLECT DATA

at the end of this manual. This data must be written into the modem memory as shown in the example.

If you do not use a modem you can connect a personal computer directly to your scale integrator using a 3 wire cable. The scale transmit data TxD must be connected to the computer receive data. The scale receive data RxD must be connected to the computer transmit data. The scale ground must be connected to the computer signal ground.

When you use a modem set to auto answer it will send the scale the number 1 to indicate the modem has connected. The scale sees the 1 and waits 5 seconds and then sends the modem menu. This is why your modem must be set for numeric responses and short form messages. Once you see the menu simply enter the letter of the function you want download. Your responses MUST be LOWER CASE. If you enter c for current data the data will include the current rate. Before you enter b for download the 120 record buffer you want to set your terminal program to store the buffer data on your hard drive.

Once you have the data on your hard drive you will want to import it into your spread sheet or data base program. Some of the data may be a repeat of data you downloaded last time. This depends on your modem time and how often you actually download the data. You should remove duplicate records from your data base.

If you are not using a modem but instead are using a direct cable connection enter a lower case letter a to bring up the menu. If you enter the number 1 the menu will appear after about 5 seconds. Once you see the menu simply enter the lower case command for the function you want to perform.

Warranty

Products manufactured by Sauk Valley Systems, Inc. are warranted to be free of manufacturing defects for a one year period after the original date of purchase. This warranty does not include damage to the product resulting from accident, misuse, improper installation or operation. If a component should become defective within the warranty period, we will repair or replace it free of charge at our option. Defective components must be returned freight prepaid to Sauk Valley Systems, Inc. or to an authorized Sauk Valley Systems, Inc. service center.

Complete products included with our system that are not manufactured by Sauk Valley Systems, Inc. such as computers, printers, chart recorders, active hubs for network expansion, etc. are warranted to the extent that they are warranted to us.

The customer's sole remedy shall be such repair or replacement as is expressly provided above, and we shall in no event be liable for any incidental or consequential damages arising out of the use or inability to use this product for any purpose whatsoever.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific legal rights. You may also have other rights which vary from state to state.

For products purchased outside the United States, see your distributor for warranty.

This product is not designed or sold as a legal for trade device.

This warranty is in lieu of any and all other warranties, expressed or implied.

Wiring Diagrams and Drawings

The following pages contain wiring diagrams for the IO option board and the remote start / stop station used for loading trucks. Use these diagrams in conjunction with the description in the manual to connect the wiring for these options. Also included are drawings showing the hole layout for mounting the scale.