LEVELCOM 300 LIQUID LEVEL COMPUTER

INSTRUCTION
MANUAL

Version 1.06

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LevelCom 300 Specifications

Power	120VAC / 2.0A / 60Hz
Supply Gas	Compressed nitrogen (N2). Consumption varies based on configuration of the LevelCom 300, depth of water and integrity of the well bubbler tube system.
Temperature	Operating range: -30F to +140F
Humidity	5 - 95% RH non-condensing
Linearity	Less than or equal to +/- 0.5%
Hysteresis	Less than .25% FSO
Enclosure	NEMA 4X non-metallic
Alarm Setpoints	Four (4) programmable setpoints
	(Relay option required for remote alarm activation)
Control Setpoints	Four (4) programmable setpoints
	(Control 1 & 2 On/Off) (Relay option required)
Security	User defined 1 - 9 character password
Options	Alarm/control relays: 2 - SPDT "Form C" relays (contacts rated 5A - "Pilot Duty")
	Communications: RS232 / RS422 / RS485 Modbus RTU
	Analog output: 4 - 20mA

Level Sensing Range (H2O)	0 – 2000 ft.
Accuracy (Full Scale)	+/-0.5% FS
Resolution (Full Scale)	8.7" (221mm)

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General Information

Bubblers are one of the oldest remote level sensing systems, and are ideal for sensing water level in wells. They operate by measuring the air pressure required to blow bubbles from a tube that opens near the bottom of the well. This pressure reading is converted to liquid depth if the specific gravity of the measured fluid is known. This ability, to measure the fluid depth remotely is one of the most important characteristics of bubblers. No sensitive electronics or machinery are mounted in the well, only a piece of tubing that is compatible with the well environment.

The LevelCom 300 Well Level Indicator answers problems long associated with submersible sensors for well level sensing. First, the calibration of the sensor can be verified because the sensor is not at the bottom of the well, the sensor is connected to the bottom of the well by a gas filled bubbler tube. Secondly, the instrument uses the same sensor to measure wellhead pressure. This removes the errors resulting from using a separate sensor for this measurement. Finally the LevelCom 300 can detect faults with the bubbler tube system, such as leaks and plugs. The instrument can be interfaced to data telemetry systems allowing remote read out of well level.

For operation, the LevelCom 300 simply requires electrical power, a source of clean, high-pressure air or nitrogen and connection to a sense tube in the well.

The LevelCom 300 measures the static head pressure at the end of the sense line. Using the programmed value for the liquid specific gravity this pressure reading is converted to a depth reading. This raw depth reading is then converted for display in engineering units of measure, which include both English units, inches, and feet, and metric units, meters.

The LevelCom 300 uses computer controlled solenoid valves, admitting pulses of gas to the system only as needed to balance against the liquid level. The unit is designed for minimal gas consumption.

When power is applied, the LevelCom 300 performs a diagnostic check of system operations. To ensure accuracy the instrument performs a **"hardware zero"** by sampling the atmospheric air pressure external to the instrument. In normal operation the LevelCom 300 automatically performs the hardware zero with each new sample operation.

Each LevelCom 300 is field programmed with the parameters and feature selections associated with the well to be monitored. These include:

Depth in English or metric units
Timing of sample cycles
Manual input of specific gravity
Four alarm setpoints with hysteresis
Analog and/or digital outputs
A user defined password

A **Hot Menu** to access certain user-selectable features without a password

The LevelCom 300 is **self-diagnostic** and is programmed to detect hardware errors, sense and supply line problems including leaks, plugged lines and low supply gas pressures. If an abnormal condition is detected, the LevelCom 300 will display the appropriate error message on the digital display to alert the operator.

Features and Definitions

The following are definitions and explanations of LevelCom 300 features and the terminology pertaining to this manual and the LevelCom 300 program.

Alarm / Control Setpoint: A user defined reference point that establishes the point at which a particular alarm or control function will activate.

Bubbler: Refers to the sensing tube installed in the well. The Bubbler to Bottom parameter is the distance between the lower end of the sense tube and the bottom of the well.

Buttons: The LevelCom 300 has a set of buttons built into the faceplate. These are used to enter the configuration information into the device, and to locally acknowledge alarm conditions.

Calibrate: The LevelCom 300 is shipped fully calibrated and while in operation automatically performs a periodic "Hardware Zero". Should the unit require field calibration please reference the calibration procedure beginning on page 39.

Communication: The LevelCom 300 can be purchased with an optional communication interface that allows the instrument to be networked to a central control or data acquisition computer. The interface is RS-422/RS-485 using standard Modbus RTU Protocol.

Initialization Purge: A Purge is the act of clears the sense tube of liquid by the application of compressed gas. The LevelCom 300 has an initialization purge function that can be used to bring the instrument into normal operation quickly without using an excess amount of gas. This function is only intended for use bringing the instrument into operation when the sense line must be cleared of water.

Configuration: The LevelCom 300 program allows users to configure the unit to a wide variety of situations. The unit is shipped with a default configuration and the user adjusts the parameters to match his own requirements thereby establishing the instrument configuration.

Demand: The user may configure the LevelCom 300 to perform sample functions on demand in lieu of automatic timed cycles. This feature is normally used in areas where the quantity of supply gas is limited or in applications not requiring constant monitoring.

Hot Menu: The hot menu is for use when the configuration will be password protected. It is a configurable menu that allows certain parameters, for example, Sample Timing, to be available to operators who don't have the password. This allows operators to change these parameters as needed while protecting the rest of the configuration from tampering.

Hysteresis: A user-defined measurement between an Alarm Setpoint and the point the alarm condition will automatically clear.

LEAK: LEAK is displayed if the LevelCom 300 has detected a leak in the main sense line. It is important to note that the LevelCom 300 will not detect a severe leak, or an open sense line. In this event the LevelCom 300 will sense atmospheric pressure, assume the well is empty and display the *less than* (down arrow symbol) indicating the level in the well is below the end of the sense line.

Lights: Refers to the LevelCom 300 front panel status and fault LED indicators.

Local: The optional alarm relays can be configured for Local Acknowledge. In this case if the relays are configured as alarm outputs the alarm output will clear when the ACK button is pressed. Otherwise the relay will clear only when the alarm condition clears.

Manual Update: In normal operation the instrument runs a sample operation at a pre-determined rate. It is possible to manually trigger a sample operation at any time, and this is called a manual update.

Menu: The LevelCom 300 configuration is organized as a series of menus. These menus are organized to simplify the configuration process by grouping related parameters together. The buttons on the instrument front panel are used to navigate through the menus.

MENU: MENU is the front panel key used to enter the LevelCom 300 configuration menus. The MENU key is also used to make selections and activate or deactivate functions in the program.

Parameter: A parameter is a number used by the LevelCom 300 to calculate a display value or to trigger an alarm. Parameters are set by the user to define the configuration of the LevelCom 300. Specific Gravity is a parameter.

Password: The LevelCom 300 can be configured for password protection of the user's configuration. The password characters are the letters A-Z. As few as 1, and as many as 9 characters can be used in the password. The LevelCom 300 is capable of being programmed with a Hot Menu, which allows easy access to frequently used functions and parameters. The Hot Menu is not password protected.

Programming: Programming refers to the setup and entry of the user configuration into the LevelCom 300.

Relays: The LevelCom 300 is available with 2 optional "Form C" relays. These relays can be used for alarm or control purposes.

Sample Operation: When the instrument goes through the process of applying a controlled charge of nitrogen into the sense line this operation is referred to as a sample operation.

Sense Line: The sense line is the bubbler tube mounted inside the well and connected to the LevelCom 300.

Specific gravity: Specific gravity is the ratio of the density of a substance to the density of fresh water, with water having the specific gravity of 1.000. It is a user-defined parameter in the Levelcom 300 program. This parameter is used to convert the static pressure reading from the sense line into a depth reading.

SURE?: "SURE?" appears when the user has entered a section of the program that will erase or overwrite the configuration. The LevelCom 300 queries the user to allow time for the user to consider if he is certain of his actions. If "SURE?" appears on the display at any point in programming and you do not know why **Don't press ENTER!**

Display Functions

The LevelCom 300 displays depth on a 6-digit display on the top of the display unit. There are also individual lights to indicate alarm and fault conditions.

Numeric: The numeric display indicates depth in the units of measure selected. Programming information and error messages are also indicated on the digital display.

Display Messages

The LevelCom 300 is designed to detect certain system problems and render messages on the display. Following is a list of messages, which could be displayed by the LevelCom 300. If an error message occurs refer to the trouble-shooting guide.

LEAK: The LevelCom 300 has determined the sense line is leaking. It must be noted the LevelCom 300 will not detect a major, catastrophic failure of the sense line. In this event the LevelCom 300 will sense the ambient atmospheric pressure, assume the well is empty and display the down arrow symbol indicating the level in the well is below the end of the sense line.

LOW N2: Indicates the LevelCom 300 has detected insufficient supply gas pressure. Confirm the gas source is operating at the proper pressure and is available to the instrument (refer to the table on page on page 3). Check gas supply fittings for tightness.

SENSE LINE PLUGGED: Indicates the LevelCom 300 is measuring an abnormally high pressure on the sense line. The LevelCom 300 will activate the Sense Line Plugged alarm indicator lamp and shift to standby mode awaiting correction of the problem.

SURE?: "SURE?" appears when the user has entered a section of the program that will erase or overwrite the configuration. The LevelCom 300 queries the user to allow time for the user to consider if he is certain of his actions. If "SURE?" appears on the display at any point in programming and you do not know why - **Don't press ENTER!**

Up Arrow or Down Arrow: To indicate an out of range reading the digital display will show flashing arrow symbols in the left most character of the digital display. When the liquid level

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SYSTEM OK ⊛   ⊛ BUBBLER TUBE PLUGGED

⊛ BUBBLER TUBE LEAK

READING VALID ⊛   ⊛ SUPPLY GAS LOW

ACK   UP   ESCAPE
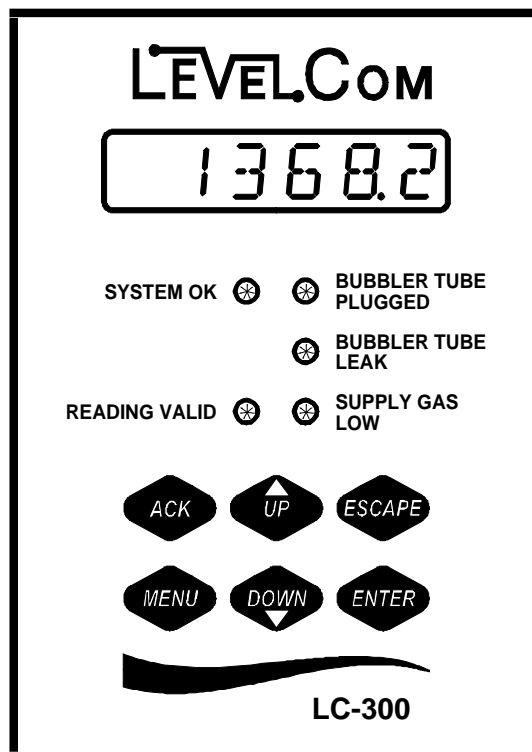
MENU   DOWN   ENTER

LC-300

Figure 1 Levelcom 300 Display

falls below the end of the sense line the instrument will display the Bubbler to Bottom value with a flashing down arrow to indicate that the fluid level can no longer be measured. If the fluid level rises above the Maximum Depth level the left most character will have a flashing up arrow to indicate that the fluid level is over the top of the well.

Lights: On the instrument front panel there are individual LED lights to indicate alarm and fault conditions.

The System OK light is normally lit to indicate that the instrument is operating correctly. When fault conditions are detected, the System OK light goes out and the corresponding fault indicator is lit. There are 3 fault indicators including Bubbler Tube Plugged, Bubbler Tube Leak, and Supply Gas Low.

In addition to these indicators there is the Reading Valid light. This light is used to indicate when the display reading has been updated after a manual or automatic sample operation. When the sample operation begins the Reading Valid light goes out, and when the new reading is obtained, the Reading Valid light is lit.

Buttons: The front panel buttons are used in normal operation to view the display units, to locally acknowledge alarms, and to manually trigger a new reading.

To view the present display units, press the ENTER button. While the button is pressed the current display units will be shown in text on the digital display, FEET for instance.

To acknowledge alarm and fault conditions, press the ACK button. If the optional relay interface is installed, and a relay is configured as a local alarm relay, the ACK button is used to acknowledge the alarm condition and clear the relay.

The instrument is configured to sample the sense line regularly. To conserve nitrogen gas it might be desired to have the instrument sample infrequently. You can trigger a Manual Update any time by pressing the UP button while the instrument is in normal operation. The Reading Valid light will go out, and when the sample operation is complete this light will once again go on, signaling the completion of the new sample operation. Then the instrument will display the new reading.

Installation
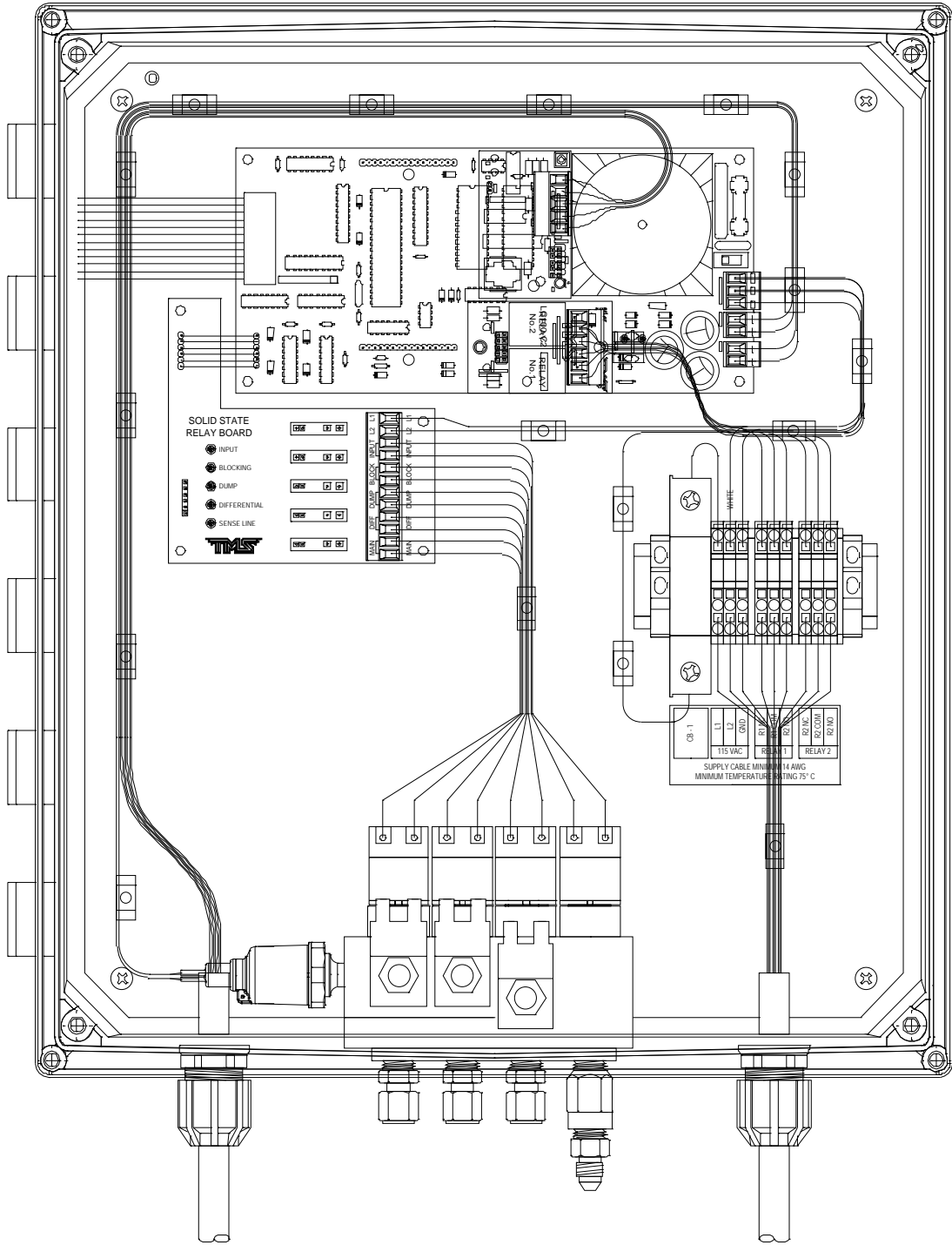
Figure 2 Levelcom 300 General Layout
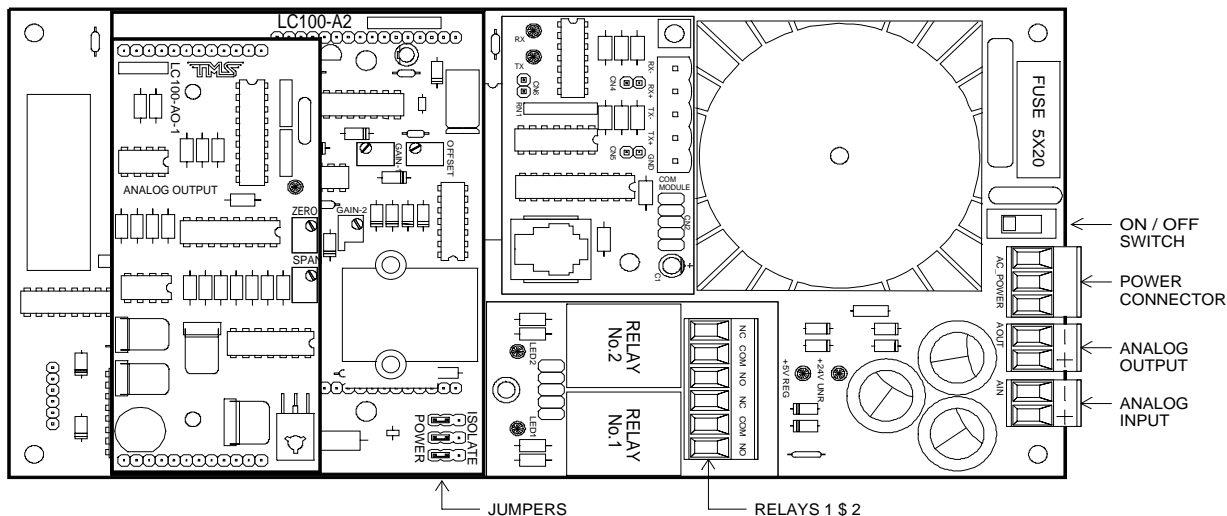
Figure 3 Main Controller Board with Options

The LevelCom 300 has been designed to be mechanically rugged and well protected against the environment. For operation, the LevelCom 300 simply requires electrical power, connection to a source of high pressure gas, and connection to a bubbler tube in the tank or well.

Mounting and wiring must be in accordance with the National Electrical Code.

Figure 2 shows a general view of the inside of the enclosure. On the right side of the box are two latches that hold the lid closed. All pneumatic and electrical connections are made on the bottom of the box so there must be adequate access for the required tubing and conduit. Make sure there is room for the lid latches to open, and room for the lid to swing open for access to the internals of the box.

The display is mounted on a swing plate that hinges to the left. To access the inside of the box for wiring remove the two hold down screws on the right side of the swing plate. These screws are captive in the swing plate so that they will not be lost. Close the swing plate and re-tighten the screws to secure it after all wiring connections have been made and all wires have been secured.

For access to electrical connections, the LevelCom 300 is designed with two 0.875" holes on the bottom of the case intended for ½" electrical conduit. Use listed 4X conduit fittings suitable .for applications on Class 1 or Class 2 wiring

Electrical Connections - General

Figure 2 is a general drawing of the inside of the Levelcom 300. Depending upon options ordered there are three possible locations for electrical connections. 120 Volt AC power wiring should be separated from any signal or low-voltage control wiring.
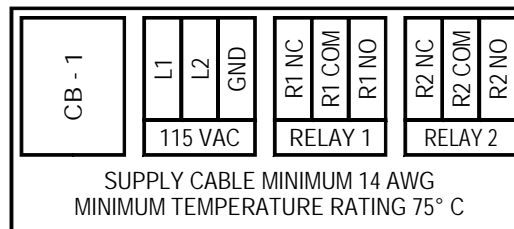
Figure 4 Main Terminal Block Label

Figure 3 shows the Main Controller Board. The options and the connectors are identified.

Electrical Connections - 115VAC

115 VAC connections are made to the main terminal block mounted to the backplane labeled **AC POWER**. Note the label on the backplane below the terminal block which identifies the terminals (**igure 4**). Note the use of the international symbol for the protective earth terminal. Use a minimum of 14 AWG wire for the power connections. This wire must have insulation temperature rating of at least 75 C.

Use the wire tie downs to band all input and output wires down. There are tie down points provided to keep the high voltage wires separated from the low voltage wires. Wiring codes require a minimum of 6 inches of slack in the field wires where they enter the box. Tie the wires down near their ends after they have been inserted into the terminals.

An external circuit breaker must be provided in the power circuit. This should be near the LevelCom 300 installation and within easy reach of the operator. If a group of LevelCom 300s are mounted together one breaker can be used for the whole group. This breaker must be clearly marked as the main power disconnect for the LevelCom 300s.

Note: the GND connection is a protective earth connection. This terminal must be made up to a proper protective earth conductor for the system.

There is a circuit breaker next to the terminal block, this is the main power switch for the enclosure. There is a power switch located on the main controller circuit board next to the 120 VAC connector. Power **ON** is the right position. This switch is normally in the ON position and is not used to control the power to the device. It is important to use the main circuit breaker to interrupt power for servicing the unit so that none of the internal wiring is energized.

Electrical Connections - Analog

Analog Output - The optional Analog Output is a 4-20 mA current type. The output may be powered by the Levelcom 300, or isolated and powered from an external source, by positioning three circuit board jumpers. External supply voltage may be up to 48 VDC.

The jumpers are located on the Analog Input Circuit Board, the larger board mounted to the main controller board. In the bottom right corner of the board are three small plastic jumpers that have been pushed onto circuit board pins, note the labels [ISOLATE] and [POWER] printed adjacent to the jumpers (**Figure 5**). Move the jumpers as required. **NOTE:** Failure to properly position the jumpers may cause damage to the circuit board.

EXTERNALY POWERED LOOP   LEVELCOM POWERED LOOP
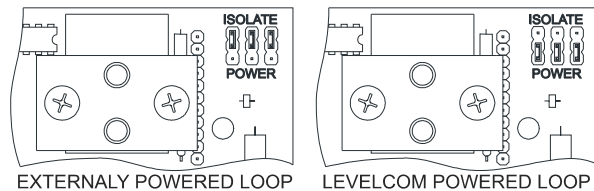
Figure 5 Analog Output Power Jumpers

The Analog Output connector is located at the left edge of the main circuit board adjacent to the Analog Input connector (**Figure 3**). The connector is a plug and socket. Pull the plug out of the socket for ease in making up the connections. Be sure to observe polarity markings.

Electrical Connections - Relay Output

Since the Relay Output is an option, this connector may not have been installed in your LevelCom 300.

Refer to **Figure 2** for the following. There are terminals on the main terminal block for the relay output. The relay output provides two form C contacts so there are three terminals for each relay. The terminals are identified on the label below the terminal block.

Note: When used with 115VAC circuits, those circuits must be powered by an Overvoltage Category II Power source.

Note: The contact arrangements are labeled with the relays de-energized. Be aware that when relays are used for alarm functions, or for system failure alarms the relays are normally energized, and de-energize to signal an alarm or fault condition. This means a NC contact is open in normal operation, and a NO contact is closed in normal operation.

NC = Normally Closed

COM = Common

NO = Normally Open

The Relay Outputs are rated for 5A non-inductive, 120 VAC or 30 VDC, or 125 VA for pilot duty. These contacts should not be used to switch large inductive loads. In cases where higher loads need to be switched, an external contactor rated for the higher current must be used. After wiring is complete secure the conductors to the wire tie down points provided on the backplane.

Electrical Connections - RS-422 Serial Communications

Since the Serial Communication Interface is an option, this five-point connector may not have been installed in your LevelCom 300. If this option has been selected, the connector can be found toward the upper side of the main controller board on the Communications Module next to the large power transformer. The connector is actually a plug and socket. Note the printing on the circuit board next to the socket which reads RX- RX+ TX- TX+ GND.

The terminals are described below:

RX- Receive Data (-polarity), Connect to Computer [TX-] Transmit Data (-polarity)

RX+ Receive Data, (+ polarity) Connect to Computer [TX+] Transmit Data, (+ polarity)

TX- Transmit Data, (- polarity) Connect to Computer [RX-] Receive Data, (- polarity)

TX+ Transmit Data, (+ polarity) Connect to Computer [RX+] Receive Data, (+ polarity)

GND Common Connect to Computer Common

Twisting the wires together is also recommended; a twisted pair is less likely to pick up or radiate interference.

The Serial Communication Interface uses the Modbus RTU protocol to allow the LevelCom 300 to communicate with a SCADA system, remote computer or other intelligent devices. The well level (in 0.1-inch increments) is readable. A "System Fail" alarm is also transmitted. The transmission system used is RS-422/485, which helps to minimize interference, and allows cable runs of up to 4000 feet. The baud rate and Parity are configurable.

For information on connections at the computer's serial port, refer to the manual supplied with the computer.

Pneumatic Connections and Manifold Functions

Pneumatic connections are made at the bottom of the LevelCom 300 manifold. **Figure 6** shows the pneumatic manifold and the external connections. The instrument is supplied with fittings installed as required by the options ordered. If it is necessary to install a fitting, thread lubricant should be used sparingly, with great care taken to keep excess from entering the manifold. **Do not use PTFE tape on any pneumatic connections to the LevelCom 300**. Fittings should be made up only as tight as necessary to be leak-free. The manifold is aluminum, and can be distorted by using excessive installation force. The pneumatic connection ports are discussed below.
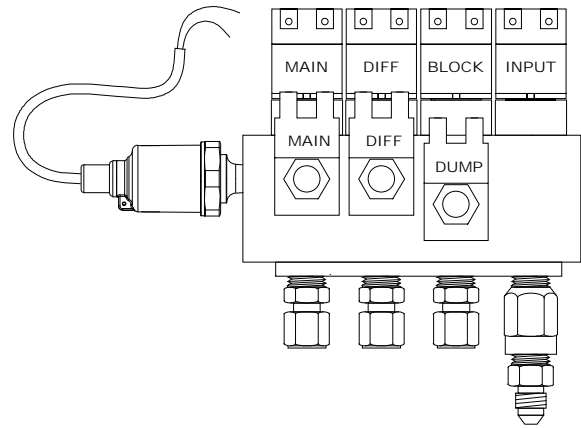
Figure 6 Pneumatic Connections

The output connections are for ¼ inch stainless steel compression fittings.

The recommended regulator for LevelCom 300 installations is Harris Regulator, Product # 3200300, Model #8700-1500-580. This is a special non-vented regulator.

The gas input connection to the LevelCom 300 is a Parker # 4-4 FTX-SS MALE 37 degree high pressure flare fitting. A high pressure hose will be needed, one end will need to connect to this fitting and the other to the regulator. Normally the regulator would be fitted with a similar high pressure flare fitting.

DUMP is used at regular intervals by the LevelCom 300 to purge its manifold of any water, or impurities, and to relieve all pressure to the internal sensor for periodic automatic zero calibration.

DIFF (Differential Pressure) is used to sense the well annulus pressure. This tubing is connected to the well head. Tubing is to be made up tight and leak free.

MAIN connects to the sense line in the well. Tubing is to be made up tight and leak free. No valves are to be installed in the sensing line.

SUPPLY is connected to a source of high-pressure nitrogen gas. The nitrogen pressure must be regulated to no greater than 1000 PSI. The fitting is a 37 degree flare fitting for connecting a high pressure hose to the gas regulator.

Wells that are vented to atmosphere only need the bubbler tube installed. Wells that are pressurized, or that may see some vacuum need the differential pressure connection installed as well. See Figure 7 and Figure 8 for examples of these different installations.
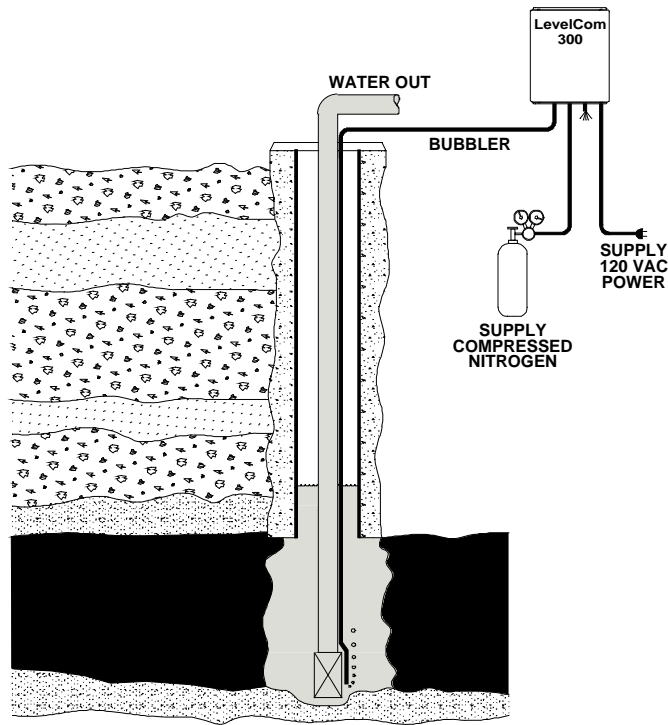
Figure 7 Typical Well Installation
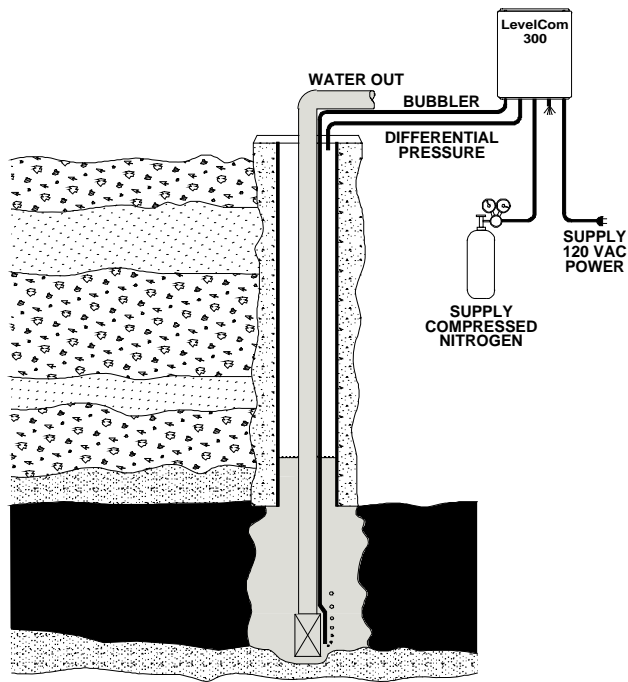
Figure 8 Well installation with Well Head Differential Pressure

Basic Programming

The LevelCom 300 is shipped with a default configuration loaded into permanent memory. For efficient use of the instrument this configuration must be changed to reflect the well being monitored. To place a LevelCom 300 in service, only those features which are going to be used need be set up.

The minimum configuration requirements for accurate operation in a fresh water well are Depth Units, Maximum Depth and Bubbler to Bottom. The Specific Gravity may also need to be adjusted if the water in the well has a high enough dissolved mineral content to effect the specific gravity.

Figure 9 Buttons

To avoid confusion and unnecessary programming steps, the LevelCom 300 has been designed to confine the program display to only those parameters which have been activated and the installed options. This means that during the programming process you may notice areas in the Configuration Flow Chart that are not displayed in the program. For example, if the optional relay outputs are not installed, then the LevelCom 300 will not display RELAY 1 or RELAY 2. In these instances, the instrument will skip to the next programming step.

The Configuration Flow Chart reflects all of the parameters and options available with the LevelCom 300. If you wish to access a parameter or option, which is not presently available to you, please call TMS for assistance.

IMPORTANT NOTE ABOUT PROGRAMMING

The LevelCom 300 is designed to be "User Friendly". We encourage you to enter into the program, browse through the configuration menus and become familiar with the data entry process, the program flow and the general operation of the unit.

Do not be concerned about changing any values while learning. After exploring the LevelCom 300 configuration program, all feature selections and parameters you have entered can be easily erased and the unit returned to the factory set default settings. To reset the LevelCom 300 to the default condition please follow the steps found on page 22 in Erase All Memory/Reset Factory Defaults

Basic Programming Key Functions,

Figure 9 shows the layout of the buttons.

ESCAPE: Allows a user to back out of a menu item without changing settings.
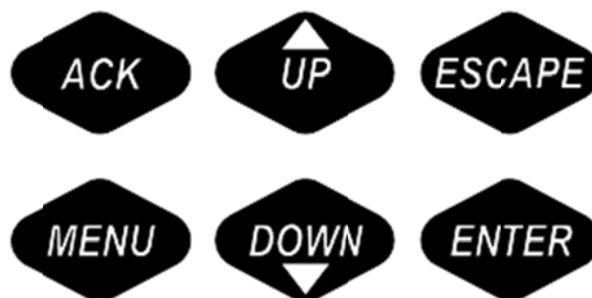
MENU: Places the unit into Program Mode. Also selects / deselects functions.

UP/DOWN: Scroll vertically through the menu. They are also used to adjust parameter values.

ENTER: Used to enter the next program level, save selections and parameter values.

Entering the program mode

Power up the LevelCom 300.

Press MENU. The unit will display SYSTEM. You are now in the LevelCom 300 configuration program.

NOTE: If the unit displays ENTER PASSWORD or HOT MENU then the LevelCom 300 has been previously programmed. Confer with the responsible party prior to proceeding.

If the unit displays HOT MENU please refer to Page 27. If the unit displays ENTER PASSWORD and the password is not available, please call TMS for assistance.

Erase All Memory Reset Factory Defaults

NOTE: This section describes removing all selections and parameters from memory and returning the unit to factory defaults. Use this section only if you have previously entered the program and made selections and adjustments you want to delete.

1. At SYSTEM press UP, the unit will display UTILITIES.

2. Press ENTER. The unit will display NETWORK ADDRESS.

3. Press UP. The unit will display MEMORY.

4. Press ENTER. The unit will display WRITE OVER BACKUP.

5. Press UP. The unit will display ERASE ALL MEMORY.

6. Press ENTER. The unit will display SURE?

7. Press ENTER. The unit will reset and display SYSTEM.

8. At SYSTEM continue with programming or press ESCAPE to return to operation with factory set defaults.

Sensor Range

The sensor range is one of the most important parameters to be set up. This parameter is used to interpret the signals from the sensor and convert them into working pressures. If this parameter is incorrectly set up the instrument will not read depth correctly, and may not function at all.

The standard sensor for these instruments is a 1000-PSI sensor. In cases where the water level is deeper than 2000 feet a 1500-PSI sensor may be installed. Verify the sensor type before adjusting this parameter. This will normally be set up at the factory and should not need to be adjusted.

1. At SYSTEM press ENTER. The unit will display DISPLAY SETUP

2. Press Down twice and the unit will display SENSOR RANGE.

3. Press Enter and the instrument will display the current sensor range configured.

4. Press UP/DOWN to scroll to the actual sensor range. The display is in PSI. The default for this value is 1000.

5. Press ESCAPE and the unit will display SENSOR RANGE.

6. Proceed with the next programming step or press ESCAPE twice to return to normal operation.

Display Setup

1. At SYSTEM press ENTER. The unit will display DISPLAY SETUP

2. Press ENTER. The unit will display DEPTH UNITS.

3. Press ENTER. The unit will display INCHES*.

4. Press UP/DOWN to scroll to the depth unit of measure you have chosen for use.

5. Press MENU to select the choice. An asterisk (*) will appear to the right of the display indicating the item has been selected.

6. Press ENTER to save the selection(s). SAVING will appear briefly on the display and the display will return to DEPTH UNITS indicating the selection has been recorded.

7. Press DOWN. The unit will display WELL SETUP.

8. Press ENTER. The unit will display MAX DEPTH.

9. Press ENTER. The unit will display the factory default Max Depth, 2000 ft.

10. Press UP/DOWN to scroll to the maximum vertical dimension of the well in the Depth Unit of measure you chose in step #5 above.

11. Press ENTER to save the new value. The display will return to BUBBLER TO BOTTOM.

12. At BUBBLER TO BOTTOM press ENTER. The unit will display 0.0.

13. Press UP/DOWN to scroll to the bubbler to bottom distance using the Depth Units you selected in step #5 above.

14. Press ENTER to save. SAVING will appear briefly on the display and the display will shift to MAX DEPTH.

15. Press ESCAPE. Unit will display DISPLAY SETUP.

16. Proceed with the next programming step or press ESCAPE twice to return to normal operation.

Timing

The Timing program establishes two parameters. Normal Sample and Low Level Sample regulate the frequency of level sample operations. The Low level trip point sets the depth where the instrument switches from the normal sample frequency to the low-level sample frequency.

The factory default for this setup is a normal sampling frequency of 6 hours, a low level sampling frequency of 6 hours, and a trip depth of 0. The low level sampling frequency trip is effectively disabled in this configuration.

It is important to understand what this sample frequency means before setting up the instrument. Gas charges are periodically applied to the sense line to make sure that all water is purged out of the line. Between these sample operations the sense line pressure is monitored and the display updated, so the reading on the display is the current pressure in the sense line even if that pressure has changed since the last sample operation.

In the Normal Sample time there is an option for sample operations every 5 minutes. This is used in testing a new installation only, and is far too wasteful of gas for normal operation.
The Normal Sample time should be chosen to reflect the rate that the water level in the well can change significantly. The nitrogen bottle will last longer if a longer sample time is selected.

The Low Level Sample rate is available if the operator wants a faster sample rate when the water level falls below a certain depth. This might be desired because the water level could

change more rapidly when the water level in the well is low. The Trip Depth is the depth where the instrument switches from the Normal Sample rate to the Low-Level Sample rate.

It should be noted that a faster sampling rate would not necessarily make the measurements more accurate. If the water level is dropping, gas will bubble out of the end of the sense tube because the pressure at the bottom of the tube will be dropping. In this case the instrument readings will be as accurate as possible and no new gas is needed in the sense line because it is already completely purged of water. If the water level is rising, however, the water will back up the sense line, slowly compressing the gas in the line. The instrument will see this as a slight change in depth but the depth reading will no longer be accurate until enough gas is supplied to the sense line to purge out the water that has backed up into the line.

If the sense line was perfectly leak free, and the water level was continually dropping, the instrument would not have to supply any gas to the sense line after the line was completely purged of water. The instrument periodically applies small charges of gas to the line only to verify that the line is completely purged. The sample times should be chosen as long as possible to conserve the nitrogen gas supply.

1. Press MENU. The unit will display SYSTEM.

2. Press ENTER. Unit will display DISPLAY SETUP.

3. Press DOWN. Unit will display TIMING.

4. Press ENTER. Unit will display NORMAL SAMPLE.

5. Press UP/DOWN to scroll to the sample cycle time you have chosen for use.

6. Press MENU to select the choice. An asterisk (*) will appear to the right of the display indicating the item has been selected.

7. Press ENTER to save the selection. SAVING will appear briefly on the display and the display will shift to NORNAL SAMPLE.

8. Press DOWN. Unit will display LOW LEVEL SAMPLE.

9. Press ENTER. Unit will display 1 HR.

10. Press UP/DOWN to scroll to the low level sample time you have chosen for use.

11. Press MENU to select the choice. An asterisk (*) will appear to the right of the display indicating the item has been selected.

12. Press ENTER to save the selection. SAVING will appear briefly on the display and the display will shift to LOW LEVEL SAMPLE.

13. Press DOWN. Unit will display TRIP DEPTH.

14. Press ENTER. Unit will display 0.

15. Press UP/DOWN to set the trip depth you need.

16. Press ENTER to save the selection. SAVING will appear briefly on the display and the display will shift to TRIP DEPTH.

17. Press ESCAPE. Unit will display TIMING.

18. Proceed with the next programming step or press ESCAPE twice to return to normal operation.

Specific Gravity

1. At TIMING press DOWN. Unit will display SPEC GRAV.

2. Press ENTER. Unit will display 1.000.

3. Press UP/DOWN to scroll to the specific gravity of the liquid stored in the tank.

4. Press ENTER to save the selection. SAVING will appear briefly on the display and the display will shift to SPEC GRAV.

5. Proceed with the next programming step or press ESCAPE twice to return to normal operation.

Advanced Programming

This section addresses the programming of the more advanced features of the LevelCom 300. These features include establishing password protection of the LevelCom 300 configuration, setting up a Hot Menu, and the setup of optional outputs.

This section assumes the LevelCom 300 has been programmed for basic use. If the unit has not been programmed please refer to page 21, Basic Programming.

Use caution as you move through the program. If you inadvertently access a section of the program containing data you do not wish to adjust, simply press ESCAPE to back out to the previous program point. Following the Configuration Flow Chart as you move through the program will assist you.

Entering the Program Mode

From normal operation press MENU. The unit will display SYSTEM.

NOTE: If the unit displays ENTER PASSWORD or HOT MENU then the LevelCom 300 has been previously programmed. Confer with the responsible party prior to proceeding. If the unit displays HOT MENU please refer to the following section. If the unit displays ENTER PASSWORD and the password is not available please call TMS for assistance.

Entering the Program Mode with a Hot Menu established

The LevelCom 300 program allows the user to establish a Hot Menu, which allows access to selectable parameters and functions without the need to enter the program. The Hot Menu feature provides a means to access and adjust commonly used features, e.g., alarm and relay setpoints, specific gravity, sample timing, etc. without entering into the full program. Items available for the Hot Menu are indicated on the Configuration Flow Chart. For instructions on programming a Hot Menu please turn to page 28.

Once programmed, the Hot Menu is instantly accessible from normal operation simply by pressing the MENU key.

If a Hot Menu is set up, then entering the Program Mode requires some additional steps.

1. From normal operation press MENU. The unit will briefly display HOT MENU and the display will shift to the first Hot Menu selection.

2. Press the UP key. The unit will display CONFIGURE SYSTEM.

3. Press ENTER. If no password is required, the unit will display SYSTEM**.** For information on passwords please see Page 28.

Password

Access to the LevelCom 300 program can be restricted by the use of a password. As previously discussed, the LevelCom 300 can be programmed with a user defined Hot Menu which will provide immediate, non password-protected access to some commonly used features.

If a password has been set up the LevelCom 300 will display ENTER PASSWORD whenever an attempt is made to enter into the program mode. Illegal attempts to access the program do not cause any problem other than frustration for the person attempting entry. Once the password has been programmed and the program exited, the password must be used. The password is entered using the same keystrokes as described below in Programming a Password steps 4 - 8.

Programming a Password

1. Press MENU. The unit will display SYSTEM.

2. Press UP/DOWN to scroll to NEW PASSWORD.

3. Press ENTER. The unit will display a flashing underline as a cursor.

NOTE: The LevelCom 300 password selection consists of the letters A-Z. A password of 1 to 9 characters can be set up.

4. Press UP/DOWN to scroll to the first character.

5. Simultaneously press MENU and the UP key to shift to the next character.

6. Press UP/DOWN to scroll to the second character.

7. Repeat steps five and six until your password is displayed.

8. Press ENTER. SAVING will appear briefly on the display and the display will return to NEW PASSWORD indicating your password has been saved.

NOTE: This password will be required to enter into the configuration program. TMS recommends you set up a Hot Menu to access those parameters you would like accessible but not password protected. **If the password is lost please call TMS for assistance.**

Hot Menu

The LevelCom 300 is programmed with a Hot Menu feature. This allows the user to set up certain parameters and functions into a menu that is instantly accessible simply by pressing the MENU key. This feature is especially helpful if the user has set up password protection.

Once the Hot Menu has been programmed the LevelCom 300 will display HOT MENU when the MENU key is pressed. The parameters set up in the Hot Menu are accessible by scrolling with the UP/DOWN keys.

Hot Menu

1. Enter Program Mode.

2. At SYSTEM press UP/DOWN keys to scroll to HOT MENU.

3. Press ENTER. The unit will display SPEC GRAV.

4. Press the UP/DOWN keys to scroll through the functions and parameters available for the Hot Menu.

5. Select those functions/parameters you wish displayed in the hot menu by pressing the MENU key. An asterisk (*) will appear to the right of the display indicating the item has been selected.

6. After selecting the Hot Menu items press ENTER. SAVING will appear briefly on the display and the display will return to HOT MENU indicating the selections have been recorded.

7. Press ESCAPE to return to normal operation.

Modbus Communication

The Levelcom 300 can be equipped with an optional communication interface. This is a standard RS-422/RS485 type interface. The instrument communicates using the Modbus protocol using Modbus RTU. The instrument may be wired for either 4 wire RS-422, or 2 wire RS485. The communication baud rate may be configured, and different parity options set. There are diagnostic functions to help troubleshoot communication problems.

To configure the communication interface follow this procedure.

1. Enter Program Mode.

2. At SYSTEM press UP key to scroll to UTILITIES.

3. Press ENTER. The unit will display COM SETUP.

4. Press ENTER and the instrument will display NETWORK ADDRESS.

5. Press ENTER and the instrument will display the current network address.

6. Use the UP/DOWN keys to scroll to the desired network address.

7. Press ENTER to save the network address. The unit will display NETWORK ADDRESS.

8. Press the DOWN key and the unit will display BAUD RATE.

9. Press ENTER. The instrument will display 1200.

10. Use the UP/DOWN keys to display the desired baud rate.

11. Press MENU to select the new baud rate.

12. Press enter to save the new baud rate, the unit will display BAUD RATE.

13. Press the DOWN key and the instrument will display PARITY.

14. Press ENTER and the instrument will display N-8-1.

15. Use the UP/DOWN keys to display the desired parity setting.

16. Press MENU to select the new parity setting.

17. Press ENTER to save the new parity setting, the unit will display PARITY.

18. Press ESCAPE to exit the communication setup menu.

Outputs

The LevelCom 300 has a number of output devices available. There are optional relays that can be configured to function as alarm, or control outputs, an optional 4-20 mA output that can be used as a gauge, or control output.

The LevelCom 300 automatically detects any installed optional output devices on power up. The Outputs menu will reflect this. For instance if no relay module is installed in the LevelCom 300 the Relays menu item will not appear in the Outputs menu. Because of this the menus on your instrument may not exactly match the menus as shown on the programming interface map at the end of this manual.

To program alarms the alarm points must first be assigned to output relays. After assigning alarms to outputs the alarm setpoints and hysteresis values can be set. For instance if you have assigned High and Low alarms to relays, you will be able to set up the alarm setpoints for these alarms under the Alarm Setpoints menu. You will not be able to set up a setpoint for the High High alarm, or the Low Low alarm though. These alarms have not been assigned to outputs.

Relay Outputs

The LevelCom 300 has two optional "Form C" relay outputs. These relay outputs allow the user to configure the LevelCom 300 to activate external operations, such as, alarms, motor controls, etc. If you have ordered relay outputs then the LevelCom 300 will display RELAY 1 and RELAY 2 under the Outputs section of the program (Please refer to the Configuration Flow Chart).

The relays can be programmed to be either alarm or control outputs. If relays are configured as alarm outputs, they will function similarly to the light or horn outputs. The relays differ from the lights and the horn in that they do not normally respond to the ACK button. They normally activate when the alarm condition occurs, and clear at the assigned hysteresis level. Relays cannot be configured to latch. As alarm outputs the relays are intended for interfacing the LevelCom 300 to existing alarm systems.

It is possible to configure an alarm relay to be locally acknowledged. In this case the relay will respond to the ACK button. This setup can be used to build a local alarm system for a group of LevelCom 300s. The relay outputs from each LevelCom 300 can be paralleled to run an alarm horn. To silence the horn, the ACK button must be pressed on the LevelCom 300, which is generating the alarm.

When a relay is configured as a System Failure relay, it will respond only to failure conditions, such as Sense Line Plugged, Sense Line Leak, and so on.

Programming Relay Outputs

NOTE: The following procedure applies to both relay outputs. Follow the same procedure for Relay 2.

Alarm Relay Configuration

Follow these instructions to set up a relay for ALARM or SYS FAIL operation.

1. Enter Program Mode.

2. At SYSTEM press UP/DOWN keys to scroll to OUTPUTS.

3. Press ENTER. The unit will display LIGHTS.

4. Press the DOWN key until unit displays RELAY 1.

5. Press ENTER. The unit will display ALARM.

6. Press UP/DOWN keys to scroll to ALARM, or SYS FAIL.

7. Press MENU to select the function of the relay. An asterisk (*) will appear to the right of the display indicating the function has been selected. Also select LOCAL if you choose to have the relay acknowledgeable from the LevelCom 300 front panel ACK key.

8. Press ENTER. SAVING will appear briefly on the display. If SYS FAIL was selected press ESCAPE to back out of the menu. If ALARM was selected please continue below.

9. The unit will display HI HI.

10. Press UP/DOWN keys to scroll through the menu selections.

11. Press MENU key to select those alarms you wish activated.

12. Press ENTER. SAVING will appear briefly on the display and the display will shift to RELAY 1.

Control Relay Configuration

When a relay is set up as a control relay there are two setpoints that must be defined; the on setpoint and the off setpoint. The relay will be energized when the level reaches the ON SETPOINT value and the relay will be de-energized when the level reaches the OFF SETPOINT value. This is simple enough but there are other factors to consider before setting the relays up.

The control option was designed with the intent of controlling a pump or a valve to maintain the level of a well. If such control is to be implemented it is important to consider what will happen in case there is a failure in the system. The LevelCom 300 will de-energize the relay when any system failure condition is indicated. These include supply air failure, plugged sense lines, or onboard hardware failures. When any of these conditions occurs, the LevelCom 300 is no longer able to measure the level in the well and it enters a fault mode and the relays are de-energized. This way the relays go to the same state they would go to if the LevelCom 300 lost power.

It is very important to consider what will happen to the controlled pump or valve in this case. Should the pump run (fail on) or should it shut down (fail off) in this case? If the pump is filling the tank it should probably shut off to avoid overflowing the tank. However if the pump is emptying the tank, and the pump can handle continuous operation it might be better for the pump to fail running, again to avoid overfilling the tank. Since the LevelCom 300 relays have form C contacts it is possible to handle all possible combinations.

First it is important to identify the required failure action. This will determine whether to use the normally open contact, or the normally closed contact of the relay. Then the proper setting of the setpoints will result in the desired action. Remember that the relay ON SETPOINT controls where the relay coil is energized, the OFF SETPOINT where the relay coil de-energizes. The function of the required relay contact can make this seem backward.

In the following a pump or valve will be referred to as Device. The word Deactivated will refer to the condition where no electric power is flowing to the Device, Activated will refer to the condition where electric power is flowing to the device.

Case 1:

Device must fail to a Deactivated condition. Device is to be activated at a high liquid level, Deactivated at a low liquid level.

Wire Device to the normally open contacts of the relay. Set ON SETPOINT to the high level, OFF SETPOINT to the low level.

Case 2:

Device must fail to an Activated condition. Device is to be activated at a high liquid level, Deactivated at a low liquid level.

Wire Device to the normally closed contacts of the relay. Set OFF SETPOINT to the high level, ON SETPOINT to the low level.

Case 3:

Device must fail to a Deactivated condition. Device is to be activated at a low liquid level, Deactivated at a high liquid level.

Wire Device to the normally open contacts of the relay. Set ON SETPOINT to the low level, OFF SETPOINT to the high level.

Case 4:

Device must fail to an Activated condition. Device is to be activated at a low liquid level, Deactivated at a high liquid level.

Wire Device to the normally closed contacts of the relay. Set OFF SETPOINT to the low level, ON SETPOINT to the high level.

Important Note:

In any of the above cases it is strongly advised that any failure case generate a remote alarm if the device is operating in an unattended area. The second relay could be configured as a SYS FAIL relay. Set up this way, the relay will be normally energized, and de-energized in any system failure case. The output of this relay could be used to operate a warning horn to alert operators to the failure condition.

1. Enter Program Mode.

2. At SYSTEM press UP/DOWN keys to scroll to OUTPUTS.

3. Press ENTER. The unit will display LIGHTS.

4. Press the DOWN key until unit displays RELAY 1.

5. Press ENTER. The unit will display ALARM.

6. Press UP/DOWN keys to scroll toto CONTROL.

7. Press MENU to activate the Control option. An asterisk (*) will appear to the right of the display indicating the function has been selected. Press ENTER.

8. The unit will display "ON SETPOINT".

9. Press ENTER. The unit will display 0.0.

10. Press UP/DOWN keys to scroll to the ON SETPOINT you have defined on your worksheet.

11. Press ENTER. SAVING will appear briefly on the display and the display will shift to OFF SETPOINT.

12. Press ENTER. The unit will display 0.0.

13. Press UP/DOWN keys to scroll to the Off Setpoint you have defined on your worksheet.

14. Press ENTER. SAVING will appear briefly on the display and the display will shift to ON SETPOINT.

Analog Output

The optional analog output module gives the LevelCom 300 a 4 – 20 mA output capability. The output can function either as a gauge output to remotely indicate depth, volume, or weight to a remote meter, or data acquisition system

It is also possible to configure the analog output as a control output. In this case there are 4 adjustable parameters to configure the output value. The Minimum Current is a value between 4 mA and 20 mA. The maximum current is a value between the minimum current value and 20 mA. The Minimum Current Setpoint is the depth where the output signal takes the minimum value. The Maximum Current Setpoint is the depth where the output signal takes the maximum value. This gives great flexibility in the configuration of the analog output.

If the Minimum Current Setpoint is below the Maximum Current Setpoint, the current will be at the Minimum Current value when the level is below the Minimum Current Setpoint. The

output will vary smoothly from the Minimum Current value to the Maximum current value when the level is between the setpoints. When the level is above the Maximum Current Setpoint, the output current will remain at the Maximum Current value.

If the Minimum Current Setpoint is above the Maximum Current Setpoint, the current will be at the Maximum Current value when the level is below the Maximum Current Setpoint. The output will vary smoothly from the Maximum Current value to the Minimum current value when the level is between the setpoints. When the level is above the Minimum Current Setpoint, the output current will remain at the Minimum Current value.

Configure as a Gauge Output

1. Enter Program Mode.

2. At SYSTEM press UP/DOWN keys to scroll to OUTPUTS.

3. Press ENTER. The unit will display LIGHTS.

4. Press the DOWN key until unit displays ANALOG OUTPUT.

5. Press ENTER. The unit will display GAUGE.

6. Press MENU to select the function of the relay. An asterisk (*) will appear to the right of the display indicating the function has been selected.

7. Press ENTER. SAVING will appear briefly on the display. The unit will display DEPTH.

8. Press UP/DOWN keys to scroll through the menu selections.

9. Press MENU key to select the gauge output you want.

10. Press ENTER. SAVING will appear briefly on the display and the display will shift to GAUGE.

11. Press ESCAPE to return to normal operation.

Configure as a Control Output

1. Enter Program Mode.

2. At SYSTEM press UP/DOWN keys to scroll to OUTPUTS.

3. Press ENTER. The unit will display LIGHTS.

4. Press the DOWN key until unit displays ANALOG OUTPUT.

5. Press ENTER. The unit will display GAUGE.

6. Press DOWN key until unit displays CONTROL.

7. Press MENU to select this function. An asterisk (*) will appear to the right of the display indicating the function has been selected.

8. Press ENTER. SAVING will appear briefly on the display. The unit will display MIN SETPOINT.

9. Press ENTER. The unit will display 0.0.

10. Press UP/DOWN keys to scroll to the MIN SETPOINT value you have defined on your worksheet.

11. Press ENTER. SAVING will appear briefly on the display and the display will shift to MIN SETPOINT.

12. Press DOWN until the instrument displays MIN CURRENT.

13. Press ENTER. The unit will display 0.0.

14. Press UP/DOWN keys to scroll to the Minimum Current you have defined on your worksheet.

15. Press ENTER. SAVING will appear briefly on the display and the display will shift to MIN CURRENT.

16. Press DOWN until the instrument displays MAX SETPOINT

17. Press ENTER. The unit will display 0.0.

18. Press UP/DOWN keys to scroll to the MAX SETPOINT value you have defined on your worksheet.

19. Press ENTER. SAVING will appear briefly on the display and the display will shift to MAX SETPOINT.

20. Press DOWN until the instrument displays MAX CURRENT

21. Press ENTER. The unit will display 0.0.

22. Press UP/DOWN keys to scroll to the MAX CURRENT value you have defined on your worksheet.

23. Press ENTER. SAVING will appear briefly on the display and the display will shift to MAX CURRENT.

24. Press ESCAPE to return to normal operation.

Manual Analog Output

The analog output can be operated in manual mode when it is set up as a control output. This mode can be used to test the system, and any devices that receive the signal from the LevelCom 300. This may be used to test the system if the output is to be used as a gauge output as well. The instrument must be temporarily set up as a control output to use this function though, and you must be sure to switch the configuration back to a gauge output when you are done testing.

1. Enter Program Mode.

2. At SYSTEM press UP/DOWN keys to scroll to OUTPUTS.

3. Press ENTER. The unit will display LIGHTS.

4. Press the DOWN key until unit displays ANALOG OUTPUT.

5. Press ENTER. The unit will display GAUGE.

6. Press DOWN key until unit displays CONTROL.

7. Press MENU to select this function if it isn't already selected. An asterisk (*) will appear to the right of the display indicating the function has been selected.

8. Press ENTER. SAVING will appear briefly on the display. The unit will display MIN SETPOINT.

9. Press UP/DOWN keys to scroll to the MANUAL.

10. Press MENU to select the manual mode. An asterisk (*) will appear to the right of the display indicating the function has been selected.

11. Press ENTER. The unit will display 0.0%. The display shows percent of output signal now, 0% is 4 mA and 100% is 20 mA.

12. Press UP/DOWN keys to scroll to the output signal level you want.

The instrument may be returned to normal operation now if you want to leave a manual output value on the instrument. In this case press ESCAPE to return to normal operation. The instrument will flash the word MANUAL on the display every few seconds to indicate that it is in manual analog output mode.

If you want to return to a controlled analog output follow the instructions from here.

1. Press ESCAPE. The display will shift to MANUAL. There will be an asterisk (*) indicating that the instrument is in Manual mode.

2. Press MENU to clear the asterisk.

3. Press ENTER. SAVING will appear briefly on the display and the display will say MANUAL. The instrument will now automatically run the analog output.

4. Press ESCAPE to return to normal operation.

Calibration

Analog Output Calibration

The calibration of the analog output can be checked and adjusted with the following procedure. Calibration is not a routine maintenance procedure. If you are not sure whether to proceed with calibration please contact TMS for guidance prior to adjusting the instrument. **This procedure must be performed by a qualified technician.**

Required Equipment

1. Accurate current meter for reading the current output value.

Figure 10 Input board with Analog Output Installed

2. Wire leads to connect to the LevelCom 300 analog output connector.

NOTE: If the analog output is being used as a control output, be sure to secure the controlled process before you begin because you may be disconnecting the LevelCom 300 from the controlled process, or you may be generating meaningless control signals while performing the calibration procedure.

Error! Reference source not found. shows the analog output option board installed on the input board. The Span and Zero potentiometers are at the top of the analog output option board.

Calibration Procedure

1. Connect the meter to the Analog output connector. If the LevelCom 300 is set up to power the analog output you can connect directly to the terminals, however if the output is set up to be externally powered you will need to connect the meter into the complete circuit.

2. Enter the LevelCom 300 program. Access the Calibrate menu and select AN OUT. Press ENTER. ZERO will be displayed. Press ENTER. The meter should read 4 mA. If it doesn't adjust the Zero potentiometer on the analog output board until the meter reads 4 mA.

3. Press UP/DOWN keys to scroll to SPAN and press ENTER. The meter should read 20mA. If it doesn't adjust the Span potentiometer until the meter reads 20 mA.

4. Press UP/DOWN keys to scroll to ZERO and press ENTER.

5. The meter should read 4 mA. If it does the calibration is complete, if not repeat steps 2 – 4 until the meter reads 4 mA when you enter ZERO, and 20 mA when you enter SPAN.

6. Now you can check the linearity of the output with the other items in this menu. When the span and zero calibration is done entering the following menu items should give the following meter readings:

   25% - 8 mA
   50% - 12 mA
   75% - 16 mA

This completes the test and calibration of the analog output circuit.

Troubleshooting

The LevelCom 300 is designed to monitor certain system functions and to display error messages when abnormal situations are detected. These functions include:

Supply Air Pressure - Low pressure

Sense Line - Plugged or leaking Sense line

Internal functions - Sensor zero and EEPROM function.

The following details some of the problems, which may be encountered and corrective actions to be taken.

NOTE: The LevelCom 300 is a delicate electronic instrument. Qualified individuals must perform repairs and troubleshooting.

Instrument displays EEPROM FAILURE

This message indicates trouble with the EEPROM (Electrically Erasable Programmable Read Only Memory) memory that is used to hold the instrument configuration. If this message occurs when the LevelCom 300 is powered up it means that there were problems when the instrument was reading the configuration from the EEPROM. If this message occurs when changing the instrument configuration it means that there were problems when the instrument was writing new information to the EEPROM. In this case the new information was not completely stored, but the old information was probably at least partially modified. The message could mean that there has been a true electrical failure of the EEPROM, however this is not the only possibility. The following will describe some tests to determine the cause of the problem.

Turn the LevelCom 300 off and after a short time restore power. If the message does not appear this time it may indicate that the problem was caused by electrical noise getting into the LevelCom 300 system. This could happen if there are relays installed and the relays are driving a large inductive load, like a motor or a solenoid (please note that the relays are rated "Pilot Duty Only"). If the relay is driving a DC relay or solenoid there should be a freewheeling diode in the circuit or else large voltage spikes will be generated on the control circuit when the relay contacts open. These spikes can generate powerful radio frequency pulses that can effect nearby electronic devices. Similarly if the relay is operating an AC motor, either directly, or through a slave relay both the starting and stopping of the motor can generate voltage spikes on the power lines and these spikes can possibly affect the LevelCom 300 electronics. In this case putting capacitors across the motor terminals can sometimes help.

This problem will not always show up immediately in a new installation. The LevelCom 300 always verifies the updated contents of the EEPROM as it writes new information. If this

verification fails, the LevelCom 300 tries again and signals a failure only after a number of verification failures. The LevelCom 300 stores multiple copies of the configuration and there is unused space in the EEPROM of a new LevelCom 300 that can be used for configuration information if there is a partial failure of the EEPROM. The electrical noise described above can interfere with EEPROM operations in extreme cases. In this case there will not actually be a failure of the EEPROM but because of the electrical noise, there may have been verification failures causing the LevelCom 300 to use new areas of the EEPROM. When all available space is used up the LevelCom 300 will generate the EEPROM FAILURE message. As a result the instrument will work well for a while and then start showing the EEPROM FAILURE condition. A way to check for this is to select the ERASE ALL MEMORY option in the MEMORY menu. This will completely erase any configuration information in the EEPROM and the LevelCom 300 will need to be reconfigured before being put back into operation. Then if the instrument works well for a while and once again starts showing the EEPROM FAILURE condition electrical noise is probably causing the trouble.

If erasing the EEPROM does not get rid of the condition then there is probably something wrong with the EEPROM and it will need to be replaced.

Instrument displays LOW N2

This message will be displayed if there is insufficient gas pressure for proper instrument operation. Check the regulator to make sure that the instrument is getting supply gas. Make sure that the gas bottle valve is open. The instrument needs enough input gas pressure to guarantee that the sense line can be completely purged. If the water level in the well is deep the instrument will need a higher input gas pressure than it would need if the water level was low. The instrument needs a minimum of 100 PSI over the sense line pressure to operate.

If this checks out there may be a problem with the Supply valve. Use the VALVES utility in the calibrate menu. Operate the Supply valve, blocking valve, and dump valve manually and gas should come out of the Drain port. If nothing happens make sure that the LEDs on the solid state relay board light when the buttons are pressed to operate the valves. If the LEDs don't light make sure that the flat cable is properly plugged onto the connector on the solid state relay board. If the connector is attached and the LEDs still don't light and the valves do not operate then there is probably an electrical problem on the main controller board. If the LED lights but a valve does not operate the valve has probably failed.

The CALIBRATE Menu

4-20

The 4-20 item gives direct access to the main output from the sensor circuit. When this item is activated the display shows the output of the analog to digital converter. This output is useful to verify that the sensor circuit is functioning. When this item is activated the valves are all de-energized. The Drain valve is run as a normally open valve so the Drain port now gives access to the pressure sensor input. It is easy to verify that the sensor circuit is

working by applying a little air pressure to the Drain port and verifying that the numbers on the display increase with increasing pressure. The ESC key is used to exit this utility.

Supply Pressure

The Supply Pressure item can be used as a check of the regulator output pressure gauge. When this item is activated the instrument opens the supply valve and reads the pressure of the input supply using the pressure sensor. This will probably be a more accurate reading of the input pressure than the small gauge on the regulator. The ECS button is used to exit this utility.

Valves

The VALVES item gives direct access to the solenoid valves. When activated the front panel buttons are used to activate the valves. The following list shows which buttons run which valves.

BUTTON	VALVE
ENTER	Supply
DOWN	Block
MENU	Dump
UP	Diff
ACK	Main Sense Line

The ESC key is used to exit this utility.

This item is useful for testing the valves. This utility must be used with some caution however. It is possible, if the Diff valve and the Dump valve were open at the same time that methane from the well head could flow through the instrument and out the dump valve. This could create a dangerous situation in an enclosed space. **It is the responsibility of the operator to use this utility in a safe manner.**

Relays

The RELAYS item gives direct access to the relays. When activated the UP button operates Relay 1, the DOWN button operates Relay 2. The relays de-energize on entering this utility. Pressing the appropriate button energizes the associated relay. This is useful for testing the function of the relays and the condition of the relay contacts. It is a useful utility when wiring to external alarm systems or control devices. The ESC key is used to exit this utility.

Display

The DISPLAY item is used to test the entire display. When activated the character display will show a rotating pattern that lights all segments in a digit including the decimal point. The ESC key is used to exit this utility.

Buttons

The BUTTONS item is used to test the front panel buttons. When active the display will show the name of the last button pressed. This is useful if there is the possibility that one or more of the buttons have failed. Simultaneously press the ENTER key and the ESC key to exit this utility.

Analog Output

If the instrument has the analog output option installed there will be another utility available called AN OUT. This is used for calibration and testing of the analog output. There are five menu items in this utility. When the display shows ZERO, pressing ENTER forces the analog output to 4 mA. When the display shows SPAN, pressing ENTER forces the analog output to 20 mA. These are intended for use in calibrating the analog output. These two functions are used while adjusting the analog output span and zero pots found on the Sensor board in the LevelCom 300. The 25%, 50%, and 75% items work the same way forcing the analog output to 8 mA, 12 mA, and 16 mA respectively. They are useful for verifying the linearity of the analog output, and are also useful for testing the field devices driven by the analog output.

Analog output trouble shooting

The analog output is a 4-20 mA output. The output may be run as a self-powered output (in which case the LevelCom 300 provides power) or as an externally powered. When set up to be externally powered the analog output circuit is electrically isolated from the rest of the LevelCom 300. If the analog output does not work check the following:

Check the connections to the Analog Output terminals. Make sure the correct connector is wired, and verify the polarity of the wiring. It may be that something is wired backwards in the loop. Refer to the wiring diagrams in the installation section of the manual.
Check the jumpers on the sensor board and make sure that the analog output is configured as self-powered or isolated. All three jumpers must be in place and set to either ISOLATE or POWER. If the jumpers are in the wrong position the output will not work.

If your instrument has the LC100-A2 or –A3 sensor input circuit board, the analog output is contained in a small circuit board attached to the sensor-input board. There is an LED on the analog output board that flashes to indicate that the board is functioning. This LED will be easy to identify; it is the only flashing LED inside the LevelCom 300 box. If this LED is not flashing the analog output module has probably failed, and should be replaced.

Modbus Troubleshooting

If the machine is not communicating the first thing to check is the wiring. Verify that the communication interface is wired correctly, use Appendix A as a guide for wiring.

Verify that the Modbus Address is set correctly. See Modbus Communication in the advanced Setup section of this manual.

Verify that the baud rate and parity settings are correct. There are some complications with the parity settings, especially in the case where no parity information is sent. In communications with desktop computers the most common parity setting is N-8-1, no parity, 8 bits per byte, 1 stop bit. In some PLCs though the only available no parity setting is equivalent to N-8-2, no parity, 8 bits per byte, 2 stop bits. In this case the parity bit is still sent, but it is always sent, acting as the second stop bit. When there is a mix up between these types the machines will communicate sometimes, but not reliably, or only in one direction. The second stop bit can sometimes be detected as the start bit of the next byte if a N-8-2 setup is communicating with a N-8-1 setup. This results in framing errors at the receiving end and failed communication. See Modbus Communication in the advanced Setup section of this manual.

Appendix A
Serial Network Wiring Diagrams

There are three typical networking configurations:
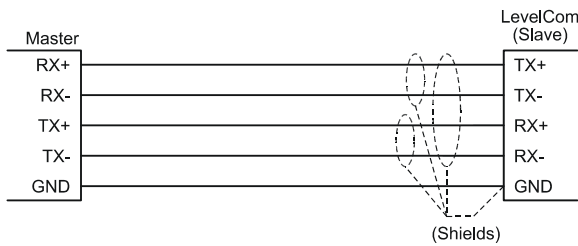
Figure 12 Four-Wire RS-485 configuration (Single Drop)
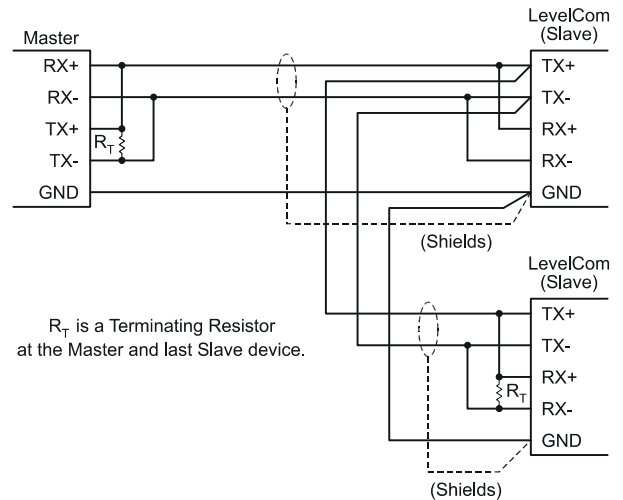
Figure 11 Two-Wire RS-485 configuration (Multiple Drops)
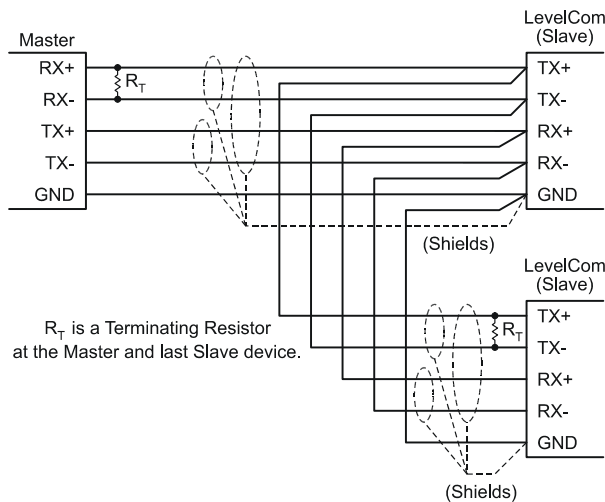
Figure 13 Four-Wire RS-485 configuration (Multiple Drops)

Appendix B
MODBUS Register Map

The MODBUS Register map is as follows:

Register	Label	Description
		Input Registers
30001	mb_depth	Depth in inches
30002	mb_diff	well head differential pressure, in PSI
30003	mb_supply	Measured supply pressure, accurate if in first low air
30004	mb_temperature	Temperature measured by onboard sensor
30005	mb_zero	the measured zero offset of the sensor, corrected for temperature
30006	mb_sg	Specific gravity * 1000
30007	mb_before_1	Depth before last sample
30008	mb_after_1	Depth after last sample
30009	mb_before_2	Depth before present sample
30010	mb_after_2	Depth after present sample
30011	mb_charges	total manifold charges so far
30012	mb_current_reading	Current sensor reading, unprocessed
30013	pressure_sp	Pressure setpoint for tracking pressure
30014	hours	clock hours
30015	minutes	clock minutes
30016	seconds	clock seconds
		Input Bit registers. These are used to signal various fault conditions
10001	mb_alm_hihi	Hi-Hi Alarm Active
10002	mb_alm_hi	Hi Alarm Active
10003	mb_alm_lo	Lo Alarm Active
10004	mb_alm_lolo	Lo-Lo Alarm Active
10005		
10006	mb_alm_loopfail	4-20mA loop failure
10007	mb_alm_sgplug	SG (Specific Gravity) line plugged
10008	mb_alm_dpplug	DP (Differential Pressure) line plugged
10009	mb_alm_eepfail	EEPROM failure
10010	mb_alm_leak	Main Sense line leak
10011	mb_alm_mainplug	Main Sense line plugged
10012	mb_alm_lowair	Low air supply pressure
		Coil Registers definition. Setting these coils triggers the Described actions. When the action is initiated by the LevelCom 300, the coil is cleared.
00001	mb_purge	Trigger purge cycle
00002	mb_sample	Trigger new sample operation
00003	mb_ack	Remote acknowledge for alarm and fault conditions
00004	mb_restart	Restart the LevelCom 300

Notes:

Input Registers

For SCADA systems the following parameters are of interest. The rest are more for development of the machine, to give some window into it's functioning. All of these parameters are 16 bit integers.

30001 mb_depth   depth in inches

Depth is given in .1 inches. The conversion factors for the other units available in the Levelcom 300 are as follows:

Feet = inches / 12

centimeters = inches * 2.54

meters = inches * 0.0254

30002 mb_diff

This is the well head pressure in PSI. The effect of this pressure has already been removed from the depth reading above, however this pressure will probably be of interest to the user separately.

30004 mb_temperature

This is the temperature in degrees F. It is a measure of the temperature of the box the machine is mounted in, not the outside air temperature. Temperature readings are used to correct for sensor zero drift between readings.

30006 mb_sg   specific gravity relative to water * 1000.

This is the specific gravity value used to convert the pressure sensor readings to depth. If the machine is not reading depth correctly, this is the first place to look for trouble. It might be that the water in the well has a specific gravity different from fresh water, in that case this parameter will be configured on the machine to a value other than 1.000. This value as read must be devided by 1000 to get the actual specific gravity value.

Input Bits

The following input bits are used to indicate fault conditions on the machine

10006 mb_alm_loopfail   4-20 mA loop failure

This signals a failure of the main pressure sensor. When this flag is active, the machine is not working and any readings of depth are invalid.

10008   mb_alm_dpplug   DP line plugged

The machine has detected too high a pressure on the well head sense line. It is most likely that the sense line is plugged.

10009   mb_alm_eepfail   EEPROM failure

The configuration EEPROM in the machine is unreadable. If the machine is communicating at all (it's Modbus address is stored in the EEPROM) this flag also signals that the machine is not functioning, and any readings of depth are invalid.

10010   mb_alm_leak   main sense line leak

A leak on the main sense line has been detected. The machine will still try to read depth, but the depth readings are probably not accurate because of the leak. If the leak is small enough the first readings after a sample operation might be fairly accurate, but the following data will be increasingly in error.

10011   mb_alm_mainplug   main sense line plugged

The machine has detected too high a pressure on the main sense line (the calculated depth is greater than the well depth). The sense line is plugged, and the machine cannot read a correct depth.

10012   mb_alm_lowair   low air

The input gas supply pressure is low. This flag is triggered when the input gas pressure is less than the sense line back pressure + 100 PSI. The machine can still function, but the gas bottle must be replaced. When this flag is active the machine will quit sampling automatically, but will still sample manually.

10013   mb_alm_rd_good   new sample operation complete

When a manual sample is requested by setting the 00002 mb_sample coil, this flag will clear. When the new sample operation is complete this flag will be set to signal that the new reading is available in 30001 mb_depth.

10014   mb_alm_no_air   final low input gas alarm

The supply gas pressure is equal to the sense line pressure. The machine can no longer provide gas to the sense line and the depth readings may not be accurate. The gas bottle must be replaced to bring the machine back into normal operation.

Coil Register Bits

The following coils are used to trigger operations on the machine. Setting them triggers the desired action, the machine will clear them by itself. If these coils are read, they should always read as 0.

00001 mb_purge   trigger purge

This starts the commisioning purge function on the machine. This is used to bring the machine into operation only. This uses quite a lot of gas and is only used to get the machine into operation quickly after the initial installation, or after work has been done on the sense line system.

00002 mb_sample   take a new sample

When this flag is set triggers a sample operation. It is intended for use when the machine is in manual sample mode, and a reading is desired. Normally the machine is configured to sample on a regular schedule and this operation is not required.

00003 mb_ack   remote acknowledge for alarm and fault conditions

If alarms are used this flag can be used to remotely acknowledge the alarms. This will probably not be used in gas well applications.

00004 mb_restart   restart the machine

This flag triggers a reset on the machine. It is intended for use when the machine is configured remotely. A restart guarantees that all new parameters are updated in the active memory. The remote configuration method is still in development so this function does not have a use at present.

Appendix C
Wiring Diagram
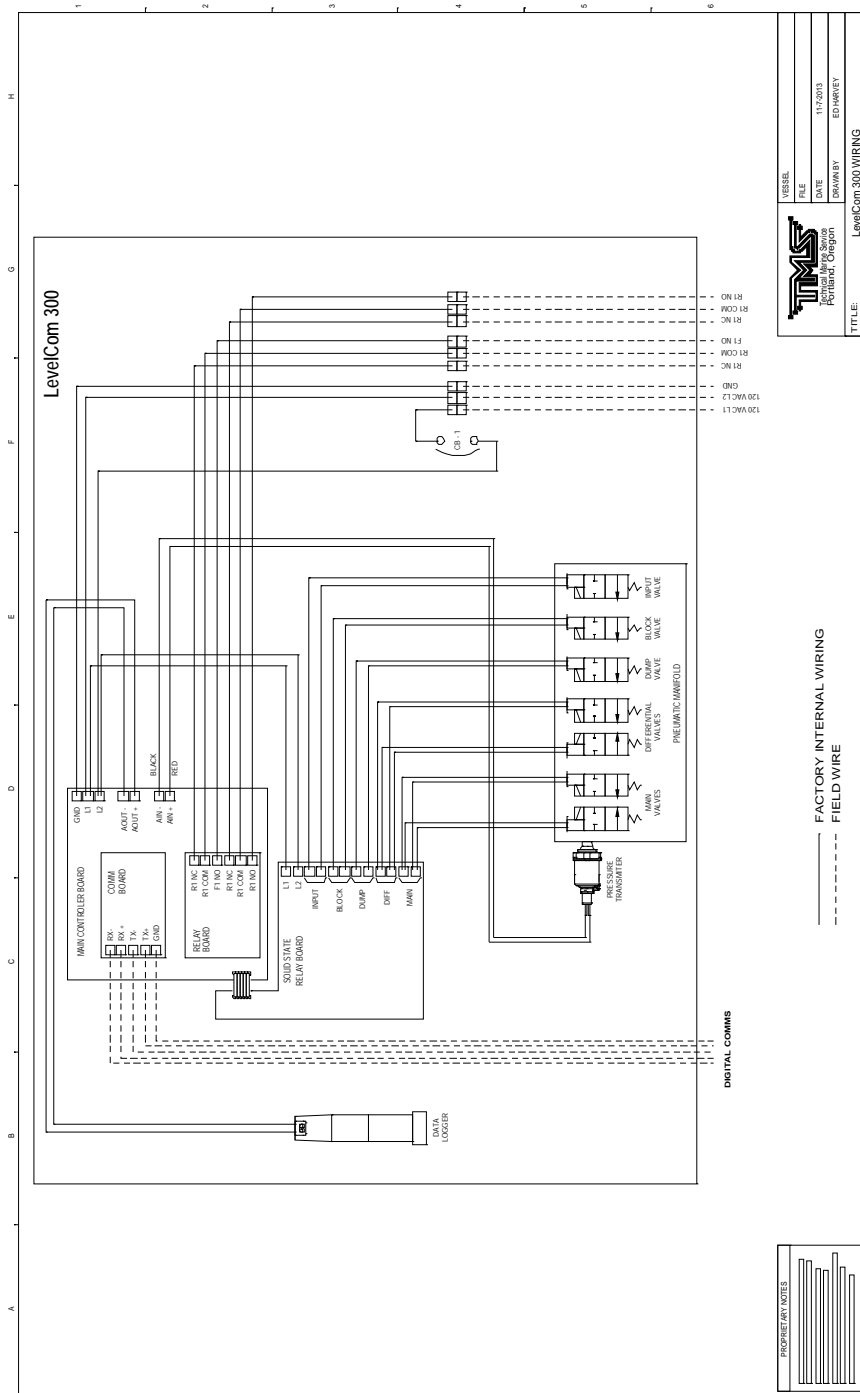
Figure 14 Wiring Diagram

Configuration Interface Map

The following pages are a map of the configuration interface. Use these maps to find your way around the interface.

First a simple map is given as a general guide to the interface. This can be used as a quick reminder for operators who already have experience configuring LevelCom 300s. Many details are left out in this diagram to make it fit on a single page.

Following the simple map is a detailed map of the complete configuration interface. This map is spread out over six pages so be careful in using it. Most of the main menu items are documented on a single page.

On the first page of the detailed map is a key to the symbols used in the map. If you don't understand the symbols you should re-read the sections of this manual and refer to this map as you read to get familiar with the layout of the map. Once you are familiar with the configuration interface you should be able to get around quickly just using the map.

Generally to navigate the configuration interface you use the UP and DOWN arrow buttons to move through the items in a single menu, you use the ENTER button to move one level into the interface, and you use the ESCAPE button to move one level back. In the diagram this corresponds to moving to the right using the ENTER button, and moving to the left using the ESCAPE button.

NORMAL OPERATION

UP BUTTON   CALLS FOR A NEW READING

ENTER BUTTON   DISPLAYS UNITS OF MEASURE THEN RETURNS TO NORMAL OPERATION

ESCAPE BUTTON DISPLAYS ANY ALTERNATE ACTIVE DISPLAY UNITS FOR 20 SECONDS

MODE

IF HOT MENU EXISTS
[THEN   IF NOT]

"HOT MENU" FLASHES

HOT MENUE ITEM
HOT MENUE ITEM
HOT MENUE ITEM
ETC.

CONFIGURE SYSTEM

IF PASSWORD EXISTS
THEN   IF NOT

ENTER PASSWORD
******
IF PASSWORD IS CORECT
IF NOT   THEN

LEVELCOM 300 LIQUID LEVEL COMPUTER

Program Flow Chart
Version 1.06   DATE 11/2013

Technical Marine Service, Inc.
Portland, Oregon

KEY

MODE BUTTON — USED TO ENTER PROGRAM MODE AND SELECT OR DESELECT PARAMETERS

ESCAPE BUTTON — EXIT LEFT TO THE PREVIOUS BOX

ENTER BUTTON — ADVANCE RIGHT TO THE NEXT BOX WHILE SAVING CHANGES TO THE CURRENT CONFIGURATION

UP BUTTON — MOVES UP THROUGH A MENU

DOWN BUTTON — MOVES DOWN THROUGH A MENU

[ ] — MESSAGE DISPLAYED AT EACH STATION

⬭ — WHERE VARIABLES ARE ENTERED WITH UP AND DOWN BUTTONS

[*] — MODE BUTTON SETS FLAG TO ACTIVATE OPTION

← HM — ITEMS THAT CAN BE ADDED TO THE "HOT MENU"

SYSTEM

DISPLAY SETUP

DEPTH UNITS
- INCHES *
- FEET
- FEET & INCHES
- CENTIMETERS
- METERS

WELL SETUP
- MAX DEPTH
- BUBBLER TO BOTTOM

TIMING

NORMAL SAMPLE
- 5 MIN
- 1 HOUR
- 2 HOURS
- 4 HOURS
- 6 HOURS *
- 8 HOURS
- DEMAND

LOW LEVEL SAMPLE
- 1 HOUR
- 2 HOURS
- 4 HOURS
- 6 HOURS
- 8 HOURS *

TRIP DEPTH — DEFAULT = 0.0

SENSOR RANGE — DEFAULT = 1000 PSI

SPECIFIC GRAVITY — DEFAULT = 1.000

COMMISSION PURGE — RUNS PURGE CYCLE AND RETURNS TO NORMAL OPERATION

TO PAGE 2

TO PAGE 1

OUTPUTS — RELAY 1 — ALARM — HI HI
                                 HI
                                 LOW
                                 LOW LOW

              CONTROL — ON SETPOINT — ◁ HM
                        OFF SETPOINT — ◁ HM

              SYS FAIL
              LOCAL

         RELAY 2 — ALARM — HI HI
                           HI
                           LOW
                           LOW LOW

              CONTROL — ON SETPOINT — ◁ HM
                        OFF SETPOINT — ◁ HM

              SYS FAIL
              LOCAL

ONLY APPEARS IF
RELAY MODULE
OPTION IS INSTALLED

ALARM SETPOINTS — HI HI ALARM — ◁ HM
                  HI HI HYS

                  HI ALARM — ◁ HM
                  HI HYS

                  LO ALARM — ◁ HM
                  LO HYS

                  LO LO ALARM — ◁ HM
                  LO LO HYS

ANALOG OUTPUT — GAUGE
                CONTROL — MIN SETPOINT
                          MIN CURRENT
                          MAX SETPOINT
                          MAX CURRENT
                          MANUAL — IN MANUAL MODE 4-20ma OUTPUT IS
                                   MANIPULATED WITH UP AND DOWN BUTTONS
                                   AND DISPLAYED 0-100% ON THE DIGITAL DISPLAY
                                   BAR GRAPH REMAINS DEPTH DISPLAY

ONLY APPEARS IF
ANALOG OUTPUT
OPTION IS INSTALLED

TO PAGE 3

HOT MENU SETUP — [ALL ITEMS MARKED AS "HOT MENU SELECTIONS" AND THAT HAVE BEEN CONFIGURED AS ACTIVE WILL APPEAR HERE AND CAN BE ADDED TO THE HOT MENU]

NEW PASSWORD — (******)

UTILITIES — **COM SETUP** — **NETWORK ADDRESS** — ( )

BAUD RATE
- 1200
- 2400
- 4800
- 9600
- 19200

PARITY
- N-8-1
- N-8-2
- EVEN
- ODD

DIAGNOSTICS
- EVENT COUNT ( )
- EXCEPTION COUNT ( )
- MESSAGE COUNT ( )
- CRC ERROR COUNT ( )

CALIBRATE
- 4-20 — [DISPLAYS RAW A/D INPUT]
- SUPPLY PRESSURE — [DISPLAYS INPUT GAS PRESSURE IN PSI]
- VALVE TEST — [PRESS BUTTONS TO CYCLE VALVES]
- RELAY TEST — [UP ENERGIZES RELAY 1 DOWN ENERGIZES RELAY 2]
- DISPLAY TEST — [CYCLES ALL LED'S]
- BUTTON TEST — [DISPLAY SHOWS IDENTITY OF ANY BUTTON PUSHED "PUSH ENTER & ESC TO RETURN TO CALIBRATE"]

ANALOG OUTPUT
- ZERO — [SETS OUTPUT TO MIN]
- SPAN — [SETS OUTPUT TO MAX]
- 25% — [SETS OUTPUT TO 25%]
- 50% — [SETS OUTPUT TO 50%]
- 75% — [SETS OUTPUT TO 75%]

MEMORY
- WRITE OVER BACKUP — [UPDATES BACKUP TO MATCH CURRENT CONFIGURATION AND RETURNS TO NORMAL CONFIGURATION]
- RESTORE FROM BACKUP — [REPLACES CURRENT CONFIGURATION WITH BACKUP CONFIGURATION AND RETURNS TO NORMAL OPERATION]
- ERASE CURRENT SETUP — [ERASES CURRENT CONFIGURATION PRESERVES BACKUP CONFIGURATION USES FACTORY DEFAULTS AND RETURNS TO NORMAL OPERATION]
- ERASE ALL — [ERASES CURRENT CONFIGURATION ERASES BACKUP CONFIGURATION USES FACTORY DEFAULTS AND RETURNS TO NORMAL OPERATION]