

# BUBBLER CONTROL SYSTEM



## Description:

The HDBCS is a fully automatic bubbler system, which does liquid level measurements in water and wastewater applications. It is a dual air compressor system with, air tank, bubbler line purge, air tank moisture drain (automatic), system status indications, tank air pressure indication, level indication, alarm outputs as well as tank air pressure signal output and level signal output. The standard style design comes prefabricated on mounting channels with the air compressors and air tank external to the bubbler control panel. Optional all integral units are also available. The bubbler system works by pumping regulated air (flow controlled) down a tube that has one end submerged in liquid, then liquid level is determined using a pressure transducer that measures the pressure required to force air through the bubbler tube.

## Standard Features:

- 120VAC input power
- Internal fuses, solenoid, operator interface terminal, controller, and 24VDC power supply.
- Air compressors, oil-less type, 120VAC, 100PSI maximum continuous pressure
- Air pressure regulator with filter (20-130PSI, factory set at 25PSI)
- Bubbler air pressure regulators (4-57PSI, factory set at 10PSI)
- Pressure transmitter (for wet well level) with  $\pm 0.2\%$  full scale accuracy
- 4-20mA output proportional to level
- 4-20mA output proportional to tank air pressure
- Analog output adjustments
- Re-ranging of analog inputs, air tank pressure and wet well level. This feature allows the end user to install pressure transmitters with different operating range.
- Compressor on/off setpoint settings.
- Automatic compressor alternation upon compressor failure
- Air compressor safe mode which limits the continuous run time of each of the air compressor. This is a factory set feature which is determined during the factory test and commissioning of the individual system.
- Attempts to clear clogged bubbler tube before alarming
- Freezes level analog output during purging
- Automatic bubbler line purge and air tank drain cycle performed at an interval of 6 hours (factory set). The time interval is field adjustable.
- Pushbutton for manual purge
- Pushbutton for alarm reset
- Graphical indication for:
  - Wet well level
  - Air tank pressure
  - Compressor running
  - Compressor run time
  - System purging
  - Air tank moisture drain active
  - Air compressor failure
  - Clogged bubbler tube indication
- Output relay contacts for Bubbler system common fault (standard) with optional:
  - High wet well level
  - Low wet well level
  - Air compressor 1 alarm
  - Air compressor 2 alarm
  - Air tank low pressure alarm
- Standard Communications: RS-232 (RJ12) port with Modbus RTU Master/Slave and ASCII In/out protocol(s) at up to 115.2k baud, RS-485 (3-wire terminal block) port with Modbus RTU Master/Slave and ASCII In/out protocol(s) at up to 115.2k baud.

## Specifications:

- Input Power: 120VAC  $\pm$ 10%, 60Hz
- Skid dimensions 76"H X 14.63"W X 24.28"D
- Ambient Operating Temperature: 40°F to 140°F normal, -28°F to 140°F with optional heater
- Storage Temperature: -4°F to 140°F
- Operator Interface Terminal: 3" liquid crystal display
- Output relay contacts: 12A @ 28VDC or 250VAC
- Analog Output: 4-20mA, non-isolated
- Analog Output Range
- Analog Input: 4-20mA, non-isolated
- Air Storage Tank Pressure Rating: 200PSI Max

## Model Selection

Base model: HDBCS-AIN4CSCMTLP

Incoming Voltage: A : 120VAC

System Design: I : Integral Air Compressors

Enclosure Type: N4 : NEMA 4

Output Signal Type: C : 4-20mA

Relay Output Options: S : Standard

Relay Output Options: CM : Air Compressors Malfunction

Relay Output Options: TLP : Air Tank Low Pressure

Operating Voltage:

A : 120VAC

System Design:

I : Integral Air Compressors

P : Plant/External Air

A : Bubbler, compressors, and tank housed inside the enclosure

Enclosure Type:

O : Open

N1 : NEMA 1

N12 : NEMA 12

N4 : NEMA 4

N3R : NEMA 3R

4XF : NEMA 4X, Fiberglass

4XP : NEMA 4X, Polycarbonate

4X4 : NEMA 4X, 304 Stainless Steel

4X6 : NEMA 4X, 316 Stainless Steel

Output Signal Type:

C : 4-20mA

V : 0-10VDC

Relay Output Option:

S : Bubbler System Common Fault

X : Loss of Plant/Eternal Air Alarm

WLA : High and Low Wet Well Level Alarms

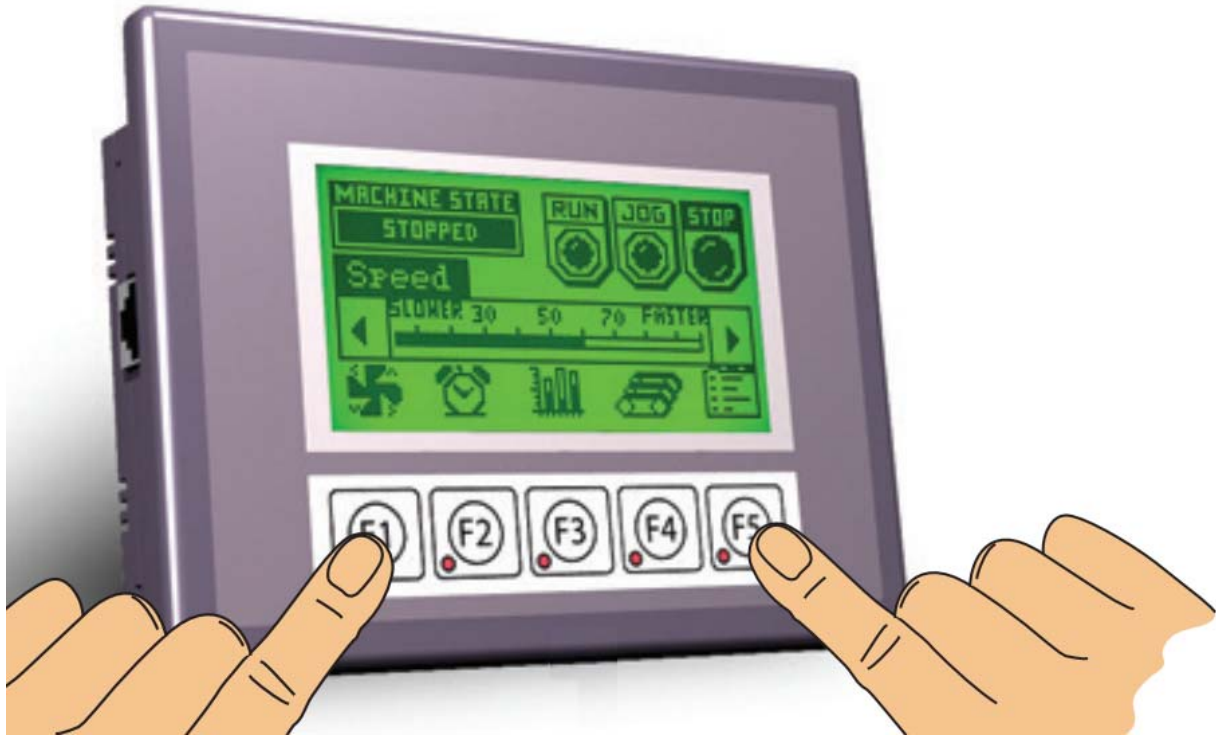
CM : Air Compressors Malfunction

TLP : Air Tank Low Pressure Alarm

ALL : Bubbler System Common Fault, High and Low Wet Well Level Alarms, Air

Compressor 1 and 2 Malfunction (one per compressor), and Air Tank Low Pressure Alarm

## System Status and Indications (LCD)



**Compressor Run Indication:** Shows which compressor is being called to run.

**Compressor Run Time:** The system keep track of the run time for each of the compressors. This serves as a diagnostic in order to detect early compressor failure. The run time should be very much equal between the two compressors and if at any time any of the two run times seems to be out of the ordinary, then that compressor needs to be considered as a future failure. Note that the run times are field resettable.

**Compressor Alarm Indication:** Shows which compressor is in alarm. This particular alarm is generated when the running compressor fails to bring the tank pressure up the lead off set point. In normal operation, the compressor runs for a period of 1 minute in order to bring the pressure to the lead off set point. If the pressure does not rise up to the lead off set point within a period of 1.5 minutes, the respective compressor is immediately turned off, the respective compressor alarm indication is turned on, and the other compressor is call to run and made the lead. The new lead compressor remains as the lead and the alarm indication stays active until the reset button is pressed or until main power is cycled.

Note that a failed air compressor is taken out of the lead lag sequence.

Both, the respective compressor alarm output relay and Bubbler System Common Fault relay are energized upon activation of this alarm.

**Air Compressor System Failure:** This alarm indicates a major failure with the air compressor system portion and couple of scenarios can generate this alarm:

1. A sudden drop of system pressure: pressure drops in matter of seconds. This indicates a major air leak or a pressure sensor failure. Before this alarm is generated, the system, by nature, will operate the compressors. This alarm will remain active until the reset button is pressed and tank pressure goes back to normal or if power is cycled.
2. When both air compressors fail, see Compressor Alarm Indication above.
3. An air compressor signal loss alarm which is generated when the air tank pressure transmitter loses power. If sensor ever needs replacing, the operator can place this particular alarm into standby mode which can then be disabled or automatically disabled after a period of 10 minutes.

**Clogged Bubbler Tube Alarm:** In normal operation, the water level rises and falls in a similar pattern. If the level rises and continues to rise until the detected level rises up near the max range, it is then assumed that the bubbler line is clogged. A purge/dump cycle is initiated the first time this condition occurs but the alarm is yet not activated. In doing so, the system is given a chance to clear the clog before the alarm is generated. If the condition is detected again within the next 20 minutes, the “Clogged Bubbler Tube” alarm is generated and the system performs another purge/dump cycle. The system will perform three more purge/dump cycles at 10 minutes interval in an attempt of clearing the clog. This alarm indication will remain active until the alarm reset push button is pressed or until main power is cycled.

The Bubbler System Common Fault relay is energized upon activation of this alarm.

**Purge/Dump Cycle:** A purge/dump cycle is displayed while the cycle is being executed.

**Wet Well Level Indication:** The water elevation is displayed as a graphical representation as well as numerical.

**Air Tank Pressure Indication:** The air tank pressure is displayed as a graphical representation as well as numerical.

**High and Low Wet Well Alarms:** These are field adjustable settings.

- The High Wet Well Level alarm is generated when the water level increases to the high wet well level alarm set point.
- The Low Wet Well Level alarm is generated when the water level decreases to the low wet well level alarm set point.

The alarms remain active until the reset pushbutton is pressed.

Both, the respective alarm output relay (High or Low Wet Well Level) and Bubbler System Common Fault relay are energized upon activation of either alarm.

**Air Compressors in Backup Mode:** This alarm is activated when the pressure in the air storage tank drops below the set point as detected by the pressure transducer mounted on the air storage tank. Upon activation of this alarm, the controller will automatically switch controls to the air storage tank pressure transducer and serves as backup to the normal control mode (pump pressure switch). A compressor will be called to run after a preset time delay elapses (factory set to 10 seconds). The compressors work in the same order as when operating in normal control mode but call to run commands are determined by the pressure transducer instead of the pump pressure switch. Lead, lag, and alternation are operational when operating in backup mode. Note that the Air Compressor in Backup Mode alarm will be activated until the reset pushbutton is pressed or until power is cycled.

**Air Tank Low Pressure Alarm:** This is a field adjustable setting. This alarm is activated when the pressure in the air storage tank drops below the set point, as detected by the pressure transducer mounted on the air storage tank. This is an indication that the Backup Mode failed to build up the pressure inside the air storage tank and the condition becomes a true alarm after the elapsed time of five minutes.

**Pushbuttons Functionality:**

- Alarm Reset: Pressing the button causes all present alarms to clear.
- Manual Purge: Purge/dump cycle is initiated upon pressing this button. The cycle will initiate if either the Compressor System Failure alarm or Clogged Bubbler Tube alarm is active.

**Lead On/Off Setpoint:** This will be used to maintain a constant air pressure inside the storage tank and it is enabled when an “Air Compressors in Backup Mode” alarm is activated. Note that normal mode of operation is from the pump pressure switch mounted on the air storage tank.

**Air Tank Pressure Settings:** It is used to enter the engineering range of the pressure transmitter that measures air tank pressure, min and max engineering values. This range will be the same range used for the corresponding analog output.

**Wet Well Pressure Transmitter Settings:** It is used to enter the engineering range of the pressure transmitter that measures air pressure in the bubbler line, min and max engineering values. The pressure value is proportional to the water level. Wet well offset values can be entered in this screen as well as setting the analog out range which correspond to wet well level.

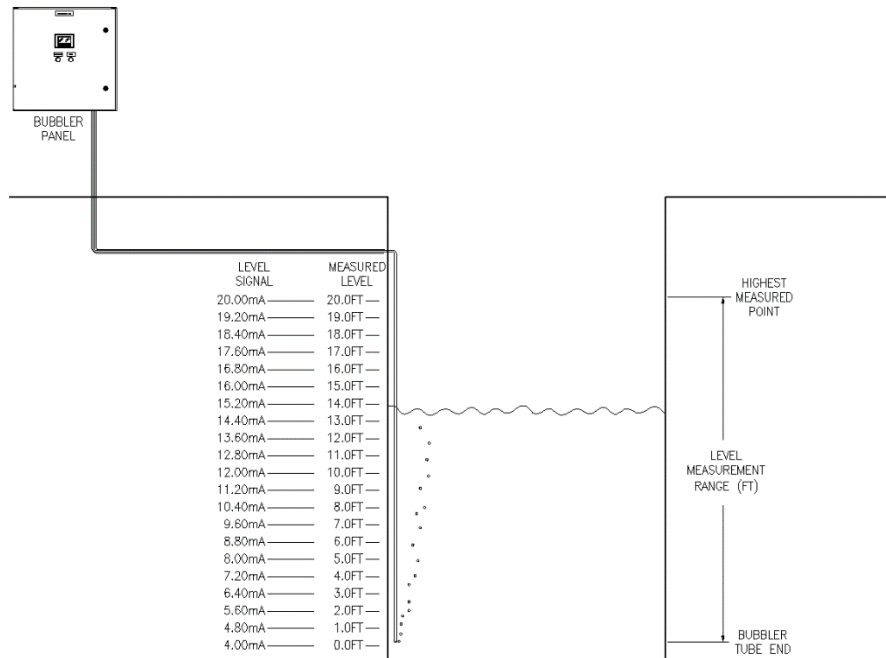
**Purge/Dump Time Interval:** factory set to 8 hours. This is the time interval at which purging is to occur. It is field adjustable.

### **LCD Operating Screens:**

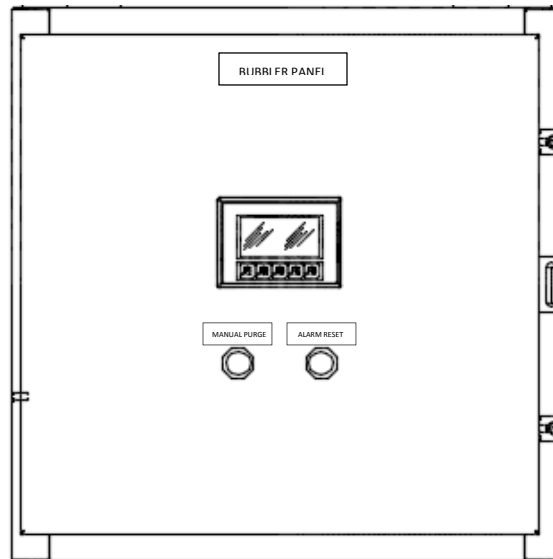
1. Settings Screen: This screen is used to properly set the operating parameters.
  - a. Air Tank Pressure
  - b. Well Pressure Transmitter:
  - c. High and low wet well level alarms setpoints
  - d. Compressor on/off setpoints
  - e. Time interval at which purging is to occur
  - f. Compressor run time reset.
2. Home Screen (Displays):
  - a. Wet well level
  - b. Air tank pressure
  - c. Compressor running
  - d. Compressor Run Time
  - e. Purge/Dump active
  - f. System alarm (when active, the alarm screen must be accessed in order to see actual alarm)
3. Alarm Screen (Displays):
  - a. Wet well high level alarm
  - b. Wet well low level alarm
  - c. Compressor 1 malfunction
  - d. Compressor 2 malfunction
  - e. Air Compressors in Backup Mode
  - f. Air tank low pressure alarm
  - g. Air Compressor System Failure
  - h. Clogged bubbler tube alarm
  - i. Air tank pressure signal lost alarm
  - j. Wet well signal lost alarm

## Level Measurement Range

Note that level measurement is not done with the entire depth of the wet well. The distance from the end of the bubbler tube to the highest measured point in the well provides the actual level measurement range. See sample below.



## Bubbler Control Panel View:



## Note:

The above panel is typical of NEMA 12 type enclosures. The front layout will be the same for different types enclosures included but not limited to NEMA 1, 3R, 4X Stainless Steel, 4X Polycarbonate, and 4X Fiberglass.

The front door mounted components are:

1. 3" Graphical display terminal which is used for displaying status and indications, and for system settings.
2. Manual purge button which is used to manually initiate a purge/dump cycle.
3. Alarm reset button which is used to reset system related alarms.

# Plumbing Diagram

Note: Pumping diagram is typical of the bubbler system with integral air compressors option.

