![Community Engineering Corps]

Ashfield Automation Study

FINAL

January 2022

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Executive Summary

Ashfield is a small rural farming community in Massachusetts with a domestic wastewater treatment plant that serves approximately 163 residences and was built in the 1990's. Ashfield desires to automate elements of the WWTP to reduce the amount of time needed by plant staff to attend to daily operations and process upsets during off hours. Ashfield has a State of Massachusetts permit (X273880) to discharge up to 25,000 gallons per day (gpd) of treated domestic wastewater to groundwater. For a few days each year during the annual Fall Festival in October, the plant receives around four times the normal flow.

This study consists of evaluating the feasibility to automate the following elements:

- Adjusting the solar tank blowers AB-1 and AB-2 operation (currently manually operated)
- Wasting of sludge from the clarifiers
- Collecting flow measurements in various locations throughout the plant
- Repairing or replacing non-functioning instrumentation
- Collecting regulatory required and process control data
- Using an auto-dialer to alert the operator staff of changing conditions or critical system failures
- Influent and effluent sampling

The following methods are proposed to automate plant operation:

- Controlling the blowers with an instrument mounted in a solar tank, additional data is needed to support the design
- Controlling sludge wasting with timer activated valves
- Sending alarms from turbidity monitoring at the clarifier and replacing the inoperable level switch at the sand filters
- Repairing or replacing the non-functioning UV intensity

The following new instruments are proposed to gather data and generate alarms:

- Sensor selected to control the blower (dissolved oxygen, oxygen reduction potential and/or ammonia)
- Nitrate sensor/transmitter
- Turbidity sensor/transmitter
- High-level float switch to replace inoperable level switch in the sand filters
- UV intensity sensor/transmitter
- Effluent flow transmitter
- Influent pH sensor/transmitter
- Effluent pH sensor/transmitter

A Supervisory Control and Data Acquisition System (SCADA), which is a combination of computer-based hardware and software, will be needed to collect and manage the data from the existing and proposed instruments.

A Class 5 Opinion of Probable Costs (OPC), which is generally prepared with very limited information and subsequently has a wide accuracy range, was prepared for the design and construction of the automation features described in the study. The total estimate is $ 419,400. In deciding on the merits of this project, Ashfield should consider the additional maintenance cost of either hiring an instrumentation technician(s) or contracting out for instrumentation and control services. Additional training of Operations Staff would also be needed on a continuous basis to use and maintain the new instrumentation and minimize corrective maintenance.

Ashfield should also consider replacing the solar tanks with coated steel, polyethylene, or concrete aeration tanks. Preliminary calculations indicate there is sufficient space inside the existing solar tank room for new tanks. These modifications are recommended to improve the treatment process that should be considered as the town continues to manage and operate the plant.

Abbreviations

BOD5	Biochemical Oxygen Demand, 5 Day
CEC	Community Engineering Corps
DO	Dissolved Oxygen
gpm	gallons per minute
gpd	gallons per day
GUI	graphical user interfaces,
GWDP	groundwater discharge permit
MHI	median household income
MGD	Millions of Gallons per day
mg/L	milligram per liter
NaOAc	sodium acetate
NaOH	sodium bicarbonate
ORP	oxygen reduction potential
PC	Preliminary conditioning
PLC	Programmable Control Logic
SCADA	Supervisory Control and Data Acquisition
s.u.	standard units
TSS	total suspended solids
USB	Universal Serial Bus
UV	ultraviolet
VFD	variable frequency drive
VOCs	volatile organic compounds
WWTP	wastewater treatment plant

Glossary

Anoxic Conditions	Oxygen is present but it is bound in a molecule such as nitrite (NO^{-2}) and nitrate (NO^{-3})
Denitrification	Microbial reduction of nitrite (NO^{-2}) and nitrate (NO^{-3}) to nitrogen gas (N^2) by splitting the nitrogen-oxygen bond and using the oxygen (O^2) for respiration
Nitrification	Microbial oxidation of ammonia (NH^4) into nitrite and then to nitrate by replacing the hydrogen atom in the molecule with oxygen atoms
Aerobic Conditions	Dissolved oxygen is present and readily available to micro-organisms

1. Background

Ashfield is a small rural farming community in Massachusetts. The community has a domestic wastewater treatment plant (WWTP) that serves approximately 163 residences. The WWTP was built in the 1990's and is not expected to require major equipment replacement at this time. Ashfield desires to automate elements of the WWTP to reduce daily operator staff demands.

As a result of the November 2020 Community Engineering Corp (CEC) scope of work, a follow-on investigative site visit, and subsequent consultation with the Chief Plant Operator Kevin Boissonnault and Town of Ashfield Sewer Board Commissioner Dan Lovett, this study consists of evaluating the feasibility to automate the following elements:

- Adjusting the solar tank blowers AB-1 and AB-2 operation (currently manually operated)
- Wasting sludge from the clarifiers
- Collecting flow measurements in various locations throughout the plant
- Repairing or replacing non-functioning instrumentation
- Collecting regulatory required and process control data
- Using an auto-dialer to alert the operator of changing conditions or critical system failures
- Influent and effluent sampling

1.1   Need for Project

To reduce operator staff demands at the wastewater treatment plant, the town is considering options for automation of the treatment plant to reduce reliance on staff labor. The plant is relatively new (built in the 1990's) and does not require major equipment replacement at this time, therefore modifications of existing equipment were considered to incorporate automation.

According to census data, the County median household income (MHI) is 77% of the State MHI, qualifying the system for support based on financial need of the population. Given the small size of the system and the relatively high cost of engineering services necessary in this portion of the State, the town attested that the Sewer Commission does not have sufficient funds to afford an engineer to conduct this study and prepare a report on what type and extent of automation is needed.

Control features at the WWTP include mechanical float and timer switches to turn pumps on and off, and a mechanical timer to cycle the return activated sludge at the clarifier. There is no Supervisory Control and Data Acquisition (SCADA) system or digital control systems.

The plant Chief Operator works full time (8 hours/day, 5 days/week). There is also an assistant operator that works a few hours each weekend. The biggest challenges for the operators are managing nitrification through the solar tanks and clarifier, maintaining sludge waste/return, and keeping the sand filters clean. The operators also manually read, and log the plant flow meter by hand, manually collect daily pH measurements as required by the permit and manually collect process control measurements.

1.2   Deliverable

The scope of work for this project as detailed in the CEC Town of Ashfield Workplan dated November 9, 2020, required the delivery of a study and the creation of a draft and final reports outlining the conceptual

design and associated costs for adding plant automation. The study review included an evaluation of intake and effluent automated samplers to report out regulatory reporting data, blower and pump automation to adjust to changing influent conditions and researching auto-dialer alerting and notifications for the operator to respond to critical system failures. This final report is intended to inform decisions on what technology might best fit the automation and reliability of the system, and to provide options for financing the proposed improvements.

2. Permit Summary

Ashfield has a State of Massachusetts permit (X273880) to discharge up to 25,000 gallons per day (gpd) of treated domestic wastewater to groundwater. Ashfield reports they are in compliance with their permit. The groundwater discharge permit (GWDP) effective date is September 24, 2020 and it expires in 2025. Ashfield must monitor the wastewater influent, effluent, and groundwater monitoring wells. The WWTP effluent may not exceed the following concentrations:

- Biochemical Oxygen Demand, 5 Day (BOD5) – 30.0 mg/L
- Total Suspended Solids (TSS) – 30.0 mg/L
- Total Nitrogen – 10.0 mg/L
- Nitrate, as Nitrogen – 10.0 mg/L
- Oil and Grease – 15.0 mg/L
- pH – must be between 6.5 and 8.5 standard units

Table 2-1 summarizes the minimum number of samples and analyses that Ashfield must perform to verify the treatment system is meeting its permit limits. Samples must be analyzed by a Massachusetts certified laboratory.

Table 2-1, Permitted Minimum Monitoring Requirements

Parameter	Frequency	Sample Type
Sample Location: Influent		
pH	Daily	Grab
BOD5	Monthly	24-hour Composite
TSS	Monthly	24-hour Composite
Ammonia, as Nitrogen	Monthly	24-hour Composite
Sample Location: Effluent		
Flow	Continuous	Meter
pH	Daily	Grab
BOD5	Monthly	24-hour Composite
TSS	Monthly	24-hour Composite
Nitrate, as Nitrogen	Monthly	24-hour Composite
Total Nitrogen	Monthly	24-hour Composite
Volatile Organic Compounds (VOCs)	Annually	Grab

Table 2-1, Permitted Minimum Monitoring Requirements

Parameter	Frequency	Sample Type
Total Phosphorus	Annually (between June 15 and September 30)	24-hour Composite
Orthophosphate	Annually (between June 15 and September 30)	24-hour Composite
Sample Location: Monitoring Wells (4 Total)		
Static Water Level	Quarterly	Measurement
pH	Quarterly	Measurement
Specific Conductance	Quarterly	Measurement
Total Nitrogen	Quarterly	Grab
Nitrate as Nitrogen	Quarterly	Grab
Total Phosphorus	Annually (between June 15 and September 30)	Grab
Orthophosphate	Annually (between June 15 and September 30)	Grab
VOCs	Annually	Grab

3.   Wastewater Treatment System

This section provides details about the wastewater treatment system. A brief overview of the extended aeration process is provided as a background, followed by a description of the original design intent for the Ashfield WWTP, and a summary of the present day facility and operation.

3.1   Extended Aeration Process Description

The following is a brief overview of the extended aeration process which works by using microorganisms in aeration tanks to consume carbon in the sewage and convert it to carbon dioxide. The microorganisms can also convert ammonia to nitrite and nitrate (nitrification). If anoxic conditions exist, microorganisms can convert nitrite and nitrate to nitrogen gas (denitrification). The liquid contents of the aeration basin are referred to as mixed liquor. Mixed liquor from the aeration tanks continue to a clarifier where the microorganisms and inert solids, referred to as activated sludge, settle. The activated sludge is returned to the aeration tanks where the microorganisms resume consumption of carbon. To ensure the clarifier effluent is clear, the depth of the solids is normally kept between 1 to 3 feet deep. Over time, the quantity of solids in the aeration tank accumulates. This rate is dependent on flow, influent carbon, total suspend solids concentrations, and the size of the treatment components. When the quantity of solids is too great, the excess is removed from the clarifier and placed into an aerated sludge holding tank, a process referred to as wasting. The operator makes these decisions by visually inspecting the system and conducting process control monitoring. To avoid shocks to the microorganisms, its best to remove small quantities of excess solids consistently and frequently. The removal of too many solids at once can cause operational upsets.

3.2   Record Drawings and Process Information

According to the Record Drawings dated 1997, the WWTP has the following treatment components listed in the order of the flow stream: bar screen, aerated grit chamber, sodium bicarbonate chemical feed system, preliminary conditioning (PC) tank, two grinder pumps, two surge tanks, an aerated digestor, eight aerated solar tank trains each with eight tanks (64 total), two clarifiers, two sand filters, sodium acetate chemical feed system, four marshes, ultraviolet (UV) disinfection, and leaching trenches

The WWTP design shows the plant is rated to treat an average and maximum daily flow of 25,000 gpd. Three months of data indicates the present average daily flow is around 14,000 gpd. It can treat peak daily flows up to 180,000 gpd when influent is directed into surge tanks. The grinder pumps in the PC Tank distribute flow to the solar tanks. If the PC tank fills faster than the grinder pumps can transfer liquids to the solar tanks, liquids will overflow into Surge Tank No. 1 and then Surge Tank No. 2. The liquids from Surge Tank No. 1 can be pumped to the PC Tank or to the Solar Tanks. Liquids from Surge Tank No. 2 are pumped to the PC Tank. The drawings show the surge tank and grinder pumps are activated by mechanical float controls.

Liquids from the solar tanks gravity flows into the bottom of two clarifiers. Activated sludge from the clarifiers is returned to the PC tank. Clear liquid from the top of the clarifiers, gravity flows through sand filters, and a marsh. The marsh is divided into four submerged chambers filled with 4.5 feet deep of crushed stone. There are 18" PVC sumps inside each chamber where samples can be taken or sensors could be mounted. Flow from the marsh is disinfected by ultraviolet light, and discharged to a drain field. During a September 2020 site visit, the WWTP operator gave additional information about the original design intent and further information was obtained from research. The original process design was expected to limit solids generation. Organics would be removed inside the PC Tank. The solar tanks were intended to grow an ecosystem of algae, plankton, snails, and plants to further remove organics and nutrients. The Marsh, was also intended to remove nutrients.

The Record Drawings show sodium bicarbonate is fed to the influent and sodium acetate is fed prior to the marsh. Sodium bicarbonate is typically used to supplement alkalinity. Alkalinity is the measure of the capacity of water to resist changes in pH, also called buffering capacity. When microorganisms convert ammonia to nitrate, alkalinity is consumed. When nitrate is converted to nitrogen gas, alkalinity is returned. When these processes are out of balance, alkalinity can become too low. When the buffering capacity is low, pH may drop below the permit limit of 6.5, resulting in a loss of the microorganisms that remove ammonia. The sodium acetate feed at the marsh was likely intended to provide additional carbon to support (feed) the microorganisms so that they would continue removing nitrogen.

3.3   Differences from the Record Drawings

The site visit revealed differences between the present system and what is reflected on the 1997 Record Drawings; these differences are depicted on Figure 3-1. A pump controller is used to operate the grinder pumps in the PC Tank instead of level switches. Timer 1 cycles the grinder pumps at 15 minutes on and 5 minutes off when a pressure sensor indicates the level is between 6,930 and 8,400 gallons. Timer 2 cycles the grinder pumps at 10 minutes on and 5 minutes off when the level is between 8,400 and 11,100 gallons. Timer 3 cycles the grinder pump at 8 minutes off and 5 minutes on when the level is above 11,100 gallons. There are four trains of eight solar tanks and plants are not being grown inside the solar tanks. Instead the PC Tank and solar tanks are acting as aeration basins similar to the extended aeration activated sludge process. Clarifier No. 1 is not in use. Methanol is on hand to provide additional carbon

at the marsh instead of sodium acetate. The majority of the marsh is not in service. Flow is directed to the the last chamber of the marsh system. Otherwise it would takes two to three days for the flow to pass through all of the marsh chambers.

3.4   Process Control Monitoring

Three months of operator daily sheets were reviewed revealing that the operator is conducting process control measurements for several parameters on a daily or nearly daily basis. It is presumed that except for the permit required samples, the process control monitoring is being conducted with field test kits. Process control monitoring is necessary to determine how to adjust the WWTP system settings such as the blower timers, activated return flowrate and when to waste sludge. Table 3-1 summarizes the process control measurements and collection frequently.

Table 3-1, Process Control Monitoring

Parameter	Location	Permit Requirement	Frequency (Based on Daily Sheets)
pH	Clarifier Effluent	None	Daily
Ammonia	Influent	Monthly	2 to 30 times a month
Ammonia	Clarifier Effluent	None	2 to 30 times a month
Nitrate	Clarifier Effluent	Monthly	20 to 30 times a month

3.5   Sampling

The operator manually measures and records pH at the influent and effluent, in accordance with the GWDP. In addition to pH, the GWDP requires 24-hour composite samples to be collected at the influent and effluent. Ashfield has refrigerated composite samplers at both locations. In addition, grab samples are required at the monitoring wells. The following is a description of common sampling procedure processes and good practices:

- Empty, clean bottles are ordered from the contract certified laboratory. Often the laboratory will ship pre-preserved bottles inside a cooler to the WWTP with pre-printed chain-of-custody forms and bottle labels.

- It is good practice to visually check the WWTP conditions prior to sampling.

- Composite samplers consist of a small pump, tubing, a 1-to-3-liter bottle, and the insulated refrigerator. It is good practice to check the condition of the composite sampler prior to sampling and to confirm the sample bottle is clean. The refrigerated composite sampler may need to be turned on.

- On the day of sampling, a clean bottle is installed inside the refrigerator. It is good practice to measure and record the temperature to ensure it is 4 degrees Celsius. It is good practice to confirm the sampler is working properly prior to leaving the site.

- At 24 hours, the sampler is turned off and the contents of the single bottle are transferred to the laboratory provided bottles. The laboratory bottles are placed into a cooler and packed with ice. The cooler is either taken to a shipping location or relinquished to the laboratory courier.

- Ashfield is required to collect samples for BOD5 and Nitrogen, both with holding times of 48 hours. The certified laboratory must receive and set up these parameters within the holding time. The remainder of the parameters have holding times that range from 7 to 28 days.

3.6   Sludge Return and Wasting

The sludge return/sludge wasting piping is equipped with a three-way valve that is used to return flow to the head of the plant or direct wasting flow to the aerated digestor. The valve position that controls the return active sludge is set on a timer. The timer actives return flow every 8 minutes and remains open for 1 minute. The operator must manually adjust the valves to waste sludge.

Sludge can be manually thickened in the aerated Sludge Holding Tank. The process includes turning off the air until the sludge settles and or floats and pumping the clear liquid to the PC tank. This process is usually conducted when the tank is nearly full in order to thicken the sludge prior to shipment and create space for more sludge. If the Sludge Holding Tank is full, waste sludge is temporarily pumped to Clarifier No. 1, which is presently not in service, and drained back when there is space.

3.7   UV Intensity Meter

The existing UV disinfection system intensity meter is non-functional. The Trojan UV3000 PTP equipment should be replaced to provide reliable intensity metering to ensure sufficient disinfection is achieved.

3.8   Computer Controls

The treatment system has a basic computer system, but it does not provide any controls for the plant. The specific details of the hardware and software are unknown. Fiber optic high speed internet service is utilized at the plant. The site no longer has traditional copper wire phone service.

3.9   Operator Effort

The Plant Chief Operator works full time (8 hrs/day, 5 days/week). There is also an assistant operator that works a few hours each weekend. In addition, the operators manually collect and record operational data. The plant flow meter data is logged on a paper chart recorder, manually read by the operator, and recorded by hand. The permit required daily pH measurements are manually collected and recorded by hand. Process control measurements are collected manually.

Table 3-2 - Operator Duties

Activity	Frequency	Duration	Description
Facility Operation	5 days/week	8 hours/day	Adjust the plant operation (blowers, return rate, wasting rate, chemical feed) to meet permit limits, record permit required data, submit permit required reports, maintain equipment, order supplies
Process control monitoring	Operator discretion as necessary to meet permit limits		Collect field measurements for parameters such as ammonia, nitrate, DO, ORP, check sludge blanket, visually check the plant

Table 3-2 - Operator Duties

Activity	Frequency	Duration	Description
Permit sampling for pH	Daily	~1 hour	Calibrate the pH probe and document, measure the influent and effluent pH and document
Permit sampling for all but pH	Monthly or quarterly	2 days	See description in Table 2-1 and the description of Sampling in Section 3.3
Sludge wasting	3 to 4 days/week	< 1 hour	Adjust the return valves to the wasting position, monitor and reset the valve

4. Equipment Alarms and Automation

The manual operational activities of adjusting the aeration blowers, wasting sludge, using the composite samplers, and decanting sludge were evaluated for automation. The blower controls and sludge wasting activities are recommended to be automated. An alarm to warn when the sand filters have been blinded or are becoming clogged is also recommended. This section describes the proposed equipment automation and alarms.

4.1 Blower Controls

Many wastewater facilities use in situ instruments to control the treatment process for increased process stability. A common control principal is to use an instrument to monitor ammonium, Oxygen Reduction Potential (ORP), or Dissolved Oxygen (DO) to adjust blower motors equipped with variable frequent drives (VFDs). The instrument(s) would be connected to a new plant Programmable Logic Controller (PLC) which, in conjunction with the new SCADA System, would provide speed control commands to the VFD that would increase or decrease the blower motor speed based on the instrument setting. In some arrangements, two sensor/transmitters are used, one at the inlet and outlet. Section 5.0 provides additional details about in situ instruments.

Influent is split into four trains of eight interconnected tanks which behave functionally like one long tank. Each train is expected to be comparable to the others. The ORP conditions in the first tank of each train is likely to be different than the last tank of each train, especially if adjustments have been made to the air manifolds to enhance denitrification within the tanks. There is a possibility that the operating conditions vary greatly between each train and if this condition exists, it would not be feasible to use one instrument to control the blowers. A study might be needed to determine the variability between the tanks and whether one of the three sensors is more likely to return consistent data. The study would consist of leasing a DO, ORP and/or ammonia probe and having the plant operator manually collect measurements from the trains and tanks over time. Another option is to include an analyzer/transmitter in the lease for collecting the measurements.

If the study indicates the trains are similar and more than one type of instrument could be used as a controller, the instrument selection should also consider operator preference, cost, and maintenance. An ORP sensor/transmitter can indicate whether aerobic, anoxic, or anerobic conditions exist and could assist the operator in achieving nitrification and denitrification. A DO sensor/transmitter would allow the operator to maintain a steady amount of air in the chamber where it is located to ensure nitrification is occurring. The ammonium sensor/transmitter would provide a direct measurement for the respective

parameter and assist the operator in ensuring nitrification is occurring. An ammonium sensor/transmitter is expected to be four to five times the cost of an ORP or DO sensor/transmitter, but provides a direct measurement of a parameter that is a permit limit.

4.2   Sludge Return and Sludge Wasting Timers

When wasting is a manual operation, it is likely to be conducted infrequently which can cause instability to the process because the action removes microorganisms from circulation. Automating sludge wasting would allow it to occur more frequently, adding stability to the process.

Several options were evaluated to automate sludge wasting. An option to connect the output from a sludge level sensor to a valve was considered, however the sensors available on the market do not have the necessary reliability. Timers are commonly used at small plants for this purpose and because of their simplicity and the operator's familiarity, they are the recommended option. The three-way valve should be replaced with modified piping and two valves, one for each flow stream as shown on the attached Figure 4-1. Each of the valves would be actuated with a timer in the plant PLC. If desired, the timer operation can be recorded and be adjustable in a plant SCADA control system. Section 6.0 provides additional details about a SCADA control system.

Adding a second analog timer to the existing three-way valve was considered, however this would add complexity to establishing and maintaining appropriate settings between returning and wasting sludge.

The operator would use process control data to make decisions for the timer settings. Over time, the timers would be adjusted based on the influent strength, quantity, and the WWTP performance. To maintain proper operation of the WWTP, adjustments to the wasting rate should be incremental, allowing the operator to evaluate impact.

Figure 4-1 Proposed Valve Modifications
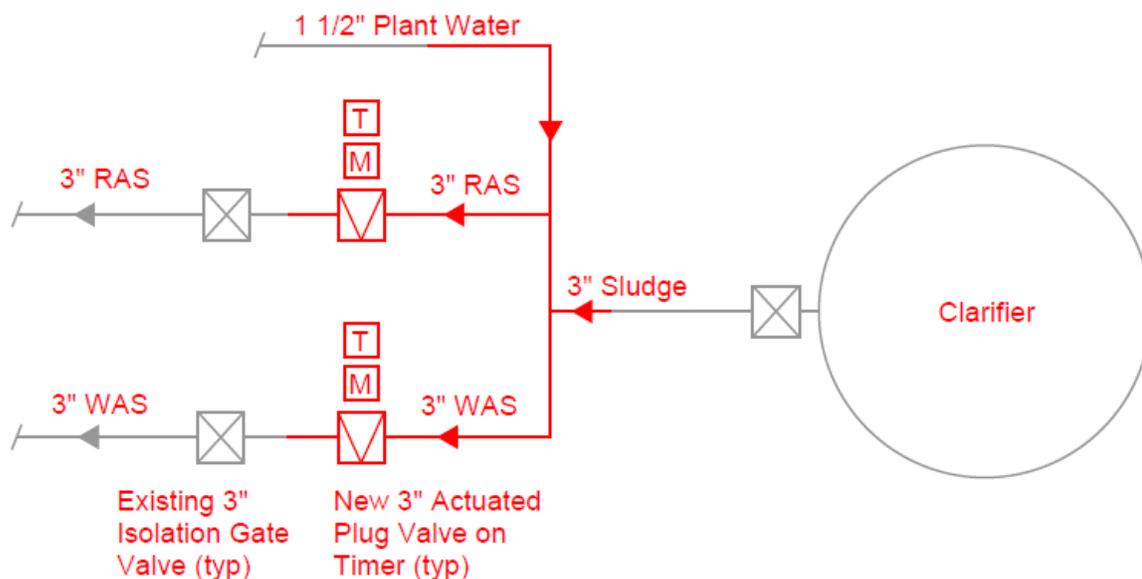
4.3   Sand Filter Alarms

The operator reported that an operational trouble spot occurs at the sand filters. When denitrification within the aeration basins is insufficient and the detention time of the sludge in the final clarifier is excessive, denitrification can occur within the clarifiers. This causes rising and floating sludge and increases the potential for it to carry over the weir to the filters. When sludge enters the filters, it coats (blinds) the surface and prevents liquids from percolating through the sand. The liquid level above the sand will increase as the filter becomes blinded and can overflow the filter walls. This condition can happen quickly giving the operator little time to respond.

Rising sludge or poorly settled solids can be detected inside the clarifier with a turbidity sensor/transmitter. The turbidity sensor /transmitter would be mounted a few feet below or near the clarifier surface, provide a signal to the plant PLC and would be programmed through the SCADA system to alarm at the operator's selected setpoint. Sensors that measure both TSS and turbidity were also considered, however they are more expensive. The TSS sensor would be recommended if color in the effluent causes the turbidity sensor to register false alarms.

The following are suggested models and manufacturers of turbidity sensors:

- Hach Model 1720E/6010101 with a model SC200, 2-channel analyzer/transmitter/controller
- Rosemount Clarity II with model 1056 analyzer/transmitter/controller
- Swan Turbiwell

If the turbidity probe in the clarifier is successful, it would give the operator more time to respond. Two additional controls are recommended for backup. Level switches are installed at the filters but they are inoperable. A new level switch, ultrasonic level detector, or immersion sensor should be mounted at the top of the sand filter to send an alarm of rising liquid levels or provide a continuous read-out and trend data. The level switch could turn off the grinder pumps so flow from the clarifier to the filters will stop providing the operator more time to respond. When the grinder pumps are turned off, the level inside the chamber will rise and overflow to the surge tank.

5.   Data Collection Automation

The manual activities conducted for the permit and process control were evaluated for automation. Automating these procedures would reduce transposition errors, reduce the need to file and maintain paperwork, allow for the generation of trend charts, and allow for the installation of alarms to warn of conditions that indicate the potential for permit non-compliance. Three permit required parameters—flow, influent pH, and effluent pH—are obvious parameters for automation. In addition, the operator is frequently collecting field measurements for ammonia and nitrate, and instruments could be used to collect this information. Methods to automate the composite samplers and decant sludge could not be identified. This section summarizes the data automation options and proposed instrumentation improvements shown on Figure 5-1.

5.1   Flow Measurement

The plant effluent flow meter signal from a v-notch weir is currently transmitted and logged on an analog chart recorder. The operator manually gathers this information and records it for submission to the

regulatory agency. The paper charts must be kept on file for five years. To automate this activity, it is recommended that the analog recorder be replaced with a digital transmitter that is wired to the plant PLC and the data recorded and logged by a SCADA system. The SCADA system would include a historian to collect the instantaneous flow meter data on a nearly continuous basis. The SCADA system would be programmed to send alarms at custom setpoints and to depict the instantaneous flow data on a trend chart that would be viewed on a computer monitor. It would be programmed to convert the instantaneous data to the equivalent of a daily flow. The daily flows could be downloaded to a spreadsheet in a format for submission to the regulatory agency. Section 6.0 provides additional details about a SCADA control system.

Incorporating additional flow metering at other locations in the plant was considered if it could improve the existing processes or recommended modifications. It was determined that no additional flow metering is warranted at this time.

The operator expressed concern that the v-notch weir is not sharp crested and may be causing inaccuracies in the flow measurement. As-built drawing M-5 shows the Fiberglass Reinforced Plastic (FRP) weir plate should be ¼-inch thick and have a 30 degree opening. If the FRP weir plate does not meet these dimensions, it should be replaced.

5.2   In Situ Measurements

The addition of in situ instruments to collect data was evaluated. In Section 4.1, the use of in situ instruments to control the blowers was described. The same instrument selected for this activity could also be used to collect process control data.

Each in situ instrument consists of a submerged probe mounted in a fixed location and an analyzer, transmitter, and/or controller. The instrument transmitter would be wired to the plant PLC and transmitted to the SCADA System. The SCADA system would include a historian to collect the nearly instantaneous measurements. The SCADA system would be programmed to send alarms at custom setpoints and to depict the instantaneous data on a trend chart that would be viewed on a computer monitor. The SCADA system would be programmed to convert the instantaneous data to a daily minimum, maximum, or average value which could be downloaded to a spreadsheet in a format for submission to the regulatory agency.

Routine activities for the management of in situ instruments include cleaning the probe, clearing air bubbles, checking the cables for damage, checking the probe against known standards, calibrating the probe, and depending on the type of probe, replacing electrolytes and/or a membrane cap.

5.2.1   pH Instrument

Ashfield is required by the permit to measure influent and effluent pH daily making these two measurements an obvious selection for automation. Since these parameters are required for the permit, the instruments must be properly installed, maintained, and calibrated on a routine basis. The instrumentation maintenance documents and data would need to be reliably saved for five years. The pH data would be saved by connecting to the plant PLC and recorded at the SCADA system to a computer server or to a secure iCloud service. If an on-site computer server is selected, the hard drive would need to be routinely backed-up.

The influent pH probe should be installed in a location where it can detect unusual pH fluctuations. The bar screen channel is not expected to be suitable because the liquid level will be too shallow. It could be installed within the grit chamber as shown in Figure 5-1, as it should have at least 3 feet of liquid. A stilling well could be used to protect the sensor. The pre-conditioning tank holds around 10,000 gallons which would attenuate influent pH fluctuations. However, if the other influent locations are not feasible, the probe might work inside the pre-conditioning tank if mounted at the inlet to the tank. If none of these options are viable, a pump and pH flow-through cell should be considered.

At the effluent, the pH probe could be mounted inside the effluent well or alternating dosing tank as shown in Figure 5-2. Both locations would have around 3 feet of liquid and there is power in the area for the UV system and effluent sampler.

The data from the instrument must be translated through the SCADA programming into a usable form for ease of submission to the State on the discharge monitoring report (DMR). The SCADA system program would identify the minimum and maximum pH result that occurred daily and provide a mechanism to export the data to an Excel spreadsheet. The SCADA system and/or sensor should be designed so that data collection can be suspended when the probe is calibrated. Otherwise, the calibration data would appear as a permit excursion and require manual correction by the operator which would defeat the convenience of automation.

The following are suggested models and manufacturers of pH sensors:

- Hach Model DPD1P1 with a model SC200, 2-channel analyzer/transmitter/controller
- Rosemount Model 3900 sensor with model 1056 analyzer/transmitter/controller
- Chemscan RDOX

5.2.2   Oxygen Reduction Potential Instrument

A fixed or portable ORP sensor is recommended to monitor for aerobic and anoxic conditions at the solar tanks as shown in Figure 5-3. This information helps to inform the operator if the proper conditions exist for the removal of organics, ammonia, and nitrate. If a portable probe is selected, one capable of storing data that can be transferred to the PLC system via a Universal Serial Bus (USB) connection is recommended to reduce transcription errors. The data could be transferred to the plant SCADA system where the software would convert it to trend charts. A limitation of using a portable probe is the data would not be available to provide alarms. If an ORP sensor is selected to control the blowers, the same sensor could also be programmed through the SCADA system to provide trend charts and alarms. Since this data collection is used for operational controls, the regulatory agencies may not require the same level of maintenance and data retention as is necessary for pH.

The following are suggested models and manufacturers of ORP sensors:

- Hach Model DRD1R5 sensor with model SC200 (2 channel) analyzer/transmitter/controller
- Rosemount 3900 sensor with model 1056 analyzer/transmitter/controller
- Chemscan

5.2.3   Ammonium Instrument

If an ammonium sensor is selected to control the blowers, the same sensor could also be programmed through the SCADA system to provide trend charts and alarms. A low range sensor is recommended, one

that can measure between 0.05 and 20 or 1 and 100-miligrams per liter (mg/L). Since this data collection is used for operational controls, the regulatory agencies may not require the same level of maintenance and data retention as is necessary for pH.

The following are suggested models and manufacturers of Ammonium sensors:

- Endress+Hauser model Liquiline CA80AM and Calibration Unit CAT810/820/860 Conditioning Unit
- ASA Analytics model ChemScan Mini Free AM

5.2.4   Nitrate Instrument

A nitrate sensor is recommended for installation at the last tank of one of the solar tank trains or a clarifier as shown in Figure 5-3. In either of these locations, the nitrate sensor could also be used to provide feedback for blower control or can be used for process control data. It would be used to ensure nitrate concentrations are low prior to the clarifier so that bulking and rising sludge does not occur. Initially it was suggested to install the nitrate probe at the marsh since it appears that the original design intent was for nitrate to be removed in this area. However, presently most of the nitrate removal is occurring prior to the clarifier and only the last chamber of the marsh is in service. The sensor would be programmed through the SCADA system to provide trend charts and alarms. Since this data collection is used for operational controls, the regulatory agencies may not require the same level maintenance and data retention as is necessary for pH.

The following are suggested models and manufacturers of Nitrate sensors:

- Endress+Hauser model Viomax CAS51D or model ISEmax CAS40D with a Liquiline CM44 Transmitter
- Foxcroft model FX-300-NO3
- S-CAN model Nitro-Lyser-II with model CON-Lyte eco Transmitter

5.3   Sampling Automation

A search for composite samplers which could be remotely operated was conducted, but no such product was found. The sampling process will continue to require physical oversight at this time.

6.   Supervisory Control and Data Acquisition

A SCADA control system will be recommended to collect and manage the data from the existing and proposed instruments. This combination of hardware and software will include a computer, networked data, graphical user interfaces (GUI), a PLC, and/or a remote terminal unit (RTU). This Section provides a description of the SCADA components.

6.1   Programmable Logic Controller

A PLC will be needed to receive inputs from each of the proposed instruments and control systems and to transmit the outputs and data to other devices. A PLC is an industrial computer consisting of hardware and software which is custom built for a facility by a System Integrator. Hardwired connections (ethernet or fiber optics) from each instrument and controller will connect via Remote Terminal Units (RTUs) to

Input/Output (I/O) cards and the I/O will be controlled through the processor unit (hardware) similar to a computer processor. In situations where an instrument is far from the processor, a radio or microwave signal can be used instead of a hardwired connection. The processor unit will have memory and software to manage the analog and digital signals. A PLC will have a Human Machine Interface (HMI) for the operator to take readings and make changes to the equipment operations. Surge protectors, and ethernet switches will also be required. Fiber optic cables are not expected to be utilized because it is not expected to have communication cable runs that exceed 300 feet.

It is recommended to select the PLC or RTU manufacturer and communication that selection to the instrumentation supplier to ensure they are using the same communication protocol. This will avoid the additional cost of a communication gateway.

6.2   Software

SCADA software will be needed to manage and report the collected data. The software would also be used to create a graphical user interface (GUI) that will provide the data in an easy-to-understand form as shown in the images in Figure 6-1. The Ashfield WWTP, as with most treatment systems, has unique features that will require a custom application. A secure, web-based, scalable software with an easy-to-use interface such as Ignition 8.1 is recommended. This software has a Historian system that allows for data logging and data visualization. The Historian system has data compression algorithms to reduce the impact of data logging on storage and transmission. Ignition 8.1 can operate on multiple platforms including Apple IOS and Microsoft OS is also usable on mobile devices. For a low cost option, VT SCADA provides a free version of their software for small systems with less than 50 I/O points.

Figure 6-1 Treatment System Operational Graphical Interface
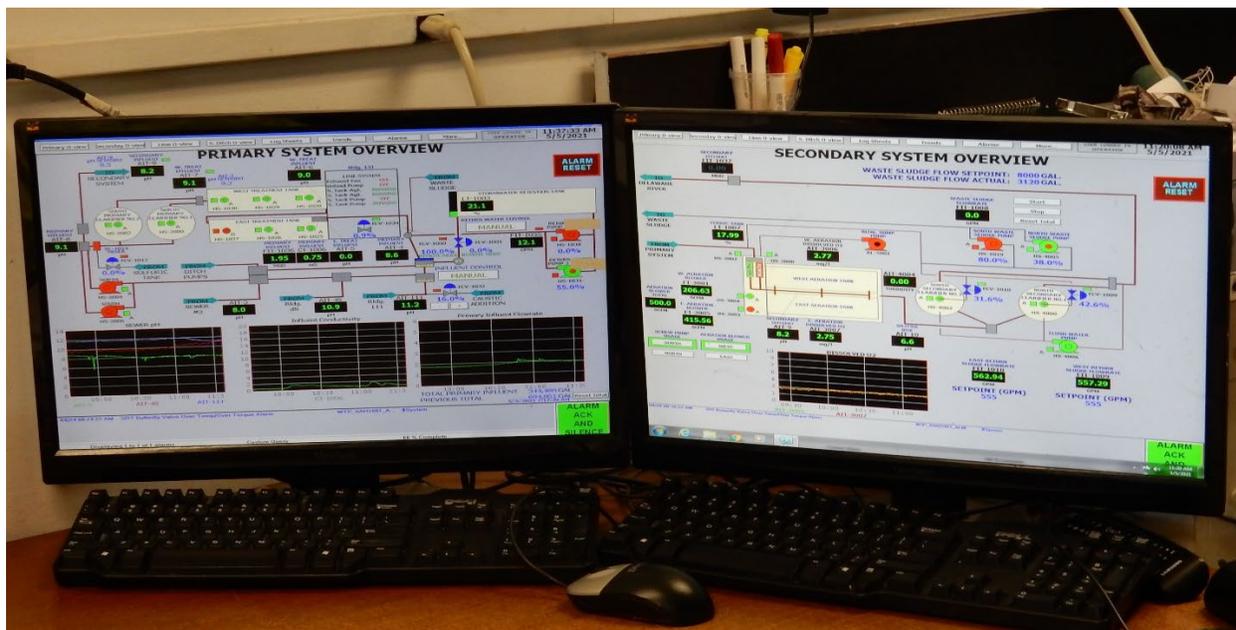
6.3   Computer

The treatment system's existing computer could be incorporated into the SCADA system. The age of the computer, it's hardware, and ability to run the software would need to be verified. It would be used to

store the flow and pH data as required by the permit and to translate the data into charts and the control interface. Microsoft Excel and Adobe Acrobat software could be used to prepare calculations and complete, print and save the Discharge Monitoring Reports.

6.3.1 Cloud Hosted Service

If it is determined that the existing computer is deficient, the option of using a cloud hosted system verses a new computer should be evaluated. If a cloud hosted system is selected, the System Integrator would be able to initiate that service along with a monthly service fee to a cloud-based service provider.

6.4 Alarms

In Section 5, in situ instruments were recommended to collect permit and process data. The SCADA system could be programmed to provide alarms at custom setpoints. At locations where in situ instruments are added, alarm setpoints can be developed for each parameter. The design drawings show the plant has existing trouble alarms.

6.4.1 Autodialer

The facility has a RACO Verbatim Autodialler Model 6280220 that is no longer in use or connected. The facility is currently using a Detectoguard system that provides a general trouble alarm. The operator must travel to the plant to determine the problem. As with computers, alarm systems and autodialler technology has improved. It is recommended that the facility update their system to a unit capable of providing more details about each alarm so that the operator has enough information to know if an after-hours visit is required or if the problem can wait for normal work hours. Suggested manufacturers include Sentinel or RACO.

The treatment system is interconnected to high-speed internet and no longer uses a traditional copper phone line. A new alarm autodialer will need to be compatible with the site's ethernet service.

6.5 Input/Output Summary

The attached Table 6-1 presents a list of the proposed new and existing signal inputs and outputs, the location of the sensor, the specific instrument, the purpose and whether it should be connected to the autodialler.

7. Opinion of Probable Cost

This report includes an Opinion of Probable Construction Costs (OPCC) to design and construct the automation features proposed in this study. The total estimate is $ 419,400 as summarized in Table 7-1 and detailed in Table 7-2.

Table 7-1, Opinion of Probable Cost Estimate Summary

Element	Budgetary Estimate
Engineering Costs	$ 150,000
Equipment and Materials	$ 126,500

Table 7-1, Opinion of Probable Cost Estimate Summary

Element	Budgetary Estimate
Construction	$ 130,000
Mobilization (5% Equipment and Labor)	$ 12,900
Total	$ 419,400

This estimate is consistent with a Class 5 OPCC which is generally prepared with very limited information, and subsequently has a wide accuracy range. The typical accuracy ranges for a Class 5 OPCC are -20% to -50% on the low side, and +30% to +100% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Class 5 costing is typically used for assessing initial project viability, analysis of alternates, or long-range planning.

7.1   Engineering Estimate

For small projects, the engineering services costs can be significant when compared to the cost of construction. The engineering estimate consists of five stages of work. The first step is to gather the information necessary to complete the design and determine if there is missing information that requires further study. The second step is to prepare conceptual layouts and obtain Ashfield stakeholders input prior to progressing design details. Following incorporation of stakeholder comments, the third step is to add the design details. The fourth step is to gather competitive bids and select a contractor. The fifth step is the construction and commissioning of the new system.

8.   Additional Suggestions

Following a review of the plant design and a meeting with the Authority, two additional plant modifications are suggested in this section. These modifications should be considered by the town as they continue to maintain and update the WWTP facilities.

8.1   Replace Solar Tanks with Rectangular Tanks

Ashfield should consider replacing the solar tanks with more durable tanks. The solar tanks are constructed of wire mesh and an internal liner held to the steel with clips. More durable materials to consider are rectangular coated steel tanks or polyethylene tanks. There are tank suppliers offering open top polyethylene tanks with similar dimensions as the existing tanks which could make this an inexpensive option as it would not require a custom order. Cast in place concrete tanks would also be appropriate as a more costly but longer lasting material.

The original design consisted of 64 tanks, each have a 6-foot diameter and holds approximately 5 feet of liquid. If all tanks were in service as designed, the total liquid volume would be 66,730 gallons. Activated sludge from the clarifier is returned to the PC Tank so it is also providing aeration treatment. If the liquid level within the PC tank averages 4 feet, the tank capacity is 10,000 gallons.

The Ashfield WWTP is designed to treat an average flow of 25,000 gpd and based on a few recent months of data, the actual average flow is around 14,000 gpd. The Ashfield WWTP has been modified to

operate in the activated sludge extended aeration process, which is a common process for small facilities. Based on the 2014 edition of Recommended Standards for Wastewater Facilities, an extended aeration wastewater treatment system with an average influent BOD5 between 200 and 240 mg/L and a design flow of 25,000 gpd should have a total aeration volume between 21,000 to 25,000 gallons. It is presumed that the original solar tank volume was greater than twice what is needed because the tanks would also be used to grow plants and for redundancy.

Some approximate calculations were prepared and indicate there is sufficient space to install four rectangular tanks inside the Solar greenhouse, three to meet the plant capacity and one redundant tank. Assuming each tank is fabricated off-site and shipped to the site, a width of 8 feet was selected because it is the maximum width of a standard truck load. A liquid depth of 5 feet was selected assuming this would minimize the need to replace the blowers. Estimating a conservative 8,000 gallons within the PC Tank, the additional aeration volume that would be provided by the four tanks would be 25,600 gallons. With these fixed dimensions, each tank would need to be 22 feet long. Depending on how they are arranged, the four tanks would need a minimum footprint of 25 feet by 41 feet or 23 feet by 48 feet which includes 3 feet around the perimeter and 1 foot of space between the tanks. The room that contains the solar tanks has a footprint of 35 feet by 121 feet.

Ashfield would need to utilize an engineering consulting firm to evaluate their WWTP flows, organic loading trends, and future growth projections. The engineers should evaluate options such as whether it would be more economical to install a new package plant. Calculations would be prepared to size future aeration tanks or new package plant. The engineer should consider designing the new aeration capacity with aerobic and anoxic zones, and internal recycle streams, to provide nitrification and denitrification. Providing nitrification and denitrification in the aeration phase of treatment could allow for the removal of the methanol feed and reduce the operational difficulty of denitrification occurring in the clarifiers. If steel tanks are selected, the engineer would need to evaluate the building foundation capacity for the additional weight.

9.   Recommended Path Forward

The following is an overview of the activities in the general order they would be conducted to construct the improvements described within this report:

1. Identify funding sources for the Capital Improvements.

2. Conduct a study on the Solar Tanks to gather data and/or narrow the instrumentation selection for controlling the blowers.

3. Hire an Engineering Consultant to complete the improvement design in coordination with the operation staff and if available, System Integrator. Request that the Consultant submit their design documents at stages of completeness such as 30%, 60%, and Final.

4. As needed, request that the Consultant support the preparation of the bid and contract documents, evaluate the bids, and identify the required permits and responsible parties. Submit permit applications for those permits that are the responsibility of the Ashfield.

5. Obtain at least three quotes and execute a construction contract with the selected bidder.

6. Oversee Construction, Testing and Start-up.

10. References

7. 2014 edition of Recommended Standards for Wastewater Facilities

8. 1997 Design Record Drawings, Drawings prepare by Weston & Sampson Engineers, Inc., Record Drawings prepared by Ganteume & McMullen, Inc.

Tables

Location	Status	Instrument	Tag	Type	Add to Autodialer	Purpose	PLC I/O	Comments
Influent Bar Screen	New	Level (float)			Yes	Alarm		To monitor for clogged bar screen
Grit Chamber	New	pH Sensor			Yes	Required Data		To collect permit required data
Power Supply or Generator	New	Automatic transfer switch		Loss Power	Yes	Alarm		Use power company app?
Preliminary Conditioning Tank	Existing	Level, pressure or float	LAHH 101	High Level	Yes	Alarm		To monitor forward feed/pumps
Solar Tank (representative)	New	TBD - Ammonia, ORP or DO Sensor			No	Controller		To control blower drives
Solar Tank (representative)	New	TBD - Ammonia, ORP or DO Sensor			Yes	Alarm		For process information
Aeration Blower (1)	Existing		QA 175	Trouble Alarm	Yes	Alarm		To monitor loss aeration
Aeration Blower (2)	Existing		QA 176	Trouble Alarm	Yes	Alarm		To monitor loss aeration
Clarifier Drive 1	Existing		WSHH 153	Torque alarm	Optional	Alarm		To monitor loss clarifier drive
Clarifier Drive 2	Existing		WAHH 154	Torque alarm	Optional	Alarm		To monitor loss clarifier drive
Clarifier - Upper 1 to 3 feet	New	Turbidity			Yes	Alarm		To monitor for floating sludge
Filters	New	Level, pressure or float			Yes	Alarm		To monitor for filter blinding
Former Marsh	New	Nitrate Sensor			Yes	Process Data		For process information
UV Disinfection	Existing		QA 163	Trouble Alarm	Yes	Alarm		To monitor loss UV
Effluent Well	New	pH Sensor			Yes	Data		To collect permit required data
Effluent Well Discharge	Existing	Flow Meter	FIT/FR 162	None	Yes	Required Data		To collect permit required data
Chemical Tank	New	Level (float)			Optional	Data		For process information
WAS	New	Timer						To automate wasting
RAS	New	Timer						

TBD = To be determined

Item	Fee	Subtotal
ENGINEERING		
Data Review/Collection	$ 10,000	
30% Design	$ 25,000	
Final Design, 12 sheets, $5,000 each	$ 50,000	
Bid Services	$ 15,000	
Construction Support	$ 50,000	
SUBTOTAL (Mark-up already included)		$ 150,000
MATERIALS AND EQUIPMENT		
pH Probe and Transmitter, Influent	$ 3,000	
pH Probe and Transmitter, Effluent	$ 3,000	
Ammonium Probe and Transmitter, Aeration	$ 8,000	
Turbidity Probe and Transmitter, Clarifier	$ 3,500	
Nitrate Probe and Transmitter, Marsh	$ 15,000	
Flow Meter Transmitter, Influent	$ 2,000	
Flow Meter Transmitter, Effluent	$ 2,000	
Control Valves, Clarifier Sludge	$ 5,000	
Timer, Clarifier Sludge	$ 500	
Pressure Differential Sensor, Sand Filter	$ 1,000	
Level Switch, Sand Filter	$ 500	
Intensity Meter	$ 1,000	
Wiring and Conduit	$ 5,000	
Data Communication Rack	$ 30,500	
PLC Control Panel	$ 25,000	
HMI Workstation	$ 5,000	
SUBTOTAL and 15% Markup		$ 126,500
CONSTRUCTION		
Labor (1 month)	$ 80,000	
PLC Programming	$ 16,000	
SCADA Programming	$ 16,000	
Historian Configuration	$ 8,000	
Report Generation Configuration	$ 8,000	
Training	$ 2,000	
SUBTOTAL		$ 130,000
Mobilization (5% of Construction Labor and Equipment Cost) =		$ 12,825
ESTIMATED PROJECT COST =		$ 419,325

Figures

PROCESS AND INSTRUMENTATION DIAGRAM

NOTES

1. NOT ALL CONTROL DEVICES AND PIPING ARE SHOWN ON THIS DRAWING. REFER TO SPECIFICATIONS AND ELECTRICAL DRAWINGS AND PROCESS DRAWINGS.
2. SLUDGE WITHDRAWAL AND TRANSFER SYSTEM DESIGNED BY WESTON & SAMPSON ENGINEERS, INC.
3. PERSONNEL EMERGENCY ALARM SYSTEM IS NOT SHOWN ON THIS DRAWING. REFER TO SPECIFICATIONS AND ELECTRICAL DRAWINGS.
4. ELAPSED (RUN) TIME METERS ARE NOT SHOWN ON THIS DRAWING. REFER TO SPECIFICATIONS AND ELECTRICAL DRAWINGS.
5. RUNNING LIGHTS (i.e. ON–OFF STATUS LIGHTS) ARE NOT SHOWN ON THIS DIAGRAM.
6. CLOUDED ELEMENTS ARE CHANGED CONDITIONS FROM THOSE INDICATED ON THE RECORD DRAWINGS.

INTAKE HEADER

AERATION BLOWERS

BLOWERS

SURGE TANK NO.2

SURGE TANK NO.1

SLUDGE HOLDING TANK

DECANT TUBE

DECANT SUMP

PRELIMINARY CONDITIONING TANK

GRINDER PUMPS

SOLAR TANKS (TYP. OF 32)

SOLAR TANK GREENHOUSE

CLARIFIER 1 NOT IN USE

CLARIFIER NO.1

CLARIFIER NO.2

SAND FILTER NO. 1

SAND FILTER NO. 2

METHANOL DAY TANK

FROM PLANT WATER SYSTEM

VENT (TYP)

BAR RACK

AERATED GRIT CHAMBER

INFLUENT

SCREENINGS

GRIT

BYPASS CHANNEL

SODIUM BICARBONATE DAY TANK

PLANT WATER

WASTE SLUDGE

RETURN SLUDGE

IN CLARIFIER PIT

SEE NOTE 2.

SAMPLE STATION

FILTER BACKWASH

LEGEND

INSTRUMENTATION
WASTEWATER
AIR
SLUDGE AND RECYCLE
FIELD MOUNTED
PANEL MOUNTED
MIXER
PUMP
PINCH VALVE
CHECK VALVE
GLOBE VALVE
KNIFE GATE VALVE
GATE VALVE
BUTTERFLY VALVE
BALL VALVE
PROGRAMMABLE LOGIC CONTROLLER PRIMARY LOCATION PROVIDED BY EQUIPMENT SUPPLIER TO BE INSTALLED BY GENERAL CONTRACTOR
PROVIDED BY EQUIPMENT SUPPLIER TO BE INSTALLED BY GENERAL CONTRACTOR

REDUCER
UNDEFINED INTERLOCK LOGIC SYMBOL
V–NOTCH WEIR
SLIDE GATE
BLOWER
SILENCER
FILTER
ULTRASONIC LEVEL ELEMENT
PRESSURE RELIEF VALVE
THREE–WAY VALVE
PRESSURE REGULATING VALVE SELF CONTAINED
HAND ACTUATOR
SOLENOID OPERATOR
NC   NORMALLY CLOSED
T   TIMER

ABBREVIATIONS

AAH - ANALYSIS ALARM HIGH
AB - AERATION BLOWER
AE - ANALYSIS ELEMENT
BFP - BACKFLOW PREVENTER
CD - CLARIFIER DRIVE
CFP - CHEMICAL FEED PUMP
DP - DECANT SUMP PUMP
FR - FLOW RECORDER
GP - GRINDER PUMP
HS - HAND SWITCH
LAH - LEVEL ALARM – HIGH
LAL - LEVEL ALARM – LOW
LE - LEVEL ELEMENT
LSH - LEVEL SWITCH HIGH
LSHH - LEVEL SWITCH HIGH HIGH
LSL - LEVEL SWITCH LOW
LSLL - LEVEL SWITCH LOW LOW
FIT - FLOW INDICATOR TRANSMITTER
MA - MOISTURE ALARM
MS - MOISTURE SWITCH
MX - MIXER
PCV - PRESSURE CONTROL VALVE
PI - PRESSURE INDICATOR
PS - PRESSURE SWITCH
PSV - PRESSURE SAFETY VALVE
PWP - PLANT WATER PUMP
QA - TROUBLE ALARM
RS - RETURN SLUDGE
SB - SURGE TANK BLOWER
SP - SURGE PUMP
TS - TEMPERATURE SWITCH
TAH - TEMPERATURE ALARM HIGH
WAH - TORQUE ALARM HIGH
WAHH - TORQUE ALARM HIGH HIGH
WS - WASTE SLUDGE
WSH - TORQUE SWITCH HIGH
WSHH - TORQUE SWITCH HIGH HIGH
YIC - EVENT INDICATOR CONTROLLER

PANELS

CP1–BLOWER CONTROL PANEL AND MCC
CP2–PLANT OPERATIONS PANEL
CP3–PUMP CONTROL PANEL
CP4–ANNUNCIATOR/ALARM PANEL
CP5–CLARIFIER CONTROL PANEL

MARSH NO.1   NOT IN USE
MARSH NO.2   NOT IN USE
MARSH NO.3   NOT IN USE
MARSH NO.4

MARSH GREENHOUSE

EFFLUENT WELL

UV DISINFECTION

EFFLUENT

HYDRO-PNEUMATIC TANK

FLOW SPLITTER

PLANT WATER MX-2

WELL WATER SUPPLY

PUBLIC WATER

PLANT BFP

PROCESS BFP

TO DRAIN

TO PLANT WATER DISTRIBUTION SYSTEM

TO DRAIN

POTABLE WATER DISTRIBUTION SYSTEM

2x4" REDUCER (TYP)

Figure 3-1
EXISTING CONDITIONS

RECORD DRAWING

No.	Date	By	Ck.By	App.By	Description
2	3/98	UAS	PEM	FWY	REVISED FOR RECORD DRAWINGS
1	5/14/95	JCV	KAB	MDG	ISSUED FOR BIDDING AND CONSTRUCTION
0	10/21/94	JCV	KAB	MDG	ISSUED FOR D.E.P. APPROVAL

Figure 4-2 – Sand Filter Alarms

Turbidity

Level Sensor

SCUM BAFFLE
"V" NOTCH WEIR
ET CONNECTION
PIPE VENT
100.00
-7
turbidity
Level
EL=1102.75
3'-6"
3'-0"
SAND FILTER
3'-0"
CLARIFIER
3" PVC UN
PVC BALL V
3" INLET
C EL=1097.
2" PVC SUM
INV EL= 10
3" STEEL F
EL=1090.
EL=1089.
TER
098.00
1 1/2" PW
RAKE ARM ASSEMBLY

Install turbidity probe in the upper 3 feet of the clarifier
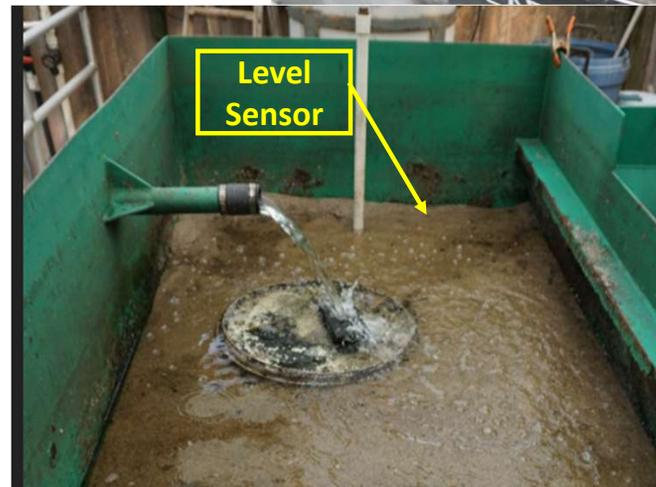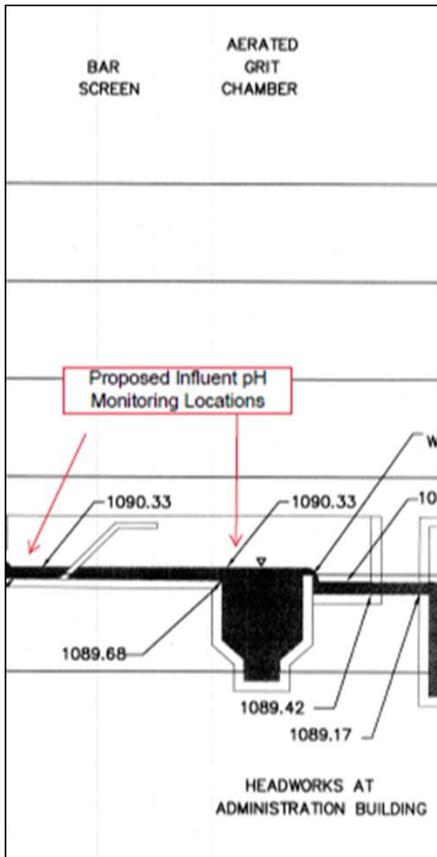Install level sensor at the top of the sand filter

Figure 5-1
PROPOSED
INSTRUMENTATION
IMPROVEMENTS

RECORD DRAWING

NOTES
1. NOT ALL CONTROL DEVICES AND PIPING ARE SHOWN ON THIS DRAWING. REFER TO SPECIFICATIONS AND ELECTRICAL DRAWINGS AND PROCESS DRAWINGS.
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3. PERSONNEL EMERGENCY ALARM SYSTEM IS NOT SHOWN ON THIS DRAWING. REFER TO SPECIFICATIONS AND ELECTRICAL DRAWINGS.
4. ELAPSED (RUN) TIME METERS ARE NOT SHOWN ON THIS DRAWING. REFER TO SPECIFICATIONS AND ELECTRICAL DRAWINGS.
5. RUNNING LIGHTS (i.e. ON-OFF STATUS LIGHTS) ARE NOT SHOWN ON THIS DIAGRAM.
6. CLOUDED ELEMENTS ARE CHANGED CONDITIONS FROM THOSE INDICATED ON THE RECORD DRAWINGS.

LEGEND
INSTRUMENTATION
WASTEWATER
AIR
SLUDGE AND RECYCLE
FIELD MOUNTED
PANEL MOUNTED
MIXER
PUMP
PINCH VALVE
CHECK VALVE
GLOBE VALVE
KNIFE GATE VALVE
GATE VALVE
BUTTERFLY VALVE
BALL VALVE
PROGRAMMABLE LOGIC CONTROLLER PRIMARY LOCATION
PROVIDED BY EQUIPMENT SUPPLIER TO BE INSTALLED BY GENERAL CONTRACTOR
PROVIDED BY EQUIPMENT SUPPLIER TO BE INSTALLED BY GENERAL CONTRACTOR

REDUCER
UNDEFINED INTERLOCK LOGIC SYMBOL
V-NOTCH WEIR
SLIDE GATE
BLOWER
SILENCER
FILTER
ULTRASONIC LEVEL ELEMENT
THREE-WAY VALVE
PRESSURE RELIEF VALVE
HAND ACTUATOR
PRESSURE REGULATING VALVE SELF CONTAINED
SOLENOID OPERATOR
TIMER
3" ACTUATED PLUG VALVE

ABBREVIATIONS
AAH	ANALYSIS ALARM HIGH
AB	AERATION BLOWER
AE	ANALYSIS ELEMENT
BFP	BACKFLOW PREVENTER
CD	CLARIFIER DRIVE
CFP	CHEMICAL FEED PUMP
DP	DECANT SUMP PUMP
FR	FLOW RECORDER
GP	GRINDER PUMP
HS	HAND SWITCH
LAH	LEVEL ALARM - HIGH
LAL	LEVEL ALARM - LOW
LE	LEVEL ELEMENT
LSH	LEVEL SWITCH HIGH
LSHH	LEVEL SWITCH HIGH HIGH
LSL	LEVEL SWITCH LOW
LSLL	LEVEL SWITCH LOW LOW
FIT	FLOW INDICATOR TRANSMITTER
MA	MOISTURE ALARM
MS	MOISTURE SWITCH
MX	MIXER
PCV	PRESSURE CONTROL VALVE
PI	PRESSURE INDICATOR
PS	PRESSURE SWITCH
PSV	PRESSURE SAFETY VALVE
PWP	PLANT WATER PUMP
QA	TROUBLE ALARM
RS	RETURN SLUDGE
SB	SURGE TANK BLOWER
SP	SURGE PUMP
TS	TEMPERATURE SWITCH
TAH	TEMPERATURE ALARM HIGH
WAH	TORQUE ALARM HIGH
WAHH	TORQUE ALARM HIGH HIGH
WS	WASTE SLUDGE
WSH	TORQUE SWITCH HIGH
WSHH	TORQUE SWITCH HIGH HIGH
YIC	EVENT INDICATOR CONTROLLER
AIT	TRANSMITTER
NC	NORMALLY CLOSED
QE	QUANTITY SENSOR

PANELS
CP1—BLOWER CONTROL PANEL AND MCC
CP2—PLANT OPERATIONS PANEL
CP3—PUMP CONTROL PANEL
CP4—ANNUNCIATOR/ALARM PANEL
CP5—CLARIFIER CONTROL PANEL

PR-2

SHEET 20 OF 41

Figure 5-2 - Influent pH Monitoring, Bar Screen, Grit Chamber or at Pre-Conditioning Tank Inlet

Location where a pump and flow-through cell may be feasible

Install stilling well and probe

Figure 5-3 – DO, ORP or Ammonia Monitoring, Aeration Basin

SOLAR TANKS (TYP. OF 32)

DO, ORP, NO^{3-} and/or. NH^{4+}

QA

SOLAR TANK GREENHOUSE
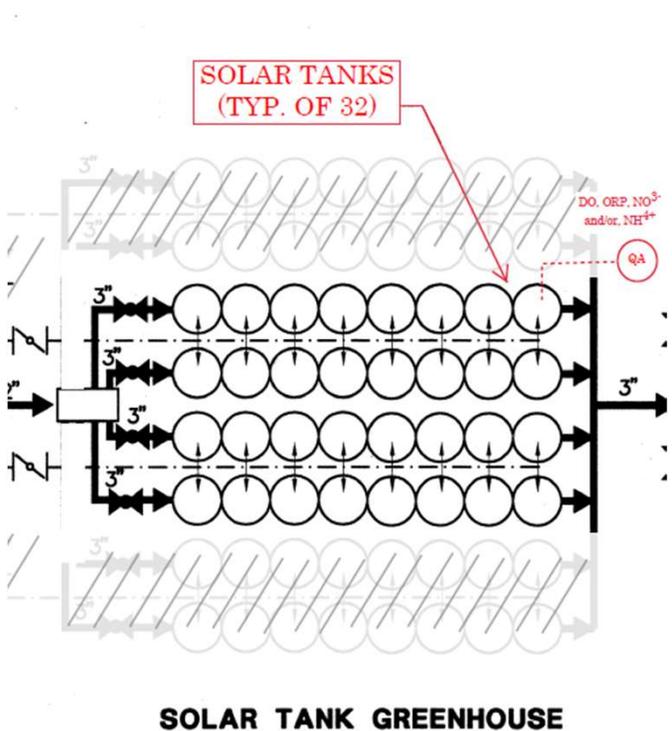
Proposed location for a Dissolved Oxygen (DO), Oxygen Reduction Potential (ORP), Ammonia, and/or Nitrate Sensor to control the blower motors and provide data

DO, ORP, Ammonia and/or Nitrate

Figure 5-4 - Effluent pH Monitoring, Effluent Well
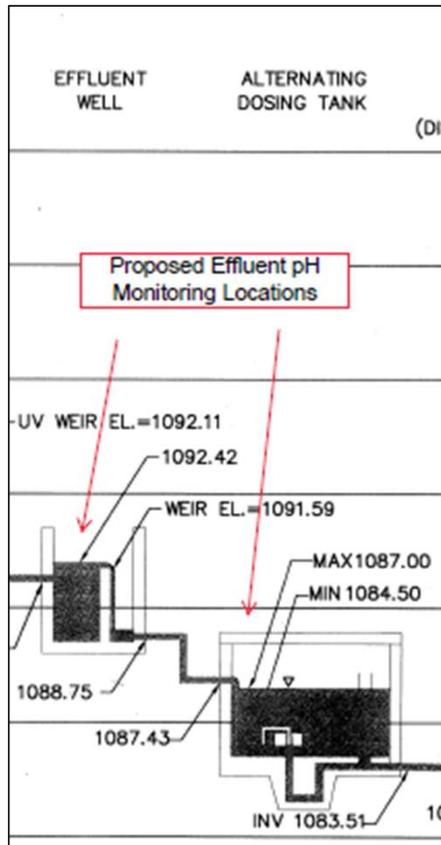
Appendix

Timer

Multiple Operating Modes and Multiple Time Ranges. DIN 48 x 48-mm Multifunctional Timer with Wide AC/DC Power Supply Range for Both High and Low Voltages.

- A wide AC/DC power supply range greatly reduces the number of timer models kept in stock.
- A wide range of applications with multiple operating modes, six modes for 11-pin models and four modes for 8-pin models.
- Ecological design with reduced current consumption.
- Easy sequence checking with instantaneous outputs for a zero set value.
- Length of 80 mm or less when panel-mounted with a P3GA-11 Socket (H3CR-A8E, 100 to 240 VAC, 100 to 125 VDC)
- PNP input models available.
- Standards: UL, CSA, NK, LR, EN 61812-1, and CE Marking.

Model Number Structure

■ Model Number Legend

Note: This model number legend includes combinations that are not available. Before ordering, please check the *List of Models* on page 2 for availability.

H3CR-A□ □ □ - □ □
    1 2 3   4 5

1. **Number of Pins**
   None: 11-pin models
   8:      8-pin models
2. **Input Type for 11-pin Models**
   None: No-voltage input (NPN type)
   P: Voltage input (PNP type)
3. **Output**
   None: Relay output (DPDT)
   S: Transistor output (NPN/PNP universal use)
   E: Relay output (SPDT) with instantaneous relay output (SPDT)
4. **Suffix**
   300:   Dual mode models (signal ON/OFF-delay and one-shot)
   301:   Double time scale (range) models (0.1 s to 600 h)
5. **Supply Voltage**
   100-240AC/100-125DC: 100 to 240 VAC/100 to 125 VDC
   24-48AC/12-48DC: 24 to 48 VAC/12 to 48 VDC
   24-48AC/DC: 24 to 48 VAC/VDC (Only for H3CR-A8E)

Ordering Information

■ List of Models

Note: 1. Specify both the model number and supply voltage when ordering.
Example: H3CR-A <u>100-240AC/100-125DC</u>
└── Supply voltage

2. The operating modes are as follows
A: ON-delay   D: Signal OFF-delay
B: Flicker OFF start   E: Interval
B2: Flicker ON start   G: Signal ON/OFF-delay
C: Signal ON/OFF-delay   J: One-shot

11-pin Models

Output	Supply voltage	Input type	Time range	Operating mode (See note 2)	Model (See note 1.)
Contact	100 to 240 VAC (50/60 Hz)/ 100 to 125 VDC	No-voltage input	0.05 s to 300 h	Six multi-modes: A, B, B2, C, D, E	H3CR-A
	24 to 48 VAC (50/60 Hz)/ 12 to 48 VDC				
	100 to 240 VAC (50/60 Hz)/ 100 to 125 VDC			Dual-modes: G, J	H3CR-A-300
	24 to 48 VAC (50/60 Hz)/ 12 to 48 VDC				
	100 to 240 VAC (50/60 Hz)/ 100 to 125 VDC	Voltage input		Six multi-modes: A, B, B2, C, D, E	H3CR-AP
	24 to 48 VAC (50/60 Hz)/ 12 to 48 VDC				
	100 to 240 VAC (50/60 Hz)/ 100 to 125 VDC	No-voltage input	0.1 s to 600 h		H3CR-A-301
	24 to 48 VAC (50/60 Hz)/ 12 to 48 VDC				
Transistor (Photocoupler)	24 to 48 VAC (50/60 Hz)/ 12 to 48 VDC		0.05 s to 300 h		H3CR-AS

8-pin Models

Output	Supply voltage	Input type	Time range	Operating mode (See note 2)	Model (See note 1.)
Contact	100 to 240 VAC (50/60 Hz)/ 100 to 125 VDC	No-input available	0.05 s to 300 h	Four multi-modes: A, B2, E, J (Power supply start)	H3CR-A8
	24 to 48 VAC (50/60 Hz)/ 12 to 48 VDC				
	100 to 240 VAC (50/60 Hz)/ 100 to 125 VDC		0.1 s to 600 h		H3CR-A8-301
	24 to 48 VAC (50/60 Hz)/ 12 to 48 VDC				
Transistor (Photocoupler)	24 to 48 VAC (50/60 Hz)/ 12 to 48 VDC		0.05 s to 300 h		H3CR-A8S
Time-limit contact and instantaneous contact	100 to 240 VAC (50/60 Hz)/ 100 to 125 VDC				H3CR-A8E
	24 to 48 VAC/VDC (50/60 Hz)				

■ Accessories (Order Separately)

Adapter, Protective Cover, Hold down Clip, Setting Ring and Panel Cover

Name/specifications		Models
Flush Mounting Adapter		Y92F-30
		Y92F-73
		Y92F-74
Protective Cover		Y92A-48B
Hold-down Clip (Sold in sets of two)	**For PF085A Socket**	Y92H-8
	For PL08 and PL11 Sockets	Y92H-7
Setting Ring A		Y92S-27
Setting Ring B and C		Y92S-28
Panel Cover	**Light gray (5Y7/1)**	Y92P-48GL
	Black (N1.5)	Y92P-48GB
	Medium gray (5Y5/1)	Y92P-48GM

Sockets

Timer		Round Sockets		
Pin	Connection	Terminal	Models	
11-pin	Front Connecting	DIN track mounting	**P2CF-11**	
		DIN track mounting (Finger-safe type)	**P2CF-11-E**	
	Back Connecting	Screw terminal	**P3GA-11**	
		Solder terminal	**PL11**	
		Wrapping terminal	**PL11-Q**	
		PCB terminal	**PLE11-0**	
8-pin	Front Connecting	DIN track mounting	**P2CF-08**	
		DIN track mounting (Finger-safe type)	**P2CF-08-E**	
		DIN track mounting	**PF085A**	
	Back Connecting	Screw terminal	**P3G-08**	
		Solder terminal	**PL08**	
		Wrapping terminal	**PL08-Q**	
		PCB terminal	**PLE08-0**	

Note: 1. The P2CF-□□-E has a finger-protection structure. Round crimp terminals cannot be used. Use forked crimp terminals.

2. The P3GA-11 and P3G-08 Socket can be used together with the Y92A-48G Terminal Cover to implement finger protection.

3. For details, refer to *Socket and DIN Track Products*.

Terminal Cover

Application	Model	Remarks
For back connecting socket	**Y92A-48G**	For P3G-08 and P3GA-11

Note: For details, refer to *Socket and DIN Track Products*.

Read and Understand This Catalog

Please read and understand this catalog before purchasing the products. Please consult your OMRON representative if you have any questions or comments.

Warranty and Limitations of Liability

WARRANTY

OMRON's exclusive warranty is that the products are free from defects in materials and workmanship for a period of one year (or other period if specified) from date of sale by OMRON.

OMRON MAKES NO WARRANTY OR REPRESENTATION, EXPRESS OR IMPLIED, REGARDING NON-INFRINGEMENT, MERCHANTABILITY, OR FITNESS FOR PARTICULAR PURPOSE OF THE PRODUCTS. ANY BUYER OR USER ACKNOWLEDGES THAT THE BUYER OR USER ALONE HAS DETERMINED THAT THE PRODUCTS WILL SUITABLY MEET THE REQUIREMENTS OF THEIR INTENDED USE. OMRON DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED.

LIMITATIONS OF LIABILITY

OMRON SHALL NOT BE RESPONSIBLE FOR SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES, LOSS OF PROFITS OR COMMERCIAL LOSS IN ANY WAY CONNECTED WITH THE PRODUCTS, WHETHER SUCH CLAIM IS BASED ON CONTRACT, WARRANTY, NEGLIGENCE, OR STRICT LIABILITY.

In no event shall the responsibility of OMRON for any act exceed the individual price of the product on which liability is asserted.

IN NO EVENT SHALL OMRON BE RESPONSIBLE FOR WARRANTY, REPAIR, OR OTHER CLAIMS REGARDING THE PRODUCTS UNLESS OMRON'S ANALYSIS CONFIRMS THAT THE PRODUCTS WERE PROPERLY HANDLED, STORED, INSTALLED, AND MAINTAINED AND NOT SUBJECT TO CONTAMINATION, ABUSE, MISUSE, OR INAPPROPRIATE MODIFICATION OR REPAIR.

Application Considerations

SUITABILITY FOR USE

OMRON shall not be responsible for conformity with any standards, codes, or regulations that apply to the combination of products in the customer's application or use of the products.

At the customer's request, OMRON will provide applicable third party certification documents identifying ratings and limitations of use that apply to the products. This information by itself is not sufficient for a complete determination of the suitability of the products in combination with the end product, machine, system, or other application or use.

The following are some examples of applications for which particular attention must be given. This is not intended to be an exhaustive list of all possible uses of the products, nor is it intended to imply that the uses listed may be suitable for the products:

- Outdoor use, uses involving potential chemical contamination or electrical interference, or conditions or uses not described in this catalog.

- Nuclear energy control systems, combustion systems, railroad systems, aviation systems, medical equipment, amusement machines, vehicles, safety equipment, and installations subject to separate industry or government regulations.

- Systems, machines, and equipment that could present a risk to life or property.

Please know and observe all prohibitions of use applicable to the products.

NEVER USE THE PRODUCTS FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON PRODUCTS ARE PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

PROGRAMMABLE PRODUCTS

OMRON shall not be responsible for the user's programming of a programmable product, or any consequence thereof.

Disclaimers

CHANGE IN SPECIFICATIONS

Product specifications and accessories may be changed at any time based on improvements and other reasons.

It is our practice to change model numbers when published ratings or features are changed, or when significant construction changes are made. However, some specifications of the products may be changed without any notice. When in doubt, special model numbers may be assigned to fix or establish key specifications for your application on your request. Please consult with your OMRON representative at any time to confirm actual specifications of purchased products.

DIMENSIONS AND WEIGHTS

Dimensions and weights are nominal and are not to be used for manufacturing purposes, even when tolerances are shown.

PERFORMANCE DATA

Performance data given in this catalog is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of OMRON's test conditions, and the users must correlate it to actual application requirements. Actual performance is subject to the OMRON Warranty and Limitations of Liability.

ERRORS AND OMISSIONS

The information in this document has been carefully checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical, or proofreading errors, or omissions.

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In the interest of product improvement, specifications are subject to change without notice.
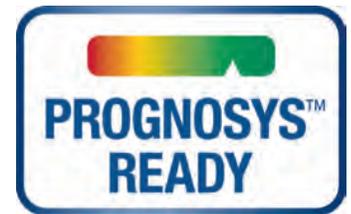
OMRON Corporation
Industrial Automation Company

http://www.ia.omron.com/

Sensors

SOLITAX®sc TURBIDITY & SUSPENDED SOLIDS SENSORS

Accurate, color-independent suspended solids and turbidity measurements.

Greater Accuracy, Less Maintenance

Hach Solitax sc sensors provide accurate, color-independent measurement of turbidity and suspended solids in drinking water, wastewater and industrial process applications. A self-cleaning device prevents biological growth and interference of gas bubbles. This system's reliable performance and full data communication capability help improve process control and reduce treatment costs associated with polymer use, digester volume, and sludge handling.

Excellent Correlation to Laboratory Analysis

Solitax sc sensors show an exceptional correlation to laboratory analysis. On-line measurement not only saves time on manual analysis, but also provides critical real-time measurements that can be used to operate the plant more efficiently.

Fully Serviceable Sensors

Conventional turbidity and suspended solids sensors are potted and are discarded when they no longer function. Solitax sc sensors are fully serviceable, which often doubles the useful life of the sensor.

Easy One-point Calibration

Factory calibrated in conformity with DIN EN ISO 7027 for long-term calibration stability. Calibration is easy with a simple correction factor procedure.

Multi-channel, Multi-parameter System

Any two Solitax sc sensors can be installed on one Hach SC200 Controller. The same controller can also accommodate any combination of parameters. All of Hach's model sc sensors are "plug and play" with no complicated wiring or set-up procedure necessary.

Be Right™

Specifications*

	For insertion in pipes		For immersion in open tanks		
Model	INSERTION inline sc	INSERTION highline sc	IMMERSION t-line sc	IMMERSION ts-line sc	IMMERSION hs-line sc
Parameter	Suspended Solids, Turbidity	Hight Range Suspended Solids, Turbidity	Turbidity	Suspended Solids, Turbidity	Hight Range Suspended Solids, Turbidity
Measuring Range Turbidity	0.001 to 4000 NTU	0.001 to 4000 NTU	0.001 to 4000 NTU	0.001 to 4000 NTU	0.001 to 4000 NTU
Measuring Range TSS-Content	0.001 mg/L to 50 g/L	0.001 mg/L to 500 g/L		0.001 mg/L to 50 g/L	0.001 mg/L to 500 g/L
Unit	Turbidity: User selectable—NTU, FNU, or TE/F Suspended Solids: User selectable—g/L, mg/L, ppm, or % solids				
Accuracy	Turbidity up to 1000 NTU; without calibration < 5% of the measured value ±0.01 NTU; with calibration < 1% of the measured value ±0.01 NTU				
Repeatability	Suspended solids content: < 3 %				
	Turbidity: < 1 %				
Response Time	1 s < T90 < 300 s (adjustable)				
Calibration Method	Turbidity: Formazin or Stablcal Standard (at 800 NTU). Suspended Solids: Sample specific, based on gravimetric TSS analysis with a correction factor procedure.				
Certifications	CE certified to EN 61326-1, EN 61326/A1, EN 61326/A2, EN 61010-1				
Flow	Max. 3 m/s (the presence of air bubbles affects the measurement)				
Operating Temperature Range	0 to 40 °C (32 to 104°F)				
Pressure Limit	Stainless steel: 6 bar or 60 m (87 psi) PVC: 1 bar or 10 m (14.5 psi) Stainless steel: 6 bar or 60 m (87 psi) PVC: 1 bar or 10 m (14.5 psi)				
Material	Optics Carrier and Sleeve: stainless steel 1.4571 or black PVC Wiper Arm: stainless steel 1.4581; Wiper Blade: silicone (standard) Optional: Viton (LZX578); Wiper Shaft: stainless steel 1.4571 Threaded cable fitting: stainless steel 1.4305 or white PVC		Optics Carrier and Sleeve: stainless steel 1.4571 or black PVC Wiper Arm: stainless steel 1.4581; Wiper Blade: silicone (standard) Optional: Viton (LZX578); Wiper Shaft: stainless steel 1.4571 Threaded cable fitting: stainless steel 1.4305 or white PVC		
Weight Sensor	Insertion stainless steel: 2.4 kg (5.29 lb.)		Immersion stainless steel: 1.38 kg (3.0 lb.) Immersion PVC: 0.52 kg (1.2 lb.)		
Cable Length	10 m (optional extension cables available)				
					Subject to change without notice

Principle of Operation

Solitax sc ts-line sensor with dual-beam optics and added backscatter detector

- Dual infrared light beams. LED light source transmits light at 45° to sensor face.
- Nephelometric photoreceptors detect light at 90° to the transmitted light beam.
- Backscatter photoreceptor (included on all models except the Solitax sc t-line) detects light at 140° to the transmitted light beam to measure suspended solids in heavily loaded sample streams.
- Self-cleaning wiper, optional.
- T-line probes measure turbidity only. TS, HS, inline, and highline sensors measure either turbidity or suspended solids.
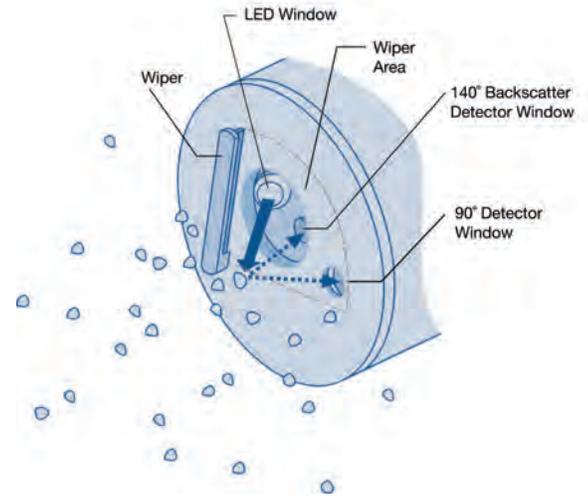
Dimensions

Hach Solitax sc sensors can be fixed to the rim of the tank for immersion applications or inserted directly through the sidewall of a pipeline for insertion applications. A variety of installation kits are available.

Solitax sc Insertion Probe
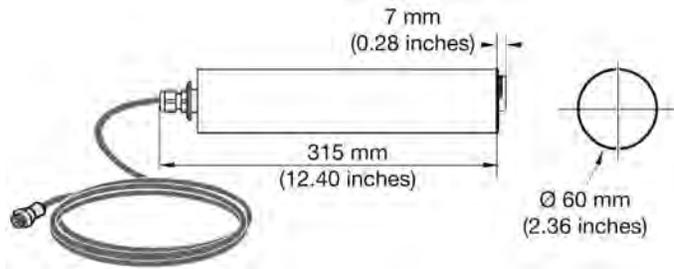
Solitax sc Immersion Probe
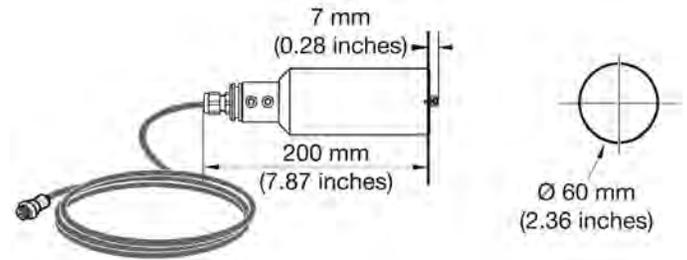
Installation / Mounting

Installation for mounting Solitax sc for immersion in open tanks. (Stainless steel pole mount kit, Prod. No. LZY714.99.53120)
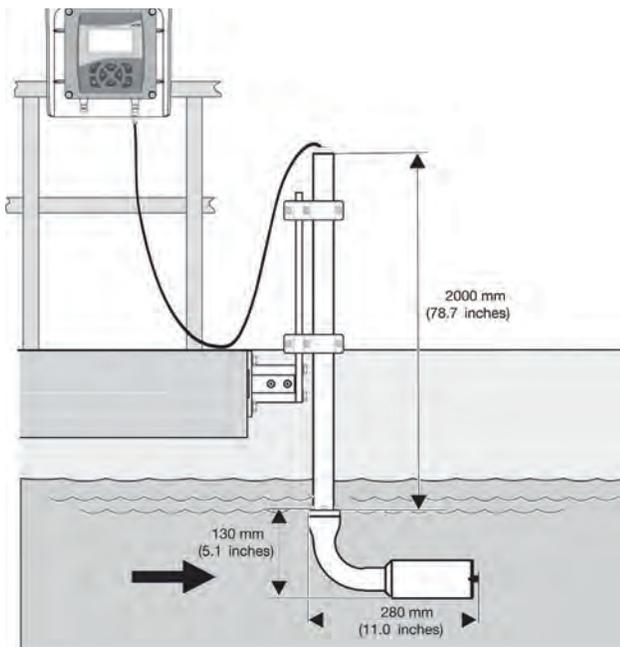
Fixture with ball valve for mounting Solitax sc models inline and highline sensors in pipes., minimum pipe size 100 mm (4-in.) (Prod. No. LZX337, max pressure 6 bar; Prod. No. 936, max. pressure 1 bar.

hach.com
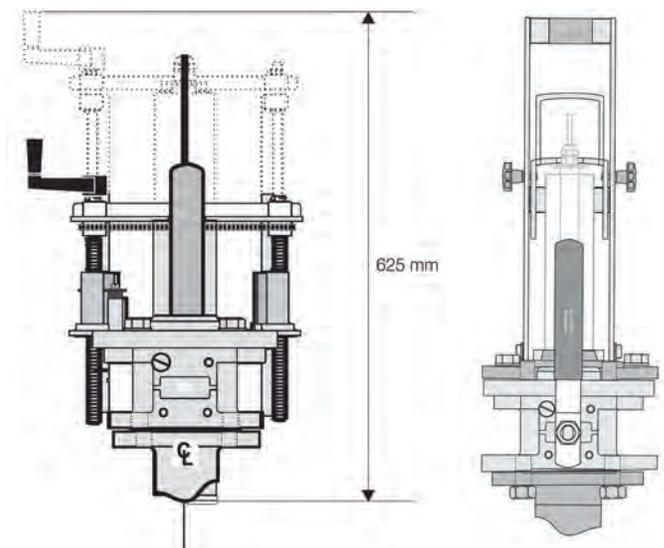
Ordering Information

Common Configurations: Solitax sc Turbidity and Suspended Solids Analyzers with SC200 controller and sensors shown

Immersion in Open Tanks Applications

2983400	Turbidity Analyzer, t-line sc, PVC, with wiper (0.001 to 4000 NTU)
2983500	Turbidity and Suspended Solids Analyzer, ts-line sc, stainless steel with wiper (0.001 to 4000 NTU, 0.001 mg/L to 50 g/L)
2983600	Turbidity and High Range Suspended Solids Analyzer, hs-line sc, stainless steel with wiper (0.001 to 4000 NTU, 0.001 mg/L to 500 g/L)

Insertion in Pipes Applications (includes insertion mounting kit)

2983700	Turbidity and Suspended Solids Analyzer, inline sc, stainless steel with wiper (0.001 to 4000 NTU, 0.001 mg/L to 50 g/L)
2983900	Turbidity and High Range Suspended Solids Analyzer, highline sc, stainless steel with wiper (0.001 to 4000 NTU, 0.001 mg/L to 500 g/L)

NOTE:
1. Power cords must be ordered separately.
2. Fixed point installation kit or handrail mount kit must be ordered separately for all immersion analyzers.

Individual Solitax sc Sensors

Immersion Sensors

LXV423.99.10000	Turbidity, t-line sc, PVC with wiper (0.001 to 4000 NTU)
LXV423.99.12000	Turbidity, t-line sc, PVC without wiper (0.001 to 4000 NTU)
LXV423.99.10100	Turbidity and Suspended Solids, ts-line sc, PVC with wiper (0.001 to 4000 NTU, 0.001 mg/L to 50 g/L)
LXV423.99.12100	Turbidity and Suspended Solids, ts-line sc, PVC without wiper (0.001 to 4000 NTU, 0.001 mg/L to 50 g/L)
LXV423.99.00100	Turbidity and Suspended Solids, ts-line sc, stainless steel with wiper (0.001 to 4000 NTU, 0.001 mg/L to 50 g/L)
LXV423.99.02100	Turbidity and Suspended Solids, ts-line sc, stainless steel without wiper (0.001 to 4000 NTU, 0.001 mg/L to 50 g/L)
LXV423.99.10200	Turbidity and Suspended Solids, hs-line sc, PVC with wiper (0.001 to 4000 NTU, 0.001 mg/L to 500 g/L)
LXV423.99.12200	Turbidity and Suspended Solids, hs-line sc, PVC without wiper (0.001 to 4000 NTU, 0.001 mg/L to 500 g/L)
LXV423.99.00200	Turbidity and Suspended Solids, hs-line sc, stainless steel with wiper (0.001 to 4000 NTU, 0.001 mg/L to 500 g/L)
LXV423.99.02200	Turbidity and Suspended Solids, hs-line sc, stainless steel without wiper (0.001 to 4000 NTU, 0.001 mg/L to 500 g/L)

Insertion Sensors

LXV424.99.00100	Turbidity and Suspended Solids, inline sc, stainless steel with wiper (0.001 to 4000 NTU, 0.001 mg/L to 50 g/L)
LXV424.99.02100	Turbidity and Suspended Solids, inline sc, stainless steel without wiper (0.001 to 4000 NTU, 0.001 mg/L to 50 g/L)
LXV424.99.00200	Turbidity and Suspended Solids, highline sc, stainless steel with wiper (0.001 to 4000 NTU, 0.001 mg/L to 500 g/L)
LXV424.99.02200	Turbidity and Suspended Solids, highline sc, stainless steel without wiper (0.001 to 4000 NTU, 0.001 mg/L to 500 g/L)

Installation Accessories

LZY714.99.53120	Stainless Steel pole mount kit for Solitax t-line, ts-line, and hs-line immersion sensors, including 10 cm base and 2 m pole with sensor adapter
5738400	Insertion Mounting Kit for inline and highline insertion sensors (ball valve safety armature and extraction system). Kit includes a 4 inch pre-coped Carbon Steel Flange. Non-coped flanges are available
AHA033NPT	Sensor Adapter, straight 1-1/2 FNPT
AHA034NPT	Sensor Adapter, elbow 1-1/2 FNPT 90°
MH236B00Z	Handrail Mounting Kit (for sensor to be used with either adapter above) includes 1.5-inch diameter by 7.5-ft long CPVC pipe and swivel/pivot/ pipe clamp assembly
LZX337	Stainless steel ball valve safety armature/ extraction fitting for in-line and hi-line probes w/o welding flange, maximum operating pressure 6 bar/87 psi
LZX936	Stainless steel ball valve armature, maximum operation pressure 1 bar/14.5 psi
LZX660	Non-coped stainless steel welding flange for insertion kit
LZX661	Non-coped carbon steel welding flange for insertion kit

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Be Right™

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Swansensor Turbiwell W/LED

Data sheet no. DenA875322XX

Nephelometric turbidimeter based on the approved alternative method to US EPA 180.1 for the automatic and continuous measurement of turbidity.
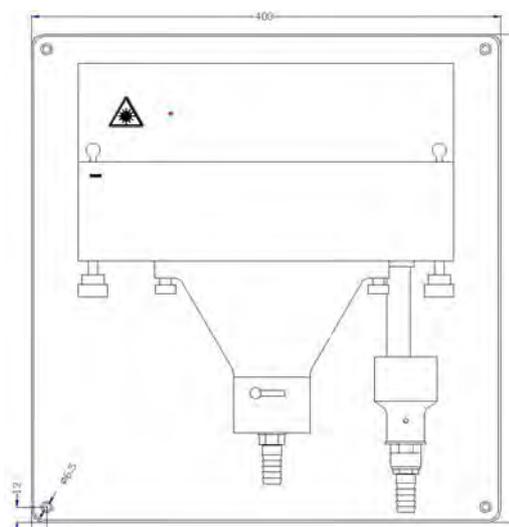
Swansensor Turbiwell W/LED

For applications in potable water, surface water treatment and effluent.
Unaffected by fouling.
Sensor assembled with fixed cable. For the use with the transmitter AMI Turbiwell.

- Non-contact turbidimeter: System optics is not in direct contact with sample, no fouling on optical surfaces.
- Two-part turbidimeter block made of PETP with drain valve.
- Heated optics to avoid condensation.
- Sensor including optoelectronics, sample chamber and turbidimeter.
- Based on the approved "Swan AMI Turbiwell" method following the regulations of the US EPA with a white LED.
- Manual or automated draining of the sample chamber.
- Easy cleaning of sample compartment.
- Factory calibrated with Formazine.

Swansensor Turbiwell W/LED

Specifications:

Turbidimeter:

Measuring range:	0.000 - 100.0 NTU, Automatic range switching
Precision:	± (0.003 NTU + 1 % of reading)

Accuracy (based on Formazine):

Range 0-40 NTU:	± (0.01 NTU + 2 % of reading)
Range > 40 NTU:	± 5 % of reading

Panel:

Dimensions:	16.5 x 15.75 x 8.6"
Material:	white PVC
Weight:	18.0 lbs

Sample conditions:

Flow rate:	approx. 5-16gal/h
Temperature:	up to 104 °F
Sampletemp.:	max. 9°F over ambient temperature
Outlet pressure:	pressure free, atmospheric drain

Sample connections:

Inlet:	¼" thread / nozzle Ø 0.39"(10mm)
Drain:	½" thread / Ø 0.62"(16 mm), tubing 0.59 x 0.78" (15 x 20 mm

Order scheme	**Swansensor Turbiwell W/LED**	**A – 8 7 . 5 3 2 .**	**2**		
			↑	↑	
Cable length……………………	5 m...		5		
	15 m...		7		
Drain valve ……………………	Manual drain valve			1	
	Automatic drain valve: "Auto-Drain" with electrical motor.......................................			2	

Accessories:

A-85.151.065   Verification kit Turbiwell W/LED Low NTU
A-85.151.075   Verification kit Turbiwell W/LED High NTU

See datasheet DenA15411X0X regarding transmitter AMI Turbiwell.

ChemScan RDOX Optical Dissolved Oxygen Probe

THE CHEMSCAN RUGGED DISSOLVED OXYGEN (RDO) RDOX PROBE USES OPTICAL TECHNOLOGY FOR MEASURING DISSOLVED OXYGEN (DO) IN DEMANDING WASTEWATER PROCESS ENVIRONMENTS, LOW-MAINTENANCE, EASY TO USE AND INTEGRATED DESIGN

The RDOX Probe lets NPDES permit holder monitor influent, effluent and treatment processes, responding quickly to oxygen and temperature changes for more accurate results

ELIMINATE MAINTENANCE
- Operates with very low drift for long periods of time
- Responds quickly and accurately to oxygen and temperature changes across the full range.
- Delivers consistent, reproducible results (<0.05 mg/L).
- Eliminates membranes and filling solutions

SIMPLE DESIGN
- Automates setup and reduces error-calibration coefficients are loaded into sensor cap.
- Flexible communications-Standard 4-20 mA, Modbus/RS485, direct or using Control Point 2.0 with local display
- Direct connection eliminates the need for a transmitter or controller, and requires only 8 to 36 VDC power

COST EFFECTIVE
- Runs aerators efficiently and mitigates risks.
- Twist lock connection allows interchangeability with all ChemScan probes
- Easily view and filter data using In-Situ telemetry systems and HydroVu™ Data Services.

ROBUST CONSTRUCTION
- Resists abrasion and photobleaching effects.
- Withstands high salinity environments-inert, non-corrosive materials used to construct probe body and sensor.
- Insensitive to interferences that plague membrane-based sensors (hydrogen sulfide, chloride, ammonium, and others).

www.ChemScan.com

Applications:
- **MUNICIPAL/INDUSTRIAL WATER AND WASTEWATER TREATMENT**

CHEMSCAN RDOX OXYGEN PROBE

SENSOR TYPE.	Optical DO probe uses Classic Sensor Cap.
RANGE, DO	0 to 60 mg/L
ACCURACY, DO	±0.1 mg/L, 0 to 20 mg/L ±2% of reading, 20 to 60 mg/L
RESOLUTION, DO	0.01 mg/L
RESPONSE TIME, CAP	T90: <45 sec. T85: <60 sec. @ 25° C
RANGE, TEMP.	0° to 50° C (32° to 122° F)
ACCURACY, TEMP.	±0.1° C typical
RESOLUTION, TEMP.	0.01° C
SALINITY, COMP.	Fixed or real-time capable
BAROMETRIC COMP.	Fixed or real-time capable
METHODS.	EPA-approved In-Situ® RDO methods 1002-8-2009, 1003-8-2009, 1004-8-2009 Standard Methods 4500-O

ENVIROLNMENTAL RATINGS

PRESSURE	150 psi from 0° to 50° C; 300 psi @ 25° C
DEPTH	210 m (689 ft) @ 25° C
OPERATING TEMP.	Probe: 0° to 50° C (32° to 122° F)
STORAGE TEMP.	Sensor cap: 1° to 60° C (33° to 140° F), in factory container Probe: -5° to 60° C (23° to 140° F)
COMPLIANCE	Heavy industrial, IEC 61000-6-2:2005
IP RATING	IP-67 with cap off; IP-68 with cap installed

CHEMICAL RATINGS

INTERFERENCES	Alcohols >5%; hydrogen peroxide > 3%; sodium hypochlorite (commercial bleach) > 3%; gaseous sulfur dioxide; gaseous chlorine. Do not use in organic solvents (e.g., acetone, chloroform, methylene chloride, etc.), which may swell the sensing element (foil matrix) and destroy it.

GENERAL RATINGS

COMMUNICATION OUTPUT	Modbus/RS485, SDI-12, 4-20 mA
POWER REQUIREMENTS	8 to 36 VDC
POWER CONSUMPTION	Maximum: 50 mA at 12 VDC
CABLE LENGTHS	Modbus and 4-20 mA: Up to 1,219 m (4,000 ft) SDI-12: Up to 61 m (200 ft)
INT. MOUNTING THREAD	1-1/4 NPT
WARRANTY	Probe: 3 years from date of shipment Cap: 2 years in typical applications

Specifications are subject to change without notice.
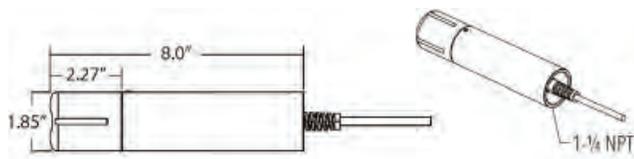
KEY ADVANTAGES

- **Long-lasting calibration**—the probe maintains calibration and operates with no drift over long-term deployments, delivering consistent, reproducible results.
- **Automatic setup**—the ChemScan RDOX Cap is pre-loaded with factory calibration coefficients, serial number, and manufacture date. ChemScan RDOX can use Classic, Fast, or ChemScan RDOX Cap. Ships with ChemScan RDOX Cap.
- **Sensor health diagnostics**—internal indicators alert you about excessive wear and remind you about regular maintenance intervals.
- **Fast response**—with patented signal processing, the probe responds quickly and maintains stability, even in dynamically changing conditions.

TECHNOLOGY

The low-maintenance ChemScan RDOX Probe measures DO and provides extremely stable, accurate results. When the probe initiates a reading, a blue LED emits blue light, which excites lumiphore molecules in the sensing element. Excited lumiphore molecules emit red light, which is detected by a photodiode. Oxygen molecules quench the excited lumiphore molecules and prevent the emission of red light—a process called "dynamic luminescence quenching." Determination of DO concentration by luminescence quenching has a linear response over a range of concentrations
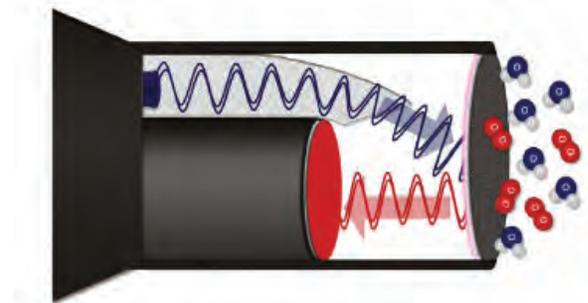
Lumiphore molecules are excited by blue light and then emit red light, which is detected by a photodiode. Optical electronics report DO concentration in mg/L.

OFFERINGS

- **Simplified integration**—use in conjunction with the ChemScan Control Point 2.0, SCADA/PLC Systems, or telemetry systems and HydroVu™ Data Services. the probe maintains calibration and operates with no drift over long-term deployments, delivering consistent, reproducible results.
- **Compliance certified**—CE, FCC Class B heavy industrial immunityand emissions certifications.
- **Twist-lock cable options**—10m or custom lengths.

www.ChemScan.com

General Purpose pH / ORP Sensor

- Enhanced performance and increased life with minimal glass cracking provided by field proven ACCU-Glass™ pH glass formulation
- New $^3/_4$ and 1" mounting threads meet a variety of application installation requirements
- Solution ground provides enhanced diagnostic capability
- Extended sensor life provided by double junction reference
- Operates in sub-zero temp down to -10°C and up to a maximum of 100°C
- Responds to changes in pH at a minimum conductivity of 0.1µS/cm when used with the low flow cell panel

Models 3900 and 3900VP are housed in a molded PPS body, making each sensor rugged and chemically resistant

The Rosemount Analytical 3900 pH sensor by Emerson Process Management is designed for general use in the following applications:

- Algin product yield maximization (food)
- Reverse osmosis membrane protection in beverage production (beverage)
- Spent acid measurement in chemical neutralization process (chemical)
- Optimizing indigo dye process (textile)
- Cooling water condensate monitoring (power)
- Refinery wastewater contaminant treatment (refinery)
- Cyanide leaching process measurement (chemical)
- Wort/water interface monitoring in breweries (beverage)
- Monitoring Reverse osmosis process for removing dissolved solids from filtered raw water (water)

ROSEMOUNT®
Analytical

EMERSON™
Process Management

FEATURES AND APPLICATIONS

Installation is easily achieved through the wide variety of mounting configurations. Both models feature 1" and 3/4" inch (MNPT) front and rear facing connections for insertion, submersion, or flow-through pH and ORP applications.

The 3900 and 3900VP are provided with a double junction reference, which protects the reference element from poisoning ions – such as ammonia, chlorine, cyanides, and sulfides – in the process. Both models are made with porous Teflon® junction positioned near the measuring electrode.

The 3900 and 3900VP are housed in a molded PPS body, making each sensor virtually indestructible and chemically resistant. Complete encapsulation eliminates leakage or high humidity problems traditionally found in other pH/ORP designs. The simplified construction, designed with user convenience in mind does not require electrolyte (KCl) replenishment or any high maintenance troubleshooting procedures.

The 3900VP is offered with a watertight sensor-to-cable connector which eliminates re-wiring and cable twisting when replacing sensors. The Variopol VP multiple pin connector is an integral part of each sensor model and uses a mating VP cable. Once the cable is installed and wired to the analyzer, sensors are easily replaced without replacing the cable and without rewiring the analyzer. Also the cable can be disconnected from the sensor before removal from the process which eliminates cable twisting.

Both models are combination sensors (pH, reference, and temperature within sensor body) and measure pH or ORP (Oxidation/Reduction Potential) of aqueous solutions in pipelines, open tanks, or ponds. Models 3900 and 3900VP are suitable for virtually all applications and are compatible with Rosemount Analytical and other manufacturers' instruments.

PHYSICAL PERFORMANCE AND SPECIFICATIONS

Measured Range: pH: AccuGlass 0-14
ORP: -1500 to +1500 mV

Percent Linearity Over pH Range:

Range	Linearity
0 - 7	97%
1 - 7	98%
4 - 7	98%
7 - 10	99%
7 - 12	97%
7 - 13	96%
7 - 14	95%

Operating Temperature: -10° to 100°C (14° to 212°F) Automatic temperature compensation -10° to 100°C (14° to 212°F)

Maximum Pressure: 790 kPa [abs] (100 psig) at 100°C (212°F)

Conductivity: Responds to changes in pH at a minimum conductivity of 0.1μS/cm when used with the low flow cell panel. The sample flow rate must be controlled to 2gph (7.6L/hr).

Materials of Construction: stainless steel, glass, Teflon®, polyphenylene sulfide (PPS), EDPM and silicone

ORP Electrode: Platinum

Process Connections:
Front facing: $^3/_4''$ and 1″ MNPT
Rear facing: 1″ MNPT

Integral Cable: 32 ft (10m) cable with integral SMART preamp; 15 ft (4.7m) cable without preamp sensor

VP8 Cable: use 24281-XX, 2.5 ft (.8m) to 100 ft (31m)

ROSEMOUNT®
Analytical

EMERSON™
Process Management

	Description	Qty	Unit Price	Subtotal
	Manufacturer: Endress + Hauser			
1	Viomax CAS51D Model No. CAS51D-1056/0 (CAS51D-AAA1A3) Photo-/Spectrometer, Photometer	1	$12,596.53	$12,596.53
2	Liquiline CM442 A digital multiparameter transmitte	1	$1,946.49	$1,946.49
			Total	$14,543.02

*Exclusive of taxes and logistic charges

	Description	Qty	Unit Price	Subtotal
	Manufacturer: Endress + Hauser			
1	ISEmax sensor CAS40D CAS40D-1009/0 (CAS40D-AA1A1A2) Ion-Sensitive, Transmitter Field	1	$6,258.31	$6,258.31
2	Liquiline CM442 A digital multiparameter transmitter	1	$1,946.49	$1,946.49
			Total	$8,204.80

*Exclusive of taxes and logistic charges

Digital ammonium and nitrate sensor ISEmax CAS40D

Ion-selective Memosens sensor for the wastewater industry

F L E X
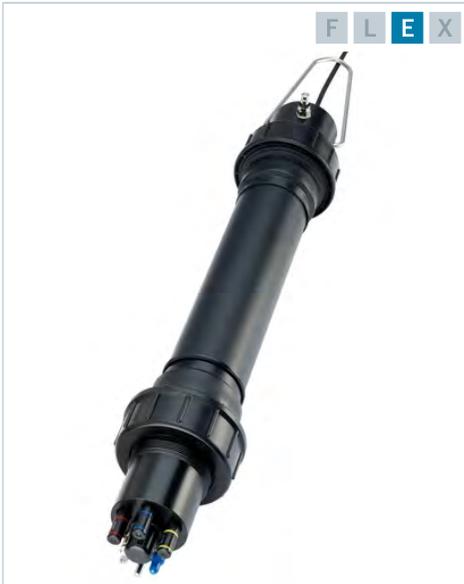
More information and current pricing:

www.us.endress.com/CAS40D

Benefits:

- Nitrate and ammonium measured directly without the need for expensive sample conditioning
- Optional potassium and/or chloride measurement compensates for cross sensitivities and ensures reliable measuring results
- Low maintenance thanks to automatic flushing unit
- Installed directly on the basin rim, no measuring container or sample-conveying pump required
- Easy handling due to storage of sensor-specific data

Specs at a glance

- **Measurement range** Ammonium: 0.1 to 1000 mg/l (NH4-N) Nitrate: 0.1 to 1000 mg/l (NO3-N) Potassium: 1 to 1000 mg/l Chloride: 1 to 1000 mg/l
- **Process temperature** 2 ℃ to 40℃ (36 to 100 ℉)
- **Process pressure** 400 mbar (160 in H2O) max. permitted overpressure

Field of application: ISEmax CAS40D is the right technology for trend measurement directly in the basin. It helps you to increase the efficiency and reduce the energy costs of your aeration processes. The sensor works without reagents saving you even further money. With its robust ion-selective membranes and excellent self-cleaning, it eases your maintenance tasks. Thanks to Memosens, CAS40D combines maximum process and data integrity with best operating comfort and simplifies predictive maintenance.

Features and specifications

Endress+Hauser

Analyser

Measuring principle

Potentiometric / ISE

Characteristic

Online measurement of nutrient parameters in
municipal wastewater treatment plants

Ion-selective electrode system for the continuous measurement of
ammonium and nitrate

Size

Diameter: 112 mm (4.41 inch)
Immersion depth: 510mm (20.08 inch)

Design

Ion-selective electrode(s) for ammonium and/or nitrate, potassium or
chloride
pH - (Reference) electrode

Ion-selective electrode for compensating cross-interference

Temperature sensor

Process temperature

2 ℃ to 40℃ (36 to 100 ℉)

Ambient temperature

-20 ℃ to 50 ℃ (-4 to 120 ℉)

Process pressure

400 mbar (160 in H2O) max. permitted overpressure

Application

Wastewater treatment plants

Analyser

Measurement range
Ammonium:
0.1 to 1000 mg/l (NH4-N)
Nitrate:
0.1 to 1000 mg/l (NO3-N)
Potassium:
1 to 1000 mg/l
Chloride:
1 to 1000 mg/l

More information **www.us.endress.com/CAS40D**

Digital nitrate or SAC sensor Viomax CAS51D

Memosens sensor for optical nitrate or SAC measurement in water, wastewater and utilities

More information and current pricing:

www.us.endress.com/CAS51D

Benefits:

- Cost-effective: Easy, chemical-free handling is safe, environmentally friendly and saves on operational expenditure.
- Extremely fast response time: Measured value processing in the sensor provides reliable real-time process information.
- Fast and easy commissioning: Sensor comes precalibrated and preconfigured ex factory.
- Enables unattended plant operation: Intelligent design and automatic air-cleaning functionality maximize availability and minimize maintenance.
- Perfect adaption to open basins: Fast and flexible sensor positioning with Flexdip CYH112 holder and CYA112 assembly system.
- Perfect adaption to pipes: Various flow cells allow easy plant integration.

Specs at a glance

- **Measurement range** 0.01 to 20 mg/l / 0.1 to 50 mg/l NO3-N 0.04 to 80 mg/l / 0.4 to 200 mg/l NO3 0.1 to 50 1/m / 0.5 to 250 1/m / 1.5 to 700 1/m SAC 0.15 to 75 mg/l / 0.75 to 370 mg/l / 2.5 to 1000 mg/l COD (254nm) 0.06 to 30 mg/l / 0.3 to 150 mg/l / 0.9 to 410 mg/l TOC (254nm)
- **Process temperature** 5 to 50℃ (41 to 120 ℉)

Field of application: Viomax CAS51D is a smart sensor that allows unattended operation in a wide range of process conditions. Just immerse it into your process and measure. The sensor's unique design is extremely robust and it is also low-maintenance thanks to its self-cleaning functionality. With Memosens digital technology, CAS51D

Endress+Hauser

combines maximum process and data integrity with simple operation. It enables lab calibration and simplifies predictive maintenance.

Features and specifications

Analyser

Measuring principle
UV photometric

Characteristic
Insitu (immersion in process), extractive with sample and flow cell
Optical photometric sensor for nitrate and SAC

Size
388 / 394 mm x 40 mm, depends on version

Design
40 mm sensor, stainless steel 316L

Process temperature
5 to 50°C (41 to 120 °F)

Ambient temperature
-20 to 60 °C (-4 to 140 °F)

Specials
G1, NPT3/4
IP68 (1m/3,3ft) water column with 1N KCl during 60d ays

Application
Drinking water, biological waste wate process, WWTP effluent
Monitoring of surface water

Measurement range
0.01 to 20 mg/l / 0.1 to 50 mg/l NO3-N
0.04 to 80 mg/l / 0.4 to 200 mg/l NO3
0.1 to 50 1/m / 0.5 to 250 1/m / 1.5 to 700 1/m SAC
0.15 to 75 mg/l / 0.75 to 370 mg/l / 2.5 to 1000 mg/l COD (254nm)
0.06 to 30 mg/l / 0.3 to 150 mg/l / 0.9 to 410 mg/l TOC (254nm)

Analyser

More information **www.us.endress.com/CAS51D**

Endress+Hauser

1-/2-channel transmitter Liquiline CM442

Expandable multiparameter field device for all industries

More information and current pricing:

www.us.endress.com/CM442

Benefits:

- **Clever simplicity:**
  One controller for all parameters and applications, intuitive user interface, automatic sensor recognition, hot plug & play with pre-calibrated Memosens sensors.
- **High flexibility:**
  Universal modules for all parameters minimize spare part stock and allow for easy extension to up to 8 channels at any time.
- **Seamless system integration:**
  Unique portfolio of communication standards suits every distributed control system (DCS).
- **Simple and safe commissioning:**
  Saving configuration on SD card enables fast set-up on duplicate installations.
- **Process control from a distance:**
  Integrated web server that allows the operator to remotely view diagnostic data, perform configurations, or access device parameters in any web browser - even via Smartphone.
- **Higher availability, lower costs:**
  Heartbeat Technology enables status-oriented maintenance and easy verification of the entire measuring point and helps to carry out optimization measures.

Specs at a glance

- **Input** 1 to 2x Memosens digital input
- **Output / communication** 2 to 8x 0/4 to 20 mA current outputs Alarmrelay, 2x relay
- **Ingres protection** IP66 / IP67

Endress+Hauser

Aeration Control and Energy Cost Reduction

Statement of the Problem

One major use of energy in a wastewater treatment facility is for operation of mechanical systems designed to introduce oxygen into the wastewater. This oxygen is necessary for biological treatment of carbonaceous matter (secondary treatment) and for oxidation of ammonia into nitrite and nitrate (nitrification). The transfer of oxygen can be accomplished by several methods. One method is the delivery of air through a network of pipes and diffusers located at the bottom of treatment basins (diffused aeration). Another method is the high speed operation of brushes, paddles and/or other mechanical arms at or near the surface of the wastewater (mechanical mixing).

A difficult control challenge is at plants that require nitrogen removal under variable flow and/or variable ammonia demand conditions. At some locations, influent ammonia delivered to the aeration basin for treatment is disproportionate to flow and highly variable throughout the day and throughout the week. (See ChemScan Application Summary # 96, Nitrification Process Control.)

Some treatment facilities do not have any capability to adjust the aeration rate in response to changes in demand. At these locations the amount of aeration supplied to the process was designed to always be in excess of the expected demand. This results in energy costs that are well in excess of the minimum required for treatment. Improper aeration can also have negative effects on sludge characteristics and on anaerobic and facultative processes such as denitrification and phosphorous removal. (See ChemScan Application Summaries #59, Denitrification Process Control and #94, Biological Nutrient Removal.) If improved treatment is required or if peak treatment demand at times exceeds the original design capacity, these plants may experience poor process performance during certain periods, poor energy performance during other periods and composite performance approaching or exceeding permit requirements.

Aeration control can be divided into two broad subjects: measurement of process variables to provide information for control adjustments and implementation of the aeration control adjustments.

Traditional Measurement Strategies

Feed Forward Control
If the objective is to adjust the aeration rate to match the requirements of the treatment process, some effort to measure or predict aeration demand may appear to be a reasonable approach. Such measurements may include flow rate, influent oxygen demand (ORP) and/or influent ammonia. These can all be classified as feed-forward control strategies. These strategies may not however, account for the many bio-chemical variables actually interacting within the process and therefore may not provide a satisfactory control signal for aeration rate adjustments.

Feed Back Control
Measurement of a process variable at or after the aeration adjustment location is a better approach. The measurement strategy can be based on regular grab samples or on automatic analysis. If grab samples are used, the frequency of analysis required for good control adjustment may be very labor intensive, especially if the measured parameters require physical or chemical analysis (such as alkalinity, COD or ammonia). If so, there is a temptation to reduce sample frequency and thus reduce the opportunities for process

optimization and energy savings.

Feed back control strategies can also be based on automatic or continuous measurement of certain process parameters that tend to vary as aeration rates are altered. The most popular of these parameters is Dissolved Oxygen. Many operators believe that the objective of the treatment process is the creation of surplus dissolved oxygen in the effluent from the aeration basin. Actually, maintaining surplus oxygen in the effluent at an arbitrarily high set point is merely a convenient way to assure that the wastewater has been fully nitrified (all ammonia has been converted to oxidized nitrogen), which can occur only after a substantial reduction in carbonaceous demand has occurred. (See Figure 1) But this is at the expense of delivering more oxygen than is actually demanded by the process. The difference between the oxygen required too achieve process objectives and the oxygen delivered to meet a "target" set point represents a pool of energy savings that can be captured by using the appropriate measurements within the process. (ORP and alkalinity are two other measurements sometimes mentioned for control, but these parameters are indirect measurements at best and are also affected by chemistries and process conditions that are unrelated to those that would require aeration rate adjustments.)

If the objective of the process is nitrification, the most direct measurement strategy to maintain control at minimum energy cost is the measurement of ammonia in the process, certainly at the end of the aeration basin or in the aeration effluent but also at additional upstream sample points. A simple feed back loop can link changes in the aeration rate directly to changes in ammonia concentration. More aeration is provided when ammonia is high, less when little or no ammonia is present.

Profile Control

The most effective approach to achieve both process control and energy management objectives would be to monitor multiple points in the aeration basin, so that aeration rates can be adjusted at the earliest opportunity. This is especially true if aeration zones within the process can be independently controlled. Analysis of ammonia at multiple sample points across the process is called an "ammonia profile".

Plants that have total nitrogen limits may also consider detection of additional

parameters at strategic points within the process. Plants that perform both nitrification and denitrification should consider analysis of nitrite and nitrate in addition to ammonia. Analysis of nitrite is an early indication of process instability and analysis of nitrate shows the end result of nitrification (See ChemScan Application Summary #96, Nitrification Process Control and #59, Denitrification Process Control.) Detection of nitrite, nitrate and ammonia at strategic sample points across the process is called a "nitrogen profile". The use of a nitrogen profile can help assure compliance with nitrogen removal requirements at a minimum cost for aeration, recirculation pumping and chemical addition. (Plants that perform chlorination may also benefit from analysis of a nitrogen profile, with possible savings from allowing controlled ammonia bleed for chloramine formation and additional savings from minimizing nitrite delivery to the chlorination process. (See ChemScan Application Summary #82, Wastewater Chloramination Process Control and #99, Chlorination Control.)

If phosphate is added to the profile, it is called a "nutrient profile".

ChemScan Measurement Capability

ChemScan can provide systems for feed back control using on-line ammonia analysis. If the sample point is after the secondary clarifier, no filtration is required prior to analysis. If the sample point is in the aeration basin or prior to secondary settling, sample filtration will be required using either a cyclic filter (low volume, self purging, short distance) or a cross flow filter (high sample flush volume, long sample distances).

ChemScan can also provide central analysis systems capable of providing ammonia profile, nitrogen profile or nutrient profile measurements at multiple sample points across the process. A few (no more than 3) nearby sample points can use a central ChemScan analyzer with cyclic filters, while applications with several (up to 8) sample points typically use a central analyzer, cross flow filter and sample sequence controller in conjunction with either a central sample pump or individual sample pumps to obtain process profile measurements.

Implementation

Implementation of aeration control strategies will depend on the type of aeration systems

in use at the plant and also on the capabilities these systems offer for control. Most control for mechanical aerators and blowers will involve the use of variable frequency drives. A variable frequency drive adjusts the speed of electric motors by modulating the power being delivered. Motor speed can thereby be matched to the amount of work demanded. Systems with variable frequency control can provide "soft start", thus avoiding high torque, current surges and stress on the motor systems.

Control of diffused aeration systems will depend on blower type and strategy for coordination of multiple blowers. Blower types include constant speed centrifugal blowers, usually controlled by modulating air inlet valves or inlet guide vanes. Positive displacement (rotary lobe) blowers are controlled using a VFD to modulate the output.

Multiple blowers are coordinated by providing either parallel control (which simultaneously adjusts the output of all blowers following addition or deletion) or cascaded control (which adjusts the output of individual blowers to a minimum or maximum output before adding or deleting the next blower needed to satisfy the overall aeration demand).

Aeration control implementation often requires custom software based on the specific processes, control strategy, aeration systems and safety factors that apply to a specific treatment facility.

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ChemScan, Inc.
2325 Parklawn Dr., Suite I,
Waukesha, Wisconsin, USA 53186
Phone: 262-717-9500
Toll Free: 800-665-7133

Site Search

SCADA System

MicroLogix 1400

Small Programmable Logic Controller

Features and Benefits

- Expand your application capabilities with up to 7 expansion I/O modules for a maximum of 256 discrete I/O

- Up to 6 embedded 100 kHz highspeed counters (on controllers with dc inputs)

- 2 Serial ports with DF1/ DH485/ Modbus RTU/DNP3/ASCII protocol support

- Ethernet port provides you with EtherNet/IP, DNP3 over IP and Modbus TCP/IP protocol support as well as web server and email capabilities

- Built-in LCD with backlight allows you to view controller and I/O status, and provides a simple interface for messages, bit / integer monitoring and manipulation

Product Description

The Allen-Bradley® MicroLogix™ 1400 from Rockwell Automation complements the existing MicroLogix family of small programmable logic controllers. MicroLogix 1400 combines the features you demand from MicroLogix 1100, such as EtherNet/IP, online editing, and a built-in LCD, plus provides you with enhanced features, such as: higher I/O count, faster High Speed Counter/PTO and enhanced network capabilities

Take advantage of the built-in LCD with back lighting to set the Ethernet network configuration, display floating point values on a user configurable display, display OEM logos at startup and read or write any binary, integer and long file elements in the data table.

Three embedded communication ports provide you with excellent communications capabilities. MicroLogix 1400 offers an isolated RS232C/ RS485 combination port; a non-isolated RS232C port; and an RJ-45 port for 10/100 Mbps EtherNet/IP peer-to-peer messaging, DNP3 over IP and Modbus TCP/IP protocol.

Similar to the rest of the MicroLogix family, MicroLogix 1400 is programmed with RSLogix 500 programming software (Version 8.1 and above) as well as RSLogix Micro programming software.

LISTEN.
THINK.
SOLVE.®

Product Specifications

MicroLogix	1766-L32BWA	1766-L32AWA	1766-L32BXB	1766-L32BWAA	1766-L32AWAA	1766-L32BXBA
Input Power	120/240 V AC		24V DC	120/240 V AC		24V DC
Memory	non-volatile battery backed RAM					
User Program / User Data Space	10K / 10K configurable					
Data Logging / Recipe Storage	128 K (without Recipe) / up to 64 K (after subtracting Data Logging)					
Battery Back-up	Yes					
Back-up Memory Module	Yes					
Digital Inputs	(12) Fast 24VDC (8) Normal 24VDC	(20) 120VAC	(12) Fast 24VDC (8) Normal 24VDC	(12) Fast 24VDC (8) Normal 24VDC	(20) 120VAC	(12) Fast 24VDC (8) Normal 24VDC
Digital Outputs	(12) Relay	(12) Relay	(6) Relay (3) Fast DC (3) Normal DC	(12) Relay	(12) Relay	(6) Relay (3) Fast DC (3) Normal DC
Analog Inputs / Outputs	None			(4) Voltage Inputs / (2) Voltage Outputs		
Serial Ports	(1) RS232C/RS485* , (1) RS232C**					
Serial Protocols	DF1 Full Duplex, DF1 Half Duplex Master/Slave, DF1 Radio Modem, DH-485, Modbus RTU Master/Slave, ASCII, DNP 3 Slave					
Ethernet Ports	(1) 10/100 EtherNet/IP port					
Ethernet Protocols	EtherNet/IP messaging, DNP3 over IP and Modbus TCP/IP					
Trim Potentiometers	2 Digital					
High-Speed Inputs	Up to 6 channels @ 100 kHz	N/A	Up to 6 channels @ 100 kHz	Up to 6 channels @ 100 kHz	N/A	Up to 6 channels @ 100 kHz
Real Time Clock	Yes, embedded					
PID	Yes (limited by loop and stack memory)					
PWM /PTO	N/A		3 channel PTO (100kHz)\PWM (40kHz)	N/A		3 channel PTO (100kHz)\PWM (40kHz)
Embedded LCD	Yes					
Floating Point Math	Yes					
Online Editing	Yes					
Operating Temperature	-20°C...+60°C					
Storage Temperature	-40°C (or -30°C)...+85°C					

* Isolated. RS232/RS485 combo port. Same as MicroLogix 1100 Comm 0

** Non-isolated RS232. standard D-sub connector.

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www.rockwellautomation.com

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Ignition 8.1
by inductive automation

Built For Everyone

The all new Long-Term Support (LTS) release introduces powerful new features to the Ignition Platform to help you develop and use projects more effectively.

"Ignition 8.1 is a milestone for Inductive Automation and for Ignition. It represents our full vision of what The New SCADA could be, and is the platform that all of our customers will want to leverage for their next generation solutions."

– Steve Hechtman
CEO & Founder, Inductive Automation

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Ignition
by inductive automation

9-9-2020

For the Plant Floor

Ignition 8.1 adds amazing features to Ignition Perspective that help you see and control your plant-floor processes more effectively than ever before.
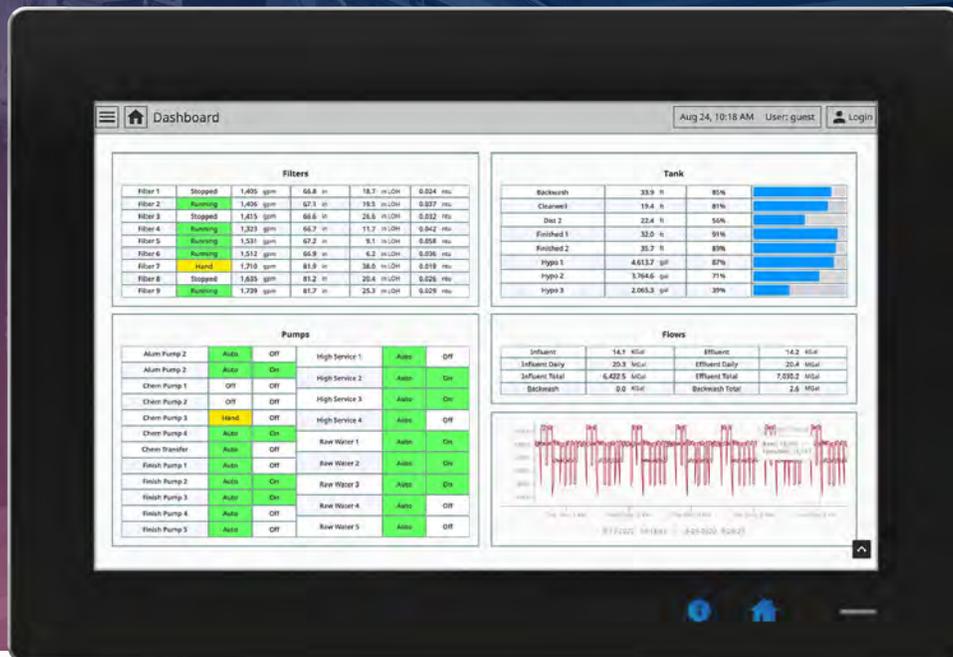
A New Perspective for the Plant Floor

With Perspective, you can create beautiful, mobile-responsive industrial applications that run natively on any mobile device and web browser. Now, with the new Perspective Workstation, you can instantly web-deploy native applications to any HMI, desktop, workstation, and multi-monitor configuration without the need for a third-party web browser.

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Run in Full-Screen Kiosk Mode

Eliminate any distractions from the underlying OS with Perspective Workstation's Kiosk mode.

Screens courtesy of Corso Systems

Control the Plant Floor from Your Phone

Put the full control of your plant floor in the palm of your hand with the Perspective App for iOS & Android.

Design for Multiple Screen Sizes at the Same Time

Save development time by designing a single Perspective application that displays beautifully on screens of any size.

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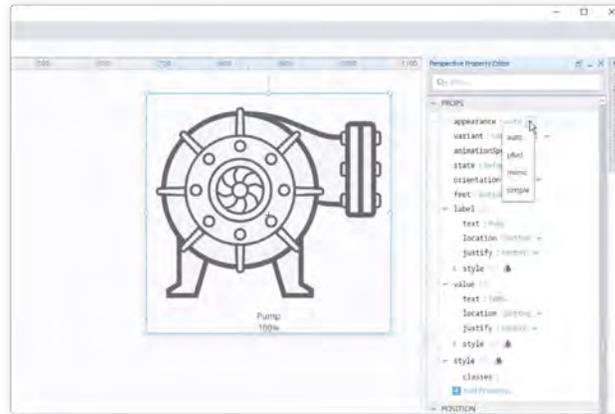
Powerful New Dynamic and Data-Driven Symbols

In 8.1, we're adding powerful dynamic symbols to the Perspective Module called Perspective Symbols. These symbols all have dynamic data models, so binding them to process values is a simple matter of drag-and-drop. They also have built-in animations so they will automatically change based on your data. With Perspective Symbols, creating beautiful HMIs is quicker and easier than ever.
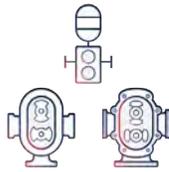
Three Distinct Styles

Each Perspective Symbol comes with three different styles: Traditional P&ID, the realistic Mimic, and the optimized Simple style.

Customize Your Symbols

Visual options such as supporting text, animation, and device orientation can be defined to fit your project.
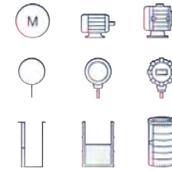
Get All the Basics & More

The initial release comes with the 2-way valve, motor, pump, vessel, and sensor, and many more symbols are coming soon.

"We were able to build a fresh, responsive display that would look amazing on any device, and that could scale massively."

– Sam Burns
Control Systems Engineer, ESM Australia

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Ignition
by inductive automation

9-9-2020

For Developers

With new super-tools like the Power Chart, refinements to the Ignition Designer, and support of Docker Hub deployments, Ignition 8.1 is making development faster and easier than ever before.
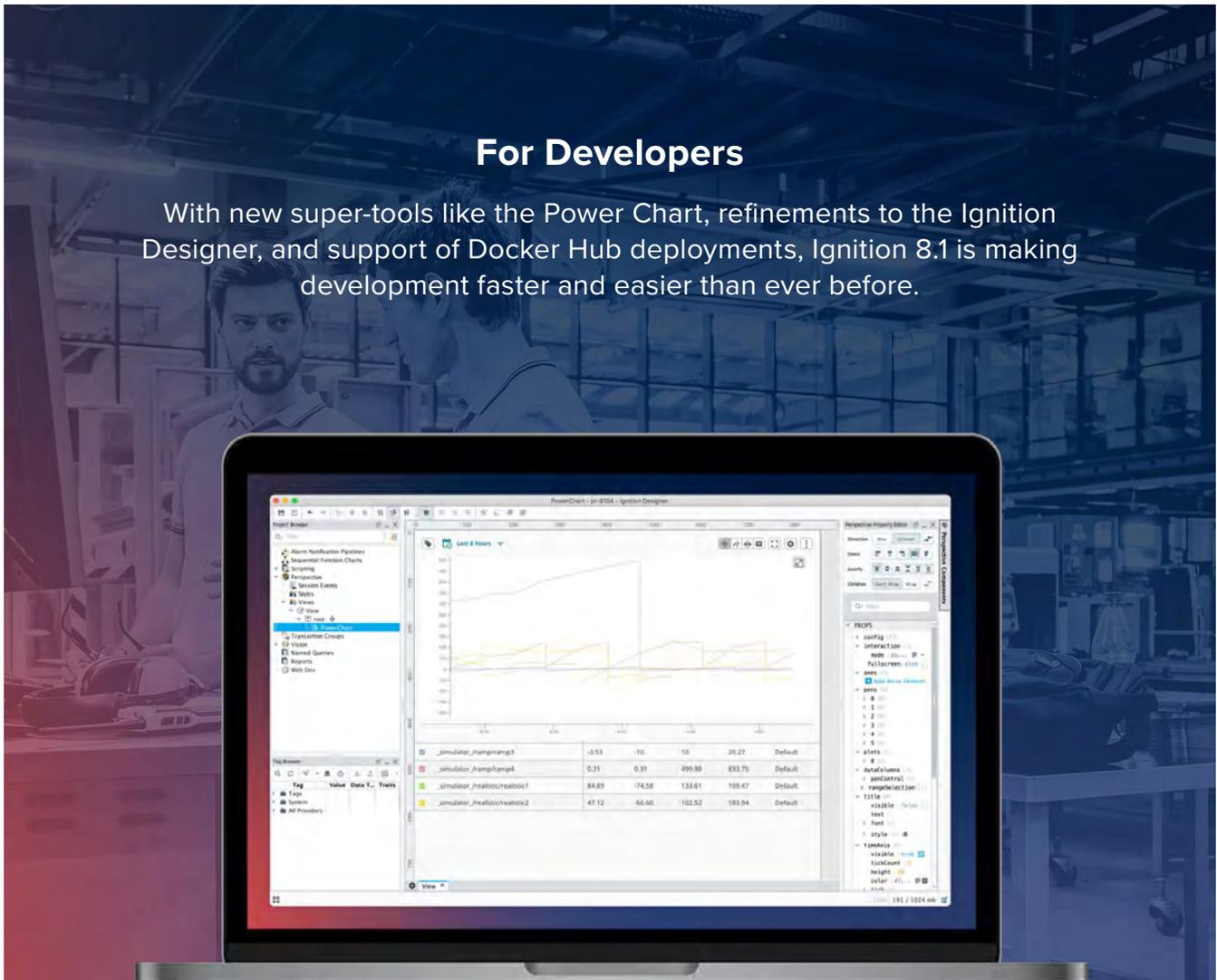
Add Powerful Ad Hoc Charts to Your Projects Instantly

The Power Chart component for Perspective allows you to quickly and easily create runtime-configurable time series charts from Tag Historian data. Now you can easily generate "ad hoc" charts within a Perspective session. Power Chart is also mobile-optimized so it adapts itself automatically for small screens.

Tag Browser Built Right In

You can easily access and analyze historical tag data right from the session window, no additional development necessary.

Data-Driven Table

Easily view dynamic chart data in a table format for quick analysis, all within the session.
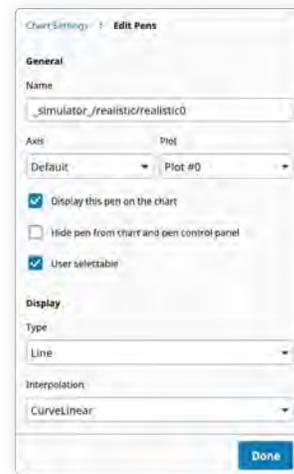
In-Session Chart Customization

You can easily and quickly customize charts by adjusting axes, chart pen parameters, and the chart's timeframe.

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9-9-2020

Develop Larger Systems Faster with Docker

Users who currently use Docker Hub will enjoy the ability to quickly develop on the Ignition platform. Quickly spin up multiple instances of Ignition and develop right away without the need for installation. You can also have multiple instances interact with each other to develop a multi-gateway architecture without the need to run multiple servers or be at multiple locations.
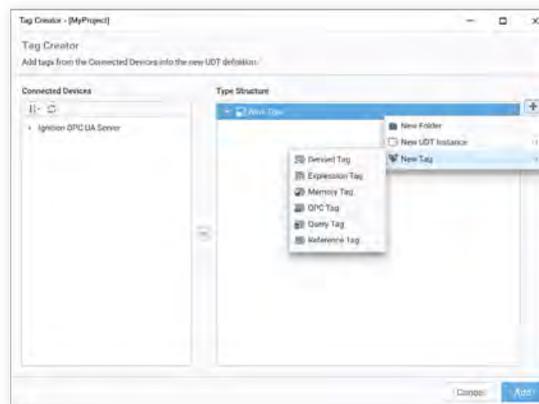
Browsing is a Breeze

In 8.1, we've refreshed the tag browser to make adding new tags to your project even easier and quicker than before. Tags are also easier to organize with new custom icons that identify tag types.

For New Users

Ignition 8.1 is packed with new features that make it easier than ever for new users to create powerful and dynamic applications from scratch.
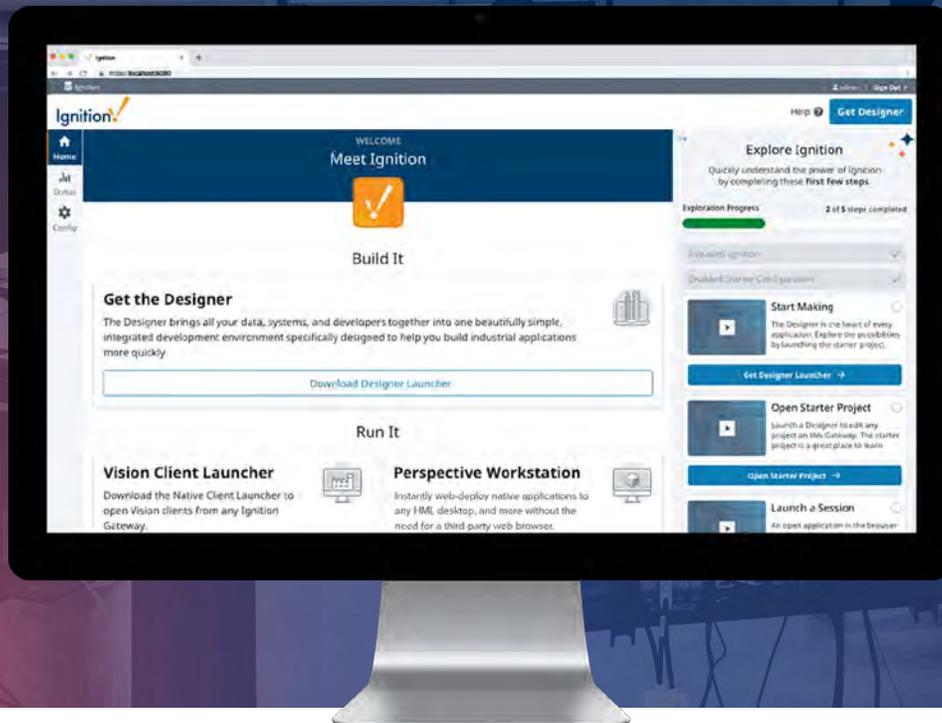
Hit the Ground Running with Quick Start

To help Ignition newcomers get up and running fast, we are introducing a feature called Ignition Quick Start. The Quick Start option provides simple tutorials and automatic configurations to set up things like security, connections to external devices, and databases faster than ever.

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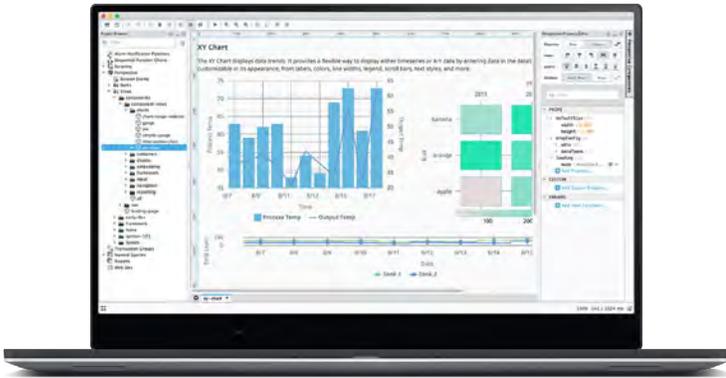
Learn by Deconstructing

Quick Start comes with a pre-configured sample project that includes core Ignition features for you to use, break apart, add to, and more to help you better understand and visualize Ignition.
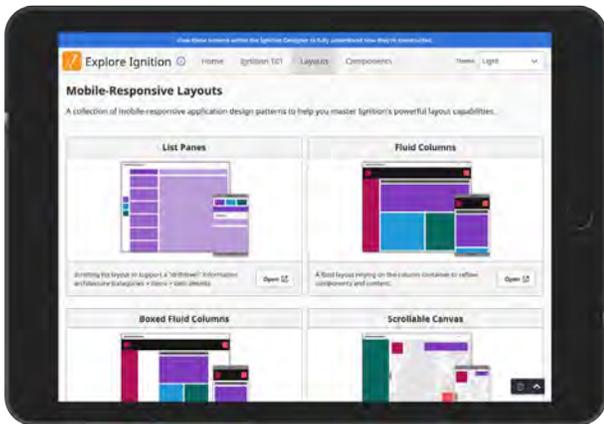
Explore Advanced Features

Learn about concepts like screen layout, components, and Python scripting.
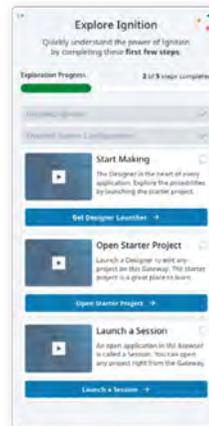
Follow Tutorials in the Gateway

Save development time by designing a single Perspective application that displays beautifully on screens of any size.
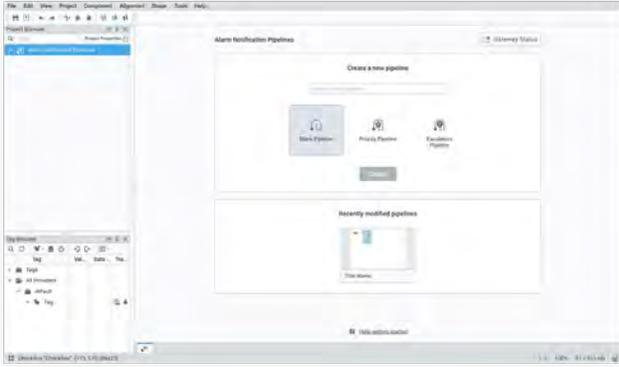
Fast-Track Your Ignition Project Work

Developing projects is now even faster with the many shortcuts we've added across the Designer in Ignition 8.1. Instead of starting with a blank workspace when creating a new project resource, you'll now have access to clickable shortcuts for things like new Perspective resources, alarm pipelines, transaction groups, and more. Jump right in and start developing your project quickly!

Learn Ignition for Free at Your Own Pace

More videos are being added to Inductive University for 8.1, so anyone can learn how to use the newest version of Ignition on their own time. Inductive University is the industry's leading online-learning website for automation software. With more than 600 educational videos, you can learn how to use Ignition on-demand, all totally free!

"Using Ignition we were able to build a flexible, well-tested, highly resilient SCADA platform...meeting both the business requirements and IT requirements in terms of availability, security, and integrations..."

– Li Lu
IT Project Manager, Dublin Airport

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For Enterprise

Ignition 8 introduced big updates for developing large-scale systems, including easy project management, and collaborative concurrent development. Ignition 8.1 builds on that with more great features to secure and expand large systems.
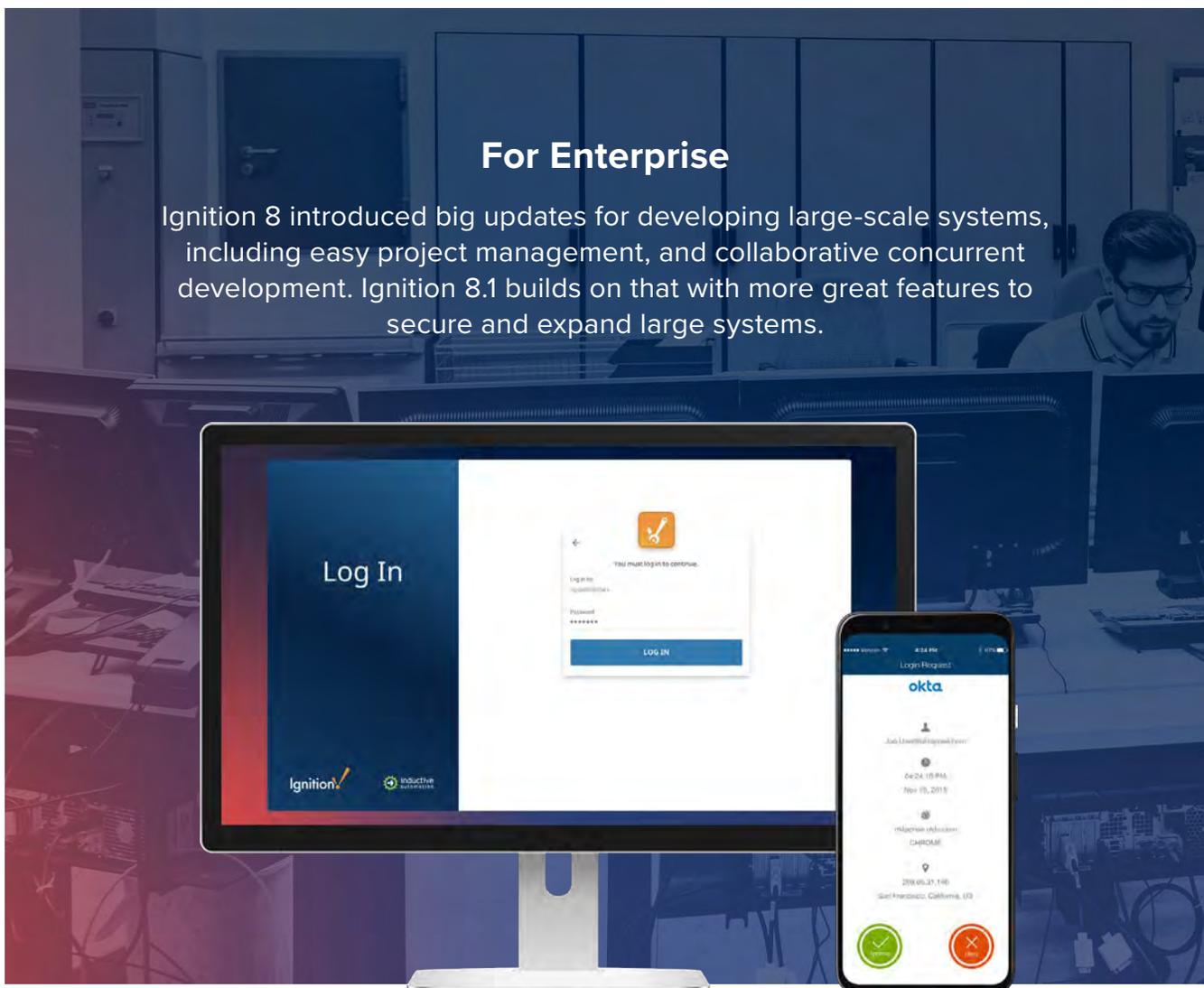

Add SSO and MFA Security to all Your Ignition Projects

Ignition 8.0 introduced support for federated identity with the Perspective Module. Now with Ignition 8.1, you can also take advantage of federated identity support for the Ignition Gateway, Designer, and the Vision Module, to add multi-factor (MFA) authentication and single sign-on (SSO) to all your Ignition projects across your enterprise.
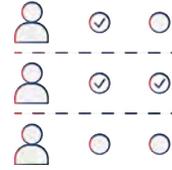
Integrate with Corporate Network Security

Ignition integrates with corporate network security using Microsoft Active Directory™.
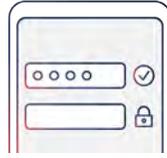
Use Trusted Identity Management

Ignition integrates with trusted federated identity technologies such as SAML and OpenID Connect.

Control User Access

Easily control access to system areas for different users with the click of a button.


Built for Enterprise-Wide Systems of all Sizes

Ignition 8 is built to scale for any size implementation within your enterprise organization. With the ability to share project-inherited resources across multiple projects, a robust tag system that can handle huge amounts of data, and the ability to simultaneously launch hundreds of concurrent clients with ease, Ignition 8 was designed with enterprise deployment in mind.

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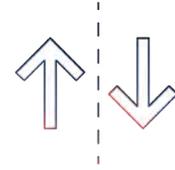www.inductiveautomation.com

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Focus on Performance

Upcoming improvements for 8.1 will focus on making its existing features even faster and more stable.
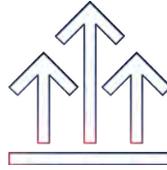
Regularly Updated

Inductive Automation will release regular updates for Ignition 8.1 for the next five years so you can always stay up-to-date.

Backward Compatibility

Ignition 8.1 is backwards-compatible, ensuring that your past projects will update safely from previous module versions.

Add Peace of Mind

There is no better way to protect your investment and future-proof your system than by adding a support contract to your Ignition purchase. That's because each support contract comes with Upgrade Protection, which includes unlimited free upgrades of purchased Ignition modules for the life of your contract, as well as access to Inductive Automation's industry-leading technical support team, so you can quickly get expert answers to your questions. Choose from three different support levels in our updated TotalCare program to fit your specific needs.

"By using Ignition we were able to develop a project that is reusable, tweakable, and we could implement feature requests rapidly...rolling out our customer's needs quicker."

—Raymond Stanford
  Senior Engineer, Steritec Automation

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Ignition 8.1 has everything you need to build reliable, reusable, and powerful projects for any industry at any size.

Unlimited Licensing Model

Add unlimited clients, screens, tags, connections & devices.

Server-Centric Web-Deployment

Easily deploy at one or more sites or in the cloud.

Modular Configurability

Use integrated modules to build the exact industrial application you need.

Cross-Platform Compatibility

Ignition works with any major operating system, even iOS and Android.

Run Web-Clients on Desktop or Mobile

Launch runtime clients in any web browser with no plugin required.

Based on Open Technology Standards

Built on HTML5, SQL, Python, MQTT & OPC UA.

Instant Installs and Updates

Install on a server in just 3 minutes, push updates to clients everywhere, instantly.

One Universal Platform

Build SCADA, MES, IIoT, alarming, reporting applications and more.

Mission-Critical

Add fault tolerance for mission-critical systems by adding redundant servers.

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by inductive automation

Ignition 8.1

To discover what Ignition can do for your company, visit:

inductiveautomation.com

Some of the companies that depend on Ignition:

Coca-Cola Johnson & Johnson FCA FIAT CHRYSLER AUTOMOBILES

NOV Morgan Stanley

Platform Specs and Requirements

Supported Operating Systems

Windows Server 2016/2019

Windows 10

macOS (10.14+)

Linux (Support for popular distributions, tested with Ubuntu 18.04)

Supported Databases

Microsoft® SQL Server

Oracle

MySQL

MariaDB

PostgreSQL

Any database with a JDBC driver

Requirements

Dual-core processor

4 GB RAM

10 GB free HD space

(Requirements vary by usage.)

To learn more about Ignition 8.1, please contact an account representative at: **800.266.7798**

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VTScadaLIGHT
Software for Monitoring & Control

A free version of our award winning SCADA software.
Perfect for small industrial and personal applications with up to 50 I/O.

⬇ Get VTScadaLight

VTScadaLIGHT provides powerful monitoring and control capabilities for your automation projects. Pros and hobbyists alike will love its built-in features and easy learning curve. Minimal PC requirements make it perfect for desktops or Panel PCs connected to small systems like micro breweries or for home automation.

VTScadaLIGHT is a Development and Runtime license with a Thin Client. Individuals, businesses, and non-profits can install it on up to 10 PCs. When you need more than 50 I/O, we make it easy.*

Watch the Fast Start Tutorial

Then download the basic and advanced course materials to build your skills.

Basic Operations and Configuration Course
(Download Course)

VTScada Quick Start Tutorial - Version...

▶

Introductory Video Series (More Video Tutorials)

Advanced Configuration and Scripting Course
(Download Course)

Sample Apps   Tech Support

Major Features

Below are a small sample of the over 1000 product features included in VTScadaLIGHT.

One Simple Install Includes the Following:
- A Human-Machine Interface built for Operators.
- A Built-in Historian with click-to-trend.
- Alarm Management and Statistics Reporting.
- An Intuitive Application Development Environment.
- Security including support for users and roles.
- System backup and redundancy capability. *
- Version Control with Change History.
- Workstation/Server Health Monitoring.
- Database connectivity such as OPC, ODBC Historian, SQL Queries, and SOAP.

More VTScada Features

Included Drivers for Most Common Hardware:
- Direct Drivers to Most PLC's and RTU's.
- Generic Modbus, DNP 3, and OPC Drivers.
- JSON Driver for IOT and IIOT.
- Edit Tags Using Built-in Tools or Microsoft Excel.

Driver List

Mobile Access Using Any HTML5 Browser:
- Built-in Application Server, with SSL support.
- Manage Alarms and View Trends in your Browser.
- See Applications in Either Full Resolution or as Mobile-Data-Saving Tag Status Lists.
- Includes One Thin Client Connection. *

More on Thin Clients

Runs on a Typical Desktop, Laptop, or Panel PC:
- Runs on Windows Vista and up.
- Historian Data Format Sips Hard Drive Space.

- Run Multiple Applications Simultaneously (50 tags total).
- Support for Multiple Monitors and Varying Resolutions.

Hardware Requirements

The Idea Studio – Build Applications with Ease:
- Drag-and-drop elements simplify page design.
- Prebuilt alarm and reporting pages included.
- Linking tags to page elements couldn't be simpler.
- Match and align elements with ease using familiar tools.
- Edit and Develop running applications without interruption.
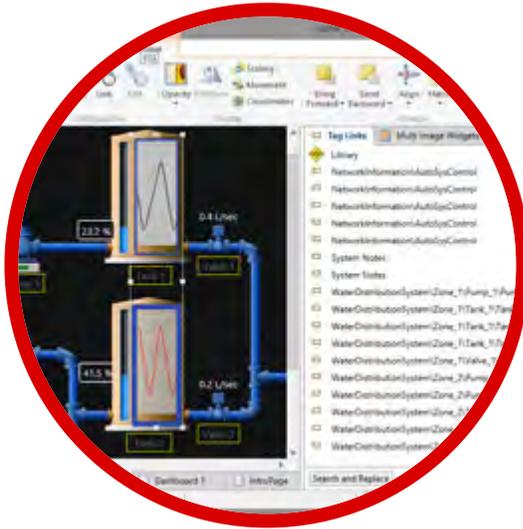
More on the Idea Studio

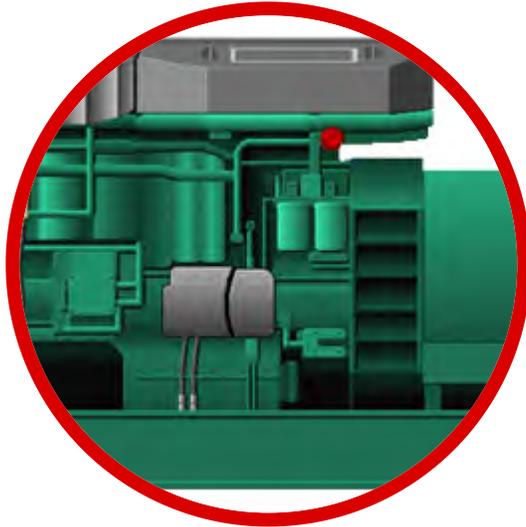## Applications Perfect for VTScadaLight

Micro Breweries & Distilleries

Environmental Monitoring

Tank Monitoring & Control

Generator Monitoring & Control

Components Not Available in the 50 Tag License

The LIGHT version of VTScada has the following features suppressed:

Alarm notifications and acknowledgment via email, SMS, and text-to-speech phone call are not available. (Alarms can be acknowledged using the thin client connection.)

More on Alarm Notification

Limit of 50 I/O – We have customers with VTScada applications running hundreds of thousands of I/O and have tested applications up to 2.5 million tags. Scroll down to learn more about upgrading.

View VTScada Pricing

* Note:

- Unlike standard VTScada, VTScadaLIGHT requires a VPN for mobile access outside your network.
- VTScadaLIGHT applications cannot synchronize with standard VTScada licenses.
- If configuring an application with multiple redundant VTScadaLIGHT licenses, the application will only support one Thin Client connection.
- OEMs or Integrators who need additional small application license packs can contact us for pricing.

Looking to Upgrade?

– Upgrading is easy –

- **Looking for the newest version?** Just download the latest version of VTScada and install it in your current VTScada directory. That's it, you can now load any of your applications using the latest version of the software.
- **Ten free licenses to get you started.** When you use up your ten free VTScadaLIGHT installs, just contact us and we will get you fair pricing for additional 50 I/O licenses. Easy for OEMs or Kickstarters.

🏷 VTScada Pricing   ⬇ Get VTScadaLight

Sales & Enquiries
1 (800) 463-2783

Technical Support
1 (855) 887-2232 (North America)
+44 (0) 1224 258910 (UK)
Email Support
ScreenConnect

Stay Connected
LinkedIn
Facebook
Twitter
YouTube
Instagram
News

Autodialers

SENSAPHONE®

REMOTE MONITORING SOLUTIONS

Sensaphone Express II

Phone Notification with Future Expansion

ASSURANCE

COUNTLESS INDUSTRIES DEPEND ON SENSAPHONE FOR THE MOST COMPREHENSIVE REMOTE MONITORING SOLUTIONS AVAILABLE. WHEN YOU NEED TO BE ABSOLUTELY SURE A REMOTE SITE IS STABLE, SECURE AND MONITORED AROUND THE CLOCK, THERE'S NO SUBSTITUTE FOR CERTAINTY.

Easy to use – everyday

The Sensaphone Express II is so easy to use just about anyone can figure it out. If not, we offer free tech support to walk you through it.

We've got a sensor for that

Sensaphone has a sensor for monitoring everything from climate conditions to security and more.

Your business is our business

With over 400,000 systems installed worldwide, we've put Sensaphone to the test in just about every application imaginable.

Suggested Applications

Agriculture
Know that the temperature, humidity, or other critical conditions where plants or animals live are in check while you're away.

HVAC
Use your Sensaphone Express II to monitor temperature, power failure and other conditions in heating and air conditioning applications.

Water & Wastewater
Use your Express II to monitor tank levels, flow rates and other critical conditions in water and wastewater applications.

Features and Specifications

Keypad

Makes programming simple and easy. LCD gives a quick visual status.
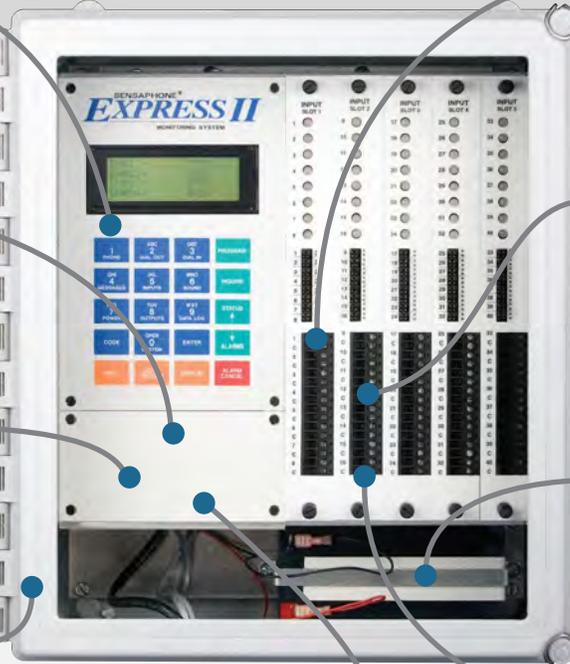
Power

Comes with a plug in power supply that also monitors for power failures.

Phone Line

Call up to 48 different phone numbers when an alarm has been detected.

Enclosure

The Expres II comes sealed in a NEMA 4X enclosure which allows it to be placed in less than ideal environments.

Microphone

Record messages in your own voice, listen in from over the phone or monitor for high sound alarms.

Output

Control a light, siren or other device. One output is standard, and up to 16 can be added.

Inputs

Accept four different input types from a wide range of sensors.

Contact —Series— | 2.8K —Series— | 10K —Series— | 4-20mA —Series—

Battery Backup

Rest easy knowing that even if the power goes out, the Express II will keep monitoring.

Expansion

Need more than eight inputs? The Express II comes standard with 8, but can expand to 40.

Popular Compatible Sensors & Accessories

2.8K Room Temperature Sensor FGD-0100

2.8K Weatherproof Temperature Sensor FGD-0101

2.8K Temperature Sensor in
Glass Bead Vial. FGD-0107

Temp Alert Temperature Switch FGD-0022

Humidistat Humidity Switch. FGD-0027

PowerOut Alert Power Failure Switch. FGD-0054

Magnetic Reed Door and Window Switch . . FGD-0006

Spot Water Detection Sensor. FGD-0013

Zone Water Detection Sensor FGD-0056

Additional 10' of Water Rope FGD-0063

Infrared Motion Detection Sensor FGD-0007

Smoke Detection Sensor for 120VAC FGD-0049

Smoke Detector w/battery backup FGD-0049-B

Float Switch. FGD-0222

Multi-Point Wireless I/O FGD-0205

Surge Suppressor for Power and Phone FGD-0067

Bluetooth Cell Phone Interface. FGD-0230

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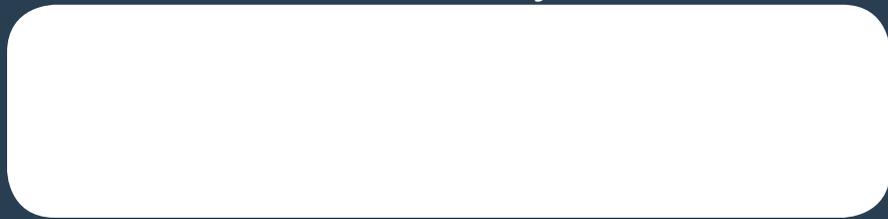
Verbatim®

…Clearly a step ahead in remote monitoring systems

by **RACO®**
REMOTE ALARMS AND CONTROLS

Verbatim ®

...the interactive alarm autodialing, monitoring, reporting, and control system..

Remote Alarm Dialing Monitor with Solid State Message Recording

Series VSS

RACO

RACO RESPONDER **(OPT)**

RACO Verbatim, the long-standing first choice of the industry, offers pace-setting functionality and expandability – its an autodialer alarm system, a remote monitoring system, a supervisory control system, a SCADA system, and a PLC network interface – in one compact package.

With an expandable, modular bus architecture and up to 32 digital inputs, 16 analog inputs, and 8 digital control outputs, the system can monitor flow, level, pressure, temperature, pH, and other types of sensors, as well as control remote electrical devices.

■ Alarm Autodialing

The system is designed to continuously monitor preset alarm points. If an alarm condition is sensed at a monitored point, the Verbatim System will automatically dial a list of 16 pre-programmed emergency telephone numbers, calling until it gets an answer. When the call is answered and acknowledged, the system reports the alarm location and status via pre-recorded voice messages.

Communicating over standard landline or wireless telephone networks, the Verbatim delivers alarm messages to standard phones, cell phones, numeric or voice pagers, and voice mail systems, and talks just as easily with computers.

■ User-Recorded Messages

The voice messages are digitally pre-recorded by the user. Anything that can be spoken is accurately stored in memory – from names and numbers to technical terms and detailed instructions. Messages are delivered with maximum clarity, lessening the chance for misunderstanding or error. And, you can easily enter or change your messages over the phone or at the front panel.

■ A Fully Interactive System

With Verbatim, you're never out of touch with your monitoring system. With any standard touch-tone phone, you can call in for a status report, review and change programming, or control a remote device. With the touch of a key, you can listen to local sounds or talk to personnel using the unit's built-in speakerphone.

When calling for status report you hear a comprehensive summary of all conditions monitored by the system, including internal power. Hard copies of event data – alarms, acknowledgements, inquiries, and programming changes – can be printed out at any time using the system's data logging capabilities.
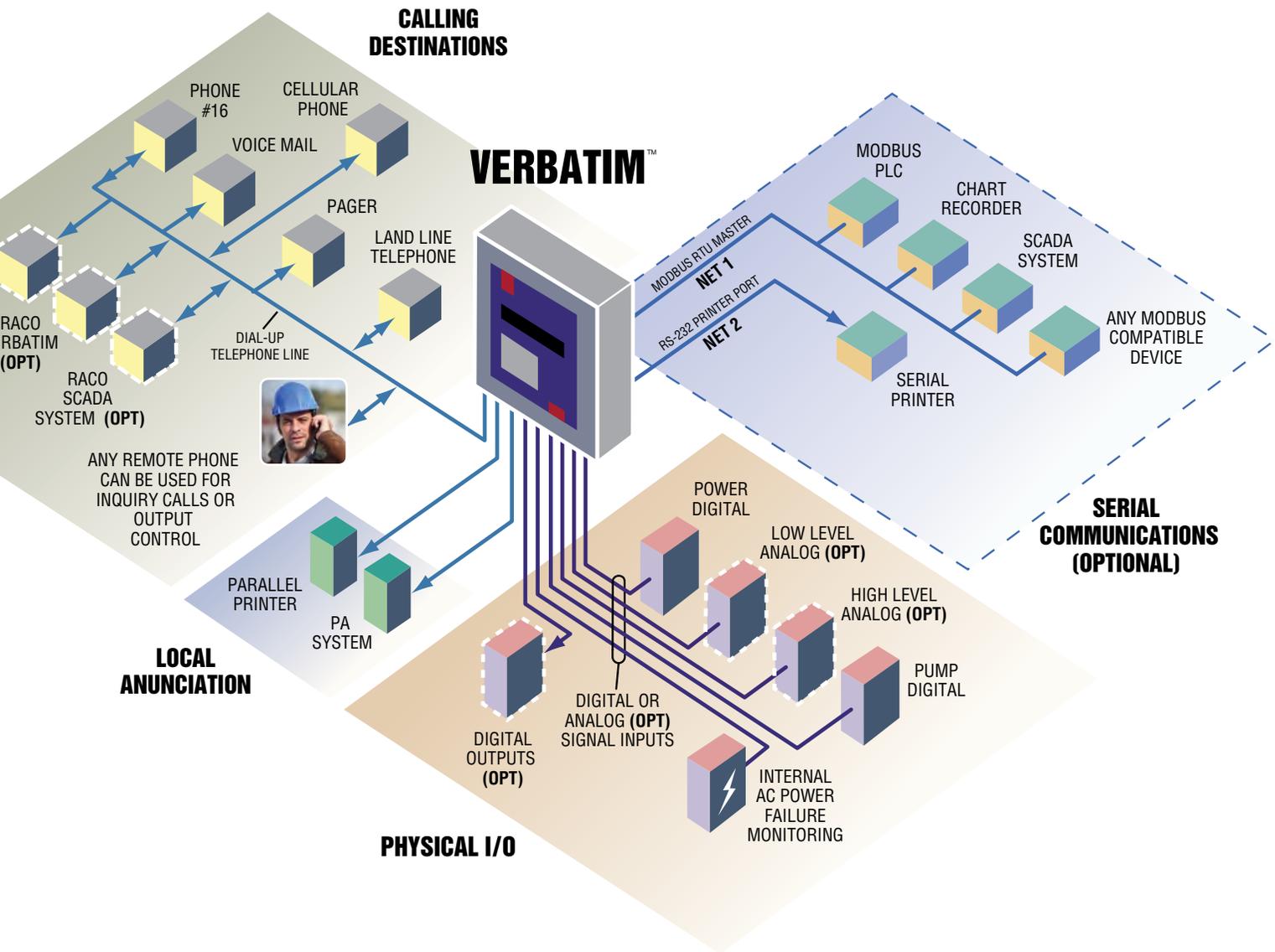
Controls and indicators are provided on the Verbatim's front panel for on-site programming and review of system operation, alarm status, and battery condition.

■ Supervisory Control System

A Verbatim System can be equipped with up to 8 digital control outputs to remotely actuate HVAC systems, pumps, compressors, and other electrical devices from a standard phone, the Verbatim front panel, or a PC.

■ SCADA System

RACO HMI / SCADA Systems provide monitoring and control of an unlimited number of Verbatim Remote Terminal Units (RTUs) over the standard dial-up telephone network. Each RTU has full alarm monitoring, reporting, and autodialing capabilities, and because Verbatim systems report by exception, they do not need to be polled. When an alarm is sensed, the RTU reports to the central computer. If the computer operator does not acknowledge the alarm, the RTU will commence autodialing.

CALLING
DESTINATIONS

PHONE #16

CELLULAR PHONE

VOICE MAIL

PAGER

LAND LINE TELEPHONE

VERBATIM™

RACO RBATIM (OPT)

RACO SCADA SYSTEM (OPT)

DIAL-UP TELEPHONE LINE

ANY REMOTE PHONE CAN BE USED FOR INQUIRY CALLS OR OUTPUT CONTROL

MODBUS PLC

CHART RECORDER

SCADA SYSTEM

MODBUS RTU MASTER
NET 1

RS-232 PRINTER PORT
NET 2

ANY MODBUS COMPATIBLE DEVICE

SERIAL PRINTER

SERIAL COMMUNICATIONS (OPTIONAL)

PARALLEL PRINTER

PA SYSTEM

LOCAL ANUNCIATION

POWER DIGITAL

LOW LEVEL ANALOG (OPT)

HIGH LEVEL ANALOG (OPT)

PUMP DIGITAL

DIGITAL OR ANALOG (OPT) SIGNAL INPUTS

DIGITAL OUTPUTS (OPT)

INTERNAL AC POWER FAILURE MONITORING

PHYSICAL I/O

PLC Network Interface

Offering alarm and monitoring for as many as 96 remote channels, the Verbatim can use RS232 communications to work with any PLC or other device using Modbus master RTU protocol.

Take Control of Remote Equipment

A Verbatim System can be used with a RACO Responder or another Verbatim to actuate pumps, compressors, gates, or other electrically operated equipment over the dial-up telephone network. Upon receipt of an alarm signal – low water level, for example – the Verbatim issues a command to activate an output relay in the Responder or other Verbatim unit, which initiates an action such as turning on a pump motor.

Memory Retained During Power Failure

Verbatim systems incorporate a non-volatile memory. Recorded alarm messages and user-entered programming is retained indefinitely in the event of a power loss.

Battery Backup for Safety

A rechargeable gel-cell battery provides up to 20 hours of continuous operation in the event of power loss. And because the system uses a precision regulated charger instead of the traditional "trickle" charger, the time required for charging is minimized and battery life is significantly extended.

Built for Long Term Survival in the Toughest Environments

Verbatim is designed and built for superior performance – year after year. The system's rugged durability is evident in its heavy-duty metal enclosure, carefully selected and proven solidstate components, and sealed membrane keyboard. Heavy-duty solid-state and gas tube surge protection is provided on all power, phone and signal lines.

Verbatim ®

Features:

- Monitors 4 channels plus internal AC power
- Solid-state message recording
- Expandable modular design
- Superior surge protection on all inputs
- Alarm call grouping
- Low cost
- Remote programming
- Nonvolatile memory
- 20 hour battery backup
- 5 year warranty

Typical Monitoring Applications:

- Boilers
- Chemical Plants
- Computer Rooms
- Facility Security
- Fish Hatcheries
- Frozen Food Storage
- HVAC Systems
- Hydroelectric Power Stations
- Pipeline & Compressor Stations
- Remote Pump Stations
- Storage Tanks
- Telephone Switchgear
- Unattended SCADA Systems
- Water & Wastewater Treatment Plants

Typical Sensors:

- Flow
- Leak
- Level
- Motion
- pH
- Power
- Pressure
- Temperature
- Vacuum

Standard Specifications:

ELECTRICAL

- *Power requirement:* 105-135 VAC, 50/60 Hz, 15 watts maximum or 8-14 VDC at 500 mA maximum.
- Battery charging: Precision voltage controlled, including automatic rapid recharge after drain.
- Battery backup: 20 hours
- Input sensing: Four unpowered contact inputs standard. Open contacts see 5 volts DC; closed contacts see 10 ma DC.
- Standard Centronics parallel printer port.

PHYSICAL

- *Surge protection:* Integral gas tube and solid-state protectors on all phone, power and signal lines. Accommodates field-installed upgrades. Rugged metal indoor enclosure.
- *Weight:* 8 lbs (3.6 kg).
- *Dimensions:* $11\text{-}^7/_8$" H x $9\text{-}^3/_4$" W x 5" D.
- *Mounting Centers:* $11\text{-}^3/_8$" vertical x 6" horizontal.

ENVIRONMENTAL

- Temperature range: 20° to 130°F.
- Humidity: 0 to 95%, noncondensing

TELEPHONE

- Rotary pulse or tone dialing, keyboard selectable.
- Dials up to 16 different numbers, each up to 60 digits long.
- Allows programming of PBX delays in 1 second increments.
- FCC Registered Part 68, "Ringer Equivalence": 0.3A.
- Alarm acknowledgement is by TouchTone key or by calling back.
- Built-in speaker phone allows two-way conversation.
- Compatible with most cellular telephone systems.

SPEECH MESSAGES

- Users record their own messages. Also includes resident vocabulary for programming guidance and for default "alarm/normal" speech if no user messages are recorded.

UL STANDARD

- Verbatim complies with UL Standards: 1459, 1950.

WARRANTY

- Five year parts and labor warranty. See our separate warranty card for details.

MODULAR OPTIONS

- *Channels.* Upgradeable to 8, 16, 24 or 32 contact channels.
- *Analog.* Custom scaled in the units of measurement required for your job. Analog alarms on a high and a low alarm setpoint. Upgradeable to 1, 4, 8 or 16 analog channels.
- *Remote Supervisory Control.* The operator can turn equipment on or off via any telephone. Upgradeable to 4 or 8 outputs.
- *Modbus Interface.* In addition to physical inputs, the unit is upgradeable to 32, 64 or 96 additional alarms of any type via RS232 and Modbus RTU master protocol.
- *Cellular Telephone.* Our Cellularm™ System provides temporary or permanent alarm autodialing over the cellular telephone network when conventional telephone lines are disabled or unavailable. Furnished in a rugged, weather-resistant housing that's easy to transport and set up.

FACTORY OPTIONS

- *Enclosure.* System available in NEMA 4X enclosure, which is corrosion proof and sealed against 12 feet of water.
- *Environmental.* Thermostatically controlled heater available, suggested for operation below 20°F or where condensation may occur.
- *Local Alarm Relay Output.* Relay activates during unacknowledged alarm conditions.
- *Secure Front Panel.* Verbatim System furnished without front panel programming controls and indicators. Restricts access to unsupervised or remotely located units, as well as reducing the initial purchase price.
- *Solar Electric Generator Systems.* Ideal for remote location applications where conventional power and telephone services are not available or too costly. Provides steady, clean power and has sufficient storage capacity for overcast and inclement weather conditions.
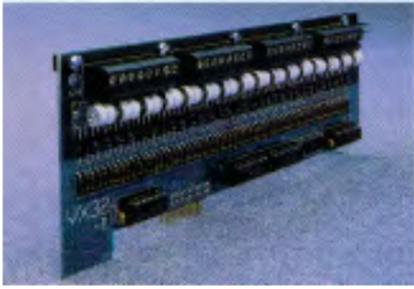

RACO

SINCE 1948

REMOTE ALARMS AND CONTROLS ®

RACO MANUFACTURING AND ENGINEERING CO.
1400 62nd Street, Emeryville, CA 94608
Tel: (510) 658-6713 • Fax: (510) 658-3153
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Literature Code: #118

Digital Input Option

Digital inputs to the Verbatim System can be added to increase the number of monitoring points. The standard configuration for a system is 4 digital inputs, expandable to 8, 16, 24 or 32 optional. The option consists of a circuit card, which plugs into the Verbatim System. The additional inputs can be configured to monitor alarms, totalizer values, and run times.

RACO Manufacturing and Engineering Co., Inc.
Fax on Demand product code 618

Cellular Alarm Autodialing

The RACO Cellularm terminal provides temporary or permanent cellular phone service when conventional telephone lines are disabled or unavailable. Cellularm is optionally furnished with a RACO Verbatim System to provide alarm monitoring reporting, and system status checking functions. Packaged in a rugged, weather-resistant housing that is easy to transport and set up.

RACO Manufacturing and Engineering Co., Inc.
Fax on Demand product code 120

Secure Front Panel Verbatim

The Verbatim System is available in a Secure Front Panel (SFP) configuration, where the unit is furnished without the front panel keypad and some of the front panel indicators that are used for programming at the panel. With this unit, system programming can only be done over the phone. The SFP system provides security for unsupervised or remotely located units and the initial purchase price is only $1,550.00.

RACO Manufacturing and Engineering Co., Inc.
Fax on Demand product code 621

Verbatim SCADA Applications

RACO SCADA System software lets you combine a Verbatim System with a Central Station Computer to interface up to 200 Verbatim Remote Terminal Units (RTUs). Simple, cost-effective system permits the use of conventional dial-up phone lines to ensure continuous monitoring, reporting, data logging, and alarm autodialing. Additionally, RACO Connections Software permits alarm autodialing in a Windows™-based, DDE-compliant MMI/SCADA System over standard dial-up phone lines.

RACO Manufacturing and Engineering Co., Inc.
Fax on Demand product code 803

Analog Signal Input Option

RACO Analog Signal Input Option for the Verbatim System allows monitoring of 1, 4, 8, or 16 analog inputs, with user-programmable gain/offset and high/low setpoints. This plug-in circuit board enables the Verbatim to report a physically variable value-water level, pressure, etc.-by means of a voice message in terms of actual physical units. User can call in for status at any time or alarm autodialing will be initiated if preprogrammed setpoints are exceeded. Standard signal input type is 4-20 mA, with other types available on order.

RACO Manufacturing and Engineering Co., Inc.
Fax on Demand product code 602

Remote Supervisory Control

The RACO Remote Supervisory Control Option for the Verbatim System lets the user actuate from 4 to 8 electrically operated devices over the dial-up telephone network using any remote touch-tone phone. The option consists of a circuit card, which plugs into the Verbatim System. The user may utilize open collector transistor outputs on the circuit card or employ an optional, separately enclosed external output relay system for remote circuit control.

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Fax on Demand product code 603
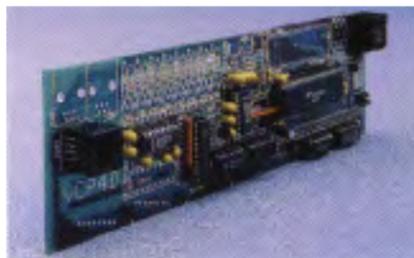
Autodialing With PLCs

When equipped with a RACO Modbus Interface Module, a RACO Verbatim System delivers cost-effective connectivity to all devices (PLCs, annunciators, chart recorders, MCCs, etc.) compatible with Modicon Modbus RTU master protocol. This option permits the addition of an alarm autodialing capability to any compatible monitoring and control network. As many as 32, 64, or 96 alarm conditions can be monitored and reported via an RS-232 connection.

RACO Manufacturing and Engineering Co., Inc.
Fax on Demand product code 620

> **Fax on Demand** - *for fax copies of technical specifications for any product shown on this page, just dial 510-658-6716 and follow the prompts. Product codes are listed with each product description.*

It wasn't easy cramming all those capabilities into this little box.

But panel shop operators, system integrators and those handling water/wastewater plant operations and maintenance are glad we did. Now they can tackle monitoring and control tasks armed with the pacesetting functionality and expandability packed into the RACO Verbatim, the long-standing first choice of the industry. And just what is a Verbatim? Well, with a modular bus architecture and up to 32 digital inputs, 16 analog inputs, and 8 control outputs, it's ...

An autodialer alarm system that, sequentially calling up to 16 numbers, communicates via standard wireless or landline telephone networks with just about anything. It delivers voice-message alarms to phones (including cellular), numeric or voice pagers, and voice mail systems, and talks just as easily to computers. And it keeps calling until alarms are acknowledged.

A remote monitoring system that continuously checks the status of all devices connected to the system. Users can call in from any phone to acquire status information on all points being monitored.

A supervisory control system for actuating devices from a phone, the Verbatim front panel or a PC.

A SCADA system comprising Verbatim RTUs in the field, a computer and RACO software. Its phone-based communications allow widespread deployment, and you can even add Local and Central Data Logging. Further, with our DDE Server Software, Verbatims are easily integrated into any DDE-compliant, Windows™-based MMI/SCADA system.

A PLC network interface that, offering alarm and monitoring for as many as 96 remote channels, uses RS232 communications to work with any devices using Modicon's Modbus protocol.

What else does our Verbatim do? It brings you proven reliability and— with prices starting at $1550 —incomparable cost-effectiveness. So what should you do? Simple. Call, visit our Web site or E-mail us for details or arrange a demonstration.

Raco Engineering and Manufacturing Co.

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