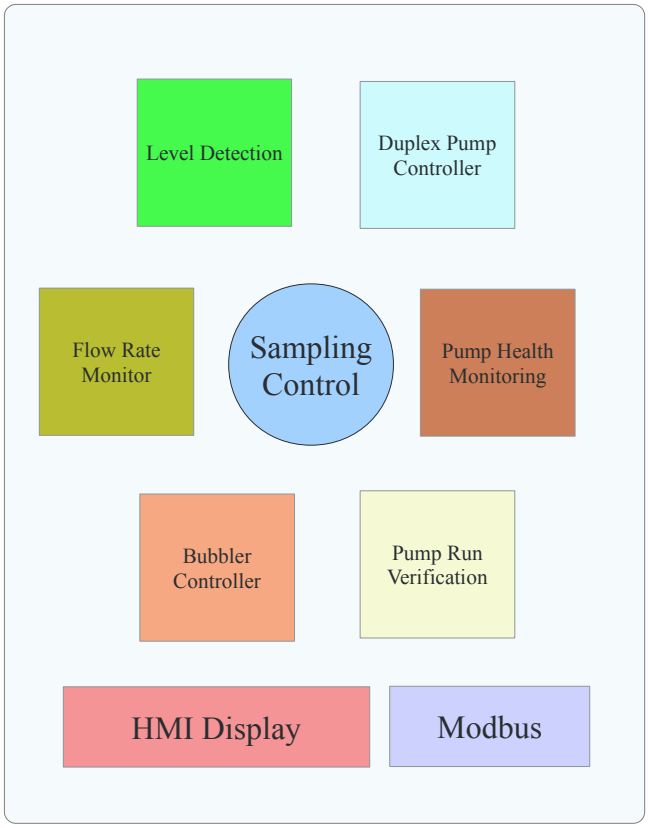
INGRAM PRODUCTS, INC.

LC Family Level Management

LC Level Controllers

The Ingram Products LC Family has been engineered to address a range of applications in the waste water management industry. The product family provides a Level Detection subsystem, with an integrated Bubbler controller, a Duplex Pump Controller, with pump Health monitoring and Run Verification, and a Flow Rate Monitoring subsystem. The product family is built using standard hardware controllers that provide an integral HMI display, a Modbus communications option and I/O expansion options.



The LC products include Level discriminators, Flow rate monitors, pump verification monitors or fully functional Level Control systems that include all sub-systems. Most products include an integrated Bubbler control subsystem that minimizes the required air pump run time.

The products are provided in small, DIN rail mounted controllers. The integrated HMI provides access to an extensive set of run time statistics covering pump health, pump performance and system operating costs.

A Modbus communications port allows networking multiple LC products and supports PC based configuration, monitoring, simulation and project management.

All units operate on 24 Vdc. Digital inputs are configurable as Normally Open or Normally Closed and use Time On/Time Off filtering for noise rejection. Analog inputs accept 0-10 Vdc or 4-20 mA inputs and include hysteresis and time filtering on all signals. Outputs are SPST relay contacts.

The LC family may be fully configured using an integral HMI display and all status and run time statistics are available through the HMI, providing full stand-alone capability.

An optional Windows based application package supports configuration, monitoring, system simulation and overall project management tools across a Modbus network or through a low cost USB adapter.

LC Family Level Management

LC Family Features

Flexible Level Detection
- Analog 0-10 Vdc, 4-20 mA
- Discrete (float switches)
- Positive or Negative Displacement

Integrated Duplex Controller
- 2 pump control (alternate, 1 – 2, 2 – 1, user defined)
- automatic switch-over if lead fail

Pump Health Monitoring
- Pump Seal Monitor
- Pump Temperature Monitor

Run Verification
- Aux Contact Monitor
- Current Monitor
- Flow Rate Monitoring
- Phase Error Monitoring

Flow Rate Monitoring
- Rate of In Flow, Total Inflow volume
- Per Pump Rate of Flow & volume

Multi-pump (Tankless) Bubbler System
- Alternator – variable duty cycles
- Variable Sampling rate, auto-tuning
- Auto-purging

Extensive Diagnostics
- Pump warning & error indicators
- System & per pump run time
- Flow rate levels

HMI statistics
- System & individual pump data
- Pump Health (seal/temperature)
- Pump Run Verification
- Flow rate trends

Communications
- Modbus RTU
- Ethernet (Modbus TCP/IP)

Highly Configurable
- All parameters configured thru HMI
- Password protected
- All values shown in engineering units
- Support for U.S., Imperial and Metric units

PC/Windows Support Software
- Configuration
- Real Time monitoring
- System simulator
- Project Management

Level Detection

The level detection subsystem accepts an analog signal representing the current liquid level and is scaled to standard engineering units (feet, meters etc.) before being compared to user defined thresholds, setting one of 5 different output 'states' indicating the current liquid level. Discrete (float switch) inputs may be used provide a back up to or as an alternative to the analog sensor.

Duplex Pump Controller

An integrated Duplex Pump controller is provided that provides alternating, fixed or user defined pump sequences and includes a Time-of-Day timer that will select alternate sequences. The Timer supports 32 set points which may be activated on a daily, weekly or monthly basis. Pump activity is triggered by the Level Detection subsystem and flow rate monitoring is provided for each pump.

Pumps which experience degraded characteristics are demoted to 'LAG only' operation. If the current LEAD pump fails the LAG pump is automatically switch in.

LC Family Level Management

Pump Health Monitoring

Pumps exist in four states: ONLINE (LEAD or LAG pump), DEMOTED (LAG pump only), DISABLED (will not be activated) or OFFLINE (user disabled).

Pump Health Monitoring uses seal leak detection and pump over-temperature detection to determine if the pump is able to act as the Lead pump, Lag pump only or should be removed from service.

Run Verification

Run verification ensures that when activated a pump operates within it's specified operating range. The system monitors the auxiliary contact from the motor starter, the pump operating current and an input from an external Phase Error detector. Run time warnings and errors are latched and must be explicitly cleared by the operator.

The operating current upper and lower ranges act as warnings (demoted) levels. Operating warnings and errors are made available as discrete outputs to activate external alarm systems as well as being accessible from both the HMI and communication interfaces.

Flow Rate Monitoring

Flow rate monitoring measures the change in level between successive samples to determine the overall In Flow, Out Flow and individual pump flow rates. The tank geometry is used to calculate the flow in standard engineering units. The user may select between US, Imperial or metric measurement units.

Alarm and/or warning outputs will be activated if the measured flow rate exceeds specific rates.

Bubbler Controller

The Bubbler controller provides a fully integrated bubbler control subsystem to monitor liquid levels. The bubbler may be operated with or without air storage tanks and supports both continuous and pulsed pump operation to minimize air usage, greatly extending the air pump life times.

The bubbler supports dual air sources and provides timed alternation between the two sources. In a tank-less system air pumps provide the air directly to the bubbler tube, eliminating the air tank. To maximize pump lifetimes the pumps may be activated on a timed basis and the alternate pump will be switched on in the case of a failure.

HMI Display

An HMI display allows setting all parameters and may be password protected. All operating statistics and run time information may be called up and error and warning conditions will be immediately displayed, taking the guess work out system maintenance.

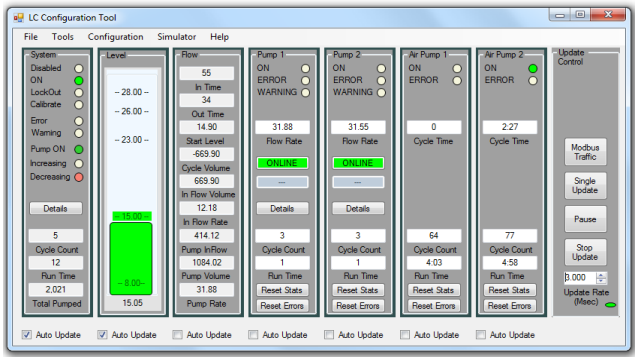
LC Family
Level Management

Communications

Communications adapters allow parameters to be set using Modbus RS485 (RTU) connections, allowing all run time statistics to be easily collected. An SMS adapter allows errors to be reported on remote phone systems.

Configuration Support

Installations may be fully configured using the integrated HMI display. A Windows based application program (LC_Config) is available that provides a GUI screen view of all operating parameters, allows setting the configuration options and includes an integrated tank/pump simulator.



Application profiles may be loaded from a computer file, allowing fast configuration within the field and current operating statistics may be collected and saved.

Small Size

Two standard DIN-rail mounted LC controllers are used, measuring 71 mm X 90 or 126 mm X 90 mm. An I/O expansion unit provides additional inputs and outputs and is available for most models.

LC-1, LC-3, LC-4, LC-5, LC-6

14 Inputs, 8 Outputs

LC-2

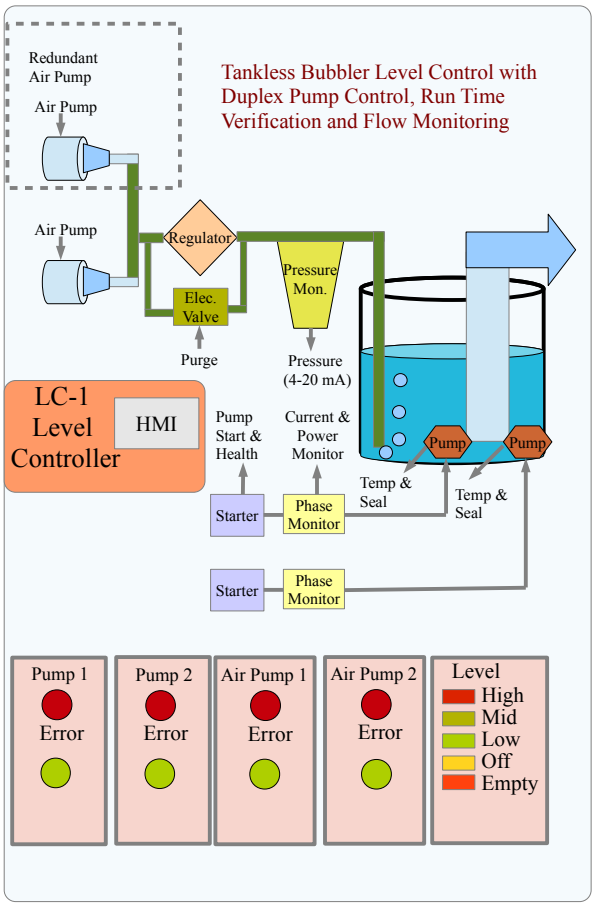
8 Inputs, 4 Outputs

I/O Expansion

14 Inputs, 8 Outputs

LC Family
Level Management

Typical Applications



Existing Duplex Controllers

There is a large installed base of Duplex pump controllers that lack diagnostic capabilities. The LC-2 Flow Monitor, requiring only 2 connections, adds pump Flow Rate monitoring without having to replace the existing control system.

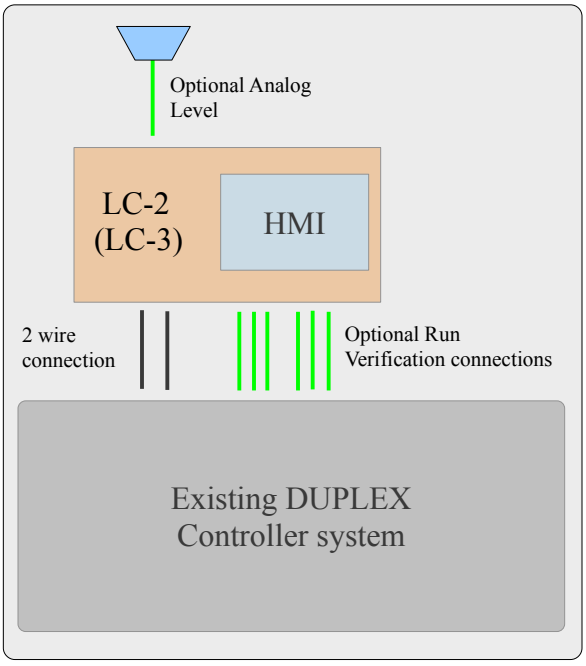
The LC-3 Pump & Flow Monitor extends the LC-2 capabilities by including pump run verification including auxiliary contact, current and phase monitoring. The optional Analog level detector adds level discrimination, allowing the unit to provide upgraded level detection and monitoring to existing Duplex systems.

New Designs

The following application illustrates an LC-1 controller providing level control on a waste water lift station. A dual air pump tank-less bubbler system is used for level monitoring. The integral Duplex Pump controller operates the two submersible pumps to control the level and includes both pump Health monitoring and Run Time Verification.

Flow Monitoring provides system level diagnostic information to reduce system operating and maintenance costs.

Although the LC-1 will operate on a stand-alone basis, with all diagnostic and configuration supported using the integral HMI, the Modbus communications port with the LC_Config monitoring software allows the operation of the system to be managed from either a local lap-top computer or remotely.



LC Family
Level Management

Modular Capabilities

	Discrete Level Inputs	Analog Level Detection	Bubbler Controller	Flow Rate Monitoring	Duplex Pump Control	Pump Health Monitoring	Pump Run Verification	Discrete Output Levels (Level Discriminator)	HMI Display	Communications
LC-1		X	X	X	X	X	X		X	X
LC-2		X	X	X				X(1)	X	X
LC-3		X	X	X			X	X(1)	X	X
LC-4		X	X(1)	X			X	X	X	X
LC-5	X	X	X	X	X	X	X(2)		X	X
LC-6	X(1)	X		X	X	X	X		X	X

(1) Requires I/O Expansion Unit
(2) Fault signal from external Soft Starter

The LC-1 controller provides an advanced, full function level control solution. The unit provides Level Detection, Duplex pump control with Health and Run Time verification, Flow Monitoring and a Bubble control sub-system.

The LC-2 is ideally suited as a low cost add-on to existing duplex control units or a Level Detector and Flow monitor front end to an external duplex controller. A simple 2 wire interface adds both Flow Rate and pump Run Time monitoring to any existing control system. The analog input may be connected to an external Depth monitor to improve flow rate accuracy. An I/O expansion unit provides discrete digital outputs allowing the unit to act as a level discriminator and bubbler controller.

The LC-3 extends the capabilities of the LC-2 by adding pump Run Time Verification for the external Duplex controller, an integrated Bubbler controller and additional status outputs for each of the pumps. An I/O expansion unit provides discrete digital outputs allowing the unit to act as a level discriminator.

The LC-4 provides an alternate output configuration to the LC-3 controller. The base unit includes 5 discrete outputs allowing the unit to act as a Flow Monitor and provide Pump Run Time Verification and Level discrimination. An I/O expansion unit provides additional status outputs for each of the pumps as well as a bubbler controller.

LC Family
Level Management

The LC-5 supports all the LC-1 functions with the addition of Discrete level inputs that may be used a a back up to or in place of the analog sensor. Pump run verification is performed by using external soft starters that provide a single fault indication for each pump to the LC-5.

The LC-6 supports all the LC-1 functions with the exception of the Bubbler subsystem. An I/O expansion unit provides additional pump status information and allows using discrete digital inputs in place of the analog detector.

Specifications

Power:	24 Vdc, @ 100 mA
Size:	126 mm X 90 mm X 58.5 mm
Environment:	IEC68-2
EMC:	IEC801-3
Inputs:	24 Vdc (digital) 200 kohms (seal detect) 0-10 Vdc/4-20 mA (external level detect)
Outputs:	NO Relay (0-240 Vac, 10 Amp resistive) NPN (sink) (24 Vdc, 2 Amp) PNP (Source) (24 Vdc, 2 Amp)
Levels:	5 Level (Zero, Off, Low, Mid, High) Set in Inches, Feet or Meters
Bubbler:	1 or 2 air pumps with or without air tank +/- 1 cm (0.3") Min sample rate 0.5 sec
Pump Sequencer:	1-2, 2-1, Alternating or user defined sequence 4 user defined sequences 2 user defined Time of Day sequence groups
Pump Health:	Seal Resistance Pump Temperature contact
Run Verification:	Auxiliary Contact Closure Pump Current (Min/Max)
Flow:	Gallons, Imp. Gallons or Liters Reported per second, minute or hour

The LC product family is UL508a compliant when used with Class II power. Slave UL508a compliant relays should be used when switching voltages greater than 48 Vdc.