SM199 DUAL PUMP CONTROLLER

INSTALLATION & MAINTENANCE GUIDE

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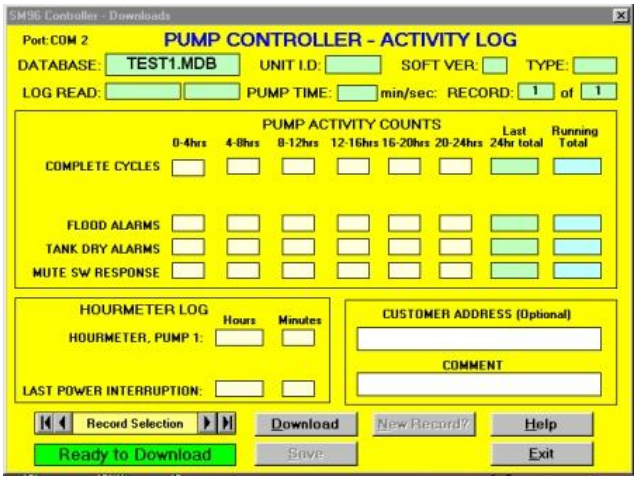
PUMP CONTROLLER – GENERAL DESCRIPTION

The SM199 pump controller is a stand-alone Dual-Pump controller to suit above-ground and submersible pumps that are required to pump out the contents of a holding tank. It will provide power to a pump when tank levels have risen to a defined threshold, and to halt the pump when tank levels have fallen to another, lower threshold. It will call for human intervention should the pump or input sensors behave in a way that do not meet normal operating parameters. The controller does this in a way that is safe for both the client and the maintenance staff.

INTEGRAL DATA LOGGER

The advanced microprocessor design within the pump controller allows statistical information to be collected by Operational staff or maintenance staff. Operational staff can use the information accumulated in each controller to ascertain usage patterns and flow rate trends over an extended period.

Maintenance staff can use the logged information to diagnose customer difficulties and faults by reading an extensive profile of the last 24 hours of pump activity. Information may be downloaded from the pump controller to a pc using a non-contact infrared link.



DUAL PUMP ACTION

The SM199 supports *dual* pump operation. Should one pump fail, then the controller will attempt to continue with the alternate pump. These pumps are generally single phase pumps up to 1.2KW, but larger pumps, including 3-Phase pumps can be supported by the addition of external contacts of a suitable rating.

ADVANCED LEVEL PROBE ARRANGEMENT

The SM199 use three level sensing probes that may be either simple conductivity probes or floatation type level switches. This advanced arrangement provides an additional layer of supervision and redundancy in the event of a stuck or damaged level probe.

A 'Learn' feature allows the pump controller to automatically calculate optimal pumping times to suit a wide range of tank sizes.

ALARM EVENTS

Two different alarm conditions sound & flash where the holding tank is in danger of overflowing or running dry. A third alarm condition will indicate the accidental reversal of the 'High' and 'Low' probes by installation staff. These alarms may also be extended to remote systems.

The audible alarm can be suppressed by the customer for a 6 hour period by pressing an **Alarm Mute** button.

MOTOR JOG FUNCTION

The SM199 has a **Motor Jog** button that allows installers to briefly activate a pump manually.

CONTROL SYSTEM ENCLOSURE

The enclosure is an ABS plastic box with a clear lid and a neoprene sealing gasket providing a waterproof/dustproof rating of IP65. (Installing staff must use cable glands and seals of suitable integrity to maintain the water proofing integrity of the enclosure.)

SAFETY INFORMATION

- This equipment must be installed and maintained by a licensed electrician
- Do not install this equipment if the enclosure or any internal components appear damaged.
- Power cabling and circuit breaker rating at the power distribution panel must be rated to support the pump type being used.
- Power should not be extended to the SM199 control unit until all cabling is in place and correctly terminated.
- The IP (Ingress Protection) rating of the control unit enclosure will be diminished if conduit seals to the enclosure are not of a high standard. Suitable cable glands and seals must be used on all conduits.
- Before drilling holes behind the control unit for mounting purposes or cable access, ensure that no active 240VAC cables in the wall cavity will be damaged by drill bits or mounting screws.
- Do not remove the cover to the control unit enclosure during inclement weather or where water spray is present.
- Do not operate this equipment until all outgoing cables to pumps and sensors are correctly terminated and sealed against the ingress of moisture.

ENCLOSURE MOUNTING PROCEDURE

WALL MOUNTING

The enclosure should be mounted to a wall or panel using stainless steel self tapping screws or bolts. If direct and prolonged exposure to sunlight and rain is anticipated, the SM199 unit should be mounted below a shaded overhead cover or within a larger enclosure.

IMPORTANT!

When drilling holes In the enclosure for conduit & cable entry care must be taken to ensure that the circuit board is not damaged in the process. Some hole saws may extend into the enclosure at the point where drilling breakthrough occurs and damage the circuit board or its components.

It is possible to unscrew and remove the pcb backplane from the enclosure during the drilling process and re-mount it after the conduits and cables are in place.

CABLE/CONDUIT ENTRY

The SM199 Pump Control Unit is normally wall mounted or mounted within a larger enclosure. External connections from the electrical supply, level sensors and pump motor are normally cabled to the unit on the outside of the wall in suitably rated conduits and connect to the enclosure via cable glands. Alternately, cable entry may be achieved by through the rear of the enclosure in the designated cable entry position.

ELECTRICAL CONNECTIONS

There are three types of electrical connection that must be made to the SM199 Pump Controller unit. There is the **240VAC supply cable**, the **Pump Motor** cables and a **Sensor cable** to the three tank level probes or switches.

The 240VAC Supply cable must be suitably rated for fixed power installations. For most installations 2.5sq mm conductors are sufficient, but cable runs greater than 40 metres with larger capacity pumps (greater than 1kw) may need to be upgraded to 4 sq. mm cable. A suitably rated isolation circuit breaker and earth leakage protector should be fitted at the building power distribution board to protect the wiring to the Pump controller.

The 240VAC supply cable terminates within the Pump Controller enclosure at the screw terminal strip labelled **240V Supply.** The Active Neutral and Earth conductors must be securely fastened to the corresponding terminals at this point.

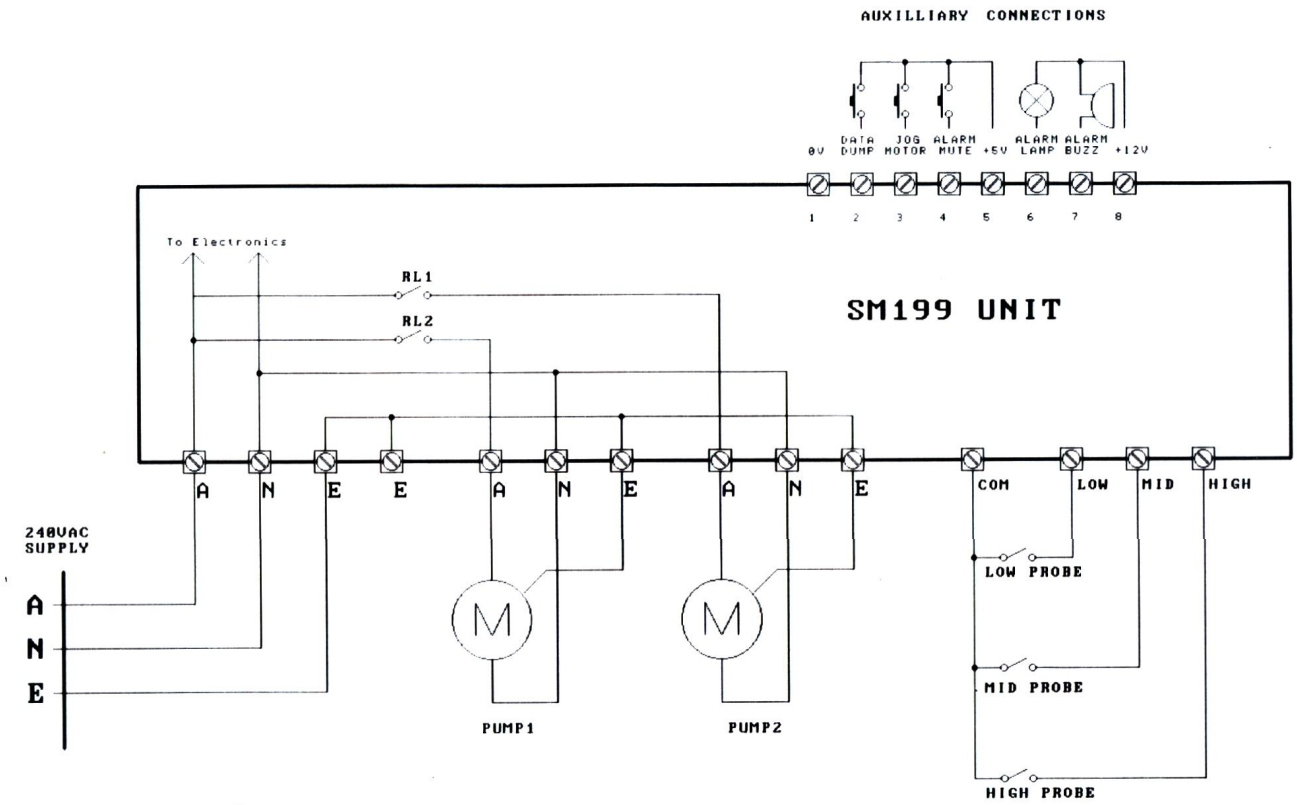
The pump power cable terminates within the Pump Controller enclosure at the screw terminal strip labelled **To Pump.** The Active, Neutral and Earth conductors must be securely fastened to the corresponding terminals at this point. The integrity of the earth connection should be tested before applying power to the Pump unit.

The cable that connects the water level probes to the Pump Control unit requires four conductors. **Level Low probe, Level Mid probe, Level High probe** and a '**common'** conductor. The electrical potential in this cable is classified as 'Extra Low Voltage' and is typically less than 5V D.C. Here the conductor size is not critical, but the cable sheath must be suitably robust for harsh outdoor environments. The sensors function by measuring electrical conductivity through the effluent between the three sensor probes and a common probe.

Where Float switches are available in lieu of conductivity probes, as may be the case where an existing installation is being upgraded to use the SM199 Controller, they may be connected to the three sensor inputs with respect to the common. The Float Switch contacts would need to be **Open Circuit** when dry and **Closed Circuit** when submersed.

The Water Level Probe cable terminates within the Pump Controller enclosure at the screw terminal strip labelled **Level Sensors.** The **Low, Mid High** and **Common** conductors must be securely fastened to the corresponding terminals at this point.

NOTE: Should the **Level Low** and **Level High** probes or wires be transposed in error, this will be detected as a fault condition by the controller when the tank first fills with water. The Alarm Lamp and buzzer will produce a triple flash/buzz every four seconds whenever the Level High probe is submersed while the Level Low probe remains dry.



Wiring layout of the SM199 Pump Controller

GENERAL OPERATION

When power is first applied to the panel the Alarm buzzer will sound for one second. This is a part of a normal start up sequence. Immediately following this start up sequence the controller will attempt to monitor the level probes and respond accordingly. If no probes are connected a **Level Low** alarm will be triggered.

The operation of the pumps is managed by monitoring three level sensors which can be either simple conductivity probes or common float switches. These sensors are designated **HIGH**, **MIDDLE** and **LOW**.

If the LOW sensor is activated, it means that the pump is in danger of running dry. The pump will stop, a large alarm LED will flash ONCE every four seconds. A small alarm beeper will also sound, but this noise may be suppressed for six hours by pressing the ALARM MUTE button

If the HIGH sensor is activated, it means that the tank is full and in danger of overflowing. The pump will be activated even if the MIDDLE sensor is not functioning in order to bring the tank contents down to an acceptable level. A HIGH alarm is indicated by a double-flash every four seconds.

(A third ‘Triple flash’ alarm condition indicates the accidental reversal of the ‘High’ and ‘Low’ probes by installation staff, but it is unlikely that the customer would ever see this event if the system was installed correctly)

Most day-to-day pump operation is controlled by the MIDDLE sensor. If it is activated, it will start a pump until this sensor goes dry. The pump will then continue to run for a fixed number of seconds (depending upon the size of the tank and pump) and stop before the LOW probe would be activated. This system provides some redundancy in the pump and probe setup against any one sensor probe from misbehaving.

The internal data log feature is supported by a special ‘Windows’ program called SM96TERM to download and display the information. (This facility is a monitoring function only and in no way affects the operation of pump control.) This program will detect when a pumping system has a single or dual pump control and will automatically configure the screen to reveal the extra fields of information related to the additional pump.

DUAL PUMP OPERATION

Under normal usage the control module will alternate between the two pumps (designated P1 and P2) so that even wear will occur on the pumps. Should a pump cycle commence and the MID probe fails to achieve a ‘dry’ state within two minutes, the controller will assume that the pump is defective and will attempt a restart with the alternate pump.
Should the alternate pump also fail, no further retries will be attempted. If the MID probe has failed and the system is using the HIGH probe as a trigger to start pump cycles, then the auto-changeover-on-fail facility will still apply.

Note that an unwanted auto-changeover may take place where a pump cycle has commenced and a large volume of water is still entering the tank faster than the level can be pumped down. If the MID probe stays wet for more than 2 minutes in a cycle, then an auto-changeover will occur.

Where unusual tank sizes and probe positions are being used, the system supports a special ‘Learn’ mode where the pumping times may be varied to suit the different tanks

MOTOR JOG

The button labeled **Jog Motor** is a test function for motor integrity. To avoid accidental operation of the Jog feature, this button will need
to be pressed for a full second before the controller will respond.

When pressed, a pump will be activated for 20 seconds. Note that this function is disabled if the Level Low probe has not detected the presence of water within the tank. This is to ensure that the pump motor will not be damaged by operating while dry.

SIMULTANEOUS PUMP OPERATION (available from July 2010)

The standard software release only ever permits one pump to operate at a time. This is appropriate where larger pumps are in use and the power infrastructure may not support more than one pump in operation. An alternative software release is available allows for more than one pump to operate simultaneously when the 'High' probe has been reached by rapidly rising levels in the tank.

Note that before this option is requested, the electrical supply and common wiring should be capable of carrying enough current to support the simultaneous load of two pumps at full load.

Unless external contactors are used for a higher switching capacity, the total pump load should not exceed 2.4kw.

PUMP BEHAVIOR:

- Under normal conditions the pumps will alternate between **Pump1** and **Pump2** with every cycle to assure even wear of equipment.

- Should the **High Level probe ever get wet**, the **High Level Alarm** will sound. It is also an indication that one pump is not coping at this time, so the alternate pump will also be engaged for the duration that the **High Level Alarm** is performing its double-flash and beep alarm.

- Should the level then fall below the **High Level probe**, this alternate pump will stop.

  At this point the controller may then automatically swap pumps as well. This is a precaution in case the high level was reached because the first pump had been defective.

  This auto-swap feature will only take place *once* with each overflow event. It is present to limit unnecessary pump changes, should high water levels in the tank trigger the **High level probe** multiple times in the course of one pump cycle.

- This simultaneous pump feature does not change the way in which High Level Alarm events are recorded by the standard Data Logger function.

ALARMS

There are three alarms that can be generated by the Alarm Lamp and Alarm Buzzer. A five second delay is built into the response time of all probes to prevent false triggering by splashes of water and electrical transients.

1. A slow flash (one burst every four seconds) indicates that the water levels in the tank are low. Specifically this means that the **Level Low** probe has no conductivity path to the **Common** probe. This is also the case where no probes are connected to the controller. During a **Level Low** alarm condition the motor is halted and inhibited from any operation.

2. A Double Flash (two bursts every four seconds) indicates that the water levels in the tank are too high. Specifically this means that both the **Level Low** *and* **Level High** probes both have a conductivity path to the Common probe.

In this state the controller forces the pump **on** until the level high condition ceases. It would indicate that (A.) The pump has failed to operate and the tank is at risk of an overflow.
(B.) The Mid Level probe is defective. (C.) The tank has is filling at a rate greater than the normal pumping rate and the tank levels have slowly risen.

3. A Triple flash (three bursts every four seconds) indicates that the **Level High** and **Level Low** probes are probably transposed during wiring. This means that the controller has sensed that the Level Low probe is dry while the Level High probe is submerged. This is an unusual state and would not normally occur after installation unless the Low probe is defective and the water levels in the tank are high.

   Pressing the **Alarm Mute** button on the underside of the enclosure will force the **Alarm Buzzer OFF** for the next six hours. The **Alarm Lamp** is unaffected by this button.

STORING A USER-SELECTABLE PUMP DELAY TIME

The SM199 controllers have a pump delay time preset in the factory of typically one minute, (although other delay periods may be requested as a 'default' setting.) This is the time that the pump will operate after the MID level probe has first become dry. The time delay should be such that the pump will take the tank level down to a short distance before the normally immersed LOW probe is exposed.

If during a normal pump cycle, the LOW probe *is* exposed, this could be because the MID probe was set too low in the tank, or the LOW probe was not set deep enough in the tank, or even that the tank capacity is too small for the standard time delay.

Another problem may occur where a bigger than normal tank is used, the standard pumping time may not be *long enough* to fully utilise the tank capacity.

Either way, the standard pumping time should be overridden with a customised pumping time. This is a learning process where the controller performs an extended pump cycle and learns the optimum time value for the current pump, tank and probe positions.

Follow these steps to set a new pump delay period.

1. Setup the LOW, MID, and HIGH probes to the desired positions within the tank.

2. Slowly fill the tank with water until the MID probe JUST GETS WET, then turn off the water. A standard pump cycle should automatically commence and the level should begin to fall.

3. Within **ten seconds** of the pump cycle commencing, **press and hold** the MOTOR JOG button (on the controller panel) for **six consecutive seconds**. When the Alarm Lamp comes on with a continuous glow, remove your finger from the button, the LEARN mode has just been activated.

4. There is nothing more for the operator to do. The pump will continue until the LOW probe is eventually exposed. The pump will halt and the slow flash LEVEL LOW alarm will be activated. The alarm may now be stopped by letting a little water back into the tank until the LOW probe is covered again.

What just happened is that the controller measured the pumping time from when the MID probe went dry until the LOW probe went dry (rounded to the nearest ten second period). The unit then subtracted 20 seconds of pumping time from this period and stored this new value into the permanent memory of the controller. It will use this new pumping time thereafter.

The new pump time can be tested by letting more water into the tank and commencing a normal cycle. If all is well, the pump should stop with the level a short distance from activating the LEVEL LOW probe.

If a portable PC is available, a standard download sequence with the SM96TERM software package will show on the screen exactly what the revised pumping time has become.

Should the result be unsatisfactory, the LEARN mode may be engaged several times until the desired pump delay is achieved.

TEST PROCEDURE

To check for correct operation of the pump controller, power is applied and the unit must successfully manage a normal pump cycle. In addition, the Level Low and Level High alarm conditions must be simulated to confirm the integrity of all probes.

Note that with all level measurements, the SM199 unit will wait for five seconds of stable conditions before responding to changes.

The starting position for these tests assumes that the pump motor is installed and the three probes are in position in the tank. The **Level Low** probe is to be submerged with some fresh water. The **Level Mid** and **Level High** probes are to be exposed (dry).

STEP	ACTION	RESULT
1	Apply power to the panel. • circuit breaker in distribution board ON	• Alarm buzzer beeps for one second. • The **+5V** led lamp should be **ON** • All other lamps should be **OFF**
2	Test the **Jog Motor** feature: Press the **Jog Motor** button for one second.	One of the two pump control relays should operate. This contact should continue to operate for **20 seconds** then halt.
3	Expose the **Level Low** probe to the air. (This may be done by removing some water from the tank or simulated by lifting the probe assembly out of the water briefly.)	A **Level Low** alarm condition should be generated. (slow flash every 4 seconds)
4	Restore the **Level Low** probe to below the water line in the tank.	The **Level Low** alarm should cease.
5	Add water to the tank until **the Level Mid** probe is submerged,	• One of the two pump control relays should operate. • The pump should now be reducing the water level. • When the **Level Mid** probe is exposed (becomes dry again), the pump should continue for 1 to 5 min, then halt. (time may vary with pump capacity and tank size) When the pump stops, the tank level should be approx 50mm *above* the **Level Low** probe. (if the Level Low probe

		becomes exposed, tripping an alarm, then probe spacing is incorrect, or tank/pump size does not match pump times in present software version.
6	Assuming Step 5 was successful, briefly disconnect the wire that comes from the Level Mid probe and add water until the Level High probe is submerged. (this will simulate a Level Mid probe failure)	• A **Level High** alarm should commence. • The pump should operate until **the Level High** probe is exposed once more • The **Level High** alarm should then cease.
7	Testing of the **Send Data** function: Press the **Send Data** button for one second	• The buzzer should sound and **the Send Data** LED lamp should go on for One Second. (a copy of the internal data log has just been sent via the infrared LED next to the Send Data LED lamp.)
12	Test the Alarm Mute feature: Activate a Level Low alarm by briefly disconnecting the Level Low probe, or by lifting the probe out of the water	When the alarm lamp flashes and the alarm buzzer sounds, press the Alarm Mute switch. The buzzer should stop sounding while the lamp continues to flash. The alarm will remain muted until 6 hours have passed or until 240V mains have been interrupted.
	TESTS COMPLETE	

SM199 SPECIFICATIONS

Cabinet Height/Width/Depth	146 x 186 x 75mm
Unit weight	1.8 Kg
No. of pumps supported	2
Supply Voltage	240VAC, 50Hz
Supply Current	10A max
Pump Capacity	2400W (one pump at a time) 1200W (simultaneous operation enabled)

EMC (C-tick) compliance	N12656
Electrical Safety compliance	CS03057V (AS3100)

WARANTY INFORMATION

A warranty period of 12 months applies to the pump control system from the date of installation. This warranty becomes void where: (A) The unit has been damaged by excessive and unreasonable impacts, or (B) Water damage has resulted from an ingress of water caused a poor cable seal (fitted by an installer), or (C) Water damage has resulted by exposure to weather where a door has not been fully closed, or (D) The controller has been used for an application other than that specified in the installation document.

The warranty implies that a repair or replacement will be given when the defective unit is returned to the supplier. The warranty does not cover delivery and handling charges, compensation for time lost, damage caused by incorrect wiring during installation, or damage to other plant and equipment at the installation site.