

INSTALLATION AND OPERATING OF F30 PUMP CONTROLLERS

The F30 pump controllers require both electrical and mechanical fitting. Installation or servicing of these controllers should only be carried out by competent qualified personnel familiar with hydraulics, pump fitting and with electrical control circuitry.

GENERAL NOTES

The F30 pump controllers are normally used to give dry run protection to pressure pump systems. By using the system's existing pressure switch, a normal pressure start pressure stop pump can be converted to either a pressure start flow stop or a flow start flow stop system. This gives some major benefits in the way the pump performs in comparison to a conventional pressure start pressure stop pump system. In addition to dry run protection, such a system will supply a relatively constant pressure, free from the cyclic pressure fluctuations that are characteristic of normal pressure systems. No pressure cycling means a small draw off air cell can be used, even on a large pump. Before installing the F30, a basic decision needs to be made as to how you want the pump to operate. The F30 can be mounted before or after the air cell to achieve totally different operating characteristics.

INSTALLING THE F30 BEFORE THE AIR CELL

If the F30 is installed between the pump and the air cell and a tap is opened, the air cell will supply the demand, large or small. The pressure will drop and eventually the pressure switch will close, starting the pump and supplying the demand. In other words there will be a delay between turning on a tap and the pump starting. This delay will depend on the draw off capacity of the air cell and the demand flow rate. This configuration has the advantage that the pump will not start every time a tap is turned on, but only if there is a genuine sustained demand for water. This configuration is what is meant by "pressure start flow stop". This configuration is ideal for large pumps where there may be small or frequent demands, such as in communal wash rooms. A large draw off air cell is often used in such systems to further reduce the pump's start stop frequency.

INSTALLING THE F30 AFTER THE AIR CELL

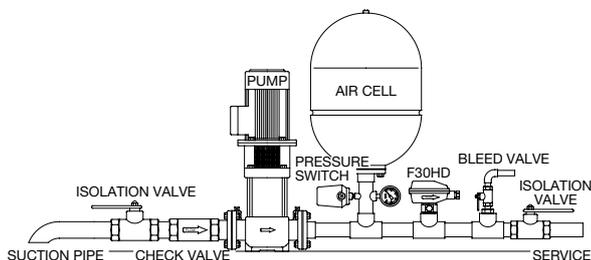
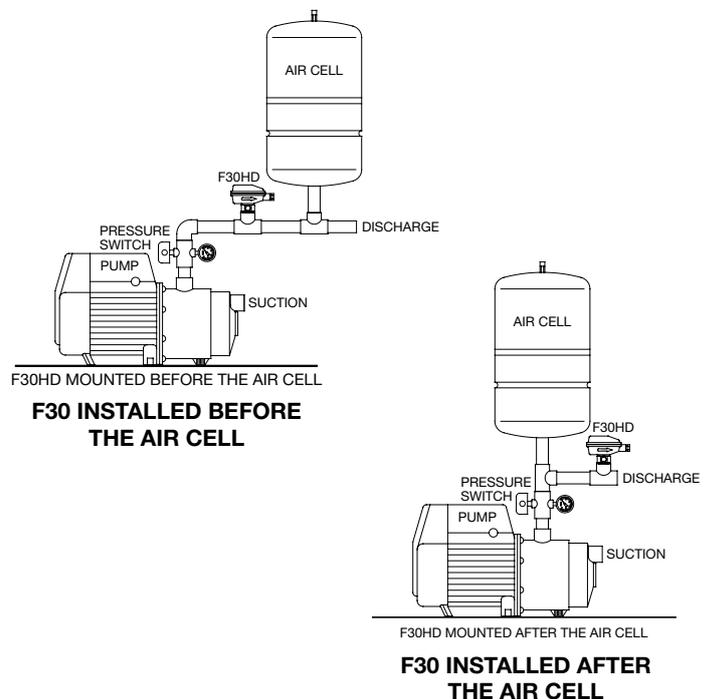
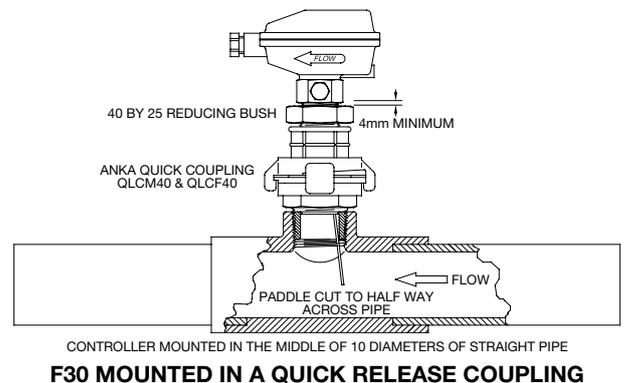
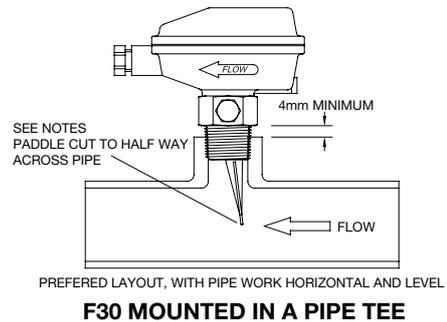
If a tap is opened too much more than a trickle with this configuration, the pump will immediately start, due to the paddle of the F30 being pushed forward by the flow from the air cell. This is what is described as "flow start". With this arrangement the only time the system will start on pressure drop is if there are leaks in the piping or a tap is left trickling. In such a situation, the pump will automatically start when the pressure switch eventually closes, re-pressurise the system and stop after a time delay, under the control of the F30. The main advantage of installing the F30 after the air cell is that the system will give an instant full pressure start at a very constant flow every time a tap is turned on. This configuration is ideal for small irrigation systems, gardens and household use. Where a gravity fed hot water system is installed, the hot and cold cycling in showers that plague normal pressure pumps are eliminated with this configuration.

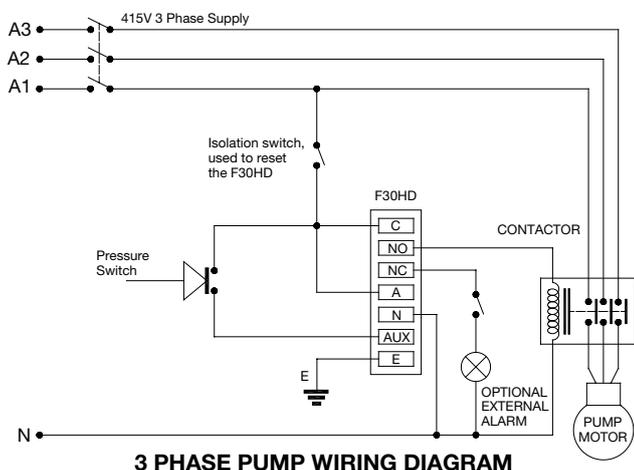
INSTALLATION

Having decided which basic configuration to use, follow the notes below. Set out are some circuit examples and some essential details on installing and adjusting the F30.

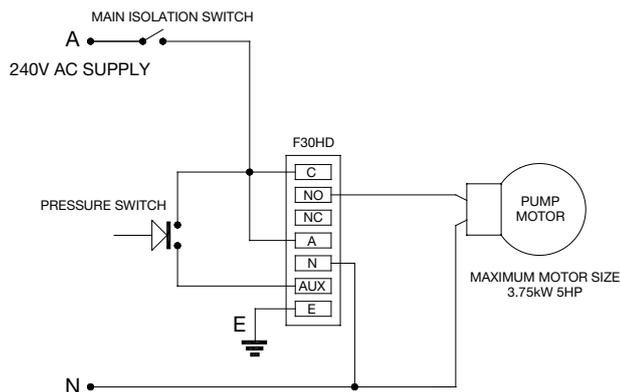
A suitable location should be selected for the controller in either the suction or delivery pipework of the pump. The controller should be installed in a location that is away from both vibration and heat, preferably out of direct exposure to the weather and above any flood level. A 1" BSP or larger socket must be provided in the pipework to fit the controller. The socket should be located on the top side of a horizontal section of the pipe with at least 5 diameters of straight pipe either side of the controller. Under no circumstances mount the controller upside down under the pipe, or close to valves, tees, bends or any other object likely to cause major turbulence in the flow.

In most installations the paddle of the controller will need to be trimmed to suit the specific pipe in which the unit is to be installed. The paddle of the controller needs a force of around 15 to 20 grams acting on it from the flow in order to operate correctly. High velocity flow can generate high forces and damage or break the paddle. As a general guide the paddle of the controller should extend to around the centre line of the pipe, or a bit past the centre. The paddle would not normally be left longer than this unless the expected flow velocity was very low. Cut the paddle so it extends to about the centre line of the pipe, or a little past the centre when screwed into its socket. Ensure the paddle will clear the sides of the socket and has enough room to swing back and forward freely. Apply Teflon tape or a suitable thread sealant and screw the controller into the socket using the spanner flats provided. Do not twist the body of the controller or use it to screw the unit into the socket, as to do so may damage the housing. When properly installed there should be a gap of at least 4mm between the top of the 1" BSP thread and the under edge of the spanner hexagon. Under no circumstances should the thread be allowed to bottom out in its socket as to do so places the thread in tension and may result in the controller housing cracking under pressure. A quick release fitting can be used between the F30 and the pipe tee, as shown in the accompanying drawing. This makes maintenance and removal very simple.

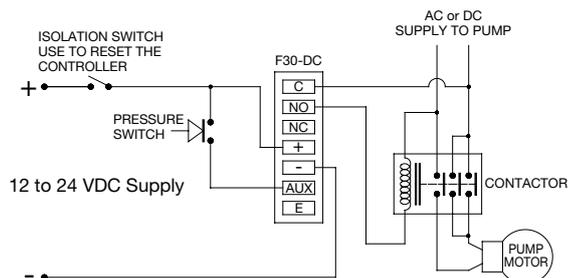




3 PHASE PUMP WIRING DIAGRAM



SINGLE PHASE WIRING DIAGRAM



F30-DC WIRING DIAGRAM

ELECTRICAL

The F30 flow switch requires a stable supply voltage in order to operate correctly. Pay particular attention to cable sizes, and ensure cables are adequate for the specific pump motor load. This is particularly relevant where long cable runs are to be used in the installation. If the voltage drop associated with the pump motor starting is excessive the F30 will reset, and may cause the pump to jog. Jogging can snap a pump shaft very quickly, so please take all precautions to ensure the voltage supply to the F30 is stable and adequate for the job. Supply voltage must be within the limits set out in the table below.

VOLTAGE RATING

MODEL	MAXIMUM SUPPLY VOLTAGE	MINIMUM SUPPLY VOLTAGE
F30-240HD F30-240	260V AC	160V AC
F30-24HD F30-24	18V AC	28V AC
F30-DC	24DC	10V DC

IMPORTANT NOTES:

Never connect a DC load across the normally open terminals of the F30HD. These controllers are only suitable for AC applications. The F30HD models are designed for motor control and do not have voltage free contacts. To operate properly all F30HD models require a minimum load of 10mA impressed across the normally open terminals. The small leakage current across the normally open terminals means the F30HD flow switches are not suitable for driving small loads such as low wattage relays or electronic timers. For such applications use a standard F30-240 or F30-24 flow switch. The F30-DC can be used in AC or DC applications, its relay contacts are voltage free.

The F30-240HD and F30-24HD flow switches incorporate a solid state drive to control a pump connected to their common and normally open output terminals. The solid state drive enables very large pump motors to be directly controlled, without the need for an interposing contactor. The maximum size motor that can be controlled directly by the F30HD flow switches is 3.75kW 5HP. At 240VAC the maximum recommended continuous current load controlled by the F30HD must not exceed 16 Amps. The maximum motor starting current should not exceed 60 Amps.

Wire the system according to the model number of the controller and the circuit schematics on this sheet. The F30 is normally connected to an external pressure switch which must be set to cut in and out at the correct settings before the controller can operate properly.

All F30 controllers have a single set of normally closed terminals, marked "C" and "NC", with a 16Amp 240V resistive rating. These contacts can be used to control an external alarm or loss of flow warning light if required.

The F30-DC is essentially a control device that incorporates an S.P.D.T. relay as its output. The F30-DC does have the capacity to directly control small AC pump motors up to 0.75kW 1HP. For all DC motor load applications, an interposing relay must be used between the F30-DC and the load.

Several examples of typical wiring arrangements are provided on this installation sheet. The circuits provided are intended as a guide only to show the most basic and common ways to connect an F30 pump controller.

FUNCTIONS OF THE INDICATOR LIGHTS

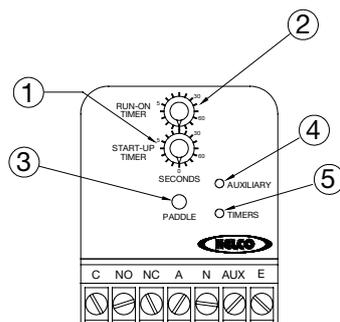
PADDLE LIGHT (3)	FUNCTION
GREEN	Indicates that the paddle is in the flow position. Normally off, this light turns green as soon as flow pushes the paddle forward. The pump will be on whenever this light is green.
SLOW RED PULSE	Blinks red every 2 seconds to indicate power is on. This light will blink red whenever the power is on but the pump is off.
RAPIDLY FLASHING RED	This light flashes rapidly red to indicate that the pump has been run dry and the F30 has shut it down. The blue auxiliary light will also be on indicating the pressure is low.

TIMER LIGHT (4)	FUNCTION
GREEN	Provided the start-up timer is not set to zero, this light indicates the start-up timer is running, only comes on when the F30 is first powered up. The pump will run while ever this light is on.
RED	Turns red to indicate the run-on timer is running. Can only come on after the start-up timer has timed out. Provided the run-on timer is not set to zero, this light will turn red whenever the paddle swings to the off position, indicating flow has stopped. This light also turns red whenever the pressure switch closes. This red light can only ever be on while the pump is running.

AUXILIARY LIGHT	FUNCTION
BLUE	This light indicates the true status of the remote pressure switch. It is on whenever the contacts of the pressure switch are closed. The pressure switch contacts must be open and this light off before the run-on timer times out. If not, the F30 will shut down the pump and go into alarm mode, with the paddle light flashing rapidly red, indicating dry run. Once in this mode, the pump will not restart until the power to the F30 is reset.

F30 CONTROL LAYOUT AND FUNCTION

- 1 **START-UP TIMER** Adjustable in steps from 0 to 180 seconds, runs once only each time the controller is powered up or reset.
 - 2 **RUN-ON TIMER** Adjustable in steps from 0 to 300 seconds. Can be used to prevent the pump from cutting out on minor supply interruptions as caused by air in the piping. Can also be used to run the pump on after the flow stops, and pressurise pipes, or to charge an air cell.
 - 3 **PADDLE** status LED turns green whenever the paddle is on (whenever there is flow), slowly blinks red when the controller is in standby mode with the paddle off, to indicate the power is on and the pump is being monitored. This LED also flashes rapidly red in alarm mode, if the pump has run dry. Once in alarm mode, the controller will not allow the pump to restart until the power to the unit has been reset. This light is an excellent tool for setting up the controllers and for diagnosing problems with the pump system.
 - 4 **AUXILIARY** This LED turns blue to indicate the true status of a pressure switch connected to the auxiliary terminal. When this LED is on, the pressure switch contacts are closed, when it is off, the pressure switch contacts are open.
 - 5 **TIMERS** This LED turns green when the main timer is running, which occurs each time the system is powered up. It also indicates when the run on timer is running by turning red. When setting up a controller this LED is essential because it allows you to observe exactly how long the timers run after the paddle has been pushed into the on position by the flow. It allows the timer dials to then be correctly set to slightly longer than the time it takes for the paddle LED to come on.
- C** Common output terminal. Power is normally looped into the common terminal from the supply active.
- NO** Normally open terminal. A switch wire is normally run from this terminal directly to the pump motor.
- NC** Normally closed terminal. Usually left unused, but can be connected to an external alarm if required.
- A** Active terminal connects to the supply active, via an isolation switch.
- N** Neutral terminal connects to the supply neutral.
- AUX** The auxiliary terminal accepts a switched input from an external pressure switch. The switched supply to the AUX terminal should be at the same voltage, and from the same phase as the main supply to the controller.
- E** Earth terminal, isolated binding post for termination of earth wires.



GENERAL LAYOUT OF F30 CONTROLS

PRESSURE SWITCH SETTING

A pressure switch is usually set to switch the pump on at about 140kPa and to switch it off at about 420kPa. When used with an F30, the pressure switch should be readjusted so it switches on at about 80 to 100kPa above the system's static pressure, and switches after a minimal rise in pressure. Set the differential setting screw on the switch to the minimum differential, and adjust the cut in pressure so that with the pump switched off, the pressure switch closes its contacts before all the pressure dissipates and it reaches a static pressure state. The object is to have the pressure switch always close its contacts on a falling pressure before all the pressure dissipates. By setting the differential to a minimum, you ensure the pressure switch will open its contacts on a rising pressure just after the pump starts. The F30 uses the state of the pressure switch to identify if the pump is running dry. It is important to have the pressure switch open its contacts before the run-on timer in the F30 times out. By setting the differential to a minimum, you allow the full range of time delay setting on the F30 run-on timer to be available for adjustment.

TIMER SETTINGS

Time delay adjustment is by means of two 16 position rotary switches. The time delays are individually programmed into the controllers to give the switches the following settings.

TIMER	DELAY IN SECONDS
Start-up Timer	0, 1, 2, 3, 4, 5, 10, 15, 20, 25, 30, 40, 50, 60, 120, 180
Run-on Timer	0, 1, 2, 3, 4, 5, 10, 15, 20, 25, 30, 40, 50, 60, 180, 300

ADJUSTING TIMER SETTINGS

When adjusting the timer settings, the power to the controller must be reset, that is, it must be turned off for a minimum of 1 second and then turned on again, before the changes will take effect. This applies to all the controllers.

BASIC FLOW SWITCH FUNCTION

The F30 pump controllers have two independent timers and are individually adjustable in steps. With both timer dials set to zero, the controllers behave like a basic flow switch, they respond solely to paddle movement. On power up, the only indication of activity will be the paddle light slowly blinking red to indicate the power is on. If the paddle is pushed into the on position, the pump will start and the paddle light will turn green. If the paddle swings to the off position (because flow stops), the pump will stop and the paddle light will revert to slowly blinking red.

OVERRIDE ON START

On power up, the F30 will start the pump. The green timer light will also come on and stay on for whatever time you have set the start-up timer to. If the paddle is pushed into the on position by flow during the time out period, the green paddle light will also come on. At the end of the time out, the timer light will go out, but if the paddle is on, the pump will continue to run. The green paddle light will remain on. If the paddle subsequently swings to the off position because flow stops, the paddle light will turn off and the pump will stop. The main paddle light will then revert to slowly blinking red.

When running the controller in the override on start mode as described, the main timer is normally set to slightly longer than the time required for the paddle light to come on. By watching the timer light and the paddle light and observing what happens on power up, it becomes a simple matter to correctly set the timer.

RUN-ON TIMER

On power up, the pump will start, the green timer light will also come on. If the paddle is pushed forward by flow, the green paddle light will also come on. After the start-up timer's initial time out, the green timer light will go out but the pump will continue to run and the paddle light will remain on, green. If the flow stops, the green paddle light will go out and the timer light will turn on red indicating the pump is running on the run-on timer. The pump will continue to run while the run-on timer is running. If the paddle then swings back into the on position before the run-on timer times out, then the pump will continue to run seamlessly. If however the paddle fails to return to the on position by the time the run-on timer times out, the pump will stop. The run-on timer's red light will go out and the green paddle light will also go out. If the paddle is subsequently pushed back into the on position, the paddle light will again come on and the pump will restart. Every time the paddle swings back to the off position the run-on timer will re-run and keep the pump running while it times out.

The main timer and the run-on timer function independently of each other and are totally flexible. For example you can set the main timer to 3 seconds to get a pump started and the run-on timer to 2 minutes to run a pump on and pressurise a pipe system or very large air cell. Alternately, you could set the main timer to 3 minutes to allow a bore pump with a self draining riser time to prime its riser, and you could also set the run-on timer to 2 or 3 minutes to pressurise a feed line to a remote stock trough, long after the main flow has reduced to a trickle.

In addition to the simple override functions the F30 controllers can accept an input from an external switch, usually a pressure switch. When used, the auxiliary input allows the controller to start on a falling pressure and to identify a dry run situation. The F30 controllers also include an alarm routine that locks out the pump in the event of dry running, preventing it from restarting until the problem is fixed or the power is reset.

To use the auxiliary input, the pressure switch must be correctly adjusted, and should be set so its low pressure contacts close on a falling pressure at 8 to 10M head pressure above the system's static pressure. In other words in a pressurised system with a slow leak, the pressure switch contacts must close before all the pressure leaches away. In addition, the pressure switch differential setting must be set to a minimum. The object is to have the pressure switch start the pump only, and then for its contacts to open as soon as the pressure starts to rise, and before the run-on timer in the F30 controller times out.

Given that the pressure switch has been correctly set up and adjusted, in a normal pumping system that has been running, and has stopped, the F30 will function in the following manner.

The paddle light will blink slowly indicating power is on. If the pressure is allowed to fall, for example if a tap is opened slowly so as not to actuate the paddle, then as soon as the pressure reaches the cut in pressure of the pressure switch, the pump starts. The blue pressure switch light and the red run-on timer light will turn on. As the pressure rises, the pressure switch contacts open, the blue light will go out and the pump will continue to run under the control of the run-on timer. When the run-on timer times out the pump will stop and the red run-on timer light will go out. The paddle light will again blink slowly red. The net effect has been to re pressurise the system. If over some period of time the pressure is allowed to leach away again, the process will repeat, the pump will automatically start, re pressurise the system and then stop and go back into standby mode.

It is important to note that the pressure switch is only used to start the system, not to stop it as in a conventional pressure system. This means the pump can function as a constant pressure system not constrained by the need to pump up to a high cut-out pressure simply because the pressure switch requires it. Taken one set further, a multistage pump can be de-staged, or a pump with a substantially flat constant flow curve can be selected to operate under the control of the F30. This can result in substantial savings in running costs and in many applications provide a highly useful constant pressure flow, free of the pressure fluctuations that plague conventional pressure systems.

DRY RUN PROTECTION

The F30 will start a pump on a falling pressure, and it expects to see the pressure rise as soon as the pump starts. At any time, during normal running or during standby, the closing of the pressure switch contacts will start the run-on timer running. If the run-on timer times out and the pressure switch contacts have not opened, the F30 will go into alarm mode. The pump will stop and the paddle light will turn red and flash rapidly. In alarm mode the paddle is overridden and even if the paddle is jammed in the on position the pump will not start. Normally in this situation, the blue pressure switch light will also be on, indicating that the pressure switch is closed and therefore the pressure is too low.

To restart the pump, turn the power off, wait for one second and turn it back on. If the pump is running dry, the F30 will again time out on its main timer, stop the pump and go back into alarm mode. With the pump primed, reset the power and observe the blue pressure switch light. As the pressure rises the blue light will go out and the pump will continue to run under the control of the main timer. When the timer times out the pump will stop and the paddle light will revert to slowly blinking red, indicating all is well and the controller is in standby mode.

SENSITIVITY ADJUSTMENT

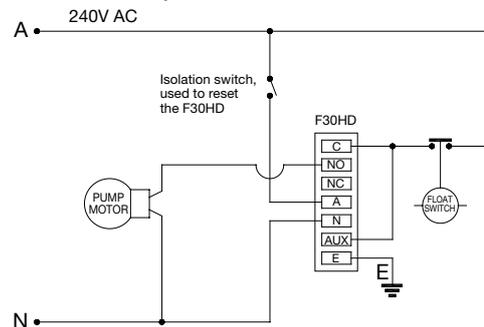
A sensitivity adjusting screw is provided for fine-tuning the controllers. Under the end of the controller's housing is a hex-headed plug that covers the adjusting screw. Remove the plug and using a broad bladed screwdriver wind the adjusting screw anticlockwise to increase the sensitivity (reduce the flow rate needed to actuate the paddle.) As supplied, the screw is wound fully in, and the controller set to its least sensitive. The maximum sensitivity is reached with the screw wound out to a point where the hex dust cover can still be refitted. Normally the sensitivity screw should be left fully in. If the paddle has been trimmed too short, the effect can be compensated for by winding the sensitivity screw out a few turns.

CONTROLLING A TANK-FILLING PUMP

The accompanying circuit shows how to wire an F30 pump controller to give a tank-filling pump loss of flow protection. With reference to the circuit, when the tank is close to empty the float switch closes and applies power to the "AUX" and "C" terminals of the F30. The pump immediately starts and runs while ever the float switch remains closed. When the tank is close to full the float switch opens, breaking power to the "C" and "AUX" terminals. The pump immediately stops. The F30 is powered independently of the float switch, through its "A" terminal, so it

will continue to run on its internal run-on timer in spite of the pump being off. When the run-on timer times out the F30 will revert to standby mode with its red light slowly blinking.

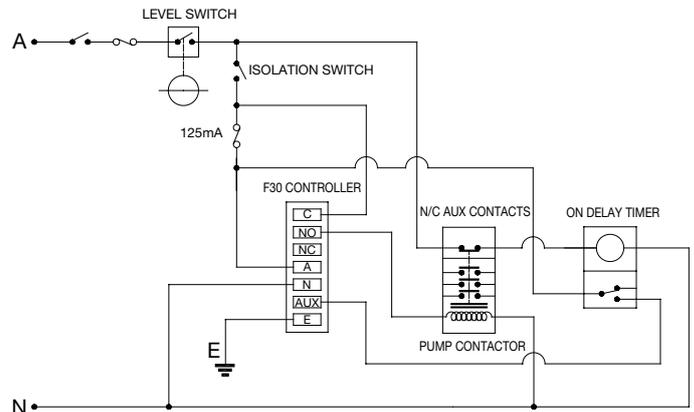
If the system is running and the tank is filling, and the pump runs dry, due to lack of water or a broken pipe, the F30 paddle will swing to the off position and the run-on timer will engage. The run-on timer will time out and the F30 will stop the pump. This is in spite of the float switch being closed and the tank calling for water. In this state the F30 will rapidly flash its red light indicating it has been run dry. The system will not restart until power to the whole system is reset.



DRY RUN PROTECTION FOR A TANK FILLING PUMP

CONTROLLING A LOW YIELD BORE PUMP

An F30 pump controller can be used in many novel ways to control a pump. The accompanying circuit diagram shows how to use a single external timer to restart a borehole pump that has stopped on loss of prime, due to low yield or high draw down.



CIRCUIT FOR AUTO RESTART OF A TANK FILLING SUBMERSIBLE BORE PUMP

A single external timer can be used to control the AUX terminal of an F30 pump controller that in turn restarts the pump after any required time delay. With reference to the accompanying circuit, when the tank level switch closes it powers up the F30 and immediately energises the pump contactor, and starts the pump. The Normally Closed auxiliary terminals of the contactor will open, so there will be no power to the external timer. If the F30 controller drops the contactor out because of lack of flow, the contactors auxiliary terminals will close and power up the external timer. The timer will run for whatever it is set to, say 2 hours, before its contacts close and power up the auxiliary terminal of the F30HD, restarting the F30 and the bore pump. As soon as the pump starts, power is lost to the external timer and its contacts open, dropping the power off the F30 auxiliary terminal. The bore pump runs on under the control of the F30. If the bore draws down again, the process will repeat with the pump restarting at whatever time interval has been set on the external timer. If the bore is still dry when the external timer powers up the system, the pump will only run for the time set on the F30 main timer, 1 to 180 seconds. In a normal situation the bore will recover during the external timer's delay, however if the bore remains dry it is highly unlikely that the short and infrequent run time of the F30 will cause any damage to the bore pump, and the user will become aware of the problem when he runs out of water in the tank.

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