KELCO F60
DIGITAL PUMP CONTROLLER

PROGRAMMING INSTRUCTIONS

Version 180516

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VERY IMPORTANT

This Kelco controller has been fully tested and calibrated. It is presently unlocked and has a simple program loaded. It is set to operate in a basic way with most of its special functions and features switched off.

On start up this controller will run the pump using its start-up timer. If it finds normal operating conditions in the pipe system it will continue to run the pump. If pressure or flow conditions change the pump will continue to run for a short period held on by the controller's built in run-on timer. If acceptable conditions fail to return the pump will be shut down after the run-on time period. Pressing the red reset button on the controller's lid or resetting the power will repeat this basic process.

To change the functions of this controller please first read the programming book supplied with this unit.

IMPORTANT

DO NOT EXPOSE THIS CONTROLLER TO VIBRATION. INSTALL ONLY IN PIPEWORK OR MANIFOLDS THAT DO NOT VIBRATE. Vibration will damage the sensitive electronics within the controller and will void your product warranty.

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Please Read Me First

The F60 pump controller is supplied pre-loaded with a simple program. It is set to mode 1 and it has it's startup and run-on timers both set to 5 seconds. All other functions are turned off or set to zero. Provided the F60 is unlocked you can restore it to this default state at any time by pressing and holding down the (P) button and pressing the (R) reset button at the same time. Doing this removes any settings you may have entered and restores the controller to its original default state.

Introduction

The F60 pump controller includes a set of functions that can be set up to control a pump. The functions range from a simple override on start timer that allows a pump to start in spite of an initial lack of flow, through to sophisticated cyclic running and stopping sequences. The functions are independently accessible and adjustable through the F60's simple programming interface. The pages that follow set out what each function does and how to set it up.

The actual selection of a suitable mode of operation and the functions used from a specific mode must be decided prior to programming and will depend on what level of control the pumping system requires. In order to achieve the best performance from this pump controller observe the following basic rules.

1) Use the least number of functions possible. Do not program in functions you do not specifically require, as to do so will make the system's operation unnecessarily complicated and may introduce unpredictable interactions between the various functions.

2) When moving from mode to mode and from function to function always reset time and pressure values back to zero before moving on. Do not leave timers setup with some value entered in and subsequently decide not to use that specific function. If you do this then enter zero values into the timers and pressure setting before exiting the unrequired function. Provided the F60 is unlocked, a quick way to reset it and clear out any unwanted settings is to press and hold down the (P) button while also pressing the (R) reset button. Doing this clears all settings out of the controller and loads in a very basic mode 1 program.

3) Set realistic and sensible values into the various functions. For example do not set a pump to stop at a lower pressure than it is set to start at. Always set the controller's starting and stopping pressure differential to as wide a difference as possible.

Programming The Controller

This pump controller is fully programmable; it accepts input via 4 push buttons. The buttons are marked (P) for programming, Up and Down for data entry and a reset button (R). Pressing the (P) button during normal operation stops the pump and allows entry to the controller's menu. Subsequent pressing of the (P) button steps you through the menu from one option to the next. Each option can be adjusted using the up and down buttons.

Pressing the (P) button stores the settings you make into the F60's memory and steps you to the next option. When you reach the end of the option list the controller asks you to press the reset button to accept the settings you have made and to resume normal running. You can automatically save any changes you have made and exit out of the menu at any stage during programming by simply pressing the reset button. The settings you make are non volatile and are recorded in the controller's memory. Your setting will not be lost if the controller is switched off for extended periods. When the unit is switched back on the controller will automatically boot up and operate using the setting last recorded in its memory.

The Four Operating Modes

The F60 can be set to operate in one of 4 fundamental operating modes. An initial choice must be made as to how you want to control the pump. Once you have made your choice, the F60's menu will ask you a series of questions that relate to the specific mode you have chosen. A table of the available functions is included here to assist with selection of a suitable mode. The 4 modes are: -

Mode 1 Timer Control

In this operating mode the controller operates under time based control and ignores the system pressure. Mode 1 provides you with a set of basic timers that includes a start-up timer to allow the pump to initially start regardless of lack of flow and a run-on timer to ignore short term interruptions to flow. In addition delayed restarting is available as is anti-cycling and burst pipe detection. In basic mode the controller will start the pump each time power is switched on or each time water flow pushes the paddle forward. The controller can also be started using an external input from a remote switch. See the section on remote input for more information.

In Mode 1 the controller does not utilise its internal pressure sensor to control the pump. Pump control is solely based on flow and time. The controller's pressure sensor is used to display the system's line pressure on its LCD screen during normal operation.

F60 Modes & Functions

MODE	1	2	3	4
Functions (# Settable)				
# Select pressure units kPa or psi	**Y**	**Y**	**Y**	**Y**
# Pre-start delay timer	**Y**	**Y**	**Y**	**Y**
# Start-up timer	**Y**	**Y**	**Y**	**Y**
# Pressure timer				**Y**
# Run-on timer	**Y**	**Y**	**Y**	**Y**
# Pressure dip timer				**Y**
# Delayed re-starting timer	**Y**	**Y**	**Y**	**Y**
# Starting pressure		**Y**	**Y**	**Y**
# Stopping pressure			**Y**	**Y**
# Cyclic running and stopping timers	**Y**	**Y**		**Y**
# Burst pipe detection	**Y**	**Y**	**Y**	
# Auto restart if run dry		**Y**	**Y**	**Y**
# Anti-cycling	**Y**	**Y**	**Y**	
# Leak detector			**Y**	
# Starts the pump at a preset low pressure		**Y**	**Y**	
# Stops the pump at a preset high pressure			**Y**	**Y**
Stops the pump if flow stops.	**Y**	**Y**	**Y**	**Y**
Displays the system pressure in preferred units	**Y**	**Y**	**Y**	**Y**
Displays the high & low pressure set points			**Y**	**Y**
Can start or start & stop the pump using an external switch (with voltage free contacts)	**Y**	**Y**	**Y**	**Y**
Starts & stops the pump on flow regardless of pressure	**Y**			
Displays the time the pump ran for in minutes				**Y**

Mode 2 Flow Control

In this mode the F60 will start the pump each time the pressure falls below a preset value or whenever the controller's paddle is pushed to the on position by flow. It will then run the pump entirely on flow. Unlike a conventional pressure system that operates between a low pressure cut-in and a high pressure cut-out, in mode 2 the controller only uses the pressure set point to start the pump, not to stop it. Once started, the F60 runs the pump while ever flow is present, thus providing a relatively steady constant flow. The pump is only shut down when flow stops or if the pump runs dry. A momentary contact external switch can also be used to trigger the starting and or the stopping of the pump in this operating mode.

Mode 3 Pressure Control

If this mode is chosen the controller will start and stop the pump under the control of the F60's built in pressure sensor. A high pressure cut-out point and low pressure cut-in point are programmed into the controller's memory and thereafter the pump is run within these pressure limits. If the pressure rises above the high pressure set point the pump will shut down. If the pressure falls to below the low pressure set point, the pump will start. If the pump runs dry, this is sensed as a combination of loss of flow and pressure lower than your low pressure set point. In this situation, at the end of any set run-on time, the pump will shut down and go into alarm mode.

In mode 3 the pump controller can also be connected to an external switch. The pump controller will start the pump each time the external switch closes its contacts. The contacts of the external switch can be set to only operate the pump while they remain closed or they can be set to only trigger the starting of the pump and not effect its stopping. Since the F60's remote input operates at low voltage and low current, a low Wattage external switch, such as a tank level switch that utilizes a low Wattage reed switch can be used to control a large powerful pump without the need for an interposing pump starter or relay. See the section on page 8 detailing the use of the remote input.

Mode 4 Pump Guard

Mode 4 presents the user with a mode of operation that is significantly different from the preceding 3 modes. In many ways mode 4 is the most powerful and flexible mode of all. It is applicable to so many areas of pump control and gives the user a very useful tool to control a pump.

When mode 4 is selected the F60 behaves as a pump guard. It monitors both flow and pressure and shuts the pump under its control down if any of the monitored conditions move outside preset limits. The pump under the F60's control will be shut down if it runs dry, if flow is lost or if the system pressure rises above or falls below precise set points. Pump guard mode presents the user with a powerful set of functions that are ideal for controlling a pump in a variety of ways. One of the main applications for the pump guard is in controlling and protecting helical rotor pumps in cow shed effluent irrigation systems. The pump guard also finds application in conventional centrifugal pump based irrigation systems, in transfer pumping and in highly specialised fertigation and aquaculture systems as well as in a myriad of industrial and mechanical services applications. The feature set available in the pump guard is ideal for the control and protection of many types of pumping systems. The pump guard is incredibly flexible and allows the user to set up and customize a variety of parameters to suit the specific requirements of the individual pumping system.

The Modes in Detail

Modes 1 to 3 are detailed on the following pages. If you intend using mode 4, details of its operation can be found on page 18. Once you have decided which of the 4 operating modes you intend using, with the F60 powered up, press and hold down the (P) button for 1 second and then release it. On releasing the button you are presented with a Kelco splash screen. Pressing (P) again steps you to a screen that displays the F60's model number. The screens that follows allows you to select the pressure units you prefer, either kPa or psi. Use the up or down keys to select between the two units. Once you have made your choice press the (P) button to step to the next selection which is the pre-start delay timer. Use the up and down keys to select Yes or No for this option. If you are unsure what a particular option does, there is detailed information available further into this book on each function.

Pressure System Operation

If operated in mode 3 the F60 will only start the pump on flow on a rising pressure. Consider a standard pressure system operated through a pressure switch. The pump will start each time the pressure switch closes its contacts and stop each time the pressure switch opens its contacts. This means that in a system with a large air cell the pump once started will run continuously until the system is fully pressurised, regardless of demand. The F60 operates in a different way.

The pump will start at a settable low pressure. It will run while ever flow is present and only stop when flow stops or the pressure rises to whatever you have set its

high pressure cut-out to. If there is no flow demand the pump will only run on for whatever time you have set on the run-on timer, perhaps a few seconds and then it will stop. It will not pump continuously until the high pressure limit is reached, as a normal pressure system will.

If a valve subsequently opens, flow will be sensed and the pump will instantly start, given the F60 is installed down stream of a suitable air cell. The effect of this is to give the user a relatively constant pressure. Each time the pump starts it does so at the pressure it last stopped at, rather than only starting from low pressure as a conventional pressure system does. With frequent opening and closing of valves the system pressure may rise and eventually reach the set cut-out pressure.

The pump will then stop regardless of any flow demand. Thereafter any flow demand will not start the pump. In other words in this operating mode the F60 will not start a pump on flow on a falling pressure, only on a rising pressure. This is to prevent the pump from hunting on and off around the high pressure cut-out point. On a falling pressure demand will be met by draw off from the system's air cell only. Once the system's pressure falls to whatever pressure you have set the cut-in pressure to, the pump will start and again revert to starting and stopping on flow demand.

The Options in Detail

On pressing the (P) button you are presented with the Kelco splash screen. Pressing (P) again steps you to screen that displays the controller's model number. The screens that follow tell you the firmware version of the specific controller and then ask you to enter your preferred pressure units, either kPa or psi. Use the up and down buttons to highlight your preferred units and then press (P) to lock in your selection and to move to the next screen which is the pre-start delay timer. Use the up and down buttons to select Yes or No to this option and press (P) to lock in your choice. Details of the pre-start timer can be found on page 7. Once past the per-start timer and its time setting you are asked to select a mode. Use the up and down buttons to highlight your prefered mode and press (P) to confirm your selection.

As you step through the available choices certain functions will be available to you to use and certain functions will not appear. Some functions are common to all modes and some are mode specific. The controller's menu has sufficient intelligence to identify selections you make and to only make available to you functions that will work with the choices you have made. The functions that follow are mode specific and may or may not be available to you depending on the choices you have made up to this point. At this point if you have chosen to use

mode 4 then jump to page 19 of the book for details of mode 4, for modes 1 to 3, read on.

Pre-Start Delay Timer

The pre-start delay timer delays the starting of the pump for a selectable period. It can be applied to the initial starting of the system on power up or it can be applied to the start up that occurs when the remote input closes, given you opt to use the remote input. It can also be applied to both scenarios if required. The delay period can be set from zero to 64800 seconds (18 hour) in one second increments. When setting the pre-start delay timer, the UP button increments up in 60 second steps and the down button increments down in one second steps. This data entry system allows you to quickly enter large time values.

If you configure the pre-start delay timer to operate on boot up then each time the controller is switched on it boots up and is prevented from starting the pump for the set time period. As soon as the set time has elapsed the pump will start and run normally, given there is a demand for water. The pre-start timer can be used to allow peripheral equipment time to boot up. For example, some VS drives require a few seconds to stabilise and the F60's pre-start delay timer can hold off the starting of the pump until the whole system has stabilised. The pre-start timer can also be used to stage or stagger the starting of multiple pumps. It is often desirable to avoid the high current draw of multiple motors starting together, and the pre-start timer can facilitate this function by delaying the starting of one of the pumps.

If you configure the pre-start timer to operate when the remote input closes then the actual closing of the external switch will initiate the pre-start delay and the pump will not start until this delay period has expired. A typical application for such a configuration would be where a bore pump was controlled by a level switch in a small tank. The pre-start delay would delay the restarting of a bore pump until the standing water level had time to recover, even in situations where the content of the tank was rapidly depleted or were agitation caused early triggering of the level switch.

To configure the pre-start delay timer select YES to the question Pre-Start Timer OFF or YES. You are then asked if you want to delay the start at power up. Select YES is you want to delay the actual starting of the pump when it is first powered up. Select OFF if you don't want to delay the initial start up but you do want to delay the restarting of the pump when the remote input closes.

Once you have made this initial selection and pressed (P) you are asked to enter

the pre-start delay time in seconds. Take care when pressing the UP button to enter your required delay, the display increments up very quickly in steps of 60 seconds. Use the down button to decrement back down to any required time in steps of one second.

After entering a suitable pre-start delay and having selected to apply it to either the initial start or to the starting that occur when the remote input closes and having pressed (P) you are asked to select a mode of operation as described in previous pages. After entering your required operating mode you are asked if you want to use the remote input functions of the F60. The remote input is described in the next section and its use and configuration along with the configuration of the pre-start delay timer determine how the pre-start delay timer will behave. The possible configurations of the pre-start timer are : -

Use the pre-start delay NO. This configuration means you don't want an initial delay on either boot up or when the remote input switch closes. It means the pre-start timer is simply OFF.

Use pre-start delay YES. Delay the start at power up YES. This configuration provides an initial delay on power up. If you subsequently choose to use the remote input it will also delay the restart when the remote switch closes.

Use pre-start delay YES. Delay the start at power up NO. This configuration assumes you will be using the remote input and it will give you the required delay once that is done. It will not, however, give you a delay on initial boot up.

Note that the alarm relay in the F60 can be configured so its contacts are closed when the pre-start timer is running and open at all other times. When set up this way the alarm relay can be used to control an external process. For example the alarm relay could be used to operate a mixer or aeration system to mix a batch of material prior to pumping it out of a holding tank. The mixer would shut down when the pump started.

Remote Input (Modes 1 to 4)

The F60 provides the user with a non-isolated nominal 24VAC supply from its LV (Low Voltage) active terminal whenever the F60 is operated from the mains or from a 24V supply. The 24V supply can be connected through a remote switch and the return wire can be connected to the "R" (remote input) terminal on the F60's terminal block. When operated from a 24V supply, the 24V active or the supply positive can be used as the source of low voltage to the remote switch and

the return wire can be connected to the “R” terminal. It is critical that the remote switch has voltage free contacts. Under no circumstances apply an external voltage directly to the “R” terminal of the F60 pump controller. See the F60 Installation Manual for further details.

An external switch such as a tank level switch or a set of external voltage free relay contacts can be used to actuate the F60 controller. The external or remote switch will operate the F60 in all 4 operating modes.

The controllers menu asks you if you intend using a remote input. If you select yes you are then asked if you require the external switch to trigger the starting of the pump only or if you want the external switch to also control the stopping of the pump. If you choose “starting only” the pump will start each time the external switch closes its contacts. Once the pump has started the external switch can open its contacts or they can remain closed without any effect on the operation of the pump unless you have also selected delayed restart. If so, then closing the remote cancels the delay and depending on the mode you are in and the system pressure, may instantly start the pump. If the contacts remain closed the pump may cycle on and off on its run-on timer in such a situation.

If you choose to have the F60 both start and stop the pump then the contacts of the external switch must remain closed while ever the pump is required to run. If the contacts of the remote switch open the F60 will immediately shut the pump down and display a message “remote switch is off”. The F60 will then not allow the pump to restart until the remote switch closes its contacts.

Having selected to use the remote input for either start only or start and stop and having pressed (P), the question that follows will depend on your previous decision to use or not to use the pre-start delay timer. If you previously answered NO to the ”use pre-start timer” question, the menu transports you to the systems next main question which is whether or no you want to use the alarm relay. If you had previously elected to use the pre-start timer and set its initial usage question to YES then upon selecting the remote inputs basic configuration and pressing YES you will be asked if you want the pre-start timer to delay the restart of the pump when the remote switch closes. If you select YES then the pre-start timer will operate each time the remote input switch closes and delay the actual starting of the pump for what ever time period you have the pre-start timer set to. If you select NO then the usage of the pre-start timer will be confined to the system’s boot up only and will not operate when the remote switch closes.

As an example of the use of the remote input. If the pump were to be controlled by an external tank level switch that started the pump each time the tank emptied

and stopped the pump each time the tank filled then you would choose to use the external remote input in “start and stop the pump” mode. If you required the pump to start each time an external relay or switch closed its contacts and thereafter run under the control of the F60 then you would choose “start the pump only” from the F60’s menu.

Alarm Relay (Modes 1 to 3)

After selecting an operating mode in the main menu and pressing (P) you are asked if you want to use the alarm relay. The F60 contains a dedicated relay (Relay 2) with 16 Amp 240VAC rated voltage free contacts. The contacts of the alarm relay can be used to control any required device within their electrical rating including an external alarm or even a second pump. The alarm relay is very versatile and can be set to operate in one of 8 different ways. If you choose yes to “use the alarm relay” you are confronted with the first of 8 screens asking you how you would like the alarm relay’s contacts to behave. You can move through the choices using the up and down buttons. Details of the choices follow.

1) Closed if Any Fault Develops (Remains open if flow stops)

If you want the alarm relay to close its contacts only when a genuine fault develops simply press (P) to accept this choice. Alarm on a fault means the alarm relay will only close its contacts if the pump runs dry, if flow is interrupted while cyclically running or while a batch control is running or if the anti cycling starts per hour rate is exceeded. The F60 identifies a dry run situation as a combination of loss of pressure and loss of flow. Note that if you have set run dry auto restart to on and have chosen repeated restarts from the run dry menu then in the event of the pump running dry the alarm relay will not close. This is because choosing repeated restarts means you accept the pump running dry as a normal event and not a true fault. If you require an alarm using this run dry configuration then using “alarm on loss of flow would be the appropriate choice. If you choose single restart from the run dry menu and the pump runs dry the alarm relay will not close its contacts unless the second attempt at restarting fails and the controller goes into permanent alarm mode.

2) Closed if Flow Stops (Remains open if a true fault develops)

The second alarm choice is really the reverse of the previous choice, it means the alarm relay will close its contacts every time flow stops, unless flow stops due to a fault. This means stopping under normal circumstances. It means the alarm relay will not close its contacts if a fault occurs, as it would if you had made the previous choice. Such faults that will not cause an alarm include running dry, flow interruptions to batch or cyclic running and exceeding the set number of pump motor starts per hour as set in the anti cycling selection.

3) Closed if Pump is Off (Regardless of flow or faults)

This choice effectively provides a set of voltage free contacts that act in reverse to the main pump relay's contacts. That is, the alarm relay's contacts will be closed when the pump relay's contacts are open and they will be open when the pump relay's contacts are closed. This configuration can be used for all manner of special applications where a set of independent electrical contacts are required. It is even possible to control a second pump via the relay's contacts. This can be done either directly or in the case of a three phase pump, via an interposing contactor. The standby pump would only run when the main pump was off.

4) Closed if Pump is On (Regardless of flow or faults)

If this configuration is chosen the alarm relays contacts will mimic the main pump relay's contacts. They will be closed when the pump relay's contacts are closed and open when the main pump relay's contacts are open. Like the previous choice, this configuration lends itself to all sorts of special control applications.

5) Closed During Pre-Start Delay (Remains open at all other times)

If you decide to use this option the contacts of the alarm relay will only be closed while the pre-start timer is running. See details of what the pre-start timer is and what it does in th eprevious pages. Basically the alarm relay contacts can be used to control some external device and provide an on state for a period of time prior to the pump turning on. A typical application would be to have an aeration system or mixer run for a set period of time and then shut down and then have the pump automatically start. Such applications are often encountered in influent and effluent mixing and processing.

6) Closed on Anti-Cycling Fault

This option is function specific. That is, if you choose this option the alarm relay will only close its contacts if the anti-cycling function is in use and has detected excessive pump starts in any given hour.

7) Closed if Pump Runs Dry

If you select this option relay 2 will only close its contacts if a true dry run situation is identified. The F60 identifies dry run as a combination of no flow and a pressure lower than your set low pressure point (starting pressure) for a period of time longer than you have set on the run-on timer.

8) Closed if Pipe Bursts

Like option 6, this alarm option is function specific. It allows you to set relay 2 to only close its contacts if the burst pipe detector is in use and has detected a burst pipe. Under all other fault conditions the relay will remain open.

Start Up Timer

The F60 uses a paddle to detect flow. The paddle is held in the no-flow position by an adjustable magnetic screw that is located in a port under the electrical housing of the controller. If flow pushes against the paddle, the paddle moves. The movement is detected by the controller and identified as flow. Initially in a system that is not running or has all its valves shut, there will be no flow and the controller's paddle will be in the off or no flow position. In order to override this initial off state and allow the pump to start, the controller uses the start-up timer. The timer ignores the initial off state of the paddle and allows the pump to run for a settable time. As soon as flow is detected the start timer terminates its run and hands control of the pump over to the paddle. The startup timer in the F60 is adjustable from 0 to 240 seconds (0 to 4 minutes) in 1-second increments. The value you enter will depend entirely on your pump system. For a fully primed pressure system or transfer pump, the start-up timer may only require one or two seconds to establish flow. In a submersible bore pump installation with a self-draining riser, it may take several minutes to establish flow past the paddle. If the start-up timer is set to zero the pump controller behaves as a simple ON/OFF flow switch, responding solely to the state of its paddle.

Run-on Timer

The F60 controller's built in run-on timer can be set to ignore minor interruptions to flow. For example, if air trapped in the pipework passes the controller's paddle, the paddle will momentarily swing into the no flow position. This would normally cause the controller to shut down the pump. The run-on timer lets the controller ignore such minor fluctuations in flow. Once triggered, the run-on timer tries to keep the pump running for whatever time you have set it to regardless of lack of flow.

During its run period the run-on timer monitors the state of the paddle and if the paddle is pushed back into the on position by flow, the run-on timer cancels its run and resumes normal running. If, however, the interruption to flow persists for longer than you have set the run-on timer too then at the end of the run on time the F60 will shut the pump down. The run-on timer can be set to any value from 0 to 900 seconds (0 to 15 minutes) in increments of 1 second. As supplied it is pre set to a default value of 5 seconds. For most applications an initial setting of a few seconds is quite adequate. The self resetting action of the run-on timer means it will keep a pump running in spite of repeated or continuous interruptions to flow.

In applications where entrained gas is present in the water, the run-on timer will ignore the continuous bouncing back and forward of the paddle by constantly resetting its time clock instant by instant.

Pressure Settings

If you select mode 2 or 3 from the mode menu, the screens that follow will ask you to enter starting and possibly stopping pressure in whatever pressure units you have chosen to use. Enter sensible pressures that are within the range of the pump and the F60 and include a reasonable differential between starting and stopping pressures. If you set the starting pressure higher than the stopping pressure, the F60 will not operate and will display a warning screen to the effect that the pressures have to be set correctly.

If you set the pressure differential (the difference between the starting and stopping pressure) too small the system may hunt on and off. This condition will be more pronounced if the system has no air cell or the capacity of the pipework is small. The F60's ability to operate on a close differential can be a major advantage in certain circumstances. In theory the cut-out pressure of the F60 can be set to 1kPa higher than the cut-in pressure. With such a setting the controller will operate on a differential of 1kPa. For actual practical usage, background pressure fluctuations and temperature variation in the system will reduce the actual usable minimum pressure differential to perhaps 10 or more kPa which is still considerably less than that of a conventional pressure switch.

In normal operation the F60 will display the system's dynamic or static pressure in whatever pressure units you have chosen whenever it is running normally or is waiting to start. It will also display any pressure set points you have entered. For example, when operating in mode 3 the LCD screen will display the current system pressure and the high and low pressure set points. From the display it is then a simple matter to watch the system pressure rise or fall toward the preset trip points that you have set the system to operate within.

Delayed Restarting

If you set this option to ON, each time the pump stops, due to flow stopping or pressure rising above your set point, the F60 controller will prevent the pump from restarting for the set period of time. The delay time can be set from zero to 99 hours 59 minutes (zero to just over 4 days) in steps of 1 minute. Delayed restarting is a form of anti-cycling and cyclic running, wherein the pump is limited in its ability to cycle on and off by being prevented from restarting for a set time period. Its

uses include preventing rapid cycling if the system's air cell becomes water logged or if a fault develops in a system's external controls. As an example of its use, consider a pressure system filling a remote tank. If the tank has a float valve that shuts when the tank is full, then the system will pressurise and shut down each time the tank fills and the valve closes. If the float valve leaks or the level drops and the valve opens the system will depressurise and the pump would ordinarily start. By utilizing the F60's delayed restarting feature, the restarting of the pump can be delayed for a period of time. Perhaps until the water level in the tank has dropped by a substantial amount.

If you choose to use the delayed restarting function and press P, you will be asked to enter the delay in hours and minutes. You will then be asked if you want automatic starting at the end of the delay period. If you choose yes to this question the controller will automatically start your pump at the end of the delay period. If you choose no, the controller will only start the pump after the delay if the pressure is lower than your set pressure, or if the external switch closes or flow is present. In the example outlined above, consider a tank that has intermittent or irregular draw off. You may choose to set the delayed restart to perhaps 12 hours. At the end of the 12 hour period the pump will automatically start and if the tank level is low, the pump will run continuously until the tank fills and the float valve in the tank closes. If however, there has been no draw off from the tank during the 12 hour period, the automatic restart at the end of the delay will start the pump and run it for whatever period you have set on the start timer (perhaps a few seconds). The F60 will sense no flow because the float valve will still be closed. The F60 will then shut down the pump and again wait for 12 hours before again attempting to start the pump.

Using this technique prevents the pump from hunting on and off when the tank is full because of slight leakage from the float valve or pipework. It allows you to set the pump to only operate after a chosen delay, and if there has been no usage of water, to test the system for demand by momentarily starting and only running the pump if there is a genuine call for water.

The delayed starting function is distinctly different in the way it operates to the cyclic running function that is also included in the F60. Delayed starting has no fixed run time. The pump will run continuously provided flow is present until it is stopped by a valve closing or until it runs dry. Cyclic running allows you to set how long the pump runs for as well as how long it stops for. If you choose to use the delayed starting option the cyclic running function that follows it will not be available to you, as its operation offers an alternative to cyclic running that excludes the combination of the two functions.

Burst Pipe Detector

The F60 includes a unique system for detecting burst pipes. The burst pipe detection system can be used in modes 1 to 3. It is most commonly used in pressure systems.

If a pressure system bursts its discharge pipe the system pressure will fall and the pump will start at its low pressure setting. The pump will then run continuously until the water source is depleted. If the discharge pipe splits and the pump has sufficient capacity the result may be continuous cycling of the pump as it attempts to satisfy the leak. The F60 addresses these two scenarios with two separate functions, anti-cycling and burst pipe detection. When both functions are activated the complete spectrum of burst pipe scenarios are covered. Anti cycling will detect cyclic starting and stopping and can be set to shut the pump down after a predetermined number of cycles. This function detects split and leaking pipes.

The burst pipe detector addresses the issue of a completely burst pipe where the pump would ordinarily discharge at its full capacity until the source of water was depleted. It does this by using a timer that times out for a settable period each time the pump runs. The timer resets back to its original setting each time the pump stops. The range of adjustment is zero to 99 hours 59 minutes in steps of 1 minute. In a typical application the burst pipe detector would be set to a time that was marginally longer than the longest time the pump would ordinarily run. For example, in a domestic pressure system day to day usage may require the pump to run for no longer than 15 minutes (for showers etc.). Perhaps once every few days the system is used for garden watering and required to run for 30 minutes. In this scenario the burst pipe detector would be set to perhaps 40 minutes. Each time the pump switches on the burst pipe detector begins to count down. In normal circumstances the pump will shut off in less than 30 minutes. This resets the burst pipe detector's timer back to 40 minutes. If however, the pump continues to run, due perhaps to a burst pipe, it will eventually reach the set point of 40 minutes. The pump will then be instantly shut down preserving whatever source water remains, or at least reducing the discharge flow by an amount equal to the pump's capacity. The F60 will then display "burst pipe detected" on its LCD screen.

The setting of the burst pipe detector is a matter of balance between nuisance tripping and maximum preservation of the water source. If the burst pipe detection timer is set too close to the actual maximum usage time, the system may trip out occasionally due to slightly excessive water usage. If however, the timer is set too long the result will be wasted water in the event of a genuine burst pipe.

The burst pipe detection system can be used to protect water reserves in tank filling and transfer pump applications. As an example, consider a tank filling application. The capacity of the pump and the tank are known so the maximum run time of such a system will be the time required to fill the tank when it is completely empty. Draw off from the tank may add to this time but fundamentally the time will be known within reasonable bounds. If the level switch in the tank fails or the float valve fails and the tank continuously overflows, eventually the pump under the control of the F60's burst pipe detector will reach the burst pipe detector's set point. The pump will then be shut down preserving what remains of the water source.

Cyclic Running

The cyclic running option is only available in modes 1 and 2. It is not available if you have chosen mode 3. The F60 can be programmed to run and stop a pump for set periods of time. Both the running and stopping times can be set to any value you choose from 1 minute to 99 hours 59 minutes (zero to just over 4 days) in increments of 1 minute. The cyclic running option is highly flexible. The run and stop timers are totally independent of each other. If a set running and stopping time are programmed in, the F60 will run the pump for whatever time it is set to and then stop for the time set on its stop timer. If a run time is set to some value and the stop time is left set at zero, the pump controller will behave as a one-shot batch controller. On pressing the reset button or switching the pump on, the pump will run for the set period and then shut down. It will not then restart until you again press the reset button or reset the power to the unit. In cyclic running mode the F60 monitors the elapsed time and displays the remaining time on its LCD screen in hours and minutes.

Cyclic running allows low yield bores to be pumped to their maximum capacity. A bore pump running under cyclic control can be set to pump the bore down to a low level, stop and wait for the standing water level to recover and then repeat the process endlessly all the while protecting it if it runs dry. For transfer pumping applications cyclic running can be used to automatically top up remote tanks without the need for float valves or level control at the tank. It can also be used for one-shot tank filling. Press the reset button and pump a set number of hours or minutes of water to a tank, and then stop until the reset button is again pressed.

Auto Restart if Run Dry

If the pump runs dry and the controller is set to mode 2 or 3 it will identify a dry run situation as a loss of both pressure and flow. The F60 is not capable of identifying a dry run condition in mode 1 because in mode 1 it only monitors flow and not the system's pressure. To identify dry run, the controller must monitor both flow and pressure, which it only does in modes 2 and 3.

If the F60 is set to operate in mode 2 or 3 it will identify any dry run situation that may occur and respond by shutting the pump down, thus preventing damage to the pump. In such a situation the controller displays a "pump ran dry" message and rapidly flashes all its lights to indicate there is a problem and can be set to close the contacts of its alarm relay (relay 2). The alarm relay can be used to control a remote alarm light, a siren or any other required device such as an auto dialer.

Alternatively, the F60 can be set to automatically attempt to restart and recover from a dry run situation after a set period of time. This process is called auto restart. If this option is chosen the controller's menu presents you with a choice, single restart or repeated restarts. Single restart will attempt to restart the pump after a set time and if the attempt fails the F60 then shuts down the pump and goes into permanent alarm mode. It displays a "pump ran dry" message, flashes all its lights and closes the contacts of its alarm relay. If however, it finds flow and or pressure when it restarts it resumes normal operation. If you choose repeated restart from the menu the controller will repeat the shut down and wait sequence and it will not go into permanent alarm mode. Once you choose repeated restart or single restart the screens that follow ask you to enter a waiting period in hours and minutes. The range of adjustment is 1 minute to 99 hours 59 minutes (zero to just over 4 days) in one minute increments. If the pump runs dry the F60 will shut it down and wait for the period you have set before attempting to restart.

The ability to restart the pump automatically if it runs dry can be a very useful function. Consider a self priming jet pump or submersible pump installed in a low yield bore. The bore can be pumped until dry and the pump under the control of the F60 can be set to shut down as soon as loss of flow is detected and then wait until the standing water level in the bore recovers before attempting to restart and again pump the bore down. Such a system maximises the yield from the bore and automatically compensates for seasonal fluctuations in the bores capacity.

Anti-Cycling

Electric motors are often limited in the number of times they can be safely started in any one hour. This is particularly important in the operation of submersible bore pumps. When a motor starts there is an initial inrush of current that produces heat in the coils and iron rotor of the motor. If the frequency of starts is excessive the accumulation of heat within the motor can cause severe damage and eventual failure of the motor. Submersible bore pump motors are particularly prone to damage from excessive cycling (starting and stopping).

The anti-cycling option built into the F60 allows the user to set the maximum number of times the pump can be safely started in any one hour period. If you select yes to this option the screen that follows will ask you to enter the maximum number of times the pump can be started in any one hour. The number of starts can be set from 1 start per hour to 1800 starts per hour. Please contact your pump supplier to obtain the correct figure for your specific pump. In operation the anti-cycling system monitors both time and the number of starts and compares the two. If the starts per hour rate is exceeded for a settable number of consecutive times in any one hour period the pump will be automatically shut down and the controller will display a message indicating the starts per hour rate was exceeded.

Number of Starts in Sequence

After setting the required number of starts per hour and pressing (P) you are asked how many starts in a continuous sequence you are prepared to accept. The default setting is 5 starts. This can be adjusted between 2 and 50 starts. Assuming you accept the default of 5 sequential starts then as a simple example of the way the anti-cycling system works, if starts per hour rate is set to 360 (one start every 10 seconds maximum) and the pump started 4 times in a row at less than 10 seconds between each start and then did not start again for 12 seconds the anti-cycling shutdown will not be invoked. If however, the pump were to start 5 times in a row with less than 10 seconds between the starts the anti-cycling system would be invoked and the pump would be shut down.

In a conventional pressure system the anti-cycling function can be used to protect the pump from damage in the event of the system's air cell losing its air charge. If air is lost from a system's air cell due to a ruptured diaphragm or leaking air valve, the pump will hunt on and off rapidly. Such rapid cycling will cause the pump to overheat very quickly. The F60's anti cycling feature can be used to shut down the pump and prevent damage in such a situation. To use the anti-cycling function for this type of pump protection simply set the starts per hour to some value that is marginally higher than the system's normal start rate. This will avoid

nuisance tripping but will shut the pump down if excessive sequential cycling is encountered.

Leak Detector

The F60 includes a unique leak detection system that can be used as a tool to analyse suspected leakage in a pressurised pumping system. The leak detector only operates in mode 3. It can be switched on or off in the main menu. It should be left switched off when not required as its display screen excludes the display of normal system pressure and messages when it is in use. To use the leak detector, open all valves feeding into the pipe system to be tested. Close all valves at the far ends of the pipework so the pipe system can be pressurised. Press the reset button on the controller, this will zero the leak detector screen and run the pump until the system is fully pressurised. Leave the system unattended for a period of time perhaps an hour or even a day or two. On returning to the system, the controller's LCD screen will be displaying the number of times the pump started and the total run time in hours minutes and seconds since the time the leak detector was zeroed. If the leak detector screen displays no starts and no run time, then no leak has occurred from the system in the interim period. If the screen displays a number of starts and a total run time, a leak has occurred and the magnitude of the leak can be assessed by considering the total run time displayed and the capacity of the specific pump. The leak detector can be used in any pressurised pumping system from a small domestic pressure or transfer system to complex irrigation and stock watering systems comprised of many kilometres of pipe.

Mode 4 Pump Guard

Setting Up The Pump Guard

Mode 4, Pump Guard offers a set of unique functions that present screens and options that differ significantly from modes 1 to 3. These differences mean that functions, for example alarm functions, described in the operation of modes 1 to 3 will behave differently in mode 4 and ask you a different set of questions. Mode 4 is therefor fully described in detail in the pages that follow as a seperate topic to the previous 3 modes.

To set the F60 to operate in pump guard mode (mode 4), first purge any pre-existing settings out of the controller by pressing the reset and (P) programming buttons together. Release the reset button and then release the (P) button. The red timer light on the top deck of the F60 will flash rapidly and the controller will display the message "Settings Cleared, Press P". Press the (P) button and the F60 will display the Kelco splash screen that sits at the start of the user menu.

Press (P) again and the screen will display the controller's model number. Pressing it again will display the firmware version. Press (P) again and you are presented with a screen that asks you what pressure units you prefer to use. The choice is kPa or psi. Select your preferred units by pressing the up or down arrow buttons to toggle between the two options. To select the preferred pressure units simply press the (P) button while your preferred units are displayed on the screen.

Once you have selected your preferred pressure units and pressed (P) you are presented with a screen that asks if you want to use the pre-start delay timer. The pre-start delay timer is a timer that can be set to delay the actual starting of the pump by a settable period between 1 second and 64800 seconds, (18 hours). The pre-start delay timer can be used for all manner of applications and can be applied to the initial startup of the pump or to the start that occurs when the remote input switch closes (if you have chosen to use the remote input) or to both the initial start and to the remote input start. For example, to delay the starting of a pump while a second pump starts.

The alarm relay in the F60 can be set up so its contacts are closed while the pre-start delay timer is running. The closed alarm relay contacts can be used to run a mixer or to operate an aeration system for a set period prior to the pump starting. This particular configuration has application in cow shed effluent processing systems and in many industrial processes. If you select YES to "Pre-Start Delay Timer" and press (P) the screen that follows asks you to enter the pre-start delay in seconds. Press the up button to enter the required delay in seconds and then press (P) to record your settings and to move to the next screen. If you do not require a pre-start delay then simply select "NO" to the initial Pre-start delay question and press the (P) button to record your settings and to move to the next screen. The next screen asks you to select a mode. Press (P) and you are presented with the first choice, "Timer Control Mode 1". Press the up or down buttons and step through to "Mode 4 Pump Guard". Press (P) to select mode 4 and to lock in your selection and to move to the next screen.

Remote Input

Once you have selected mode 4 "Pump Guard" and pressed (P) you are asked if you want to use the F60's remote input feature. Selecting "YES" and pressing (P) configures the F60 to expect an external switch input at its remote input terminal. An external switch such as a tank level switch or the contacts of an external relay or any switch with voltage free contacts can be connected between the LV (low Voltage) and R (remote input) terminals of the F60. When set up this way and with "Use Remote Input" set to "YES", the F60 will only allow a pump under its control to run while the external switch is closed. When open, the F60 stops the

pump and displays the message “External Switch is OFF”. It will also display the total time in minutes the pump ran for prior to the remote switch opening.

The Alarm Relay

Having decided whether or not you require an external input and pressed (P), the screen that follows asks you if you want to use the F60’s alarm relay. The F60 has a relay (relay 2) that provides a set of 240VAC 16A rated normally open voltage free contacts. The contacts of the alarm relay can be configured in a variety of ways both for alarm functions and to control all sorts of external equipment. For example, to control a mixer or aeration system during the pre-start delay as previously described.

If you select YES to the “Use Alarm Relay” question and press (P) there follows a menu that allows you to select the way in which the relay will behave. Pressing the up or down buttons allow you to move from one choice to the next. Pressing (P) confirms your selection and moves you to the next main menu function. If you decide to use the alarm relay, it can be configured in the following ways.

Close If Any Fault Develops

Choosing this configuration means the alarm relay will close its contacts if for any reason the F60 detects a problem and shuts down the pump. For example, if the F60 shuts the pump down because the pump ran dry then with this choice as soon as the main pump relay opened its contacts the alarm relay would close its contacts. The alarm relay’s contacts would then remain closed while ever the F60 remained powered up or until the reset button was pressed.

Closed Only If Flow Stops

The second alarm menu choice only closes the alarm relay if a true loss of flow is detected. In any other fault condition the F60 will shut the pump down and display an appropriate message as to what the fault was but the alarm relay will remain open unless the specific condition, in this case loss of flow, is detected.

Closed Whenever The Pump Is Off

With this choice the alarm relay will act as a set of contacts that are the reverse of the main pump relay’s contacts. When the pump relay (relay 1) is on the alarm relay’s contacts will be open and when the pump relay is off the alarm relay’s contacts will be closed. This configuration has all manner of applications in general control and in operating peripheral equipment.

Closed Whenever The Pump Is On

This configuration means the alarm relay will mimic the main pump relay. It will

be on when the pump is on and off when the pump is off. Since relay 1 and relay 2 are electrically and mechanically separate this configuration allow 2 separate circuits to be controlled in synergy.

Closed During Pre-Start Delay

This configuration means the alarm relay will only close its contacts during the run of the pre-start timer. A typical application for this configuration was described previously wherein an effluent mixer was run via the alarm relay while the pre-start delay timer ran. When the pre-start delay timer timed out the mixer switched off and the transfer pump turned on.

Closed On A High-Pressure Fault

If you select this option then the alarm relay will only close its contacts if the F60 detects a pressure higher than your preset high-pressure trip point. In such a situation the F60 will shut the pump down and display a message to the effect that the pressure was too high and the alarm relay will close its contacts. The contacts can be wired to operate a remote alarm or to actuate an auto dialer. If this configuration is selected the alarm relay will not close its contacts under any fault condition except a high-pressure fault.

Closed On A Low-Pressure Fault

This configuration is similar to the previous one except in this case the alarm relay will only close its contacts in response to the F60 shutting down the pump after detecting a sustained pressure lower than your set low pressure trip point.

Closed If Pump Runs Dry

As the name indicates, the alarm relay will close its contacts if the F60 identifies a true dry run situation. In pump guard mode the F60 identifies dry run as a combination of no flow and a sustained pressure lower than your low-pressure set point.

Having selected to use or not use the alarm relay and if so chosen, having selected an alarm relay configuration, pressing (P) confirms your selection and steps you to the next main menu question.

Low-Pressure Trip

The low-pressure trip point is one of the two pressure limits outside of which the F60 will shut down the pump. Set the low-pressure trip point to a sensible value that is well below the actual pressure you expect the system to operate at. This is to give the system pressure plenty of room to fluctuate without causing nuisance tripping. The range of pressure adjustment is 0 to 2000 kPa or 0 to 290 psi. It is entirely practical to leave the low-pressure trip set to zero. Doing this means the

F60 will not stop the pump regardless of how low the pressure gets. When set this way the F60 will not detect dry run since it uses a combination of low pressure and lack of flow to identify a true dry run. In such a situation the F60 would shut down the pump due to lack of flow rather than due to dry run if flow was lost. Once you have set the low-pressure trip point, press (P) to record your setting and to move to the next menu question.

High-Pressure Trip

The high-pressure trip point is the maximum pressure you want the system to reach before shutting down. The range of adjustment is 0 to 2000 kPa or 0 to 290 psi. The high-pressure trip point must be set to some value higher than the low-pressure trip point. If you try to set the high-pressure trip to a lower value than the low-pressure trip point the F60 will not accept the setting and advise you to check your settings. If you choose to leave the high pressure trip point set at zero, meaning you don't want an upper pressure limit, then the F60 will automatically set it for you to 2000kPa or 290 psi which is the maximum pressure the F60 itself can continuously tolerate.

Start-Up Timer

Once you have set your high and low pressure trip points the F60 asks you to enter a start-up time. The start-up time is the time the controller will ignore a lack of flow when first started. The time range is zero to 240 seconds (0 to 4 minutes) in increments of 1 second. The start-up timer can be left set to zero and the F60 will behave like a basic on off flow switch. For the vast majority of applications the start-up timer should be set to some value sufficient to ensure flow pushes the F60's paddle into the on position before the timer times out. If the time is insufficient and the start-up timer times out and no flow has been detected the F60 will shut the pump down and display the message "Flow Lost". The start-up timer is supplied with a default setting of 5 seconds pre-programmed in. If you are unsure what to set the start-up time to then initially leave it set to the default 5 seconds and press (P) to move on.

Pressure Timer

The pressure timer is a single shot timer that only runs once each time the F60 boots up and starts the pump. Its purpose is to allow time for the system pressure to rise to above whatever low pressure trip point you may have set. The pressure timer can be set to any time from zero to 900 seconds (15 minutes). In some irrigation systems it may take 5 or more minutes for line pressure to rise to an acceptable level due simply to the time it takes for long pipes to fill and pressurise. Set the pressure timer to some time that you estimate is long enough for the pressure in the system to rise to above the pressure you have set the low-pressure

trip to. The pressure timer is self-terminating, that is, it monitors system pressure and terminates its run as soon as pressure above your low-pressure trip point is detected. You may have set the pressure timer to some long delay such as 5 minutes, however, if the F60 detects pressure above your low pressure trip point 10 seconds after start-up then the pressure timers 5 minute run will automatically terminate and the F60 will move into normal running. The F60 monitors flow while the pressure timer is running and if flow is lost the F60 leaves the pressure timer and runs its run-on timer allowing time for flow to recover. The run-on timer is described in detail further on in this book. Given flow recovers, the F60 reverts to running the pressure timer from 1 second less than the point it left off. The flow may be interrupted any number of times during the initial start-up due to paddle bounce or simply to surging in the pipe system while the system pressure is rising. All that will happen is the F60 reverts to running the run-on timer and keeps the pump running until the flow returns or the run-on timer times out. If that happens then the F60 shuts the pump down and displays the message “Flow was Lost”. The F60 is supplied with the pressure timer preset to 10 seconds. Having set the pressure timer to some value that suits the specific system, press the (P) button to lock in your setting and to move to the next menu setting.

Pressure Dip Timer

Once the system pressure rises to above whatever pressure you have set the low-pressure trip point to, the F60 enters normal running. Normal running is a condition where the system pressure is in between the low-pressure trip point and the high-pressure trip point and flow is present. In this state the F60 monitors both flow and pressure and ensures the system is operating properly and remains within the set parameters. If the system pressure falls below your set low-pressure trip point the F60 reverts to running the pressure dip timer. The purpose of the pressure dip timer is to let the pump system tolerate minor dips in pressure without shutting down the pump. Minor dips in pressure can be caused by valves opening and closing in irrigation systems and for a variety of reasons. Without the pressure dip timer such minor pressure fluctuations would trigger an instant pump shut down. The pressure dip timer is an automatically self-terminating timer with an adjustment range of 0 to 240 seconds (0 to 4 minutes) in 1 second increments. The F60 is supplied with the dip timer preset to a default value of 5 seconds. Increase or decrease this value to suit your system using the up or down buttons and then press (P) to confirm your setting and to move to the next main menu question.

Run-On Timer

After setting the dip timer you are presented with the run-on timer. The run-on timer monitors the system flow and allows minor interruptions to flow without causing the system to be shut down. Interruptions to flow can be caused by

entrained air in the pipework or due to valves in the system opening and closing. Without the run-on timer the F60 would shut down the pump as soon as such interruptions to flow were detected. The run-on timer is an automatically self-terminating timer with an adjustment range of 0 to 900 seconds (0 to 15 minutes) adjustable in 1 second increments. The F60 is supplied with the run-on timer set to a default value of 5 seconds. To change this setting press either the up or down button and enter in your required time delay. The run-on timer self terminates its run as soon as flow is detected. This means that if you set it to some value, for example, to 30 seconds and flow recovers in 2 seconds then the run-on timer will terminate its run in 2 seconds and return to normal running. If however, flow does not recover then the run-on timer will continue to run the pump for the full 30 seconds and then shut the pump down and display the message “Flow was lost”. Once you have set the run-on timer press (P) to lock in your setting and to move to the next menu question.

Cyclic Running

The F60 lets you set a fixed run time for the pump and if required, a fixed stop time. In effect this is batch pumping. The batch pumping can be cyclic with an independently settable run and stop time or it can be single shot pumping where the pump runs for a fixed time and then shuts down until re-started by a reset or by the remote input opening and then re-closing. This whole regime of control is called cyclic running.

Cyclic running is a very useful feature. It can be used to pump down a low yield bore and then shut down the pump and wait for the standing water level to recover before repeating the process. It can also be used in stock watering systems to pump for a preset period and then shut down for a preset period. Such a setup is ideal for watering chicken sheds and controlling stock troughs as it avoids the constant cycling associated with conventional pressure systems when used in such applications. If you require cyclic running use the up and down buttons to select YES and then press the (P) button. If you don’t require cyclic running, just press (P) at the default NO screen to jump over the various cyclic running settings and to move to the next main menu question.

If you do choose to use cyclic running you are first asked to enter a run time, first in hours and then in minutes. You can set the run time to anything from 2 minutes to 99 hours 59 minutes in 1 minute increments. Simply enter the required running hours using the up and down buttons and press (P) and then enter the required running minutes. Once you have entered the required running time press (P) and enter the required stopped time, again in hours and then in minutes. The adjustment range is 1 minute to 99 hours 59 minutes in 1 minute increments. If you leave the stopped time set to zero the F60 identifies this as meaning you want

an infinite stopped time, you don't want a fixed stopped time and therefore want the F60 to not restart the pump. In effect this means the cyclic running becomes a one-shot batch pumping system. Typical applications for such a setup include sending fixed hours or minutes of pumped water to a tank and having the pump then shut down until the next time the reset is pressed or the remote input switch is reset. In general cyclic, running allows a pumping system to be set to pump for a fixed time and then shut down for a fixed time. For example to pump water onto a paddock for 30 minutes and then stop for 24 hours and then repeat the process endlessly. Once you have made your cyclic running settings, press (P) to confirm your selections and to move to the next main menu question.

Interruptions to Cyclic Running

It is worth noting that If flow is interrupted while the pump is running in cyclic mode the F60 reverts to running its run-on timer. If flow returns before the run-on timer times out the F60 returns to the cyclic run at a point 1 minute less than the time it stopped to run the run-on timer. Constant paddle bouncing can therefore cause the set cyclic run to progressively step toward zero thus reducing the actual cyclic run time. If unchecked this will eventually lead to a zero run time error on the screen. In this situation pressing the reset clears the error and returns the F60 to your original settings.

If the remote input has been selected and cyclic running is interrupted by the remote switch opening, the time remaining in the effected run period resets to zero. It then recommences at whatever cyclic run time you have entered once the remote switch closes. In effect opening the remote switch cancels the cyclic run and closing it restarts the cyclic run at its beginning.

Auto Restart On A Fault

If the F60 shuts down the pump because a fault was detected, the auto restart on a fault function can be set to restart the pump after a settable delay period. Faults that may shut the pump down include over pressure, under pressure, loss of flow or the pump running dry. If you don't require auto restart press (P) and move on. If you do select this function, you will be asked if you require single restart or repeated restarts. If you select single restart then on a fault condition the F60 will shut the pump down, wait for whatever delay time so set and then restart the pump. If a subsequent fault is later detected the F60 will again shut the pump down, however, this time it will not restart, it will simply go into a permanent alarm state. If you choose repeated restart then each time a fault is detected the F60 will shut the pump down and wait for the set delay, restart and resume normal operation. While shut down and waiting to restart either on a single restart or repeated restarts the F60 displays on its screen the reason for the shut down, the

time in hours and minutes remaining before the restart and the total elapsed time in minutes the pump ran for before it shut down. If a subsequent fault again shuts the pump down, the F60 will again shut down, wait and then restart and repeat this sequence endlessly. Having decided if you require single or repeated restart, press (P) to move on. You are next asked to select one of five fault conditions to use to instigate an auto restart. Details of the five reasons follow.

Pump Ran Dry

If this fault condition is selected the F60 will only automatically restart if it identifies a true dry run fault. Dry run is a combination of no flow and a sustained pressure less than your low-pressure set point. Under all other fault conditions the F60 will still shut the pump down but will revert to a permanent alarm screen and display the reason for the shut down and the total time the pump ran for, it will not, however, auto restart.

Flow Stopped

If this fault condition is selected the F60 will only automatically restart if it shut down due to loss of flow. Under all other fault conditions the controller will simply go into permanent alarm and display the reason for the shutdown.

Pressure Too High

If this fault condition is selected the F60 will only automatically restart if it shut down due to excess pressure, excess pressure being any pressure that is greater than your high pressure set-point. Under all other fault conditions the controller will simply go into permanent alarm. When restarting after the set delay time the F60 will retest the system pressure and if the pressure is still excessive, the pump will immediately shut down and again wait for the set delay period before repeating the process.

Pressure Too Low

If this fault condition is selected the F60 will only automatically restart if it is shut down due to the system pressure being less than your low pressure trip point for longer than you have set on the pressure-dip timer. Under all other fault conditions the controller will simply go into permanent alarm. When restarting after the set delay time the F60 will first run the start-up timer and try to establish flow. Given flow is established, the F60 next runs the pressure timer to allow time for the system pressure to rise above your low-pressure trip point. If the pressure does rise to above the low-pressure set point, the F60 returns to normal running. If however, pressure does not rise sufficiently the F60 will again shut down due to low pressure and again waits for the set time period before repeating the process. Under all other fault conditions the F60 will still shut the pump down but will revert

to a permanent alarm screen and not auto restart.

Any Fault

If any fault is selected from the options list the F60 will automatically restart after a delay if it shut down due to any of the previously listed faults. After the set delay time has elapsed the F60 will attempt to restart the pump and establish flow and pressure. When shut down due to a fault the F60 displays on its screen the reason for the shutdown and the time remaining before restarting will be attempted. Also displayed is the total elapsed time the pump ran for in minutes.

Once you have selected one of the five reasons for restarting the pump, press (P) to confirm your selection and to move to the next menu question.

Waiting Time

Having selected auto restart and the conditions under which the controller will restart the pump, the menu next asks you to enter in the required delay, first in hours and then in minutes. The range of adjustment is 1 minute to 99 hours 59 minutes in 1 minute increments. Set the hours first using the up and down buttons and then press (P). Enter the required minutes and again press (P). This records your settings to the controller's memory and steps you to the next question.

Accept Settings

This is the end of the menu. Select "YES" to confirm all your previous settings or use the up and down buttons to select "NO". If you select "NO" the F60 will transport you back to the start of the main menu and subsequent pressing of the (P) button will allow you to step through the menu and change any parameter you are not happy with. If you accept the default "YES" and press (P) you are then asked to press the reset button to start the pump. The F60 will start the pump and attempt to run the system using the setting you have programmed in. If the settings you have initially made prove unsatisfactory then simply pressing and holding down the (P) button for about 1 second and then releasing it will shut the pump down and take you to the top of the main menu where you can step through the settings and make appropriate changes. Having made a specific change you can confirm the setting by pressing the (P) button and then press the reset button to exit out of the menu and return to normal running. You do not have to repeatedly press the (P) button and step right through the menu. Just make the specific change you want and then press reset to resume normal running.

Total Run Time Display

In pump guard mode (mode 4) the F60 keeps track of how long the pump runs for regardless of what it may be doing. On shutting down the pump for any reason

the controller displays on its screen the total run time in minutes. The pump may have stopped because of high pressure or because flow was lost. Regardless of the reason and regardless of whether it ends up in permanent alarm or in auto restart waiting to restart, it displays the total time it previously ran for. In auto restart mode it does this by displaying alternate screens that change every 5 seconds. One screen displays the reason for the shutdown and the time remaining before restart and the second screen displays the total run time. Total run time includes all peripheral times such as run-on and pressure dip time and the initial flow start and pressure start times. It also includes run time incurred during cyclic running. The run time display has a range of 1 minute to 9999 minutes (about 7 days). The run time display automatically resets to zero each time the pump starts.

The total run time display accumulates time at all times the pump is running. The total run time display is only reset to zero by a power interruption or by pressing the reset button on the F60. If the pump's run is interrupted by the remote switch opening, or by some fault condition that you have set to auto restart then the total run time display will continue to accumulate run time once the remote closes or the auto restart process restarts the pump.

Auto Restart, Permanent Alarm And The Alarm Relay

The alarm relay can be configured to close its contacts if one of 8 fault conditions are encountered. The auto restart function in the F60 can be set to shut the pump down and restart after a delay time if one of 5 fault conditions occur. The way the alarm relay responds to a fault and the way the controller in general responds to a fault are independent of each other. It is therefore perfectly practical to have the controller shut down and either remain shut down or wait and automatically restart due to one fault condition while the alarm relay responds to a separate condition. For example, you could set the alarm relay to only close its contacts if the pump ran dry, and have the pump only automatically restart if it shut down due to high pressure.

Normal Running

When the F60 is running the pump normally with flow present and with a line pressure that is in between the high pressure and low-pressure trip points, the F60 displays information about the system on its screen. The screen displays your high and low pressure trip points in your preferred pressure units. It also displays the current dynamic or static pressure in the pipe. At a glance you can see precisely what the system is doing and where the pressure is in relation to your pressure trip points. In addition the F60 displays the flow status as a green or red flow light on its top deck and the state of the pump, red for stopped and green for running. If a remote input is connected between the LV and R terminals

of the F60 and the external switch is closed, the blue remote input light on the top deck of the F60 will also be on.

LCD Screen Back Light

The LCD screen on the F60 pump controller has a built in backlight. The backlight switches on automatically whenever you are programming the controller and when the controller is displaying certain fault conditions. In normal operation the backlight remains off.

The LCD screen backlight can be switched on manually at any time by pressing and holding down the down arrow button. The screen will remain illuminated while ever you are depressing the down button. The screen will switch off as soon as you release the button. The LCD backlight can't be permanently switched on, it only operates while the down button is held in.

Program Lock (All Modes)

The F60 includes a hidden lock. When activated the lock disables the programming button (P), thus rendering the controller's menu inaccessible.

To lock or unlock the F60, press the up and down buttons together while the pump is in normal operation (not while it is being programmed). Pressing the up and down buttons together while in normal running mode shuts the pump down and opens the controller's lock screen.

Once the lock screen is displayed the F60 can be locked or unlocked by pressing the up or down buttons. Pressing P then exits the lock screen and the controller resumes normal operation. When locked, pressing the (P) button has no effect on the F60 and does not take you into the menu in the usual way. Access to the menu can then only be obtained by first unlocking the (P) key.

WARNING

If the F60 Pump Controller is used in a manner not specified by the manufacturer the pump protection provided by the controller may be impaired or negated. In addition, all warranties stated or implied will be rendered invalid.

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VERY IMPORTANT

This Kelco controller has been fully tested and calibrated. It is presently unlocked and has a simple program loaded. It is set to operate in a basic way with most of its special functions and features switched off.

On start up this controller will run the pump using its start-up timer. If it finds normal operating conditions in the pipe system it will continue to run the pump. If pressure or flow conditions change the pump will continue to run for a short period held on by the controller's built in run-on timer. If acceptable conditions fail to return the pump will be shut down after the run-on time period. Pressing the red reset button on the controller's lid or resetting the power will repeat this basic process.

To change the functions of this controller please first read the programming book supplied with this unit.

IMPORTANT

DO NOT EXPOSE THIS CONTROLLER TO VIBRATION. INSTALL ONLY IN PIPEWORK OR MANIFOLDS THAT DO NOT VIBRATE. Vibration will damage the sensitive electronics within the controller and will void your product warranty.