AUTOMATIC FLUSH CONTROL SYSTEM
FOR RE-CIRCULATING EVAPORATIVE COOLING SYSTEMS

Installation, Operation, and Maintenance Manual

ENERGY SAVER

Features

- Requires Only a Single 24VAC Power Source
- All Solid State (no moving parts)
- State-of-the-Art Digital Electronics
- Manufactured Using SMT (Surface Mount Technology) Components
- Built-In LCD (Liquid Crystal Display) for Setting Parameters and Displaying System Status
- Programmable Real-Time Schedule for Convenience with Optional Battery Backup to Preserve the Schedule During Power Outages
- *Automatic Freeze Protection with Optional Plug-In Board*
- Completely Automatic Operation
- User Friendly Design

Description

Energy Saver's model AFR-M is a powerful CMOS micro-computer system requiring only a single 24VAC power source. It is designed to completely flush the evaporative system's reservoir automatically according to a real-time schedule programmed by the user or installer. This reduces the build-up of materials in the re-circulated water resulting in cleaner operation and improved efficiency.

A real-time clock is used so that a schedule may be set that does not interfere with normal system operation. That is, the flush operation may be programmed to a time of day that the system would not normally be operating.

The system will also auto-detect the presence of an optional plug-in board which adds the capability to automatically protect the system plumbing from damage caused by unexpected freezing temperatures.

Energy Saver's model AFR-M provides a highly reliable digital solution to improving the efficiency of the evaporative system and increasing the life span of the evaporative media.

Block Diagram
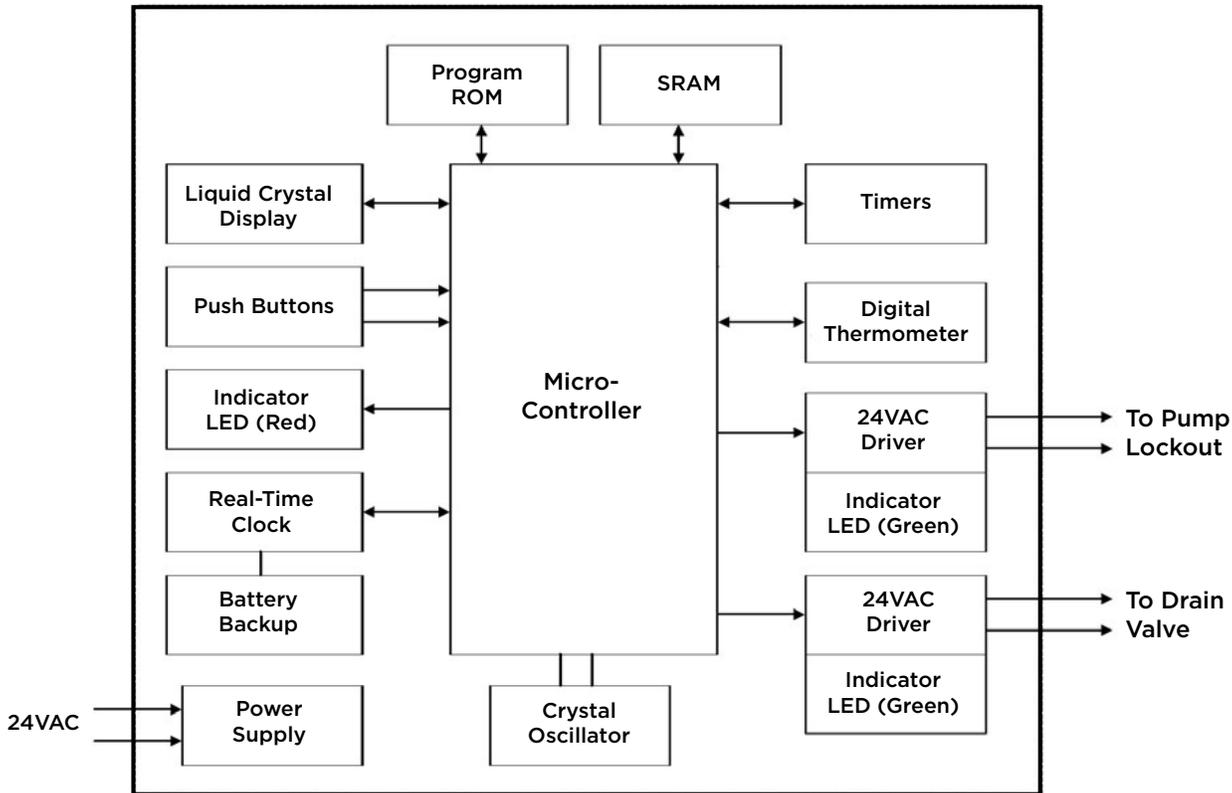
Specifications

POWER SUPPLY INPUT	24VAC - 60 Hz @ 40VA
PUMP LOCKOUT CONTROL OUTPUT	24VAC - 60 Hz @ 10VA
DRAIN VALVE CONTROL OUTPUT*	24VAC - 60 Hz @ 10VA

AUTO-FREEZE OPTION

SUPPLY VALVE CONTROL OUTPUT	24VAC - 60 Hz @ 10VA
DRAIN VALVE CONTROL OUTPUT*	24VAC - 60 Hz @ 10VA

USER CONTROLS AND INDICATORS

- LCD (Liquid Crystal Display) for setting parameters and displaying status.
- Momentary push buttons for setting parameters.
- Red LED (Light Emitting Diode) indicates system activity.
- Green LEDs indicate the status of each output.

* A drain valve driver already exists on the Automatic Freeze Protection Option board. However, a flush cycle requires control of this valve whether or not the option board is installed. So a redundant driver for this valve exists on the main board. Only one driver will be active at any one time.

Functional Description

Energy Saver's model AFR-M provides a simple yet powerful architecture to meet the system application requirements.

The power supply uses the 24VAC input signal to create 5VDC to power the microcontroller and the other low voltage digital components.

The program ROM (Read-Only Memory) is programmed at the factory to provide the system operation that is presented in this document.

The system timers use the divided-down crystal frequency and are programmed to provide interrupts to the microcontroller at a specific elapsed time or at regular time intervals.

The microcontroller communicates with the digital thermometer and the real-time clock at regular time intervals and uses this information to cause system events as well as displaying this information on the liquid crystal display.

The user can interact with the system using two small pushbuttons located beside the display.

In general, the MODE button may be used to review the different screens of information about the system. The SET button allows you to change certain information which is currently being displayed.

When the cursor is turned off, the MODE button changes the screen of information presented on the display. The SET button turns on the cursor and positions it to the first data field to be changed.

Then once the cursor is on, the SET button changes the data at the cursor position and the MODE button moves the cursor to the next data field to be changed. When there are no more data fields that can be changed, the MODE button turns off the cursor and once again may be used to review information about the system.
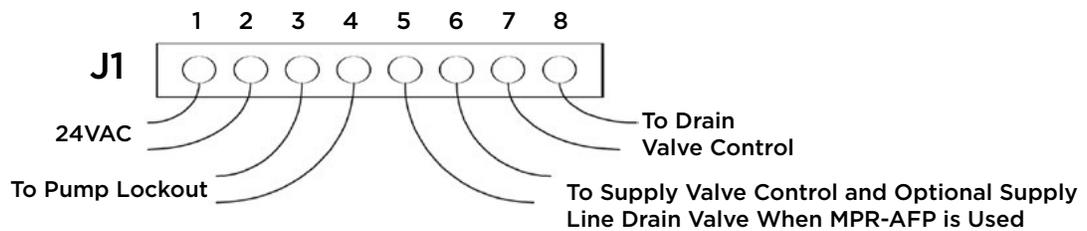
Connections

J1 is a terminal block connector for supplying power input to the board and provides outputs for connecting up to three electronically controlled valves.

The main board controls the pump lockout and the drain valve. The pump lockout connects to pins 3 and 4 of the terminal block. This signal may be used to drive a normally-closed relay to disconnect the power to the re-circulating pump. The electronic control for the drain valve connects to pins 7 and 8 of the terminal block.

Connect the 24VAC power source for the board to pins 1 and 2 of the terminal block.

The connection for the supply valve control is shown below but the driver for this valve is part of the Automatic Freeze Protection Option board. This board must be installed and set up to operate this valve.

J1

1 2 3 4 5 6 7 8

24VAC

To Pump Lockout

To Drain Valve Control

To Supply Valve Control and Optional Supply Line Drain Valve When MPR-AFP is Used

Operation

When power is applied to the unit, the red indicator light will turn on and the following screen will be displayed:

```
* ENERGY SAVER *
  Initializing...
```

After approximately three seconds, the day of the week, time of day and the current temperature will be displayed.

Once the system clock and a flush schedule have been set, system operation is completely automatic. The unit will continually monitor and display time and temperature and use this information to cause system activity.

The temperature will cause system activity only if the Automatic Freeze Protection Option board is installed and the drain time on that board is set to a non-zero value. Then if the temperature drops below the freeze setting, the unit will completely drain the system plumbing to protect it from damage.

The current day of the week and time of day is compared to the flush schedule to determine if it is time to perform the auto-flush algorithm.

When this occurs, the system will compute and update the scheduled day of the week for the next cycle and start the current flush cycle. When the cycle completes, the system will then wait for the next programmed cycle.

Operation (continued)

When the system is running, it is easy to determine the status of the system by observing the display and the indicator lights. The green lights simply follow the state of their respective output drivers and are on whenever that driver is active. The red indicator light blinks at different rates to indicate current system activity.

The display will also show current system activity and will otherwise default to showing the day of the week, time of day and the current temperature.

System Status Indicators

Display	Red Indicator Light	System Status
Initializing...	On steady for three seconds	Power-on initialization
SYSTEM IDLE	Blinks at two second intervals	Auto-flush and auto-freeze algorithms are both inactive
TURNING OFF PUMP DRAINING SYSTEM CLOSING DRAIN TURNING ON PUMP	Blinks at one second intervals	Auto-flush cycle in progress
See above plus CLOSING SUPPLY OPENING SUPPLY	Blinks two times per second	Auto-freeze algorithm in progress - temperature has dropped below freeze setting
SYSTEM DRAINED	Blinks at five second intervals	Auto-freeze drain time has elapsed and temperature does not exceed freeze setting

Setting the Clock

In order for the flush schedule to be meaningful, the system clock must first be set to the correct day of the week and time of day.

To set the system clock, press and release the MODE key until the time of day and the current temperature is displayed.

```
SUN  12:00  AM
77°F
```

The clock may be set and displayed in a 12-hour (AM/PM) format or a 24-hour (military time) format. To change the clock mode, press and hold the MODE key until the clock display changes to 24-hour format.

```
SUN  00:00
77°F
```

To change back to 12-hour format, press and hold the MODE key again until the clock display returns to 12-hour format.

```
SUN  12:00  AM
77°F
```

To set the correct time, press and hold the SET key until the cursor appears underneath the day of the week then release the key.

```
SUN  12:00  AM
77°F
```

Press the SET key until the correct day of the week is displayed. Then press and release the MODE key to advance the cursor to the hour field.

```
MON  12:00  AM
77°F
```

Press the SET key to increment the hour until it is correct. Then press and release the MODE key to advance the cursor to the minutes field.

```
MON  4:00  AM
77°F
```

Setting the Clock (continued)

Press the SET key to increment the minutes until it is correct.

```
MON  4:3O   AM
77°F
```

Then press and release the MODE key to advance the cursor to the next field. If the 24-hour clock format is selected, then the clock is set and the cursor will be turned off.

If the 12-hour clock format was selected, then the cursor will advance to the AM/PM field and it will change to a blinking block style.

```
MON  4:30   AM
77°F
```

Pressing the SET key will toggle this setting.

```
MON  4:30   PM
77°F
```

Press and release the MODE key when this is correct and the cursor will be turned off.

NOTE: Pressing and releasing the SET key will change the temperature scale (Fahrenheit vs. Celsius) whenever a temperature is being displayed if the cursor is turned off. This is why you must press and hold the SET key to set the clock. Also, the clock format may be changed (12-hour vs. 24-hour) whenever a time of day is being displayed by pressing and holding the MODE key.

Setting the Flush Schedule

Assuming that a flush schedule has not previously been set, press and release the MODE key until the following is displayed:

> NO SCHEDULE SET

This screen means that a schedule does not exist and therefore a flush cycle will never be performed by the system. To set up a schedule, press and release the SET key and the display will show the first screen of the schedule which describes how often the cycle should run and at what time of day.

> EVERY DAY
> AT: 12:00 AM

And the cursor will appear underneath a phrase describing how frequently a flush cycle should run. This frequency can range from EVERY DAY to ONCE A WEEK. Or it may be set to NEVER which disables this functionality. Press the SET key to display the menu of frequency selections.

> EVERY 3 DAYS
> AT: 12:00 AM

When the frequency is correct, then press and release the MODE key and the cursor will move to set the time of day to run a flush cycle.

> EVERY 3 DAYS
> AT: 12:00 AM

The procedure for setting this time is the same as setting the clock. Press the SET key to change the data at the cursor position, then press and release the MODE key to advance the cursor to the next field.

> EVERY 3 DAYS
> AT: 3:15 AM

When advancing the cursor from the last field, then the second screen will be displayed which describes the day of the week to start the schedule and the runtime of the cycle.

> STARTING ON: SUN
> RUNTIME: 2 MINS

Setting the Flush Schedule (continued)

Press the SET key to select the day of the week to start the schedule. Exercise care when setting this value. Even if you have set the frequency to EVERY DAY, this setting could delay the first flush cycle for up to a week.

```
STARTING ON: WED
RUNTIME:    2 MINS
```

Then press and release the MODE key to accept the displayed selection, and the cursor will move to the run time field.

```
STARTING ON: WED
RUNTIME:    2 MINS
```

Press the SET key to set how long the flush cycle should run in minutes. This value sets how long the drain valve will be open and can range from two to sixty minutes in one minute increments. The default value is the minimum time of two minutes. Press the SET key to increment the run time. When the maximum time is reached, the displayed value will wrap around to the minimum value, and the value will once again increment.

```
STARTING ON: WED
RUNTIME:    2 MINS
```

When the correct value is displayed, press and release the MODE key and the cursor will turn off and the current system status will be displayed.

```
SYSTEM IDLE
77°F
```

System Setting Parameters

Press and release both the MODE and SET keys simultaneously and the following screen will be displayed:

```
D1:    5    D2:    5
D3:    5    D4:    5
```

These are delay times in seconds used by the system when performing the auto-flush or auto-freeze algorithms. D1 and D3 are used by the auto-flush algorithm and all four delay times are used by auto-freeze. The default value for all four times is the minimum time of five seconds. The delay times can range from five to sixty seconds in one second increments. To change any of these delay times, press and release the SET key and the cursor will appear underneath the value for D1.

```
D1:    5    D2:    5
D3:    5    D4:    5
```

D1 is the amount of time in seconds for the system to wait after turning off the pump before it opens the drain valve. At the beginning of a flush cycle, the pump will be turned off and the drain valve will be opened to flush the system. This allows the user to vary the amount of time between these two events. Press the SET key to increment this time value. When the maximum time is reached, the displayed value will wrap around to the minimum value, and the value will once again increment.

```
D1:    15   D2:    5
D3:    5    D4:    5
```

When the value displayed is correct, then press and release the MODE key to accept the currently displayed time, and the cursor will move to the next value.

```
D1:    15   D2:    5
D3:    5    D4:    5
```

Press and release the MODE key again to position the cursor underneath the value for D3.

```
D1:    15   D2:    5
D3:    5    D4:    5
```

System Setting Parameters (continued)

D3 is the amount of time in seconds for the system to wait before turning the pump back on after the drain valve has been closed. At the completion of a flush cycle, the drain valve will be closed then the pump will be turned back on to resume normal operation. This allows the user to vary the amount of time between these two events.

Press the SET key to increment this time value.

```
D1:    15    D2:      5
D3:    30    D4:      5
```

Then press and release the MODE key to accept the currently displayed time, and the cursor will move to the next value.

```
D1:    15    D2:      5
D3:    30    D4:      5
```

When the cursor is positioned at the value for D4, pressing and releasing the MODE key will turn off the cursor.

Then pressing and releasing the MODE key once more will save the delay times and restore the previous screen.