



# The Water Master

Operating Instructions and Technical Specifications

Michigan Aqua-Tech  
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### OVERVIEW

The Water Master is a self-contained leak detection system designed to minimize, and in most cases, completely eliminate the damage to residential and commercial facilities caused by failed or faulty plumbing systems, fixtures and appliances. By design, the Water Master detects leaks in the plumbing system before they are visibly detectable. That means Water Master detects leaks while they are tiny before they can cause real damage and sometimes hidden damage like black mold before things get out of hand. It prevents catastrophic growth of leaks by monitoring water pressure and flow within the plumbing system. In essence, Water Master reliably anticipates a problem before visible signs of leakage are evident thereby avoiding costly damage while conserving precious water.

For residential applications, it is installed in the main water supply line at the point of entry into a residence and monitors the entire plumbing system from that location. For commercial applications, multiple Water Master units are installed in zoned clusters so that leaks may be tracked and monitored conveniently and as close to the source of the problem as reasonably possible. The Water Master is designed to conserve water and energy upon installation while providing protection against costly property damage and destruction resulting from an undetected water leak.

The Water Master requires no remote sensors to detect puddled water in the facility because it detects and shuts off leaks as it monitors water pressure and water flow within the plumbing system before it even reaches the walls or floors. It operates on standard 120 VAC so there are no batteries to service or replace. In the event of a power outage, the unit fails safe, that is, it turns the water off to prevent a leak catastrophe before it could ever occur. If water is needed while the power is off, the built in *manual bypass valve* can be opened restoring the flow of water where needed.

In addition to reliable leak prevention and protection, the Water Master also conserves water and saves Water Master users from costly mistakes such as dripping faucets and forgotten running taps. Using internal applied logic that differentiates between normal water usage and potentially damaging leaks, Water Master saves water consistently. Dripping or leaking faucets are leaks that would go undetected by all sensor type shut off units. This water simply goes to the drain system.

The Water Master is shipped from the factory with the operating program installed and is ready to protect your building as soon as it is installed and power is applied. The operating program was written and tested to meet the needs of virtually every commercial or residential property. With the vast array of appliances, devices and features installed in properties today, the Water Master is easily reconfigured, if necessary, to meet the specific application needs for any given circumstance. Of course, if help is needed or questions arise, customer support is only a phone call away at 989-295-0050. Rest assured, that Water Master will be there to protect your property from water damage due to leaks around the clock and without inconvenience.

### HOW IT WORKS

The Water Master uses computer logic and physics when preventing water damage from leaks through early detection. Quite simply, the Water Master monitors water pressure and water flow within the system while

looking for the characteristic patterns that leaks exhibit. Since water is not compressible, this physical characteristic provides a solid baseline from which the Water Master determines the presence of a leak. Water pressure begins to drop over a measured period of time in the presence of a leak. The Water Master periodically checks the system for leaks at user settable intervals. Of course, the Water Master is smart enough to check for water flow when beginning a test cycle so that real demand for water, for example running a faucet, does not create the false impression of a leak. Only when specific user settable thresholds are reached over time does the Water Master report the leak and shuts off the water supply. It also transmits an electronic signal to optionally interconnected monitoring devices or systems. A more detailed explanation of the operating principles behind the Water Master may be found in the Technical Data and Configuration Mode sections of this document.

Each Water Master includes everything necessary for providing comprehensive leak detection and protection. The Water Master includes an integrated Automatic Safety Valve, Manual By-Pass Valve; a frequency-keyed, wireless remote control used for remote access and system programming plus a comprehensive, easy to use, control panel for complete system monitoring and adjustment.

### Residential Applications

A single Water Master provides complete coverage for most homes. Programmed at the factory to cover typical household usage, the Water Master is easily installed by a qualified plumber and ready to go. Water Master can handle the widest variety of water usage applications within the home including water sprinkler systems, jacuzzis, hot tubs, reverse osmosis water filters, dishwashers, clothes washers, ice makers and more. On rare occasions, demanding water usage might require a minor adjustment in the configuration of your Water Master. The rest of this document contains additional details to help Water Master deliver maximum protection for every situation. In addition, the Water Master can be easily connected to a home security system for added protection.

### Commercial Applications

Water Master is designed to handle the complexity of today's demanding commercial facilities including, but not limited to, apartments, condominiums, dormitories, office buildings, hospitals, churches, prisons, manufacturing plants, shopping malls, restaurants, retail establishments and military bases. In complex commercial environments, demand for water is, in effect, continuous with overlapping requests coming from many different locations within the property. In these situations, the Water Master is best deployed in a zoned arrangement where each unit manages a cluster of plumbing facilities.

In a hotel with 300 or 400 rooms for example, anticipating and heading off leaks before they cost serious money is challenging. Typically, groups of rooms, perhaps, 4 or 8 or even 12 rooms are serviced off of a common tap (hot/cold) in the ceiling. A Water Master can be installed for each of these room clusters thereby managing leak detection and prevention for each group of rooms serviced. Integration with the property management system provides remote reporting of detected leaks automatically. Monitoring leak detection in manageable clusters such as this, allows the property owner to localize the tracking of leaks and minimize the amount of time and effort in finding and fixing a leak without inconveniencing occupants.

### INSTALLATION

Installation by a qualified plumber is highly recommended to ensure quality results. Even though the installation process is fairly simple, it is critical that all connections have the highest quality integrity.

The Water Master may be connected to a monitoring or security system for reporting system status and water leak shutoffs. For monitoring systems capable of bidirectional communication, the Water Master can be interfaced for remote reset operation.

Please call customer support at (989) 295-0050 for any questions regarding the plumbing installation or the integration of the Water Master into a monitoring or security system.

### STARTUP AND TESTING

#### Plumbing and Water Supply

- Open all taps on the premises or in the zone. Open the bypass valve on the Water Master. Turn to the left, parallel to the pipe. Slowly open the main water supply valve and allow the plumbing system to fill with water. After waiting several moments, close all taps starting from the nearest to the most distant. The objective is to remove as much air from the system as possible.
- Inspect the new installation for leaks and correct as necessary. Close the bypass valve on the Water Master. Turn to the right, perpendicular to the pipe.

#### System Power

- Plug the Water Master power cord into a 120 VAC outlet. The Red Power On lamp should turn on.

#### Initial Flow Check

- Turn the *Flow Guard Knob* (the dial reads in minutes x 10) to the maximum position of 10 for 100 minutes of continuous flow. The *Flow Guard Knob* (denoted on the device with the nomenclature: FLOW GUARD MINUTES above the dial and READING X 10 below the dial) is located on the main panel. It is used to set maximum period of time that continuous water flow demand time will be permitted by the Water Master. This time period reflects the typical water usage patterns present in each property. When the demand time setting expires, the Water Master will automatically shut off the water thus eliminating costly mistakes.
- Open any tap in the plumbing system and observe the flow of water. Water flow should be as usual, slightly slow down, and then go back to normal. This process verifies that the Water Master is reacting to a water demand request. The yellow Flow Detected Lamp should turn on within 2 seconds and remain on until the tap is shut off.

#### Excess Flow Fault Check

- Turn the *Flow Guard Knob* to the minimum position indicated by the minimum mark just below the numeral 1.

- Open a tap in the residence. The yellow Flow Detected Lamp should turn on. Allow the water to continuously run while observing the time. In approximately 1 minute, the water will automatically shut off. The yellow Flow Detected Lamp will go out and the red Flow Fault Lamp will come on.

### Flow Guard Set Up

- Turn the *Flow Guard Knob* to the desired position for the specific property. Normally, 20-25 minutes is usually plenty of time for everyday applications. It is recommended that the setting be adjusted to the lowest time possible. **Set the Flow Guard Minutes interval to accommodate typical continuous flow demand scenarios like taking a shower, running a bath and so forth. The value set here represents the amount of time that the unit will allow a continuous run of water to accommodate the water usage needs within the property under normal use. Manual Override is available for unusual situations when water demand is atypically high or when the power has failed.**

### Water Master Operating Modes

As the Water Master monitors and tracks water flow and leaks, it passes through a small number of operating modes in performing its tasks. Keep in mind that when the unit is powered on, the automatic valve opens and the plumbing system is pressurized with water. If a demand is present, the Water Master goes to the demand flow mode. If not, after 10 seconds, the automatic valve will go to the normally closed position or the standby mode.

#### Standby Mode

The unit is in Standby Mode (automatic valve closed) whenever the unit is not performing any particular task and while the unit is powered on and pressure is normal.

#### Re-pressure Mode

Demand Flow occurs whenever low pressure is detected and water flow is present in the system above the low flow threshold. The unit remains in Demand Flow Mode until the call for water has ended or the Water Demand Override Mode has been requested. When the demand for water is complete, the unit returns to Standby Mode.

#### Demand Flow Mode

Demand Flow occurs whenever water flow is present in the system above the low flow threshold. The unit remains in Demand Flow Mode until the call for water has ended or the Water Demand Override Mode has been requested. When the demand for water is complete, the unit returns to Standby Mode.

#### Water Demand Override Mode

This mode is invoked whenever there is an unusually large need for water flow, for example, watering the yard or while washing the cars or the children are playing with the slip and slide. Water Demand Override Mode may be initiated by pressing the B button on the wireless remote while the water is flowing. The unit enters Water Demand Override Mode for the preset time that is programmed into the unit (2 hours by default). When the

demand for water ends, the unit returns to Standby Mode and the override request is automatically canceled. If the preset time limit is reached, the unit will go to the Flow Fault mode.

### Leak Test Mode

The unit enters Leak Test Mode periodically based on the Leak Test Cycle Time as configured in the unit. During this mode, the unit performs a variety of tests examining water flow and water pressure within the system. When a pressure drop is found, the rate of pressure drop is measured to determine whether or not a leak may be present. If the criteria for the detection of a leak are met, the system is placed into Leak Fault Mode and the water is turned off. Otherwise, the system returns to Standby Mode. If a flow demand is made while in the Leak Test mode, the test is instantly stopped and the flow is allowed. When the demand is complete, the test will restart.

### Leak Fault Mode

When the unit declares a leak condition. The water is turned off by the automatic safety valve and the unit reports that a leak fault has occurred. In the event that the unit is connected to a remote monitoring system, the leak fault is signaled back. Optionally, the unit may be reset remotely from the monitoring system. ***Always verify the presence of leak before resetting the system, especially when doing so remotely.***

### Flow Fault Mode

Flow Fault Mode occurs when a flow of water has been detected for a period of time exceeding the value set on the Flow Guard dial or the preset limit of the Water Demand Override mode. The water is turned off by the automatic safety valve and the unit reports a flow fault has occurred. In the event that the unit is connected to a remote monitoring system, the flow fault is signaled back. Optionally, the unit may be reset remotely from the monitoring system. ***Always verify the presence of leak before resetting the system, especially when doing so remotely.***

### Low Flow Fault Mode

When the number of consecutive low flows detected exceeds the Low Flow Fail Count, a Low Flow Fault is declared. The water is turned off by the automatic safety valve and the unit reports a flow fault has occurred. A Low Flow Fault may or may not indicate a leak and is characterized as somewhere between a drip type leak but less than a material flow of water. In the event that the unit is connected to a remote monitoring system, the low flow fault is signaled back. Optionally, the unit may be reset remotely from the monitoring system. ***Always verify the presence of leak before resetting the system, especially when doing so remotely.***

### Configuration Mode

Placing the unit in configuration mode allows the user to change any of the operating parameters of the unit. Instructions on how to update or revise the operating program can be found in the sections “Technical Data” and “Sequence of Operation” with detailed step-by-step instructions provided in the “Configuration Mode” section.

### When the Power Goes Out

In the event of a power failure, the Water Master fails safe with the water turned off. The manual bypass valve may be opened when water is required prior to the restoration of power. Furthermore, Water Master remembers the previous state of unit prior to the interruption of power. Water Master provides continuous protection even in the event of a power outage so there are no surprises when the lights come back on.

**REMEMBER: the manual bypass valve must be closed when the power is restored.**

### Using the Wireless Remote

The wireless remote provides convenient access to essential Water Master functions while elsewhere (within range of approximately 100 feet) on the premises. When multiple Water Masters are installed in a property, they are frequency keyed in pairs. In addition, the wireless remote is used for reconfiguring the Water Master as described later.

### Wireless Remote Buttons

Button	Code	Action	Description
A	PB-A	System Reset	This button resets the system based on system mode. Same as pushing the <i>Reset Button</i> (PB-1) on the front panel. If pushed while in <b>Standby Mode</b> , the Water Master will perform a leak test.
B	PB-B	Flow Override (Bypass)	If pressed while in Demand Flow Mode, the Water Master keeps the Water Valve (CV-1) open as long as water continues to Flow (FS-1). (up to 2 hrs)When water stops Flowing (FS-1), any effects of pressing the button are canceled.
C	PB-C	Vacation Mode (Shutdown)	<i>Water Valve</i> (CV-1) is forced off until the unit is reset. Both <i>Flow Detected</i> (PL-2) and <i>Leak Test</i> (PL-4) lamps are turned on.
D	PB-D	Program Mode (Configuration Mode)	If pressed 3 times within 6 seconds while in the standby mode, the Water Master will enter Program Mode. Pushing this button while in Program Mode will exit the operation and the Water Master will go back to <b>Standby Mode</b> .

### Configuring the Water Master

Under certain circumstances, the Water Master may be reconfigured to account for specific situations occurring within the property. Placing the unit in Configuration Mode will require the Wireless Remote and access to the control panel on the device.

1. To enter Program Mode, push the D Button on the wireless remote 3 times within 6 seconds.
2. Leak Test Lamp will begin to blink.
3. Select function by pressing the A Button on the wireless remote 1 time for each step of configuration sequence.
4. Verify pilot lamps are still blinking.
5. Adjust to desired value (1-10, 1-20, 1-100) using the adjustable Flow Guard Knob.
6. Send new value to the control system by pushing the system Reset Button on the front of the main panel.
7. Pilot Lamp will be on for 2 seconds showing the value has been accepted.
8. Repeat for any other adjustments.
9. Exit Program Mode by pushing the D Button on the wireless remote 1 time.
10. Value has been loaded and the Water Master will return to normal operation.

Lamp	Code	Configuration	Setting Code
Leak Test	PL-4	Leak Test Cycle Time (1-100 Minutes)	TM-1
Leak Fault	PL-5	Leak Test Decay Time (1-100 Minutes)	TM-2
Flow Detected	PL-2	Override Time (1-10 Hours)	TM-4
Flow Fault	PL-3	Low Flow Leak Time (1-10 Seconds)	TM-8
Leak Test and Leak Fault	PL-4, PL-5	Leak Test Failure Threshold (1-10 Times)	RG-1
Leak Test and Flow Fault	PL-4, PL-3	Low Flow Failures Threshold (1-10 Times)	RG-2
Flow Detected and Flow Fault	PL-2, PL-3	Surge Flow Time (1-10 Seconds)	TM-5
Flow Detected and Leak Fault	PL-2, PL-5	Surge Window Time (1-10 Seconds)	TM-6
Flow Detected and Flow Fault	PL-2, PL-3	Restore Default Values	USER
Leak Test and Leak Fault	PL-4, PL-5		

**NOTE:** To exit Configuration Mode, press *D Button* (PB-D) on the wireless remote at any time.

**NOTE:** While in Configuration Mode, some of the front panel lamps will be continuously blinking to indicate which configuration setting is being altered.

- Pressing the A Button (PB-A) on the remote advances the unit to the next configuration option.
- Pressing the Reset Button (PB-1) on the front panel stores a new value into the currently selected configuration option based on the current value of the *Flow Guard Knob* or, in the case of the defaults option, stores default values into all user configurable settings.
- The indicator lights, which were blinking, then turn solid for 2 seconds to indicate that the value has been stored.
- The Configuration Mode can now be exited by pressing the D Button (PB-D) on the wireless remote.
- When exiting Configuration Mode, go to Standby Mode.

## Configuration Settings

The Water Master is easily configured to handle virtually any water demand situation and continue to provide comprehensive leak detection and protection. The following tables describe the various settings that are user changeable.

### Non-Stored Configuration Settings

The *Flow Guard Timer* sets the duration for the maximum time continuous water can flow on demand under normal Water Master operation except when there is a *Manual Override Signal*. The user adjustable time range is 1-100 minutes with a recommended setting in the range of 20-35 minutes. The *Flow Guard Knob*, located on the front of the control panel, is used to dial in the number of minutes allowed.

It is recommended that the setting be adjusted to the lowest time possible. **Set the Flow Guard Minutes interval to accommodate typical continuous flow demand scenarios like taking a shower, running a bath and**

so forth. The value set here represents the amount of time that the unit will allow a continuous run of water to accommodate the water usage needs within the property under normal use. Manual Override is available for unusual situations when water demand is unusually high.

### Internally Stored Configuration Settings

The rest of the configurable parameters are stored in electronic memory and are configured using the wireless remote and the control panel as described above. The settings below may be adjusted to personal taste or to meet particularly unique water demand conditions. *Default settings cover about 95% of the likely usage scenarios that most homeowners or commercial property managers will encounter.* These parameters are described in the following table.

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Configuration Setting	Adjustable Setting	Pilot Lamp Indicator	Definition	Default
Leak Test Fail Count	1-10 Value	Flow Fault / Leak Fault	Number of consecutive times allowed for a failed leak test to occur before declaring a leak.	3
Notes	<p>The following diagram illustrates how the Water Master cycles through tests using the default value of 3 with typical intermittent water demand.</p> <p style="text-align: center;"><b>Time</b></p>			
Leak Test Cycle Time	1-100 Minutes	Leak Fault	The time between consecutive leak tests after demand for water, if called for, has been fulfilled.	20 Minutes
Notes	<p>You may change the cycle time for your convenience. Keep in mind that the longer the cycle time, the longer the interval between consecutive tests. The following graph illustrates how the cycle time might need to be adjusted to accommodate the periodic demand in a particular property. Notice that once the interval between tests is increased, it is possible for the Water Master to successfully complete a test under live conditions as denoted by the green bar.</p> <p style="text-align: center;"><b>Time</b></p>			

Configuration Setting	Adjustable Setting	Pilot Lamp Indicator	Definition	Default
Leak Test Decay Time	1-100 Minutes	Leak Fault	The time allowed for a pressure drop to be measured indicating a leak.	5 Minutes
Notes	<p>This parameter controls the amount of time the Water Master has in which to measure a drop in system pressure that would indicate the presence of a leak. Increasing the time interval gives the unit more time to detect small leaks. By their nature, small leaks require more time to leak enough water for water pressure to drop above the measurable threshold in the unit. Shortening the time span may cause small leaks to go undetected for longer periods of time. <b>Occasionally, plumbing systems may have variable compressible items within the system, for example, a pressure bellows to provide an air pressure buffer (dead band, hysteresis) to protect pumps from burning out. The Leak Test Decay Time should be increased to accommodate pressure changes due to these items so as to avoid false detection of leaks.</b></p> <p>The following diagram illustrates how increasing the time span allows the Water Master to measure the pressure drop under live conditions and avoid erroneous results.</p>			

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Configuration Setting	Adjustable Setting	Pilot Lamp Indicator	Definition	Default
Manual Override Time	1-10 Hours	Flow Fault	The period of time that the Water Master will allow water flow in excess of the Flow Guard Minutes setting whenever the B button is depressed on the Wireless Remote.	2 Hours
Notes	Depress the B button on the remote to initiate Manual Override.			
Low Flow Fail Count	1-10 Value	Flow Fault / Leak Fault	Number of consecutive times allowed for a low water flow demand.	3
Low Flow Rate Time	1-20 Seconds	Flow Fault	Time window for low pressure detection indicating a low water flow demand. Measured in seconds x 2.	8 Seconds
Notes	<p>Adjust this setting when there might be multiple low flow appliances that may overlap their demand for water over the course of a day. If the setting is too high, then the number of false positive leaks will increase. The number of simultaneous low flow appliances will mean that the pressure drops faster so this setting will need to be adjusted accordingly.</p> <p>If the setting is too low, then a low flow situation might be mistaken for a real leak. If a low flow device has a water usage rate that is very low, then increase the span of time to detect and differentiate whether it is a low flow condition or a leak. Set the time lower when multiple low flow devices overlap causing the pressure drop to occur faster and have a leak detected sooner to avoid false leak detection.</p>			
Surge Flow Time	1-10 Seconds	Leak Fault / Flow Fault	Time required for a demand flow signal to be established.	2 Seconds
			<b>Not for residential adjustment.</b>	
Surge Window Time	1-20 Seconds	Flow Fault / Leak Fault	Time allowed for the demand flow signal to verify flow rate.	10 Seconds
			<b>Not for residential adjustment.</b>	
Restore Default	N/A	All Pilot Lamps On	Pressing the panel to reset restores all default settings.	Default Values

## TECHNICAL DATA

User Inputs located on main front panel:

Inputs	Code	Description
<b>System Reset</b>	PB-1	Black button located in the center of the control panel.
<b>Flow Guard Minutes Knob</b>	SP-1	Variable Resister Input (1-10 X 10) located in the lower center of the control panel.
<b>Wireless Remote</b>	RC-1	Radio frequency remote provided with unit featuring four buttons: A. System Reset B. Flow Override (Bypass) C. Vacation Mode (Shutdown) D. Program Mode (Configuration Mode)

User Outputs located on main front panel:

Inputs	Code	Description	Color
Pilot Lamp	PL-1	Power On	Red
Pilot Lamp	PL-2	Flow Detected	Yellow
Pilot Lamp	PL-3	Flow Fault	Red
Pilot Lamp	PL-4	Leak Test	Yellow
Pilot Lamp	PL-5	Leak Fault	Red

Standard Inputs (Terminal strip wiring as supplied from the factory):

Inputs	Code	Relay	Description
Power	TB-1		120 VAC; Black-Hot, White Return/Neutral, Green-Ground
Flow Switch	TB-3	Normally Open Contact	Closes contact at approximately 0.21 Gallons per Minute (gpm) on increasing flow.
Pressure Switch	TB-4	Normally Closed Contact	Opens contacts at approximately 30 psig on increasing pressure.

Standard Outputs (Terminal strip wiring as supplied from the factory):

Outputs	Code	Relay	Description
Control Valve	CV-1, TB-6	Normally Closed Contact, Full Port	120 VAC, 60 Hz.

Auxiliary Inputs (terminal strip wiring):

Inputs	Code	Relay	Description
External Reset	TB-5	Normally Open Contact, Multiple switches wired in parallel	This allows the user to reset a fault condition from a hardwired switch or from a remote monitoring system.
Flow Guard Override	TB-2	Normally Open Contact, Usually from a relay or flow switch	Indicates that a long demand item needs water (i.e. Sprinkler systems, water softeners, etc.).

Auxiliary Outputs (terminal strip wiring):

Inputs	Code	Relay	Description
Fault	TB-1	Normally Open Contact (Closed on fault) requires power to system for operation.	Reports leak faults detected to interfaced remote monitoring systems.
Power	TB-8		5VDC and Common (for service only).
Ground	Not Labeled		For shielding far right terminal on PCB.

Non-Stored Configuration Settings:

Inputs	Code	Description
Flow Guard Timer	TM-3	Duration of allowed demand use, located in center of the control panel

- The maximum continuous time water can run, except when there is a *Manual Override Signal*.
- Recommended setting of 20-25 minutes.
- User adjustable time of 1-100 minutes.

EEPROM Stored Configuration Settings:

Timer	Code	Recommended Time Setting	Adjustable Time Setting	Description
Leak Test Cycle	TM-1	20-25 Minutes	1-100 Minutes	Interval between leak tests.
Leak Test Decay Timer	TM-2	5 Minutes	1-100 Minutes	Duration of leak test.
Flow Guard Override Timer	TM-4	2 Hours	1-10 Hours	Auxiliary Input, the maximum time water can run when the Flow Guard Time is being overridden.
Surge Flow Timer	TM-5	2 Seconds	1-10 Seconds	Minimum time allowed to establish a flow signal, the time allowed to establish a verified flow. A flow signal pulse from the flow switch is expected when the plumbing system re-pressures. The flow switch must remain activated for the adjustable time period in order for a logical flow signal to be generated.
Surge Window Timer	TM-6	10 Seconds	1-10 Seconds	Time allowed for flow verification. The maximum time allowed for a verified flow signal to be established and begin the next programmable step.
Low Flow Rate Timer	TM-8	8 Seconds	1-20 Seconds	Determines possible low flow use versus leak. The time window at the beginning of a leak test where a low pressure condition is considered a “low flow” instead of a leak.

Limits:

Limit	Code	Default Setting	Adjustable Setting	Description
Leak Failure Limit	RG-1	3	1-10	The number of leak test failures that it takes to initiate a leak fault.
Low Flow Failure Limit	RG-2	3	1-10	The number of low flow failures that it takes to initiate a flow fault.

Other:

- Last known state (Normal, Leak Fault, Flow Fault, etc.) hardware program is not accessible.
- The state is updated in EEPROM when a fault occurs or a fault is cleared.

Partial List of Internal Variables:

Variable	Description	Setting
<b>Current State</b>	Leak Fault, Flow Fault, Normal, etc.	
<b>Leak Failure Count</b>	The number of leak tests failed due to a possible leak (NOT within the low flow leak time) since the last leak test passed.	The maximum number allowed to fail is set with leak test failures.
<b>Low Flow Failure Count</b>	The number of leak tests failed within the low flow leak time since the last leak test passed.	The maximum number allowed to fail is set with low flow failures.

## SEQUENCE OF OPERATION

### Power Up

- The red Power On Lamp is lit. If power was lost while in a faulted condition, the Water Master will return to the same condition and wait for the system to be reset.
- Faults are as follows:

Fault	Description	Signal
<b>Leak Test Fault</b>	Leak Fault	Red pilot lamp on
<b>Flow Guard Fault</b>	Flow Fault	Red pilot lamp on
<b>Low Flow Fault</b>	Leak Fault, Flow Fault	Red pilot lamp on

- All values are set to defaults.
- Timers = Configured values
  - Leak Failure Count (RG-1) = 0
  - Low Flow Failure Count (RG-2) = 0
- Start *Leak Test Timer* to perform next leak test (TM-1).
- Go to **Standby Mode**.

### Standby Mode

- Go to **Re-pressure Mode** then return to this point.
- Turn the *Water Valve* (CV-1) off.
  - If flow is detected while timing, go to **Demand Flow Mode**.
  - If low pressure is detected go to **Re-pressure Mode**.
  - If the *Reset Button* (PB-1) is pushed, go to **Leak Test Mode**.
  - When the *Leak Test Timer* (TM-1) times out, go to the **Leak Test Mode**.

### Re-pressure Mode

- Turn Water Valve (CV-1) on.
- Start Surge Window Timer (TM-6)
  - If flow starts, start *Surge Flow Timer* (TM-5)

- If flow continues until *Surge Flow Timer* (TM-5) expires, go to **Demand Flow Mode**.
- If demand override turns on, go to **Demand Override Mode**.
- When Surge Window Timer (TM-6) is up, return to calling mode (Demand Flow Mode, Leak Test Mode, or Standby Mode).

### Demand Flow Mode

- Low pressure is detected.
- Turn Water Valve (CV-1) on.
- Start Demand Time Timer (TM-3).
  - When flow is detected, the *Demand Time Timer* counts down the demand time.
- If any Reset Button (PB-1, PB-A, or Wired Remote Reset PB-R) is depressed the Demand Time Timer (TM-3) will be reset.
- If the B Button (PB-B) is pressed on the wireless remote:
  - Keep *Water Valve* (CV-1) open.
  - Wait until water stops *Flowing* (FS-1).
  - The *Flow Detected Indicator* (PL-2) is turned off.
  - Restart *Leak Test Timer* (TM-1).
  - The Water Master returns to **Standby Mode**.
- If Demand Override Input (TB-2) closes, go to Water Demand Override Mode.
- If the Water Flow (FS-1) continues past the demand time:
  - The *Water Valve* (CV-1) is turned off.
  - The *Flow Fault Indicator* (PL-3) is turned on.
  - The *Flow Detected Indicator* (PL-2) is turned off.
  - The current state is set to flow fault.
  - The Water Master waits for the reset input.
- If the Water Flow (FS-1) stops before the preset time:
  - The *Flow Detected Indicator* (PL-2) is turned off.
  - Restart *Leak Test Timer* (TM-1).
  - The Water Master returns to Standby Mode.

### Water Demand Override Mode

- When Demand Override Input (TB-2) is detected, the Water Valve (CV-1) is opened.
- The Flow Detected Indicator (PL-2) is turned on.
- Override Timer (TM-7) starts.
  - If any Reset Button (PB-1, PB-A, or PB-R) is depressed the Override Timer (TM-7) will be reset.
  - If the Demand Override Input (TB-2) stays detected until the Override Timer (TM-7) expires:
    - The *Water Valve* (CV-1) is turned off.
    - The *Flow Fault Indicator* (PL-3) is turned on.
    - The *Flow Detected Indicator* (PL-2) is turned off.
    - The current state is set to flow fault.
    - The Water Master waits for the reset input.

- If the Demand Override Input (TB-2) opens before the Override Timer (TM-7) expires:
  - The *Flow Detected Indicator* (PL-2) is turned off.
  - Restart *Leak Test Timer* (TM-1).
  - The Water Master returns to **Standby Mode**.

### Leak Test Mode

- Go to Re-pressure Mode.
  - The Leak Test Indicator (PL-4) is turned on.
  - The Water Valve (CV-1) is turned off thus closing the water inlet and trapping the water pressure in the plumbing system.

**Note:** The actuated valve can be influenced by head pressure. If head pressure were to fall, the pressure after the valve will follow. If the head pressure rises, the trapped pressure after the valve will stay the same.

- Leak Decay Timer (TM-2) starts.
- Low Flow Leak Timer (TM-8) starts.
  - If the Leak Decay Timer (TM-2) expires and the Pressure Switch (PS-1) never indicated low pressure:
    - The *Water Valve* (CV-1) is turned on.
    - The *Leak Test Indicator* (PL-4) is turned off.
    - The *Leak Failure Count* (RG-1) is set to 0.
    - The *Low Flow Failure Count* (RG-2) is set to 0.
    - The *Leak Test Timer* (TM-1) is reset.
    - The Water Master returns to **Standby Mode**.
- If there is a drop in pressure the Water Master:
  - Turns Water Valve (CV-1) on.
  - If Flow (FS-1) is indicated for longer than the Surge Time (TM-5) and within the Surge Window Time (TM-6):
    - The Leak Test Indicator (PL-4) is turned off.
    - The Leak Test Timer (TM-1) is reset.
    - The Water Master goes to Demand Flow Mode.
  - If flow is NOT indicated for longer than the Surge Time (TM-5) within the Surge Window Time (TM-6):
    - If the Low Flow Leak Timer (TM-8) has expired when the pressure dropped:
      - *Leak Failure Count* (RG-1) is increased by 1.
      - If the *Leak Failure Count* (RG-1) is greater than or equal to the *Leak Failure Limit* (RG-1):
        - ❖ The *Water Valve* (CV-1) is turned off.
        - ❖ The *Leak Fault Indicator* (PL-5) is turned on.
        - ❖ The *Leak Test Indicator* (PL-4) is turned off.
        - ❖ The current state is set to leak fault.
        - ❖ The Water Master waits for the reset input.

- If the *Leak Failure Count* (RG-1) is NOT greater than or equal to the *Leak Failure Limit* (RG-1):
  - ❖ The *Leak Test Indicator* (PL-4) is turned off.
  - ❖ The *Leak Test Timer* (TM-1) is reset.
  - ❖ The Water Master goes to **Standby Mode**.
- If the *Low Flow Leak Timer* (TM-8) has NOT expired when the pressure dropped:
  - The *Low Flow Failure Count* (RG-2) is increased by 1.
  - If the *Low Flow Failure Count* (RG-2) is greater than or equal to the *Low Flow Failure Limit* (RG-2):
    - ❖ The *Water Valve* (CV-1) is turned off.
    - ❖ The *Flow Fault Indicator* (PL-3) is turned on.
    - ❖ The *Leak Fault Indicator* (PL-5) is turned on.
    - ❖ The *Leak Test Indicator* (PL-4) is turned off.
    - ❖ The current state is set to flow fault.
    - ❖ The Water Master waits for the reset input.
  - If the *Low Flow Failure Count* (RG-2) is NOT greater to or equal than the *Low Flow Failure Limit* (RG-2):
    - ❖ The *Leak Test Indicator* (PL-4) is turned off.
    - ❖ The *Leak Test Timer* (TM-1) is reset.
    - ❖ The Water Master goes to **Standby Mode**.

### Configuration Mode

- Configuration Mode is entered by pressed the D Button (PB-D) on the remote 3 times within 6 seconds in any mode except Power Up or Fault Modes.
- The Water Valve (CV-1) is opened and remains open for as long as the Water Master remains in Configuration Mode.
- Start the 20 minute Configuration Timer (TM-9). If this timer expires while still in Configuration Mode, exit.
- While in Configuration Mode, some of the front panel lamps will be continuously blinking to indicate which configuration setting is being altered:

Lamp	Code	Configuration	Setting Code
Leak Test	PL-4	Leak Test Cycle Time (1-100 Minutes)	TM-1
Leak Fault	PL-5	Leak Test Decay Time (1-100 Minutes)	TM-2
Flow Guard	PL-2	Override Time (1-10 Hours)	TM-4
Flow Fault	PL-3	Low Flow Leak Time (1-10 Seconds)	TM-8
Leak Test and Leak Fault	PL-4, PL-5	Leak Test Failure Threshold (1-10 Times)	RG-1
Leak Test and Flow Fault	PL-4, PL-3	Low Flow Failures Threshold (1-10 Times)	RG-2
Flow Guard and Flow Fault	PL-2, PL-3	Surge Flow Time (1-10 Seconds)	TM-5
Flow Guard and Leak Fault	PL-2, PL-5	Surge Window Time (1-10 Seconds)	TM-6
Flow Guard and Flow Fault	PL-2, PL-3	Restore Default Values	USER
Leak Test and Leak Fault	PL-4, PL-5		

- Pressing the A Button (PB-A) on the remote advances to the next configuration option.
- Pressing the Reset Button (PB-1) on the front panel stores a new value into the currently selected configuration option based on the current value of the front panel potentiometer or, in the case of the defaults option, stores default values into all user configurable settings.
- The indicator lights that were blinking then turn solid for 2 seconds to indicate that the value has been stored.

- The Configuration Mode can now be exited by pressing the D Button (PB-D) on the wireless remote.
- When exiting Configuration Mode, go to Stand-By Mode.

### PROGRAMMING INSTRUCTIONS

The following procedure describes how the internal firmware may be updated. A factory technician usually performs this procedure.

1. Select board and note the serial number to test records file.
2. Connect power cord and insert PCB into test stand, power up.
3. To load program, connect the cable to interpreter and to PCB.
4. Select program icon on desktop, control program loads.
5. To check configuration, connect cable directly to the PCB serial port.
6. Select configuration icon on desktop, configuration window appears.
7. Select Com Port 4.
8. Press connect.
9. Press retrieve values.
10. Push *D Button* (PB-D) on wireless remote 3 times within 6 seconds.
11. Push *A Button* (PB-A) on wireless remote 1 time to advance to each parameter.

**NOTE:** To exit Configuration Mode, press *D Button* (PB-D) on wireless remote at any time.

### Programming Details

Remote Button Descriptions:

Button	Action	Description
A	System Reset	Advances to the next configuration option.
B	Flow Override (Bypass)	
C	Vacation Mode (Shutdown)	All systems off, Flow Detected and Leak Test Lamps on.
D	Program Mode (Configuration Mode)	Program, Enter and Exit Configuration Mode.

### Configuration Settings

Configuration Setting	Adjustable Setting	Pilot Lamp Indicator	Definition	Default
Leak Test Cycle Time	1-100 Minutes	Leak Test	The time after each demand when a leak test begins.	20 Minutes
Leak Test Decay Time	1-100 Minutes	Leak Fault	The time allowed for a pressure drop to indicate a leak.	5 Minutes
Manual Override Time	1-10 Hours	Flow Detected	The period that the demand timer has no effect on fault trip.	2 Hours
Low Flow Rate Time	1-20 Seconds	Flow Fault	Time window for low pressure to indicate a low water flow demand.	8 Seconds
Leak Test Fail Count	1-10 Value	Leak Guard/Leak Fault	Number of times allowed for a failed leak test.	3
Low Flow Fail Count	1-10 Value	Flow Fault/Leak Guard	Number of times allowed for a low water flow demand.	3
Surge Flow Time	1-10 Seconds	Flow Guard/Flow Fault	Time required for a demand flow signal to be established.	2 Seconds
Notes	<p><b>For Commercial Applications Only.</b> Surge flow time validates whether or not there is bona fide water flow in the system as opposed to the momentary bump, for example when the system is repressurized for a test. Flow must be present consistently for the specified interval to count as a flow or it will not start the flow test. This is a safety feature when the main valve is opened. When in the middle of a leak test, a real flow might occur, for example a tap is turned on. This parameter looks for consistent flow for the specified interval to determine if there is a bona fide flow or not. If the unit sees pressure go down for more than the specified interval and doesn't see a flow (flow must remain up during the specified interval), a leak is present. If the flow period is less than time specified, then the tiny flow is not detected.</p>			
Surge Window Time	1-20 Seconds	Flow Guard/Leak Fault	Time allowed for the demand flow signal to verify flow rate.	10 Seconds
Notes	<p><b>For Commercial Applications Only.</b> After the surge flow time interval is exceeded and flow is fulfilled, then the flow will remain on for the surge window time after the demand for flow is apparently ended to avoid short cycling the system. A tap is turned on and then quickly turned off. Flow continues from the valve for the window time specified. It must see a window of NO FLOW, before it turns off the flow. This parameter ensures that short, quick, intermittent requests for are not stopped prematurely whenever they might occur during the normal processing cycle of the Water Master.</p>			
Restore Default	N/A	All Pilot Lamps On	Pressing the panel to reset restores all default settings.	Default Values

### To change a value on a selected unit:

1. To enter Program Mode, push the D Button on the wireless remote 3 times within 6 seconds.
2. Leak Test Lamp will begin to blink.
3. Select function by pressing the A Button on the wireless remote 1 time for each step of configuration sequence.
4. Verify pilot lamps are still blinking.
5. Adjust to desired value (1-10, 1-20, 1-100) using the adjustable Flow Guard Knob.
6. Send new value to the control system by pushing the system Reset Button on the front of the main panel.
7. Pilot Lamp will be on for 2 seconds showing the value has been accepted.
8. Repeat for any other adjustments.
9. Exit Program Mode by pushing the D Button on the wireless remote 1 time.
10. Value has been loaded and the Water Master will return to normal operation.

**NOTE:** To exit Configuration Mode, press *D Button* (PB-D) on wireless remote at any time.

## FREQUENTLY ASKED QUESTIONS

See website [www.michiganaquatech.com](http://www.michiganaquatech.com)

## WARRANTY INFORMATION

6 Month Limited Warranty (Parts and Labor)