WATERLEAK-X-SYSTEMS - SYSTEM DESCRIPTION

The Water Detection System has four basic electronic units that make up a minmum system. These are:

- Central Control Unit (CCU)
- Valve Control Unit (VCU)
- Signal Repeater – Temperature Sensor (SRTS)
- Water Detection Unit (WDU) (At least one, and up to 49)

All four units in the system use a common radio "packet" format on 418 Mhz "ISM" band, for sending or receiving data regarding events associated with the system. Each of these packets contains:

- A "Start Header" (two ASCII characters)
- A "Sender Type" (one ASCII character) representing what type of module is sending the packet such as "C" for CCU, "V" for VCU, "R" for repeater (SRTS), or "S" for WDU sensor)
- A "Sender ID" consisting of a 12 character hexidecimal internal serial number unique to every unit and used to limit communications only to units belonging to one system. (I.E. A neighbors system cannot act on or generate commands that another system will act on.). A "null" byte of zero follows the serial number as a section termination character.
- A "Command Byte" (one ASCII character)
- Three bytes of "Command Support Data" (2 bytes plus terminating byte)
- Two hexidecimal ASCII characters plus terminator byte (0) for "unit status data"
- One ASCII character "." as a STOP character
- A one byte CRC (Cyclic Redundancy Check) value to determine if any bits were dropped in transmission.

A typical radio packet (always 25 bytes) would contain data similar to the one shown here: (colors varied to show separate portions of packet). The three underlined characters are actually non-printable "null" bytes embedded in the packet. This packet would have come from a WDU sensor with an internal serial number of "0004BF082031" that is reporting a leak.

"*AS0004BF0820310L010010.3B"

Part of the system "setup" procedure is the act of "pairing" all units that are used in one system. All units have a unique 48 bit internal serial number that is part of the radio packets contents (in a hexidecimal number format). In order for one unit to "pay attention to" another unit, it must first be "introduced" through the act of "pairing". Anytime one of the units in a system receives a valid radio packet, the first thing the unit does is look up the serial number in the list of "paired units". If that serial number is not found, the packet is simply discarded. If any form of data is received on the frequency used by the system, and the data format does not exactly fit the systems proprietary protocol, then that data is also simply discarded and ignored.

When a radio packet is broadcast from one unit to another, an "acknowledgment" radio packet is expected to be received by the sending unit (with exception of a WDU unit). If an acknowledgment is not received within a few hundred milliseconds, the packet will be sent again. This will be attempted several times before an error will be inidcated by the system.

The CCU (Central Control Unit) performs a couple different important function for the system.

It is essentially the electronics controller in charge of the system, and also performs the operation of connecting to the Internet and sending out text messages informing system owners or managers of system status changes (i.e. Leak-detected, low battery, power loss events after restoration, etc). Any commands to the Valve Controller must be initiated by the CCU. The CCU also keeps track of the status of all other system units. All units are expected to "check in" aproximately every twenty four hours to report their status and battery condition. The actual check-in time can be plus or minus two hours and is intentionally "randomized" to prevent multiple simultaneous transmissions as well as to prevent "periodic" or predictable regular check-in times which would be against FCC requirements for this type of radio system. If any unit does not check in within a 48 hour time period, the owner/operator of the system will be informed of the "silent" device so that it can be checked. The CCU has a connection output available to optionally allow the unit/system to be tied into an already installed alarm panel monitored by a service. This connection is also available on the VCU for convenience in connecting the neares unit into the alarm panel.

   The VCU (Valve Control Unit) has the main function of controlling the water valve coming into the facility/residence when an event ocurrs requiring automated intervention. When a water leak is detected by one of the WDU (Water Detection Units) that information is sent by radio signal to the Central Control Unit which in turn sends a command to the Valve Control Unit to close the incoming water supply valve. The VCU can optionally be connected as well, to an additional "VENT" valve to relieve the water line pressure to a sink or drain. If that valve is present, then it would open as soon as the main water supply valve is closed. When the leak situation is corrected and the VCU is command to turn the main water supply back on, the vent valve (if present) will be closed before the water supply valve is opened. The VCU is battery backed up using 8 primary (non-rechargeable) Lithium AA size batteries. This allows the VCU to perform it's function within a several hour time period, in the case of a power failure.

   The WDU (Water Detection Unit) is a "transmit only" device. It contains no radio receiver. Up to 49 of these units can be used with a system to monitor a wide area for water leaks. The WDU unit works on a very sensitive "conductance" measurement using sensors on the bottom of the unit to detect water. An optional low profile plug in sensor can also be used with any of the WDU's to extend the reach of the sensor into low profile areas (such as under appliances, etc) or to allow one WDU to monitor two areas in close proximity to each other for leaks (such as behind a toilet and inside a vanity). Each WDU has a unique internal ID/serial number that it transmits when communicating with the CCU. When the system is initially set up, each WDU is assigned to a specific area and that area information is entered into the CCU so that when a leak is detected, the specific location of that leak can be reported.

   An *optional* unit that can be used with the water detection system is the "SRTS" (Signal Repeater Temperature Sensor) unit. The main purpose of an SRTS unit in the system is to pick up radio packets from (paired) units that can't reliably reach the CCU, and re-brodcast those radio signals from a point closer to the CCU so that it can be received. This allows sensors to extend to areas that otherwise would be too distant or possibly blocked by radio signal barriers, etc to communicate reliably with the system. An added advantage to having at least one SRTS in the system configuration is that it can detect the room temperature whereever that unit is located, and report this to the CCU on a regular basis. The CCU can be set up in it's configuration menus to report temperatures that are outside of specified limits. This allows the system to detect heat system or airconditioning system failures and report those to the system owner/manager.