

## Technical Description of the ZRW100 Plug-in Switch Module

*Written by Russell A. Phillips, RF Engineer for Advanced Control Technologies, Inc.  
July 2002*

The ZRW100 is a wall-mounted switch that is designed for on/off control of 120VAC loads as large as 15Amps. It requires 120VAC, 60Hz to power it. While the ZRW100 can work as a stand-alone switch, it is intended to work as a part of a group of similar, compatible modules that are all controlled by a wireless remote control.

This switch module uses a high-speed micro-controller to control the switching circuitry, to execute instructions, and to control communications with other devices. It also features a flash memory IC to provide non-volatile retention of certain data. In addition, the ZRW100 contains a transceiver that is identical to the transceivers found in each of the modules that it works with. It is electrically equivalent to the transceiver used in the remote control.

These transceivers operate in half-duplex fashion to provide two-way communications. The communications, while varied, most often consist of a command from the remote control followed by an acknowledgement by the addressed module(s) that a valid command was received.

The transceiver operates in the 900MHz ISM band at 908.42 MHz. The data, which is digital in nature, is Manchester encoded and sent using FSK modulation at a 9600 bit/sec rate. The deviation of the modulation is plus and minus 10 KHz.

A 7.3728 MHz crystal oscillator is used both as a clock for the micro-controller and also as a reference oscillator for the fractional PLL frequency synthesizer. This PLL is used to generate both the local oscillator for the receiver and the fundamental frequency of the transmitter. The output power of the transmitter portion of the transceiver is controlled by the micro-controller which causes the transmit power to be very low for some setup functions.

Modulation of the transmitter is accomplished in the PLL by having the micro-controller cause it to use one divisor when the modulating data is low and a slightly different one, when it is high.

The receiver is a single conversion type. The local oscillator runs at 908.22 MHz (200 KHz below the receive frequency).

A wireless transmission occurs briefly in response to one of two events: 1) A manually issued command initiated by the User, or 2) An automated command that is initiated when the internal time of day clock matches a previously User-programmed time.

The communications are done using a protocol called the Z-Wave protocol, which is a wireless network protocol that has been especially designed for home automation products. It defines how various types of information are to be formatted into frames. These frames not only include commands and data, but also source and destination

information, as well as checksums that are used for error detection. The ZRW100, the remote control, and other modules make up a wireless local network, where each of the modules can function as wireless repeaters (also half duplex). There is provision within the protocol for intelligent and adaptive routing and also for handling collisions.

Except for a handful of discrete passive components, the entire transceiver is contained in one integrated circuit, the CC900 made by Chipcon. The transmitter and receiver share a common antenna. A SAW filter is used to help minimize receiver overload from strong signals on nearby frequencies. The antenna used in the ZRW100 is a wire antenna located inside the device. There are no external connections to the antenna. Any conducted emissions from the transceiver that may appear on the power lines are minimal and within applicable FCC limits.

The switching function is accomplished by use of a reed relay. The micro-controller toggles the state of the relay in response to the User pressing the rocker switch on the front of the unit, or in response to a command received from a remote control.