

# Build your own PL513/X-10 Voice Recognition Control System

I find it very interesting that Bill Gates of Microsoft had some comments on speech recognition on his latest TV commercial. It seems that he's working on software to allow you to control your computer with voice recognition. Well, it's nice to know that we're on the right track. In fact, while Mr. Gates is envisioning the future, we're happy to bring it to you now...and without needing a computer in the process!

We've done several projects in the past including a hardware modification of a Radio Shack X-10 controller with voice recognition. Although it worked quite well, we had limited success with it as a marketable item. The reason is simple. People want simplicity in construction as well as operation. The next step was to use a X-10 manufactured developer interface known as the PL513. We designed a FREE Visual Basic program to use the serial port of your computer to control a PL513. This let you use the computer to control your lights and appliances throughout your home or business.

Now, for the final step. A voice recognition system which uses a PL513 interface and a voice recognition module from Sensory. We designed a Quantum Research proximity sensor to interface the system to enable a simple but effective way of initiating the voice control and a simple design which eases construction. Since it easily fits inside a PC speaker enclosure using a piggybacked PCB...it's a cinch to be your next project.

## **What's a PL513 ?**

To give you a better understanding, let's redefine what X-10 is. It's a protocol for sending signals over your power wiring to remotely control devices in your home/business. It does this by modulating a 120 kHz. signal on the 60 Hz. AC cycle. There is a starting sequence code (2 cycles) followed by a house code (4 cycles) followed by a key or function code (5 cycles). So...an eleven bit code is sent for each command.

The PL513 module has a 4-pin RJ11 standard phone jack attached to a small case which plugs into the AC power line. A red LED illuminates when power is present and dims whenever a valid X-10 command is send. Inside the unit is a 120 KHz. oscillator which interfaces to the power wiring plug. Also contained is an Opto-isolator which provides an indication of when the AC cycle crosses zero. That's all there is to the interface. For those of you with a true engineering spirit, please visit X-10's website @ <http://www.x10.com> There you will find a 12-page document free for the downloading which covers all the specifications, including schematic, for the PL513. The document is entitled Technical Note for PL513\TW523.

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## **What's the PIC for ?**

Another good question. Although the PL513 provides a power line interface and zero-crossing signals, it's a far cry from a smart interface. Let's go a little more in-depth into the protocol and I think you'll see what I mean. Each time a code is sent, you have to send a complementary bit immediately after each bit on each alternating half cycle. For example, the start code which is 1110, is sent as 1 0 1 0 1 0 0 1. This format is true for the house codes and key/function codes as well. And you have to repeat it twice with 3 cycles of silence in between. And at least 2 repeats for each dim and brighten command CONTINUOUSLY without any missing cycles.

And for the clincher, each 1 bit must be sent three times on each cycle. This allows the system to be used on 3-phase power systems. Since a power cycle (each half) is 8.33 msec., a 1 msec. burst happens at zero crossing (within 50 usec.) and again at 2.778 msec. and again at 5.556 msec. This is all available in detail with diagrams and explanations so do your brain a favor and get the spec sheet. I guarantee it'll be a lot easier to understand!

The PIC also decodes the signals from the VoiceDirect module. It has 8 output lines which can control up to 15 separate outputs. Outputs 1-8 are verbatim, but outputs 9-15 are output 8 + outputs 1-7. For example, output 12 would be output 8 + output 4. Obviously, some way of deciphering the outputs is needed as well so the PIC takes care of both decoding from the VoiceDirect module and encoding the 11-bit code for each X-10 command sent to the PL-513 module. Finally, the PIC detects the proximity signal output from QT 110 and initiates a 3 second repetitive timer which shuts off with a SILENCE voice recognition command.

## **VoiceDirect to the rescue**

Sensory Corporation is a high tech company based in Silicon Valley in California. Their website @ <http://www.sensoryinc.com> provides a wealth of information and technical background. They are the manufacturers of the VoiceDirect series of voice recognition modules for whom I am a consultant/developer. They have developed modules which had the necessary support circuitry and firmware to make their modules a plug and go solution to many needs. The kit contains the microphone, speaker, switches, and resistors necessary for a standalone application.

## **Quantum Research**

This version uses proximity detector located inside the top of a small speaker enclosure to initiate the recognition mode and the PIC will pulse the recognize line low every three seconds for continuous voice prompting. Then I used another command to silence the unit after I had spoken whatever commands I needed. This works quite well, but it does require an initial physical contact to get the unit to respond. This is all accomplished by the QT110 chip from Quantum Research. A resistor and capacitor complete the circuitry and the proximity sensor is a Radio Shack piezo buzzer removed from its plastic cover.

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## Putting it all together

Now that we've discussed the various pieces of the system, it's time to put it all together. The VoiceDirect module comes as a 2" x 2" assembly with standard posts to accept 0.1" male headers. This allows the module to be piggybacked on a perf board or PCB for compact installation. A small computer speaker enclosure (without amplifier) is a good choice for mounting the unit. Obviously, you can use your own imagination and mount the unit anywhere you want...including out of sight! Our prototype had the microphone mounted in the enclosure. I got a pair of multimedia speakers for \$4.50 at a computer show. It actually had a hole in the enclosure that the microphone was installed in and mounted it with some clear adhesive.

## Setting it up

Setup begins with the toggle switch in the **PROGRAM MODE**. This prevents the repetitive timer from being activated and triggering the **RECOGNIZE** line which is being toggled by the PIC. Pushing the **RECOGNITION PUSHBUTTON** will prompt you to say the following commands. Use whatever names you want for Channels 1-8...they at your command! But...the remaining channels are hardcoded so you'll have to select something suitable for it's function. Then flip the toggle switch to **RUN**. Since the commands are hard coded in the PIC, here's the breakdown of actual commands by **channel # in the system**:

<u>Command Word</u>	<u>Function (X-10)</u>
1	Channel 1
2	Channel 2
3	Channel 3
4	Channel 4
5	Channel 5
6	Channel 6
7	Channel 7
8	Channel 8
9	All Units Off
10	All Lights On
11	On
12	Off
13	Dim
14	Brighten
15	Silence

Pressing the **RECOGNIZE & TRAIN PUSHBUTTONS** together for 1 second will erase the memory...and it will even tell you so. That way the unit can be reprogrammed for different locations or another person at a later date. Well, that pretty well covers the system. We hope you will get as much excitement and enjoyment out of your system as we did ours! And don't forget that this system would be ideal for elderly or handicapped individuals.

Once you've got it **TRAINED THE WAY YOU LIKE IT**...simply place your hand on top of the enclosure and the system will begin prompting you to 'SAY A WORD'. Simply tell the system what you want done...and viola...it will happen! It will keep this up until it recognizes the silence command. Although the house code is set in firmware to House Code 'A', any single house code will be programmed free of additional charge when requested with your order. Two different kits are available from Shepard Engineering Concepts. The first one consists of the preprogrammed PIC, ceramic resonator, and 78L05 voltage regulator for \$ 20.00 delivered anywhere in the continental U.S. The second kit includes the VoiceDirect module kit and all components included above for \$ 70.00 including s& h anywhere in the continental U.S. Please make payments payable to: Dennis Shepard.

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