Honorable Mention

TROBOT 2.0
The TROBOT 2.0 is a compact six-axis robot powered by small RC-style servo motors. A W7100 evaluation kit acts as a servo controller interface between the robot and a PC running ABB’s Robot Studio.

Toby Baumgartner
United States | tbaumg@gmail.com

“The TROBOT 2.0 consists of six small RC-style servos, was assembled from custom laser cut plastic, and is controlled by a W7100 embedded controller. The real power of the system is that it communicates with ABB’s Robot Studio software and runs as a virtual Industrial Robot Controller from a PC-based system. The W7100 was a good fit for this project because the Ethernet controller handled the socket messaging between my computer running Robot Studio and the W7100 very well.”—Toby Baumgartner

CDP Finder
The Cisco Discovery Protocol (CDP) Finder connects to a Cisco switch, router, or other device and listens for the Cisco Discovery Protocol. The W7100-based device is used to locate unlabeled and mislabeled connections.

Robert McCown
United States | robert.mccown@yahoo.com

“My company needed to identify old unlabeled connections and even some new mislabeled or misplaced cables. One solution was to build something from scratch. I searched for a development board with an Ethernet port, a display, and a processor fast enough to parse the data. The W7100 chip was perfect, and the IMCU prototyping board was everything I needed.”—Robert McCown

GSM SMS Java Web Server Sender
Sending SMS texts can get expensive. This W7100-based stand-alone Java web server is an affordable solution. Password protection is incorporated for security purposes.

Anastasios Kanakis
United Kingdom | electronix79@hotmail.com

“I built this project in order to provide SMS communication for a specific group of users. These users know a password so they can have access. I used a W7100 development board and GSM modem with RS-232 connector. The W7100 works as a web server. It was a perfect choice because it includes everything in one 100-pin chip.”—Anastasios Kanakis

Lightweight Embedded DHCP Server
The “DHCPLite” is a light-weight embedded DHCP server featuring an IMCU7100 evaluation board and a real-time clock chip. The handy design is meant to be an easy-to-operate system that doesn’t require professional configuration and management.

Perianayagam KS
India | prayagam@veni.net

“I wanted to use the IMCU to implement a very useful and yet complex application such as a DHCP server. The W7100 is an interesting chip with rich peripherals and built-in TCP/IP Stack and Integrated MAC and PHY. The stack is supported by an elegant memory model. It is enough to implement in any embedded network appliance. One can enjoy developing programs for network applications using this device. I had great fun while writing programs for it.”—Perianayagam KS

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Surge Suppression
Tips and Tools for Protecting Circuitry

Electromagnetic pulses always pose a danger to circuits. You have many tools at your disposal, from tranzorbs to MOVs. The key is choosing the right part for the job and putting it in play.

It's mea culpa time. Yes, it's my fault. I am embarrassed to admit that when it comes to my home projects, I don't always do what I preach. And now I'm dealing with the consequences. Let me explain.

A year ago, I replaced my garage door opener, and because I was not happy with its features, I used Arduino and built my own controller for it. Fast forward to the present. During the last few days, we've had a plenty of lightning storms in my area. Well, this morning, after a thunderous night, with relative humidity over 95%, the thing is as dead as the proverbial doornail. When I opened it up, I quickly realized that the electronics were cooked.

CIRCUIT DAMAGE
What I'm talking about here are "indirect lightning effects." That means effects caused by the lightning's electromagnetic field coupled through wiring to the controller. We can't worry about the "direct effects." That's a totally different ball game. And as long as we have no bare metal part of a circuit exposed to the elements, the chance of getting zapped is small. But the indirect effects are nothing to sneer at either.

The controller is located in the garage with a big composite door and control wiring strung around the walls. It would be reasonable to assume this to be an installation in a "partially protected environment," which is defined as a Level 2 lightning environment. The lightning electromagnetic field-induced electrical pulses in the system wiring can lead to data corruption, system malfunction, and, in the worst case, permanent damage. A product can be tested for its susceptibility to lightning by running its external wiring through current transformers connected to a generator to induce the appropriate test waveforms. Doing so enables you to determine whether a functional upset occurs or not.

The actual voltage levels induced by lightning in the wiring—and thus affecting the electronics—are hard to predict, as they depend on wiring routing, shielding effectiveness, and so on. Therefore, for circuit design, pin injection levels defined in Standards are important. Pin injection tests were developed to establish circuits' damage tolerance by directly injecting test pulses into them. The pulses model the worst-case situation potentially seen by each I/O resulting from its wiring exposure to the lightning electromagnetic field. Circuits must survive such energy spikes without damage. We can reasonably assume that if a circuit survived the pin injection test, it will survive real life exposure to the lightning electromagnetic field without damage too, although the controller function may still get upset. We shall discuss what to do about it some other time.

Most equipment located in inhabited areas will be potentially exposed to Levels 1 or 2. External communications equipment, power distribution lines, aerospace vehicles, and automobiles are frequently exposed to levels
significantly higher. As you can see in Figure 1, there are three basic pin injection waveforms that interface circuits must be designed to survive. Figure 1a is a damped 1-MHz sinusoid. Table 1 shows the voltage-to-current levels for each waveform and its immunity level.

**CIRCUIT PROTECTION**

What can you do with this knowledge? For many input circuits, as long as you can add a series resistor of at least 10 kΩ, the worst case will be represented by Figure 1a. At Level 2, 250-V damped sinusoid will be injected into the input. If the input 10-kΩ resistor is followed by a couple of signal diodes rated for more than 25 mA current connected to the power rails, the pulses will be clamped to a safe level (e.g., 0 V and +5 V). The diodes need to be fast to minimize the remnant spike due to their finite speed, and therefore a small capacitor should be added to absorb that spike. This will also work well for electrostatic discharge (ESD) protection. It is equally important to make sure the series resistor is rated to survive the maximum voltage and the accompanying power spike without flash-over. Wire-wound or metal-oxide similar to Zener diodes, but they are much faster and can absorb a lot of pulse energy. To select the correct transzors, the energy of the waveform—which is the area under the curves in Figure 1—needs to be calculated. It is the integral of the waveform over time, but it’s easier to rely on application data from manufacturers, as they provide empirical equations for device selection.

When high-power components are used for outputs, it may be preferable to select an output device for the highest expected voltage and current shown in Table 1 instead of adding transient protection. For one application, I used a thyristor to switch a 200-V/400-A load. By selecting a thyristor rated for 1,200 V, the need for any additional lightning protection at Level 3 was eliminated.

Instead of transzors, you can also protect the equipment with other devices, such as metal oxide varistors (MOV). I have always used transzors up to and including Level 5. I learned how to use them effectively and the results have been as expected. As I am a creature of habit, I’ve had no reason to try something else, other than gas discharge tubes. These really big guns are used for the multiple-stage protection of equipment exposed to the worst conditions. It’s likely you won’t need them for anything other than special applications.

**TIME TO REBUILD**

Other than that, I am beginning to rebuild my garage door controller. But this time I’m going to heed my own advice. I promise. #

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