One-Wire Lightning Monitor

This article describes the construction of an experimental lightning monitor for use with the Dallas Semiconductor 1-wire bus. This monitor provides real-time data on lightning activity by counting the number of lightning strikes in the area. This device is designed to either be used stand-alone or to supplement the WS-1 One-Wire Weather Station, providing the weather hobbyist additional weather data.

The necessary software to display the data is left up to the reader. The data is accessed by reading the value of the counter via the 1-wire bus. Currently versions of TiniWeatherServer, as well as DalSemi's TMEX are capable of reading the counter value.

The hardware is divided into 3 sections: the Lightning Sensor Unit (LSU), the Interface Board, and the Counter Board. The design

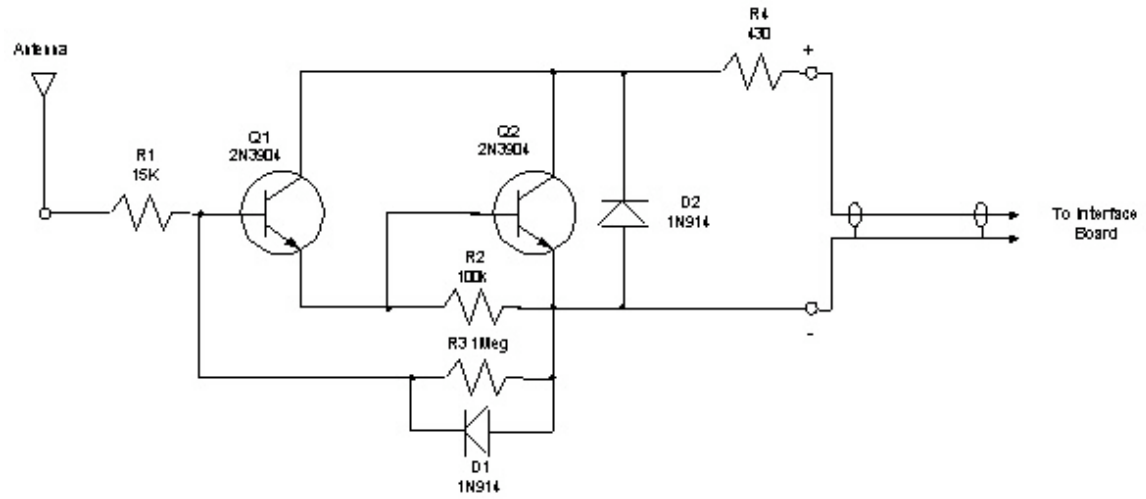
presented built each section separately, however is there no reason all three circuits can't be combined on a single board.

The counter used in this example is a DalSemi Rain Gauge board, available as part of the 1-wire Rain Gauge. Alternatively, you can build the counter board from scratch.

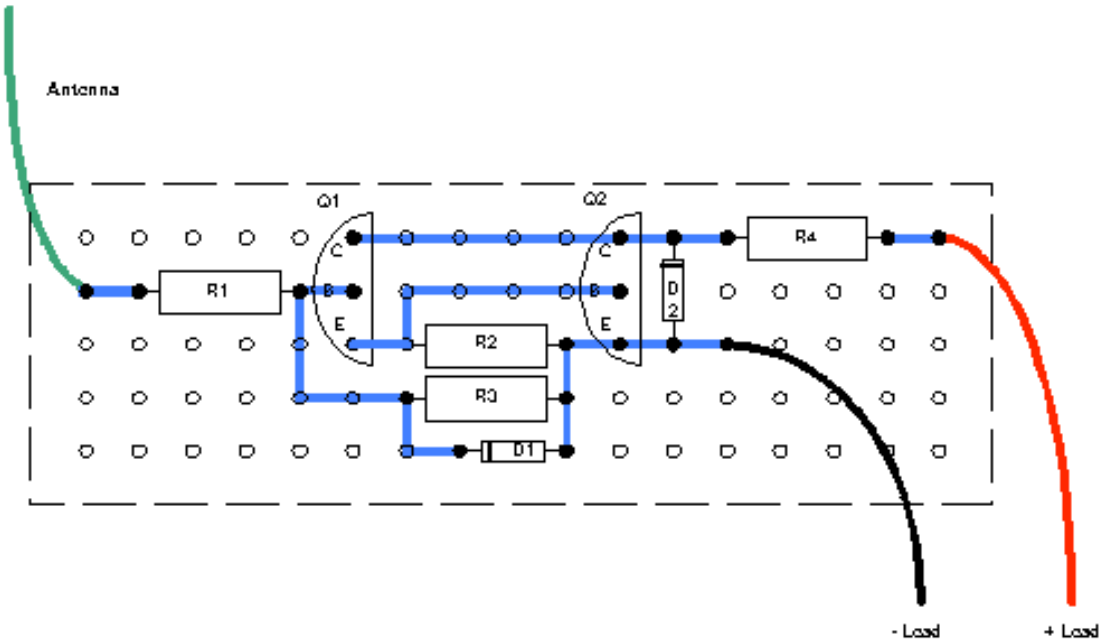
The entire lightning detector is now also available in a kit or fully assembled form at Hobby-Boards.

The Lightning Sensor Unit

The lightning sensor unit performs the lightning detection. Referring to the schematic, energy from the lightning is received from the antenna, passes through the hi-gain Darlington pair, allowing current to flow through Q2 during each lightning strike.

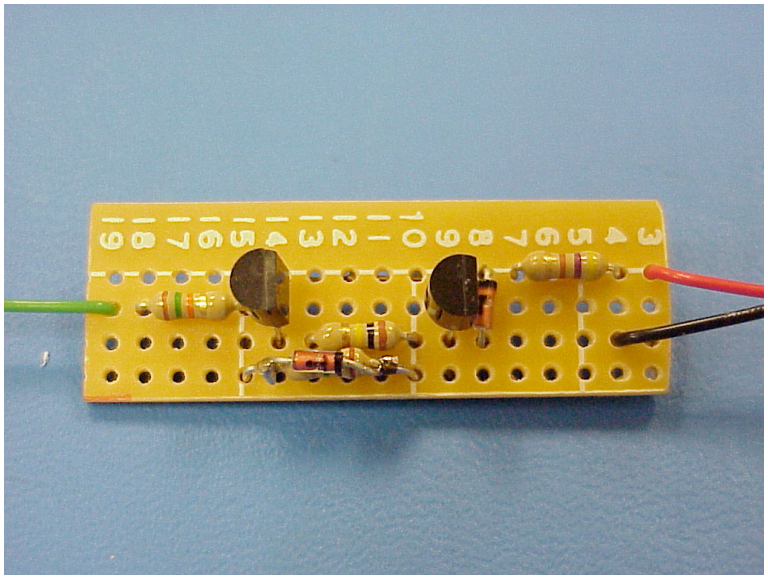


Schematic for the Lightning Sensor Unit



Layout for the LSU board

The antenna is simply a 30 cm copper rod or wire. The circuit can be assembled on a small piece of perf board. A possible layout is shown above. The low side of the LSU (black or - lead) must be connected to a good earth ground in order for the LSU to work properly. A metal water pipe or a ground rod near the installation should work fine.

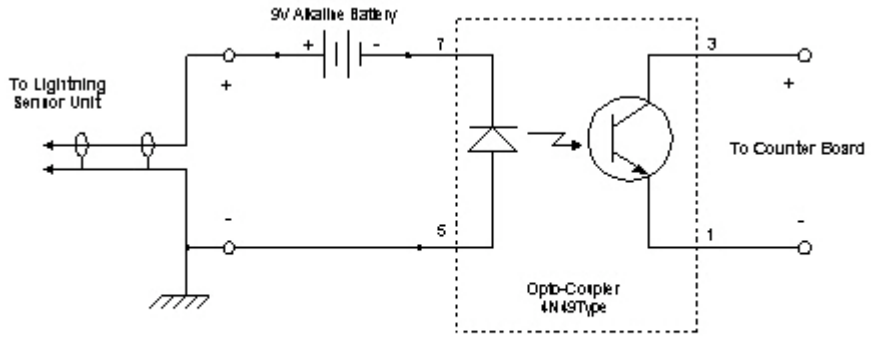


Completed Lightning Sensor Board

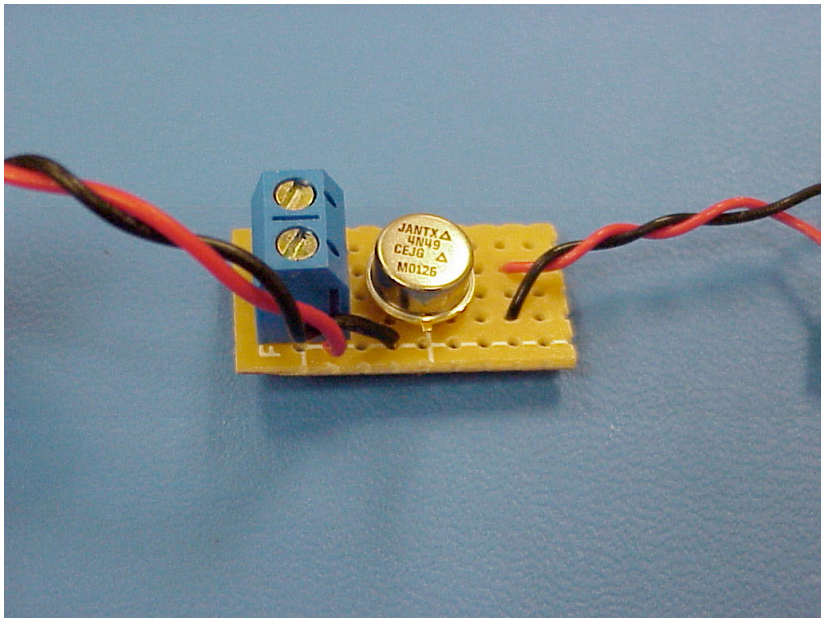
The entire assembly should be housed in a waterproof container. A piece of 3/4 inch PVC pipe works great. The photo below shows the LSU assembled into 3/4 inch PVC pipe with a tee for mounting, and the coax cable routed through the bottom. The pipe should be long enough to fit the antenna without folding. Use RTV to hold the wire straight inside the PVC pipe.

The Interface Board

The interface board couples the LSU with the counter board, providing power for the LSU and isolation for the counter board. If you are assembling the counter board from scratch, then this circuitry may be included on the same board. Because the low side of the LSU is tied to earth ground, a potential ground loop may be created if the 1-wire bus is not isolated. To prevent this, and provide a small amount of lightning protection, an opto-isolator connects the LSU to the Counter board. This design shows a 4N49, but the selection is not critical. Current thru the LED is limited by R3 on the LSU. The 9-volt battery provides the necessary drive through LSU Q2 to power the LED side of the opto-coupler. Because current only flows during a lightning detection, the battery should last over 2 years.



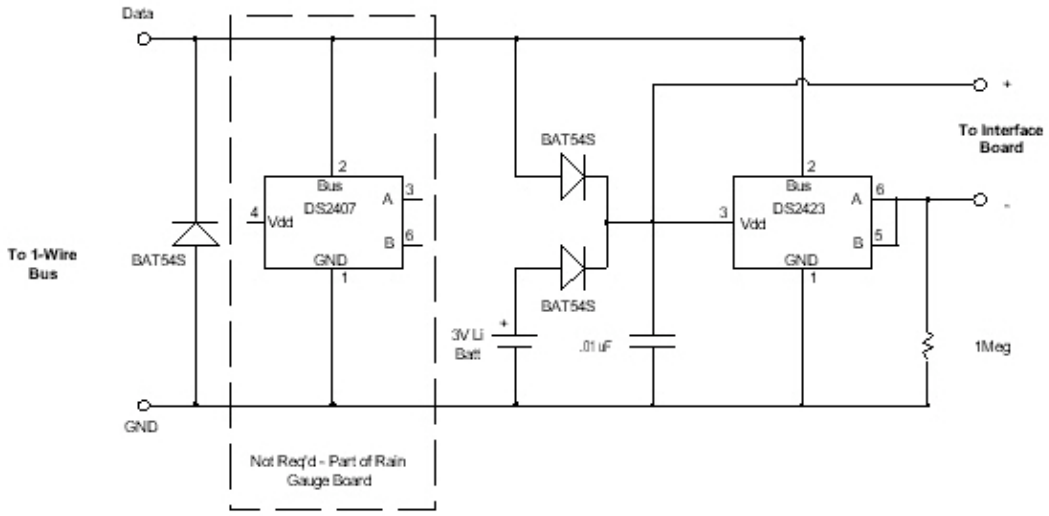
Schematic for the Interface Board



Completed Interface Board

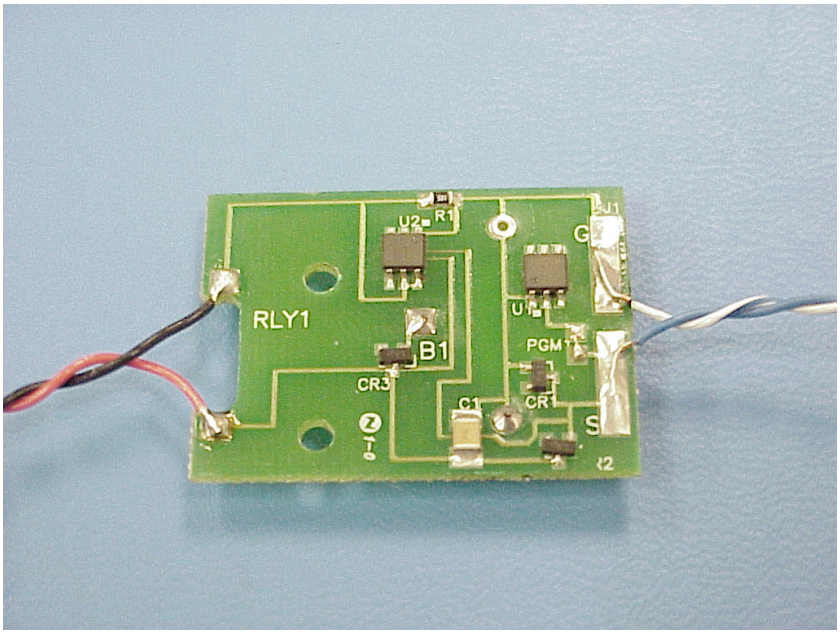
The Counter Board

I used a pre-built counter board from the Rain Gauge kit. Just remove the reed switch and solder wires to the pads. Otherwise, you can build it from scratch. The rain gain board contains a DS2407 switch, which is not used in this project. The battery and the associated steering diode may be left out if your 1-wire bus is constantly powered and your not interested in keeping a long-term running count of lightning strikes. The 1-wire bus side should be connected to your 1-wire bus. In the photo below a RJ-11 phone jack is crimped to a 6" twisted pair.



The Counter Board Schematic

The counter and interface boards can be mounted in a weather-tight enclosure in a location with easy access. Radio shack sells a weather proof telephone wiring box that works great. It can also house the other 1-wire connections.

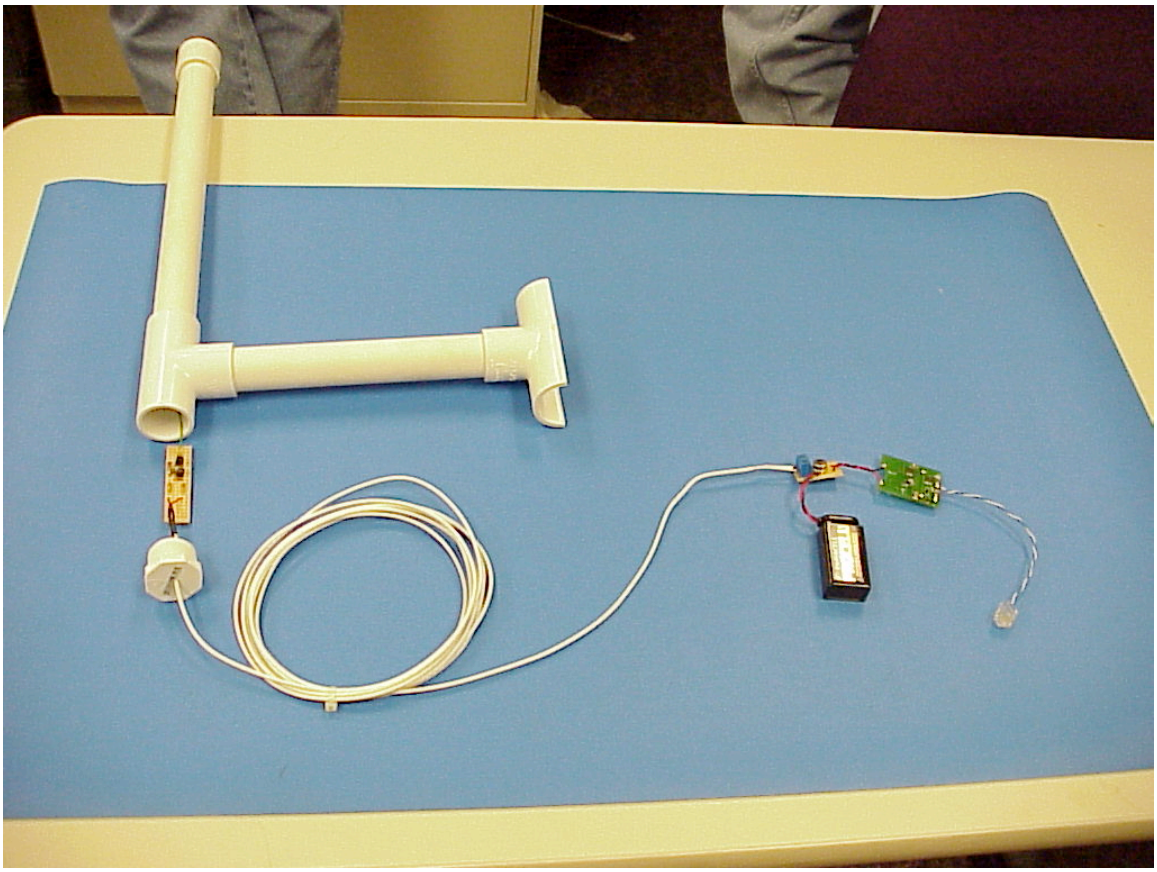


The Rain Gauge Counter Board

Installation and Test

The LSU should be connected to the interface board using a suitable length of coax cable. Selection of the coax is not critical. I used the smaller RG133, however standard RG-58 works fine. The shield on one end should be connected to the minus (-) side of the LSU. The shield on the other end should be tied to a good earth ground and to the minus(-) input on the interface board. If your using a metal pole, be sure to ground it also. The earth ground is important because the LSU is measuring the EMF between its antenna and ground. It also provides a path for lightning should it get a little to close.

The interface board connects directly to the counter board. If the counter board is more than a foot away, using twisted pair wiring may help eliminate false triggers.



Once everything is connected, you'll need software to read the counter, such as TMEX. Launch the software and detect the 1-wire device. Select the counter and view the count on page 15 (same as the rain gauge).

Next you will need a lightning simulator. I found that a $2.99 "scripto" utility lighter, the kind with an electronic spark, works great. The are available at most grocery and hardware stores. Hold the lighter within a few inches of the LSU and click the sparker. You should see the counter increment. If not, retrace your wiring and check the battery. If it still wont count, touch a jumper across D2 on the LSU board. This will bypass the LSU and the counter should increment.

An inexpensive Lightning Generator

Once everything checks out, install the sensor in the PVC pipe and the interface/counter boards in a weather-tite enclosure near the LSU. Next, mount the LSU at least 5 feet above the ground. The higher the sensor, the farther away you'll be able to detect lightning. At 10 feet, range should be between 30 to 50 miles. If your interested in just local conditions, lower heights work best.

The method I have chosen to display lightning activity is to count the number of strikes per minute. This gives you a feeling for how active the lightning storm is. Increasing SPMs indicate the storm is moving

closer, while decreasing values indicate the storm is moving away.

Experiment with different mounting heights and display options. Please send me an e-mail if you have any suggestions. You can also subscribe to the 1-wire weather list to share your results and improvement suggestions.

Disclaimer

This project is for experimental use only. The user assumes all responsibilities for assembly, installation, and use. This circuit is provided without warranty and the author makes no claim that this device will work in any particular application. Having an antenna up in the air with a cable running into your house during a thunderstorm could invite trouble. Keep a safe distance away from the display during thunderstorms. Do not use in applications where failure or incorrect operation could jeopardize someone's safety. Always exercise caution when working outdoors during a thunderstorm. This schematic is provided for noncommercial use only. Batteries not included.

You can e-mail me at weatherprojects@mac.com if you have any questions or suggestions.

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