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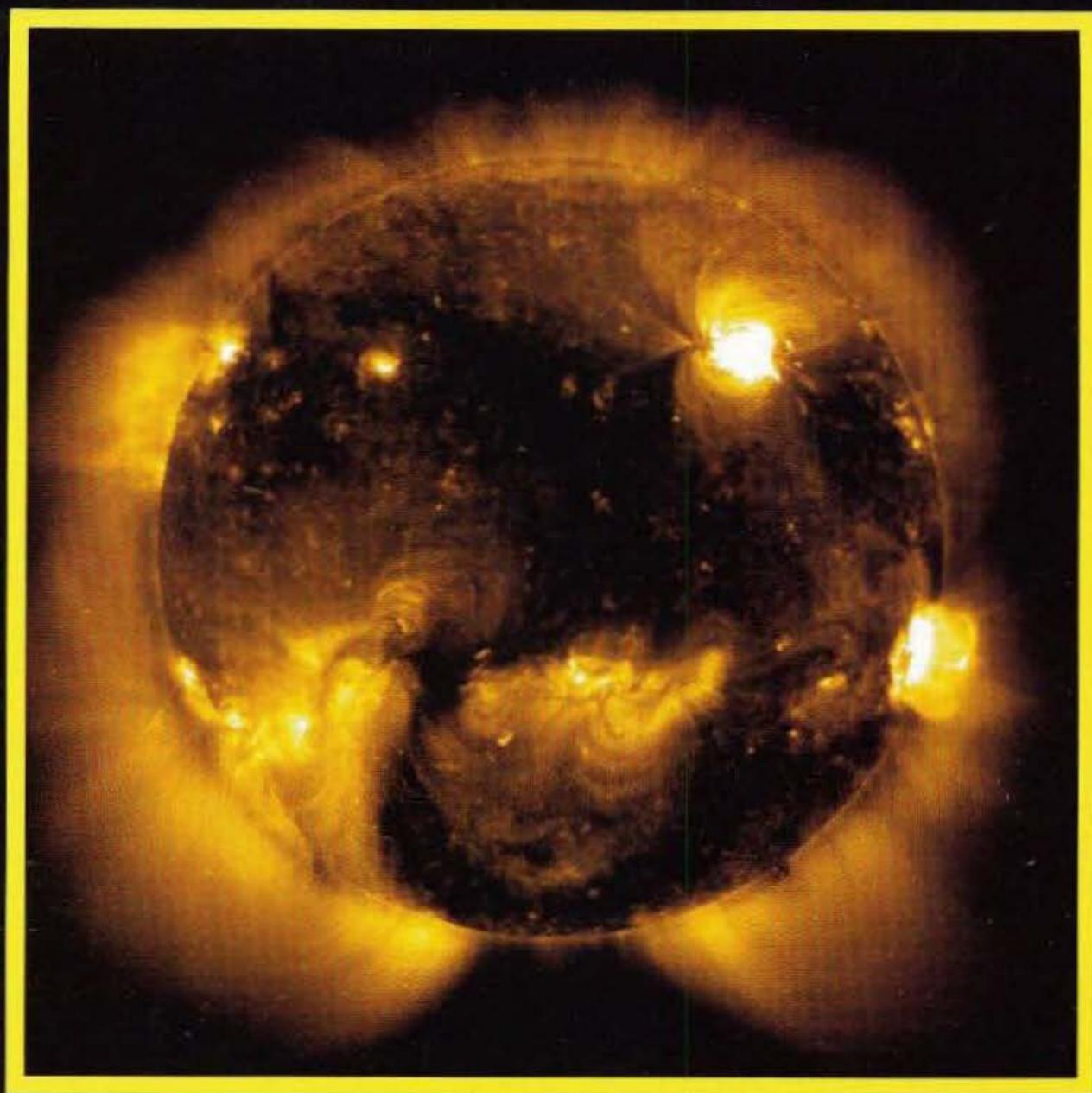
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## Monitoring Solar Mischief



### Which Antenna Is Best for You?

### Really Simple 20m Antenna

### Build a Dream Receiver

### And a VFO, Too!

### Review:

### IC-706MKII — Wow!



9803

# Here Comes the Sun

## *Part 2: Geomagnetic monitoring.*

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Even though it's possible to get geomagnetic data from the *GOES 8* and *GOES 9* satellites via the Internet, it's a lot of fun to monitor the effects of solar activity with your own equipment. While the changes in the magnetic field are much smaller on the surface than at an altitude of 23,000 miles, they still can be measured. Also, since it's impractical to monitor the Internet 24 hours a day, it would be handy to have a device to sound an alert whenever a strong geomagnetic event is detected.

One of the easiest effects to measure is "Earth Currents." Whenever the geomagnetic field changes, electricity is induced in all conductors within it, and this includes the Earth itself. By driving a pair of long copper rods into the ground 100 feet or more apart, a voltage differential can be measured between them when the field shifts. Connect each rod to the meter with shielded cable, and ground the shield at one end only. The meter must be a zero-center type, since the polarity depends on the direction of the magnetic shift. A sensitive zero-center microammeter with several switchable series resistors could be used to set different

ranges. You could also use an auto-polarity digital multimeter set to the mV scale.

A second method of monitoring geomagnetic shifts is to use a compass. Since it's no fun to sit staring at the little blue arrow all day, we can build a circuit that will do this for us. The easiest way is to drill a small hole, 1/16-inch or less, through the compass disk near the rim, at the EAST position. Drill a matching hole at the WEST position so that the disk will still balance on the needle.

By shining light from an infrared LED through one of these holes and receiving it with a phototransistor below the disk, we can tell if the compass disk rotates even slightly. The circuit shown in **Fig. 1** can be used to activate a small piezo alarm when the light is cut off. You don't need the entire compass—just the disk and needle. I mounted mine on a small piece of pine board which I could then rotate slowly until the hole in the disk matched the position of the LED and phototransistor.

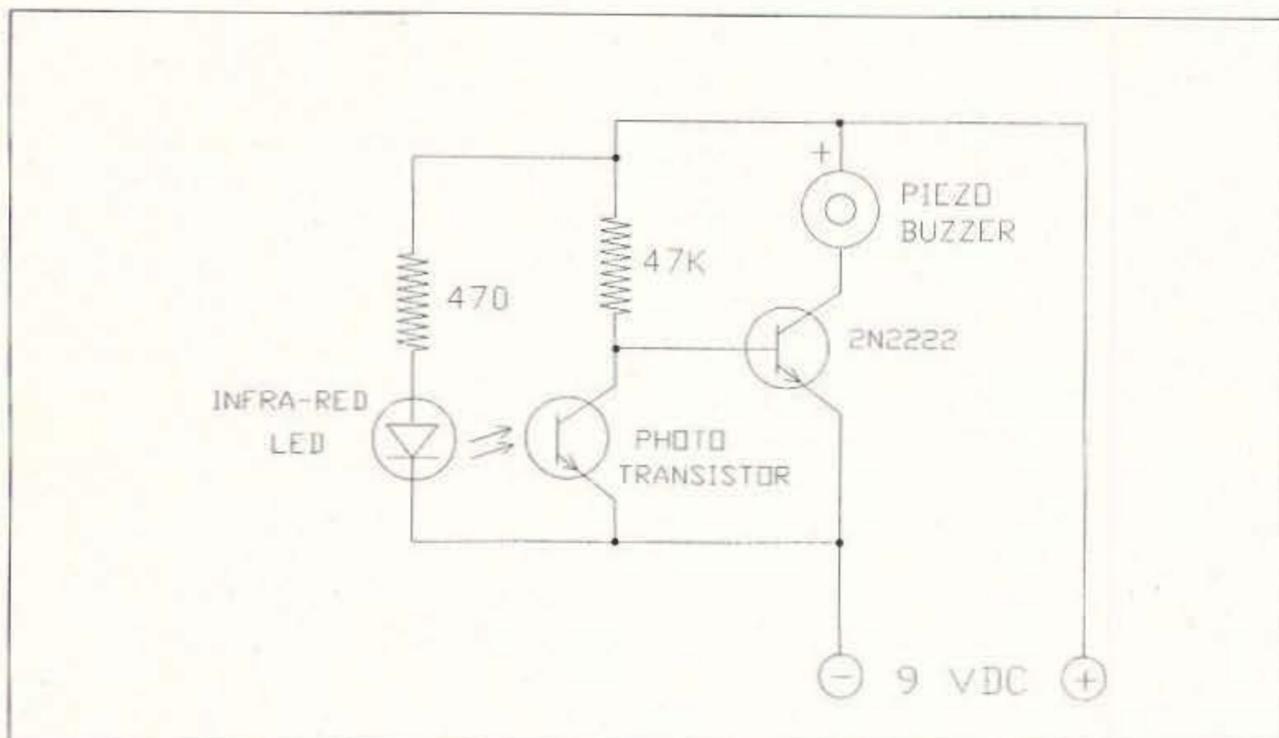
This device, though simple to the extreme, is actually quite sensitive, as you can prove by waving a small

magnet around the room. You will need to put a box over the whole thing to prevent air currents from disturbing the compass.

An even more sensitive device is the magnetometer. Originally designed as a "UFO Detector," this device has an iron rod that serves the same function for the magnetic field as an antenna does for radio waves. The lines of flux from the geomagnetic field are concentrated in the iron, and a coil consisting of many turns of fine wire is wound around the rod. Changes in the magnetic flux induce a voltage in the coil, which can then be amplified and used to trigger an alarm.

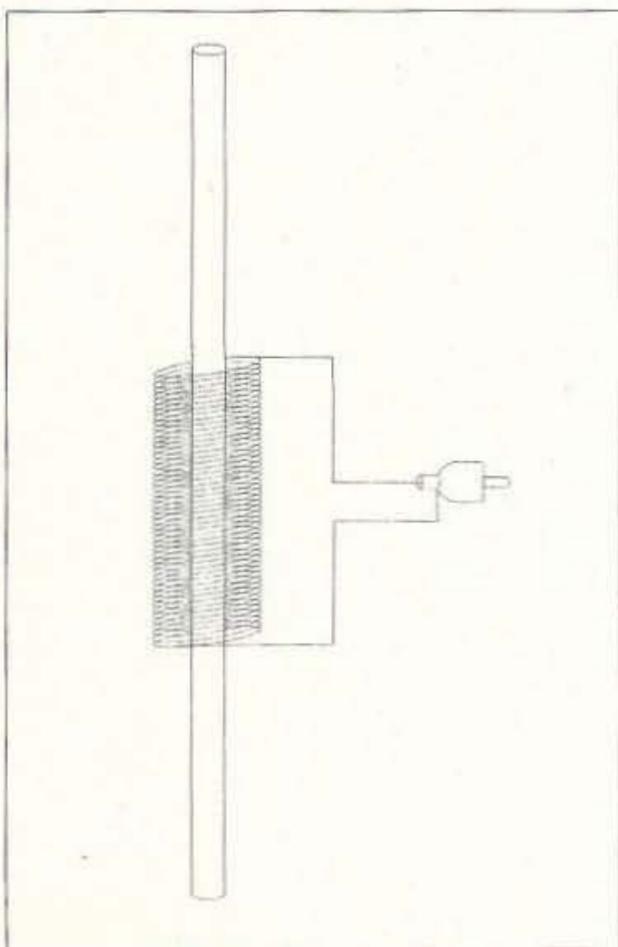
Iron rods are not commonly found around the house, but for our purposes, milled steel will work just fine. (It is, after all, more than 90% iron.) For portable devices, a #10-32 bolt passed through the center of a coil from a small relay will make a good sensor that will fit inside the enclosure used for the electronics.

Increasing the size of the rod and the number of turns will make the device far more sensitive. The best one I've built consisted of an entire one-quarter-pound spool of #36 magnet wire. I



**Fig. 1.** The "Dark Detector." By positioning the LED above a hole in the compass disk and the phototransistor below, the alarm will sound when small magnetic fluctuations cause the compass to rotate.

didn't wind the coil—I just fished out the inner end of the wire and used the whole spool as it was. The plastic spool had a one-inch diameter hole through it, so I used a piece of one-inch round steel bar stock 18 inches long, passed through the center of the spool. Coated with urethane varnish and mounted inside a piece of plastic PVC pipe, it made a very sensitive sensor when mounted on the roof, away from stray magnetic fields.



**Fig. 2.** A very large coil of fine wire wound around a bar of iron or steel will detect very small fluctuations in the geomagnetic field.

**Fig. 3** shows the circuit diagram of the magnetometer. One stage of a dual op amp amplifies the signal from the sensor, which is then fed to a window comparator using an LM339. The output from the comparator triggers a 555 timer connected as a one-shot, which turns on the piezo alarm for several seconds. The gain of the amplifier stage is set with a one-megohm pot, which is adjusted just below the point at which the alarm sounds.

The second section of the dual op amp is used as an audio amplifier. The 2.2- $\mu$ F capacitor couples any audio frequencies detected by the sensor to the op amp, which can then be heard via headphones or connected to an external amplifier and speaker. Some very strange sounds can occasionally be heard from this device, especially before a thunderstorm. (Of course, if you're using an outside-mounted sensor and AC line power, *do not* use this device during a thunderstorm ... especially when using headphones!)

The switch in series with the piezo alarm lets you turn the alarm off. This is handy for adjusting the gain, and also so that you can advance the gain to maximum and listen to the audio without being driven insane by the constant beeping.

**Fig. 4** shows the printed circuit board pattern for the magnetometer, and **Fig. 5** shows the parts layout. Be sure to orient the integrated circuits,

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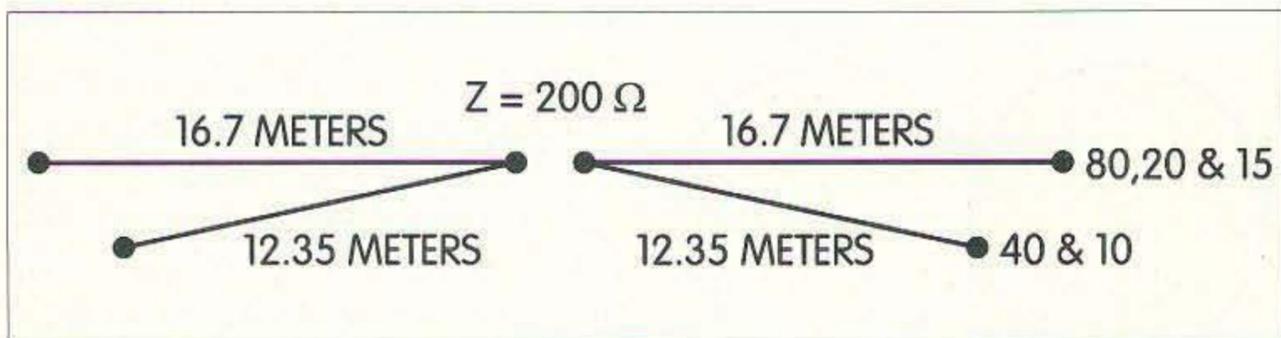


Fig. 6. Multiband antenna.

months, I have been in antenna heaven with my new MFJ-259 Antenna Analyzer. This has been a joy to use and has saved me untold hours during antenna construction and testing. Other methods of SWR testing may be used, but quite frankly my other test equipment is tending to gather dust.

Fig. 6 shows an antenna which quite a few of my amateur friends have tried with good results. While I have not tried this antenna myself, those whom I have worked on the air using the antenna have been quite happy with its performance. The elements are chosen not to be self-resonant on any band, but to exhibit a mean impedance of approximately 200 ohms at the feedpoint on 80, 40, 20, 15, and 10 meters. It may be fed with an open-wire, such as air-spaced 300-ohm line, a four-to-one

balun, or two lengths of coaxial cable. The last method is claimed to reduce noise pickup by the feeder. The two lengths of coaxial cable should be exactly the same length—RG-58CU would be suitable for reasonably short runs. Ground the two braids at the shack and join the braids at the antenna end. The two inner conductors are joined to the antenna and to a 4:1 balun at the shack.

While theoretically the antenna should have an impedance of approximately 200 ohms on all five bands, you will probably need an antenna tuner to achieve a good match.

This does not exhaust the antenna possibilities for HF operation, but hopefully will be sufficient to help you examine your options for a quick start with a new antenna setup. 73

## The IC-706MKII Shack-in-a Box

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### Parting comments

The new ICOM 706MKIIG model will include the 440 MHz band. This can be considered normal model progression. ICOM must compete with the new Yaesu FT-100, which includes 440. Anything else earthshakingly new about the G model? Not really. Am I going to run out and get a G model? Nope—I don't have a need for the additional coverage. But the G model is evidence of the continuing trend toward more power in smaller boxes.

There are two after-market items I wish were available to use with the 706MKII:

- A high/low cut audio filter—without the other DSP frills (therefore inexpensive).
- A keypad for direct frequency entry—à la Stone Mountain Engineering's QSYer (no longer produced).

If any of you are interested in designing/marketing such devices, remember: They could be applicable to not just the ICOM 706 series, but also the new Yaesu FT-100 and whatever else Kenwood is cooking up to compete with, too. 73

## NEVER SAY DIE

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speakers are now almost 50 years old.

It's been a while since I told the story, but this all started when I was working at Airborne Instrument Laboratories on Long Island (NY) as an engineer. Well, I was putting in time while looking for a job as a television producer-director. I got started in that business as the chief cameraman at WPIX, Channel 11 in New York. Then I put KBTB in Dallas on the air as the director of their live shows. When that station went to all film to save money, I was out of work, so I went back into engineering.

One of my projects had an engineer, John Karlson, who'd invented and patented a wideband microwave antenna. Hmm, says I, microwaves and audio have the same wavelengths, so this ought to make a good speaker enclosure, too. When a TV directing job opened up at WXEL in Cleveland, I lent my audio test equipment to Karlson so he could get busy developing a completely new kind of speaker system. About a year later, I

got really fed up with my directing job, which turned out to be strictly routine news and sports shows, and moved back to New York. There I found that Karlson had done nothing. So, with me pushing, we spent the summer using an open field as a laboratory and designed a speaker cabinet using his antenna principle. Its size was mainly determined by the size of my car door so we could cart it around. The sound it produced was awe-inspiring.

We took it to Avery Fisher (you've heard of Avery Fisher Hall at Lincoln Center?). He listened and offered to sell it with his Fisher audio equipment and give us a 4% royalty. Karlson wanted to go for that, but I saw this as an opportunity to build our own business.

Neither of us had any money, so I borrowed \$1,000 from the bank on my car to get some sample units made at a local woodshop. We wrote an article for *Radio News* which brought in a bunch of prepaid orders, and we were in business. The hi-fi stores took one listen and ordered

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## Here Comes the Sun

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thunderstorm many miles away. A number of these devices are in use as "UFO Detectors," and the portable devices might even be useful in investigating strange phenomena such as crop circles or poltergeist activity.

More information on these and other devices can be found on the Internet by going to my site at [<http://www.bioelectrifier.com>] and clicking on the SOLAR link. You can also reach me via E-mail at the address at top or by clicking on the "hot key" on my Web site. 73

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