John M. Franke WA4WDL
1006 Westmoreland Ave., Apt. 225
Norfolk VA 23508

Can Hams Counter Police Radar?

—electronic warfare: another step

There is a growing interest among amateur radio operators in the development of a simple and inexpensive method to jam or otherwise defeat police radar units. This article is written to discuss the various methods I have used and to offer some suggestions for future work.

Electronic warfare is a highly-developed military science, the purpose of which is to render useless the electronic sensor and communications equipment of the enemy. This article will be limited to the narrow realm of CW Doppler radar jamming.

The best place to start is to obtain an accurate description of the hostile unit, the police radar. A block diagram of typical police radar is shown in Fig. 1. The radar consists of an unmodulated CW source, either a klystron or a solid state Gunn or Impatt oscillator, a duplexer to isolate the transmitter and receiver, a common antenna, a detector-mixer, and an audio-frequency meter. Typical transmitter output power is in the neighborhood of 10 to 100 milliwatts. The transmitter frequency is 10,525 MHz, very close to the 10,000 to 10,500 MHz amateur band. Typical antenna gain is between 10 and 20 dB.

In operation, radiation from the oscillator passes through the duplexer to the antenna, where it is radiated in a narrow beam. Energy striking cars is Doppler-shifted by an amount proportionate to the car's velocity. The reflected energy is picked up by the antenna and fed to the detector-mixer. Some of the transmitter output is mixed with the reflected signal. The detector-mixer, usually a simple point-contact diode of the 1N23 series or a hot carrier diode in the newer units, detects the difference frequency, which is measured by the audio-frequency meter and displayed as mph on a meter or LED display.

An audio-frequency meter is used because the Doppler shift is approximately 31.4 Hz per mile per hour velocity, or a speed of 100 mph produces a Doppler shift of 3140 Hz.

Methods of Deception

1. CW Jamming

This is the first method amateurs consider, but it is actually one of the least effective and most expensive. To use this method requires operation outside the amateur band. It also would be necessary to use a scanning

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Note: Don't let that complex synthesizer fake you out. All you need is a common audio oscillator, not a laboratory generator like Fig. 2. *73* takes no stand in the developing warfare between police radar and hams interested in countermeasures. The more we read about it, the more convinced we are that police radar should be outlawed as an invasion of person by possibly damaging microwave radiation. — Ed.

receiver, i.e., a spectrum analyzer, and a voltage-controlled jammer oscillator. The receiver is needed to lock onto the exact radar frequency, because the radar transmitter is not of crystal stability. Then the jammer must be offset from the radar's frequency by an amount equal to the desired false Doppler shift. Again, this method is expensive and requires operation outside the amateur band.

2. Noise Jamming

Noise jamming is a technique pioneered for use against radars in the 1940s and is still effective today, but it's not for amateurs who wish to retain their licenses. Noise jamming consists of modulating a transmitter with broadband noise. The bandwidth of the noise spectrum is made large enough to cover the operating band of the hostile radar. Covering the police radar band would require a noise bandwidth of 10 MHz. The radar's receiver has a bandwidth of only 10 kHz. The result is that, by having to spread the jamming energy over ten megahertz of which only ten kilohertz is effective, only one-thousandth of the jammer power is being used. Also, this method requires operation outside the amateur band.

3. Baseband Jamming

This method is the least expensive and most reliable method that I have tried. The method is simple and does not require operation outside the amateur band. It involves transmitting a tone-modulated carrier within the amateur band. Since police radars have an untuned front end, the detector-mixer will act as a detector for frequencies outside the police radar band. If the jammer transmitter, operating inside the 3 cm amateur band, is amplitude-modulated by, say, 3140 Hz, the detector-mixer will detect the 3140 Hz tone and display a speed of 100 mph. Hence, the radar can be deceived into reading any desired speed by merely modulating an oscillator by a tone corresponding to the equivalent Doppler shift for that speed. I have been able to deceive radar units as far away as one mile using this scheme with a 15-milliwatt Gunn oscillator and a 15 dB gain horn antenna. The schematic of the unit is included in Figs. 2 and 3. Fig. 2 shows the phase locked synthesizer used to generate equivalent speeds of 1 to 99 mph with thumbwheel switches. The design is a hybrid of CMOS and TTL logic because the parts were on hand. The design is not optimum, but it does work. Fig. 3 shows the modulator which switches the Gunn diode oscillator on and off. The photographs show the car used for the tests.

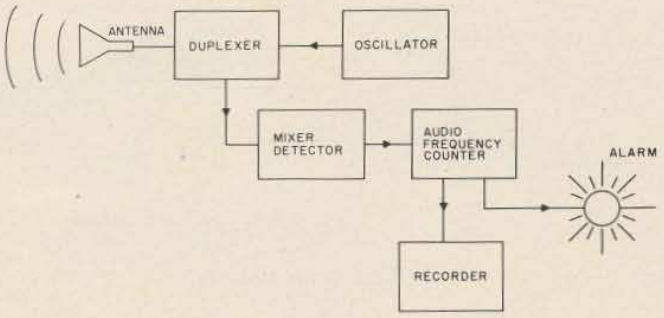


Fig. 1. Simplified block diagram of police radar.

4. Passive Jamming

This area is most interesting in that no transmitter is used. In baseband jamming, the deception is accomplished by transmitting a tone-modulated carrier whose modulation frequency corresponds with the desired Doppler frequency. In passive jamming, it is the reflected radar signal which is modulated to produce the deception. This is accomplished by varying the apparent size or radar cross section of your car. Using an inflatable car and varying the air pressure would work, but a simpler technique is to use an antenna with a varying impedance load. A test unit was constructed with a small horn

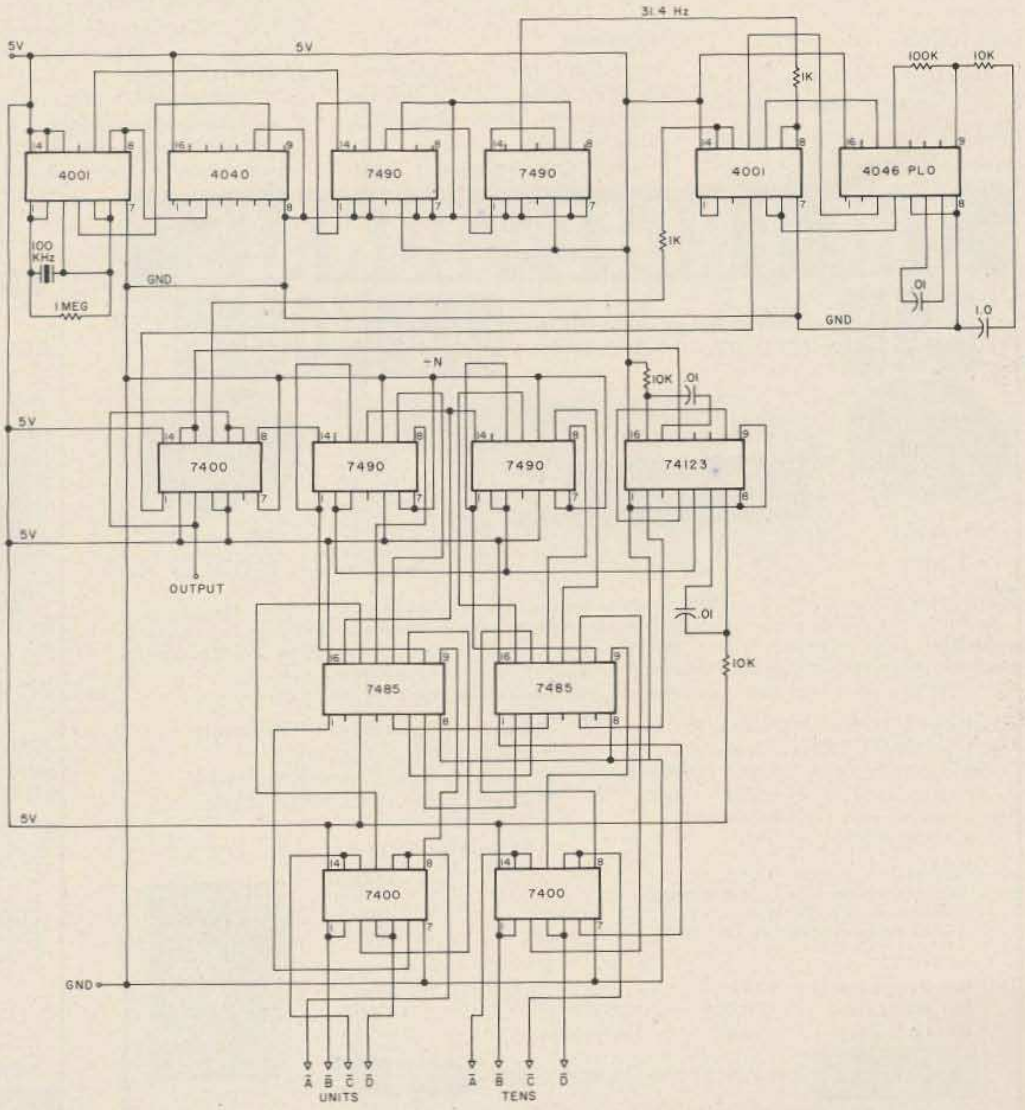


Fig. 2. Phase locked synthesizer.

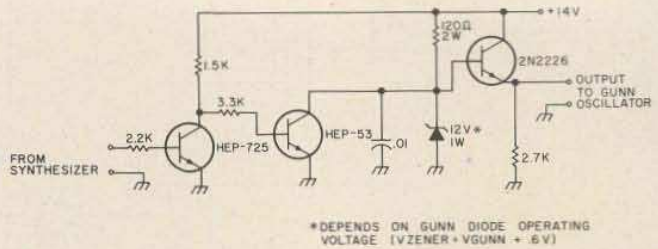
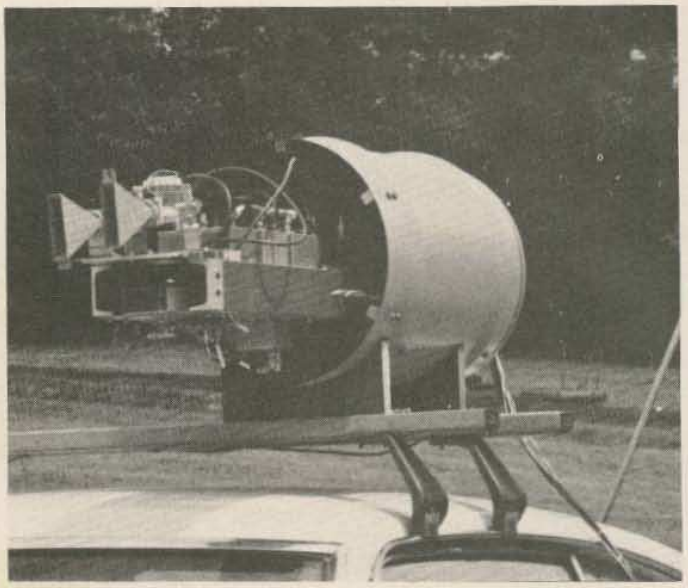


Fig. 3. Gunn diode modulator.



antenna, pin diode switch, and dummy load. The switch is used to alternately terminate the antenna with the matched dummy load or a dead short. The net effect is an amplitude-modulated reflected wave that is capable of deceiving the police radar at ranges of only 20 yards. However, the addition of larger and more advanced antenna designs is expected to increase this range significantly.

Conclusion

Baseband jamming is the most effective and economic method for deceiving police radars. The circuitry is within amateur capabilities. A listing of suggested literature is included and is recommended for potential designers. This article has been limited in scope and theory with the intent that interested amateurs will be able to build workable equipment using these simple guidelines. This article does not cover the full legal problems, and, for that reason, it would be interesting to hear from lawyer amateurs. ■

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