FARMINGDALE, NY 11735

RADAR SPEED-GUN CALIBRATOR

In regard to Anthony Stevens' article, "Radar Speed-Gun Calbrator" (**Radio-Electronics,** August 1986), there seems to be a little information that he left out—and the reader should be aware of it.

On the first page of the article, he mentions that the Doppler shift is about 31 Hz per MPH of target velocity. That is correct, but he fails to point out that that amount of Doppler shift only applies to radar guns operating at the 10.525GHz frequency (X-band). He also does not inform the reader that the Gunn diode and microwave horn in the parts list will only work in conjunction with the X-band radar units—that is, assuming that they are the same ones as shown on the lead page of the article. Also not mentioned is whether or not a K-band diode and horn is available.

While the K-band output is mentioned in passing on page 42, he does not elaborate on any of the details. The K-band output is derived from a different divider chain, because the Doppler shift on that band is different than it is on the X-band for a target traveling at the same speed.

Although there are several K-band frequencies used, I used 24.5 GHz for my computation. That results in a Doppler shift of 73.1 Hz per MPH. That can be figured out by one of two methods. One is to multiply the ratio of 24.5 GHz to 10.525 GHz (2.328) by 31.4; the other is to use the formula for Doppler shift, DS:

$$DS\ (Hz/MPH) = 89.49/\lambda$$

where λ is the wavelength in centimeters, which equals 30/frequency in GHz.

Another item of note from the "Ask-RE" column in that same issue. A reader asked about an IC that would convert from a RGB signal to a composite signal. The author of the column did not know of a chip for generating the sync. Refer to the article on Cable-TV descrambling on page 53, and you will find an IC to do just that. There is an article in a back issue of *Ham Radio* that provides complete construction instructions. I'm not sure which issue it was, but I think it came out four or five years ago.

And finally (I know, I know; my high school English teacher said never to start a sentence with *and*), who is the new advertiser on page 14? (Mr. Sestero refers to the NutriWheat Diet Program.—*Editor*) I'm sure that I speak for many of your faithful readers when I say that we don't need that kind of advertising in an electronics magazine. It reminds me of reading through the old *Mechanix Illustrated* magazines of 20 years ago. Please, let's not repeat that.

ROBERT T. SESTERO
Baltimore, MD

We start sentences with "and" regularly—in spite of what our high school English teachers said. We also use prepositions to end sentences with. Times change.—Editor

RADAR DETECTORS

Being trained as a physicist, and having been employed for the Department of Defense since 1962, I have amassed more than a little knowledge and experience with Doppler Radar. I have been amused at several of the letters concerning traffic radar, especially since I was cited in Kansas near Emporia for driving at 78 mph in a 1973 Vega SW with two cylinders operating so inefficiently that its maximum speed was 54 mph on flat highway.

I was particularly interested in the letter from Mr. Richard Kolasinski (**Radio-Electronics,** August 1982), who says "...but I have yet to hear of a radar-detector in car being used for any *other* purpose except to avoid getting caught when speeding." I must inform Mr. Kolasinki that it is common practice for amateurs operating two-meter transceivers, and knowledgable Citizen Radio Services operators (11 meters) to operate radar-warning receivers (RWR) to inform them that it is unwise to transmit at a specific time while they are being "painted" by Doppler Radar, even though they are not speeding. That is to avoid getting caught when *not* speeding, as it has been shown numerous times that such transmission will heterodyne with the traffic-radar carrier frequency in the K-band (10.5 - 10.55 GHz).

He should also be advised that Mr. Rod Dornsife, a former San Diego police officer, testified in court at Burlington, KY on January 17, 1980, that radar equipment and radar operators have a 30% error rate (also known as false-alarm rate) on a nationwide basis. He should also be advised that Dade County Judge Alfred F. Nesbitt was cited for driving at 63 mph during the weekend of July 4, 1982, even though his cruise control was set at 55 mph, and it was his first citation in 45 years of driving. Judge Nesbitt convened a court hearing after he learned that Florida police had clocked a speeding banyan tree and a house moving at 28 mph during 1979. Obvious the actual target and the intended target were not identical, and that problem is one of the deficiencies of traffic radar systems. Judge Nesbitt's hearing did, in fact, document other instances of the radar system's fallibility. Eighty cases based upon radar evidence were then dismissed, and Dade County police are now required to support an arrest with evidence obtained through pacing.

If anyone does a large amount of traveling via the automobile, it would be prudent to equip his or her car with cruise control and an RWR of the superheterodyne type for self-defense.

One might well ask, with respect to the "moving" tree or house, just what *did* the radar system measure? First of all, it must have been a strong reflector of K-band frequencies, such as a metallic surface. Next, Doppler systems require that the radar return be different from the transmitted carrier by an amount equivalent to an audio frequency. The calibration test consists of a tuning fork oscillating at a frequency usually corresponding to 60 mph, and the vibration must be in the direction of the beam. A roadsign vibrating about a vertical axis in a strong wind also provides a good radar return, as does an electrical transmission line suspended above the roadway, or a nearby windmill rotating in the wind and also in the radar beam.

It is possible that any one of those reflectors were in the beam directed at the house or the tree by the police operator. However, since the operator's mind has isolated the target, more often than not, that is all that he considers as a potential target. Thus, the guilt oftentimes cannot be validated "beyond resonable doubt" since his eye cannot corroborate the intended target as the actual target. Even if there is only a single vehicle within a reasonable distance of, or inside, the radar beam, a transmission of a suitable radio frequency has been shown to cause a false measurement and the interference is unseen by the operator.

There are far too many circumstances for even a very accurate system to fail to provide a true measurement, let alone the traffic-radar systems now on the market and in actual use. A traffic-radar system could be built that would function with as little as a 5% false-alarm rate, but such systems would be orders of magnitude more expensive than current systems, and still might not provide evidence "beyond a reasonable doubt" in all courts of law.

In the defense of my innocence after my citation in 1977, I qualified myself as an expert witness and the prosecution acquired the services of the gentleman who designed the radar system which provided the evidence against me, the Kustom Signal, Inc. *MR-11*.

I testified to all of the above circumstances as being possible, provided a mechanic's data as to the condition of the engine in my vehicle, and prompted my attorney in his eliciting testimony from the arresting Kansas State Trooper. What came out was that every time the Trooper drove past a particular place on a highway, the radar indicated 88 mph even when his was the only vehicle within seven or eight miles. I, myself, have heard sophisticated RWR's sound off and give a visual indication of an RF field in the K-band capture band with no other vehicles in sight. The RF energy is there, but it does not emanate from traffic radar.

How could one defend himself in court without knowing that he had been "painted" and taken pains to record and verify his vehicle's speed? Possibly Mr. Kolasinski would conclude that the driver is guilty, regardless of the circumstances, simply because the radar measured a number. At any rate, the designer of the *MR-11* told me later that this was the first case of the many that he had had, that he had lost! I wonder why.

J. FRANK FIELDS
Lawrence, KS

RADAR DETECTORS

First of all, I would like to say that this letter reflects only my personal opinion and is in no way a policy statement of the R.C.M.P. or any other police force for that matter. I am a member of the R.C.M.P. in Canada and have been for the past five years. I am also an electronic audio tech.

For some time I have been listening to the radar and radar detector arguments with amusement. Firstly let me speak on the radar.

My writing has been prompted by the Feb 80 letter "Radar Detectors vs The Law". The writer points out that radar has come under severe attack recently—especially moving radar—because of situations that can cause false readings. I have operated radar for the past four years and I agree with the writer on that point.

However, picking out a speeder in a group is quite simple—he is the one whose car is going the fastest. As for "batching", ghost readings, and large speeding trucks behind unsuspecting motorists, the radar operator is instructed in the use of the radar and is supposed to be able to recognize those problems and sort them out from the true readings. However, modern technology has yet to perfect the "idiot proof" instrument. Radar is not "idiot proof".

I should mention after watching the flow of traffic for five years that an officer can judge the speed of a vehicle quite accurately, with only the use of his eyes and sense of timing.

Now on the subject of radar detectors. I do not feel anything wrong with a person owning and operating a radar detector if he can afford it and the law permits it in the area he lives. But let's be honest with ourselves and others, and admit what is usually the real reason for radar detector use.

Many people quote such notable persons as mayors, traffic control techs, and electronic engineers as saying, "Radar detectors promote safe driving by making drivers aware of their speed, thus slowing them down, and slower speeds reduce accidents."

I cannot dispute that slower speeds reduce accidents, but we will most likely read the statistics in the future and see that there were few, if any, accidents in the vicinity of traffic officers operating radar. However, what about the stretch of highway where there is no officer operating radar. What will remind drivers of their speed there? Hardly anything!

If we are honest with ourselves we will realize that, for most drivers on the road owning radar detectors, the primary reason is to escape detection when they wish to exceed the speed limit.

For the last several years a device has been marketed that satisfies all the claims of radar detector owners and distributors. It is called *cruise control.* It helps you keep a constant speed and prevents your speed from "creeping" when going downhill. It also gives you a better average speed over a long distance, and any professional driver knows that this will save you gas and time in the long run. (On a steep downgrade, your car can exceed the Cruise Control speed setting. So you must still be cautious.—*Editor*

For your own protection, from salespeople marketing radar detectors, you should know that a detector only detects a radar beam when it is present. Modern radar units have a microwave lock-off switch that allows the operator to turn off the radar beam until you are well within its range. When the beam hits your car your detector will go off. Being so close to the transceiver, you are also being clocked. Chances are you'll get your speeding ticket, lose your detector, and get an additional fine for having a detector in your possession. All the while a detector distributor is counting your hard-earned dollars and waiting for you to come back to buy another. There are no detectors on the market, nor will there ever be, that can detect a radar *set*—they only detect a radar *beam.*

For your own protection, you are better off to buy and use a cruise control. However, if you wish to use a detector, make sure that your State or Provincial laws allow it or you could lose your investment. Lastly, don't use your detector so that you can speed undetected. With the widespread use of microwave lock-off switches, and officer-awareness of detector operation, the only people making money will be the State or Provincial traffic boards and the radar detector distributors.

R. BROWN, Cst.
St. Albert, Alberta, Canada

RADAR DETECTORS

In the December 1981 "Letters" section, Mr. Horn overrates the law as a safety device. Most drivers come with two police detectors—one on either side of the nose—and the truth is that the law has little effect on the way they drive. Driving habits reflect one's intelligence, skill, alertness, experience, self-discipline, and attitude toward respect for safety of self and others. The law makes little prescriptive contribution. Fatality rates among radar-detector-equipped drivers may tend to be lower than average, because such drivers tend to be alert and self-defensive. The law's most significant effect is in the persuasion of the public that officials have taken action. The net result of radar detectors on the nation's traffic picture will be a slight reduction in speed-trap revenue, and nothing more.

J.D. DENNON,
Warrenton, OR

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THE RADAR DETECTOR

I should like to comment on the letter, "Radar Detector," by John W. Ecklin, which appeared in your June 1979 issue.

When Mr. Eckland stated that we have the "erroneous idea that not even light can travel faster than 186,000 miles-per-second or c," he said a mouthful. Scientists across the country are in hot debate, and are doing intense research, on the possibilities of mass and/or energy moving at a speed greater than that of light, or any known electromagnetic energy for that matter.

In his theory of relativity, Albert Einstein stated that no object can exceed the speed of light. And since energy is directly related to an object (mass) by the equation $E=mc^2$ we can see that energy in the form of electromagnetic radiation would also be subject to the limit of the speed of light.

Mr. Eckland mentioned that the electromagnetic radiation would pick up the speed of its source, and thus gain additional velocity. He also asked how the Doppler effect could occur unless the speed of the electromagnetic radiation—in this case radar waves—picked up or lost some speed because of its source's velocity.

The Doppler effect is directly related to time, and not the velocity of the radiation but the velocity of the source. Suppose that a radiation source were moving a hundred miles-per-second forward and the radiation were moving c (the speed of light) in the opposite direction. When the radiation was picked up by a detector, the detector would register a frequency change—thus the Doppler effect. But in no way was the radiation's velocity increased or decreased; it merely arrived later than it would have if it had been moving toward the detector. And since time is directly related to frequency in this case, the Doppler effect can occur without an increase in the velocity of the radiation.

To put it simply: An electromagnetic wave leaving its source does not gain additional speed, no matter how fast its source is moving forward. The velocity of the source only determines *when* the wave will arrive with reference to the source's velocity. A star is a moving electromagnetic source. When it emits electromagnetic radiation, that radiation leaves the star at c, no matter what the velocity of the star itself may be—even if it were a million miles a second, the wave remains constant at c.

By the way, there is one thing that can exceed the speed of light—or possibly is not governed by any laws of motion, energy, mass, etc., and that is—Time. Figure that one out.

As the saying goes: "It's all in your relative position-Relativity."

MICHAEL A. ALVARADO II,
Norwalk, CT.

RADAR JAMMER

This is in response to your editorial comments concerning speed radar jammers in the December 1978 issue.

I recently received a flyer for a police radar calibrator ("illegal to use to jam police radar") that may be the device you refer to. Such a device can indeed cause a stationary Doppler radar to give a false reading if they are both in the same frequency band (X, K or whatever). However, consider this:

A moving oncoming police radar (for example, Kustom Signals' *MR-7*) probably will not be adversely affected by the steady tone that would jam a stationary radar. This is because internally the unit has two audio bands—a low Doppler band, representing the police-cruiser speed with respect to the road surface, and a high Doppler band within which the heterodyne signal from the oncoming vehicle will fall. The high-frequency band signal will represent the sum of the speeds of the cruiser and the target. In real life this sum might be equal to 115 mph (cruiser, 50 mph; target, 65 mph).

In this example, in order to jam the radar, you would need to transmit an indicated speed of 105 mph. Suppose the cruiser slows down to 35 mph; you will pass him and indicate 70 mph. At 105 mph the stationary Smokey will just love you.

Such a moving radar can be jammed by using a glide tone passing through the high Doppler band. This must change at a rate indicating a speed change greater than 3.15 mph. This causes the internal verifier circuits to reject the input. The effect of this technique on a stationary radar is unpredictable and not worth the risk.

There are also serious side effects in transmitting your own signal: 1) your own radar detector is overwhelmed and useless; 2) every detector in the oncoming traffice lanes will be set off, resulting in a mass slowdown. (A recent excursion down an interstate highway while testing a prototype microwave device, not a jammer, pointed this out. No one could spot the Smokey, so everyone slowed down.)

A practical jammer is feasible, but it would need to be activated only when an incoming signal is present and would have to transmit CW (*C*ontinuous *W*ave) at an offset from the police signal that would produce the desired heterodyne.

Passive methods are possible. Create a plasma screen large enough to hide your vehicle behind, then turn it on and off at the desired rate to modulate the returned microwave energy. A bank of neon or fluorescent tubes on the front would do it. A tuned cavity with a modulating device will return a jamming echo within 50 to 60 feet of a roadside radar. You could coat your vehicle with microwave absorber and then make them think you are a big fuzzy caterpillar.

If these so-called jammers proliferate, the only result will be increased confusion on the highways and the opportunity for government agencies to intrude further

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into our personal lives. Oh yes, the 55-mph limit has had one good effect: Look at the shot in the arm it gave the electronics industry!

RICHARD L. PEARSON
Pearson Electronics
Gastonia, NC