Radar Detectors

How radar detectors work

Police radar guns “see” a vehicle by transmitting a microwave pulse. Then they make use of the Doppler Effect: the frequency of the transmitted pulse is compared to the frequency of the reflection, and speed is calculated by using

Speed is calculated when a pulse is reflected to the RADAR transmitter.

the difference between them.

Think of a radar signal as a beam of light from a flashlight. When you shine a flashlight at an object, your eyes perceive the light reflected from the object.

Now imagine yourself as the object being illuminated. You can see the light from the flashlight from a much farther distance than the person with the flashlight could ever hope to see you. That’s because the beam loses energy over distance. So while the beam has enough energy to reach you, the reflected light doesn’t have enough energy to travel all the way back to where it started.

That’s the idea behind radar detectors. They look for radar “beams” and find them before they can return a strong enough reflection to “illuminate” you.

Detectors use superheterodyne reception to accomplish this. Radar detectors are essentially microwave radio receivers that make noise or flash lights when they sense an incoming signal on specific frequencies. Superheterodyne reception also allows detection of radar around curves or over hills, and it extends detection range straight ahead.

Different Types of Radar

The Federal Communications Commission has dictated that police radar must operate on specific frequency bands:

**X-Band Radar: 10.5 – 10.55 GHz**

Dating from the 1950s, X-band radar is the easiest to detect because of its lower frequency and higher power output. Depending on terrain, temperature and humidity, X-band radar can be detected from a distance of 2 to 4 miles, yet it can only take accurate readings of speed from a distance of ½ mile or less.

Unfortunately, police radar is not the only source of X-band signals. Garage door openers, microwave intrusion alarms, microwave towers, and other high-tech equipment can fool a radar detector into giving off an X-band alert. Filters and redundant sampling are used to combat this “falsing.”

**K-Band: 24.05 – 24.25 GHz**

K-band, the most common type of police radar, made its appearance in 1978. The first K-band hand-held radar guns could only be used from a stationary position. Later, a “pulsed” version was introduced that could be used from a stationary or moving vehicle.

K-band radar waves have a relatively small wavelength and so are more easily absorbed by water molecules in the air. At the power level found in police radar guns, K-band has an effective clocking range of about ¾ mile.

Depending upon terrain (around a corner, over a hill, etc.), K-band waves can be detected from a range of ½ to 2 miles.

K-band guns also have what’s known as “Instant-On” radar. This is basically a kill-switch option which keeps the transmitter in “hot standby” mode, ready to be activated by an officer when the target is within 200-300 yards. If it’s been aimed at you, you’re speed has been measured by the time the detector alerts you. If it is being used to target vehicles ahead of you, your detector may provide a warning in time for you to adjust your speed.

**Ka Photo Cop and Ka Wideband: 34.2 – 35.2 GHz**

In 1987 the FCC allocated a frequency on yet another band, Ka, for police radar use. With that came the introduction of photo radar (also known as “photo-cop”).

The photo-cop system works at 34.3 GHz and combines a Ka-band radar gun with an automated camera. A vehicle approaching at or above a predetermined speed will trigger the camera. The photo shows the front of the vehicle, license plate, driver’s face, the date, location, and time. The unit can clock and photograph up to 200 vehicles per hour. Alleged speeders are not stopped. The film is processed and a citation is mailed to the registered owner of the vehicle, ordering him or her to pay the fine or appear in court.

**Radarm Frequency Bands**

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Photo-cop’s effective range is 120-300 feet and it transmits a continuous signal which is a plus for radar detectors. The distance at which it can be detected varies depending upon a detector’s Ka-band sensitivity. Better detectors can typically sniff out a photo-cop system ¼ to ½ mile away.

Only a handful of cities use photo radar. Industry sources predicted widespread interest and expanded use, but that has not been the case. Legal controversies along with prohibitive expense have caused officials to stick with more traditional methods of speed detection.

The FCC later expanded Ka-band radar use to a range of 34.2 – 35.2 GHz. This became known as Ka Wideband

**Ka Super Wideband: 33.4 to 36.0 GHz**

The introduction of the “stalker” radar gun raised the stakes in the detection game. Unlike all previous guns – the Stalker can be
FCC licensed for any frequency in the Ka-band between 33.4 GHz to 36.0 GHz, and so cannot be picked up by detectors designed only for X, K, and photo radar. Stalker guns are being used across the country.

In response, manufacturers developed detectors with “Super Wideband” technology that sweeps all of the Ka-band allocated to radar, as well as providing continued protection against X, K, and photo radar.

Laser Detectors

Laser speed guns determine speed differently than radar guns. A series of light pulses is transmitted, and the difference in time between pulses and reflections is used to calculate speed. This all takes place very rapidly (at the speed of light, as a matter of fact). A single pulse typically requires only a few nanoseconds to transmit and return.

The advantages of a laser gun are compelling: the laser light beam is far narrower than a radar beam, allowing more accurate pinpointing of a specific vehicle; and the total time needed for capturing a speed reading is less than half a second versus 2 to 3 seconds for radar.

The drawbacks are also important to note: laser guns are very expensive, they can’t be used from a moving vehicle or from behind glass, and accurate aiming requires a tripod or a very steady hand.

Despite initial claims that a laser gun is not detectable, it is. And as the laser beam moves away from the laser gun, it widens and becomes even easier to detect. Vehicle speeds are typically measured at roughly 1,000 feet (½ mile); at that distance the laser beam is over 3 feet wide. Many of the laser detectors in use have a working distance of approximately 1½ miles (at that distance a laser gun’s beam covers two lanes of traffic).

Glossary

Audible/Visual Alerts – Ideally, a detector will give a different alarm for each type of radar it senses, along with some indication of how far away the source of the radar is. The most common audible warning is a series of “beeps” or “braps” that grow faster as you near the source. Visible alarms can be either a digital display of signal strength or a series of LEDs.

Auto-Mute – Replaces a continuous audio alert with a single alert followed by clicking. This can preserve your sanity during extended radar encounters while continuing to notify you of the presence of radar.

City/Highway Switch – Helps eliminate false alarms from non-police X-band emissions encountered in urban areas. This is usually accomplished by reducing the detector’s sensitivity since the ability to “see” long distances is not critical on city streets.

Dash Mount – Velcro® strips usually serve to keep the detector in place.

Dim/Dark Mode – For keeping the detector inconspicuous while driving at night, this feature dims or eliminates all illuminated alarms and controls.

“Instant-On” Protection – Practically speaking, you can’t really defend yourself against Instant-On radar; if it’s been aimed at you, your speed has been measured by the time your detector gives an alert. However, if the radar was targeted at a car ahead of you, a detector with sensitive K-band reception will alert you. High K-band sensitivity is what allows manufacturers to promote a detector as giving Instant-On Protection.

K-Band – The most frequently used radar frequency band: 24.05 – 24.25 GHz.

Ka-Band – Encompasses “Wideband” and “Super Wideband.” Photo radar operates on the Ka-band at 34.3 GHz, while the newer hand-held, stationary “Stalker” guns operate anywhere from 33.4 to 36.0 GHz. Radar detectors must be able to scan a range of frequencies to detect “Stalker” guns.


Mute or Volume Control – Allows you turn down or turn off a detector’s audible alerts, while keeping the visual alerts.

Pulse Radar – A refinement of the original K-band radar gun. Pulse radar can be used from a moving vehicle as well as from a stationary position. Pulse radar guns transmit a burst of energy every two seconds.

Remote Mount – A two-piece system in which the antenna is mounted behind your car’s front grille and the controls are under the dash. You sacrifice a small degree of sensitivity in exchange for low visibility.

Selectivity – A detector’s ability to detect police radar while ignoring the presence of such devices as automatic garage door openers and microwaves (which may operate on closely neighboring frequencies). A good radar detector offers high selectivity and is highly sensitive.

Sensitivity – A detector’s ability to detect police radar. Most radar detector manufacturers improve sensitivity as they add features and move up the product line.

Factors Affecting Range

According to a recent Car & Driver study, a significant loss in detection range occurs when vehicles contain windshields with metallic film embedded, and when commercially available tint films are applied.

Radar detection range is most affected by windshields with metallic film solar-barrier treatments, found in Ford products with Instaclear windshields, GM products with PPG and Everclear windshields, and in some high-end imports. In these vehicles, detection capability drops by a startling 95 percent!

Laser detection range is always affected by glass, sometimes losing up to 80% of its sensitivity. It’s also affected by tint films -- the darker the tint, the more loss.

Some tint films contain a metallic layer, and these can reduce radar detection capability by as much as 37 percent.

Remote Mount – A refinement of the original K-band radar gun. Pulse radar can be used from a moving vehicle as well as from a stationary position. Pulse radar guns transmit a burst of energy every two seconds.

Safety Warning System Alerts – Radar detector manufacturers use radar to promote highway safety. Transmitted radar signals alert drivers to changing or hazardous road conditions, such as road construction or accidents. If your radar detector is equipped with this feature, it will emit different sounding alerts for safety warnings and speed detection warnings. Visual alerts help distinguish the type of safety warning.

Super Wideband Detector – The latest generation of radar detectors specifically designed to pick up X, K, and the full range of Ka-band frequencies.

VG-2 – Used by police to detect vehicles with operating radar detectors. VG-2 detects a detector’s oscillator leakage. Many manufacturers now offer radar detectors which are shielded from VG-2 or detect VG-2 and shut down when they encounter it.

Visor Mount – Visor clips attach the detector to the sun visor.

Wideband Detector – A detector that scans the Ka frequencies between 34.2 and 35.2 GHz. These do not offer full Super Wideband coverage.

Windshield Mount – Suction cups and a bracket attach the detector to the windshield.

X-Band – The first frequency band allocated for police radar: 10.5 – 10.55 GHz.