Vacaville Police Department
660 Merchant Street
Vacaville, California 95688

RADAR OPERATOR UPDATE

EXPANDED COURSE OUTLINE

Purpose Statement: Provides training and update of legal and technical uses of radar, set up and calibration of equipment, detecting anomalous and spurious readings, and court preparation. Meets requirements for California vehicle code section 40802**.**

I. Introduction and Orientation (1 Hour)

A. Course goals and objectives
   i. Registration

II. SPEED AND ENFORCEMENT (1 Hour)

A. Speed in Relation to Traffic Safety
   i. Excessive speed overwhelms driver capabilities
   ii. Excessive speed increases accident severity
   iii. Historical trends have always linked speed with highway fatalities

B. Speed Enforcement in Relation to Traffic Safety
   i. Rigorous enforcement has been shown to maintain the safety benefit
   ii. This enforcement is needed for all types of roads

III. HISTORY AND THEORY (2 Hours)

A. Doppler Principle
   i. Founder Christian Johann Doppler
   ii. Definition of principle
   iii. Examples

B. Radar
   i. Uses sound waves
   ii. Acronym
   iii. Developed by military in World War II
   iv. Band identification (S, K, X)
   v. Traffic radar detects motion, not direction

C. Radio Waves
   i. Lengths
   ii. Travel at the speed of light

D. Frequency

i. Number of waves transmitted in one second
ii. Expressed as cycles, waves and hertz
iii. Units of measurement (kilo, mega, giga)
iv. High frequency shorter than low frequency

E. Doppler Frequency
i. The difference between the transmitted and returned frequency
ii. Examples for X, K and Ka bands

F. Beam Length Infinite unless:
i. Reflected
ii. Absorbed
iii. Refracted

IV. VEHICLE CODE LAW AND COURT DECISIONS (2 Hours)

A. Types of speed offenses
i. Basic speed law
ii. Prima facie speed limits
iii. Absolute speed law

B. Speed traps
i. Speed trap prohibition
ii. Speed trap defined
iii. Speed trap evidence

C. Sections not included under speed traps
i. Local streets and roads
ii. School zones
iii. Railroad crossings
iv. Uncontrolled blind intersections
v. Construction zones
vi. Tunnels or brides
vii. Absolute speed limits
viii. Children's playgrounds
ix. Senior citizen's center/facility

D. Speed Surveys
i. Defined by California Vehicle Code
ii. State Traffic Manual sets guidelines
iii. Conducted under normal conditions
iv. Define 85th percentile/critical speed
v. Define 10 mph pace

E. Federal regulations related to radar
i. FCC license not required by operator
ii. FCC license required for radio technicians
iii. National Highway Traffic Safety Administration (NHTSA) minimum standards for radar training
iv. National Institute of Standards and Training (NIST) developed minimum performance standards

F. Court Decisions
i. State vs Dantonio

ii. State vs Tomanelli
iii. Honeycutt vs Commonwealth
iv. State vs Wilcox
v. State vs Shelt
vi. State vs Halopoff
vii. State vs Hanson
viii. State vs Miller
ix. State vs Aguilera
x. State vs Kruegar
xi. State vs Defiore
xii. People vs Goulet

V. STATIONARY RADAR OPERATION (2 Hours)

A. Three components
   i. Counting unit
   ii. Antenna
   iii. Power source

B. Installation
   i. Cable connections
   iii. Power up unit last
   iv. Power supply considerations
   v. Antenna considerations
   vi. Counting unit considerations
   vii. Microwave radiation considerations

C. Testing
   i. Light segment test
   ii. Internal circuitry test
   iii. External test (tuning fork)

D. Audio setting
   i. Significance of Doppler audio
   ii. Volume level

E. Automatic locks and alarms
   i. Not acceptable equipment
   ii. Lock/alarm for non targets
   iii. Encourages operator inattentiveness
   iv. No tracking history
   v. Thumb wheel broadcasts enforcement tolerance

F. Radar beam
   i. Shape and characteristics
   ii. Main beam
   iii. Zone of Influence
   iv. Side lobe
   v. Beam width
   vi. Beam range

G. Cosine Angle

i. Define
ii. Effect on stationary operation
iii. Calculation

H. Target Selection
i. Target size
ii. Target position
iii. Target speed

I. Automatic Gain Circuitry
i. Purpose
ii. Describe how it works
iii. Operational considerations

J. Transmitter Use
i. on/off switch
ii. Impact on radar detectors
iii. Reduction of microwave radiation exposure
iv. Relationship to the tracking history

K Tracking History
i. Visual observation
ii. Audio confirmation
iii. Radar verification

L. Site selection
i. Demonstrated need
ii. Traffic and road conditions
iii. Safety considerations

M. Demonstration
i. Demonstrate Stationary RADAR on College Roadways

VI. MOVING RADAR OPERATION (2 Hours)

A. Basic principles
i. Patrol speed determination
ii. Closing speed determination
iii. Target speed determination
iv. Low/high Doppler

B. Testing
i. Light segment test
ii. Internal circuitry test
iii. External test

C. Installation
i. Counting unit
ii. Antenna considerations

D. Cosine Angle
i. Low Doppler cosine effect and determination

ii. High Doppler cosine effect and minimization
iii. Double cosine effect and determination
iv. Examples

E. Shadowing
i. Cause
ii. Effect
iii. Detection
iv. Examples

F. Tracking History
i. Visual observation
ii. Audio confirmation
iii. Radar verification
iv. patrol speed verification

G. Radar Detectors
i. Radio receivers
ii. Potential effectiveness
ii. Defeat of detectors
iii. State laws restricting detectors

H. Radar Jammers
i. Radio transmitter
ii. Federal Communications Commission (FCC) regulations
iii. State law
iv. Detection of radar jammers
v. Law enforcement response to potential violators

I. Demonstration
i. Demonstrate Moving RADAR on College Roadways

VII. RADAR EFFECTS (2 hours)

A. External Mechanical Interference
i. Caused by moving objects
ii. Avoidance/elimination

B. Random Radio Frequency Interference (RFI)
i. Patrol vehicle interference
ii. Police and business band radios
iii. Citizen band radios
iv. Lights
v. Power lines
vi. Avoidance/elimination

C. Harmonic Signal Interference
i. A multiple of a base frequency
ii. Causes
iii. Avoidance/elimination

D. Own Speed Capture Effect

i. Applies only to moving mode
ii. Simultaneous display
iii. Caused by multiple reflections
iv. Filters to defeat
v. Avoidance/elimination

E. Pulsating Signal Amplitude Effect
i. Applies only to moving mode
ii. Caused by irregular surfaces
iii. Avoidance/elimination

F. Feedback/Scanning Effect
i. Possible only with two piece equipment
ii. Caused by improper installation/use
iii. Avoidance/elimination

G. Audio Effect
i. Caused by an extremely loud radio
ii. Avoidance/elimination

H. Antenna Vibration Effect
i. Caused by movement of antenna
ii. Avoidance/elimination

I. Motorcycle Considerations
i. Special operating situations
ii. Additional maintenance and care

J. Dented Antenna Horn Effect
i. Causes a distorted beam
ii. Avoidance/elimination

K. Windshield Obstruction Effect
i. Reduced range
ii. Distorted signal
iii. Avoidance/elimination

L. Beam Reflection Effect
i. Caused by reflective surface
ii. Reads speeds from opposite direction
iii. Avoidance/elimination

M. Weather Effects
i. Rain or snow reduce range
ii. Low Doppler pick up difficult
iii. Avoidance/elimination

N. Heat Build up Effect
i. Causes component values to change
ii. Causes circuitry damage
iii. Avoidance/elimination

O. Power Surge Effect
   i. Occurs when power is first turned on
   ii. Avoidance/elimination

P. Automatic Gain Control
   i. Increases sensitivity
   ii. Avoidance/elimination

Q. Panning Effect
   i. Caused by sweeping motion of antenna
   ii. Avoidance/elimination

R. Batching Effect
   i. Caused by a change in the patrol vehicle speed
   ii. Avoidance/elimination

S. Multi path Signal Effect
   i. Cause by a reflected signal
   ii. Avoidance/elimination

VIII. VISUAL SPEED DETERMINATION (3 hours)

A. Speed Determination Techniques
   i. General observations
   ii. Practical techniques
   iii. Practice with RADARs for confirmation

IX. RADAR EVIDENCE (1 hour)

A. Subpoena Duces Tecum
   i. Define
   ii. Application to radar

B. Documents
   i. Certification of operator
   ii. Vehicle speedometer calibration
   iii. Vehicle maintenance record
   iv. Vehicle radio suppression documentation
   v. Radar operator's manual
   vi. Radar certification
   vii. Tuning fork certification
   viii. Radar maintenance log
   ix. Officer's daily activity log

X. PRACTICAL EXERCISES AND TESTING (4 hours)

A. Introduction
   i. Safety rules on roadways
   ii. Overview of exercises and learning activities

a. Practice using stationary RADAR (groups of 2-4)
b. Practice using moving RADAR (groups of 3 per car)
c. Intentionally create RADAR effects/errors for experience (learning activity)
d. Record observations/unusual readings to review in class

iii. Testing procedures
iv. Post course field practice
a. N.H.T.S.A. Recommendations (32 hours after completion of course)

B. Speed Estimate Practice
i. Stationary
ii. Moving

C. Speed Estimate Testing
i. Stationary
ii. Moving

XI. COURTROOM TESTIMONY (2 hours)

A. Techniques of Effective Courtroom Testimony
i. Advance preparation
ii. Proper dress
iii. Proper demeanor

B. Considerations for Radar Case Examination
i. Officer's qualifications
ii. Knowledge of related California Vehicle Code law
iii. Knowledge of equipment
iv. Knowledge of radar principles
v. Knowledge of beam width and range
vi. Knowledge of radar effects
vii. Application of tracking history
viii. Target determination

XII. WRITTEN EXAMINATION (2 hours)

A. Written test
i. Grades and certificates