TEXAS DEPARTMENT OF PUBLIC SAFETY
RADAR SHIFT LOG

Date	Start Time	Cal.	End Time	Cal.	Operator & I.D.
1-5-88	. M8-	202			
1-5-88	8:00 AM	✓	5:00 P	✓	DOE #3333
1-5-88	5:30 P	✓	1:00 A	✓	SMITH #1111
	RANGE ON REAR ANTENNA IS POOR				
	IN BOTH MODES. ACCURACY				
	OK. ALL TESTS ARE OK.				
1-6-88	8:00 A	✓	10:30 A	✓	DOE #3333
	REAR ANTENNA		COMPLETELY	QUIT.	
	REMOVED SET FOR REPAIRS.				
1-10-88	REINSTALLED IN M8-202 AFTER REPAIRS.				
1-10-88	2:30P	✓	5:00 P	✓	DOE #3333
1-11-88	8:00 A	✓	5:00P	✓	DOE #5333
1-12-88	INSTALLED SET IN		D8-400		
1-12-88	8:30 A	✓	5:00P	✓	DOE #3333

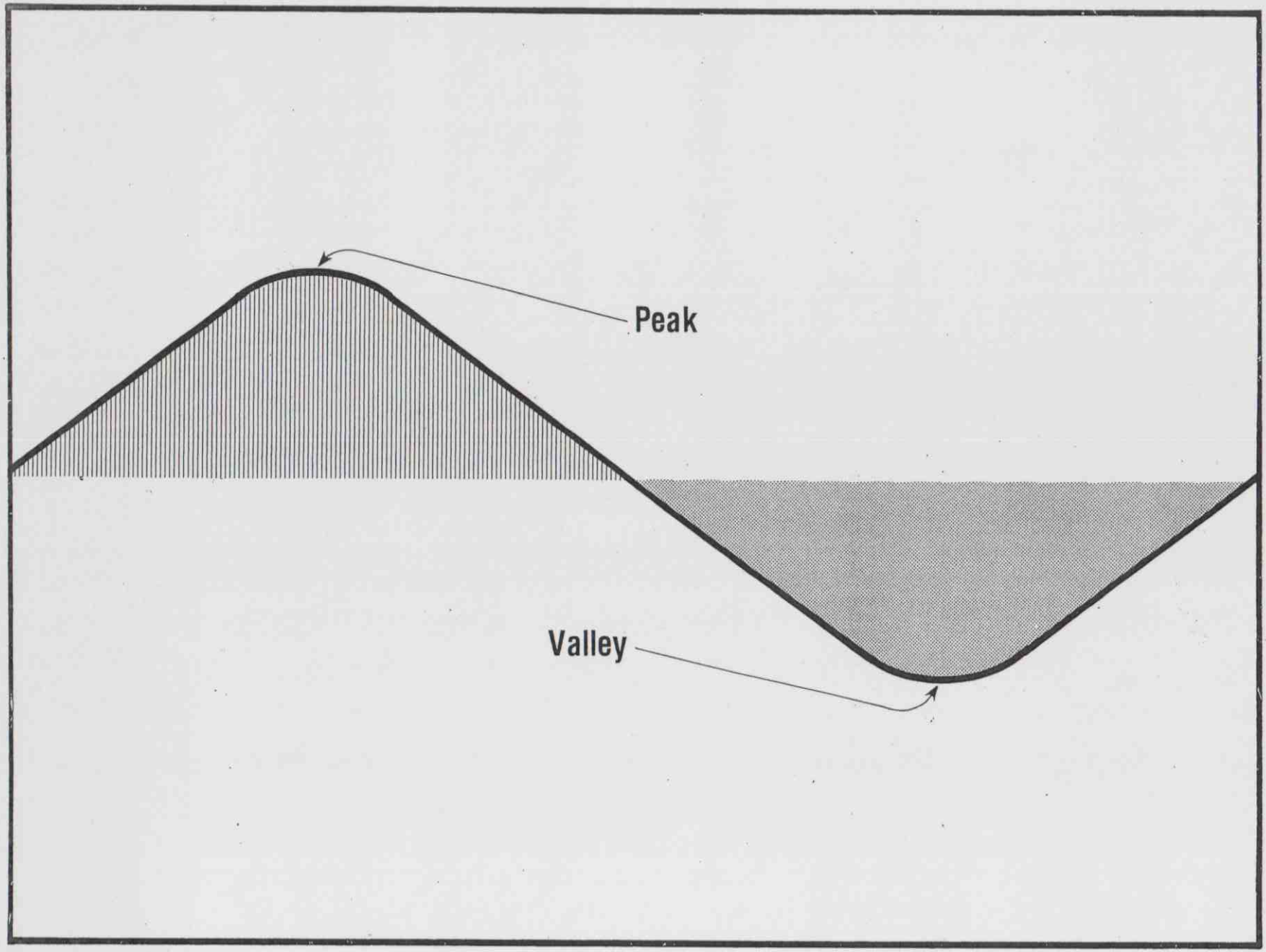
MAINTENANCE AND REPAIR LOG

Date taken out of service: 1-6-88 By: DOE #3333
Problem: REAR ANTENNA QUIT
Repair By: DPS COMM. SHOPS, AUSTIN
Nature of Repair: INSTALLED NEW XTAC & TUNED FREQ.
Date placed back in service: 1-10-88 By: DOE #3333
Internal Cal. ✓ L/T ✓ External Cal. ✓
Comments: UNIT WORKS FINE.

Date taken out of service: By:
Problem:
Repair By:
Nature of repair:
Date placed back in service: By:
Internal Cal. _____ L/T _____ External Cal. _____
Comments:

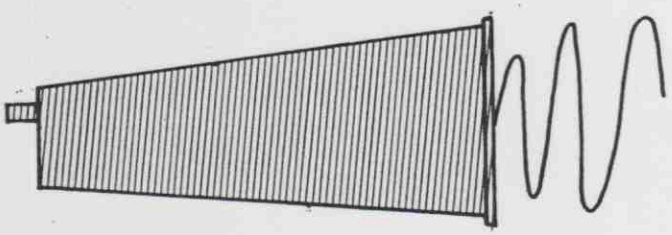
TUNING FORK CERTIFICATION LOG

Serial #	Date Checked	O.K.	Checked By
123456	1-15-88	✓	Lt. Snow #0001
456789	1-15-88	✓	Lt. Snow #0001



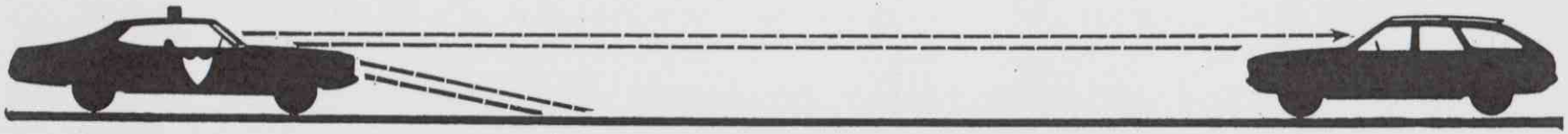
ANNEX #1-1

BASIC METHOD OF RADAR SPEED MEASUREMENT



- Radar device sends out radio signal.
- Signal strikes a solid object (car) and is reflected (bounced) back toward radar receiver.
- If there is relative motion between the object and the radar, reflecting signal will be different from the transmitted signal.
- Amount of difference indicates the speed of the relative motion.

PRINCIPALS OF MOVING RADAR



50 MPH

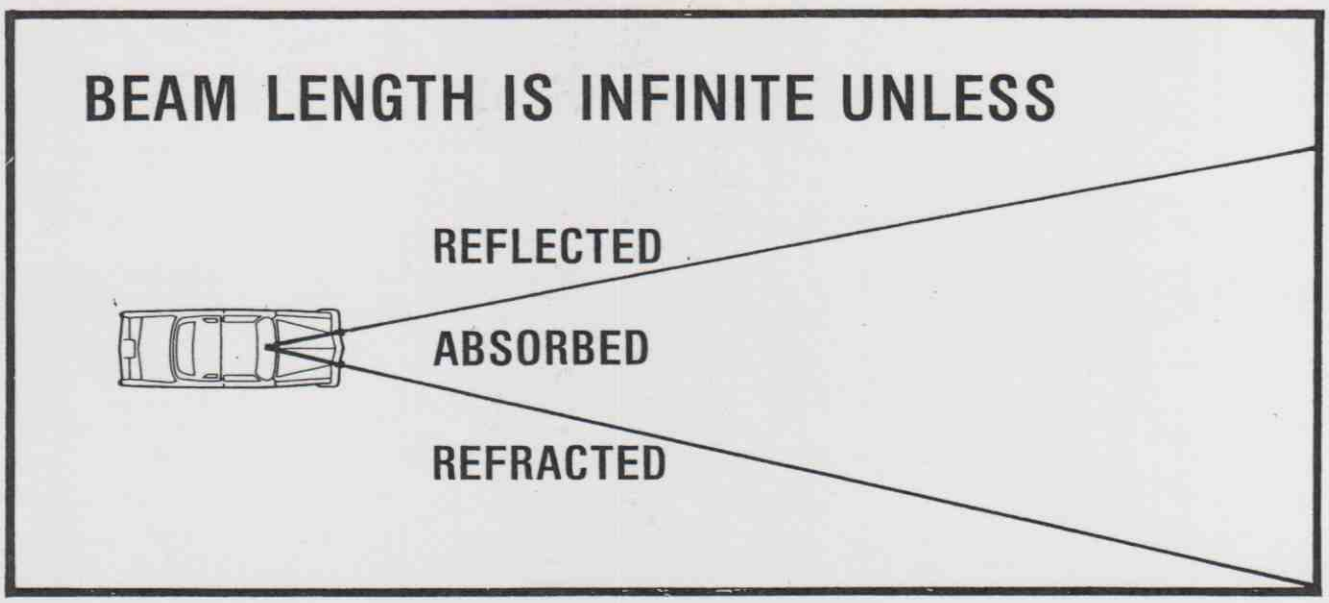
70 MPH

1 CONTINUOUS BEAM OF ENERGY IS SENT OUT
2 DOPPLER SIGNALS ARE RETURNED
50 MPH SIGNAL "GROUND" SPEED
120 MPH SIGNAL "TARGET" SPEED

THE COUNTING UNIT PROCESSES BOTH AND SUBTRACTS

COMBINED SPEED		GROUND SPEED		TARGET SPEED
120	MINUS	50	EQUALS	70

ANNEX #1-3


BEAM LENGTH IS INFINITE UNLESS
REFLECTED
ABSORBED
REFRACTED

FREQUENCY = The number of waves (cycles or hertz) transmitted in one second.

RADAR = Radio Detection And Ranging

FREQUENCIES —

1. X-Band = 10,525,000,000 cycles (waves, hertz) per second or 10.525 GIGA hertz

1 GIGA = 1 Billion

2. K-Band = 24,150,000,000 cycles per second or 24.150 GIGA hertz

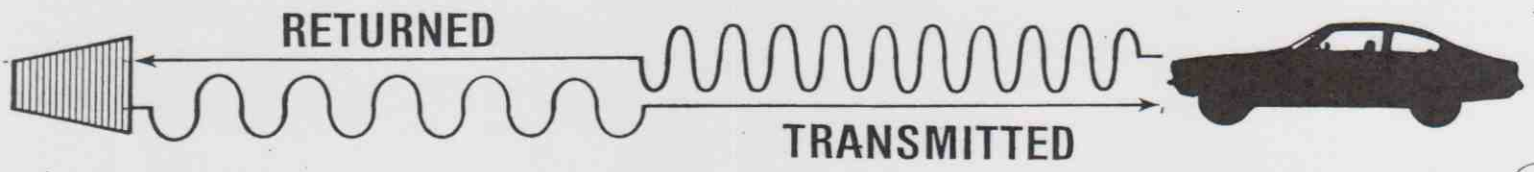
Travels at the speed of light

186,000 miles per second

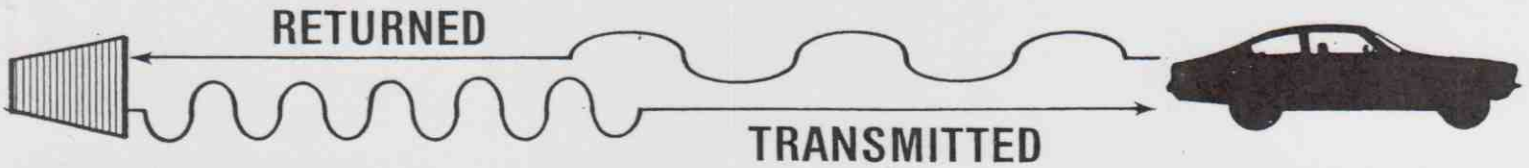
THE DOPPLER FREQUENCY OR DOPPLER SHIFT

The difference between the transmitted frequency and the returned frequency

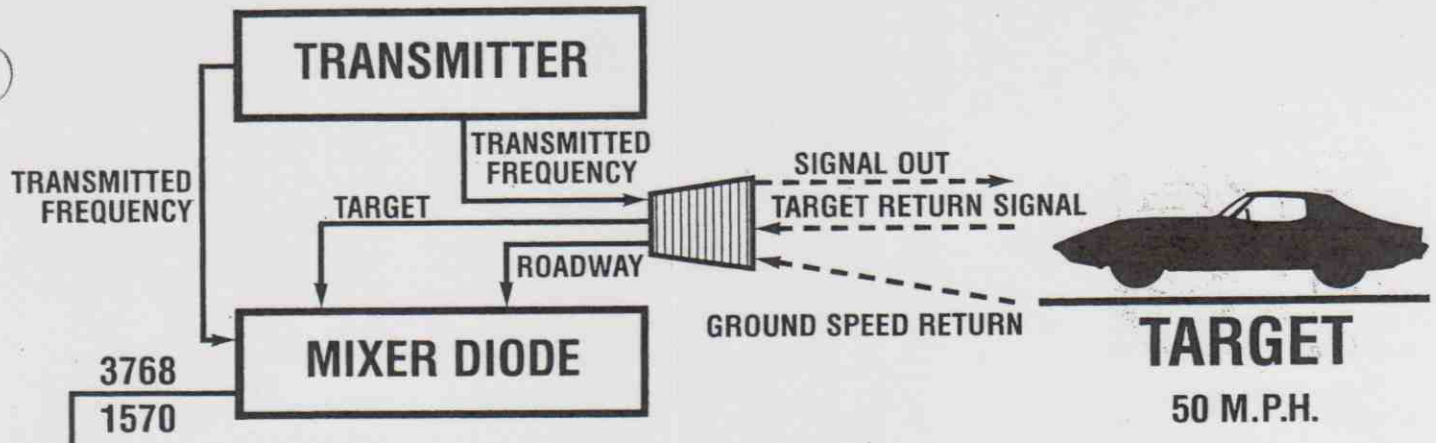
VEHICLE APPROACHING RADAR:



VEHICLE GOING AWAY FROM RADAR:

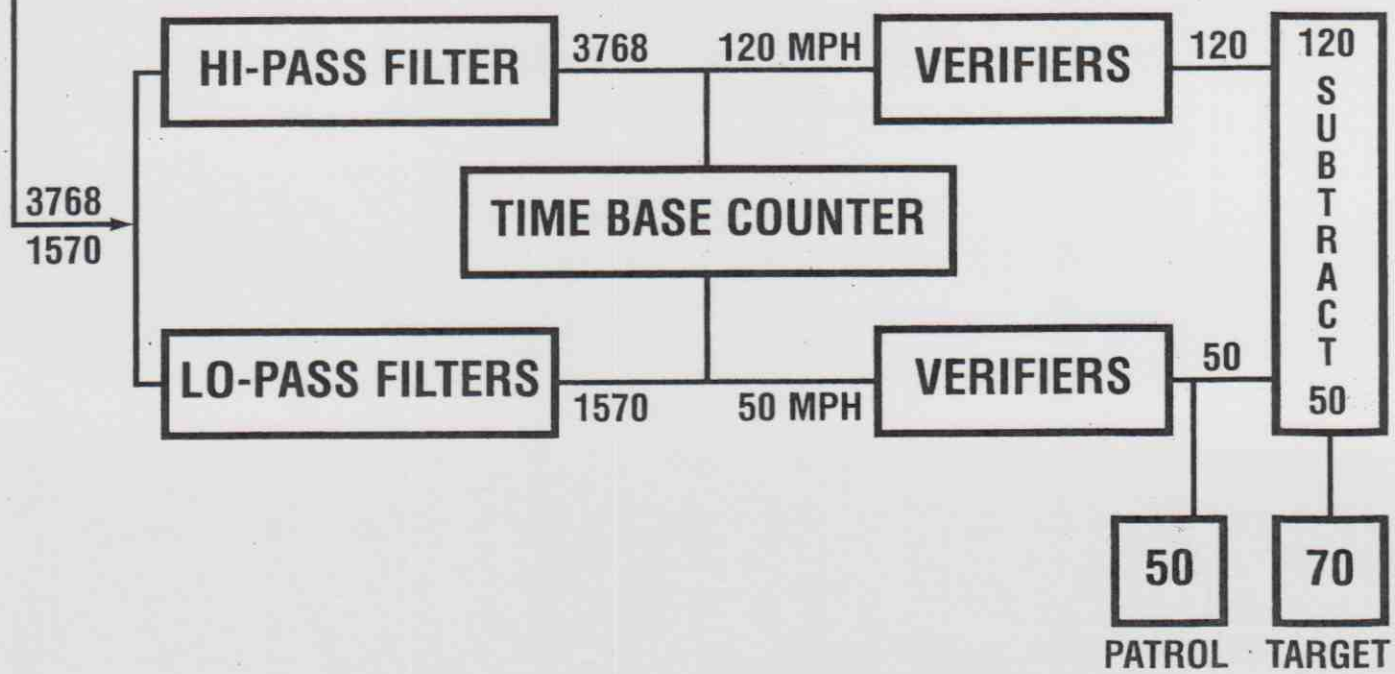


X-Band Shift - 1mph = 31.4 c.p.s.
K-Band Shift - 1mph = 72.0 c.p.s.

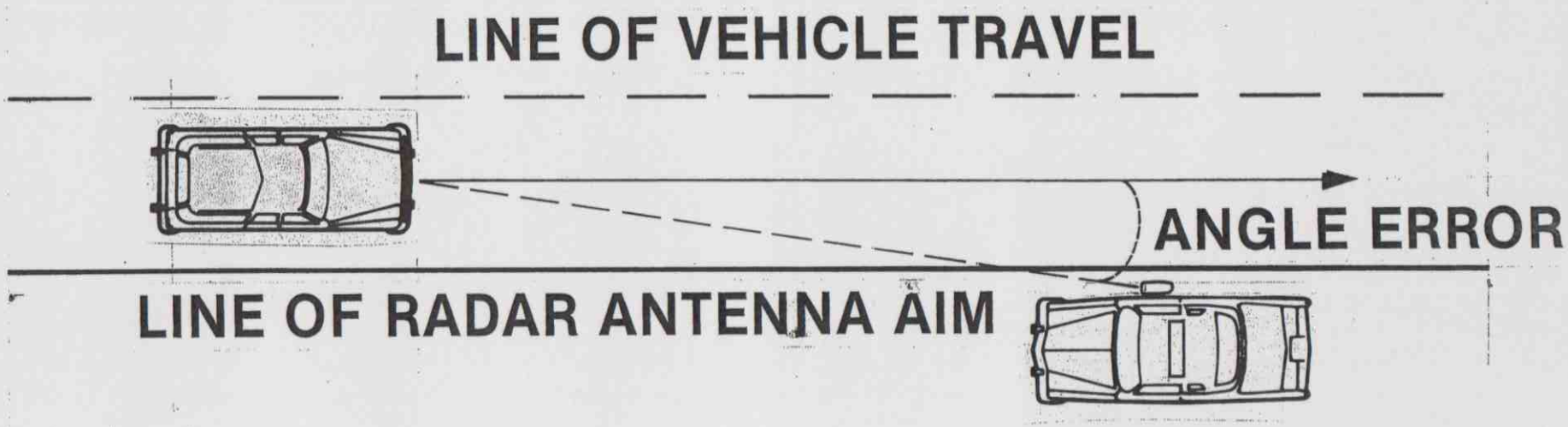


PATROL VEHICLE SPEED – 50 M.P.H

TARGET RETURN - COMBINED SPEED - 120 M.P.H.
GROUND SPEED RETURN - PATROL SPEED - 50 M.P.H.



ANGLE BETWEEN RADAR ANTENNA AND VEHICLE MUST BE AS SMALL AS POSSIBLE TO AVOID ERROR READING.



TRACKING HISTORY CHECKLIST STATIONARY MODE

1. VISUAL OBSERVATION.

a. Identify target.
b. Estimate speed.
c. Confirm target is in range.
d. Check environment.

2. AUDIO CONFIRMATION.

a. Pitch - Indicates speed.
b. Amplitude - Indicates motion.

3. RADAR SPEED VERIFICATION.

a. Stable readout for three-five seconds.
b. Readout must agree with visual and audio.
c. Manual lock. (optional)

TRACKING HISTORY CHECKLIST
MOBILE MODE

1. VISUAL OBSERVATION.

a. Identify target.
b. Estimate speed.
c. Confirm target is in range.
d. Check environment.

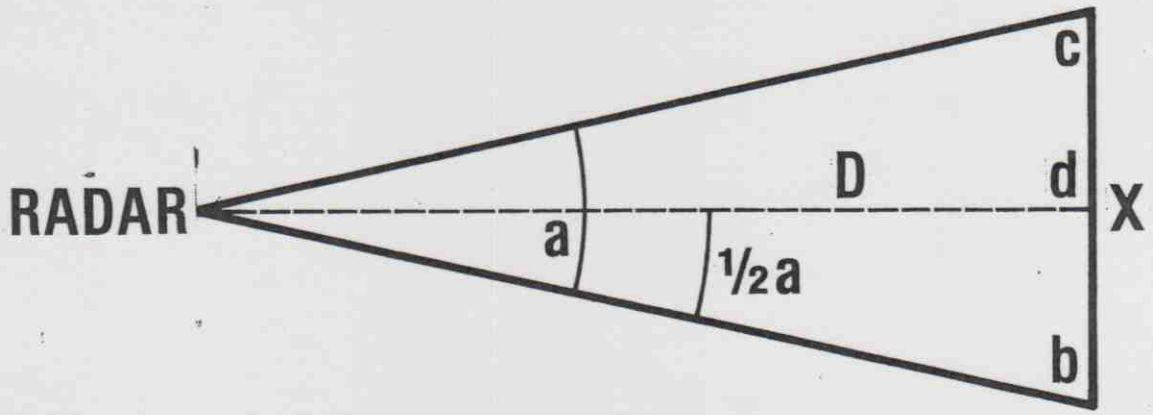
2. AUDIO CONFIRMATION.

a. Pitch - Indicates speed.
b. Amplitude - Indicates motion.

3. RADAR SPEED VERIFICATION.

a. Stable readout for three-five seconds.
b. Verify patrol speed.
c. Readout must agree with visual and audio.
d. Manual lock. (optional)

BEAM WIDTH FORMULA



X = Width of signal (unknown)
D = Distance
$\angle a$ = Known angle
$\angle d$ = 90° (right angle)
$X = 2 \times D \times \tan \angle \frac{1}{2}$
$X = 2(\tan \angle \frac{1}{2}) \times D$

(CONSTANT)

for 12°, X = 2(tan 6°) or (_____) × D
for 16°, X = 2(tan 8°) or (_____) × D
for 18°, X = 2(tan 9°) or (_____) × D
for 24°, X = 2(tan 12°) or (_____) × D

TEXAS DEPARTMENT OF PUBLIC SAFETY
RADAR CERTIFICATION PROGRAM
PRACTICAL EXAMINATION AND DEMONSTRATION

A. Unit Set Up
- ( ) Power Supply
- ( ) Cable Connections
- ( ) Stable Mounting

B. Calibration Check
- ( ) Digital Light Test
- ( ) Internal Circuitry Test
- ( ) Single Tuning Fork, Stationary Mode
- ( ) Dual Tuning Forks, Moving Mode
- ( ) Single Tuning Fork, Stationary Mode
- ( ) Dual Tuning Forks, Moving Mode
- ( ) Speedometer Comparison

C. Stationary Operation
- ( ) Location Selection
- ( ) Antenna Positioning

Target Identification - Tracking History
- ( ) Visual Observation
- ( ) Audio Confirmation
- ( ) Radar Speed Verification

Stationary Radar Runs

1	2	3	4	5	
					Radar Indicated Speed
					Test Car Indicated Speed

Must be within ±1 MPH

D. Moving Operation
- ( ) Location Selection
- ( ) Antenna Positioning

Target Identification - Tracking History
- ( ) Visual Observation
- ( ) Audio Confirmation
- ( ) Radar Speed Verification

Moving Test Runs

1	2	3	4	5	
					Radar Indicated Speed
					Test Car Indicated Speed

Must be within ±1 MPH

E. Same Lane Operation
- ( ) Location Selection
- ( ) Antenna Positioning

Target Identification - Tracking History
- ( ) Visual Observation
- ( ) Audio Confirmation
- ( ) Radar Speed Verification

Same Lane Moving Test Runs

1	2	3	4	5	
					Radar Indicated Speed
					Test Car Indicated Speed

Must be within ±1 MPH

F. Other Operational Considerations
- Cosine Effect (Target)
- Cosine Effect (Patrol car ground speed)
- Range Control (if equipped)
- R.F. Interference
- Internal Interference (wiper, fan motor, etc.)
- Planning Effect
- Shadowing Effect
- Batching Effect
- Look Past Effect
- Beam Dropout

NOTE: Some of these operational effects may be difficult to produce. If the desired effect is not demonstrable it will be sufficient for the operator to demonstrate the technique for producing the effect and explaining to the instructor his knowledge about the effect.

G. Speed Estimations

1. Stationary

1	2	3	4	5	
					Estimate
					Actual

2. Moving

1	2	3	4	5	
					Estimate
					Actual

3. Same Lane

1	2	3	4	5	
					Estimate
					Actual

(Speed estimations must be within ±5 MPH)
(Operator must obtain 4 out of 5 correct for certification)

COMMENTS: _____

_____

_____

Pass ( ) Fail ( )

Field Instructor: _____ Date: _____

TEXAS DEPARTMENT OF PUBLIC SAFETY
CERTIFICATION OF ACCURACY - TUNING FORKS

TUNING FORK, serial # _____ has been tested and found to oscillate at _____ cycles per second. It will cause a calibration signal of _____ miles per hour when used with a Doppler traffic radar operating on the manufacturer's assigned radar frequency of _____ GHz.

TUNING FORK, serial # _____ has been tested and found to oscillate at _____ cycles per second. It will cause a calibration signal of _____ miles per hour when used with a Doppler traffic radar operating on the manufacturer's assigned radar frequency of _____ GHz.

_____
Certified By

Subscribed and sworn to before me, the undersigned authority, on this the _____ day of _____, A.D. 20 _____ .

_____

My commission expires _____

OPERATOR'S INSTRUCTIONS
MODEL TB-1 TUNING FORK CALIBRATION

The TB-1 Tuning Fork Calibrator allows you to test your radar external tuning forks to the exact hertz to National Bureau of Standards accuracy.

To Test Tuning Fork:

1. Turn TB-1 to "On" position.

2. Make sure digital reading is clear. (If not, push reset button)

3. Strike Tuning Fork on nonmetallic object and place and corner of the butt end of the fork in the shown circle on TB-1.

4. Compare the number displayed on TB-1 (cycles per second) with the chart below with appropriate miles per hour stamped on the tuning fork.

5. If the display falls within the tuning fork frequency acceptance range on the chart, then your tuning fork is correct.

6. Push "Reset" button to clear TB-1 and check next tuning fork.

7. Turn TB-1 to "Off" after completing all tests to protect batteries.

8. Note: Batteries are rechargeable type and a recharger is furnished in the package. Keep batteries fully charged for optimum operation. When batteries are weak green pilot light will extinguish. Recommended charge is 18 hours.

To Test with National Bureau of Standards:

1. Turn TB-1 switch to "NBS".

2. Plug telephone pickup coil in bottom of TB-1. Place coil around the Receiver end on telephone.

3. Dial the National Bureau of Standards at 1-(303)-499-7111, Boulder, Colorado.

4. The NBS will transmit either 500, 600, or 1,000 cycles (1 cps) depending on time of minute called. A continuous 600 Hz tone is broadcast during every odd minute from 0 seconds to 45 seconds except for a 0.04 second hole where the second's tick occurs, and except for minutes 9, 45, 57, 49, and 51 of every hour. If your TB-1 displays any of these readings then it insures you of it's accuracy to the NBS.

DECATUR RADAR
FORK FREQUENCY CHART

X-BAND

FORK VALUE	1 = 31.389 Hz MPH in Hz	1 = 19.504 Hz KPH in Hz	1 = 36.122 Hz Knots in Hz
5	156.9	97.5	180.6
10	313.9	195.0	361.2
15	470.8	292.5	541.8
20	627.8	390.1	722.4
25	784.7	487.6	903.0
30	941.6	585.1	1083.7
35	1098.6	682.6	1264.3
40	1255.5	780.2	1444.9
45	1412.5	877.7	1625.5
50	1569.4	975.2	1806.1
55	1726.4	1072.7	1986.7
60	1883.3	1170.2	2167.3
65	2040.3	1267.8	2347.9
70	2197.2	1365.3	2528.5
75	2354.2	1462.8	2709.1
80	2511.1	1560.3	2889.8
85	2668.1	1657.8	3070.4
90	2825.0	1755.4	3251.0
95	2981.9	1852.9	3431.6
100	3138.9	1950.4	3612.2

X-BAND

FORK VALUE	1 = 31.389 Hz MPH in Hz	1 = 19.504 Hz KPH in Hz	1 = 36.122 Hz Knots in Hz
5	360.1	223.8	414.4
10	720.2	447.6	828.8
15	1080.3	671.4	1243.3
20	1440.5	895.2	1657.7
25	1800.6	1119.0	2072.1
30	2160.7	1342.9	2486.5
35	2520.8	1566.7	2900.9
40	2880.9	1790.5	3315.4
45	3241.0	2014.3	3729.8
50	3601.1	2238.1	4144.2
55	3961.3	2461.9	4558.6
60	4321.4	2685.7	4973.0
65	4681.5	2909.5	5387.5
70	5041.6	3133.3	5801.9
75	5401.7	3357.1	6216.3
80	5761.8	3581.0	6630.7
85	6121.9	3804.8	7045.1
90	6482.1	4028.6	7459.6
95	6842.2	4252.4	7874.0
100	7202.3	4476.2	8288.4

MPH RADAR
TUNING FORK FREQUENCY CONVERSION

X-BAND TUNING FORK FREQUENCY IN M.P.H.	TUNING FORK FREQUENCY IN C.P.S.		TUNING FORK FREQUENCY IN M.P.H.	K-BAND TUNING FORK FREQUENCY IN C.P.S	
	LOW	HIGH		LOW	HIGH
10	299	329	10	685	756
15	456	486	15	1045	1116
20	613	643	20	1405	1476
25	770	800	25	1765	1836
30	927	957	30	2125	2196
33	1021	1051	33	2341	2412
35	1084	1114	35	2485	2556
40	1241	1271	40	2845	2916
45	1398	1428	45	3206	3277
50	1555	1585	50	3566	3637
55	1712	1742	55	3926	3997
60	1868	1898	60	4286	4357
65	2025	2055	65	4646	4717
70	2182	2212	70	5006	5077
75	2339	2369	75	5366	5437
80	2496	2526	80	5726	5797
85	2653	2683	85	6086	6157
88	2747	2777	88	6306	6374
90	2810	2840	90	6447	6518
95	2967	2997	95	6807	6878
100	3124	3154	100	7167	7238
105	3281	3311	105	7527	7598
110	3438	3468	110	7887	7958
115	3595	3625	115	8247	8318
120	3752	3782	120	8607	8678

CUSTOM SIGNAL

X-BAND	TUNING FORK FREQUENCY IN C.P.S.	
	LOW	HIGH
35 MPH	2532	2552
50 MPH	3640	3660
65 MPH	4722	4742

Ka BAND RADAR
TUNING FORK FREQUENCY CONVERSION

Ka-BAND TUNING FORK FREQUENCY	TUNING FORK FREQUENCY IN CPS*	
	LOW	HIGH
10	983	1087
15	1501	1605
20	2018	2122
25	2536	2639
30	3053	3157
35	3574	3678
40	4088	4192
45	4606	4709
50	5123	5227
55	5589	5693
60	6158	6262
65	6676	6779
70	7193	7297
75	7711	7814
80	8228	8332
85	8746	8849
90	9263	9367
95	9781	9884

* Computations based on traffic RADAR transmitting at 34.7GHz. 1 MPH is equal to 103.5 hertz.