

FALCON

HAND-HELD TRAFFIC RADAR

OPERATOR'S MANUAL

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TABLE OF CONTENTS

INTRODUCTION	1
CONTROLS AND INDICATORS	
Rear View	2
Side View	4
INSTALLING THE RADAR	5
TEST SEQUENCE	
Power On	7
Lamp Test	7
Automatic Circuit Test.....	7
Tuning Fork Test.....	7
Moving Test	8
Doppler Audio	8
SYSTEM OPERATION	
Control Selections	9
Monitoring Target Speeds.....	9
Locking and Releasing Targets.....	10
Hold Function	10
GENERAL INFORMATION	
Theory of Operation.....	11
Interference	11
Power Source for the FALCON.....	12
Recommended Care and Maintenance.....	12
Microwave Emission	13
TROUBLESHOOTING GUIDE	14
TECHNICAL SPECIFICATIONS	15
REFERENCES	
Case Law.....	16
FCC Rules.....	17
RADAR LOG	18

INTRODUCTION

Your new Kustom FALCON radar combines the latest in engineering expertise with ease of operation to give you a traffic radar system to meet all your stationary radar needs.

To avoid possible operator confusion, and in accordance with NHTSA Model Performance Specifications, the FALCON's display will blank if strong RF interference is present, or if voltage is too low for proper operation, or if the system's internal circuit check fails. For greater ease of operation, LED indicators will light if any of these conditions is encountered.

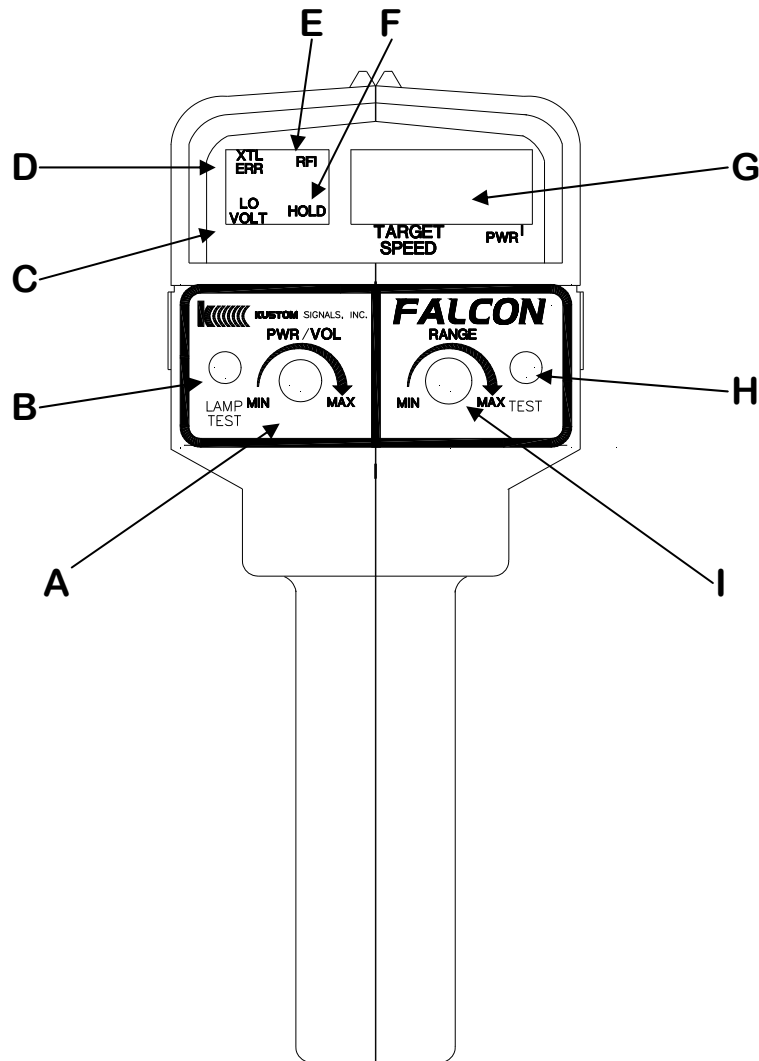
The FALCON is hand-held, and operates on K-Band, which enables it to pick up targets at greater distance, update speeds quicker, and select between multi-lane targets with greater accuracy.

Another FALCON feature is the Hold Mode, which enables the operator to escape detection by radar detection devices. For operator convenience, an LED indicator on the display will light when the Hold Mode has been activated.

To get the most from your new FALCON, we urge you to read this operator's manual carefully. While this manual is not intended as a training manual and cannot replace a training class, it does describe the FALCON's control and their functions as well as give information on operating procedures. If you have questions or experience operating difficulty, contact your Kustom Signals representative or our Customer Service personnel for assistance.

CONTROLS AND INDICATORS

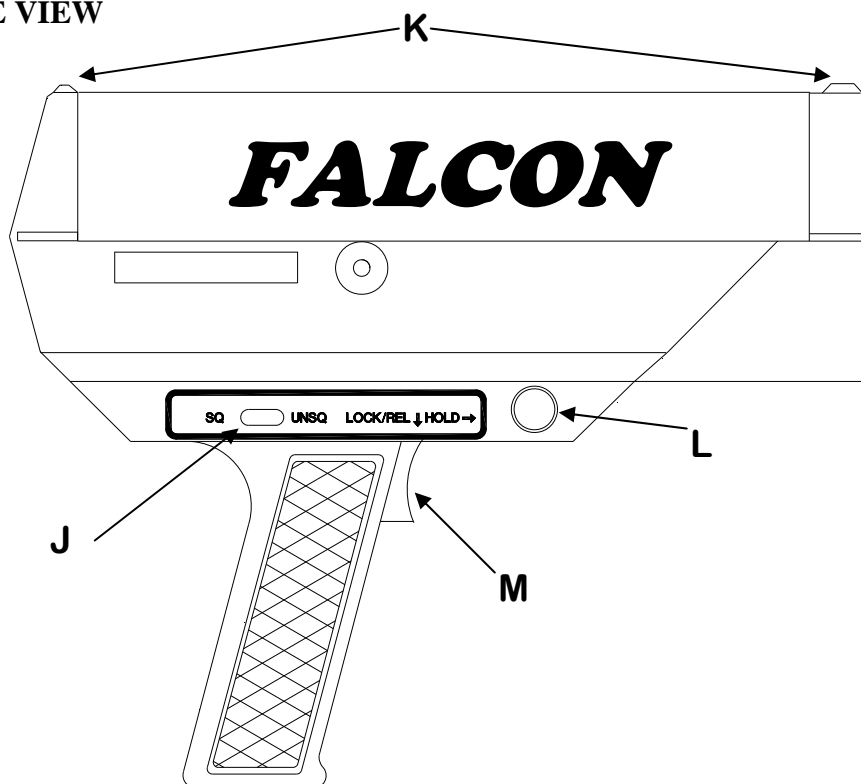
REAR VIEW



- A. POWER/VOLUME (ON/VOL). Dual purpose control for ON/OFF and target Doppler audio volume. Turn the control clockwise to activate the radar and to adjust the level of the Doppler audio.
- B. LAMP TEST. When the LAMP TEST button is pressed, the system will illuminate all display segments. The display will register "888" and the four LED indicators (XTAL ERR, LO VOLT, RFI, HOLD) will light, indicating proper functioning of all lighting segments.
- C. LOW VOLTAGE INDICATOR (LO VOLT). When lit, indicates battery voltage has dropped below 10.8 volts, resulting in the inhibiting of further speed measurements and blanking of the target display within 2-3 seconds.

- D. CRYSTAL ERROR INDICATOR (XTAL ERR). When lit, indicates dual crystal comparison has failed, resulting in the inhibiting of further speed measurements and the blanking of the target display within 2-3 seconds.
- E. RFI INDICATOR (RFI). When lit, indicates the presence of strong RF interference, resulting in the inhibiting of further speed measurements and blanking of the target display within 2-3 seconds.
- F. HOLD INDICATOR. When lit, indicates the HOLD switch has been depressed and the microwave source is turned off. Audio is automatically turned off.
- G. TARGET DISPLAY. Three full digits which display target speeds between approximately 10 and 199 MPH. The rightmost decimal point (center decimal point for tenths units) will illuminate to indicate when the unit is receiving power.
- H. TEST. Pressing this button causes the radar to perform an internal circuit test resulting in a readout of "32" in the display. This will be accompanied by a brief audio signal. This test readout cannot be locked in by the operator.
- I. RANGE. Allows the operator to reduce or extend the effective range of the radar. Fully clockwise is the maximum range position.

SIDE VIEW



- J. SQUELCH/UNSQUELCH. Provides manual override to the normal audio squelch when the display is blank. In the SQ position, audio will only be heard while a target speed is being displayed.
- K. AIMING SIGHTS. Enables the operator to correctly aim the FALCON antenna to obtain maximum effective range.
- L. HOLD. Pressing this button places the system in the Hold Mode to avoid detection by traffic radar detectors. All microwave emission will be shut off, the display will blank, and the HOLD indicator will light. This button also releases the system from the Hold Mode.
- M. LOCK/RELEASE (TRIGGER). Pulling the trigger once will lock a target vehicle's speed into the display. The display will flash and a short 500 Hz tone will be heard. Audio is automatically unsquelched while a reading is locked. Pulling the trigger a second time will release a locked-in speed.

NOTE: Some localities do not permit the use of any speed locking function. For this reason, your unit may not be equipped with the Lock/Release capability. (The trigger will be present, but will not be functional.)

INSTALLING THE RADAR

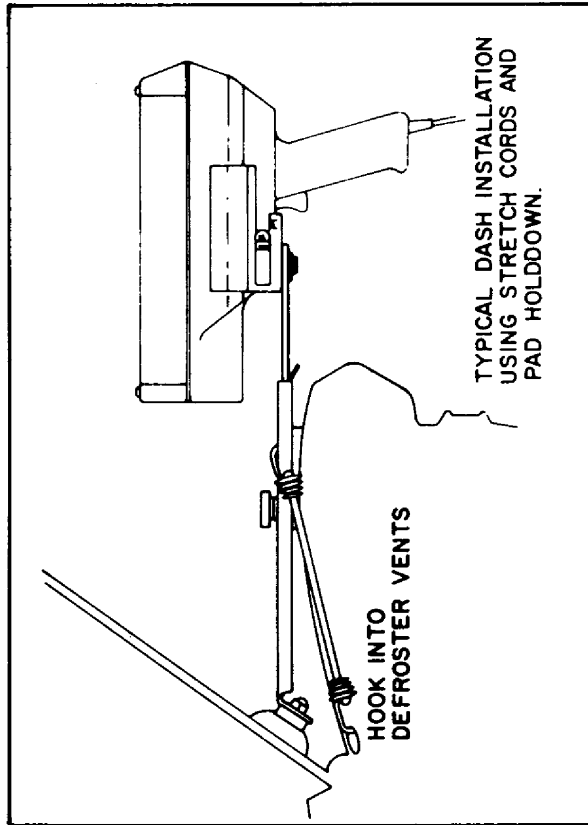
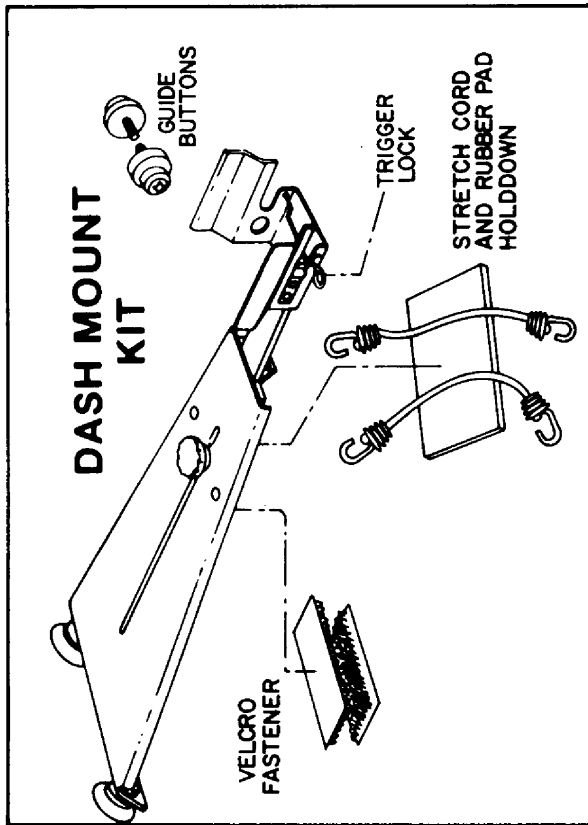
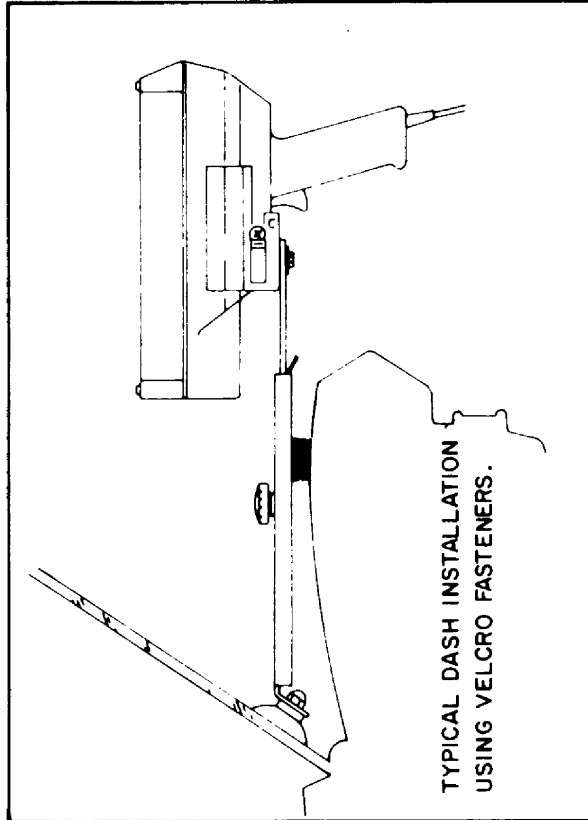
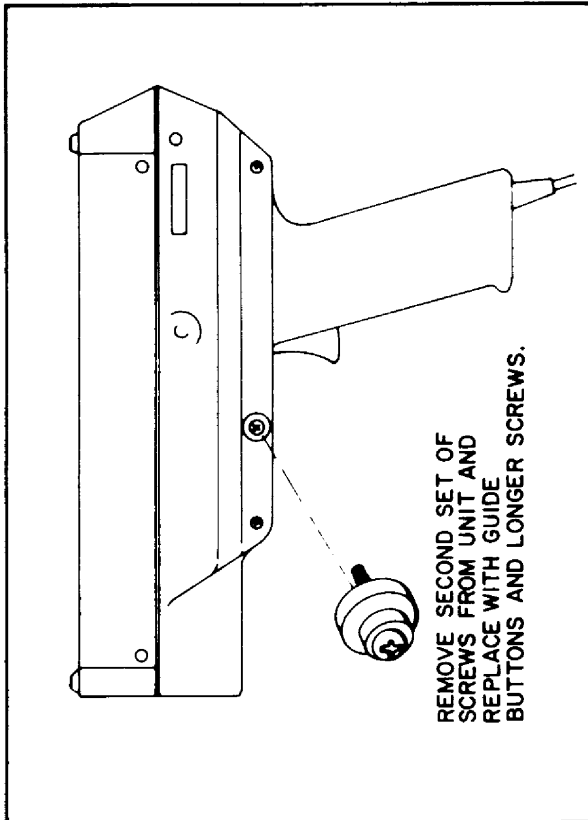
If the optional dash mount is to be used, install as described below. Insert the FALCON's power cord plug into the vehicle's cigarette lighter receptacle, auxiliary power receptacle, or portable battery pack. (Some models have internal batteries which also may be used as power sources.)

NOTE: Ignition systems in certain vehicles sometimes interfere with the proper operation of any traffic radar system. Therefore, an auxiliary power receptacle and shielded cable, which can be mounted under the dashboard and wired directly to the battery, is available for your FALCON.

To install the auxiliary receptacle and cable: Mount the receptacle in the desired location and ground the black wire to the receptacle bracket. Run the cable to the battery; attach the white wire to the positive terminal, and the black wire to the negative terminal. Ensure all attachments are firm and will not easily vibrate loose.

To install the optional dash mount:

1. Place the bracket on top of the dashboard. Slide the FALCON into the U-shaped holding bracket until the radar is securely locked into the bracket.
2. Start the vehicle's engine, then turn the PWR-VOL control to the ON position. Switch the SQ-UNSQ control to the UNSQ position. Adjust the audio to a comfortable listening level above the engine noise.
3. With the FALCON and mount sitting in the middle of the dashboard, and the antenna aimed straight ahead, adjust the heater/air conditioner fan motor to a mid-range fan speed.
4. Listen for fan noise in the audio; adjust the position of the radar/mount left or right as needed for a NULL or no fan noise.
5. Moisten the bracket's suction cups; slide the bracket toward the windshield, keeping it level. Push the suction cups firmly against the windshield. Attach the stretch cords to the mount and hook into defroster vents.
6. Use the aiming sights on top of the radar to make sure the radar is aimed correctly. Due to the highly directional beam transmitted by the FALCON, both the horizontal and vertical aiming is important to the effective operation of the unit.



TEST SEQUENCE

For the purpose of assuring functionality and accuracy, we recommend that the internal test, lamp test, tuning fork test, and moving test be conducted at the beginning and end of each patrol shift. The results can be recorded in a radar log (such as the one at the rear of this manual) for future reference. If the unit fails any of these tests, it should be removed from service immediately and taken to an authorized service center for repair.

POWER ON

Turn the POWER/VOLUME knob clockwise. Check the lower right corner of the display to ensure the power indicator (decimal point) is glowing. If the indicator does not come on when the POWER/VOLUME knob has been turned past the PWR OFF point, recheck the connection to the power source.

NOTE: Battery voltage must be between 10.8 VDC and 16.5 VDC for proper operation of the FALCON.

LAMP TEST

Press the LAMP TEST button. The display should register "888", and all four LED indicators on the left should light. If any other number appears, do not place the unit in service until the problem has been corrected.

AUTOMATIC CIRCUIT TEST

To ensure the FALCON is operating properly, press the TEST button. If the system is working correctly, "32" will appear in the display.

Prior to every display of target speed, the FALCON automatically performs a brief, internal comparison of two quartz crystals. (This test does not appear in the display.) If these crystals do not correlate within a high degree of accuracy, "XTAL ERR" will light and the target speed display will not be allowed. If this occurs, take the unit out of service and send to an authorized service center for repair.

TUNING FORK TEST

1. Turn the RANGE control fully clockwise (maximum range).
2. A 50 MPH (80 KPH) tuning fork is supplied with the FALCON. Strike the tuning fork on a hard, non-metallic surface, such as the rubber heel of a shoe. Hold the vibrating tuning fork approximately one inch in front of the antenna. The display should register "50" ("80"). Please note--readings of ± 1 MPH(KPH) are considered acceptable.

TEST SEQUENCE

If the proper reading is not obtained:

1. Make sure that Kustom Signals K-Band tuning forks have been used ("K-Band" is stamped plainly on each fork). X or Ka-Band tuning forks, or tuning forks designed for use with other manufacturers' radar, will not give the proper readings.
2. Striking the tuning forks too hard may produce false overtones which may be read as speeds slightly above or below those specified. These possible false readings are momentary, and the proper readings should appear as the false overtones dissipate. Do not move the tuning forks after placing in front of the antenna.
3. Ensure the system is not in the Hold Mode.
4. Extremely cold or extremely hot tuning forks may give readings slightly above or below those specified, due to the effect of extreme temperature on the metal. If this is the case, warm or cool the forks to normal room temperature before use.

NOTE: If correct readings are not obtained after the above points have been rechecked, the system should be shut down and taken out of service.

MOVING TEST

For an additional check of the unit, aim the radar straight ahead, drive the patrol vehicle, and compare the reading in the display with the vehicle's speedometer. The speed registered in the display and speedometer should coincide, or be within reasonable limits (allowing for minor speedometer error). These comparisons, on a day-by-day basis, are a reliable way to check the accuracy of your radar. If there are major discrepancies between the speed registered and the vehicle speedometer, the system should be taken out of service until the discrepancies are resolved. (This check is one of the best ways to verify the proper operation of your radar.)

DOPPLER AUDIO

To receive Doppler audio, set the POWER/VOLUME control past the Power-Off position. Volume of the audio can be increased by turning the control clockwise. The audio pitch will correspond to the speed being displayed; that is, the greater the speed, the higher the pitch. Audio will be present from approaching or receding vehicles. The audio presentation is especially useful in the case of multiple targets, when target identification is more difficult. The operator has the option of squelched or unsquelched audio by setting the SQ-UNSQ switch to the desired position. When no target is present, selecting the Unsquelched mode allows the operator to listen for possible interference in the operating area.

SYSTEM OPERATION

CONTROL AND FUNCTION SELECTION

Select squelched or unsquelched audio by moving the switch to the desired position. Adjust the PWR/VOL control for comfortable listening to the Doppler audio level.

Adjust the RANGE control for proper target acquisition distance. For most applications, fully clockwise (maximum range) will be the most useful setting. In denser traffic, or where maximum distance is not desired, reduce the range to the desired distance. If range is unsatisfactory, first check antenna aim (it should be straight, level, and pointed straight ahead) and position of RANGE control to ensure it has not been inadvertently turned down.

MONITORING TARGET SPEEDS

Once the radar has been properly set up and tested (see preceding sections), it is ready for use. Acquiring and displaying valid target (and patrol) speeds requires obtaining a proper tracking history, as described below:

1. Visually observe target vehicle and estimate its speed.

Recheck antenna aim.

Observe other vehicles which may be in the radar beam and which are potential targets (or may block the radar's "view" of the selected target), especially those which are larger, closer, or much faster than the selected target.

Be alert to terrain or roadside features, which can cause interference, incorrect readings, or display blanking. (Such features include power lines, radio/TV transmitters, bridges, guardrails, and other large reflectors, etc.)

2. Listen to the Doppler audio. The pitch of the tone should correspond to the visual estimate made above. The tone should be clear and strong; scratchy, "buzzy", or garbled tones could indicate interference of some sort.
3. Check the radar TARGET display. The reading should closely match the visual estimate and the pitch of the audio tone.

LOCKING AND RELEASING TARGETS

NOTE: To comply with various state and local requirements, your unit may not be equipped with the lock feature. References to the lock feature do not apply to these units.

1. Observe approaching or receding target vehicles; obtain proper tracking history.
2. Pull the trigger to lock in the target speed. The unit will beep once and the locked-in speed will flash.
3. Audio is automatically unquieted once LOCK has been activated. The operator will hear Doppler audio from other target vehicles, although their speeds will not appear in the display.
4. Note that pressing the TEST button will erase any locked-in speed, and that the numbers appearing in the display with either the Lamp Test or the Circuit Test cannot be locked in.
5. To release a locked-in speed, pull the trigger a second time.

HOLD FUNCTION

The advanced electronics in the FALCON enable it to completely escape detection by traffic radar detectors by eliminating all microwave transmission in the Hold Mode. To activate the HOLD function:

1. Press the HOLD button. Both the radar display and the Giant Display will become blank (if the display is unlocked), the HOLD LED indicator will light, and audio will be shut off.
2. Press the HOLD control button a second time to release the system from the Hold Mode. When released from the Hold Mode, the FALCON will acquire target speed almost instantly.

NOTE: If the operator desires to shut off the microwave emission to avoid detection when the unit is locked on a target speed, he may do so by pressing the HOLD button once. The HOLD indicator will light, microwave emission will cease, and the locked-in speed will continue to be displayed. Releasing the system from the Hold Mode will not release the locked-in speed.

GENERAL INFORMATION

THEORY OF OPERATION

The FALCON radar transmits a radio frequency of 24.150 Gigahertz, in accordance with Federal Communications Commission regulations. The transmitted signal strikes a moving target and returns to the antenna at a different frequency because there is relative motion between the two objects (radar unit and target).

This returning signal is compared to the transmitted signal; the difference in frequency between them (Doppler frequency) is proportional to the speed of the target. The Doppler frequency is translated by the radar into a speed and displayed on the screen.

INTERFERENCE

Interference from any external event can influence the operation of the FALCON. These influences can be natural or man-made. A knowledgeable operator will not be confused by these external influences.

Natural events such as driving rain or blowing dust can cause a scattering effect, or diffusion, which can decrease the effective range of the radar. Terrain can also affect the FALCON's range. Should the patrol car be on a slight decline, with the radar mounted on a dash mount, the antenna could be shooting short of the target vehicle. If on a slight incline, it could be shooting over the target vehicle. Range will be shortened in either case.

Man-made influences are by far the most troublesome, because they generally involve electronic signals, which may cause spurious displays. Electronic noises can be generated by: power transformers, radio transmitters (especially those in the patrol vehicle), neon lights, etc. These influences generate a phenomenon called "harmonics", which can cause a radar to display a false reading. The FALCON is equipped with an RFI (Radio Frequency Interference) detector that will cause the display to blank in the presence of strong RF fields. No target speed measurement can be made when the RFI indicator is on to prevent possible readings caused by the interference.

Intermittent readings need not be confusing if the officer is familiar with the operation of the FALCON. For example, if the antenna is pointed at the dashboard of the patrol vehicle, it may be reading the speed of the heater/defroster fan because most dashboards are now made of plastic. A specially designed dashboard mount is available which will help to eliminate this intermittent reading.

If the power supply voltage to the radar unit drops below the level required for proper operation, the "LO VOLT" indication will appear and speed displays will be inhibited as long as the low voltage condition persists. This prevents false readings from occurring during periods of low voltage.

POWER SOURCE FOR THE FALCON

Cigarette lighter receptacles have been the traditional power source for traffic radar. However, poor grounding, electronic ignition bleedover, and alternator noise in newer cars can combine to create an unacceptably high level of ambient electronic interference. Symptoms of such interference include abnormal tones or noise heard in the audio and/or decreased range.

If radar operation is degraded by the electrical interference present in the vehicle, it is recommended that a two-conductor, shielded cable be run from the battery directly to an auxiliary receptacle installed at the dash or on the console. This should effectively eliminate the power source problems.

RECOMMENDED CARE AND MAINTENANCE

The FALCON is a sturdy, reliable piece of equipment designed and built to give trouble-free service. Following certain basic care guidelines will help ensure it gives you that trouble-free service.

1. As with all electrical or electronic equipment, protect from moisture. Should liquid of any kind get inside the unit, remove power immediately and send for repair. Prompt action can minimize damage.
2. Other than the fuse, there are no user-serviceable parts in the FALCON. Replace fuses with the correct size and type--excessive current due to oversize fuses will cause serious damage not covered by warranty. NEVER wire directly into AC current!! Damage caused in this way may not be repairable.
3. Do not pick up or carry the FALCON by the power cord. Do not yank or twist the power cord, especially near the handle of the unit--broken wires inside the power cord are a common cause of intermittent operation.

If the radar exhibits decreasing range over a period of time, the unit should be examined by an authorized service center for possible receiver diode degradation. Receiver diode degradation has no effect on the unit's accuracy, but will result in unsatisfactory range.

MICROWAVE EMISSION

Traffic radar operators may have some questions about the biological effects of exposure to the microwave energy produced by the radar devices. According to all credible evidence, the emission levels resulting from traffic radar use pose no threat whatsoever, either to the radar operator or to target vehicle occupants.

One widely recognized authority for safe limits of nonionizing radiation exposure is the American National Standards Institute, which recommends maximum exposure levels for the frequencies on which Kustom traffic radar systems operate (ANSI/IEEE C95.1-1992, "Standard for Safety Levels With Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz"). These exposure levels, expressed in terms of power density, are 7 mW/cm² for X-band radar units, and 10 mW/cm² for K-band and Ka-band radar units. Similarly, the Occupational Safety and Health Administration (OSHA), a division of the U.S. Department of labor, recommends a 10 mW/cm² exposure limit for all three frequency bands ("Radiation Protection Guide", 29 CFR, Chapter XVII, Subpart G, Part 1910.97). This limit is clearly accepted by most reputable scientific and medical authorities.

Kustom radar systems utilize microwave transmitters, which produce aperture power densities, measured directly at the face of the antenna, in the range of approximately 0.3 to 2.3 mW/cm². Typical levels for the vast majority of units are in the 0.4 to 1.0 mW/cm² range, which is but a small fraction of the recognized safe limits. Bear in mind that these are level measurements taken directly in the main beam of the antenna, and that the power densities produced at the sides and rear of the unit are typically at least one hundred times lower than in the main beam.

Another reference document on this topic is a DOT publication entitled "Field Strength Measurements of Speed Measuring Radar Units" (NHTSA Technical Report #DOT-HS-805 928). This report documents a series of tests performed by the National Bureau of Standards on twenty-two commonly used models of traffic radar units, from six different manufacturers including Kustom. Aperture power density levels measured were from 0.25 to 2.82 mW/cm², while back-lobe power density values ranged from 0.001 to 0.02 mW/cm². These measurements were obtained with the radars mounted inside vehicles, as in normal operating conditions. Since the NBS study, other laboratories have duplicated these types of measurements, producing consistently similar results.

For a free copy of the latest information regarding the safe human exposure standards, please call or write Kustom to request the "RF Emissions Packet." You may contact us at our corporate headquarters:

Kustom Signals, Inc.
9652 Loiret Blvd.
Lenexa, KS 66219-2406
(913) 492-1400

While traffic radar devices do emit microwave energy, the levels are so low that there are no probable harmful effects. You may use your Kustom radar unit with complete confidence in its safety, as well as in its accuracy

TROUBLESHOOTING GUIDE

If you are having operating difficulty, recheck the operating information in this manual, then check the following before notifying your Kustom Signals representative of a problem.

<u>Problem</u>	<u>Possible Solution</u>
Unit will not turn on or no pilot light	Check fuse. For access to fuse, remove tip of power plug by turning counterclockwise. NOTE: Replace fuse ONLY with 2A Slo-Blo! Check for dirty cigarette lighter receptacle, dirty battery cables, or dead battery. Use auxiliary receptacle connected directly to battery, or portable battery pack, or switch vehicles.
Intermittent readings (display readings that temporarily blank)	Often caused by interference from stray RFI (check RFI indicator) or from the vehicle's electrical system. Use auxiliary receptacle connected directly to the battery. If this fails, use a battery pack or switch vehicles. If the problem clears up, the vehicle's electrical system needs attention.
Lack of Range	Check RANGE control setting. Check antenna aim and ensure the beam is not being obstructed. Check for interference from the heater/defroster/air conditioner fan. Switch vehicles (electrical system interference sometimes affects performance).
Displays are blank, power indicator is on	Check RANGE control setting. Check indicator lights on front panel. No readings will be displayed if any of these (except POWER) are lit.

TECHNICAL SPECIFICATIONS

MICROWAVE

Frequency:	24.25 ± .1 GHz (K-Band)
Output Power:	12 mW typical, 40 mW max
Source:	Gunn-effect diode
Antenna Type:	Conical Horn
Polarization:	Circular
3 dB Beamwidth:	12° ± 1°
Antenna Gain:	Approx. 23 dBi
Power Density:	<5 mW/cm ² (measured at face of antenna)
Receiver Type:	Low-noise Schottky barrier diode

COUNTING UNIT

Operating Voltage Range:	10.8-16.5 VDC, 13.6 VDC nominal	
Nominal Power Reqm'ts:	Voltage (VDC)	Current (A)
With displays illum:	13.6	0.7
Without displays illum:	13.6	0.3
With target present:	13.6	0.5
Without target present:	13.6	0.3
Standby (HOLD):	13.6	0.1
Environmental:	-30 °C to + 65 °C; 90% relative humidity at +37 °C, non- condensing	
Target Speed Range:	Typically 15 to 155 MPH (24 to 248 KPH) over a broad sensitivity range. This unit complies with IACP/NHTSA specifications for target channel sensitivity (DOT HS-806-191, rev. May, 1989).	
Accuracy:	± 1 MPH (± 2 KPH)	

REFERENCES

CASE LAW

This section on case law is included so that the radar operator and those individuals responsible for apprehension and arrest can familiarize themselves with the more important legal cases involving the use of traffic radar. Much of the referenced material may be obtained at your community's local law library or through the prosecutor's office

Reference A--State v. Dantonio (N.J.) 1955 115 A2d 35, 49 ALR 2d 460. The landmark case on the use of traffic radar.

Reference B--State v. Shelt (Ohio) 1975 75-D 0-3682, L-75-166. Establishes that the court may take judicial notice of the reliability of moving radar.

Reference C--Honeycutt v. Commonwealth (Ky.) 1966 408 SW2d 421. Court establishes that a tuning fork test is an accurate method of determining accuracy and that a properly constructed radar, along with the visual observations of a trained operator, is an accurate means of determining the speed of vehicles.

Reference D--Krueger, Pantos and Payne V. State of California 1986 (class action Suit) 887092, DP44339, and DP54571. Court ruled that properly built and tested radar used by trained operators can determine the speed of vehicles. The judge dismissed each of the defendants' claims that outside influences render the radar readings inaccurate in the moving mode of operation. He ruled that proper classroom and field training enables an officer to avoid any false or inaccurate readings due to outside influences.

The court held and took judicial notice of the accuracy of Doppler radar in both the stationary and moving modes of operation.

**FEDERAL COMMUNICATIONS COMMISSION: TRANSMITTER RULES
AMENDED**

The Commission has amended its rules to eliminate the required annual measurement of transmitter power, frequency and modulation, and to specify transmitter power in terms of output power for licensees in the Public Safety, Industrial, and Land Transportation Radio Services.

The action was the result of a rulemaking procedure initiated October 29, 1976 on request of HT & B Electronics.

Under the rules, which amend Part 89, 91, and 93, licensees will continue to be required to operate their transmitters within the specified technical parameters.

For the sake of convenience and simplicity of transmitter power measurement, the FCC specified that in the future, transmitter output power, rather than the direct current input power to the final radio frequency stage, be the standard parameter used to indicate transmitter power. The FCC defined transmitter output power as that power measured at the transmitter output terminals when connected to a load of the impedance recommended by the equipment manufacturer.

**FEDERAL COMMUNICATIONS COMMISSION; RADAR UNIT LICENSING
AMENDED (PART 90)**

The Commission has eliminated a requirement for local governmental entities licensed in the Public Safety Radio Services to obtain a separate authorization for radar speed detection devices.

This change will reduce paperwork for the Commission's licensing staff and for police and other local government units, which will no longer have to apply for new radar authorizations or modify or renew existing licenses and may operate speed detection devices as part of their base/mobile communications Systems.

To provide the Commission with a record of such units in use, licensees will be required to list the number of speed detection units and the frequencies on which they operate at the time of renewal of their land mobile authorizations. Ordinarily, this would be once every five years and would not be a significant addition to the renewal process, the Commission noted.

This action became effective February 1, 1983.

