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ROAD TRAFFIC

The Radar Speed Measuring Device Approval 1998

The Secretary of State, in exercise of the powers conferred upon him by section 20(4) and (5) of the Road Traffic Offenders Act 1988 (a) (Speeding offences etc: admissibility of certain evidence) having prescribed for the purposes of that section a device designed or adapted for measuring by radar the speed of motor vehicles (b), hereby approves as from 10th February 1998 for the purpose of detection of offences specified in section 20 (2) (a), (b), (c) or (d) the device known as the **Speedar SR1 Speed Measuring Device** - manufactured by Ottery Electronics.



Alun Michael
Minister of State

Home Office
20th January 1998

EXPLANATORY NOTE

(This note is not part of the Approval)

Section 20 of the Road Traffic Offenders Act 1988 provides for the admissibility in evidence of records from prescribed devices. Such devices must be of a description prescribed by the Secretary of State and of a type approved by him for the purpose of that section. By the Road Traffic Offenders (Prescribed Devices) Order 1992 (S.I.1992/1209), the Secretary of State prescribed devices designed or adapted for measuring by radar the speed of motor vehicles. This approval approves as from 10th February 1998 for the purpose of the detection of speeding offences the type of device known as the **Speedar SR1**.

(a) 1988 c.53; section 20 was substituted by section 23 of the Road Traffic Act 1991 (c.40).

(b) The Road Traffic Offenders (Prescribed Devices) Order 1992 (S.I.1992/1209).

Speedar with Repeater Display

Document to be added when approval is obtained

Speedvision

Document to be added when approval is obtained

Specifications of the Speedar Range

Speedar is part of a range of hand-held radar speedmeters, operating in the 24GHz band, intended for the measurement and display of the speed of vehicles approaching or receding from the operator. It will require minimal re-training effort for any operator familiar with hand-held traffic radar although it does incorporate features not normally found in current radars. These are explained in the text that follows and also under the Operating Instructions on page 22.

The models described are Speedar SR1, the basic speedmeter, Speedar with a Repeater Display, Speedvision, the Speedar with added Video camera and screen and Speedlog, the traffic data logging radar.

Construction

All versions

The unit is a complete one-piece, gun-shaped, hand-held Doppler radar formed from a sturdy aluminium extrusion with a rubber handle and built-in lanyard fixing.

The repeater display is housed in a rugged aluminium free-standing case with rubber feet and carrying handle.

The Speedvision additionally contains a high definition video camera and lcd colour viewing screen which may be folded down when not in use.

Display

Speedar and Speedvision

The 128 x 64 dot graphics display allows the display of proper rounded numerals with no possibility of erroneous readings due to segment failure. There is a built-in real time clock showing time of day, which automatically shows the time at which the lock button was operated, together with a storage facility to display the relevant speed limit when a reading is locked, so that speed, direction, time of offence and speed limit are all shown on the display at once when the lock button is pressed.

Speedvision

Speedvision also shows video of the target with the above details superimposed on the frame. The video is frozen when the lock button is pressed.

The speed shown by the Speedar will be repeated on the repeater display for oncoming traffic only.

Speedlog shows several different information screens which are described in the Operating Instructions on page 30

Direction Sensing

All versions

The direction of the target which the Speedar is tracking is shown on the display to assist the operator when checking the speed of a vehicle where there is more than one possible target (this information is also shown when the reading is locked).

Repeater display shows the speed of oncoming vehicles only.

Speedvision includes the direction information superimposed on the video output.

Speedlog indicates direction by means of arrows and the legends TO and FROM.

Lock

Speedar

Readings may be locked with the lock button on the handle and will be erased when unlocked. THEY CANNOT BE RECALLED THEREAFTER.

Speedvision

In addition to the normal Speedar lock, the video frame will also be frozen with Speed, Direction, Date and Time superimposed on the frame.

Speedlog

Readings are stored at each press of the trigger button when a target is in view.

Accuracy

All versions

±1 MPH (or km/h).

Data Output

Speedar SR1 and Speedvision

No output socket fitted.

Speedar used with repeater display and Speedlog.

A built-in RS232 link enables speeds to be output to a repeater display or a portable printer either in real time or when the lock is operated.

Speedlog sends stored traffic logging data to a pc.

Calibration

No adjustment is possible or permissible. All timings are generated by the crystal-controlled microprocessor. The time of day is generated by an independent crystal-controlled clock with battery back-up. An accurate tuning fork is used to verify system accuracy. Additionally, there is an inbuilt check which gives a reading of **057** to verify correct circuit functioning. This compares the two internal crystal-controlled clocks against one another.

Permissible Ambient Temperature Range

Use -5°C +70°C.

Storage -20°C +70°C.

Transmitted Microwave Beam

All versions

Frequency 24.10GHz \pm 25MHz.

Beam Width 13° or less (3dB down), side lobes suppressed by greater than 24dB.

RF Source Solid state Gunn diode oscillator, output power 5mW minimum, 10mW maximum, typically 0.22mW/cm².

Receiver

All versions

Antenna Waveguide horn (also used by transmitter).

Mixer Diodes Schottky Barrier type, two diodes allow detection of the direction of motion of a target.

Camera

Speedvision only

Permanently attached Sony FCB-1X47/P colour camera module with automatic focus and exposure control. Zoom controlled by Speedvision to approximate to the radar beam width.

Viewing Screen

Speedvision only, 3½" pal lcd backlit display.

Power

6V Nominal supplied by a rechargeable, clip-on NiMH mobile-phone battery.

Speedvision only

Socket for external 12V battery to supply screen backlight. Camera also supplied from external power when connected.

No voltages in excess of the input supply voltages are developed. Servicing may be undertaken with no special precautions other than static protection.

Circuitry

All components are solid state; all signal processing functions are accomplished using CMOS integrated circuits. System control is handled by a microprocessor, an independent battery backed-up real-time clock maintains time of day and date (optional) and a built-in RS232 interface allows for the transfer of data to or from the radar (optional).

Outputs

Speedar SR1 standard version, none.

Speedar with remote display and Speedlog, 9 pin D connector supplying speed and direction information, 2400 Baud, 8 data, no parity, 2 stop bits.

Speedvision, pal video VBS 1 Volt p-p (Sync negative).

Mechanical

Speedar and Speedlog

The unit is gun shaped, 270mm long and 90mm square cross-section, not including the handle.

Speedvision

The unit is adapted from the standard Speedar to have a fold-up viewing screen, a built-in video camera and a connector for display power and video output.

Repeater Display

The display is housed in a rugged waterproof aluminium case with a fold-down cover to protect the window when not in use. Additionally the cover when folded up shows the message YOUR SPEED or other message as ordered.

Material

The case is a robust aluminium extrusion with a rubber handle fitted with a lanyard fixing ring.

Weight

Speedar and Speedlog	2.5lb / 1.2Kg including battery
Speedvision	3 lb / 1.4 Kg including battery
Repeater display	30 lb /14 Kg including battery and charger

Battery Fixing

Clip-on automatic connection using Ericsson compatible mobile-phone batteries type 237.

Antenna

70mm aperture, waveguide type.

Internal Assembly

The electronic components are assembled on a single printed circuit board which may be removed and tested without having to unsolder any wires. The display and switches are on a separate board which plugs into the main board.

Battery Care

All versions

Any NiMH charger suitable for an Ericsson type 237 battery may be used including in-car chargers. The charger supplied will recharge the battery within one hour.

The charger supplied should be switched on before the battery is inserted. When the charger has powered on, the battery may be inserted and the large NiMode button should be pressed once for fast charge. Subsequent presses of this button cycle the charger through fast normal and slow charge. When the battery is fully charged, the charger will make a warning sound and the full indicator will show.

New batteries should always be conditioned by fully charging and discharging them 3 times to attain their maximum capacity. Discharging should be carried out by pressing the DIS button after the NiMode button.

Any discharged battery that is not warm to the touch after charging, or shows full after a few minutes charge, will need conditioning.

The charger for the repeater display is built into the case of the display and requires connecting to the mains with the lead supplied. The internal battery will be recharged in 14 hours and is sufficient for about 40 hours use between charges. It is however recommended that the unit be charged overnight every other day when in use.

Neither the Speedar nor the repeater display batteries should be allowed to fully discharge while the equipment is switched on. In the case of the Speedar, Speedlog and Speedvision batteries, damage to the display screen will result if these are regularly allowed to fully discharge while the equipment is switched on and left on for long periods.

To avoid this possibility it is recommended that the battery is removed when the Speedar is put away in its carry case for any period exceeding 3 hours. This avoids the possibility of inadvertently switching on the equipment as it is stowed in its carry case.

Use of the Doppler effect in Traffic Radar

The Speedar hand-held traffic radar equipment is based on the well-known and legally-accepted principle known as the Doppler effect. This is a fundamental law of physics first demonstrated by the Austrian physicist Christian Doppler in 1842. It applies to the alteration in frequency caused when a wave of energy of any sort is reflected or transmitted from a moving surface. Everyone is aware of the operation of this principle in everyday life, albeit unconsciously. For instance, its effects are shown whenever a vehicle passes whilst sounding its horn. As the vehicle approaches, the sound from its horn is perceived to be at a higher pitch than when it is receding.

As applied to traffic radar, the Doppler effect means that a radio frequency signal emitted from a stationary radar and reflected from a moving target will experience a change in frequency of the reflected wave directly proportional to the speed of the target, relative to the radar transmitter.

In whichever direction the target is moving, the change in frequency will be the same for the same relative speeds. The difference between an approaching and a receding target being that an approaching target will give a reflected frequency higher than the transmitted frequency, a receding target will give a reflected frequency lower than the transmitted frequency.

The Speedar transmits at 24.10GHz. The transmitted microwaves strike a moving target vehicle and some are reflected back. If the vehicle is approaching, more waves, ie. a higher frequency, will be reflected back to the radar; if the vehicle is receding, less waves, ie. a lower frequency, will be reflected back to the radar. The difference in frequency between the transmitted signal and that received back after reflection is known as the Doppler shift. This frequency shift falls within the audio band for the transmitter frequencies and vehicle speeds for which the equipment is used.

The circuitry in the Speedar compares the frequency of the transmitted and reflected signals in a homodyne mixer and from the Doppler audio difference frequency that is detected, the circuitry calculates and displays the speed and direction of the moving target.

General Operating Notes

This section applies to all Speedar devices and must be read and understood before using the equipment.

Over the years since its introduction, much has been said about the use of hand-held radar as a method of speed limit enforcement. Criticisms have come from the motoring press, motoring organisations and expert witnesses, some of which have been justified, others have not, due to mis-information. It is now however generally accepted as an accurate and reliable form of speed measurement. These notes are intended to assist in establishing a method of operation designed to avoid pitfalls and instil confidence in the user of the equipment. It must be made clear from the outset that hand-held radar, or any radar which transmits its beam down the road, has its limitations. There are circumstances and environments to which different methods of detection are better suited. However, hand-held radar in the right place and in the hands of a properly-trained operator is an effective and easy-to-use method of speed measurement.

Target Identification

Target identification is the first essential and should form a major part of operator training. An operator must consider every approaching or receding vehicle in front of the radar as a possible target, whose speed could be displayed, regardless of its position relative to the radar device. This requires the operator to be aware of all vehicles including those outside the normal beam coverage area. To achieve this end, it is necessary for the operator to understand the properties of the radar beam, about which there have been more misunderstandings and erroneous statements than about all other aspects of the use of hand-held radar combined.

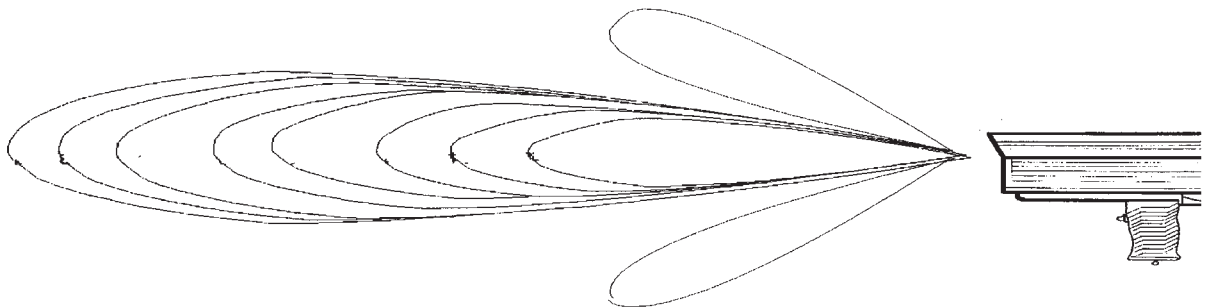
The radar signal is generated in a miniature transmitter device called a Gunn effect diode, located in the oscillator cavity. This device produces an oscillating electrical signal. This signal is directed through a coupler and out of the horn in a cone shape. At any one frequency, the width of this cone-shaped beam is a function of the aperture size, that is, the opening at the end of the horn. The larger and longer the horn, the narrower the beam; narrowing the beam in this way is relatively cheap but has obvious disadvantages if the resultant horn becomes too cumbersome to use.

The two basic properties of the transmitted beam are frequency and amplitude. Frequency, expressed in Hertz, is a measure of how frequently the signal changes polarity. For instance, a fluorescent lamp changes 100 times per second (2xUK mains frequency) whereas the Speedar transmitter changes 24,100,000,000 times per second. The frequency of the emitted signal is constant unless it is reflected from, and thus modified by, a moving object which produces a Doppler shift. Amplitude, on the other hand, is the strength of the signal, which diminishes very rapidly as it travels through the atmosphere. This characteristic has the effect of pushing back into the distance all vehicles behind the nearest one and,

when added to the effect of the AGC circuits, means that the nearest vehicle will, almost invariably, be the target the Speedar is measuring. It is important to realise that other factors do modify this characteristic but it is an extremely important factor and the reason for the credibility of police radar. Contrary to popular belief, the wider the radar beam, the easier it is for the operator to identify the target vehicle. The amplitude, or strength of the radar signal, falls off following the inverse square law on its outward travel. Not only does it diminish on its outward journey but also during its return after it is reflected by the target; this means that it diminishes by a fourth order function on its trip there and back known as the $1/R^4$ law. In practice, the antenna must be made directional. This is done by narrowing the beam and the product of this narrowing is called forward gain. Because of forward gain and the effects of the $1/R^4$ law, the antenna pattern takes on an elliptical shape with side lobes.

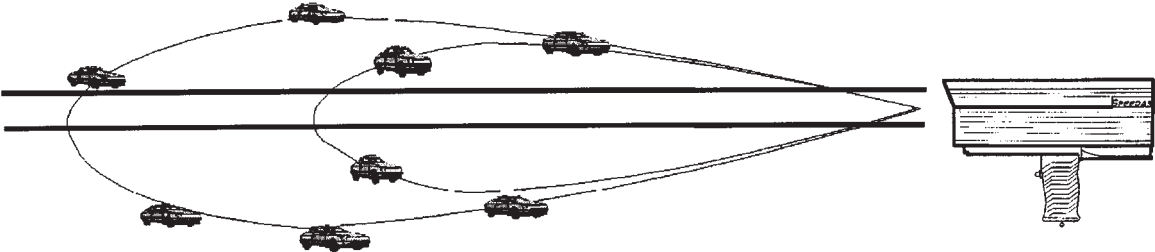
This shape is quite different from the wedge shape often described. The fattening of the beam shape nearest the antenna is highly beneficial to stationary radar in that it enhances the $1/R^4$ law which causes the radar to lock on to the nearest vehicle (usually the strongest target return). On the centre line of the beam the $1/R^4$ law holds true without modification, it is equally true on each of the contours of equal sensitivity. A contour of equal sensitivity being a line described by the beam shape, on which all targets of identical size and shape will reflect the same amount of signal.

The drawing above shows several of these contours of which there are an infinite number.



The description of a beam width of 13° refers to the half power point in any axis. It is not the total width of the beam, which is much greater. There is no way to define the beam width by a solid line of demarcation or cut off, nor can it be described by a definite border, on one side of which the beam exists and on the other side it does not.

Taking the contours of equal sensitivity falling at 500 and 1000 feet and placing an identical car anywhere around these contours, there would be a different strength signal reflected along each contour, but every one of the cars on the same contour would reflect the same strength signal.



Now erasing all the contours except the parts illuminating the carriageway



Each of the contours now illuminates only one car and the radar will read the speed of the nearer, all other things being equal. If the first car has a reflecting area of 10 square feet, the second would need an area of over 160 square feet to predominate. This is the simple and ideal situation but look more closely at the possibilities. When the radar beam strikes a vehicle, it is reflected in various directions according to the angles of the bodywork; only those signals which are reflected straight back are received by the radar.

A blunt square-shaped body work will reflect a stronger signal than a modern streamlined shape. A Mini, for instance, is a better target than many modern larger cars. For the same reason the rear of most present-day cars will be more reflective than the front. It has been shown that a distant vehicle will have to reflect a signal of over 16 times the strength of an identical vehicle half the distance away in order to have its speed displayed, rather than that of the nearer vehicle. However, under the $1/R^4$ rule, a vehicle 750 feet away would need only to reflect a signal just over five times as large to override a vehicle 500 feet distant. This could be possible in the case of a car and a truck. It follows that there are varying degrees of this situation ranging from vehicles of similar proportions to the last example given. In all cases, it is with reference to vehicles in the centre of the beam where the reflected signal is at its strongest.

Reflections

The radar beam can be reflected from various objects, just as a light beam is reflected from a mirror, and obviously the closer the reflector, the stronger is the reflection. Such potentially-reflecting objects include road signs, telephone boxes, metal hoardings, bus shelters, park railings, etc. Maximum reflection will occur only if the angle of the object was such as to reflect the beam directly to the rear of the operator. In a typical situation the reflector is usually so angled, or so far away, that it subtends a small angular portion of the total radar beam, so that at no time would a vehicle approaching from the rear, produce more return signal than one approaching from in front in the centre of the beam. If there is a large and critically-positioned reflecting object and no vehicle approaching from in front, the Speedar may briefly read the speed of a vehicle approaching from behind the operator. However, no properly-trained operator would be using a radar in these conditions.

This effect can be demonstrated by pointing the Speedar at the wing mirror of a car from a distance of about two feet. It will be possible to measure the speeds of vehicles approaching from behind the car out of sight of the operator. Note the direction indication will be correct, i.e. approaching, since the vehicle will be approaching the operator although moving in the direction that will be seen as receding once it has passed the reflector.

Interference

A device as sensitive as a hand-held radar is susceptible to possible radio interference and such interference could cause spurious readings if no precautions were taken to prevent them. As the batteries of the Speedar are incorporated in the instrument and there is no power cable to act as an aerial, such radio interference is minimised. However, under extreme circumstances, it is possible that the Speedar might be affected and, in such cases, the internal detection circuitry will halt operation of the Speedar and show the **RF Interference** legend on the display. No further operation of the Speedar will be possible until the interference source is removed. If the source of interference is stationary and local, this possibility should have been discovered during initial site checks for interference and that site ought not to have been used.

Choice of Site

All the factors outlined in the preceding paragraphs must be taken into account when selecting an operational site for speed limit enforcement. The recommendations which now follow go in many respects beyond the purely technical needs. However, it is imperative not to allow, through carelessness, areas of doubt which may be used as a defence, bearing in mind that a defendant needs only to cast doubt on the validity of the evidence of the prosecution to be acquitted. An operator must take every precaution not to use the Speedar where there is the slightest doubt about the circumstances.

Choose a location on the highway where oncoming vehicles can be seen over a sufficient distance (the higher the speed limit, the greater this has to be) to allow, after speed estimation, a stable reading before locking the reading.

Ensure that the vehicle being checked will, throughout the check period, be in sight of the operator, remain near the centre of the beam and that no obstructions such as hedges, fences or buildings come between it and the Speedar.

Search the area for:

- television or radio transmitters
- rotating radar aerials
- overhead high voltage cables
- large revolving signs (eg. on garage forecourts)
- large cooling fans
- illuminated fluorescent tubes in close proximity

Historically all the above have been considered to present the possibility of false readings being caused on the radar, experience shows however that most in fact cause no malfunction of the radar and provided the safety checks are carried out at the proposed site and there are no spurious readings produced, the radar can be used at sites containing overhead cables and television transmitters, Other aerials such as are found on mobile phone masts are normally of very narrow beamwidth which in general will not generate any significant field at ground level. Provided the operator is out of the line of sight of the aerial horn and the safety checks have been thoroughly carried out, it will be safe to use the radar in such circumstances.

To remove any doubt, always check thoroughly by searching with the Speedar throughout 360°. Do this by holding the Speedar in the normal way and rotating in a complete circle. Repeat this with the Speedar held above and below the normal angle of sight. If any readings not due to traffic appear on the radar display, or if the **RF Interference** legend appears, then move to a location with no interference.

NEVER CARRY OUT SPEED CHECKS AT A SITE WHERE INTERFERENCE IS FOUND

Check the area ahead of the Speedar

Avoid positions near possible reflections from road signs, telephone kiosks, metal bus shelters, metal hoardings, large metal doors on factories, sheds, etc. metal fences, railings or similar objects. As a guide, one should keep at least 15 yards distant from small objects (e.g. lampposts) and up to 50 yards from large metal buildings, hoardings and the large type trunk route advanced direction signs.

Speed Checking a Target Vehicle

Once an acceptable site has been found, re-check the correct functioning of the Speedar by means of the internal test and tuning fork. It is advisable, though not essential, to check the Speedar against the certified speedometer of a police car. This test is understood by magistrates and is recommended *vide* the case *R v Hughes 1981*, although it is less accurate than the inbuilt test and tuning fork. Speed checking may now start, remember that the Speedar corroborates the speed of a vehicle as estimated by the operator. Therefore the target vehicle should be identified and estimated as travelling in excess of the speed limit before the Speedar is used. A stable reading must then be held for three seconds. This can be judged from three blinks of the display. A stable reading is defined as a reading which does not vary other than by small increments (if the target is accelerating or decelerating) and is in keeping with a trained operator's observation of the behaviour pattern of the target vehicle.

The recommendation of three seconds is not in any way essential to the operation of the Speedar itself, each speed reading measured by the Speedar is a separate event and is not influenced by previous readings. The time of 3 seconds is given as a recommendation by ACPO. However, it should be pointed out that radar driven traffic cameras for instance are deemed to be accurate after a single reading.

It is only after all these points have been satisfied that the speed reading should be locked by depressing and releasing the lock button. A constant reading accompanied by the **Locked** legend will now be displayed. The display will also show the time at which the reading was locked and the current speed limit (provided that this has been set correctly beforehand) and will remain held on the display until cleared by pressing the lock button again. Where there is only one vehicle in the beam, target identification is no problem. If more than one vehicle was present, the strongest reflected signal will predominate. The display will also indicate the direction in which the tracked vehicle is moving aiding the user in identifying the vehicle. This is generally the nearest vehicle but see the paragraphs under Target Identification on page 12. Should two signals of identical strength but different speeds be received simultaneously, the display will blank out until one signal predominates. As traffic density increases, the display will switch from vehicle to vehicle and from direction to direction following the strongest reflected signal until such time as a stable reading is impossible to obtain. The task is now beyond the scope of the Speedar or any radar device.

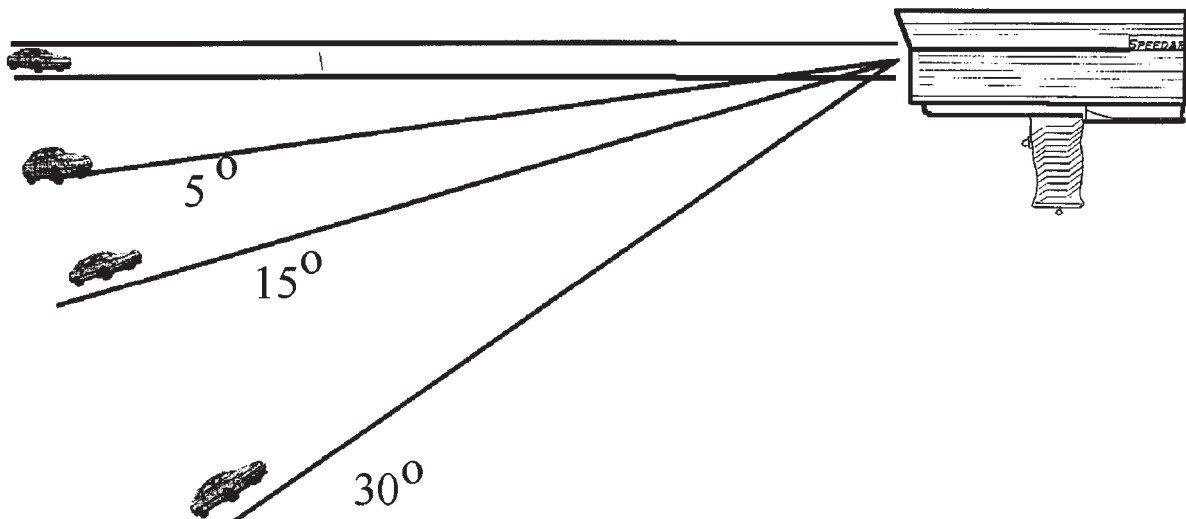
Under no circumstances should the operator try to exclude unwanted vehicles by panning the beam. At all times the beam must be directed straight down the centre of the road. See under Cosine Error page 19 for the errors caused by not having the Speedar pointing directly at a vehicle.

When the Speedar is used inside or alongside a vehicle whilst a speed check is being carried out, **DO NOT**:

- keep the engine running
- start the engine
- operate any moving parts (windscreen wipers, heater fans, etc.)
- transmit any radio signals

Cosine Error

The Cosine Error is the amount by which the true speed reading is reduced, if the Speedar is not sighted in the direct line of approach of the vehicle whose speed is being checked. In practice it is rarely necessary to be more than 10 to 15 feet off the direct line and this produces a negligible error which is always in the motorist's favour. The following figures and drawing illustrate the principle and indicate the error at varying angles.

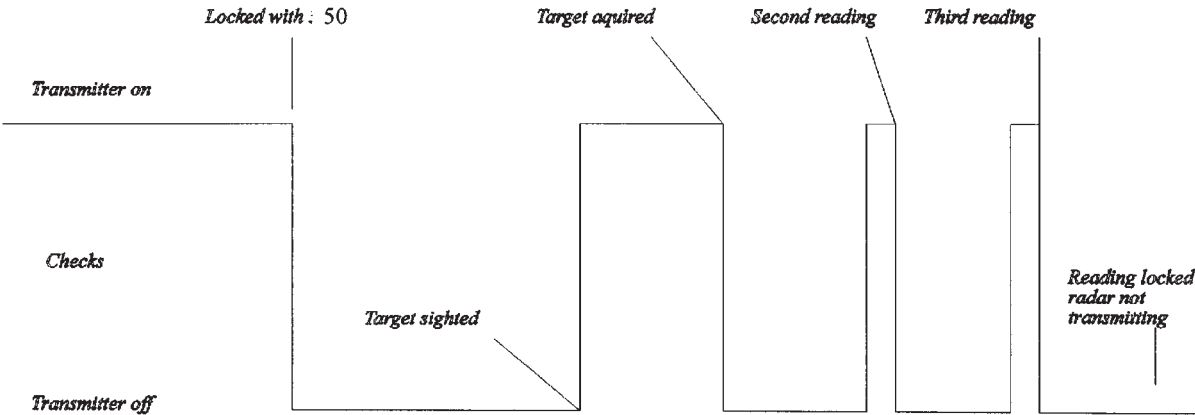


Off axis degrees	Cosine	Reading error (too low)
1	.9998	.001%
5	0.9962	.38%
15	0.9659	3.42%
30	0.8660	13.40%

How to Ensure Minimum Visibility to Radar Detectors

When the display is locked and showing a speed reading, the Speedar is not transmitting and is therefore not detectable. To ensure minimum visibility to snoopers and other radar detectors, the Speedar should transmit as little as possible. This can be achieved as follows.

Carry out the standard tests to confirm that the Speedar is operating correctly, finally press the lock button. Strike the tuning fork in front of the Speedar and this will automatically lock figures on the display and therefore turn the transmitter off. The Speedar is not now detectable. When a target vehicle is to be checked, press the lock button again to unlock the Speedar, each time the screen blinks it has taken a measurement of the target's speed. After as long a period as operational instructions require (typically 3 seconds), press the lock button again to hold the reading. Each measurement of the target vehicle's speed takes about 65mS, i.e. less than a tenth of a second. At all other times the Speedar is not transmitting and is therefore undetectable.



Typical transmitting pattern
Average transmit duty cycle is 7%

Battery Voltage

The Speedar is designed to operate from 6V. Should the voltage drop below 5.8V the range of the Speedar will start to reduce. When the battery voltage falls below the minimum acceptable level, **Low battery** will appear on the display and the Speedar will cease to operate. The battery should be removed and charged with the charger supplied. The spare battery should be fitted and speed checking may continue.

In normal use a battery will last for six hours without charging; it may be charged in one hour or less using the charger supplied, or may alternatively be charged with an in-car charger unit supplied as an optional accessory. Chargers suitable for Ericsson type 237 batteries may be used if available.

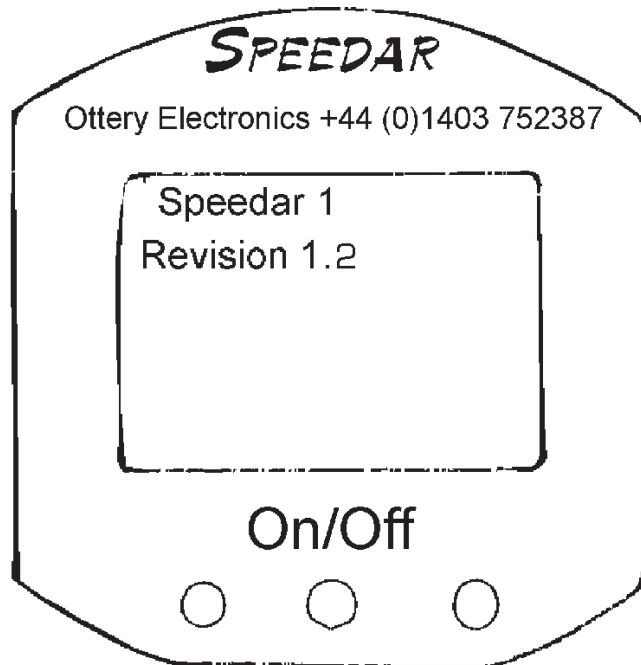
Speedvision uses the same battery as the Speedar but in the case where there is no external battery attached to power the display, the video camera is also powered by the Speedvision battery. In these circumstances the battery life is reduced to 2 hours.

The Repeater display has its own internal 12V NiCd battery and mains powered charger. Battery life is normally 40 hours.

Speedar Operating Instructions

Having read the foregoing operating notes the user is now ready to operate the radar

Switch on by pressing the red button on the front panel. The display will indicate both the model number and software revision number before reverting to the main measurement screen.

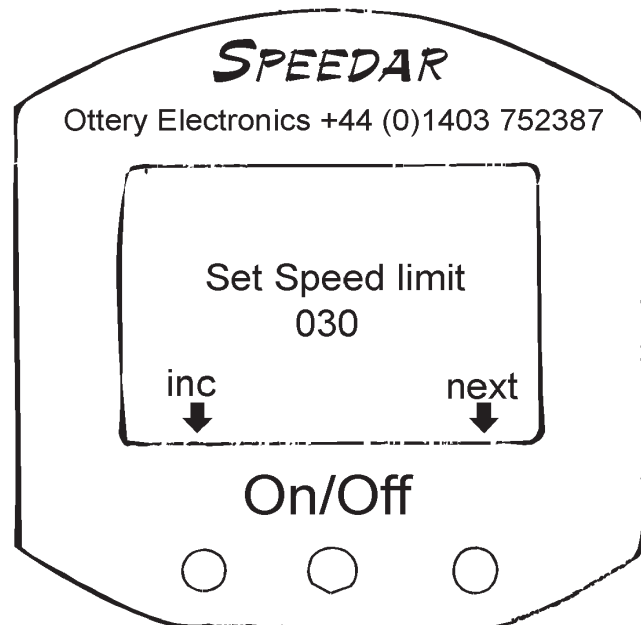


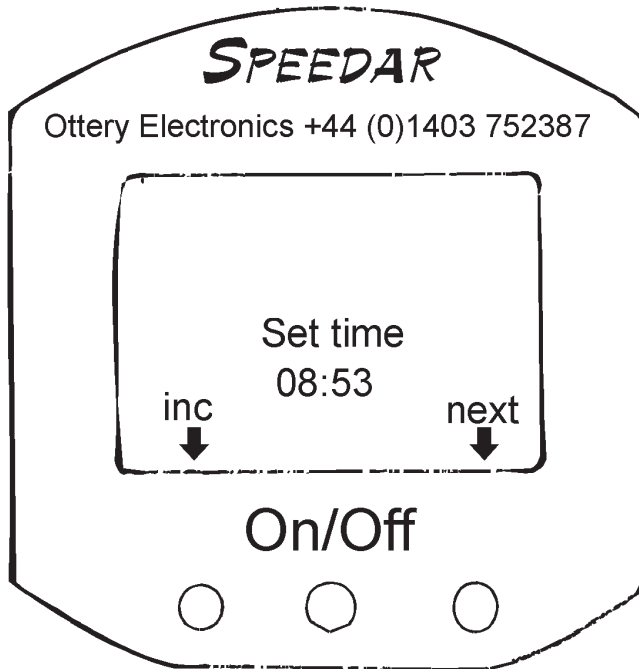
For the first operating session of any day, check the time and if required, set the speed limit indication as follows.

Press both green buttons together, the display will read

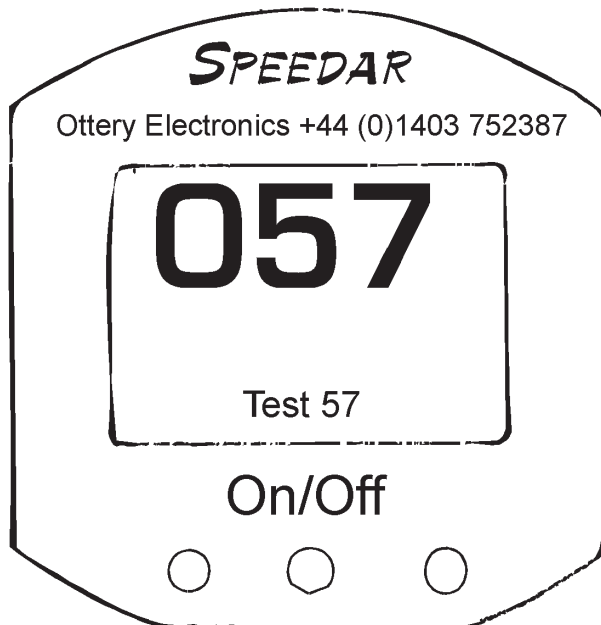
Set Speed limit

A cursor will blink on the left-most digit. The speed may be altered by pressing the green buttons as indicated by the messages on screen, i.e.. **inc** increments the selected digit by one; **next** stores that digit and moves on to the next. When the cursor is stepped off the right-most digit, the speed limit will be stored and the screen will revert to the measurement mode. This setting has no other effect than to cause a reminder of the speed limit to appear on screen when a reading is locked.





To set the time indication, press both green buttons until the **Set Speed limit** screen appears, then press both green buttons again and the **Set time** screen will appear. Digits are set in the same way as for speed limit. When the cursor is stepped off the right-most digit, the time is stored in the Speedar's real-time clock.



For every operating session, check the internal operation of the Speedar by pressing both the green buttons together three times and on the third press hold them down. **057** will be displayed on the screen to verify that the internal circuitry is operating correctly. Carry out an independent check using the tuning fork. Gently strike the fork and hold it a few inches in front of the centre of the Speedar. If the reading is the same as that stamped on the tuning fork (usually 50MPH or 80km/h), plus or minus one MPH or km/h, the Speedar is functioning correctly.

Take up the selected position by the roadside as close as is practicable to the kerb line. Carry out the checks for possible interference as detailed by the relevant authority. Aim the Speedar down the road and hold steady. When a vehicle approaches (or recedes), the Speedar will produce speed readings as the vehicle comes within range or enters the beam area. The direction of the vehicle will also be indicated, i.e. **oncoming** or **receding**. At this point the display backlight will illuminate and the reading will be held for one second. Successive readings will be taken every second until either the vehicle moves out of range or the lock button is pressed.

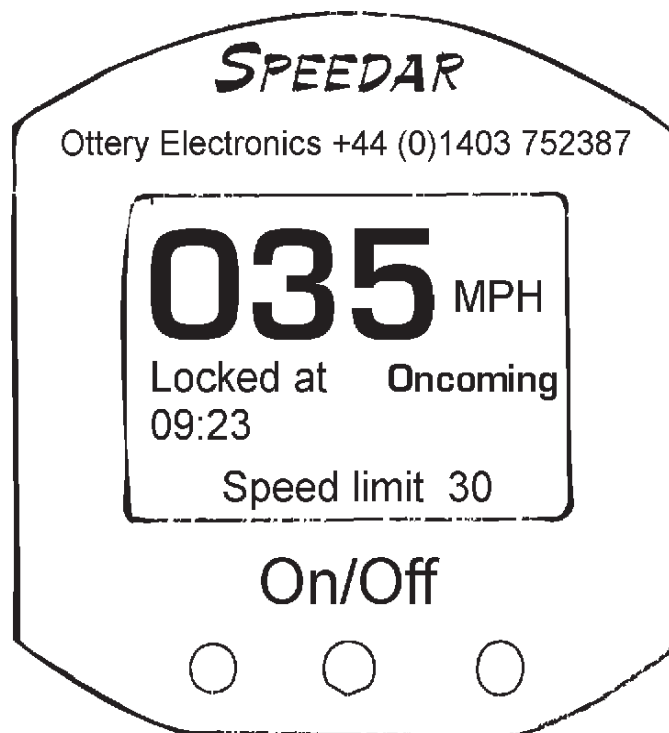
Once the reading has been observed for the required period of time, activate the lock button on the handle. The display legend will change from **Running** to **Locked**. The time at which the speed was locked will be frozen on the display as will the direction information. A reminder of the current speed limit will appear at the bottom of the screen showing the information entered earlier.

The speed shown will generally be that of the nearest vehicle whether coming towards the Speedar or moving away (but see below).

The lock may then be pressed again and the speed reading will clear, preparing the Speedar to display the speed of the next vehicle.

Where a large vehicle is close behind a small vehicle, the signal reflected from the large one will be stronger than that from the small one, in which case the speed of the large vehicle will be shown even though the small vehicle is nearer.

If the target vehicle is gaining or losing speed, the speed reading will change accordingly until the lock is operated and the last reading is locked in. **Note that it is NOT possible to recall readings.**



It is important to aim the Speedar down the road as nearly parallel to the road as possible. DO NOT FOLLOW THE VEHICLE with the Speedar as this will lead to inaccurate (too low) readings as the angle between the Speedar and target increases. For the same reason, the first reading taken as a vehicle passes the operator coming from behind will be lower than the true speed.

The Speedar is designed to exclude any targets travelling slower than about 12MPH (19km/h). The range of the Speedar is 400 to 600 metres dependent upon the size and shape of the target vehicle and the prevailing weather conditions. Heavy rain will reduce the range. The operator should be aware however that the Speedar will be able to see vehicles through mist or fog which may be invisible to the operator.

The **Battery low** legend appears in the display when the battery voltage has dropped below a preset level. The Speedar ceases to operate whilst this indicator is on. The battery should be removed for charging and replaced by a fully-charged spare.

It is important that the batteries should be charged after use so that they are always ready for use. They cannot be overcharged using the charger supplied and may be left plugged in for up to 12 hours when not in use. The charger supplied will fully recharge the batteries within one hour or less. Being Nickel Metal Hydride the batteries are not subject to any form of memory effect and need not therefore be fully discharged before charging. If a Speedar is not used for a long period, the batteries should be charged before use.

In the presence of radio frequency interference of a greater strength than the Speedar can tolerate before giving false readings, the legend **RF Interference** will appear on the display. The Speedar will not operate whilst this is displayed and therefore no false readings can be shown in the presence of interference.

Speedar with Repeater Display

When a repeater display is attached to a Speedar, the basic operating instructions are unaltered. The Speedar is still operated in the normal way, its readings however are also shown on the repeater display so that oncoming traffic can also see the speed the Speedar is reading. For obvious reasons the repeater display will only show the speeds of oncoming (relative to the Speedar) traffic.

When connected to a repeater display the speedar is only approved when using the cable supplied by the manufacturers. This cable is three metres long.

There are only two additional controls on the repeater display which need to be set before use.

The thumbwheel switches on the rear of the display should be set to read the MINIMUM speed which is to be shown by the repeater display. Only speeds greater than this number will be displayed.

Loosen the screw fasteners each side of the cover stays and swing the cover upright to show the warning message YOUR SPEED, reposition the stays to hold the cover upright and re-tighten the screws.

Plug in the connecting cable at both ends and tighten the thumbscrews (Speedar end). Attach the plug to the repeater display carefully, it will only fit one way round and should not be forced.

Push the on/off button and the ON light will illuminate, if the light remains off the internal battery is flat and must be recharged.

Speed checking may now be carried out in the normal manner.

If it is required to change the minimum speed reading on the repeater display the unit must be switched off and on again to recognise the new value set on the thumbwheels.

Charging

The internal battery in the repeater display is sufficient for 40 hours use. The unit should be recharged at least every other day when in use. The internal charger must be connected to the mains supply using the lead supplied and the charger switched on with the charger power switch. The unit will recharge overnight.

It is important that the display is switched off after use as allowing the internal battery to go flat whilst the equipment is switched on could cause damage to the display and battery.

Speedvision Operating Instructions

General

Speedvision is the newest adaptation of the Speedar radar. It incorporates a high quality video camera and fold out viewing screen which enable the operator to see on screen the vehicle who's speed the radar is measuring. Also superimposed on the screen are the speed, direction, time and date. This screen may be frozen at any time when there is a target in view by locking the Speedvision in the normal way, the superimposed information is also frozen with the picture.

The video information may be output to either a video recorder, or a video printer. If a video recorder is used, the stored image has sufficient clarity that when displayed on a monitor or TV screen, vehicle number plates may also be distinguished. The viewing screen allows the operator to choose the optimum moment to freeze the video so that the number plate is clearly visible.

The basic operation of the radar remains unchanged from the standard Speedar thus previous training on radar speed measuring devices can be utilised allowing users rapid conversion to the Speedvision. Naturally this also means that the normal precautions used when making a radar speed measurement, as previously described, must be observed. Since, in common with the Speedar, the Speedvision shows the direction of the vehicle being measured, this makes it much easier for the operator to be certain of their target and the addition of the video screen gives further assistance in this respect.

Battery power for the viewing screen is supplied by an external battery. In the absence of an external battery, the radar and camera are still operational and the Speedvision may be used in this mode if it is more convenient to observe the picture on an external screen, e.g. one incorporated in the video recorder, or if a screen is not required. Video data is output through the attached phono plug, using the same cable as connects the external battery.

All functions of the camera are fully automatic including focus, brightness and focal length of the inbuilt zoom lens. On power up, the camera is set to pre-set values for the initial focus and focal length which is calculated to give a field of view which closely approximates to that of the radar when it has a target in view. When there is no target in view, although it is possible to set the camera to a corresponding wide angle position, in practice it is difficult to arrange for the camera to zoom quickly enough. In some cases to achieve the normal field of view and the camera focal length is therefore fixed at a predetermined value.

Use

Operator is expected to familiarise themselves with the basics of radar speed measurement as set out in the General Operating Notes section of this handbook (page 12). This forms the basis for measurements made using the Speedvision. In practice the only differences between using the Speedvision and using the Speedar, or other hand-held radar speed measuring device, are the setting up and connecting of the Speedvision to external equipment, e.g. battery, video recorder or video printer.

It is perfectly possible for an operator to use the Speedvision held in one hand in the same way as a standard radar. However, for long periods of use or for users who find it tiring to hold the equipment, a tripod bush is provided at the front of the Speedvision. Either a tripod or monopod may be attached to this bush. Where the Speedvision is to be stood by the roadside and not held, a tripod is needed. For operators who wish to hold the Speedvision and may wish to move quickly or turn to face different directions of traffic, a monopod is ideal as it takes all the weight of the Speedvision, leaving the operator free to concentrate on aiming the equipment.

Operation is simply a matter of connecting the external battery to illuminate the viewing screen, connecting the video output to an external video recorder or printer if a permanent record of offences is required and switching the Speedvision on.

If it is required to use the built-in viewing screen, lift up both the side latches and raise the screen to the vertical position. Push the screen down so that the lug on top of the screen housing engages with the slot on the top of the Speedvision body. Push down both side latches to lock the screen in place. Connect the external battery and video cable to the socket on the right side of the Speedvision. Connect the battery end of the cable to the external battery.

If the internal screen is not being used it is possible to operate without the external battery.

Switch on the Speedvision by pressing the red on/off button. The Speedvision will display the software version number and model type in the same way as the Speedar. Time and speed limit are both set in exactly the same way as the Speedar, see the Operating Instructions for the Speedar on page 22 of this handbook.

All the normal checks as set out in the Speedar Operating Instructions must be carried out to ensure that the site chosen is not subject to interference.

Video is available all the time the external power is connected or the Speedvision is switched on. Power to the video camera will be supplied either from the external battery or, if this is not connected, from the Speedvision battery.

If video recordings of offences are to be made, connect the video recorder input to the output connector from the Speedvision. If video prints are to be made, connect the output from the Speedvision to the video printer input.

Speed checking can now be carried out in exactly the same manner as with a Speedar or other radar speedmeter, with the following additional feature.

When the lock button is pushed, it locks the speed reading on the Lcd display of the Speedvision, just as it would on a normal Speedar. In addition it freezes the video frame on the viewing screen at that point and the video output now becomes a single repeating frame containing the view as seen by the camera at the instant of lock, with the speed, direction, date and time superimposed on the frame. It is not possible to freeze the frame when a speed is not being measured by the Speedvision, nor is it possible to recall previously frozen frames or measurements except on the video recorder if attached.

A further press on the lock button will unlock the Speedvision and unfreeze the video.

After use the screen should be folded back down by lifting up the side latches, then lifting the screen out of its latched position and folding it back flat into the main body of the Speedvision.

Because of the less robust nature of the Speedvision compared to the Speedar due to the folding screen, operators should take greater care when using the Speedvision. For instance, throwing it into the back of a car when it is not in use is a bad idea. The Speedvision will be much less vulnerable to damage if it is replaced in its carry case after use.

Speedlog Traffic Data Logger Operating Instructions

This equipment is an adaptation of the Speedar standard police traffic radar, as such it works on the same principles and should be used with due regard to the conditions described in the method of use contained in the standard Speedar handbook.

The Speedlog is designed to be used to capture and store a log of vehicle speeds such as would be needed for a traffic survey. It saves the operator having to record data manually and then transcribe it later into a computer with all the risks that that incurs of miskeying or otherwise wrongly entering data.

The operator simply stands or sits in a car beside the road to be surveyed and when a vehicle which fits the conditions of the survey, e.g. free flow, is seen, the speed will be shown on the display. The direction of travel, either left to right or right to left, is automatically indicated by the arrow above the **To** or **From** column and when the trigger button is pressed, one reading will be stored for the appropriate direction. The total number of readings will be incremented, the new average speed and 85 percentiles will be calculated and the results updated on the screen. The 85%ile values are only displayed when the number of readings is greater than 10.

When sufficient readings have been taken for either or both directions, the display will show a total of the number of vehicles in each direction, the average speeds for both directions and a simple approximation to the 85 percentile for each direction. This will be approximately correct for numbers of vehicles exceeding 50 but it is recommended that for absolute accuracy a more rigorous algorithm is applied than can be accommodated in a relatively simple piece of hand-held roadside equipment.

Operation

Switch on the Speedlog using the red on/off button.

The display will show the opening screen with an arrow at the left hand side of the first line. This arrow, or the cursor in the case of data entry or choice, is moved up and down by the four green navigation buttons identified by the multidirectional arrow symbol on the Speedlog front panel.

The first operation is to set the system time. Normally this will be correct as it is maintained internally, however it may be useful to utilise a local time where for instance the log is started at time 00:00 and all logged times thereafter will be relative to this, thus saving the trouble of having to work out the total time of the log or the frequency of vehicles.

Press the yellow select button and the **set time** screen will appear. The cursor will be blinking over the first digit. This digit can be incremented or decremented by use of the appropriate navigation button. When the first digit is correct, move on to the next with the left or right

navigation button. Each digit may be altered as much as required and returned to at any time using the navigation buttons. When the time is set correctly, store it and exit this screen by pressing the yellow select button. The initial screen will reappear.

Move the arrow down one position to set date, press the yellow select button and the **set date** screen will appear. As with the time, this will normally be correct as it is maintained internally. Set the date in the same manner as was described for setting the time and when correct, press the select button to store the data. The set units screen will appear.

A choice of MPH or km/h measuring units is available. Once selected, the choice of units will be stored and applied to all future measurements. To change between them, move the cursor as before. When the choice is correct, store the units with the yellow select button. The initial screen will reappear.

Move the arrow down to the **Choose site no** option and press the yellow select button. A choice of a pair of site numbers will be shown. This may be incremented or decremented in pairs by the navigation buttons as before. Sites always appear in pairs so that both directions of traffic may be logged at the same time at any site. When the site pair has been chosen, press the yellow accept button.

The option will be given to clear the site of all information, the default selection is **no**, if the site is not cleared logging will continue from the last recorded reading at that site. This means that the logger may be switched off at some point and the logging operation continued after a break, from where it was stopped. Press the yellow button to select your choice.

The site name option will appear. Each pair of sites may be given an alphanumeric name of up to 8 characters to enable the site to be easily identified, e.g. A224 or BY-PASS. This is achieved by using the navigation buttons to change the character that the cursor is blinking over. NOTE in this case the characters cannot be returned to. After the cursor has been moved off a character it will not return. When the site name is satisfactory, press the yellow button to store it. When the name exceeds eight characters it will be automatically stored when the cursor moves beyond position eight.

The main selection screen will reappear.

Move the arrow down to the **log readings** position and select it with the yellow button. The logging screen will appear. This shows the following information.

The direction of traffic which the next press of the log button will store, indicated by an arrow over the active direction, either **TO** or **FROM**. The speed of the vehicle to be logged appears next to the legend **Current speed**. The remainder of the screen shows the logged information for each direction. Note the 85% row will remain blank until at least ten vehicles have been logged as the reading is insufficiently accurate below this number of samples. It becomes more accurate as the number of logged readings increases, but note that using the tuning fork to test the logger and storing multiple readings of the exactly the same value will give meaningless results.

When logging has been completed or the operator wishes to stop logging for a period, press

the yellow select button and the Speedlog will return to the initial screen. The data will be maintained internally for up to ten years in the absence of any external power. It is quite safe to change batteries at any time without loss of data. Switching off the logger at any time will not result in loss of data.

The final option on the main screen is **Download**. Selecting this will enable the stored data to be dumped into a PC for further manipulation. Switch off the logger, connect the cable between the logger and the PC port. This will be either Com1 or Com2. Since it is most common for the mouse to use Com1, the spare port on the rear of the PC will almost certainly be Com2. In some cases however Com2 is used by an internal modem. In this event it will be necessary either to remove the modem from Com2 either by changing the modem port selection or, where this cannot be done, by physically removing the modem, or by utilising an alternative port where this is available.

Switch the logger back on and move the arrow down to the **Download** position. Select this option with the yellow button. An information screen will appear showing the download commands available.

Before being able to download the stored data, the PC port and communication protocol must be set correctly. This may be done using any suitable comms program or with the inbuilt Windows Terminal or HyperTerminal program. The required communications protocol is 2400 Baud 8 data bits 2 stop bits no parity no flow control and the comms program must be set for direct connection to the port, i.e. no modem, and ASCII transfer.

To set this up using HyperTerminal proceed as follows.

Open HyperTerminal, The new connection window will appear. Enter a name for the connection, e.g. Speedlog and click on OK. The Connect to window will appear. All these entries except 'Connect using' may be ignored. Choose the port you are using in the 'connect to' line and click on OK. The port settings window will appear. Set the Bits per second to 2400, Data bits to 8, Parity to none Stop bits to 2, Flow control to None and click on OK.

The connection is now set correctly

Having connected the logger to the PC and selected the download function, type into the HyperTerminal window the following.

S (upper case) (site no) e.g. 00 followed by enter, or carriage return, (if local echo is enabled, these characters will appear on the hyperterminal screen as you type).

The following information will be loaded into the HyperTerminal window from Speedlog.

Site No (e.g.) 00

Site name (e.g.) A233

Date and time of first reading (eg 15/12 09:43)

No of readings (e.g.) 37

Average speed (e.g.) 26

85%ile (e.g.) 32

Then enter one or other of the following.

D (upper case) followed by enter or carriage return

or DT followed by enter or carriage return.

D will cause a string of comma separated speeds to be dumped to HyperTerminal. This is a form in which data may be loaded into other programs, e.g. Excel, for further analysis. The stored string of speeds will be output as below.

050,049,050,050,050,049,080,081,081,081,050,050,050,050,049,050,050,

DT will give a list of speeds and times one per line

Site No 00

Site name A322

Date and time of first reading 15/12 09:43

No of readings 017

Average speed 057

85%ile 066

THE USER ENTERED DT HERE

050,09:43

049,09:43

050,09:44

050,09:44

050,09:44

049,09:44

080,09:44

081,09:44

081,09:44

081,09:44

050,15:48

050,09:58

050,09:58

050,09:58

049,09:58

050,14:46

050,14:46

It is necessary to enter the site number before each D or DT command. Incorrect entries will be ignored by the Speedlog software, but if an enter command has been given, the site number will have to be entered again before the Speedlog will respond.

Technical Descriptions

Speedar and Speedvision

Preamp Board

The outputs from the two mixer diodes are amplified by IC1 a and b by 60dB. R1 and R2 are load resistors to match the mixer diode source impedances. C3,C5 are DC blocking capacitors. D1,D2 and D3,D4 act as limiters in the presence of overload inputs and reduce the amplifier gains to approximately 1 as the output swing exceeds the diodes forward voltages. C5,R4 and C4,R3 form a high pass filter at approximately 800Hz.

Analog Channels 1 and 2

The outputs from the preamplifiers are fed to band pass filters in each channel consisting of amplifiers IC1 and IC22. These filters remove the out-of-band noise and cut the bandwidth to 9KHz (800Hz to 9.8KHz). This reduces the out-of-band signals passed to the rest of the system hence improving the signal to noise ratio. IC2 forms an agc stage for each channel using Q2 and Q10 as variable resistors to adjust the gain.

The other two amplifiers in IC2 form tracking filters in each channel. At the tracking filter centre frequency, the outputs will be in phase with the inputs at the input to IC4, a D-type flip flop, used as a bang/bang phase comparator. The output of this comparison is integrated by C12,C71 and used to control the resistance of Q1,Q9 which drives the centre frequency of the filter up or down. This filter will lock on any in-band frequency, once locked it rejects other input frequencies and thus helps to discriminate between multiple targets by tracking the current target frequency, until any other conflicting signal is about 6dB greater than the currently locked frequency.

The outputs from the tracking filters are squared in comparators IC3,IC21 and channel 1 is fed to a phase lock loop IC5. This ensures that only one frequency can be passed to the frequency measuring circuits and also provides error signals when the frequency loop is not locked.

Channel 2 does not have this circuitry as it is only required to sense the relative phase of channel 2 compared to channel 1. The signal frequency in both channels will be identical. The phases are compared in IC23 and passed to the logic controller.

Logic

The function and system control of the whole instrument are handled by the embedded microcontroller IC11 which with its associated memory and demultiplexing latches form an 8-bit microcomputer. The display and real-time clock are also accessed as addresses on the address bus. IC16 forms a -6V generator for the display and analog amplifiers. IC12 is a watchdog which resets the system under conditions of power fail, or software crash serviced by one IO bit from the controller. IC10 is an RS232 interface IC allowing the input and download of data to the system.

The display backlight and transmitter supply are turned on or off by one IO bit each. The Doppler frequency and Doppler error signal are interrupt signals to the controller. Signal phase, RFI, lock switch, low battery and two front panel switch inputs are read by an IO port. IC15 is permanently powered when a battery is fitted and in conjunction with the switch on the front panel forms the power on/off circuitry driving Q6,Q7 to supply power to the entire instrument.

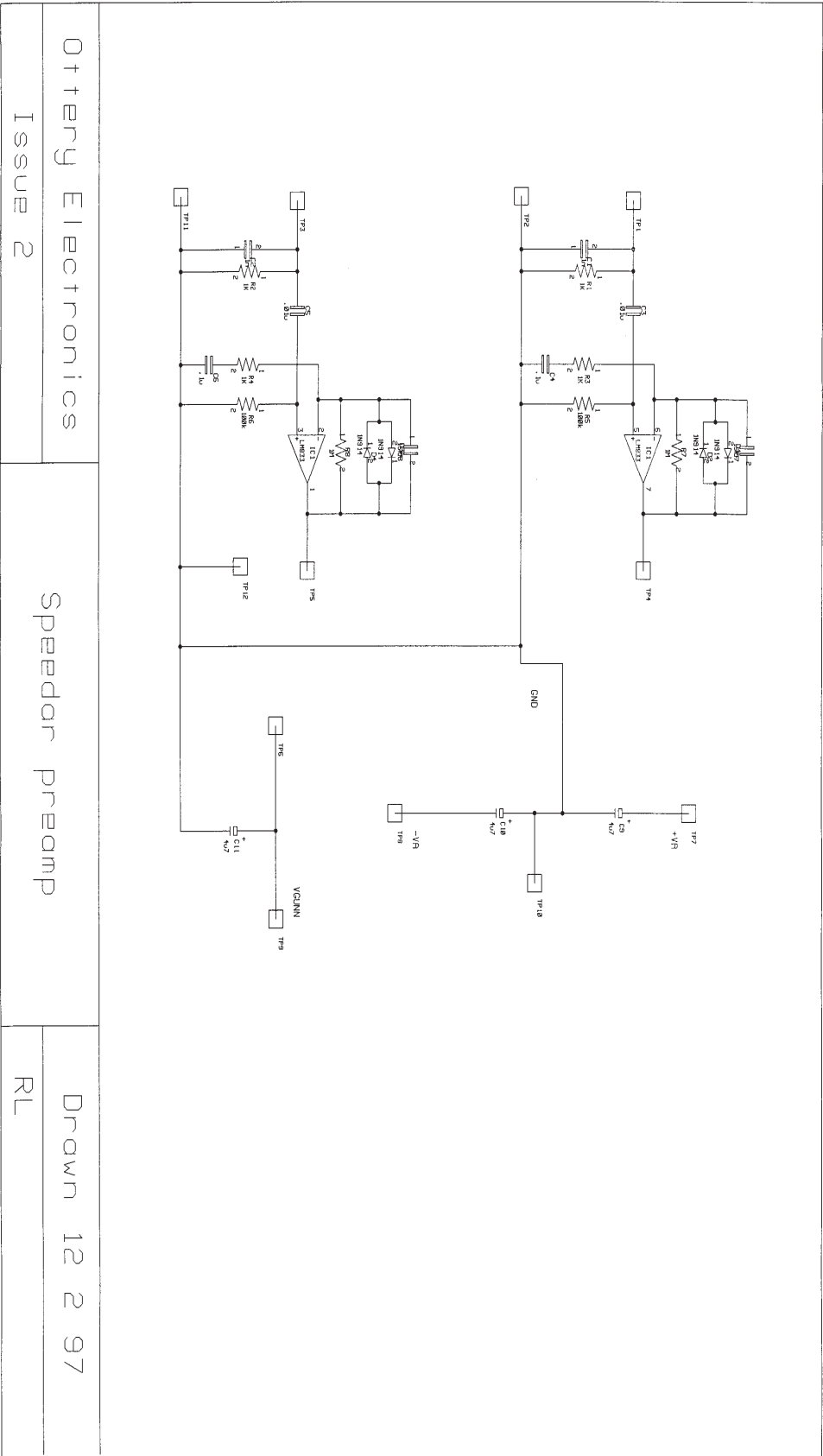
The real-time clock IC14 outputs a square wave to an IO port on the controller with a frequency derived from its onboard crystal. The frequency output is selected from a divider chain by the controller. Normally this is set to 4Hz to provide the 1-second timing interval between readings. However, under test conditions, this is set to 4096Hz and measured by the controller as if it were a Doppler input frequency. This results in a test reading of 057 on the display and is the result of comparing two independent crystal-controlled frequencies.

Speedvision

The video camera is separate from the Speedar circuitry and is controlled via the built-in RS232 interface in the Speedar. Power is supplied to the camera from either the Speedvision battery or an external battery if connected. This changeover is automatic.

Speedlog

The microprocessor circuits include an additional battery backed up 64K RAM which stores all the information logged. Because of the need for additional input switches to navigate the screen, the RFI and Battery low functions are not available.



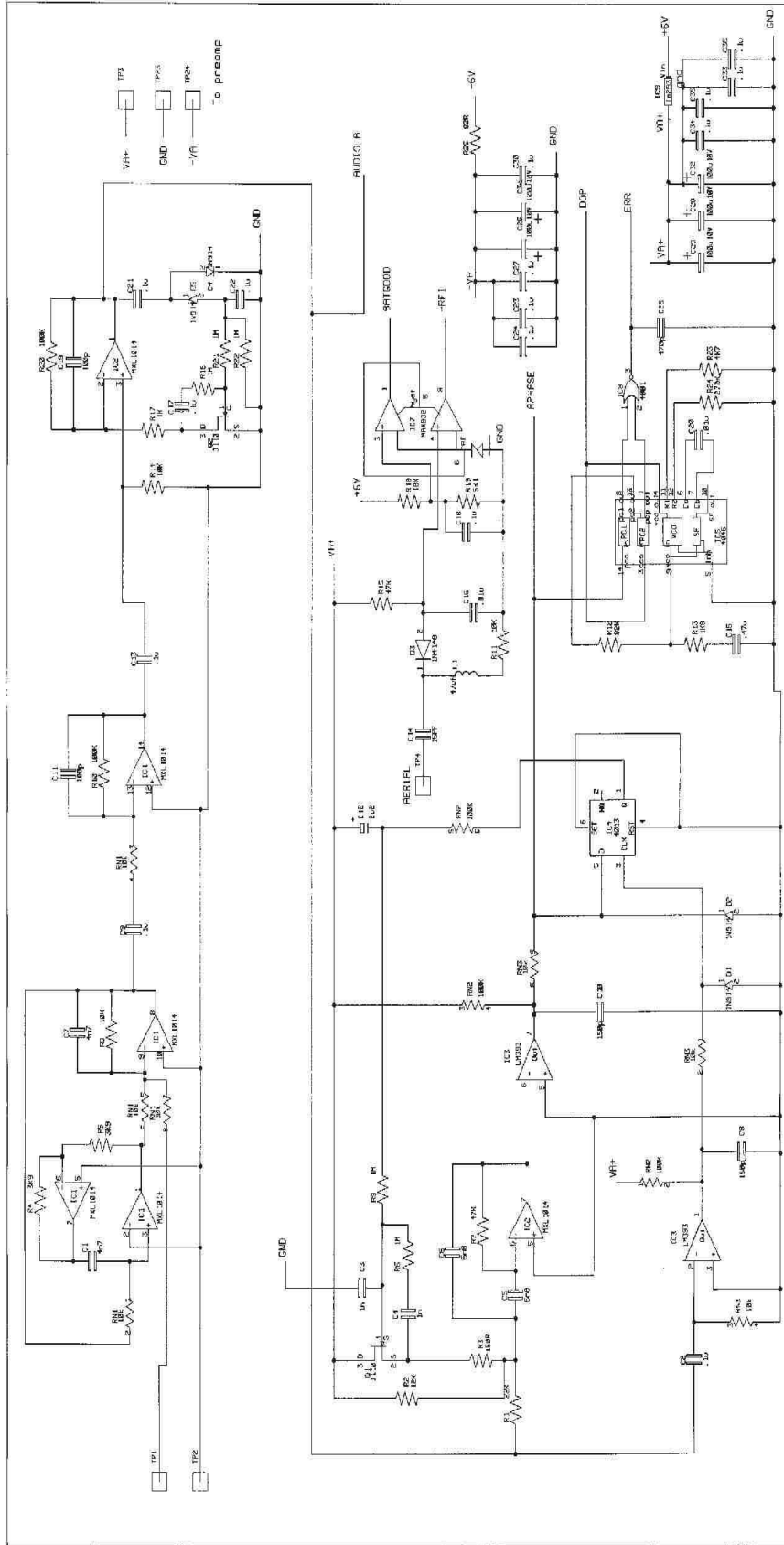
Ottery Electronics

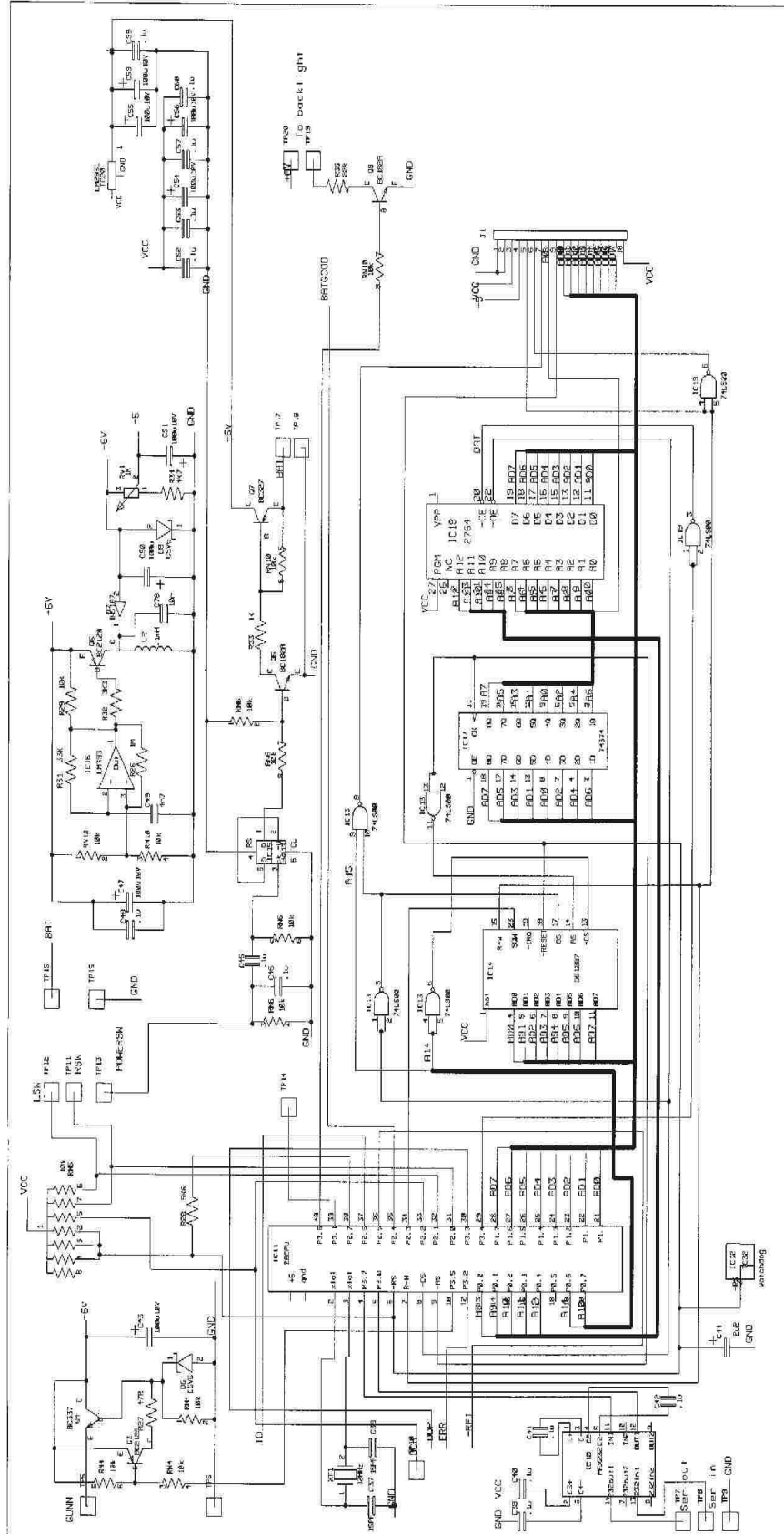
Issue 2

Speedar preamp

Drawn 12 2 97

RL





Drawn 12 2 97
RL

Speeder logic

Issue 2

Warranty and Maintenance

Warranty

The Speedar, Speedvision Speedlog and Repeater Display are warranted to the original purchaser to be free of defects and Ottery Electronics (OE) undertakes to repair the equipment to the specification, or to replace at its option, any unit which fails because of defective parts or workmanship for a period of two years from the original date of purchase. This Warranty applies only to internal electronic components and circuitry. It excludes normal wear and tear such as broken switches, connectors, trim and cases, exterior hardware, damaged lcd displays, batteries and physical abuse.

The Speedar, Speedvision and Speedlog should be kept in their carry cases when not in use. The Repeater Display should have the protective cover folded flat against the display window to protect the window from scratches.

Maintenance

OE holds stocks of component parts and printed circuit boards. In normal circumstances, OE is able to repair and return by carrier, equipment within 72 hours of receipt. If damage or malfunction is suspected for any reason, the initial checking procedure should be carried out and if the equipment is not functioning correctly, it should be returned to OE with, wherever possible, full details of the type and circumstances of defect or damage incurred.

Calibration

Each Speedar or Speedvision is supplied with a Calibration Certificate covering both the unit and the tuning fork. Both should be returned to OE annually for re-calibration as required by Home Office regulations. A record is kept of calibration dates and, if required, users can be notified when re-calibration becomes due.

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