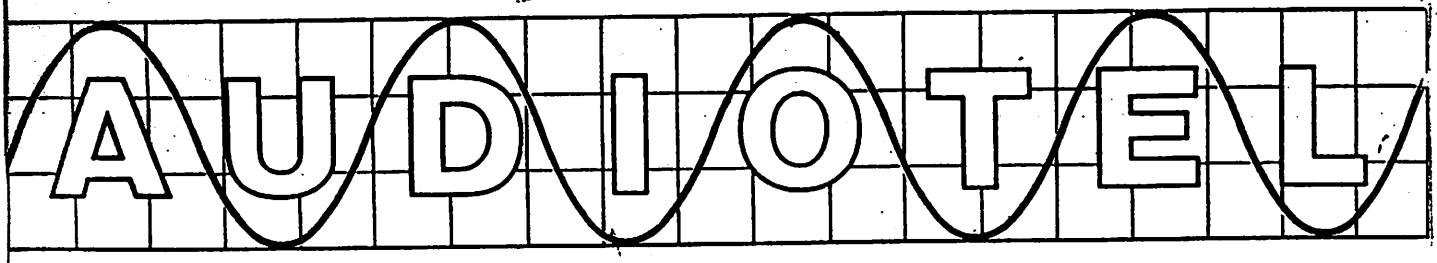
Audiotel International Ltd

Scanlock 2000

Operator's Manual

December 1988



Issue 3

Should any problems arise, or if further technical support is required, please contact:

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Or contact your local agent or supplier.

Preface

To the user!

Thank you for buying Scanlock 2000. This operating manual will enable you to get the best out of your Scanlock. If you are already familiar with Scanlock you will notice a number of new operating methods. Those with a technical background will find the last section in this manual of interest.

This manual is divided into nine sections of which the first eight should be read by all users. Getting to know Scanlock fully will take a little time but the rewards in terms of improved information security are great.

The first four sections enable the user to prepare Scanlock for operation. Section five gets the user familiar with Scanlock without carrying out a search for hidden transmitters. Section six describes search methods. An introduction to different transmitter types is given in section seven. How to provide protection when sensitive meetings are in progress is described in section eight. Finally section nine outlines the signal processing methods used in Scanlock

If you should encounter any problems with your Scanlock, or if further explanation is needed on a particular feature then do not hesitate to contact us.

Should you be visiting our area and can spare an hour or so we will be pleased to meet you and show you our manufacturing site.

Audiotel prides itself on after-sales service. The telephone, telex and fax numbers are at the front of this manual. Please remember that you have not just bought a Scanlock, you have bought a service as well.

Section 1

1.1 Introduction

Scanlock 2000 is a radio receiver designed for rapid detection, identification and location of hidden transmitters used for eavesdropping purposes.

Scanlock's advantage over conventional counter-surveillance devices lies in its ability to automatically tune across a very wide frequency range quickly to a radio signal that at the antenna input is significantly stronger than any other signal. Once locked to this signal however, Scanlock continues to search for any new stronger signal.

Suppose a low-powered transmitter is concealed at one end of a room If Scanlock is located at the other end then at that position the strongest signal may be due to a local radio station. Thus the local radio station's transmission will be heard. As Scanlock is moved about the room a position will be reached where the strength of the low-powered transmitter is greater than that from the radio station due to the now diminished distance between Scanlock and the concealed transmitter. Scanlock will then tune automatically to this signal and the transmitter will be heard. Scanlock's facilities enable the operator to confirm the presence of an eavesdropping transmitter and to physically locate it with ease.

It is this combination of Scanlock's fast automatic tuning and the fact that Scanlock can be moved during the automatic tuning operation to minimise the distance between Scanlock and any concealed transmitter that makes Scanlock highly effective and easy to operate.

There are situations where background radio signals, due perhaps to a nearby broadcast station, are very strong and the distance between a very low-powered concealed transmitter and Scanlock may be too small to allow full protection to be gained through automatic operation only. For these situations Scanlock's manual tuning mode is used. Due to Scanlock's sophisticated signal processing, the manual tuning operation is very quick. The extra sensitivity gained through manual control offsets the fact that it is not practical to initially move Scanlock around the area under search during this operation.

In addition to detecting, identifying and locating conventional transmitters, that is, those which radiate their signals through an antenna into the surrounding space, Scanlock can detect 'mains carrier' or 'current carrier' devices that transmit along a pair of AC power cables (from which they normally draw their power) in preference to the surrounding space. The eavesdroppers receiver is connected at a distant point to the AC power cabling. Generally, receivers to detect such transmitters are available only separately and may be expensive.

1.2 Other Applications

Eavesdropping transmitters are not only used to eavesdrop on conversation, they can be used to check if a property is empty and therefore unguarded. Illegal entries into property using this technique to reduce risk have been reported in the national press.

Tracking transmitters attached to vehicles can be detected, identified and located using Scanlock.

1.3 Training Transmitters

A conventional transmitter together with a mains carrier transmitter are invaluable aids in gaining familiarity with the operation of Scanlock. It is preferable that the conventional transmitter is capable of sub-carrier operation.

Suitable transmitters are available for this purpose from Audiotel. The purchaser must check with the local Wireless licensing department as to the legality of operating such transmitters.

1.4 Accessories

Scanlock 2000 is provided with the following accessories. These should be checked on unpacking (please observe comments about unpacking in Section 2).

Leather Carrying Case OR Attache Case with inserts	1
Shoulder Strap	1
AC Power Lead	1
Rechargeable Ni-Cad Battery Pack	2
Antenna	1
Antenna Extension Lead	1
Headphones	1
Remote Alarm	1
PP3 Battery for Alarm	1
Connecting Lead for Alarm	1
Fuse Set	1

Any shortages must be notified at once.

1.5 Guarantee

The equipment is guaranteed for a period of two years form the date of original purchase. Please refer to our Standard Terms and Conditions relating to claims under guarantee and return of equipment. These are available on request.

1.6 Servicing

Equipment should be returned to Audiotel in the event of any need for servicing or repair. If this is impractical then servicing should only be carried out by qualified personnel. Servicing by the customer or his agent during the guarantee period may invalidate the guarantee.

Scanlock is constructed on a modular basis. Fault location information and replacement modules are available form Audiotel or your local supplier.

Section 2

Preparation for Use

2.1 Unpacking

The shipping container should be inspected for any damage. If there is evidence of damage this should be retained until the equipment is checked and all accessories (see section 1) accounted for. This will assist in any claims for damages due to transit.

For initial operation and checking out, release the flaps on either side of the leather carrying case (as applicable) and pull the unit out. Discard the plastic wrapper.

2.2 Warning

The two rechargeable batteries are held in the cardboard frame surrounding the Scanlock and its leather carrying case. Never allow the battery packs to be short-circuited as they are capable of delivering very high currents which could result in fire hazard. Do not crush or incinerate the battery packs. Follow the charging procedures described in this manual.

Battery packs are supplied in a completely or nearly discharged state for safer transit. The initial charging procedure is described further on.

2.3 AC Operation

For re-charging. a battery pack or for AC operation Scanlock 2000 requires a power source of 110/120 or 220/240 VAC, 48-60 Hz, single phase. Operation of Scanlock is not possible in the fast charge mode (described further on).

2.4 AC Voltage Selection

Please refer to figure 1

CAUTION To prevent possible damage select the correct operating voltage supply. Also ensure that an adequate earth connection is provided at the power source socket.

The power input socket is above the battery door and allows operation from 110, 120, 220 or 240 VAC supplies. The setting is visible through the module window. To change, slide the fuse compartment window to the left and pull the lever marked 'Fuse Pull' and extract the fuse by fully rotating the lever to the left. Using a small pair of pliers or small screwdriver pull the printed circuit voltage selector card out and align it such that the correct operating voltage appears on the top left side. Insert the card firmly, push lever back in position and replace the fuse. The correct fuse rating for all operating is:

250. mA 1.25 inch Anti-surge

Spares are provided in the accessory kit.

The other fuses included in the kit are for internal use only and should only be used after consultation with Audiotel.

2.5 Power Cable

A three-wire power cable is supplied in accordance with international safety

standards. When correctly connected this grounds the chassis of the unit. To avoid the possibility of injury or death the chassis, via the cable supplied, must be grounded before AC power is supplied. Any extension cable or isolating transformer supply must provide a suitable earth connection.

Power cable connections are as follows:

Brown	= Live
Blue	= Neutral
Yellow/Green	= Earth or Ground

2.6 Operating Environment

The operating environment should be within the following limits:

Temperature	+5 deg C to +40 deg C
Humidity	Less than 95% relative, non-condensing

When AC power is connected it may be noticed that the panel around the power input socket or the chassis top cover may become warm. This is quite normal.

2.7 Storage and Shipment

When not in use the unit should be stored in a clean, dry environment. The permissible storage temperature range is 0 deg C to +55 deg C.

The original packing should be retained in case the unit needs to be returned to Audiotel. Before despatch of any equipment to Audiotel the Sales department must be contacted. The address, telephone, telex and fax numbers are listed at the front of this manual. If the original packing material is not available then a sturdy airfreight quality carton together with generous cushioning material must be used. The carton should be marked clearly with the destination and customer's name. 'FRAGILE' labels or markings should be attached.

Section 3

Battery Power Supply

3.1 Charging the batteries

This may be carried out after the initial operation described in section 4.

Beneath the AC input socket is the battery compartment door. Open the door by releasing the retaining screw (but do not remove completely). If no battery is present then it may be necessary to shake the door out. If a battery is present then the door is ejected. Please note, older Scanlock's have a slide door. Insert a pack in the direction indicated on the pack (battery terminals first and indication label towards the control panel of Scanlock). Push battery in slowly but firmly. If difficulty is found in inserting the battery remove the battery and re-insert.

Connect the AC power supply lead (see previous section for voltage selection and AC power lead connections). The red LED (light emitting diode) in the 'Power switch will illuminate whenever AC power is present and regardless of whether Scanlock is 'off' or 'on' . Depress the 'Charge' switch. The yellow LED above the switch will illuminate to indicate that the battery is undergoing a timed charge cycle..If the LED does not illuminate then wait 2 minutes as a completely discharged battery will initially draw so much current that the LED will not illuminate. If after this period the LED has not illuminated then re-insert battery and repeat.

The fast charge time cycle lasts approximately 7 hours. At the end of this period the charge LED will extinguish. FOR INITIAL CHARGING ONLY, repeat the cycle once only with the same pack present and without discharging the pack. Carry out this two-cycle operation for the second pack.

After initial charging of the packs the fast charge mode should only be used when a pack is completely exhausted. Repeated fast charging of packs that are not completely exhausted will reduce the capacity of the pack to retain charge.

Note: If during fast charging the timed cycle is interrupted by disengaging the AC power lead or by turning Scanlock on then the cycle internal timer is reset and a new 7-hour cycle initiated on reselection of the fast charge mode.

Whenever AC power is connected and a battery pack is present but the fast charge mode has not been selected then continuous 'trickle' charging occurs. The cells used in the battery pack are capable of withstanding over 10,000 hours of overcharge at this trickle rate at normal temperatures without damage. Complete recharging of an exhausted pack will take approximately 16 hours.

The second battery pack is stored in the compartment in the base of the leather carrying case or in the appropriate compartment in the Attache carrying case.

3.2 Memory Effects

If a Ni-Cad battery undergoes a regular charge and partial discharge cycle then 'memory' effects within the materials comprising the individual battery cells lead to reduced capacity. This process can be reversed by occasionally discharging the pack completely (leave Scanlock turned on until the green battery LED in the 'Power' switch is extinguished) and re-charging using the fast charge mode.

3.3 Long Term Discharge

The switch-on circuitry within Scanlock consumes a minute amount of current even though the Scanlock is not in use. This combined with normal self-discharge characteristics of Ni-Cad batteries will however discharge a battery over a long period. If the unit has been unused for a period of over a month the batteries should be recharged before use.

3.4 Battery Indicator

The green LED in the 'Power' switch indicates the presence and state of the battery. A steady, bright LED indicates satisfactory operation. If the LED flashed then the battery should be replaced or re-charged. If use continues then the LED will become steady again but will rapidly dim and eventually extinguish. During the flashing and later phase operation of Scanlock is not satisfactory.

Please note: It will be found that Scanlock cannot be turned off or on if the battery is too discharged. This is remedied by changing the battery or by connecting the AC supply.

Section 4

Controls, Indicators, Inputs and Outputs

4.1 Controls

All switches are momentary-contact types and are fully interlocked electronically to prevent incorrect operation. Integral LEDs (light emmitting diodes) indicate switch selection. Functions are as follows:

AM	Selects amplitude demodulation of received radio signals.
FM	Selects frequency demodulation of received radio signals.
SC	Selects Sub-carrier demodulation of received radio signals.
MC	Selects frequency demodulation of mains carrier signals. The AC power cable must be connected as signals are detected directly from the AC supply not through the antenna.
FREQ	Activates the signal reference meter. This does not indicate the frequency of the radio signal tuned to. The meter provides a correlation between signals acquired automatically and those tuned-to manually. If during automatic operation Scanlock locks to a broadcast station at a meter reading of '345' then by selecting manual tuning and adjusting the manual tune control until '345' is once again indicated on the reference meters recovers the original broadcast station. This function is particularly useful when a strong intermittent external transmission (for example, from a nearby radio taxi) causes Scanlock to automatically retune from an eavesdropping transmitter whenever the transmitter is active. During the time when this external transmitter is off the operator notes the signal reference number then selects this number under manual tuning control. The search can then continue for the eavesdropping transmitter regardless of whether the external transmitter is active or not.
M/TUNE	Selects manual control and enables the manual tune control. If manual tune has not been selected then Scanlock will automatically seek the strongest signal.
S/WAVE	Selects Soundwave operation. A 1.8 KHz tone is emitted through the loudspeaker. If this tone is detected by Scanlock in a radio transmission tuned to (either automatically or manually) then the tone is interrupted to give a 'Bleep...Bleep...Bleep...'. The loudness is independent of the volume control setting. During Soundwave operation Scanlock simultaneously checks the AM, FM and SC demodulators
LOCATE	When selected a tone is emitted from the loud speaker that varies in intensity and pitch according to the strength of

radio signals tuned to. This is used to physically locate a concealed transmitter. The closer Scanlock is to the transmitter the greater (on average) the field strength reading and hence greater intensity and higher pitch of the Locate tone.

To improve accuracy of the location procedure the antenna is progressively collapsed down as the transmitter is approached. For higher power transmitters the antenna can be removed altogether if necessary.

POWER — On/Off control.

CHARGE — Selects the fast charge mode. Cannot be selected if the unit is "ON".

VOLUME — Adjusts loudness of the internal loudspeaker and external headphones when connected.

MANUAL — Ten-turn control allowing manual selection of radio TUNE signals across the frequency range covered by Scanlock.

SQUELCH — Sets a threshold above which the strength of all the incoming radio signals will close a pair of relay contacts (see Lock Remote output below) and mute the output from the internal loudspeaker or headphones when connected. The LED above the squelch control will illuminate whenever this threshold is exceeded.

4.2 Displays

FIELD STRENGTH — The strength of any radio signal that Scanlock is tuned to whether under automatic or manual control is indicated by the 12-segment LED display. Please note: The display is not calibrated to a high level accuracy. Readings from the display are for comparative purposes only.

In early versions of Scanlock the field meter measured the total field strength in both tuning modes or was switched from total field strength to tuned signal strength upon selection of the manual tuning control.

The locate tone is an audio indication of the field strength as indicated by the display.

SIGNAL REFERENCE — Displays a numerical value associated with a signal tuned-to automatically or manually. This enables the operator to manually tune to a signal previously acquired automatically. This display does not indicate the frequency or relative frequency of any radio signal tuned to.

4.3 Inputs

ANTENNA — The front panel 'N' input socket accepts the antenna or antenna extension lead. Any other antennas or extension leads should be compatible with a 50 ohm input impedance.

AC POWER	Please refer to Section 2

4.4 Outputs

HEADPHONES	3.5 mm jack socket suitable for headphones of 8 ohms impedance or greater. CAUTION, take care when connecting headphones to ensure that the volume control is turned down to prevent damage to hearing.
RECORDER	3.5 mm jack socket for recording audio output. Output level is nominally 50 mV rms. Input impedance of recorder should be nominally 10 kOhm.
LOCK	3.5 mm jack socket for switching of external REMOTE equipment (such as the remote alarm provided) whenever the total radio field strength exceeds the threshold set by the squelch control. Relay contacts are rated at 30 VDC, 1 A maximum.
I.F. OUT	Output for connection to a spectrum analyser or to 2 MHzthe Spectrum Monitor available from Audio. Enables the operator to carry out a visual examination of signals tuned-to. Output level is nominally 50 mV rms centred on 2 MHz with a bandwidth of approximately 300 KHz.

Section 5

Basic Check-out and Familiarisation

5.1 Introduction

The following will familiarise the operator with Scanlock and will check the unit out to ensure that all controls and functions are satisfactory.

5.2 Powering Up

Connect the AC power cable, insert a battery and turn the unit on. Note that the LED in the FM switch is illuminated. Scanlock will always 'wake-up' in the automatic tune/FM demodulation mode.

Turn the squelch control fully anti-clockwise. Advance the volume control. Random noise, a 'rushing' sound, will be heard through the loudspeaker. Turn the volume control fully anti-clockwise, connect the headphones and adjust the volume control. The internal loudspeaker will be muted and the audio will be heard through the headphones. Disconnect headphones.

Automatic Tuning

Connect the antenna to the control panel input socket and extend fully. Scanlock will tune automatically to the strongest radio signal and provided that this signal is frequency modulated audio will be heard. In many cases this signal will be instantly recognisable as a radio broadcast or two-way private radio communication. A buzzing sound indicates that the signal tuned-to is from a television broadcast. If no one signal is consistently the strongest then Scanlock will rapidly transfer from one signal to the other as relative levels vary. In later Scanlocks this action will be noticeable through the field strength meter which will show the various changes in signal strength level as automatic tuning occurs. If radio signals are very weak then it is possible that random noise will be heard.

5.4. Manual Tuning

Activate the signal reference meter. Set the manual tune control fully anti-clockwise. The meter will indicate a value of between '0' and '10'. Rotate the tuning control slowly clockwise through its total range of ten turns. The display at the fully clockwise position of the tuning control indicates a value of approximately '1050'. During the tuning process many radio stations will be heard. Some will be amplitude modulated enabling the AM switch and function to be checked. An individual radio signal will be heard more than once during the tuning process, this is quite normal.

5.5 Sub-carrier Demodulator

Select sub-carrier demodulation at some point. Generally loud, random noise will be heard. As there are no legitimate sub-carrier broadcasts any intelligible audio heard will be either from break-through of an FM source or, of course, form a nearby sub-carrier eavesdropping transmitter. Breakthrough from an FM signal will be distorted and be accompanied by noise.

5.6 Soundwave

Return to automatic tuning by pressing the Manual Tune select switch (the LED when illuminated in the manual tune switch indicates that tuning is under manual control).

Select Soundwave. A tone will be heard. The intensity is independent of the volume control setting.

5.7 Locate and Remote Alarm

Select Locate. A 'ticking' sound whose intensity and pitch depends on the strength of the radio signal tuned to as indicated by the field strength meter will be heard. Collapse the antenna down and note that the pitch and intensity drop as does the field strength meter reading. The locate function enables the operator to determine the position of a hidden eavesdropping transmitter by measurement of its signal strength. On average the signal strength decreases the greater the distance between the transmitter and any measuring equipment ie, Scanlock. (The effects of walls, metallic objects and other objects prevent the steady diminishing of field strength with distance). The location of the transmitter is however, always apparent as the field strength will be maximised at this position.

Whilst locate is selected advance the squelch control clockwise until the LED above the control is extinguished, the audio output will always be muted at this point. Connect the remote alarm via the lead supplied (ensure the alarm has been fitted with the PP3 battery supplied). Rotate the squelch control anti-clockwise. The LED on the control panel will illuminate. The alarm LEDs will also illuminate and the beeper will be heard depending on the position of the toggle switch on the panel of the alarm. Collapse the antenna down. Advance the squelch control clockwise and note that the threshold to de-activate the alarm etc is less than that with the antenna fully extended. When the antenna is collapsed it operates at lower efficiency in the frequency band of radio signals that normally contribute most to the total field strength of signals at a given location.

5.8 Mains Carrier

Select mains carrier operation. The signal reference and field strength displays and the LED above the squelch control will immediately extinguish. These displays are not relevant to mains carrier operation in Scanlock.

Depending on the level of mains-borne noise a buzz or hum will be heard. If an office wireless intercom is in use then the audio will be heard from that. Select Soundwave. It may be noticed that sound-wave when used in conjunction with mains carrier is quite quiet, this is normal. In the presence of a mains carrier eavesdropping transmitter the sound-wave tone will operate at normal volume.

During mains carrier operation it is immaterial whether the antenna is connected or not. Signals are picked up directly from the AC power cable.

5.9 Any Problems?

If during the above routine Scanlock does not behave in the manner described re-check the operating procedures. If it appears that the unit is faulty contact Audiotel or your local supplier first. State the fault and await the response from Audiotel or the supplier. Do not send the unit back until instructed to by Audiotel or your local supplier.

Section 6

General Search Procedures

6.1 Introduction

As described in earlier sections Scanlock has various facilities for detection, indentification and location of an eavesdropping transmitter. Used carefully and with consideration any transmitter within the operational capability of Scanlock will be found.

There are occasions where speed of search is more important than a higher level of protection or where an operator unfamiliar with eavesdropping transmitters and their detection is required to carry out a search.

An additional consideration is whether it is desirable to prevent the eavesdropper from knowing that a search is under way and that the eavesdropping transmitter has been located.

Four methods are described. In each method it is essential that the countermeasures search is carried out in a methodical and detailed fashion. A rushed search can give a false sense of security.

THE METHODS DESCRIBED ARE LISTED IN INCREASING ORDER OF THE LEVEL OF PROTECTION GIVEN. METHOD 4 IS THE MOST EFFECTIVE BUT IS THE MOST TIME CONSUMING TO IMPLEMENT. METHOD 1 GIVES THE LOWEST LEVEL OF PROTECTION BUT IS THE QUICKEST TO IMPLEMENT.

Important! There may be more than one transmitter present. After locating and deactivating or isolating the first repeat the search procedure.

Each method is divided into two sections describing the search for radio transmitters and the search for mains carrier devices.

Note. The squelch control is set to '0' when carrying out the following procedures. With greater familiarity the control can be used to good effect - see the additional operating notes at the end of this section.

6.2 Method 1. Fast Search - Normal

Automatic tuning is used in conjunction with Soundwave to give the fastest search method possible. During the search Scanlock simultaneously checks AM, FM, and SC (Sub-carrier) transmissions across its entire frequency range. That is from 10 MHz to over 1.8 GHz. Direct listening for room audio is only used if Soundwave gives a positive response.

Radio Transmitters.

Step 1: Attach antenna via the extension lead and fully extend.

Step 2: Select automatic tuning and Soundwave.

Step 3: Move about the area under search in such a way as to minimise the distance between Scanlock and any potential transmitter. All parts of the area under search should be checked. Do not assume that because a corner or cupboard is difficult to reach that a transmitter will not be concealed there.

If the sound-wave tone is interrupted stop moving and check over the area just covered. An occasional interruption of the Soundwave tone is normal, a continuous interruption resulting in 'Bleep...Bleep...Bleep' is very strong evidence of a transmitter.

Step 4: With a positive interruption of the Soundwave tone select FM and listen for room audio. Advance the volume control to encourage audio feedback from the transmitter to Scanlock. Select SC or AM if FM does not yield results. Use headphones if background room noises prevent feedback to listen for room audio in the transmission detected.

Step 5: When a transmitter has been detected and identified select Locate and adjust the volume control for comfortable listening. Move Scanlock and its antenna about the area in the direction of increasing field strength and hence increasing intensity and pitch of the locate tone. Progressively collapse the antenna down to decrease the sensitivity of Scanlock until the locate tone rises sharply in intensity and pitch when the antenna is passed over a small localised area. This will be the location of the transmitter. If necessary remove the antenna to provide better location.

By collapsing the antenna down (or by removing it) and finding the position within the area under search that gives a high field strength reading helps eliminate 'false' positions within the area. Reflections within the structure of a building gives rise to peaks and dips in the field strength of radio signals. However, with the antenna set to lower sensitivity only a location at the site of the transmitter's antenna will be identified. Do not immediately collapse the antenna down as the transmitter's location is approached, this may cause the signal to be lost.

Mains Carrier Transmitters

Step 6: Connect Scanlock to an AC power point via the AC power cable. Select MC (Mains Carrier) and Soundwave and listen for continuous interruption of the tone.

Step 7: Connect Scanlock to each power point in turn (this is necessary in case different power points are connected to different supply phases. During connection to each point ensure that any electrical items such as televisions or lamps are connected as these could contain a mains carriertransmitter. Turn light switches on to activate any switched transmitters connected to the lighting circuits. Connect Scanlock to the lighting circuits via suitable light socket adaptors.

Step 8: If soundwave gives a positive indication then turn Soundwave off (press S/Wave) and listen directly for room audio.

Step 9: If the location of the mains carrier transmitter is not obvious from the characteristics of the sounds heard through Scanlock then selectively disconnect electrical items (eg, television, lamps, extension plug assemblies) and turn light switches to off. If this does not help then move a sound source (a colleague talking or some tape recorded music etc.) around the room until it is

obvious that the sound source is near the microphone of the transmitter.

Notes:

Higher power transmitters with good audio pick-up will give a positive Soundwave indication over a wide area, that is, at appreciable distances from the transmitter location. In this case collapse the antenna down to about half its length (or shorter if necessary) to reduce the sensitivity of Scanlock. This allows easier localisation of the transmitter.

In very unusual circumstances certain types of radio transmission from external sources will cause Soundwave to be continuously interrupted as if an eavesdropping transmitter had been detected. Selection of FM, SC or AM enables the operator to listen to the transmission and confirm whether the transmission is from an external source.

6.3 Method 2: Fast Search - Silent

This method differs from the above in that the intention is not to alert the eavesdropper that a countermeasures search is under way. For this reason Soundwave is not used. Headphones are worn at all times and the three demodulators are selected in turn. The operator moves about the area listening for room audio via Scanlock. An innocuous sound source, such as a colleague talking or a tape recording is used to provide a reasonable level of room audio.

Radio Transmitters

Step 1: Attach antenna via the extension lead and fully extend

Step 2: Connect headphones and adjust volume control for comfortable listening.

Step 3: Select FM

Step 4: Move about the area under search in such a way as to minimise the distance between Scanlock and any potential transmitter.

Step 5: Repeat Step 4 but with SC selected.

Step 6: Repeat Step 4 but with AM selected.

If during steps 4, 5 or 6 room audio is heard through the headphones then a transmitter is present in the area under search.

Step 7: After a transmitter has been detected and identified select Locate, collapse the antenna down to reduce sensitivity as necessary and locate transmitter.(see step 5 in method 1 above for a full description). Take care when approaching the transmitter site to prevent the eavesdropper from hearing the search taking place.

Mains Carrier Transmitters.

Step 8: Connect Scanlock to an AC power cable. Select MC (Mains Carrier) and listen via the headphones for room audio.

Step 9: Connect Scanlock to each power point in the area in turn (this is necessary in case different power points are connected to different

supply phases). Ensure that any electrical items such as televisions or lamps are connected as these could contain a mains carrier transmitter. Turn light switches on to activate any switched transmitters connected to the lighting circuits. Connect Scanlock to the lighting circuits via suitable light socket adaptor.

Step 10: If room audio is heard via Scanlock and the location of the transmitter is not obvious from the characteristics of the sounds heard then selectively disconnect electrical items (television etc.) and turn light switches to off. If this does not help then move the sound source around the area until it obvious that the sound source is near the transmitter.

6.4 Method 3. High Level Search - Normal

In addition to automatic tuning the manual tuning mode is selected. The sensitivity of Scanlock is better under manual control and so enables weaker signals to be detected. Manual tuning is also required where there are very strong transmissions from legitimate sources such as television broadcast stations. In the presence of very strong background signals the effectiveness of a search using automatic tuning is reduced since Scanlock's antenna must be much closer to any potential transmitter within the area under search.

Method 3 described the procedure where alerting the eaves dropper is unimportant. As with method 1 above Soundwave is used. Direct listening is only required to confirm a positive indication from Soundwave.

Step 1: Repeat Method 1 above from steps 1 to 5 inclusive. This allows rapid removal of 'easily' found devices.

After step 1 Scanlock is placed at a central point within the area (if it is a large area then 2 or more locations are chosen in turn) and the antenna connected directly to Scanlock and fully extended.

Step 2: Select Manual Tuning (M/Tune). Turn reference meter on (Freq) and select Soundwave. Starting at the extreme anticlockwise position (meter reads around 0 to 10), SLOWLY rotate the tuning control clockwise through its range of ten revolutions. The meter will read over '1000', typically '1050'. Take particular care when the field strength meters indicates a higher reading.

Step 3: If the Soundwave tone is interrupted at any point carefully retune about this position of the tuning control. An occasional interruption is normal and does not indicate the presence of a transmitter within the area.

Step 4: With a positive interruption of the Soundwave tone note the reference meter reading and select FM. Listen for room audio. Advance the volume control to encourage direct feedback from the transmitter to Scanlock. Use the headphones if necessary to aid direct listening. Some minor adjustment of the manual tuning control may be necessary to improve reception.

Step 5: With the transmitter detected and identified through steps 3 and 4 above select Locate. Adjust the manual tuning control about the initial position as necessary. Attach the antenna via the extension lead and move about the room in the direction which increases the locate tone

pitch and tone. Progressively collapse the antenna down as described in step 5 Method 1 above.

Mains Carrier Transmitters

Repeat Method 1, steps 6 to 9 inclusive above.

6.5 Method 4. Higher Level Search - Silent

As described in Method 2 above headphones are used at all times and Soundwave is not used as this would reveal that countermeasures are in use to the eavesdropper.

Step 1: Repeat Method 2 steps 1 to 7 inclusive above. This allows fast removal of 'easily' found devices.

After step 1 Scanlock is placed at a central point within the area (if it is a large area then two or more locations are chosen in turn) and the antenna connected directly to Scanlock and fully extended.

Step 2: Connect headphones and adjust volume control to suit. Select manual tuning (M/Tune). Turn the reference meter on (Freq) and select FM. Starting at the extreme anticlockwise position (meter reads from '0' to'10'), SLOWLY rotate the tuning control clockwise through its range of ten revolutions. The meter will read over '1000', typically '1050'. Using the innocuous sound source listen for any room audio via Scanlock.

Step 3: If room audio is heard directly connect the antenna via the extension lead. Select locate and adjust tuning control as necessary to maximise the field strength meter reading and hence the locate tone pitch and intensity. Move Scanlock and the antenna about the area. Progressively collapse the antenna to provide better localisation of the transmitter (see step 5 method 1 above).

Mains Carrier Transmitters

Repeat Method 2 above, steps 8 to 10 inclusive.

6.6 Notes

Use of the squelch control.
During an automatic search or during the location process (whether in the automatic or manual mode) the operator may find the continual presence of audio (whether a locate or soundwave tone for example) very tiring. The squelch control mutes the audio output whenever the total field of radio signals present at Scanlock's antenna is less than the threshold set by the squelch control. If the squelch control is advanced fully clockwise for example then Scanlock would need to be very near to a transmitter in order that this threshold is exceeded and thus the audio output restored. As the field strength is on average greater nearest to a transmitter then the squelch control can be progressively advanced to limit the audio output during a search.

The Squelch control should be set to '0' during manual tuning whenever AM, FM, SC or soundwave have been selected.

A certain class of transmitter (those with low deviation or modulation levels) is more readily detectable by direct listening. Soudwave is less effective in these circumstances.

Section 7

Introduction to Transmitter Types

7.1 Introduction

The following gives a brief survey of transmitter types. The basic operating parameters of each type should be remembered whilst carrying out countermeasures. For example, VOX (voice activated) transmitters require a suitable level of audio before they are detectable through their transmissions. Therefore during a silent search the innocuous background audio must be sufficiently loud to activate such devices (if it does not then the transmitter will be worthless under normal conditions).

In Section 8 of this manual the operating procedures for Scanlock to give protection against remotely-controlled or hand-carried transmitters is described.

7.2 Remote Microphone

Normally the microphone used to pick up room sounds is either built into the transmitter or connected by a short length (say up to one metre) of cable. A transmitter may, however, be separated from its microphone by a considerable length of cable. This gives the eavesdropper some advantages. A bulky transmitter could be placed outside the sensitive area likely to be searched to reduce the chances of detection. Alternately, the transmitter may be sited such as to improve its antenna and thus transmission characteristics to give greater range. The concealment of the microphone connecting cable does raise problems for the eavesdropper however.

It is essential that adjoining rooms to the sensitive area are checked. It must be remembered that Soundwave will not be effective in these cases as it is unlikely that Scanlock will acquire the signal from the relatively distant transmitter when used in the sensitive area. When checking the adjoining areas it is also unlikely that the microphone will pick-up the soundwave tone. Therefore Methods 2 or 4 using direct listening as described in section 6 are employed.

7.3 VOX (Voice Activated) Transmitter

As described in the introduction to this section this type of transmitter will only be active when there is sufficient audio activity in the sensitive area. Use of soundwave or a sufficiently loud innocuous sound source will activate such devices enabling their detection by Scanlock.

7.4 Telephone Transmitters

These devices are active only when a telephone is in use. Dial a colleague (who is aware that countermeasures are in use) to activate any devices. If possible conduct a search with Scanlock as near to the telephone cables as possible. They should be followed to their exit from the building as a device may be connected at any point along the telephone line.

7.5 Remotely Controlled Transmitters

These are sophisticated devices that combine an eavesdropping transmitter with a receiver. On a command transmitted by the eavesdropper the receiver turns the transmitter on and off a necessary. This has two advantages. Firstly power is not wasted in transmitting when there is nothing worth listening to in the area of interest and secondly, the transmitter can be de-activated whilst a countermeasures

search is under way. Since the transmitter will be active during a sensitive meeting then use of Scanlock at this time will give protection. Please refer to Section 8.

7.6 Bodyworn Transmitter

These are often larger than conventional eavesdropping transmitters but can be of extremely high quality and have high power output. Worn under clothing the transmitter's microphone is quite capable of picking up room conversation. Please refer to Section 8.

7.7 Briefcase Transmitter

An attache case brought into a meeting or conveniently left behind after a meeting can conceal an eavesdropping transmitter. Please refer to Section 8.

7.8 AC Powered Transmitter

Most devices are battery powered and allow simple installation into a room (and as such they present the greatest threat). These should not be confused with mains carrier devices. Transmission to the distant receiver is through an antenna which may be seperate or may be the AC power cable earth wire. During the search for radio transmitters ensure that all electrical fittings within the area (eg television, desk lamps) are connected to the AC supply to activate such devices.

Section 8

Continuous protection Against Eavesdropping Devices

8.1 Introduction

The precious hours taken to carry out a search for eavesdropping devices may be wasted if during a subsequent sensitive meeting a transmitter is remotely activated or carried into the meeting by hand or attache case.

Scanlock will give protection against such devices.

It is preferable if Scanlock and its antenna are placed within the sensitive area during the meeting. This is often impractical and so a location adjoining the sensitive area is chosen. If possible an extension lead (available form Audiotel) is used to place the antenna discreetly within the sensitive area.

8.2 Manual Tune Check

This is the prefered method of providing continuous protection if it is not possible to place the unit or the antenna in the sensitive area.

The operator selects FM and tunes slowly through the manual tuning range listening for any audio that originates from the sensitive area. This is repeated for SC and AM in turn. This procedure should be repeated at intervals throughout the duration of the sensitive meeting.

8.3 Automatic Tune Check

The operator connects the remote alarm provided in the Scanlock kit to the 'Lock Remote' socket above the squelch control. Before the meeting starts (and preferraeably immediately after the area has been checked) the squelch control is advanced until the audio is muted and the Squelch LED is extinguished. The toggle switch is set to give a silent or audible alarm. If the radio field strength subsequently exceeds the squelch threshold then the alarm will be triggered alerting the operator.

Using direct listening the operator confirms whether the new signal is from a recently activated transmitter or from an intermittant legitmate source such as a taxi passing close by.

Section 9

Scanlock Operating Principles

9.1 Signal Conversion in Conventional Receivers

In a conventional superhetrodyne radio receiver signals from the antenna are filtered (pre-selected) and then mixed with the output from the receiver's local oscillator. The output from the local oscillator is (ideally) a single frequency which is greater or less than the frquency of the wanted (channel) signal by a fixed amount which is equal to the first intermediate frequency (or IF). Mixing produces signals which have frequencies equal to the sum and difference frequencies of the original input from the antenna and the local oscillator.

A selective bandpass filter centred on the first IF of the receiver passes the wanted signal for further processing (often to a second IF stage).

In VHF equipment used for mobile radio IF frequencies are 10.7 MHz and 21.4 MHz, a typical second IF frequency is 455 KHz.

After down-conversion to frequencies which are readily processed the channel signal passes to the demodulator for recovery of the information associated with the channel transmission. Normally this means recovering audio (ie, speech) which is passed to an amplifier and loudspeaker or other output stage.

9.2 Signal Conversion in Scanlock

The local oscillator in Scanlock is tunable across the frequency range 10 to 20 MHz (approximately). Tuning is either automatic or manual through the operator's control panel. The output is passed to a harmonic generator which produces multiples of the original frequency. For example, if the local oscillator is set at 15 MHz then the output from the harmonic generator is 15, 30, 45, 60 MHz and so on.

Signals from the antenna pass directly to the mixer, no preselection (except rejection of signals below 10 MHz) occurs.

It can be seen that any incoming signal will produce a mixer product that has a frequency of between 0 and 10 MHz. Thus the radio spectrum from 10 MHz to above 2 GHz is, in essence, compressed into bands ranging from 0 to 10 MHz.

9.3 Signal Selection - 2 MHz IF

0 -10 MHz is the first IF of Scanlock. The second IF is 2MHz.

A bandpass filter centred on 2 MHz selects signals for further processing and eventual demodulation. The output of the 2 MHz filter is available through a socket on the control panel for connection to an external spectrum analyser (such as the Audiotel SM1 Spectrum Monitor) for detailed signal analysis.

9.4 Automatic Tuning

In its automatic mode of operation Scanlock continuously scans the compressed spectrum (0 - 10 MHz) for the strongest signal. On selection of a signal that is significantly stronger than the remainder the local oscillator is automatically adjusted to ensure that the different product between the relevant harmonic of the local oscillator and the original frequency of the strongest signal is centred on 2 MHz.

9.5 Manual Tuning

In the manual tuning mode the frequency of the local oscillator is adjusted by the operator through the control panel.

It is seen that as the local oscillator is tuned through its entire range then every frequency within the operating bandwidth of Scanlock will produce at least one down-converted product centred on 2 MHz.

A given signal will (depending on its frequency) be down-converted to 2 MHz more than once as the local oscillator is tuned through its range. Thus as the manual tuning control is advanced a given rado station will be heard more than once.

9.6 Signal Reference Meter

The meter on the front panel displays the local oscillator control voltage. In both manual and automatic tuning modes a given signal, for example, a radio station, will be tuned into 2 MHz at several values of the meter. A radio station may be heard at 158, 342, 612 etc.

It is apparent that as it is not known which harmonic of the local oscillator is responsible for down-converting the original signal the meter does not display a value that is directly related to the frequency of the original signal. It is not practical to display the frequency of any incoming signal with Scanlock.

9.7 Bandwidth of the 2 MHz IF Filter

The second IF in Scanlock has a bandwidth of approximately 300 KHz to facilitate automatic tuning and to allow reception of wide deviation transmitters used for eavesdropping purposes (for example, some Sub-carrier types).

One consequence of this is that narrow-band devices, whilst readily detectable with Scanlock in both automatic and manual tuning modes, give lower audio outputs from the relevant demodulator.

The agc output from the 2 MHz IF drives the field strength meter and the locate tone. Thus the field meter gives relative measurements of the strength of signals tuned to.

9.8 Demodulators

After selection by the 2 MHz IF the tuned-to signal is simultaneously presented to the three demodulators within Scanlock. Selection by the operator of the relevant control panel switch feeds the appropriate demodulated output to the audio amplifier.

9.9 Soundwave

On selection of the Soundwave mode the three outputs from the demodulators are fed into the Soundwave circuitry. Noise is filtered and amplified to produce a miximum volume tone centred on 1.8 KHz. If this tone is detected at a high enough level from anyone of the demodulators then the tone is interrupted to alert the operator that an audio feedback loop has been detected between Scanlock and a tuned-to transmitter within listening range.

It is clear from the description above that Soundwave will be most effective in detecting transmitters that have good audio sensitivity and wide deviation. Narrowband transmitters are detectable less readilly with Scanlock using Soundwave. Direct listening can be more effective by selection of the appropriate demodulator.

9.10 Mains Carrier Detection

With the exception of the demodulators and the Soundwave facility none of the above signal processing technique applies to the detection of mains carrier devices by Scanlock.

A wide band detector is connected via the AC power cable to the power circuitry to be checked. The soundwave mode can be selected to give positive confirmation that a mains carrier transmitter is within listening distance of Scanlock. Signal acquisition is automatic and frequency demodulation is used to recover audio.

9.11 Frequency Coverage

The frequency of Scanlock is as follows:

Radio	10 MHz - above 2 GHz
Mains Carrier	25 KHz - 260 KHz

There is no radio coverage (even at a reduced level of performance) between 0 and 10 MHz.

Radio Coverage

Technically, eavesdropping devices can be manufactured for operation between 0 and 10 MHz and above, say 4 GHz (a sensible upper limit for the operating range of Scanlock). However, the wide availability of receivers for operation between 0 and 30 MHz (many commercial stations operate from 200 MHz upwards) make the use of eavesdropping devices below 30 MHz very risky since they may be detected by readilly available receivers. Additionally there are some technical problems (not insurmountable) in the manufacture of miniature transmitters below 10 MHz. Audiotel are not aware at the present time of any eavesdropping radio transmitters operating below 30 MHz (mains carrier devices are omitted for the purposes of this discussion).

At the other frequency extreme the engineering problems associated with a miniature microwave transmitter are greater. Additionally, transmitters are generally less efficient at these frequencies resulting in poor battery life or the need for a large capacity or AC power supply. Propagation characteristics make use of microwave transmitters difficult in some circumstances.

Mains Carrier

Mains Carrier devices are radio transmitters operating at frequencies suited to the direct transmission of the signal along a pair of cables in preference to radiating into the surrounding space under given conditions. As the frequency of the transmitter rises the amount of radiation increases as the transmission medium (the AC power cable) begins to act like an antenna. Any device operating above 200 KHz is detectable by a commercial Long Wave radio.

9.12 An Effective Approach To Countermeasures

Counter-surveillance measures are a necessary compromise between the level of protection offered by the equipment, its complexity of operation, and its size, portability, servicability and cost.

Clearly, complex equipment requires skilled operators. Due to this necessity, protection for a sensitive area is not available on a day-to-day basis simply because

the skilled operators are required elsewhere with the countermeasures equipment.

Complex equipment in the hands of unskilled personnel negates its effectiveness leading to a false sense of security.

Scanlock gives an excellent countermeasures facility that detects the bulk of eavesdropping transmitters, in a form that is simple to implement on a day-to-day basis at a cost which allows the extension of protection to many areas through the purchase of more than one unit.

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