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SUPERBROOM PLUS TA

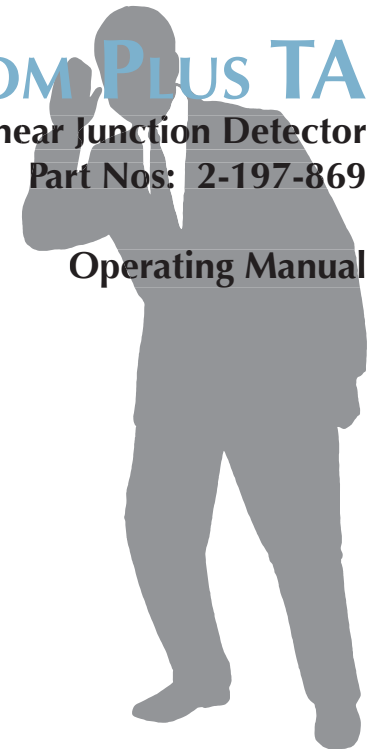
Non-Linear Junction Detector

Part Nos: 2-197-869

Operating Manual

SuperBroom Plus TA Operating Manual - Part No: 2-197-871

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APPENDIX D TECHNICAL SPECIFICATION

TRANSMITTER SECTION

Frequency	869.4MHz - 869.65MHz
Channel Spacing	12.5KHz
Hop Rate	1Min per channel
Power	EU Low - up to +13dBm EU High - up to +27dBm Non EU - up to +33dBm
Output Filter	High order combline bandpass filter, 2nd and 3rd harmonic rejection >125dB

RECEIVE SECTION

Filtering	High order coaxial bandpass filter.
Frequency	1738.825 - 1739.275 MHz and 2608.2375 - 2608.9125 MHz
IF	21.4MHz and 455KHz dual conversion, FM and AM demodulation.
Sensitivity	-130dBm for visible RSSI LCD bargraph indication -130dBm for audible Geiger click indication.

SWEEP ANTENNA HEAD

Antenna	Linear polarised transmit antenna. Microstrip circularly polarised receive antennas. (Circularly polarised receive antennas respond to cross-polarised signals)
Head Display	16-segment LED bargraph for signal strength (4-bit resolution). LED display for power output and other status information.

OUTPUT

Audio	Through internal switched loudspeaker or headphones for : Signal strength given by Geiger type click or Receiver demodulated output.
Output	Maximum 1.8V p/p into 8ohms.
Displays	Signal strength LCD bargraph (7-bit resolution) Selected function LEDs

POWER REQUIREMENTS

Battery	Internal Li-Ion rechargeable battery provides between 3 and 20 hours of operation dependent on transmit power.
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APPENDIX C – TX, RX1 & RX2 FREQUENCY PLAN

Channel No	TX Freq in MHz	RX1 Freq in MHz	RX2 Freq in MHz
1	869.4125	1738.8250	2608.2375
2	869.4250	1738.8500	2608.2750
3	869.4375	1738.8750	2608.3215
4	869.4500	1738.9000	2608.3500
5	869.4625	1738.9250	2608.3875
6	869.4750	1738.9500	2608.4250
7	869.4875	1738.9750	2608.4625
8	869.5000	1739.0000	2608.5000
9	869.5125	1739.0250	2608.5375
10	869.5250	1739.0500	2608.5750
11	869.5375	1739.0750	2608.6125
12	869.5500	1739.1000	2608.6500
13	869.5625	1739.1250	2608.6875
14	869.5750	1739.1500	2608.7250
15	869.5875	1739.1750	2608.7625
16	869.6000	1739.2000	2608.8000
17	869.6125	1739.2250	2608.8375

Contents

CE MARK EMC COMPLIANCE, RADIO TYPE APPROVAL AND LOW VOLTAGE DIRECTIVE	1
SETTING UP	2
WHAT YOU SHOULD HAVE	2
IMPORTANT SAFETY INFORMATION	2
ENVIRONMENTAL CONDITIONS	4
POWER REQUIREMENTS	4
CONTROLS & INDICATORS.....	8
FRONT PANEL CONTROLS	8
THE ANTENNA HEAD DISPLAY	13
FRONT PANEL LCD DISPLAY	14
OPERATION	16
BASIC DESCRIPTION	16
FREQUENCY HOPPING MODE.....	16
POWER MODE.....	16
MANUAL MODE	17
INITIAL SEARCH TECHNIQUE	17
PRACTICAL CONSIDERATIONS - INNOCENT ELECTRONIC ITEMS.....	19
PRACTICAL CONSIDERATIONS - METAL JUNCTIONS.....	20
THEORY OF OPERATION - HARMONIC RADAR.....	21
PRINCIPLE OF OPERATION.....	21
THE NON-LINEAR JUNCTION	21
SUPERBROOM HARMONIC RADAR.....	22
APPENDIX A - OPTIONAL ACCESSORIES	24
APPENDIX B – TRANSMITTER POWER V INDICATED LEVEL....	25
APPENDIX C – TX, RX1 & RX2 FREQUENCY PLAN	26
APPENDIX D TECHNICAL SPECIFICATION.....	27



MN400533 iss. I



EC Declaration of Conformity to R&TTE Directive 1999/5/EC

Manufacturer: Audiotel International Ltd.
Corby Road, Weldon, CORBY, Northamptonshire, NN17 3AR

Representative: N/A. TCF resides with manufacturer as above
(residing in the EC holding the TCF)

DESCRIPTION OF EQUIPMENT:

Product: SuperBroom Plus TA

Model Number(s): 2-197-869

Variants include:

Rating: 7.2V @ 2.5A internal Lithium Ion battery. External AC/DC Battery charging adaptor input, 100 - 240Vac $\pm 10\%$, 47-63Hz, 0.5A @ 230Vac (1A max @ 100V) when using universal input power supply supplied.

Product covered: Production serial numbers from: 012896-01 (Nov 2001)

DECLARATION

We declare, under our sole responsibility, that the products identified in this declaration, and to which this declaration relates, conform to all the applicable requirements of EU Directive 1999/5/EC and is CE-marked accordingly:

Article 3.1 a: BS EN 60950:2000 used to show compliance with the *Low Voltage Directive 73/23/EEC as amended by 93/68/EEC*.

Article 3.1 b: EN 300 220-1 V1.2.1 (1997-11), ETS 300 683 (June 1997) used to show compliance with the *EMC Directive 89/336/EEC as amended by 92/31/EEC*.

Conformity was assessed using a Technical Construction File
No: MN400533 Issue: I

THE AUTHORISED SIGNATORY TO THIS DECLARATION, ON BEHALF OF THE MANUFACTURER, IS IDENTIFIED BELOW:

Name: I. Roberts

Position/Title: Technical Director

Signature:

APPENDIX B – TRANSMITTER POWER V INDICATED LEVEL.

H = 4W

h = 2W

9 = 1W

8 = 500mW EU High

7 = 250mW

6 = 125mW

5 = 100mW

4 = 50mW

3 = 20mW EU Low

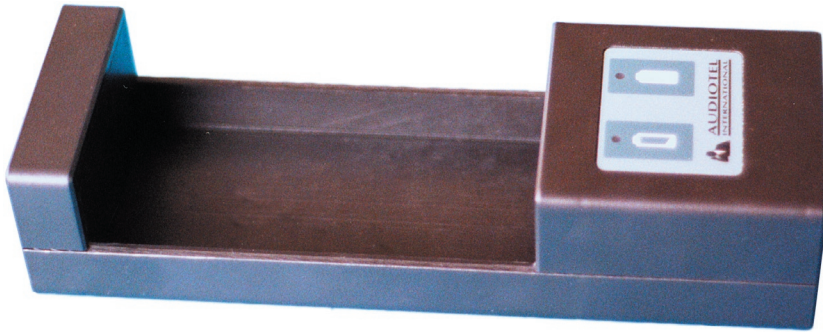
2 = 10mW

1 = 1mW

L = 6uW



APPENDIX A - OPTIONAL ACCESSORIES



STAND ALONE LITHIUM ION BATTERY CHARGER

- Charges SuperBroom Li-ion battery packs only.
- 16 hr charge time for complete recharge.
- Uses external AC/DC Adaptor as supplier with SuperBroom.
- LED indicators showing battery charge status.
- Fits in SuperBroom carry case.
- Recommended with additional battery pack to allow extended use of SuperBroom unit.

CE MARK EMC COMPLIANCE, RADIO TYPE APPROVAL AND LOW VOLTAGE DIRECTIVE

The CE mark is affixed to the Super Broom Unit, to confirm compliance with the following European Community Directives:

Council Directive 1995/5/EC on the approximation of Laws of Member States relating to Radio and Telecommunications Terminal Equipment

and the following LVD, EMC and Radio Type Approval standards:

EN 60950:2000

EN 300 220-1 (1997-11)

ETS 300 683 (June 1997)

UK Air interface 2030 V1.1



SETTING UP

This Section Covers the contents list for your SuperBroom, important safety information and charging the unit ready for operation.

WHAT YOU SHOULD HAVE

SuperBroom is supplied as a ready-to-use kit. You should have the following items:

- SuperBroom Main Unit Assembly
- Universal AC/DC Adaptor
- AC Power Lead
- Headphones
- Carrying Case
- Operating Manual
- Test Target (an electronic Component embedded in a clear plastic puck)

If any item is missing or damaged contact us or your local agent immediately for advice.

IMPORTANT SAFETY INFORMATION

SUPER BROOM USES A LITHIUM-ION BATTERY PACK

CAUTION *Danger, risk of explosion if battery packs are tampered with, misused or abused. Replace and use only those battery packs supplied by Audiotel International Ltd.*

Do not open, puncture, drop, crush or tamper with battery packs

Do not short circuit the battery packs

Do not incinerate or subject battery packs to excessive heat



The harmonic signals produced are detected by the two receivers in SuperBroom and their respective signal strengths displayed.

Because SuperBroom has receivers for both second and third harmonics, and because electronic and metal non-linear junctions give differing returns, SuperBroom is able to provide the user with discrimination between electronic devices and non-electronic, metallic artefacts.

Although the main application of SuperBroom is the detection of electronic devices, this principle is employed in some equipment to detect concealed man-made metallic artefacts.

This method of detection is termed 'Harmonic Radar'.

In conventional Radar a radio signal is emitted which is reflected off a target to produce an echo at the same frequency. SuperBroom's method of operation is to detect echoes at harmonics of the signal emitted.

Some users refer to a Harmonic Radar as a 'Non-linear Junction Detector'.



Non-linear junctions can also be formed when two metal objects are in contact due to complex chemical behaviour at the junction of the objects.

SUPERBROOM HARMONIC RADAR

The signal generated by SuperBroom is a spectrally pure radio signal within the frequency band of 869.4 – 869.65 MHz (There are 19 frequency channels of which only the 10 optimum channels, selected during SuperBrooms's start up self-check procedure, are used at any time). Any non-linear junction within range re-radiates the radio energy at harmonic frequencies of the incident signal. In this case the frequencies produced are:

1738.825 – 1739.275 MHz - usually termed the 'second harmonic'

2608.2375 – 2608.9125 MHz - usually termed the 'third harmonic'

and so on. A complete frequency plan is given in appendix C.

The nature of the non-linear junctions within **electronic components** is such that the strongest harmonic produced is usually the **second harmonic**, with the third harmonic usually appreciably weaker. Other harmonics are usually very weak.

In contrast to this the nature of the non-linear junctions between **metal objects** are such that the strongest harmonic produced is usually the **third harmonic**, with the second harmonic usually appreciably weaker (but may be roughly equal in some situations). Other harmonics are usually very weak.

Spent battery packs should be returned to Audiotel International Ltd. Do not use the AC Power Lead or AC/DC Adaptor if:

- The AC Power Lead cable or its plugs become frayed or otherwise damaged
- The AC/DC Adaptor casing is cracked or otherwise damaged
- The AC Power Lead or AC/DC Adaptor are exposed to rain, liquids or excessive moisture

The AC Adaptor should only be used in controlled office environments with a maximum ambient temperature of 35° Centigrade and Relative Humidity of 85%.

Do not use the SuperBroom if:

- The SuperBroom unit is exposed to rain or other excess moisture
- The unit has been damaged
- You suspect the unit requires servicing

You should take the following precautions.

- Do not point the antenna at a person's eyes or head
- Do not leave the antenna in close proximity to any part of the body for prolonged periods.
- Do not use near inflammable fluids or explosives or in any area where the use of radio communications equipment is prohibited
- Do not use in close proximity to any person fitted with a heart pacemaker or any other life support system
- Switch off SuperBroom when not in use, this minimises exposure to RF energy and prolongs battery life.

SuperBroom may interfere with operation of some electrical equipment.



ENVIRONMENTAL CONDITIONS

The Super Broom has been designed to operate within the following conditions:

Temperature conditions of +5°C to +35°C (The LCD may slow down at +5°C.)

POWER REQUIREMENTS

SuperBroom only operates powered by its internal battery pack. The external AC/DC Adaptor is used to recharge the battery only and cannot be used to directly power SuperBroom.

BATTERY

The internal rechargeable Lithium Ion battery pack gives 3-20 hours continuous use (dependent on the power output setting). The battery will need to be recharged when the front panel LCD display shows approximately 6.5 V. The battery is automatically recharged when external power is applied to the SuperBroom via the external AC/DC Adaptor. Internal protection circuitry protects the battery. If for any reason the battery suffers any transient fault such as short-circuit, overcharging or deep discharge, the pack will shutdown. It will remain in this state until recharged by connection of the external AC/DC Adaptor.

If the SuperBroom is left switched on, as the battery power level falls, the following sequence of events will eventually occur:

- 1 SuperBroom enters a reset state, this is indicated by all 6 LEDs on the left-hand side of the front panel illuminating.
- 2 The battery pack protection circuitry will shut down the battery pack. All signs of life will be absent.



THEORY OF OPERATION - HARMONIC RADAR

This section is intended to explain how SuperBroom detects electronic devices and why it has two receivers. Understanding this theory is not essential to operation of SuperBroom but should help users perform a faster sweep and be more appreciative of operation.

PRINCIPLE OF OPERATION

SuperBroom detects electronic Components that are:

Diodes

or Transistors

or Integrated Circuits

These components are used to make electronic devices (together with other components such as resistors and capacitors, for example). SuperBroom can detect electronic devices regardless of whether the device is powered or operational although this may affect how well it can be detected from a given distance.

SuperBroom does not react to resistors, capacitors, transformers, batteries and other components that do not contain diode- or transistor-like materials.

SuperBroom does not detect metal objects except when metallic semi-conducting junctions are formed - this is explained below.

THE NON-LINEAR JUNCTION

Distortion of a signal results in generation of harmonics of the incident signal. Higher frequencies are produced which are a whole number multiples (integer multiples) - termed 'harmonics' - of the incident signal.



PRACTICAL CONSIDERATIONS - METAL JUNCTIONS

Although metal junctions usually result in stronger third harmonic and weaker second harmonic return signals a particular metallic junction may give an 'electronic Component' like return.

Metallic junctions are often very sensitive to vibration and this vibration can be heard if LISTEN is selected (also select '2nd') and the area tapped with a rubber faced hammer or other object that will not cause material damage.

A box of paper clips is a good example of a metallic target and experimentation will demonstrate the value of LISTEN.

At any time during or after the above sequence attaching the unit to an external power supply via the external AC/DC Adaptor will start to recharge the SuperBroom battery pack.

WARNING *Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type recommended by the manufacturer. Dispose of batteries according to the manufacturer's instructions.*

CHARGING THE BATTERY

SuperBroom is designed to automatically enter a dormant state when power is applied via the external AC/DC adaptor, (positive centre), SuperBroom input is protected against, reverse-polarity and over-current.

The AC/DC Adaptor supplied will work with AC voltages from 100 to 240VAC.

The Charger socket is located on the right-hand panel of your SuperBroom. It is recommended that the SuperBroom is left to charge for 6 hours to ensure a full charge.

When connected to the AC/DC Adaptor the Battery Charge Status LED on the front display panel is illuminated Red. When the battery is fully charged the front panel LED changes to Green.

Note When your SuperBroom is first unpacked the internal battery pack may not be fully charged.

Caution *Only use manufacturers recommended external AC/DC adaptor.*



Replacing Batteries

Note Ensure AC/DC adaptor is isolated from the AC mains and removed before replacing battery pack

The battery compartment is accessed via a removable door on the base of the SuperBroom unit (see opposite). The door is secured by a 1/4 turn screw. The Battery packs are specially configured for use with the SuperBroom and should only be replaced with Audiotel supplied battery packs.

The battery packs have built-in protection circuitry and are designed to prevent reverse polarity connection.

Disposal of Batteries

At the end of a battery pack's useful life it should be returned to Audiotel for correct disposal. Incorrect disposal may cause serious injury.

PRACTICAL CONSIDERATIONS - INNOCENT ELECTRONIC ITEMS

Most electronic items will be visible and therefore obvious sources of a false alarms. The transmitter power output and receiver sensitivity of SuperBroom are both high enough to detect large (in this context 'large' refers to their 'detection size' rather than physical size) objects from many metres away. If it is not practical to move electronic items then the power setting must be reduced to limit the detection range. This can, of course, make detection of 'small' targets more difficult.

Some electronic items may not be obvious. Examples include:

Electronic items on the other side of a wall, door, ceiling or floor

- Smoke Detectors
- Security Devices
- Door locking or Access Control systems
- Lighting Dimmers

Body worn items such as

- pagers
- radio telephones
- deaf-aids
- electronic keys

When a device has been detected always check that no innocent object is concealed nearby.

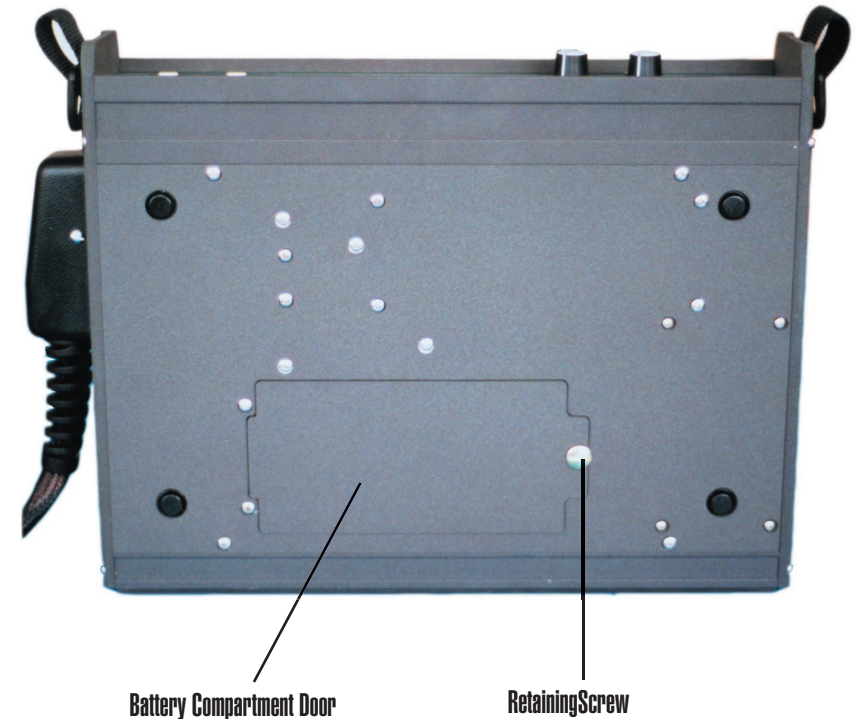


It is recommended that users initially adopt the following search strategy. As experience is gained, users can develop their own techniques and methods.

- 1 Set the maximum legal transmitter power for country of operation at the set power menu during startup (UK = EU High).

Note For non EU countries TX power is set using the rotary power output control (9).

- 2 Begin with the SuperBroom set to **CLICK** , **COMPARE** and Power mode (these are the default settings). Select DSP mode by pressing Listen.
- 3 Set the **Volume** control to minimum, set the **Squelch** control fully anticlockwise and connect the **headphones**. Adjust the volume control to suit (using the Test Target to generate a signal if necessary). The headphones are not needed at this stage so can be worn around the neck
- 4 Pass the **Antenna Head** over all surfaces in the search area so that, ideally, the distance between the antenna head and a potential concealment is minimised (for efficient operation the minimum distance should not be less than 6 inches). **Repeat** coverage of an area after rotating the antenna head through 90 degrees
- 5 If a target is detected the difference in second and third harmonic signal strengths will be displayed on the Antenna Head. Move the antenna until the COMPARE signal strength reaches a maximum.
- 6 Search the identified location for the device.

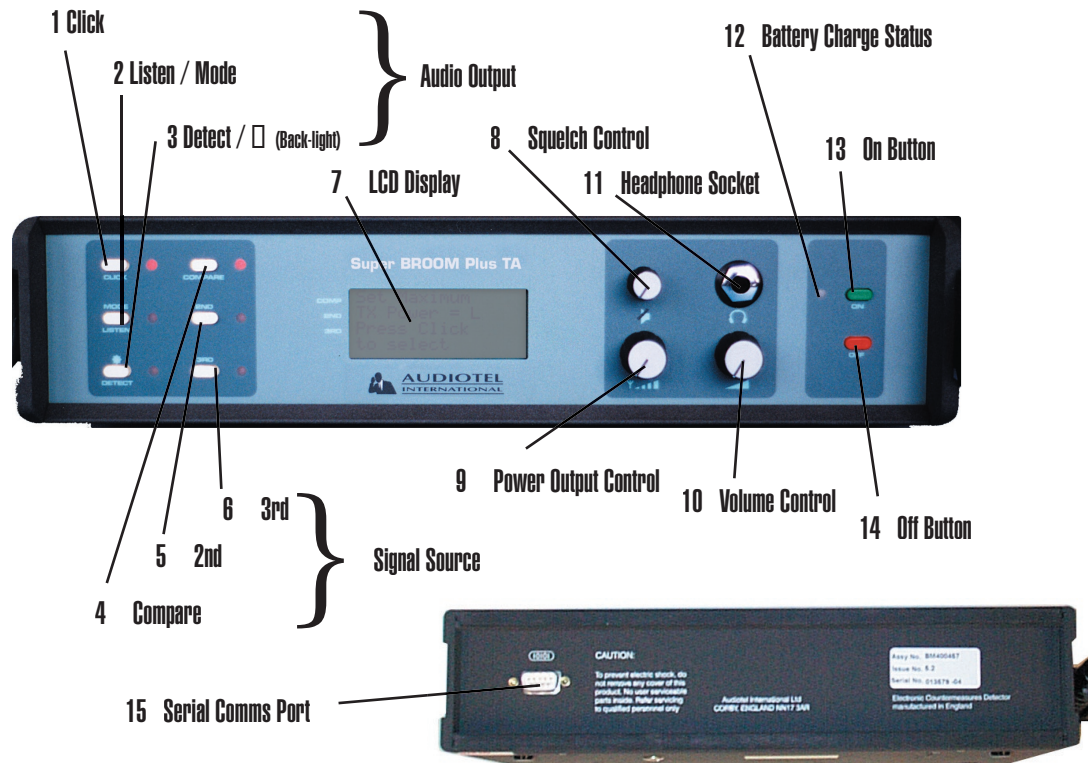


Battery Compartment Door

RetainingScrew



CONTROLS & INDICATORS



FRONT PANEL CONTROLS

1 CLICK

Selects Click audio output, (default audio output) the audio output is a 'Geiger' type click which increases in frequency as the signal strength increases. This is used mainly when pinpointing the location of a target as the click rate will usually be at its maximum closest to the target

Note 1 During start up in the 'Set Tx power' menu this button (click) sets the maximum TX power to 20mW (EU low power setting).

MANUAL MODE

This is the default mode for power control. The user manually sets the transmitter output power level using the rotary Power Control (9) from L up to the maximum power set during startup.

DSP MODE

In DSP mode due to the continually controlled power output level the battery life is optimised, this can extend battery life considerably compared with manual mode.

In this mode a software algorithm is used to control the transmitter output power. As the antenna approaches a target non-linear junction the transmitter power is reduced. This avoids overloading the target junction with radio energy which can give rise to false indications. When the antenna is moved away from the target junction the power output is increased by the controlling algorithm.

In DSP mode the changes in power level are transparent to the user as the received signal indication levels (Geiger click, bar graph, front panel display) will continue to rise and fall as the antenna gets closer to or moves away from the target.

When in DSP mode the rotary power output control (9) can be used to reduce the transmitter power below the maximum set during startup to a minimum of power level 2.

INITIAL SEARCH TECHNIQUE

It is strongly recommended that users have electronic devices concealed for them by a colleague in order to gain practical experience under controlled conditions.

Some users prefer to carry the SuperBroom with the carrying strap around the neck rather than over the shoulder so that the front panel display is easily seen.

OPERATION

BASIC DESCRIPTION

The Type Approved Super Broom is a frequency agile non-linear junction detector utilising Dynamic Channel allocation. There are a total of 19 channels available within the operating band of 869.4 – 869.65MHz. When SuperBroom is switched on the receivers are calibrated. The ambient RF Background is measured and a search algorithm selects 10 RF channels for optimum operation. This ensures that potential interfering signals are avoided, thereby reducing false triggering.

Note If you are not familiar with the principles of detection using Harmonic Radar or Non-linear Junction Detection you may wish to read the *Theory of Operation* section later in this manual before attempting to actually use SuperBroom.

FREQUENCY HOPPING MODE

When either EU-Low or EU-High is selected during start up, the unit will automatically hop around the optimum 10 channels at 1 minute intervals.

Note 1 Frequency plan is given in the appendices.

Note 2 when Non-EU is selected at start up, the Optimum Tx channel is selected, frequency hopping is disabled, detect function enabled and the unit is no longer EU compliant.

Caution **Operation in this un-license mode is the responsibility of the user.**

POWER MODE

SuperBroom can be used in one of two power control modes. The power mode is selected using the Listen/Mode button on the front panel.

2 LISTEN / MODE

The function of this button depends on which signal source is selected. When the Compare button is selected this button acts as the Mode button as described below. When 2nd or 3rd signal sources are selected this button acts as the Listen button as described below

Listen

Selects Listen audio output, this allows you to listen to the returned signal via an Amplitude Modulation detector. If the target is, for example, an electronic timer with an audio frequency clock signal then the electronic clock may be heard as a regular sound when LISTEN is selected.

Mode

Toggles between the default MAN (manual power control) and DSP (Digital Signal Processing) automatic power control. The current power mode is indicated on the bottom line of the LCD display. When in DSP mode the decimal point on the single character LED display on the antenna head flashes to indicate this mode has been selected.

Note 1 During start up in the 'Set Tx power' menu this button (listen) sets the maximum TX power to 500mW (EU high power setting).

3 DETECT / □ (BACKLIGHT)

When the Compare button is selected this button toggles the LCD back-light On and Off. This button operates the Detect function only under the following conditions:

Note 1 During start up in the 'Set Tx Power' menu, this button (detect) selects the Non EU option. This enables the rotary TX output power control (9) for the operator to set power, please refer to Appendix B for guidance.
In Non EU operation the Optimum Tx channel is selected, frequency hopping is disabled, detect function enabled and the unit is no longer EU compliant.



FRONT PANEL LCD DISPLAY

START UP DISPLAY

The LCD will show the following sequence of events as SuperBroom carries out automatic programming and calibration of the two receivers and transmitter within the unit. Error messages will be shown if SuperBroom detects a problem with internal circuitry.

AUDIOTEL INT
SUPERBROOM + TA
ADVANCED NLJD
SW400725v*. *

Manufacturers Name and Product type

Software release number

Calibrating RSSI

Automatic calibration of both RX1 & RX2 receivers signal strength indicators RSSI outputs and measures RF back ground.

Tx Synthesiser

This step tunes the transmitter. The frequency set will depend on the RF back ground

SET TX POWER
CLICK = EU Low
LISTEN = EU High
DETECT = Non EU

To set the maximum power for the transmitter. Choose EU Low or EU High for EU operation. Choosing Non EU allows the user to set Tx power using the power output control (9), refer to appendix B as a guide.

5 2ND

Selects the second-harmonic receiver as the signal source for the audio output and signal strength indicated on the antenna head display.

6 3RD

Selects the third-harmonic receiver as the signal source for the audio output and signal strength indicated on the antenna head display.

7 LCD DISPLAY

See under Front Panel Display section Later in this manual.

8 SQUELCH CONTROL

This sets a signal strength threshold. If the signal strength is below the threshold the audio output is cut off.

The squelch control operates in 'COMPARE', '2nd' and '3rd' modes.

9 POWER OUTPUT CONTROL

Note *Within Europe where Type Approval is a legal requirement, it is the users responsibility to comply with the legal maximum power for the country where the equipment is being operated (for the UK this is the higher EU limit (500mW erp), which is set during start up in the 'Set TX power' menu by selecting EU High).*

Adjusts the output power of the SuperBroom transmitter. (see appendix B for SuperBroom TX output power levels).

Depending on the Power Mode selected (see under *mode - 2 LISTEN/MODE* earlier) the control is used as follows.

In manual mode the control is used by the operator to set the output power at all times, from the maximum set during startup down to L.



In DSP mode, SuperBroom automatically sets the power level relative to the maximum TX level set at start-up in the 'Set Tx Power' menu. The power control allows the transmitter power to be reduced from the maximum set during startup down to level 2.

10 VOLUME CONTROL

Adjusts the audio output level.

11 HEADPHONE SOCKET

Caution Always reduce the volume control to its minimum value before connecting the headphones. Set the Squelch control to its minimum value so that the audio level can be gauged when setting the volume control.

The headphone socket above the Volume control is suitable for a 1/4 inch 'Stereo' type jack plug. The audio amplifier is capable of driving a range of headphone types.

12 BATTERY CHARGE STATUS

The Battery Charge Status LED is only illuminated when the external AC/DC Adaptor is supplying power to SuperBroom.

- When it is illuminated Red the internal battery is being charged.
- When it is Green the internal battery is fully charged.

13 ON BUTTON

Press this button to turn the SuperBroom on.

14 OFF BUTTON

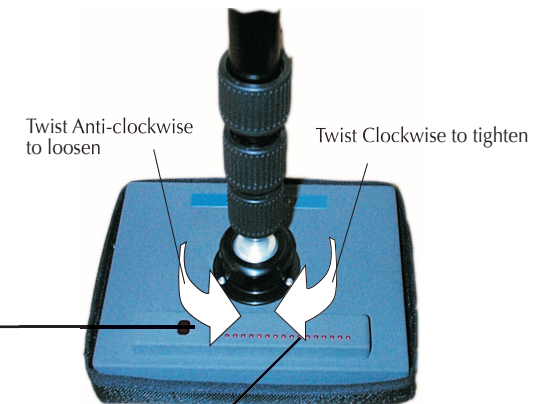
Press this button to turn the SuperBroom Off.

15 SERIAL COMS PORT

9-way D-type ATE serial interface.

THE ANTENNA HEAD DISPLAY

The SuperBroom Antenna Head incorporates a bar graph and a single character LED display.



BAR GRAPH DISPLAY

A 16-segment bar graph mimics the signal strength display for the signal source selected.

COMPARE - displays the difference between the signals from the two receivers. If the third harmonic is stronger than the second there is no output.

2nd - displays the signal strength of the second harmonic.

3rd - display the signal strength of the third harmonic.

SINGLE CHARACTER DISPLAY

When unit is set to 'DSP' mode the decimal point on the single character display will flash. When the unit is set to 'MAN' (Manual) mode or 'DSP' mode the character display indicates the transmitter output power setting in the range:

L 1 2 3 4 5 6 7 8 9 H