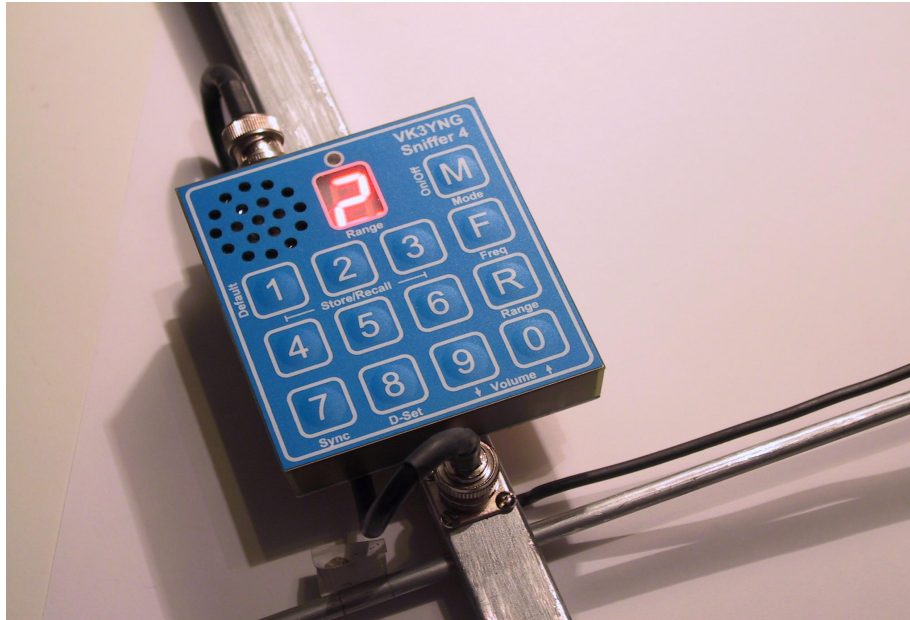# VK3YNG Foxhunt Sniffer Instruction Manual

The VK3YNG Foxhunt Sniffer is a specially designed synthesised VHF direction finding receiver covering 120MHz and 144MHz bands.

The receiver is designed for quickly finding the direction of beacons or hidden transmitters. Anything from distant weak signals to very close "sniffing" of transmitters running many watts of output power can be pin pointed accurately without suffering "overload" problems that plague other designs. Full auto-ranging operation allows the operator to quickly and intuitively locate the source of a signal without twiddling knobs or watching meters. The operator is freed to concentrate on more important things such as negotiating terrain or reading maps.

The unit is also available in a fully tested Board level format for those who wish to integrate the unit into other equipment or build their own housing.

Introduction

The VK3YNG sniffer is designed to allow quick, easy and accurate determination of the direction of a transmitted signal in either the 120-123MHz or 143-150MHz bands. The sniffer provides enough sensitivity to determine the direction of a signal from many kilometres away. This is useful for ARDF or Radio Sport use. It also provides enough attenuation to accurately determine the direction of signals right up to the source of the signal without suffering from overload or compression effects.

Attenuation (signal reduction) is provided automatically in steps of approximately 15dB each time a particular signal strength threshold is reached. The number of 15dB steps of attenuation is shown on an LED display. For example, a display value of zero indicates maximum sensitivity, where a value of 9 indicates a very strong signal that requires approximately 135dB of attenuation.

Signal strength indication is provided by an audible tone that increases in frequency (pitch) with increasing signal level. This is done because the human ear is a much more sensitive to changes in pitch than sound level. There is also no inertia or overshoot problems as tend to occur with signal meters. A special software algorithm ensures that the received signal strength tone does not suffer from "compression" effects that occur at higher signal levels with some designs.

Auto Power Down

The sniffer will automatically power down after 10 seconds if either of the following two conditions are met.
1) There has been no key pressed for at least 10 minutes.
2) There has been no "upward" progression in range for at least 10 minutes.
The sniffer will give five short beeps just before the unit powers down.

Low Battery Indication

The sniffer functions accurately to supply voltages down to approximately 2.7 volts. Below this the accuracy becomes compromised or the sniffer may power itself down.

When power has dropped to 2.7 volts or lower, the display decimal point is enabled to warn the user that batteries are in need of replacement.

Display Brightness

A high efficiency Seven Segment Red LED is used for the range display. It has two brightness settings, one for daytime use and a significantly reduced brightness level for night use. A light sensor located immediately above the display automatically determines the brightness level.

Reduced Functionality mode:

This mode may be useful for first time operators. It allows the sniffer to be used in its most basic format and hides all programmability options from the user. This mode is very useful for scout foxhunting for example.

Quick Button Reference:

The following table gives quick index to key functions in both normal and reduced functionality modes.

Button	Operation in Normal mode	Operation in reduced functionality mode
1	Recall channel 1 (Hold to store frequency/mode)	Recall only channel 1
2	Recall channel 2 (Hold to store frequency/mode)	Recall only channel 2
3	Recall channel 3 (Hold to store frequency/mode)	Recall only channel 3
4	Recall channel 4 (Hold to store frequency/mode)	Recall only channel 4
5	Recall channel 5 (Hold to store frequency/mode)	Recall only channel 5
6	Recall channel 6 (Hold to store frequency/mode)	Recall only channel 6
7	ARDF mode Start of cycle Synchronisation	No function
8	Range down Delay Set/Display. 1 to 5 seconds. 0=peak hold mode.	Show relative Battery capacity in %
9	Volume Down	No function
0	Volume Up	No function
R	Manual Range set/disable	No function
F	Frequency Entry (4 digits follow)	No function
M	Power/Audio Mode Select (Tone/AM/FM, Hold for power off)	Power On/Off only (instant power off)

Alternative Key Functions:

The default operation mode of the sniffer can be reconfigured by holding down certain keys while powering up the unit. The sniffer will maintain this operation mode for subsequent power up/down cycles.

Button	Display during power-up	Function if pressed during power-up
7	H	Normal operation. Selects normal tone range and disables reduced functionality mode if set.
8	L	Low-Tone mode (RSSI tones at quarter frequency. Resolution slightly reduced at low tone frequencies)
F	5	Reduced key functionality mode ("scout" mode)
R	t	Toggle (Enable/disable) auto range change announcement tones

Detailed Button Operation

M Mode/Power switch:

Power On:

Pressing this button once powers on the unit to the frequency and mode stored in memory channel 1.

Mode Selection:

Pressing this button momentarily while the unit is powered up cycles the unit through its operating modes and briefly displays the selection on the display. The modes cycle through in the following sequence: "**A**" – AM reception, "**F**" - FM reception and "**t**" – Signal strength Tone. The cycle then repeats. When headphones are used, one channel is always set to give signal strength tone, while the other channel follows the selected mode. This is useful for hunting different continuous carrier transmissions where the transmitters' identification is given using either AM of FM modulation.

In reduced functionality mode, the sniffer is forced into "Signal Strength Tone" mode only.

Power Off:

Pressing and holding the Mode button for greater than 1 second will power down the unit. In reduced functionality mode, the unit will power off immediately when the Mode button is pressed.

$\boxed{1}$ through $\boxed{6}$

Memories

Buttons 1 through 6 allow storing and recalling of memory modes and frequencies.

Recall functions.

Pressing any of the buttons 1 through 6 in normal operation mode will recall the frequency and mode stored in non-volatile memory. In normal operation mode, the display will display the last 4 digits of the selected memories frequency in kilohertz. For example, a stored frequency of 147.425MHz will flash up the sequence "7 4 2 5". The first two (100 and 10) megahertz digits are inferred by first entered digit as per the following table:

Setting of "MHz" digit	Band selection
0, 1, 2	120-122.995MHz
3 through 9	143-149.995MHz

The recalled frequency is not displayed in reduced functionality mode.

Store functions

Pressing and holding any of buttons 1 through 6 will result in the selected frequency and mode being stored in the selected memory. The button must be pressed and held until two short beeps are heard in succession. This confirms that the data has been committed to memory.

The Store function is disabled in reduced functionality mode.

7 *Sync Button*

This button is used to synchronise the receiver for ARDF (international style) foxhunting. Three short beeps are generated as confirmation of pressing this button. This synchronises the receiver for use in international style foxhunting for a one-minute cycle, five-transmitter system.

The sync button should be pressed at the start of transmitter one's cycle. At 50 seconds into the cycle, the sniffer will generate three short beeps giving 10 seconds warning that the current transmitter's cycle is about to end. If the sniffer is currently receiving at range 1 or lower, at four seconds before the completion of the current transmitter cycle the sniffer broadcasts a number of beeps corresponding to the number of the transmitter in the cycle which is about to commence. The pitch of these beeps is set slightly lower than the "50 second" beeps. The display also briefly flashes the number of the next transmitter.

If a range down delay (d-Set) of zero is selected and the sniffer is not currently configured for manual ranging, the sniffer will automatically select range zero at the start of the next transmitters' cycle regardless of the current signal strength.

Holding this key during power-up cancels the Low RSSI Tone mode and the Reduced Key Functionality mode. In this mode the signal strength tones function normally and the maximum signal strength pitch is 8KHz. This mode is set as the factory default.

This key is disabled in reduced functionality mode.

8 *D-Set button*

Ranging up on the sniffer happens automatically with minimal delay. To implement short term peak detection, there is an intentional delay before the sniffer ranges down. This delay is programmable between 1 and 5 seconds using the D-Set button. For beginners, a value between 3 and 5 seconds is recommended. For more advanced users, 1 or 2 seconds gives better results. The factory default is 2 seconds.

To set the range down delay, press the "D-Set" button. The display will respond by displaying the letter "d". Pressing buttons 1 through 5 will then set and store the new range down delay. Pressing any other button except zero (0) or nine (9) will briefly display the current range down delay in seconds. The display then reverts to displaying the current range.

Setting a range down delay of zero disables down ranging. In this case the sniffer operates in a "peak hold" arrangement and down ranging is disabled. In this mode manual ranging is disabled and pressing the "range" button will reset the current peak hold range to zero.

Holding this key during power-up causes the sniffer to operate in lower tone RSSI mode. This mode may prove useful to those who have difficulty hearing higher audio frequencies. In this mode the signal strength tone frequencies are divided by 4. The top tone pitch is limited to about 2KHz and resolution becomes slightly limited at the lowest tone frequencies. (note: this mode has no effect on the pitch of supervisory beep and tone frequencies)

Relative Battery Voltage indication:

Pressing the "D-Set" button then pressing the "9" will display two digits giving an indication of the relative battery capacity in percentage. 99% indicates a full battery while 0% indicates the point where sniffer operation becomes significantly compromised.

In reduced functionality mode, the "D-Set" button indicates relative battery capacity directly without requiring the "9" button to be pressed.

9 0 *Volume Control*

During normal operation, the "9" and "0" buttons allow the setting of volume. The display briefly shows the new level and reverts to displaying the current range when the button is released.

These buttons are disabled in reduced functionality mode.

R *Range Control*

Normally the sniffer automatically selects the best range for the currently received signal. In some situations it may be necessary to range the sniffer manually. The range control button can be used for this purpose. This button also has controls a number of other features depending on the mode selected.

In auto-ranging mode, pressing this button briefly displays the letter "r" in the display, and then the display reverts to displaying the current range. Pressing any digit then manually selects the range. The display briefly displays "r" followed by the selected range. The sniffer remains in manual ranging mode until defeated by pressing the "R" button a second time. This re-enables auto-ranging.

Holding this key during power-up toggles the states of the "range tone announcement" flag. When this flag is set, the sniffer generates a "be-bop" tone sequence whenever the sniffer ranges up or down. The frequency of the tones gives the operator audible indication of the current range and the direction of the change. When this flag is cleared, range changes happen without announcement.

This key is disabled in reduced functionality mode.

Peak Hold Mode

This range button also resets the peak range hold function if the down range delay (D-set) is set to zero. In peak hold mode, manual ranging is disabled.

Peak range memory

If the ranging button is pressed twice in succession, the second time the button is pressed the display will briefly show the maximum range the sniffer has achieved since power up or the last successful frequency change..

In ARDF mode, (see Sync button section) the peak range value is automatically reset at 30 seconds into the current transmitter cycle. This is very useful if there is a need to check what range the sniffer got to just before the previous transmitter finished its cycle.

This function is not available when Peak Hold mode (dSet=0) is selected.

⬜F *Frequency Entry*

The sniffer can operate at any frequency in the range 120.000-122.995 and 143.000 - 149.995MHz in 5KHz steps. Pressing the "F" button initiates frequency entry. The display confirms this by displaying "F". The sniffer then expects four digits to be keyed in to set the desired frequency. If an error occurs while entering frequency, the letter "E" is briefly displayed and the sniffer then reverts to the previous operation frequency. The first digit sets both the 1MHz frequency and the band. 0 through 2 sets the 120MHz band. 3 through 9 sets the 140MHz band.

This key is disabled in reduced functionality mode.

Factory default frequencies

Memory	Frequency	Mode
1	145.300MHz	Tone
2	145.700MHz	Tone
3	144.250MHz	Tone
4	146.500MHz	Tone
5	121.500MHz	Tone
6	146.575MHz	FM

Note: 121.5MHz is used as an international personal, maritime and aeronautical distress beacon frequency. With an appropriate antenna, the sniffer can be used to locate ELT and EPIRB emergency beacons.

Maximising Battery Life

There are a number of solutions for extending battery life with the sniffer. The most critical one is the volume setting. Battery life is reduced considerably when using the internal speaker on a high volume level with a continuous signal. Use the lowest volume level possible when using the internal speaker or use external headphones. Volume is automatically limited to settings of "5" and under when the low battery threshold is reached in an effort to extend battery life.
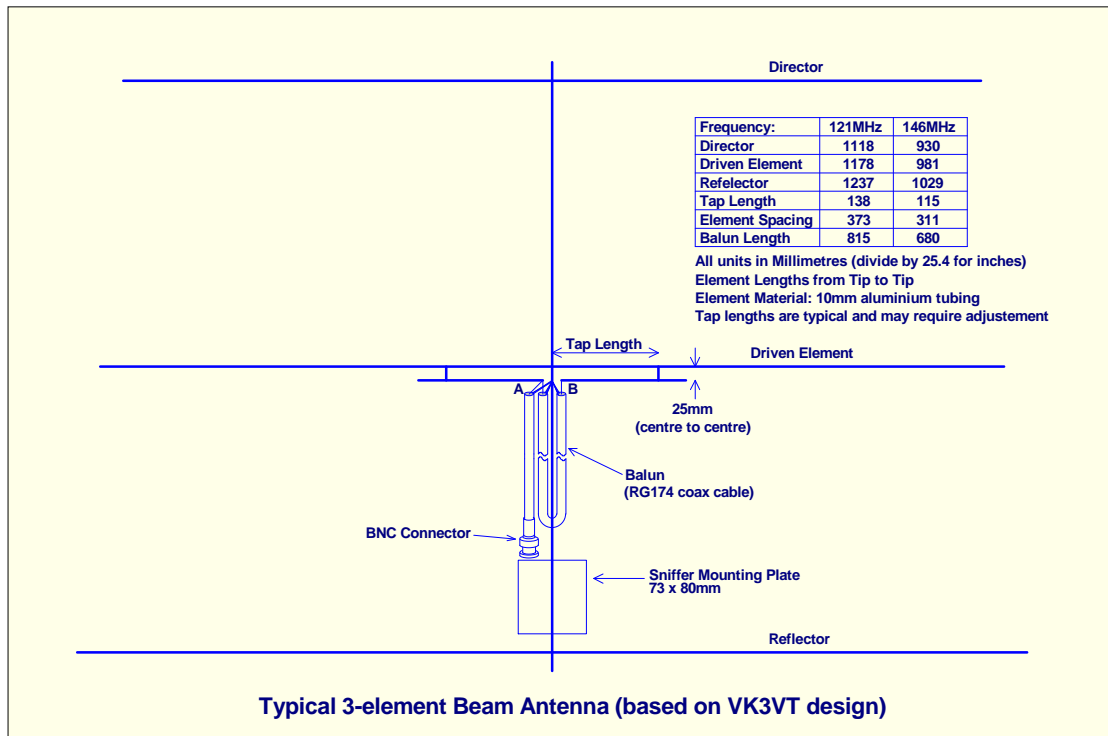
The display also operates at a higher intensity level for daytime use which puts more load on the battery. Typically night time only operation increases alkaline battery life by about 30%.

Users who would like to get the longest use between battery changes should consider using Lithium AA batteries. These batteries have a very long shelf life and capable of providing well over 14 hours of continuous daytime operation.

Do not use single cell NiCd or NiMh batteries as their terminal voltage (1.2V) is too low. Zinc Carbon and General Purpose Manganese batteries are also not recommended.

Sample antenna designs

The antenna design is largely a matter of personal choice. For portable use, designs vary between two and four elements. More elements give better directivity and more precise bearings but are more difficult to carry around. For most situations, three elements offers a good compromise. Here is an example of antenna designs for 120 and 146MHz.

Frequency:	121MHz	146MHz
Director	1118	930
Driven Element	1178	981
Refelector	1237	1029
Tap Length	138	115
Element Spacing	373	311
Balun Length	815	680

All units in Millimetres (divide by 25.4 for inches)
Element Lengths from Tip to Tip
Element Material: 10mm aluminium tubing
Tap lengths are typical and may require adjustement

Typical 3-element Beam Antenna (based on VK3VT design)

Specifications:

Frequency Coverage	120-122.995MHz, 143-149.995MHz in 5KHz steps
Channel Bandwidth	16KHz
Sensitivity	Better than -120dBm
Maximum signal level	Greater than +30dBm
Power Supply	3VDC (2xAA Alkaline or Lithium penlight cells)
Battery Life*	Typically 3+ hours (alkaline), 14+ hours (Lithium)
Memories	6, programmable (stores mode and frequency)
Receive modes	AM, FM, Signal strength Tone
Max RSSI frequency	Programmable 2KHz or 8KHz
Size	76mm(W), 80mm(H), 25mm(D) not including BNC connector
Antenna Connection	BNC
Headphone Connection	3.5mm stereo

*Note: Battery life is dependant sound level and display intensity. See section on battery life.

VK3YNG Sniffer MK4 - Block Diagram
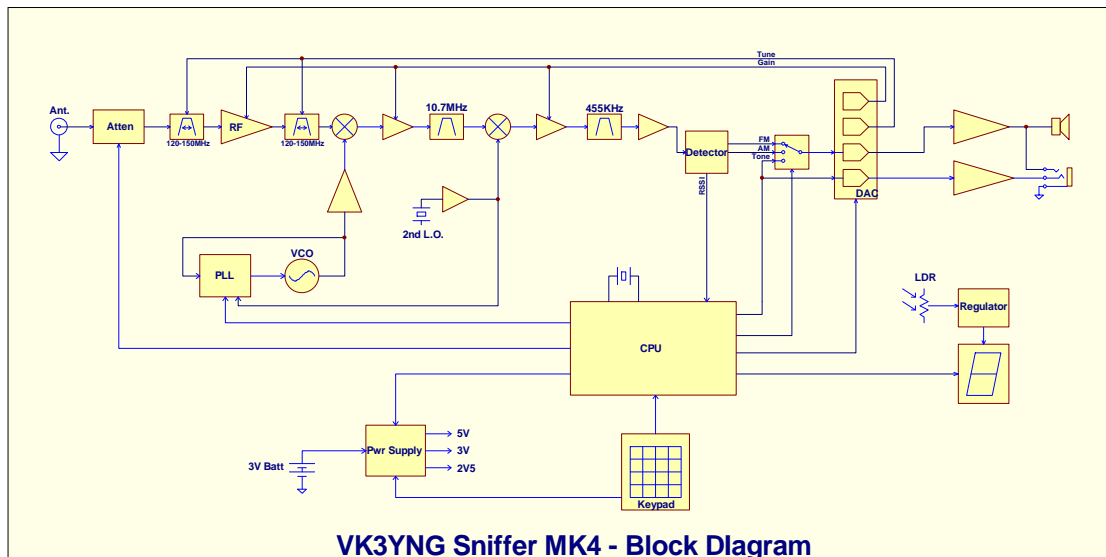
Links:

More information on foxhunting and techniques can be found on the following web sites:

Australian ARDF website: http://www.ardf.org.au

Joe Moell's Foxhunting website   http://www.homingin.com

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Revision History:

Manual Revision	Date (dd/mm/yy)	Description
1.0	23/01/02	Initial Release of manual Hardware release 1.0, Firmware release 1.0
1.1	26/07/02	*Manual revision 1.1:* Included quick button reference details and rewritten some button function details. Added sample antenna designs, block diagram, tips for extending battery life, links and contact information *Hardware release 1.1:* Addition of improved VCO module *Firmware release 1.1:* Added display range display override. Display shows range instead of Tx number in ARDF mode if range goes up. Added ability to see battery voltage in reduced functionality (scout) mode Volume control disabled in reduced functionality (scout) mode. Relative battery capacity (0-99%) can be displayed. Different tones used for ARDF mode transmitter number announcement beeps. Transmitter announcement beeps now set top four seconds before minute boundary (was 2 seconds) Peak range detector added which holds peak range for 30 seconds in ARDF mode. Range hold mode simulates the "Green button" on the "YQN" sniffer by using the "range" button.
1.2	28/10/02	Manual updated to release 1.2 to link with firmware revision. No code or hardware changes
1.3	02/11/02	*Hardware Release 1.2:* Improved Power Supply noise filtering *Firmware release 1.3:* Added auto volume reset (limits setting to "5" under low battery conditions) Recalling a channel multiple times in the presence of a signal would cause the sniffer to range up each time a button was pressed and not range back down if the channel was recalled more than 9 times in a row. Range is now reset to zero if the received frequency is changed or preserved as is if the same frequency is recalled. Frequency will be displayed if no range up is required.