1 Contents

2 Introduction

Thank you for purchasing the AOR AR7030 high dynamic range, short wave, all mode receiver. The AR7030 is designed using the very latest DDS (Direct Digital Synthesis) technology to ensure the highest levels of performance and reliability. A TCXO (Temperature Compensated Crystal Oscillator) is provided for high stability.

To get the best possible results from your AR7030 we recommended that you carefully read this manual and familiarise yourself with the receiver. Many apparent faults are often due to accidental mis-operation of the receiver so, if you think there is a problem, carefully read all of the manual before deciding to return the receiver for repair.

Every effort has been made to make this manual correct and up to date. Due to continuous development of the receiver and by error or omission anomalies may be found and this is acknowledged.

2-1 Accessories supplied

Mains power supply
Infrared remote controller and batteries
Operating manual

2-2 Overview - read *THIS* if nothing else

The AR7030 receiver pushes forward the frontiers of performance and microprocessor operation. In order to get the very best out of the receiver you will need to carefully read through all the sections of this handbook, however there are a few points worth noting first:-

a. The receiver has been designed to be compact and robust enough for transportable operation, and as such there are relatively few front panel controls. The infrared remote controller should be considered as an extension of the front panel, offering single button access to many primary functions. The receiver can be operated without the infrared controller but more button presses may be required to perform the same operation.

The infrared control input is accepted by sensors on both the front and rear panels of the receiver. If you cannot reliably enter commands with the controller in close proximity to the front panel, move it to one side of the receiver and make sure that an object behind the receiver will provide a reflection into the rear sensor. The infrared controller is powered by two AAA size 1.5V batteries (supplied) which have to be fitted before it can be used... observe the polarity carefully.

You cannot harm the receiver by pressing buttons, turning knobs or exploring the menu options - experiment without worry. Only by using the receiver will you become fully conversant with its operation.

If you really mess up the settings, a LOAD DEFAULT facility has been included so that you can return the set to its out-of-box condition (except for frequency memory contents). Loading the defaults will ensure:- sensible filters are selected for each mode of reception, no PBS offset, no BFO offset for CW and DATA modes, maximum IF gain with AGC on, auto synchronous AM, auto RF attenuation, flat tone control settings, standard line output levels etc.

To load the default settings, press ○● (to return to the SETUP menu), rotate the spin-wheel ◁ ▷ one click anti-clockwise so that the legend **Deflt Set** is displayed, and then press the * button. **Loaded ..** is briefly displayed in place of the clock to confirm selection.

Should the filters appear incorrectly aligned or non-symmetrical, please refer to FILTER CALIBRATION in section 6-2 and look through section 6-1.

b. The receiver does not have a standard format of display readout - it can be configured to display time or pass band shift or filter selection or treble / bass tone selection or VFO selection or AGC or memory configuration... whatever YOU choose. The spin-wheel ◁ ▷ and the * button will retain their last assigned functions when the MENU button is pressed allowing a selected function to be changed whilst the S-meter is displayed.

To return to the SETUP menu and CLOCK display, press ○●. To display the S-meter and return to the root level of the menu system, press MENU.

You may tune the receiver, change the volume and reception mode or select fast tune whilst any menu is shown on the display because these front panel controls have only one dedicated function. These are fixed controls, and are indicated in this manual with white lettering on a black background, similar to the lettering on the front panel. Similarly the ○● and MENU buttons always have a defined function. The other receiver controls, arranged beneath the display, are referred to as SOFT-KEYS, because their function varies according to the context of the selected menus. In these cases the control description is displayed on the receiver's LCD and in this manual with black lettering on a grey background. When no menu is displayed on the LCD - when the S-meter is shown - then the underlying buttons select the menu indicated on the panel:- MEMORY, RF / IF or FILTER.

c. Each mode can have, and will retain, a different filter bandwidth (chosen from those available), pass band shift (PBS) setting, BFO setting and AGC speed. When adjusting any of these settings the values are changed only for the current mode selected. Squelch value for NFM mode is held separately from the value for all other modes.

d. It is possible to save and load up to three of your favourite receiver set-ups, one for casual listening, one for serious DXing, one for data communication or whatever you choose. Each mode can have your own choice of filter bandwidth, pass band offset, BFO setting and AGC speed, along with global settings of the tone controls, auto / manual synchronous AM, auto / manual RF attenuator and line output levels. All these settings can be held in one of the SETUP MEMORIES, A, B or C. Using the setups can avoid having to recall many different menus, and provides a useful short cut to changing listening modes.

The setup memories are accessed through the SETUP menu by turning the spin-wheel ◁ ▷ until the required memory (A, B or C) is selected along with the required function:- Load to setup the receiver with the settings held in the memory or Save to transfer the receiver's settings into the memory. Press the * button to actually load or save the setup.

```
14:27:34    15.070.00 AM
SetA:Save   Off Timr Cnfg
```

```
14:27:34    15.070.00 AM
SetA:Load   Off Timr Cnfg
```

e. The AR7030 has two VFOs, A and B - (Active and Background). Each VFO holds settings of volume, tone, receive frequency, reception mode, filter bandwidth, PBS, BFO, RF attenuator, IF gain, AGC speed, squelch, scan delay time and scan mode. The contents of the VFOs can be exchanged using the A/B button, only the active VFO can be tuned.

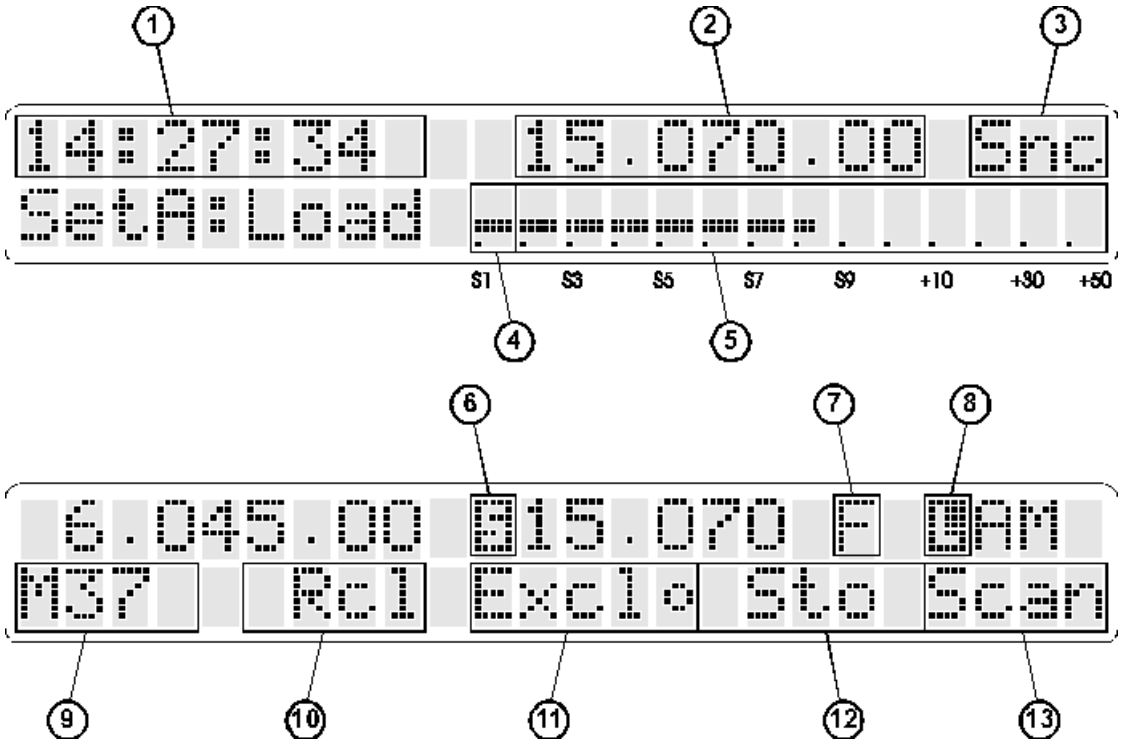
Note: The background VFO data will be lost when power to the receiver is switched off.

f. The 100 frequency memories store receiver frequency, reception mode, filter bandwidth, PBS offset and squelch level. BFO frequency is stored instead of squelch level for in CW and DATA modes. Once recalled, (into the active VFO) it is possible to tune away from the memory data or change mode at will - for this reason there is little point in storing the same frequency with different modes in different memories, even when DXing a broadcast where AM, USB, LSB or Snc modes might be needed.

Memory contents are not modified by changing any receiver settings - they will only alter if the Sto button is pressed. Any previous contents are then overwritten.

g. The receiver's display is split into several different areas. The current FREQUENCY and MODE are always visible, but other information varies depending upon the operating condition and the menus selected. This illustration may be useful for reference.

1 Auxiliary information (volume, squelch etc) / keypad entry
2 Receive frequency
3 Reception mode
4 Attenuator (A) or preamplifier (P) indicator
5 Signal strength meter (S-meter)
6 Squelch open / close indicator
7 Fast tuning indicator
8 Dial lock indicator
9 Spin-wheel ◁ ▷ function
10 * button function
11, 12, 13 Menu button functions



2-3 Quick reference guide

Key

Buttons shown white on black are labelled on the front panel, for example MEMORY MENU
Buttons shown black on grey are soft-keys labelled on the display, for example Tone VFO
The spin-wheel is labelled on the display and shown with up/down arrows, for example ◁ ▷ **Gain**
Soft keys shown with a bullet after the legend operate as toggles (on / off). The bullet shows the current state - solid for on and hollow for off.

Power

To turn the receiver on, press ○● To turn the receiver off, press ○● Off or ○● ○●

Display

To display the S-meter, press MENU To display the clock press ○●

Filters

To change filter, press MENU FILTER and use < bw or bw > Alternatively, cycle through filters with Flt
To shift the filter passband, press MENU FILTER and use ◁ ▷ **PBS**
To adjust audio frequency in CW and DATA modes, press MENU FILTER BFO and use ◁ ▷ **BFO**
To adjust audio tone, press MENU FILTER Tone and then use ◁ ▷ **Treb** or Bass ◁ ▷ **Bass** as required

RF and IF Gain

To adjust RF gain, press MENU RF - IF and use < RF or RF > for adjustment in 10dB steps
To adjust IF gain, press MENU RF - IF and use ◁ ▷ **Gain** (for RF and IF controls together)
OR press MENU FILTER Tone Gain and use ◁ ▷ **Gain** (for IF gain with filter bandwidth)

Squelch

To adjust squelch level, press MENU RF - IF VFO and use ◁ ▷ **Sql** (for squelch with dual VFO)
OR press MENU MEMORY Scan and use ◁ ▷ **Sql** (for squelch with memory scan)
OR press MENU FILTER and use ◁ ▷ **Sql** (in NFM mode for general listening)
With squelch active Mut • will mute the receiver's audio with no signal, and Hold • will stop scanning if a signal is present

Memories

To select and preview a memory, press MENU MEMORY and use ◁ ▷ **Mxx**
To recall from a memory (into the VFO), press MENU MEMORY, use ◁ ▷ **Mxx** to preview then press Rcl
To store into a memory (from the VFO), press MENU MEMORY, use ◁ ▷ **Mxx** to preview then press Sto

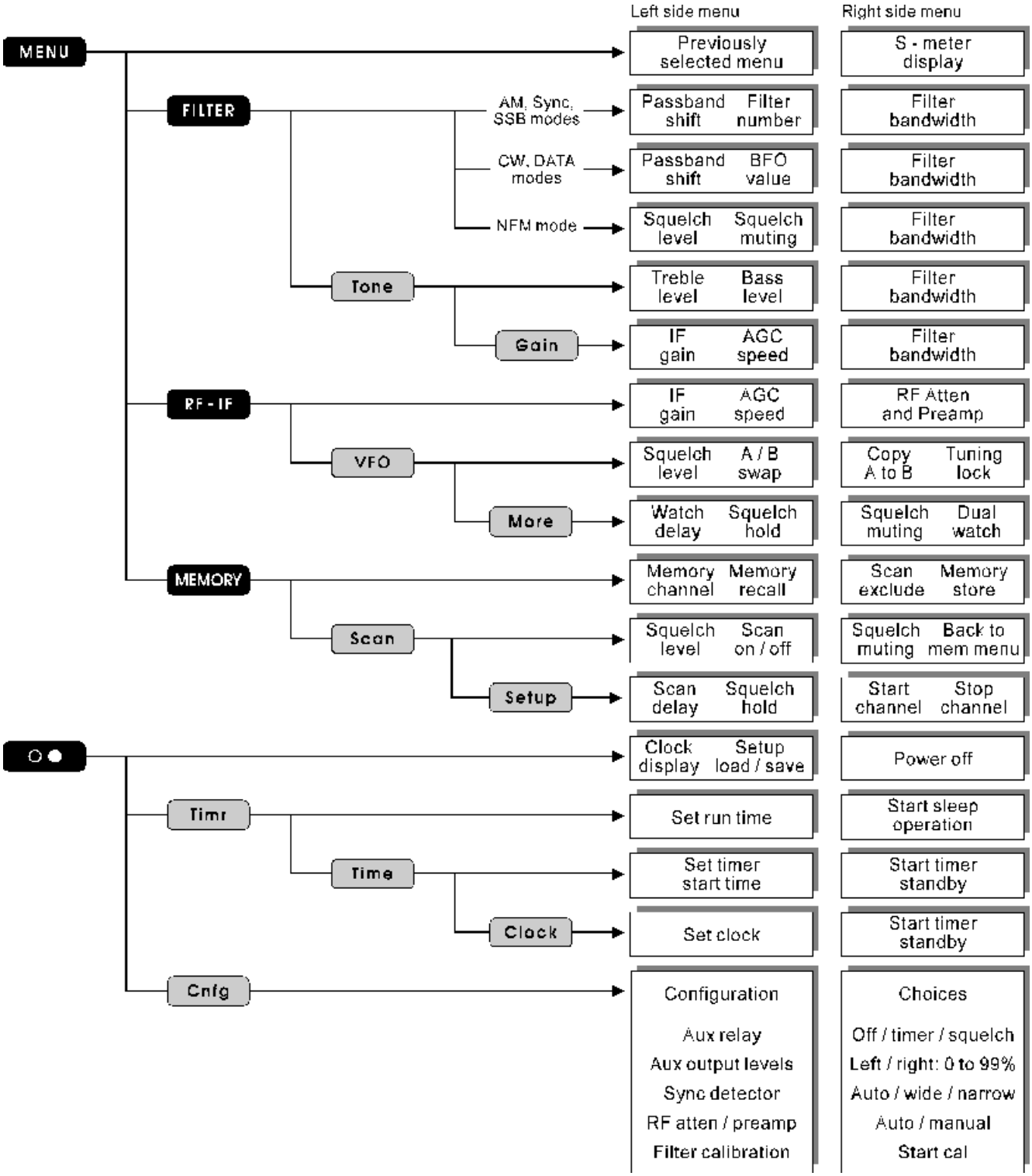
Scanning

To set scan speed, press MENU RF - IF VFO More and use ◁ ▷ **Dly** (for dual VFO scanning)
OR press MENU MEMORY Scan Setup and use ◁ ▷ **Dly** (for memory scanning)
To scan the two VFOs, press MENU RF - IF VFO More Dual •
To scan memory channels, press MENU MEMORY Scan Scan •
To set memory block for scanning, press MENU MEMORY Scan Setup then use Mxx → ◁ ▷ **From**
or →Mxx ◁ ▷ **To**
To exclude memories from scan, press MENU MEMORY, use ◁ ▷ **Mxx** to select then press Excl •

Clock and Timer

To set timer run time or sleep time, press ○● Timr and use ◁ ▷ **Mins** and +Hr
To set timer start time, press ○● Timr Time and then use ◁ ▷ **Hrs** or Mins ◁ ▷ **Mins** as required
To set clock time, press ○● Timr Time Clock and then use ◁ ▷ **Hrs** or Mins ◁ ▷ **Mins** as required
To start sleep mode countdown, press ○● Timr Sleep
To arm timer for switch-on, press ○● Timr Arm

2-4 Menu structure



2-5 Infrared remote controller - quick reference

Key

N Number key 0 through to 9

BS Backspace key (deletes last numeric keypress)

CLR Clear key (deletes whole numeric entry)

All keys labelled **+** or **-** will auto-repeat if held pressed.

Tuning

To enter a frequency directly, press N N N N . N kHz

OR press N N . N N N N MHz

Frequencies can have any number of digits, with or without a decimal point, up to a maximum of 9 characters.

Resolution of entries can be to 1Hz, with the receiver rounding to the nearest tuning step.

Frequencies of 50kHz or less are taken as tuning step size, not as receiver frequency.

To tune the receiver in steps, press TUNE + or TUNE - (step size set as described above).

To switch between active and background VFOs, press VFO A/B (VFO-A is copied to VFO-B if B is not already set).

Volume

To change the volume setting, press VOLUME + or VOLUME -

Mode

Mode key CW / NFM selects CW mode or NFM mode if CW is already selected.

Mode key LSB / USB selects LSB mode or USB mode if LSB is already selected.

Mode key AM / SYNC selects AM mode or Sync mode if AM is already selected.

Filters

To change the selected filter, press FILTER then + or -

To move the filter passband, press PBS then + or - To clear PBS offset, press PBS CLR

To alter the audio tone, press TREBLE or BASS then + or -

Memories

To select and preview a memory, press N N PREVIEW (one or two digits may be entered).

To preview the currently selected memory, press PREVIEW

To select next or previous memories, press + or - after PREVIEW or MEM have been pressed.

To select and recall a memory (into the VFO), press N N MEM (one or two digits may be entered).

To recall the currently selected memory (into the VFO), press MEM

To recall the next (and subsequent) memories (into the VFO), press MEM . . MEM . . MEM etc.

To select a memory and store (from the VFO), press N N STORE (one or two digits may be entered).

To store into the currently selected memory (from the VFO), press STORE

3 Major Features

The new AR7030 is the result of a combined project between AOR and internationally acclaimed UK designer John Thorpe. The AR7030 represents the very latest and best ever "JT" design concentrating on exceptional strong signal handling with enhanced microprocessor features and facilities. It is manufactured by AOR MANUFACTURING LTD based in Derbyshire, UK.

✶ Excellent strong signal handling

In Europe, especially at night, strong signal handling is of prime concern and this is where the AR7030 stands ahead of the field - offering an IP3 greater than +30dBm (typically +35dBm, reduced by about 10dB with the preamp switched on) and dynamic range greater than 100dB in AM mode with a 5.5 kHz filter and greater than 105dB in SSB mode with a 2.2 kHz filter. This fantastic strong signal handling is made possible by the innovative configuration of a lateral DMOS FET QUAD first mixer running at 15V, relay switching in the front end (instead of the more usual diodes) and the use of shielded inductors throughout the signal path.

✶ High sensitivity and selectivity

All this and great sensitivity - better than 0.5uV for 10dB S/N in AM mode and better than 0.3uV for 10dB S/N in SSB (with the preamp switched on). Selectivity too is razor sharp offering greater than 95dB @ 10kHz SSB and almost 110dB @ 20kHz.No other receiver in its class, nor indeed at a considerably higher price can match the sheer performance excellence of the AR7030.

✶ High Tech

The receiver is built around a TCXO frequency standard which provides the reference for all its circuitry, ensuring the ultimate in stability and optimum alignment. A single loop DDS system provides the clean local oscillator essential for low reciprocal mixing levels and seamless tuning in approximately 2.7Hz steps (no tuning "plops" at regular intervals). The receiver is a double conversion super heterodyne with intermediate frequencies of 45MHz and 455kHz.

The IF filters are self-aligned by the receiver using advanced microprocessor control, ensuring "spot on" alignment and symmetry of passband characteristics essential for serious ECSS listening. The main PCB will accept a number of different filters including various Murata types and Collins mechanical units, all will be self-aligned! The displayed filter bandwidths are not fixed but actually measured by the receiver permitting various displays such as 2.2kHz, 2.3kHz, 2.4kHz, 2.5kHz etc depending upon the particular filter fitted.

✶ Computer control port

Virtually every aspect of the AR7030 is controllable via the REMOTE port. The AR7030 may be connected directly to a host computer such as a PC (via RS232 link) with which, for example, frequency memories may be loaded, frequency and mode changed and signal activity logged - expanding the listening station even further.

✶ All mode receive over a wide frequency range

All reception modes are available as standard: USB, LSB, CW, AM, Synchronous AM, NFM, DATA. The receive coverage is 0 - 32 MHz, the AR7030 has not been disabled below 150 or 30 kHz, or made insensitive in the medium-wave band. The standard fitted IF filters include: 2.2kHz, 5.5kHz, 7.0kHz and 10kHz with two additional positions available for CW or other filter options.

✶ Auto synchronous tuning

The receiver is capable of tuning itself automatically in synchronous AM mode using a new variable bandwidth synchronous detector. Simply select synchronous mode, tune the receiver to approximately the correct frequency so that intelligible audio can be heard and wait... within a few seconds the AR7030 will sample the frequency, tune to the carrier (its great watching it tune itself!) and lock solidly onto the station. Should you prefer, you may select fully manual operation of the synchronous detector.

✶ Pass band tuning (even on synchronous AM)

Enhanced features include pass band tuning of approx ±4.2kHz, variable audio pitch on CW and DATA modes and an advanced, self tracking, synchronous detector for AM listening to eliminate the effects of transmitter or receiver drift as well as reducing distortion from selective fading. The pass band tuning may be used in synchronous AM mode to select synchronous USB, LSB, DSB or anything in between.

✶ Full AGC control plus IF gain

A specially developed AGC release characteristic produces outstanding SSB quality with quick recovery from strong signals and noise spikes. Gentle signal compression has also been included to reduce the audible effects of noise pulses. An IF gain control is available along with three AGC speeds and AGC defeat.

A built-in six level attenuator provides many levels of sensitivity:- +10dB, 0dB, -10dB, -20dB, -30dB and -40dB, however given the excellent strong signal handling of the AR7030 this is going to be a control rarely required! The receiver can automatically switch in the attenuator to keep incoming signals within its AGC range. Of course you may manually select attenuation should you prefer.

✶ Aerial input including whip amplifier

The rear panel of the AR7030 has inputs for a wire aerial with ground connection, 50 OHM SO239 connection plus selection of a high impedance whip amplifier which is fitted as standard.

✶ Audio output

Audio output is of high quality and clear tone when using the built-in top mounted speaker. A 3.5mm external speaker jack is provided on the rear panel which mutes

the internal speaker, the amplifier provides more than 2 WATTS of audio - there are even treble and bass controls. A stereo 3.5mm front panel socket provides headphone output from a separate internal stereo amplifier and may drive mono or stereo 'phones. The auxiliary outputs (left and right) have separately adjustable levels and may be used to drive an external recorder or data decoders.

✶ Dot matrix LCD

A 48 character, rear illuminated dot matrix LCD with rear panel adjustable contrast provides a huge amount of information, a wide range accurate signal meter and text based menus.

✶ Assignable controls

Assignable controls enable you to place the functions YOU want at your fingertips - they retain the last used operation when the menus are removed, and include a press button * and a spin-wheel ◁ ▷.

✶ Infrared remote controller

A full featured 32 button infrared remote control is provided as standard and provides access to all commonly used facilities, including: tuning, volume, tone, memory functions, pass band shift and filter selection, as well as providing a numeric keypad for direct frequency entry.

TWO infrared sensors are employed, one on the front panel and one on the rear, so that the controller may be used from almost any position around the receiver.

✶ Stylish strong cabinet

The AR7030 features a custom CNC machined solid aluminium front panel with extruded aluminium shaped sides, metal top, bottom and rear panels. The front panel finish is brushed and anodised with the sides and other surfaces toned in a matching textured paint. Smooth curved lines, detailed panel breaks, top mounted domed speaker grille and ergonomically placed controls spell out the attention to detail of this robust, solid cabinet.

4 Precautions

4-1 Location

Do not use or leave the receiver in direct sunlight (especially the LCD). It is best to avoid locations where excessive heat, humidity, dust and vibration are expected. Always treat the receiver with care.

Take care to avoid spillage or leakage of liquids into the receiver and a.c. power supply. Special care should be taken to avoid liquid entering around the controls, through the speaker grille or via the connection jacks.

Avoid static discharge from aerial systems especially when using long wires - earth them to a central heating radiator or similar earthing point in order to discharge the wire before connection to the receiver. Always disconnect and earth any external aerial system if an electrical storm is expected.

Avoid a rapid disconnection then reconnection of the power supply. If disconnected, leave at least two seconds before reconnecting again. Ensure that all power connections are secure.

Avoid strong RF fields from nearby transmitters. If in doubt, disconnect the AR7030 from the aerial and switch the set off.

4-2 Looking after your receiver

Always keep the receiver free from dust and water. Use a soft, dry cloth to gently wipe the set clean. Never use abrasive cleaners or organic solvents which may damage certain parts.

4-3 Power requirements

The AR7030 is designed for operation from its supplied mains adapter. Operation is possible from a d.c. supply of 12 to 15V, which should be able to supply up to 800mA, but for full performance always power the receiver from 15V d.c rather than from 12V. (The receiver's frequency coverage is not guaranteed above 30 MHz when operating from a 12V supply).

EMC NOTICE - This receiver may not fully comply with the E.C. EMC directive if operated from an external power source other than the supplied AC adapter.

The d.c. input socket uses a 2.1mm coaxial power connector, and a 14mm long plug is recommended. This connector is configured CENTRE POSITIVE, the chassis of the receiver is at negative ground. The low noise power supply provided is pre-wired and provides a regulated 15V d.c. output with suitable connectors being fitted as standard for the a.c. mains input and connection to the AR7030.

The AR7030 has a rear panel socket for connection of an RF earth, allowing a separate earth to be taken to a water pipe, central heating system radiator or external earth rod. If fitting a separate external earth rod, consider the implications carefully if your mains supply uses a Protective Multiple Earth (PME) system. If in doubt consult an expert electrician. Never earth to a gas pipe!

SAFETY NOTICE - Always disconnect the power supply from the a.c mains when not in use.

4-4 Aerial (antenna) connection

The AR7030 has two aerial inputs, selected by a rear panel switch, allowing three basic types of connection (the actual choice of suitable aerial is almost limitless).

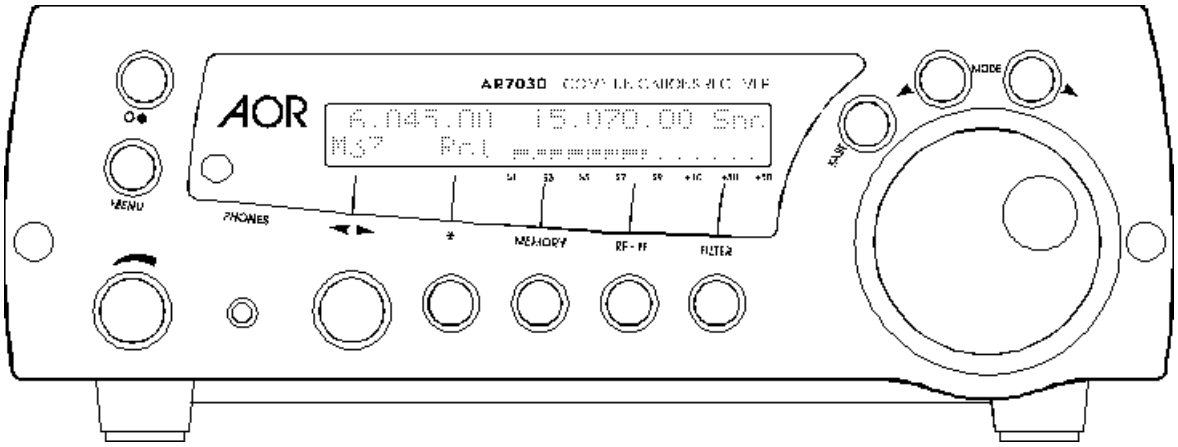
1. 50 OHM (unbalanced) SO239 socket for connection of dipoles, long wires with matching devices, active aerials, verticals, yagis etc.

2. WHIP may be selected to activate an impedance matching amplifier when a telescopic aerial or very short wire is fitted to the 50 OHM SO239 socket.

3. WIRE aerial input is used for connection of long wire or similar relatively high impedance aerial systems.

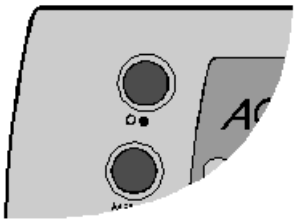
5 Controls and functions

Front panel



5-1 On/Off power switch

This button, located in the upper left corner of the front panel, switches the set on and off and selects the SETUP menu for general configuration of the receiver and setting of the clock and timer facilities.



To switch the receiver on, connect a suitable power source and press the power switch for about one second.

To switch the receiver off, press the power switch TWICE, or use the Off soft-key from the SETUP menu. When switched off, whilst the receiver is still connected to its adapter, the clock time display will continue with a dim backlight.

5-2 Liquid Crystal Display (LCD)

Display of operating condition is provided by a high contrast, green backlit, dot matrix LCD. Information includes frequency, mode, bandwidth etc. Menu legends for the controls beneath the display are also provided along with an accurate 70 segment signal strength meter (S-meter).

5-3 Main rotary tuning control - MAIN DIAL

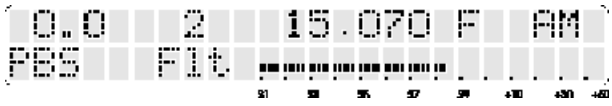
The large rotary tuning control is prominently located to the right of the front panel. This control changes the received frequency up and down. Often referred to as the VFO (Variable Frequency Oscillator), a rather historic name for a tuning mechanism, in this operating manual it is referred to as the MAIN DIAL.

The receiver tunes in a very smooth manner with increments as small as 2.655 Hz. Excellent tuning dynamics increase the rate of tuning depending upon how fast the tuning control is rotated and the mode of reception.

It is possible to electronically lock the main dial to prevent accidental tuning. A lock indication (reversed **L**) is displayed on the LCD in this case.

5-4 Fast tuning button FAST

FAST tuning increases the speed of tuning when using the main dial. The letter F is displayed after the kHz of the frequency display when fast tuning is selected - the FAST button switches this mode on and off. If tuning in automatic synchronous AM, the fast tuning mode is cancelled automatically when the receiver samples frequency and locks onto the transmission.



5-5 Mode selection buttons ◁MODE MODE▷

The mode selection buttons are located in the top right corner of the front panel. They select all of the available modes in sequence: Dat (data reception), CW, LSB, USB, AM, Snc (synchronous AM) and NFM, the sequence then repeating. The current mode is displayed to the right of the frequency readout on the LCD.

5-6 Volume control

The volume is adjusted by the rotary encoder located in the lower left of the front panel. The volume level is displayed as a percentage on the top left of the LCD whilst the control is turned. The range is 0% (minimum) to 96% (maximum).

Note: It is normal for very low level audio to emanate from the speaker even when the volume is at 0%, especially in NFM mode.

5-7 Spin-wheel ◁ ▷

This encoder is used to make selections from various menus and to change the values of receiver settings such as pass band shift (PBS), IF gain, squelch etc. The function of the spin-wheel at any instant is displayed above it on the LCD.

5-8 General button *

This button is used to make selections from menus as a soft-key. The assigned function is displayed above it on the LCD.

5-9 Memory menu button MEMORY

Initially used to choose the MEMORY menu for selection of memory channel, scan parameters and audio mute. It is also used as a soft-key to make selections from other menus.

5-10 RF and IF settings button RF - IF

Initially used to choose the RF gain / attenuator, IF gain and VFO selection menu. It is also used as a soft-key to make selections from other menus.

5-11 Filter menu button FILTER

Initially used to choose the filter bandwidth display / selection menu along with pass band shift (PBS) and audio tone control. It is also used as a soft-key to make selections from other menus.

5-12 Headphone socket

This 3.5mm socket will provide output to either stereo or mono headphones, no switching is required. Connection to this socket disables the internal speaker and any speaker connected to the rear EXT LS socket. Headphones should be of a nominally low impedance around 8 to 200 OHMS.

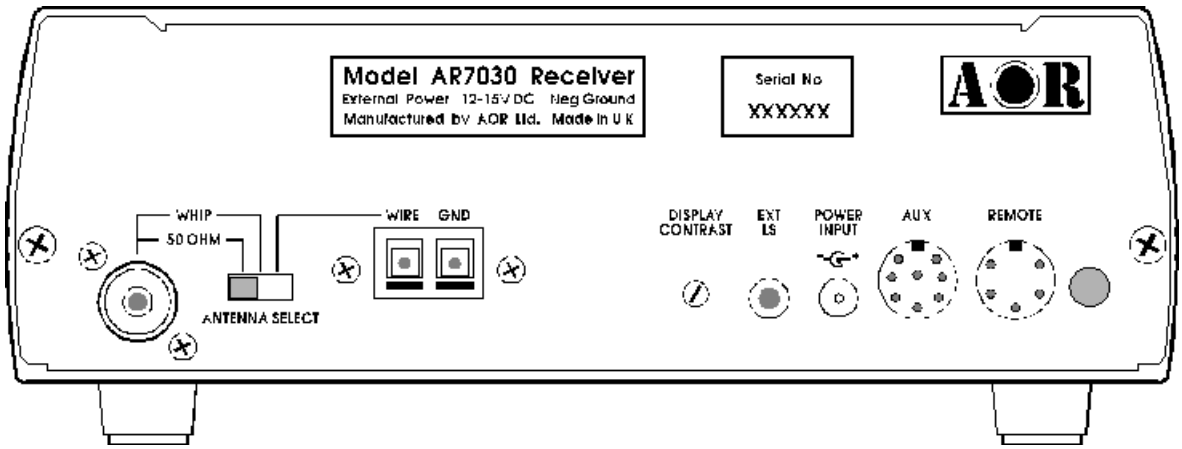
5-13 Bail bar

The front of the receiver may be lifted up clear of the table top to allow easy access to the front panel controls and clear visibility of the LCD. Pull the bar forward to lift the front of the receiver upward, rubber cushions prevent slipping on a table top.

5-14 Internal speaker

The AR7030 is fitted with a top mounted loudspeaker which provides excellent audio reproduction under most conditions.

Rear panel

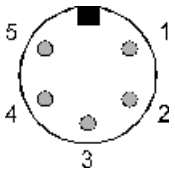


5-15 Computer control socket

This accessory socket is used for connection to a computer via RS232 link.

The socket is a 5-pin / 240° DIN with the following connections:

Pin 1 External supply output available, nominal 14V @ 100mA MAX
Pin 2 RXD
Pin 3 TXD
Pin 4 No connection
Pin 5 GROUND



Connection to a PC should be as follows:

AR7030	**PC 9-D**	**PC 25-D**
pin 2	pin 3	pin 2
pin 3	pin 2	pin 3
pin 5	pin 5	pin 7 (GND)

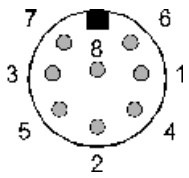
5-16 Auxiliary equipment socket

This accessory socket is used for connection to tape recorders and data decoders. Two audio outputs are provided unaffected by volume and tone settings. A mute input and a 455 kHz IF output are also present.

The socket is of an 8-pin DIN, circular configuration with pin 8 being at the centre. The connections are as follows:

Pin 1 MUTE - ground to mute the receiver (in conjunction with a transmitter)
Pin 2 GROUND
Pin 3 External supply output available, nominal 14V @ 100mA MAX
Pin 4 Auxiliary audio output (LEFT) 0-800mV from 1kohm
Pin 5 Auxiliary audio output (RIGHT) 0-800mV from 1kohm
Pin 6 Aux control relay contact A (for tape recorder motor control)
Pin 7 Aux control relay contact B (for tape recorder motor control)
Pin 8 455 kHz IF output -20dBm / 50 ohms

The aux relay can only be used for low voltage control, **NEVER CONNECT MAINS TO THE AUX RELAY CONTACTS**.



5-17 DC power input

This is a 2.1mm coaxial power socket designed to accept external d.c. input from an ac adapter. See section **4-3** for supply details.

5-18 External speaker output socket

This 3.5mm mono jack socket provides audio output to drive an external speaker unit. Connection to this socket automatically disables the internal speaker but not a headphone if connected to the front panel socket.

An external speaker should have a minimum 8 ohm impedance and power handling of 2 watts or greater.

5-19 Display contrast adjustment

This rotary control adjusts the LCD display contrast and viewing angle. Adjust this for optimum display readability - it may need re-adjusting if the viewing angle is changed or if there is a significant change in temperature. The normal control position will often be slightly less than fully-clockwise.

5-20 Ground (chassis) connection

Ground connection for an external RF earth. This often reduces noise.

5-21 Wire aerial connection

Connect a long wire aerial to this terminal.

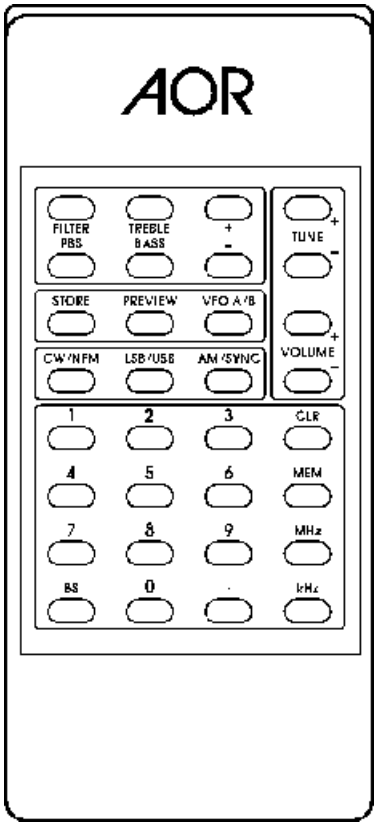
5-22 Antenna selection switch

This slide switch is used to select the aerial connection and function: 50 OHM, WHIP or WIRE.

5-23 50 OHM aerial socket

50 OHM SO239 socket designed for connection to unbalanced 50 OHM aerials with coaxial feeders, or, with the selection switch in the WHIP position, a telescopic aerial.

Infrared controller



5-24 Filter change key FILTER

One of a group of six keys contained within an outline, the FILTER key chooses filter selection for subsequent change with the + and - keys. When FILTER is pressed the receiver briefly displays the legend **Filter** along with the sequence number (1 to 6) of the current filter (the standard receiver displays 1 to 4 because it is fitted with 4 filters). This message is displayed for about 5 seconds then the display returns to its previous condition.

For example, if the narrowest filter (2.2 kHz as standard) is currently selected, the display will show **Filter 1**

The + and - keys can be used to step through the available filters with the display confirming the selection. + and - will continue to modify the filter selection until one of the other change keys PBS TREBLE BASS or the MEM or PREVIEW key is pressed.

5-25 PBS change key PBS

One of a group of six keys contained within an outline, the PBS key selects passband shift for subsequent change with the + and - keys. When PBS is pressed the receiver briefly displays the legend **PBS** along with the current shift value in kHz (-4.2 to +4.2 with 0.0 indicating no shift). This message is displayed for about 5 seconds then the display returns to its previous condition.

The + and - keys can be used to increase or decrease the passband shift value with the display following the changes, and will continue to modify PBS until one of the other change keys FILTER TREBLE BASS or the MEM or PREVIEW key is pressed.

The PBS can be quickly turned off (set to zero) by pressing PBS then CLR.

5-26 Treble change key TREBLE

One of a group of six keys contained within an outline, the TREBLE key selects treble audio tone for subsequent change with the + and - keys. When TREBLE is pressed the receiver briefly displays the legend **Treb** along with the current value in dB (-8 to +8 with +0 indicating a flat response). This message is displayed for about 5 seconds then the display returns to its previous condition.

The + and - keys can be used to increase or decrease the treble tone value with the display following the changes, and will continue to modify treble tone until one of the other change keys FILTER PBS BASS or the MEM or PREVIEW key is pressed.

5-27 Bass change key BASS

One of a group of six keys contained within an outline, the BASS key selects bass audio tone for subsequent change with the + and - keys. When BASS is pressed the receiver briefly displays the legend **Bass** along with the current value in dB (-9 to +9 with +0 indicating a flat response). This message is displayed for about 5 seconds then the display returns to its previous condition.

The + and - keys can be used to increase or decrease the bass tone value with the display following the changes, and will continue to modify bass tone until one of the other change keys FILTER PBS BASS or the MEM or PREVIEW key is pressed.

5-28 Increase and decrease keys + -

The + and - keys are contained within a group of six and are used to change the selected filter or values of PBS or tone control settings (see above). They can also be used to step through the frequency memories if used after either the MEM or PREVIEW keys have been pressed. These keys will auto-repeat if held down for more than half a second.

5-29 Tune-up and Tune-down keys TUNE + TUNE -

These two keys allow the receive frequency to be varied (tuned) upwards or downwards in any selected step size between 2.7 Hz and 50 kHz. These keys will auto-repeat if held down for more than half a second.

The step size is set by entering a frequency via the keypad of 50 kHz or less. Tuning using the TUNE + and TUNE - keys can be done in addition to using the main dial.

5-30 Volume increase and decrease keys VOLUME + VOLUME -

These two keys allow the volume of the receiver to be varied between minimum and maximum. They will auto-repeat if held down for more than half a second.

5-31 Store into memory key STORE

The STORE key is used to store the current receiver frequency and mode into the current memory channel. The legend **Stored ..** on the receiver's display confirms operation, and appears for about 5 seconds in the top left corner. Keying in a memory number before pressing STORE will use that memory.

5-32 Memory preview key PREVIEW

The PREVIEW key is used to preview, rather than recall, the frequency contained in the currently selected memory. The memory's stored frequency is displayed in the top left corner of the LCD for about 5 seconds. If no data is stored in the memory, the frequency **000.00** is displayed.

A particular memory may be examined by keying in its number then pressing PREVIEW. Subsequently pressing + or - will step through memory channels.

5-33 Change VFO key VFO A/B

The VFO A/B key swaps between active and background VFOs (A and B). If no data has been previously stored in the background VFO, the current contents of the active VFO are copied to the background VFO which is then recalled... nothing appears to happen on the LCD in this situation as the contents of the two VFOs are identical.

Each VFO contains nearly all of the current operating conditions of the receiver, including frequency, mode, filter, PBS, volume, treble, bass, squelch, IF gain, AGC speed and tuning step size for TUNE + and TUNE -.

Note: The Background VFO information is lost when power to the receiver is switched off.

5-34 Mode select keys CW / NFM LSB / USB AM / SYNC

These keys, contained in a group of three, are used to directly select the reception mode as an alternative to stepping through a list of modes with the front panel buttons. When any of these keys is pressed the mode specified first is selected unless that mode is already in use, in which case the second mode is chosen.

Foe example, to change from AM mode to USB mode, the LSB / USB key would be pressed twice. Subsequent presses would then toggle between LSB and USB modes.

5-35 Number keys 0 . . . 9 and .

The numeric keypad is used to enter frequencies, step sizes and memory numbers. The receiver will display keystrokes in the top left corner of its display as they are entered until input is completed or a long time elapses (about 20 seconds after the last keystroke).

The . key is used when keying frequencies to enter fractions of kHz or MHz as desired. It is not needed when entering whole numbers.

5-36 Backspace key BS

Pressing BS will delete the last keypress from your entry. This only works with the number keys while the current keyed input is displayed on the LCD - it will not undo an operation once it is completed.

5-37 Clear key CLR

The CLR key will delete a whole line of entered digits to allow a fresh start.

5-38 Memory recall key MEM

The MEM key is used to directly recall memory frequencies into the VFO. Each time the key is pressed, the receiver advances to the next memory channel and receives what ever frequency is stored. The + and - keys may also be used in conjunction with MEM to select the starting position for memory recall. When the desired memory channel is displayed in the top left corner of the LCD, the MEM key then recalls the data and tunes the receiver.

Additionally the MEM key can be used in conjunction with the numeric keypad to directly recall a memory. For example to recall and listen to the frequency stored in memory 25, press 2 5 MEM. The legend **Mem 25** is briefly displayed in the top left corner of the LCD to confirm selection and the receiver is tuned to the memory frequency.

5-39 Frequency entry keys MHz kHz

These keys complete a key entry and tune the receiver. Frequencies can be entered in MHz or kHz and terminated with the appropriate key. Frequency accuracy can be to 1Hz, with the receiver tuning to its nearest step (maximum error is 1.4Hz).

For example, to tune to 15.070 MHz (which is 15070 kHz),

press 1 5 . 0 7 MHz
(to enter frequency in MHz)

or press 1 5 0 7 0 kHz
(to enter frequency in kHz)

6 Receiver operation - Main functions

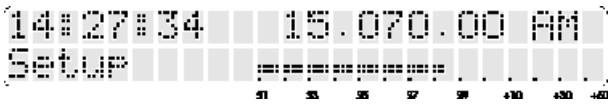
It may be useful to refer to the overview and quick reference guides in section 2 of this manual whilst working through this section.

6-1 First switch-on

Connect an appropriate aerial to the input on the rear of the receiver and make sure that the ANTENNA SELECT switch is correctly set. The selection of aerial depends upon your location and specific requirements but may include a dipole or long wire.

Plug the d.c. cable of the supplied mains adapter into the power socket on the rear of the AR7030 and then plug the adapter into the mains supply. Never connect the receiver directly to the a.c. mains.

Press and release the power button ○●, the receiver will turn on and the LCD back light will illuminate.



Firstly, check the clock time - it should be displayed at the top left corner of the display. If it has started from 00:00:00 instead of reading a sensible time then it is likely that the small rechargeable battery in the receiver has run down.

This battery operates the clock and retains some calibration data in memory, so you should work through sections 6-2 and 6-3 to restore this data before using the receiver. To re-charge the battery leave the receiver connected to its mains adapter for about 48 hours (it doesn't matter whether the receiver is switched on or off). The charge should last for many months.

If the clock looks OK then you can skip sections 6-2 and 6-3 for the time being, but have a look at them later.

6-2 Filter calibration

If the data retention battery is discharged, or you have added extra filters, or you have just got bored with listening to your radio then you can run through the filter calibration procedure. This is an automatic process once started and takes about half a minute. Choose the SETUP menu by pressing the ○● button and then choose CONFIGURE by pressing Cnfg (the soft-key function shown on the display above the FILTER button). Rotate the spin-wheel one click anti-clockwise to display **Filter calibrate:** and press Start.

The receiver will display the filter number currently being calibrated, signal level, -20dB and -6dB frequency offsets for high-side and low-side calibration. The AR7030 generates and injects a variable frequency signal from the DDS and uses the AGC system to measure the filter passband characteristics. In the process, the -6dB bandwidth, centre frequency and USB and LSB carrier insertion frequencies are determined. A list of filters is then generated in ascending bandwidth order, regardless of the physical position in which any filter has been fitted.

Ideally the calibration should be made when the set is at its normal operating temperature (i.e. after about 30 minutes of use). You may carry out the calibration as often as you like... it will not affect the performance of the receiver if run more than once but it is interesting to watch!

The displayed bandwidth is rounded to the nearest 0.1kHz so there may be slight variations in the results between different calibration runs. Some filters are quite sensitive to temperature changes.

Note: Most filter manufacturers usually quote a *minimum* pass-band bandwidth (and a maximum stop-band bandwidth) so in practice filters often measure wider than their specification. The receiver, of course, doesn't know the spec - it can only measure what's fitted. In fact the standard 5.5kHz filter fitted to the AR7030 has a specified bandwidth of 4kHz, so be careful when comparing the filter calibrate results with bandwidths specified for optional filters or other receivers.

Ceramic filters, such as the Murata ones fitted to the AR7030, have very rounded filter characteristics. Many people like the AM audio sound produced by this type of filter, however such a filter is very difficult to accurately measure. Collins mechanical filters can be fitted to the AR7030 and have much sharper shoulders making them easier to measure. Collins produces a 4.0 kHz AM mechanical filter which will provide excellent results, the optional 500 Hz CW mechanical filter and 2.5 kHz mechanical filter are also very good. The displayed bandwidth is not important for the receiver's performance - it is only used by the receiver to build its filter table in ascending order and as identification of which filter is selected at any time.

Typical displayed bandwidths for the standard filters are:-

Filter 1	Displays as 1.8 to 2.3 kHz (Spec. nominal 2.2 kHz)
Filter 2	Displays as 5.4 to 5.9 kHz (Spec. minimum 4kHz)
Filter 3	Displays as 6.3 to 7.0 kHz (Spec. minimum 6kHz)
Filter 4	Displays as 9.5 kHz (Spec. minimum 9kHz)

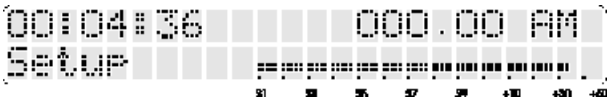
Typical displayed bandwidths for the optional Collins filters are:-

Collins 500 Hz Displays as 0.7 or 0.8kHz

Collins 2.5 kHz Typically displays as 2.3 kHz

Collins 4.0 kHz Typically displays as 3.5 kHz

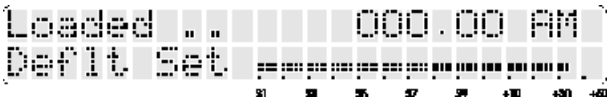
When the filter setup is complete, the receiver's display returns to frequency readout.



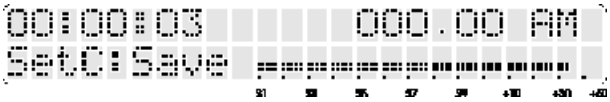
6-3 Memory restoration

If the data retention battery is discharged (refer section 6-1) then some of the setup memories may contain rubbish which will cause unusual operation of the receiver. To avoid this problem the following procedure should be followed after the filter calibrate operation. It is only necessary to do this if the clock time has been lost.

From the SETUP menu (press the ○● button if **Setup** is not displayed above the spin-wheel), Rotate the spin-wheel one click anti-clockwise so that the legend **Deflt Set** is displayed then press the * button. The legend **Loaded..** confirms that default settings are in operation.



Rotate the spin-wheel again one click anti-clockwise and press Save (the soft-key legend above the * button), then repeat twice more. This will save default settings in all three setup memories - the display should show **SetC:Save** then **SetB:Save** then **SetA:Save**.



Now enjoy !

6-4 Changing receive frequency

There are THREE main ways in which receive frequency may be selected and tuned, the choice is dependant upon the type of operation (transportable / desktop) and personal preference.

a. Main rotary tuning dial

The most obvious method for tuning the receiver is by the rotary tuning control (main dial). This is the traditional approach and provides the best human interface to the receiver.

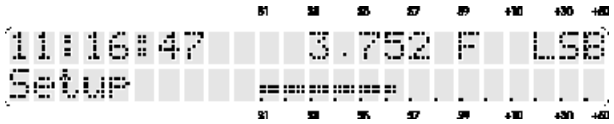
To increase displayed frequency rotate the main dial clockwise. In SSB modes the tuning speed is around 1kHz per revolution for silky-smooth tuning. As the main dial is rotated more quickly, the receiver steps up the tuning rate, if the main dial continues to be rotated quickly, so the tuning speed is increased again and again. Careful attention has been paid to the tuning dynamics so that the operator is largely unaware that anything happens and the tuning speed remains intuitive.

To decrease the displayed frequency, rotate the main dial anti-clockwise, auto increase in tuning speed operates in both directions.

Note: The main dial uses a mechanical encoder, and from time to time, as with all such devices, contact noise may cause the display to creep up or down very slightly. Should this happen a tiny movement of the tuning knob will be enough to clear the problem. The control likes to be used... give it a few turns once in a while.

FAST TUNING: Should you wish to tune VERY quickly, such as when changing bands, it is possible to manually increase the tuning rate of the receiver.

Above-left of the main dial at about the 10 o'clock position is the FAST button. Pressing this changes the frequency display by putting an **F** (for fast) where the fractions of kHz digits are normally shown. The tuning rate of the main dial will be very fast while the **F** is displayed.



To cancel fast tuning, simply press the FAST button again, it acts as a toggle.

Note: When tuning in AUTO SYNCHRONOUS AM, the FAST tuning is automatically cancelled when the self tune process starts.

b. Numeric keypad

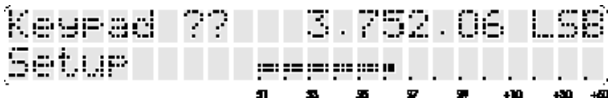
For rapid change to a known frequency, the infrared controller keypad provides the simplest, quickest and most accurate route. Frequencies may be entered as MHz or kHz, there is backspace correction and cancel entry to further add to convenience.

The numeric keys 0 to 9 are used in conjunction with . , kHz , MHz , CLR and BS . A summary of key operation is as follows:-

0 to 9	Used to enter the digits of desired frequencies.
.	Used as a decimal separator when entering frequencies as MHz or kHz.
kHz	Used to complete frequency entry as kHz.
MHz	Used to complete frequency entry as MHz.
CLR	Used to cancel frequency entry and abort the process

BS Used to backspace frequency entry from the right hand side, each additional press of this key deletes one further figure. This is useful for correcting a mistake without the need to re-enter the whole frequency.

Frequency entry using the infrared controller is accepted in the range 0.051 MHz (actually 50.977 kHz) to 32 MHz (actually 32.01672 MHz). Frequencies above the specified top limit up to about 44 MHz will result in the receiver tuning to the top frequency limit just above 32 MHz. Incorrect frequency entry usually results in an error message **Keypad ??** being displayed in the top left corner of the LCD.

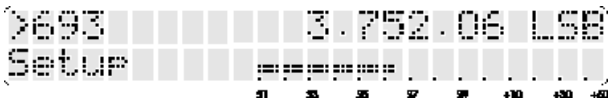


You cannot key in a frequency of 50 kHz or less to tune the receiver. Instead this is how the tuning keys' step size is set.

Examples: An example frequency entry using the kHz key of 693 kHz (0.693 MHz), as follows:-

6 9 3

As the frequency is entered through the keypad, the digits are displayed in the top left hand corner of the LCD, to the right of a **>** symbol.



When the entry is completed using the kHz key, the frequency transfers to the main VFO frequency readout of the LCD and the top left display returns to its previous state.

Another example of frequency entry for the international search and rescue frequency 5680 kHz (5.680 MHz) would be as follows:-

5 6 8 0 kHz

When the kHz key is used, the AR7030 automatically calculates where the decimal MHz separator should be inserted.

It is possible to enter frequencies using kHz and a decimal point for hundreds and tens of Hz. This may be useful for certain data communications applications such as FAX. For example, to tune to 132.5 kHz type:-

1 3 2 . 5 kHz

As frequency increases past a few MHz, it becomes more natural and easier to enter frequencies directly in MHz.

An example frequency entry of 14.250 MHz (14250 kHz) would be as follows:-

1 4 . 2 5 0 MHz

As the frequency is entered through the keypad, the input is displayed in the top left hand corner of the LCD, to the right of a **>** symbol. When the entry is completed using the MHz key, the frequency transfers to the main VFO frequency readout of the LCD and the top left display returns to its previous state.

It is not necessary to add leading or trailing zeros to any frequency. Entry of 14.250 MHz may alternatively be:-

1 4 . 2 5 MHz

The three trailing zeros will be added automatically to the display by the AR7030.

Similarly, when frequencies below 1 MHz are entered, it is not necessary to precede with zeros. To enter a frequency of 0.198 MHz (198 kHz) using the MHz key:-

. 1 9 8 MHz

The preceding zeros are assumed by the AR7030 and trailing zeros added automatically.

Cancelling frequency input: At any time during frequency entry via the keypad, the process may be aborted by pressing the CLR key. Any input displayed in the top left corner of the LCD is cancelled and the displayed reverts to its previous state.

Correcting frequency entry during input: Should a mistake be made while entering frequency via the keypad, it may be corrected using the back-space key BS**.** However, the entry cannot be corrected once the kHz or MHz keys have been pressed.

Each time the BS key is pressed, the frequency entry (progress is displayed in the top left of the LCD following a **>** symbol) is deleted from the right-most digit (the last one entered). Each additional press of this key deletes one further digit. This is useful for correcting a mistake without the need to retype the whole frequency.

For example, if the entry has been mis-typed as 6 9 4 and the mistake realised before the kHz key is pressed, press BS to delete the figure **4**. Enter 3 to replace it, then complete the process by pressing kHz.

c. Tuning step keys TUNE + TUNE -

Occasionally it is convenient to tune up and down the frequency spectrum in specific step sizes such as 5 kHz for short wave, 9 kHz for European medium and long wave or 10 kHz for US medium wave. The step tuning facility also makes fine tuning sprawling amateur band nets easy when the receiver is just out of reach.

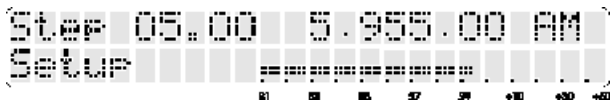
First the tuning step size needs to be defined and this is achieved using the numeric keypad. For example, to select a tuning step of 5 kHz from the from the infrared controller type:-

5 kHz

Other permutations are also accepted:-

0 5 kHz
or 0 . 0 0 5 MHz
or . 0 0 5 MHz

The LCD briefly confirms entry as **Step 05.00** in the top left of the LCD to show that the entry is accepted as a step size and not a frequency to tune to.



Each time the keys TUNE + or TUNE - are pressed, the receiver will step up or down by 5kHz (as this is the step size currently selected). The LCD frequency readout changes as the receiver tunes to new frequencies. You may hold down the TUNE + or TUNE - keys for continuous tuning in the selected step size.

To select a tuning step of 10 Hz, type

. 0 1 kHz

To select the smallest possible tuning step, type

. 0 0 2 kHz

VFO-A and VFO-B can store different step sizes.

Note: The receiver stores all of its frequencies in binary steps (the AR7030 doesn't think in decimal!) and as a result the last digit of the displayed frequency may gain or loose 10 Hz especially if the TUNE keys are used repeatedly. This is simply because the step size cannot be stored as an exact number of kHz.

d. Other methods of frequency selection

It is also possible to recall memories into the active VFO as a means of changing frequency. For instance, a number of memory channels could be set up with the centre or most popular section of your favourite amateur bands or broadcast bands then recalled as the starting point for manual tuning.

Frequency selection may also be accomplished using an external computer connected to the remote port.

6-5 Changing reception mode

The AR7030 is equipped with seven reception modes as standard, these being:- DATA, CW, USB, LSB, AM, Synchronous AM and NFM.

Mode selection buttons are ergonomically placed above the main dial, located toward the top right corner of the front panel. These mode buttons have only one function and are not used for anything else, this makes them available at all times - reception mode may be changed regardless of what menu is displayed on the AR7030 LCD (except when it's switched off!).

The mode buttons select from a rolling list:-

Dat (data reception)
CW
LSB
USB
AM
Snc (synchronous AM)
NFM

The reception mode is displayed to the right of the frequency readout on the LCD. Any reception mode may be selected on any frequency within the receiver's short wave coverage.

Mode may also be changed using the keys of the infrared controller CW / NFM, LSB / USB and AM / SYNC. Data reception mode cannot be selected from the infrared controller.

The keys select the mode listed first (to the left) i.e. CW, LSB and AM unless that mode is already in operation, when they will select the mode listed second i.e. NFM, USB and SYNC.

AM Amplitude Modulation - Used by broadcast services throughout the world on long wave, medium wave and short wave.

For best results use either the 5.5 kHz IF filter (for normal operation) or the 7.0 kHz IF filter for higher fidelity when signals are strong and free from interference. You will have to experiment with the setting of the AGC so medium speed (**Med**) may be a good starting point.

Snc Synchronous AM - the AR7030 uses a new automatic variable bandwidth synchronous AM circuit which is capable of automatically tuning the receiver and locking on to fading transmissions. It is also possible to select manual synchronous AM although the default is automatic.

Synchronous AM is a special form of AM detection capable of reducing the effects of fading on long wave, medium wave and short wave signals.

LSB Lower Side Band - is a form of Single Side Band (SSB). LSB tends not to be used commercially but is extensively used by radio amateurs on frequencies below 10 MHz. This assists the separation of commercial and amateur users on traditionally shared bands and prevents them from unintentionally speaking with each other.

SSB is a very efficient method of transmission as the unwanted second sideband and carrier have been removed. This allows the full transmitter power to be employed in carrying useful information within the wanted sideband. As a result greater distances are possible on SSB and a smaller frequency bandwidth is required than most other modes.

The AR7030 uses true carrier re-insertion so that voice becomes intelligible - with ease. However due to the complexities of SSB, audio may never sound quite 100% natural and often listeners comment on it sounding a little like Donald Duck. This is normal, and with practice you soon become used to tuning and listening to SSB... it is not a problem specific to the AR7030.

The setting of AGC speed is important for SSB reception. Usually a SLOW setting provides the best results when background noise will usually be reduced. Select the 2.2 kHz IF filter and experiment with the AGC and IF GAIN for best results. If splatter is encountered from adjacent channels, it may help to reduce the bass audio tone control to **-5** and the treble control to no more than **+2**.

When listening to amateur band nets and wishing to keep background noise to a minimum, rotate the IF gain control anti-clockwise to reduce gain so that the S-meter graphic just lifts with voice peaks, this can reduce the background noise especially during pauses in speech.

Do remember that reducing the IF GAIN control (which increases deflection of the S-meter) reduces the sensitivity of the receiver, the normal position is fully clockwise: 99% = maximum sensitivity.

USB Upper Side Band - The same comments apply as for LSB. By convention, radio amateurs use USB above 10MHz. USB is used by most commercial long distance point-to-point communication links on short wave including shipping and oceanic air traffic control.

CW Continuous Wave - Often referred to a carrier wave or Morse code. The BFO injection frequency may be varied for optimum reception. An optional Collins, 500Hz, 7 resonator, mechanical filter may be fitted and will greatly aid rejection of unwanted signals on this mode.

Dat Data mode - the data mode enables different carrier reinsertion (BFO) and pass band (PBS) settings so that it can be tailored for whatever decoder is attached to the receiver (FAX or RTTY, etc).

When the PBS menu is chosen in CW or DATA modes, the BFO frequency is also displayed (where the filter number is usually shown).

NFM Narrow-band Frequency Modulation - this provides high quality communication for relatively short distance operation. NFM uses a greater frequency bandwidth than other modes such as SSB so is only used at the higher frequency end of the HF band. Typically, on short wave, FM is used by Citizen Band radio in some geographical locations and 10m amateur band operation centred around 29.6 MHz. Always select the widest filter (10 kHz).

On the FILTER menu the spin-wheel is assigned to squelch level, in place of PBS on other modes (PBS is pointless in NFM mode). The squelch level is expressed as a percentage and the soft key Mute• (the * button) turns squelch muting on or off. When the squelch is advanced far enough to cancel the background noise, a reversed **S** is displayed to the left of the frequency readout. If the **Mute** bullet is filled (i.e. muting enabled) the audio will be silenced in the absence of a transmission.

If the squelch control is set too low, or muting is not enabled the background noise may be quite loud in the absence of a transmission. For ease of listening the squelch control should be rotated clockwise until the reversed **S** indicator just comes on. This adjustment should be carried out when no signal is present - the point where the squelch indicator changes is known as the threshold point. Do not advance the squelch control more than necessary or the receiver will not un-mute when weak signals are received.

Note regarding squelch: The squelch operation on the AR7030 is driven from signal strength, so it will work in all reception modes. The reverse **S** on the LCD indicates when the squelch is active... you may enable or disable muting as you wish. The squelch is also used to control scanning and dual VFO operation.

Automatic synchronous AM: The receiver will display an **(S)** as the mode indication on the LCD while evaluating the frequency of the tuned signal, then will re-tune the receiver automatically before locking on to the transmission. Even if the transmission subsequently moves in frequency to some degree, the AR7030 will track it automatically, but the display will not change. The auto-track reduces the chances of unlock due to thermal changes in the receiver or wandering transmitters.

The exact process is:-

(S) The receiver is in AM mode, switches off any passband shift and evaluates the frequency of the transmission. The receiver is automatically re-tuned as necessary. The set is capable of determining centre frequency to better than 100 Hz with an error of around 30 Hz being typical. Sometimes it is spot on!

Initially a wide synchronous detector bandwidth is employed as the receiver 'homes in' on the desired signal. When almost on target a narrow bandwidth is selected which can cope with deep fades.

Any previous PBS setting is re-applied.

Snc The receiver is now locked onto the transmitters carrier signal. Any carrier reduction and the accompanying selective fading distortion will be greatly reduced.

Even if the transmission frequency wanders (such as pirate, low cost stations) the receiver will track it and remain firmly locked. Although the set is effectively re-tuned to maintain lock, the display is not updated, this reduces any annoying effect of numbers blinking back and forth.

(A) While **Snc** mode is selected, you may turn the main dial to tune the receiver without first returning to AM mode. The receiver will automatically drop back to standard AM and will display the legend **(A)** to indicate that it is temporarily receiving in AM mode. This is to prevent unpleasant whistles which are associated with tuning a receiver while in synchronous AM mode. The synchronous AM system will automatically reactivate a few seconds after tuning has stopped.

Note: Pass band tuning may be used in conjunction with synchronous AM for selecting double sideband, upper sideband or lower sideband. Do not swing the PBS control too far while receiving in synchronous AM because the receiver will have difficulty locking when the carrier is moved outside of the filter passband.

Manual synchronous AM : If you prefer to be in total control, the automatic synchronous AM system may be switched off and a manual system used in its place with selectable wide and narrow bandwidths.

From the SETUP menu (press the ○● button if **Setup** is not displayed above the spin-wheel) choose Cnfg to go the to CONFIGURE menu.

Rotate the spin-wheel until the display indicates **Sync detector:**

Pressing the soft-key on the right will change the synchronous detector through its three modes:- **Auto**, **Narrow** and **Wide**. Narrow and Wide are both manual modes. Operational changes are made immediately so that you can assess the results. Press the MENU button to exit from CONFIGURE.

In wide mode the synchronous detector is easy to tune but deep fades may result in an unlock and some distortion. Narrow mode requires precise tuning but copes better with deep fades. In either mode the frequency indicated at the lock point may be offset by a couple of hundred Hertz from the transmission frequency. This is quite normal and will vary with temperature. The frequency readout is not accurate because the detector calibration is by-passed in manual mode. Once the receiver is locked, phase error is used to produce tuning aid symbols **<<<** or **>>>** to enable optimum tuning.

In manual synchronous mode, the AR7030 should be tuned in a similar manner to any other receiver equipped with synchronous AM - so that there is no beat note (this is referred to as zero beat). Zero beat is a null point at the centre of an AM transmission where the carrier is phase locked to an injected carrier generated by the AR7030. There will be ascending tones when tuning to either side when the carriers are not locked.

Even when tuning in manual synchronous AM, the AR7030 provides useful status information:-

Snc Synchronous AM mode is selected and is locked. This is always displayed for the first couple of seconds after synchronous mode is selected.

(U) Synchronous AM is unlocked, you can usually hear a beat note.

<<<The detector is locked but not optimally tuned to give the best audio quality. To correct this, tune the receiver to a lower frequency by rotating the main dial anti-clockwise.

>>>The detector is locked but not optimally tuned to give the best audio quality. To correct this, tune the receiver to a higher frequency by rotating the main dial clockwise.

(A) The receiver is being tuned and has temporarily switched to AM mode. While synchronous AM is selected, you may turn the main dial to tune the receiver without first returning to AM mode. The receiver will automatically drop back to AM mode and will display the legend **(A)** to indicate this. The synchronous AM system will automatically reactivate a few seconds after tuning has stopped.

6-6 IF filter bandwidth selection

As standard the AR7030 is fitted with four different filter bandwidths. USB, LSB, CW and DATA modes require a narrow filter of 2.5 kHz or less while AM and Synchronous AM require a wider bandwidth of 4.0 to 7.0 kHz and NFM requires a bandwidth of 9.0 to 15.0 kHz. The wider the filter, the better the audio quality but the receiver is then more prone to adjacent channel interference. For this reason different bandwidths can be selected for each mode. A further two filters, giving a greater selection of bandwidths, may be installed.

The receiver identifies its filters by number, 1 being the narrowest up to 4 as the widest on the standard unit. If more are fitted the order is maintained, so the widest may be number 5 or 6. The numbers are independent of the circuit position where the filters are installed. To help the operator, the receiver also displays the bandwidth of the current filter selected. This figure is established by the receiver for each filter fitted when the calibration routine is run (see section 6-2).

To review the current filter at any time press the FILTER key on the infrared controller and the currently selected filter will be displayed in the top left corner of the LCD for about 5 seconds.

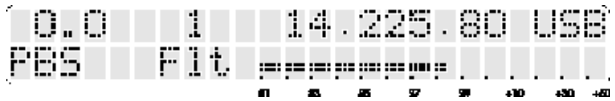
On the standard model fitted with four filters, the USB/LSB default filter (2.2 kHz) is displayed as:-

After pressing FILTER the bandwidth can be changed using the + and - keys.

Filter selection from the receiver's front panel requires the FILTER menu. If the S-meter is not displayed, press the MENU button to return to the menu root. Press the FILTER button to choose the FILTER menu - the LCD will show PBS, filter number, filter bandwidth plus a menu link to TONE. The exact form of the menu depends on the selected mode, for example NFM has squelch in place of PBS and CW or DATA modes include BFO.

To change filter, press the buttons beneath the up or down arrows on either side of the displayed filter bandwidth. To cycle through the available filters, press the Flt button (available in LSB, USB, AM and Sync modes).

To restore an S-meter display, press the MENU button.



VFO-A and VFO-B and each mode may have different filter selections in order to provide the greatest flexibility, especially when moving between AM and SSB while DXing using ECSS.

6-7 Passband Shift (PBS)

The AR7030 is fitted with a powerful system to help eliminate the effects of adjacent channel interference by shifting the passband of the IF filter upward or downward in frequency. PBS operates in all modes except for NFM and each mode retains its individual PBS setting. For example, if you apply a PBS offset in AM mode it will not be the same in other modes such as USB or LSB, which adds versatility to the receiver and reduces the amount of unnecessary button pressing when changing modes, when DXing using ECSS (listening to AM with SSB modes) etc.

PBS may be used when receiving in Synchronous AM mode so that USB, LSB or anything in between may be selected, but avoid so much offset that the carrier cannot get through the filter - don't apply more than half of the filter bandwidth.

PBS offset adjustment from the receiver's front panel requires the FILTER menu. If the S-meter is not displayed, press the MENU button to return to the menu root. Press the FILTER button to choose the FILTER menu - the LCD will display **PBS** above the spin-wheel, indicating this as the spin-wheel function. The current PBS offset appears in the top left corner of the LCD. A value of **0.0** indicates no offset (the default setting).

Turn the spin-wheel to change the PBS offset. Press the MENU button to restore an S-meter display, .

When an IF filter bandwidth greater than 3.0 kHz is in use, the PBS control shifts the passband in 100 Hz steps (0.1 kHz). When a narrower filter is used the steps reduce to 33 Hz (0.033 kHz). The PBS offset is displayed to the nearest 100Hz step.

The infrared controller may also be used to check, modify and cancel PBS settings at any time. Press the PBS key to review the current value, which will be displayed on the top left of the LCD (for about 5 seconds). Once the PBS key has been used, the value of the PBS offset may be increased or decreased using the + and - keys on the remote controller. To quickly reset PBS to zero press PBS CLR.

6-8 Audio tone controls

The AR7030 is equipped with separate treble and bass tone controls, which are especially useful for reducing the effects of whistles, spit and splatter on crowded bands, and refine the audio quality when listening to good solid transmissions. Tone control settings may be reviewed and modified either from the infrared controller or from the front panel of the receiver.

Adjusting the tone controls from the receiver's front panel requires the FILTER menu then the TONE menu. If the S-meter is not displayed, press the MENU button to return to the menu root. Press the FILTER button and then the Tone soft-key to choose the TONE menu - the LCD will show **Treb** above the spin-wheel, indicating this as the spin-wheel function. **Bass** is displayed above the * button, and pressing this will reverse the **Treb** and **Bass** designations, allowing either to be modified by turning the spin-wheel. The current settings (in dB) are displayed in the top left corner of the LCD. Values of **+0** indicate a flat response.

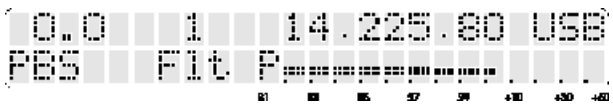
To restore an S-meter display, press the MENU button. The treble and bass controls will remain available on the spin-wheel and * button.

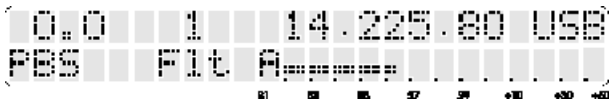
The infrared controller may also be used to check and modify the tone control settings at any time. Press the TREBLE or BASS keys to review the current value, which will be displayed on the top left of the LCD (for about 5 seconds). Once either of the tone keys has been used, the appropriate setting may be increased or decreased using the + and - keys on the remote controller.

Note: VFO-A and VFO-B may contain different audio tone settings.

6-9 RF Gain (Attenuator and Preamp)

The RF gain setting switches in attenuators or preamplifier to suit the band conditions and aerial in use. Using the attenuator (RF gain settings with negative values) can be useful for reducing the level of unwanted strong signals - the preamplifier (+10 setting) can help to extract weak signals from the noise. The AR7030 has six settings of RF gain:- +10dB (preamplifier on, the legend **P** is displayed to the left of the S-meter), 0dB (no indication on the LCD, this is the normal setting), -10dB (when the attenuator is on an **A** is displayed to the left of the S-meter), -20dB, -30db and -40dB. Each VFO may contain different settings of RF gain.





RF gain settings are made in the RF / IF menu. If the S-meter is not displayed, press the MENU button to return to the menu root. Press the RF-IF button to choose the

RF / IF menu - the LCD will show **Gain** above the spin-wheel, but this is IF gain (see section 6-11) - the RF gain setting is shown in the centre of the display between up and down arrows. For example **< RF+00 >** indicates the normal setting.

Pressing the buttons below the up or down arrows changes the RF gain setting. The value displayed is actually the *maximum* value that the receiver will use. Unless specifically disabled (see section 9-4) the RF gain will be reduced automatically when strong signals are received - this maximises the AGC range of the receiver. Signal strengths over S9+40dB will reduce RF gain, which will be restored again if signal strength falls below S9+10dB. There is a small delay in this automatic system to prevent spurious switching during signal fades.

To restore an S-meter display, press the MENU button.

6-10 Automatic Gain Control (AGC)

The RF / IF menu is used to select the AGC setting, which may be different for each mode and VFO. The AR7030 features a newly designed AGC system with a special release characteristics for very smooth audio especially when monitoring SSB.

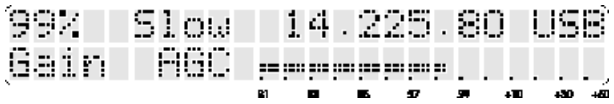
If the S-meter is not displayed, press the MENU button to return to the menu root. Press the RF - IF button to choose the RF / IF menu - the LCD will show **AGC** above the * button and the AGC setting (Fast, Med, Slow or Off) above that. Pressing the AGC soft-key will cycle through the four settings.

The default settings for each mode are:-

AM	Slow
Snc AM	Slow
USB	Medium
LSB	Medium
CW	Medium
Data	Medium
NFM	Fast (no other setting recommended)

Generally speaking Slow AGC will provide the best audio quality when signal strength is steady. Under fluctuating signal conditions a faster speed will keep track of the changing signal level. When listening to SSB transmissions a faster speed will increase the noise during pauses in transmission, but will enable a weak signal to be heard more quickly after a strong transmission or a burst of interference. When tuning quickly, AGC is automatically set to fast speed - it returns to the user setting when tuning stops. AGC off can be used in conjunction with the IF gain control for squeezing the very last ounce of performance out of the receiver under difficult conditions.

To restore an S-meter display, press the MENU button. The AGC speed control will remain available on the * button.



6-11 IF Gain control

The IF Gain control reduces the amplification in the receiver's IF circuits and has the effect of reducing the sensitivity of the receiver. Normally this job is performed by the AGC system, and the control is left at maximum gain (99%), but reducing the gain can be useful to limit noise when listening to CW or SSB signals. The IF Gain control *must* be used if the AGC is turned off.

The RF / IF menu is used to adjust the IF Gain setting, which may be different for each mode and VFO. If the S-meter is not displayed, press the MENU button to return to the menu root. Press the RF - IF button to choose the RF / IF menu - the LCD will show **Gain** above the spin-wheel and the gain setting (3% to 99%) above that. Turning the spin-wheel will alter the gain.

To restore an S-meter display, press the MENU button. IF Gain control will remain available on the spin-wheel .

Note: Because the IF Gain, S-meter and squelch systems are inextricably linked, the signal strength indication will increase as IF Gain is reduced. Squelch operation is impaired unless the IF Gain control is set to its maximum 99%.

6-12 Squelch control

The AR7030 is equipped with an all mode squelch system which may be used to eliminate unwanted background noise when monitoring a normally inactive frequency (such as 5.680MHz international search and rescue) or for scan control when dual VFO or memory scan is selected. The squelch is not normally used when listening to broadcast transmissions because they are continuous. In this case the squelch level is set to 0% (squelch off).

The squelch operation is controlled by signal strength and can be used to mute the receiver's audio, control the scan / hold (for memory scanning and dual VFO operation) and control the auxiliary relay (for switching a tape recorder). Each of these functions can be enabled or disabled as required (see also sections 7-3, 8-4 and 9-4).

Squelch level is adjusted with the spin-wheel, the function being available from several menus when it is likely to be needed (in NFM mode and when scanning memories). General access to the squelch level is easiest through the VFO menu. If the S-meter is not displayed, press the MENU button to return to the menu root. Press the RF - IF button and then the VFO soft-key to choose the VFO menu - the LCD will show **Sql** above the spin-wheel,

indicating this as the spin-wheel function. When the spin-wheel is turned, the squelch level (as a percentage) will be displayed at the top left of the LCD for about 5 seconds. When the squelch level is advanced above the current signal strength, a reversed **S** is displayed to the left of the frequency readout.

The VFO menu is split into two parts - each can be selected using the More or Back soft-keys. In the second part of the menu there is a soft-key labelled **Mut** followed by a bullet. If the bullet is filled (i.e. muting enabled) then audio will be silenced when squelch is active (reversed **S** displayed).

Use the Back soft-key to return to the first part of the VFO menu with squelch control on the spin-wheel. To restore an S-meter display, press the MENU button - squelch control will remain available.

6-13 Beat Frequency Oscillator (BFO)

In the CW and DATA reception modes the AR7030 is equipped with a variable BFO. This allows the pitch of the resolved signal to be changed without moving the filter passband relative to the signals being received. For CW listening the note of the resolved Morse can be set as desired. In DATA mode the audio fed to a decoder can be set to the correct frequency without having to de-tune the receiver. A combination of BFO and PBS settings can tailor the receiver to almost any signal / decoder combination, and both settings are stored along with frequency in the receiver's memories.

BFO settings default to 800Hz for CW mode and 1.35kHz for DATA mode - they are adjustable in 33Hz steps.

BFO adjustment is available along with PBS offset from the receiver's FILTER menu when either CW or DATA modes are selected. If the S-meter is not displayed, press the MENU button to return to the menu root. Press the FILTER button to choose the FILTER menu - the LCD will display **PBS** above the spin-wheel, indicating this as the spin-wheel function. **BFO** is shown above the * button, and pressing this will exchange the **PBS** and **BFO** legends, enabling either setting to be altered by turning the spin-wheel. The current settings of PBS offset and BFO frequency appear in the top left corner of the LCD.

Press the MENU button to restore an S-meter display - PBS and BFO settings will remain available on the spin-wheel.

7 VFO functions

7-1 Tuning control LOCK

It is possible to lock the main dial to prevent accidental change of frequency. No other front panel function, infrared control or computer control operations are affected. The tuning knob is not mechanically locked, but its rotation is ignored.

Dial lock is selected from the VFO menu. If the S-meter is not displayed, press the MENU button to return to the menu root. Press the RF - IF button and then the VFO soft-key to choose the VFO menu.

Dial lock is toggled on and off with the Lock soft-key, a reverse **L** on the display between frequency and mode indicates the main dial is locked.

7-2 Selecting VFO-A and VFO-B

The AR7030 has two VFOs, A and B - (Active and Background). Each VFO holds settings of volume, tone, receive frequency, reception mode, filter bandwidth, PBS, BFO, RF attenuator, IF gain, AGC speed, squelch, scan delay time and scan mode. Only the active VFO can be tuned. The two VFOs make the AR7030 ideal for chasing split-frequency / split-band amateur band nets or comparing short wave transmissions on different frequencies.

Selection of the active VFO is by swapping the active and background VFO contents. This can be done either from the infrared controller or from the front panel VFO menu. Additionally the active VFO can be copied into the background VFO, which is very useful for marking a frequency for later return. If the background VFO has not been assigned a frequency then a swap operation will actually result in a copy.

Note: The background VFO data will be lost when power to the receiver is switched off.

From the infrared controller the contents of the VFOs can be exchanged using the VFO A/B button.

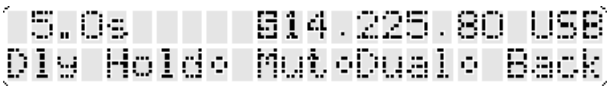
From the receiver's front panel, use MENU RF - IF and then VFO to choose the VFO menu. VFO contents can be exchanged using the A/B soft-key, or VFO-A copied to VFO-B using the B←A soft-key.

From the above illustration, pressing the A/B soft-key again would produce:

7-3 Dual VFO operation

The AR7030 can implement a scanning system between the two VFOs termed DUAL VFO operation. This facility is more versatile than the memory scanning (section 8) because each VFO can have individual volume, delay and hold characteristics. This can be especially useful for automatically checking for activity on an amateur band net frequency or for checking international search and rescue frequencies such as 5.680 MHz USB while generally listening to a completely different frequency and mode.

Dual VFO operation is selected from the second section of the VFO menu. Select RF-IF then VFO and More to get to this menu.



First, an explanation of some terms used in the scanning system:-

DELAY Dly Sets the *minimum* time that a VFO is monitored before changing to the other VFO. It can be set from half a second to 30 seconds by turning the spin-wheel and each VFO can have a different delay. This allows one VFO for general listening and the second to be monitored briefly at regular intervals - similar to a priority facility if the hold facility is used on the second VFO.

HOLD Hold• The soft-key legend **Hold** is followed by a bullet which indicates the current VFO's state. When the bullet is filled (hold enabled) the receiver will remain tuned to that VFO provided the signal level is above the squelch threshold (see section 6-12). When the signal level falls, the delay time will be invoked before the other VFO is monitored. If hold is disabled the receiver will monitor for the delay time before changing to the other VFO. The Hold• soft-key toggles hold mode on and off.

MUTE Mut• The soft-key legend **Mut** is followed by a bullet. If the bullet is filled (i.e. muting enabled) then audio will be silenced when squelch is active (reversed **S** displayed). The Mut• soft-key toggles muting on and off.

DUAL Dual• The soft-key legend **Dual** is followed by a bullet which indicates if Dual VFO mode is active. If the bullet is filled (i.e. dual VFO enabled) then the receiver will switch between VFOs when the delay and hold conditions permit. The Dual• soft-key toggles dual VFO mode on and off - additionally dual VFO will be turned off if menus other than the VFO menu or the S-meter are selected on the display.

More and Back soft-keys switch between the two sections of the VFO menu.

Example: To set a broadcast frequency on one VFO for general listening with the international search and rescue frequency as a priority watch:-

1. Select the VFO menu - use MENU RF-IF and then the VFO soft-key.

2. Tune to a broadcast frequency for general listening, for example 15070kHz, AM mode. Set the volume as required. Turn the squelch off by rotating the spin-wheel anti-clockwise until **Sql 0%** is displayed at the top left of the LCD.

3. Select the other part of the VFO menu with More, then set the delay to 15 seconds (or whatever you want) by turning the spin-wheel. Make sure that the **Hold** and **Mut** bullets are turned off (press the soft-keys if necessary).

4. Return to the first section of the VFO menu with Back and then select the other VFO with A/B. Now tune to the international search and rescue frequency 5680kHz, USB mode.

5. When there is no signal (only noise) increase the squelch level with the spin-wheel until the reversed **S** squelch indicator appears (if the indicator is already displayed, first decrease and then increase the level). This has set the squelch threshold.

6. Increase the volume slightly, so that when the frequency becomes active it will be noticeable. Press the More soft-key and then set the delay to 1 second with the spin-wheel. Enable hold and mute with the Hold• and Mut• soft keys so that both bullets are filled.

7. Finally activate dual VFO by pressing the Dual • soft-key. Scanning can be stopped by pressing this key again. Whilst scanning you can go to either VFO menu (using the More and Back soft-keys) and display the S-meter (using the MENU button) - selecting any other menu will stop scanning, but leave all items set up ready to start again when required.

The receiver will monitor the second VFO for 1 second every 15 seconds. Should the VFO containing 5680kHz become active, the HOLD setting ensures that the receiver remains on-frequency until the transmission clears and squelch closes**.** Many factors affect the way in which dual VFO operates, particularly if SSB is in use. If the squelch takes a little while to close each time the VFO is switched, set AGC to fast on the priority VFO and maybe add some RF attenuation to the general listening VFO. Problems usually only occur if there is a very large difference in signal strengths between the two stations. Squelch flutter can prevent the receiver from moving off the priority frequency when there is no channel activity. Increasing the squelch level and turning MUTE off can often help.

The dual VFO facility is very versatile and powerful. You will probably find uses for it that the designers never thought of!

8 Memory facilities

The AR7030 is equipped with 100 frequency memories. VFO data may be stored in any memory channel, recalled, previewed, overwritten, and included or excluded from scanning.

Each memory channel can hold receiver frequency, IF bandwidth, PBS, squelch setting (in AM, NFM and SSB modes), and BFO setting (in CW and DATA modes).

Most memory operations (storing, recalling, preview) can be done either from the front panel or using the infrared controller. Scanning can only be controlled from the front panel. Memory channels are never empty, but to start with they all contain the frequency 000.00 - the AR7030 treats this as a null frequency and will automatically exclude these memories from scanning (although they can be recalled). Storing a new frequency into a memory will overwrite the previous contents.

See also section 9-1 for setup memories.

8-1 Preview memory contents

Using the infrared controller, a memory frequency can be previewed (without altering the receiver's frequency or the memory contents) by entering the memory number followed by PREVIEW. For example, to look at memory number 12, press 1 2 PREVIEW. The frequency in the memory will be displayed at the top left of the LCD for about 5 seconds. The + and - keys can be used to move to next or previous memories, which in turn may be examined with PREVIEW. After a preview, you can use the MEM key to recall the memory or the STORE key to overwrite it.

From the front panel choose the MEMORY menu - use MENU and MEM. The current memory number **Mxx** is displayed above the spin-wheel, and a preview of the memory frequency displayed above that.

Use the spin-wheel to select the desired memory number, and preview its contents.

8-2 Store into memory

Using the infrared controller, the current VFO settings can be stored in a memory by entering the memory number followed by STORE. For example, to store the current VFO data into memory number 12, press 1 2 STORE. The message **Stored ..** is briefly displayed at the top left of the LCD to confirm the operation.

If STORE is pressed without first entering a memory number then the current memory (the last one referred to) is used. This is useful to preview memory contents before storing, so that you don't overwrite a frequency that you want. For example to preview memory 12 before storing, press 1 2 PREVIEW. The frequency currently in memory 12 is displayed at the top left of the LCD. Should

you wish this frequency to be overwritten, press STORE. If you want to keep memory 12 unaltered, then choose another memory before storing. The next or previous memories can be selected using the + or - keys (then PREVIEW), or a new memory number can be keyed in.

From the front panel choose the MEMORY menu - use MENU and MEMORY. The current memory number **Mxx** is displayed above the spin-wheel, and a preview of the memory frequency displayed above that.

Use the spin-wheel to select the desired memory number, and preview its contents. To store the current VFO data into the chosen memory, press the Sto soft-key. The message **Stored ..** is briefly displayed at the top left of the LCD to confirm the operation.

8-3 Recall from memory

When a memory is recalled, its contents are copied into the active VFO and the receiver is tuned to the memory's frequency. After this operation the receiver can be tuned, mode changed, or any other settings altered without modifying the memory contents - the only way to change a memory is with a store operation.

Using the infrared controller, a memory can be recalled into the VFO by entering the memory number followed by MEM. For example, to recall memory number 12, press 1 2 MEM. The message **Mem 12** is briefly displayed at the top left of the LCD, and the receiver will tune to the memory frequency to confirm the operation.

If MEM is pressed without first entering a memory number then the current memory (the last one referred to) is recalled, unless the last thing that you did was to recall the memory. In this case the *next* memory is recalled - by repeatedly pressing MEM each memory in turn can be listened to. After using PREVIEW to look at a memory, MEM will recall that memory. The next or previous memories can be selected using the + or - keys, followed by MEM to recall.

From the front panel choose the MEMORY menu - use MENU and MEM. The current memory number **Mxx** is displayed above the spin-wheel, and a preview of the memory frequency displayed above that.

Use the spin-wheel to select the desired memory number, and preview its contents. To recall the chosen memory data into the VFO, press the Rcl soft-key. The receiver will tune to the new frequency to confirm the operation.

8-4 Memory scanning

A set of memory channels within the AR7030 can be automatically recalled and checked for activity - the receiver uses the squelch setting to determine whether the frequency is active or dormant. This is referred to as *scanning*. Of course, you need to have stored frequencies in at least two memory channels for this process to operate. As each memory channel can retain an individual squelch level the scanning process can operate even when some channels are more noisy than others (due to higher background band noise or interference).

Firstly a block of memory channels to scan is defined (the default block comprises memories 1 to 10). Unwanted channels in the block may be excluded from the scan sequence (but you should leave at least two available otherwise the scan is pointless). The scan process can then be started, either at a steady speed (allowing channels to be monitored manually), or using squelch to pause the scan on active channels (with continuation when the signal drops or by manual intervention).

After the scan has worked its way through the block of memories it will start again at the beginning. This will give results as expected if the start channel number is lower than the stop channel number. If, however, the start channel number is higher than the stop channel the scan system will work from the start channel up to memory 99 and then from memory 0 up to the stop channel. This process will then repeat. Scanning cannot be started if the start and stop channels are the same.

Scanning operation is controlled from the SCAN and SCAN SETUP menus. Use MEMORY then Scan (and Setup) to get to these menus.

An explanation of some terms used in the scanning system:-

DELAY Dly Sets the *minimum* time that a channel is monitored before changing to the next channel. It can be set from half a second to 30 seconds by turning the spin-wheel.

HOLD Hold • The soft-key legend **Hold** is followed by a bullet which indicates the current state. When the bullet is filled (hold enabled) the receiver will remain tuned to that channel provided the signal level is above the squelch threshold (see section 6-12). When the signal level falls, the delay time will be invoked before the next channel is monitored. If hold is disabled the receiver will monitor for the delay time before moving to the next channel. The Hold • soft-key toggles hold mode on and off.

Mxx Mxx→ The memory number displayed before the arrow is the first channel of the block of memories to be scanned. Pressing the Mxx→ soft-key allows the spin-wheel to modify this (spin-wheel legend is **From**).

Mxx →Mxx The memory number displayed after the arrow is the last channel of the block of memories to be scanned. Pressing the →Mxx soft-key allows the spin-wheel to modify this (spin-wheel legend is **To**).

SQUELCH Sql Sets the minimum signal level that will stop the scan (if HOLD is enabled) or unmute the audio (if MUTE is enabled). When the scan is active the squelch level will be recalled from each memory channel as it is monitored. If the squelch level is changed with the spin-wheel then the new value will be stored back into the memory automatically.

SCAN Scan• The soft-key legend **Scan** is followed by a bullet which indicates if scanning is active. If the bullet is filled (i.e. scanning enabled) then the receiver will switch to the next channel when the delay and hold conditions permit. The Scan• soft-key toggles scanning on and off - additionally scanning will be turned off if menus other than SCAN or SCAN SETUP or the S-meter are selected on the display. Pressing Scan• TWICE when scan is active will manually advance to the next channel.

MUTE Mut• The soft-key legend **Mut** is followed by a bullet. If the bullet is filled (i.e. muting enabled) then audio will be silenced when squelch is active (reversed **S** displayed). The Mut• soft-key toggles muting on and off.

EXCLUDE Excl• The soft-key legend **Excl** is followed by a bullet. If the bullet is filled (i.e. memory channel excluded) then this memory will not be checked during the scanning cycle. The first channel in the block of memories to be scanned will not be excluded, even if it is so marked. The Excl• soft-key toggles exclude on and off for the currently selected memory channel.

Setup and Back soft-keys switch between the SCAN and SCAN SETUP menus. The Mem soft-key returns to the MEMORY menu.

Note: It is possible to use the infrared controller MEM key to manually advance the scan to the next channel, but this does not check for excluded memories or for the end of the scan block (it just recalls the next memory as the MEM key normally does). It is possible to jump outside of the scan loop by using this key and left to its own devices the receiver will work round all of the memories until it returns to the loop. If this occurs it can be simply fixed by pressing the Scan• soft-key TWICE.

Example: To scan memory channels from 5 to 9 with memory 8 excluded. It is assumed that useful frequencies have been stored in these memories. In this example the frequencies are all intermittent communication channels, so the receiver is set to stop and monitor a channel when it finds a signal:-

1. Select the MEMORY menu - use MENU and MEMORY. Turn the spin-wheel to select memory 5 and make sure that the bullet after **Excl** is not filled. Press the Excl• soft-key if necessary.

Step through each memory up to 9 using the spin-wheel making sure that none are excluded, except for number 8 which we want to omit from the scan.

2. Select the SCAN SETUP menu - use the Scan soft-key and then the Setup soft-key. This step is to define the scanning memory block.

If the start channel number **Mxx** is not set to 5 then press the Mxx→ soft-key and use the spin-wheel to set the block start to 5. The legend **From** will appear over the spin-wheel indicating that the block start is being changed.

If the stop channel number **Mxx** is not set to 9 then press the →Mxx soft-key and use the spin-wheel to set the block end to 9. The legend **To** will appear over the spin-wheel indicating that the block end is being changed.

3. Press the Dly soft-key (if **Dly** is not above the spin wheel) and then use the spin-wheel to set the scan delay to **5.0s** - the value is displayed at the top left of the LCD.

Make sure that the **Hold** bullet is turned on (press the Hold• soft-key if necessary).

Note: This scan speed (5 seconds delay) is rather slow for the present application, but it will be easy to see what is happening, and it will also be possible to adjust the squelch levels while the scan is running. Once everything is set the scan delay can be reduced to about 1 second for this example.

4. Return to the SCAN menu with Back and make sure that the **Mut** bullet is turned on (press the Mut• soft-key if necessary).

5. Start the scanning process with the Scan• soft-key (the bullet will be filled when scan is running). The memory channel currently being monitored is shown above the **Scan** legend. Press Scan• again if you want to stop the scan.

The squelch threshold can be adjusted for each of the memories (if necessary) during this first scan pass. When the squelch level is changed the new value will automatically be stored in the memory channel whilst the scan is active. Also the scan delay timer is re-started when the spin-wheel is turned so you have longer than 5 seconds to make the adjustment.

The squelch level should be set so that the reversed **S** squelch indicator is shown when there is only noise present on a particular memory channel. The setting should be as low as possible so that any signal will exceed the squelch level and pause the scan.

Note: If you change the squelch level when the scan is not running then the data in the memory will not be updated automatically. In this case, to update the squelch data in the memory return to the MEMORY menu (use the Mem soft-key) and then store the new settings (use the Sto soft-key). The complete key sequence for this is Mem Sto Scan.

To manually advance the scan to the next channel press Scan• TWICE.

The scan delay can be adjusted whilst the scan is running. Go to the SCAN SETUP menu (use the Setup soft-key) and use the spin-wheel to change the delay time. The scan will automatically stop if you try to change the block start and end channels, or if you select a non-scanning menu.

8-5 Memory technical details

Data is stored in the AR7030 in a number of different ways, using RAM maintained by an internal rechargeable and an EEPROM. The memory holds information relating to the receiver's alignment and filter setup, default setup, three additional user definable setups, VFO-A status, 100 memory channels and clock.

Generally speaking, memory is split into four sections:-

a. Power-down memory:
stores general settings while the receiver is switched off.

b. Setup memories (3):
store particular configurations of settings.

c. Frequency memories (100):
store frequency and associated information.

d. Background VFO (VFO-B):
stores complete receiver status, but data is not held when power is removed from the receiver.

a. Power-down memory. With default settings (shown in brackets).

Contains:-
Tuned frequency and mode.
IF bandwidth for each mode.
Passband shift for each mode.
BFO setting for CW and DATA modes.
AGC speed for each mode.
IF gain and RF gain (Max, 0dB).
Volume, Treble and Bass.
Squelch level and muting (Min, On).
Scan start and stop channels (1, 10).
Scan delay time and hold mode (5s, Off).
Timer start and run times.
Frequency lock (Off).
Aux output level.
IR remote tuning step size.

b. Setup memories (3 memories: A, B and C). With default settings (shown in brackets).

Contains:-
IF bandwidth for each mode (2.2kHz, 5.5kHz).
Passband shift for each mode (Zero).
RF gain (0dB).
BFO setting for CW mode (800Hz).
BFO setting for DATA mode (1.35kHz).
AGC speed for each mode (Med, Slow).
Squelch muting and scan hold (On, Off).
Treble and Bass (Flat).
Aux output level (Max).
IR remote tuning step size (1kHz).

c. Frequency memories (100 memories: 0 to 99).

Contains:-
Tuned frequency and mode.
IF bandwidth and passband shift.
Squelch setting for AM, NFM and SSB modes.
BFO setting for CW and DATA modes.
Scan include / exclude.

d. Background VFO (VFO-B)
(not stored at power-down).
Contains:-
Tuned frequency and mode.
IF bandwidth and passband shift.
IF gain, RF gain and AGC speed.
Volume, treble and Bass.
Squelch level.
BFO setting.
Scan delay time and hold mode.
IR remote tuning step size.

9 Setup, Timer and Config menu options

The SETUP menu allows access to the three receiver setup memories: A, B and C. The CONFIG menu allows various manual / automatic options to be set and the auxiliary output levels adjusted. It is also the route to the filter calibration routine. Both of these menus differ from all of the other receiver menus in that item selection is made by rotating the spin-wheel. Both menus have eight items so it doesn't take too long to find the one that you want. Once the required item is chosen a soft-key is used to action or change the selected item.

9-1 Setup menu options

The SETUP menu is selected by pressing the ○● button - **Setup** is displayed above the spin-wheel.

Turning the spin-wheel ◁ ▷ will produce to following items. These are actioned by pressing the * button:-

Item	Action (press the * button)
Setup	None (used only to indicate SETUP menu is selected)
SetA:Load	Loads the receiver with settings from memory A
SetB:Load	Loads the receiver with settings from memory B
SetC:Load	Loads the receiver with settings from memory C
SetA:Save	Saves the current receiver settings in memory A
SetB:Save	Saves the current receiver settings in memory B
SetC:Save	Saves the current receiver settings in memory C
Deflt Set	Loads the receiver with all of the default settings

A load operation is confirmed with a **Loaded ..** message displayed briefly at the top left of the LCD. Save operations are confirmed with a **Saved ..** message.

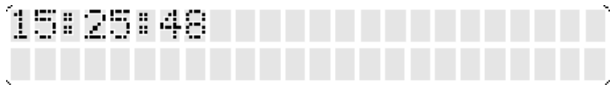
The three SETUP MEMORIES can save your favourite receiver set-ups, one for casual listening, one for serious DXing, one for data communication or whatever you choose. Each mode can have your own choice of filter bandwidth, pass band offset, BFO setting and AGC speed, along with global settings of the tone controls, auto / manual synchronous AM, auto / manual RF attenuator and line output levels. Using the setups can avoid having to recall many different menus, and provides a useful short cut to changing listening modes.

If you suspect that some settings are wrong, or want to return the receiver to a known condition the LOAD DEFAULT facility is available. This will ensure that sensible filters are selected for each mode of reception, no PBS offset, no BFO offset for CW and DATA modes, maximum IF gain with AGC on, auto synchronous AM, auto RF attenuation, flat tone control settings, standard line output levels etc. The SETUP MEMORIES are not affected by the LOAD DEFAULT operation, only the current receiver settings are changed.

9-2 Timer settings

The AR7030 is equipped with a 24-hr clock and timer. The clock is permanently displayed on the LCD while the set is connected to external power and switched off. When the receiver is on, the clock display can be turned on by pressing the ○● button.

When the set is off, the clock is displayed and the LCD illumination is dimmed (not switched off completely) to make the AR7030 useful as a bedside radio... admittedly it makes an expensive clock radio alarm. If no power is applied the clock will not be displayed, but it is kept running by a small, internal, rechargeable battery.



Timer operation allows the AR7030 to be programmed to switch on at a predetermined time and stay on for a period of time before switching off again. Also a sleep timer allows the receiver to switch off automatically after a set period (up to 4 hours - for insomniacs).

The TIMER menu is accessed from the SETUP menu. If necessary press ○●, then press the Timr soft-key.

The run time (in minutes) displayed at the top left is used for both the timer operation time and the sleep timer. In fact when timer operation starts the sleep mode is invoked to provide a count-down display and then switch the receiver off.

Setting the sleep timer: The sleep timer (and timer mode run time) is set in *minutes*. From the TIMER menu, use the spin-wheel to set the **Run =** time (shown at the top left). Pressing the +Hr soft-key will add 60 minutes to the time, which can be between 1 and 255 minutes.

To activate the sleep timer press the Sleep soft-key.

The sleep time will count down to zero, when the radio will switch off. The receiver can still be tuned, modes changed and volume adjusted. To cancel the sleep timer press the MENU or ○● buttons. The sleep timer is synchronised to the clock so that it changes when the clock seconds are at zero. For this reason one minute is added to the run time so that the set doesn't switch off too soon.

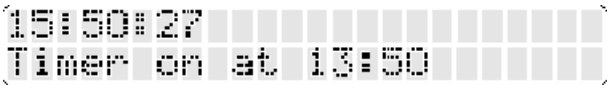
Setting the timer for automatic switch-on: The switch-on timer is set in 24-hr format and, if armed, will turn the receiver on when its setting matches the clock time. Once the receiver is switched on, the sleep timer is invoked to turn the set off again after the required run period.

Select the TIMER menu (press ○● and Tlmr) and then press the Time soft-key.

The timer time (switch-on time) is shown at the top left as **Tmr=hh:mm**. The time can be set using the spin-wheel - pressing the * button changes between setting hours and setting minutes.

If you have not yet set the run time, go back to the previous menu (press the Back soft-key) and use the spin-wheel. (See above - setting the sleep timer).

When start and run times are set, press the Arm soft-key to enable the timer switch-on. The receiver will turn off but will be switched on again at the appointed hour. Receiver settings at switch-on will be the same as when the Arm soft-key was pressed.



The Arm soft-key is available in both TIMER menus so it doesn't matter whether you select switch-on time or run time first.

Note: For correct timer operation the external supply must be left connected to the receiver. If the supply is disconnected and then re-connected before the start time the timer will operate correctly, but the **Timer on at ...** message will not be displayed. The timer will not operate correctly if power is not restored before the start time.

Note: If the receiver is switched on manually before the start time then the timer arming is cancelled. To continue with timer operation the receiver *must* be switched off using the Arm soft-key. Timer settings will not have changed. To cancel a timer setting, simply switch the receiver on and off using the ○● button.

The timer will only switch the receiver on once - it will not repeat daily unless it is re-armed. The settings, however, remain unchanged so for daily operation all that is needed is to switch the set off using ○● Tlmr Arm .

9-3 Setting the clock

The real-time clock is set in 24-hr format - you can set it to local time or UTC depending on your needs, but if you use the timer then that must be set to the same time standard.

Select the TIMER menu (press ○● and Tlmr) and then press the Time and Clock soft-keys.

The current clock time is shown at the top left as **Clk=hh:mm**. The time can be set using the spin-wheel - pressing the * button changes between setting hours and setting minutes. The clock display is constantly updated from the internal clock - there is no need to rush through the setting for fear that the clock has been stopped.

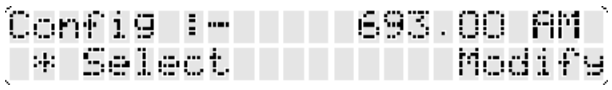
Whenever the *minutes* are changed the seconds count is set to zero. To set the clock accurately to a time signal make sure that you turn the spin-wheel (adjusting minutes) as the signal occurs. If the displayed time is correct you can go on and then back by one minute - this will leave the time correct but zero the seconds. Hours can be changed without affecting the minutes or seconds of the clock.

Pressing the Back soft-key will return you to timer settings, pressing MENU or ○● buttons will return to the SETUP menu.

9-4 Config menu options

The CONFIG menu is selected form the SETUP menu by pressing the Cnfg soft-key (press ○● Cnfg)

Config :- is displayed at the top left of the LCD and **Select** above the spin-wheel. **Modify** is labelled above two soft-keys - either can be used to change configuration settings, and they are used as increase and decrease buttons for the Aux output levels.



Turning the spin-wheel ◁ ▷ will produce to following items. The current setting is shown on the right of the display. Pressing the soft-keys below the setting will change it:-

Item	Settings
Select	None (**Modify** is informative legend for the soft-keys)
Aux relay:	**Off Timer Squelch**
Aux output muting:	**Off On**
Aux o/p (L):	**0%** (off) to **99%** (max)
Aux o/p (R):	**0%** (off) to **99%** (max)
Sync detector:	**Auto Narrow Wide**
RF Gain:	**Auto Man**
Filter calibrate:	**Start** (pressing either soft-key starts the automatic calibration process)

All settings take effect immediately the soft-keys are pressed, so the aux relay will switch on and off as its settings are changed and the synchronous detector bandwidth changes can be heard. Press the MENU or ○● buttons to leave the CONFIG menu once you have set what you want.

Aux relay: Determines the switching function of the relay contacts available on the AUX socket.

Off	Contacts always open (default setting).
Timer	Closed when the receiver is switched on.
Squelch	Closed when the received signal is above the squelch threshold.

The aux relay is often used to control a tape recorder motor. It can only be used for low voltage control, **NEVER CONNECT MAINS TO THE AUX RELAY CONTACTS**.

The **Timer** setting is useful for recording programs unattended - it will switch the tape on and off with the receiver. The **Squelch** setting will start the tape to record intermittent signals, such as communication channels.

Aux output muting: This selection has the same effect as the Mut• soft-key on the VFO menu, but applies squelch muting to the aux outputs rather than the loudspeaker / headphone output. The default setting is **On**.

Aux o/p (L): Sets the aux output level for the left channel output. The default is 99% (maximum, about 800mV) and it may be varied down to 0% (off) on a logarithmic scale. The RF - IF button reduces the level and the FILTER button increases it.

Aux o/p (R): As above for the right channel output.

Sync detector: Sets the way in which the AM synchronous detector operates.

Auto	The synchronous detector will automatically tune the receiver and select wide and narrow bandwidths appropriately. (Default setting).
Narrow	Manual mode synchronous detection enabled with narrow bandwidth PLL. The receiver must be manually tuned to zero beat and correction made for any frequency variations.
Wide	Manual mode synchronous detection enabled with wide bandwidth PLL. The receiver must be manually tuned to zero beat, but tuning is not too critical.

Note: If changing from **Wide** to **Narrow** in manual mode, don't stay on the **Auto** selection for more than a second because the receiver will start its auto-tune sequence.

RF Gain: Enables or disables the automatic RF Gain control. If enabled, the receiver will automatically decrease RF Gain when the S-meter reads above S9+40dB. The default setting is **Auto**, select **Man** only if you are a purist or want to do some obscure lab measurements on the receiver.

Filter calibrate: Select **Start** for the receiver to calibrate its IF filters. See section 6-2 for full details.

10 Optional accessories

Additional and substitute 455 kHz IF filters: The AR7030 is designed to accept a total of six IF filters, this means that two optional filters may be fitted in addition to the standard four provided. Within reason, any 455 kHz filter may be fitted but the PCB is drilled to accept Murata and Collins filters.

To gain access for filter fitting, both top and bottom covers need removing. The top is held by four screws requiring a 2.5mm hex key to undo them. When replacing the top, make sure that it is pressed fully home (flush to the sides) before putting the screws in. The screw threads are not long enough to pull the top down into the side pieces without damaging the threads. **Tighten the screws only finger tight - do not over tighten**. The bottom plate is held by six No.2 posidrive screws.

Note: Fitting optional IF filters is not difficult but does require the use of a soldering iron and we recommend that it is carried out in a specialist workshop.

Planned options: The design of the AR7030 is such that many extra features can be added and seamlessly incorporated into its operating system. Options should include a features upgrade (alphanumeric memory labelling and multi-channel calendar / timer), internal rechargeable battery and carrying case for portable use, audio notch filter and noise blanker, and a stereo, band II FM extension is under consideration.

11 Aerials (Antennas) and earth systems

The subject of aerial choice (and earth) can be quite complex. There are many advantages and disadvantages of each aerial type to consider before connecting an external aerial to your receiver.

One interesting phenomenon is that aerial theory and practice can be surprisingly different. Within common sense bounds, aerial construction is one of the few remaining areas for listeners to easily experiment and often achieve fantastic results.

Whip aerial: Whip aerials can give fair results for casual listening. For best results external aerials in clear space are recommended.

Location: It is important to mount any external aerial as high as possible and in clear space. If possible the aerial should have a clear path to the horizon. Results are usually disappointing when an installation is in a loft space.

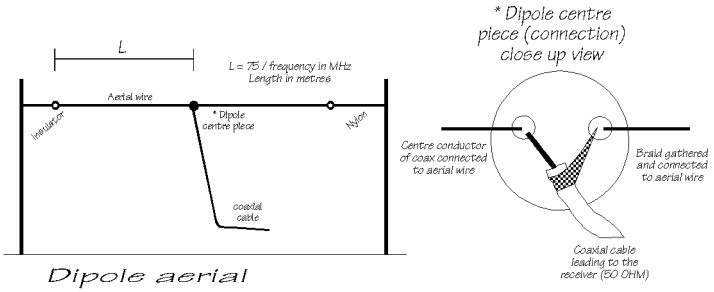
Long wire aerials: For short wave reception a random length of long wire approximately 10 to 20 metres in length forms a good compromise. The wire should be connected to the WIRE input of the AR7030. If possible try to locate the receiver close to a window so that the wire has the shortest and most direct run from the rear of the receiver to the outside world.

Never attach the wire aerial directly to a support or wall. Instead attach a short length (about one metre) of insulating cord (such as nylon) to each support (house or tree for example) and then onto the aerial wire. Allow the wire aerial to drop diagonally into the window and receiver rather than straight down, close to the wall. Keeping the aerial away from supports and buildings will reduce the loss of signal from the wire aerial and prevent unwanted noise from entering the aerial system.

Transformer coupled long wire aerials are becoming very popular as they allow coaxial cable to be used as the down-lead from the wire aerial into the receiver. The transformer converts the medium impedance at the end of the wire to a lower value, suitable for 50ohm coaxial cable. In this instance the path of feeder is unimportant and chances of noise entering the aerial system reduced. The 50ohm aerial input of the AR7030 is ideally suited for such an aerial system.

Dipoles: For the very best results you should consider a dedicated aerial such as a single or multi-band dipole or similar aerial. It is quite easy to make a dipole for short wave. Short wave are usually mounted horizontally. It is worth noting that dipoles are also quite effective on two and three times their design frequency so you can cover a few bands at once. Reception using a half-wave dipole is best at right angles to the direction of the aerial, however if used at two or three times it's fundamental frequency, reception is best along the direction of the aerial.

A dipole has two legs running in opposite directions. One leg is connected to the centre conductor of the coaxial feeder cable while the other leg is connected to the outer screen of the coax. A simple formula can be used to calculate the required length of each leg for a half wave dipole:-



Dipole aerial

Length of each leg in metres = $\frac{75}{\text{Frequency in MHz}}$

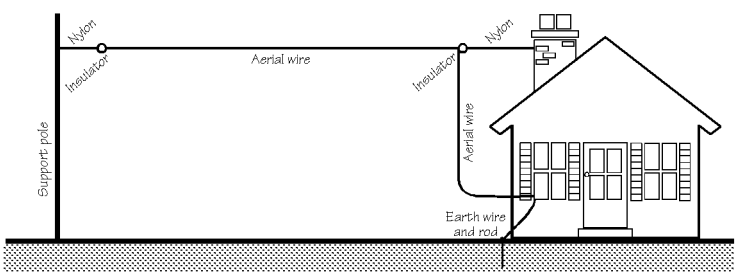
For example, a half-wave dipole resonant at 14.2MHz would have each leg 5.3 metres long. The total length of the aerial would be 10.6m plus the supporting cords.

Coaxial cables: When connecting dipole aerials to receivers 50ohm coaxial cable should be used. For short wave URM43, URM76 or RG58U is ideal.

Aerial Tuning Units (ATUs) and Preselectors: An ATU can improve the selectivity of any receiver when listening to short wave and connected to a long wire aerial (other than a very short wire of just a few metres). Preselectors will normally work with 50ohm aerial systems although they may include matching for long wires. This valuable extra selectivity is created by the ATU or preselector rejecting out of band signals enabling the receiver to single out one band of frequencies while rejecting potentially strong unwanted transmissions. One disadvantage, however, is the need to constantly re-tune the ATU or preselector when changing receiver frequency.

Passive devices, which contain no active circuitry and generally do not need power, will not normally degrade the performance of the AR7030. Users should be aware that devices with pre-amplifiers or active matching units are unlikely to have such a high dynamic range as the AR7030 so the receivers performance will be degraded by the device.

Earth systems: A separate connection from the receiver to earth may improve aerial efficiency and reduce noise. Suitable earth points include connection to a water pipe, central heating radiator or external earth rod. If fitting a separate external earth rod, consider the implications carefully if your mains supply uses Protective Multiple Earth (PME)



Typical long wire aerial setup including an earth wire and rod

system. If in doubt consult an experienced electrician.

Connecting an external earth wire may greatly reduce the local noise encountered when listening on the short wave bands. It is very important to provide a good earth should you use an aerial tuning unit.

A short length of thick gauge earth wire may be connected to a nearby central heating radiator or water pipe but never use a gas pipe for earthing. Ideally a separate earth rod should be used but not if the receiver must be distant from the rod - if too long the earth system may well pick up noise rather than remove it. If a long run of earth wire is necessary, it may be worth considering a screened earth system. This simply comprises a 50 ohm coaxial cable with the centre and screen shorted at the earth rod end and only the centre connected to the **GND** connection of the AR7030, the outer screen braid being cut back and insulated.

12 Propagation - short wave bands

Unlike VHF and UHF transmissions which generally propagate only short distances (to the horizon plus a small amount), short wave transmissions may travel for many thousands of kilometres. Depending upon the frequency in use, time of day, season of the year and sun spot activity transmissions may propagate completely around the world.

Radio signals are electromagnetic waves very similar to light beams. As such they do not readily follow the curvature of the earth but attempt to travel out into space. Luckily the frequency spectrum of short wave is often reflected back down to the earth by the upper layer of the earth's atmosphere called the **ionosphere**.

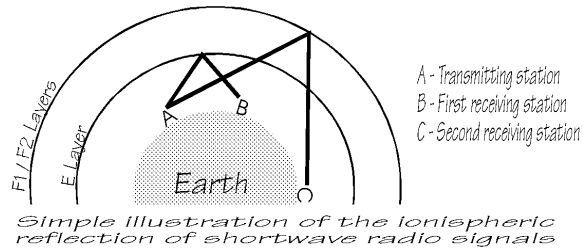
When the reflected signals reach the earth again they may either be received or reflected back up into space. Often they will be reflected back by the ionosphere yet again providing reception into another and possibly more distant location. The ionosphere is constructed of many layers of ionised gas. Of particular interest to short wave listeners' are the lower **E** and upper **F1** and **F2** layers although a lower **D** layer exists during day time.

D layer: During day time the lower **D** layer forms around 60 to 80 kilometres above the earth's surface. This layer tends to absorb low frequencies reducing the distance covered by medium wave transmissions. At night time when the **D** layer dissipates, medium and low frequency transmissions may propagate over much greater distances because they can reflect from the higher layers.

If the transmitted frequency is too high to be reflected by an ionospheric layer or the wave meets the layer at too steep an angle, transmissions will pass straight though without being reflected and will travel upward to the next ionospheric layer.

E layer: Above the **D** layer is the **E** layer - located at a height of about 100 kilometres. The **E** layer tends not to absorb signals as much as the **D** layer but reflects some signal back to earth where it may be received some distance from the original point of transmission.

Usually in autumn and spring **sporadic E** propagation results from dense pockets of **E** layer ionosphere, reflecting even the higher VHF and UHF transmissions causing patterning on television sets. This is to the delight of radio amateurs who are then able to communicate for many hundreds and even thousands of kilometres on frequency bands usually capable of only local reception.



Simple illustration of the ionlepheric reflection of shortwave radio signals

F1 and F2 layers: During the day time there are two upper layers of the ionosphere, these being the **F1** layer at about 200 kilometres and the **F2** layer at about 400 kilometres. As evening falls, these layers combine to form a single **F** layer. It is the **F** layer that is largely responsible for short wave propagation over great distances. The density of the ionospheric layers vary depending upon season, time of day and sunspot activity (which is believed to follow an eleven year cycle of good and bad propagation conditions).

Often large areas of the earth's surface lie between the point of transmission and the region were the transmission is reflected down to - in this area there will be little or no reception. For this reason **F** layer propagation is often referred to as **skip propagation** and the reflected signal as **sky wave**.

Generally speaking only frequencies below 30MHz are reflected by the ionosphere. Higher frequencies pass straight through even the **F** layers and continue outwards into space for ever.

Choice of frequency: Depending upon the time of day and desired skip distance, different frequencies will be selected by radio amateurs and commercial users such as short wave broadcasters and oceanic air traffic control. For instance the **MUF** (maximum usable frequency) is often stated for a path between two locations at a particular time. Choosing a frequency above the **MUF** will not produce results as transmissions will pass straight into space.

Many propagation predictions and statistics are published and usually available from most country's national amateur radio and short wave listeners' representatives. Various publications are produced giving transmission and contact details for world-wide reception. These titles include:-

Passport To World Band Radio, IBS North America, Box 300, Penn's Park PA 18943, USA.

World Radio TV Handbook (WRTH), PO Box 9027, 1006 AA Amsterdam, The Netherlands

or BPI Communications, 1515 Broadway, New York 10036, NY USA.

13 Technical specification

Performance figures relate to a typical production receiver and are not guaranteed levels.

Test signals:- AM mode : Modulated to 70% depth at 1kHz
FM mode : Deviated by 1.5kHz at 1kHz
SSB mode : Unmodulated carrier, resolved at 1kHz

1. Receiver system

Dual conversion super heterodyne system with intermediate frequencies of 45MHz and 455kHz.
High dynamic range mixer using a DMOS lateral FET quad.
Tuning by single loop PLL / DDS system from a TCXO reference.
All receiver functions under microprocessor control.

2. Reception and Tuning

Tuning continuous from 0 to 32MHz in 2.655Hz steps (10.62Hz in AM and NFM modes).
Frequency settability from keypad to ± 1.4Hz.
Tuning rate from spin-wheel 1kHz per rev (4kHz in AM and NFM modes), increasing with rapid rotation.
Fast tuning mode increases rate by 256 times.

Reception modes : AM Envelope detector and PLL synchronous detector.
SSB Upper and Lower sideband.
NFM Narrow band FM.
Other CW and Data.

3. Display and Controls

All receiver states displayed on back-lit, liquid crystal, character / graphic display.
Display is 2 lines of 24 characters, S-meter graphic is 70 segments form S1 to S9+50dB.
Frequency display to 10Hz resolution.

Rotary controls : Volume spin-wheel (with detent).
General spin-wheel (with detent) used with the menu system.
Tuning spin-wheel (free running).
Display viewing angle / contrast (on rear panel).

Push buttons: Power on / off and setup menu.
Menu select (1 button) and menu choice (4 buttons).
Mode select (2 buttons).
Fast tune.

Remote keypad : 32-key infra-red remote control
Numeric keypad.
Volume and tone.
Filter select and passband shift.
Tuning and memory operations.
Computer remote control of all functions via 1200 baud, RS232 type interface.

4. Memories

100 frequency memories contain :
Tuned frequency, mode, I F bandwidth and passband shift.
Squelch setting for AM, NFM and SSB modes.
BFO setting for CW and DATA modes.
Scan include / exclude.

Three setup memories contain :
I F bandwidth, passband shift, BFO, squelch and AGC speed settings for each mode.
Treble and bass settings, aux output levels and aux relay operation, squelch muting and scan hold.
R F gain, auto / manual switching and Sync detector auto / manual mode and bandwidth.
Remote keypad tuning step size.

5. R F Input

Three antenna inputs (selected by rear-panel switch) :

50ohm unbalanced via SO-239 connector.
600ohm unbalanced via wire grip connector.
Hi-Z whip input (on SO-239) with reduced R F performance.
R F band split at 1.7MHz with high-pass and low-pass filters.
R F pre-amplifier and attenuators give +10 / 0 / -10 / -20 / -30 / -40dB R F Gain.
Switching is automatic with manual override.

6. I F System

Four I F filters fitted as standard, nominal bandwidths :

2.2 kHz (default for SSB, CW and Data modes)
5.5 kHz (default for AM and Sync modes)
7.0 kHz
10 kHz (default for NFM mode)

Provision for two more optional filters (at 455kHz) of any bandwidth from 250Hz to 10kHz.
Passband frequency adjustable by ± 4.2kHz for all filters.
Resolved audio frequency is adjustable by ± 4.2kHz in CW and Data modes.
AGC is carrier derived with peak detector in SSB modes and mean detector in AM modes.
AGC release speed selectable : Fast / Medium / Slow. AGC can be switched off.
Manual I F gain control operates as maximum gain limit.
Squelch operation is derived from AGC level, with optional audio muting and aux relay operation.
455kHz I F output available from the AUX connector at about -20dBm / 50ohms.

7. Audio System

Entire audio path is two-channel (stereo) with mono loudspeaker output.
External LS output (disconnects internal LS) via 3.5mm mono jack : 2.2W into 8ohms.
Headphone output (disconnects internal LS) via 3.5mm stereo jack (mono compatible) : 2.5V from 100ohms.
Aux outputs (independently adjustable levels) via 8-pin DIN connector : 0 to 800mV from 1kohm.
Treble tone control : 8dB at 2kHz in 2dB steps.
Bass tone control : 9dB at 200Hz in 1dB steps.

8. Power supply

15V from external a.c adapter, current 300 to 500mA typical, 1A max. 30mA on standby.
Will operate on 12 to 15V d.c with degraded performance at 12V.
EMC compliance is not guaranteed with all types of power supply.

9. Dimensions

Case :	238 x 77 x 191mm (W.H.D)
Overall :	238 x 93 x 227mm (W.H.D)
Weight :	2.2kg.

10. Sensitivity

All measurements are p.d. at 50ohm input. Figures in brackets indicate R F preamp switched on.
SSB and AM values are for 10dB S+N/N, NFM value for 12dB SINAD.

Frequency	USB (2.2kHz filter)	AM (5.5kHz filter)	NFM (10kHz filter)
20 kHz	1.9uV (1.4uV)	-	-
100kHz	0.73uV (0.34uV)	-	-
500kHz	0.50uV (0.18uV)	0.85uV (0.33uV)	-
1.0MHz	0.52uV (0.19uV)	0.88uV (0.36uV)	-
1.8MHz	0.56uV (0.21uV)	0.95uV (0.38uV)	-
5MHz	0.50uV (0.19uV)	0.86uV (0.35uV)	-
14MHz	0.58uV (0.23uV)	1.0uV (0.42uV)	-
28MHz	0.60uV (0.23uV)	1.0uV (0.40uV)	1.2uV (0.48uV)
32MHz	0.68uV (0.24uV)	1.1uV (0.43uV)	-

11. Selectivity

The following data is taken from measured performance of the 455kHz I F system and ignores effects of the 45MHz roofing filter and any audio frequency response tailoring. AGC was switched off.

Filter stop-band attenuation :	All filters > 110dB	
2.2kHz filter characteristics :	-6dB bandwidth :	2.29kHz
	-60dB bandwidth :	3.34kHz
	-80dB bandwidth :	4.98kHz
	6/60 shape factor :	1 : 1.46
5.5kHz filter characteristics :	-6dB bandwidth :	5.54kHz
	-60dB bandwidth :	9.11kHz
	-90dB bandwidth :	10.75kHz
	6/60 shape factor :	1 : 1.64
7kHz filter characteristics :	-6dB bandwidth :	6.90kHz
	-60dB bandwidth :	11.60kHz
	-90dB bandwidth :	13.36kHz
	6/60 shape factor :	1 : 1.68

12. Dynamic range

Reciprocal mixing effects : Quoted figure is unwanted signal strength, relative to noise floor, that decreases wanted signal S+N/N ratio by 3dB.

Tested at 12.75MHz in USB mode with 2.2kHz filter. Wanted and unwanted signals both unmodulated.

Noise floor : -123dBm

Signal separation	Signal rejection	Local osc SSB phase noise
5kHz	90dB	-123dBc/Hz
10kHz	99dB	-132dBc/Hz
20kHz	109dB	-142dBc/Hz
50kHz	119dB	-152dBc/Hz
100kHz	> 125dB	< -158dBc/Hz

Blocking effects : Quoted figure is unwanted signal strength that reduces wanted signal level by 1dB (with no AGC action). Tested in USB mode with R F pre-amp switched off.

Wanted signal at 20MHz, unwanted signal at 10.7MHz, both unmodulated.

Blocking signal strength : +14dBm (1.12V) Blocking dynamic range : 137dB

Intermodulation effects : Quoted dynamic range figure is the difference between the receiver nose floor and the level of two equal unwanted signals required to produce an intermodulation product at the noise floor level. The IFDR figure here is calculated from measuring the intermodulation level produced by two signals at 0dBm, and verified by re-calculation at -5dBm.

Tested at around 12.7MHz in USB mode with 2.2kHz filter and R F pre-amp switched off.

Noise floor : -123dBm

Signal separation	Intermodulation-free dynamic range	3rd order intercept point (IP^3)
5 / 10kHz	92dB	+15dBm
10 / 20kHz	100dB	+27dBm
20 / 40kHz	104dB	+32dBm
50 / 100kHz	104dB	+33dBm
100 / 200kHz	105dB	+34.5dBm

Switching in the R F pre-amp reduces IP^3 by about 10dB, and IFDR by about 2dB.

Second order intermodulation effects : Measured as above with two signals of 0dBm at around 12.7MHz, resolving the SUM frequency at 25.5MHz.

Intermodulation-free dynamic range : 104dB 2nd order intercept point : +85dBm

13. Spurious responses

Unwanted signal rejection : Quoted figures are the levels of unwanted signal, relative to wanted, required to produce a similar S+N/N ratio. Many figures vary depending on the frequency the receiver is tuned to, so ranges of values are given.

Spurious response	Frequency	Rejection
1st I F	45MHz	85 to > 100dB
2nd I F	455kHz	> 100dB
1st I F image	Fr + 90MHz	85 to > 100dB
2nd I F image	Fr + 910kHz	> 95dB
Others	Fr ± >10kHz	> 85dB

14. AGC characteristics

Dynamic characteristics quoted for a 30dB change in input level between -90dBm and -60dBm.

Output range (AM mode) :	19dB		
Attack time (to within 2dB of final level) :	4ms (SSB modes)	8ms (AM and Sync modes)	
Holdoff time (for first 2dB change) :	250ms (fast)	450ms (med)	1.0s (slow)
Decay time (to within 2dB of final level) :	700ms (fast)	1.15s (med)	2.0s (slow)

15. Audio quality

In-band intermodulation : For 2 signals more than 200Hz apart, all intermodulation products < -37dB.
Harmonic distortion : SSB modes, input signal at S9, THD < 0.2%.
AM modes, input signal at S9, THD < 1.3%.
Noise : AM mode ultimate S/N ratio 52dB (unweighted).

16. Frequency stability

The receiver uses a single frequency reference which is a temperature compensated crystal oscillator. TCXO specification is ±2.5 ppm from -30°C to +75°C, and will typically give a receiver stability better than ±1ppm from 10°C to 40°C.

Specification subject to change due to continuous development of the receiver. E&OE.