# Model 565 ORION Specifications

**Claimed performance numbers are actual measurements of production ORION units by the Ten-Tec engineers.**

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**GENERAL:**

**Frequency range:** **Sub RX: 100 kHz-30 MHz, Specifications apply > 1.8 MHz;**

**TX & Main RX: 1.8-2.0, 3.5-4.0, 5.25-5.40 (when allocated), 7.0-7.3, 10.1-10.15, 14.0-14.35,18.068-18.168, 21.0-21.45, 24.89-24.99, 28.0-29.7. 10 kHz margin at band edges for M.A.R.S.**

| | |
|---|---|
| **Tuning Step Size:** | **1, 10, 100, 1k, 10k and 100 kHz** |
| **Frequency Accuracy:** | **± 1 PPM at room temperature;<br>± 3 PPM over operating temperature. TCXO is standard.** |
| **Rated RF Load:** | **50 ohms nominal, 2.0:1 maximum SWR.** |
| **Antenna jacks:** | **2x SO-239; 1x RCA female.** |
| **Modes:** | **USB, LSB, AM, FM, CWUSB, CWLSB, AFSK,<br>Panoramic Stereo ™ (Binaural w/spatial perception).** |
| **IFs:** | **Main RX & TX - 9 MHz, 450 kHz, 14.0 kHz;<br>Sub RX - 45 MHz, 450 kHz, 14.0 kHz.** |
| **Display:** | **320x240 transflective, graphic LCD, white LED backlight, adjustable contrast, Reversible to black background with white lettering.** |
| **Freq. Control:** | **Receivers operate on any two bands simultaneously;<br>Transmitter uses either VFO.** |
| **Supply Voltage:** | **13.8 Vdc nominal.<br>Reverse-polarity & over-voltage protection are standard.** |
| **Operating Temperature Range:** | **0-50° C** |
| **Dimensions (H x W x D):** | **5.25" x 17.0" x 18.75" (13.3 x 43.2 x 47.6 cm)** |
| **Weight:** | **approximately 20 lb. (9.2 kg)** |
| **Construction:** | **Al chassis, steel cabinet, glass-epoxy printed-circuit boards.** |
| **PC control port:** | **EIA-232 standard, DE-9F.** |

## The following features & specifications apply to both receivers:

| | |
|---|---|
| **Digital AGC systems:** | **Programmable AGC threshold, hold, & decay times, fast attack.<br>Independent controls for each receiver.** |
| **Passband Tuning:** | **Independent controls for each receiver.** |
| **RX Audio Equalizers:** | **Bass/treble boost/cut up to 6 dB/octave.** |
| **RX Audio Output Powers:** | **2 W into 4 ohms, < 3% THD.** |
| **Line-level Output:** | **0 dBm into 600 ohms.** |
| **RX Notch Filters:<br>Notch affects S-meter:** | **IF DSP, > 50 dB depth, adjustable width.** |
| **Auto-Notches:** | **IF DSP, Multi-tone, adjustable on each receiver.** |
| **RX Noise Reduction:** | **IF DSP, adjustable on each receiver.** |

## MAIN RECEIVER:

| | |
|---|---|
| **SSB Sensitivity:** | **<0.18 µV typical for 10 dB SINAD at 2.4 kHz BW, pre-amp on.<br><0.5 µV typical for 10 dB SINAD at 2.4 kHz BW, pre-amp off.** |
| **AM Sensitivity:** | **<1.50 µV for 10 dB SINAD at 6.0 kHz BW, 30% modulation, 1 kHz, pre-amp off.** |
| **FM Sensitivity:** | **<2.50 µV for 12 dB SINAD at 15 kHz BW, 3-kHz deviation, 1 kHz, pre-amp off.** |
| **Selectivity:** | **Standard 9-MHz-IF crystal filter BWs - 15 kHz, 6 kHz, 2.4 kHz, 1.0 kHz<br>Optional crystal filter BWs - 1.8 kHz, 500 Hz & 250 Hz. All ganged w/ DSP or independent.** |
| **Selectivity -SSB & CW:** | **590 built-in DSP filters from 100-6000 Hz.** |
| **Selectivity – AM:** | **4 & 6 kHz. 15 kHz four** |
| **Selectivity – FM:** | **15 kHz.** |
| **IP3 (Third Order Intercept Point):** | **+25 dBm typical - 20-kHz spacing at 2.4 kHz BW, pre-amplifier off;<br>+24 dBm typical, 5-kHz spacing, BW = 500 Hz, pre-amplifier off.** |

**Main RX – continued –**

| | |
|---|---|
| **IMD3 Dynamic Range:** | **101 dB typical, pre-amp off, 20-kHz and 5-kHz spacing.** |
| **IP2 (Second Order Intercept Point):** | **+75 dBm typical.** |
| **LO phase noise:** | **-136 dBc/Hz typical from 0.5-20 kHz offset.** |
| **Image rejection:** | **>70 dB.** |
| **IF rejection:** | **>70 dB.** |
| **Other Spurious Response Rejection:** | **>90 dB, F>1 MHz.** |
| **Internal birdies:** | **None stronger than specified sensitivity.** |
| **Current drain:** | **2 A typical, audio reduced.** |
| **RIT range:** | **± 10 kHz.** |
| **S-meter Reference:** | **S9=50 µV.** |
| **TX > RX Recovery time:** | **< 20 ms** |
| **Noise Blankers:** | **Two independent noise blankers:<br>9 MHz - Hardware - on/off.<br>$IF_3$ - DSP, adjustable.** |

## SUB RECEIVER:

| | |
|---|---|
| **SSB Sensitivity:** | **0.35 µV typical for 10 dB SINAD*<br>at 2.4 kHz BW.** |
| **SSB & CW Selectivity:** | **590 IF DSP filters - 100-6000 Hz BW.** |
| **AM Selectivity:** | **IF DSP filters - 4& 6 kHz.** |
| **FM Selectivity:** | **Ceramic filter - 15 kHz.** |
| **IP3:** | **+5 dBm typical, 20-kHz spacing.** |
| **IP2:** | **+71 dBm typical.** |
| **Image rejection:** | **> 70 dB.** |
| **IF rejection:** | **> 70 dB.** |
| **S-meter Reference:** | **S-9=50 µV** |
| **Recovery time:** | **< 20 ms.** |
| **Noise blanker:** | **Software, adjustable 0-9.** |
| **SINAD*** | **Signal-to-Noise-and-Distortion Ratio.** |

**TRANSMITTER:**

| | |
|---|---|
| **Power output:** | **ALC Adjustable 5-100 W, ± 1 dB.** |
| **Telegraphy (CW) & SSB Duty cycle:** | **continuous service @ 100W** |
| **AM, FM, AFSK, PSK Duty cycle: (constant-carrier modes):** | **continuous with cooling fan accessory.** |
| **Microphone Input Impedance:** | **>10 k-ohms at 1 kHz.** |
| **Microphone sensitivity:** | **5 mV for full power output; Internal gain-range adjustment; DC power for electret elements.** |
| **Line-level input:** | **6 dBm into 600 ohms for full output.** |
| **Speech processor:** | **RF compression - 0-9 adjustment.** |
| **TX Bandwidth:** | **900-3900 Hz in 10-Hz steps.** |
| **TX Frequency Response:** | **50-3900 Hz maximum @ 6 dB points, adjustable.** |
| **TX Equalizer:** | **Up to 6-dB/octave; bass/treble boost/cut.** |
| **TX Speech Monitor:** | **Modulated IF after filtering, processing.** |
| **SSB Carrier Suppression:** | **> 50 dB.** |
| **Unwanted Sideband Suppression:** | **> 60 dB at 1 kHz.** |
| **Harmonic & Spurious Outputs:** | **> 50 dB below 100 W; > 40 dB below 5 W.** |
| **T/R Switching:** | **PTT or VOX on SSB, AM, FM, AFSK; Adjustable QSK on CW;** |
| **CW Keyer Speed Range:** | **10 -60 wpm, adjustable weighting.** |
| **CW Rise & Fall Times:** | **Adjustable 3-10 mSec;** |
| **CW Offset:** | **Programmable 300-1200 Hz in 10 Hz steps. Sidetone pitch automatically matches selected CW offset.** |
| **XIT range:** | **± 10 kHz** |
| **FM deviation:** | **± 5 kHz peak nominal.** |
| **Current drain:** | **25 A max.** |

The specification of "**25 amperes**" covers **ORION**'s performance under all specified conditions, but if your antenna impedance is between 50 and 100 ohms, including moderate reactance, a 22-ampere power supply will run **ORION** at close to full power. If you must have full power under all specified conditions, **ORION** needs 25 amperes.

**ORION** SECOND PRINTING
28 MARCH, 2003

## TABLE OF FIGURES



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## TABLE OF CHANGES:

## 31 MARCH 2003:

**ORION second printing includes addendum of 26 March 2003 and paragraphs 1.16 & 1.17.**

# 1. INTRODUCTION

## 1.1. Read the Manual!

It is surely more fun to use a new piece of radio gear than to spend time reading through a thick manual. We cannot force you to study this book, but we surely do recommend it, and tried very hard to make the reading interesting and informative! Our aim in designing and producing this radio was to meet the demands of increasingly intense competition in DX and contesting. The features and performance **ORION** brings to ham radio will enhance HF radio contacts of all sorts, while opening new possibilities for amateur radio operation. The radio, and your own grasp of what it will do, offer world class reception and transmission of CW, SSB, digital modes, FM, and AM on all our amateur HF bands, plus excellent general coverage reception from 100 kHz to 30 MHz.

## 1.2. ORION Is Different

The hams and "civilians" at Ten-Tec thank you for choosing this top-of-the-line high performance transceiver engineered and manufactured in the USA. We worked to bring some important *radio-sport* innovation to this design. We feel that we did that without sacrificing ease of operation for ordinary non-competitive modes of amateur radio. Dual-receiver radios are no longer unusual in the amateur market, but Ten-Tec extends the flexibility of this class to new and more useful levels.

The many differences between **ORION**, its competition, and even its **OMNI** ancestors, mean that some improvements are internal, or less than obvious at first glance. This assures that a thorough study of this manual will help you understand and get more enjoyment from **ORION**'s power and versatility. Your **ORION** can do much more than might be apparent from a casual exploration of the panel controls. You now own one of the finest transceivers in amateur radio. We urge you to learn all about it!

## 1.3. Unpacking

Examine **ORION** for signs of shipping damage. Should any damage be apparent, notify the delivering carrier immediately, stating the full extent of the damage.

Retain all damaged cartons. Liability for shipping damage rests with the carrier. We recommend that you keep the carton and fillers in the event that storage, moving, or shipment becomes necessary.

The following hardware and accessories come standard with your **ORION**. Make sure that you have not overlooked anything.

**Figure 1-1 Included Parts.**

| Qty | Part # | Description |
|---|---|---|
| 1 | #27074 | Mini-ATC Blade Fuse, 25 Amp. |
| 1 | #35003 | Phono Plug |
| 1 | #35057 | 4-pin Microphone Connector |
| 1 | #35163 | 1/8 in. Stereo Plug |
| 1 | #35165 | 2-pin Power Connector Shell |
| 2 | #41020 | Female Power Pins |
| 6 ft | #46159 | Wire, Red &Blk, #12 |
| 1 | #35013 | Phone Plug, 3-circuit |
| 1 | #35331 | Shell, Band Data Plug |
| 15 | #41068 | Band Data Plug Pins |
| 1 | #38040 | .050 Hex Wrench |
| 1 | #38088 | .062 Hex Wrench |
| 1 | 38313 | T10 Torx Wrench |
| 1 | #38244 | Microphone Clip |
| 1 | #46176 | Accessory Cable. 5-pin DIN to Phono |
| 1 | #74020 | Warranty Card |
| 1 | #74279 | User's Manual |
| 1 | #86095 | DC Power Cord |

### 1.4. Headphone Precaution

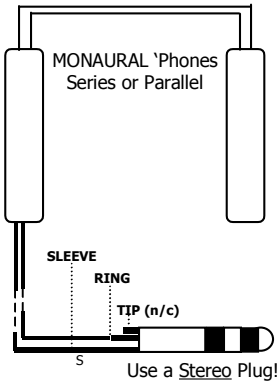
Please **DO *NOT* PLUG A MONO PHONE PLUG**, (two-circuit) **INTO ORION**'s **FRONT PANEL PH JACK**.

The jack is for stereo headphones, and is between the two other connectors on the front panel.

A mono plug will short-circuit one of the two audio channels, causing **damage to the radio**. Use a stereo (3-circuit) plug such as one that comes packed with your radio. Using stereo-wired phones lets you take full advantage of **ORION**'s advanced features.

See Figure 1-2 for a diagram showing how to wire a stereo plug to use mono 'phones with **ORION**. Connect low-impedance (<50-Ω) phones in series. Connect high-impedance phones in parallel. See also 1.9.

**Figure 1-2 Wiring Mono 'Phones**




### 1.5. Power Supply Installation

The **ORION** transceiver requires a source of well-filtered and regulated DC voltage. The supply voltage can range from +12.8 to +15.0 VDC but +13.8 VDC is the optimum value. The voltage source must be capable of supplying 22 amperes.

We recommend using the included DC power cable (P/N 86095). We have also included spare connector pins (P/N 41020) and a spare 2 pin power connector shell (P/N 35165) for building your own cable. The power supply plug will attach in only one way to the polarized two-pin DC connector on **ORION**'s rear panel. Use no less than #14 gauge (#12 recommended) stranded wires for three-foot long connections to accommodate the high current demand during transmit. Use heavier gauge wire for longer power supply leads.

**DO NOT EVER CONNECT AC POWER TO ORION!**

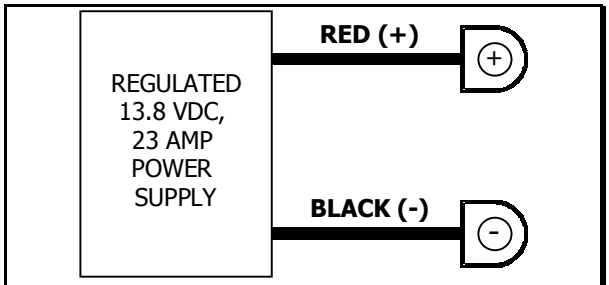



**Figure 1-3 DC Power Connections**

**NOTE:** always enable the power source first and then the transceiver. If a generator or alternator supports the dc source, always turn off the transceiver before starting or shutting off the dc source equipment. These recharging devices often generate large voltage spikes that can damage the transceiver.

### 1.6. Antenna Jacks

The circuit design protects the transmitter against damage from short-term load impedance mismatches ranging from a dead short to an open circuit. Operation at or near full power output is possible with an unbalanced (coax fed) load impedance between 25 and 100 ohms (~2:1 SWR). Single wire antennas, balanced feedline types, or antennas with higher SWR will require an antenna tuner (internal option or external station accessory) to present the

transmitter with an acceptable load. It is always advisable to reduce power to the lowest practical level while operating a manual or automatic antenna tuner.

**ORION**'s power amplifier includes overcurrent and over-temperature protection for the transistors in case of an improper RF load.

The three antenna connections to the transceiver are via two SO-239 connectors and a phono jack on the rear panel. These carry markings of **ANT 1**, **ANT 2**, and **AUX RX. ANT 1** and **ANT 2** are for transmitting and receiving. **AUX RX** (the phono jack) is a receive-only connection. Connect up to three antennas at one time and you can assign transmit and receive functions to them via the **MENUS** system or keys on the transceiver front panel. See further details in paragraphs 3.4.2 and 3.4.4.

### 1.7. Station Ground

A good ground system is essential for optimum operation of any HF transmitter. The best solution is to connect all the station equipment chassis together using a heavy gauge of flat ground braid. Use a short length of braid to connect to a ground rod. If you are not using a linear amplifier, a less ideal ground may suffice. A ground connection to a copper cold water pipe was often suitable, but that is now a violation of the National Electrical Code. Be aware that many modern water connections use plastic pipe, and are **not** suitable ground connections.

Antenna type and its proximity to the station are also factors in choosing ground methods. With good resonant antennas located away from the station, the AC ground in your house wiring might be adequate.

### 1.8. External Speaker

**ORION** provides a connection for an external speaker via a ¼-inch mono phone jack on the rear panel. The recommended external speaker load is 8 ohms. The sleeve connection is at chassis ground.

### 1.9. CW Key

**ORION** has two jacks for keying the transceiver in **CW** mode. The front panel provides a ¼" stereo jack for connection of an external key, keyer, or paddles (see Figure 1-4 for using the **ORION**'s internal keyer). The rear panel has a 1/8" stereo jack connected in parallel. **ORION** powers up with its internal keyer ready for your paddles. Inserting a two-circuit plug into the **CW** jack can immediately cause unintentional keying and RF output.

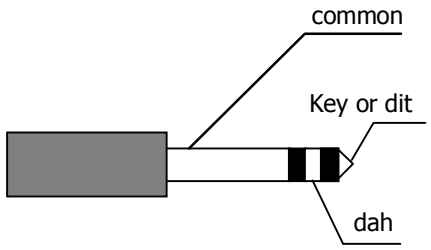



**Figure 1-4 Paddle Wiring for Using Internal Keyer**

***Before*** you plug in your straight key, semiautomatic "bug" or external keyer which uses a two-circuit phone plug, **disable the internal keyer** as follows: Push **MENUS** then push **AGC** (the key to the right of **CW** on the screen). Select "**Internal Keyer on**" in the menu by slowly turning the **VFO A** knob clockwise. (It will not change **ORION**'s frequency.) Now rotate **MULTI** to change "**on**" to "**off**".

The **PTT** pin in the **AUX I/O** rear jack allows you to connect an independent keyer or computer to share CW keying.

## 1.10. Microphones

Any Ten-Tec microphone equipped with a 4 pin microphone connector works without modification. Most dynamic, ceramic, crystal, or electret microphones also work. When adapting another microphone, please refer to the connector-wiring diagram in Figure 1-5. We include a spare 4-pin microphone connector (P/N 35057) in the packing kit. Be sure to use shielded cable to prevent RF interference. Electret elements and some microphones with built-in preamplifiers will require the DC voltage available at pin 4. The microphone circuit operates well with microphone impedances above 600-Ω having output levels of 5 mV or more.

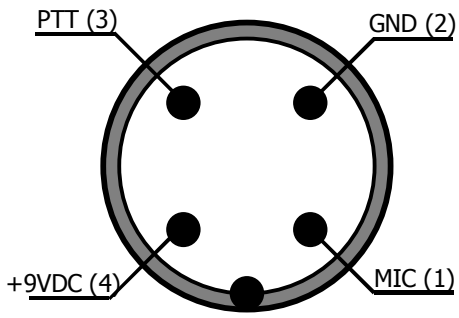



**Figure 1-5 Microphone Connections**

## 1.11. Analog Meter

**ORION** features a large, easy-to-read meter to indicate incoming signal strength and RF power output. Ten-Tec calibrates S9 at 50 microvolts RF input.

## 1.12. Connections To Other Accessory Equipment

The **ORION** design provides connectors for interface to a variety of station equipment. This may include linear amplifiers, terminal node controllers, phone patches, external keyers, and computer equipment.

The rear panel has the following connectors for necessary and optional station equipment:

**ANT 1** is an SO-239 coaxial receptacle for one 50-ohm **RX/TX** antenna feedline with SWR of 2:1 maximum. This connection (only) uses the internal automatic tuner option when supplied. With the tuner option, **ANT 1** can accommodate a much wider range of mismatches.

**ANT 2** is an SO-239 coaxial receptacle for a second 50-ohm **RX/TX** antenna feedline with SWR of 2:1 maximum;

**GND** is a 10-32 stud and wing nut for connecting the chassis to station ground per paragraph 1.7.

The following connections comprise a cluster of twelve phono jacks:

**RX ANT** – receive-only antenna;

**TX OUT 1** and **TX EN 1** – QSK keying loop (full break-in) for external RF power amplifier #1 (see Figure 1-6);

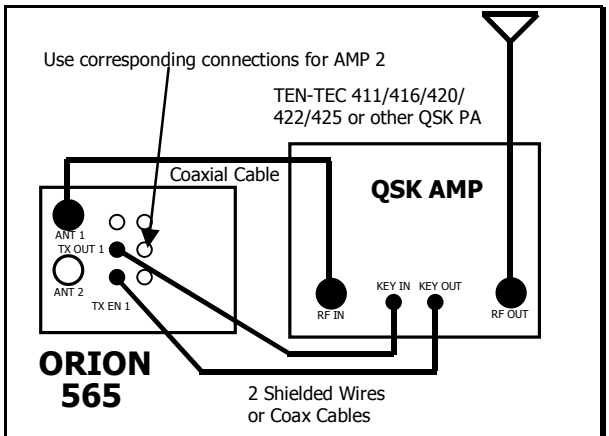



**Figure 1-6 Connecting a QSK PA**

**TX OUT 2** and **TX EN 2** – QSK keying loop for external RF power amplifier #2 (see Figure 1-6 again);

**+13.8 V AUX** – DC for station accessories, 2A maximum;

**AMP 1 KEY** –keyline for external non-QSK power amplifier #1 (see Figure 1-7); The external amplifier keyline should not apply more than +13.8V (output inactive) nor should it draw more than 250 mA (output active). Some older amplifiers have 110 VDC on the keyline. Such amplifiers *require a relay or transistor switch* between the **ORION AMP 1 KEY** jack and the amplifier keyline to avoid damaging **ORION**.

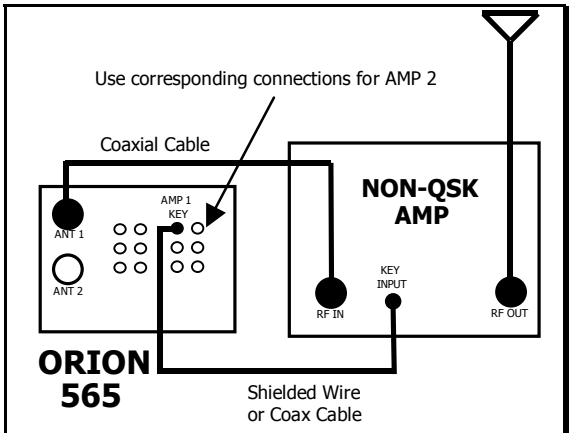



**Figure 1-7 Connecting a Non-QSK PA**

**AMP 2 KEY** –keyline for non-QSK external power amplifier #2 (see Figure 1-7); The capabilities and precautions for this circuit are the same as for the **AMP 1 KEY** circuit described above**.**

**XVRT KEY** – transmit keyline for external transverter (see Figure 1-8); The capabilities and precautions for this circuit are the same as for the **AMP 1 KEY** circuit described above**.**

**XVRT RF** – low-level TX RF output for external transverter (as Figure 1-8 shows); The RF output level is approximately +5 dBm into 50 ohms. Both transverter support connections get activated on the **TX** menu.

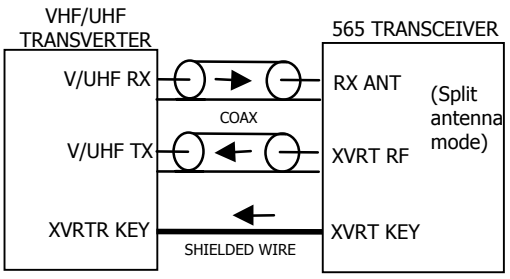
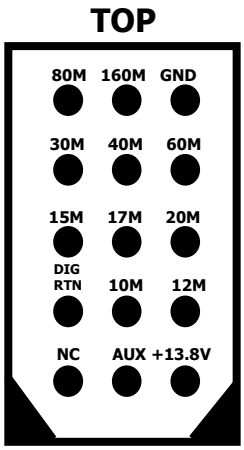



**Figure 1-8 Connecting a Transverter**

**SPARE** – Two unwired phono jacks.

**BAND DATA 1** and **BAND DATA 2** – These are 15-pin receptacles (see Figure 1-9. One works with **ANT 1** and **AMP 1** and the other works with **ANT 2** and **AMP 2.** They contain pull-down lines for 5 to 13-volt control of amplifiers and other devices to be switched by amateur band selection. See Figure 1-10 for an example of controlling a relay and Figure 1-11 for an example of controlling a multi-band device with logic circuitry. The external load should **not** apply **more than +13.8V** (output inactive) **nor** should it draw **more than 250 mA** (output active).

**Figure 1-9 Band Data Connector**




**BAND DATA 1** and **BAND DATA 2** are associated with **ANT 1** and **ANT 2** respectively. They will find uses in stations having multiple antennas or power amplifiers with band-control inputs.

## 1.13. Connecting to Hercules and Other Equipment

Ten-Tec's Model 420 Hercules Amplifier and Model 253 Automatic Antenna Tuner require positive 12-volt (nominal) control lines to coordinate their operation with the transceiver. To facilitate their operation with **ORION**, we designed the Model 311 Band-Data Converter. This accessory converts **ORION**'s active-low Band Data lines to the positive logic required by older Ten-Tec equipment and other devices. See the Model 311 Instructions for more information.

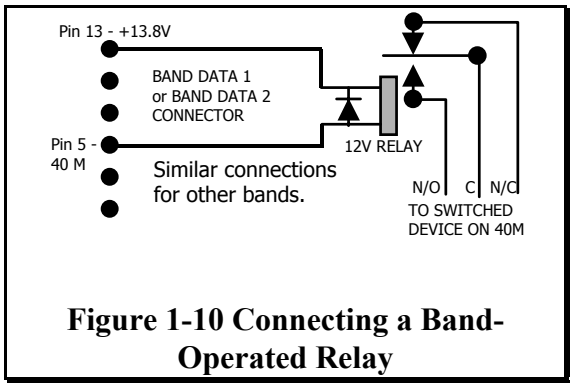



**Figure 1-10 Connecting a Band-Operated Relay**

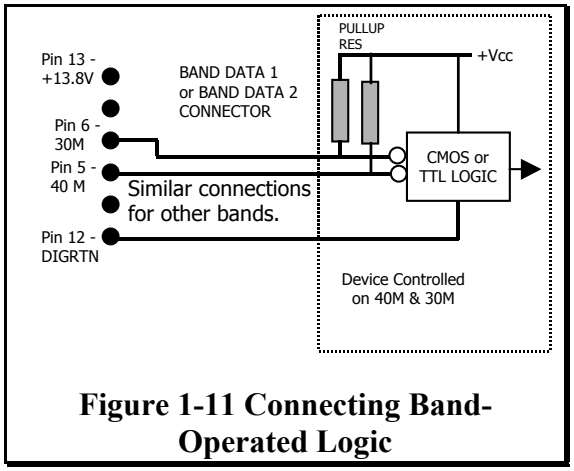



**Figure 1-11 Connecting Band-Operated Logic**

**EXT SPKR** – ¼ inch phone jack for connecting an external speaker. Tip connection is hot and sleeve is grounded.

**KEY** – 1/8" inch phone jack for connecting your paddles, external key, or keyer per Figure 1-4.

**AUX I/O** – This is a 5-pin DIN receptacle for external modem audio and keyline. See Figure 2-25. Use the PTT and Ground connections for an independent CW contest keyer.

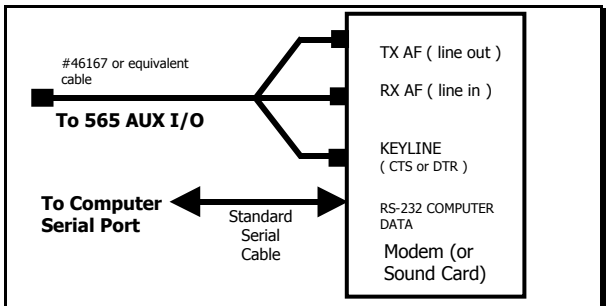



**Figure 1-12 Connecting to a Sound Card or Modem**

A computer sound card can connect here. You will need shielded wire for the connections. We recommend our #46176 cable. See also 2.6 below.

**REMOTE** – 8-pin DIN receptacle for connecting optional Model 302R external keypad and tuning knob.

**SERIAL DATA** – 9-pin RS-232 port for external computer data connection. A suitable third party program (not produced by Ten-Tec) can control every function on **ORION**. Ten-Tec will make control information available.

## 1.14. TEN-TEC ORION Accessories

The accessories in Figure 1-2 are available for **ORION**, and the Ten-Tec store has other supplies and equipment. Visit **www.tentec.com** or contact the Sales Department for information and advice. Ten-Tec's walk-in retail store normally stocks those accessories bearing an "R"

number and other parts are available from factory stock.

### 1.15. If All Else Fails …

On rare occasions, the transceiver might not accept commands from the front panel properly or it might operate erratically. Surges on the power supply line or an unforeseen set of circumstances can confuse the microprocessors. This technology has improved but it is still possible to have a "lock-up." If cycling the power on and off does not correct the problem, reset the microprocessor using the **MASTER RESET** per paragraph 2.2.

### 1.16. Tuning Knobs – Drag Adjustment

The two main knobs have individual *drag* controls. To adjust the drag on either tuning knob, hold the skirt while rotating the knob about a quarter turn. Counterclockwise twisting will loosen them and clockwise twisting will increase the drag. Loosen them up or increase the drag to your preference.

### 1.17. M.A.R.S. Operation

**ORION**'s internal logic controls band-edge limits that can be loosened only slightly. The "problem" is that the design of **ORION MAIN TX** and **RX** features fairly tight amateur-band filters for high-performance. The response of these filters will seriously degrade performance at some point beyond band edges. We chose not to characterize this effect, but to concentrate instead on performance for amateur frequencies. Based on a small amount of demand for M.A.R.S. operation, we are studying the situation. ORION's physical design makes changing a semiconductor device (as on Pegasus and Jupiter) a job reserved for professional technicians with uncommon tools. Watch our website for results.

**Figure 1-13 ORION Accessories**

| | |
|---|---|
| 238A | 2kW antenna tuner |
| 701 | Hand microphone |
| 705 | Desk microphone |
| 963 | 13.8 V, 25 amp switching DC power supply |
| 217 | Xtal filter, 500 Hz BW |
| 218 | Xtal filter, 1800 Hz BW |
| 219 | Xtal filter, 250 Hz BW |
| 302R | External Keypad/Knob |
| 307B | External speaker |
| 310 | Fan Kit |
| 311 | Band Data Converter for Hercules & 253 Tuner |
| (565AT) | Internal Automatic Tuner |
| 35057 | 4 pin microphone connector |
| 80573 | 2 pin DC connector with pins |
| STUDIO ONE R9624 | Heil Sound Microphone |
| CC-1-TT R9625 | Heil Microphone Cable for Ten-Tec |
| TB-1 R9626 | Heil Microphone Table Stand |
| LX-1 R9627 | Heil Microphone Studio Boom Stand |
| MA-1 R9628 | Heil Microphone Adjustable Boom |
| SB-1 R9629 | Heil Microphone Short Boom |
| AT8410a R9700 | Audio Technica Microphone Shock Mount for Booms |

# 2. GETTING STARTED

## 2.1. Introduction

Our emphasis in this section is to convey the information you need to *start* enjoying **ORION**. Chapter 3 explains further details. A sophisticated HF transceiver such as **ORION** has many more features and capabilities than can be accommodated with individual knobs and keys ("buttons") on a panel of reasonable size. Many seldom-used or occasionally used functions are accessible via a "soft-key" organized **MENUS** interface. Briefly press **MENUS** to enter this area, and press **MENUS** again (or any key outside the pop-up submenu) to return to the control screen.

## 2.2. Before You Power Up

This manual uses font conventions below:

- Words in **Label** format refer to names seen on the panel or to specific **ORION** functions;
- Words in **KEY** format appear on **ORION**'s keys;
- Words in **DISPLAY** format appear on **ORION**'s LCD screen.

Shortly after you turn **ORION** on, all the LED indicators including **ALC** will light up briefly. This does not mean **ORION** is transmitting – it is only a self-test.

We suggest doing a Reset as you power up **ORION** for the first time. This clears out any memory locations or special settings that were created as a result of factory testing and burn-in.

- To Reset **ORION**, turn the transceiver power OFF for a few seconds.
- Press and hold the **MAIN RX/TX** key (directly under the **Power** switch) while turning power **ON**.

Hold the **MAIN RX/TX** key until **ORION** displays "**MASTER RESET COMPLETE**" and the version number of the resident firmware. This action returns the transceiver to the factory default settings. Release the **MAIN RX/TX** key.

The Reset submenu (see Figure 2-1) next presents the user with **Clear User Settings?** and a choice of **Yes** or **No**. User settings comprise the 200 VFO memories and any stored *USER profiles* (see 3.8.9). Pressing the soft- key **AN** for **YES** will clear out any previous user-entered data. Pressing the **RECALL** soft-key for **NO** (or simply delaying your response) will restore **ORION** to default settings without disturbing the user memories.

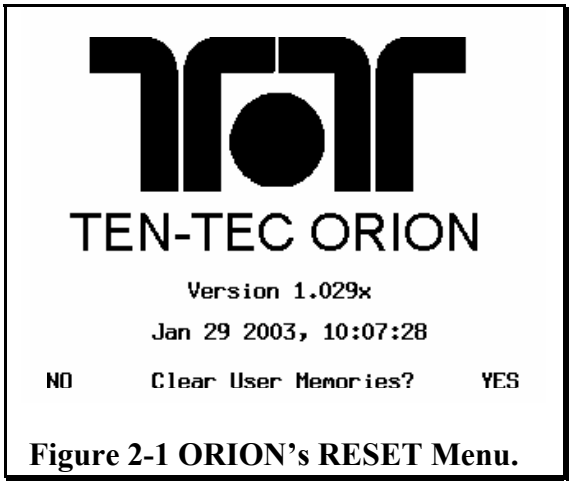



**Figure 2-1 ORION's RESET Menu.**

Before transmitting, ensure that your antenna is suitable for the frequency, or else connect a 50-ohm dummy load (100W) to the **ANT 1** jack.

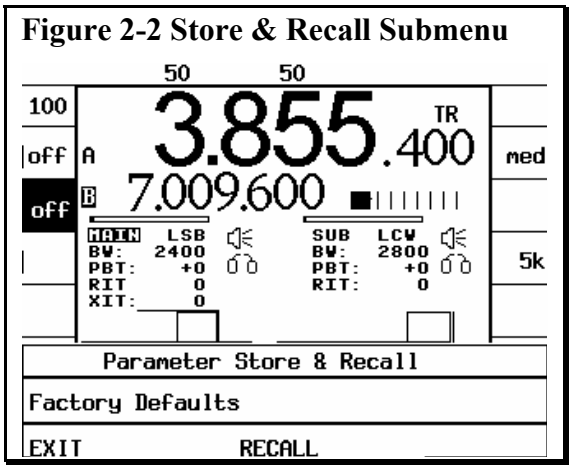
### *2.2.1. Restoring Initial Settings – "Long Recall"*

With a transceiver of **ORION**'s power and flexibility, a new user could get "lost in the rigging", but rescue from confusion is as close as the **RECALL** key at the lower left corner of the radio screen.

**To perform a "Long RECALL",**

Press and hold the **RECALL** key for at least 3 seconds. **ORION** displays the Figure 2-2 pop-up submenu below the receiver data.

**Figure 2-2 Store & Recall Submenu**




Push **NR**, the soft- key below **RECALL** to restore **ORION** factory defaults without erasing user memories. You have just found **ORION**'s *PANIC BUTTON!*

**NOTE**: While the submenu of Figure 2-2 is showing, *no other controls will work*! There is a soft-key **EXIT** for simply abandoning the reset operation (if you don't want to press the **RECALL** soft key). The submenu shows **Factory Defaults**, but turning the **MULTI** knob brings a selection of four more stored USER Profiles for experienced operators. See more about USER Profiles in paragraph 3.8.9.

The **Factory Defaults** control settings, which apply after a long press on **RECALL**, will allow you to get started quickly. You can customize **ORION** operation to fit your preferences more closely as you become familiar with the transceiver.

With **ORION** in a known and useable state, the operator is free to continue learning the controls. Push **EXIT**.

### *2.2.2. A QUICK GUIDE to ORION*

There are 5 key points for understanding the **ORION** design. As Figure 2-3 shows, **ORION** has three radio units: one Transmitter (**TX)** and two independent Receivers, **MAIN** and **SUB**.

1) Either of the two **RX/TX** antennas can feed any (or all) of the radio units via the **ANT** switch group under the S-meter.

2) Either **VFO A** or **VFO B** can control any or all of the radio units via the **VFO** switch group next to the **ANT** group.

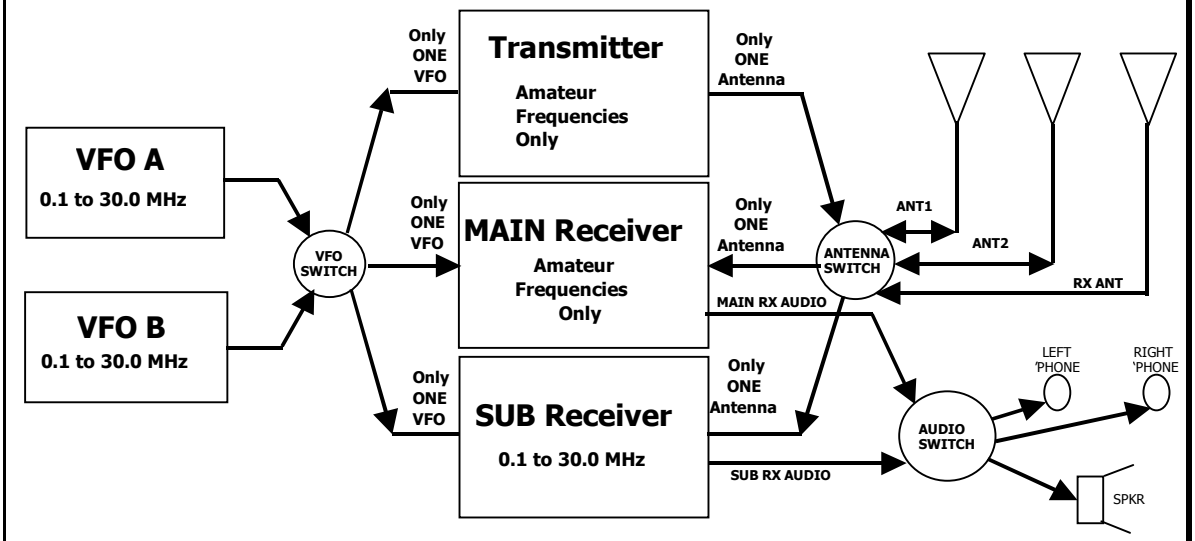
3) Any radio unit will accept only *one* of the antennas and *one* of the VFOs.

4) Both **VFO**s hold band information independently.

5) The **RX ANT** can feed either or both receivers.

The examples below arbitrarily use **VFO A** and **ANT 1**, but **VFO B** and **ANT 2** or *any* combination of a **VFO** and **ANT** will work just as well. **ORION** tunes its three radio units to the desired frequencies with the operator's choice of VFOs. The *left* tuning knob is always **VFO A**, and **VFO B** is always the *right* one. Their capabilities are identical.

**Figure 2-3 Understanding ORION's Design**




To set up **ORION** in other than the **Factory Defaults** (Long **RECALL**) condition, you must do at least the following:

1) Assign **ANT1** or **ANT2** to **TX** and **RX**. You may want to assign an antenna to **SUB** as well.

2) Assign one or both **VFO**s to receiver(s) and transmitter. You may want to assign a **VFO** to **SUB** as well. See 2.2.5.

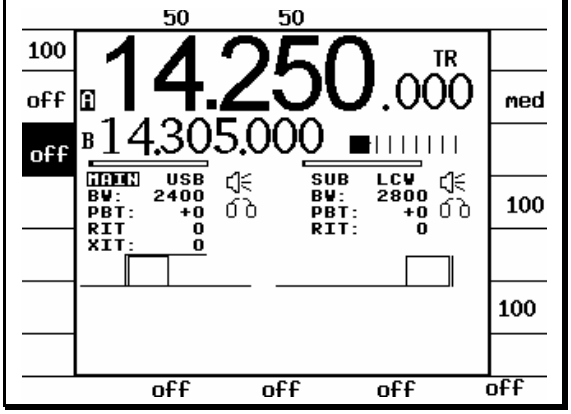
3) Choose band, frequency, and **MODE** for one (or both) receivers. See 2.2.6

4) Assign the **AUDIO** routing (See 2.2.7) for one (or both) receivers.

### *2.2.3. LOOK AT THE SCREEN*

Take a moment to learn about a few screen features. The larger frequency readout is always **VFO A** and the smaller is always **VFO B**. The **Factory Defaults** setting arbitrarily assigns **VFO A** to the **TX** and **MAIN RX** as a starting point.

**Figure 2-4 Factory Default Screen**




Note the letters **T** & **R** to the right in the **VFO A** area. If we chose to assign **VFO B** to **Tx** & **Rx**, those letters would be in the **VFO B** area**,** just above the Signal Strength bargraph. If we also assigned **VFO B** to the **SUB** receiver, we would then see **TRS** in the **VFO B** area.

To the left of the frequency readouts are the labels **A** and **B**, showing which VFO

is which. At this point **A** has the highlight. This signifies that changing bands with the numeric pad will affect **VFO A** only. More on that below….

Below the **VFO B** area, there are two columns of data on key settings – one each for the **MAIN** & **SUB** receivers. At the top of each column is a thin horizontal bargraph. The darkened portion of each shows the relative setting of receiver volume controls, **MAIN AF** & **SUB AF**. In the startup condition, both controls are at minimum volume and both audio channels are switched to the speaker and to both sides of a stereo headphone pair. These **AF** controls allow unconditional control of audio volume.

In the **MAIN** column, below the bargraph, notice that **MAIN** is highlighted in reverse video. This is a reminder that the **MAIN RX** key (between the two tuning knobs) is lit. If you press the **SUB RX** key, both the highlight and the light on the key would move to **SUB**. Stay in **MAIN** for now.

Looking at the data, we see that the **MAIN** receiver mode is Upper Sideband (**USB**) and the **SUB** receiver is also in Upper Sideband, although it is inactive (no VFO assignment & no **S** in either VFO area). Bandwidth is **2400** for **MAIN** and **2800** for **SUB**.

In this initial state, the Passband Tuning (**PBT**) for both receivers is zeroed, as are the two Receiver Incremental Tuning (**RIT**) controls and the Transmitter Incremental Tuning (**XIT**). In each column, **ORION** shows a graphical representation of the filter bandwidth that includes any modification to the response made by controls such as **RIT**, **PBT**, **L**ow **CUT**, and **H**igh **CUT**.

Next to some of the surrounding keys, the screen shows current settings. For this default condition, most of them are inactive until the operator presses the associated key and turns the **MULTI** knob to change settings. The RF Power (**PWR**) is at 100%. The **AGC** timing is **med**ium. Tuning **STEP** size is **100** hertz. The **RFGAIN** is at its normal setting of 100%.

Just above the **SUB** data column is a graphic representation of signal strength in the **MAIN RX**. When **ORION** is transmitting the graphic changes to an **SWR** readout. Above 6:1, the readout says **SWR HIGH**.

One more **ORION** screen feature to note is the set of speaker and headphone icons to the right of each receiver data area. For the factory default condition, the speaker and both sides of stereo ‘phones are connected to both **MAIN** and **SUB** audio. Because it has no VFO connected, the **SUB** is inactive for now. To minimize any operating difficulty, **ORION** provides dedicated volume controls for each receiver.

### *2.2.4. Assigning Antennas*

The **MAIN RX** and **TX** normally use the same antenna. Paragraph 3.4.3.3 covers the only exception to that rule. The column of antenna selection keys at the far left of the panel can assign either **ANT 1** or **ANT 2** to the (**MAIN**) **RX/TX**. At the same time the **SUB RX** may use **ANT 1**, **ANT 2**, **RX ANT** or no antenna. Assigning an antenna is as simple as pressing the appropriate **ANT** key and seeing it light.

### *2.2.5. Transceiving on One VFO*

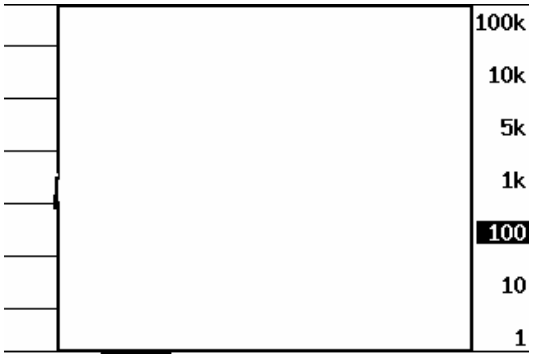
With the **MAIN RX/TX** on **ANT1**:

- Tune **VFO A** to a suitable operating frequency, consistent with the

connected antenna, operating mode, and your privileges. To change tuning step size, press **STEP** and use the resulting soft-key submenu (Figure 2-5) to select the tuning increment.

- Under the **RIT** knob, press **RX CONTROLS > MAIN**. The key lights.
- Press **VFO A > TX**. (Within ham bands only).
- Press **VFO A > RX**. (Within ham bands only). See the switches in Figure 2-6.

**Figure 2-5 Tuning Step Submenu.**




Press **MODE** and select an appropriate mode of operation with the *soft key-submenu*. See Figure 2-7 below. Soft key submenus "pop" over **ORION**'s display when some functions offer several choices. Make the desired choice by pressing the key next to your choice in the right-hand column of the screen.

The **TX** operates on the mode you selected for **MAIN RX** with the band and frequency of the **VFO** connected to **TX**.

In Figure 2-7 below, we pressed **MODE** to bring up the submenu, and then we pressed the **ATTN** key to select **USB**. Press **MENUS** again to leave the submenu.

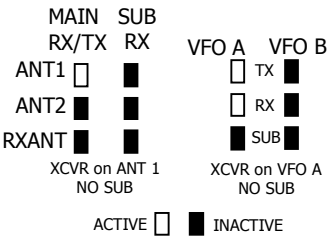



**Figure 2-6 Transmitting on One VFO**

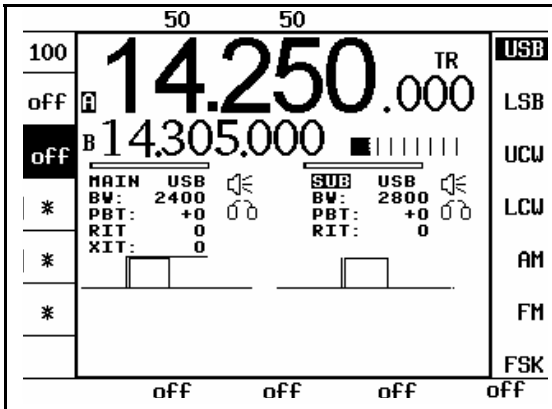



**Figure 2-7 ORION's Mode Submenu.**

### *2.2.6. Bandswitching*

The screen highlights either **A** or **B** to show which VFO is currently activated for one-stroke band changing. At power-up, or after a reset operation, **VFO A** is the default, but we make it easy to move that designation to the other VFO. To change the band switching shortcut to **VFO B**, press and briefly hold **A/B** so that the highlight moves to **VFO B**. To return band switching to **VFO A**, press and briefly hold **A/B** again. With the highlight indicator on **VFO A**, press a band key suited to your antenna and amateur privileges.

You are now ready to operate on one antenna. If you hooked up other

antennas as well, try using them after doing the following steps.

### *2.2.7. Routing Receiver Audio*

**ORION** has 2 audio sources (**MAIN RX** and **SUB RX**) and each has 4 potential destinations (**SPEAKER**, **LEFT PHONE**, **RIGHT PHONE**, or **BOTH** phones) which the operator selects. The **Factory Defaults** setting connects both the **MAIN** and **SUB RX** to speaker and to both headphones. The separate **AF** controls for **MAIN** and **SUB** let the operator adjust the audio mix. Use headphones wired for stereo, as we recommend, and direct audio from either receiver (or both) to either ear! See Figure 2-8 below.

- Press the **AUDIO** key to bring up a soft key submenu on the display with the destinations: **LEFT** (headphone), **RIGHT** (headphone), or **BOTH**.
- Press the key next to the destination you want to change and use **MULTI** to select the source(s): **MAIN**, **SUB** or **BOTH**.
- Proceed to the next destination by tapping its soft key.
- Exit the **AUDIO** submenu by pressing **AUDIO** or any other key.
- Tap **AUDIO** again at any point. The submenu saves your changes and closes.

Aside from the audio routing described here, there are audio **Equalization** and **Binaural Rx** functions in the **AUDIO** submenu, and we discuss them in paragraph 3.2.

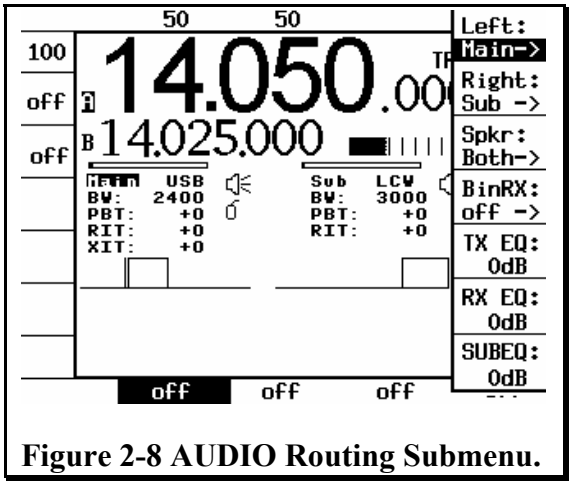



**Figure 2-8 AUDIO Routing Submenu.**

## 2.3. Basic Operating Examples

Let's look at some examples of basic operation:

### *2.3.1. Operating on One Antenna*

We will assume you have a ham-band antenna on **ANT1**.

- Press **MAIN RX/TX** > **ANT1**, (top left key under the S-meter).

### *2.3.2. Operating Split-Frequency*

- Press **VFO A** > **TX**.
- Press **VFO B** > **RX**. See Figure 2-9.

Choose the *same band* for receiving and transmitting!

Choose your band and TX operating frequency per 2.2.5 and 2.2.6. (Ham band frequencies only).

### *2.3.3. Operating a Reverse Split*

Operating a *reverse-split* means exchanging the transmitting and receiving frequencies that you used in a split-frequency setup. Starting with the settings just above:

- Press **VFO B** > **TX**. (Ham bands only).

See Figure 2-10 below.

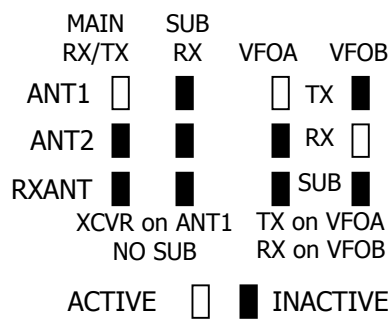



**Figure 2-9 Transceiving Split-Frequency.**

- Press **VFO A** > **RX**. (Ham bands only).

Your transmitter and receiver have swapped frequencies. Compare the lit switches in Figure 2-9 and Figure 2-10.

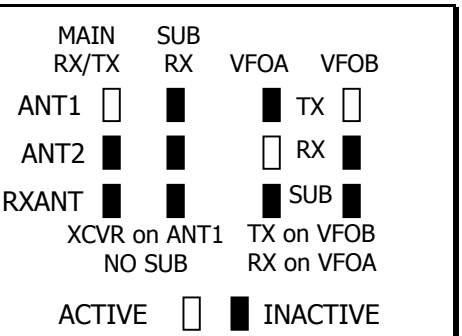



**Figure 2-10 Transceiving "Reverse Split".**

### *2.3.4. Using the VFO & ANT Switches*

If you have more than one antenna, hook antennas up to **ANT2** or **AUX RX** antenna as well.

- Try using **ANT2** and **RX ANT** on the **RX/TX**.
- Try changing **RX/TX** to **VFO B**.

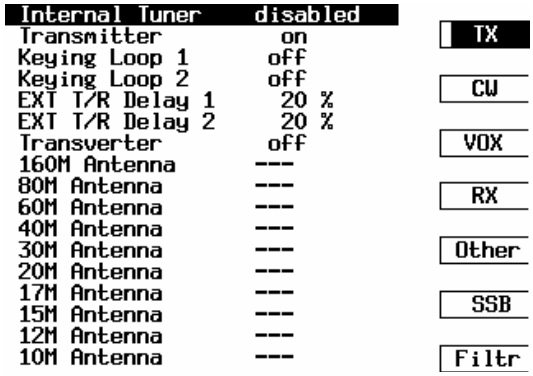
### *2.3.5. Turning the Transmitter Off and On.*

A responsible amateur radio operator takes steps, per FCC regulations, to prevent accidental or unauthorized transmission, especially when not in the shack.

To enable or disable **ORION**'s transmitter:

- Push **MENUS** and select the **TX** soft key at the right side of the screen.
- Select the **TRANSMITTER** item by turning the **VFO A** tuning knob to highlight it as in Figure 2-11.
- Rotate the **MULTI** control to select **ON** or **OFF** as required.
- Push **MENUS** again to return to the operating screen.

**Figure 2-11 Transmit Menu**




### *2.3.6. VFO Memory Operation*

**ORION** provides 200 *VFO Memories* that store and recall amateur or general coverage frequencies along with the **MODE** of the receiver in use at the time of storage.

#### 2.3.6.1. Storing VFO Data to Memory

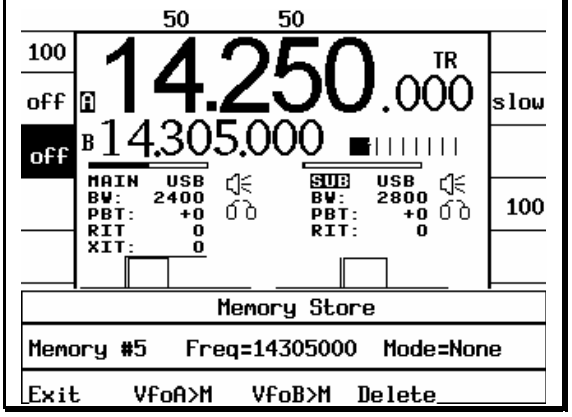
Use either of the **VFO A>M** or **VFO B>M** keys to initiate a storage operation. Each key is near its VFO tuning knob. When the operator presses one of these storage buttons, the bottom

of the radio screen changes to display the contents of the current memory location. The operator may choose to store the VFO data in the location displayed or may use the **MULTI** control to choose another storage location. After choosing the memory number, press either **VFO A>M** or **VFO B>M** soft key to store the desired VFO data in the current location. Each location will store the data from either VFO – one VFO to a location.

Example:

- Set **VFO A** to **14.230.000** MHz.
- Press the **VFO A > M** key (near its tuning knob).
- The **Memory Recall** submenu appears as Figure 2-12 below, (but usually with some different memory contents).

**Figure 2-12 Ready to Store VFO & Mode.**




*Either*

- Store your frequency in this memory (#5) by pressing the **VFO A>M** soft key,

*Or*

- Choose another memory using the **MULTI** knob or the numeric pad and *then* press **VFO A>M** soft key.
- Now, the memory location you chose holds the frequency from **VFO A** and the menu closes.

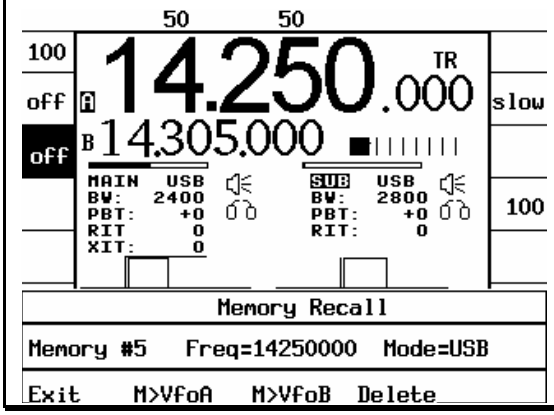
Even though this example stored **VFO A** in memory, notice that the memory soft keys allow you to store **VFO B** even though you pressed the **VFO A>M** key to start! It is really easy to store *both* VFOs in successive locations.

While the **Memory Store** submenu is on screen **no ORION controls will work** (except the soft keys in **Memory Store**). You must **Exit** before you do anything other than the soft key functions.

#### 2.3.6.2. Recalling a Memory to a VFO

To recall data from memory to either of the VFOs, *briefly* press the **RECALL** key and the **Memory Recall** submenu, Figure 2-13, displays the location number and contents of the last selected memory. [Remember what a *long* press will do? Check out paragraph 2.2.1. ]

**Figure 2-13 Recalling a Memory Location**




The operator may choose to recall the **VFO** data from there or may use the **MULTI** control to choose another memory location for recall. After

choosing the location to recall, press either **VFO ENTER** soft key on the submenu to load the data to the desired VFO. Remember that a VFO connected to *only* the **SUB RX** will accept any frequency from 0.1 to 30 MHz, but a VFO whose connections include *either* **MAIN RX** or **TX** will accept only legal amateur frequencies. An attempt to recall a memory to a VFO assigned to either **RX** or **TX** will display an error message and return that VFO to its previous frequency. Of course you can recall an amateur frequency to both VFOs by pressing both **M>VFO** soft keys in succession.

You must **Exit** before you can do anything other than the soft key functions.

## 2.4. Additional Capabilities

### *2.4.1. Turn SUB Receiver On and Off*

Turn **SUB** ON as follows:

- Assign a **VFO** to it. See Figure 2-14. Any frequency or band will work unless you have **TX** or **MAIN** on the same **VFO**. Using a **VFO** attached to either **TX** or **MAIN** requires staying within ham band limits.
- Assign any antenna to it. You may share **ANT1** or **ANT2** with any or all of **ORION**'s two other radio components! You might want to put **SUB** on the **RX ANT** (receive only).
- Assign its **AUDIO** output per 2.2.7.

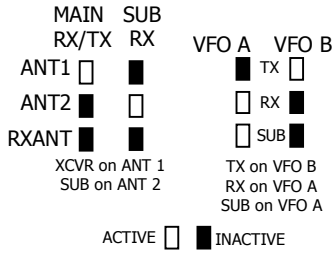



**Figure 2-14 Add SUB Rx to VFO A.**

- Press **RX CONTROLS > SUB** per Figure 2-15.
- Press **MODE** and select a mode of operation with the soft key submenu, as in Figure 2-7.
- Adjust the **MAIN** and **SUB AF** controls to suit your preferences.

For example:

- Press **VFO A** > **SUB RX**,
- **ANT 2** > **SUB RX.**

See Figure 2-14

- **SUB AUDIO** to **SPKR**.

See paragraph 2.2.7.

Turn **SUB** off by pressing whichever **VFO** > **SUB RX** key is currently lit.

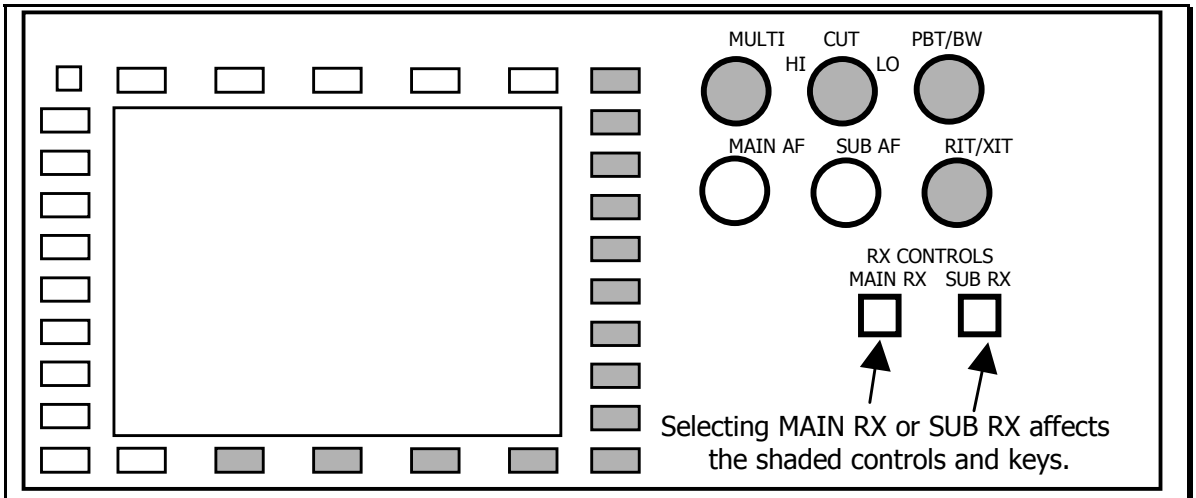



**Figure 2-15 ORION Controls Serve One Receiver at a Time.**

**ORION**'s **MAIN RX** is *always active* on one VFO or the other.

### *2.4.2. Selecting MAIN RX or SUB RX controls*

In Figure 2-15, the shaded set of receiver knobs and keys works for either receiver per the operator's selection. The **MAIN RX** and **SUB RX** keys (between the VFO knobs) assign all receiver controls to one receiver at a time. See Figure 2-15. Adjustments on one receiver are independent of adjustments on the other receiver unless the **PBT Track** or **BW Track** in the **RX** Menu are ON. This is a special case for **DIVERSITY** operation per paragraph 2.4.5.

Light the indicator for the **MAIN RX** key under **RX CONTROLS** by pressing that key. The **SUB RX** key indicator will be dark. All receiver controls will affect the **MAIN RX** in this condition.

Light the indicator for the **SUB RX** key under **RX CONTROLS** by pressing that key. The **MAIN RX** key indicator will be dark. All receiver controls will affect the **SUB RX** in this condition.

### *2.4.3. Using More Than One Antenna*

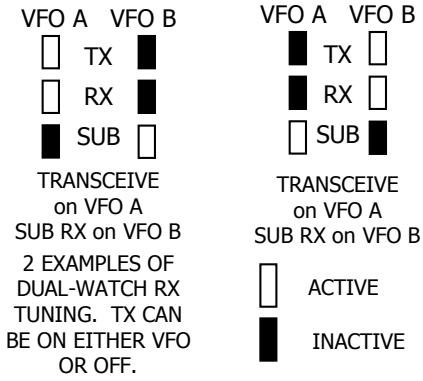
Using more than one antenna connection on **ORION** is convenient for several reasons:

- You may have different antennas for different bands, such as dipoles or verticals for lower bands and a beam for higher bands.
- You may have antennas with different directionality or polarization.
- You may have antennas sufficiently separated in distance to provide *Diversity Reception*.
- You may have a separate receive-only antenna, such as a 160-meter Beverage Antenna or a small loop.

### *2.4.4. Tuning Two Receivers Independently –Dual Watch*

**ORION**'s two receivers are *truly independent* for maximum utility and convenience. If you press **VFO B** for **RX** and **VFO A** for **SUB** (or vice versa) the receivers can be on the same or different frequencies, or the same or different

bands. See Figure 2-16. They may use the same antenna or different antennas.




The transmitter can tune with either the **MAIN** or the **SUB**'s VFO, and switching **TX** between them takes only a tap on a **VFO** key. This feature will be particularly valuable for contesting and DX-chasing.

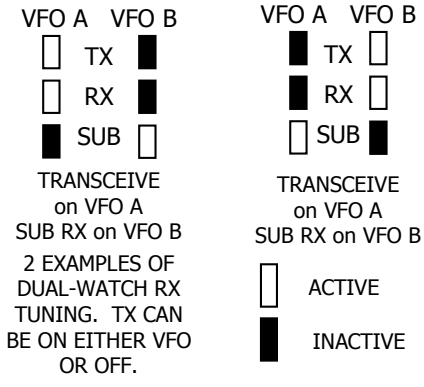



**Figure 2-16 Dual-Watch Tuning Examples.**

### *2.4.5. Tuning Two Receivers Together – Diversity RX*

If you select either **VFO A** or **VFO B** for *both* **MAIN** *and* **SUB** receivers they will tune to the same frequency. All other receiver controls can operate with independent adjustments. **MENUS>RX** has items to allow **SUB RX PBT** and **BW** to track the settings on the **MAIN RX**. That may benefit *Diversity Reception*. For **Diversity Reception** to work, each receiver must use its own antenna, and the antennas must be separated sufficiently ($^1/_4$ to ¾ wavelength), or have different polarization. Now a distant signal will fade at different times on each receiver. This mode can be a great DX asset under unsettled HF conditions. See Figure 2-17 for some of the VFO and Antenna Switch settings that are useful for **Diversity Reception**.

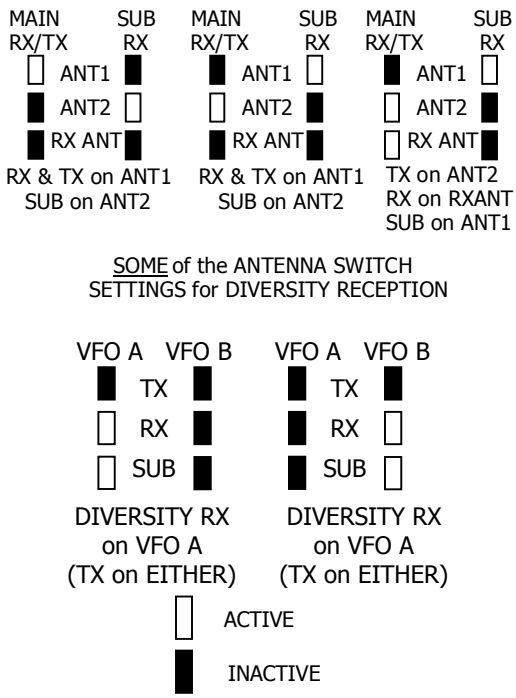



**Figure 2-17 VFO & Some Antenna Settings for DIVERSITY RX.**

## 2.5. ORION's Menus

Press the front panel **MENUS** key to access these behind-the-panel settings. Choose one of the soft-submenu highlights in the right column using the adjacent keys. In the menu of your choice, use the **VFO A** knob to move the highlight on the menu item, then change the setting with the **MULTI** knob. This rotary control (**MULTI**) near the top center of the front panel adjusts many radio functions and menu settings, described throughout this manual. Push

**MENUS** again to store the settings and leave the menu. The figures below show the initial (Factory) settings

**Figure 2-18 TX Menu**

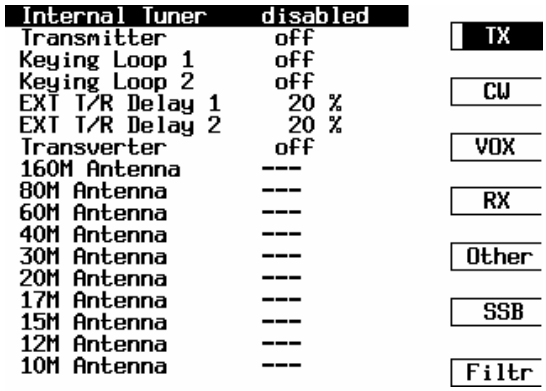



**Figure 2-19 CW Menu**

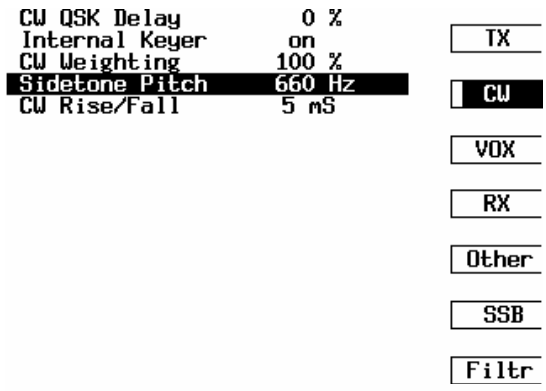



**Figure 2-20 VOX Menu**

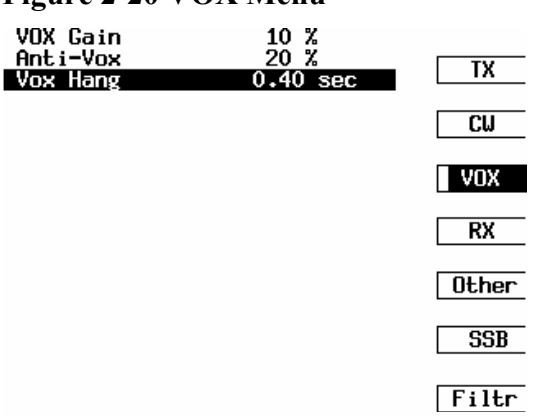



**Figure 2-21 RX Menu**

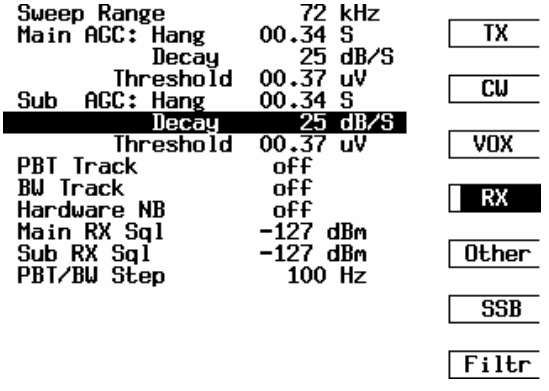



**Figure 2-22 Other Menu**

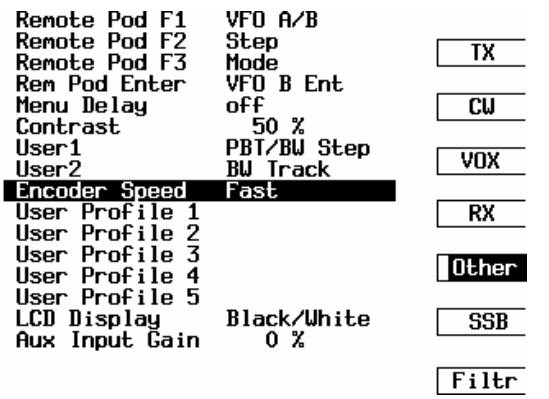



**Figure 2-23 SSB Menu**

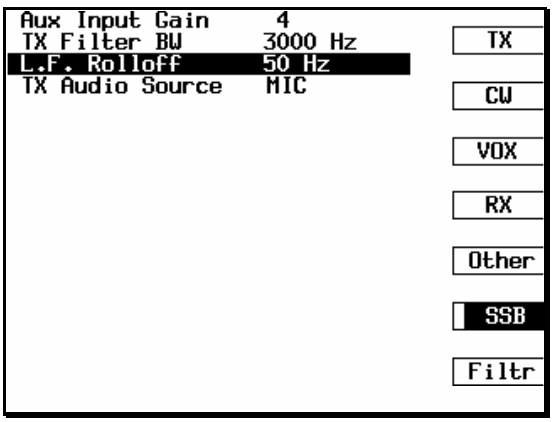
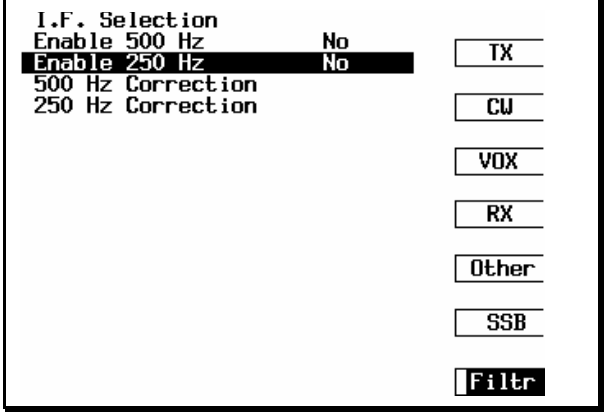


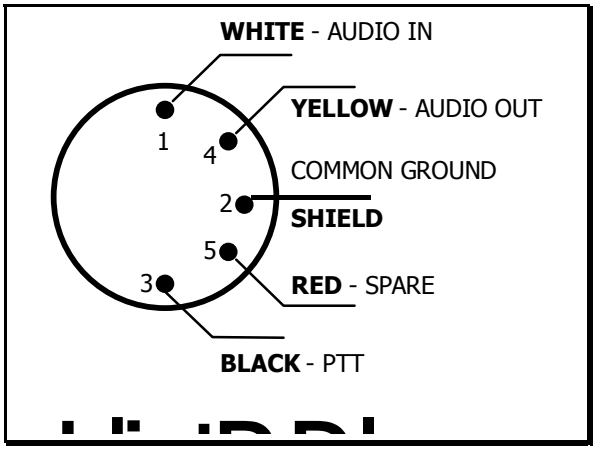
**Figure 2-24 Filter Menu**




## 2.6. Using External Modems

In Figure 2-25, the colors indicated correspond to those on the recommended Ten-Tec #46176 accessory cable.

**Figure 2-25 AUX I/O connections**




For computer Sound-Card modes of digital modulation, connect **AUDIO IN** to Sound Card Line Output, and connect **AUDIO OUT** to Sound Card Line Input, using whatever adapter or patch cord your equipment requires (usually a cord with phono male plug connected to 3.5 mm stereo phone plug).

See also paragraph 1.12. Check your sound-card documentation for proper connections. Depending on just how your station components are connected and powered, you may be able to use these modes *without* an external interface adapter. It would be prudent to use a second receiver or a nearby ham to critically listen to your signal for evidence of hum, noise, or distortion. Attention to proper audio level, shielding and grounding is always necessary. Your particular setup may require breaking ground loops with isolation transformers as commercial interface boxes use.

# 3. TRANSCEIVER DETAILS

## 3.1. Introduction to ORION Design

The **ORION** design brings new and exciting capabilities to competitive amateur operating *without complicating traditional modes of ham radio practice.* A simple control operation (paragraph 3.1.) will restore **ORION** to a familiar and conventional transceiver configuration.

For reference, recall **ORION**'s basic design in Figure 2-3 above. **ORION** comprises three radio elements. **ORION** provides a high performance amateur-band transmitter (**TX**) and receiver (**MAIN RX**) plus an *independent* 0.1 to 30 megahertz sub-receiver (**SUB R**X).

The following sections not only describe **ORION**'s basic operational functions, but also provide suggestions to optimize radio operation for specific situations.

## 3.2. Receiver Audio Submenu

The **AUDIO** pop-up submenu allows the operator to separately select one or both receivers for the speaker and for each side of a stereo-wired headphone pair. The dedicated controls for **MAIN** and **SUB** receivers make it easy to adjust the volume mix for those who listen to both at once.

### *3.2.1. Binaural Reception*

Ten-Tec's Binaural Reception feature, called "panoramic stereo" in the advertisements, uses our DSP system to particularly good advantage for the CW operator. High-pass and low-pass filtering, combined with time delays, produce a three-dimensional spatial illusion from a monaural audio source. The addition of spatial dispersion makes it easier to pick out one signal among many. With stereo headphones on, low frequencies appear to come from your left and high frequencies from your right. Frequencies near the selected CW offset appear to come from the center. During a CW pileup, you might be surprised how that makes signals easier to separate.

### *3.2.2. Audio Equalization*

**ORION** provides Audio Equalization (**EQ**) for both receivers and for the transmitter. The **AUDIO** key submenu gives access to these "tone control" features. They enable tailoring audio frequency response for greater effectiveness and to accommodate your preferences. The three controls are independent functions of their soft keys and the **MULTI** control.

The **Tx Eq** (Transmit Equalization) establishes a specific audio profile for your transmitted audio from either the **MIC** or **AUX** audio input sources. The **Tx Eq** effects range in 1-dB steps from high pitched at –20 dB to essentially flat response at zero dB to very bassy at +20 dB.

The graphs show what the response curves are all about. Figure 3-1 through Figure 3-3 illustrate responses at the extremes and in the center of the equalization controls. Lower numbers of decibels indicate a gentler slope.

The same curves apply to both receiver equalizers and the transmitter equalizer.. The displayed setting of the equalizers refers to the amplitude in dB (at about 100 Hz) relative to the highest frequency in the passband. For example, the –20-dB setting shows –20 dB at 100 Hz relative to 0 dB at 6 kHz.

Figure 3-4, below, has some suggested settings to get you started.

**Figure 3-1 Minus 20 dB Equalization**

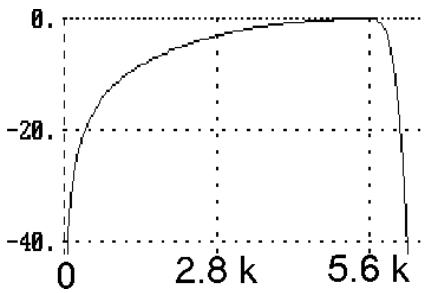



**Figure 3-2 Flat Equalization**

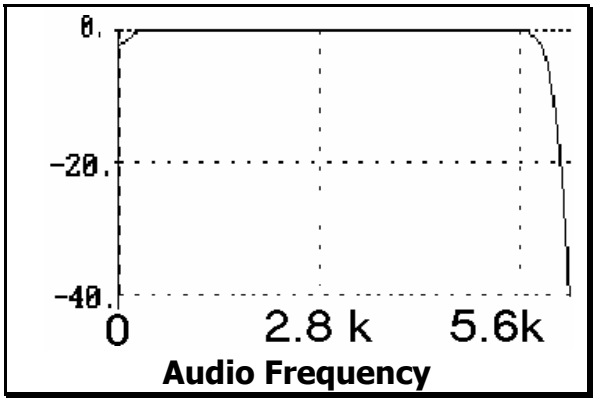



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**Figure 3-3 Plus 20 dB Equalization**

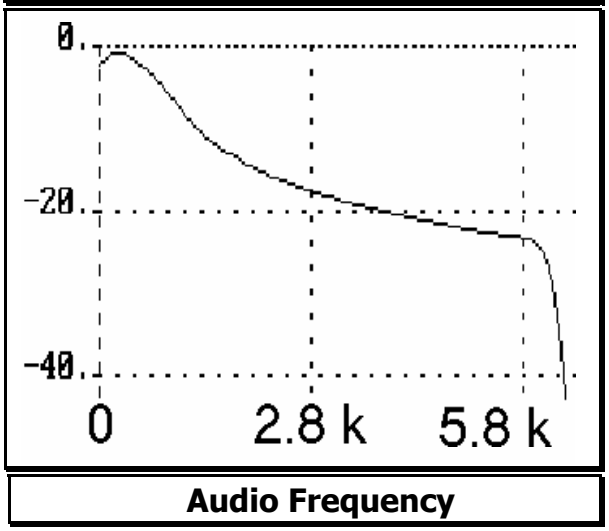


**Figure 3-4 Suggested TX EQ Settings**

| Input Source | Input Device | MODE | MIC Gain | AUX Gain | TX EQ |
|---|---|---|---|---|---|
| Studio One Mic. | MIC | SSB | 45 | zero | -14 dB |
| #705 Desk Mic. | MIC | SSB | 50 | zero | -16 dB |
| Sound Card Interface | AUX | PSK31 | zero | 75 | -14 dB |
| Sound Card interface | AUX | MFSK | zero | 55 | 0 dB |

### 3.3. ORION's RECALL Key

The **RECALL** key near the lower left corner of the display screen provides an easy way to return **ORION** to simple transceiver operation in the event a new operator gets "tangled in the rigging". Pressing *and holding* **RECALL** for a few seconds brings up the **PARAMETER STORE & RECALL** submenu, which starts by offering **Factory Defaults**. Pressing the soft key for **Recall**, **NR**, at that point puts **ORION** into a known starting point from which it is relatively simple to continue exploring other modes or to get on the air.

You must **Exit** this submenu before you can control anything other than the soft key functions.

The front panel screen and indicators show the default settings. The operator is now free to change any of those settings at his discretion.

**Please note:** After recovering the Factory Default radio conditions, exiting the Recall submenu, and before transmitting, the operator is responsible for ensuring that the antenna connected to the **ANT 1** port and the selected **MODE** are suitable for the frequency and band setting. Of course the operator may change any control settings as desired.

### 3.4. VFOs, Receivers, and Antennas

In keeping with our design philosophy of maximizing operator flexibility, we describe a number of useful combinations of frequency control and antenna selections for the Transmitter, Main Receiver, and Subreceiver. At the far left of the panel the matrix of 12 keys that control the Antenna connections and VFO assignments provides many antenna-plus-VFO combinations well suited to particular on-air situations.

#### *3.4.1. VFO Selection*

The VFO Switch, selects frequency control for each of the 3 radio elements. We review their rules of operation below.

##### 3.4.1.1. RX VFO Operation

The **RX** (for main receiver) is *always* active on either **VFO A** or **VFO B**. On either VFO,

**RX** will accept any frequency within amateur band limits for ITU Region 2.

#### 3.4.1.2. SUB RX VFO Operation

The **SUB RX** (for Subreceiver) can use **VFO A, VFO B**, or can be inactive. On either VFO, **SUB RX** will accept any frequency between 0.1 and 29.999.999 MHz *unless* **RX** or **TX** shares the same VFO. Press the lighted **SUB RX VFO** key to disable the **SUB RX**, making both **SUB** LEDs dark.

#### 3.4.1.3. TX VFO Operation

The **TX** key lights under either **VFO A** or **VFO B** except when the operator has selected a **MENUS>TX** item to deactivate it. The same function responds to the **MULTI** knob to reactivate the **TX**. If neither **TX** key (**VFO A** or **VFO B**) light is on, the **TX** is inactive. On either VFO, **TX** will accept any frequency within amateur band limits for ITU Region 2.

### *3.4.2. VFO Switching Examples*

To transceive on **VFO A**, select the **TX** and **RX** keys under **VFO A**. Alternatively, you may transceive on **VFO B** or switch back and forth between two frequencies (or two bands if your antenna permits it).

Put the Subreceiver on either **VFO A** or **VFO B**, by pressing the **SUB RX** key under the desired VFO column, or disable the **SUB B** by pressing the lighted **SUB** key and noticing that it extinguishes.

To split your transmit and receive frequencies, select one VFO for the **TX** and the other one for the **RX**. You may also use the **SUB** on either frequency.

Reversing the frequency split is as simple as changing the two VFO assignments.

### *3.4.3. Antenna Selection*

The Antenna Switch matrix selects an antenna for each of the radio units. **ORION** will connect only one antenna to each radio element.

#### 3.4.3.1. ANT 1 and ANT 2 Operation

**ANT 1** and **ANT 2** have the same rules of operation:

Either antenna can connect to the **MAIN RX/TX** combination, to the **SUB RX**, or to all three radios together. There is also a *Split Antenna Mode* (below) by which each antenna port can connect to the **TX** and **SUB**.

#### 3.4.3.2. RX ANT Operation

The **RX ANT** port can serve the **SUB RX**, or in *Split Antenna Mode* (see 3.4.3.3) it can serve the **MAIN RX**, the **SUB RX**, or both.

#### 3.4.3.3. Split Antenna Mode

**ORION** usually transceives with **MAIN RX/TX** on your choice of either **ANT 1** or **ANT 2,** but not split between them. To split the receiver to a separate antenna, start with both **RX** & **TX** on **ANT 1** (or both on **ANT 2)**; press the **RX ANT** key in the **MAIN RX/TX** column. The Transmitter remains connected as it was, but the Main Receiver connection moves to the **RX ANT** and there are now two lighted keys in the **MAIN RX/TX** column. This is the *only way* to have the **MAIN RX** on a different antenna than the **TX.**

### *3.4.4. Antenna Selection Examples*

To monitor both receivers, connected to **ANT 1**:

- Using the 6-key VFO Switch, select **TX** and **RX** for **VFO A**. Select **SUB RX** for **VFO B**.

- Using the 6-key Antenna Switch, select **ANT 1** for **both MAIN RX/TX** and **SUB RX**.

- You are now listening to both receivers on one antenna with two different frequencies (or bands).

To monitor both receivers, with the **MAIN** receiver using **ANT 1** and the **SUB RX** using **ANT 2** on the same frequency:

- Using the 6-key VFO Switch, select **TX, RX,** and **SUB RX** for **VFO A**.

- Using the 6-key Antenna Switch, select **ANT 1** for **MAIN RX/TX** and **ANT 2** for **SUB RX**. This is one way of using **ORION**'s *Diversity Reception*.

### *3.4.5. Diversity Reception*

Perhaps the most innovative feature made possible by **ORION**'s architecture is *Diversity Reception*. A diversity receiver system has the ability to receive a signal simultaneously on two different receivers and antenna systems. In the past, amateur transceivers have not offered single-knob tuning and tracking of two receivers on separate antennas. Because **ORION** can do exactly that, Ten-Tec now provides Diversity Reception to the amateur market.

Commercial and military HF stations have long used Diversity Reception to improve path reliability under fading conditions. This mode takes advantage of the phenomenon that two antennas at locations separated by over a quarter wavelength (or with different polarization) will experience fading at different times.

*Diversity Reception* has potential advantages for DXers and contesters. Signal hunters can now use two directional antennas pointed in two different directions to ensure not missing anything as the operator tunes across the band.

The 160-meter DXer can use a vertical radiator for transmitting efficiency and a Beverage or small loop for effective receiving. He can monitor a single frequency simultaneously with two receivers using *Diversity Reception* if his station boasts two effective receiving antennas.

You can choose to hear each receiver in a separate ear of stereo headphones, or one receiver in headphones and the other on the speaker. The separate **MAIN** and **SUB AF** gain controls allow the operator to optimize the audio mix for best signal-to-noise ratio. Some operators may prefer to hear both receivers in both ears and the **ORION** soft key **AUDIO** submenu allows that, too. The **PBT** and **BW Tracking** items in **MENUS > RX** are a convenience in Diversity Reception.

### *3.4.6. VFO Control And Radio Flexibility*

You may find it desirable to be able to monitor both transmit and receive frequencies of a DX pileup to ascertain the rhythm and listening frequency of the DX operator.

#### 3.4.6.1. Dual-Watch DX example:

The DX station is transmitting on 14.195 MHz and listening for calls on 14.210 MHz. Tune **VFO A** to 14.195 and press **RX**. Tune **VFO B** to 14.210 and press **TX** and **SUB RX**. You now have the main receiver on the DX transmitting frequency of 14.195, are receiving the 'domestic' side of the pileup on 14.210, and are ready to transmit on 14.210.

#### 3.4.6.2. Dual-Watch Contest example:

Contest operators can transceive on one VFO to run contacts, while searching for multipliers with the second receiver on another frequency, band, or antenna, depending on the station's resources and the operator's strategy.

## 3.5. Band -Changing and Frequency Entry

The 16-key pad on the far right side of **ORION** services either VFO to implement band changing, direct frequency entry, and access to four band-stacking registers per ham band. There are also keys for copying the VFO contents from A to B and vice versa. The keypad bears ham band designations for the **160**, **80**, **40**, **30**, **20**, **17**, **15**, **12**, and **10** meters bands as well as numerals for direct frequency entry. Should the amateur radio service obtain access, as we expect, to a new band in the 5 MHz (**60m**) region, **ORION**'s hardware is ready for it and a flash ROM update will activate the firmware for that band.

### *3.5.1. Default VFO*

To accommodate a band switch and band-stacking register shortcut on two VFOs with only one keypad, we designate one of the VFOs as *default* (having the shortcut), but we make it easy to move that designation to the other VFO. The radio screen highlights either **A** or **B** to show which VFO is currently default for band-changing and Band Stacking. At power-up, or after a reset operation, **VFO A** is the default. To change the default to **VFO B**, press **A/B** for one second. To return default to **VFO A**, press **A/B** for one second.

### *3.5.2. Band-changing Short-cut – Default VFO*

To change ham bands for either VFO, make it the default VFO (It may already be default!) and then simply press the key for the desired band.

### *3.5.3. Direct Frequency Entry*

The procedure for keypad entry of frequency is identical for **VFO A** and **VFO B**. For direct frequency entry to a VFO, press either **VFO A ENTER** or **VFO B ENTER**. The selected VFO display on the screen will change from numbers to dashed lines. Type the desired frequency on the keypad. You may truncate a frequency entry with zeros by pressing the **VFO A ENTER** key again. Example: If you want to change **VFO A** to **14.200.000** MHz, it is not necessary to enter all the zeros on the keypad. Press **VFO A ENTER**, '**1**', '**4**', '**2**', and then **VFO A ENTER**. **ORION** will add the rest of the zeros for you. Keypad frequency entries for **VFO B** uses the **VFO B ENTER** key in the same manner.

At any point *after* the hundreds of kilohertz position, you may enter a decimal point to escape the entry. When the frequency entry is complete, you may send the direct entry to either VFO by pressing the appropriate **ENTER** key. This means **ORION** will accept direct frequency entry no matter which VFO is default and the entry will go to the operator's choice of VFOs.

#### 3.5.3.1. Frequency Restrictions

Note: **ORION**'s Main **RX** and **TX** have amateur band coverage only. If you attempt to directly enter a frequency outside the ham bands to a VFO assigned to either of them, an error message appears and the display reverts to the last legitimate frequency used.

Frequencies outside the amateur bands are available *only on the Sub Receiver*.

Example: On the 6-key VFO Switch under the S-meter, assign **TX** to **VFO B, RX** to **VFO A,** and **SUB RX** to **VFO B.** On the band change keypad, press **VFO B ENTER**, enter a frequency outside the amateur bands, and press **VFO B ENTER** again. The error message appears, indicating an illegal (non-amateur) frequency assignment. The transmitter will not key up on an out-of-band frequency. Either correct the frequency or move **TX** and **RX** to the other VFO if it is in a ham band.

### *3.5.4. Copy or Swap VFO Contents*

The **A>B** and **B>A** keys are for copying frequency information from one VFO to the other. To copy **VFO A** frequency to **VFO B**, press **A>B**. To copy a **VFO B** frequency to **VFO A**, press **B>A**. The frequency in **VFO A** moves to **VFO B**, **VFO B**'s frequency moves to **VFO A**. Please note that these keys do not change any other radio properties other than frequency.

### *3.5.5. RIT and XIT*

**RIT** (receiver incremental tuning) allows the operator to move receiver frequency above or below its VFO setting without affecting the transmitter frequency, even if the transmitter and receiver are on the same VFO. **RIT** operates on the **MAIN RX** or **SUB RX** frequency as selected by the **MAIN RX** and **SUB RX** keys immediately above the **RIT** and **XIT** keys.

When the **RIT** key is active the radio screen displays the amount of frequency offset adjusted by the **RIT/XIT** knob. **ORION** provides an **RIT** range of +/- 9.99-kilohertz. When the **RIT** key is active, pushing it again turns off the offset. **ORION** stores the last offset adjustment for the selected **RX** so that it may be reused at the next key press.

**XIT** (transmitter incremental tuning) allows the operator to move transmitter frequency above or below its VFO setting without affecting either receiver frequency, even if the transmitter and receiver are on the same VFO. **XIT** operates only on the **TX**, but otherwise functions as the **RIT** does.

### *3.5.6. SWEEP (Band Scope)*

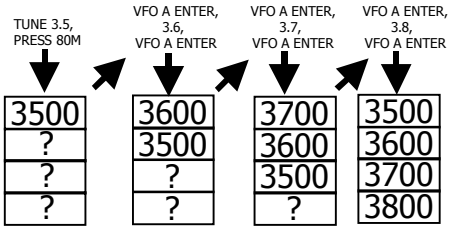
**ORION**'s Band-Scope is a real-time picture of a selected range of frequencies in real time. Pushing the **SWEEP** key allows you to switch it on the **MAIN RX** or turn it off. An item in **Menus>RX** sets its frequency span from among five choices.

### *3.5.7. Band-stacking Registers*

**ORION** provides four band-stacking registers per ham band -- a very handy way for the operator to move quickly among four frequencies on the same band. These ham-band-only registers are available to either VFO when it is the default VFO.

An example will show how to load and recall the four registers. When you press the band key for the band currently in use by the default VFO, the radio stores the VFO frequency in the register at the top of the stack and tunes the VFO to the frequency stored in bottom of the stack. Pressing the same band key again causes the transceiver to return to the original frequency.

**Figure 3-5 Band Stacking Registers.**




On the default VFO press the **BAND** key for the current band to change to the next register for that band. Repeat this operation three times to step back to the original register.

## 3.6. MAIN and SUB RX Controls

Each receiver controls all its functions independently. Please remember that the **MAIN RX** and **SUB RX** keys are for selecting which receiver you want to adjust at a given moment, *not* for enabling or disabling a receiver.

### *3.6.1. PBT /BW Control*

The **PBT/BW** rotary control changes its function between Passband Tuning and Bandwidth when the operator briefly pushes the knob toward the panel. LED indicators show which function the knob is performing at any time.

#### 3.6.1.1. Passband Tuning

**PBT** (Passband Tuning) shifts the receiver's passband up or down with respect to the tuned frequency when the **PBT** LED indicator is on. A **MENUS** item in the **RX** category permits the **PBT** control to affect both **MAIN** and **SUB** receivers simultaneously.

#### 3.6.1.2. Bandwidth

**ORION**'s **BW** control signals the DSP to change the IF filter selectivity. Both the **MAIN** and **SUB** receivers provide adjustment of bandwidth in 10 hertz steps between 300 Hz and 6 kHz. A **MENUS** item in the **RX** category permits the **BW** control to affect both **MAIN** and **SUB** receivers simultaneously.

Further details of the bandwidth control appear in 3.6.2.

### *3.6.2. CRYSTAL FILTER SELECTION*

**ORION**'s high performance **MAIN** receiver has 4 standard and 3 optional crystal filters, ranging from 15 kHz to 250 Hz in bandwidth, ahead of the DSP IF. The bandwidth logic normally selects a filter from this group, based on the DSP bandwidth setting. This coordination between the two sets of filters results in the tightest possible roofing filter in the first IF stages for any bandwidth setting, contributing strongly to receiver dynamic range.

An **MENUS/RX** item allows the operator to override the automatic selection of crystal filter by the DSP **BW** control for purposes not envisioned by the receiver design engineers.

### *3.6.3. HI CUT/ LO CUT Passband Tuning*

**ORION** has a dual-function **HI/ LO CUT** control that modifies the **PASSBAND TUNING** function. **HI CUT** and **LO CUT** functions allow the operator to move one side of the filter or the other towards the center of the passband. This can be especially useful for rejecting adjacent frequency interference. The **HI /LO CUT** control changes its function between **HI CUT** and **LO CUT** when the operator briefly pushes the knob toward the panel. LED indicators show which function the knob is performing at any time. The independent **HI CUT** and **LO CUT** settings for the

selected receiver appear on the radio display.

See Figure3-6 for examples of **HI CUT** and **LO CUT** operation.

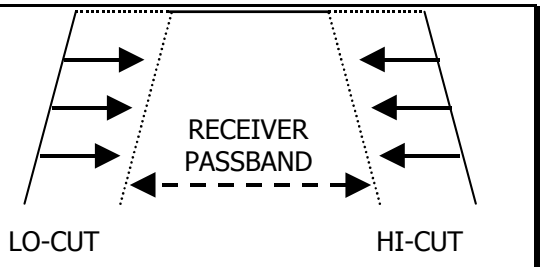



**Figure3-6 HI-CUT and LO-CUT Effects on the Passband.**

## 3.7. Receiver Function Keys

Fourteen receiver function keys surround the right-hand half of the receiver display screen. These keys affect functions on the receiver selected by the **RX CONTROLS** key, **MAIN RX** or **SUB RX**.

Many of them temporarily enable the **MULTI** control to adjust the function selected by pressing the key. Others simply turn a function on or off or step it through a sequence of settings. A **reverse video** screen annunciator shows the operator which control function is active. Settings made using the function keys or **MULTI** control persist after switching to another function, and after you switch off the transceiver.

### *3.7.1. Sidetone*

The **S-TON** key assigns the **MULTI** control to adjust the audio volume of the CW sidetone. A related **MENUS** item uses **MULTI** to adjust the audio pitch for a CW signal centered in the passband. The range of adjustment is 300 – 1200 hertz. The keying sidetone matches this frequency while transmitting. The **SPOT** tone matches this frequency while receiving. Default tone is 750 hertz.

### *3.7.2. Notch*

The **NOTCH** key assigns the **MULTI** key to adjust the rejection notch frequency and its width. When the operator presses the **NOTCH** key, **MULTI** controls the notch center frequency (**C**) over the range of 20 – 4099 hertz in step sizes set in **MENUS**>**RX**>**PBT/BW/NOTCH Step**. Pushing the **NOTCH** key repeatedly cycles its function from center frequency (**C:**) to notch width (**W:**) to **off**. You can adjust notch width in 10 Hz steps from 10 Hz to 300 Hz.

### *3.7.3. Attenuator*

**ORION** provides an RF attenuator to protect the receiver front-end against overload when extremely strong signals are present. The default position is **off**, but three successive presses of the **ATTN** key add 6, 12, and 18 decibels of loss in steps. The fourth press returns the attenuator to its **off** setting.

### *3.7.4. AGC*

The **AGC** key steps the timing of the automatic gain control through the sequence **SLOW**, **MED**, **FAST,** and **PRGM**. In the **PRGM** setting, the operator can customize **AGC THRESHOLD** plus **HANG**, and **DECAY,** times via their **MENUS** items and the versatile **MULTI** control.

### *3.7.5. Sweep*

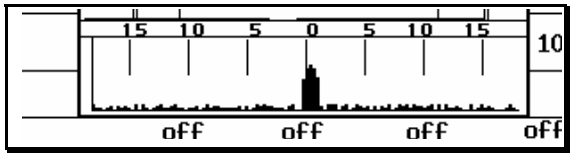
Pressing the **SWEEP** key will alternately enable and disable **ORION**'s spectral display for the **MAIN RX**. By continually scanning a range of frequencies below and above the receiver's center frequency, **ORION**'s **BAND SCOPE** provides a real-

time view of signals in the visual format of a spectrum analyzer. See Figure 3-7. It can help locate activity (or inactivity) on a given range of frequencies. The tuned frequency is in the center of the scale. Movement of the active tuning knob scrolls the Band Scope display across the screen.

### *3.7.6. Sweep Range*

This **MENUS** item provides the **MULTI** control with five choices of frequency span for **ORION**'s continuous real-time Band Scope display. Frequency span values from 4.5 kilohertz to 72 kilohertz are available. The 36 kHz span appears below.

**Figure 3-7 ORION's Band Scope**




### *3.7.7. Spot*

The **SPOT** key momentarily injects an audio tone in 'phones or speaker to match the pitch of a CW signal centered in the receiver passband as an aid to zero-beating that signal. Tuning the receiver so that the pitch of a CW signal matches the **SPOT** tone sets that VFO to the same frequency as the signal. While **SPOT** is active, **MULTI** adjusts its volume.

### *3.7.8. RF Gain*

The **RFGAIN** key assigns the **MULTI** control to adjust the RF gain in the selected receiver. **ORION**'s receiver design provides excellent selectivity and dynamic range. Under most conditions, leave **RF** gain at 100%. Should you experience receiver overload, the **RF** gain control can limit receiver distortion and/or overload response in the presence of extremely strong signals. There is also a switchable front-end attenuator (see paragraph 3.7.3).

### *3.7.9. Preamp*

The **PREAMP** key alternately inserts or bypasses the RF preamplifier in the **MAIN RX**. The RF preamplifier in the **SUB RX** is always on.

### *3.7.10. Mode*

The **MODE** key brings up a soft key submenu that temporarily reassigns the column of keys along the right side of the radio screen. **ORION** modes are **USB**, **LSB**, **UCW**, **LCW**, **AM**, **FM**, and **FSK**. **UCW** and **LCW** are conventional CW modes, except that the operator chooses whether the BFO is above or below the target signal frequency to minimize QRM. Each screen label key is directly beside a key that selects the mode of the chosen receiver. Please note that the **TX** always follows the mode of the **MAIN RX.**

### *3.7.11. Auto-Notch*

Pushing the alternate action **AN** (automatic notch) key enables this sophisticated DSP algorithm and puts its indicator on the screen. There is no frequency adjustment for the automatic notch. It seeks out and nulls all constant carriers in the receiver passband. This notch works well for SSB modes but is **not useful** in either CW or digital modes because it tends to notch out the desired signal as well as the QRM!

### *3.7.12. Noise Reduction*

Pushing the **NR** (noise reduction) key activates or deactivates **ORION**'s DSP noise reduction algorithm. This system identifies desired signals mathematically and tracks them with a set of adaptive filters. **NR** suppresses broadband noise by

as much as 15 dB depending upon the noise statistics.

### *3.7.13. Noise Blanker*

The **NB** key assigns the **MULTI** control to adjust **ORION**'s DSP Noise Blanker in the selected receiver to one of nine threshold levels or to disable the function.

**ORION**'s **MAIN RX** has an analog noise blanking IC at the first IF, ahead of the selective filters to avoid stretching noise pulses. Access its **ON/OFF** control by pressing **MENUS** > **RX**. Scroll to the **HARDWARE NB** item using **VFO A**, then select **ON** or **OFF** with the **MULTI** knob.

## 3.8. Transmitter Function Keys

Surrounding the left side of the radio screen are eleven function keys that affect transmitting. Their modes of operation are similar in principle to the receiver function keys described in paragraph 3.7.

### *3.8.1. VOX*

This key turns **VOX** on and off with alternate strokes. The **ORION MENUS>VOX** screen has lines for adjustment of **GAIN**, **DELAY**, and **ANTIVOX** settings.

### *3.8.2. Sidetone*

**S-TON** (sidetone level) controls the CW sidetone volume with the **MULTI** knob. A pitch adjustment is another function of the **MENUS>CW** screen and defaults to 750 Hertz. **S-TON** settings are effective only in **CW** mode. **ORION** matches the pitch of a receiver signal centered in the passband to the transmitter sidetone pitch. This makes it easy to adjust the transmitter to the same frequency as a particular received signal.

### *3.8.3. Microphone*

The **MIC** key enables the **MULTI** control to adjust the audio level in the path from microphone to transmit circuitry. The screen displays the setting on a scale from 0 to 100 percent. You have the correct **MIC** adjustment for your speaking voice and microphone position when the **ALC** Led just flickers on voice peaks.

### *3.8.4. Tune*

Push **TUNE** to activate or deactivate this function. It keys the transmitter in **CW** mode, regardless of the operating mode selected. This produces a steady RF carrier, useful for observing the output power setting or adjusting an external antenna coupler. If the optional automatic antenna-tuner is installed, an item under **MENUS**>**TX** enables the operator to enable or disable it. It is prudent to reduce power to 20% before activating **TUNE** with the auto-tuner enabled

**Be certain that a proper antenna or dummy load is connected before pressing TUNE, and avoid causing interference to others**.

### *3.8.5. Power*

The **PWR** key enables the **MULTI** control to adjust the RF output level. The screen displays the setting on a scale from 1 to 100 percent.

### *3.8.6. Monitor*

**MON** enables or disables the Monitor function by which the operator can hear his microphone audio for purposes of adjusting any equipment prior to the **MIC** input. Note that **MON** operates on **ORION**'s modulated IF signal. Therefore it reflects adjustments made to **ORION**'s microphone gain, speech processor, transmit equalization, and transmission bandwidth. You can test audio sound

with various microphones and adjust controls on audio equipment connected to the microphone input. The default setting is **off**. **MON** is active only in **SSB, AM**, and **FM** modes, and for auditioning stored voice or CW messages.

When **MON** is active, the **MULTI** control adjusts the audio Monitor volume in the operator's speaker or headphones.

### *3.8.7. Speech Processor/ CW Speed*

The **SP** key is a dual-function key dependent on the selected **MODE**. In **LSB**, **USB**, or **AM**, it alternately activates or deactivates **ORION**'s speech processor. When the speech processor is active, the **MULTI** knob adjusts the amount of processing on a scale of 0 to 100%. A moderate amount of speech processing increases the "punch" of your signal, but too high a setting degrades voice quality.

The **SP** key assumes its role as speed control for the internal keyer when **ORION** is in **CW** operation. Activate the button by pressing **SP**, and set the speed with the **MULTI** control. The range is from 10 to 60 WPM.

**SP** is inactive in **FM** and **FSK**.

### *3.8.8. Send 1 … Send 3*

**ORION** has three **MODE**-sensitive **SEND#** keys. Each key provides for the recording and transmission of a distinct message in CW and in voice. An asterisk (*****) next to each key shows whether its memory holds a message in the current (CW or voice) **MODE** or is empty. **ORION** stores and retrieves messages to and from distinct memory locations, depending on what mode the operator uses to record it and what mode is active at the time of retrieval.

Examples: The operator records "*CQ contest, this is WA2YL, QRZ*" while in **LSB**. She also switches to CW mode and records "*de WA2YL WA2YL K*", using her paddles with **ORION**'s keyer. Even though she stores both of them as **SEND 1**, when she presses **Send1** **ORION** retrieves "*de WA2YL K*", when she is using **CW** and "*CQ contest, this is WA2YL, QRZ*" if she is using **LSB**, **USB**, **AM**, or **FM**.

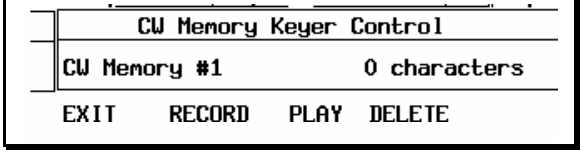
The preferred way to audition messages is to use the **PLAY** soft key while in the **USER** Memory submenus described in 3.8.8.1 and 3.8.8.2. Pressing and quickly releasing one of the **SEND#** keys will cause immediate recall and transmission of the selected message, (unless you purposely disable the transmitter to audition the message without transmitting. Remember to re-enable the transmitter when you are done!)

#### 3.8.8.1. Recording CW Messages

To record **CW,** place the transceiver in **CW MODE**. The CW recorder always uses the internal keyer connected to the operator's paddles. Set the Keyer SP control to convenient speed. Pressing and holding any **SEND#** key for ~2 seconds will temporarily disable transmitting, (and any other control operation) while **ORION** brings up the **CW Memory Keyer Control** in Figure 3-8. Four keys under the display show their functions: **EXIT**, **RECORD**, **PLAY**, and **DELETE**. While the submenu is active, you can use the **MULTI** knob to select any of the 3 memories. Recording begins with the first CW element (dits, dahs, and spaces are elements). The message recorder includes whatever pauses the operator makes and shows the total number of characters stored. Memory capacity is 512 elements.

Briefly pressing the **Stop** soft key terminates recording and stores the message. The screen displays an asterisk next to the selected **SEND#** key to show that it holds a message. To erase a stored CW message, push the **DELETE** key. The **PLAY** soft key will audition a CW message without transmitting. You can **EXIT** the submenu to adjust **S-TONE** pitch and volume appropriately, turn the **AF** controls to suit, and then return to the Recorder. The three messages persist through power cycles and simple reset operations.

**Figure 3-8 CW Memory Keyer Submenu**




You must **Exit** the **CW Memory** submenu before you can do anything except the soft key functions.

#### 3.8.8.2. Recording Voice Messages

Pressing and holding a **SEND#** key for 2 seconds while in SSB or AM **MODE** will temporarily disable transmitting while **ORION** places the **DIGITAL VOICE RECORDER CONTROL** submenu on the screen as Figure 3-8 shows. The submenu works just as it does in **CW**, but with **VOICE** substituted in the title.

Voice recording uses the currently active push-to-talk (PTT) or **VOX** settings. While the submenu is active, you can use the **MULTI** knob to select any of the 3 memories. Recording begins when you press the **RECORD** soft key. The **RECORD** legend changes to **STOP** and an elapsed time display starts running. Briefly pushing the **STOP** key terminates recording. **SAVE** stores the message in 25 seconds. The screen displays an asterisk next to the selected **SEND#** key to show that it holds a message. To audition a voice message without transmitting, **MON** must be ON (**EXIT** the submenu to set it, if necessary). To erase a stored voice message, push the **DELETE** key. Voice messages #1 & #2 may be up to 4.5 seconds duration and will last through a power cycle or a simple reset.

You must **Exit** the **Voice Recorder** submenu before you can do anything except the soft key functions.

### *3.8.9. Parameter Store & Recall*

**ORION** can store *five* "USER profiles", each a complete record of *all* control and **MENUS** settings. This is especially useful when different operators will be using the same radio, as in a Field Day, club station, or multi-op contest operation.

As previously described, holding down **RECALL** enables the "PANIC BUTTON". The pop-up submenu offers a **Factory Default** program of settings, and its **RECALL** soft key will then return **ORION** to the settings that come from the factory. "Long-**RECALL**" brings up the **Factory Defaults** as the first choice, but the **MULTI** control can select four more locations (#1 - #4) for storing or recalling 4 more complete radio states and menu settings.

To store a transceiver setup, first set *all* the radio controls and menus as you desire to recall them. You must do this from *outside* the **Parameter Store and Recall Menu**, because it disables all other actions until you **EXIT**. Having set everything to your liking, press and hold **RECALL** until the Factory Defaults screen appears. At that point, select one of the four other

locations and tap **STORE**. **Saved** appears. **EXIT** the submenu.

> You must **Exit** the **Store and Recall** submenu before you can do anything other than the soft key functions.

**ORION** provides **USER1** and **USER2** keys as shortcuts to store and recall your two most often needed transceiver settings without going into the **Parameter** submenu.

To program either **USER 1** or **USER 2** to record **ORION**'s complete control and **MENUS** state, first set *all* the radio controls and menus as you desire to recall them. Then just press and hold the desired **USER** key until the legend **Storing Parameter Set #n** appears. Release the key and **Store Complete** shows briefly. To recall one of the recorded states to **ORION**, from outside the submenu, briefly press the desired **USER #** key and wait for the data to load.

## 3.9. VFO <> Memory Operation

### *3.9.1. Store VFO >M*

**ORION** uses the **VFO A>M** and **VFO B>M** keys (located between the tuning knobs) to store frequency and mode to any of 200 user-selected locations. When the operator presses one of these buttons, the bottom of the radio screen displays the contents of the currently selected memory. The operator may choose to store the **VFO** data there or may use the **MULTI** control to choose another storage location. When the Memory Store submenu is at the bottom of the screen, use its soft keys to store either VFO to any memory, overwriting its existing memory contents.

> **Exit** the **Memory Store** submenu before attempting to operate any other controls.

### *3.9.2. Recall Memory to VFO*

To retrieve data from memory, the user presses **RECALL** briefly, and the screen displays the contents of the last memory used. The operator now has a few options:

- To recall the stored **VFO** data to **VFO A** by pressing **VFO A ENTER;**
- To recall the stored **VFO** data to **VFO B** by pressing **VFO B ENTER.** It does not matter where the data originated.
- To retrieve data from some other memory, first select it using the **MULTI** control to find data in any location. When the desired data appears on the screen, use either **VFO A ENTER;** or **VFO B ENTER** to load it into one of the **VFO**s.

> **Exit** the **Memory Recall** submenu before attempting to operate any other controls.

## 3.10. Tx Menu Functions

### *3.10.1. Internal Tuner*

**MULTI** enables and disables the optional auto-tuner, if it is installed.

### *3.10.2. Transmitter*

**MULTI** enables or disables the transmitter per paragraph 2.3.4.

### *3.10.3. Keying Loops 1&2*

**ORION** has two keying loops for Ten-Tec's (and some other's) QSK amplifiers. Use shielded cable to make the two connections shown in Figure 1-6. The keying loops are associated with the like-numbered **ANT** connections.

### *3.10.4. External T/R Delays 1&2*

Non-QSK amplifiers use the **EXT T/R** outputs on the rear panel to switch them between transmit and receive states. These menu items provide adjustment of the time delay between cessation of transmitter keying (by CW, PTT, or VOX) and return

of the amplifier to the receive state. The range is 0 – 100 %.

### *3.10.5. Transverter*

Per paragraph 1.12 above, **ORION** provides keyline and low-level RF for transverters when **Transverter** is **ON**. In this state **ORION** disables the transmitter's final amplifier stage. While many transverters interface with 10-meter IF radios, **ORION** transverter outputs are available on any band.

### *3.10.6. 160M Antenna, Etc.*

As a convenience to amateurs whose station setup is fairly stable **ORION** provides a list at **MENUS**>**TX** which can automate antenna assignments, band-by-band. For each ham band, the choices are:

**ANT1**,
**ANT2**,
**ANT1>TX with RX ANT >RX,**
and
**ANT2 >TX with RX ANT >RX**.

In connection with the **BAND DATA** outputs for **ANT1** and **ANT2**, and using your external coaxial relays, quite elaborate automatic antenna switching is possible. The front panel **ANT** keys can always override the menu settings. **SUB RX** antenna assignments are manual-only.

## 3.11. CW Menu Functions

With the exception of **Sidetone Pitch**, these functions pertain to CW transmission.

### *3.11.1. CW QSK Delay*

When operating CW, you can adjust the time ORION takes to switch back to receive after a Morse character. The range is 0 – 100%.

### *3.11.2. Internal Keyer*

Enable the internal keyer by highlighting this item and turning it **on** with **MULTI**. To use an external keyer or straight key, turn internal keyer **off**. See also paragraph 1.9.

### *3.11.3. CW Weighting*

The weighting control (**MULTI**) sets the ratio of dot-to-element space. Some external amplifiers adversely affect weighting, a problem this adjustment can minimize. 100% is normal weighting.

### *3.11.4. Sidetone Pitch*

This item enables multi to adjust **ORION**'s CW sidetone from 300 to 1200 hertz in 20-hertz steps. The CW receive offset is the same as the sidetone.

### *3.11.5. CW Rise/Fall*

The keying waveshape adjusts keying edges from 3 To 10 Milliseconds using **MULTI** at the **CW Rise/Fall** menu item. 3 mS sounds fairly hard and 10 mS is very soft. The default setting (5 mS) is a good compromise.

## 3.12. VOX Menu

**VOX** works in all voice modes. This can allow simplified T/R control in data modes. The adjustments are conventional. Turn **VOX** ON with the front panel key near the upper right corner of the screen Press **MENUS** and then the **VOX** soft key to access the adjustments.

### *3.12.1. VOX Trip Level*

The trip level sets the audio level (**MIC** or **AUX I/O**) that will switch the transceiver from receive to transmit. Adjust it for your normal speaking voice and distance from the microphone.

### *3.12.2. Anti-VOX Level*

Unless Anti-VOX is properly set, audio from the speaker may feed back to the microphone causing inadvertent transmission and VOX chattering. Set Anti-VOX Level high enough so that your normal placement of speaker and microphone and normal receiver volume do not cause false tripping.

### *3.12.3. VOX Hang*

Without a proper Hang setting, the transceiver will drop back to receive between words. Set VOX Hang so that your normal speaking cadence does not cause switching between words.

## 3.13. Rx Menu

As is the case with other menus, you select the menu item by moving the highlight with the VFO A tuning knob.

### *3.13.1. Sweep Range*

**In MENUS>RX, ORION** offers five ranges of frequency coverage, from 4.5 to 72 kilohertz, centered on the tuned frequency. The Band Scope operates on the **MAIN** receiver when activated by its front panel key.

### *3.13.2. Programmable AGC*

This feature is unique to Ten-Tec and should encourage some experimentation for particular signal conditions. The Programmable Automatic Gain Control settings are active when the **AGC** screen indicator reads **prog** (for "programmable") and the operator brings up **MENUS > RX**. **ORION**'s AGC attack time is set at its optimum (quite fast) value. Ten-Tec set the fixed AGC values based on our experience and extensive testing, but some operators might find it interesting to try some variations of those settings.

You can record the values you select in the **USER1** and **USER2** profiles for easy recall. The programmable **AGC** properties are **Hang**, **Delay**, and **Threshold**. Paragraphs below describe the programmable parameters.

### *3.13.3. Main AGC Hang Setting*

Scrolling the highlight brings you to **AGC Hang. Hang** sets the time that receiver gain remains constant after a signal peak sets it. The range is from "zero" to nearly 11 seconds.

### *3.13.4. Main AGC Decay Setting*

At the expiration of the **AGC Hang** time, and with a lower level of signal present, AGC will decay, raising the receiver gain until the level rises to the design point. This decay rate is adjustable from 5 dB per second (quite slow) to 1000 dB per second which is nearly instantaneous. Step size varies in convenient increments over this large range of adjustment.

### *3.13.5. Main AGC Threshold*

An important AGC characteristic affecting dynamic behavior of the receiver is **AGC Threshold**, the RF level at which receiver gain starts to vary with signal level. The range of adjustment is from a low level of 0.37 microvolts (at or below atmospheric noise level) to a very high level of 191.48 microvolts (greater than S9+10 dB).

Signals at or above the threshold will activate the AGC and signals below it will not. The **THRESHOLD** adjustment is a lot like an IF Gain control. A high threshold is a lot like a low IF Gain setting; a low threshold is like a high gain setting.

### *3.13.6. Sub AGC Items*

These 3 independent adjustments affect the **SUB** receiver in the same manner as the **MAIN RX** settings affect that unit.

### *3.13.7. PBT Track*

Passband tuning adjustments in one receiver are normally independent of those in the other. In *Diversity Reception*, (per paragraph 2.4.5) with both receivers tuning on the same VFO, it may be convenient to have **PBT** on the **SUB RX** track with the **MAIN RX PBT**.

### *3.13.8. BW Track*

Using the same rationale as for **PBT Track, ORION** provides for the **SUB** Bandwidth control to track the **MAIN RX BW**.

### *3.13.9. Hardware Noise Blanker*

Both receivers have DSP Noise Reduction (**NR**), but the **MAIN RX** also has a dedicated hardware noise blanker (**NB**) ahead of the crystal filters. A front panel key and **MULTI** can adjust the threshold level of blanking when you activate this **Hardware NB** menu item.

### *3.13.10. Main RX Squelch*

**ORION** has a Squelch function that blanks receiver audio when RF signal levels are below a set threshold. Squelch is usually applied to **FM** operation because of its high noise level without signal. Because this is a seldom-adjusted control, we moved it to the **RX** menu. The range of threshold adjustment is from –127 dBm (an S-unit below S1) to 0 dBm (73 dB over S9!).

### *3.13.11. Sub RX Squelch*

**SUB RX Squelch** operates in the same manner as **MAIN RX** Squelch.

### *3.13.12. PBT/ BW Step*

The step size adjustment for the **PBT** and **BW** controls provides 10, 50 and 100 hertz per step. This feature provides slow, medium, and fast rates to suit operator preferences.

## 3.14. Functions of the "OTHER" Menu

As one might suspect, this is the catchall menu group for the functions which otherwise defy easy classification.

### *3.14.1. External Function Keys*

The optional Model **302R** External Pod accessory includes three programmable function keys labeled **F1**, **F2**, and **F3**. The function of each key is programmable by pressing **MENUS** and **OTHER**. Turn the **MAIN TUNING** knob to scroll the highlight to the desired item. Then use the **MULTI** control to adjust the selected function. Figure 3-9 below lists the available assignments to the Function keys.

| |
|---|
| **VFO A/B** |
| **STEP** |
| **MODE** |
| **SWEEP ON/OFF** |
| **USER1** |
| **USER2** |
| **SEND1** |
| **SEND2** |
| **SEND3** |
| **VFO A ENTER** |
| **VFO B ENTER** |

**Figure 3-9 302 Function Key Choices**

### *3.14.2. Menu Delay*

Selecting the **Menu Delay** function allows the user to adjust the way **ORION**'s menus interact with him. Use the **MULTI** control to adjust how long menu items persist after a key is pressed. Some operators will prefer a longer time until they develop more familiarity with the controls.

### *3.14.3. Contrast*

There is a range of Contrast settings from "washed out" to "too dark". "Just right"

for your lighting and preference is somewhere in between!

### *3.14.4. Main & Sub Encoder Rates*

To suit the preferences of diverse operators, **ORION**'s **Other** menu offers a choice between **slow** and **fast** rates for each of the following controls:

- **MAIN Tuning Encoder Rate**
- **SUB Tuning Encoder Rate**
- **CW RIT Rate**
- **SSB RIT Rate**
- **Pod Encoder Rate**

## 3.15. SSB Menu

Here we have the menu items related to SSB and digital modes.

### *3.15.1. Aux Input Gain*

Highlighting this item assigns the **MULTI** knob to adjust **Aux Input Gain** over its range with a 0 – 100% scale. If your station setup permits it, running a relatively high audio level to the **AUX I/O** connector and using a low gain setting for this item will generally result in good signal to noise ratio and a clean signal.

### *3.15.2. Tx Filter BW*

Adjustment range is from 900 to 3900 hertz. Before returning to a normal voice mode, the operator will need to check this menu setting if he has narrowed it.

### *3.15.3. - IMPORTANT:*

The **ORION** operator should be aware of the implications of using wide SSB filtering while transmitting.

Audio fidelity generally improves with the use of wider SSB transmit filtering. A 3.0 kHz transmit bandwidth has a more "well-rounded" audio response than a narrower bandwidth. Wider transmit bandwidth, however, increases the potential for interference with stations using adjacent frequencies.

The FCC regulations (Part 97) governing amateur radio operation do not specify a maximum transmit bandwidth for SSB communication. However, FCC regulation 97.307(a) requires amateur stations to occupy no more bandwidth than is necessary for the emission type in accordance with good amateur practice. In amateur practice, SSB radio transceivers use *between 2.4 and 2.8 kHz*, and *this range is the de facto standard for a communications-grade SSB transmit signal*. Regulation 97.307(b) requires that emissions outside the "necessary bandwidth" must not cause splatter interference to operations on adjacent frequencies. FCC enforcement has recently cited this issue as a current amateur problem!

While these are broad regulations subject to interpretation, the responsibility for complying with the regulations rests with the operator. Using a SSB transmit bandwidth wider than necessary for communications and causing interference to adjacent stations while doing so is specifically what these regulations are addressing. In summary, what may be an acceptable bandwidth on a given band at a given time may not be acceptable on another band, or at another time.

## 3.16. Filter Menu

### *3.16.1. Crystal Filter Selection*

**ORION**'s **Auto** setting chooses the optimum 9 MHz crystal filter (from those installed) for the current **MAIN RX BW** setting. To allow user experimentation per Ten-Tec tradition, turning the **MULTI** knob at **I.F. Selection** will set and hold any of the following filter selections in any mode: **250 Hz** and **500 Hz** (optional filters), **1 kHz**, **1.8 kHz** (optional filter), **2.4 kHz**, **6**

**kHz**, and **20 kHz**. Selecting an uninstalled filter position will disable the **MAIN RX**. We recommend the **Auto** setting for all normal operating.

### *3.16.2. Enabling Optional Filters*

The factory setting for enabling any of the three optional crystal filters is **Off**. If you have any of these filters in your radio, you should turn the corresponding items **On** so that the automatic crystal filter selection can use it to advantage.

### *3.16.3. 500 and 250 Hz Center Frequency Adjust*

For particularly critical operations, it may be desirable to adjust the center frequency of the very narrow crystal filters with greater precision than is inherent in production filters. For the optional 500 and 250 Hz filters, two menu items enable **MULTI** to adjust center frequency over a ±250 Hz range.

**Please note** that there are two usual situations that will require you to go back to **MENUS**>**Filter** and enable them again:

1. After performing a "Long **RECALL**" to **Factory Defaults**.;
2. After a radio *RESET* per paragraph 2.1, if you answered **Yes** to **Clear User Settings**.

## 3.17. Firmware Version and Flash Updates

To see **ORION**'s firmware version and date information on the opening screen (Figure 2-1), press and hold the **MENUS** key.

To prepare **ORION** for a flash memory update, compare the version number and date on your screen with the version offered on **www.rfsquared.com**. If the Internet version is newer than yours is, follow the instructions on the site to download the new file.

After downloading the update file, read the **How To** file that came with it, and connect a standard 9-pin serial port cable from your computer to **ORION**'s **SERIAL DATA** receptacle on the rear panel.

- Turn off **ORION** power for a few seconds.
- Press and hold **RECALL** while restoring power. **ORION** displays **FLASH UPDATE MODE**.
- Run the **update.exe** program and wait about a few minutes for your computer to announce a successful download. It takes less than 3 minutes.

# 4. Hardware Information.

## 4.1. Major Parts

The transceiver comprises 13 printed circuit board subassemblies plus one optional subassembly, as Figure 4-1 shows:

**Figure 4-1 ORION Subassemblies**

| Part # | Name | Designator |
|---|---|---|
| 81908 | Input/Output Board (I/O) | A0 |
| 81909 | Low Pass Filter (LPF) | A1 |
| 81897 | Power Amplifier (PA) | A2 |
| 81906 | RF Converter (RFCNV) | A3 |
| 81910 | 9 MHz IF (IF) | A4 |
| 81911 | I.F. Converter (IFCNV) | A5 |
| 81907 | Subreceiver (SUB) | A6 |
| 81917 | Logic and DSP (DSP) | A7 |
| 81913 | Keypad (KEY) | A8 |
| 81936 | Power Distribution Board (PWR) | A9 |
| 81912 | Synthesizer (SYNTH) | A10 |
| 81916 | Motherboard (MBD) | A11 |
| 81915 | Rear Connector Board | A12 |
| 81957 | Sweep Amplifier | A13 |
| 81956 | optional Autotuner | A14 |

See Figure 4-2 for a block diagram showing the relationship of these subassemblies in the transceiver. **A11**, the Motherboard, forms **ORION**'s central electrical spine interconnecting all but two of the printed circuit boards (PCBs). For clarity, the block diagram does not explicitly show **A11**'s myriad interconnections. Miniature coaxial cable and connectors carry essentially all signals between boards. Shield partitions suppress possible inter-board crosstalk.

## 4.2. Subassembly Location

The centrally located Motherboard (**A11**) connects the Logic board (**A7**), Keypad board (**A8**), and other front panel parts with the I/O (**A0**) and Rear Connector (**A12**) boards which populate the rear panel. Along the way, **A11** picks up DC and control line connections from **A1**, **A4**, **A5**, and **A6** in 4 compartments above the chassis deck. Below the chassis deck, **A3**, **A9**, and **A10** also connect to the Motherboard. The optional Autotuner (**A14**) connects via wires and plug-in cables to **A0**. Each signal-processing module has its own compartment.

Figure 4-3 maps the physical locations of these subassemblies in **ORION**'s chassis.

**A0** and **A2** share the rear panel space, with each taking up most of the height and about half the width of the panel. The Rear Connector board (**A12**) shares the panel half dominated by the PA. It carries 5 connectors whose design suits them to mounting on a board perpendicular to the panel. Together with 19 connectors on **A0**, they comprise almost all of **ORION**'s input/output connectors for DC, audio, control, and RF. The **MIC**, **CW**, and **PH** (headphone) jacks are in front.

## 4.3. Signal Path – Main Receiver

Figure 4-4 diagrams the path a Main RX RF signal takes from antenna to audio. A signal from one of **ORION**'s 3 antennas enters one of the antenna jacks on the rear panel, where I/O (**A0**) selects the path to the RFCNV (**A3**) via cable 2. Amateur band preselection, pre-

amplification, and high dynamic range conversion to the first IF take place in the RF Converter.

From **A3**, cable 11 brings the IF signal to the 9-MHz IF (**A4**), where the hardware noise blanker operates in a wideband environment. Cables 14A and 14B route the wideband IF signal through the Sweep Amplifier (**A13**) to **A7** for use in ORION's band scope feature. Three standard and three optional crystal filters (normally selected by the **BW** control) define the tuned signal bandwidth ahead of DSP filtering. This stage provides enough amplification to maintain the receiver sensitivity despite unavoidable filter losses. The amplified and band-limited signal feeds the IF Converter (**A5**) via cable 16.

**A5** provides conversion to the 2nd IF, amplification, filtering, and conversion to the 3rd IF for processing in the **A7** Logic board. Cable 18 carries the 14 kHz third IF to the DSP in **A7**.

After digital signal processing in **A7**, the recovered audio travels through the Motherboard to the headphone jack on **A8** and to the **EXT SPKR** and **AUX I/O** jacks on **A12**. From **A12** wire cable 36 runs to the internal speaker.

The Synthesizer board (**A10**) supplies 1st local oscillator signal to **A3** via cable 12, and 2nd LO to **A5** via cable 19.

### 4.4. Subreceiver Signal Path

For the Subreceiver, the signal path starts at an antenna jack selected by the I/O board (**A0**) and proceeds to **A6**, the Subreceiver board. This board comprises the entire analog circuitry of the Subreceiver, accomplishing conversion of HF signals successively to 45 MHz, 450 kHz, and 14 kHz intermediate frequencies. 3rd IF signal travels to the DSP via cable 20. Audio from **A7** goes through the Motherboard (**A11**) to the headphone jack on **A8**. The audio signal also reaches the **EXT SPKR** and **AUX I/O** jacks via **A11** and **A12**. From **A12** it runs through wire cable 36 to the internal speaker.

The Synthesizer board (**A10**) supplies a 2nd local oscillator signal and a frequency reference for the Subreceiver 1st local oscillator to **A6**. Cables 23 and 21 carry these signals.

### 4.5. Transmitter Signal Path

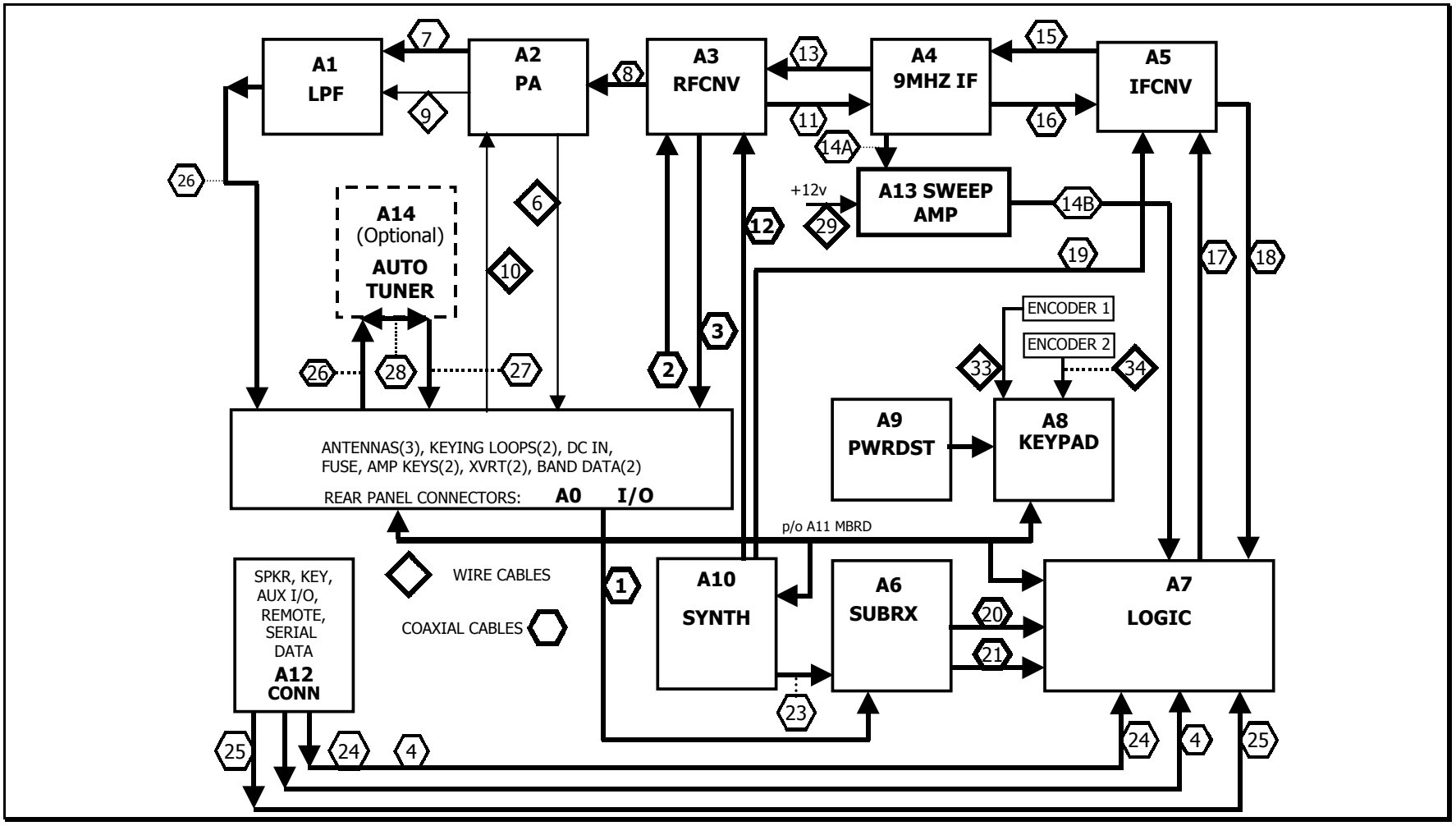
The TX signal path has the **MIC** and **CW** (key/keyer) jacks on **A8** as sources. Other sources are the **KEY** and **AUX I/O** jacks on **A12**. The audio signals from **MIC** and **AUX I/O** travel via cables 25 and 24 respectively. Keying lines get to **A7** via **A11**.

From the DSP, cable 17 carries keyed or modulated 3rd IF to **A5**. The 9 MHz output from the IFCNV feeds **A3** via cable 13. The resulting HF signal can go to the **XVRTR RF** jack on the I/O board through cable 3, or to the PA (**A2**) via cable 8.

From **A2** the path to the LPF board is via cable 7. Cable 27 brings the high level amateur band HF to **AO**, the I/O board. On the I/O board, the signal is routed to the selected **ANT1** or **ANT2** RF output connector.

If it is installed, the optional Autotuner (**A14**) is connected in the **ANT1** path only. Cable 26 provides the **A14** input path, and cable 27 is the output path. If the transceiver has no **A14**, cable 28 replaces the Autotuner.

**Figure 4-2 Subassembly Cabling**


A1
LPF
A2
PA
A3
RFCNV
A4
9MHZ IF
A5
IFCNV
A13 SWEEP
AMP
+12v
A14
(Optional)
AUTO
TUNER
ENCODER 1
ENCODER 2
A9
PWRDST
A8
KEYPAD
ANTENNAS(3), KEYING LOOPS(2), DC IN,
FUSE, AMP KEYS(2), XVRT(2), BAND DATA(2)
REAR PANEL CONNECTORS: A0 I/O
p/o A11 MBRD
SPKR, KEY,
AUX I/O,
REMOTE,
SERIAL
DATA
A12
CONN
WIRE CABLES
COAXIAL CABLES
A10
SYNTH
A6
SUBRX
A7
LOGIC
1
2
3
4
6
7
8
9
10
11
12
13
14A
14B
15
16
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34

**Figure 4-3 Plan View of ORION Chassis**

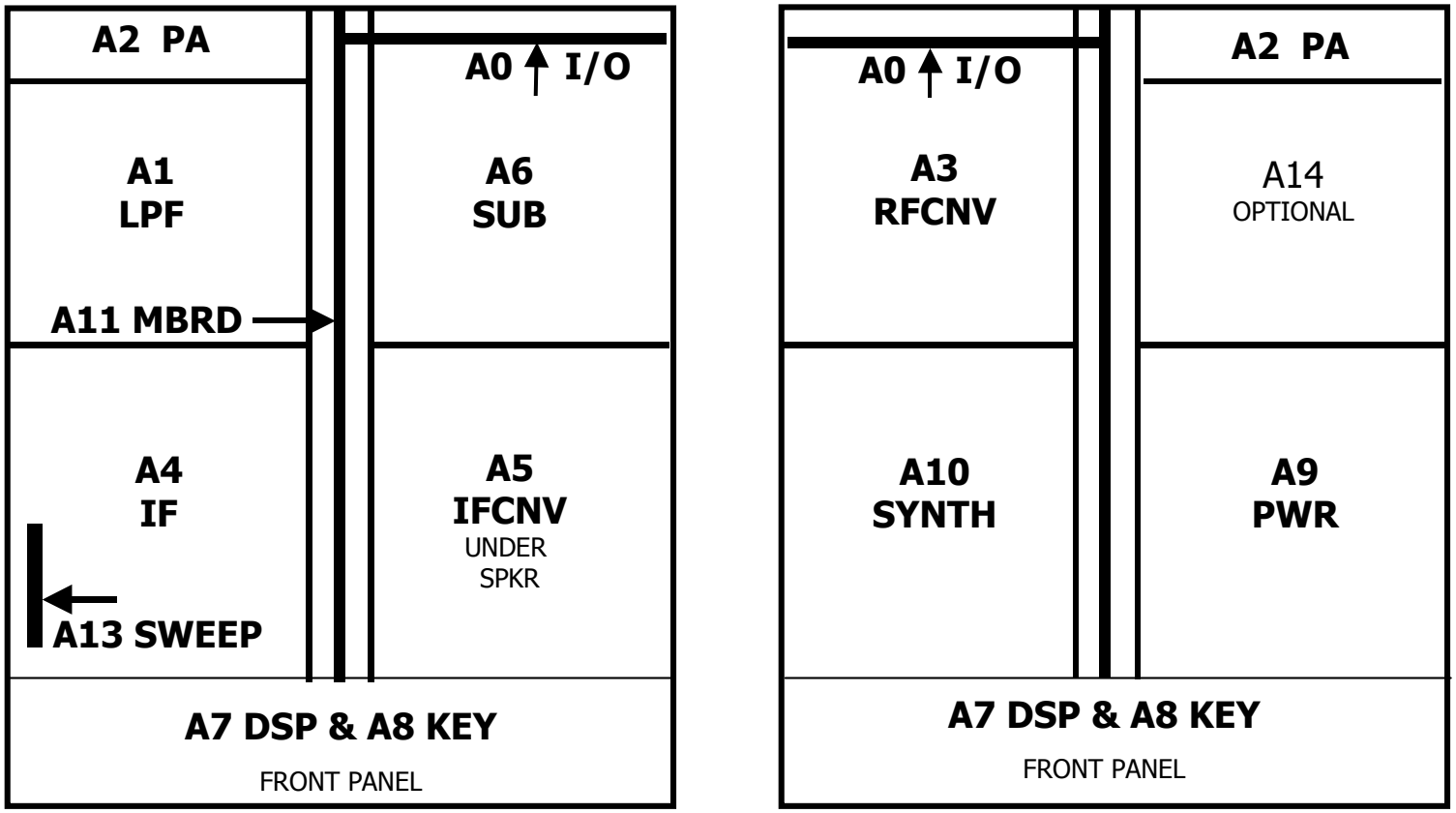

**Figure 4-4 Signal Path – Main Receiver**

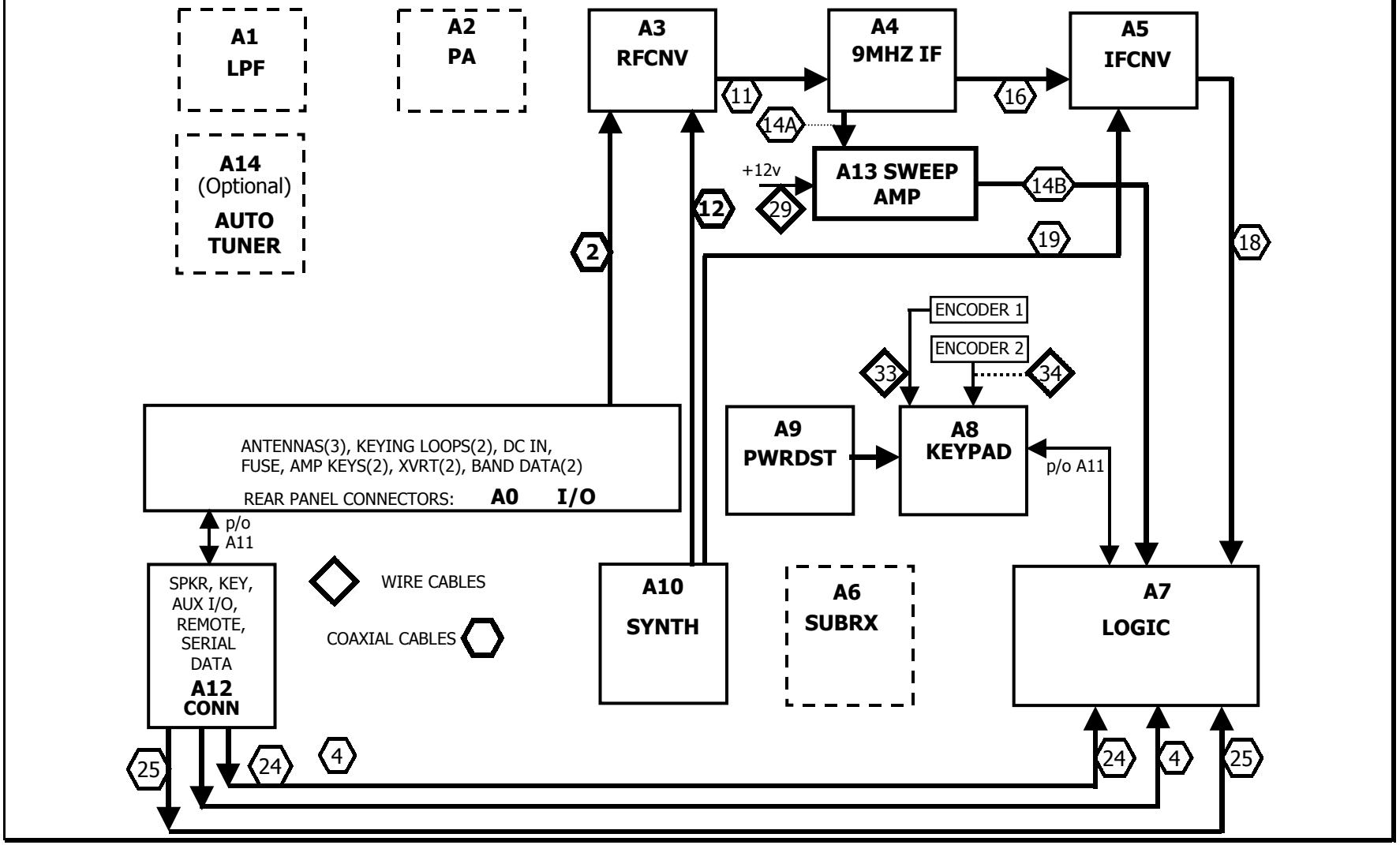

**Figure 4-5 Subreceiver Signal Path**

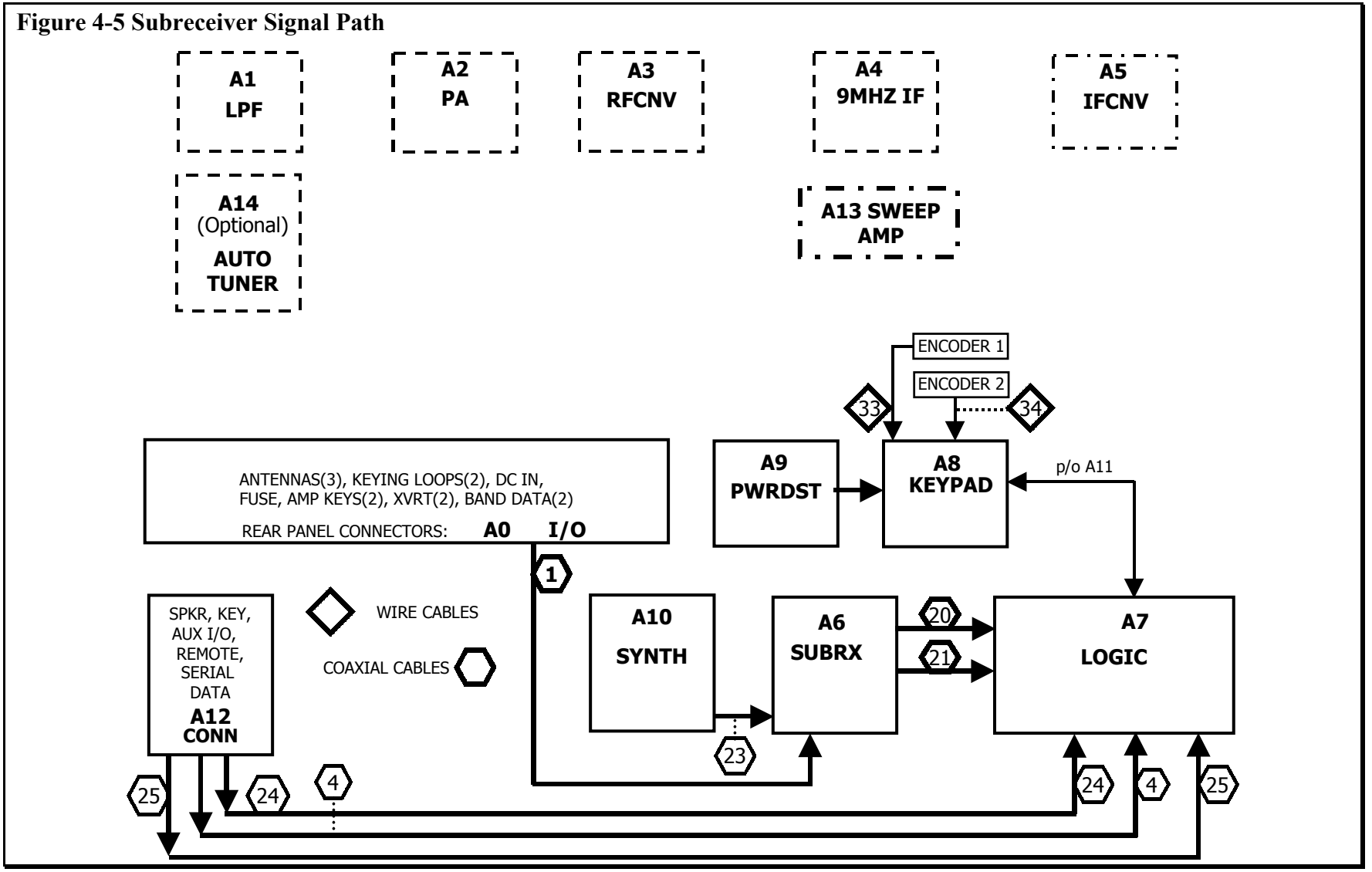

**Figure 4-6 Transmit Signal Path**

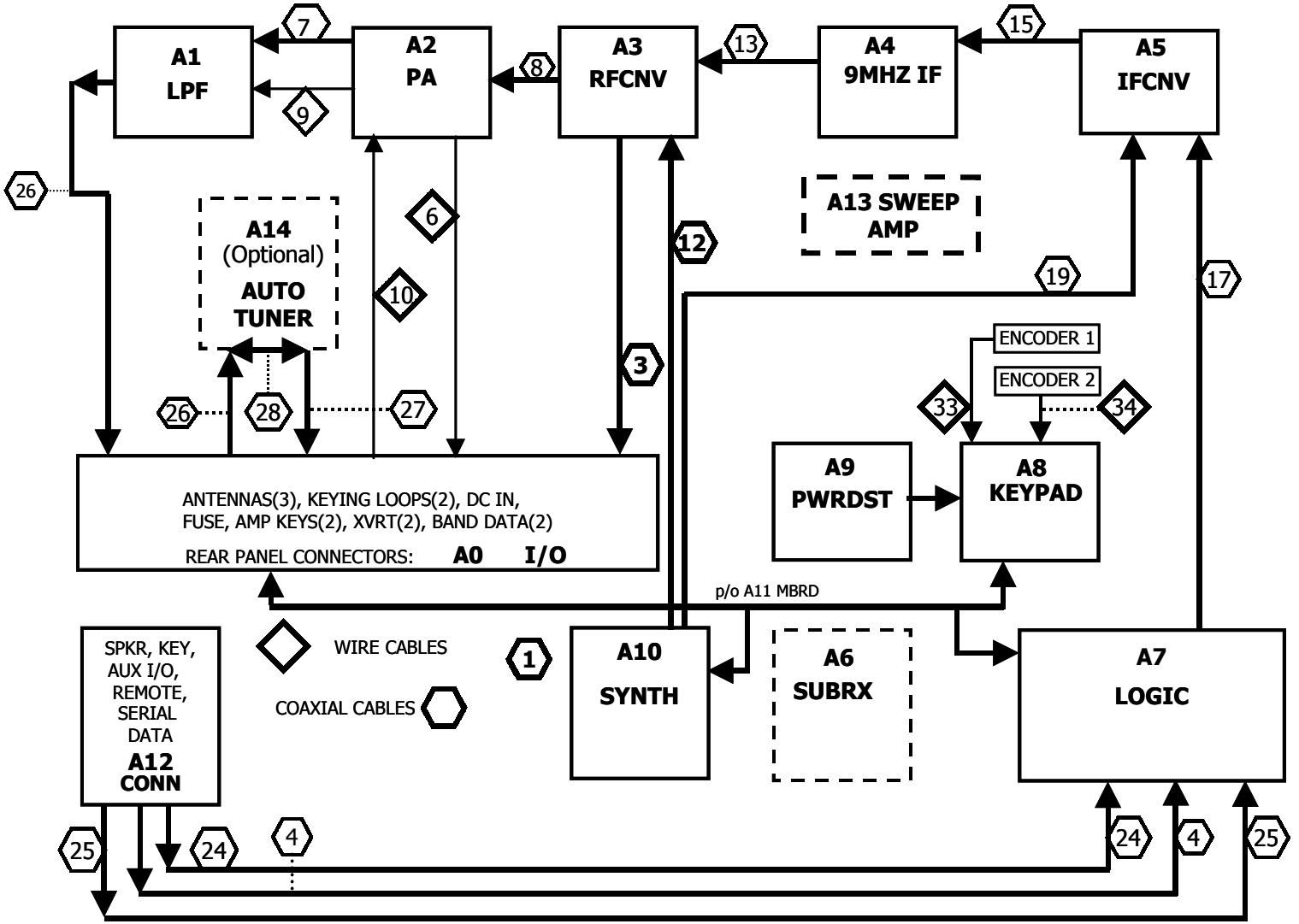

**Figure 4-7 Major ORION Cables**

| Ass'y | From Name | Function & Direction | Type | To Name | Assy | ID # |
|---|---|---|---|---|---|---|
| A0 | I/O | Sub Rx Ant In | RG174 | Sub Rx | A6 | 1 |
| | | Main Rx Ant In | RG174 | Main Rx | A3 | 2 |
| | | XVERT Out | RG174 | Main Rx | A3 | 3 |
| | | Main Rx Audio Out | RG174 | DSP/CPU | A7 | 4 |
| | | Tx RFOut | RG174 | Lowpass | A2 | 5 |
| A2 | PA | PA Temp Out | 2-3 Term | I/O | A0 | 6 |
| | | PA RF Out | RG188 | Lowpass | A2 | 7 |
| | | PA RF In | RG174 | Main RX | A3 | 8 |
| | | T-voltage Out | 2-Term | Lowpass | A2 | 9 |
| | | 13.8 V In | #16 Red | I/O | A0 | 10 |
| A3 | Main Rx | 1st Rx IF Out | RG174 | 9 MHx IF | A4 | 11 |
| | | 1st LO In | RG174 | Synth | A10 | 12 |
| | | 1st Tx IF In | RG174 | 9 MHx IF | A4 | 13 |
| A4 | 9 MHz IF | IF to Sweep Amp | RG174 | Sweep Amp | A13 | 14 |
| | | Main Sweep In | RG174 | Sweep Amp | A13 | 14A |
| | | 1st IF Out | RG174 | IF Converter | A5 | 15 |
| A5 | IF Conv | 3rd Tx IF In | RG174 | DSP/CPU | A7 | 17 |
| | | 3rd Rx IF Out | RG174 | DSP/CPU | A7 | 18 |
| | | Main RX LO Ref | RG174 | Synth | A10 | 19 |
| A6 | Sub Rx | Sub Rx 3rd IF Out | RG174 | DSP/CPU | A7 | 20 |
| | | Sub 1st LO Ref | RG174 | Synth | A10 | 21 |
| | | Sub 2nd LO Ref | RG174 | Synth | A10 | 23 |
| A7 | DSP/CPU | Aux Audio In | RG174 | Conn | A12 | 24 |
| | | Mic Audio | RG174 | Key Pad | A8 | 25 |
| | | Power Switch | 2-Term | Pwr Sw | | 30 |
| | | S-Meter | 4-Term | S-Meter | | 31 |
| | | CCFL Backlight | 2-Term | CCFL | 1-Wht-A<br>2-Blk-K | 32 |
| A8 | Keypad | Encoder 1 Out | 5-Term | | Enc1 | 33 |
| | | Encoder 2 Out | 5-Term | | Enc2 | 34 |
| A9 | Pwr Dist | 5V DC | 2-3-Term | Dsp/CPU | A7 | 35 |
| A11 | | Motherboard: | | | | PWB |
| | | Power & Control | | | | PWB |
| A12 | Conn | Speaker | 2-Term | Speaker | | |
| A14 | Tuner | Tuner RF In | RG188 | I/O | A0 | 26 |
| | | Tuner RF Out | RG188 | I/O | A0 | 27 |
| | | No-Tuner Jumper | RG188 | I/O | A0 | 28 |

## 4.6. Schematic Diagrams

**ORION**'s schematic diagrams will be available on CD-ROM.

# 5. Trouble Shooting

While we cannot cover every possible problem, here are some hints for dealing with some potential difficulties.

### 5.1. Check the Obvious!

- Is your DC power source okay?
- Check power supply, cable and connector(s).
- Is the 25 ampere fuse loose or missing?
- Antenna Problems? Try a dummy load. Every ham should have one!
- Is the proper antenna connected?
- Is any external antenna switch connected and properly set?
- Have you checked **ORION**'s Control Settings?

Have you double-checked **ORION**'s many control settings, including those on all **MENUS** screens, for your intended mode of operation?

### 5.2. Reset the Processor.

See paragraph 2.2.1. We have learned that this can cure a multitude of "bugs" in a few seconds.

### 5.3. Back to Basics

You should try the "Long RECALL" per 2.2.1 and determine if the trouble persists in that state.

### 5.4. No Audio from Receiver.

- If you are using the **SUB Rx**, does it have a **VFO** and an **ANT** assigned?

If frequency controls act normally --

- Which receiver are you controlling at the moment?
- What routing is set in the **AUDIO** submenu?

If S-meter seems to be reacting to signals --

- Is receiver squelched? Push **MENUS**▷**Rx** to check **Squelch Threshold** setting. Turn it to **–127 dBm**.
- Check adjustment of **MAIN AF** or **SUB AF** control as necessary. Check setting of **RFGAIN** controls for **MAIN** or **SUB** receiver.
- Try a set of headphones in case the speaker has failed. Set **AUDIO** submenu.
- Check inside the cabinet for cable connectors that may have loosened in shipment or rough handling.

### 5.5. Symptom: distorted SSB

- Be certain the **MIC** gain is set properly in accordance with paragraph 3.8.3. The **ALC** Led should just flash briefly on voice peaks.
- Check the setting of **SP**, the speech processor. An excessively high setting can reduce audio quality.
- A frequent cause of a distorted SSB signal is inadequate RF grounding resulting in RF feedback. Common RF grounding problems are:
- No ground connection: or
- Too long a lead to a good ground.
- Another potential cause of distorted SSB arises when the station is in the near field of the antenna. This is a problem many apartment dwellers face.

## 5.6. Diagnosing RF Feedback Problems

- Every amateur station should have access to a well-shielded 50-ohm dummy load. Start troubleshooting by disconnecting all RF accessory equipment from the transceiver output. Likewise disconnect all accessories from other radio connectors, leaving only the microphone. Be certain your microphone cable is well shielded. Connect the dummy load to the Antenna receptacle with a short coaxial cable.
- A nearby HF receiver (or a local ham friend's station) will likely have little trouble hearing your very low power RF signal when you transmit 100 watts into the dummy load. If the distortion problem does *not* disappear under these conditions, your rig may well have a problem and you should call Ten-Tec's service department. If the problem goes away, as is likely, you can begin the process of re-connecting accessories one-at-a-time to isolate the problem.

## 5.7. RF Grounding

- Many problems relate to the lack of an RF station ground, as contrasted with a safety ground connection. We recommend bonding all equipment chassis together with short heavy metal braid or strap. Make these connections from chassis ground lug to chassis ground lug and connect the last piece in the chain feeding the antenna to a good earth ground. This lead needs to be as short as possible. Lengths near ¼ wavelength on any band used can be particularly troublesome when the far end is connected to earth.
- Ten-Tec recommends following the good advice in the ARRL Handbook for dealing with RF grounds and safety grounds.

## 5.8. No Transmit, but Receiver works

- Check the following items in **ORION**'s **MENUS** to decide if the setting is right for the operating mode you plan to use:
- Is the gain setting correct for the **MIC** or **AUX I/O** as appropriate?
- Is the **TRANSMITTER ENABLE ON**?
- Is the **KEYER ENABLE ON**?
- Is the **KEYING LOOP** set properly for your mode of operation? With no amplifier or with a non-QSK amplifier the menu should indicate **KEYING LOOP** off. See paragraph 3.10.3**.**

## 5.9. No Receiver, but ORION Transmits

- Check the **PBT** setting or turn it off. It may be set outside the passband.
- Disconnect any external equipment that might be pulling the PTT line **MIC** or **PBT** connector to ground.
- Is the internal **KEYER** enabled with a mono plug in the **KEY** jack? That would cause a constant stream of dits when you apply power.
- Check settings of the **SQL**, **AF**, and **RF** controls.

### 5.10. No operation in VOX

- Check the switch on the bottom of the Model 705 microphone.
- Check **ORION**'s screen to see if the menu items for **VOX** are active and set properly. If any of the three settings is at zero, **VOX** will not operate.

### 5.11. When All Else Fails…

- If the measures above do not fix the problem, please consult with our service department.

# 6. INDEX