SECTION 1: INTRODUCTION

1.1 OVERVIEW

This manual serves a twofold purpose: (1) to introduce you to the Model 5150 HF/SSB, its various operating modes and capabilities, and (2) to guide you during transceiver system installation and operation.

1.2 GENERAL DESCRIPTION

The Hull Model 5150 HF/SSB transceiver provides reliable communications between ships, from ships to private or public shore stations and point-to-point between land stations.

The Model 5150 is a solid-state 125 Watt HF/SSB transceiver, microprocessor controlled and completely synthesized. The transmitter section covers 1.6 to 30 Mhz. In receive, you may tune from 490 kHz to 30 MHz in 10 Hz steps, enabling you to listen to safety information on Navtex and AM radio broadcasts.

The Model 5150's scanning functions make it easy for you to find active frequencies. You can place up to 40 channels in user memory, to be scanned sequentially, at rates of 0.1, 1, and 3 seconds per channel. With Hull's Scan/Squelch and DSC options, you may set scanning to stop on squelch or selective call.

The Model 5150's standard operating modes are USB, LSB and AME. FSK, CW and full double sideband AM are options. Also, with Hull's extensive line of accessories, your new transceiver can function as a telegraphy (SITOR, AMTOR, CW, Baudot, Packet) and FAX (including Weather FAX) station.

1.2.1 FRONT PANEL

The illuminated front panel eases nighttime viewing. Frequencies may be entered either by the keypad or the tuning knob. The factory programmed channels include USCG and ITU channels plus there are over 200 user programmable channels.

The analog meter displays forward or reverse power and received signal strength. The meter automatically switches function depending on whether you are transmitting or receiving.

1.2.2 POWER REQUIREMENTS

The Model 5150 is intended for operation on a 13.6 VDC nominal, negative ground system (a 28 VDC version Model 5150 SSB28 is also available), and is fully compatible with the Hull Electronics family of linear amplifiers, antenna couplers and broadband antennas.

1.2.3 INSTALLATION

The Model 5150 is a complete single-package unit intended for shelf, ceiling, or bulkhead mounting. When properly installed, the Model 5150 meets or exceeds all applicable FCC requirements.

1.3 TECHNICAL SPECIFICATIONS

Table 1-1 defines the technical specifications for the Model 5150 HF/SSB Transceiver.

Table 1-1.
Technical Specifications

GENERAL.

Input Voltage: 13.6 VDC +/- 15%
Input Current-Transmit: 25.0 ADC maximum,
10 ADC average on voice.
-Receive: 0.6 ADC maximum (unlighted).
Size: 4.7"H x 12.3" W x 15" D
(12.7 cm H x 31.2 cm W x 38.1 cm D).
Antenna Coupler: Hull Model H-403 CU.
Weight: 12.5 lb. (5.8 kg.)
Operating Temperature Range: -30 C to +55 C.
Frequency Stability: +/- 10 Hz.
Frequency Control: Fully synthesized in 10 Hz steps.
Operating Modes: 2K80J3E, USB and LSB; 2K80H3E, AME are standard;
300HJ2B, FSK; and 160HJ2A, CW are optional.
2nd I.F. Bandwidths: USB, LSB, and AM equivalent, 2.5 kHz.
FSK and CW, 500 Hz;
AM, 5 kHz.
Switching Time: 20 ms maximum half duplex with 800 kHz split.

TRANSMITTER.

Frequency Range: 1.6-30 MHz continuous coverage.
Output Power: 125 W PEP and CW +/-1 dB
Intermodulation Distortion: -32 dB 3rd order,
ref. PAVG
-37 dB 5th & 7th order,
ref. PAVG
-65 dB 9th & higher,
ref. PAVG.
Total Audio Harmonic Distortion: 5% maximum.
Carrier Suppression: 45 dB minimum.
Hum and Noise Suppression: 50 dB minimum.
R.F. Harmonic Output: -65 dBc maximum.
Spurious Output: -65 dBc maximum.
Audio Input Level: -6 dBm to +3 dBm,
600 Ohms for full power.
Audio Response: 300 Hz-2.8 kHz +/- 3dB,
USB & LSB;
1450 Hz-1950 Hz +/- 3 dB, FSK;

RECEIVER.

Frequency Range: 490 kHz to 30 MHz,
continuous coverage.
Sensitivity: 0.35 uV for 10 dB SINAD,
USB and LSB;
0.20 uV for 10 dB SINAD,
FSK;
1.00 uV for 10 dB SINAD,
AM.
490 to 1600 kHz 10 uV for 10 dB SINAD
Selectivity: -60 dB @ carrier frequency minus 1 kHz, USB;
-70 dB @ carrier frequency minus 3 kHz, USB;
-80 dB @ carrier frequency minus 6 kHz or more.
Spurious Response: -80 dB minimum.
Image Response: -80 dB minimum.
Intermodulation Distortion: +11 dBm 3rd order intercept point.
Recovery Time: 15 ms maximum, SITOR and full break-in CW.
AGC Characteristics: 3uV to 300,000 uV maximum,
<3 dB audio level change.
Total Harmonic Distortion: 5% maximum.
Audio Output: 4.0 W minimum into internal loudspeaker,
10 uV CW input signal; 0 dBm typical,
600 Ohms output to accessory connector.
Squelch: Audio derived syllabic squelch.
Scanning: Up to 10 channels, can stop on squelch or selective call.
Scan Rate: 0.1s, 1.0s, and 3.0s per channel, selectable.
Fine Tuning: In synthesized 10 Hz steps via front panel tuning knob.
Monitoring of Transmit Frequency,
Half Duplex Channels: Standard via keypad.

Note:

★ Specifications are subject to change without notice due to developments in technology.

1.4 OPTIONAL EQUIPMENT

The Model 5150 transceiver has a wide variety of options and accessories. These include:

- CW and FSK filter
- CW full break-in mode
- two tone alarm generator
- scan/squelch option
- cooling fan for continuous duty
- automatic antenna couplers
- linear amplifiers
- radio-computer telex equipment
- radio-computer FAX equipment
- digital selective calling (DSC)

For further information on these and other options and accessories, consult Section 2 (Installation), Section 4 (Accessories and Options), or your Hull dealer or representative.

1.5 WARRANTY INFORMATION

We ship this product with our limited warranty certificate and registration card. Please be sure to complete this card and return it to us as soon as possible.

SECTION 2: INSTALLATION

2.1 OVERVIEW

Installation of the Model 5150 consists of three main tasks: (1) locating and mounting the transceiver and any accessory equipment, (2) installing cables to the power source, and (3) erecting a suitable antenna/ground system.

This section guides you through installation of your Model 5150 Transceiver, including unpacking, antenna, grounding, and safety considerations, transceiver mounting, and basic precautions you must take to ensure your radio's satisfactory performance.

2.2 UNPACKING AND INSPECTION

Carefully remove the transceiver from the shipping carton.

Your Model 5150 Transceiver is supplied with the following items:

- Model 5150 HF/SSB Transceiver
- hand-held microphone with bracket
- operation manual, frequency lists
- mounting cradle

Inspect the transceiver and accessories for damage. Report any damage or shortages to Hull Electronics.

We also recommend that you retain the original box and packing, as it makes a convenient way to transport the unit.

2.3 RF SAFETY SUGGESTIONS

Radio-frequency (RF) protection is an important safety concern. This involves minimizing human exposure to strong RF fields. These potentially dangerous fields occur near or around antennas. Please take time to study and follow these general suggestions:

- Confine RF radiation to the antenna, where it belongs. Provide a good ground for your equipment. Poor quality feed line and improperly installed connectors can be a source of unwanted radiation. Use only good quality coaxial cable. Be sure that connectors are of good quality and are properly installed.

- Run your feed lines away from where you or other people sit in or near your operating room.

- Do not sit or stand close to your antenna system or feed lines while operating.

- Do not operate RF power amplifiers or transmitters with the covers or shielding removed.

- In higher-power operation, keep the antenna away from people. Humans should not be allowed within 10 to 15 feet of vertical antennas.

- Always try to install your antennas where people and animals cannot touch them.

- Never touch an antenna that has RF power applied. Be sure RF power is off and stays off before working on or adjusting an antenna.

2.4 ANTENNA SYSTEMS

The antenna is a very important factor affecting transmission and reception. It is for this reason that we strongly recommend that you install only a quality antenna in your new 5150 Transceiver system. Sections 2.4.2 and 2.4.3 describe some of the more effective antennas for ship and base station installations.

CAUTION

Standing wave ratios in excess of 2:1 may cause severe transmitter performance degradation!

Only a properly matched antenna system will allow maximum power transfer from the 50Ω transmission line to the radiating element. If the standing wave ratio (SWR) rises much above 2:1, circuits in the Model 5150 act to reduce power output to prevent damage to the transceiver. Your Hull dealer or representative is qualified to assist you in selecting the proper antenna

and antenna system accessories to meet your application requirements.

2.4.1 ANTENNA COUPLER

The Hull Model H-403CU Automatic Antenna Coupler is intended primarily for use with the Model 5150 Transceiver. The Model H-403CU coupler matches the varying impedances of a wide variety of antennas to the 50Ω impedance required by the transceiver. Tuning to the exact frequency selected is automatic and takes place after you select a new channel.

The coupler is a complete single-package unit intended for either interior or external mounting. The package is weatherproof but should not be considered submersible. All necessary power for operating the coupler is obtained from the companion transceiver. The procedure in Section 2.8.2 details the Model H-403CU installation.

2.4.2 SHIP INSTALLATIONS

Most ship installations, because of restricted space, consist of vertical whip or fairly short wire antennas.

To match the antenna to the transceiver, you need an automatic antenna coupler such as the Model H-403CU. Also, depending upon whether your vessel is of metal or non-metal construction, the grounding system can become an important consideration.

For more information on antenna systems, ground systems, radio wave propagation and frequency selection, refer to Sections 2.4.4 through 2.8.4.

2.4.3 BASE STATIONS

One of the most convenient antenna systems for base station use is the broadband antenna. This antenna provides a good impedance match over a wide frequency range. Our broadband antenna provides adequate matching to the Model 5150 Transceiver without need for couplers or extensive ground systems. Broadband antennas also offer good radiation performance.

Hull Electronics offers several broadband models, including antennas designed to cover 1.6 to 30 MHz, 150W PEP and 1000W PEP, and 3.5 to 30 MHz, 150W PEP and 1000W PEP.

For more information on antenna systems, ground systems, radio wave propagation and frequency selection, refer to Sections 2.4.4 through 2.8.4.

2.4.4 HF PROPAGATION

Many different factors affect radio waves as they travel from one place to another. The height of your antenna above ground, the type of antenna used, the frequency of operation, the terrain, the weather, and the height and density of the *ionosphere* (a region of charged particles high above the earth's surface) all affect how radio waves travel. A basic knowledge of HF propagation fundamentals will both aid you in the selection of an appropriate antenna system and effective operation of your transceiver.

2.4.4.1 IONOSPHERIC PROPAGATION

Nearly all radio communications on frequencies below 30 MHz is by means of *sky waves.* After leaving the transmitting antenna, sky waves travel from the earth's surface at an angle that would send them out into space if their paths were not bent enough to bring them back to earth. As Figure 1 shows, the radio wave travels outward from the earth and encounters a region of ionized particles in the atmosphere. This region, the ionosphere, begins about 30 miles from the earth's surface and extends to about 260 miles. The ionosphere refracts (or bends) radio waves. At some frequencies the radio waves are refracted enough so they return to earth at a point quite distant from the originating station.

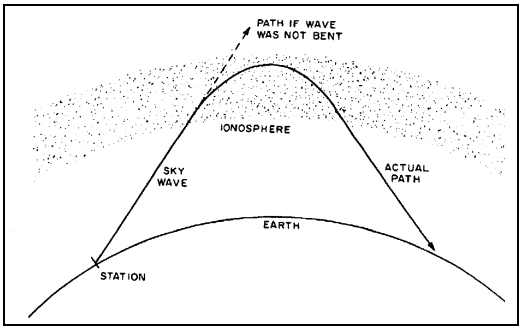

Figure 1. Ionospheric refraction.

The earth's upper atmosphere is composed mainly of oxygen and nitrogen, with traces of hydrogen, helium, and several other gases. The atoms that make up these gases are electrically neutral--they have no charge and exhibit no electrical force outside their own structure. When these gas atoms absorb ultraviolet radiation from the sun, however, electrons are knocked free and the

atoms become positively charged. These positively charged atoms are called *ions*, and the process by which they are formed is called *ionization*. Several ionized layers are formed at different heights in the atmosphere.

2.4.4.2 IONOSPHERIC LAYERS

As Figure 2 shows, the ionosphere consists of many layers of charged particles. These layers have been given letter designations.

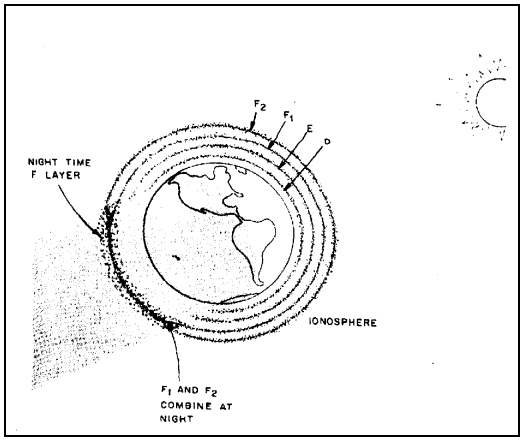

Figure 2. Ionospheric layers.

The *D Layer* is the lowest layer in the atmosphere that affects propagation. At about 30 to 55 miles above the earth, this layer is in a relatively dense part of the atmosphere. The amount of ionization in this layer varies widely depending on how much sunlight hits the layer. At noon, ionization in the D layer is maximum or very close to it. By sunset, the ionization disappears.

The D layer is ineffective in bending HF (high-frequency) signals back to earth. The D layer's major effect on long-distance communication is to absorb energy from radio waves. Absorption is most pronounced at midday, and is responsible for the short daytime communications ranges on the lower frequencies.

The next layer, the *E Layer*, appears at an altitude of about 60 to 70 miles above the earth. The atmosphere at this height is still fairly dense--enough so that ionization produced by sunlight does not last very long. This makes the E layer useful for bending radio waves only when it is in sunlight. E-layer ionization levels reach a minimum just before sunrise, local time. Using the E layer, a radio signal can travel a maximum distance of about 1250 miles in one hop (where the refracted signal comes back to earth).

The layer of the ionosphere most responsible for long-distance communication is the *F Layer*. This layer is actually a very large region ranging from about 100 to 260 miles above the earth, depending on the year, latitude, time of day and solar activity. F-layer ionization reaches a maximum shortly after noon local standard time, but tapers off gradually toward sunset. At this altitude, the ions and electrons recombine slowly, so the F layer remains ionized throughout much of the night, reaching a minimum just before sunrise. After sunrise, ionization increases rapidly for the first few hours, then increases slowly to its noontime maximum.

During the day, the F layer splits into two parts, F1 and F2, with central regions at altitudes of about 140 and 200 miles, respectively. At night, the two layers recombine to form a single F layer slightly below the higher altitude. The F1 layer does not have much to do with long-distance communications; it tends to cause effects similar to those caused by the E layer. The F2 layer is responsible for most long-distance communications in the HF bands. A one-hop radio transmission can travel a maximum distance of about 2500 miles using the F2 layer.

Speaking of distance, a radio signal will often be reflected from the reception point on the earth into the ionosphere again, reaching the earth a second time at a still more distant point. Under some conditions it is possible for as many as four or five signal hops to occur over a radio path, but no more than two or three hops is the norm. In this way, HF communications can be conducted over thousands of miles.

2.4.4.3 FREQUENCY SELECTION

Another important factor influencing HF propagation is the frequency range over which communication can be carried via the ionosphere. What most operators want to know is the maximum usable frequency (MUF) for a particular distance at the time of day when communication is desired. The MUF is the highest frequency that allows a radio wave to reach the desired destination, using E- or F-layer propagation.

Why is the MUF so important? If you know the MUF, you can make an accurate prediction as to which frequencies will give you the best chance for communication via a particular path. For the strongest signals at the greatest distance, it is important to select operating frequencies fairly near the MUF.

How can you determine the MUF for your desired communications? The MUFs can be estimated with sufficient accuracy using the prediction charts that appear in *The ARRL Operating Manual* (see Appendix D for reading list).

Stations WWV and WWVH are also a good source of propagation data. WWV is located in Colorado and WWVH in Hawaii. You can tune them on 2.5, 5, 10, 15 and 20 MHz. Between 18 and 19 minutes past each hour the solar flux and magnetic field information are given. The solar flux number can be used to determine the MUF for any particular path. Hull Electronics have some public domain software for PC compatible computers which is very useful in determining MUF.

You can observe the MUFs by using your continuous coverage receiver. Frequencies up to the MUFs are in round-the-clock use. When you "run out of signals" while tuning upward in your chosen frequency range, you have a good clue as to which frequencies are going to work well, right then.

2.4.4.4 REFLECTION

Radio wave reflection also influences HF propagation. Reflection occurs at any boundary between materials of differing electrical conductivity. Depending on their length (or frequency), radio waves may be reflected by buildings, trees, vehicles, the ground, water, ionized layers in the upper atmosphere, or at boundaries between air masses having different temperatures and moisture content. Ionospheric and atmospheric conditions are important in practically all communication beyond purely local ranges.

2.4.4.5 ANTENNA HEIGHT

Your antenna's height above ground can strongly influence HF propagation. Since any surrounding objects can have a negative effect on the antenna's ability to radiate signals effectively, try to install your antenna as high and in the clear as practical.

2.4.4.6 ANTENNA TYPE

The type of antenna you use also influences propagation characteristics. While there are many different types of antennas, with widely varying radiation characteristics, the type you chose for your installation will probably be most strongly influenced by available space. While many base station operators use a horizontally-polarized antenna for CW and SSB work, a large horizontally-polarized antenna (such as a broadband antenna) can be a bit unwieldy for maritime mobile operation. In this case a vertically-polarized antenna is often a necessity.

What is meant by "polarization?" Polarization describes a characteristic of a radio wave. Radio wave polarization is determined by the position and direction of the electric field with respect to the earth's surface. If the lines of the electric field of a radio wave are parallel to the ground, the wave is *horizontally polarized*. If the lines are perpendicular to the ground, the wave is *vertically polarized*. An antenna that is parallel to the earth's surface, such as a dipole, produces horizontally-polarized waveforms. One that is perpendicular to the surface of the earth, such as a quarter-wave vertical, produces vertically-polarized waveforms. An important thing to keep in mind is that for optimum short-haul performance, your antenna's polarization should be the same as that of the station with which you are trying to communicate.

If you should desire more detailed information on this and other useful and interesting aspects of HF propagation, please consult the reading list in Appendix D.

2.5 POWER CABLES

If you operate the transceiver from a 13.8 VDC power source, peak current may be as high as 25 amps. Power cables should be at least 10-gauge wire for cable runs up to 12 feet; for longer runs use at least 8-gauge wire. When connecting the set, you must observe proper polarity. If the power cables are improperly connected, a protective diode in the radio will blow a rear-panel fuse.

If you plan to operate the transceiver from a 120/240 Volt power source, use our 150 ACV or 150 ACCV AC Power Supply.

2.6 OPTIONAL EQUIPMENT

Your Model 5150 transceiver is a versatile radio, with many different operating modes available to you. It can be upgraded for telex transmission and computer networking using the HF radio link. In fact, Hull Electronics offers complete accessory packages with modem, power supply, and software for FAX, Weather FAX and Packet, as well as entire telex/FAX stations, including Model 5150 Transceiver, modem, IBM PC-compatible computer and software. CW and FSK, and two-tone emergency tone generator modules are

available as optional accessories. These modules may be ordered pre-installed from the factory.

The Model 5150 DSC Digital Selective Calling option will provide immediate distress signaling and positioning information in an emergency situation, and is compatible with IMO and SOLAS requirements for Class A DSC equipment. Available by 3rd quarter 1992.

The Hull Model 5150 FAN cooling fan accessory provides continuous CW and telex operation full output. This cooling fan is also recommended for ARQ or SITOR operation.

You may also equip your transceiver with many other practical accessories as your applications dictate. See Hull's Accessories and Options List in Section 4.

2.7 REAR PANEL CONNECTIONS

Figure 3 shows the interconnections between the Model 5150 SSB Transceiver, Model H-403CU antenna coupler, antenna, and power source.

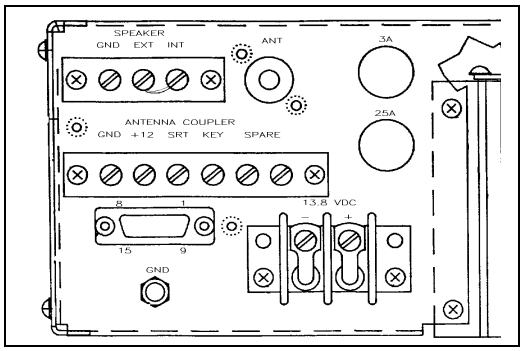

Figure 3. Rear panel connections.

For pin detail, see Section 2.10.

2.8 INSTALLATION PROCEDURE

Plan the location of the transceiver and microphone bracket before starting the installation. The radio should be secured to a solid surface, using the mounting cradle and self-tapping screws provided.

The mounting cradle is reversible, enabling you to mount your transceiver on an existing shelf, to a bulkhead, or to an overhead surface.

CAUTION

The transceiver should never be installed in a closed rack unless forced air circulation is provided through the cabinet!

2.8.1 MOUNTING

Shelf mounting:

(1) To mount the transceiver on an existing shelf, install the mounting cradle on a solid surface. Use the supplied self-tapping screws.

(2) Install the transceiver into the mounting cradle. Use the small bracket at the rear of the mounting cradle to engage the slot on the large heatsink at the rear of the radio. Insert the thumbscrews into both sides of the radio.

(3) Mount the microphone bracket in any convenient location near the mounting cradle.

Overhead or bulkhead mounting:

(1) For overhead or bulkhead mounting, install the mounting cradle on a solid surface. Use the supplied self-tapping screws.

(2) Install the transceiver into the mounting cradle. Reverse the small bracket at the rear of the mounting cradle, and change the location of its engaging pin. Use this bracket to engage the slot on the large heatsink at the rear of the radio.

(3) Mount the microphone bracket in any convenient location near the mounting cradle.

2.8.2 ANTENNA COUPLER

Installation:

(1) Install the Model H-403CU into your chosen location and connect the coupler to both the transceiver and the antenna. Figure 3 illustrates these connections.

(2) Locate the coupler close to the antenna base and as near as possible to the ground system. Mounting may be either vertical or horizontal.

Connection to the ground system must be short and direct. Use 2-inch wide copper strap if possible, or use several parallel runs of heavy wire. Section 2.7.4 discusses suitable ground systems.

If you pass the antenna lead-in through a bulkhead, use a good quality glass feed-through insulator. The lead-in wire must be well insulated (GTO, for example) since voltages at this point are quite high.

(3) Connect the coupler to the transceiver with a 4-conductor shielded cable (this is the control cable) and a suitable length of RG- 8/U coaxial cable with a UHF male connector at each end. The length of both cables is not critical; they can be made as long as needed up to about 100 ft.

(4) Route the coupler's control and coaxial cables through the stuffing glands at the cabinet bottom. Connect the control cable to the terminals at the bottom of the chassis. Connect the ground strap to the bolt at the cabinet bottom. Connect the lead-in wire from the antenna to the large insulated terminal at the cabinet top.

2.8.3 ANTENNA

You may use either a vertical whip or wire antenna with the Model H-403CU coupler. The antenna may be of any length up to 150 feet. The antenna may be mounted as convenient; however, you should avoid locating the antenna near surrounding metal objects such as rigging, stacks, outriggers, or other antennas.

2.8.4 GROUND SYSTEM

If your vessel is of metal construction, run the grounding strap to the nearest metal member connected to the hull. This connection must be electrically secure. If possible, use a stainless bolt brazed or silver-soldered to the metal member.

If your vessel is of wood or glass construction, proper grounding becomes more difficult. For the lower frequencies, 2 through 4 MHz, a copper strap (such as copper plummer's strap or even copper ground foil) to the engine block and other large metal objects will usually suffice. Copper foil, copper plumber's strap and other types of foil are available at air conditioning and hardware stores.

For the higher frequencies, you must establish a ground plane near the antenna base. Your ground plane can consist of large metal objects at deck level, copper screening, several runs of parallel wire, and so on.

You can create an effective ground by building a resonant *counterpoise* for each band. The lengths required are:

6 MHz . . . . 38 ft
8 MHz . . . . 28 ft
12 MHz . . . . 19 ft
16 MHz . . . . 14 ft
22 MHz . . . . 10 ½ ft

These counterpoises can consist of 16-gauge wires, moderately well insulated, with one end of each wire connected to the ground post of the antenna coupler. You should lay out the wires horizontally under the deck in as straight a line as possible. The various wires can be bunched together. Make certain that the wire ends do not touch any metal objects.

If you have any further questions concerning antenna coupler installation or grounding, please refer to the Model H-403CU Antenna Coupler Instruction Manual or contact your Hull representative.

2.9 NOISE SUPPRESSION

For optimum receiver performance, the electrical system on your vessel must be treated for noise suppression. Noise suppression techniques include bypassing and filtering alternators and shielding ignition systems.

When you feel that you have installed sufficient noise suppression equipment, operate the receiver with all electrical equipment running. Listen for signs of receiver blocking in both SSB and AM modes. If blocking occurs, locate the equipment causing the

interference and treat as necessary to eliminate the problem.

2.10 REAR PANEL CONNECTION DETAIL

There are two connector strips on the rear panel of the transceiver: a 15-pin accessory connector and a 6-pin antenna tuner terminal strip. The rear panel also contains an external speaker terminal strip with ground lug.

2.10.1 ACCESSORY CONNECTOR

The 15-pin connector provides access to various circuits within your transceiver. This connector enables operation with RF amplifiers, ARQ terminals, and Selective Call units. Connections include:

Harmonic Filter selection (6 pins):

PIN NO.	FILTER
6	1.6 - 2.8 MHz
7	2.8 - 4.5 MHz
8	4.5 - 7.0 MHz
9	7.0 - 11 MHz
10	11 - 19 MHz
11	19 - 30 MHz

Pin 2 - +12 VDC
Pin 3 - 600 Ohm AF out
Pin 4 - 600 Ohm AF out (squelched)
Pin 5 - Push-to-talk (PTT)
Pin 12 - CW key
Pin 13 - ALC IN (+ volts)
Pin 14 - 600 Ohm AF in
Pin 15 - Scan. Ground this lead to interrupt channel scanning.

2.10.2 ANTENNA TUNER TERMINALS

The antenna tuner terminal strip connections provide signals to the tuner. Connections include:

Pin 1 - GND
Pin 2 - +12 VDC
Pin 3 - Start
Pin 4 - Key
Pin 5 - Spare (NC)
Pin 6 - Spare (NC)

2.10.3 EXTERNAL SPEAKER JACK

This terminal strip accepts an external speaker of from 2 to 16Ω impedance. The strip also contains a ground lug (leftmost lug).

3.1 OVERVIEW

The Model 5150 SSB Transceiver provides communications between ships, from ships to private or public shore stations, and point-to-point between land stations. Operating the transceiver is simple and straightforward; most of the time you will simply select a channel or frequency, set the audio control to a comfortable level, and press the microphone switch to transmit.

This section contains operating information on the Model 5150's controls, including the audio, mode, and squelch controls. The section also contains step-by-step instructions for keypad operation, and will guide you through procedures such as setting and programming channels and initiating scanning operation. Also, you will learn how to make both voice and CW contacts with your transceiver.

CAUTION

Do not attempt to transmit until the radio has been turned on for at least 15 minutes!

The crystal controlling the transmitting frequency is equipped with a precision oven that requires 15 minutes to stabilize in temperature. Transmitting before the 15 minute warm-up period has elapsed may cause a violation of FCC regulations (MAYDAY conditions excepted).

3.2 LICENSE CONSIDERATIONS

You should not attempt to operate the transceiver until it has been properly installed and checked by a licensed technician. Also, it may be necessary for you, the operator, to possess a valid operator's license. For more information on licensing requirements, refer to applicable FCC rules and regulations or ask your Hull dealer to assist you.

3.3 FRONT PANEL CONTROLS

Figure 4 illustrates the Model 5150's front panel controls.

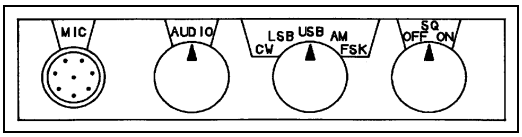

Figure 4. Mode controls.

3.3.1 AUDIO CONTROL

The audio control adjusts receiver volume. To *increase* volume, rotate the audio control knob clockwise. To *decrease* volume, rotate the knob counter-clockwise.

3.3.2 MODE SWITCH

The mode switch selects the desired operating mode (CW, LSB, USB, AM, and FSK).

3.3.2.1 SSB MODES

For most SSB operation, set the switch to USB (Upper Sideband). LSB is available as standard, but is illegal for most operations in the U.S. Amateur radio is a notable exception.

3.3.2.2 AM MODE

The AM position is used for communicating with a station equipped only with an AM transceiver, or for receiving AM broadcasts.

3.3.2.3 CW MODE

The CW (Continuous Wave) setting permits communication by telegraphy using Morse Code. The CW function requires an external telegraph key. When this mode is selected, the sidetone is enabled so that the operator can listen to his own sending. The CW tone will be audible in the loudspeaker.

3.3.2.4 FSK MODE

FSK is an optional mode and is installed at the factory. This setting is used with external teletype equipment and requires a special filter. Accessories are connected through the Model 5150's rear-panel accessory plug.

3.3.3 SQUELCH CONTROL

The squelch control may be set either ON or OFF. To blank out extraneous noise between received transmissions, set the squelch control to "ON."

3.3.4 TUNING KNOB

Use the tuning knob, along with the display, to "dial in" the desired channel or to vary the transmit and receive frequencies. Tuning step size is selectable via the "digit select" keys on the front panel keypad, and is continuous throughout the entire range.

The tuning knob also controls the panel backlighting intensity in four steps via a pushbutton function. The keypad, display, meter, and mode controls are all backlighted.

Press ~ before any new entry operation.

3.3.5 KEYPAD

The keypad has four main functions: (1) channel/frequency selection, (2) channel scanning, (3) tuning range selection, and (4) selection of two-tone emergency signalling (if your radio is equipped with this option). Section 3-4 details keypad use.

3.3.6 FREQUENCY DISPLAY

The backlighted LCD frequency display clearly displays the currently selected channel or frequency in kHz.

3.3.7 ANALOG METER

The easy-to-read multi-function analog meter provides a visual indication of forward/reflected power on transmit and relative signal strength on receive.

3.4 POWER ON/OFF &OPERATIONS

3.4.1 POWER ON/OFF

3.4.1.1 To turn the power on:

Make sure the DC power is connected to the rear terminal strip. Press any key on the keypad to turn transceiver on. The display shows the software version:

SOft: 3.11

followed by the channel number:

CH:1201

3.4.1.2 To turn the power off:

Press the ~ key and hold it down until the power goes off.

3.4.2 SELECTING A CHANNEL

The following sections show you how to use the 5150 SSB's keypad and tuning knob to:

- Select a channel number
- Program a channel
- Free-tune the transceiver
- Fine-tune the transceiver

3.4.2.1 CHANNEL TYPES

The 5150 SSB offers you a variety of channels. These channels include ship-to-shore public service (ITU)--either voice or telex, factory pre-programmed channels, and user-programmable channels. (Please refer to Appendix E for a list of pre-programmed channels.)

3.4.2.1.1 To select a VOICE channel:

(1) Press ~C.

Display shows:

CH:

(2) Enter the desired 3 or 4 digit channel number. Example:

1201.

Display shows:

CH:1201

3.4.2.1.2 To select a TELEX channel:

(1) Press ~CC.

Display shows:

ch:

(2) Enter the desired channel number.

Example:

1201.

Display shows:

ch:1201

3.4.2.1.3 To CLEAR a channel entry:

(1) Press ~.

Display shows:

. ~

You are now ready to select another channel.

3.4.2.1.4 Using the tuning knob to select channels:

You can also use the tuning knob to tune through the channels. This only works when a valid channel number is displayed. Turn the knob either direction and the channel number will be incremented or decremented. All the ITU and user programmable channels can be selected in this way.

3.4.3 PROGRAMMING A CHANNEL

You may store *simplex* (transmit and receive on same frequency) and *half-duplex* (transmit frequency different from receive) channels into user memory. Channels 201 through 399, and channels 501 through 540 are reserved for your use.

For more detailed information on frequency selection, please see Section 3.4.4 through 3.4.5.

3.4.3.1 To program a SIMPLEX channel:

(1) Press ~C.

Display shows:

CH:

(2) Enter the desired 3 or 4 digit channel number. Example:

201.

Display shows:

CH: 201

If the selected channel is vacant, the display will show eight horizontal dashes:

This will not occur if the channel was selected via the tuning knob.

(3) Press ~.

(4) Enter digits of desired frequency.

For example, to enter the frequency 6218.6, press the following keys:

62186.

(5) Press P.

Display shows:

6218.60~

Tip: *You may wish to make up a reference card listing all of your stored channels and associated frequencies.*

3.4.3.2 To RECALL a stored channel:

(1) Press ~C.

(2) Enter the desired channel number.

or:

(1) Press C.

(2) Use the tuning knob to select the desired channel.

3.4.3.3 To program a HALF-DUPLEX channel:

(1) Press ~C.

Display shows:

CH:

(2) Enter the desired 3 or 4 digit channel number. Example:

201.

Display shows:

CH: 201

If the selected channel is vacant, the display will show eight horizontal dashes:

----

(3) Press ~. Enter digits of RECEIVE frequency.

APPENDIX A: GLOSSARY

AMTOR AMateur Teleprinting Over Radio. AMTOR provides error-detecting capabilities such as ARQ.

Antenna coupler A Radio Frequency transformer used to connect an antenna to a feed line or to connect a feed line to a radio.

ARQ Automatic Repeat Request. An AMTOR/SITOR communication mode. In ARQ, also called Mode A, the two stations constantly confirm each other's transmissions. If information is lost, it is repeated until the receiving station confirms correct reception.

Baudot A five-bit digital code used in teleprinter applications.

Break-in The ability to hear between elements or words of a keyed signal.

Counterpoise A wire or group of wires mounted close to ground, but insulated from ground, to form a low-impedance, high-capacitance path to ground. Used in HF to provide an RF ground for an antenna. (Also see ground plane.)

CW Continuous Wave. Often used as a synonym for Morse Code communication. Morse Code signals may be produced by interrupting the continuous-wave signal from a transmitter to form the dots and dashes.

FSK Frequency-Shift Keying. A method of transmitting radioteletype information by switching an RF carrier between two separate frequencies.

Ground plane A system of conductors placed beneath an elevated antenna to serve as an earth ground. (Also see counterpoise.)

Half-duplex operation To transmit and receive on separate frequencies.

ITU International Telecommunication Union. The United Nations specialized agency that deals with telecommunications. Its purpose is to provide standardized communications procedures and practices, including frequency allocation and radio regulations on a worldwide basis.

Modem Short for modulator/demodulator. A modem modulates a radio signal to transmit data and demodulates a received signal to recover transmitted data.

Navtex A form of AMTOR used to send navigational bulletins and weather information primarily to ships at sea.

Packet Radio A system of digital communication whereby information is broken into short bursts. The bursts ("packets") also contain addressing and error-detection information.

PEP Peak Envelope Power. The average power supplied to the antenna feed line by a transmitter during one radio-frequency cycle at the highest crest of the modulation envelope, under conditions of normal operation.

RTTY Radioteletype.

Semi-duplex To transmit and receive on different frequencies

Simplex To transmit and receive on the same frequency.

SITOR Simplex Telex Over Radio. Like AMTOR, SITOR provides ARQ capabilities. Telex transmission and reception is on the same frequency.

Split Same as semi-duplex.

SWR Standing Wave Ratio. A measure of the impedance match between the feed line and the antenna.

VFO Variable frequency oscillator. A somewhat outdated but frequently used term for indicating a freely tunable oscillator internal to the transceiver.

WEFAX Weather Facsimile. Transmitted throughout the Short-Wave radio spectrum, primarily to provide information to ships at sea. Typical stations broadcast weather maps

showing current and predicted weather conditions.