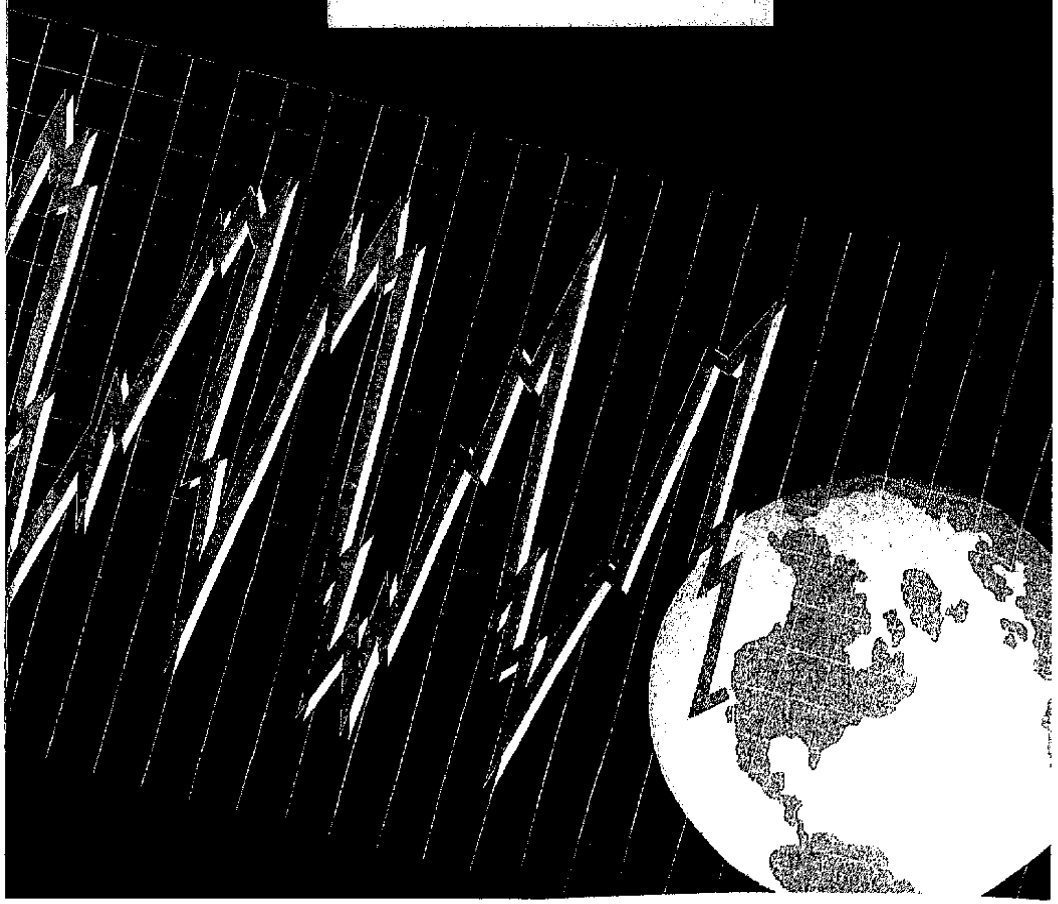
TRANSWORLD™
for communications

TW100
HF SSB TRANSCEIVER
OPERATOR'S MANUAL



TRANS WORLD COMMUNICATIONS, INC. ■ A ADATRON COMPANY

TW100
HF SSB TRANSCEIVER
OPERATOR'S MANUAL

TRANSWORLD™
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Manual Part No. TW100-MSOP
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Escondido, CA 92029, U.S.A.
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Warranty

Trans World Communications, Inc. (TWC) warrants that new TWC equipment has been manufactured free of defects in design, material and workmanship. If the equipment does not give satisfactory service due to defects covered by this warranty, TWC will, at its option, replace or repair the equipment free of charge.

The warranty is for a period of 90 days from the date of installation. In the event that the equipment is not installed within 90 days of factory shipment, satisfactory evidence of the installation date must be submitted.

Limitations:

This warranty does not cover physical damage caused by impact, liquids or gases. Defects caused by lightning, static discharge, voltage transients, or application of incorrect supply voltages are specifically excluded from this warranty.

Return Of Equipment - USA:

The equipment shall be returned freight prepaid to the Service Department, Trans World Communications, Inc., 304 Enterprise Street, Escondido, California 92029. The equipment should be packed securely, as TWC will not be responsible for damage incurred in transit. Please include a letter containing the following information:

- Model, serial number, and date of installation.
- Name of dealer or supplier of equipment.
- Detailed explanation of problem.
- Return shipping instructions.

TWC will return the equipment prepaid by United Parcel Service, Parcel Post or truck. If alternate shipping is specified, freight charges will be made collect.

Return Of Equipment - Foreign:

Write for specific instructions. Do not return equipment without authorization. It is usually not possible to clear equipment through U.S. Customs without the correct documentation. If equipment is returned without authorization, the sender is responsible for all taxes, customs duties and clearance charges.

Limited Parts Warranty:

This warranty shall cover all parts in the equipment for a period of 12 months from the date of installation, subject to the previous conditions and limitations. The parts will be replaced free of cost. The labor charges will be made at the current TWC hourly service rate.

Parts Replacement:

If it is not practical, or the purchaser does not want to return the equipment to the factory, this warranty is limited to the supply of replacement parts for a period of 12 months from the date of equipment installation. The following instructions for the supply of replacement parts should be followed:

- Return defective parts prepaid to: Parts Replacement, Trans World Communications, Inc., 304 Enterprise Street, Escondido, California 92029.
- Include a letter with the following information:

  Part number(s).

  Serial number and model of equipment.

  Date of installation.

Parts returned without this information will not be replaced. In the event of a dispute over the age of the replacement part, components date coded over 24 months prior will be considered out of warranty.

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Tables (Continued)

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FIGURE 1-1.
TW100 Microprocessor-Controlled HF Transceiver.

General Information

1.0 General Description

The Transworld TW100 is a high-performance, 100-W, single-sideband transceiver designed for operation on any of the frequencies in the range 1.6-30 MHz. A wide variety of models and options are available to make the transceiver suitable for marine or land mobile operation, fixed-base operation or as a component in a high-performance HF communication system.

This manual has been prepared for the operator of the Transworld TW100 transceiver. It has not been designed for the technician or engineer and does not cover detailed technical or installation information. The TW100-MS technical manual gives comprehensive information on the transceiver and is essential for servicing and adjustment of the transceiver.

1.1 Modes of Operation

Single sideband (SSB) is the premier mode for voice communications in the HF range. Most commercial operation is on the upper sideband (USB), although there are some countries where lower sideband (LSB) is specified. The TW100 will be equipped for USB operation unless LSB is specifically requested. If the licensing authorities permit USB and LSB operation, the transceiver may be equipped for operation on both sidebands. This is an advantage, as sidebands may be switched to avoid interference or give an additional channel frequency.

AM has almost disappeared from the HF bands except for broadcast stations. The compatible AM mode (A3H) is available in the transceiver and is used for communicating with AM stations. Telegraphy (CW) is sometimes used for HF communications, and skilled operators may achieve superior communications under difficult conditions.

Radioteletype operation has become an increasingly important form of HF communication and the transceiver has been designed for operation in this mode (FSK). A special

modem is required to convert the FSK signal for interface with a terminal unit.

1.2 Transceiver Description

The TW100 is a solid-state, high-frequency, single-sideband transceiver operating in the HF spectrum from 1.6-30 MHz. Complete coverage of this range is available in 100-Hz increments with no gaps or disallowed frequencies in the coverage.

The transceiver has a minimum power output of 100 W (PEP or average). Over much of the frequency range, the power output may be set as high as 150-W PEP. The adjustable ALC circuitry may be set to limit the power output at any desired level and also protect the amplifier against antenna mismatch.

The transceiver uses an up-conversion system with the first IF at 75 MHz and the main selectivity at 1650 kHz. With this system, the main spurious products do not fall within the operating range, which ensures freedom from spurious response in both the transmitter and the receiver. The front end of the receiver uses a passive double-balanced mixer with a high intercept point, which gives freedom from intermodulation and overload. The antenna is coupled to the transceiver through six seven-pole, elliptic function filters providing a high degree of harmonic attenuation and rejection of out-of-band signals. The receiver is equipped with a noise-immune squelch system designed for SSB operation. This is a great operator convenience as it eliminates background noise, yet opens reliably, even on weak SSB signals. The squelch circuit is preset and is controlled by an ON/OFF switch.

1.3 Frequency Selection

The transceiver uses a microprocessor to control the frequency selection. The microprocessor operates in three different modes to suit the particular class of operation desired. The operational mode may be selected by an internal switch or may be permanently set by the use of a special coding circuit. No crystals are required, for all frequency control is derived from a single temperature-controlled, precision crystal oscillator. No tuning or adjustment is required for any frequency change.

In Mode 1 the transceiver channel frequencies can be programmed by the operator. Channel 00 is designated as the free-tuning channel and the frequencies may be quickly changed from the keypad and may be programmed for simplex or duplex operation.

In Mode 2 the operator can also display the channel frequency on any of the preprogrammed frequencies. If the channel is programmed for semiduplex operation, the transmit frequency may be displayed. Channel 00 may be programmed by the operator, but it will only operate in the receive mode.

In Mode 3 the operator may select any one of the preprogrammed channel frequencies by entering the channel number on the keypad. The channel number is shown on the display.

The channel frequencies are permanently retained in memory using a lithium battery with a life in excess of ten years.

1.4 Power Supplies

The transceiver circuitry operates at 12 V and is designed for direct operation from a 12-V vehicle-type battery. The final amplifier operates directly from the supply source (the transistors have a maximum collector voltage of 36 V) and is protected from voltage surges by a 20-V "TRANSORB". The transceiver circuitry is supplied through a 12-V regulator that maintains full output with almost no input voltage differential. If the voltage falls below 12 V, the full available input voltage will be applied to the exciter, which continues to operate down to 10 V. This system provides safe operation from a 12-V vehicular system, even with poor regulation. An optional internal 115/230-V, 50/60-Hz ac supply may be fitted for SSB operation. A separate, external heavy-duty power supply is used for FSK operation. An optional model is available for 24- to 32-V operation.

1.5 Remote Control (Optional)

The transceiver may be fitted with the optional remote control. The tone (AFSK) remote control provides full control of the transceiver over a telephone line and is particularly useful when the transceiver cannot be installed at the operating site.

1.6 Antennas

Further information on antennas is provided in Section 4 of the transceiver technical manual. The transceiver will operate correctly into any matched 50-ohm antenna.

1.7 Specifications

Technical specifications for the transceiver are listed in Table 1-1.

TABLE 1-1.
Technical Specifications.

GENERAL	
Frequency Range:	1.6-30 MHz in 100-Hz synthesized steps.
Frequency Entry:	Keypad-controlled microprocessor.
Channels:	100 simplex and half-duplex.
Channel Programming:	Mode 1 front panel. Mode 2/3 internal. SX models require external programmer.
Continuous Entry:	Channel 00 by keypad entry. Mode 1: Transmit & receive. Mode 2: Receive Only. Mode 3/SX models: Disabled.

TABLE 1-1.
Technical Specifications (Continued).

Frequency Display:	6 Digit by keystroke (locked out in Mode 3).
Protection Against Unauthorized Frequency Change:	Coding device may be removed to lock transceiver in Mode 2 or Mode 3.
Tuning:	Up & down pushbutton switches (receive only), 100-Hz steps.
Scanning:	Automatic on up to 98 channels.
Antenna Impedance:	50 Ω.
Temperature Range:	-30^{o} to $+60^{o}$ C.
Frequency Control:	Temperature-controlled master oscillator ± 0.0001%, ± 20 Hz maximum. (1 part in 10^{7} with HS10 option).
Modes:	Simplex and half-duplex.
Operation Modes:	A3J, (USB/LSB*), A3A* (SSB reduced carrier), A3H (compatible AM), A1 (CW), F1 (teletypes).* * Optional
Size (w x h x d):	(Ac & dc) 34.3 cm x 10.7 cm x 44.5 cm.
Weight:	Ac—13 kg, dc—11.6 kg.

TABLE 1-1.
Technical Specifications (Continued).

POWER SUPPLY

13.6 Vdc:	Receive 620 mA, Transmit 12 A average SSB.
28 Vdc:	Receive—350 mA, Transmit—7 A average SSB.
	Internal ac power supply 110/230 V, 50/60 Hz for SSB operation.
	External power supply 110/230 V, 50/60 Hz for FSK operation, complete with built-in FSK modem.

TRANSMITTER

Power Output:	125 W PEP, 100 W average (FCC type accepted at 120 W).
Antenna Mismatch:	Protected against mismatch including open and shorted antennas.
Carrier Suppression:	Greater than -50 dB.
Unwanted Sideband:	-60 dB at 1 kHz, typical.
Spurious Suppression:	Greater than -63 dB, typical.
Harmonic Suppression:	-63 dB, typical, (except below 2 MHz).
Audio Input:	150 Ω, VOGAD for constant audio level. 600 Ω at 0 dBm (rear connector).
Audio Bandwidth:	2.4 kHz (Optional 2.7 kHz).
Intermodulation Distortion:	-32 dB typical.
ALC:	Less than 1-dB increase for 20-dB increase in audio input.
Metering:	Relative RF output, VSWR (internal connection).

TABLE 1-1.
Technical Specifications (Continued).

RECEIVER

Sensitivity:	0.35 μV for 10 dB S + N/N.
Selectivity:	300 to 2700 Hz -6 dB, -60 dB at 5 kHz, typical.
Image Rejection:	Greater than 80 dB.
IF Rejection:	Greater than 80 dB.
Conducted Radiation:	-85 dBm.
AGC Characteristics:	Less than 6-dB audio increase from 3 μV to 300,000 μV.
Intercept Point:	+11 dBm (+23 dBm with attenuator activated).
Intermodulation:	-85 dB.
Clarifier:	±125 Hz.
Squelch:	Audio derived, noise immune.
Audio Output:	4 W into 3 Ω, internal loudspeaker.
Metering:	RX signal strength.

Specifications subject to change without notice.

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Installation

2.1 Introduction

To get the correct performance from the transceiver it is necessary to install the transceiver correctly. This is particularly important in marine and land mobile installations where poor mounting and power source connections can seriously degrade transceiver performance. In every installation, the antenna system is the key to satisfactory performance. Care should be taken to ensure that the best possible antenna, adjusted for low VSWR on each channel, is used. Most complaints of poor performance can be traced to an unsatisfactory antenna installation.

2.2 Power Supply

Two power connectors are installed in the rear-panel casting. The ac power connection is made through the preassembled power cable fitted with a three-pin connector that plugs into the connector at the rear of the transceiver. The other end of the cable is fitted with a three-pin power connector. One of the following wire codes will be used.

PHASE	BLACK	BROWN
NEUTRAL	WHITE	BLUE
GROUND	GREEN	GREEN-YELLOW STRIPE

The power cable will indicate the correct voltage for the ac power supply. If the voltage is not correct, the connections for the power transformer must be changed in accordance with the instructions in the diagram of Figure 2-1. The fuse should also be changed (115 V 3 A, 230 V 1.5 A).

The transceiver is supplied with a 12-AWG power cable with a two-pin connector. Connections to the rear panel should be made as shown in Figure 2-2. The power source should apply 13.6 V at 20 A and the connections should be made to minimize voltage drop in the cable. Care must be taken not to reverse the supply polarity. This will cause the dc supply fuse to blow.

CAUTION!

Do not operate the transceiver on the ac supply while connected to the dc power source. This could result in overcharging the battery or charging at an excessive rate.

2.3 Dc Power Connections

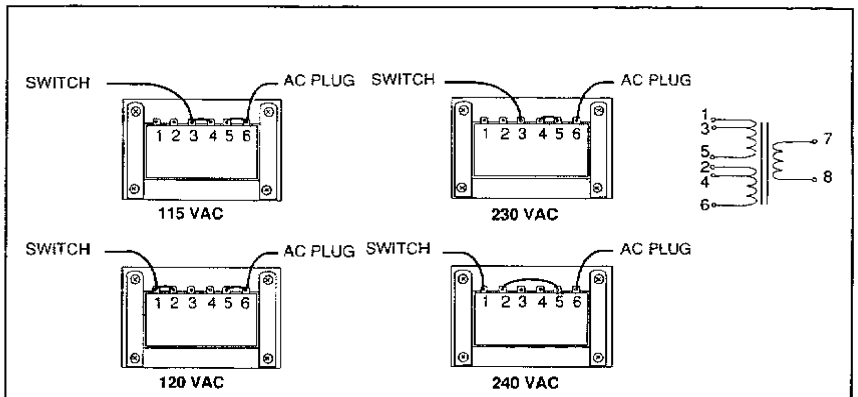
The power cable should be connected to the battery by the shortest possible route. It is essential that a low-resistance connection be made to the battery terminals. **DO NOT** use the vehicle body to make the negative ground return. Use heavy-gauge cable for the wiring (#14 AWG up to 3 meters, #10 or #12 AWG for longer runs). Make sure that the cable is clear of the vehicle's pedals and other moving parts. The cable can probably be routed through an existing grommet in the fire wall and should be kept as far as possible from the ignition wiring to prevent the pick-up of noise. If a new hole is required in the fire wall, make sure that a grommet is fitted to prevent chafing of the wire. Remember that a short in the power cable could cause a fire in the vehicle. High resistance connections can cause heating and eventually will arc, which causes another fire hazard and seriously affects the transceiver performance. It is a good precaution to fit a 50-A fuse in the positive line at the battery. Figure 2-3 is a drawing of the dc power cable showing the cable's pin connections.

2.4 Fixed Station

The transceiver is shipped ready for operation on a desk top. Make sure there is adequate space for ventilation around the heat sink. The front of the transceiver may be raised by lifting the bale under the front feet.

2.5 Marine Installation

The transceiver is mounted in place using the mobile mounting brackets. The brackets are arranged so that they may be reversed for top or bottom mounting.



NOTE

To gain access to the power transformer connections, remove the screws from each corner of the heat sink. Remove the ground connection to the main filter capacitor. The rear panel may be tilted back to give full access to the power transformer primary.

FIGURE 2-1.
Power Transformer Connections.

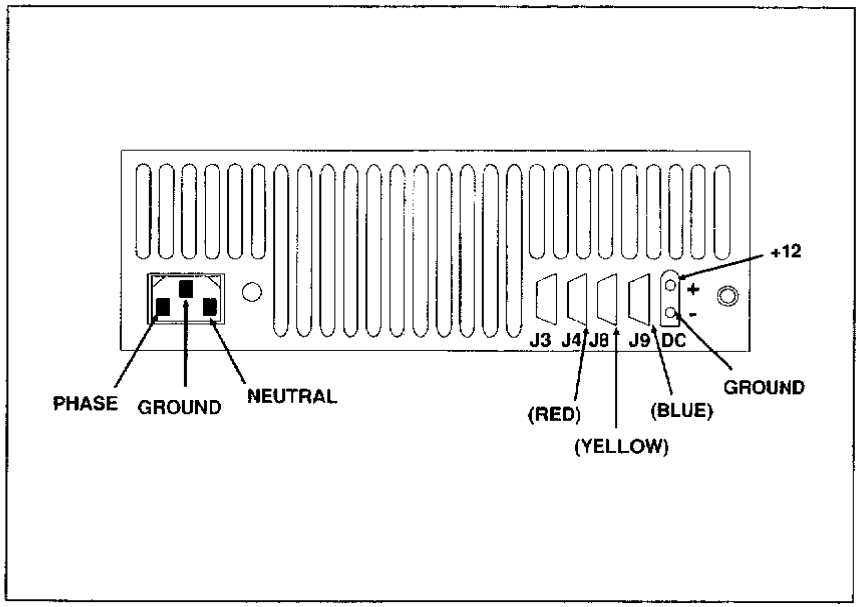


FIGURE 2-2.
Rear Panel Connectors.

2.6 Vehicular Installation

The mobile mounts are used to mount the transceiver to the vehicle. It will frequently be necessary to fabricate supplementary brackets to suit the particular vehicle. After mounting the transceiver, ensure a low-resistance connection is made to the frame of the vehicle.

2.7 Mobile Noise Suppression

The engine can cause severe interference in the receiver if noise suppressors are not fitted. Modern vehicles are sometimes fitted with suppressors and no further attention may be required.

The transceiver should be installed and the receiver checked for interference to determine if suppressors need to be fitted. The two main sources of interference are the ignition and the generator. The components should be fitted in accordance with the directions supplied with the kit. In some vehicles, noise may still be present, even after standard noise suppression methods have been used. Further information on mobile noise suppression is beyond the scope of this manual, and it is recommended that reference be made to a textbook on mobile installation.

2.8 Tuning Adjustments

The transceiver is completely broadband in both the receiver and transmitter. This means no retuning is required after installation or after changing channel frequencies. It is very important that the antenna system be correctly adjusted to provide a proper match on all channel frequencies. Refer to the transceiver technical manual for detailed information on the antenna system and method of adjustment.

2.9 Microphone

If the transceiver has been ordered without a microphone, a connector will be supplied. The transceiver will operate satisfactorily with most dynamic, magnetic or ceramic microphones. The microphone input impedance is 150 Ω, nominal. The gain of the VOGAD adjusts automatically to compensate for both microphone output and voice level.

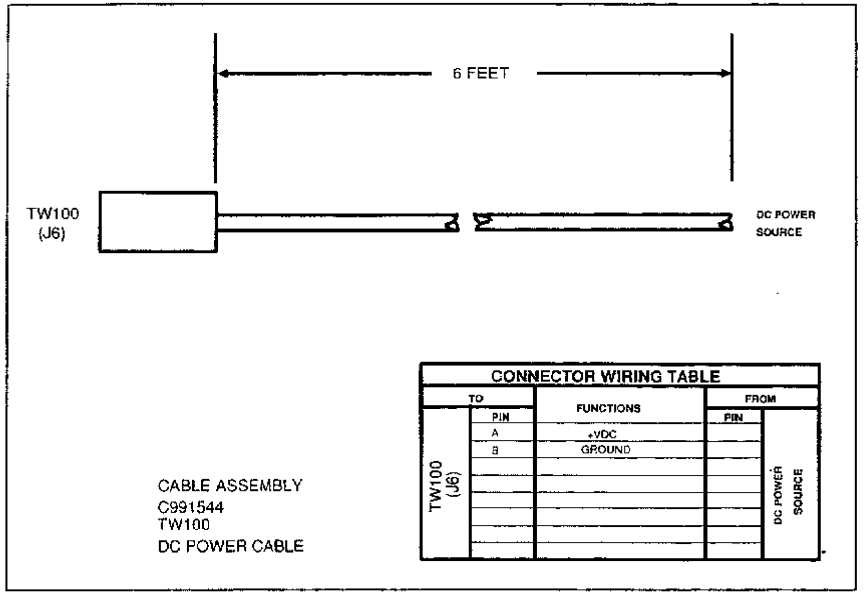


FIGURE 2-3.
Power Transformer Connections.

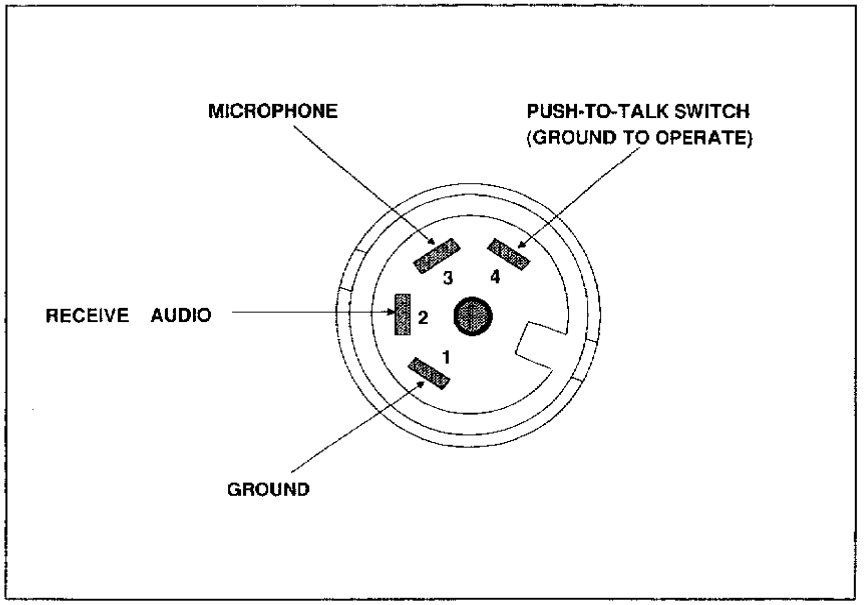


FIGURE 2-4.
Rear Panel Connectors.

Figure 2-4 shows the pin connections for the transceiver microphone.

2.10 Accessories

Figure 2-5 is a detailed block diagram showing the TW100 and its family of optional accessory equipment. Connections are made via six connectors on the rear of the transceiver. As can be seen from the figure, there are more audio accessories than there are available transceiver connectors. Therefore, if it is desired to attach more than one audio accessory to the rear panel, special cabling must be made up. Either Y-cables or junctions boxes are generally used, with each installation being given special consideration.

2.10.1 Antenna Tuner Connections

J4 is the accessory connector used to provide control information to companion ATU's. Table 2-1 shows the pin-outs for J4. Normal 100-W installations use the AT100 ATU, with control cable C991530 as shown in Figure 2-5. Other possible configurations include the following control cable requirements:

1). AT100 Memory ATU	C991547
2). RAT1000 ATU	C991552

For more detailed information on ATU cabling and installation, see the appropriate ATU technical manual. A special case of interest is when the TW100 is used with the TW500A/RAT1000 combination. In this case, a special interface box is required whose connections and purpose are described in the RAT1000 technical manual.

2.10.2 Audio Accessory Connections

J8 is the accessory connector used to provide control information to companion audio equipments requiring 600-Ω line impedance. Table 2-2 shows the pin-outs for J8.

2.10.3 RF Power Amplifier Connections

J3 is the accessory connector used to provide control information to companion high-power RF amplifiers. Table 2-3 shows the pin-outs for J3.

2.10.4 Dc Input Power Connections

J6 is the accessory connector used to provide primary dc power to the TW100 from external power supplies. Table 2-4 shows the pin-outs for J6.

2.10.5 RF Output Connections

J5 is the connector used to provide the 50-Ω RF signal output. Broadband antennas and dipoles can be connected directly to J5, while antenna tuners and high-power amplifiers use the following RF cables:

1). TW100 (J5) to AT100	C991535
2). TW100 (J5) to TW500A	C991539
3). TW100 (J5) to TW1000A	C991539

2.10.6 Remote-Control Connections

J9 is the connector used to attach the TW5201 remote-control unit. Table 2-5 shows the pin-outs for J9.

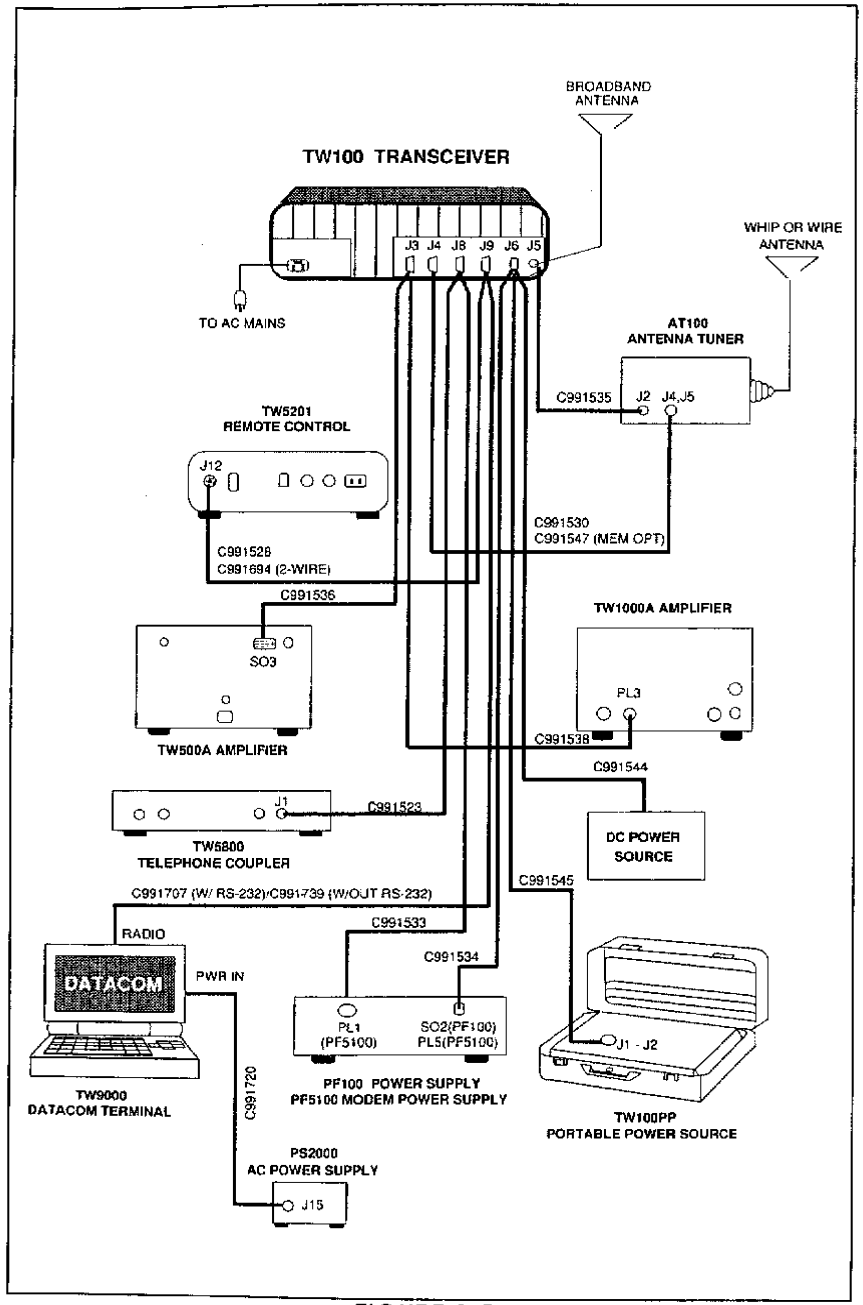


FIGURE 2-5.
TW100 Transceiver and Optional Accessories.

TABLE 2-1.
TW100 (J4) Connector Pinouts and Accessory Equipment Connections.

Pins on TW100 (J4)	Description	Pins on AT100 (J4)	Pins on AT100-MEM	Pins on RAT1000
1	Ground	1	J4-1	C
2	+12 Vdc	4	J4-4	—
3	Strobe	—	J5-1	H
4	ATU Key	2	J4-2	A
5	ATU Tune Initiate	3	J4-3	D
6	Clock	—	J5-2	G
7	Data Out	—	J5-4	E
8	Check Tune	—	J5-3	F
9	+28 Vdc (+28 V Model)	—	—	J

TABLE 2-2.
TW100 (J8) Connector Pinouts and Accessory Equipment Connections.

Pins on TW100 (J8)	Description	Pins on TW5800	Pins on PF5100
1	Ground	1	—
2	+12 Vdc	5	—
3	PTT	4	2
4	Ground	—	4
5	RX Audio	2	3
6	Ground	—	6
7	TX Audio	3	5
8	SC Alarm (Opt)	—	—
9	+28 Vdc (+28 V Model)	—	—

TABLE 2-3.
TW100 (J3) Connector Pinouts and Accessory Equipment Connections.

Pins on TW100 (J3)	Description	Pins on TW500A	Pins on TW1000A
1	Ground	7	J
2	Amp. ALC	SWR1000	I
3	Amp. PTT	10	H
4	2-3 MHz filter	1	A
5	3-5 MHz filter	2	B
6	5-8 MHz filter	3	C
7	8-13 MHz filter	4	D
8	13-20 MHz filter	5	E
9	20-30 MHz filter	6	F

TABLE 2-4.
TW100 (J6) Connector Pinouts and Accessory Equipment Connections.

Pins on TW100 (J6)	Description	Pins on TW100PP/PF100/PF5100
A	+ dc	A
B	Ground	B

TABLE 2-5.
TW100 (J9) Connector Pinouts and Accessory Equipment Connections.

Pins on TW100 (J9)	Description	Pins on TW5201	Pins on TW9000
1	Ground	—	6
2	+ 12 Vdc	—	—
3	PTT	*	9
4	Remote Enable	—	—
5	RX Audio (0 dBm, Unsq.)	—	10
6	Ground	1	8,11
7	TX Audio (0 dBm)	—	7
8	Remote Control (RX)	2	3**
9	Remote Control (TX)	3	1**

NOTES:
* Jumper 4 to 6 in TW100-TW5201 cable on TW100 (J9) end.
** with RS-232

Operation

3.1 Introduction

The transceiver is designed for use by unskilled operators. Normal operation involves only the selection of the correct channel (or channel frequency), picking the desired mode of operation and setting the audio-gain control to a comfortable listening level. Receive or transmit operation is controlled by the CW key or microphone switch.

All controls, indicators and connectors on the front panel are described in Sections 3.2, 3.3, and 3.4. They are also indicated by numerical call-outs in Figure 3-1. These call-outs are referenced in the text by numbers in parentheses following the section sub-headings. Detailed operating instructions begin in Section 3.5.

3.2 Front-Panel Controls

Operator controls on the transceiver front panel are as follows:

3.2.1 Power On/Off Switch (POWER) (1)

Up/Down rocker switch which controls the power to the transceiver with both ac and dc power sources. Press down for off and up for on; the red indicator light is ON when the power is switched on.

3.2.2 Audio Gain Control (AUDIO GAIN) (2)

Adjusts the audio volume in receive mode. Full CCW position is minimum volume and full CW position is maximum volume.

3.2.3 Clarifier Control (CLARIFIER) (3)

In the OFF position (full CCW) the clarifier is disconnected and the receiver operates on the same frequency as the transmitter. The clarifier allows a small change in receiver fre-

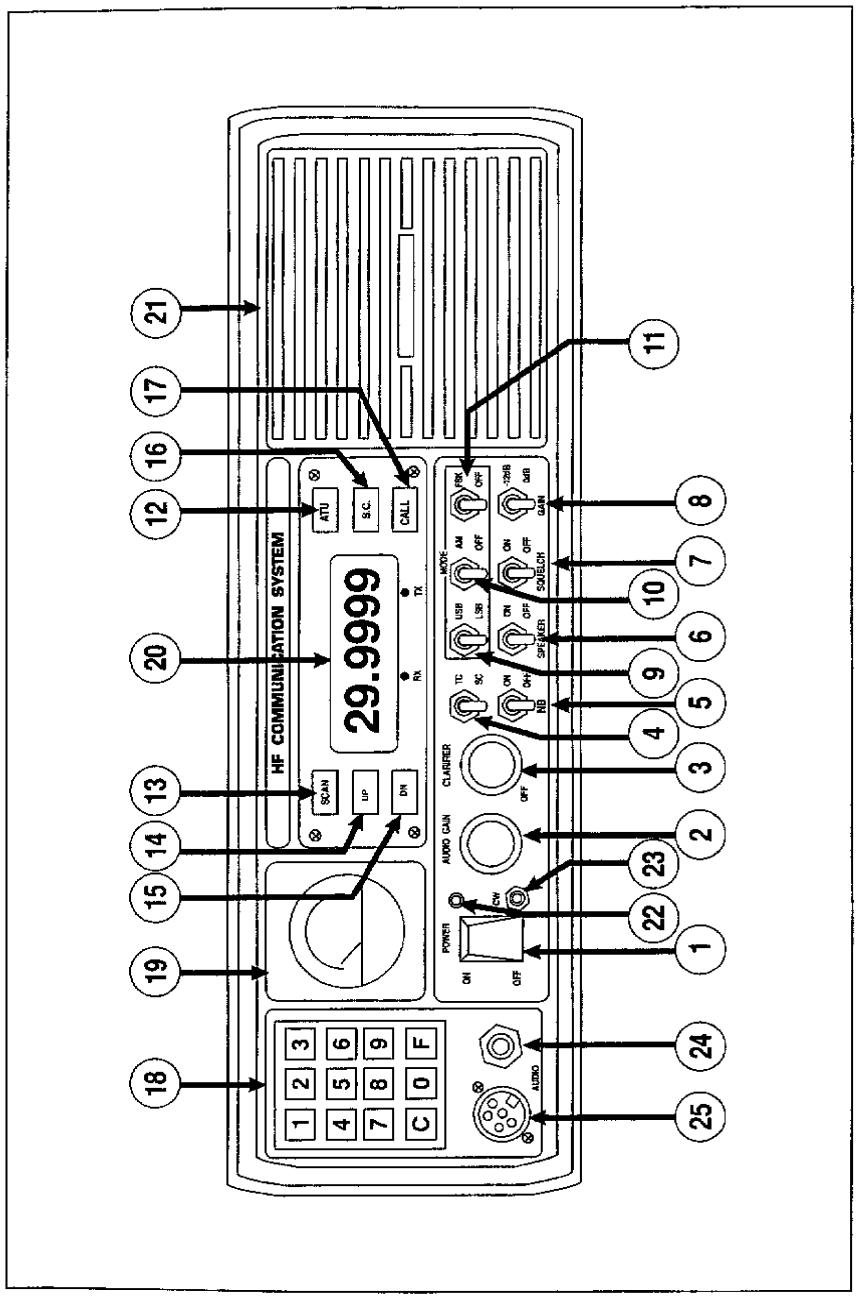


FIGURE 3-1.
Front Panel Controls.

quency and is used to correct the pitch of the voice, or to tune an FSK signal.

NOTE
This switch must be in the OFF position for selective-call operation when the Selcall Option is installed.

3.2.4 Transcall/Selcall Switch (TC/SC) (4)

Used to turn the Transcall or Selcall circuits on when these options are installed. See Sections 3.12 and 3.13 for detailed operational instructions.

NOTE
When the Transcall Option is installed, both Transcall and Selcall operating modes are available. Turning the Switch to TC allows for Transcall mode operation; turning to SC allows for Selcall mode operation.

When only the Selcall option is installed, turning the switch to SC allows for Selcall mode operation; turning to TC turns Selcall off. This switch must be in the SC position for proper operation of the ALE version of the transceiver.

3.2.5 Noise-Blanker On/Off Switch (BLANKER)(5)

Used to turn the Noise-Blanker circuits on when the Noise-Blanker Option is installed.

3.2.6 Speaker On/Off Switch (SPEAKER) (6)

This switch turns the speaker audio on or off.

3.2.7 Squelch On/Off Switch (SQUELCH) (7)

This turns the squelch circuits on. The squelch eliminates background noise and is internally set to open on weak voice signals.

3.2.8 Receive-Attenuator Control (GAIN) (8)

This switches a 12-dB attenuator into the receiver front end. It is used to improve the IMD performance of the receiver and is especially effective in a strong signal environment.

3.2.9 Mode Switches (MODE) (9, 10 and 11)

The three mode switches are labeled 9, 10, and 11. They are used to select either USB or LSB operation (9), turn the AM carrier injection on (10), and turn the FSK circuitry on (11).

LSB. To select LSB operation, turn the USB/LSB switch to LSB, the AM switch to OFF and the FSK switch to OFF.

NOTE

LSB is usually used if there is interference on the other sideband. In many countries (including the USA) this mode is illegal and will not be fitted into the transceiver.

USB. Used for most normal SSB operation. Turn the USB/LSB switch to USB, the AM switch to OFF and the FSK switch to OFF.

AM. Compatible AM (AME). This mode is used to provide a signal that is intelligible to an AM station. It is unlikely to be required for normal communications. Turn the USB/LSB switch to USB, the AM switch to AM and the FSK switch to OFF.

FSK. This mode is for use with RTTY and ALE systems. Turn the USB/LSB switch to USB, the AM switch to OFF, and the FSK switch to FSK.

3.2.10 Automatic-Antenna-Tuner Control (ATU) (12)

The ATU switch is used to initiate a tune cycle of an Automatic Antenna Tuner (AT100 or RAT100). Whenever the switch is depressed, the tuner will go into a tune cycle; the tuning is automatic and a tone is present in the loudspeaker during the tune cycle.

3.2.11 Scan-Mode Initiate Switch (SCAN) (13)

Used to control the transceiver scan mode. See Section 3.11 for operation.

3.2.12 Up/Down Tuning Switch (UP, DN) (14, 15)

Switch 14 controls the UP tuning and 15 controls the DOWN tuning. See Section 3.10 for operation.

3.2.13 Selcall Switches (S.C., CALL)(16,17)

Switch 16 controls the entering of the three-digit Selcall code and switch 17 controls sending of the Selcall code. See Section 3.12 for operation.

3.2.14 Keyboard (18)

The keyboard is used to program channel frequencies. See Sections 3.6 through 3.9 for operation.

3.3 Front-Panel Indicators

Indicators on the transceiver front panel include the following:

3.3.1 Meter (19)

The meter operates in both receive and transmit:

Receive: The meter indicates the relative signal strength of the received signal. The midscale position is calibrated for a signal strength of 100 microvolts.

Transmit: The meter reads average power output and should read approximately full scale at 100-W output. The meter will indicate between 3 and 4 on a normal voice transmission and should deflect to almost full scale on a whistle in the CW mode. A low meter reading usually indicates a mismatched antenna.

3.3.2 Frequency Display (20)

The display shows the selected channel and/or channel frequency; the frequency indicates the first digits. A moving decimal point indicates whether a receive or transmit frequency is displayed. For further operation, see Sections 3.6 through 3.9.

3.3.3 Loudspeaker (21)

The speaker is used during receive and its audio output is controlled by the setting of the AUDIO GAIN control (3.2.2). Turning the SQUELCH switch (3.2.6) on will mute the speaker during conditions of background noise or extraneous single-tone signals.

3.3.4 Power-On Lite (22)

Indicates that the power is turned on to the transceiver when lit.

3.4 Front-Panel Connectors

Connectors on the transceiver front panel are as follows:

3.4.1 CW Jack (23)

A receptacle for an external CW key plug. To operate on CW (Morse) plug the key into the small jack and use either USB or LSB. The transmitter automatically switches on when the key is pressed. When the key is released, there is about a one-second "Hang Time" until the transceiver returns to the receive mode.

3.4.2 Headphone Jack (24)

A receptacle for an external set of headphones. Inserting the appropriate headphones will automatically mute the transceiver loudspeaker.

3.4.3 Audio Jack (25)

A four-pin receptacle for an external hand microphone, handset, or headset. The VOGAD circuit automatically adjusts the audio gain to provide full transmitter output. Speak close to the microphone in a clear voice. Shouting will not provide any increased output and may reduce intelligibility.

3.5 Operating Modes (Internal)

The transceiver may be supplied in one of three operating modes. The choice of operating mode will usually be determined by the licensing authority for the equipment. Check the operating mode of the equipment as some features are not available in Modes 2 and 3.

Mode 1: All facilities, including the programming of transmitting frequencies, are available in this mode. This mode is normally only available to trained operators.

Mode 2: In this mode the operator has no control over the transmitting frequency and must operate in the pre-programmed channel frequencies. Channel 00 is available as a free-tuning receiver.

Mode 3: In this mode the transceiver operates as a channelized transceiver with permanently programmed channels. The tuneable receiver is not available and channel frequencies cannot be displayed.

3.6 Operation—Programming Memory Channel Frequencies In Simplex

The memory-channel frequencies are channels 01 through 99. These channel frequencies can only be changed in Mode 1. The channel frequencies are entered into permanent memory and retained by a lithium battery with a nominal shelf life of ten years. It is recommended that the battery be changed at five-year intervals.

To program a frequency into any of the memory channels, the operator must do the following:

1. Enter the channel number as follows:

   a) Press the "C" key.

   b) Press the key corresponding to the first number of the channel.

   c) Press the key corresponding to the second number of the channel.

Example. To enter channel 14, press "C", press "1", press "4".

Example. To enter channel 7, press "C", press "0", press "7".

2. Press the "F" key and hold it down.

3. Press the "C" key and release it.

4. Release the "F" key.

NOTE

It is important to follow this sequence. Make sure that the "F" key is pressed before the "C" key and not released until after the "C" key is released. (The frequency previously stored in memory will be displayed at this time.)

5. Enter the desired channel frequency.

6. Press the "F" key.

3.7 Operation—Programming Memory-Channel Frequencies In Half-duplex

To program half-duplex frequencies, i.e., different receive and transmit frequencies, do the following:

1. Perform steps 1 through 6 of Section 3.6; this enters the receive frequency.

2. Press the "F" key so that the decimal point is in the TX position.

3. Press the "F" key and hold it down.

4. Press the "C" key and release it.

5. Release the "F" key.

6. Enter the transmit frequency.

7. Press the "F" key.

3.8 Operation—Memory-Channel Selection

After specific memory channels have been programmed, recalling them is a simple matter. The following procedure is used.

1. Press the "C" key.

2. Press the two-digit channel number.

NOTE

All channel numbers have two digits—01 to 99. Channel selection is the only function available in Mode 3.

3. Press the "F" key to display the receive frequency (the moving decimal pointer on the display will be in the "receive" location).

4. Press the "F" key again to display the transmit frequency (the moving decimal pointer on the display will be in the "transmit" location).

NOTE

Continuously pressing the "F" key will cause the display to alternate between monitoring the receive and transmit frequency. The display will automatically return to the "receive" frequency after a transmit cycle is ended and the PTT is released.

3.9 Operation—Free-Tune Channel

Channel 00 is used for free tuning the transceiver. Both simplex and half-duplex frequencies can be programmed into channel 00. The last entered frequency is retained in the transceiver memory.

3.9.1 Programming The Free-Tune Channel

1. Press the "C" key.

2. Press the "0" key twice.

3. Enter desired channel frequency.

4. Press the "F" key. (The selected frequency should now be displayed with the moving decimal pointer at the "receive" location).

3.9.2 Programming The Free-Tune Channel For Half-duplex Frequencies

When one frequency is entered, the transceiver automatically assumes that it is a simplex frequency. For half-duplex operating, do the following:

1. Do steps 1 through 4 of section 3.9.1. This programs the receive frequency.
2. Press the "F" key.
3. Enter the desired transmit frequency.
4. Press the "F" key. The decimal pointer should now be in the "transmit" location.

3.9.3 Re-Calling The Free-Tune Channel

Since the last frequency programmed into the free-tune channel is stored in memory, it is an easy matter to re-call this channel.

1. Press the "C" key.
2. Press the "0" key twice. The transceiver is now in the free-tune mode and the last entered frequency is displayed.

3.10 Fine Tuning The Transceiver

The UP and DOWN buttons in the front panel permit tuning of the transceiver frequency up or down from the original programmed frequency. The following procedures apply:

1. A single push steps the transceiver 100 Hz. The frequency can be changed in 100-Hz steps either up or down by pushing the appropriate button continuously (push, then release—push, release—etc.).

2. If the button is held down, the frequency steps at a rate of 4 kHz per second.
3. Only the receive frequency can be changed in the above-mentioned manner. Any change entered is retained only until the channel is changed. If the channel is changed and then changed again back to the original channel, the original frequency is once again displayed; any frequency offset previously put in is forgotten.
4. On the free-tune channel (CH00), it is possible to change the frequency in memory permanently by pressing the "F" key after any up/down frequency stepping.

3.11 Operation—Scan Mode

The transceiver can scan between 2 and 98 channels when in the scan mode. To do this, follow this procedure:

1. Program the desired frequencies into the transceiver starting at channel 01. Use the programming procedure described in Section 3.6.
2. Enter the channel which is one greater than the highest channel to be scanned.
3. Press the "F" key and hold it down.
4. Press the "C" key and release it.
5. Release the "F" key.
6. Press the "SCAN" key. The scan limit is now set and retained in memory. Channels will be scanned at the rate of one every three seconds.
7. Pressing the "SCAN" key again will initiate the scan sequence. To stop the scan sequence, press the "SCAN" key again.

   It is necessary to stop the scan mode to enter new keypad functions.

NOTE

The scan mode can be initiated for a desired frequency at any time by pressing the "SCAN" key, provided a scan limit was previously set for that frequency. If a new scan limit is not set as outlined in steps 1 through 6, the transceiver will scan the channels defined by the scan limit previously set.

3.12 Operation—Selcall

The selective-calling system is an optional feature. Check that it is fitted to the transceiver before using this function. Each transceiver is assigned a selective call code (001 to 255). This code is internally programmed in the Selcall module.

Press the "S.C." key and enter the three-digit code for the desired station. Press the "CALL" button—this will switch the transmitter on and will then send the selective-call code.

The station called will stop scanning and send back a transpond signal. The Selcall module at the station called displays "CALL" on the LCD display, and sounds the call alarm tone at both stations.

When a call is received, press the "SCAN" key to stop the scan. After the call is completed, press any key on the keypad to cancel the "CALL" display. If the scan mode is in use, press the "SCAN" key again to initiate scan.

3.13 Operation—Transcall

The Transcall feature is optional. Check that it is installed before attempting to use it.

Each transceiver in the Transcall domain utilizes the three-digit Selcall code (001 to 255) for identification. This is internally programmed in the option module. In addition, each unit in the system should be programmed to scan the same number of "Transcall" channels. This is also an adjustment in the option module (see Section 12.2 of the technical manual).

To initiate a Transcall, press the "S.C." key and enter the three-digit code for the desired station. Flip the toggle switch from "SC" to "TC", and press the "CALL" button

after the scan has begun. An arming tone will sound, and the transceiver will now be under full control of the Transcall circuit. Normal operation involves scanning, along with brief transmissions on each channel. When both stations become synchronized, they will step together and seek the channel providing best communications. Following this sequence (lasting a maximum of five minutes), the transceiver will automatically switch to the best channel and sound an alarm. A "no contact" beeping tone will be heard at the sending station if the stations do not become synchronized.

3.13.1 Abort/Exit From Transcall Mode

The Transcall calling sequence may be stopped in progress, provided that the two stations have not yet synchronized. To abort, the calling station must hold the "CALL" key in for two seconds to stop the transmission.

Exiting the Transcall mode (either before "CALL" is pressed, or after the best channel has been selected), is achieved by flipping the toggle switch from "TC" to "SC", then pressing "F" on the keypad. The display will clear within three seconds.

3.13.2 Transcall Scan

When scanning in the Transcall mode, the receiving station will also respond to a valid Selcall. The scan limit is determined by the setting internally programmed in the option module.

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Servicing

4.1 Introduction

Detailed servicing information is beyond the scope of this manual and only experienced personnel should make adjustments or attempt any serious service work. Reference to the technical manual is essential.

The transceiver is of modular construction. If spare modules are available nontechnical personnel will be able to repair most faults in the field. Frequency calibration is a very simple procedure in the transceiver, and information has been included on this adjustment. It is very strongly recommended that the nontechnical personnel receive instruction from an experienced technician in the replacement of modules.

4.2 Routine Maintenance

The transceiver normally requires no periodic maintenance except to check the calibration of the master oscillator. This procedure is described in Section 4.4. It is often convenient to program an unused channel to a known frequency standard such as WWV. This will enable the operator to make regular checks of the frequency calibration.

The exterior of the transceiver should be kept clean by wiping with a damp cloth and polishing with a soft dry cloth. Make sure that all knobs are secure and the connectors are tight. When the transceiver is opened, make sure the coaxial connectors are tight and the module connectors are firmly in place. If the small pin connectors are removed, it is advisable to tighten the spring contacts by squeezing with a pair of pliers before replacement. Remove any dirt or dust using compressed air.

4.3 Access & Module Replacement

Module location diagrams are shown in Figures 4-1 and 4-2. Access and module replacement are as follows:

4.3.1 Cover Removal

The top and bottom covers are each retained by six screws. Remove the retaining screws and the covers can then be lifted off the transceiver.

CAUTION!

If the transceiver is fitted with an ac power supply, the full main supply voltage is present at the transformer primary, input connector, fuse holder and front-panel power switch. It is recommended that an external dc power supply be used when servicing the transceiver. When the transmitter is operating, high RF voltages are present on the modules M7 and M10. Use caution as these RF voltages can cause unpleasant burns.

4.3.2 Module Replacement M1-M6

Modules M1-M6 are the six modules contained in the diecast boxes. The modules are retained by screws in the front left and rear right corners. Remove these screws first, as this permits the modules to move forward and backward and gives more room to unscrew the coaxial connectors. These connectors and the ten-pin connectors should be removed and the module can be lifted out of the transceiver. Modules M5 and M6 are stacked and the retaining screws hold both modules in place.

4.3.3 Module Replacement M7

This module is removed by disconnecting all of the connectors. Remove the five mounting screws.

4.3.4 Module Replacement M8

Remove the three-pin connectors. Unscrew the four mounting screws in each corner and one screw in the center of the module. Remove the mounting hardware from the "TAB-PACK" transistors and take care not to lose the special shoulder washer and the insulator. When the module is replaced, take care to use thermal compound on the transistor flange. The insulator must be in place and the shoulder washer mounted so that there is no possibility of a short to

the chassis. Tighten the transistor mounting screws securely so that there is a good thermal contact to the chassis.

4.3.5 Module Replacement M9

This module is removed by disconnecting all of the connectors. Unscrew the five retaining screws.

4.3.6 Module Replacement M10

It is not recommended that the RF power module be replaced by nontechnical personnel. Detailed information on the replacement of this module is covered in Section 8.6.6 of the technical manual.

4.3.7 Pin Connectors

Small pin contacts are used for connecting wires to modules M7, M8 and M9 and for internal use inside the enclosed modules. These pins have an excellent locking action and will require a firm pull for removal. Always grasp the body of the pin with a pair of pliers and pull directly vertical when removing the connectors. If the contact is moved from side to side to aid removal, it will weaken the spring tension in the contact. If this happens, squeeze the end of the contact back together using a pair of pliers. It is very important to ensure that the pins snap firmly in place when the contacts are reinstalled.

4.3.8 Panel Components

It is possible to remove and replace most panel components with the front panel in place. If it is necessary to obtain greater access to the panel, remove modules M1, M5 and M6. This will give access to the four screws holding the panel in place. These screws are located on the two plates at each side of the rear of the panel. Remove the four screws and the panel can be tipped forward to give complete access to all components.

4.3.9 Component Access Modules M1-M6

The top side of the printed circuit board is accessible when the top covers of the boxes are removed by unscrewing the

four screws at each corner of the box. This gives access to all test points and alignment adjustments.

The integrated circuits are installed in sockets and can be replaced without removal of the circuit boards. When a circuit board must be removed for service, disconnect the pin connectors from the coaxial connectors at each end of the box. Remove the four mounting screws at each corner of the circuit board. The multipin connector will lift out of the slot at the end of the box and the circuit board and connector can be removed together without unsoldering the leads.

NOTE

There are two additional mounting screws holding the PC board in place in the module M6. It will also be necessary to remove the two screws holding the connector filter in this module. The screws are located at the end of the box on each side of the connector.

4.4 Frequency Calibration

The transceiver uses one temperature-controlled master oscillator to control both synthesizers. This means that only one adjustment is required for all channel frequencies. The adjustment procedure requires the use of an accurate frequency counter.

1. Connect the frequency counter to the 5120-kHz reference output. This is the front connector on Module 5. The output is 50 ohms and may be directly connected to the counter.

2. Turn on the transceiver and wait for 10 minutes so that thermal stability is reached.

3. Adjust the piston trimmer C21, (accessible through the hole in the top cover of Module 5) until the counter reads 5120.000 kHz.
4. This completes the calibration procedure. Reconnect the cable to the module.

Periodic checks should be made of the 1650-kHz oscillator. This is a stable, low-frequency oscillator and should seldom require adjustment.

1. Connect an accurate frequency counter to the carrier oscillator output test point. This can be accessed through the indicated hole in the M1 cover.

2. Switch the clarifier to the off position.

3. Adjust the 1.650 oscillator adjustment (R59) until the frequency reads exactly 1650.000 kHz.

In an emergency, it is possible to calibrate the transceiver by programming one of the channels to receive a frequency standard such as WWV. If there is any beat note present, the transceiver requires calibration. Turn the clarifier to "OFF". Turn up the volume and adjust C21 on Module 5 to zero beat. It will be difficult to hear the low-frequency beat because the carrier frequency is suppressed by the IF filter. It is possible to hear the beat against the reference tone and as a roughness on the voice modulation. With careful adjustment, it is possible to calibrate the transceiver within at least 10 Hz.

4.5 Basic Fault Location - Table 4-2

This information will assist in locating faulty modules without the use of test equipment. This information provides only a basic guide, and some fault conditions cannot be recognized without test equipment. Use this procedure to try and determine the fault area. If this approach is not successful, the modules should be replaced systematically until the faulty module is located. Remember that some of the preliminary tests can indicate which modules are operational. For example, the two synthesizer modules M5 and M6 are used in both the receive and transmit modes. This means that they are not faulty if either the transmitter or receiver is operational.

Before replacing any modules, check all cables and connections carefully. A broken wire or a loose connector may prevent the module from operating. When modules are replaced, it is not normally necessary to make any adjustments or to realign the transceiver.

With the exception of the RF power module M10, all modules may be replaced using a wrench and a screwdriver. The correct procedure for replacing the modules is described in Section 8.6 of the technical manual.

TABLE 4-1.
Fault-Location Chart.

(This chart gives fault symptoms that can be isolated by observation of the transceiver operation).		
SYMPTOM	**POSSIBLE FAULT**	**ACTION**
Power LED does not light.	Faulty power source.	Measure power source.
	Blown fuse(s).	Replace fuse.
NOTE *If the fuse blows again, check the "Transorb", D1, mounted on the 20-A fuse holder on the rear heat sink. The "Transorb" may fail in the shorted mode if subjected to sustained overload or a voltage transient exceeding 5 kW. If the "Transorb" has blown, it is important to determine the cause, which is certain to be external to the transceiver. Repeated replacement of fuses and "Transorb" may cause severe damage to the transceiver.*		
No Audio Output.	Defect in M1, loudspeaker or squelch on.	Turn squelch off, and turn audio gain up. If the speaker is completely dead, the fault is probably in the M1 module or speaker. Repair or replace.

TABLE 4-1.
Fault-Location Chart (Continued).

Transceiver operates on only one frequency or group of frequencies.	Defect in M7 RF Filter Module.	Check relays and filter components for nonoperating frequency(ies).
Transceiver does not operate on frequencies above/below 15 MHz.	Defect in VCO Q1 (1.6-15 MHz) or Q2 (15-30 MHz).	Replace module M6 or repair.
Transmitter has no output except for carrier in AM mode.	Defective microphone. Defective audio module M1.	Replace or repair. Replace or repair.
Transmitter has low output on one channel.	Antenna or tuner mismatch.	Measure VSWR and adjust antenna or tuner as required.
Speech sounds garbled and/or clarifier consistently tunes at extremes of range.	Master oscillator out of calibration.	Recalibrate (refer to Section 4.4).
Transmitter does not operate when PTT switch is activated.	Defective microphone. Defective T/R Switching.	Check by shorting pin 4 on microphone socket.

TABLE 4-2.
Module Fault-Location Chart.

Preliminary	
Check power switching. Press PTT switch. Relay should click and receiver should mute.	
M1 Audio Module	
Transceiver operates in either TX or RX mode.	■ 1650-kHz carrier oscillator is operational.
Audio completely dead, not even slight hiss with squelch off, and maximum audio gain.	■ Module or loudspeaker defective.
No output from microphone. Carrier present in AM mode.	■ M1 or M2 defective, also check microphone.
M2 1650-kHz Module	
Receiver operational.	■ Module will also be operating in transmit mode.
Disconnect "RX-Out" coax connector.	■ If noise level does not decrease, module is defective.
M3 75-MHz Mixers Module	
Carrier output in AM mode.	■ M3, M4, M5, M6, M10 operational in transmit mode.
Disconnect "RX-Out" coax connector.	■ If noise level does not decrease, module is defective.
M4 HF Mixers & Driver Module	
Carrier output in Am mode.	■ M3, M4, M5, M6, M10 operational in transmit mode.
Disconnect "RX-Out" coaxial connector.	■ If noise level does not decrease, module is defective.

TABLE 4-2.
Module Fault-Location Chart (Continued).

M5 Synthesizer—100-Hz Loop	
Transceiver operates in either transmit or receive mode.	■ Module is operational.
Disconnect "OSC-Out" coax connector.	■ If noise level does not decrease module may be defective.
M6 Synthesizer—10-kHz Loop	
Transceiver operates in either transmit or receive mode.	■ Module is operational.
Channel frequencies do not operate below 15 MHz.	■ Defective 1.6 to 15-MHz VCO in module.
Channel frequencies do not operate above 15 MHz.	■ Defective 15 to 30-MHz VCO in module.
NOTE *A failure in the master reference oscillator in the module M5 will stop M6 from operating.*	
M7 RF Filter Module	
Refer to "Preliminary" at beginning of chart for T/R power switching.	
Relay K1.	■ Check relay clicks when PTT operated.
Signal path through filters from antenna.	■ Disconnect "RX-ANT" antenna coax connector from M4. Temporarily connect antenna to "RX-ANT" connector. If receiver operates, defect in M7. Filter selection or connections to antenna connector.

TABLE 4-2.
Module Fault-Location Chart (Continued).

M8 Power Supply Regulator	
Check input voltage to module at input terminal.	■ Should be above 12 V in dc model. ■ Should be approximately 18 V in ac model.
No output from M8 in both transmit and receive mode.	■ Module defective.
M9 Microprocessor Module	
Faults in this module are indicated by incorrect channel selection.	■ Check wires and connections.
Failure to retain channel frequencies when transceiver is switched off.	■ Replace lithium battery. (Nominal life is 10 years.)
M10 RF Power Amplifier	
No simple check without instruments.	■ Voltages and connections should be carefully checked before replacement.
M11 LCD Display Module	
Transceiver appears to be operating correctly, but display is not operating.	■ Check connections.
Microphone	
Transmitter does not operate.	■ Check by replacement of microphone. ■ Ground pin 4 of connector and touch pin 3 with hand. If transmitter shows RF output, microphone is faulty.

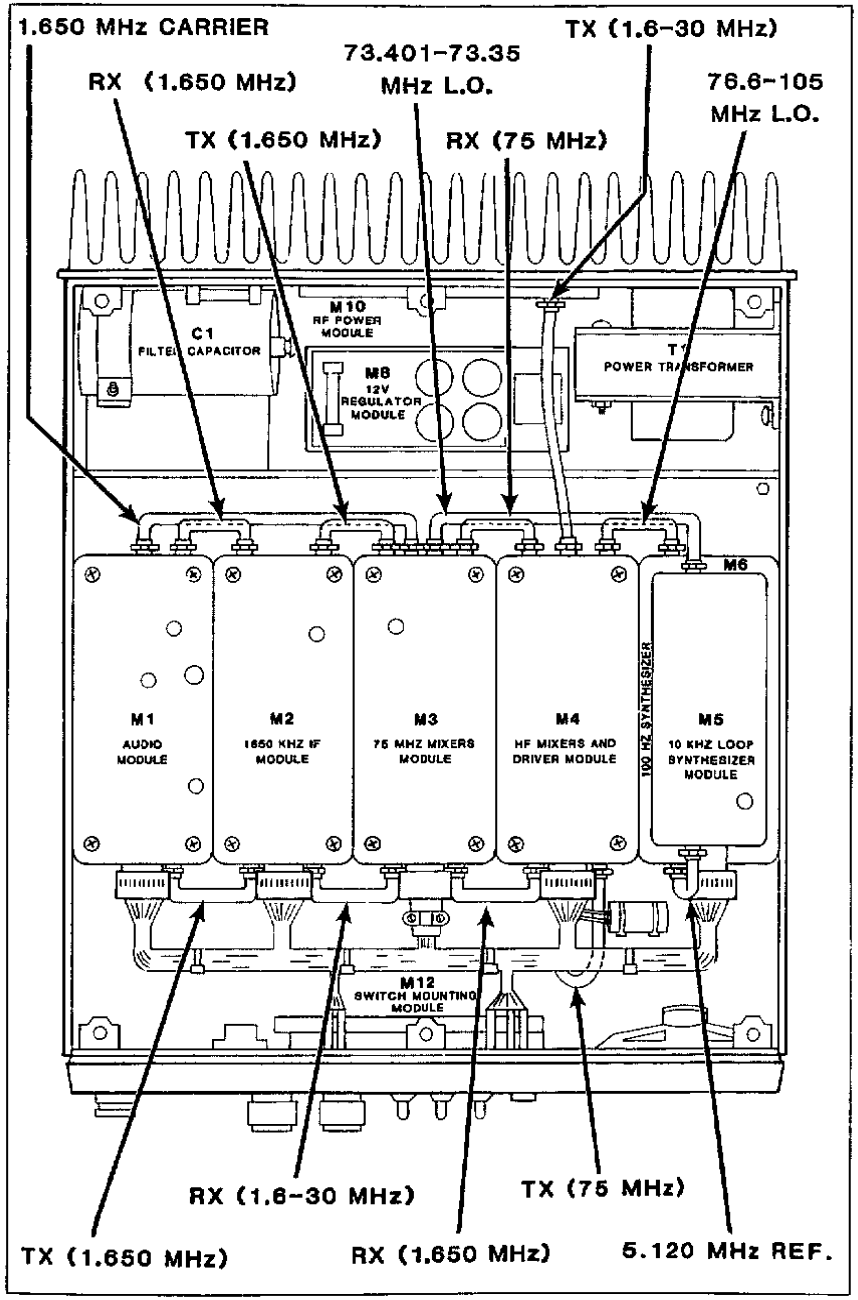

FIGURE 4-1.
Module Location Diagram - Top.

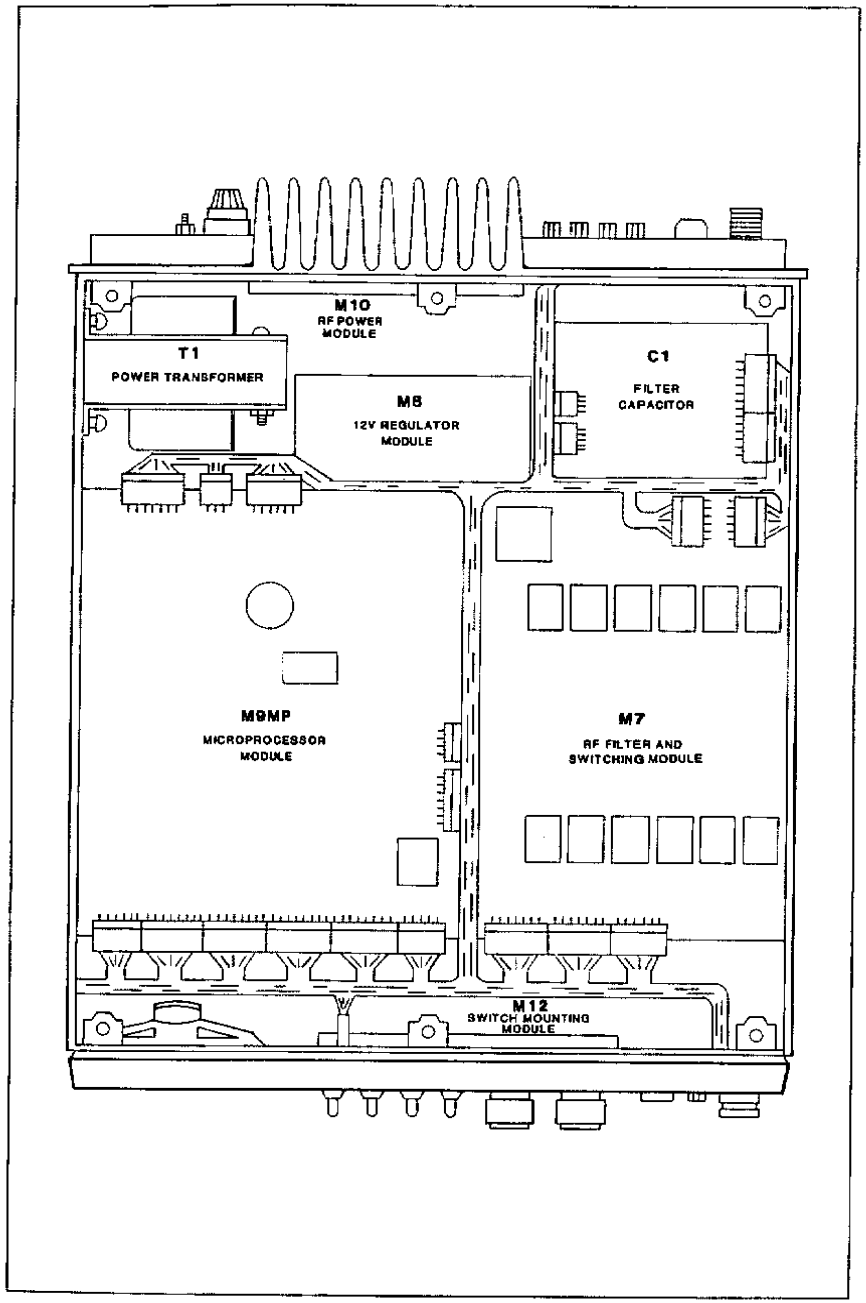

FIGURE 4-3.
Module Location Diagram - Bottom.