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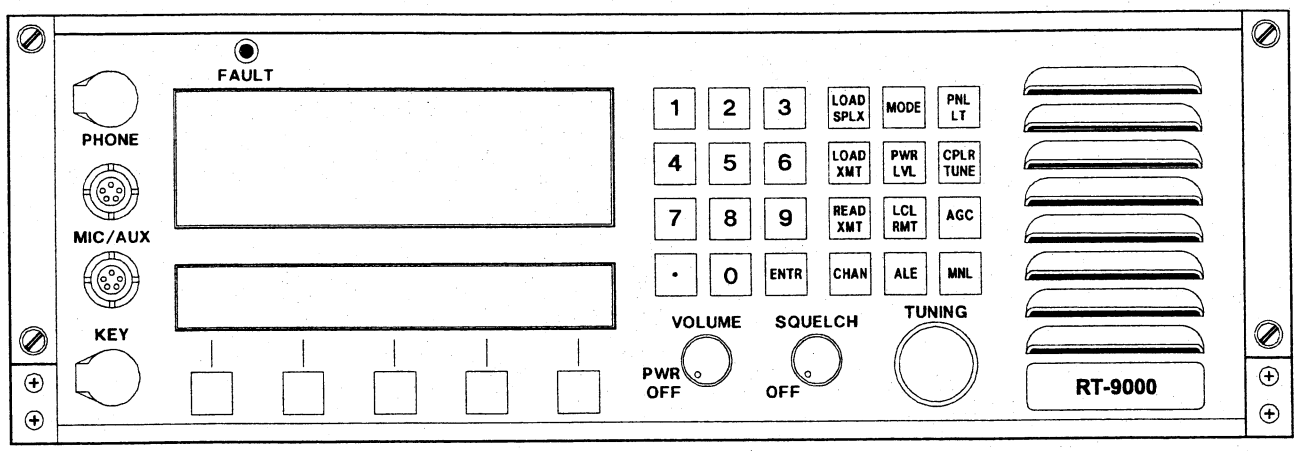

RT-9000
DIGITAL HF/SSB
TRANSCEIVER

OPERATION
AND
MAINTENANCE MANUAL

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ADDR Address
AGC Automatic Gain Control
ALC Automatic Level Control
AM Amplitude Modulation
AME Amplitude Modulation Equivalent
AMP/AMPL Amplifier
ARQ Automatic Request
AUD Audio
AUTO Automatic
AUX Auxiliary
BAUD A variable unit of data transmission speed (bits per second)
BELL U.S. Telephone standards
BFO Beat Frequency Oscillator
BITE Built In Test Equipment
BRD Board
CH /CHAN /CHL/CHN Channel
CLR Clear
CMOS Complementary Metal Oxide Semiconductor
CPLR Coupler
CPU Computer
CW Carrier Wave
dB Decibel
dBm Decibels referred to 1 milliwatt across 600 ohms
DSBSC Double Sideband Suppressed Carrier
DSP Display
DUART Dual Asynchronous Receive/Transmit
EEPROM Electrically Erasable and Programmable Read Only Memory
EPROM Electrically Programmable Read Only Memory
EMI Electromagnetic Radiation Interference
ENTR Enter
FAX Facsimile
FEC Forward Error Correction
FREQ Frequency
FSK Frequency Shift Keying
FWD Forward
GRP Group
HF High Frequency
Hz Hertz
IC Integrated Circuit
IF Intermediate Frequency
I/O Input/Output
IONCAP Ionospheric Communications Analysis and Prediction
kHz Kilohertz
kW Kilowatt
ISB Independent Sideband
LCD Liquid Crystal Display
LCL Local
LED Light Emitting Diode
LK Link
LO Local Oscillator
LP/LPX Lincompex
LRU Lowest Repairable Unit
LSB Lower Sideband
LT Light
LVL Level
MAN Manual
M CH Manual Channel
MED Medium
MHz Megahertz
MIC Microphone
MIL-STD Military Standard
MNL Manual
ms Millisecond
MTTR Mean Time To Repair
MTR Meter
NAR Narrow
O.D. Olive Drab
PA Power Amplifier
PC Printed Circuit
PEP Peak Envelope Power
PLL Phase-Locked Loop
P/N Part Number
PNL Panel
POSTSL Post-Selector
PRESEL Pre-Selector
PTT Push-To-Talk
PWR Power
RCV/RX Receive
REFL Reflected
REV Revision
RF Radio Frequency
RFI Radio Frequency Interference
RFL Reflected
RMT Remote
RS232 Computer control, hardwired up to 50 feet maximum
RS422 Computer control, hardwired up to 4000 feet maximum
RS485 Computer control, hardwired for multiple users
RTTY Radio Teletype
SEL Select
SLO Slow
S MTR Signal Strength Meter
SPKR Speaker
SPLX Simplex
SRAM Static Random Access Memory
SSB Single Sideband
TCXO Temperature Compensated Crystal Oscillator
TGC Transmit Gain Control
THD Total Harmonic Distortion
TTL Transistor Transistor Logic
TX/XMT Transmit
USB Upper Sideband
UTC Universal Time
VCO Voltage Controlled Oscillator
VHF Very High Frequency
VRMS Volts Root Mean Square
VSWR Voltage Standing Wave Ratio
W Watt
WPM Words Per Minute
* Asterisk indicates function selected

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SECTION I

GENERAL INFORMATION

1.1 SCOPE OF MANUAL

This manual contains information necessary to install, operate, and maintain the RT-9000 HF/SSB Digital Transceiver. Installation information is in Section II. Operating Instructions are in Section III. Theory of Operation is in Section IV. Maintenance and Repair Procedures are in Section V. Information in this manual applies to all equipment configurations, unless otherwise stated in the text or illustrations. Information exclusive to RT-9000A is contained in Section VI.

1.2 PURPOSE OF EQUIPMENT

The RT-9000 is a 125 Watt HF/SSB Digital Transceiver capable of providing communications from 1.6 to 29.99999 MHz (receive 100 kHz to 29.99999 MHz). Modes of operation include USB, LSB, AME, and CW (FSK, FAX, High Speed DATA, ARQ and FEC are available with optional external modems). The RT-9000 is designed to be used in fixed station or mobile environments and can be computer or remotely controlled via RS232/422/485/FSK tones. The standard features along with the available options make the RT-9000 the most versatile and expandable HF system on the market today.

Features of the RT-9000 include: simplex or half-duplex operation, manual or memory frequency selection in 10 Hz steps, 128 programmable channels, AC/DC operation with auto changeover, keyboard entry, nonvolatile memory using EEPROM (no batteries required), BITE to LRU (Lowest Repairable Unit), receive scanning, computer control, and high speed data capability.

1.3 GENERAL DESCRIPTION

The RT-9000 can be used in base station 19 inch rack installations, on table tops, in mobile installations and transportable cases. Its rugged package makes the RT-9000 ideal for all environments. Internally, the RT-9000 is designed with the service technician in mind. Descriptive readouts on the front panel (BITE) and modularized plug-in assemblies make the MTTR (Mean Time To Repair) less than fifteen (15) minutes. LEDs located on the assemblies allow the technician to pin-point the faulty module immediately. The RT-9000 is lightweight for its capability, only thirty-six pounds (36 lbs.) when used on DC only and forty-nine pounds (49 lbs.) with AC supply installed. Available in Olive Drab (OD) or Gray, the RT-9000 is compatible with most radio station color schemes. If a particular color other than OD or Gray is required, contact the Sunair Marketing Department for information concerning changes to the standard colors.

The RT-9000 has a simple, easily understood front panel. First time users can operate the radio without extensive training. The wide screen LCD is continuously updated by the microprocessor with operational status such as Frequency, Channel, Mode, BFO, AGC, Power, Local or Remote Control. The LCD also contains a bar graph meter which selectively indicates signal strength, forward RF power, reverse RF power and remote transmit and receive audio levels. The built-in-test routines include power amplifier and antenna coupler status in plain English messages which appear in the display. Softkeys, and a softkey menu LCD, display selected options such as Time, CW Filter, etc. The softkeys also provide access to remote control configuration, meter selection, speaker control and other operating features not found on the front panel keyboard.

1.4 TECHNICAL SPECIFICATIONS

1.4.1 GENERAL

FREQUENCY RANGE: Transmit - 1.6 to 29.99999 MHz; Receive - 100 kHz to 29.99999 MHz in 10 Hz steps.

PROGRAMMABLE CHANNELS: 128 Simplex or Half-Duplex.

FREQUENCY STABILITY: 1 X 10^{6} (Optional + 1 part in 10^{8}).

MODES OF OPERATION: USB, LSB, CW, AME, DATA (RTTY, ARQ, FEC, FAX with optional external modems).

MEMORY RETENTION: Non-Volatile.

SCAN/SWEEP: Manual or automatic Rate/Dwell programmable.

BFO: ± 1.99 kHz, 10 Hz Resolution.

SYNTHESIZER LOCK: 10 ms.

T/R SWITCHING TIME: 10 ms.

REMOTE INTERFACE: RS232/422/485 (FSK Tone Optional).

RF INPUT/OUTPUT IMPEDANCE: 50 Ohm nominal, unbalanced.

BITE: Fault isolated to module level (LRU), descriptive readout on front panel and individual module indication.

INPUT POWER: 115/230 VAC ± 15%, 50/60 Hz; +26 VDC ± 15%; With both input powers connected unit operates AC/DC Auto Changeover.

SIZE - INCHES (CM): 5.96H (15.2) X 17.83W (45.4) X 17.66L (44.9).

WEIGHT - LBS (KG): DC - 36 (16.3); AC - 49 (22.3).

CONSTRUCTION: Modular plug-in assemblies.

1.4.2 RECEIVER SECTION

SELECTIVITY: SSB - 300 to 3000 Hz @ 6 dB; CW - 500 Hz @ 3 dB, centered at 1 kHz (Optional); AM - ± 300 Hz @ 6 dB; (Optional Phase Delay Compensated Filters Available).

SENSITIVITY: SSB - 0.5μV for 10 dB (S+N)/N; AM - 3.0μV for 10 dB (S+N)/N; CW - 0.3μV for 10 dB (S+N)/N; (Degradation below 2.0 MHz).

AUDIO OUTPUT: 5 Watts into internal speaker < 5% THD; Two selectable lines, at -20 dBm to +10 dBm into 600 Ohms; Headset, low impedance.

IMAGE & IF REJECTION: 80 dB minimum.

SPURIOUS REJECTION: 80 dB minimum.

AGC CHARACTERISTICS: Attack Time - 10 ms nominal; Release Time -23 ms fast, -200 ± 100 ms medium, 1 ± 200 sec slow.

SQUELCH: Syllabic.

ANTENNA INPUT PROTECTION: 100 VRMS, self resetting.

INTERNALLY GENERATED SPURIOUS: 99.5% of the available frequencies from 100 kHz to 30 MHz at or below 0.5µV equivalent input at the antenna terminal.

1.4.3 TRANSMITTER SECTION

OUTPUT POWER: Normal Operation - 125 Watts PEP and Average for SSB; 125 Watts CW; 40 Watts Carrier in AM. Low Power Operation - 65 Watts (Adj) SSB; 65 Watts (Adj) CW.

HARMONIC SUPPRESSION: -45 dB second order, -55 dB third and higher orders.

INTERMODULATION DISTORTION: 36 dB below PEP.

CARRIER SUPPRESSION: 50 dB below PEP.

UNDESIRED SIDEBAND: 50 dB below PEP @ 1.5 kHz.

HUM & NOISE LEVEL: 50 dB below PEP.

VSWR: Operates at VSWR 2.0:1 (Automatic power reduction above 2.0:1).

AUDIO INPUT: Microphone, aux. connector, and two selectable 600 Ohm lines at -20 dBm to +10 dBm.

AUTOMATIC LEVEL CONTROL: 125 Watts ±1 dB.

AUDIO COMPRESSION: 10 dB nominal (Internal Disable).

1.4.4 ENVIRONMENTAL

TEMPERATURE: -30°C to +50°C.

HUMIDITY: 100% at 50°C.

RAIN: MIL-STD-810D, Method 506.2.

SHOCK: MIL-STD-810D, Method 516.3.

VIBRATION: MIL-STD-810D, Method 514.6.

1.5 HIGH FREQUENCY PROPAGATION

When HF radio is used, a limited amount of communication is accomplished in a direct line. Some radio waves will travel outward from the transmit antenna along the ground (ground wave propagation) but these waves soon lose their strength and are eventually lost. The greater use of HF radio is via Skywave Propagation which, simply stated, is a process of using the ionosphere to bend the radio waves back to earth to arrive at the distant station. To be successful in using the ionosphere in this manner you must:

a) Have a general knowledge of the ionosphere and its effect on radio waves.
b) Select the proper frequency to work in conjunction with the condition of the ionosphere.
c) Ensure the angle of radiation of the radio waves is correct for the condition of the ionosphere and the distance to the receiving station.

Proper frequency selection is critical for effective communication. To select the proper frequency, consulting any of the available sources of such information as 'IONCAP' would be of great benefit. In the absence of such information, viable paths may be selected by receiver monitoring for calls originating near the destination of interest or by trial and error. For example, a high frequency at night, when the ionosphere is at its weakest, would be too strong and the signal would go completely through the ionosphere and out into space. Too low a frequency during the day, when the ionosphere is the most dense, would create a situation where the signal is so weak the ionosphere would totally absorb the radio waves and nothing would return to earth. The general rule of thumb, then is; higher frequencies in the day, lower frequencies at night.

The angle of radiation or take-off angle of a given antenna is also crucial to effective communication. The distance from where the signal exits the transmit antenna to the point at which it returns to earth depends on the angle it enters the ionosphere. If the angle is HIGH, the distance of the signal will be SHORT. If the angle is LOW, the distance will be FAR. The angle of radiation also presents another problem. Too steep an angle means the area of interaction between radio wave and ionosphere is smaller and the danger of the radio wave going straight through and into space increases. Check the literature of the antenna system in use to be sure the angle of radiation or take off angle is consistent with the distance over which you wish to communicate.

1.6 ALE (Automatic Link Establishment) MODEMS

HF radio can provide reliable communication where all other means of communication fail. The key is to know how HF skywave propagation works and to observe the basic rules for its use.

ALE Modems provide a good deal of simplification to the operational scenario. Proper selection of antennas and viable frequencies must still be made at the time of system commissioning, but the daily routine of selecting proper frequencies is accomplished automatically, thus allowing the radio in an ALE network to function much like a telephone.

All of the control functions for operating the Sunair ALE Modems are built-in to the RT-9000 software. Adding such a modem at a later date is easily facilitated. A discussion of 'ALE' operating routines is presented later in this manual.

1.7 EQUIPMENT SUPPLIED

The following is a list of equipment, with appropriate Sunair part numbers, supplied with the RT-9000 or RT-9000A Transceiver.

Supplied Equipment:	Sunair Part Numbers:
Transceiver, RT-9000 Transceiver, RT-9000A	8076001056 GRAY 8112001057 GRAY
Hand Held Microphone Assembly	8076000602
Manual	8076000505
Mating Connector Kit (RT-9000) Mating Connector Kit (RT-9000A)	8076000491 8112000492
Power Cord Assembly, 115VAC or Power Cord Assembly, 230VAC	8076002095 8076002192

1.8 OPTIONS AVAILABLE

The following is a list of optional equipment or accessories available for use with the RT-9000 or RT-9000A Transceiver.

Optional Equipment/Accessories:	Sunair Model /Part Numbers:
Internal Lyncompex Module	8076097096
High Stability Reference Oscillator	5024013701
Digital Antenna Coupler, CU-9125	8085000296 O.D. 8085000253 GRAY
Kilowatt Digital Antenna Coupler, 1000 Watt Operation, CU-9100	8104001094 O.D. 8104001051 GRAY
Solid State Kilowatt Amplifier, LPA-9600	8105001055 GRAY
Automatic Link Establishment (ALE) Modem, MD-9188A	8101001051 GRAY
Automatic Link Establishment (ALE), Embedded Processor Assembly (RT-9000A only)	8112010099
Remote Control Unit (Computer Control), RPC-9286D	8078201001
Remote Control Unit, RCU-9310	8078001053 GRAY

Optional Equipment/Accessories:	Sunair Model /Part Numbers:
Headset	0840200005
Headset, Lightweight	1010690027
CW Key with Phone Plug	5024000994
Clock	1011190010
Handset Assembly	8076000793
Desktop Microphone	8076000891
Shockmount Assembly (Mobile Application)	8076002591
Rackmount Kit with Slides	8076004853 GRAY
Blower Kit	8076006091
Power Cord Assembly, DC	8076002290
Audio Interface Cable	8076004594
Tone Modem (PC Assembly FSK Modem, 300 baud)	8076115094
Running Spares Kit (Fuses)	8076904099
Field Module Kit	8076905095
Service Kit 9000 Series Contains: Repair Alignment Tools 1011480034 PC Assembly, Card Extender 8076003091 Puller, PCB 8076003105	8076003393

SECTION II

INSTALLATION

2.1 GENERAL

Section II contains all necessary instructions for the unpacking, inspection, and if necessary, reshipping of damaged equipment or parts. In addition, further information regarding location and mounting considerations, power requirements, antenna and ground system hook-ups and final checkouts after installation is also provided.

2.2 UNPACKING AND INSPECTION

As soon as you have received your unit(s), unpack and inspect all components and accessories. Check the packing list to be sure you have received all items ordered, and that all items necessary for operation have been ordered.

NOTE: Be sure to retain the carton and its associated packing materials should it be necessary to reship damaged equipment.

Do not accept a shipment when there are visible signs of damage to the cartons until a complete inspection is made. If there is a shortage of items or any evidence of damage, insist on a notation to that effect on the shipping papers before signing the receipt from the carrier. If concealed damage is discovered after the shipment has been accepted, notify the carrier immediately in writing and await his inspection before making any disposition of the shipment. A full report of the damage should also be forwarded to Sunair's Product Services Department. Please be sure to include the following information for prompt service:

a) ORDER NUMBER.
b) MODEL AND SERIAL NUMBER.
c) NAME OF TRANSPORTATION AGENCY.
d) APPLICABLE DATES.

Upon receipt of this information arrangements will be made, by Sunair, for repair or replacement.

2.3 RETURN OF EQUIPMENT TO FACTORY

The shipping carton for the RT-9000 has been designed to protect the equipment during shipment. The container and its associated packing materials should be used to reship the unit. When necessary to return equipment to Sunair for warranty or non-warranty repair, an authorization number is required. This number can be obtained from our Product Services Department: TELEPHONE: (954) 525-1505, FACSIMILE: (954) 765-1322.

If the original shipping carton is not available, be sure to carefully pack each unit separately, using suitable cushioning material where necessary. Very special attention should be given to providing enough packing material around connectors and other protrusions from the Transceiver. Rigid cardboard should be placed at the corners of the equipment to protect against denting. **DO NOT** USE DUNNAGE (STYROFOAM PEANUTS) FOR PACKING PROTECTION, they may allow the unit to shift while being shipped and become damaged.

When returning subassemblies or components for repair or replacement, be sure to pack each separately, using suitable cushioning material.

Shipment to be made PREPAID consigned to:

Sunair Electronics, Inc.
Product Services Department
3101 SW Third Avenue
Fort Lauderdale, Florida 33315-3389
U.S.A.

Plainly mark with indelible ink all mailing documents as follows:

US Goods Returned For Repair
Value For Customs - $(Amt.)

Mark ALL SIDES of the package:

FRAGILE - ELECTRONIC EQUIPMENT!

NOTE: Before shipping, carefully inspect the package to be sure it is marked properly and is securely wrapped.

2.4 GENERAL INSTALLATION AND MOUNTING INFORMATION

Satisfactory operation of this equipment will depend upon the care and thoroughness taken during installation.

2.4.1 GENERAL INSTALLATION

For installation and use with KW equipment, modems, and other peripherals. Use this manual in conjunction with their respective operating manuals for complete installation information.

a) Carefully plan transceiver/peripherals/coupler/antenna locations, observing the following requirements before starting installation.

b) Provide best possible RF ground for transceiver and coupler. Use flat copper strap 1" wide, or No. 6 or larger wire, and connect to ground terminal at rear of transceiver. Leads to ground system should be as short as possible.

c) Provide separation between coupler output and transceiver with its associated wiring. Coupler may be mounted up to 100 feet from transceiver if RG58 RF coax cable is used, or further if RG8 RF coax cable is used.

d) Antenna lead from coupler to antenna must be insulated for at least 10kV potential. The lead should run parallel to metal fittings or other metal objects that are bonded to the system ground. The coupler should be as close to the antenna as possible, and never more than three (3) feet distant as this will decrease antenna efficiency.

e) If the transceiver is installed on a wood or fiberglass boat, approximately ten (10) to twelve (12) square feet of metal surface area in contact with the water should be provided for use as an RF ground.

f) If operated on DC power, check for correct polarity before applying power.

NOTE: Linear amplifiers with low level drive such as used in the RT-9000 will oscillate if the RF power output is radiated or conducted into the low level stages. Evidence of this situation is erratic or excessive power output. This is caused by close proximity of the coupler output and antenna to the transmitter and/or inadequate RF grounds. Carefully following the above procedures will prevent this from occurring.

Connection of the RT-9000 to power sources, antennas, antenna couplers and other equipment may be accomplished as follows:

NOTE: Refer to Section VI for RT-9000A.

TO ADD	CONNECT	NOTE
AC Power	AC source to J1 on rear panel.	See Figure 2.4.1.1.
DC Power (DC Power Cable Optional)	DC source to J3 on rear panel.	See Figure 2.4.1.1.
Antenna	Antenna to J4 on rear panel.	Only if antenna coupler not required.
Microphone	Microphone to J3 on front panel.	See Figure 2.4.1.1.
CW Key	Key to J1 on front panel.	See Figure 2.4.1.1.
Headphones	Headphones to J2 on front panel.	See Figure 2.4.1.1.
Antenna Coupler (CU-9125)	Antenna coupler control line from J1 (CU-9125) to accessory connector J6 on rear panel of the RT-9000. Coaxial signal line from J2 (CU-9125) to antenna connector J4 on rear panel of the RT-9000.	See Figure 2.4.1.1 and consult CU-9125 Manual (Figures 2.2 and 2.8).
Power Amplifier (LPA-9600)	LPA control lines from J5 (LPA-9600) to accessory connector J6 on the rear panel of the RT-9000. Coaxial signal line from J2 (LPA-9600) to antenna connector J4 on rear panel of the RT-9000.	See Figure 2.4.1.1 and consult LPA-9600 Manual (Figure 2.1).
"ALE" Modem (MD-9188A)	Control lines from J4 (MD-9188A) to remote connector J8 on the rear panel of the RT-9000. Modem audio lines from J1 (MD-9188A) to audio connector J5 on the rear panel of the RT-9000.	See Figure 2.4.1.1 and consult MD-9188A Manual (Figure 2.4.1.2).
External Data Modems (Direct Connection RT-9000)	Connect modem audio and keyline to RT-9000 through audio connector J5 on the rear panel of the RT-9000.	See Figures 2.4.1.1 and 2.4.1.2.
External Data Modems (Direct Connection MD-9188A)	Connect modem audio and keyline to MD-9188A through audio connector(s) J2 and J3 on the rear panel of the MD-9188A.	See Figure 2.4.1.3 and consult MD-9188A Manual.

TO ADD	CONNECT	NOTE
Remote Control (RCU-9310)	Control lines from J6 (RCU-9310) to remote connector J8 on the rear panel of the RT-9000. Remote Audio from J4 (RCU-9310) to audio connector J5 on rear panel of RT-9000.	See Figure 2.4.1.1 and consult RCU-9310 Manual.
Remote Control (RPC-9286D)	Control lines from J2 (RPC-9286) to remote connector J8 on the rear panel of the RT-9000. Signal line from J3 (RPC-9286) to audio connector J5 on rear panel of the RT-9000.	See Figure 2.4.1.1 and consult RPC-9286 Manual.
Blower Kit	Connect Fan Plug to J2 on rear panel of RT-9000.	See Figure 2.4.1.1.
5 MHz Output	Connect external 5 MHz user to J7 and change jumper plug on 1A2A6.	See Figure 2.4.1.1 and Figure 5.9.16.
5 MHz Input	Connect external 5 MHz source to J7 and change jumper plug on 1A2A6.	See Figure 2.4.1.1 and Figure 5.9.16.

2.4.2 BASE STATION INSTALLATION

The RT-9000 is equipped with rubber feet so that it can be placed directly on a table, desk or similar flat surface. The front feet are taller than the rear feet to tilt the Transceiver at a convenient operating angle. Minimum clearances of one (1) inch at the sides and two (2) inches at the rear and top should be allowed to provide for adequate cooling of the rear panel heat sinks. If extended periods of RTTY transmission are anticipated, forced air cooling of the heat sinks is recommended. Figure 2.4.1.1 shows the applicable outline dimensions of the equipment and the location of inputs and outputs for microphones, antennas, antenna couplers, remote controls, signal lines, and modems.

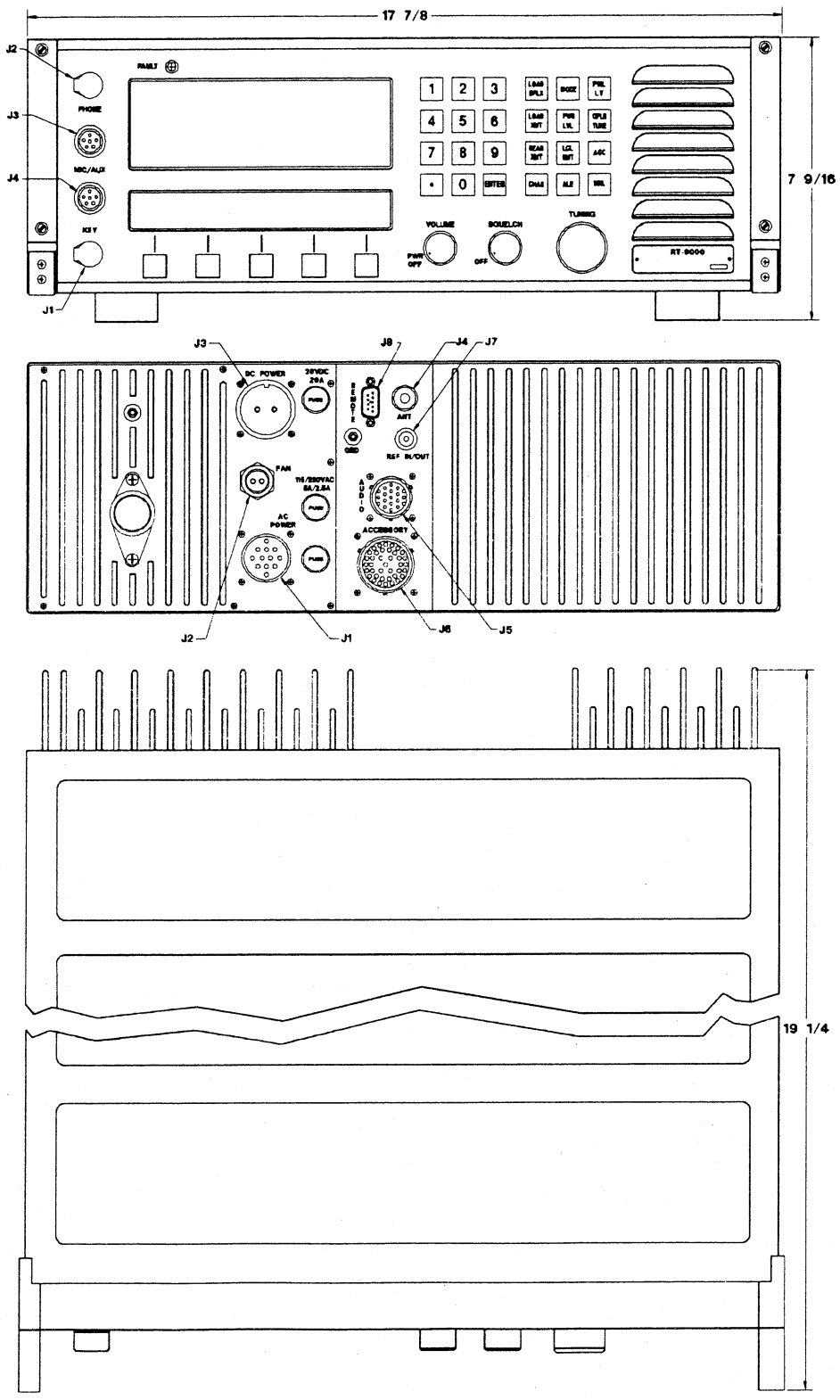

Figure 2.4.1.1 RT-9000 Outline Dimensions and Connector Locations. See Section VI for RT-9000A.

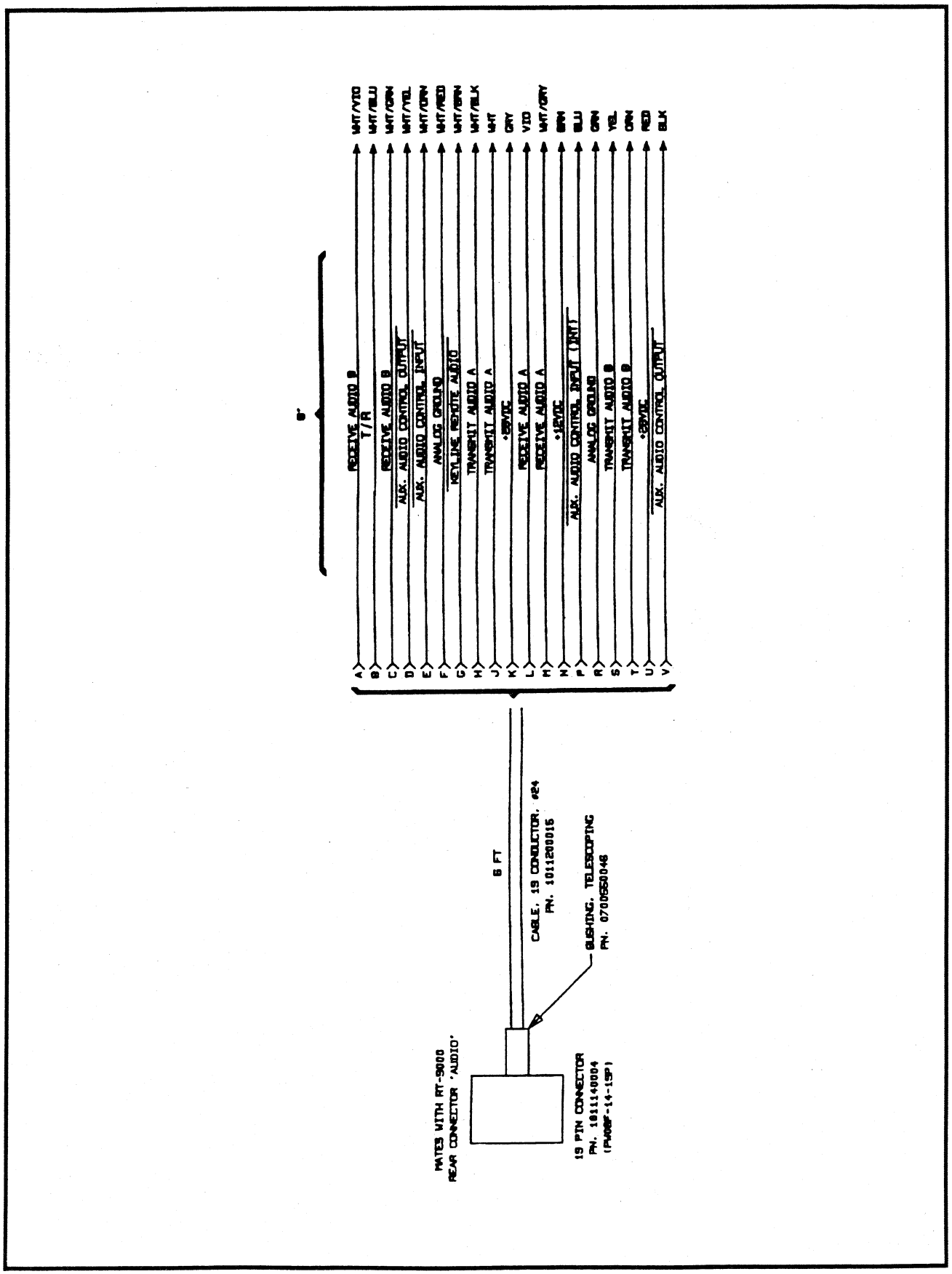

Figure 2.4.1.2 Cable Assembly, RT-9000 Audio Interface.

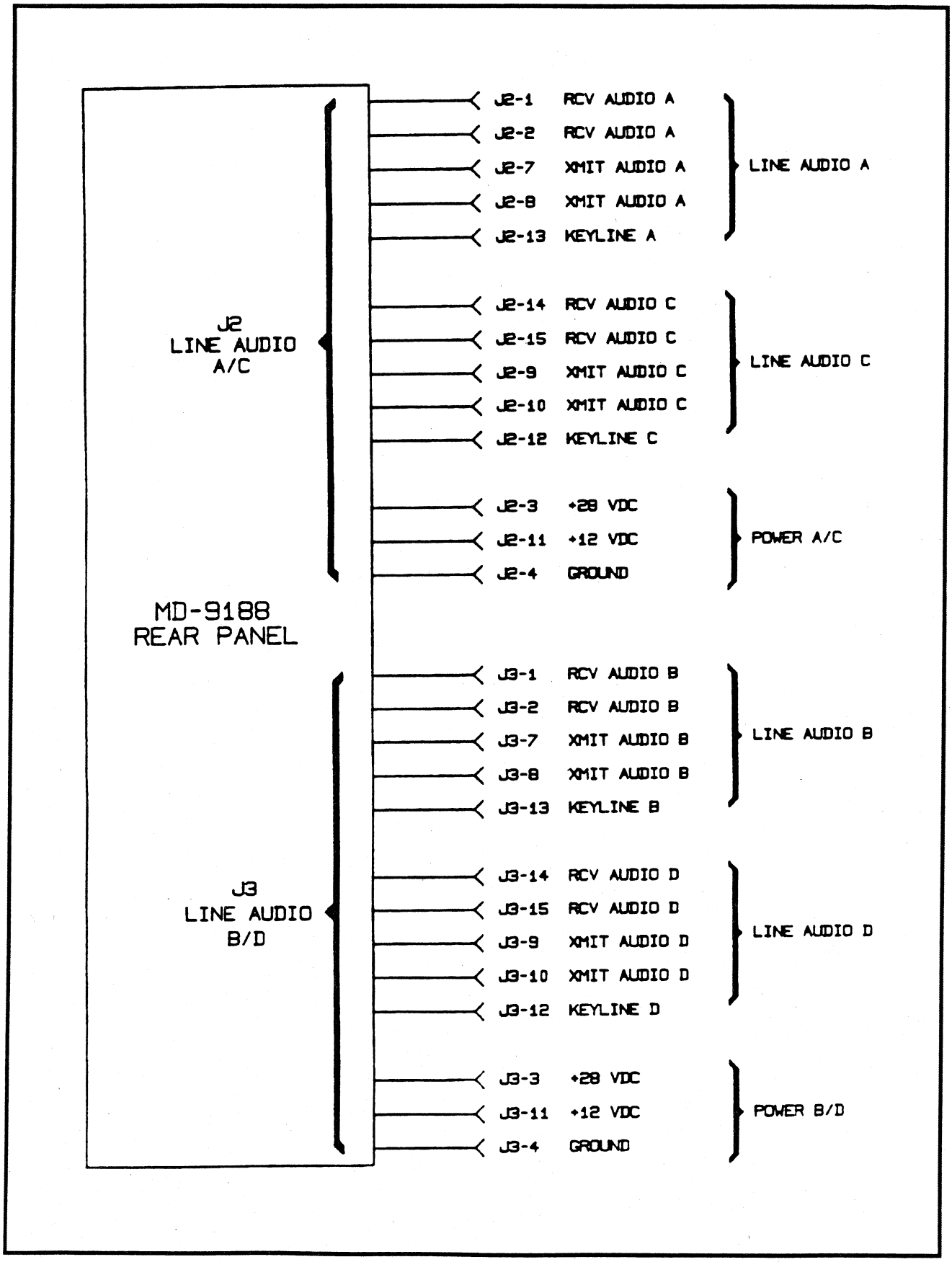

Figure 2.4.1.3 MD-9188A RCV/XMT Line Audio Interface.

2.4.3 VEHICULAR INSTALLATIONS

The RT-9000 Shockmount Assembly (Sunair p/n 8076002591) is designed to mount the transceiver in vehicular/mobile installations. Figure 2.4.3.1 gives the applicable outline dimensions for the RT-9000 coupled with the shockmount.

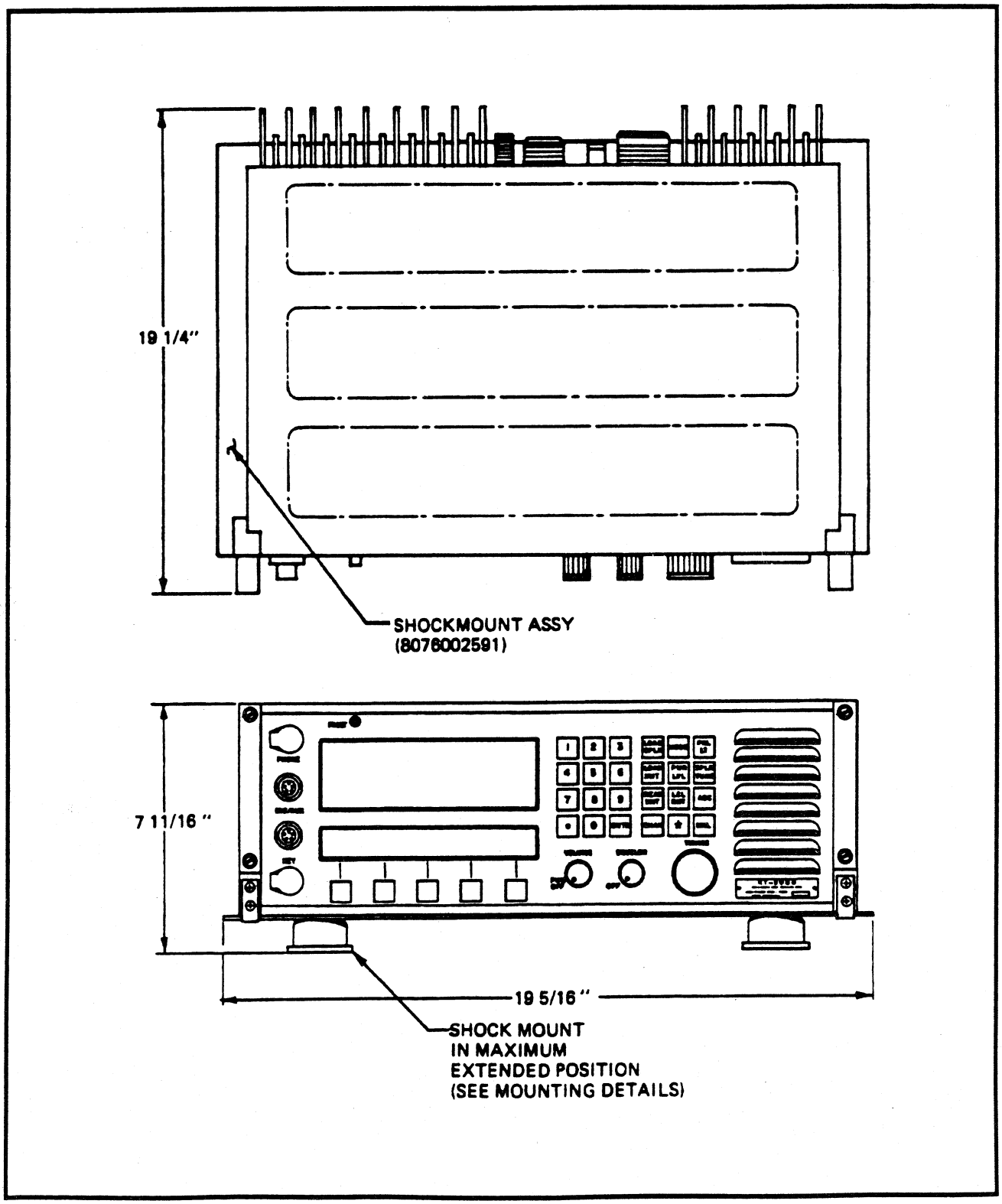

Figure 2.4.3.1 Outline Dimensions of RT-9000 with Shockmount.

In order to minimize RF pickup, it is important that the ground strap supplied with the shockmount be securely fastened between the ground post on the transceiver and the bottom of the right rear shock isolator (see detail in Figure 2.4.3.2). It is also important to ground the antenna coupler to the frame of the vehicle by the shortest possible path.

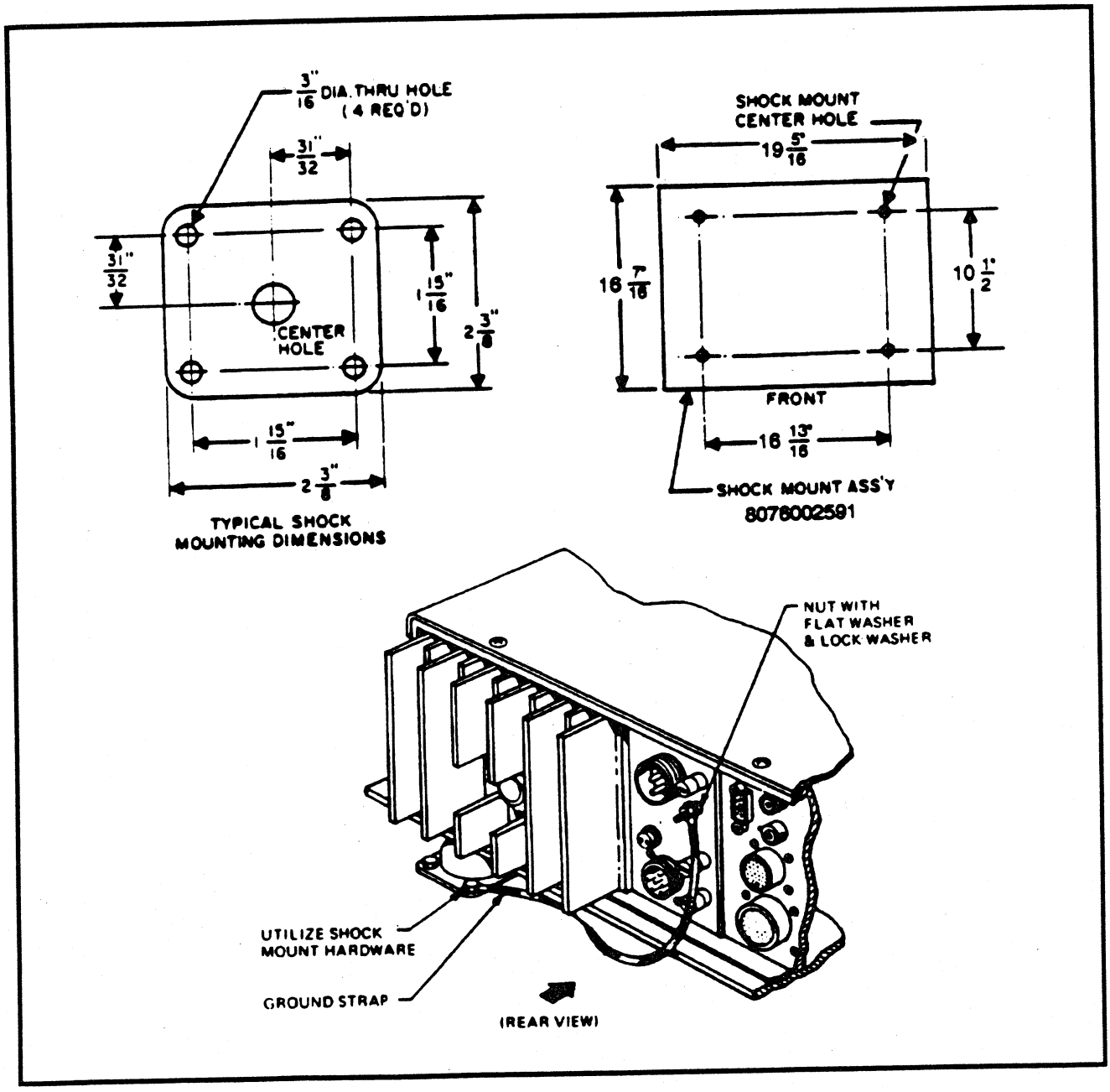

Figure 2.4.3.2 Grounding of RT-9000 to Shockmount.

2.4.4 MARINE INSTALLATIONS

In marine installations, follow the same recommendations as outlined in paragraph 2.4.3. If the transceiver is installed on a wood or fiberglass boat, a ground plate of twelve (12) square feet minimum area in contact with the water should be installed. A heavy ground lead such as a one inch (1") wide strap or braid should be connected between the ground post on the transceiver and the ground plate. The length of this ground lead should be held to an absolute minimum commensurate with a neat installation.

2.4.5 RACK INSTALLATIONS

The transceiver may be conveniently mounted in a standard nineteen inch (19") rack using the Rackmount Kit (Sunair p/n 8076004853[GRAY]. The kit includes rack slides, associated hardware and filler panels. The transceiver, in the rack mounted configuration, requires a standard panel space of seven inches (7") high. Refer to Figure 2.4.5.1 for assembly details.

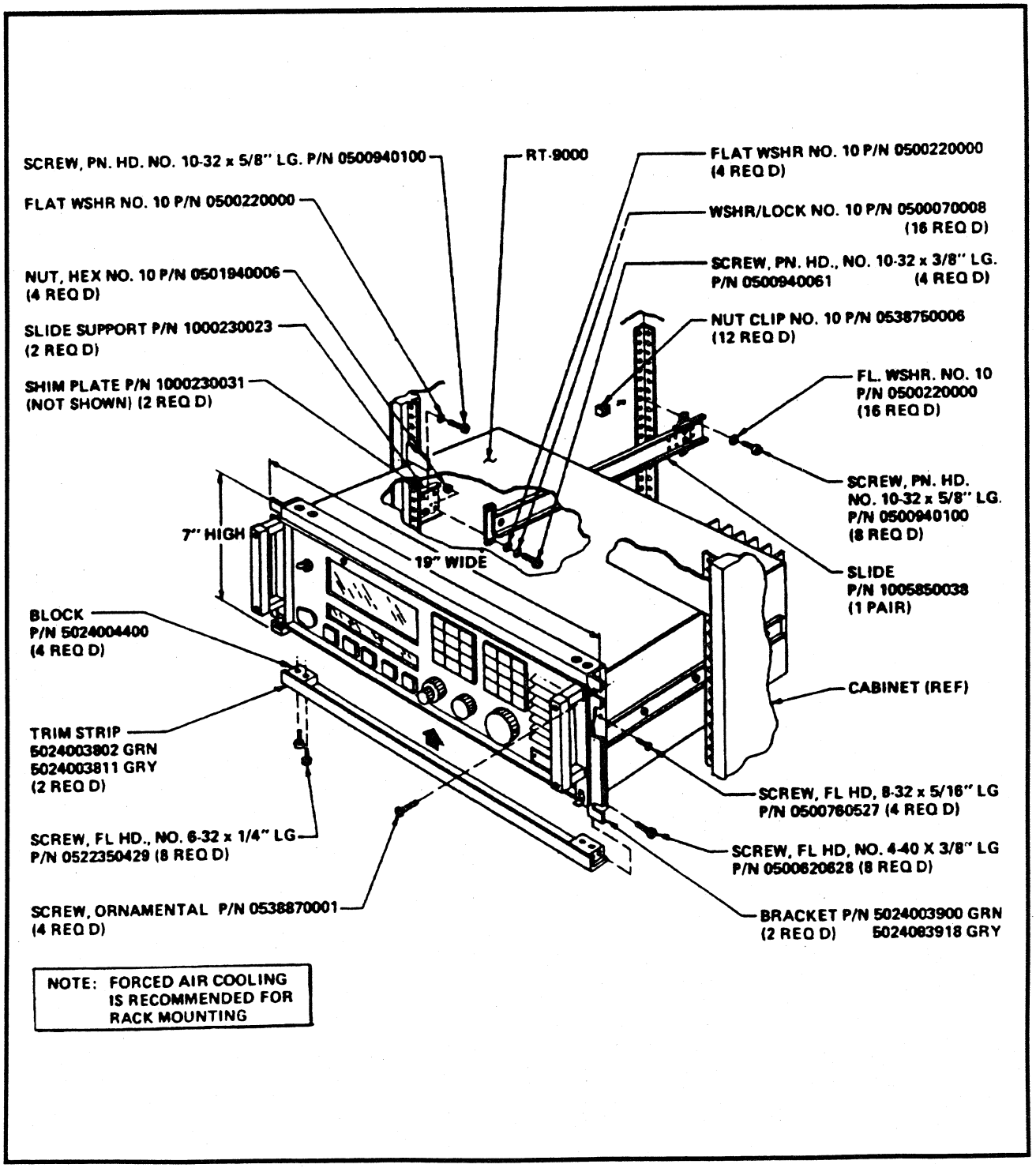

Figure 2.4.5.1 Installation of RT-9000 in Equipment Rack.

2.5 ANTENNAS AND GROUND SYSTEMS

2.5.1 GENERAL

The RT-9000 is designed to operate into a 50 Ohm resistive antenna system with a maximum Voltage Standing Wave Ratio (VSWR) of 2:1. When used with the CU-9125 Digital Antenna Coupler, the system will match antennas ranging from sixteen (16) foot whips to 150 foot long wires. The coupler will also efficiently match nine (9) foot whip antennas at frequencies above 4 MHz.

As there are numerous types of antennas, a complete discussion is beyond the scope of this manual. Antennas for use in the 1.6 to 30 MHz spectrum generally fall into three of the following categories:

a) Narrow Band 50 Ohm Antennas.
b) Random Length Non-Resonant Antennas.
c) Broad Band 50 Ohm Antennas.

NOTE: Some general **DOs** and **DON'Ts** of antenna installation are:

a) The antenna should be clear of all large objects such as trees, buildings and power lines.

b) Although the CU-9125 Digital Antenna Coupler will match electrically short antennas (i.e. those under 1/8 wavelength), such antennas are not efficient radiators. If the installation permits, antennas over 1/8 wavelength long at the lowest operating frequency should be used. (Antenna length generally limits system performance in vehicular applications at frequencies below four [4] MHz) as proper size would be inappropriate for the vehicle.

c) When using whip antennas, the ground system actually forms part of the radiating system. Where space permits (such as in a base station installation) a good ground plane or radial system should be installed at the base of the antenna.

NOTE: An inadequate ground system is most often responsible for disappointing performance when using a whip antenna.

d) In vehicular installations and marine installations in a metal hull ship, one inch (1") wide strap or braid should be connected between the antenna coupler ground and the frame of the vehicle. The length should be as short as possible. In an installation aboard a wood or fiberglass boat, a ground plate with at least twelve (12) square feet in contact with the water should be attached to the hull and a short one (1) inch wide strap should be connected between the coupler ground post and the plate. As previously mentioned this ground lead should be as short as possible.

2.5.2 NARROW BAND 50 OHM ANTENNAS

Typical of this type of antenna are the Doublet and the Inverted V. Both types of antennas may be assembled from the Sunair Doublet Antenna Kit (Sunair p/n 0996240004). Their operation is efficient for only a narrow band of frequencies within approximately 1 1/2% of their center frequency. The antenna coupler is NOT generally required if the frequency span of the antenna is not exceeded. Both antennas exhibit somewhat directional characteristics. The direction of maximum radiation is perpendicular to the antenna wire. The inverted V antenna is particularly suitable for communication with nearby mobile stations (with vertical antennas) since a portion of the radiation is in a vertical direction.

2.5.3 RANDOM LENGTH NON-RESONANT ANTENNAS

Whips and longwires are popular non-resonant antennas. The whip antenna is often used in mobile, marine, portable or semi-portable installations because it is rugged and self-supporting. The antenna impedance is strongly dependent on the operating frequency, therefore, an antenna coupler MUST BE used to match the antenna to the transceiver. Best radiation efficiency will be obtained if the antenna is at least 1/8 wavelength long at the lowest operating frequency; however, this requirement does not result in a practical size antenna for low frequency operation. Thirty-five (35) foot whip antennas offer a good compromise between practical height and good electrical performance at low frequencies. The CU-9125 Digital Antenna Coupler is designed to efficiently match whip antennas of sixteen (16) foot length or greater. An efficient match may also be obtained for a nine (9) foot whip above 4 MHz. The whip's performance is greatly influenced by its ground system. For temporary base station installations, a minimum of four (4), six (6) foot long ground rods should be driven into the ground symmetrically placed around the antenna base. The rods should be bonded together with heavy strap and then connected to the antenna coupler ground by another short heavy strap. If the antenna is mounted on the roof of a building, where a short ground lead to the coupler cannot be obtained, a minimum of four (4) symmetrically placed ground radials should be installed at the base of the antenna, bonded together, and connected to the antenna coupler ground post. The radials should be made of number twelve (12) gauge wire or larger and should be at least 1/4 wave long at the lowest operating frequency. The radiation pattern is omni-directional in the horizontal plane.

The longwire antenna, is a popular base station antenna where a wide range of operating frequencies are used. The antenna impedance varies greatly with frequency and, therefore, MUST BE matched to the transceiver with an antenna coupler. The CU-9125 will efficiently match longwire antennas up to 150 feet in length. The radiation pattern of the longwire antenna is also a function of the operating frequency. The two (2) most popular length longwire antennas, 75 and 150 feet (Sunair P/Ns 0999200003 and 099210009) exhibit excellent low frequency radiation efficiency.

2.5.4 BROADBAND 50 OHM ANTENNAS

These are generally complex, expensive antennas requiring a large area for installation. Their use is usually limited to high performance base station installations which must operate at an extended frequency range. As this class of antennas has approximately 50 Ohm output impedance over the rated band of frequencies, an antenna coupler is NOT required.

Some common examples are:

a) Discone (a vertical antenna with an omni-directional pattern).

b) Log Periodic (a broadband antenna with a directional pattern, this antenna is often made in a rotatable configuration).

Consult Sunair's Marketing and Product Services Departments for specific recommendations.