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- ★ Automatic HF Link Establishment—ALE
- ★ High-Speed Data Transmission (2400 bps)
- ★ Digitized LPC Voice Over HF
- ★ Embedded Voice/Data Encryption
- ★ ECCM—Frequency Hopping

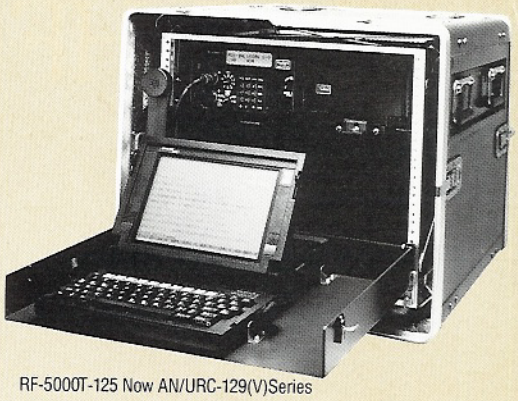
ALL IN *ONE* SMALL, TACTICAL PACKAGE

H A R R I S

RF-5000 SERIES

RF-5000V-125 Now AN/GRC-231(V)Series

RF-5020R/T Now RT-1642(P)/U



RF-5000T-125 Now AN/URC-129(V)Series

AN/GRC-231(V)

Vehicular/Base Series

AN/URC-129(V)

Transportable Series

NOW NOMENCLATURED

The Harris RF-5000 series tactical HF digital communications system is now nomenclatured—AN/GRC-231(V) Vehicular Radio Set and AN/URC-129(V) Transportable Radio Set.

The Receiver-Transmitter (RT-1642(P)/U) is the common element to all 20 watt, 125 watt, 400 watt radio set configurations. Plug-in options include a 2400 BPS High-Speed Data Modem Module (MD-1273/U) and an Automatic Link Establishment (ALE) Controller Module (CD-27/U).

A complete array of nomenclatured communication accessories, such as power amplifiers, power supplies, antenna couplers, vehicular mounts, and base-station mounts are also available to fulfill your mission requirements.

Contact our Marketing Department for more details.

DESCRIPTION	NOMENCLATURE	EQUIVALENT RF-5000 MODEL
Receiver-Transmitter, Radio	RT-1642(P)/U	RF-5020R/T Receiver-Transmitter (1.6 to 30 MHz)
Modem, Communications	MD-1273/U	RF-5110MD 2400 BPS High-Speed Modem Option Module
Control, Freq Selector	CD-27/U	RF-5120AFC Adaptive Frequency Controller (ALE) Option Module
Amplifier-Coupler, Radio Frequency	AM-7417/U	RF-5030PA/CU-20 Power Amplifier/Coupler, 20 Watts PEP
Amplifier, Radio Frequency	AM-7418/U	RF-5031PA-125 Power Amplifier 125 Watts PEP/Average
Amplifier, Radio Frequency	AM-7419/U	RF-5034PA-400 Power Amplifier 400 Watts PEP/Average
Mounting Base, Electrical Equipment	MT-6730/U	RF-5071VSM Shockmount for RF-5020R/T, RF-5031PA-125, or RF-5051PS-125
Mounting Base, Electrical Equipment	MT-6731/U	RF-5072VSM Dual Shockmount for RF-5020R/T and RF-5031PA-125, or two RF-5051PS-125s.
Mounting Base, Electrical Equipment	MT-6732/U	RF-5074VSM Single Shockmount for RF-5034PA-400
Power Supply	PP-8292/U	RF-5051PS-125 Power Supply, 125 Watt Base Station

DESCRIPTION	NOMENCLATURE	EQUIVALENT RF-5000 MODEL
Power Supply	OP-XXXX/U* (*Nomenclature Pending)	RF-5054PS-400 Power Supply, 400 Watt Base Station
Shipping and Storage Container, Electrical Equipment	CY-8615/U	RF-5087T-125 125 Watt Transportable Case
Radio Set	AN/URC-129(V)1	125W Transportable System with KG-84C and GRiD Computer
Radio Set	AN/URC-129(V)2	400W Transportable System with KG-84C and GRiD Computer
Radio Set	AN/GRC-231(V)1	RF-5000V-20 20 Watt Vehicular System
Radio Set	AN/GRC-231(V)2	RF-5000V-125 125 Watt Vehicular System
Radio Set	AN/GRC-231(V)3	RF-5000V-400 400 Watt Vehicular System
Coupler, Antenna	CU-2397A/G	RF-382A-02 Fast-Tune Antenna Coupler
Shipping and Storage Container, Electronic Equipment	CY-8618/U	400 Watt Transportable Case
Interconnecting Box	J-4896/U	KG-84C I-Box for Transportable Systems

HARRIS

HARRIS CORPORATION RF COMMUNICATIONS GROUP
1680 University Avenue Rochester, New York 14610 USA
Tel.: 716-244-5830 Fax.: 716-244-2917, 716-325-1572 • TELEX: 240313 RFCOM UR

MANUAL ASSEMBLY NUMBER: 10181-0032F
MAY 1991

HARRIS

RF COMMUNICATIONS

RF-5000 TACTICAL COMMUNICATIONS SYSTEM

SYSTEM MANUAL

PUBLICATION NUMBER: 10181-0032F
MAY 1991

RF-5000 TACTICAL COMMUNICATIONS SYSTEM

SYSTEM MANUAL

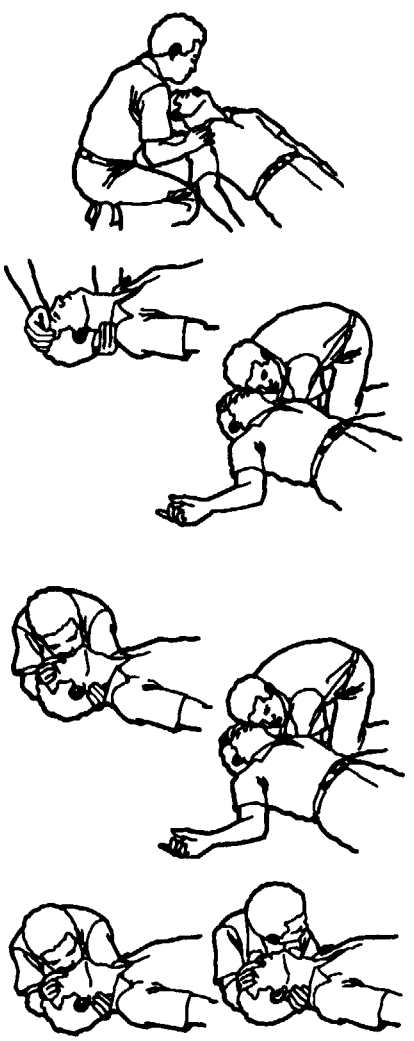
HARRIS CORPORATION RF COMMUNICATIONS GROUP 1680 University Avenue Rochester, New York 14610 U.S.A. Tel: 716–244–5830 Cable: RFCOM; Rochester, N.Y. TELEX: 240313

Equipment manufactured by Harris Corporation, RF Communications Group meets stringent quality and safety standards. However, high voltages are present in many radio products, and only a skilled technician should attempt to remove outer covers and make adjustments or repairs. All personnel who operate and maintain the equipment should be familiar with this page as a safety preparedness measure. Although this procedure is reproduced as a service to the personnel involved with this equipment, Harris Corporation assumes no liability regarding any injuries incurred during the operation and repair of such equipment, or the administration of this suggested procedure.

ELECTRICAL SHOCK: EMERGENCY PROCEDURE

The victim will appear unconscious and may not be breathing. If the victim is still in contact with the voltage source, disconnect the power source in a manner safe to you, or remove the victim from the source with an insulated aid (wooden pole or rope). Next, determine if the victim is breathing and has a pulse. If there is a pulse but no breathing, administer artificial respiration. If there is no pulse and no breathing, perform CPR (if you have been trained to do so). If you have not been trained to perform CPR, administer artificial respiration anyway. Never give fluids to an unconscious person.

WHEN BREATHING STOPS



FIRST, send someone to get a **DOCTOR**.
THEN, administer first aid to restore breathing (artificial respiration):

1 **IF A VICTIM APPEARS TO BE UNCONSCIOUS**
TAP VICTIM ON THE SHOULDER AND SHOUT, "ARE YOU OKAY?"

2 **IF THERE IS NO RESPONSE**
TILT THE VICTIM'S HEAD, CHIN POINTING UP. Place one hand under the victim's neck and gently lift. At the same time, push with the other hand on the victim's forehead. This will move the tongue away from the back of the throat to open the airway.

IMMEDIATELY LOOK, LISTEN, AND FEEL FOR AIR.
While maintaining the backward head tilt position, place your cheek and ear close to the victim's mouth and nose. Look for the chest to rise and fall while you listen and feel for the return of air. Check for about five seconds.

3 **IF THE VICTIM IS NOT BREATHING**
GIVE FOUR QUICK BREATHS.
Maintain the backward head tilt, pinch the victim's nose with the hand that is on the victim's forehead to prevent leakage of air, open your mouth wide, take a deep breath, seal your mouth around the victim's mouth, and blow into the victim's mouth with four quick but full breaths just as fast as you can. When blowing, use only enough time between breaths to lift your head slightly for better inhalation.

If you do not get an air exchange when you blow, it may help to reposition the head and try again.
AGAIN, LOOK, LISTEN, AND FEEL FOR AIR EXCHANGE.

4 **IF THERE IS STILL NO BREATHING**
CHANGE RATE TO ONE BREATH EVERY FIVE SECONDS.

For more information about these and other life–saving techniques, contact your Red Cross chapter for training.
"When Breathing Stops" reproduced with permission from an American Red Cross Poster.

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SPECIFICATIONS

RF–5020 R/T TRANSCEIVER

GENERAL	
Frequency Range:	1.6 to 29.99999 MHz in 10–Hz steps
Channels:	2.84×10^6 in 10–Hz increments
Frequency Stability:	$\pm 0.25 \times 10^{-6}$
Modes of Operation:	LSB, USB, AME, CW
Preset Channels:	Up to 100
Self–Test:	Full built–in–test to the module level
RF/Input/Output Impedance:	50 ohms nominal, unbalanced
Power Input (with optional power supply):	+26.4 Vdc per MIL–STD–1275 115/230 Vac 47–400 Hz; +12 Vdc)
Remote Control:	Detachable Front Panel RS–232 Asynchronous Interface
Data Interfaces:	Asynchronous Synchronous
Temperature Range:	–40° C to +70° C
Environmental:	MIL–STD–810D
Size:	7.5W x 12.1D x 5.5H in. (19.0W x 30.8D x 14.0H cm)
Weight:	6.8 kg, (15 lbs)
Plug–In Options:	RF–5110MD High–Speed Data Modem RF–5120AFC Automatic Link Establishment RF–5121ALE Automatic Link Establishment RF–5130LPC Digitized Voice (LPC) RF–5140FH Frequency Hopping RF–5150DE Embedded Data Encryption
RECEIVER	
Sensitivity:	–113 dBm for 10 dB SINAD
Audio Output:	3 watts to internal speaker
Squelch:	Front–panel adjustable
Selectivity:	3 kHz at –3 dB; 3.8 kHz at –60 dB
Image and IF Rejection:	Greater than 80 dB
Spurious Responses:	Below –120 dBm on 99.9% of channels
AGC:	Mode dependent, automatically selected with manual override

SPECIFICATIONS (Cont.)

RF–5020 R/T TRANSCEIVER (Cont.)

TRANSMITTER	
Power Output:	Nominal 100 mW; Peak or Average
Carrier Suppression:	Greater than 60 dB
Undesired Sideband Rejection:	Greater than 60 dB
Intermodulation Distortion:	–45 dB
Spurious Outputs:	Below –120 dBm on 99.9% of channels
Audio Input:	Dynamic microphone (1 mV) or 600 ohm @ 0 dBm for full rated output

RF–5030PA/CU–20 20–WATT HF POWER AMPLIFIER/ANTENNA COUPLER

GENERAL	
Frequency Range:	1.6 to 29.99999 MHz
RF Input/Output Impedance:	50 ohms nominal, unbalanced
Power Input:	+26.4 Vdc (per MIL–STD–1275) @ 3.0 Amps, maximum
Temperature Range:	–40° C to +70° C
Environmental:	MIL–STD–810D
Size:	5.25W x 7.5D x 2.65H in. (13.3W x 19.1D x 6.7H cm)
Weight:	2.3 kg (5.0 lbs)
POWER AMPLIFIER	
Power Output:	20 Watts PEP (5 Watts Avg.) into 50 Ohms
RF Drive Requirements:	Nominal 100 mW (+20 dBm)
Intermodulation Distortion:	–30 dB
Output Connector:	BNC
ANTENNA TUNER	
Tuning Mode:	Automatic
Tune Cycle Time:	200 millisecond typical
Antenna Tuning Capability:	9 – 35 ft. (2.7 – 10.7 m) whips 75 – 150 ft. (23 – 46 m) long wires

SPECIFICATIONS (Cont.)

RF–5031PA–125 125–WATT HF POWER AMPLIFIER

GENERAL	
Frequency Range:	1.6 to 29.99999 MHz
RF Input/Output Impedance:	50 ohm nominal, unbalanced
Power Input:	+26.4 Vdc (Per MIL–STD–1275) @ 15 Amps, maximum
Temperature Range:	–40° C to +70° C
Environmental:	MIL–STD–810D
Size:	7.5W x 10.1D x 5.4H in. (19.0W x 25.7D x 13.8H cm)
Weight:	5.8 kg (12.8 lbs)
POWER AMPLIFIER	
Power Output:	125 Watts PEP/Average into 50 Ohms
RF Drive Requirements:	+20 dBm (100 mW)
Intermodulation Distortion:	–30 dB
Harmonic Output:	–40 dB

RF–5034PA–400 400–WATT HF POWER AMPLIFIER

GENERAL	
Frequency Range:	1.6 to 29.99999 MHz
RF Input/Output Impedance:	50 ohms nominal, unbalanced
Power Input:	+26.4 Vdc (per MIL–STD–1275) @ 55 Amps, maximum
Temperature Range:	–40° C to +55° C
Environmental:	MIL–STD–810D
Size:	12.0W x 16.4D x 7.7H in. (30.5W x 41.7D x 19.6H cm)
Weight:	20.5 kg (45 lbs)
POWER AMPLIFIER	
Power Output:	400 Watts PEP/Average into 50 Ohms
RF Drive Requirements:	+20 dBm (100 mW)
Intermodulation Distortion:	–30 dB
Harmonic Output:	–40 dB

SPECIFICATIONS (Cont.)

RF–5110MD HIGH–SPEED DATA MODEM (OPTION)

39–TONE MODE	
Data Rates:	2400, 1200, 600, 300, 150, 75 bps
Transmission Mode:	Half Duplex
FEC Coding:	(14, 10, 2) Reed–Solomon Code at 2400 bps (7, 3, 2) Reed–Solomon Code at lower bps rates
Interleaving:	Four levels (short, long, alternate short, alternate long)
Tone Library:	39 Tones, 675 – 2812.5 Hz, 56.25 Hz Tone Spacing; Doppler tracking tone: 393.75 Hz
Modulation:	TDPSK, four phase
Demodulation:	128 point FFT
Doppler Correction:	75 Hz; tracking up to 3.5 Hz per second
Channel Bandwidth:	3000 Hz
BINARY FSK MODE	
Data Rate:	300, 150, 75 bps
Transmission Mode:	Half Duplex
Signaling:	Phase Continuous Binary FSK
FSK Modes:	Front–Panel Selectable Wide Shift: 2000 Hz 425 Hz Narrow Shift: 2805 Hz 42.5 Hz Alternate: 2000 Hz 85 Hz Programmable Mark, Space: 350 to 3250 Hz
DATA INTERFACES	
Data:	Asynchronous (9600, 4800, 2400, 1200, 600, 300, 150, 75 baud), ASCII Synchronous (2400, 1200, 600, 300, 150, 75 baud; internal clock)
Control:	RTS CTS, XON–XOFF, CTRL–B (key), CTRL–C (unkey)
Electrical:	RS–232C
Remote Control:	Full function

SPECIFICATIONS (Cont.)

RF–5120AFC ADAPTIVE FREQUENCY CONTROLLER (OPTION)

PROGRAMMING	
Parameters:	Radio channels, local address, network addresses, add channels, delete channels, delete addresses, time of day, preamble length, on–air bit rate
CHANNELS	
Number:	100 simplex and/or half–duplex
Frequency Range:	1.6 to 29.99999 MHz
Modes:	USB, LSB
SCAN	
Rate:	100 msec/channel
Scanned Channels:	100 maximum
Channel Scan List:	Automatically generated
ADDRESSES	
Format:	4–digit numeric
Total Available:	8019 individual, 81 group, 9 net, 1 broadcast
Programmed Addresses:	30 maximum
Channels per Address:	20 maximum
SELECTIVE CALLING	
Modes:	Channel selection: Automatic, Manual
Handshake:	3–way for individual, 1–way for group
LINK QUALITY ANALYSIS	
Measurement:	Bidirectional weighted average SNR (point to point)
Number of Channels:	20 maximum
Group LQA:	Not available
Addresses Queued:	10 maximum
Matrix Size:	30 address x 20 channels
SIGNALING	
On–Air Bit Rate:	200, 100 bits/second (selectable)
Coding:	Golay Forward Error Correction (FEC)
Preamble (Stop Scan):	0.5 sec./chan + 0.5 sec. (RF–7100 mode); 0.1 sec./chan. + 0.1 sec. (RF–5120 mode)
Integrated Data Modem:	100/50 bits/sec. throughput
BUILT–IN TEST	

SPECIFICATIONS (Cont.)

RF–5120AFC ADAPTIVE FREQUENCY CONTROLLER (OPTION) (Cont.)

INTERFACES	
Remote Control Interface:	Via Async data port RS–232C
Engineering Orderwire:	Via Async data port RS–232C

RF–5121ALE AUTOMATIC LINK ESTABLISHMENT (OPTION)

PROGRAMMING	
Parameters:	Radio channels and channel groups, local address, network, addresses, time of day, LQA start time and repeat interval, antenna coupler tune time
Retention:	5 Year minimum
CHANNELS	
Number:	100 simplex and/or half duplex
Frequency Range:	1.6 to 29.999999 MHz
Modes:	USB, LSB, AME, FSK, CW
SCAN	
Rate:	5 channels per second
Scanned Channels:	100 maximum
Channel Scan Groups:	1
SELECTIVE CALLING	
Types:	Individual, net, allcall, selective allcall; receive only for group, any, selective any, and wildcard calls
Link Protection:	Optional (per FED–STD–1049 when published)
Channel Selection:	Automatic or manual
Handshake:	3–way for individual, net, group, any, wildcard
	1–way for allcalls
Other:	Digital squelch, listen before transmit (ALE traffic only, key–to–call, addressing
ADDRESSES	
Format:	15 character alphanumeric
Local Addresses:	20 maximum
Network Addresses:	20 maximem
Individual Addresses:	100 maximum

SPECIFICATIONS (Cont.)

RF–5121ALE AUTOMATIC LINK ESTABLISHMENT (OPTION) (Cont.)

LINK QUALITY ANALYSIS	
Types:	Sounding and LQA e xchange
Measurement:	1–way and 2–way weighted average based on SNR and pseudo bit error rate (PBER)
Number of Channels:	100 (1–way or 2–way)
Queueing:	Address (individual or net), start time, and repeat interval
Addresses Queued:	10 maximum
Quantity	100 channels X 100 addresses
SIGNALING	
Modulation:	Phase continuous 8–ary FSK
Symbol Rate:	125 baud
SIGNALING (CONT.)	
Bit Rate:	375 bits/second
Coding:	Golay FEC, 2/3 majority vote, interleaving
Calling Cycle:	1 second to 79 seconds (depending on call type, channels scanned, and call sign length)
BUILT IN TEST	
Functions Tested:	RF–5121ALE, radio, power amplifier, coupler
REMOTE CONTROL	
Interface:	RS–232
Rate:	300 to 9600 baud asynchronous
Other:	2 stop bits, 8 data bits, no parity ASCII character based (compatible with existing RF–5000 remote control)

RF–5130LPC LINEAR PREDICTIVE CODING DIGITIZED VOICE (OPTION)

GENERAL	
Audio Input:	Handset connector: 1.5 mV RMS into 150 ohms 600 ohm aux connector: 0/–10 dBm
Bit Rates:	2400 or 800 bps
Bit Error Tolerance:	2 x 10^{-2} random BER for DRT greater than 80
Synchronization:	Frame sync at beginning of message
Tracking:	Continuous sync during message
End of Message:	End of message data or loss of tracking data for two seconds

SPECIFICATIONS (Cont.)

RF–5140FH FREQUENCY HOPPING MODULE (OPTION)

GENERAL	
Hop Rate:	20 hops/second
Data Rate:	75, 150, 300 bps
Forward Error Correction:	Frequency diversity (all rates): 14, 10, 2 Reed–Solomon (75, 150, 300 bps)
Hop Nets:	10 (Sync on only one of the ten nets)
Hopping Bandwidths:	Wide Band: Programmable from 50 kHz to 1 MHz; Minimum Lower Frequency: 1.6 MHz Maximum Upper Frequency: 29.995 MHz; Narrow Band: 50 kHz, 100 kHz, or 250 kHz (center frequency dependent); Frequency List: same as wide band
Frequency Spacing:	3 kHz
Frequency List:	Minimum 15 frequencies; maximum 100 frequencies
Hopset Exclusions:	Sub–bands (10 total)
PN Generator:	Non–linear, repeat cycle > 5 years
Initial Sync Time:	29 seconds — once per 24–hour period
Late Net Entry Time:	29 seconds
In–Net Message Sync:	Coarse Sync: continuous for > 24 hours; Fine Sync; 200 msec, typical after keydown

RF–5150DE DIGITAL ENCRYPTION MODULE (OPTION)

GENERAL	
Available Codes:	1×10^{52}
Key Codes:	Six key codes of the 1×10^{52} available codes are assignable to any single channel or frequency–hopping net
Front–Panel Controls:	Code selection, fill, zeroize, encryption ON/OFF
Synchronization:	Burst synchronization while in single channel and continuous synchronization while in frequency hopping

SPECIFICATIONS (Cont.)

RF–5150DE DIGITAL ENCRYPTION MODULE (OPTION) (Cont.)

PROGRAMMERS

RF–5960 Master Code Programmer

The RF–5960 Master Code Programmer provides programming of the RF–5150DE Data Encryption Option with six key codes with up to 1 x 10^{52} possible combinations in a portable configuration. Operates from 115/230 Vac, 50/60 Hz, or as a portable unit on an internal BB–590/U Rechargeable NICAD Battery. The internal battery is automatically recharged when operated on ac.

Available Codes:	1 x 10^{52} possible settings
Power:	115/230 Vac, 50/60 Hz, internal BB–590/U Rechargeable NICAD Battery
Size:	5.38H x 7.5W x 8.5D inches (11.8H x 16.5W x 18.7D cm)
Weight:	11.5 lbs. (29 kg.)

RF–5961 Field Code Programmer

The RF–5961 Field Code Programmer is a pocket–sized unit that permits programming of the RF–5150DE Digital Encryption Unit option with six key codes having up to 1 x 10^{52} combinations. A self–contained lithium battery retains codes. Has emergency code dump feature. Requires an RF–5960 Master Code Programmer to insert codes.

Key Codes:	Stores six of the available 1 x 10^{52} codes for loading
Power:	Internal lithium battery
Size:	1.25H x 1.93W x 5.6D inches (2.8H x 4.2W x 12.3D cm)
Weight:	0.5 lbs. (1.3 kg.)

ABOUT THIS MANUAL

This manual contains information necessary to install, operate, and program the RF–5000 System and options.

RF–5000 TACTICAL COMMUNICATIONS SYSTEM

SYSTEM MANUAL

RF–5000 Tactical Communications System

SECTION 1

INTRODUCTION

1.1 GENERAL DESCRIPTION

The RF–5000 Tactical Communications System is a high–performance, integrated, voice/data, high–frequency tactical communication system operating over the 1.6 to 30 MHz frequency range. Optional modules can be installed to expand the system features to include:

- High–Speed, 2400–Baud Data Modem
- FSK Data Modem
- Frequency Hopping
- Automatic Link Establishment Controller
- Digitized Voice
- Data/Digitized Voice Encryption
- Full Remote Control

Figures 1–1 and 1–2 illustrate possible applications of the RF–5000 System in a communications system.

1.2 MAJOR SYSTEM COMPONENTS

An RF–5000 system typically consists of an RF–5020R/T Receiver/Transmitter (R/T) and one of the following:

- an RF–5030PA/CU–20 20–watt Power Amplifier/Antenna Coupler
- an RF–5031PA–125 125–watt Power Amplifier
- an RF–5034PA–400 400–watt Power Amplifier
- an RF–5031PA–125 125–watt Power Amplifier and an RF–3230 1–kW Linear Power Amplifier

The RF–382A–02 Antenna Coupler may be used with the RF–5031PA–125 and RF–5034PA–400 Power Amplifiers. The RF–2601 or RF–601A Antenna Couplers may be used with the RF–3230 1–kW Power Amplifier.

1.2.1 RF–5020R/T Receiver Transmitter

The RF–5020R/T, shown in the frontispiece, covers the 1.6 to 30 MHz frequency range. All normal RF–5000 System functions are controlled from the front panel. A 32–character, liquid crystal, alphanumeric display provides system status and data entry to simplify operation and programming. All RF–5000 System option modules are installed in the RF–5000R/T chassis, eliminating the need for exterior accessories.

1.2.2 RF–5085MT–FP R/T Mount for the RF–5020R/T's Front Panel

The front panel (P/N RF–5010FP) is easily removed by finger–release latches. The RF–5085MT–FP Mount can then be used to remotely mount the front panel up to 50 feet (15 m) from the RF–5020R/T for operator convenience. This application is shown in figure 1–3. The RF–5085MT–FP uses the 10181–9830 cable to interconnect between the RF–5085MT–FP and the R/T chassis. The receiver/transmitter can be mounted on either the RF–5071MT single shock mount or with the RF–5031PA–125 on the RF–5072MT dual shock mount.

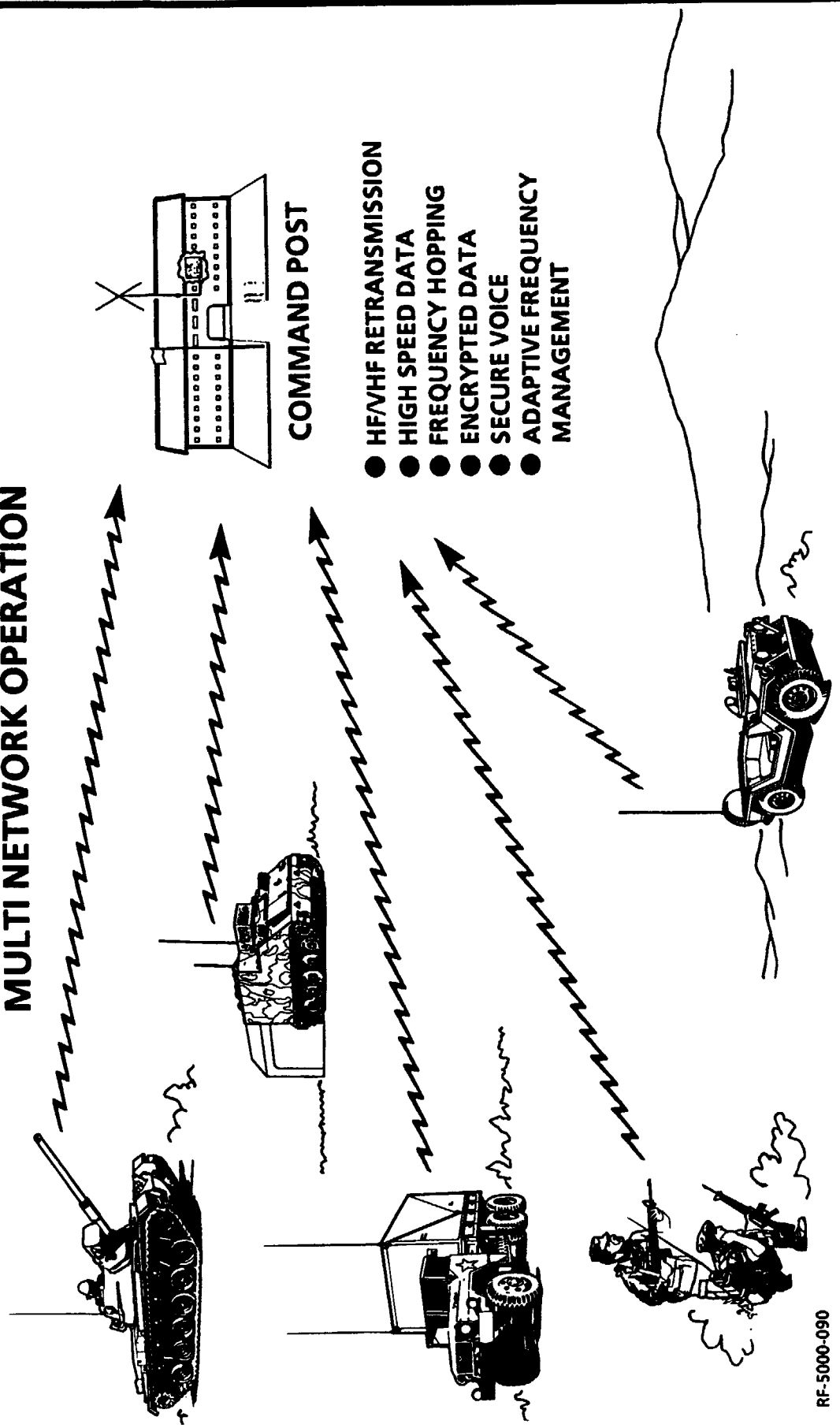


Figure 1–1. RF–5000 Multi–Network Operation

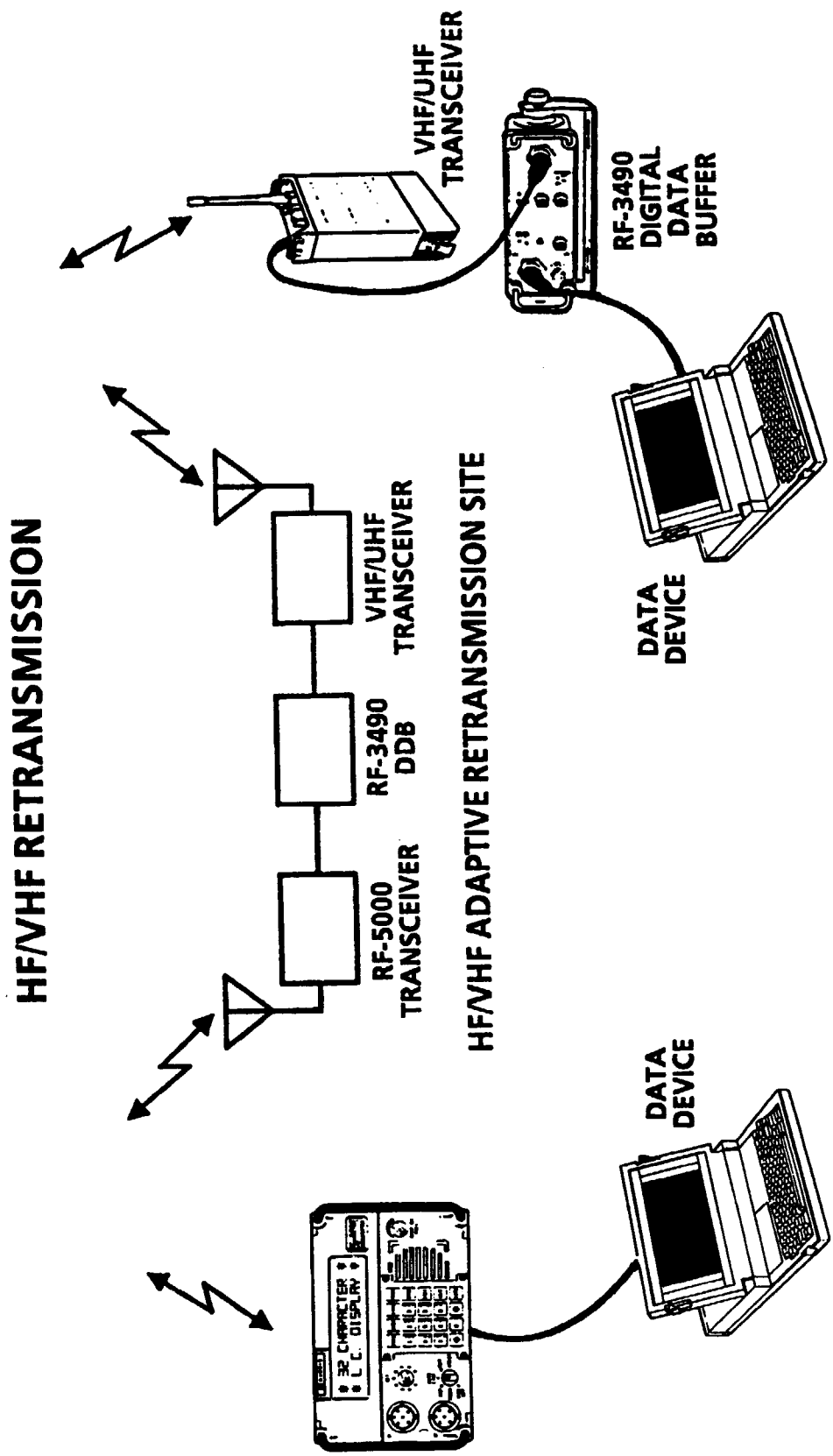


Figure 1–2. RF–5000 HF/VHF Retransmission

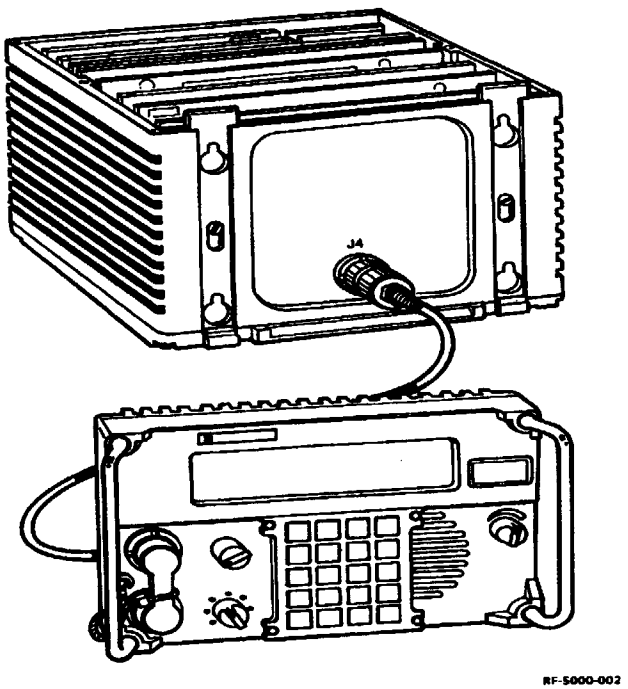


Figure 1–3. Typical Remote Front Panel Installation with RF–5085MT–FP

1.2.3 RF–5030PA/CU–20 20–Watt Power Amplifier

The RF–5030PA/CU–20 is shown in figure 1–4. This unit amplifies the 100–milliwatt output of the RF–5020R/T to 20 watts. The coupler automatically matches a full range of 9 – to 35–foot (2.7 to 10.7 meter) vehicular or base station whip antennas, and also the RF–1936 NVIS (Near Vertical Incidence Skywave) antenna.

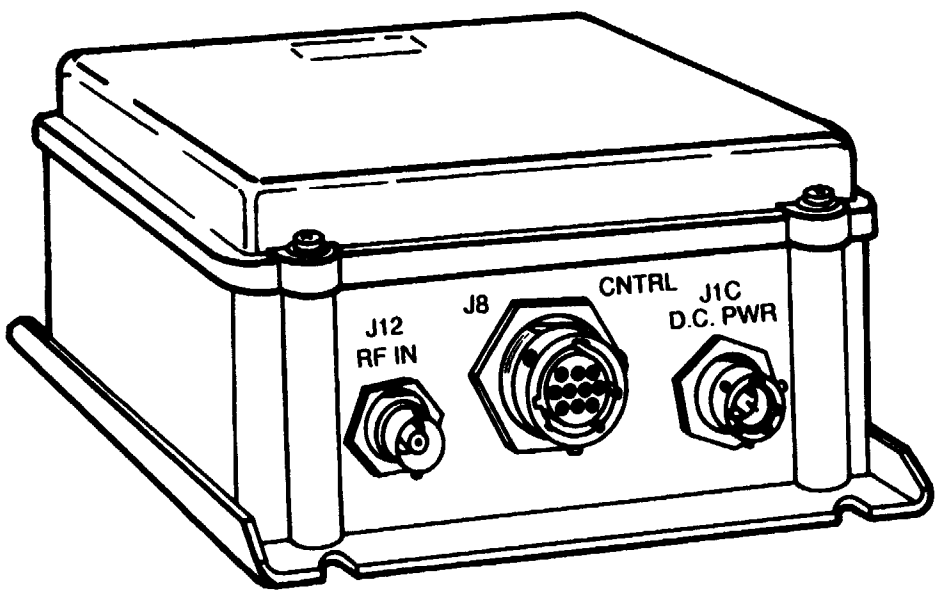


Figure 1–4. RF–5030PA/CU–20 20–Watt Power Amplifier

The RF–5030PA/CU–20 has two antenna outputs. If the RF–5000 is to operate into a broadband antenna where no tuning is required, the 50–ohm output is used. This connection bypasses the internal coupler circuitry. The standard unbalanced load connector is used with whip, long–wire, and unmatched dipole antennas that require impedance matching for efficient operation into these systems. The typical tune cycle time is 200 milliseconds.

1.2.4 RF–5031PA–125 125–Watt PEP/Average Power Amplifier

The RF–5031PA–125 automatically tunes in response to control inputs from the RF–5020R/T. It also contains an integral power supply, control circuits, harmonic filters, and provides power supply overload protection for the R/T. Primary dc power for the R/T is routed from the source, through protection circuits in the power amplifier, and through the control cable to the R/T. The R/T also monitors the presence and operational status of both the power amplifier and the coupler through the power amplifier to the R/T control cable.

Although the power amplifier is typically located near the R/T, it can be separated by up to 150 feet (45.7 meters). The power amplifier can be mounted on the RF–5071MT single shock mount or with the RF–5020R/T on the RF–5072MT dual shock mount.

There are no controls or indicators on the RF–5031PA–125 other than a resettable circuit breaker which provides overload protection to the system. The RF–5031PA–125 is shown in figure 1–5.

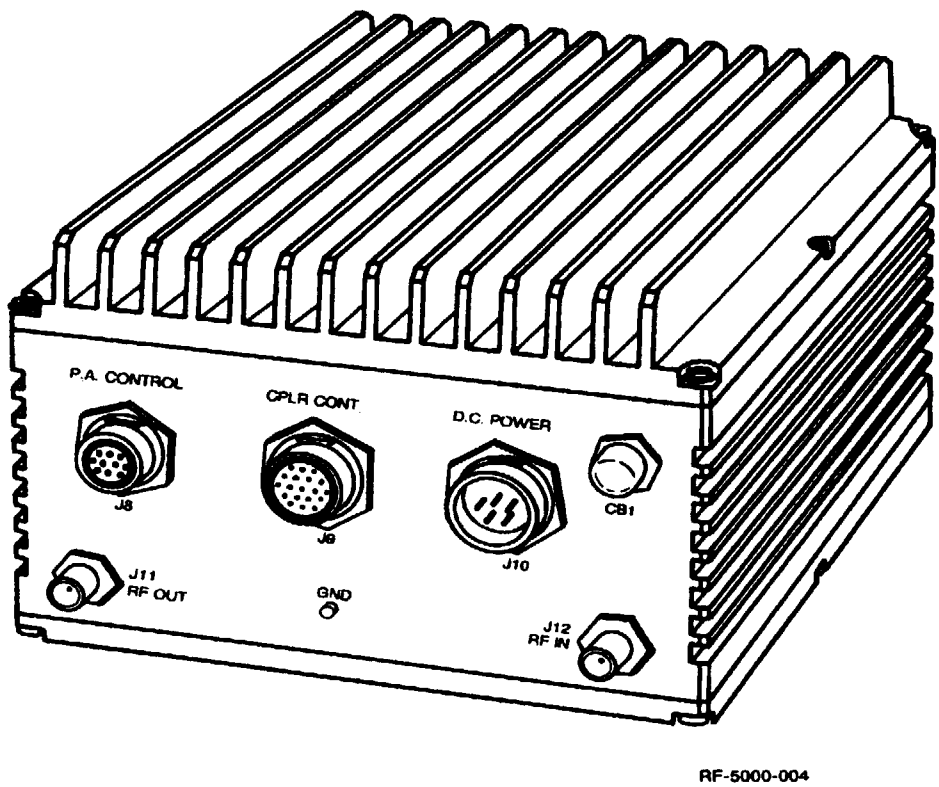


Figure 1–5. RF–5031PA–125 System Interface Features

1.2.5 RF–5034PA–400 400–Watt Power Amplifier

The RF–5034PA–400 400–Watt Power Amplifier is shown in figure 1–6. Like the 20–watt and 125–watt power amplifiers, the 400–watt power amplifier is operator transparent, but does contain a resettable circuit breaker. It requires either a separate antenna coupler or operation into a broadband antenna system that appears to the power amplifier as a 50–ohm load (within the VSWR specifications). The power amplifier can be mounted on the RF–5074MT shock mount for installation in vehicular applications.

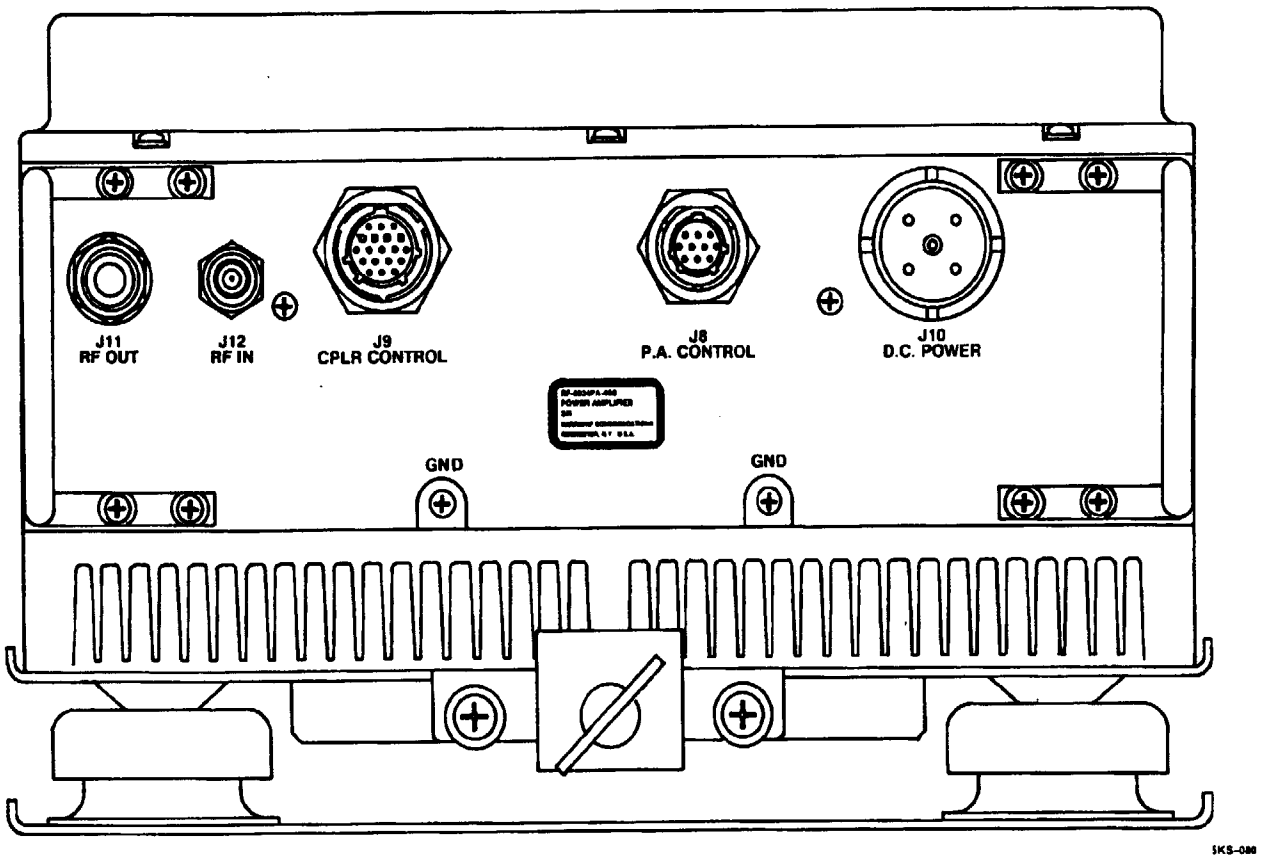


Figure 1–6. RF–5034PA–400 400–Watt Power Amplifier with RF Shock Mount

1.2.6 RF–3230 1000–Watt Power Amplifier

The RF–3230 1–kW linear power amplifier is used along with the RF–5031PA–125 (as the driver amplifier) to form the RF–5000 1–kW System. The RF–3230 is a fast–tune (100 msec) 1.6 to 30 MHz, linear power amplifier. The amplifier delivers 1000 watts into a 1.5:1 VSWR and is fully protected for any VSWR. Operating modes are FULL POWER (1000 watts), adjustable LOW POWER mode, and BYPASS mode. In BYPASS mode the system operates as a RF–5000–125 125–watt system. The RF–3230 is designed to be installed in a rack. The system requires either an optional antenna coupler, such as the RF–2601 or the RF–601A, or a broadband antenna.

1.2.7 RF–382A–02 Automatic Antenna Coupler

The RF–382A–02, shown in figure 1–7, is a 500–watt PEP/250 watt average fast tune automatic antenna coupler. This unit automatically matches the output of the RF–5031PA–125 Power Amplifier or RF–5034PA–400 Power Amplifier to a wide range of whip, dipole, and long–wire antennas over the full operating range of the system. After an initial tuning cycle, the tune time of the RF–382A–02 is 25 milliseconds. The initial tune cycle time is typically less than one second.

All RF–382A–02 Antenna Coupler operation is automatic in response to control signals from the R/T (through the power amplifier). Coupler status is reported back to the R/T through the power amplifier control cable. There are no operator controls on the coupler.

1.3 SYSTEM CONFIGURATIONS

The RF–5000 is offered in several standard system configurations, including vehicular, base station and transportable. Information on these configurations is included in the installation section of this manual.

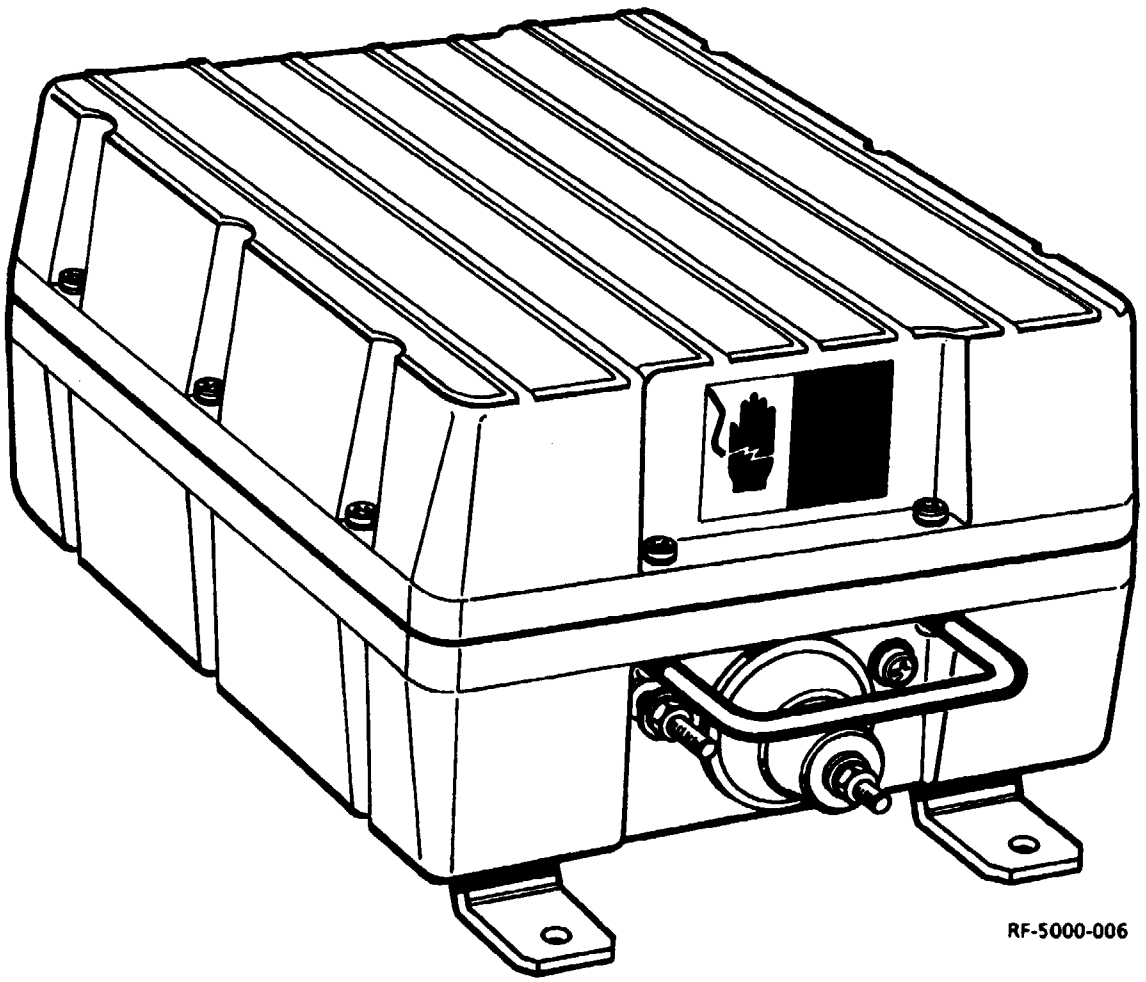


Figure 1–7. RF–382A–02 Automatic Antenna Coupler

1.4 OPTIONAL EQUIPMENT

The RF–5000 system is available with a number of options and a variety of optional equipment. Table 1–1 lists some of these available options.

Table 1–1. Options for the RF–5000 System

Part Number	Option	Description
RF–3016–03	CW Key with Knee Clip	Useful for vehicular CW operation.
RF–3016–04	CW Key–Base Station	Includes key, cable, and plug.
RF–3014–01	Handset with Boom Microphone–Dynamic Mike Element	Single Earpiece
RF–3014–02	Handset with Boom Microphone–Dynamic Mike Element	Dual Earpiece
RF–294–07	Microphone	Palm–held noise–cancelling microphone.
RF–294–08	Headset	Two–earphone headset unit.

Table 1–1. Options for the RF–5000 System (Cont.)

Part Number	Option	Description
RF–294–10	Retransmission Control Unit	Interconnects two R/T Assemblies for retransmit operation.
RF–294A	Radio Intercom Set	Audio system providing crew members of heavy–duty vehicles with radio and communication facilities. (Requires RF–294A–01 Audio Frequency Amplifier.)
RF–294A–01	Audio Frequency Amplifier	Amplifies intercom as well as received audio signals. (Requires a 10181–9850 Interface Unit to interconnect RF–294A to the RF–5020R/T.)
RF–294A–02	Intercommunications Set Control (External)	Provides radio and intercom facilities to personnel outside the vehicle (through the RF–294A–03).
RF–294A–03	Intercommunications Set Control (Driver	Provides radio and intercom facilities to driver.
RF–294–04	Intercommunications Set Control (Commander)	Provides radio and intercom facilities for the commander or other personnel in vehicle.
10181–9850	Interface Unit RF–294A to RF–5020R/T	Serves as a junction box to interface the RF–294A to the RF–5020R/T Assembly.
H–250/U	Handset	Lightweight handset.

SECTION 2

INSTALLATION

2.1 GENERAL

The RF–5000 System is delivered in several configurations for vehicular, base station and transportable applications. When purchased in a standard system configuration, all interface cables are precut and assembled to the appropriate length.

This section contains the information required to install the RF–5000 System in a vehicular , base station, or rack–mounted configurations.

2.2 UNPACKING AND INSPECTION

The RF–5000 equipment is packed in corrugated boxes for shipment, as shown in figure 2–1. A two–piece foam enclosure protects the equipment against corrosion and rough handling. Unpack the equipment from the boxes as follows:

a. When the unit is received, carefully inspect the exterior of the box. Look for any damage, signs of rough handling, weather exposure (i.e., water damage), or signs of tampering. Carefully note any problems and report them to the proper authority. An external sticker on the shipping box provides additional instructions concerning inspection of the package.

b. Refer to figure 2–1 for unpacking instructions. A knife or similar instrument is required to open the box. Keep the packing box in a secure place for possible future use.

c. After removing the equipment from the box, check the equipment against the packing slip to see that the shipment is complete. Report all discrepancies to the proper authority.

d. Use normal care to move the boxed equipment into the general location where it is to be installed. Various configurations will dictate the weight of the equipment. Exercise care when moving boxed assemblies to and from locations.

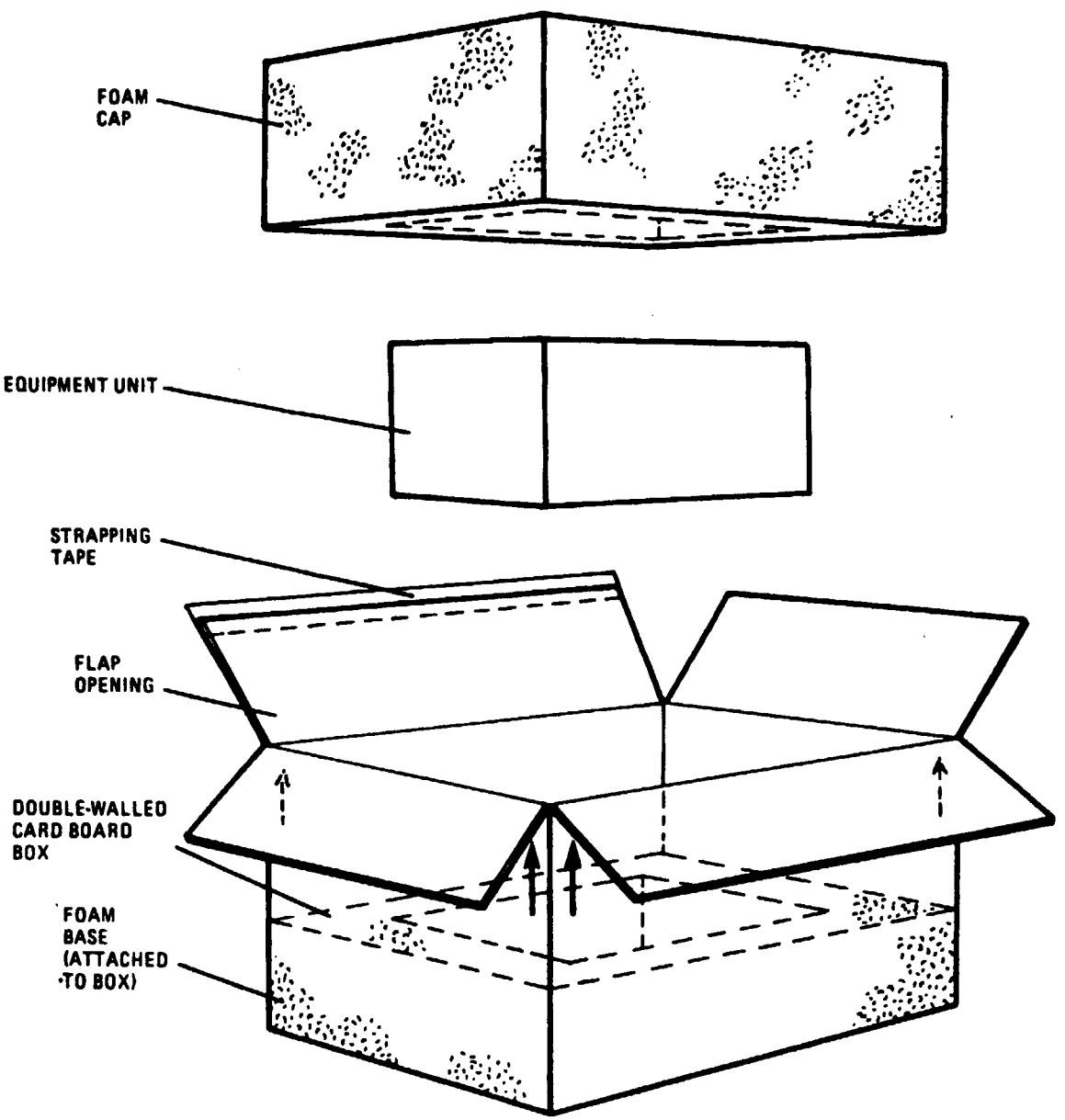
2.3 REQUIRED TOOLS

Installation requires no special tools, other than those found in a mechanic's/technician's standard tool set. A typical vehicular installation requires a hammer, punch, pliers, and power drill. A base station installation requires standard and Phillips screwdrivers and an adjustable wrench.

2.4 SITE SELECTION

Where possible, mount the vehicular transceiver in a position easily usable by the operator. For base station operation, select a ventilated and well–lighted operating location. Avoid placing the system in a busy or congested area or where there is excessive noise. The following factors are general site location considerations:

- Availability of power source, earth ground, antenna, etc.
- Ease of operation, maintenance, or removal and replacement.
- Ventilation
- Clearance of connection cables to the back of the radio, antenna coupler, etc.



UNPACKING PROCEDURE

1. PLACE BOX ON FLOOR WITH ARROWS MARKED ON EACH SIDE POINTING UP.
2. CUT TAPE ON TOP OF BOX AND REMOVE FOAM CAP FROM BOX.
3. LIFT EQUIPMENT UNIT OUT OF BOX.
4. SAVE BOX AND FOAM CAP FOR RESHIPMENT.

382-001

Figure 2–1. Unpacking the Equipment

2.5 INSTALLATION PRECAUTIONS

- Select a dry, ventilated location.
- If possible, avoid installing the system in a high–impulse noise environment such as high–voltage lines, electronic ignitions, motors, generators, etc.
- When installing in a vehicle, avoid mounting the system in front of the vehicle's heater air outlet.
- Shock mounting should be used for all vehicular installations and any non–vehicular installation that will experience excessive vibration.
- **DO NOT** locate the antenna near trees, power lines, or large metal structures.

2.6 SYSTEM CONFIGURATIONS

This section lists the equipment contained in the vehicular, base station, and transportable versions of the RF–5000. Also included is the equipment list for the rack–mounted version of the RF–5000 system. Ancillary kits, listed in paragraph 2.6.5 , are supplied with each version and contain the cables, connectors, etc. necessary for installation.

2.6.1 Vehicular Systems

The RF–5000V–20 is a 20–watt vehicular HF–SSB transceiver system consisting of:

RF–5020R/T	Receiver Transmitter
RF–5071VSM	Shock Mount for RF–5020R/T
RF–5030PA/CU–20	Power Amplifier/Antenna
H–250/U	Lightweight Handset

The RF–5000V–125 is a 125–watt vehicular HF–SSB transceiver system consisting of:

RF–5020R/T	Receiver Transmitter
RF–5031PA–125	Power Amplifier – 125 watt
RF–5072VSM	Shock Mount for RF–5020R/T and RF–5031PA–125
H–250/U	Lightweight Handset

The RF–5000V–400 is a 400–watt vehicular HF–SSB transceiver system consisting of:

RF–5020R/T	Receiver Transmitter
RF–5034PA–400	Power Amplifier – 400 watt
RF–5071VSM	Shock Mount for RF–5020R/T
RF–5074VSM	Shock Mount for RF–5034PA–400
H–250/U	Lightweight Handset

2.6.2 Base Station Systems

The RF–5000B–125 is a 125–watt output base station consisting of:

RF–5020R/T	Receiver Transmitter
RF–5031PA–125	Power Amplifier – 125 watt
RF–5051PS–125	Power Supply – 125 watt base station
RF5081–BMT–125	Base Station Shock Mount for: RF–5020R/T, RF–5031PA–125, and RF–5051PS–125
H–250/U	Lightweight Handset

The RF5000B–400 is a 400–watt output base station consisting of:

RF–5020R/T	Receiver Transmitter
RF–5034PA–400	Power Amplifier – 400 watt
RF–5054PS–400	Power Supply – 400 watt base station
RF–5084BMT–400	Base Station Shock Mount for : RF–5020R/T, RF–5034PA–400, and RF–5054PS–400
H–250/U	Lightweight Handset

For information on the RF–5000 1–kW 1000–Watt Base Station, refer to the RF–5000 1–kW System Service manual, publication number 10221–5339.

2.6.3 Transportable Systems

The RF–5000T–125 is a 125–watt output transportable system consisting of:

RF–5020R/T	Receiver Transmitter
RF–5031PA–125	Power Amplifier – 125 watt
RF–5051PS–125	Power Supply – 125 watt
RF–5087T–125	Transit Case
H–250/U	Lightweight Handset

The RF5000T–400 is a 400–watt output transportable station consisting of:

RF–5020R/T	Receiver Transmitter
RF–5034PA–400	Power Amplifier – 400 watt
RF–5054PS–400	Power Supply – 400 watt base station
RF–5087T–400	Transportable Cases–400 Watt for: RF–5020R/T, RF–5034PA–400, and RF–5054PS–400
H–250/U	Lightweight Handset

2.6.4 Rack–Mounted Systems

The RF–5000R–125 is a 125–watt output rack mountable transceiver system consisting of:

RF–5020R/T	Receiver Transmitter
RF–5031PA–125	Power Amplifier – 125 watt
RF–5051PS–125	Power Supply – 400 watt
RF–5082RKMT–125	Rack Mount Kit
H–250/U	Lightweight Handset

2.6.5 Ancillary Kits

Tables 2–1 through 2–13 list the ancillary kits provided with the RF–5000 equipment:

Table 2–1. RF–5020R/T Ancillary Kit, 10181–9000 (Rev. C)

Qty	Part Number	Description
1	H–250/U	Handset
1	MS3116J14–19P	Connector, 19 Pin
1	UG–88C/U	Connector, BNC Cable Plug
1	P–0339	Connector, Audio, 6 Pin
1	10181–0032	RF–5000 System Manual

Table 2–2. RF–5085MT–FP Ancillary Kit, 10181–9035 (Rev. B)

Qty	Part Number	Description
3	MS51958–63	Screw, PH, SS 10–32 x 1/2
3	MS35338–138	Washer, Lock, Split, SS #10
3	MS15795–808	Washer, Flat, SS .219 x .438 x .049

Table 2–3. RF–5000V–20 Ancillary Kit, 10181–9100 (Rev. C)

Qty	Part Number	Description
1	10181–9821–006	Cable, Coax, 6 Foot
1	10181–9822–006	Cable, Control, 6 Foot
1	10181–9827	Cable Assembly, 20W PA/CU, DC Power

Table 2–4. RF–5000V–125 Ancillary Kit, 10181–9101 (Rev. D)

Qty	Part Number	Description
1	10181–9821–002	Cable, Coax, 2 Foot
1	10181–9822–002	Cable, Control, 2 Foot
1	10181–9826–020	Cable Assembly, PA, DC Power

Table 2–5. RF–5000V–400 Ancillary Kit, 10181–9102 (Rev. B)

Qty	Part Number	Description
1	10181–9821–006	Cable, Coax, 6 Foot
1	10181–9822–006	Cable, Control, 6 Foot
1	10181–9828–020	Cable, DC Power, 20 Foot

Table 2–6. RF–5000B–125 Ancillary Kit, 10181–9500 (Rev. D)

Qty	Part Number	Description
1	10181–9826–020	Cable Assembly, PA, DC Power
1	10181–9821–004	Cable, RF, 4 Foot
1	10181–9822–004	Cable, Control, 4 Foot
1	10181–9833–004	Cable, DC Power, 4 Foot
1	MS3116J14–19P	Connector, 19 Pin

Table 2–7. RF–5000B–400 Ancillary Kit, 10181–9525 (Rev. D)

Qty	Part Number	Description
1	10181–9834–001	Cable Assembly, DC Power, 1 Foot
1	10181–9821–004	Cable, RF, 4 Foot
1	10181–9822–004	Cable, Control, 4 Foot

Table 2–8. RF–5000T–125 Ancillary Kit, 10181–0060 (Rev. –)

Qty	Part Number	Description
1	10181–9821–002	Cable, Coax, 2 Foot
1	10181–9822–002	Cable, Control, 2 Foot
1	10181–9824–100	Cable Coax, 100 Foot
1	10181–9833	Cable Assembly, PA, DC Power

Table 2–9. RF–5071VSM Ancillary Kit, 10181–9030 (Rev. B)

Qty	Part Number	Description
4	MS35307–358	Bolt, Hex Head, 3/8–16 x 3/4
4	MS51971–3	Nut, 9/16 Hex 3/8–16
8	MS35333–76	Washer, Lock, SS, Int. #3/8

Table 2–10. RF–5072VSM Ancillary Kit, 10181–9031 (Rev. B)

Qty	Part Number	Description
4	MS35307–358	Bolt, Hex Head, 3/8–16 x 3/4
4	MS51971–3	Nut, 9/16 Hex 3/8–16
8	MS35333–76	Washer, Lock, SS, Int. #3/8

Table 2–11. RF–5074VSM Ancillary Kit, 10181–9032 (Rev. B)

Qty	Part Number	Description
4	MS35307–358	Bolt, Hex Head, 3/8–16 x 3/4
4	MS51971–3	Nut, 9/16 Hex 3/8–16
8	MS35333–76	Washer, Lock, SS, Int. #3/8

Table 2–12. RF–5051PS–125 Ancillary Kit, 10181–9010 (Rev. B)

Qty	Part Number	Description
1	10181–9831	Cable Assembly, AC Power
2	M55181/3–03	Connector Plug, 4 Pin, Male
5	F03–0003–022	Fuse, 20A CER SB 250V
5	F–0001	Fuse, 1/8A QA 250V

Table 2–13. RF–5054PS–400 Ancillary Kit, 10181–9535 (Rev. B)

Qty	Part Number	Description
1	10181–9836–002	Cable, DC/DC Jumper, 2 Foot

2.7 MOUNTING SYSTEMS

Shock mounts are available for vehicular installations, and a front–panel mount can be used to remotely locate the front panel for ease of operation. Also available is a slide assembly included with the RF–5000R–125 for rack mounting in a standard 19–inch wide rack. These mounts are described in paragraphs 2.7.1 through 2.7.5. Table 2–14 identifies the hardware included with the shock mount assemblies.

Table 2–14. Shock Mount Hardware Kit

Item No.	Part Number	Description	Qty.
1	MS35307–358	Bolt, 3/8–16 x 3/4	4
2	MS35333–76	Washer, Lock, Int. Thread, SS	8
3	MS51971–3	Nut, 9/16 Hex 3/8–16	4

2.7.1 RF–5071VSM Single–Unit Vehicular Shock Mount

The RF–5071VSM is a single–unit vehicular shock mount that is used with the RF–5020R/T in the 20–watt transceiver system and with either the RF–5020R/T or the RF–5031PA–125 in the 125–watt transceiver system. It is also used as the shock mount for the R/T in the 400–watt transceiver system.

Figure 2–2 shows the RF–5071VSM used in the single–unit shock mount configuration. Figure 2–3 shows the RF–5071VSM used as a single–unit shock mount with the RF–5031PA–125. The RF–5020R/T and the RF–5031PA–125 use the same type single–unit shock mount.

2.7.2 RF–5072VSM Dual–Unit Vehicular Shock Mount

The RF–5072VSM is a dual shock mount unit that accepts both the RF–5020R/T and the RF–5031PA–125 power amplifier. Figure 2–4 shows the RF–5020R/T together with the RF–5031PA–125 in this dual shock mount unit.

2.7.3 RF–5074VSM Vehicular Shock Mount

The RF–5074VSM is the vehicular shock mount for the RF–5034PA–400 in the 400–watt transceiver system. Figure 2–5 shows the 400–watt shock mount.

2.7.4 RF–5085MT–FP Mount for RF–5020R/T's Front Panel

The RF–5085MT–FP mount is used to remotely mount the removable RF–5020R/T's front panel up to 50 feet (15 meters) from the RF–5020R/T for installation in a shelter, vehicle, or base station.

The RF–5085MT–FP has a built–in connector that mates with J3, located on the RF–5020R/T's front panel. Cable assembly 10181–9830 is used to interconnect the RF–5020R/T's front panel and the RF– 5085MT–FP mount to the R/T chassis. This cable assembly connects at J3, located on the rear cover of the removable RF–5020R/T's front panel, and J4, located on the front of the RF–5020R/T chassis. Figure 1–3 shows the location of connectors J3 and J4.

RF-5020R/T RECEIVER/TRANSMITTER DIMENSIONS

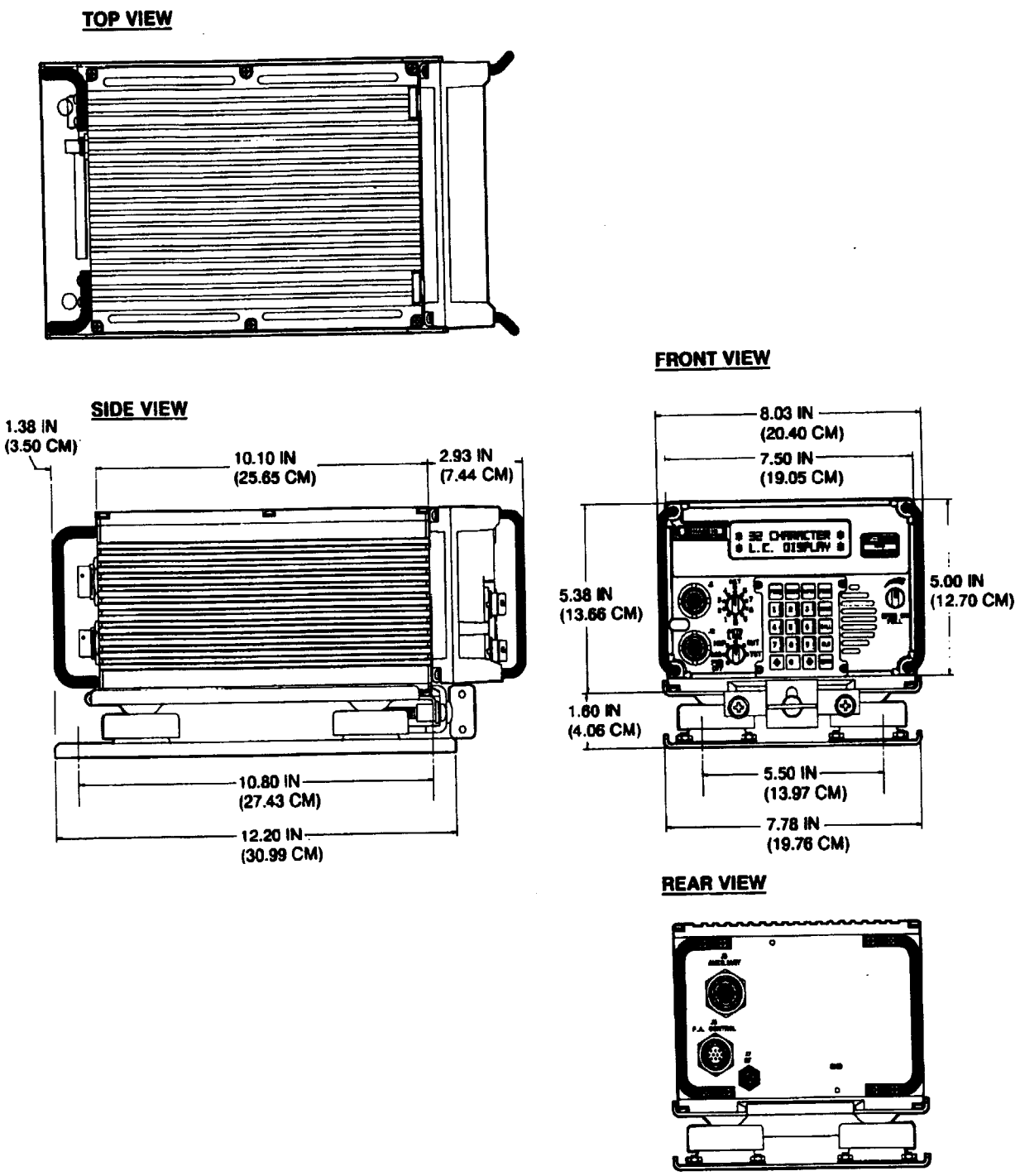


Figure 2–2. RF-5020R/T Single-Unit Shock Mount Installation

RF-5031PA-125 125 WATT HF POWER AMPLIFIER DIMENSIONS

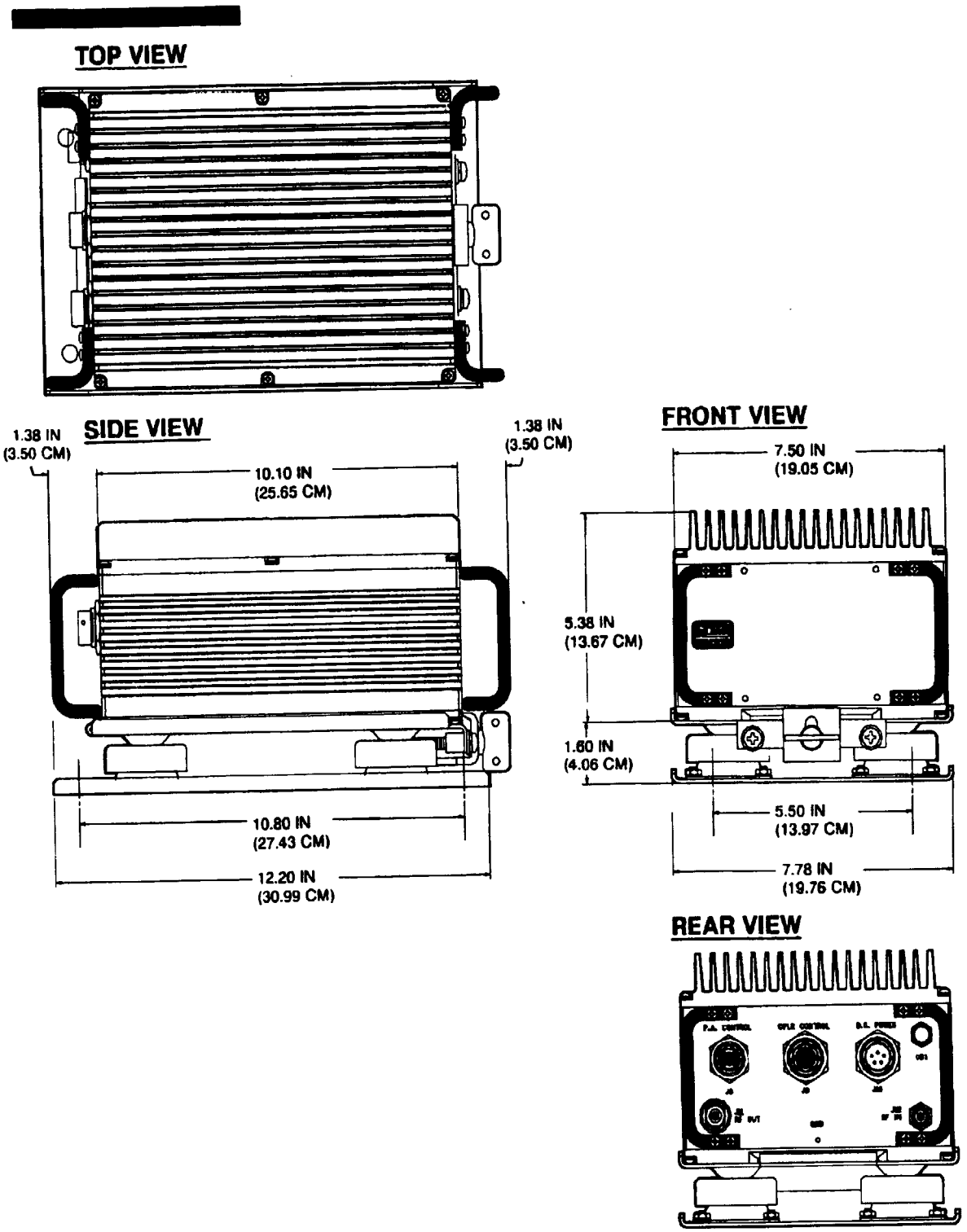
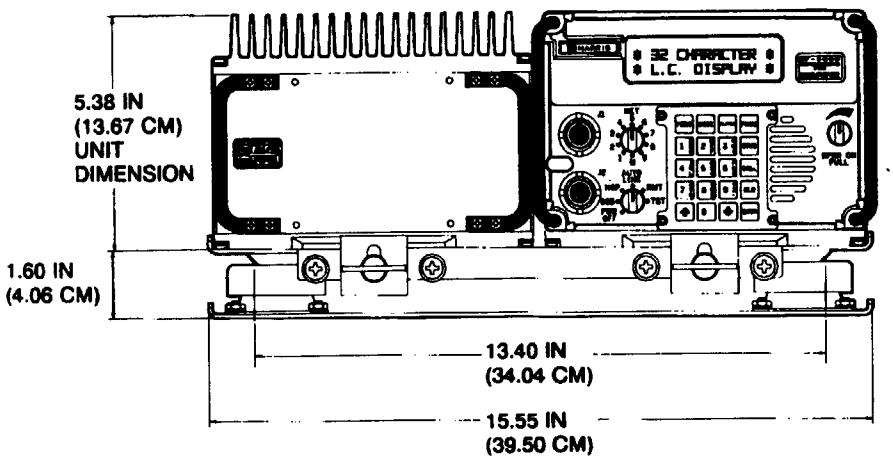


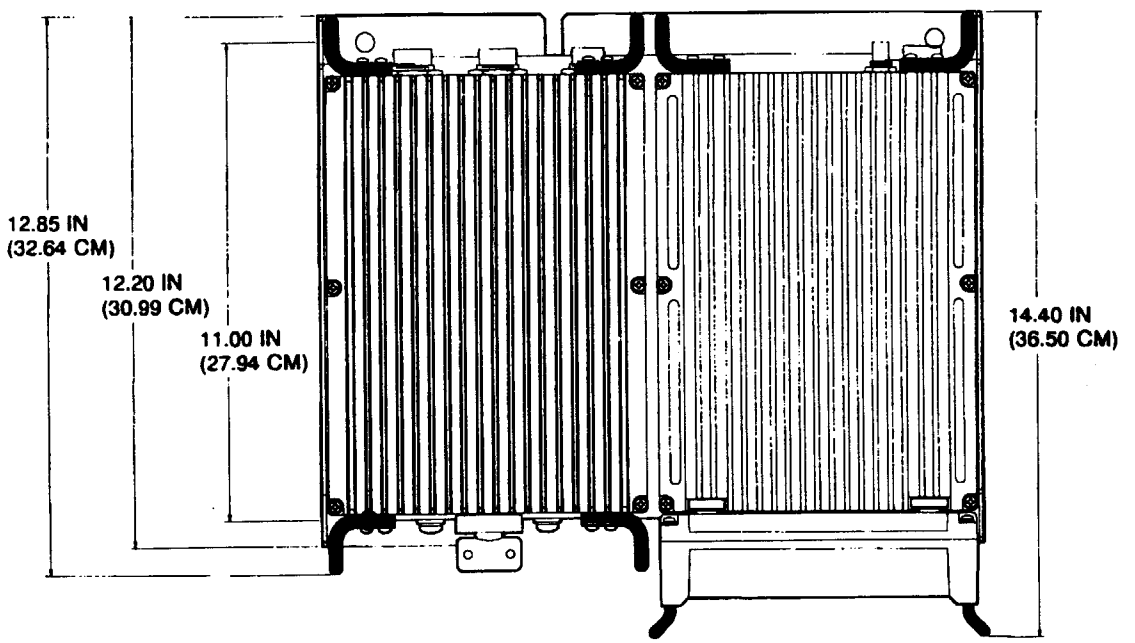
Figure 2–3. RF-5031PA-125 in RF-5071VSM Single-Unit Shock Mount

RF-5000V-125 125 WATT HF-SSB VEHICULAR TRANSCEIVER DIMENSIONS

FRONT VIEW



TOP VIEW

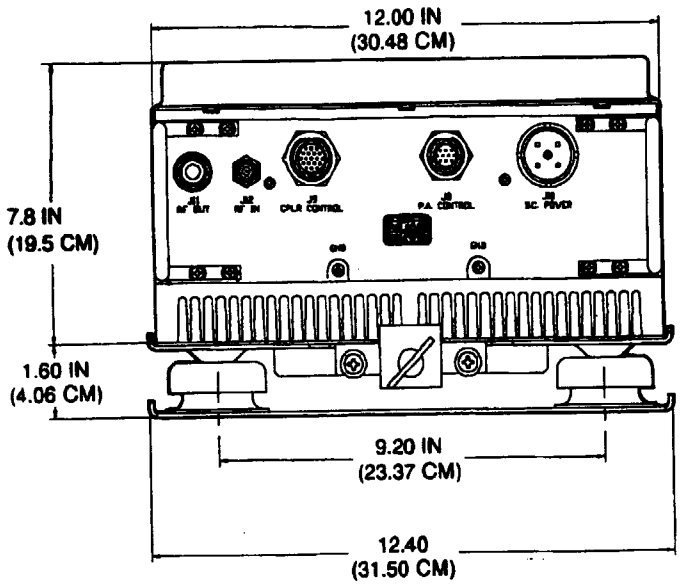


5KS–084

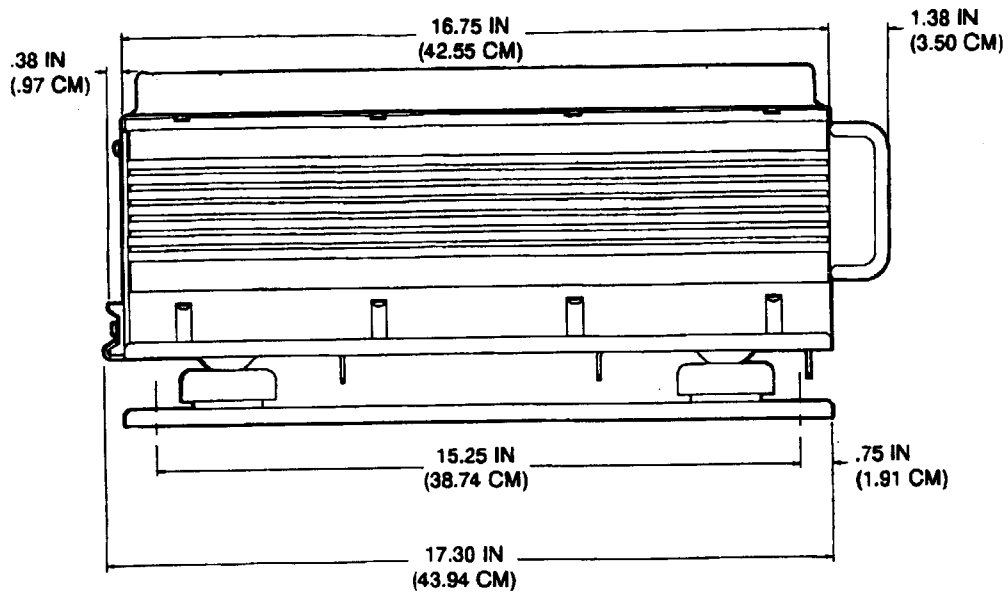
Figure 2–4. RF-5020R/T and RF-5031PA-125 In RF-5072VSM Dual Shock Mount

RF-5034PA-400 400 WATT HF POWER AMPLIFIER DIMENSIONS

FRONT VIEW



SIDE VIEW



5KS–085

Figure 2–5. RF-5034PA-400 in RF-5074VSM Shock Mount

2.7.5 Installing the RF–5000R–125 in a Standard 19–Inch Wide Rack

The RF–5000R–125 is shipped unassembled for installation in a standard 19–inch equipment rack. Mounting the RF–5000R–125 requires an RF–5082RKMT Rack Mount Kit which is described in table 2–15.

Table 2–15. RF–5082RKMT Rack Mount Kit Parts List, 10181–5120 (Rev. A)

Qty	Part Number	Description
1	10181–5125	RF–5082 Tray
3	10322–2028	Clamp, Hold Down
2	SM–C–415032	Clamp, Front
2	SM–B–415025	Washer
2	10181–9801	Bar, Retainer
2	MS171436	Pin, 1/16 Spring
2	SM–C–415027	Screw, Clamp
8	MS51957–81	Screw, PH, 1/4–20 x 3/4
8	MS15795–810	Washer, Flat 1/4
8	MS35338–139	Washer, Lock
1	10322–2032	Clamp
1	10253–9500	Slide Kit
1	MS15795–812	Washer, Flat
14	MS51958–64	Screw, PH, 10–32 x 5/8
14	MS35338–138	Washer, Flat, #10
8	MS15795–808	Washer, Lock #10
1	10075–1253	Knob
10	MS3367–1–9	Ty–Wrap
1	10299–0575–12	Ground Strap
1	10299–0576–12	Ground Strap
1	10299–0575–24	Ground Strap
8	MS24693–C50	Screw, FH, 8–32 x 1/2
8	MS15795–807	Washer, Flat #8
8	MS75338–137	Washer, Lock #8
8	MS35649–284	Nut, 8–32
8	MS24693–C273	Screw, FH, 10–32 x 5/8

2.7.5.1 Assembly and Installation of Slides

The following items are contained in the slide kit, P/N 10253–9500:

- Left–side slide
- Right–side slide
- Two brackets, 4000–0528–CL
- Two brackets, 4000–0528–CR
- Four nut bars

- Four sets hardware, 5701

  Each set contains:

  – Two 8–32 PH screws
  – Two #8 flat washers
  – Two #8 lock washers
  – Two 8–32 nuts

See figure 2–6 for slide assembly information. Details A and B of this drawing show a detailed view of the assembly of a front bracket.

NOTE

In the left–side slide the rear bracket is a 4000–0528–CL and the front bracket is a 4000–0528–CR. In the right–side slide the rear bracket is a 4000–0528–CR and the front bracket is a 4000–0528–CL.

Make sure that the slide locking levers are at the front of the rack.

It is necessary to fully extend the slide in order to attach the front bracket. The lever at the top of each slide assembly releases the lock which holds the slide in the open or closed position.

Detail C of figure 2–6 shows a detailed view of the assembly of a rear bracket. Note that the hardware for the rear bracket of each slide should initially be installed loosely to allow for adjustment to the depth of the rack. Be sure to fully tighten the hardware after the length adjustment has been made.

Install the slide assemblies in the desired position in the equipment rack before attaching the mounting tray.

2.7.5.2 Assembly and Installation of Mounting Tray

Follow this procedure to install the mounting tray.

a. Extend the two slides from the rack until they lock in the fully–extended position.

b. Place the mounting tray assembly on the slides. See figure 2–7 for the proper orientation of the tray in the rack.

c. Attach the mounting tray to the slide assemblies using four PH 10–32 panhead screws, nuts, and washers for each slide assembly.

2.7.5.3 Installation of Equipment

Refer to figure 2–7 for positioning of the equipment on the mounting tray. Mount the equipment on the tray using the following procedure:

a. Position the RF–5031PA–125 Power Amplifier so that the connectors face to the right side of the tray when viewed from the front.

b. Fit the lower rear edge of the power amplifier into the raised lip at the back of the mounting tray. Tighten the hold–down clamp until it fits snugly against the front edge of the power amplifier.

c. Position the RF–5051PS–125 Power Supply so that the connectors face the front of the tray.

d. Fit the lower rear edge of the power supply into the raised lip on the left side of the mounting tray. Tighten the wing nut on the left of the tray to hold the power supply in position.

e. Position the RF–5020R/T so that the front panel faces the front of the tray.

f. Fit the lower rear edge of the R/T into the raised lip on the right side of the mounting tray. Tighten the wing nut on the right of the tray to hold the R/T in position.

g. Next, the electrical connections to the radio system should be made.

1. Connect one end of coaxial cable (P/N 10181–9821) to the RF IN connector J12 on the RF–5031PA–125 Power Amplifier.

2. Connect the other end of the coaxial cable to the RF connector J7 on the RF–5020R/T.

3. Connect one end of the R/T–PA Control Cable (P/N 10181–9822) to the PA CONTROL connector J8 on the RF–5031PA–125 power amplifier.

4. Connect the other end of the R/T–PA Control Cable to the PA CONTROL connector J6 on the RF–5020R/T.

5. Connect one end of Dc Power Cable (P/N 10181–9833) to the DC POWER connector J10 of the RF–5031PA–125 Power Amplifier.

6. Connect the other end of the Dc Power Cable the the DC POWER connector J15 on the RF–5051PS–125 Power Supply.

7. Connect one end of the Ac Power Cable to J17 on the RF–5051PS–125 Power Supply.

8. Connect the other end of the Ac Power Cable to the ac power source.

NOTE

The ac and dc power cables should be dressed along the left side of the RF–5051PS–125 chassis. The cables should be secured to both the front and rear handles of the power supply with the supplied cable ties.

9. If required, connect a control cable to the AUXILIARY J5 connector on the RF–5020R/T.

10. Connect a ground strap (P/N 10299–0575) from the RF–5031PA–125 ground connection to the ground connection on the mounting tray, see figure 2–7.

11. Connect a ground strap (P/N 10299–0575) from the RF–5020R/T ground connection to the ground connection on the mounting tray.

12. Connect a ground strap (P/N 10299–0576) from the RF–5051PS–125 ground connection to the ground connection on the mounting tray.

13. Secure the cables in position using the supplied cable ties.

h. Refer to figure 2–7 for the location of the ship or building ground connection on the tray. Refer to paragraph 2.9 for guidelines on shipboard grounding.

i. Verify that the rack mounted assembly slides in and out of the rack with no interference from the cables. The slides should lock in the extended and the retracted positions. The slide locking lever on each slide must be depressed to release the locking mechanism.

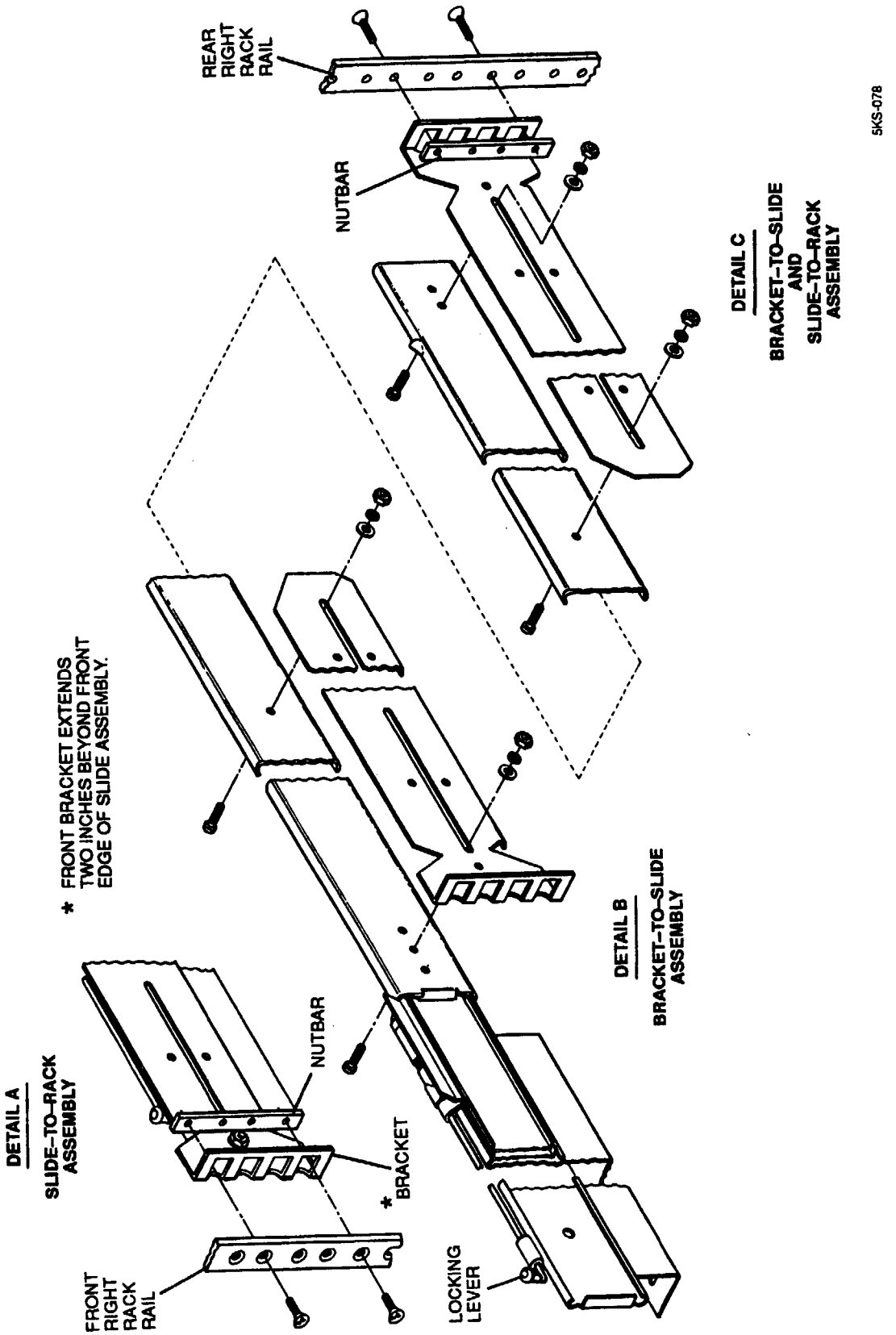


Figure 2–6. Slide Assembly Details

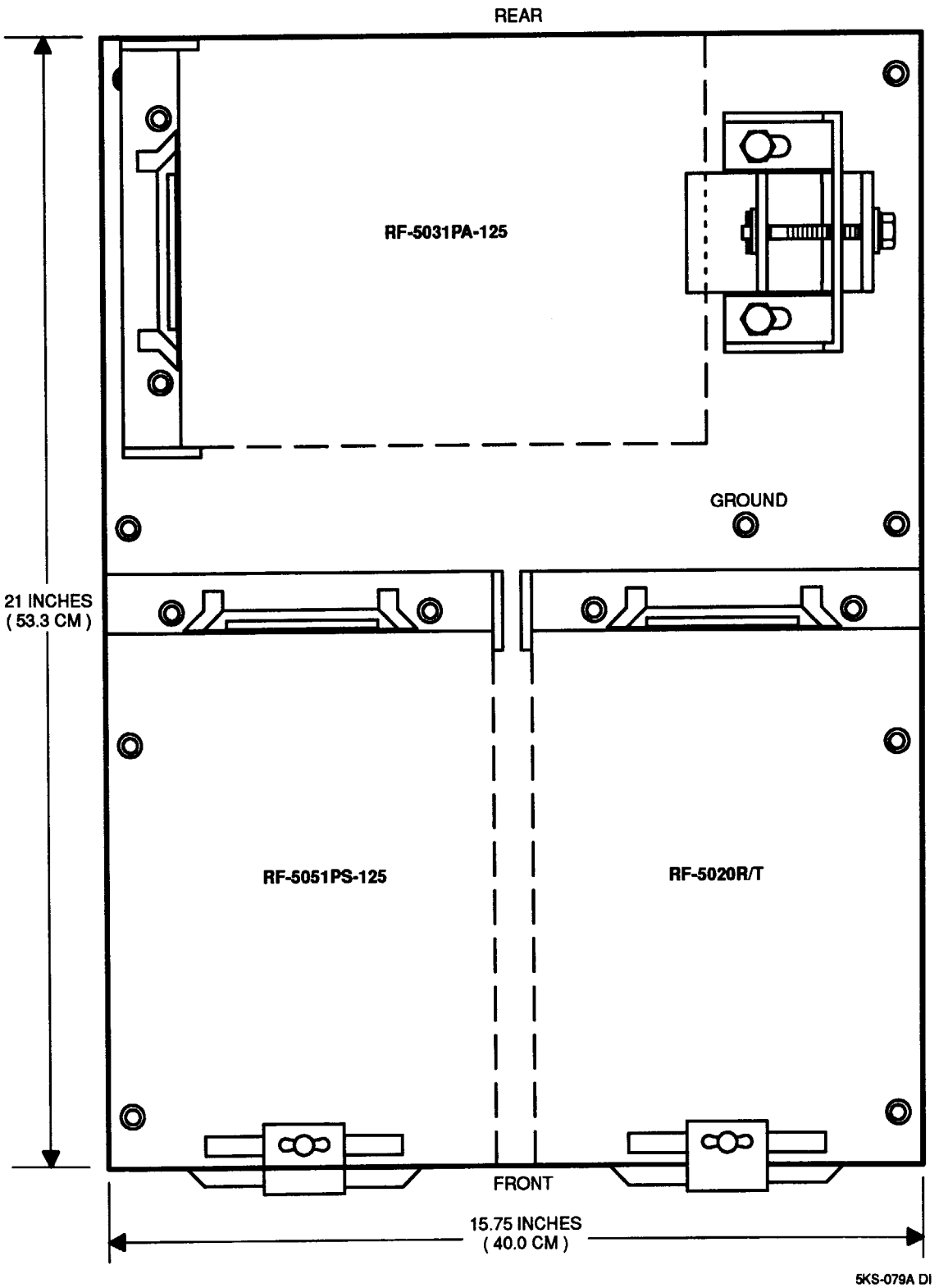


Figure 2–7. Position of Equipment on Mounting Tray

2.8 CABLE CONNECTIONS

Interface cables are supplied for standard system configurations. In these systems, it is only necessary to connect the unterminated end of the dc power cable at the nominal +26.4 Vdc power source. This source must be capable of supplying +26.4 Vdc at greater than 4.5 A in 20–W systems, +26.4 Vdc at greater than 15 A in 125–W systems, and 26.4 Vdc at greater than 50 A in 400–W systems.

Table 2–16 shows the system cables for the RF–5000. Figure 2–8 shows cable connections for the 20–watt configuration, figures 2–9 and 2–10 shows cable connections for the 125–watt configurations and figures 2–11 and 2–12 show cable connections for the 400–watt configurations.

2.8.1 Cables for Vehicular Installations

The RF–5000V–20, RF–5000V–125, and RF–5000V–400 watt transceiver systems are supplied with a Control Cable Assembly (10181–9822) and a Coax Cable Assembly (10181–9821). These are used to connect the R/T assembly to the power amplifier assembly. Six–foot (1.8 m) lengths are used in the 20–watt and 400–watt systems. Two–foot (0.6 m) lengths are used in the 125–watt system.

Figure 2–13 and table 2–17 show the cable connections and details for the Control Cable Assembly (10181–9822). Figure 2–14 and table 2–18 show the cable connections and details for the Coax Cable Assembly (10181–9821).

NOTE

For information on the RF–5000 1–kW System, refer to the RF–5000 1–kW System Service Manual, publication number 10221–5339.

In the vehicular configuration, a 20–foot (6.1 m) Dc Power Cable Assembly is used between the power amplifier and the primary 26.4–Vdc power source.

Figure 2–15 and table 2–19 show the cable connections and details for the Dc Power Cable Assembly, 10181–9827, used on the 20–watt transceiver system.

Figure 2–16 and table 2–20 show the cable connections and details for the Dc Power Cable Assembly, 10181–9826, used on the 125–watt transceiver system.

In the 400–watt vehicular transceiver system, the Dc Power Cable Assembly, 10181–9828, differs only in cable type. Table 2–21 shows the cable connections and details for this cable assembly.

Figure 2–17 shows the two cable type options for the PA to Coupler RF Cable. These cables are common in both the 125–and 400–watt vehicular systems. The RG–8A/U type cable, 10181–9825, is recommended for use in applications that require less than 20 feet (6.1 m) of cable, with a 10–foot (3.1 m) limit preferred. The RG–213A/U type cable, 10181–9824, is recommended for lengths over 10 feet.

Tables 2–22 and 2–23 show the cable connections and details for these two cable assemblies.

Figure 2–18 and table 2–24 show the cable connections and details for the Power Amplifier to RF–382A–02 Antenna Coupler Control Cable Assembly, 10181–9823, used in the 125–watt and 400–watt vehicular systems.

Table 2–16. RF-5000 System Cables

125–Watt Transceiver Systems		400–Watt Transceiver Systems	
VEHICULAR		**VEHICULAR**	
10181-9822	R/T-PA Control Cable	10181-9822	R/T-PA Control Cable
10181-9821	R/T-PA Coax Cable	10181-9821	R/T-PA RF Coax Cable
10181-9826	Dc Power Cable	10181-9828	Dc Power Cable
10181-9825,-9824	PA to Coupler RF Coax Cable	10181-9825,-9824	PA to Coupler RF Coax Cable
10181-9823	PA to Coupler Control Cable	10181-9823	PA to Coupler Control Cable
BASE		**BASE**	
10181-9822	R/T-PA Control Cable	10181-9822	R/T-PA Control Cable
10181-9821	R/T-PA Coax Cable	10181-9821	R/T-PA RF Coax Cable
10181-9831	Ac Power Cable	10181-9831	Ac Power Cable
10181-9825,-9824	PA to Coupler RF Coax Cable	10181-9825,-9824	PA to Coupler RF Coax Cable
10181-9823	PA to Coupler Control Cable	10181-9823	PA to Coupler Control Cable
10181-9833	RF-5031PA-125 Dc Power Supply Cable	10181-9834	RF-5034PA-400 Dc Primary Power Supply Cable
TRANSPORTABLE		**TRANSPORTABLE**	
10181-9822	R/T-PA Control Cable	10181-9822	R/T-PA Control Cable
10181-9821	R/T-PA Coax Cable	10181-9821	R/T-PA RF Coax Cable
10181-9831	Ac Power Cable	10181-9831	Ac Power Cable
10181-9825,-9824	PA to Coupler RF Coax Cable	10181-9825,-9824	PA to Coupler RF Coax Cable
10181-9823	PA to Coupler Control Cable	10181-9823	PA to Coupler Control Cable
10181-9833	RF-5031PA-125 Dc Power Supply Cable	10181-9834	RF-5034PA-400 Dc Primary Power Supply Cable
RACK MOUNTED		**20–Watt Transceiver Systems**	
10181-9822	R/T-PA Control Cable	**VEHICULAR**	
10181-9821	R/T-PA Coax Cable	10181-9822	R/T-PA Control Cable
10181-9833	Dc Power Supply Cable	10181-9821	R/T-PA RF Coax Cable
		10181-9827	Dc Power Cable

Note: The optional Remote Front Panel Interconnect Cable, 10181-9830 and the optional RS-232 Auxiliary Cable, 10181-9842 can be used in all RF-5000 System configurations. For information on the RF-5000 1-kW System, refer to the RF-5000 1-kW System Service Manual, publication number 10181-5339.

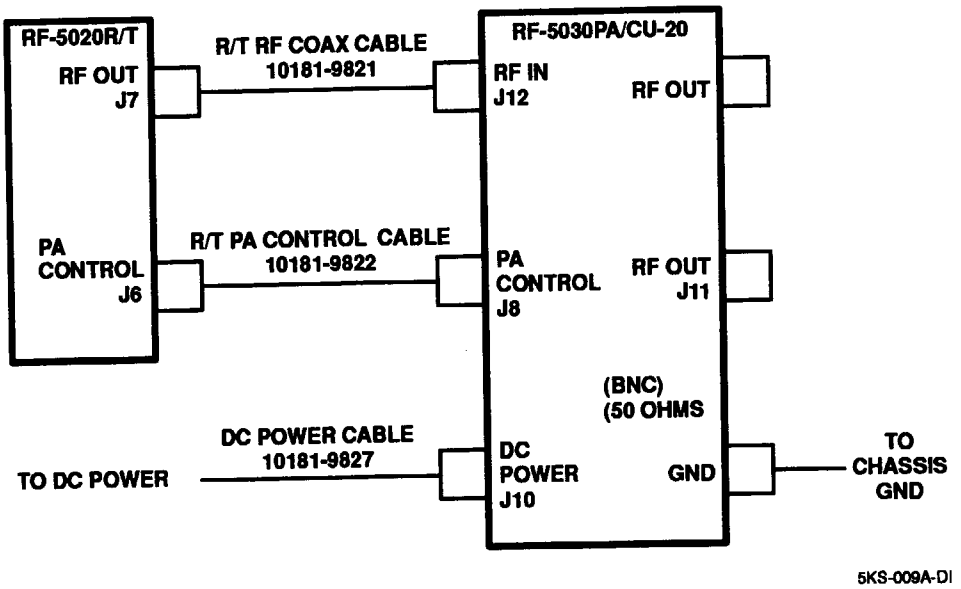


Figure 2–8. RF–5030PA/CU and RF–5020R/T Interconnect Diagram

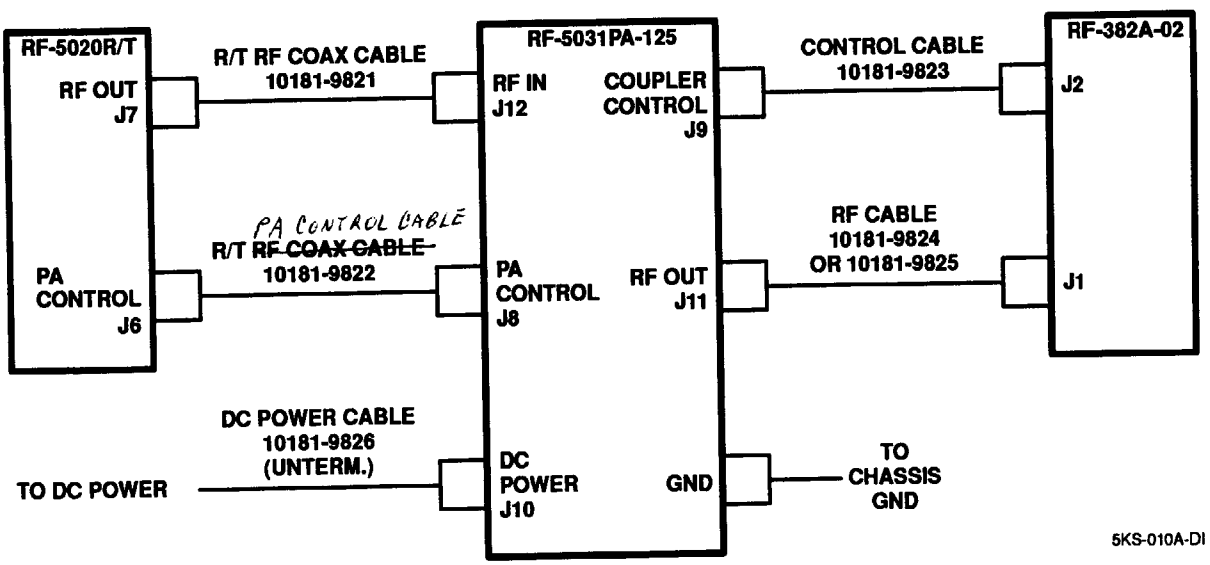


Figure 2–9. 125–Watt Vehicular Interconnect Diagram

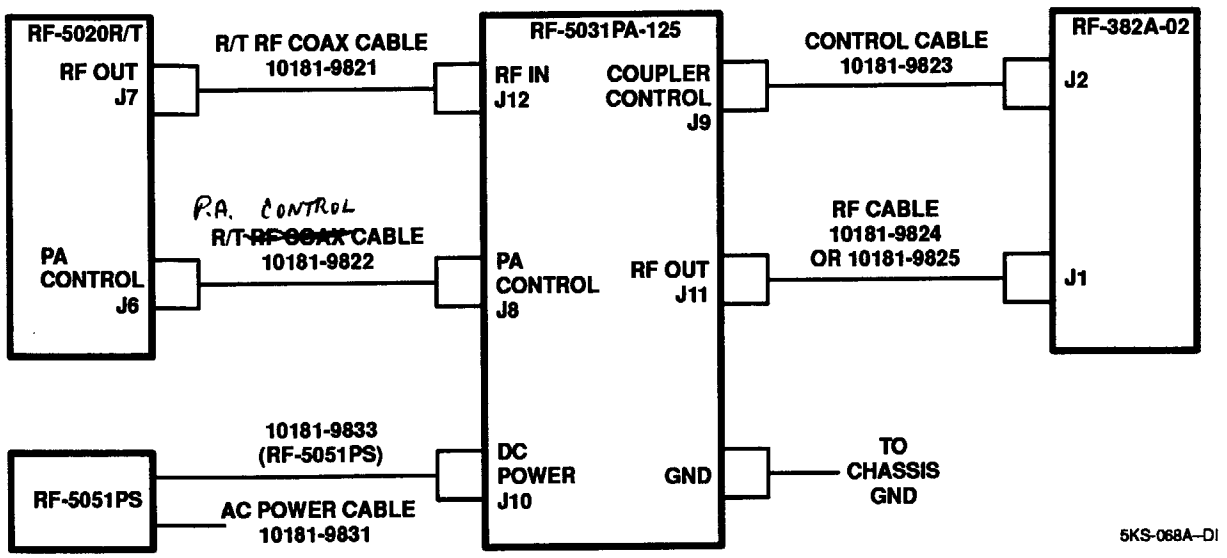


Figure 2–10. 125–Watt Base Station and Transportable Interconnect Diagram

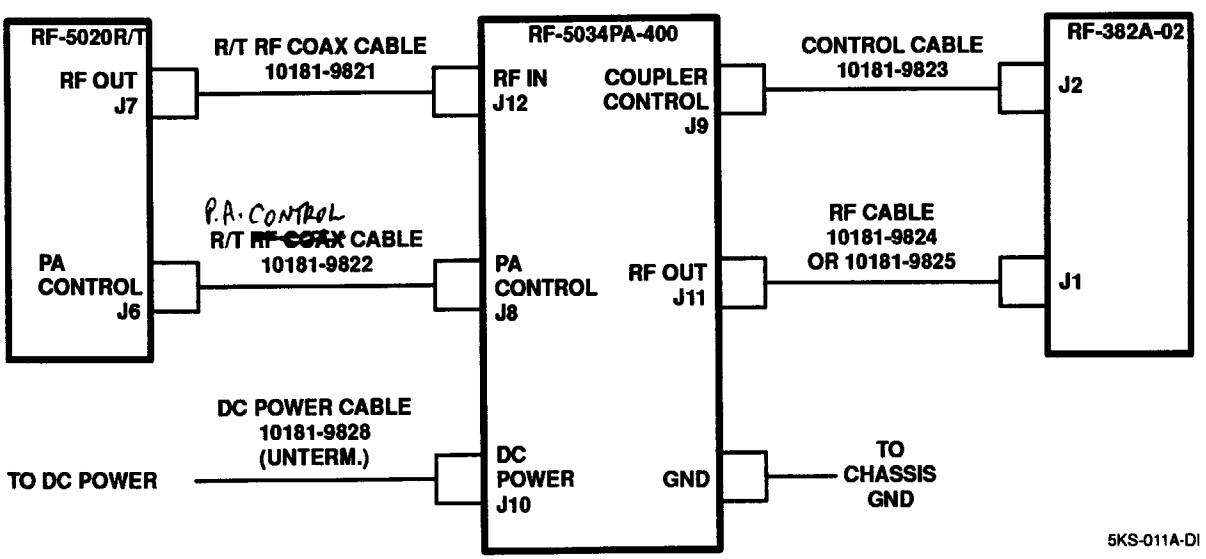


Figure 2–11. 400–Watt Vehicular Interconnect Diagram

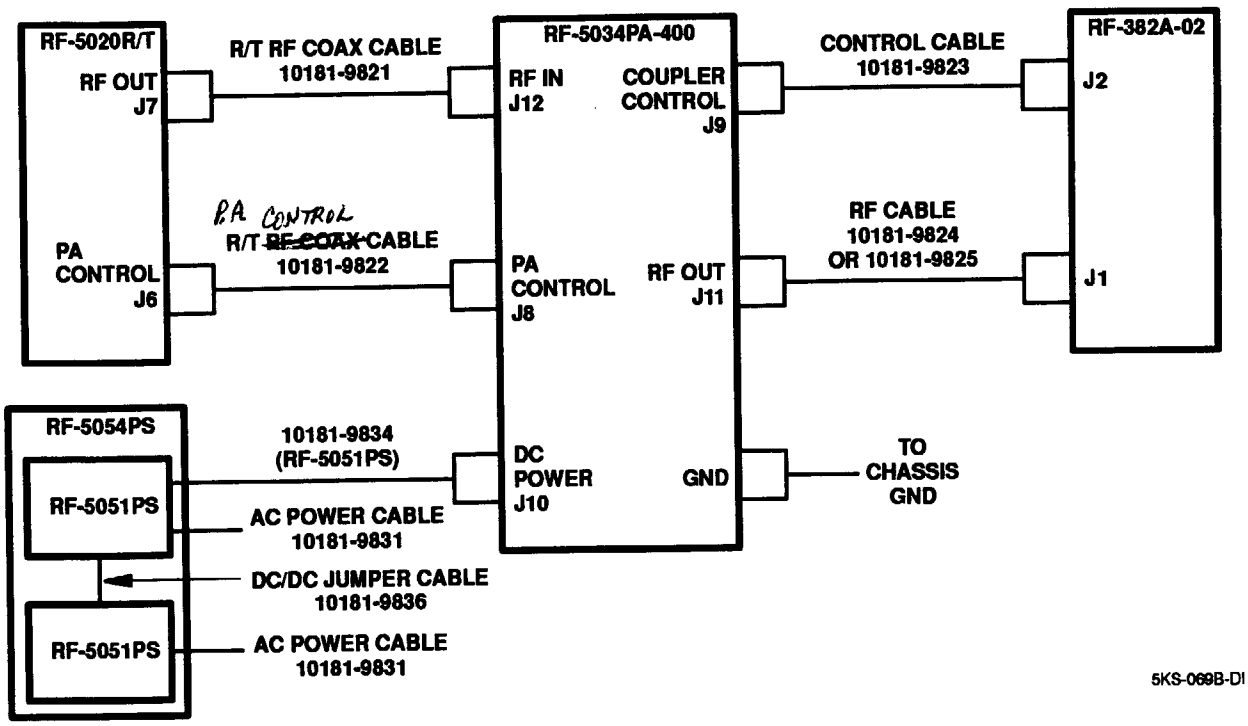
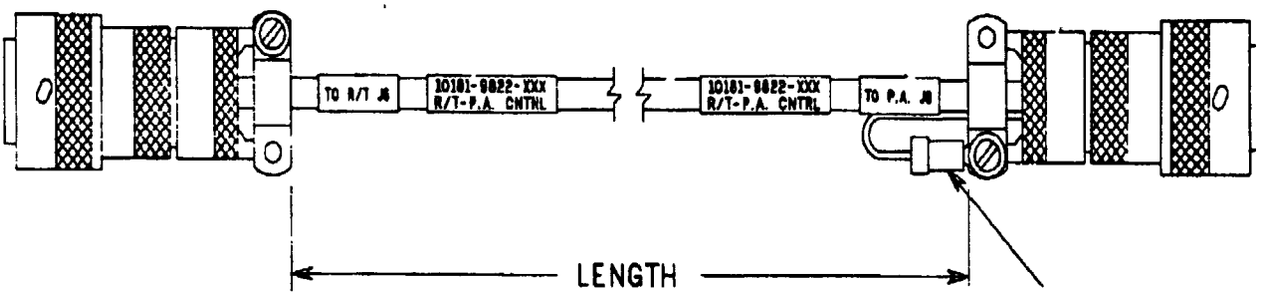


Figure 2–12. 400–Watt Base Station and Transportable Interconnect Diagram



PART NO.	LENGTH
10181-9822-002	2 FEET
10181-9822-006	6 FEET
10181-9822-020	20 FEET
10181-9822-050	50 FEET

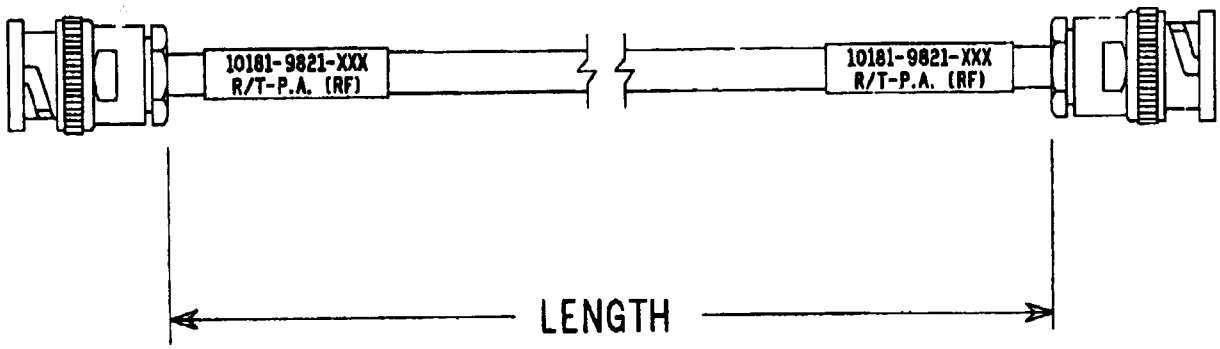
5KS-051

Figure 2–13. Receiver/Transmitter–Power Amplifier Control Cable Assembly, 10181–9822

Table 2–17. Wire Connections and Signal Levels for the R/T–PA Control Cable Assembly, 10181–9822

From R/T Chassis J6 Connector		To PA Chassis J8 Connector	
Pin	**Function**	**Signal Level**	**Pin**
A	Hop Clock	RS–232C Output	A
B	PA Control Data –	5 Vdc or 0 Vdc Differential Data	B
C	PA Control Data +	0 Vdc or 5 Vdc Differential Data	C
D	$\overline{\text{ON}}$/OFF	Ground Closure	D
E	Primary Power Return	Ground	E
F	Primary Power Return	Ground	F
G	PA Feedback –	Feedback Return	G
H	PA Feedback +	0–25 Vdc (4 Vdc at rated PEP)	H
J	+ 26.4 Vdc	R/T Supply Voltage	J
K	+ 26.4 Vdc	R/T Supply Voltage	K
J09–0011–101	MS3116J12–10S	MS3116J12–10P	J09–011–001
R/T	Cable Connectors		PA

Cable: 12–Conductor, 20 AWG, Shielded



PART NO.	LENGTH
10181-9821-002	2 FEET
10181-9821-006	6 FEET
10181-9821-020	20 FEET
10181-9821-050	50 FEET

5KS-052

Figure 2–14. Receiver/Transmitter–Power Amplifier RF Coax Cable Assembly, 10181–9821

Table 2–18. Wire Connections and Signal Levels for the R/T–PA RF Coax Cable Assembly, 10181–9821

From R/T Chassis J7 Connector		To PA Chassis J12 Connector	
Pin	**Function**	**Signal Level**	**Pin**
Center Shield	RF RX/TX Signal Ground	100 mW Ground	Center Shield
BNC Type	UG–88C/U	UG–88C/U	BNC Type
R/T	Cable Connectors		PA

Cable: RG232/U Coaxial Cable

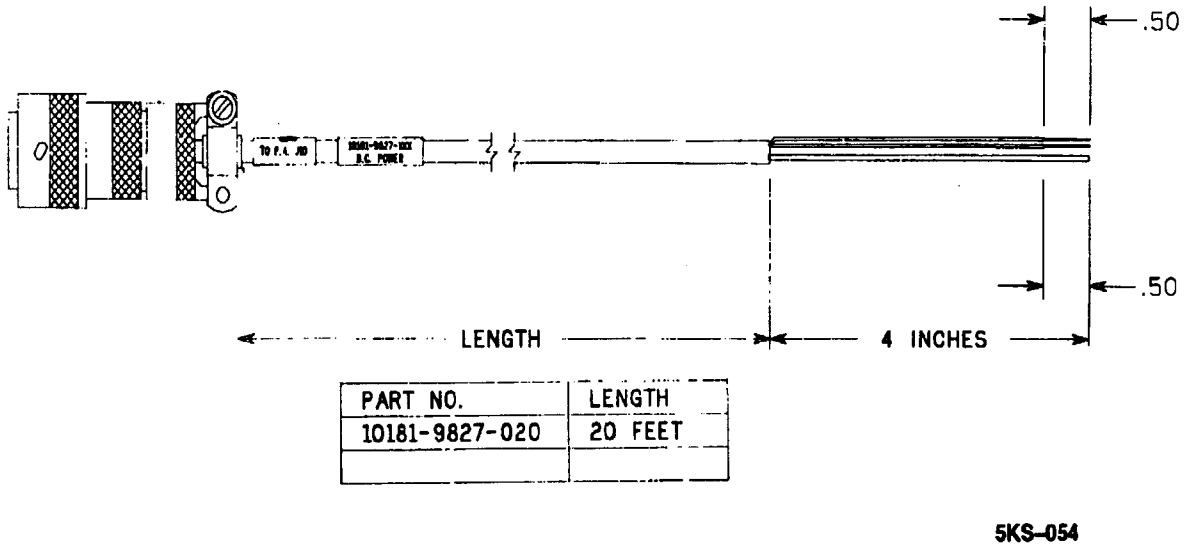


Figure 2–15. 20–Watt Power Amplifier/Antenna Coupler Primary Power Cable Assembly, 10181–9827

Table 2–19. Wire Connections and Signal Levels for the 20–Watt PA/Antenna Coupler Primary Cable Assembly, 10181–9827

From PA Chassis J10 Connector		To Primary 26.4–Vdc Power Source	
Pin	**Function**	**Signal Level**	**Pin**
A	Shield	Shield Ground	—
B	Primary Power Return	Ground	—
C	+ 26.4–Vdc Primary Power	+26.4 Vdc, 5 A Maximum	—
J09–0011–103	MS3116J8–33S		Unterminated
PA	Cable Connectors		

Cable: Two–Conductor, 20 AWG, Shielded

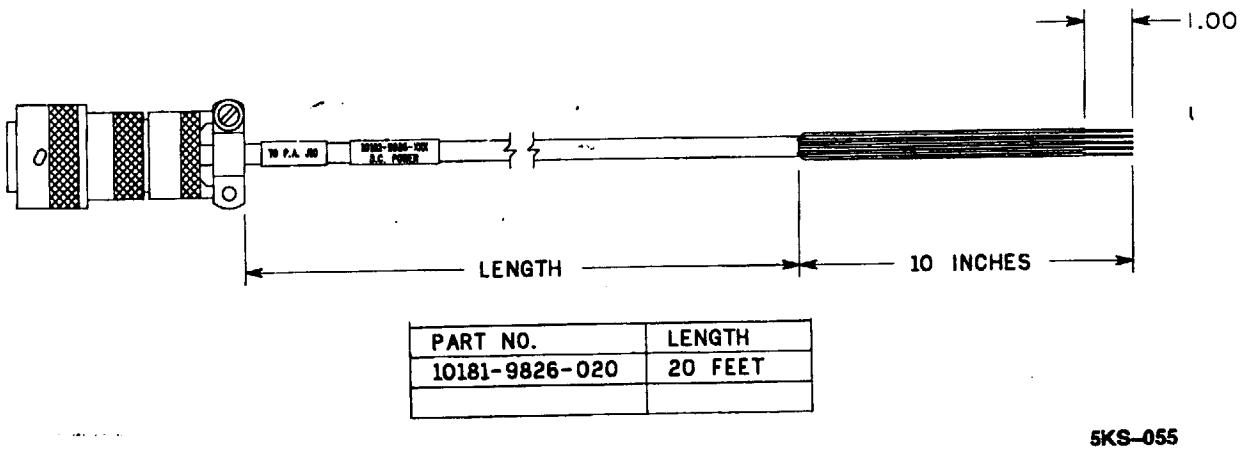


Figure 2–16. RF–5031PA-125 125-Watt Power Amplifier Primary Power Cable, 10181-9826

Table 2–20. Wire Connections and Signal Levels for the RF-5031PA-125 125–Watt Power Amplifier Primary Power Cable Assembly, 10181–9826

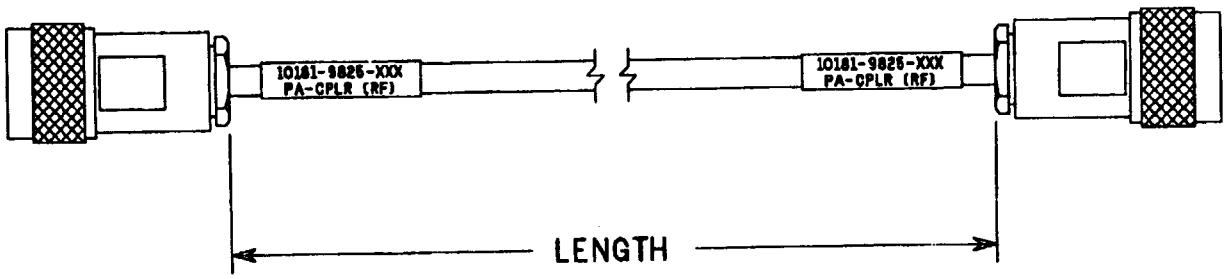
From PA Chassis J10 Connector		To Primary 26.4–Vdc Power Source	
Pin	**Function**	**Signal Level**	**Pin**
A	Shield Ground	Ground	—
B	+ 26.4–Vdc Primary Power	+ 26.4–Vdc , 15 A Maximum	Red
C	Primary Power Return	Ground	Black
D	Primary Power Return	Ground	Brown
E	+ 26.4–Vdc Primary Power	+ 26.4–Vdc, 15 A Maximum	Orange
J09–0011–102	MS3116J14–5S		Unterminated
PA	Cable Connectors		

Cable: Five–Conductor, 16 AWG, Shielded

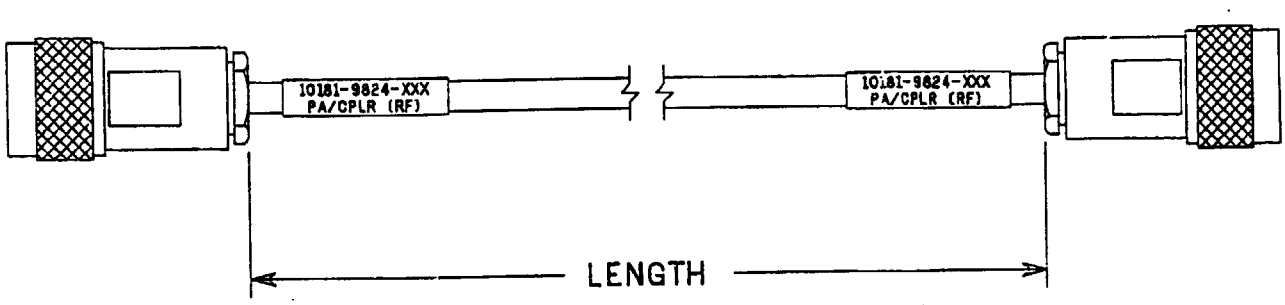
Table 2–21. Wire Connections and Signal Levels for the RF–5034PA 400–Watt Power Amplifier Primary Power Cable Assembly, 10181–9828

From PA Chassis J10 Connector		To Primary 26.4–Vdc Power Source	
Pin	**Function**	**Signal Level**	**Pin**
A	+ 26.4–Vdc Primary Power	+ 26.4 Vdc, 60 A Maximum	—
B	+ 26.4–Vdc Primary Power	+ 26.4 Vdc, 60 A Maximum	—
C	Primary Power Return	Ground	—
D	Primary Power Return	Ground	—
UW2020MA00	UW1220FA17		Unterminated
PA	Cable Connectors		

Cable: Four–Conductor, 12 AWG, Shielded



PART NO.	LENGTH
10181-9825-006	6 FEET
10181-9825-010	10 FEET
10181-9825-020	20 FEET



PART NO.	LENGTH
10181-9824-010	10 FEET
10181-9824-020	20 FEET
10181-9824-050	50 FEET
10181-9824-100	100 FEET
10181-9824-150	150 FEET

5KS-056

Figure 2–17. Power Amplifier to Coupler RF Cable Assemblies, 10181–9825 and 10181–9824

Table 2–22. Wire Connections and Signal Levels for Power Amplifier to Antenna Coupler RF Cable Assembly, 10181–9825

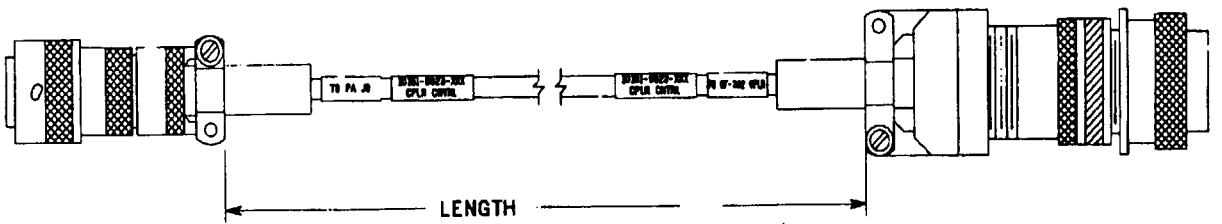
From PA Chassis J11 Connector		To RF–382A–02 Antenna Coupler J1 Connector	
Pin	**Function**	**Signal Level**	**Pin**
Center	RF RX/TX Signal	400 Watts	Center
Shield	Ground	Ground	Shield
Type N	UG–536B/U	UG–536B/U	Type N
PA	Cable Connectors		CU

Cable: RG–142B/U Coaxial Cable

Table 2–23. Wire Connections and Signal Levels for Power Amplifier to Antenna Coupler RF Cable Assembly, 10181–9824

From PA Chassis J11 Connector		To RF–382A–02 Antenna Coupler J1 Connector	
Pin	**Function**	**Signal Level**	**Pin**
Center	RF RX/TX Signal	400 Watts	Center
Shield	Ground	Ground	Shield
Type N	UG–21D/U	UG–21D/U	Type N
PA	Cable Connectors		CU

Cable: RG–213/U Coaxial Cable



PART NO.	LENGTH
10181-9823-006	6 FEET
10181-9823-010	10 FEET
10181-9823-020	20 FEET
10181-9823-050	50 FEET
10181-9823-100	100 FEET
10181-9823-150	150 FEET

5KS-057

Figure 2-18. Power Amplifier to RF-382A-02 Antenna Coupler Control Cable Assembly, 10181-9823

Table 2-24. Wire Connections and Signal Levels for the Power Amplifier to RF-382A-02 Antenna Coupler Control Cable Assembly, 10181-9823

From ~~R/T~~ PA Chassis J9 Connector		To CU Chassis J2 Connector	
Pin	**Function**	**Signal Level**	**Pin**
D	Shield	Shield	A
D	Ground	Ground	A
H	Coupler Key	Ground = Key	B
G	Coupler Fault	Ground = Fault	C
L	Tune Pulse	Ground = Tune	E
K	Tune Power Request	Ground = Tune Power	F
N	Bypass Command	Ground = Bypass	G
F	+ 26.4 Vdc to RF-382	2.5 A Maximum	H
M	+ 26.4 Vdc to RF-382	2.5 A Maximum	I
T	Key Disable	Ground = Key Disable	J
C	Thermal Fault	Ground = Thermal Fault	N
J09-0011-002	MS3116J14-19P	Bendix 8819 10-260390-27S	J46-0022-007
R/T	Cable Connectors		CU

Cable: 24-Conductor, 12 AWG, Shielded

2.8.2 Cables for Base Station and Transportable Installation

The 125–watt and 400–watt base station and transportable transceiver system are supplied with an 8–foot (2.4 m) Ac Power Cable, 10181–9831. Table 2–25 shows cable connections and details for this cable assembly.

The 125–watt base station and transportable transceiver systems use the RF–5051 Power Supply – RF–5031 PA–125 Dc Primary Power Supply Cable, 10181–9833.

Table 2–26 shows the cable connections and details for this cable assembly which is used between the RF–5051PS–125 power supply and the RF–5031PA–125 125–watt power amplifier.

Similarly, the 400–watt base station and transportable transceiver systems use the RF–5051 Power Supply – RF–5034PA–400 Dc Primary Power Supply Cable, 10181–9834, between the power supply and the power amplifier. Table 2–27 shows the cable connections and details for this cable assembly.

An interconnect cable, 10181–9836, can be used to connect two RF–5051PS–125 Power Supplies operating in parallel to provide dc primary power for an RF–5034PA–400 400–Watt Power Amplifier. Table 2–28 shows the cable connections and details for this cable assembly.

Table 2–25. Wire Connections and Signal Levels for the Primary Ac Power Supply Cable, 10181–9831

From Power Supply Chassis J17 Connector		To Ac Line Plug	
Pin	**Function**	**Signal Level**	**Pin**
A	Line	115/230 Vac, 15 A Maximum	—
B	Ground	Ground	—
C	Neutral	115/230 Vac, 15 A Maximum	—
MS3114E123P–N	MS3116J123S–N		Ac Line Plug
PS	Cable Connectors		

Cable: Three–Conductor, 16 AWG

Table 2–26. Wire Connections and Signal Levels for the RF–5051 Power Supply to RF–5031PA–125 Dc Primary Power Supply Cable, 10181–9833

From PS Chassis J15, J16 Connectors		To PA Chassis J10 Connector	
Pin	**Function**	**Signal Level**	**Pin**
Shield		Ground	A
A	Primary Power Return	Ground	C
B	Primary Power Return	Ground	D
C	+ 26.4–Vdc Primary Power	+ 26.4 Vdc, 15 A Maximum	B
D	+ 26.4–Vdc Primary Power	+ 26.4 Vdc, 15 A Maximum	E
MW20F(M)A00	MW10M(M)A17	MS3116J14–5S	J09–0011–102
PS	Cable Connectors		PA

Cable: Five–Conductor, 16 AWG, Shielded

Table 2–27. Wire Connections and Signal Levels for the RF–5051 Power Supply to RF–5034PA–400 Dc Primary Power Supply Cable, 10181–9834

From PS Chassis J17 Connectors		To PA Chassis J10 Connector	
Pin	**Function**	**Signal Level**	**Pin**
A	Primary Power Return	Ground	C
B	Primary Power Return	Ground	D
C	+ 26.4–Vdc Primary Power	+ 26.4 Vdc, 60 A Maximum	A
D	+ 26.4–Vdc Primary Power	+ 26.4 Vdc, 60 A Maximum	B
MW20F(M)A00	MW10M(M)A17	UW1220FA17	UW2020MA00
PS	Cable Connectors		PA

Cable: Four–Conductor, 12 AWG, Shielded

Table 2–28. Wire Connections and Signal Levels for the RF–5054 Power Supply Interconnect Cable, 10181–9836

From PS Chassis J15 Connector		To PS Chassis J15 Connector	
Pin	**Function**	**Signal Level**	**Pin**
A	Primary Power Return	Ground	A
B	Primary Power Return	Ground	B
C	+ 26.4–Vdc Primary Power	+ 26.4 Vdc, 30 A Maximum	C
D	+ 26.4–Vdc Primary Power	+ 26.4 Vdc, 30 A Maximum	D
MW20F(M)A00	MW10M(M)A17	MW10M(M)A17	MW20F(M)A00
PS	Cable Connectors		PS

Cable: Five–Conductor, 16 AWG, Shielded

2.8.3 Cables for Rack–Mounted Installation

The 125–watt rack–mounted transceiver system is supplied with an RF Cable Assembly, 10181–9821–002, which is shown and described in figure 2–14 and table 2–18. Also included is the Ac Power Cable, 10181–9822–002, shown and described in figure 2–13 and table 2–17. The Dc Power Cable 10181–9833–004, which is used with the RF–5051 Power Supply, is shown and described in table 2–26.

2.8.4 Remote Front–Panel Mount Interconnect Cable (Optional)

The Remote Front–Panel Interconnect Cable, 10181–9830, is used between the RF–5020R/T's front panel and its chassis. The RF–5085MT–FP is required for remote mounting of the front panel and for securing the front panel to the interconnecting cable. Table 2–29 shows the cable connections and details for the Remote Front–Panel Mount Interconnect Cable, 10181–9830.

NOTE

For cable lengths longer than 5 meters, a cable with separate shielded pairs of conductors should be used for connections to pins A and J and to pins E and F. This will minimize cross talk between data and audio signals.

Table 2–29. Wire Connections and Signal Levels for the Receiver/Transmitter to Remote Front–Panel Mount Interconnect Cable, 10181–9830

From R/T Chassis J4 Connector		To Remote Front–Panel Mount J3 Connector	
Pin	**Function**	**Signal Level**	**Pin**
A	FP Power On	Ground Closure = Power On	A
B	FP Audio –	600 Ohm Balance – 10 dBm	B
C	+ 26.4–Vdc Primary Power	26.4 Vdc, 0.5 A Maximum	C
D	Primary Power Return	Ground	D
E	Data to FP	RS–232 Interface	E
F	Data from FP	Logic 0 = 0 Vdc, Logic 1 = + 5 Vdc	F
G	Not Used		G
H	Chassis GND/Shield	Chassis Ground	H
J	FP Audio +	600 Ohm Balance – 10 dBm	J
K	Not Used		K
10181–2037	MS3116E12–10P	MS3116J12–10S	
R/T Chassis	Cable Connectors		Remote FP Mount

Cable: 12–Conductor, 20 AWG, Shielded Pair

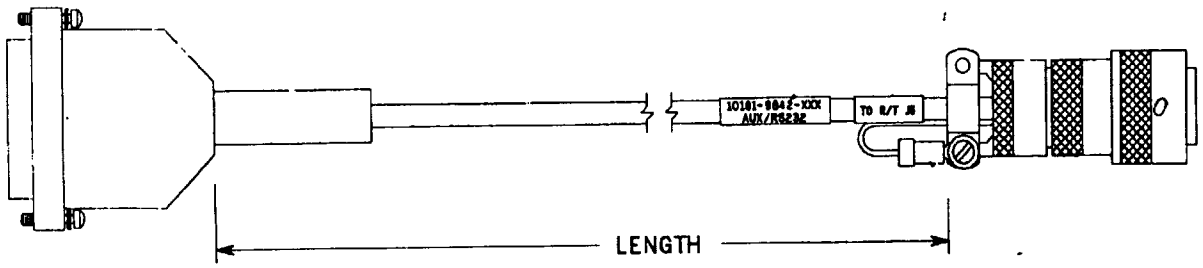
2.8.5 RS–232 Auxiliary Cable/J5 Auxiliary Connector (Optional)

Figure 2–19 identifies the RS–232 Auxiliary Cable Assembly, 10181–9842, which connects at J5 on the RF–5020R/T Chassis Rear Panel. The J5 auxiliary connector provides remote operations interface as well as synchronous and asynchronous interface. The location of the J5 connector is shown on figure 2–20.

The Asynchronous/Remote Control interface provides a serial data interface for computers, teletypes, ARQ/Packet message controllers, and remote control terminals. Table 2–31 lists the pin assignments for remote control/asynchronous interface operation.

The Synchronous Interface provides a serial data interface for facsimile, cryptographic, and secure voice units that require synchronous data transmission. Table 2–32 lists the pin assignments for synchronous interface operation.

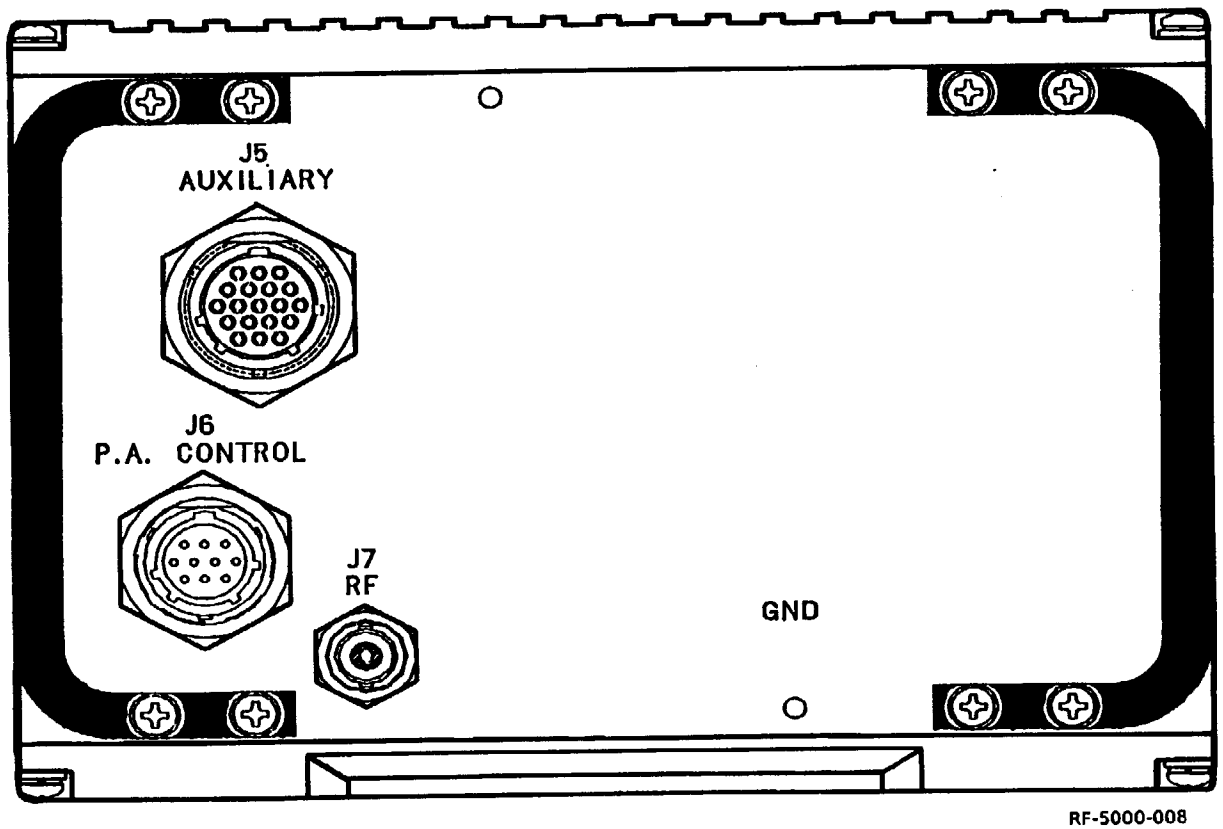
Table 2–30 list the input/output definitions for the remote operations audio/control signals.



PART NO.	LENGTH
10181-9842-006	6 FEET
10181-9842-010	10 FEET
10181-9842-025	25 FEET

5KS–053

Figure 2–19. RS–232 Auxiliary Cable



RF-5000-008

Figure 2–20. RF–5020R/T Rear–Panel Connectors

Table 2–30. Remote Operations Audio/Control Input/Output Signals for J5 on the R/T

Pin	Function	Interface
U	Audio Keyline Input	Ground closure
L	TX Audio –	–10 or 0 dBm
N	TX Audio +	–10 or 0 dBm
T	Retransmit Keyline Output	Ground Closure
C	RX Audio +	–10 or 0 dBm
P	RX Audio –	–10 or 0 dBm
D	Remote Off/On Input	Ground closure
A	Analog Ground	

Table 2–31. Asynchronous/Remote Control Input/Output Signals

Pin	Function	Interface
R	TX Data Async	RS–232
V	RX Data Async	RS–232
H	Request to Send Async	RS–232
B	Clear to Send Async	RS–232
M	Digital Ground	Signal Ground
K	Receive Level Sense Detect	RS–232

Table 2–32. Synchronous Input/Output Signals

Pin	Function	Interface
F	TX Data Sync	RS–232
E	RX Data Sync	RS–232
G	Request to Send Sync	RS–232
S	Clear to Send Sync	RS–232
M	Digital Ground	Signal Ground
K	Receive Level Sense Detect	RS–232
J	Sync Clock	RS–232

2.9 GROUNDING

The importance of grounding cannot be overemphasized. Inadequate grounding degrades system operation and causes RF voltages to be present on the chassis. These voltages could cause equipment damage and present a serious personnel hazard.

WARNING

Inadequate or defective grounding presents a personnel hazard that could result in serious injury or death.

CAUTION

Inadequate or defective grounding could damage the equipment.

2.9.1 Mobile Grounding

All ground cables should be as short as possible, ideally less than 12 inches (30 cm). Paint, grease, rust, etc. must be scraped away so that only bare metal is visible at grounding points. Use the chassis frame or a welded steel body panel for the grounding point. Never ground to trim or hinged panels (door, hood, etc.) or to surfaces which are removed from the chassis (dash, seats, etc.). Ground cables should be fabricated from tinned, braided copper of the correct length. Ground terminals are provided on the transceiver and antenna coupler, and should be used for this purpose. Position ground strap to the transceiver such that shock mount action is not inhibited. If the RF–382A–02 Antenna Coupler is used, refer to its manual for antenna grounding procedures.

2.9.2 Shipboard Grounding

For shipboard applications, the same basic grounding rules apply. If the ship is constructed of non–conductive materials, a special grounding system must be made. Normally, a steel bulkhead is a satisfactory mounting and grounding surface. However, it may be necessary to run a special ground line from the water to the transceiver. This is accomplished in a variety of ways, the most common being the installation of lead or chemically–treated copper or brass plate(s) to the underside of the ship. These are then connected to a solid–conductor (12 AWG or larger) wire, which is run the shortest possible distance to the transceiver, antenna coupler, and antenna. **DO NOT** connect the transceiver ground to any instrument grounds that might exist (such as depth or radar transducer ground) as this may cause noticeable interaction between the transceiver and such equipment. Any special ground system installed must be terminated at the primary power (dc) ground, preferably directly at the battery terminal labeled (–). This reduces ignition noise pickup and prevents possible ground loops.

2.9.3 Fixed Station Grounding

The transceiver ground terminal must be connected to a grounded pipe (such as a cold water pipe), preferably where the pipe enters the ground, or a steel or copper rod (Harris P/N E–250) driven six to ten feet into the soil. In situations where the water table is far below the surface (such as desert or mountainous terrain), it may be necessary to create an artificial ground system by burying steel or copper plates six to ten feet below the surface, and connecting them together directly below the transceiver location. In all cases, such grounds must be connected to both transceiver and antenna coupler using at least No. 8 copper cable directly from the ground point. Do not daisy–chain ground connections, as voltage differentials will develop over long distances. Any artificial ground system must additionally be connected to the primary power source ground to prevent generation of RFI and high–voltage electromagnetic fields around the equipment.

2.10 POWER REQUIREMENTS

The required voltage at the power amplifier is 26.4 Vdc. If the Harris–supplied cable is not being used, line drop should be taken into consideration and the wire should be 12 AWG or larger for 125–watt systems.

CAUTION

When connecting dc power to the power amplifier, be sure to use the correct cable. System faults and malfunctions will occur if the wrong cable is used.

The RF–5000V–125 System is designed to operate from a standard 26–V 60–amp vehicular battery–alternator system, typical of the M151A2 or land–rover type system. Power hook up must use a negative ground.

2.11 ANTENNA CONSIDERATIONS

Harris Corporation, RF Communications Group, recommends using the RF–382A–02 Fast Tune Antenna Coupler with the RF–5000 System in the 125–watt and 400–watt configurations. The RF–382A–02 is fully compliant with the timing and interface requirements of the RF–5000 System. If use of an antenna coupler is not possible, and if enough space is available, a folded dipole broadband antenna may be used. The RF–1927/RF–1928 and RF–1933 are broadband antennas that can be used with the RF–5000 system.

NOTE

For information on the RF–5000 1–kW configuration, refer to the RF–5000 1–kW System Service Manual, publication number 10221–5339.

A number of factors should be considered before erecting an antenna. Radio signals are absorbed and reflected by nearby obstructions such as hills, trees, buildings, and power lines. Avoid these if possible, especially when they are in a direct line with the RF signal path. Signal strength is usually greatest from the top of a hill, over level terrain, or over water. Mountainous or hilly terrain may present unpredictable transmission or reception problems. Some antennas are more directional than others, and must be correctly oriented for maximum signal gain. A good earth ground connection and radial grounding system improves antenna performance and protects the equipment and personnel from lightning and electrical shock.

2.11.1 RF–1927/RF–1928 Broadband Dipole Antenna

The RF–1927 Broadband Dipole Antenna is designed for use with transceiver equipment with up to 150 watts RF output power over a frequency range of 3 to 30 MHz. An antenna coupler is not required for impedance matching.

The RF–1928 Broadband Dipole antenna has the same features as the RF–1927 with the addition of all materials necessary for transportable construction. Included with the antenna are masts, guys, stakes, preconstructed radiating element, and vertical feedline.

2.11.2 RF–1933 Broadband Dipole Antenna

The RF–1933 is a broadband dipole antenna for use with transceiver equipment with up to 1000 watts RF output power over a frequency range of 2 to 30 MHz. An antenna coupler is not required. This antenna is physically longer than the RF–1927/RF–1928 series, but has a higher efficiency.

2.11.3 RF–382A–02 Fast Tune Automatic Antenna Coupler

The RF–382A–02 Fast Tune Automatic Antenna Coupler utilizes fast–tune microprocessor–based circuitry. Timing of the coupler operations are designed to be compatible with adaptive operation. The RF– 382A–02 is recommended for installations that require the use of an antenna coupler.

The RF–382A–02 connects to the 125–watt or 400–watt power amplifier at J1 and J2 on the antenna coupler, as shown in figure 2–21.

When using either the 125–watt or 400–watt power amplifiers with an RF–382A–02 Antenna Coupler, set the S2 DIP switch on the antenna coupler's A3 Assembly as shown in figure 2–22. Setting this switch to the specified positions ensures proper operation of the RF–382A–02 Antenna Coupler when used with 125–watt or 400–watt power amplifiers.

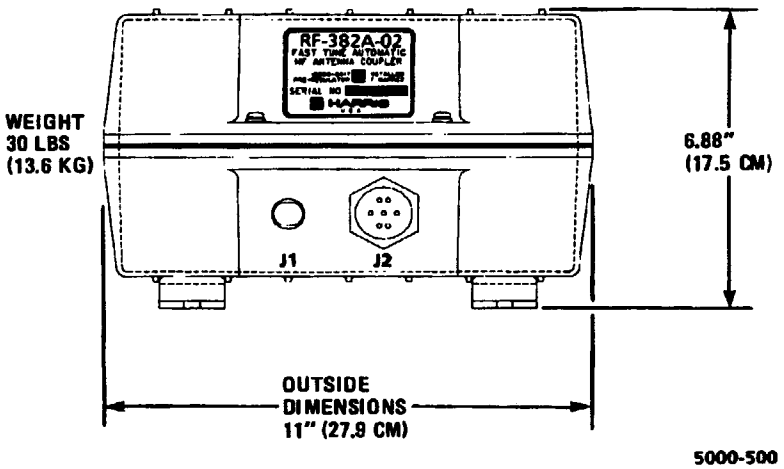


Figure 2–21. RF–382A–02 Antenna Coupler Rear Panel

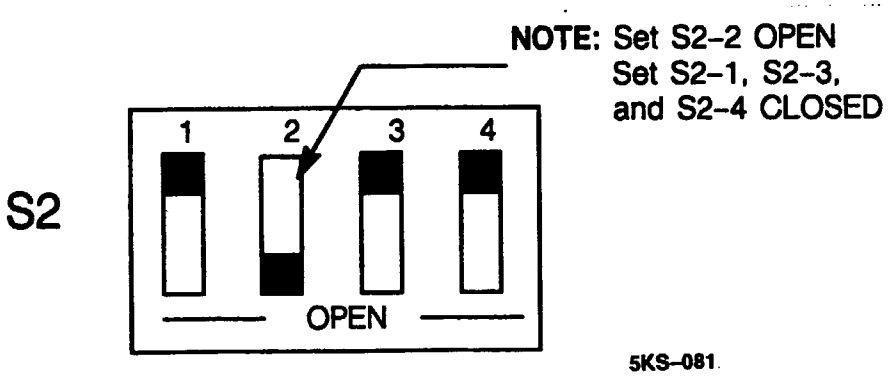


Figure 2–22. RF–382A–02, Control PWB A3, S2 Switch Settings

2.12 RF–5020R/T AND POWER AMPLIFIER CONTROLS AND CONNECTORS

2.12.1 RF–5020R/T – Receiver/Transmitter

Shown in figure 2–1, front–panel handset/headset connectors J1 and J2 are used for:

- J1 – audio handset/headset connector with additional 600–ohm unbalanced receive and transmit connectors
- J2 – audio handset/headset connector with data and data clock lines for an external fill device.

CW operation is supported by toggling the keyline with the push–to–talk (PTT) button on a handset or with a CW key connected to the keyline and ground pins on J1 and J2.

Table 2–33 list the pin assignments for J1 and J2.

The RF–5020R/T provides an interface for remote control and asynchronous/synchronous data via its rear–panel J5 auxiliary connector. The transceiver controls the RF–5000 power amplifiers and antenna couplers and receives primary dc power from the power amplifiers via the J6 connector. The 100 mW RF output of the RF–5020R/T's exciter is available at J7. The RF–5020R/T rear–panel connector locations are shown on figure 2–20.

Table 2–33. J1/J2 Input/Output Signals

Pin	Function	Signal Level
J1–A	Ground	
J1–B	RX Aud No 1	0 dBm into 1 kohms
J1–C	Push to Talk	Ground Closure
J1–D	TX Aud No 1	Impedance: 150 ohms, Level In: –56 dBm
J1–E	TX Aud No. 2	Impedance: 600 ohms (unbalanced), Level In: –10 dBm
J1–F	RX Aud No. 2	Impedance: 600 ohms (unbalanced), Level Out : –14 dBm into 600 ohms
J2–A	Ground	
J2–B	Same as J1–B	Reserved
J2–C	Same as J1–C	Reserved
J2–D	Same as J1–D	Reserved
J2–E	CLK	Reserved
J2–F	Data I/O	Reserved

2.12.2 Power Amplifier Controls and Connectors

The RF–5000 Series of power amplifiers have similar connector and circuit breaker descriptions and reference markings. Figure 2–23 shows the location of CB1 as well as the RF–5031PA–125 Power Amplifier connectors J8 through J12.

- CB1 – Primary Power Circuit Breaker

  CB1 provides primary power protection. Under normal use, the circuit breaker is enabled and system power is controlled by the RF–5020R/T's front–panel FUNCTION control. The circuit breaker is not intended to serve as the system power switch and should be reset only if tripped.

NOTE

The circuit breaker trips only if EXCESSIVE power is used by the power amplifiers or RF–5020R/T.

- J8 – Power Amplifier CONTROL

  The RF–5020R/T controls the power amplifiers and the antenna coupler and receives primary dc power from the power amplifiers via J8.

- J9 – CPLR CONTROL

  Antenna Coupler control and primary dc power is supplied by J9. The connector interface is compatible with the RF–5000 series of antenna couplers and the RF–382A–02 Antenna Coupler.

CAUTION

Only the RF–382A–02 or RF–5000 Series antenna couplers should be used with the RF–5000 System power amplifiers. Do NOT use the RF–382–01 Antenna Coupler.

- J10 – DC POWER

  The +28–Vdc primary power is supplied to the RF–5000 System through J10.

- J11 – RF OUT

  The RF output of the power amplifier is provided at J11. J11 is a BNC connector on the RF–5030PA/CU and N–type connectors on the RF–5031PA–125 AND RF–5034PA–400.

- J12 – RF IN

  The 100–mW RF input to the power amplifier is via J12 which is a BNC–style connector.

- ANTENNA

  The RF–5030PA/CU–20 provides an antenna connection at the antenna coupler output, shown in figure 2–24.

2.13 INITIAL SETUP AND CHECKOUT

When the transceiver is installed and all connector cables attached, verify that all items listed below are completed.

- All connectors are attached and associated hardware is secure.
- Ground wires are connected between the RF–5020R/T, power amplifier, and a known good ground. Examples of a good ground are a cold water pipe, a long copper stake pounded into solid earth, or a system ground bus at an existing site.
- Check securing hardware to be sure the equipment cannot be tipped over or moved.
- Check that area cooling is adequate for removing heat that may build up during equipment operation.
- Verify that the power source is of adequate capability and adequately protected for the radio's load, and that installation of the power cable is correct.
- Verify that the antenna is in place, correctly connected, and protected against accidental contact. If an antenna coupler is used, follow the guidelines in the coupler manual to be sure it is correctly installed.
- Check any companion equipment such as the power supply, remote control, and power amplifier for operational readiness.

After each item on the above list has been checked, the equipment is ready for the application of power. To verify operation, select TST at the RF–5020R/T. The system automatically runs a self test that measures all required voltages to test the equipment. Then perform a TST 4 (VSWR) to check the voltage standing wave ratio. Refer to sections 3 and 4 for basic operation and programming information.

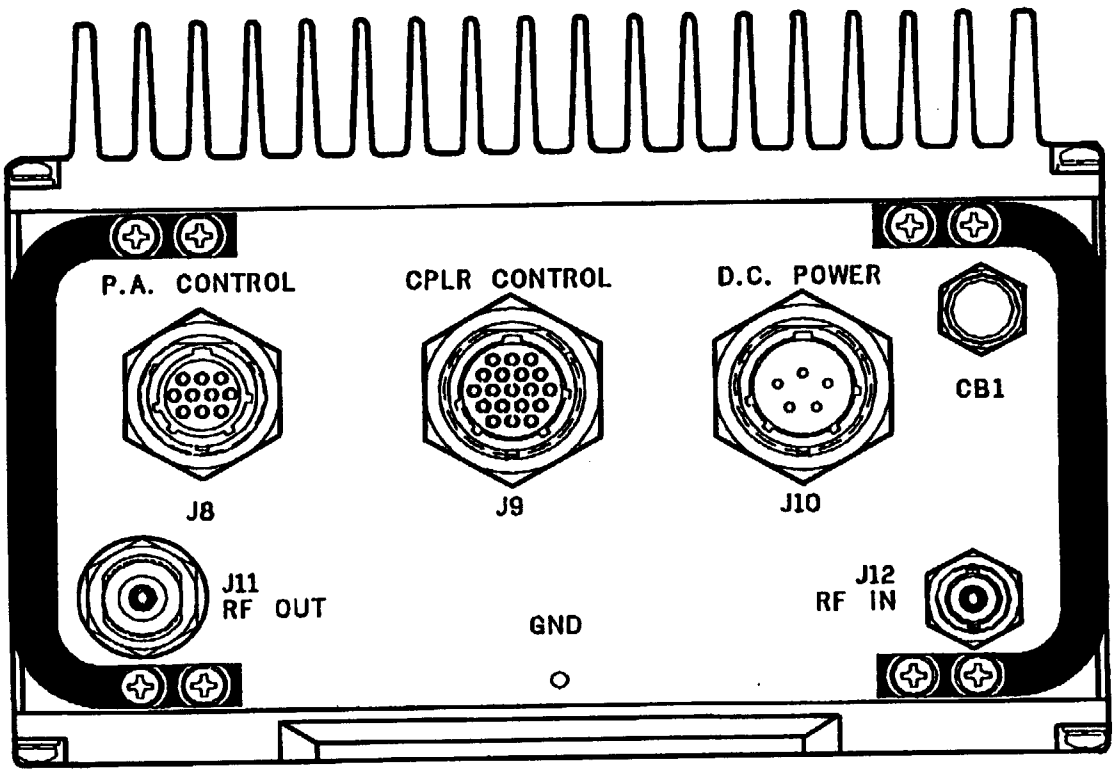


Figure 2–23. RF–5031PA–125 Power Amplifier Rear Panel RF-5000-011

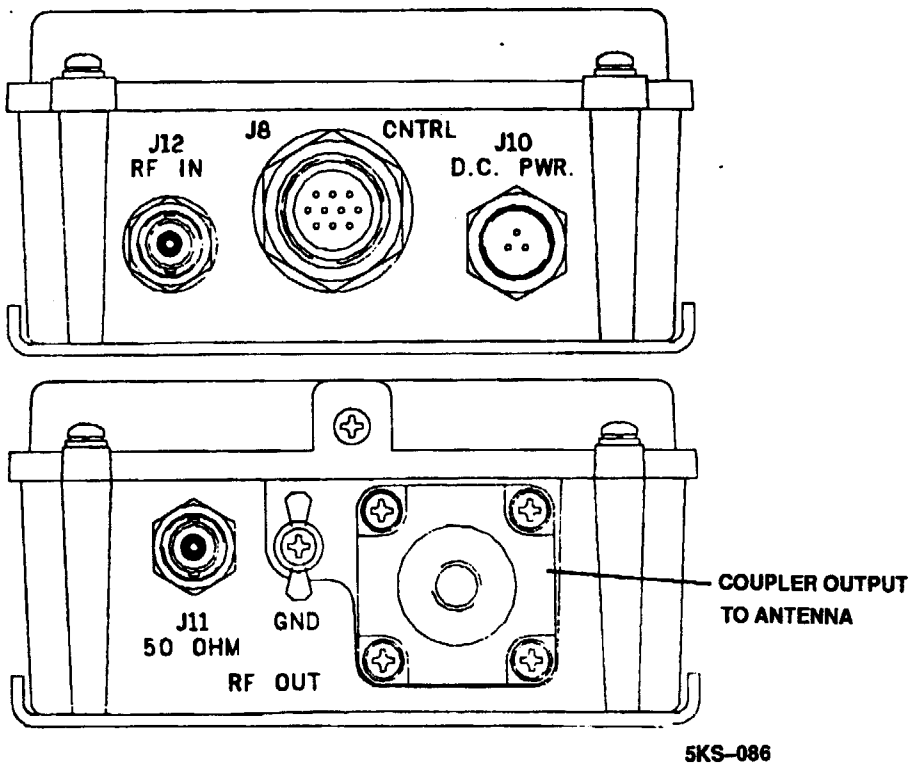


Figure 2–24. RF–5030PA/CU–20 Power Amplifier/Coupler

SECTION 3

OPERATION

3.1 GENERAL

All RF–5000 System operation is controlled, programmed, and monitored from the RF–5020R/T's front panel or via the remote control interface. The power amplifiers and antenna couplers have no controls or indicators other than protection circuit breakers. During normal operation, the power amplifiers and antenna couplers are controlled via the RF–5020R/T's front panel.

This section describes RF–5020R/T's front–panel controls, indicators, displays, and connectors, as well as basic operating procedures for SSB.

3.2 RF–5020R/T'S FRONT–PANEL CONTROLS, INDICATORS, AND CONNECTORS

Figure 3–1 shows the front–panel controls, indicators, and connectors. These are briefly described in table 3–1. A basic understanding of these controls, indicators, and connectors is necessary before attempting to operate the RF–5000 system.

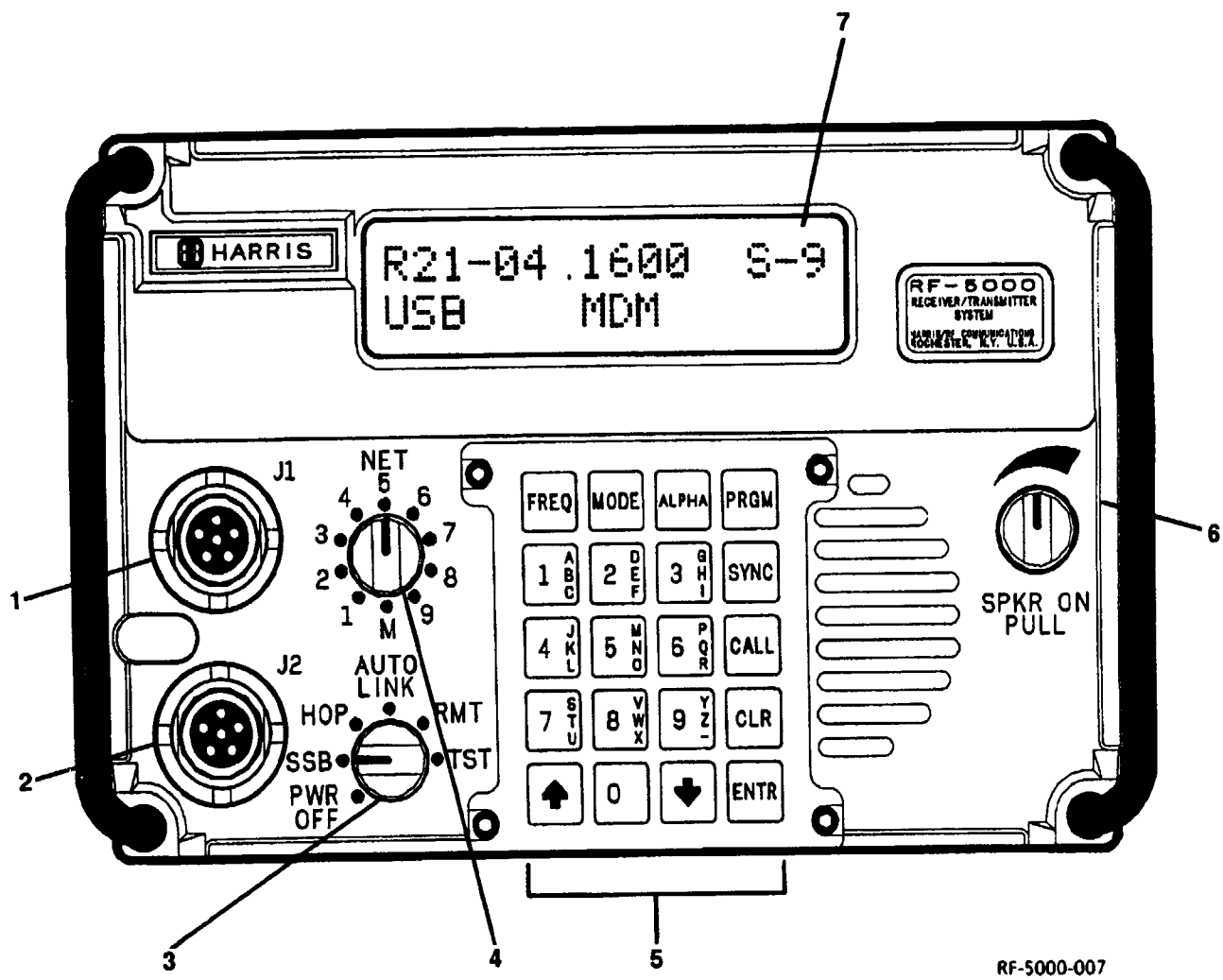
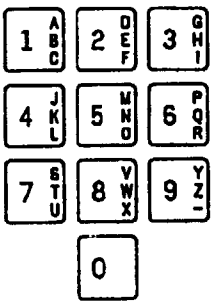


Figure 3–1. RF–5020R/T Front Panel

Table 3–1. Front–Panel Controls, Indicators, and Connectors

Figure 3–1 Number	Controls, Indicators, Connectors	Function
1	J1	Handset/headset connector that also provides an additional 600–ohm unbalanced receive and transmit audio interface.
2	J2	Handset/headset connector that also provides data and data clock interfaces for an external fill device.
3	FUNCTION CONTROL	Controls the operation of the RF–5000 system.
	PWR OFF	Turns RF–5000 system ON/OFF
	SSB	Single channel voice and data operations (USB, LSB, AME, CW)
	HOP	Frequency–hopping/ECCM operation (OPTION)
	AUTOLINK	AUTOLINK® Automatic Link Establishment (RF–5120AFC or RF–5121ALE Option)
	RMT	Remote control mode via AUX connector J5
	TST	Test RF–5000 system operation
4	NET CONTROL	In conjunction with the FUNCTION control, selects the operating channel, hopping net, or AUTOLINK®
	1–9	Net or channel selection for 1 to 9.
	M	Allows manual selection of a channel (00 through 99) via the KEYPAD.
5	KEYPAD	Changes operating modes, programs channel/net parameters, enables option features, and initiates call sequences. Detailed descriptions of keyboard operations are discussed in the OPERATING, PROGRAMMING, and OPTION TAB sections of this manual.
	FREQ Key [FREQ]	Allows operator to change the frequency of the net/channel.
	MODE Key [MODE]	Allows operator to change the operating mode (USB, LSB, AME, CW) and to enable/disable options such as the high speed data modem, data encryption, or digital voice.

Table 3–1. Front–Panel Controls, Indicators, and Connectors (Cont.)

Figure 3–1 Number	Controls, Indicators, Connectors	Function
5	KEYPAD (Cont.)	
	ALPHA Key 	Enters alphanumeric call signs, station IDs, and data messages (not currently used).
	PRGM Key 	Allows operator to program channel, interface, and option parameters from a sequence of menus.
	SYNC Key 	Initiates net synchronization in the HOP mode.
	CALL Key 	Initiates a call sequence in the HOP and AUTOLINK® modes.
	CLR Key 	Clears programming entries, resets a program sequence, and is used to control AUTOLINK® sequences.
	ENTR Key 	Enters a program parameter change, such as frequency or mode.
	ARROW Key 	Scrolls through menu selections, increments/decrements frequency, BFO.
	[0] – [9] Keys 	Enters numeric data (such as frequency) or alphanumeric data when used with the ALPHA key.
6	SPEAKER ON	Adjusts the volume of the handset/headset (via the J1 or J2 connectors) or the integral speaker. The control must be pulled out to activate the speaker and does not affect the AUXILIARY (J5) audio output level.
7	DISPLAY	Displays current operational and/or programmed information. See paragraph 3.3 for additional information.

3.3 RF–5020R/T DISPLAY

Two 16–character lines make up the 32–character LCD display. Selectable backlighting controls the visibility of the display.

The RF–5020R/T display provides the operator with a variety of display menus to assist in the operation and programming of the RF–5000 System. A different menu is used for each mode of operation. The modes are:

- SSB (single channel)
- HOP (frequency–hopping operation, RF–5140FH Option)
- AUTO LINK (automatic link establishment, RF–5120AFC or RF–5121ALE Option)
- RMT (remote control operation)
- TST (self test)

The following paragraphs describe each of the displays except AUTO LINK and HOP which are described in the System Options section under their own tab sections.

3.3.1 RECEIVE Display – SSB

A typical RECEIVE display is shown in figure 3–2.

3.3.2 TRANSMIT Display – SSB

A typical TRANSMIT display is shown in figure 3–3.

3.3.3 FREQUENCY Display – SSB

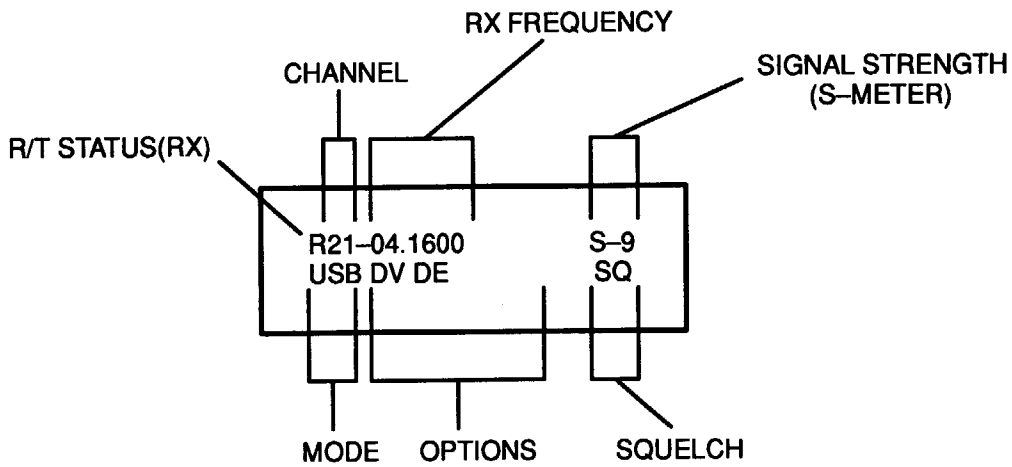
The FREQUENCY display occurs when the FREQ key is pressed and the RF–5020R/T is operated in the SSB (single channel) mode. Figure 3–4 shows a typical FREQUENCY display where RX FREQ indicates the current receive frequency and TX FREQ indicates the current transmit frequency.

3.3.4 MODE Display – SSB

The MODE display occurs when the MODE key is pressed. It is used to prompt the operator when entering a different modulation mode, changing squelch sensitivity, or when enabling an internal option. Continuing to momentarily press the MODE key causes the display to scroll through the MODE selections. Two of the selections are shown in figure 3–5.

NOTE

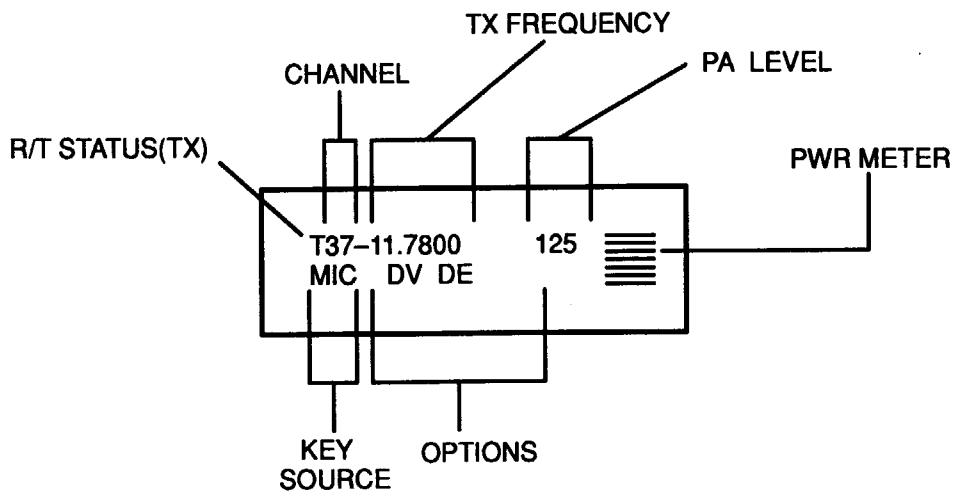
If an option is not installed, this is indicated by a NOT INSTALLED prompt on the second line of the display.



The above display indicates the following information about the state and operation of the RF–5000 System:

- R/T status – R (receive)
- Channel – selected programmed channel
- Frequency – receive frequency
- S–Meter – indicates relative received signal strength
  S–0 (lowest)...S–9, +10... +60 (highest)
- Mode – USB, LSB, CW, AME
- Options – DV (Digitized Voice On), DE (Digital Encryption On)
- Squelch – SQ (squelch enabled)

Figure 3–2. Typical RECEIVE Display – SSB



The above display occurs when the RF–5020R/T is keyed and indicates the following information about the state and operation of the RF–5000 System:

- R/T status – T (transmit)
- Channel – selected programmed channel
- Frequency – transmit frequency
- PA Level (power output setting in watts)
  Exciter only – 0.1
  20–watt PA – 20, 10, 5
  125–watt PA – 125, 50, 10
  400–watt PA – 400, 200, 100, 50
  1–kW PA – 100, 500, 125
- PWR Meter – relative transmit power bar graph indicator
- Key Source – MIC – handset keyline J1 or J2
  AUX – remote keyline of AUX J5 connector
  DATA – internal modem transmitting
  AUTO – AUTOLINK®
- Options – DV (Digitized Voice On), DE (Digital Encryption On)

Figure 3–3. Typical TRANSMIT Display – SSB

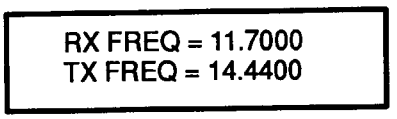


Figure 3–4. Typical HALF–DUPLEX FREQUENCY Display – SSB

Figure 3–5. Typical MODE Displays – SSB

3.3.5 PROGRAM Display – SSB

The PROGRAM display is shown in figure 3–6.

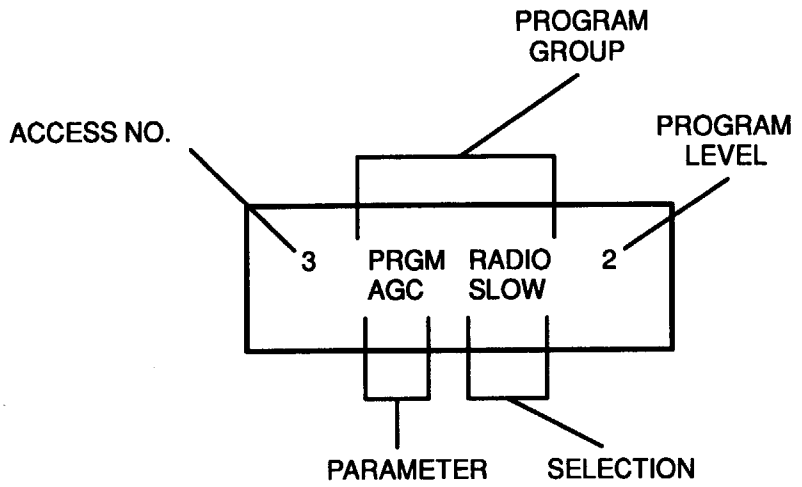
3.3.6 REMOTE Display

The REMOTE Display occurs when the FUNCTION control is placed in the RMT (Remote Control) position or when the RF–5020R/T is turned on using the AUXILIARY connector's (J5) remote on/off control line. Figure 3–7 illustrates two typical REMOTE displays.

3.3.7 TEST Display

The self–test gives the operator a quick check of the operational status of the RF–5000 System. The routines are accessed by setting the FUNCTION control to the TST (Test) position. Test messages and fault code information are described in the Maintenance section of this manual.

Examples of the displays that occur during self test are shown in figure 3–8.



The above display occurs when the PRGM key is pressed to change a programmable operating parameter. Programmable parameters are grouped according to function and option to simplify operation. The programmable operating parameters are grouped as follows and are discussed in section 4:

- ACCESS NUMBER – Number used to directly access a programmable parameter.
- PROGRAM GROUP – Function or option being programmed
- PROGRAM LEVEL – Level of program sequence
- PARAMETER – Operating parameter
- SELECTION – Value or state of parameter to be selected

Figure 3–6. Typical PROGRAM Display – SSB

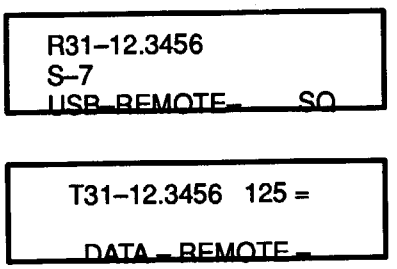


Figure 3-7. Typical REMOTE Displays

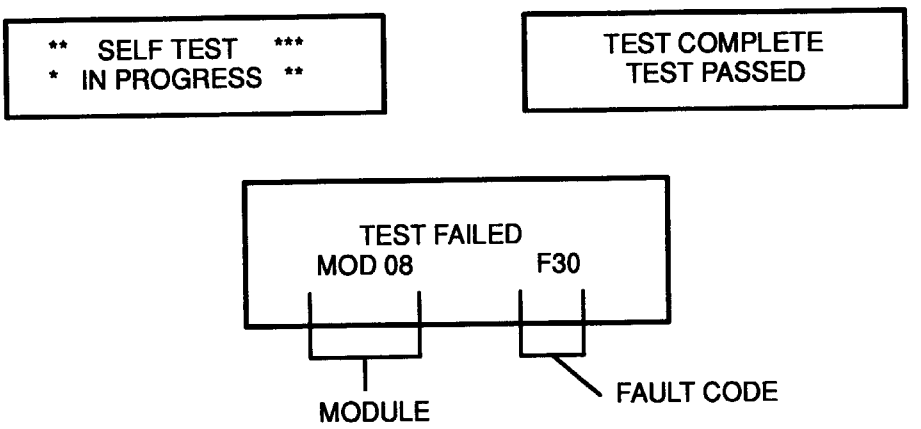
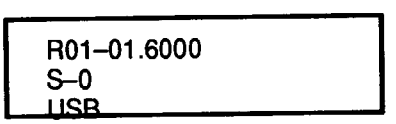


Figure 3-8. Typical Self-Test Displays

3.4 BASIC OPERATIONS – SSB

This section describes front-panel control for basic single channel operation. Control of system options is described in separate tab sections.

The default value for all unprogrammed channels is shown below.



NOTE

When the RF–5020R/T is turned on from a cold start, approximately 30 seconds is required to achieve frequency stability for single channel voice and data operation. Full stability is achieved in three minutes.

3.4.1 Selecting a Channel (NET) and an Operating Mode

There are two methods for selecting channels (NETS):

- Channels 1 through 9 can be entered directly by selecting the desired channel on the NET control knob.
- Placing the NET control in the M position enables MANUAL keypad selection of all channels (0 through 99):

a. Place the NET control in the M position. RX display shows previously manually–selected channel.

b. Use the keypad numbers to select the desired channel.

c. Press the ENTR key to load the new channel.

The MODE key allows the selection of the radio modulation mode (USB, LSB, AME, or CW), squelch, data modem baud rate, and the enabling of the data encryption and digitized voice options. Continuing to momentarily press the MODE key scrolls the MODE display through the MODE menus. The ARROW keys are then used to scroll through the desired mode or option selections.

Pressing the MODE key selects the displayed menu selection and advances to the next menu. Pressing the ENTR key selects the displayed menu selection and returns to the RECEIVE display.

Figure 3–9 shows the various operating modes that can be selected.

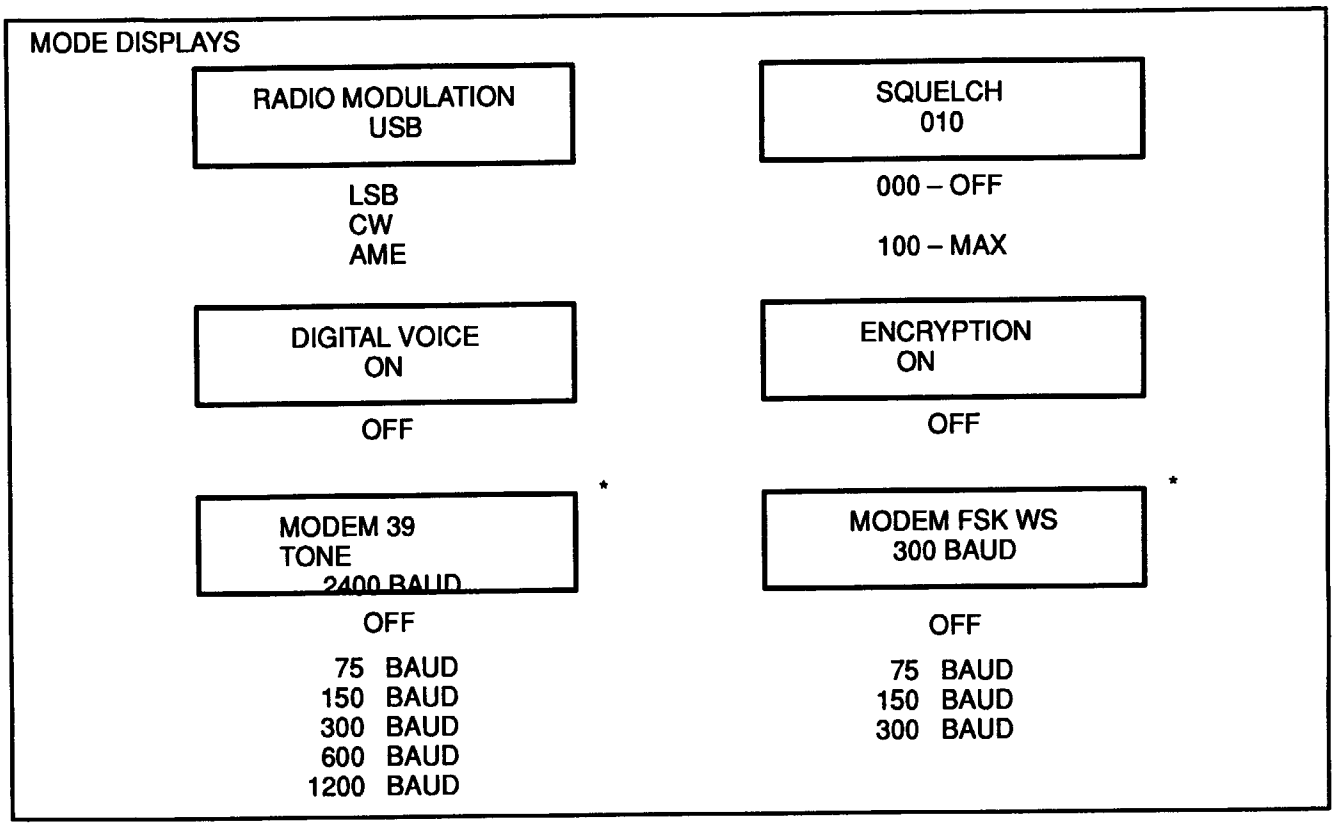
NOTE

When a mode is selected, the IF filter bandwidth is automatically set to the nominal operating value. See paragraph 4.2.1.

Follow the steps of figure 3–10 to turn on the RF–5000 System and initialize the NET (channel) settings, the power amplifier, and the antenna coupler. These steps also allow the operator to select a simplex channel (NET) and an operating mode.

3.4.2 Changing the Operating Frequency (Simplex and Half–Duplex)

The RF–5020R/T is structured to simplify frequency programming. With the FUNCTION control in SSB and the channel selected, follow the steps in figure 3–11 to change the operating frequency. The RX and TX frequency displays are entered with a resolution of 100 Hz.



* Display depends upon selected modem mode.

Figure 3–9. Changing the Operating Mode

3.4.3 Keying the RF–5020R/T

The RF–5020R/T can be keyed from the following KEY SOURCES:

- MIC – J1 or J2 handset connectors
- AUX – Remote Keyline AUXILIARY (AUX) connector J5
- DATA – Request To Send control line (RTS) AUX connector
- DATA – Control B data character (key), Control C (unkey) AUX connector
- REMOTE – Key/Unkey remote control commands

3.4.4 Frequency Scrolling with Arrows

The ARROW keys can be used to scroll the operating frequency. The scrolling increment can be programmed using the PRGM key. The procedure is discussed in paragraph 4.2.5.

In simplex operation, both the RX and TX frequencies are scrolled. In half–duplex, the RX frequency is scrolled.

The arrow keys are enabled when the FREQ button is pressed.

SELECTING A CHANNEL (NET) AND AN OPERATING MODE

1. Set FUNCTION control to SSB (single–channel mode.

2. Set NET control as desired (1 through 9 or M).

   The LCD display shows the selected channel and its current frequency (or default frequency) setting. For example:

   ```
   R01–01.6000
   S–0
   USB
   ```

3. Press the MODE key to access radio modulation mode.

   ```
   RADIO MODULATION
         USB
   ```

4. Use the arrow keys to select the modulation mode (LSB, USB, AME, CW).

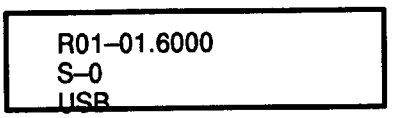
5. Press the ENTR key to set the MODE. The display shows the entry:

   ```
   R01–01.6000
   S–0
   USB
   ```

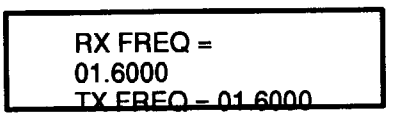
Figure 3–10. Selecting a Channel (NET) and an Operating Mode

CHANGING THE OPERATING FREQUENCY

The LCD shows the selected channel, its current frequency or default frequency setting, the radio modulation mode, or internal option.



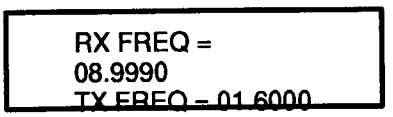
1. Press the FREQ key. The current RECEIVE and TRANSMIT frequencies display. Note that the left most digit of the RX FREQ blinks. This means that it can be changed.



2. Use the keypad to change the RX FREQ. The CLR key can be used to change a digit entry or move the digit that can be changed (blinking digit) to the left.

NOTE

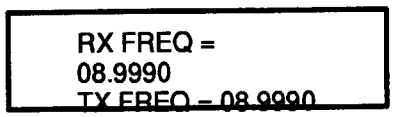
Enter the leading zero for frequencies below 10 MHz; eg 08.9990 MHz. The digit that can be entered blinks.



3. When the frequency is selected, press the ENTR key to load the RX frequency.

Figure 3–11. Changing the Operating Frequency (Sheet 1 of 2)

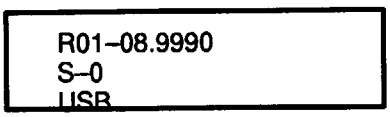
CHANGING THE OPERATING FREQUENCY (CONT.)



4. Once the RX frequency is entered, the TX (transmit) frequency is automatically updated to match the RX frequency. At this time, a different TX frequency can be selected for half–duplex operation.

   Pressing the ENTR key loads the TX frequency and the display returns to the channel setting with the new frequency selection.

   The front–panel display returns to the RECEIVE display.



NOTE

Keying the RF–5020R/T with the handset places the R/T in transmit and causes the TRANSMIT display to appear.

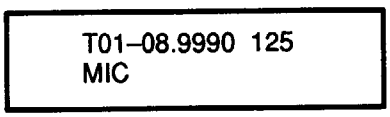


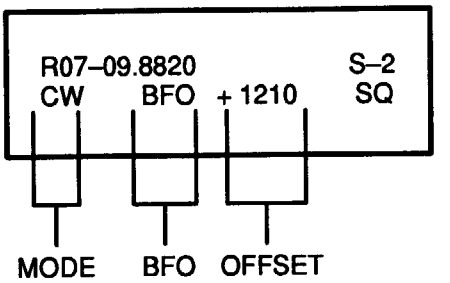
Figure 3–11. Changing the Operating Frequency (Sheet 2 of 2)

3.4.5 BFO Operation

BFO operation is enabled using the PRGM key sequence as described in paragraph 4.2.9:

a. BFO Operation can be accessed by pressing 9 PRGM. To enable the BFO, use the up/down arrows to display ON and then press the ENTR key.

b. The current BFO displays:



Use the ARROW keys to increment or decrement the receive frequency in 10–Hz steps (range ± 4000 Hz).

c. To cancel BFO operation, repeat step a, selecting OFF.

NOTE

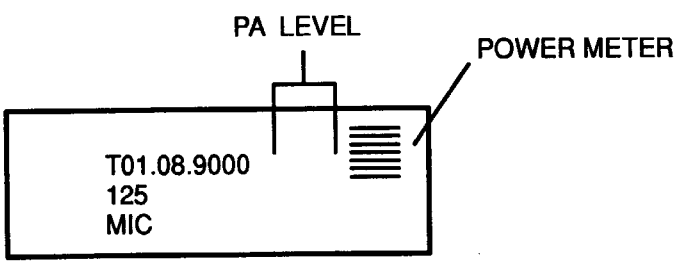
The BFO range exceeds the passband of the IF filters in some modes. If no audio is present, disable BFO operation and use the frequency scrolling with the ARROW keys for fine tuning. BFO support is only for USB–voice, LSB–voice, and CW.

3.4.6 Power Amplifier Control

The RF power output of the power amplifiers is programmable. Power output control is enabled using the PRGM key sequence as discussed in paragraph 4.2.4:

a. To access the RF power output of the power amplifiers, press 5 PRGM.

b. The front–panel display indicates the selected power level and a bar graph indicator shows relative transmit power in reference to the power setting. For example:



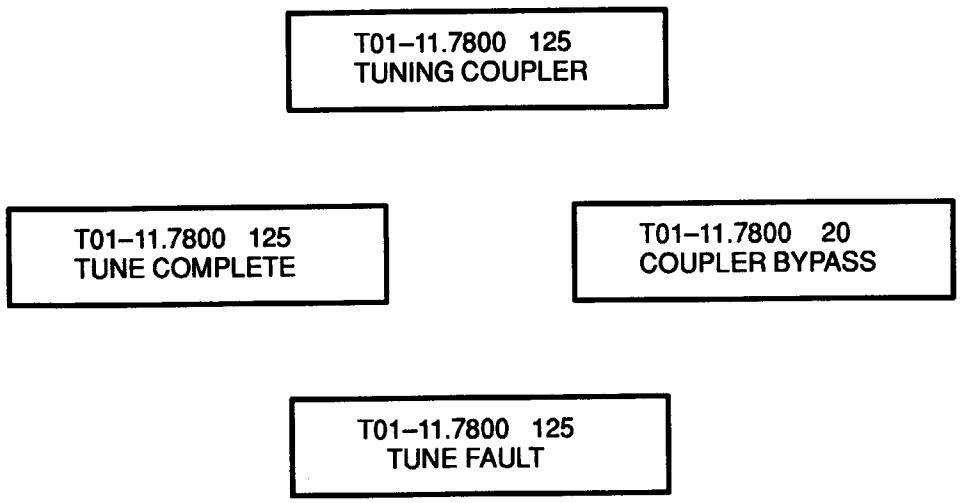
The power amplifier settings that are available for each power amplifier are listed in figure 3–3.

3.4.7 Antenna Coupler Operation

The RF–5000 System provides automatic antenna coupler tune operation when the system is configured with an RF–5030PA/CU–20 Power Amplifier/Antenna Coupler, an RF–5000 Series Antenna Coupler, or an RF–382–02, RF–2601, or RF–601A Antenna Coupler.

A channel (NET) change or a frequency change greater than 1% initiates a channel change command to the coupler which causes an automatic retune the next time the RF–5020R/T is keyed. The retune time is approximately 200 milliseconds for the RF–5030PA/CU–20 and 25 milliseconds (retune to a learned frequency) for the RF–382–02.

Coupler status is monitored on the front–panel display as shown below.



The TUNING COUPLER prompt is displayed while the unit is tuning.

The TUNE COMPLETE prompt is momentarily displayed at the completion of the tune sequence.

The COUPLER BYPASS prompt indicates that the RF–5030PA/CU–20 Power Output connector (J12) has been selected as the RF OUTPUT during the auto tune sequence.

The TUNE FAULT prompt indicates that a tune was not possible. A retune can be attempted by rekeying the radio. If the TUNE FAULT prompt persists, the antenna should be checked. A new channel or operating frequency can also be selected.

Note that antenna couplers are designed to tune with antennas that exhibit a nominal range of impedances. Under certain conditions a tune may not be possible at the specified operating frequency.

Refer to the applicable Antenna Coupler Instruction Manual for tuning information.

SECTION 4

PROGRAMMING

4.1 PROGRAMMING – SSB

This section discusses programming of basic system parameters from the front panel. Remote control and system option programming are covered in their respective tab sections.

When programming the RF–5000 System, prompts, menus, and messages display to assist in the programming selection. Operating parameters, such as AGC, IF bandwidth, modem waveform, data interface baud rate, etc., are divided into program groups according to function and option to simplify the programming procedure.

There are two main programming levels in the RF–5000 System:

- Program Group (first level) – access to group of parameters
- Operating Parameter (second level) – access to a specific parameter

NOTE

A third–level programming level is available in some selections in the CONFIG PROGRAM GROUP. These are described in their respective sections.

The PROGRAM GROUP (first–level menu) is accessible by pushing the CLR PRGM key sequence. This displays the first program group. In the SSB mode, these are:

- RADIO – Defines channel characteristics such as AGC, IF Bandwidth, PA Power Setting, and BFO.
- MODEM – When this option is installed, defines the modem waveform, baud rate, and method of data transmission.
- DATA PORT – Defines asynchronous and synchronous interface parameters.
- CONFIG – Defines system installation and test configuration.
- LOAD – Used to load encryption keys from a fill device.
- ENCRYPTION – Used to provide secure data and digitized voice transmission.
- ZEROIZE – Allows operator to zeroize (erase) all channel settings, and return unit to default status.

NOTE

The ZEROIZE command should be used with caution. Once erased, the settings cannot be recovered.

Table 4–1 lists the program groups and the operating parameter for the first and second levels of programming.

Operator sheets are included at the end of this section showing the operating parameters available in SSB, ALE, and hopping modes.

Table 4–1. Program Levels

Program Group (First Level)	Access No.	Operating Parameters (Second Level)	Access No.	Paragraph
RADIO	1			4.2
		IF Bandwidth	2	4.2.1
		AGC	3	4.2.2
		RF Gain	4	4.2.3
		Output Power	5	4.2.4
		Increment	6	4.2.5
		Compression	7	4.2.6
		Clipping	8	4.2.7
		BFO	9	4.2.8
MODEM (Option)	10			4.3
		Modem Port	11	4.3
		Modem Type	12	4.3
		Modem Baud	13	4.3
		Interleave (39–tone only)	14	4.3
		Mark Frequency (FSK only)	15	4.3
		Space Frequency (FSK only)	16	4.3
DATA PORT	17			4.4
		Async Rate	18	4.4.1
		Bits	19	4.4.2
		Stop Bits	20	4.4.3
		Parity	21	4.4.4
		Flow	22	4.4.5
		Echo	23	4.4.6
CONFIG	25			4.5
		Light	26	4.5.1
		Audio	27	4.5.2
		Time of Day	28	4.5.3
		System Config	29	4.5.4
LOAD RADIO	38	Load Encryption Keys via Fill Gun		4.6
ENCRYPTION	39			4.7
		Select Encryption Key	40	4.7
		Select Key Number	41	4.7
		Enter Encryption Keys	42	4.7
ZEROIZE	99			4.8

4.1.1 Accessing Program Groups and Operating Parameters

There are three ways to access program groups and operating parameters:

- Access via Program Group – CLR PRGM

a. With an RX display on the LCD display, press the CLR key followed by the PRGM key. This causes the "1 PRGM RADIO" group to appear in the display.

b. Each subsequent press of the PRGM key advances the display to the next program group.

c. To access the displayed program group's operating parameters, press the ENTR key.

- Direct access via Access Number – Access Number [N] PRGM

  Each parameter has been assigned an access number. With an RX display on the LCD display, press the access number [N] followed by the PRGM key. This causes the specified parameter to appear in the display.

- Repeat Access – PRGM

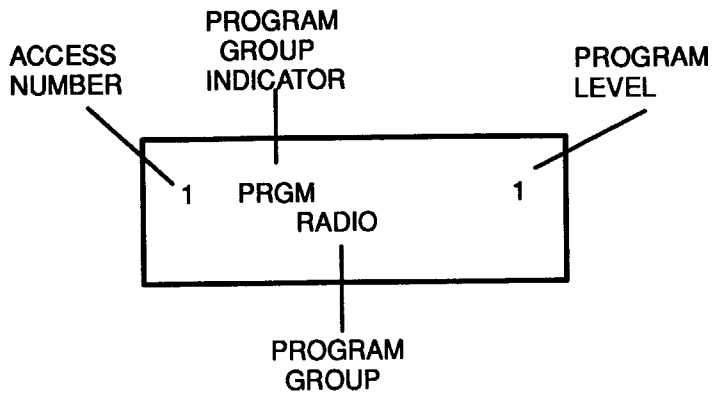
  After an operating parameter has been selected and entered and the LCD has returned to the RX DISPLAY, pressing the PRGM key causes the last accessed PRGM function to appear in the display.

4.1.2 Accessing/Exiting Program Levels

Figure 4–1 uses typical LCD displays to illustrate the general key sequence for accessing/exiting program levels.

4.1.3 Making Programming Selections

The PROGRAM display occurs when the PRGM key is pressed. Continuing to momentarily press the PRGM key causes the display to scroll through the program groups. An example of a first–level program group display is shown below:

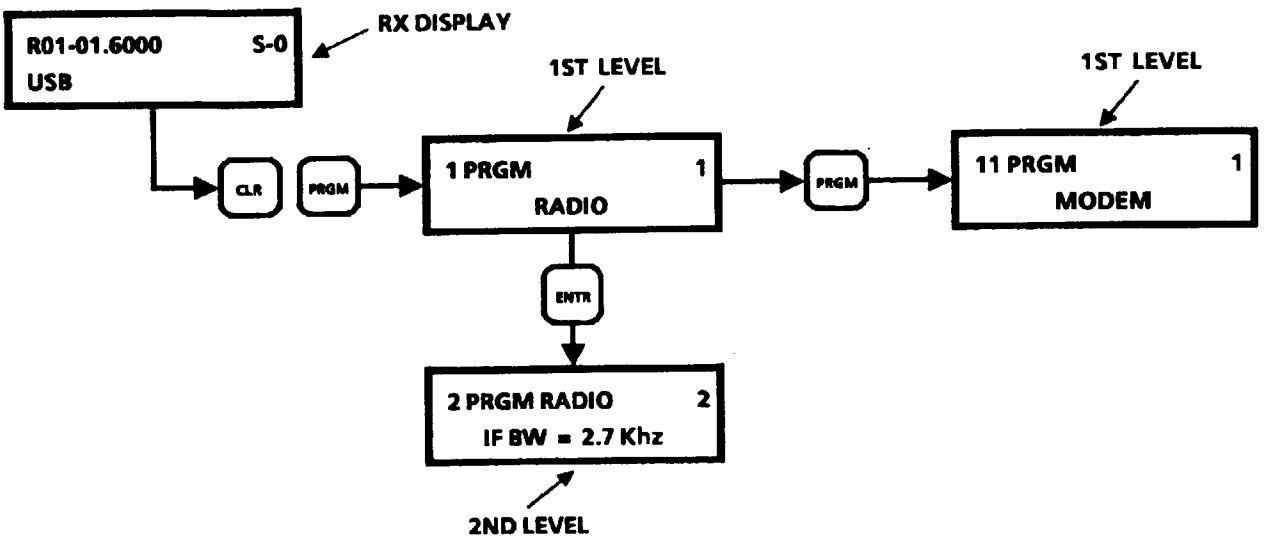


ACCESS NUMBER – Number used to directly access a programmable parameter

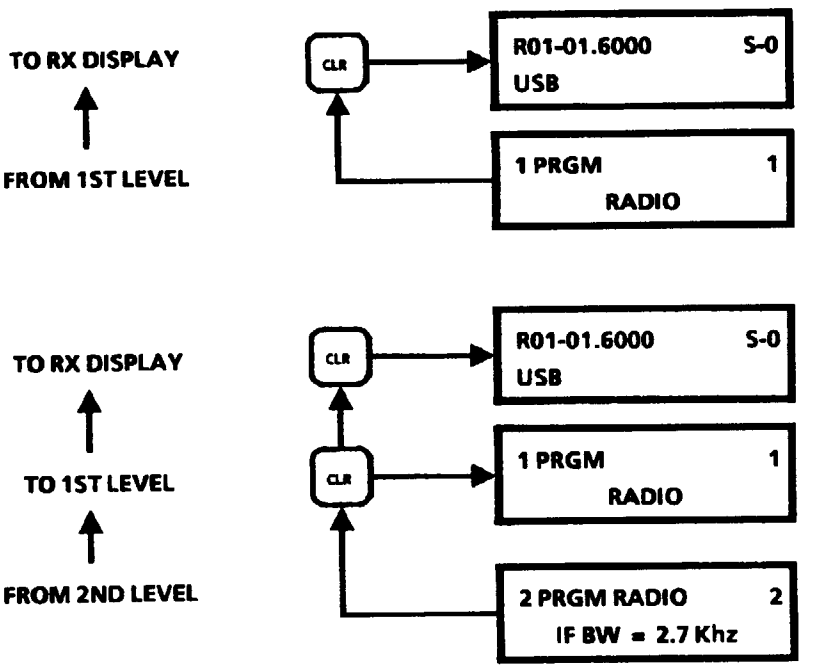
PROGRAM LEVEL – Level of program sequence

PROGRAM GROUP – Program group

TO ACCESS PROGRAM LEVELS



TO EXIT PROGRAM LEVELS



NOTE:

PRGM — ADVANCES DISPLAY TO NEXT PARAMETER ON SAME LEVEL

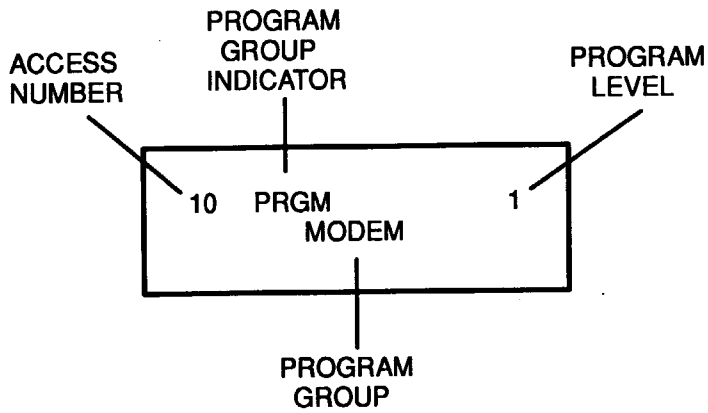
ENTR — ADVANCES DISPLAY TO SECOND LEVEL PARAMETER

CLR — MOVES THE DISPLAY UP ONE LEVEL

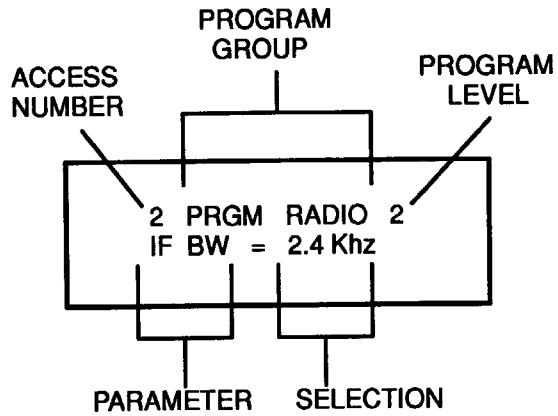
**RF-5000-011

Figure 4–1. Accessing/Exiting Program Levels

To advance the display to the next program group, press the PRGM key:



To access the SECOND LEVEL menu, press the ENTR key:



PARAMETER – Operating Parameter

SELECTION – Value or state of parameter to be selected **(BLINKING)**

To select a different operating parameter, use the ARROW keys (or keypad, if appropriate) to scroll through the selections and then press the PRGM key. This stores the displayed value and advances the display to the next programmable parameter.

4.2 1 PRGM – RADIO GROUP

The RADIO group parameters define channel characteristics which are used to enhance channel performance under unique conditions such as poor channels or LPI operation. Table 4–2 defines which operating parameter settings are stored by an individual channel and which affect the RF–5000 System as a whole.

Table 4–2. Radio Program Group Operating Parameter Selections by Channel or RF–5000 System

Access Number	Function	Programmable by Channel	Programmable by System
2	IF BANDWIDTH	X	—
3	AGC	X	—
4	RF GAIN	X	—
5	OUTPUT POWER		X
6	INCREMENT		X
7	COMPRESSION		X
8	CLIPPING		X
9	BFO	–	–

4.2.1 2 PRGM – IF Bandwidth

Different bandwidth settings are available based on the radio modulation mode and option selected for the NET. The IF bandwidth is programmable for each NET. Table 4–3 lists the IF bandwidth selections for SSB and the modem and LPC VOICE options.

Table 4–3. IF Bandwidth Selections

USB/LSB	AME	CW	MODEM	LPC VOICE
1.5 kHz	3.0 kHz	0.35 kHz	3.0 kHz*	3.0 kHz*
2.0 kHz	4.0 kHz	0.68 kHz		
2.4 kHz	5.0 kHz	1.0 kHz*		
2.7 kHz	6.0 kHz	1.5 kHz		
3.0 kHz				

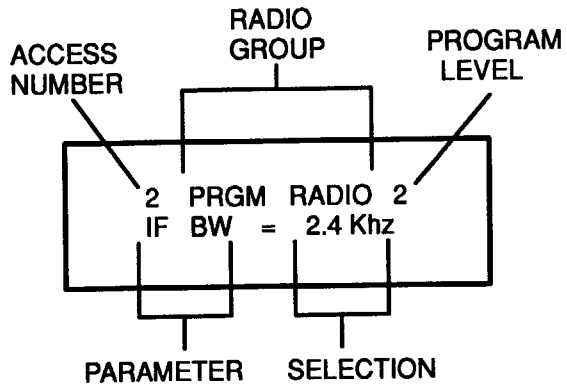
* Normal bandwidth setting

When the MODEM or the LPC VOICE option is enabled, the 3.0–kHz bandwidth selection is automatically selected and cannot be changed without turning off the enabled option.

For voice and CW operation, select the narrowest IF bandwidth that provides acceptable voice quality and operational performance.

When using external voice or data equipment connected through the AUXILIARY connector, consult the equipment manual for proper bandwidth selection.

A typical IF bandwidth display is shown below:



- Use the ARROW keys to scroll the display through the parameter list; e.g., for SSB – USB: 3.0 kHz, 2.7 kHz, 2.4 kHz, 2.0 kHz, 1.5 kHz.
- To store the displayed selection in memory, follow one of the three options listed below:

a. To store the displayed selection in memory and return to the RX display, press the ENTR key.

b. To store the displayed selection in memory and advance the display to the next parameter in group; i.e., AGC, press the PRGM key.

c. To store the displayed selection in memory and return to the FIRST LEVEL display, press the CLR key.

4.2.2 3 PRGM – AGC

The AGC – receive AUTOMATIC GAIN CONTROL function provides selection of various timing constants controlling the receive AGC rate. A typical AGC display is shown below:

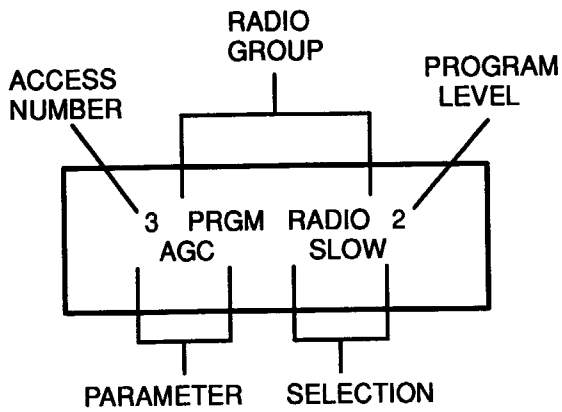


Table 4–4 shows the AGC programming selections. The Med or Fast settings may be preferred for CW operation or if significant static is present; e.g., lightning. The Data setting is provided for use with external data modems. The Slow and Med settings should be selected when using the internal modem option.

Table 4–4. AGC Programming Selections

AGC Settings	Attack Time	Hang Time	Decay Time
OFF	—	—	—
DATA	25 msec	0 msec	16 msec
FAST	25 msec	100 msec	100 msec
MED	25 msec	500 msec	750 msec
SLOW*	25 msec	1500 msec	1500 msec

* Normal AGC setting

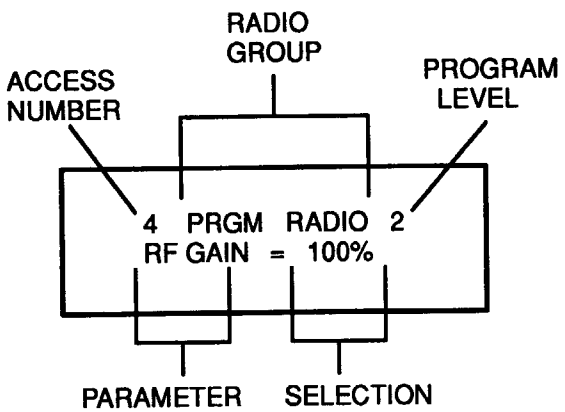
4.2.3 4 PRGM – RF Gain

The RF GAIN function provides control over receiver gain. For normal operation, RF gain is set at 100%. Reduced gain is only useful when receiving exceptionally strong signals. RF gain can be set from 100% (maximum gain) to 000% (minimum gain).

NOTE

The RF GAIN function reduces the ability to receive low–strength signals and should be used with care.

A typical RF GAIN display is shown below:



NOTE

When RF Gain is set to a value below 100%, the S–Meter blinks.

4.2.4 5 PRGM – Output Power

Power amplifier output power control settings are listed in table 4–5; a typical display is shown below:

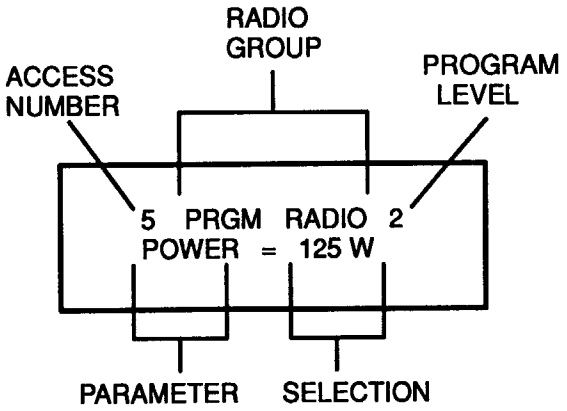


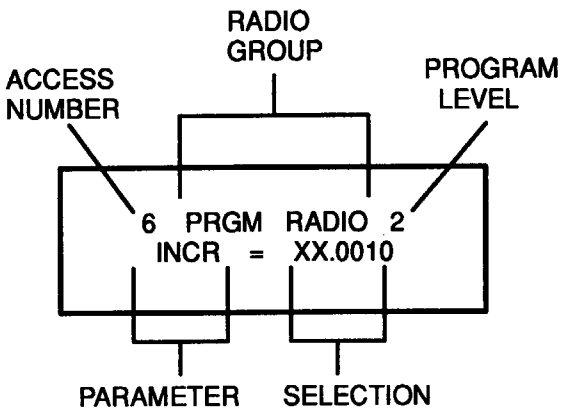
Table 4–5. Power Amplifier Settings In Watts

Power Amplifier	Settings
1000–watt PA	1000*, 500, 125
400–watt PA	400*, 200, 100, 50
125–watt PA	125*, 50, 10
20–watt PA	20*, 10, 5
Exciter Only – no PA	0.1

*Normal output power setting

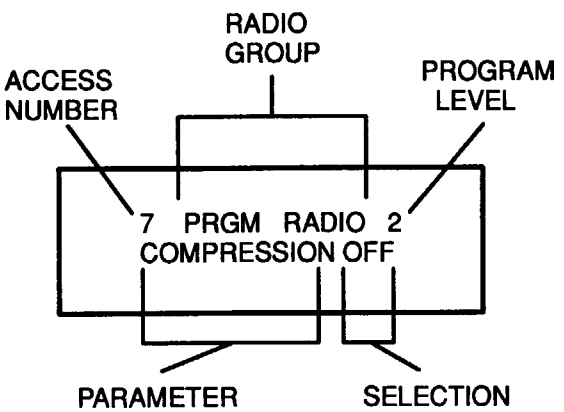
4.2.5 6 PRGM – Increment

The INCREMENT function sets the frequency tuning increment to be used when tuning the channel/net frequency with the ARROW keys. The default selection made by this system is 1 kHz until programmed.



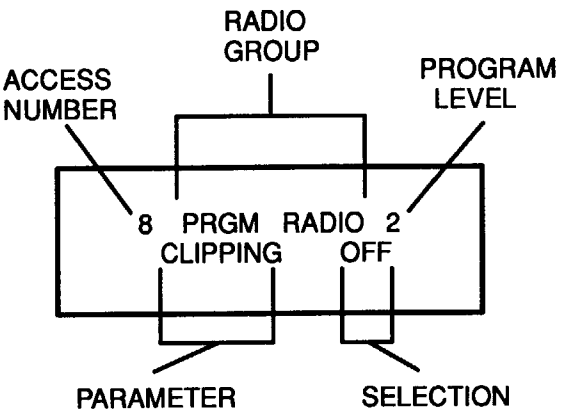
4.2.6 7 PRGM – Compression

The COMPRESSION function minimizes peaks in the microphone and AUXILIARY transmit audio, increasing the average transmitted audio signal power. Ordinarily, compression is turned OFF and is intended for use in marginal signal conditions to increase received intelligibility. It is not required for normal operation or recommended for use with external voice processors or data modems.



4.2.7 8 PRGM – Clipping

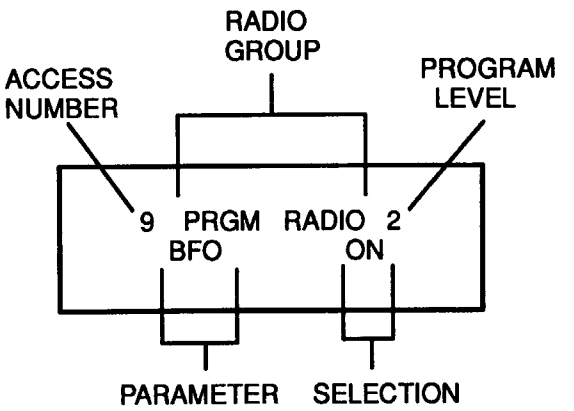
The CLIPPING function increases the microphone and AUXILIARY transmit audio gain and enables an analog clipping circuit to increase the average transmitted audio signal power. During normal operation, clipping is turned off. It is intended for use in marginal signal conditions to increase intelligibility and is not required for normal operation or recommended for use with external voice processors or data modems.

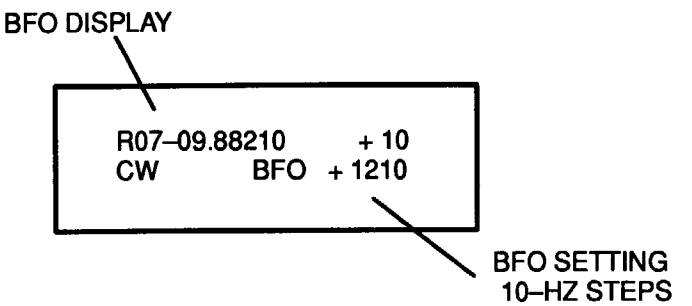


4.2.8 9 PRGM – BFO

BFO (Beat Frequency Oscillator) operation is only supported for USB – voice, LSB – voice, and CW modes. Once enabled, BFO operation is controlled using the ARROW keys to increment or decrement the receive frequency.

BFO operation is disabled when AME, modem, hopping, or AUTOLINK™ is selected, a new frequency or channel is selected, or by turning BFO off using this program sequence.





NOTE

The BFO range exceeds the passband of the IF filters in some modes. If no signals are present, disable BFO operation and frequency scroll using the ARROW keys.

4.3 10 PRGM MODEM GROUP (OPTION)

The modem module is an optional module. When it is not installed in the RF–5000 System, a display similar to the one shown below occurs when any of the PRGM access numbers associated with the MODEM group are selected:

```
10  PRGM MODEM  1
    NOT INSTALLED
```

Programming instructions for the modem option are found in the System Options section under its own tab section.

4.4 17 PRGM – DATA PORT GROUP

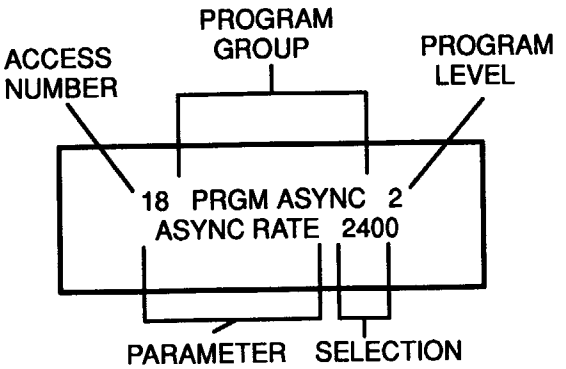
The DATA PORT group parameters define the asynchronous data, synchronous, and remote control (asynchronous port) data interfaces. This group of parameters is usually programmed at the time of installation or when a new data terminal, computer, or cryptographic unit is interfaced to the RF–5020R/T. The RF–5020R/T can support both an asynchronous and a synchronous device. Separate control lines are provided for each interface.

Care must be taken to ensure that the RF–5020R/T data port parameters agree and are compatible with the data device interface.

The DATA PORT command allows programming of the ASYNCHRONOUS DATA INTERFACE PORT located at J5 on the rear panel of the RF–5020R/T. The asynchronous port is used for both asynchronous data transmission and remote control.

4.4.1 18 PRGM – Async Rate

The ASYNC RATE defines the baud rate that is used to communicate with an external data device via the asynchronous data port. The interface baud rate can be different than the over–the–air baud rate as defined by the MODEM BAUD RATE command. This allows a data terminal or personal computer to be used as both the remote control unit and as a data message device.



NOTE

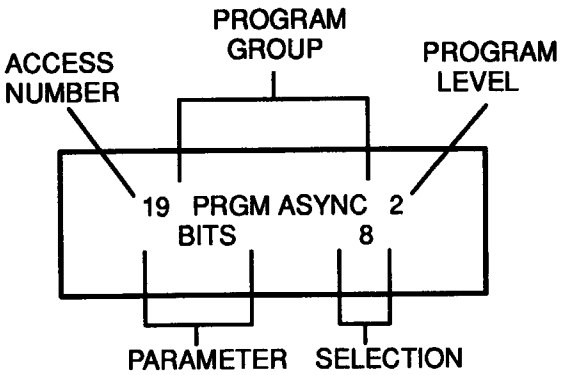
It is recommended that the 2400–bps setting be used for the asynchronous interface. Long remote control cables (beyond 10 meters) also limit the speed of operation. Once reliable operation has been confirmed at 2400 bps, higher baud rates can be attempted.

The asynchronous rate selections in bps (bits per second) are:

75	1200
150	2400
300	4800
600	

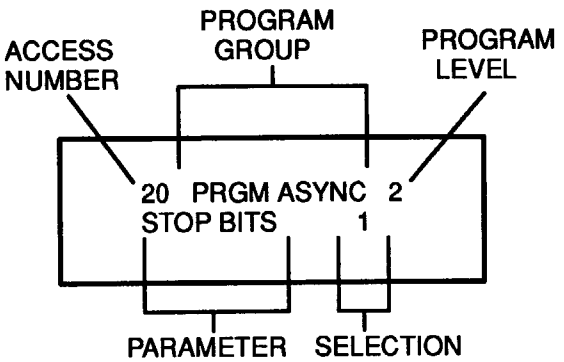
4.4.2 19 PRGM – Bits

The BITS command sets the number of bits used to define an asynchronous data character. The settings in data bits in data character are 5 through 8, with 8 data bits in data character as the normal async port bits setting.



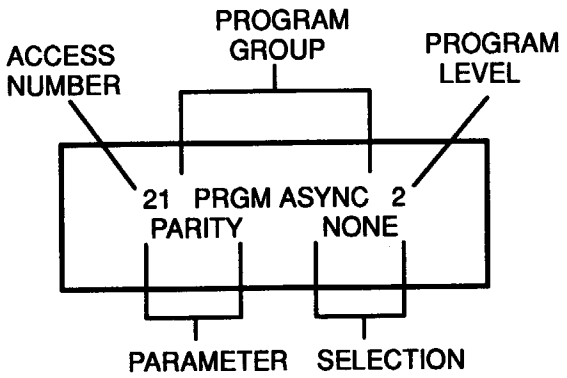
4.4.3 20 PRGM – Stop Bits

STOP BITS defines the number of bits used to indicate the end of a data character. The stop bits settings are 1 and 2, with 1 being the normal async port stop bits setting. A typical display is shown below:



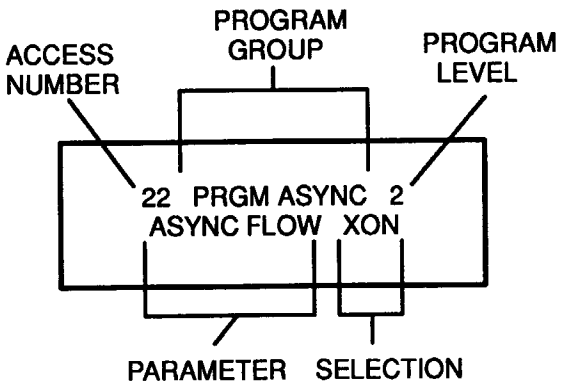
4.4.4 21 PRGM – Parity

PARITY sets type of error checking recognized by the RF–5020R/T asynchronous data port. The parity settings are ODD, EVEN, and NONE, with NONE being the normal async port parity setting. A typical display is shown below:



4.4.5 22 PRGM – Flow

The FLOW command enables use of either a data control character (XON/XOFF) or the asynchronous port Clear to Send (CTS) data signal line to control data flow between a data device and the RF–5020R/T asynchronous port. This parameter determines how the transceiver is keyed. Consult the data device technical and program software manuals for the required setting. A typical display is shown below with XON as the normal async port flow setting:

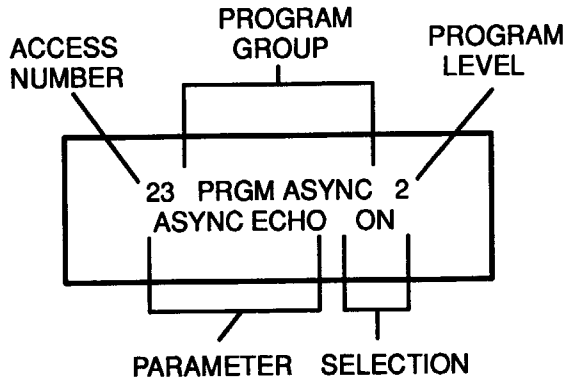


4.4.6 23 PRGM – Async Echo

The ECHO command causes the RF–5020R/T to transmit back (echo) the asynchronous data characters to the data device. The normal async port echo setting is ON. Consult the data device manual to determine if ECHO is required.

NOTE

ECHO should be disabled when using the RF–5020R/T with the RF–3490A Data Buffer. A retransmission of the buffer data back toward the source occurs if ECHO is enabled.

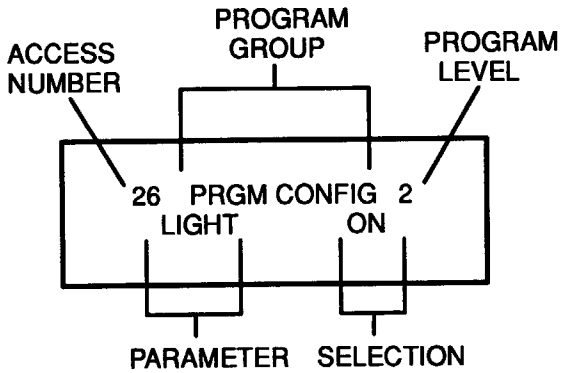


4.5 25 PRGM – CONFIG GROUP

The CONFIG group parameters define the display backlight, audio interface, and system test configurations. This group of parameters is usually programmed at the time of installation.

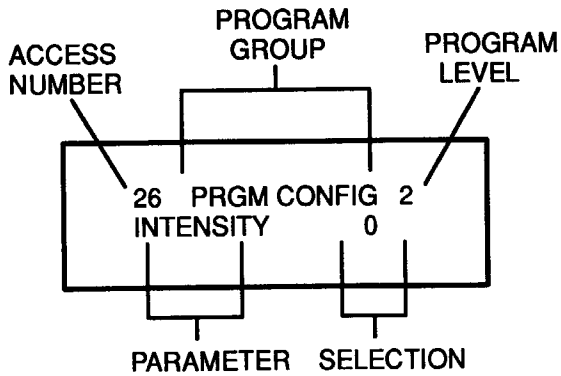
4.5.1 26 PRGM – Light

The LIGHT function controls the display backlight. The backlight selections are OFF, ON, and MOMENTARY. Ordinarily the backlight is turned ON. The MOMENTARY setting turns the backlight on for 15 seconds after the NET or FUNCTION key is pressed.



When the backlight is ON, press the ENTR key to vary the intensity of the LCD display:

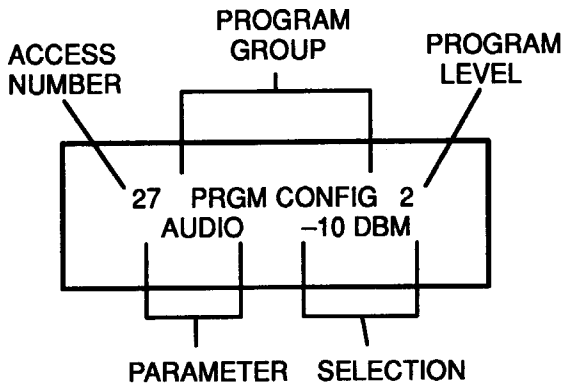
- Use the ARROW keys to scroll the display through the intensity levels; 0 to 9.
- To store the intensity level, press the ENTR key.



4.5.2 27 PRGM – Audio

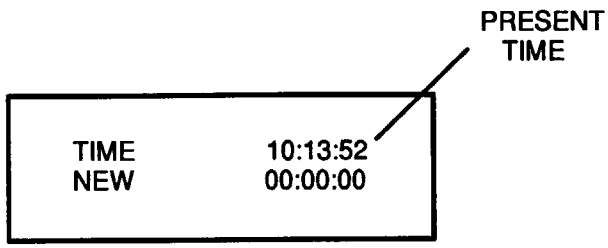
The AUDIO function controls the sensitivity of the AUXILIARY transmit audio interface. Programming of this parameter is only required if an external audio interface via the Auxiliary Connector (J5) is required. The audio settings are:

- 0 dBm – For 0–dBm nominal level interface
- –10 dBm – For –10–dBm nominal level interface



4.5.3 28 PRGM – Time of Day

The TIME OF DAY function sets the internal RF–5020R/T real–time clock. The clock uses the 24–hour time convention; i.e., 1:00 PM equals 13:00. A typical prompt to change the time of day follows:



4.5.4 29 PRGM – System Configuration Group

The CONFIG – SYSTEM CONFIG group defines the system configuration self test. When programmed, the RF–5020R/T scans the installed system elements and options and compares them against the defined configuration. Any defined options not installed are displayed.

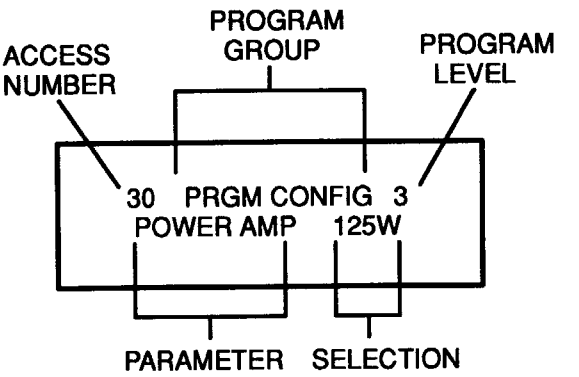
This function is useful when assembling systems for a mission to ensure that each system contains the appropriate options without having to remove the cover and inspect the installed modules.

Programming of the SYSTEM CONFIG parameters is not required for the RF–5020R/T to function properly. The system will operate as configured with the installed, functional modules.

4.5.4.1 30 PRGM – Power Amplifier

This function defines the system power amplifier. The settings include:

- NONE – No PA installed
- 20W – 20–watt power amplifier
- 125W – 125–watt power amplifier
- 400W – 400–watt power amplifier
- 1 kW – 1000–watt power amplifier

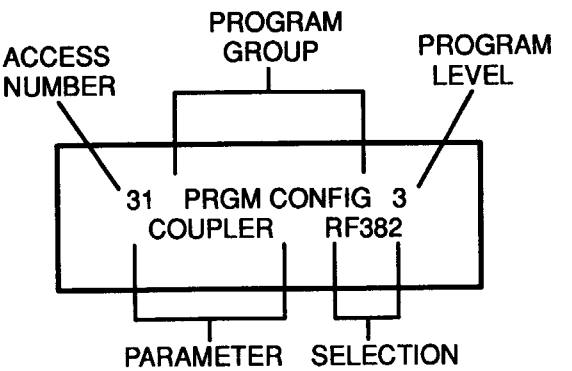


4.5.4.2 31 PRGM – Coupler

This function defines the system antenna coupler. The settings include:

NONE – No antenna coupler installed

- RF382 – RF–382 Antenna Coupler
- RF5000 – RF–5000 Series Antenna Coupler
- RF–2601–RF–2601 Antenna Coupler



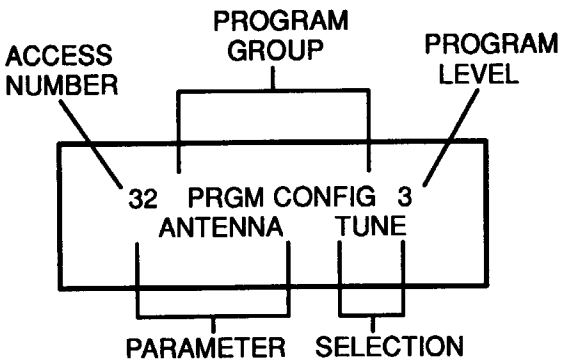
4.5.4.3 32 PRGM – Antenna

This function defines the 20–watt power amplifier antenna interface. There are three settings: AUTO, BNC, and TUNE.

The AUTO setting causes the RF–5030PA/CU to first attempt to tune via the BNC (J11) RF OUT connector. If the VSWR is less than 2.0:1, then J11 is selected. If the VSWR is greater than 2.0:1, then the antenna coupler output is tuned and used, if a satisfactory tune is achieved (VSWR is greater than 3.0:1). This sequence is repeated if the channel frequency is changed more than 1%.

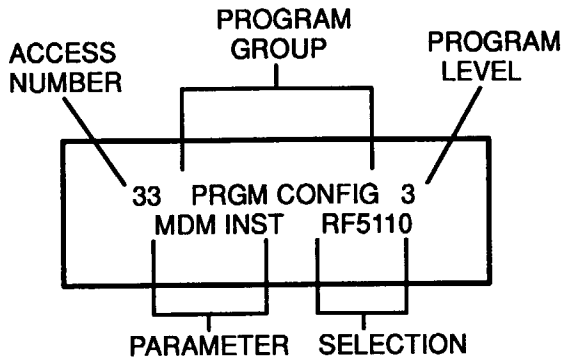
The BNC setting directs the output of the power amplifier to the BNC connector, bypassing the antenna coupler. This is for use with broadband antennas.

The TUNE setting directs the output through the antenna coupler.



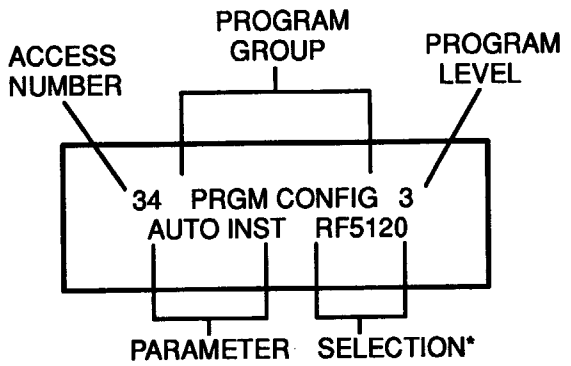
4.5.4.4 33 PRGM – Modem

This function defines the High Speed Data Modem option.



4.5.4.5 34 PRGM – AUTOLINK

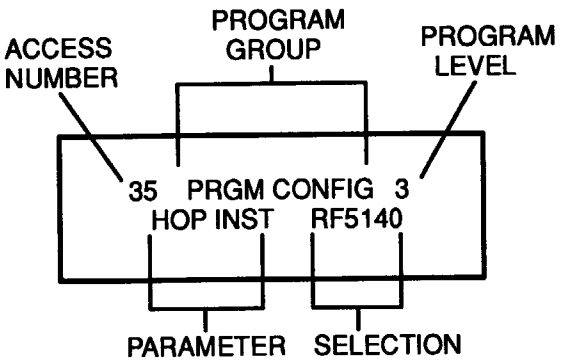
This function defines the Automatic Frequency Controller option.



*RF–5121 appears if this option is installed.

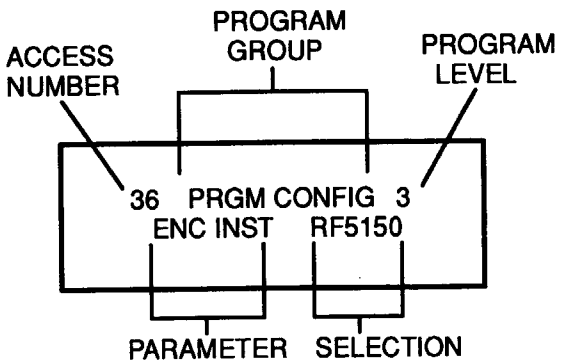
4.5.4.6 35 PRGM – Hopping

This function defines the Frequency Hopping option.



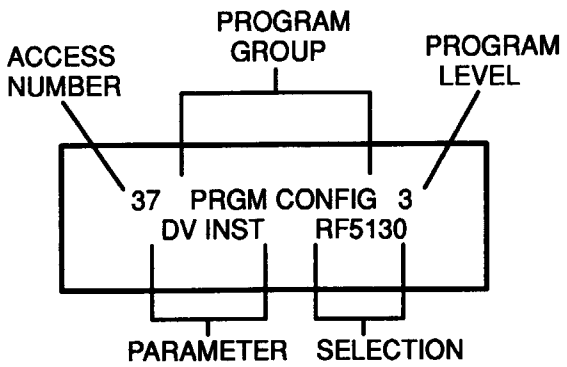
4.5.4.7 36 PRGM – Data Encryption

This function defines the Data Encryption option.



4.5.4.8 37 PRGM – Digital Voice

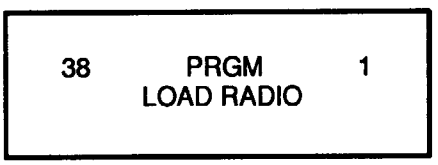
This function defines the Digital Voice option.



4.6 38 PRGM – LOAD RADIO

The LOAD RADIO command is used to load encryption key variables into the radio from a fill device when the RF–5150DE Digital Encryption module is installed in the RF–5000 System.

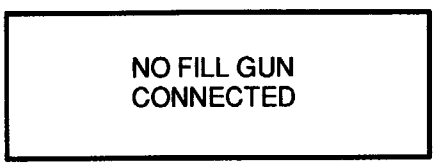
When the 38 PRGM function is entered, the following display shows on the LCD:



When the operator selects this program by pressing the ENTR key, the following prompt appears:

If the operator attaches the fill device to the front panel of the RF–5020R/T and presses the ENTR key, the loading of key variables begins.

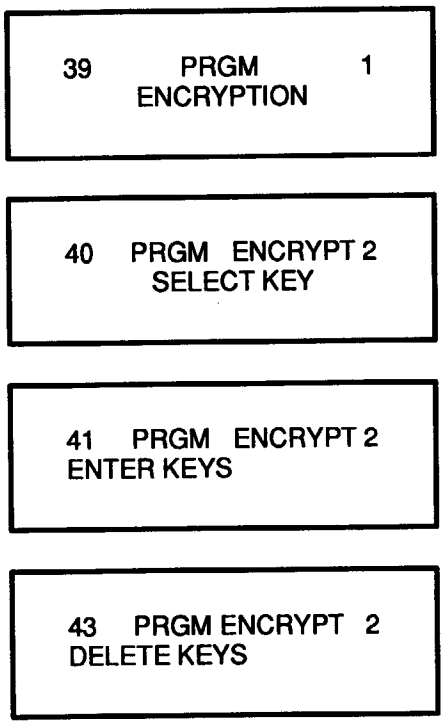
If a fill device is not attached, the following message appears on the display:



Complete programming instructions for the 38 PRGM – LOAD RADIO function are found in the Digital Encryption section of this manual.

4.7 39 PRGM – ENCRYPTION GROUP

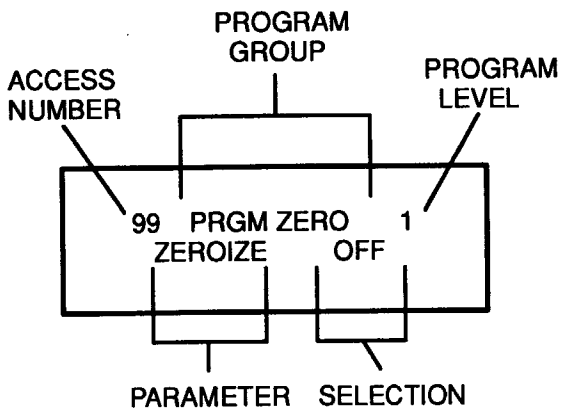
The ENCRYPTION group parameters allow the operator to select and enter encryption key numbers. The ENCRYPTION group consists of the following displays:



Complete programming instructions for the 39 PRGM – ENCRYPTION function are found in the Digital Encryption section of this manual.

4.8 99 PRGM – ZEROIZE

The ZEROIZE command sequence causes the RF–5020R/T to erase all of the programmed channel parameter and option settings. To minimize the chance of an accidental erasure, a command sequence is required:



To cancel the ZEROIZE command sequence.

a. Press PRGM to advance the display to the RADIO GROUP.

b. Press CLR to return to the RECEIVE DISPLAY.

To initiate the ZEROIZE command sequence.

a. Press ENTR to advance to the ZEROIZE command.

b. Use the ARROW keys to scroll the display between OFF and ON.

c. Select ON and press the ENTR key to zeroize the RF– 5020R/T.

d. Select OFF and press the ENTR key to terminate the zeroize sequence (or press the CLR key).

NOTE

The ZEROIZE command should be used with caution. Once erased, the settings cannot be recovered.

RF–5000 Operator Sheet (SSB)

P = PRGM key e = ENTR key

1 RADIO P→ e↓	10 MODEM P→ e↓	17 DATA PORT P→ e↓	25 CONFIG P→ e↓	38 LOAD P→	39 ENCRYPTION P→ e↓	99 ZEROIZE P↓
2 IF BW P↓	11 PORT P↓	18 ASYNC RATE P↓	26 LIGHT P↓		40 SELECT KEY P↓	(GO TO 1)
3 AGC P↓	12 TYPE P↓	19 BITS P↓	27 AUDIO P↓		41 ENTER KEYS P↓	
4 RF GAIN P↓	13 BAUD P↓	20 STOP BITS P↓	28 TIME P↓		43 DELETE KEYS P↓	
5 POWER P↓	14 INTERLEAVE P↓ (39-tone only)	21 PARITY P↓	29 PRGM CONFIG e↓ P→	(GO TO 6)	(GO TO 40)	
6 INCR[EMENT] P↓	15 MARK FREQ P↓ (FSK only)	22 FLOW P↓	30 POWER AMP P↓			
7 COMPRESSION P↓	16 SPACE FREQ P↓ (FSK only)	23 ASYNC ECHO P↓	31 COUPLER P↓			
8 CLIPPING P↓	(GO TO 11)	(GO TO 18)	32 ANTENNA P↓			
9 BFO P↓			33 MDM INST P↓			
(GO TO 2)			34 AUTO INST [ALE] P↓			
			35 HOP INST P↓			
			36 ENC INST P↓			
			37 DV INST P→	(GO TO 30)		

RF–5000 Operator Sheet (RF–5120AFC ALE)

P = PRGM key e = ENTR key

45 NETS P→ e↓	52 LQAS P→ e↓	57 ALE CONFIG P→ e↓	99 ZEROIZE	
46 NET CALL P↓	53 ACTIVE LQA P↓	58 LOCAL CALL P↓		
47 COPY NET P↓	55 CONFIG LQAS P↓	59 PREAMBLE P↓		
48 NET CHANNEL P↓	56 LQA CALL P↓	60 BIT SPEED P↓		
49 ADD CHANNEL P↓	(GO TO 53)	61 RAD SILENCE P↓		
50 DEL CHANNEL P↓		62 LSTN_B_XMIT P↓		
51 DELETE NET P↓		63 KEY TO CALL P↓		
(GO TO 46)		65 TIME OUT P↓		
		(GO TO 58)		

RF–5000 Operator Sheet (HOP)

P = PRGM key e = ENTR key

66 NETS P→ e↓	71 EXCLUSION BANDS P→ e↓	76 HOP CONFIG P→ e↓	99 ZEROIZE	
67 DELETE NET P↓	72 DELETE ALL P↓	77 DATA PORT P↓		
68 NET ID P↓	73 EXCL BAND P↓	78 POWER LEVEL P↓		
69 HOP TYPE P↓	74 DELETE BAND P↓	79 SELECT KEY P↓		
70 HOP FREQ P↓	75 PRGM EXCLUD (HI/LO LIMIT) P↓	EXIT		
EXIT	EXIT			

SECTION 5

DATA INTERFACE/REMOTE CONTROL

5.1 GENERAL

The RF–5000 is intended to serve the tactical environment with its diversity of data devices and controls. Special design emphasis was placed on simplifying remote control operation to allow systems to be easily configured and adapted to changing requirements. The RF–5000 can be remotely controlled either via the detachable front panel or the asynchronous interface.

5.2 REMOTEABLE FRONT PANEL

The front panel of the RF–5000 can be removed and remoted up to 50 feet (15 meters) via cable for installation in a shelter, vehicle, or base station. Table 5–1 lists the pin assignments for connector J3 located on the front panel of the RF–5020R/T and J4 located on the chassis of the RF–5020R/T. Cable assembly 10181–9830 and the remote front–panel mount RF–5085MT–FP are used to interconnect the front panel to the R/T chassis.

Table 5–1. Pin Assignments for Connectors J3 and J4

Pin	Definition
A	Front Panel Power On
B	Front Panel Audio –
C	+ 28 Vdc
D	Primary Power Return
E	Data to Front Panel
F	Data from Front Panel
G	Not Connected
H	Chassis Ground/Shield
J	Front Panel Audio +
K	Not Connected

5.3 REMOTE INTERFACE – AUXILIARY CONNECTOR J5

The J5 auxiliary connector, located on the rear panel of the RF–5020R/T, is the primary interface for remote operation of the entire RF–5000 System. Table 5–2 lists the input/output signals for the audio/control signal lines of the J5 auxiliary connector.

The asynchronous/remote control interface provides a serial data interface for computers, Teletypes, ARQ/Packet message controllers, and remote control terminals. Table 5–3 lists the input/output signals for asynchronous/remote control interface. These are RS–232–compatible signals.

The synchronous interface provides a serial data interface for facsimile, cryptographic, and secure voice units that require synchronous data transmission. Table 5–4 lists the input/output signals for the synchronous interface. These are RS–232–compatible signals.

Table 5–2. Audio/Control Input/Output Definitions

Pin	Function	Interface
U	Audio Keyline Input	Ground Closure
L*	TX Audio –	–10 or 0 dBm
N*	TX Audio +	–10 or 0 dBm
T	Retransmit Keyline Output	Ground Closure
C*	RX Audio +	–10 or 0 dBm
P*	RX Audio –	–10 or 0 dBm
D	Remote Off/On Input	Ground Closure
A	Analog Ground	

* NOTE: The TX and RX audio level is programmable for either a nominal –10 dBm or 0 dBm level. See paragraph 4.5.2.

Table 5–3. Asynchronous/Remote Control Input/Output Definitions

Pin	Function	Interface
R	TX Data Async	RS-232
V	RX Data Async	RS-232
H	Request to Send Async	RS-232
B	Clear to Send Async	RS-232
M	Digital Ground	Signal Ground
K	Receive Level Sense Detect	RS-232

Table 5–4. Synchronous Input/Output Definitions

Pin	Function	Interface
F	TX Data Sync	RS-232
E	RX Data Synch	RS-232
G	Request to Send Sync	RS-232
S	Clear to Send Sync	RS-232
M	Digital Ground	Signal Ground
K	Receive Level Sense Detect	RS-232
J	Sync Clock	RS-232

5.4 REMOTE CONTROL VIA ASYNCHRONOUS INTERFACE

Remote control software is included in the RF–5020R/T to provide control of all system functions. Remote control interface is via the RS–232C asynchronous port available at the J5 auxiliary connector on the rear panel of the transceiver. A text–like ASCII protocol is used for remote control allowing computer terminals, laptop computers, or personal computers to control and monitor RF–5000 System functions without custom software.

The remote control data device must appear to the RF–5020R/T as a computer terminal. Computers can use one of several communication terminal emulation programs, such as PROCOMM PLUS™, CROSSTALK™, RELAY GOLD™, or a similar program. Setup for PROCOMM PLUS™ is shown below.

The asynchronous data interface for both the RF–5020R/T and the remote control data terminal should be programmed as follows:

Character Bits:	8
Stop Bits:	1
Parity:	NONE
Flow:	XON/XOFF
Echo:	OFF

The remote control data device should be set to the following:

Duplex:	FULL
Flow Control:	XON/XOFF
Alt–F3	Toggle display to "NO LF AFTER CR"

If the remote control data device is used to transmit or receive data messages using a high–speed data modem or is used to program the RF–5020R/T using a data file transfer, then the following data device software parameters should be programmed.

ASCII Transfer Setup

Upload (to RF–5020R/T)

Echo Locally: YES

CR Translation: NONE

LF Translation: STRIP

Download (to RF–5020R/T)

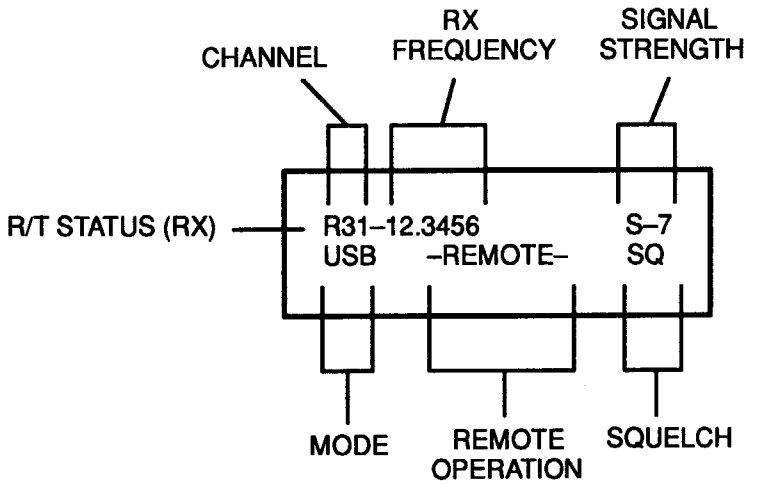
CR Translation: NONE

LF Translation: NONE

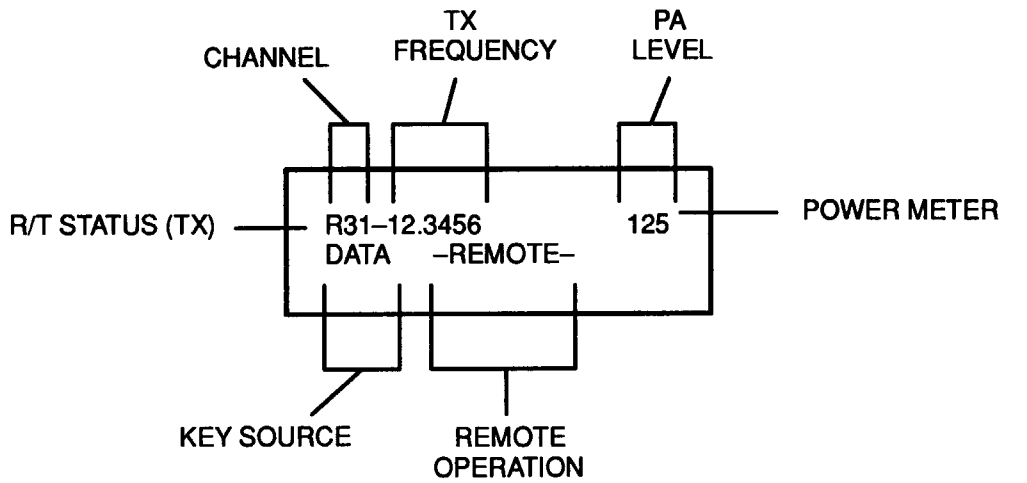
Remote control menus are included in the following paragraphs that illustrate the menus that are displayed by the internal remote control software of the RF–5020R/T and detail the high level of RF–5000 System programmability.

Remote control operation is enabled when the RF–5020R/T FUNCTION control is placed in the RMT position.

REMOTE RECEIVE DISPLAY



REMOTE TRANSMIT DISPLAY



5.4.1 Configuring the RF–5000 From a File

A PC may also be used to load configuration files into the RF–5000 Transceiver. This procedure is similar to transmitting a file except that the system is left in Receive Mode.

Follow this procedure to configure the RF–5000 from a file.

a. Create a configuration file using PC edit. See APPLICATION NOTE A, paragraph A.6.1.

b. Enter the program options and parameters into the file. See figure 5–1 for a list of RF–5000 commands. Refer to the appropriate sections of the RF–5000 System Manual for additional information.

c. Upload the file to the RF–5000:

1. Determine the name of the configuration file name to upload:

(a.) Press ALT–F followed by the ENTER key to see a listing of current files.

(b.) Press the ESC key to return to the Terminal Mode.

(c.) Press ALT–V from the Terminal Mode and then type the name of the file to view the contents of a file and verify the actual text.

(d.) Press the ESC key to return to the Terminal Mode.

2. Once the correct file name is determined press the Page Up (or PgUp) key. A menu appears requesting the type of protocol to be used.

3. Press 4 to select the ASCII protocol.

NOTE

The ASCII protocol must always be used. The use of any other protocol produces unpredictable results.

4. Type the name of the file to upload and press the ENTER key. The file appears on the screen as it is uploaded.

NOTE

Do **not** place the system in the Transmit Mode (keyed) when uploading a configuration file.

5.4.2 Asynchronous Remote Control Port Programming

The asynchronous data port program parameters (17 PRGM–Data Port Group) also define the asynchronous remote control port parameters since the port serves both functions. Before attempting remote control operation, both the asynchronous port program parameters and the external remote control data device must be programmed to the appropriate settings. Programming of the asynchronous data port is covered in paragraph 5.4.2.1.

```
Basic Radio control commands:

  AGC  AUDIO          BANDWIDTH       BFO
  CLIPPING            COMPRESSION     DATE            DAY
  DGT_SQUELCH         DISPLAY         DV              ENCRYPT
  FREQUENCY           FTUNE           HELP            KEYLINE
  LIGHT               MODE            NET             POWER
  REMOTE              RESET           RFGAIN          RXFREQUENCY
  SHOW SSB            SQUELCH         TEST
  TIME TXFREQUENCY    TXGAIN          ZERO

Radio configuration commands:

  ANTENNA             AUTO_INST       CONFIG          COUPLER
  DV_INST             ENC_INST        HOP_INST        MODEM_INST
  POWER_AMP           VERSION

Data Port control commands:

  ASYNC
   BAUD                BITS            STOP
   PARITY              FLOW

Modem control commands:
  MODEM
   ASYNC               BAUD            INTERLEAVING    MARK
   OFF  SPACE          SYNC            TYPE

RF-5110 Adaptive commands:

  ADDCH               BASEBAND        CALL            COPYNET
  DEC  DELCH          DISPCH          DISPCS
  ERASE               HELP            INC             KEY_TO_CALL
  LOCALCALL           LSTN_BEFORE     LQA             PREAMBLE
  RAD_SILENCE         SCAN            SCORE           SET
  SHOW SPEED          STOP            TIME_OUT

Frequency hopping commands:

  HOP  DISPLAY        EXCLUDE         HOPLIST
  HOPSET              HOPTYPE         MODEM           SHOW
  SYNC NET            NETID

Data Encryption commands:

  ENCRYPT
   ON   OFF            KEY             SELECT
  CLRKEYS             ENC_KEY         FG_KEY          USE_KEY
```

Figure 5–1. RF–5000 Commands (Sheet 1 of 3)

COMMAND	FUNCTION			FR PANEL ONLY
	SSB	HOP	ALE	
?	Y	Y	Y	
ADDCH			Y	
AGC	Y	N		
ALE	Y	Y	Y	
ANTENNA	Y	Y		Y
ASYNC	Y	N		
AUDIO	Y	Y		
AUTO_IN	Y	Y		Y
BANDWID	Y	N		
BFO	Y	Y		
CALL			Y	
CLIPPI	Y	N		
CLRKEYS	Y	Y	Y	Y
COMPRE	Y	Y		
COPYNET			Y	
COUPLER	Y	Y		Y
DEC			Y	
DELCH			Y	
DGT_SQ	Y	Y	Y	
DISPLAY	Y	Y	Y	
DV	Y	N	Y	
DV_INST	Y	Y		Y
ENC_INS	Y	Y		Y
ENC_KEY	Y	Y	Y	
ENCRYPT	Y	Y	Y	
ERASE			Y	
EXCLUDE		Y		
FREQUEN	Y	N		
HELP	Y	Y	Y	
HOP	Y	Y	Y	
HOP_INS	Y	Y		Y
HOPLIST		Y		
HOPSET		Y		
HOPTYPE		Y		
INC			Y	
KEY_TO			Y	
KEYLINE	Y	Y	Y	
LIGHT	Y	Y	Y	
LOCALCA			Y	
LQA			Y	

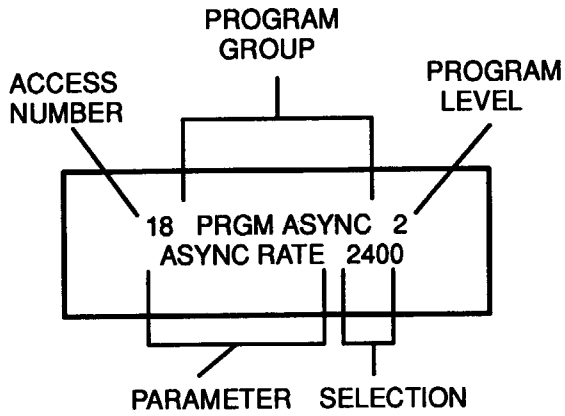
Figure 5–1. RF–5000 Commands (Sheet 2 of 3)

COMMAND	FUNCTION			FR PANEL ONLY
	SSB	HOP	ALE	
LSTN_B			Y	
MDM_INS	Y	Y		Y
MODE	Y	N		
MODEM	Y	Y	Y	
NET	Y	Y	Y	
NETID		Y		
POWER	Y	Y	Y	
POWER_A	Y	Y		Y
PREAMBL			Y	
RAD_SIL			Y	
REMOTE	Y	Y	Y	
RFGAIN	Y	Y		
RXFREQU	Y	N		
SCAN			Y	
SCORES			Y	
SET			Y	
SHOW	Y	Y	Y	
SPEED			Y	
SQUELCH	Y	N		
SSB	Y	Y	Y	
STOP			Y	
SYNC		Y		
TEST	Y	Y	Y	
TIME	Y	Y	Y	
TIME_OU			Y	
TXFREQU	Y	N		
USE_KEY	Y	Y	Y	
ZEROIZE	Y	Y	Y	

Figure 5–1. RF–5000 Commands (Sheet 3 of 3)

5.4.2.1 8 PRGM – Async Rate

The ASYNC RATE defines the baud rate that is used to communicate with an external data device via the asynchronous data port. The interface baud rate can be different than the over–the–air baud rate as defined by the MODEM BAUD RATE command. This allows a laptop computer (or other computer) to be used as both the remote control unit and as a data message device.



NOTE

It is recommended that the 2400–bps setting be used for the asynchronous interface since many laptop computers, IBM™ compatible computers, and communication software have exhibited problems operating at 4800 and 9600 bps. Long remote control cables (beyond 10 meters) also limit the speed of operation. Once reliable operation has been confirmed at 2400 bps, higher baud rates can be attempted.

The asynchronous rate selections in bps (bits per second) are:

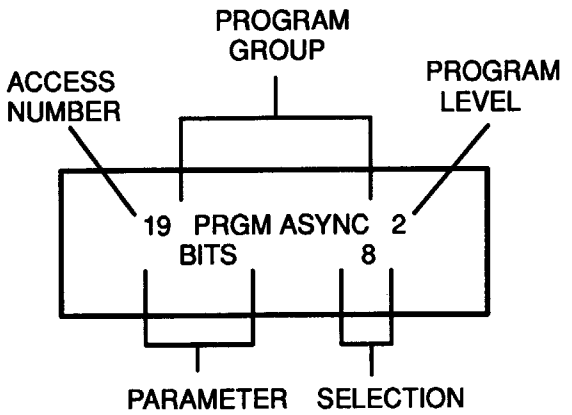
75	1200
150	2400
300	4800
600	

NOTE

The data device connected to the asynchronous/ remote control interface must be set to the same baud rate as the asynchronous port.

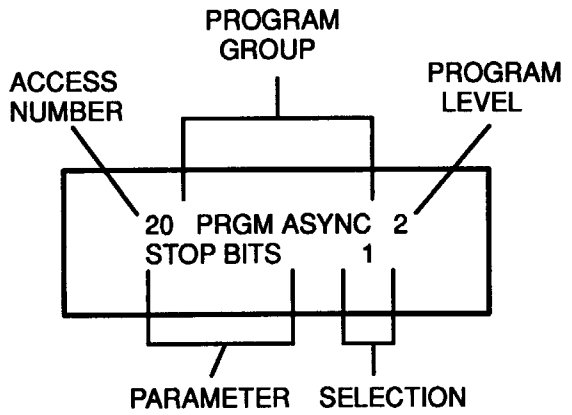
5.4.2.2 19 PRGM – Bits

The BITS command sets the number of bits used to define an asynchronous data character. The settings in data bits in data character are 5 through 8, with 8 data bits in data character as the normal async port bits setting.



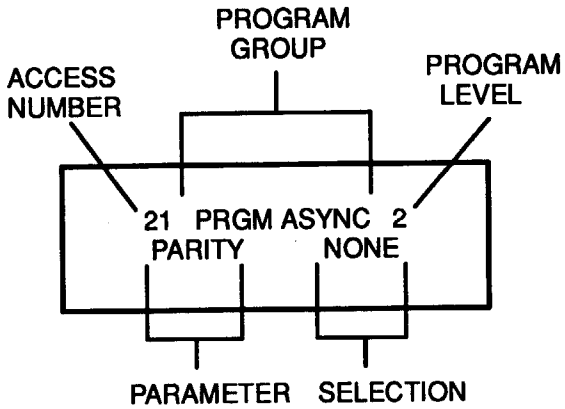
5.4.2.3 20 PRGM – Stop Bits

STOP BITS defines the number of bits used to indicate the end of a data character. The stop bits settings are 1 and 2, with 1 being the normal async port stop bits setting. A typical display is shown below:



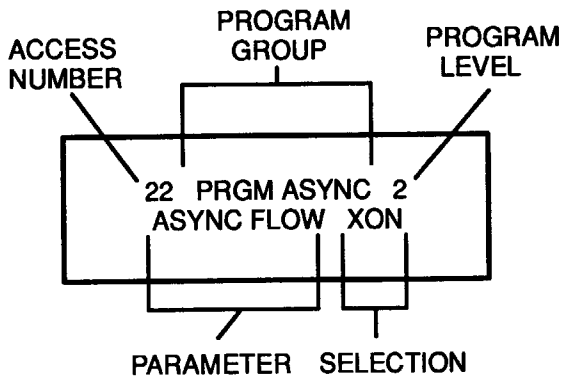
5.4.2.4 21 PRGM – Parity

PARITY sets type of error checking recognized by the RF–5020R/T asynchronous data port. The parity settings are ODD, EVEN, and NONE, with NONE being the normal async port parity setting. A typical display is shown below:



5.4.2.5 22 PRGM – Flow

The FLOW command enables use of either a data control character (XON/XOFF) or the asynchronous port Clear to Send (CTS) data signal line to control data flow between a data device and the RF–5020R/T asynchronous port. Consult the data device technical and program software manuals for the required setting. A typical display is shown below with XON as the normal async port flow setting:

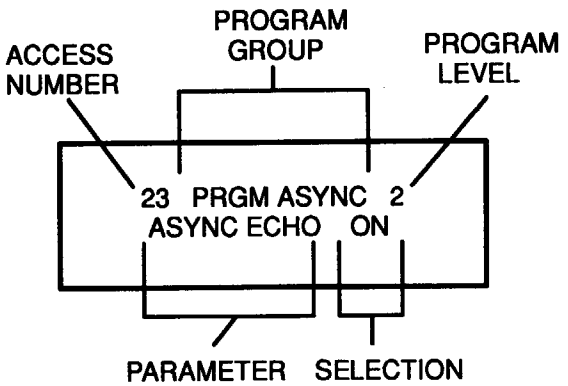


5.4.2.6 23 PRGM – Async Echo

The ECHO command causes the RF–5020R/T to transmit back (echo) the asynchronous data characters to the data device. The normal async port echo setting is ON. Consult the data device manual to determine if ECHO is required.

NOTE

ECHO should be disabled when using the RF–5020R/T with the RF–3490A Data Buffer. A retransmission of the buffer data back toward the source occurs if ECHO is enabled.



5.5 REMOTE CONTROL OPERATION

Once the RF–5020R/T is properly programmed and the FUNCTION control is placed in the RMT position, the SSB, HOP, or ALE prompt and status listing appears on the remote control data device screen indicating that the RF–5020R/T is in the remote control mode and which mode has been enabled.

Remote control operation is similar to front–panel operation. The display prompt SSB>, HOP>, or ALE> is equivalent to the FUNCTION control and indicates the selected mode of operation.

Commands are entered after the > prompt character. If the prompt is not shown before the display cursor, pressing the carriage return or enter key on the data device restores the prompt.

5.5.1 Changing Function Operating Modes

The FUNCTION operating mode can be changed by entering:

SSB – Single Channel Mode

HOP – Hopping Mode

ALE – AUTOLINK™ Mode

The RF–5020R/T is placed in the designated mode if the R/T is configured to support hopping or AUTOLINK™ operation.

5.6 REMOTE CONTROL FUNCTION COMMANDS

The remote control SHOW and HELP commands are provided to assist in remote control operation.

5.6.1 Remote Control SHOW Function Command

Entering SHOW on the remote control data device provides a listing of the current status and settings of the R/T for the FUNCTION mode selected. A typical remote control SHOW listing for SSB is shown below. HOP and AUTO mode listings are given in their corresponding subsections.

REMOTE CONTROL – SHOW MENU

```
SSB > show
Net 00
Key Off
RxFr 01600000 TxFr 01600000
BFO +0000
Mode USB
Band 2.7
AGC slow
RFG 100
Modem Off
DV off
Dgt_squelch off
Encrypt off
Cur key 99
Squelch 000
Power 125
Clipping off
Compress off
Audio 0dBm
```

5.6.2 Remote Control HELP Function Command

Entering HELP on the remote control data device provides a listing of the general commands used to control basic operation of the system for the FUNCTION mode selected. The listing for the SSB mode is shown below. The general commands are structured similar to the front–panel commands. HOP and ALE mode listings are given in their corresponding subsections.

REMOTE CONTROL – HELP MENU

SSB > HELP

AGc	–	(OFf, SLow, MEd, FAst, DAta)	ALE	–	Autolink Mode
AUDio	–	(0Dbm, –10dBm)	BFO	–	±BFo offset
CLipping	–	(ON, OFf)	COMpression	–	(ON/OFf)
TIme	–	(hh:mm:ss)	MODE	–	(USb, LSb, AMe, CW)
FReq	–	select frequency	TXFreq, RXFreq	–	half duplex
HOp	–	hopping mode	SSb	–	single channel mode
Keyline	–	(ON, OFf)	RFgain	–	(0.. 100)
MODEM	–	modem command	Net	–	(0.. 99)
ASync	–	async command	DGT_sq	–	Dig Squelch (ON, OFf)
SHow	–	show status	DISplay	–	(net from, net to)
SQuelch	–	(0.. 100)	DV	–	Dig Voice (ON, OFf)
TEst	–	perform self test	ZERO	–	clear channel memory

POWer – (20W: [20, 10, 5] – 125W: [125, 50, 10] – 400W: [400, 200, 50]–1–kW:[1k, 500, 125])

BAndwidth – (When Mode = USB/LSB [1.5, 2.0, 2.4, 2.7, 3.0]
= AME [3.0, 4.0, 5.0, 6.0]
= CW [.35, .68, 1.0, 1.5])

ENCRypt	–	(ON, OFf)	USE_KEY	–	(1..6)

ENC_KEY XX YYYYYYYYYYYY XX – key number (1–6)

NOTE

Only the capital letters of the commands need to be entered. AG slow – programs AGC to slow setting.

Typing a listed command and parameter controls the R/T. For example:

- NET 02 – switches net setting to NET 02
- FR 0160000 – programs the operating frequency to 1.600 Mhz

To program a channel by remote control, a simple text string is used. For example:

Net	07
Freq	1642370
Band	USB
AGC	Slow

A text file on a personal computer can be generated containing the complete programming information for each NET of the system. The file can then be transferred to the RF–5000 via the remote control interface and completely program the RF–5000 for a specific mission.

5.7 INTERFACE FUNCTION COMMANDS

The interface function commands provide status information for programming of both the asynchronous and synchronous data ports.

5.7.1 ASYNC SHOW Function Command

The ASYNC SHOW function command provides a listing of the status and settings of the asynchronous data port. A typical remote control – ASYNC SHOW menu is shown below:

REMOTE CONTROL – ASYNC SHOW MENU

```
SSB > ASYNC SHOW

Async Baud      4800
Async Bits      8
Async Parity    none
Async Stop      2
Async Echo      on
Async Flow      xonxoff
```

5.7.2 ASYNC HELP Function Command

The ASYNC HELP function command provides a listing of the commands used to control the asynchronous data port. A typical remote control – ASYNC HELP menu is shown below:

REMOTE CONTROL – ASYNC HELP MENU

```
SSB > ASYNC HELP

Async commands consist of the following, preceded by ASync:

BAud    –  75/150/300/600/1200/2400/4800
BIts    –  5/6/7/8 (character bits)
ECho    –  on/off
PArity  –  none/odd/even
STop    –  1/2 (stop bits)
FLow    –  xonxoff/cts
```

SECTION 6

MAINTENANCE

6.1 GENERAL

This section contains information concerning preventive maintenance procedures, describes self–test as a troubleshooting procedure, and lists display messages.

Also included in this section is information that pertains to the handling of static–sensitive CMOS devices. To protect static–sensitive devices from damage, the following precautions should be followed:

- Keep all static–sensitive devices in their protective packaging until needed. This packaging is usually conductive and should provide adequate protection for the device. Storing or transporting static–sensitive devices in conventional plastic containers could be destructive to the devices.
- Remove power to a unit before inserting or extracting a static–sensitive device. This applies also to printed wiring boards which contain static–sensitive devices.
- Double check test equipment voltages and polarities before conducting any tests. Verify that no transients exist.
- Use only properly–grounded soldering irons and tools. The use of ungrounded soldering tips destroys these devices. **Never use soldering guns.**
- Avoid contact with the leads of the device. The component should always be handled very carefully by its ends or by the side opposite the leads.
- While handling static–sensitive devices or assemblies containing them, avoid contact between synthetic clothing and printed wiring board circuits or component leads.

6.2 PREVENTIVE MAINTENANCE

The RF–5000 System is essentially maintenance free. For reliable operation, prevent dirt build–up anywhere in the system. Keep electrical contacts clean and free from corrosion. To clean contacts, use a soft cloth or cotton dipped in alcohol.

Use the protective cover provided for the front–panel jacks when they are not in use.

6.3 TROUBLESHOOTING

Primary troubleshooting does not normally require extensive technical background or sophisticated test equipment. Relying heavily on self–test, the procedures for isolating a faulted module are normally within the abilities of the experienced radio operator. Using this procedure, the operator can quickly identify the module that is faulted, replace the module, and return the system to service.

6.4 SELF–TEST

The self–test routine, initiated at the RF–5020's front panel, performs numerous checks on the operational status of the RF– 5020R/T and the RF–5000 System's power amplifier. The system self–test is performed without on–the–air transmission.

NOTE

The RF–5020R/T self–test routine does not test the operational status of an RF–382A–02 Antenna Coupler used as part of the RF–5000 System. See the RF–382A–02 Antenna Coupler Instruction Manual for information on the coupler's self–test.

Setting the FUNCTION control to the TST position initiates a system self–test.

TEST IN PROGRESS

```
** SELF TEST ***
* IN PROGRESS **
```

TEST COMPLETE

```
TEST COMPLETE
TEST PASSED
```

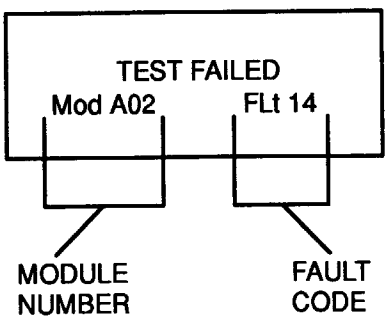
If a fault condition occurs, its source is displayed on the LCD display as a fault code. Table 6–1 lists the module identified by each fault code.

Table 6–1. Module Numbers

Module Number	Module/Equipment Identified
A01	Synthesizer
A02	Receiver/Exciter
A03	ALE Controller
A04	Modem
A05	ALE Controller (MIL–STD–141A)
A06	Main Controller
A07	Power Supply
A08	Interface
A09	LPC Digitized Voice
A20	Front Panel
A30	Power Amplifier
A40	Antenna Coupler

NOTE

If the FUNCTION or NET control is changed during a self–test, a fault condition will probably be displayed, since the test routine was not allowed to sequence through all of the tests. A test sequence should be allowed to finish before any new control, keyboard, or remote control command is issued.



Additional self–tests are accessed by entering their access number on the numeric keypad (numbers 1 – 7) and then pressing the ENTR key. The functions of these self–tests are defined in table 6–2 and described in subsequent subparagraphs.

Table 6–3 lists the module numbers and gives fault code descriptions.

Table 6–2. Self–Test Functions

Test Number	Test Functions
1	System self–test
2	Configuration
3	Versions
4	VSWR
5	–Reserved–
6	–Reserved–
7	Repetitive self–test

Table 6–3. Fault Code Listing

Module No.	Fault Code No.	Description
A01	10	Synthesizer serial data fault
	12	Synthesizer out of lock
A02	01	Communications fault
	02	Microprocessor Internal RAM fault
	03	ROM fault, invalid checksum
	04	RAM fault, dual port RAM
	05	50–MHz synthesizer fault
	06	TMS320 not responding (not running)
	07	Handshake with TMS320 fault
	08	Dual port RAM collision fault
	09	Exciter output fault – low or non–existent
	0A	Exciter gain fault – excessive gain for full power
	0B	TMS320 fault – TMS320 not functioning properly
	14	Hop clock fault
	19	Receiver gain fault
	81	TMS320 ROM fault
	82	TMS320 internal RAM fault
	83	TMS320 external RAM fault
	84	TMS320 dual port RAM
	85 – 86	Bad filter fault
	87	Bad fault code returned from filter test
	88 – 92	External sample clock fault
	93 – 9D	Internal sample clock fault

NOTE

Fault 09 or 0A can be caused by either a bad A02 Module or a shorted coax between the R/T and the PA.

Table 6–3. Fault Code Listing (Cont.)

Module No.	Fault Code No.	Description
A03	01	Communications fault
	02	Microprocessor Internal RAM fault
	03	External RAM fault
	04	ROM fault
	05	Timer fault
	06	A/D fault
	07	Reserved
	08	Filter fault – low attenuation below passband
	09	Filter fault – low attenuation above passband
	10	Filter fault – high attenuation in passband
	11	Modem demodulator fault
	12	Modem modulator fault
A04	01	Communications fault
	14	Hop clock fault
	15	Frame clock fault
	1F	FEC ROM fault
	20	FEC RAM fault
	21	FEC dual port RAM fault
	22	80C186 modem dead fault
	23	80C186 modem/FEC dual port RAM
	24	FFT dual port RAM fault
	25	80C186 modem ROM fault
	26	80C186 modem RAM fault
	27	Sample clock fault
	28	Canned FFT fault – 10181–3400 PWB
	29	Sample (serial) data fault
	2A	SSY dual port RAM fault
	2B	SSY communications fault
	2C	SSY ROM fault
	2D	SSY RAM fault

Table 6–3. Fault Code Listing (Cont.)

Module No.	Fault Code No.	Description
A05	01	Communications fault
	02	Microprocessor (Internal RAM) fault
	03	ROM fault
	04	External RAM fault
	05	DRAM fault (8051 side)
	06	DRAM fault (80C186 side)
	07	Communications fault between 80C31 and 80C186
	08	General TLC32044 AIC failure (U10)
	09	General TMS320C25 DSP failure (U6)
	10	80C186 external RAM failure
	11	Signal processor BITE timeout failure
A06	02	Microprocessor Internal RAM fault
	03	ROM fault
	04	RAM fault
	05	Real time clock fault
	07	DUART counter fault
	08	DUART serial data fault
	14	Hop clock fault
A07	02	1.2–MHz reference fault
	05	Spur synthesizer unlock fault
	06	Spur synthesizer lock fault
A08	01	Communications fault
	02	Microprocessor Internal RAM fault
	03	ROM fault
	04	RAM fault
	07	Baud rate fault
	08	DUART serial data fault
	09	Synchronous serial data fault
	15	Frame clock fault
	30	+ 5 V supply high fault
	31	+5 V supply low fault

Table 6–3. Fault Code Listing (Cont.)

Module No.	Fault Code No.	Description
A08 (Cont.)	32	+28 V supply high fault
	33	+28 V supply low fault
	34	+15 V supply high fault
	35	+15 V supply low fault
	36	–15 V supply high fault
	37	–15 V supply low fault
	38	PA TLC fault
	39	Tone detection fault
	40	RX gain fault
	41	TX gain fault
	42	Clipper circuit fault
	43	TX path fault
	44	Cannot turn clipper off fault
A09	01	Communications fault
	11	ROM fault
	12	Microprocessor Internal RAM fault
	13	Microprocessor External RAM fault
	14	Dual port RAM fault
	81	TMS320C25 ROM fault
	82	TMS320C25 external RAM fault
	83	TMS320 dual port RAM fault
	85	Sample clock fault
	86	AIC fault
A20	01	Communications fault
	02	Microprocessor Internal RAM fault
	03	ROM fault
	04	RAM fault
	05	LCD fault

Table 6–3. Fault Code Listing (Cont.)

Module No.	Fault Code No.	Description
	NOTE The following A30 fault codes are for the 125-Watt Power Amplifier only. For a complete list of 20-watt and 400-watt power amplifier fault codes, refer to the respective power amplifier maintenance manual.	
A30	01	Communications fault
	02	Microprocessor fault
	03	ROM fault
	04	RAM fault
	05	Low dc voltage
	06	D/A failure
	07	High temperature
	08	High pre–filter power
	09	High input RF
	10	High current draw
	11	High reflected power
	12	High forward power
	13	Inability to turn bias on
	14	Inability to turn bias off
	15	Hop clock failure
	16	No RF detected
	17	Bad harmonic filter
	20	Low dc voltage
	21	Lost foldback (high current)
	22	Open PA (internal connections)
	23	Last filter bad (possible lack of coverage)
	24	Lost RF during TLC test
	25	–1.5 dB high power
	26	–3.0 dB high power
	27	–6.0 dB high power
	28	–9.0 dB high power
	29	–1.5 dB low power
	2A	–3.0 dB low power
	2B	–6.0 dB low power
	2C	–9.0 dB low power

6.4.1 System Self–Test – 1 ENTR

If the operator runs various test functions and finds it necessary to recheck basic system operation, pressing the 1 and then the ENTR key initiates the same test sequence as performed by setting the FUNCTION control to TST.

NOTE

System tests can be run via remote control by typing SSB> TE X, where X = the test number.

```
–TEST– 1
Normal Sys. test
```

TEST IN PROGRESS

```
** SELF TEST ***
* IN PROGRESS **
```

TEST COMPLETE

```
TEST COMPLETE
TEST PASSED
```

6.4.2 Configuration – 2 ENTR

This self–test routine verifies the configuration options the factory or the user has programmed. The RF–5000 will then test for the presence of those options and report a "CONFIG FAULT" if the option is not installed (TEST 1). It should be noted that the system can be programmed to show an option as being installed in the system even if it is not, thus giving a configuration fault.

TYPICAL DISPLAYS:

```
–TEST– 2
Display Config.
```

```
–TEST– 2
MDM Inst RF5110
```

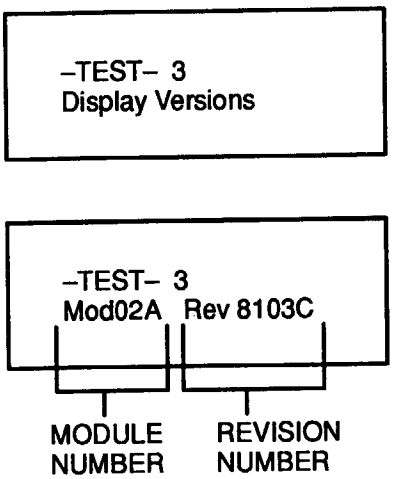
RF–5110MD High–Speed Modem Option shown as installed.

```
–TEST– 2
ENC Inst none
```

RF–5150DE Data Encryption Option shown as not installed.

6.4.3 Version – 3 ENTR

This self–test routine verifies the configuration and options of the RF–5000 System by displaying the modules that use microprocessors and the version of the software.



The module numbers in the standard configuration of the RF–5000 System are:

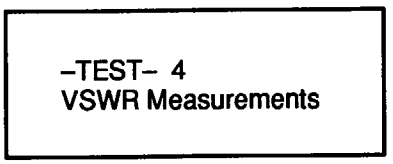
- Mod01 – Synthesizer
- Mod02A – Receiver/Exciter
- Mod02B – Digital IF
- Mod06 – Main Controller
- Mod08 – Interface Module
- Mod10 – Motherboard Assembly
- Mod11 – Remote/Rear Panel Interface Module
- Mod20 – Front Panel

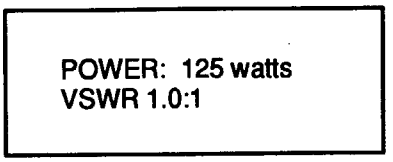
Optional modules that can be installed in the RF–5000 System are:

- Mod03 – ALE Controller
- Mod04A – High–Speed Data Modem
- Mod04B – High–Speed Data Modem
- Mod04C – High–Speed Data Modem
- Mod04D – ECCM Data Modem
- Mod05A – ALE Controller (MIL–STD–141A)
- Mod06B – ECCM Controller
- Mod08B – Data Encryption Controller
- Mod09A – LPC Voice Digitizer
- Mod09B – LPC Voice Digitizer

6.4.4 Voltage Standing Wave Ratio (VSWR) – 4 ENTR

The VSWR self–test measures the forward power output and the VSWR at the output of the power amplifier. A 300–millisecond CW tone is transmitted allowing a short approximate measurement of forward power and VSWR.





6.4.5 Reserved for Future Use – 5 ENTR

6.4.6 Reserved for Future Use – 6 ENTR

6.4.7 Repetitive Self–Test – 7 ENTR

The repetitive self–test provides continuous self testing. It is provided to assist in troubleshooting intermittent problems. The RF–5020R/T continues self–test until a fault occurs or the R/T is turned off. Changing the FUNCTION control to another position may cause a fault indication. To stop a repetitive test initiated by remote control, send several carriage return characters. The test stops and a fault code may be displayed.

6.5 MODULE REPLACEMENT

The R/T chassis contains modules A1 through A11. Modules A1 through A9 are designed as plug–in modules. The modules are designed so that no adjustments or alignments are necessary after replacement. Access to these modules is gained by removing the top cover.

CAUTION

Do not attempt to remove the bottom cover of the R/T chassis without first removing all of the R/T plug–in modules AND the A10 Motherboard. The ribbon cable interconnecting the A11A1 Remote Interface Assembly with the A11A2 Rear Panel Filter Assembly is located under the A10 Motherboard. The A10 Motherboard is mounted to the bottom cover. Improper removal of the bottom cover may damage the interconnect cable, A10 Motherboard, or plug–in modules.

The location of the plug–in modules is shown in figure 6–1. The modules are designed to be installed in only one direction. Proper orientation of the modules is shown by color coding. The module numbers are screened in black on one side of the chassis and are screened in white on the other side. Each module card has black and white card clamp release levers which should be matched with the corresponding color on the chassis. Each module in the RF–5020R/T has two card clamps, one on each side of the module. To install or remove a module, the lever on the top of both clamps MUST be in the up (vertical) position.

CAUTION

The levers on the clamps must be in the up (vertical) position when installing or removing any module. The clamps expand when the levers are in the down (horizontal) position, mechanically clamping the module to the chassis. Damage to the module may result if the module is forced into position.

Figure 6–2 shows the proper positioning of the module clamp levers and the color–coding positioning system used to properly orient the modules in the chassis.

Most modules are installed on a module–mounting plate. This plate provides a mounting surface for individual modules and also serves as a shield between modules.

CAUTION

When replacing individual modules, care should be taken to ensure that the proper size hardware is used to reassemble the modules to their respective plates. The use of hardware which is too long can result in interference between modules and may cause damage to components in reassembly or during vibration.

6.5.1 Module Removal Procedure

Refer to this procedure to replace a faulted module identified by self test. Figure 6–1 shows the location of all RF–5020R/T modules.

a. Remove power from the RF–5020R/T by turning the front–panel FUNCTION control to the PWR OFF position.

b. Disconnect the cable from the power amplifier control connector (J6) located on the rear panel of the R/T chassis.

c. Loosen the six captive screws securing the top cover of the R/T and remove the top cover.

d. Carefully detach any module cables before attempting to remove a module from the chassis.

e. Each module in the RF–5020R/T has two card clamps, one on each side of the module. To install or remove a module, the lever on the top of both clamps MUST be in the up (vertical) position. Figure 6–2 shows the proper positioning of the module clamp levers and the color–coding positioning system used to properly orient the modules in the chassis.

CAUTION

The levers on the clamps must be in the up (vertical) position when installing or removing any module. The clamps expand when the levers are in the down (horizontal) position, mechanically clamping the module to the chassis. Damage to the module may result if the module is forced into position.

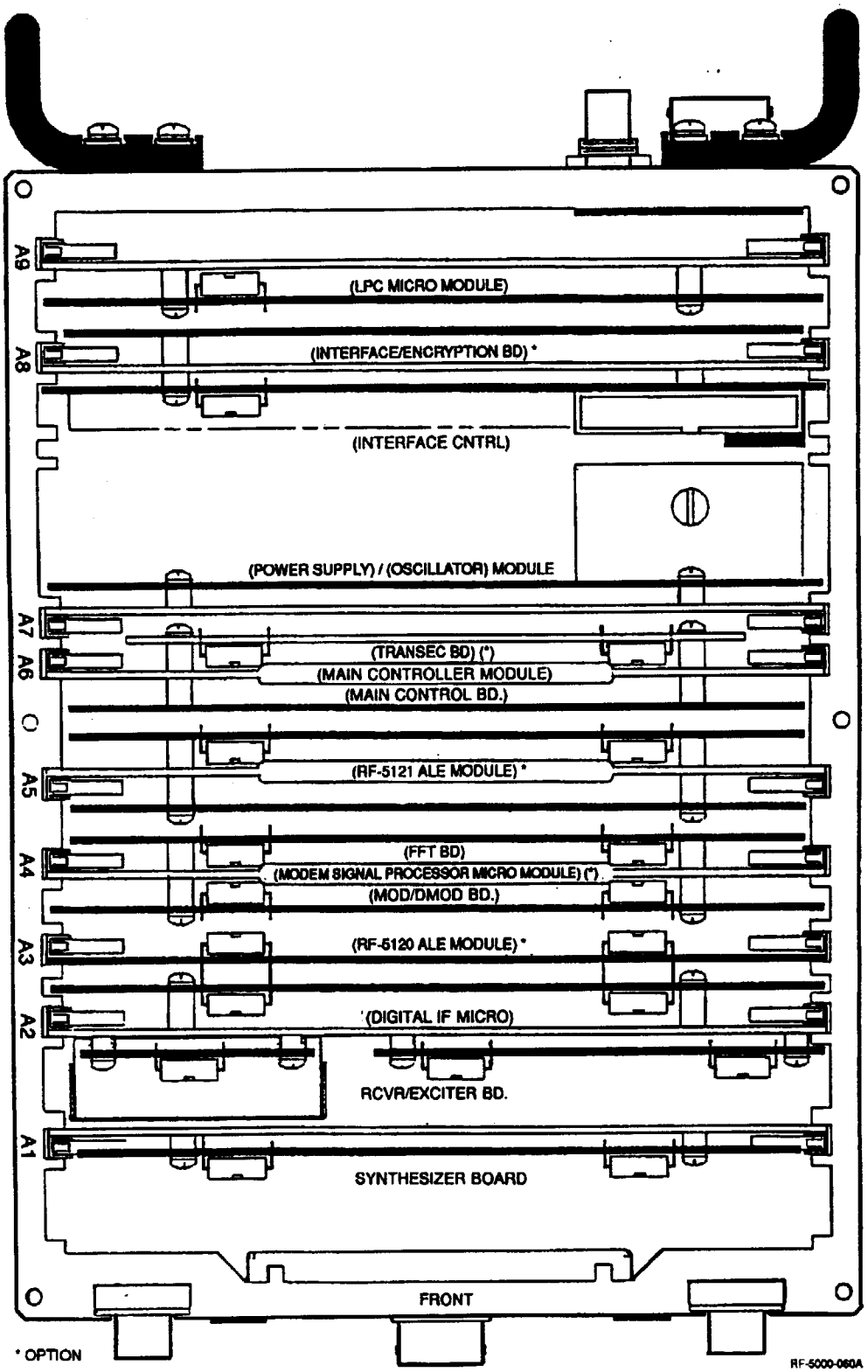
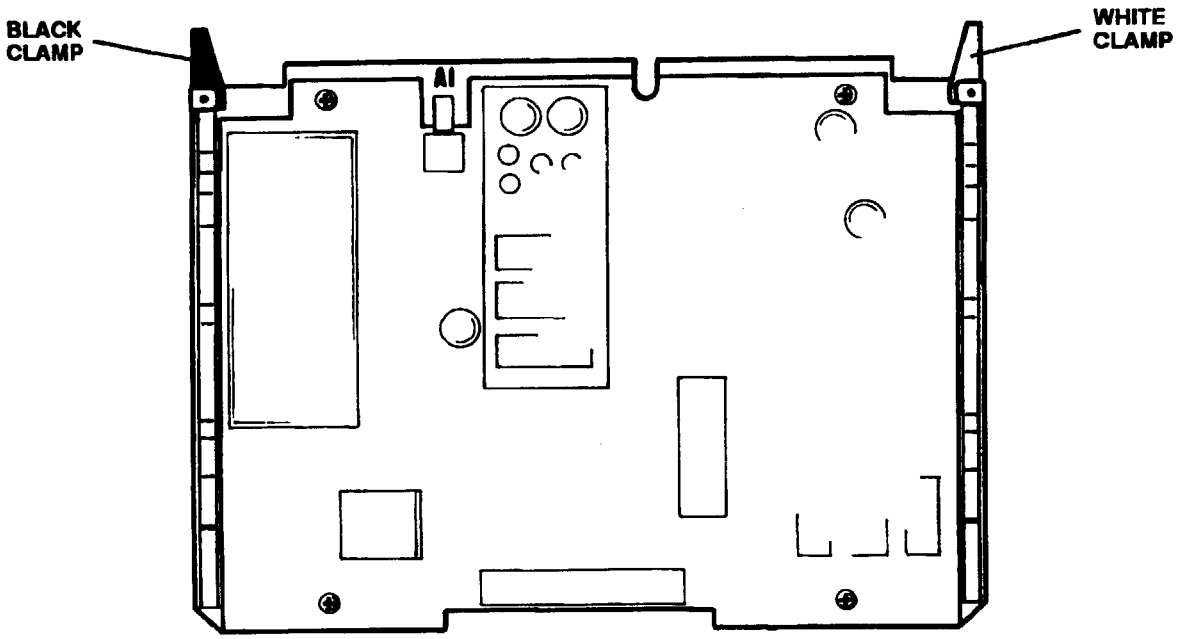
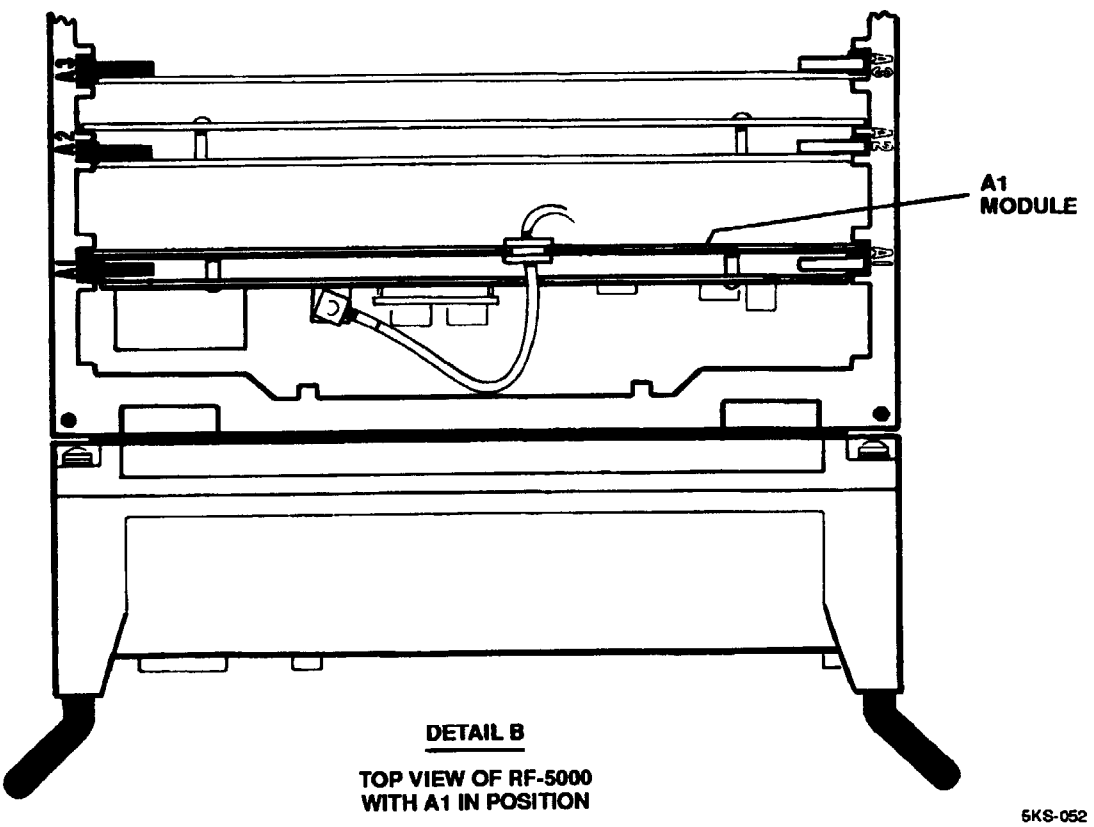


Figure 6–1. Location of Internal Modules



DETAIL A

A1 MODULE SHOWN REMOVED



DETAIL B

TOP VIEW OF RF-5000
WITH A1 IN POSITION

5KS-052

Figure 6–2. Module Removal and Orientation

6.5.2 Module Installation Procedure

a. Position the replacement module so that the wire side of the printed wiring board (PWB) is toward the front of the R/T chassis and the component side of the module is facing towards the rear of the chassis (see figure 6–2).

NOTE

Proper orientation of the modules is shown by color coding. The module numbers are screened in black on one side of the chassis and are screened in white on the other side. Each module card has black and white release levers which should be matched with the corresponding color on the chassis. When a module is correctly oriented, the module number is visible from the front of the chassis.

b. With the clamp levers in the up (vertical) position, insert the module until it is fully seated.

c. Move the clamp levers to the down (horizontal) position.

d. Carefully reattach any module cables.

e. Replace the top cover and carefully tighten all six screws. Care should be exercised to ensure that the cover gasket is properly seated.

f. Reattach the power amplifier control cable to J6 on the R/T chassis.

6.6 RF–5000 SYSTEM MESSAGES

The following subparagraphs show operational, warning, and fault messages that may appear on the RF–5020R/T's front–panel display during operation. The messages include explanations and, where appropriate, recommendations for action.

6.6.1 Operational Messages

T01–11.7800 125 =
TUNING COUPLER

Situation: RF–5000 Series or RF–382A–02 Antenna Coupler tuning. Antenna coupler timing requires approximately 20 milliseconds to retune to a programmed frequency and approximately 2 seconds to tune to a new frequency.

T01–11.7800 125 =
TUNE COMPLETE

Situation: Antenna coupler tuning complete.

T01–11.7800 125 =
TUNE FAULT

Situation: Antenna coupler tune fault. Antenna coupler is unable to tune the antenna at the operating frequency.

Action: Move frequency more than 1%, then rekey. If condition still exists, check antenna, antenna coupler, and cables.

T01–11.7800 125 =
COUPLER BYPASS

Situation: This prompt indicates that the RF–5030PA/CU–20 power output connector (J12) has been selected as the RF OUTPUT during the auto tune sequence.

6.6.2 Power Amplifier Warning Messages

T01–11.7800 125 =
PA OVER TEMP

Situation: Power amplifier high–temperature warning. Power amplifier may shut down if transmission is continued at this power level.

T01–11.7800 125 =
HIGH VSWR

Situation: Power amplifier warning.

Action: Retune by changing NET setting. If VSWR is still high, check antenna, antenna coupler, cable, and connectors.

T01–11.7800 125 =
PA LOW DC INPUT

Situation: Power amplifier warning indicating low +28–Vdc primary supply voltage.

Action: Check primary supply voltage and supply cable.

T01–11.7800 125 =
COUPLER OVERTEMP

Situation: Antenna coupler temperature has exceeded warning limit. Continued transmission may result in a coupler HIGH TEMP fault shut down.

T01–11.7800 125 =
COUPLER GONE

Situation: Power amplifier warning.

Action: Retune by changing NET control setting and rekeying. If condition still exists, check coupler and cabling.

T01–11.7800 125 =
COUPLER WARNING

Situation: Power amplifier warning.

Action: Retune by changing NET control setting and rekeying on a different frequency. If condition still exists, check coupler and cabling.

T01–11.7800 125 =
PA WARNING

Situation: A general fault occurs when the power amplifier senses a condition that prevents normal operation.

Action: The system should be retuned and rekeyed. If the condition still exists, check the power amplifier, antenna coupler, and cabling.

T01–11.7800 125 =
NO PA

Situation: The RF–5020R/T is unable to communicate with the power amplifier.

Action: Run self–test to confirm. If the condition still exists, check the power amplifiers and cables.

6.6.3 Power Amplifier Fault Messages

A power amplifier fault message is displayed when the RF–5000 System senses an operating condition that exceeds normal operating limits. The system inhibits normal operation until the condition is rectified.

T01–11.7800 125 =
PA OVERTEMP

Situation: The power amplifier operating temperature has exceeded its operating limits. Transmission is inhibited until the power amplifier has cooled.

T01–11.7800 125 =
PA OVER CURRENT

Situation: The power amplifier senses an excessive current condition.

T01–11.7800 125 =
PA BAD FILTER

Situation: The power amplifier senses a loss of harmonic filter operation or transmitter level control.

T01–11.7800 125 =
HIGH DC INPUT

Situation: Primary power supply voltage exceeds operating limits.

T01–11.7800 125 =
COUPLER FAULT

Situation: The antenna coupler has reported a fault condition to the PA and is inhibiting transmission.

Action: Check coupler.

T01–11.7800 125 =
1 KW PA FAULT

Situation: The RF–3230 1–kW Power Amplifier has reported a fault condition.

Action: Check the RF–3230 or place in the bypass (OFF/RESET) mode.

RF–5110MD MODEM OPTION

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RF–5110MD HIGH–SPEED DATA MODEM OPTION

1. GENERAL

The Harris RF–5110MD High–Speed Data Modem is a plug–in option designed to combat the complexities of ionospheric propagation which limit the rates at which data may be passed over an HF radio link. In the high–rate, 39–tone mode, a channel transmission rate of 3466–bits per second (bps), achieved by time differential phase shift keying (TDPSK) of 39 tones, is combined with a Forward Error Correcting code to produce data rates ranging from 75 to 2400–bits per second. In the FSK mode, the RF–5110MD can operate with a binary FSK modem, from rates of 75 to 300 bps. Asynchronous and synchronous data transmission is supported. Interface to the RF–5110MD is via the auxiliary connector J5 data ports of the RF–5020R/T.

The versatility and speed of the RF–5110MD make it suitable for a variety of applications, including:

- Narrow–Band Secure Voice
- High–Speed Burst Data
- Digital Facsimile
- Slow–Scan Television

The 39–tone mode utilizes time–differential QPSK modulation of 39 tones, for a resultant channel rate of 3466 bps. Reed–Solomon coding, coupled with selectable time interleaving, provide for robust performance under marginal HF channel conditions. At rates of 600 bps and below, in–band time/frequency diversity gives added protection in selective fading and low signal–to–noise ratio (SNR). The waveform incorporates fast synchronization techniques and allows for rapid recovery from deep fades.

The modem also includes an FSK mode of operation for compatibility with binary FSK modulator/ demodulators. User selection of mark/space frequency, over the range of 350 to 3250 Hz (2.5–Hz resolution), are accommodated. Data rates of 75, 150, and 300 bps are supported.

1.1 Data Terminal Interface

The RF–5020R/T provides both an asynchronous and a synchronous data port interface for use with computers, Teletypes, ARQ and Packet Radio message controllers, cryptographic units, FAX units, and other data transmission devices.

The data interfaces are accessible via the AUXILIARY CONNECTOR (J5) located on the rear panel of the RF–5020R/T. Refer to Section 5, Data Interface/Remote Control, for a discussion of data port interfaces and programming.

When used for data transmission in the non–remote control mode, the RF–5020R/T enables the asynchronous interface and keys the R/T when the asynchronous Request to Send line (pin H) is asserted (switched high) or when a Control–B data character is sent. When the RF–5020R/T is ready to accept data, it asserts the Clear to Send line (pin B). The Receive Line Signal Detect line (pin K) is asserted when data is received and can be used to enable a data device or a data retransmission system such as the RF–3490 Digital Data Buffer with the AN/PRC–117A VHF Frequency Hopping Manpack Transceiver.

The asynchronous interface is disabled and the R/T is unkeyed when the RTS line is returned to a low state or when a Control–C data character is sent.

In the remote control mode, data transmission via the asynchronous port is enabled when a Control–B data character is sent. The port now functions as a data port, the internal modem is enabled for data transmission, and the transmitter is keyed. A Control–C data character terminates the data transmission, unkeys the R/T, enables the internal modem for data reception, and returns the asynchronous port to the remote control function.

The synchronous interface is provided for interface to facsimile, cryptographic, and secure voice units that require synchronous data transmission. The RF–5020R/T can support both an asynchronous and a synchronous device. Separate control lines are provided for each interface.

When transmitting data, the RF–5020R/T enables the synchronous interface and keys the R/T when the synchronous Request to Send line (pin G) is asserted, switched high. When the RF–5020R/T is ready to accept data, it asserts the Clear–to–Send line (pin S). As in the asynchronous interface, the Receive Line Signal Detect line (pin K) is asserted when data is received and can be used to enable a data device or a data retransmission system.

The synchronous interface is disabled and the R/T is unkeyed when the RTS line (pin G) is returned to a low state.

When interfacing to a synchronous device the RF–5110MD provides the clock signal.

1.2 RF–3466/3466A Compatibility

The RF–5110MD is compatible with the RF–3466/3466A modem. The high–rate, 39–tone mode of the RF–5110MD supports NORMAL PREAMBLE and NORMAL – ALTERNATE SHORT/LONG interleaving modes of the RF–3466/3466A. This decision decoding is used when receiving data.

Baud rates of 75, 150, and 300 bps are supported when sending FSK.

1.3 Remote Control

Full remote control operation and programming of the RF–5110MD is supported by the RF–5020R/T. The remote control commands, menus, status, and HELP screen are similar to those used in single channel (SSB) operation.

2. INSTALLATION

When ordered with an RF–5020R/T, the RF–5110MD is installed and tested at the factory.

The RF–5110MD Module is installed in the A4 Module location (see figure 6–1) of the RF–5020R/T chassis as follows:

a. Remove power from the RF–5020R/T by turning the front–panel FUNCTION control to the PWR OFF position.

b. Disconnect the cable from the power amplifier control connector (J6) located on the rear panel of the R/T chassis.

c. Loosen the six screws (captive hardware) securing the top cover of the R/T and remove the top cover.

d. The RF–5110MD module has two card clamps, one on each side of the module. To install or remove the module, the lever on the top of both clamps MUST be in the up (vertical) position.

CAUTION

The levers on the clamps must be in the up (vertical) position when installing or removing any module. The clamps expand when the levers are in the down (horizontal) position mechanically clamping the module to the chassis. Physical damage to the module may result if the module is forced into position.

e. With the front of the RF–5020R/T facing the installer, position the module so that the black A4 indicator on the left side of the chassis matches the black A4 indicator on the module card clamp and the white A4 indicator on the right side of the chassis matches the white A4 indicator in the module card clamp. The A4 marking on the middle portion of the module will also be visible.

f. With the clamp levers in the up (vertical) position, insert the module into the A4 slot until it is fully seated.

g. Move the clamp levers to the down (horizontal) position.

h. Replace the top cover and carefully tighten all six screws. Care should be exercised to ensure the cover gasket is properly seated.

i. Reattach the power amplifier control cable to J6 on the R/T chassis.

j. Connect the data terminal to the RF–5020R/T via the auxiliary connectors and program the modem and data port parameter at the R/T and the data terminal.

3. PROGRAMMING

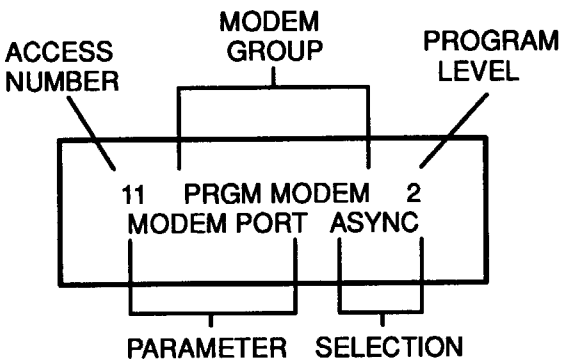
Modem parameters can only be programmed when the front–panel FUNCTION control is in the SSB position or via remote control.

3.1 10 PRGM MODEM GROUP

The MODEM group parameters define modem characteristics. To simplify operation, up to five preset modem configurations can be programmed. The operator can then select a configuration instead of programming each modem parameter for each channel.

3.2 11 PRGM – Modem Port

The MODEM PORT command enables modem operation and selects either the asynchronous or synchronous data interface for data transmission and reception. The selections toggle between ASYNC and SYNC. A typical display is shown below:



3.3 12 PRGM – Modem Type

The modem option is capable of supporting up to five modem waveform settings, as described in table 1. The MODEM TYPE command is used to select the desired waveform:

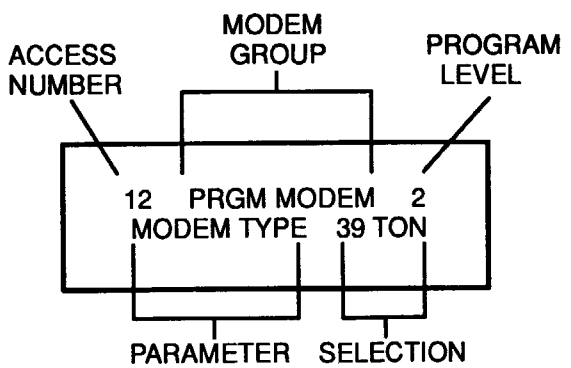


Table 1. Modem Type Settings

Type	Definition
39 TON	39–tone high–speed data waveform up to 2400 bps
FSKNS	FSK narrow shift: center frequency 2805 Hz ±42.5 Hz
FSKWS	FSK wide shift: center frequency 2000 Hz ±425 Hz
FSK–A	FSK narrow shift: center frequency 2000 Hz ±85 Hz
FSK–V	FSK programmable mark and space frequencies. When this FSK mode is selected, 15 PRGM and 16 PRGM parameters are used to set mark and space frequencies. Default value is 1170 Hz ±100 Hz. Mark and space range is 390 to 3250 Hz.

3.4 13 PRGM – Modem Baud

The BAUD RATE function selects the over–the–air data transmission speed used by the RF–5110MD High–Speed Modem option. The selectable baud rates are a function of the modem type; 39–tone or FSK. When the modem is ENABLED for synchronous data transmission, the over–the–air baud rate command also controls the synchronous port data rate.

NOTE

When an FSK setting is selected and the asynchronous data interface is enabled, a random character may occasionally display. This does not affect normal operations. The FSK sensitivity is set at maximum in order to receive weak FSK signals. If a signal is not present, the FSK decoder will react to noise causing random characters to appear.

Table 2 defines the modem baud settings. A typical display is shown below.

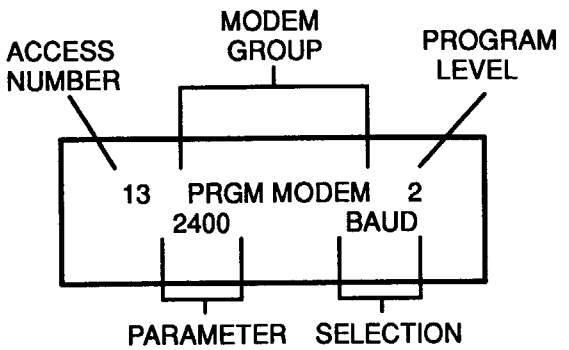


Table 2. Modem Baud Settings

FSK setting	39–Tone Setting	BPS
	2400	2400
	1200	1200
	600	600
300	300	300
150	150	150
75	75	75
OFF	OFF	Modem option is disabled

3.5 14 PRGM – Interleave

Data interleaving is used by the modem option with the RF–3466 (39 tone) compatible waveform to minimize data errors due to fading and burst noise interference. The data transmission is delayed by the times indicated in table 3 and are due to the additional data processing. The long setting results in the lowest bit error rate.

NOTE

This program is disabled when FSK has been selected.

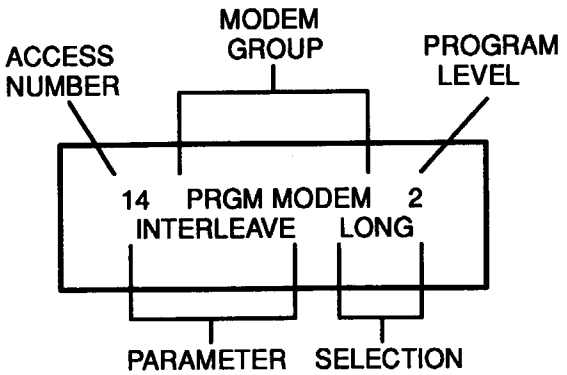


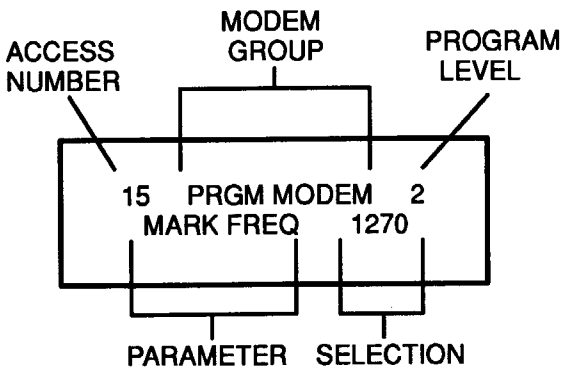
Table 3. Data Throughput Times

Setting	Baud Rate	Delay
LONG*	2400 bps – Async	10.1 sec
	2400 bps – Sync	9.9 sec
	75 – 1200 bps	14.1 sec
SHORT	2400 bps – Async	0.34 sec
	2400 bps – Sync	5.1 sec
	75 – 1200 bps	1.7 sec
ALTERNATE	2400 bps – Async	2.75 sec
LONG	2400 bps – Sync	3.85 sec
	75 – 1200 bps	6.70 sec
ALTERNATE	2400 bps – Async	1.58 sec
SHORT	2400 bps – Sync	2.50 sec
	75 – 1200 bps	4.30 sec

* Normal modem interleave setting

3.6 15 PRGM – Mark Frequency

The MARK FREQ function sets the FSK–V programmable mark frequency. It can be set to any frequency between 350 and 3250 Hz and is set internally with a resolution of 2.5 Hz.



Selection of FSK mark and space frequencies should be done with care if attempting to use non–standard frequencies.

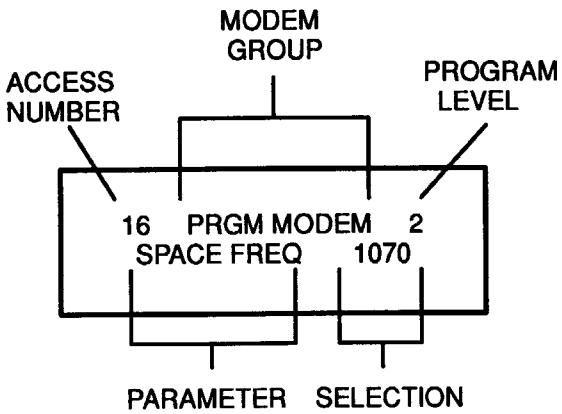
For any given pair of mark and space frequencies, there is a limit to the baud rate that can be achieved. For a narrow mark/space frequency separation, a minimum ratio of frequency separation to baud rate should be 67%.

$$\frac{\text{Mark – Space Frequency Difference (Hz)}}{\text{Maximum data rate (baud)}} \geq 67\%$$

Therefore, a 300 baud data rate requires a minimum mark/space frequency separation of 200 Hz.

3.7 16 PRGM – Space Frequency

The SPACE FREQ function sets the FSK–V programmable space frequency. It can be set to any frequency between 350 and 3250 Hz and is set internally with a resolution of 2.5 Hz.



3.8 Narrow–Shift FSK Tuning Display

Narrow–shift FSK employs a ±42.5–Hz frequency shift. This presents no difficulties when two RF–5000 Systems are communicating because the RF–5000 has a frequency standard with one–quarter part–per–million stability. However, if an RF–5000 communicates in narrow–shift FSK mode with a radio having a less–stable frequency standard, problems could be experienced. A radio with a frequency standard with one part–per–million stability at a frequency of 30 MHz could have a frequency drift of 30 Hz. This is unacceptably high when using a ±42.5–Hz frequency shift.

When the RF–5000 is placed in the narrow–shift FSK mode, the S meter becomes a T meter with a 0–9 display. The up and down arrow keys increment the frequency in 10–Hz steps with a maximum possible shift of ±30 Hz. Press the up and down arrow keys to maximize the T meter reading.

4. OPERATION

The MODE key, located on the front panel of the RF–5020R/T, allows the selection of modem baud rates. The transmission of data is covered in the Data Interface/Remote Control section of this manual.

It is important to note that any setting changes made to a given waveform affect all modes that use that waveform.

5. REMOTE CONTROL OPERATION

Full remote control operation and programming of the RF–5110MD is supported by the RF–5020R/T. The remote control command, menus, status, and help screen are similar to those used in single channel (SSB) operation.

5.1 Modem Show Menu

The MODEM SHOW command displays the current settings and status of the modem for the selected net.

REMOTE CONTROL – MODEM SHOW MENU

```
SSB > MODEM SHOW

Modem Type 39 Tone
Modem Async
Modem Baud 2400
Modem Inter Long
```

5.2 Modem Help Menu

The MODEM HELP command displays a list of modem commands. These commands must be prefixed with the word MODEM to be recognized by the RF–5020R/T.

EXAMPLES:

MODEM ASYNC	–	enables the modem in the asynchronous data transmission mode
MODEM BAUD 300	–	programs the over–the–air modem baud rate to 300

REMOTE CONTROL – MODEM HELP MENU

```
SSB > MODEM HELP

Modem commands consist of the following, prefixed by MODEM:
ASync       –   async mode      BAUd   –   (75, 150, 300, 600, 1200, 2400, VOice*)
INTerleave  –   (LOng/SHort)    OFf    –   disable modem
MArk        –   mark freq       SPace  –   space freq
SYnc        –   sync mode       TYpe   –   (39 TONE/FSKWs/FSKNs/FSK–A/FSK–V)
```

* Available for synchronous operation only.

5.3 Interface Commands

The INTERFACE COMMANDS provide status information programming of both the asynchronous and synchronous data ports.

5.3.1 Interface Command: Async Show

The ASYNC SHOW command provides a listing of the status and settings of the asynchronous data port.

REMOTE CONTROL – ASYNC SHOW MENU

```
SSB > ASYNC SHOW

Async Baud      9600
Async Bits      8
Async Parity    none
Async Stop      2
Async Echo      on
Async Flow      xonxoff
```

5.3.2 Interface Command: Async Help

The ASYNC HELP command provides a listing of the commands used to control the asynchronous data port.

REMOTE CONTROL – ASYNC HELP MENU

```
SSB > ASYNC HELP

Async commands consist of the following, preceded by ASync:

BAud    –  75/150/300/600/1200/2400/4800/9600
BIts    –  5/6/7/8 (character bits)
ECho    –  on/off
PArity  –  none/odd/even
STop    –  1/2 (stop bits)
FLow    –  xonxoff/cts
```

RF-5120AFC
ADAPTIVE OPTION

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RF–5120AFC AUTOLINK® ADAPTIVE FREQUENCY CONTROLLER OPTION

1. GENERAL

The RF–5120AFC AUTOLINK® Adaptive Frequency Controller plug–in option for the RF–5020R/T Receiver/Transmitter is designed to provide automatic adaptive high frequency management through a combination of selective calling, Link Quality Analysis (LQA), and RF–5000 System control. Operation is compatible with the Harris RF–7110 and RF–7166 AUTOLINK® Systems.

The RF–5120AFC extends the SSB single–channel operation of the RF–5020R/T to include fully automatic HF link establishment, optimum channel selection via link quality analysis, preset channel scanning, selective calling (individual, group, network, and broadcast), and digital squelch. Full RF–5000 System remote control and built–in test functions are automatically expanded to support RF–5120AFC operation.

The RF–5120AFC provides selective calling using four–character numeric call signs entered at the front panel or via remote control. All inter–link messages are Golay forward error correcting coded to improve selective call detection over channels with a low signal–to–noise ratio and to minimize false responses. The RF–5120AFC may be programmed with up to 30 individual addresses. These 30 addresses can be part of any group or network.

During a Link Quality Analysis (LQA) sequence, channel quality measurements are made for each channel assigned to the call sign or network. The measurements are stored, ranked according to the link quality, and then used to select the optimum channel for link establishment. The LQA measurements can be programmed to be made automatically at defined time intervals or before a call is placed to another unit.

2. AUTOLINK® SYSTEM CONCEPTS

The capabilities provided by the RF–5120AFC when installed in the RF–5020R/T Receiver/Transmitter are listed below:

- Automatic selection of the best channel
- Selective calling and link establishment
- Channel scanning
- Four–level network capability
- Real–time Link Quality Analysis (LQA)
- Automatic Listen–Before–Talk
- Intelligent radio silence
- Engineering order wire
- Remote operation
- Built–in test
- Harris RF–7110/7166 AUTOLINK® System compatibility

The RF–5120AFC AUTOLINK® System combines receive channel scan, LQA, and automatic link establishment to adapt to changing HF channel conditions. The scan capability allows the operator to monitor many available channels for incoming calls. Link quality analysis is performed automatically to evaluate and rank the network channels based on their estimated performance. Automatic link establishment, based on the LQA performance

scores, assures that communication links are established on the optimum available channels, taking full advantage of the LQA.

2.1 Call Signs

When an AUTOLINK® network is formed, each RF–5120AFC equipped RF–5020R/T– or RF–7110/7166–based system in the network is assigned a different four–digit numeric call sign. The call sign is analogous to a telephone number and identifies a particular user with a unique number (e.g., 1234). When placing a call to another unit, the operator enters the unit's call sign as part of the calling sequence.

Besides identifying an individual unit, the call sign can also identify the group or net in which a particular unit resides. All units that have a call sign whose first and second digits are the same (e.g., 12XX) are members of the same group with 1200 as their GROUP CALL SIGN. Similarly, all individuals whose first call sign digit is the same (e.g., 1XXX) are members of the same net, with 1000 as their NET CALL SIGN.

Table 1 defines the call sign structure for the RF–5120AFC.

Table 1. Call Sign Structure

Type	Call Sign	Call Sign Designation
Individual	1234	Addresses an individual unit
Group	1200	Addresses all units with 12XX
Net	1000	Addresses all units with 1XXX
Broadcast	0000	Addresses all units

2.2 Channels

Each call sign is assigned a list of channels by the operator. These channels are used when communicating with that specific call sign. The channel numbers used correspond to the RF–5020R/T SSB channel numbers. This simplifies channel frequency entry and network programming.

Channels common to GROUP, NET, and BROADCAST call signs are used for link establishment when their GROUP, NET, or BROADCAST call signs are used. An example is shown in table 2.

2.3 Scan Mode

The SCAN mode is entered automatically when the RF–5020R/T front–panel FUNCTION control is placed in the AUTOLINK® position or when the CALL CLR key sequence is entered when in the AUTOLINK® mode. The scan rate is approximately 100 milliseconds per channel with up to 100 channels being monitored.

When an incoming call is received, the RF–5020R/T stops scanning and the message SIGNAL RECEIVED is displayed. If the incoming call is addressed to the receiving unit, then receipt of the call is acknowledged to the originating unit and both units prompt the operator that call link has been established. If the incoming call is not addressed to the unit, the scanning is resumed.

2.4 Call Placement

The operator (caller) can initiate an automatic selective call to any other AUTOLINK® operator (target) from the front panel of the RF–5020R/T or via remote control. The RF–5120AFC takes the R/T out of the scan mode, reviews the LQA measurement data for the channels assigned to the target unit, selects the best channel indicated by the LQA scores, and initiates a call request to the target on that channel.

Table 2. Example of Call Signs

	INDIVIDUAL CALL SIGNS					
	1234	1235	1466	2211	2222	2361
INDIVIDUAL CHANNELS	01 02 04 06 10 14 16	01 02 05 07 10 14 16	01 03 09 14 16	01 09 10 12 15 16	01 09 10 11 14 16	01 10 11 14 16
	1200	GROUP CALL SIGNS			2200	
GROUP CHANNELS	01 02 10 14 16				01 09 10 16	
	1000	NET CALL SIGNS			2000	
NET CHANNELS	01 14 16				01 10 16	
		0000	BROADCAST CALL SIGN			
BROADCAST CHANNELS		01 16				

To establish a link between individual units, a preamble and three messages must be passed between the two units.

- The PREAMBLE is a message that commands all scanning units to stop scanning and wait for the SOUND MESSAGE.
- The sound message is sent by the caller after the preamble and is followed by a RESPONSE MESSAGE from the target unit.
- After the response message, a PROBE MESSAGE is sent by the calling unit and the two units are linked.

Once the link is established, both operators (the caller and the target) are notified and normal communication can begin.

Only the sound message is passed to establish a broadcast, net, or group link. With this format, the caller does not have to receive a response message from every target unit in the net or group. After the sound message is sent, the caller's display shows the group, net, or broadcast call sign. All target units in the link also display the group, net, or broadcast call sign.

The preamble message has a duration specific to the particular application and is programmed as part of the RF–5120AFC setup. The calling unit must transmit a preamble long enough to accommodate the unit which must scan the maximum number of channels. This ensures that the unit can scan through all of its channels and still receive the command to stop scanning.

The operator must program this number with an understanding of how many channels all of the other units in the network are scanning. It is desirable to keep the preamble length to a minimum since it directly affects the length of time required to place a call or perform an LQA.

The operator can also place a selective call on a single channel (manual call).

In the case of a broadcast call, the RF–5120AFC places a call only if all units share a common channel. The LQA scores for each of the common channels are combined and a call is placed on the common channel with the highest aggregate score.

2.5 Network Operation

Interaction between RF–5120AFC/RF–7110/7166 AUTOLINK® systems is done using a free–net approach. This means that each node of the network is able to establish links, terminate links, and gather LQA data independently and under its own authority. This is opposed to a direct net in which each node of the network must request and then receive authorization from a net controller before initiating communication with another unit. The free–net approach minimizes connect time, reduces overhead traffic on the channels, and eliminates the need of a central net controller that is used in a directed net system.

2.6 Key to Call

The KEY TO CALL mode allows the operator to automatically place a call to the last call sign called when the transmitter is keyed either in voice or data mode. Once the link is established, normal operation is resumed. This feature is useful when a majority of calls are made to a single call sign.

2.7 Late Net Entry

If a site wishes to enter a previously established AUTOLINK® link, the operator may do so by issuing an individual, net, group, or broadcast call.

2.8 Third Party Add–On

When two or more AUTOLINK® sites are linked, one of the linked parties may call another station and include that station in the established link. The calling station does this by placing a manual call to the third party, using the same channel as the current link. When the third site responds, it is connected to the link and the front panel of the R/T is updated to reflect the multiple calls.

2.9 Link Quality Analysis (LQA) Testing

The RF–5120AFC selects the best available channel for a communication link between two units based on the Link Quality analysis (LQA) channel measurements made between the two units. The resulting composite score for each channel in each direction (A>B and B<A) is then ranked and the channel with the highest score is used. These measurements can be made before initiating a selective call or can be programmed to be performed periodically and stored for future use in selecting a channel.

The unit requesting an LQA measurement initiates a sequence similar to placing a call. The target unit stops scanning and sends a response back to the calling unit. The calling unit then sends a probe message to the target

and, instead of remaining on the present channel, both units proceed to the next channel to exchange messages and collect LQA data. The number and order of the channels tested is determined by whether a BEST 3 or ALL LQA test is being conducted.

2.9.1 BEST 3 LQA Test

A BEST 3 LQA test is conducted on only the three best channels of the target unit. This is the most common mode of LQA testing and is performed whenever the caller has three valid (non–zero) LQA channel scores for the target unit. Channels found to be unusable for contact during LQA call or operator calls have their LQA scores zeroed, so non–zero scores imply that the channel is usable. The channel with the highest LQA score is tested first, followed by the channel with the second highest score, then followed by the channel with the third highest score. Once the three channels are tested, the units return to their pre–LQA mode of operation. If contact fails on any one of the tested channels or if one of the channels drops out of the top three ranking, the LQA test changes from the BEST 3 testing mode to the ALL LQA testing mode.

2.9.2 ALL LQA Test

An ALL LQA test, as the name implies, performs LQA measurements on all the channels assigned to the target call sign. The order of testing is from the highest frequency to the lowest. This type of testing is necessary after net reprogramming, if BEST 3 testing fails, if previous LQA tests have been performed for an extended period of time, or if the LQA score matrix does not have three valid (non–zero) scores for the target.

2.10 Listen Before Transmit (LBT)

This feature addresses Federal Communication Commission (FCC) non–interference requirements. When the Listen–Before–Transmit feature is enabled, the RF–5120AFC samples the incoming signal for two seconds prior to transmitting. If traffic is detected, the unit steps to the next logical channel without transmitting and repeats the process. Note that the two–second delay is present in all call and LQA message exchanges regardless of whether LBT is enabled. This is necessary to maintain compatibility between systems with and without LBT enabled. LBT works only with auto calls, not manual calls.

2.11 Engineering Order Wire (EOW)

The Engineering Order Wire (EOW) feature allows the operator to transmit and receive data messages using the FSK mode of the RF–5120AFC.

When the RF–5110MD modem is programmed to support the synchronous port, the EOW supports asynchronous data communications. This is useful if the synchronous port and high–speed data modems are operating with facsimile machines or video image retransmission systems. The EOW can then be used to support message and image transmission coordination.

2.12 Radio Silence

With the Radio Silence feature enabled, the RF–5020R/T is inhibited from automatically transmitting a response to incoming calls or LQA requests. An incoming call request causes the R/T to stop scanning and signals the operator with a call alarm. When an operator call is initiated and the calling unit has Radio Silence enabled, the unit transmits the call message to the target unit, but does not expect a response and assumes that the link has been established.

The operator is not prevented from keying the R/T when Radio Silence is enabled. If an incoming LQA request is received, the unit stores the quality of the signal it receives, but does not respond to the calling unit.

2.13 Remote Control

Full remote control operation and programming of the RF–5120AFC is supported by the RF–5020R/T. The remote control commands, menus, status, and HELP screen are similar to those used in single channel (SSB) operation.

Operational parameters can also be downloaded over the remote control interface. A text file on a personal computer can be generated containing the complete programming information for each net, call sign, configuration, parameter, etc., of the system. The file is then transferred to the RF–5000 via the remote control interface and can completely program the RF–5000 for a specific mission.

2.14 Group LQA

The RF–5120AFC does not support the group LQA feature implemented in the RF–7110/RF–7166 Adaptive Communication Controllers. The feature performs LQAs between all members of a group and transfers all of the LQA scores between all members.

3. INSTALLATION

When ordered with an RF–5020R/T, the RF–5120AFC is installed and tested at the factory.

The RF–5120AFC module is installed in the A3 Module location (see figure 6–1) of the RF–5020R/T chassis as follows:

a. Remove power from the RF–5020R/T by turning the front–panel FUNCTION control to the PWR OFF position.

b. Disconnect the cable from the power amplifier control connector (J6) located on the rear panel of the R/T chassis.

c. Loosen the six screws (captive hardware) securing the top cover of the R/T and remove the top cover.

d. The RF–5120AFC module has two card clamps, one on each side of the module. To install or remove the module, the lever on the top of both clamps MUST be in the up (vertical) position.

CAUTION

The levers on the clamps must be in the up (vertical) position when installing or removing any module. The clamps expand when the levers are in the down (horizontal) position mechanically clamping the module to the chassis. Physical damage to the module may result if the module is forced into position.

e. Position the module so that the bottom of the printed wiring board (PWB) is toward the front of the R/T chassis and the component side of the module is toward the rear of the chassis.

f. With the clamp levers in the up (vertical) position, insert the module into the A3 slot until it is fully seated.

g. Move the clamp levers to the down (horizontal) position.

h. Replace the top cover and carefully tighten all six screws. Care should be taken to ensure the cover gasket is properly seated.

i. Reattach the power amplifier control cable to J6 of the R/T chassis.

No external connections are required for interface or operation of the RF–5120AFC.

3.1 Initial Parameter Programming

NOTE

Before programming adaptive functions, place the FUNCTION control in SSB and verify that the channels and frequencies are correct for your application. In addition, if the RF-382-02 Antenna Coupler is being used in the system, the power level in SSB mode should be programmed for at least 50 watts.

The following operational parameters must be programmed before operation and set in coordination with the other sites in the net. If the settings are not coordinated, the system may function, but overall reliability is reduced.

- Channels
- Local Call Sign
- Network Call Signs
- On the Air Bit Speed

Paragraph 4. in this subsection provides a detailed description of the programming procedures.

For optimum performance, the following parameters should also be programmed:

- Radio Silence
- Listen Before Transmit
- Key to Call
- Time Out

When establishing a net, it is helpful to use a worksheet to coordinate call sign and channel assignments, configuration setting, LQA schedules, etc. Table 3 is an example of such a worksheet. Blank copies of this worksheet can be found at the end of this section.

4. PROGRAMMING

The RF-5120AFC is programmed via the front panel or the remote control interface and uses the same programming procedures as the RF-5020R/T.

During programming, various prompts, menus, and messages are displayed to assist in the selection of operating parameters. Programmable parameters, such as Local Call Sign, Net Channels, Preamble Length, LQA Interval, etc., are grouped according to function and option.

Three programming menu levels are used. The FIRST LEVEL menu, accessible by pushing the CLR PRGM key sequence, presents the programming parameter groups. In the AUTOLINK® mode these are:

- PROGRAM NETS – Defines AUTOLINK® net channels and call signs
- PROGRAM LQAS – Defines LQA call sign, interval, and start times
- ALE CONFIG – Defines AUTOLINK® system configuration parameters such as local call sign, modem bit speed, and preamble length
- ZEROIZE – Defines the ZEROIZE command sequence.

Table 4 lists the access number/program group and the operating parameter (and access number) for the first and second levels of programming.

Table 3. Sample Programming for Establishing a Net

LOCAL CALL SIGN 4111		
NET	NET CALL SIGNS	NET CHANNELS
1	4112	01, 02, 03, 04, 05, 06, 07, 08, 09
2	4115	01, 02, 03, 04, 05, 06, 07, 08, 09
3	4255	02, 09, 11, 12, 14
4	5733	10, 13, 14, 15
5		
6		
7		
8		
9		
10		

CONFIGURATION SETTINGS:		
58 PREAMBLE LENGTH	08	0.5 sec/chan + 0.5 sec – 7100 mode 0.2 sec/chan + 0.2 sec – 5120 mode
59 ON THE AIR BIT SPEED	200	100/200 bits per second
60 RADIO SILENCE	OFF	ON/OFF
61 LISTEN BEFORE TRANSMIT	OFF	ON/OFF
62 KEY TO CALL	ON	ON/OFF
64 TIME OUT	OFF	ON (15 min)/OFF

Table 4. Program Levels

45 PROGRAM NETS	52 PROGRAM LQAS	57 ALE CONFIG	99 ZEROIZE
46 NET CALL SIGN	53 ACTIVE LQA	58 LOCAL CALL SIGN	
47 COPY NET	55 CONFIG LQA	59 PREAMBLE	
48 NET CHANNELS	56 LQA CALL	60 BIT SPEED	
51 DELETE NET		61 RADIO SILENCE	
		62 LSTN BEFORE XMIT	
		63 KEY TO CALL	
		65 TIME OUT	

As shown in table 4, each program group, except 99 ZEROIZE, contains a second level of parameters which may be programmed; e.g., call sign, preamble length. If more then one selection must be made to program a parameter, a third level is used.

4.1 Accessing Program Groups and Operating Parameters

There are three ways to access program groups and operating parameters:

- Access via Access Number/Program Group – CLR PRGM

a. With an RX display on the LCD display, press the CLR key followed by the PRGM key. This causes the "45 PRGM NETS" group to appear in the display.

b. Each subsequent press of the PRGM key advances the display to the next program group.

c. To access the displayed program group's operating parameters, press the ENTR key.

- Direct Access via Access Number – Access Number [N] PRGM

  With an RX display on the LCD display, press the access number [N] followed by the PRGM key. This causes the specified parameter to appear in the display.

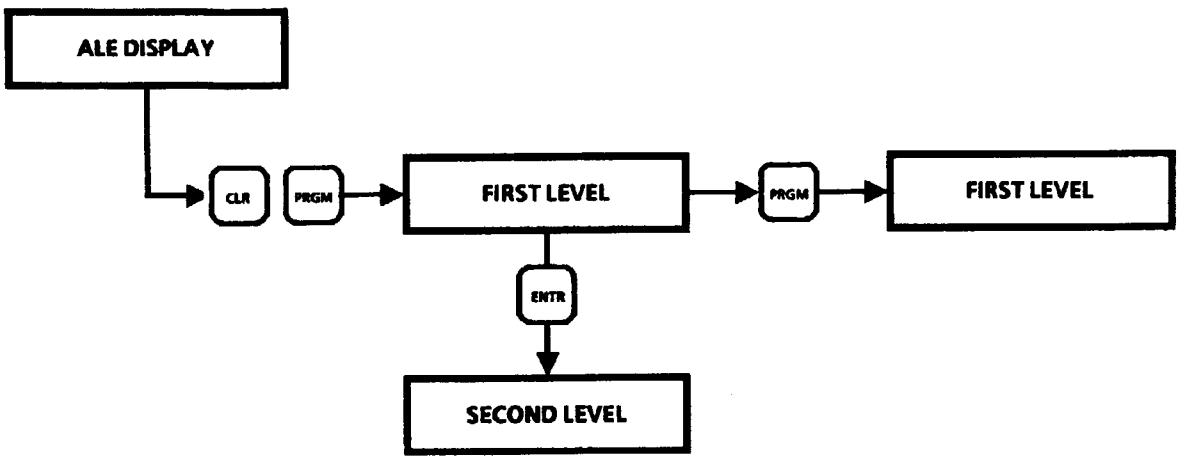
- Repeat Access – PRGM

  After an operating parameter has been selected and entered and the LCD display has returned to the RX DISPLAY, pressing the PRGM key causes the last accessed PRGM function to appear in the display.

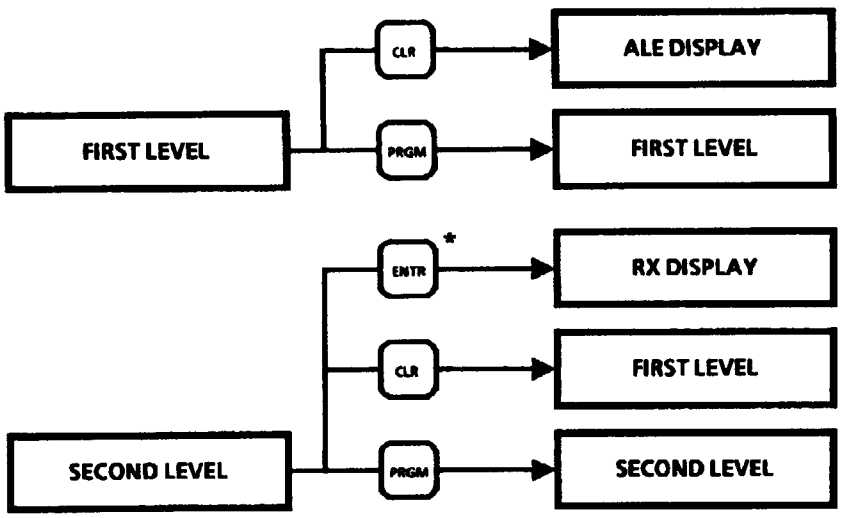
4.1.1 Accessing/Exiting Program Levels

Figure 1 illustrates the general key sequence for accessing and exiting program levels.

TO ACCESS PROGRAM LEVELS

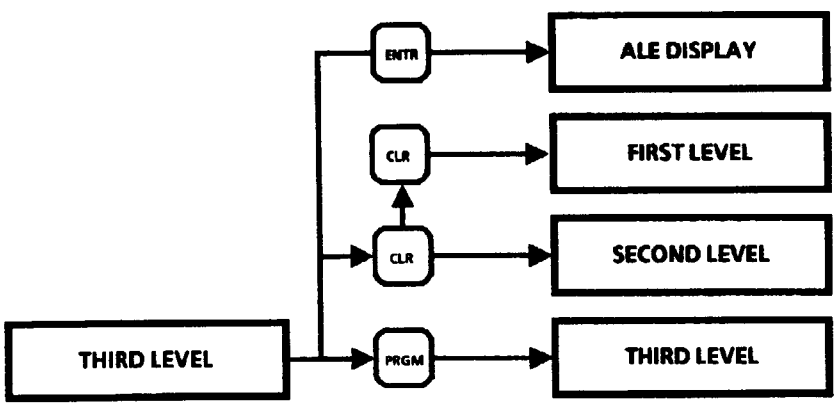


TO EXIT PROGRAM LEVELS



* Pressing the **ENTR** key returns the RF-5020R/T to the RX DISPLAY if a THIRD LEVEL selection is not required.

The **CLR** key moves the display up one level and the **PRGM** key advances the display to the next parameter on the same level.

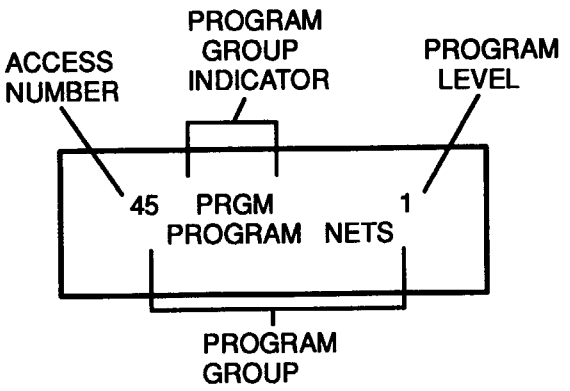


**RF-5000-012B

Figure 1. Accessing and Exiting Program Levels

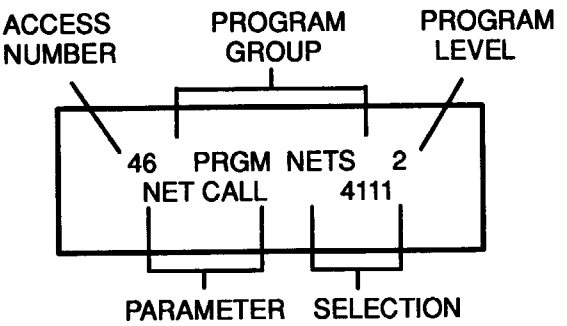
4.1.2 Making Programming Selections

The PROGRAM display occurs when the PRGM key is pressed. Continuing to momentarily press the PRGM key causes the display to scroll through the program groups. Pressing the ENTR key selects the displayed group and the first programmable parameter is displayed. An example of a first-level program group display is shown below:



ACCESS NUMBER	–	Number used to directly access a programmable parameter
PROGRAM LEVEL	–	Level of program sequence
GROUP	–	Program group

To access the SECOND LEVEL menu, press the ENTR key:



PARAMETER	–	Operating parameter
SELECTION	–	Value or statement of parameter to be selected

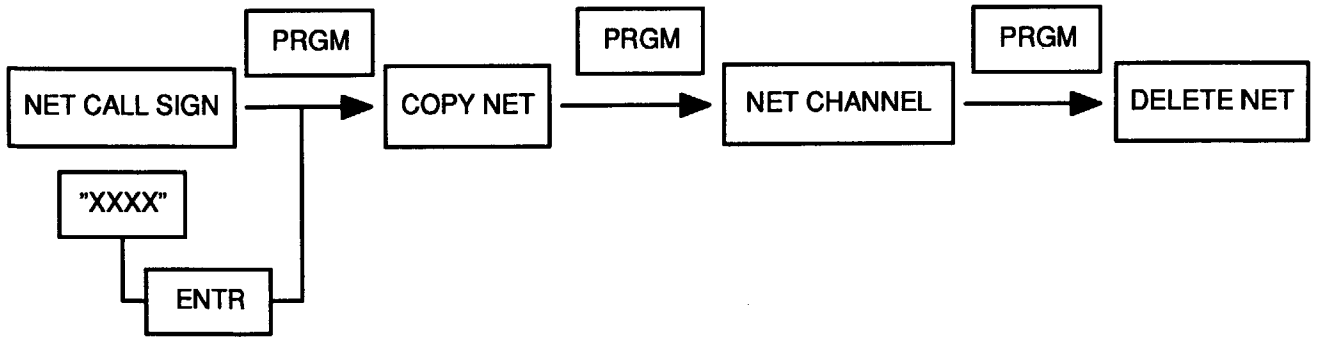
To select a different operating parameter, use the ARROW keys (or keypad, if appropriate) to scroll through the selections and then press the PRGM key. This stores the displayed value and advances the display to the next programmable parameter.

To store the displayed selection in memory, follow one of the three options listed below:

- To store the displayed selection in memory and return to the RX display, press the ENTR key.
- To store the displayed selection in memory and advance the display to the next parameter in the group, press the PRGM key.
- To store the displayed selection in memory and return to the FIRST LEVEL display, press the CLR key.

4.2 45 PRGM – NET PROGRAMMING

The PROGRAM NETS group parameters define AUTOLINK® net characteristics such as net call signs and net channels.



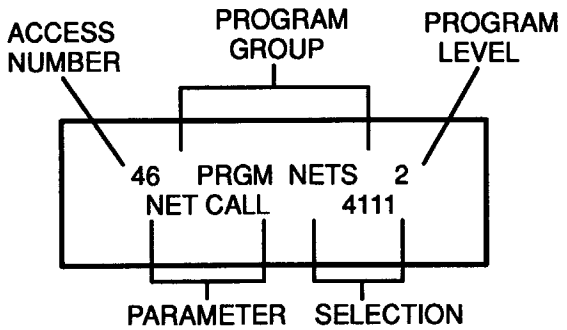
There are four programming functions in the PROGRAM NETS GROUP:

- NET CALL SIGN – allows programming of net call sign
- COPY NET – allows operator to copy the channel assignments from one net to a new net
- NET CHANNEL – allows programming of the net channels
- DELETE NET – allows operator to delete a net call sign from the network

When a new call sign is entered, the operator is prompted through the entire programming sequence. When a previously programmed call sign is entered, channels may be added, deleted, or the call sign deleted.

4.2.1 46 PRGM – NET CALL SIGN

This program function allows entry of the network call signs. Net channels are then assigned to each call sign. A typical NET CALL SIGN display is shown below:



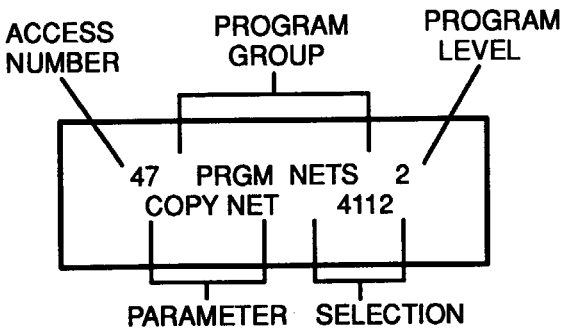
To program a call sign, the four–digit call sign number for the net is entered and the ENTR key is pressed. The arrow keys can be used to scroll through the programmed NET CALL SIGNs.

NOTE

The last call sign entry is displayed. If the entry deleted a net, use the ARROW keys to display the currently active nets.

4.2.2 47 PRGM – COPY NET

The COPY NET command allows channels programmed for an existing net to be copied to the new net. A typical COPY NET display is shown below:

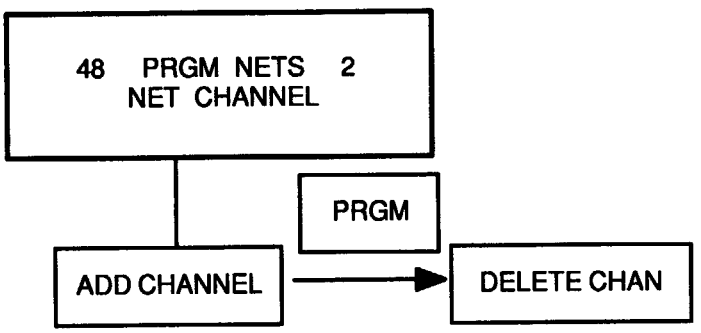


4.2.3 48 PRGM – NET CHANNELS

The NET CHANNEL function allows an operator to add new channels to a net (or remove net channels from a net). The net channel number corresponds to the net channel number programmed in the SSB mode. All channel settings (frequency, mode, AGC setting, etc.) are also used in the AUTOLINK® mode. Entering the channel number eliminates the need to reenter all of the channel parameters when programming AUTOLINK® operation.

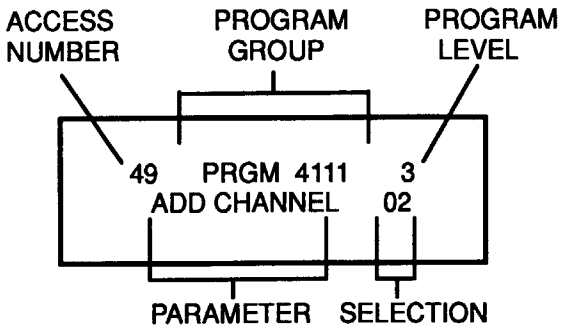
NOTE

If an RF-382A-02 Antenna Coupler is being used, key the coupler in SSB mode before adding NET CHANNELS.



4.2.3.1 49 PRGM – ADD CHANNEL

The ADD CHANNEL command allows entry of new channels to a net:



a. To add a channel, enter the two–digit channel number (leading zero entry is required for channel 00, 01, ... 09) and press the ENTR key.

b. Use the ARROW keys to scroll through the programmed net channels. The net call sign is shown on the top line of the display.

c. To return the display to normal operation, press the ENTR key.

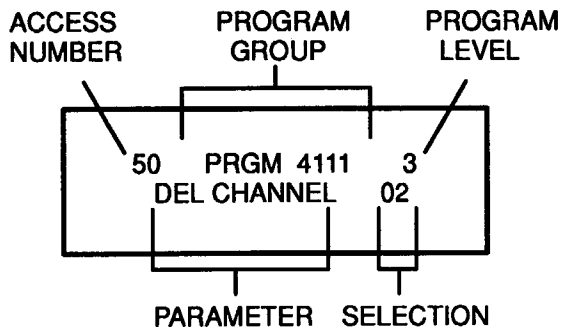
To return the R/T to the ADD CHANNEL menu, press the PRGM key.

To advance the display to the DELETE CHANNEL menu without adding the entered channel number to the net list, press the PRGM key a second time.

To return the display to the NET CHANNEL display, press the CLR key.

4.2.3.2 50 PRGM – DELETE CHANNEL

The DELETE CHANNEL command allows removal of channels from a net:



a. To delete a channel, enter the two–digit channel number (leading zero entry is required for channel 00, 01, ... 09) and press the ENTR key.

b. Use the ARROW keys to scroll through the programmed net channels. The net call sign is shown on the top line of the display.

c. To return the display to normal operation, press the ENTR key.

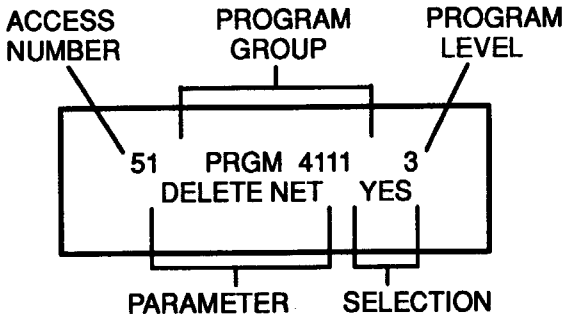
To return the display to the DELETE CHANNEL menu, press the PRGM key.

To advance the display to the ADD CHANNEL menu without deleting the the entered channel number from the net list, press the PRGM key a second time.

To return the display to the NET CHANNEL display, press the CLR key.

4.2.4 51 PRGM – NET DELETE

The NET DELETE command allows removal of the net call sign (entered using 51 PRGM) and all information associated with it. To delete a net call sign:



a. Press the PRGM key until NET DELETE appears on the display.

b. Use the ARROW keys to toggle between DELETE NET YES and DELETE NET NO.

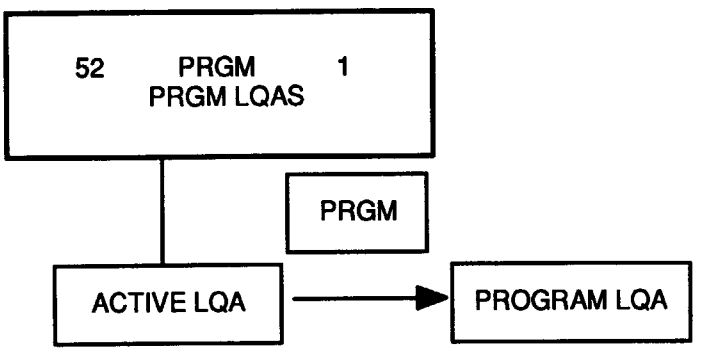
c. To delete a net call sign, press the ENTR key when DELETE NET YES displays.

4.3 52 PRGM – LQA PROGRAMMING

The LQA Programming Group controls LQA activity. LQAs can be programmed to occur once or can be scheduled to be programmed at fixed intervals. Automatic LQA measurements allow communications links to be established based on up–to–date LQA scores. A manual LQA measurement (single measurement) can be made at the operator's convenience; e.g., just before a call, if link conditions are changing rapidly.

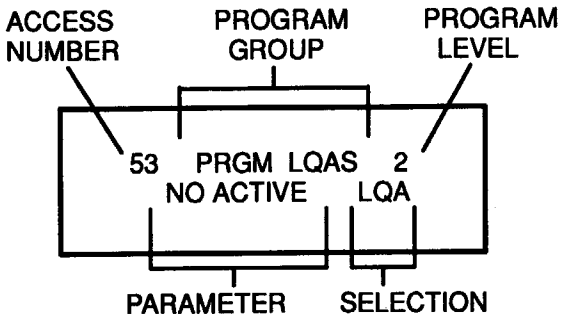
There are two programming functions in the LQA PROGRAMMING GROUP:

- ACTIVE LQA – used to review and stop active LQAs
- PROGRAM LQA – allows programming of new LQAs



4.3.1 53 PRGM – ACTIVE LQA

The ACTIVE LQA function displays active LQAs and allows an LQA to be deleted. If there are no LQAs programmed, the radio displays:

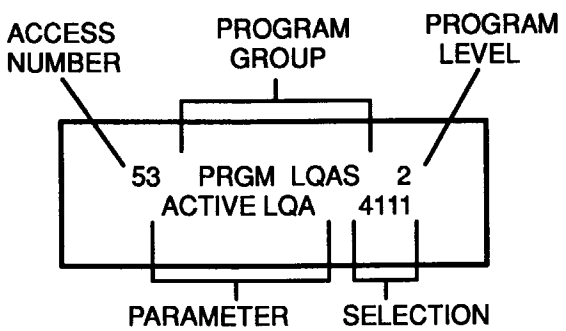


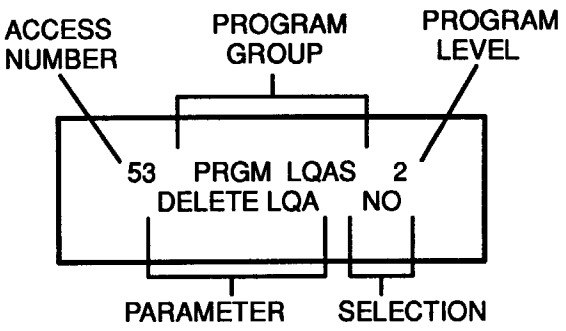
If one or more LQAs are programmed, the display shows the call signs which have been programmed for LQAs.

a. Use the ARROW keys to scroll through the list of call signs programmed for LQAs.

b. Press the ENTR key to select a call sign to be deleted.

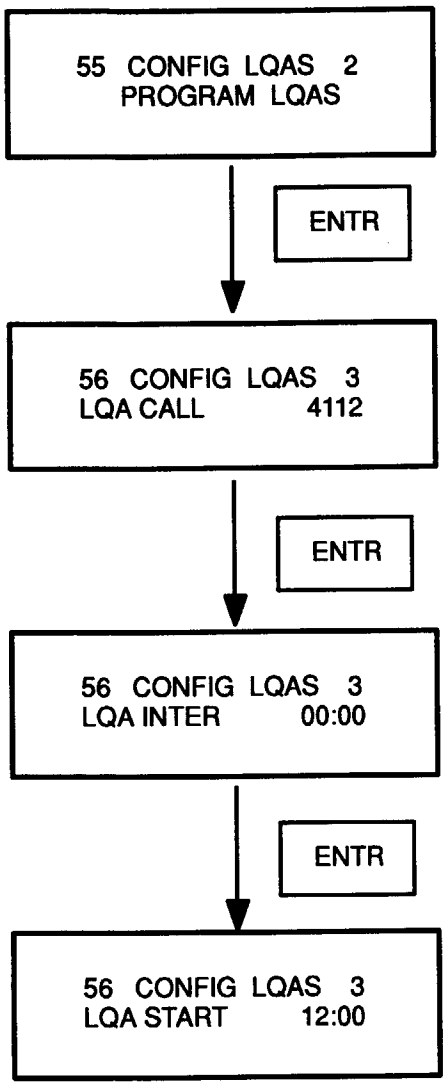
c. The display then prompts for confirmation. Press an ARROW key to confirm deleting the LQA and the ENTR key to delete the LQA.





4.3.2 55 PRGM – CONFIG LQA

The program LQA function is a three–step sequence that initiates either a manual or automatic LQA. It is used to select the station call sign on which an LQA is to be performed, establish the time interval for the LQA measurement, and program its start time. This procedure is shown below.



NOTE: Scheduled (timed) LQA information is stored during momentary power outages.

Enter station call sign with which LQA is to be performed and press the ENTR key.

The display shows 00:00. Pressing the ENTR key without entering a two–digit number initiates a single LQA measurement.

Entering 00:30 causes an LQA to be performed every 30 minutes.

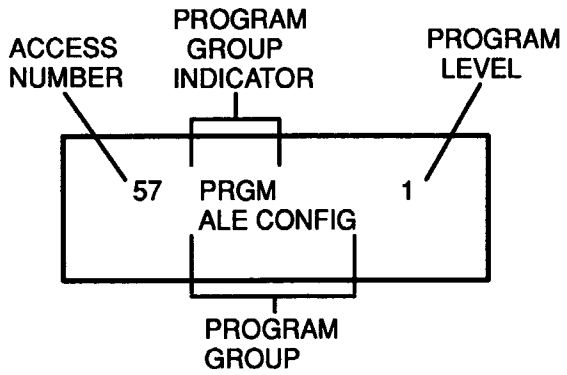
The display shows current time of day. (NOTE: The RF–5020R/T internal clock is set using the SSB 37 PRGM – CONFIG GROUP.) Enter the start time and press the enter key.

Pressing the ENTR key without entering a time starts the LQA at the end of the programming sequence.

4.4 57 PRGM – CONFIGURATION

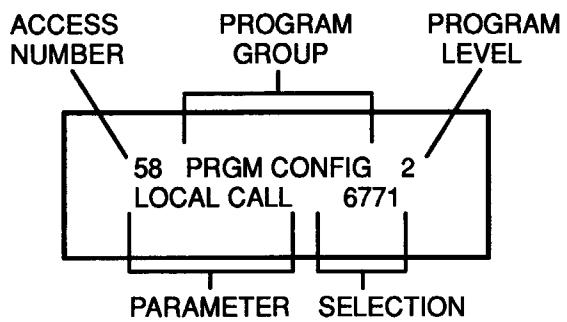
The ALE CONFIGURATION GROUP contains system control parameters for basic operation and control over special features and modes of operation. These parameters are listed below. The parameters highlighted with an "*" must be programmed for basic operation.

- Local Call Sign*
- Preamble Length*
- On the Air Bit Speed*
- Radio Silence*
- Listen Before Transmit
- Key to Call
- Time Out



4.4.1 58 PRGM – LOCAL CALL SIGN

The LOCAL CALL SIGN is the four–digit network call sign number assigned to this radio. This is the call sign number that others in the network use to reach this station.



NOTE

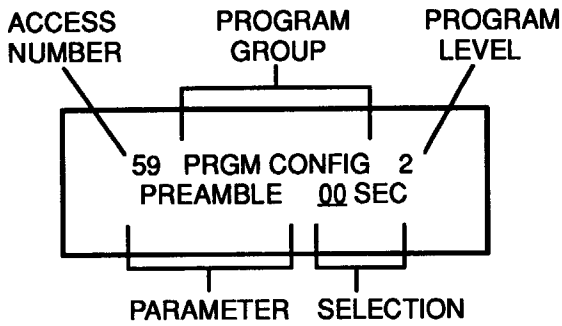
The LOCAL CALL SIGN *CANNOT* be programmed if a net with the same call sign is already programmed. The net must be deleted.

4.4.2 59 PRGM – PREAMBLE

The PREAMBLE is a data pattern used during call and LQA processes to stop the scan function at the target station. The preamble length is determined by the maximum number of channels which any station in the net is scanning. All stations must have the same preamble length.

The RF-5120AFC automatically calculates the maximum number of channels in its AUTOLINK® net lists. The number of channels plus one is then multiplied by 0.5 seconds and this time is used as the preamble length. This number can be used if it is equal to or greater than the preamble lengths used at the other stations in the net. The net preamble length can also be entered if it differs from the calculated value.

The RF-5120AFC bases the automatic preamble length calculation on the RF-7110 scan rate of 0.5 seconds per channel. The RF-5020R/T scan rate is 0.1 seconds per channel. If the AUTOLINK® net uses only RF-5020R/Ts with the RF-5120AFC, the preamble length can be reduced to speed up call and LQA processing times. It is recommended that a time of 0.2 seconds per channel be used in this case to calculate the preamble rate (0.1 seconds can be used if link conditions are good).



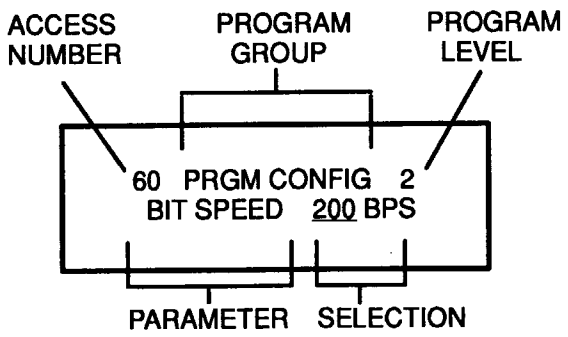
PREAMBLE LENGTH
0.5 sec/chan + 0.5 sec – 7100 mode
0.2 sec/chan + 0.2 sec – 5120 mode

NOTE

Whenever the net programming is changed, the RF-5120AFC recalculates the minimum preamble length. Always check preamble length **AFTER** changing net programming.

4.4.3 60 PRGM – BIT SPEED

The RF–5120AFC uses a frequency shift keying (FSK) modem for system signaling. The modem bit rate can be programmed to either 100 or 200 bits per second (bps). The normal bit rate is 200 bps to minimize call and LQA processing time. During adverse conditions, the bit rate should be dropped to 100 bps for increased communications reliability.



- Use the ARROW keys to select the desired setting:

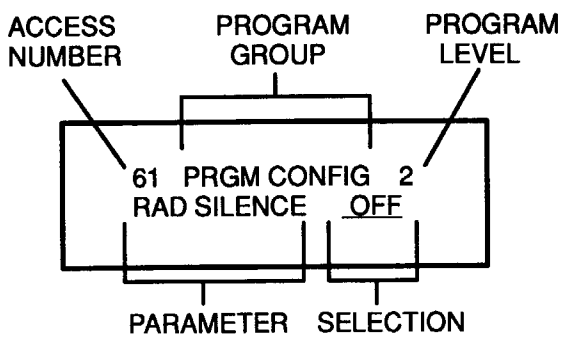
  BIT SPEED SETTINGS:

100	–	100 Bits per second
200	–	200 Bits per second (normal setting)

4.4.4 61 PRGM – RADIO SILENCE

In radio silence mode, the RF–5120AFC does not respond to the sounding messages of LQAs or to calls from other stations. Received messages are continuously evaluated for score quality and the results and channel ranking scores are updated at the radio silent station; however, the scores are not passed over the air.

Radio silence mode does not prevent the radio silent station from initiating a call or keying the RF–5020R/T, nor does it prevent the system from linking to a received group, net, or broadcast call since these modes do not require a response message from the receiving stations. In addition, a link can be established in response to an individual call from another radio silent unit. This link occurs after the initial sound message is sent. No response message or probe message occurs.



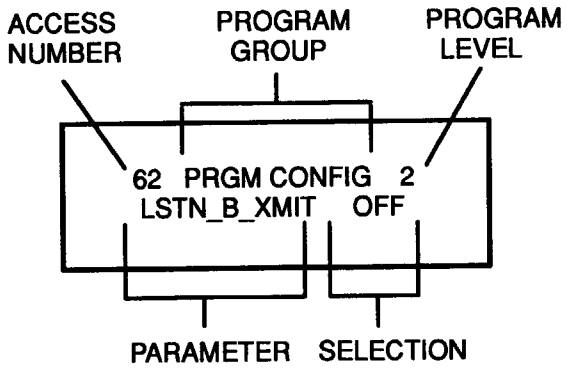
- Use the ARROW keys to select the desired setting:

  RADIO SILENCE SETTINGS:

OFF	–	Radio silence disabled (default setting)
ON	–	Radio silence enabled

4.4.5 62 PRGM – LISTEN BEFORE TRANSMIT

The LISTEN BEFORE TRANSMIT mode inhibits the local station from transmitting on a busy channel while an LQA or automatic call process is being performed. If the channel is busy, the controller moves to the next best channel and listens again. This continues until the controller finds an unoccupied channel.



- Use the ARROW keys to select the desired setting:

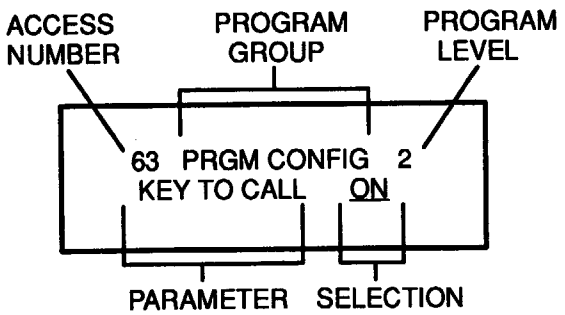
LISTEN BEFORE TRANSMIT SETTINGS:

OFF	–	Listen before transmit disabled (default)
ON	–	Listen before transmit enabled

4.4.6 63 PRGM – KEY TO CALL

The KEY TO CALL mode allows the operator to automatically place a call to the last call sign called when the transmitter is keyed either in voice or data mode. Once the link is established, normal operation is resumed. This feature is useful when a majority of calls are made to a single call sign.

Broadcast calls are not supported in the KEY TO CALL mode.



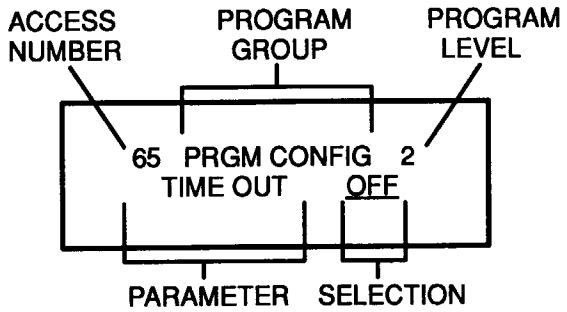
- Use the ARROW keys to select the desired setting:

KEY TO CALL SETTINGS:

OFF	–	Key to call disabled
ON	–	Key to call enabled (normal setting)

4.4.7 65 PRGM – TIME OUT

The TIME OUT feature returns the RF–5120AFC from the linked mode to the scan mode if the R/T has not been keyed or received modem data for fifteen minutes. This prevents a station from remaining in a linked mode after a call has been received, but the operator is unable to respond.



- Use the ARROW keys to select the desired setting:

  TIME OUT SETTINGS:

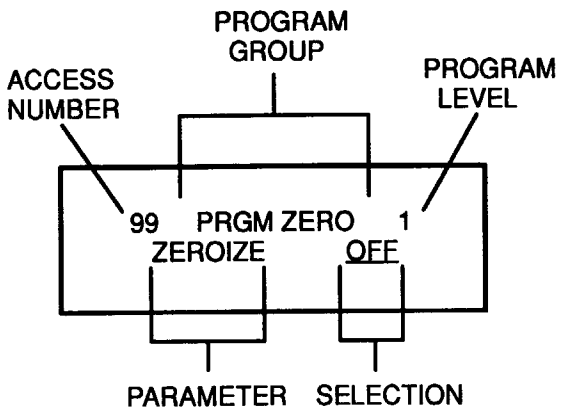
  OFF – Time out is disabled (normal setting)
  ON – Time out is enabled

NOTE

The TIME OUT feature should be turned off when long data messages are to be received. The system may time out when waiting for a data message.

4.4.8 99 PRGM – ZEROIZE

The ZEROIZE command causes the RF–5020R/T to erase all of the programmed channel parameter and option settings. To minimize the chance of an accidental erasure, a command sequence is required:



NOTE

The ZEROIZE command should be used with caution. Once erased, settings cannot be recovered.

To cancel the ZEROIZE command sequence:

a. Press PRGM to advance the display to the AUTOLINK® GROUP.

b. Press CLR to return to the RECEIVE DISPLAY.

To initiate the ZEROIZE command sequence:

a. Press ENTR to advance to the ZEROIZE command.

b. Use the ARROW keys to scroll the display between OFF and ON.

c. Select ON and press the ENTR key to zeroize the RF–5020R/T.

d. Select OFF and press the ENTR key to terminate the zeroize sequence (or press the CLR key).

NOTE

The RF–5020R/T must be reprogrammed after a ZEROIZE sequence has been performed.

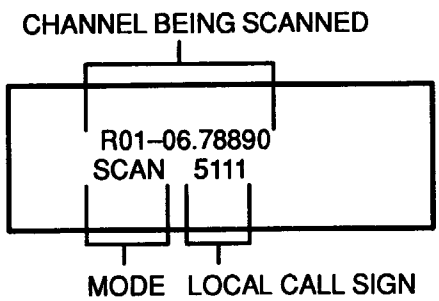
5. OPERATION

The following paragraphs describe RF–5120AFC operation.

5.1 Scan Operation

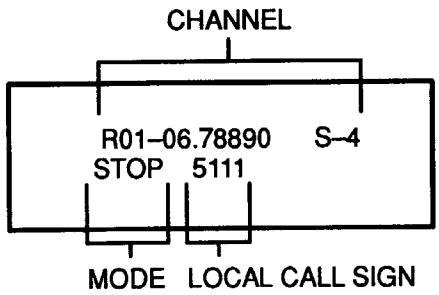
When the RF–5020R/T FUNCTION control is placed in the AUTOLINK® position, the RF–5120AFC is enabled and placed in the SCAN mode. The RF–5120AFC scans the composite list of channels for all of the network call signs.

TYPICAL FRONT PANEL DISPLAY DURING SCAN MODE:



- Press the CLR key to stop the SCAN mode. This places the R/T in the STOP mode.

TYPICAL FRONT PANEL DISPLAY DURING STOP MODE:



- Use the ARROW keys to scroll through the channels. This is useful to monitor channels for activity.

- Use the CLR key to resume SCAN mode.

5.2 Calling Mode

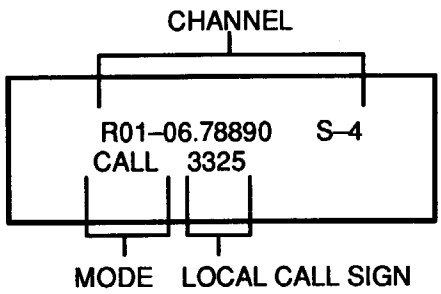
During AUTOLINK® operation, the operator can place or receive a call.

5.2.1 Placing a Call

The calling operator can initiate either an automatic or a manual call to another station in the net:

a. Press the CALL key to initiate a call.

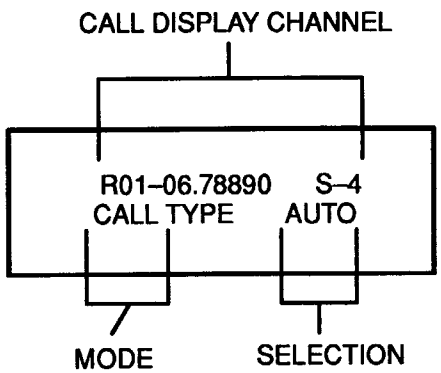
The R/T stops scanning and displays the call sign of the last called station:



b. Enter the call sign of the targeted station (if different from the displayed call sign) and press the ENTR key to advance the display to the CALL TYPE.

c. Use the ARROW keys to select either an AUTOMATIC call (a call using the LQA scores to select the best channel) or a MANUAL call (a call which uses an operator–selected channel).

d. Press the ENTR key to initiate the call.



When a manual call is selected, the display prompts "USE CHANNEL *XX*," requesting the number of the channel to be used to place the call.

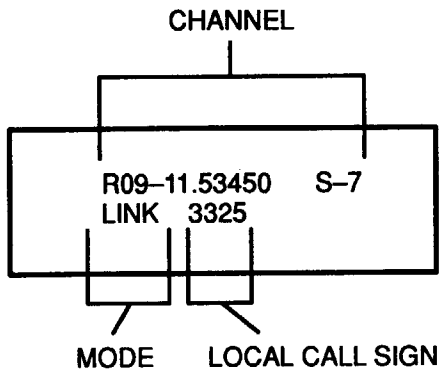
- To initiate the call, enter the channel number and press the ENTR key.

The display momentarily displays "CALLING 3325" and starts the call process.

An AUTOMATIC call is placed first using the best three channels as ranked by the LQA scores. Should the call not succeed on one of the three channels, the RF–5120AFC controller attempts call placement over all of the call sign's channel list starting with the highest frequency channel and advancing through the list to the lowest frequency channel.

A manual call attempts a call only on the operator–selected channel.

A successful link to an individual station is indicated in the display and by an audible beep.



If a call can not be placed, it is indicated by a front–panel prompt of "NO ACKNOWLEDGE," and an audible beep. The RF–5120AFC resumes the SCAN MODE.

If a call is placed to a station which is already linked to another station, the display prompts "LINK BUSY 3225."

NOTE

If the KEY TO CALL feature (63 PRGM) is enabled, a call to the last entered call sign will automatically be initiated when the unit is keyed while in the scan mode.

5.2.2 Receiving a Call

When an incoming call or LQA request is received, the RF–5020R/T stops scanning and the message "SIGNAL RECEIVED" displays.

If the preamble message indicates an incoming call and is addressed to the receiving unit, then receipt of the call is acknowledged to the originating unit and both units prompt the operator, "LINK XXXX," which indicates that call link has been established.

If the incoming call is not addressed to the unit, the scanning is resumed.

5.3 Initiating a Link Quality Analysis

A Link Quality Analysis is initiated using the sequence outlined in paragraph 4.3and summarized below:

a. Press 62 PRGM – LQA PROGRAMMING

b. Enter "LQA Call *4112*"

c. Enter "LQA INTER *00:00*"

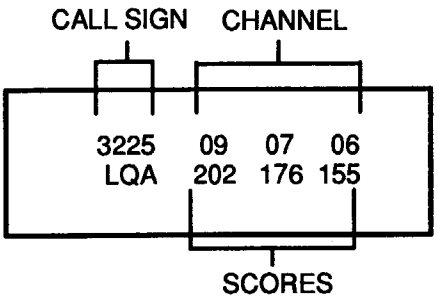
d. Enter "LQA START *12:00*"

5.4 Viewing LQA Scores

To review the LQA scores:

a. Press the MODE key to advance the display to the SCORE display.

b. Enter the desired call sign and the best three channels and respective scores are displayed.



The LQA score indicates the relative quality of the channel with "0" representing a channel where no valid measurement could be made and "223" representing the highest score.

5.5 Late Net Entry

If a site wishes to enter a previously established AUTOLINK® link, the operator may do so by issuing an individual, net, group, or broadcast call.

5.6 Third Party Add On

When two or more AUTOLINK® sites are linked, one of the linked parties may call another station and include that station in the established link. The calling station does this by placing a manual call to the third party, using the same channel as the current link. When the third site responds, it is connected to the link and the front panel of the R/T is updated to reflect the multiple calls. Automatic calls are not permitted. The operator does not need to enter the channel; the call will always be performed on the linked channel.

5.7 Engineering Order Wire

The Engineering Order Wire (EOW) feature allows the operator to transmit and receive data messages using the FSK mode of the RF–5120AFC. The EOW uses the asynchronous data interface of the Auxiliary connector (J5). After a link is established, the EOW can be keyed in response to the Request–to–Send (RTS) line of the asynchronous data port or upon receiving a Control–B (^B) data control character. To unkey the EOW, the modems respond to the RTS line or to a Control–C (^C) data control character.

When the RF–5020R/T is also equipped with the RF–5110MD High Speed Data Modem, the modem is used for data communications when it is programmed to support the asynchronous port. The RF–5110MD must be programmed to the OFF state if the EOW is to be used.

When the RF–5110MD modem is programmed to support the synchronous port, the EOW supports asynchronous data communications. This is useful if the synchronous port and high–speed data modems are operating with facsimile machines or video image retransmission systems. The EOW can then be used to support message and image transmission coordination.

NOTE

If the operator enters scan mode while transmitting order wire, an EOW abort command causes the receiving station to go to SCAN. If too many uncorrectable errors are detected on the receiving end, EOW.ABORT displays and scanning resumes.

6. REMOTE CONTROL OPERATION

Full remote control operation and programming of the RF–5120AFC is supported by the RF–5020R/T. The remote control commands, menus, status, and HELP screen are similar to those used in single channel (SSB) operation and have been optimized for AUTOLINK® operation.

Operational parameters can also be downloaded over the remote control interface. A text file on a personal computer can be generated containing the complete programming information for each net, call sign, configuration parameter, etc., of the system. The file can then be transferred to the RF–5000 via the remote control interface and completely program the RF–5000 for a specific mission.

6.1 SHOW Menu

Entering ALE> SHOW provides a status listing of the RF–5120AFC. The command can be used to monitor ALE operation and to confirm configuration setting. The NET displayed is the NET being scanned or used at the time when the command is issued. A typical SHOW menu is shown below.

```
ALE > show
Net 00
RxFr 01600000 TxFr 01600000
Key Off
Modem
DV off
Dgt_squelch off
Encryption
Time_Out off
Lstn_B_Xmit off
Key_To_Call off
Rad_Silence off
Local Call 1111
Speed 200
Preamble 1
Scanning
Not_Linked
```

6.2 HELP Menu

Entering ALE> HELP displays a listing and structure of RF–5120AFC remote control commands.

A typical HELP menu is shown below.

```
ALE > help
Adaptive commands consist of:
CALl        –  (callsign) (chan)          SHow        –  display ALE status
KEY_To_call –  (ON, OFf)
LOcalcall   –  (callsign)                 LSTn_b      –  (ON, OFf)
LQa         –  (STArt, STOp) (callsign)   (interval hh:mm) (start hh:mm)
PReamble    –  (length in seconds)        RAD_silence –  (ON, OFf)
SCAn        –  start scanning             STop        –  manual scanning
SCOre       –  (callsign)                 SEt         –  (callsign) (ch1 ch2 ch3 ...)
SPeed       –  (100/200)                  SSB         –  single channel mode
HOp         –  hopping mode
INC         –  up through scan list       DEC         –  down through scan list
ADD         –  (Callsign) (Chan)          DEL         –  (Callsign) (Chan)
TIME_Out    –  ON, OFf)                   COPYNET     –  (Call from) (Call to)
ERASE       –  Clear ALE Callsigns and channels
ZERO        –  Clear channel memory
The following are valid when NOT scanning
MODEM       –  (modem command)            DV          –  Dig Voice (ON, OFf)
```

6.3 Remote Control Programming

Table 5 is an example of a data file that can be used to program basic RF–5020R/T operation and program the RF–5120AFC controller. The data file first places the RF–5020R/T into the SSB mode. Channel parameters are then entered and the RF–5110MD High Speed Modem settings are set for each channel.

Configuration data is entered to enable the internal self test to check installed modules against the desired configuration. The power amplifier is set to the 125–watt output setting.

Table 5. Remote Control Programming

SSB MODE	SSB
CHANNEL DATA	NET 01 FREQ 04143600 MODE USB AGC SLOW MODEM TYPE 39 TONE MODEM ASYNC MODEM BAUD 300 MODEM INTER LONG NET 02 FREQ 06223100 MODE USB AGC SLOW MODEM TYPE 39 TONE MODEM ASYNC MODEM BAUD 300 MODEM INTER LONG NET 03 FREQ 06845000 MODE USB AGC SLOW MODEM TYPE 39 TONE MODEM ASYNC MODEM BAUD 300 MODEM INTER LONG NET 04 FREQ 08154600 MODE USB AGC SLOW MODEM TYPE 39 TONE MODEM ASYNC MODEM BAUD 300 MODEM INTER LONG NET 05 FREQ 08878900 MODE USB AGC SLOW MODEM TYPE 39 TONE MODEM ASYNC MODEM BAUD 300 MODEM INTER LONG
CONFIG DATA	POWER_AMP 125W MDM_INST RF5110 AUTO_INST RF5120
PA SETTING	POWER 125
AUTO MODE	ALE
CLEARS ALL ALE CALL SIGNS AND CHANNEL DATA	ERASE
NET CALL SIGNS	SET 4111 01 02 03 04 05 SET 4112 01 02 04 05 SET 4113 01 02 04 05 SET 4114 01 02 03 04 05
LOCAL CALL SIGN	LOCAL 4115
AUTO CONFIG	SPEED 200 RAD_SIL OFF

The RF–5020R/T is then placed in the AUTOLINK® mode. Entering a CLEAR command on the remote control device deletes previously programmed call signs and nets. New network calls and channel assignments are entered, the local call sign is entered, and ALE configuration parameters are set.

The SET command is used to program network call signs. The following sequence programs the network call sign 4111 for channels 01 – 05.

ALE> set and 4111 01 02 03 04 05

Entering SET 4111 without channel numbers removes the call sign from the network call sign list. Entering SET without a call sign displays all call signs with their corresponding programmed channel numbers.

6.4 Scan Operation

- To enter the SCAN mode, type SCAN.

  ALE> SCAN
  SCANNING

- To stop scanning, enter STOP.

6.5 Calling Mode

To place an automatic call, enter the call sign.

ALE > CALL 4111

Calling 4111
Net XX
Key Auto
Key Off
Key Auto
Key Off
Linked_Ind_4111
Key Off

To place a manual call, enter the call sign followed by the channel number.

ALE > CALL 4111 08

Calling 4111
Key Auto
Net 08
Key Off
Key Auto
Key Off
Linked_Ind_4111
Key Off

If a link can not be established, a NO ACK message is displayed.

6.6 Initiating a Link Quality Analysis

To start a single LQA measurement:

ALE > LQA START 4111

To start a scheduled LQA measurement:

ALE > LQA START 4111 01:00 12:00

In the above display, LQA start on 4111 is set for intervals of one hour and will begin at 12:00.

6.7 Viewing LQA Scores

To view the LQA scores:

ALE > SCORE 4111

CHAN: 05 SCORE: 202
CHAN: 03 SCORE: 191
CHAN: 04 SCORE: 165
CHAN: 02 SCORE: 0
CHAN: 01 SCORE: 0

The LQA score indicates the relative quality of the channel with 0 representing a channel where no valid measurement could be made and 223 representing the highest score.

6.8 Engineering Order Wire

The Engineering Order Wire (EOW) feature uses the asynchronous data interface of the Auxiliary connector (J5). After a link is established, the EOW can be keyed in response to the Request–to–Send (RTS) line of the asynchronous data port or upon receiving a Control–B (^B) data control character. To unkey the EOW, the modems respond to the RTS line or to a Control–C (^C) data control character.

Programming Worksheet for Establishing a Net

LOCAL CALL SIGN _____

NET	NET CALL SIGNS	NET CHANNELS
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

CONFIGURATION SETTINGS:

58 PREAMBLE LENGTH	_____	0.5 sec/chan + 0.5 sec – 7100 mode 0.2 sec/chan + 0.2 sec – 5120 mode
59 ON THE AIR BIT SPEED	_____	100/200 bits per second
60 RADIO SILENCE	_____	ON/OFF
61 LISTEN BEFORE TRANSMIT	_____	ON/OFF
62 KEY TO CALL	_____	ON/OFF
64 TIME OUT	_____	ON (15 min)/OFF

Programming Worksheet for Establishing a Net

LOCAL CALL SIGN _____

NET	NET CALL SIGNS	NET CHANNELS
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

CONFIGURATION SETTINGS:

58 PREAMBLE LENGTH	_____	0.5 sec/chan + 0.5 sec – 7100 mode 0.2 sec/chan + 0.2 sec – 5120 mode
59 ON THE AIR BIT SPEED	_____	100/200 bits per second
60 RADIO SILENCE	_____	ON/OFF
61 LISTEN BEFORE TRANSMIT	_____	ON/OFF
62 KEY TO CALL	_____	ON/OFF
64 TIME OUT	_____	ON (15 min)/OFF

Programming Worksheet for Establishing a Net

LOCAL CALL SIGN _____

NET	NET CALL SIGNS	NET CHANNELS
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

CONFIGURATION SETTINGS:

58 PREAMBLE LENGTH	_____	0.5 sec/chan + 0.5 sec – 7100 mode 0.2 sec/chan + 0.2 sec – 5120 mode
59 ON THE AIR BIT SPEED	_____	100/200 bits per second
60 RADIO SILENCE	_____	ON/OFF
61 LISTEN BEFORE TRANSMIT	_____	ON/OFF
62 KEY TO CALL	_____	ON/OFF
64 TIME OUT	_____	ON (15 min)/OFF

Programming Worksheet for Establishing a Net

LOCAL CALL SIGN _____

NET	NET CALL SIGNS	NET CHANNELS
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

CONFIGURATION SETTINGS:

58 PREAMBLE LENGTH	_____	0.5 sec/chan + 0.5 sec – 7100 mode 0.2 sec/chan + 0.2 sec – 5120 mode
59 ON THE AIR BIT SPEED	_____	100/200 bits per second
60 RADIO SILENCE	_____	ON/OFF
61 LISTEN BEFORE TRANSMIT	_____	ON/OFF
62 KEY TO CALL	_____	ON/OFF
64 TIME OUT	_____	ON (15 min)/OFF

RF-5121ALE OPTION

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RF-5121ALE AUTOMATIC LINK ESTABLISHMENT OPTION

1. GENERAL

The RF-5121ALE Automatic Link Establishment Option (ALE option) is a plug-in option for the RF-5020R/T Receiver/Transmitter. It provides automatic adaptive high frequency management through a combination of automatic link establishment (ALE), link quality analysis (LQA), and RF-5000 System control. Operation is compatible with MIL-STD-188-141A Appendix A. The RF-5121ALE is interoperable with the Harris RF-7210 Adaptive Controller and the RF-3272 adaptive option products.

The RF-5121ALE option extends the SSB, single-channel operation of the RF-5020R/T to include fully automatic HF link establishment, best channel selection via link quality analysis, channel scanning, selective calling, and digital squelch. Full RF-5000 System remote control and built-in test functions are automatically expanded to support RF-5121ALE option operation.

The RF-5121ALE ALE function provides selective calling using alphanumeric call signs up to 15 characters long, entered from either the front panel or remote control port. It supports a number of call techniques, including individual, net, all, and selective all. It also supports reception of group, any, selective any, and wildcard calls.

The RF-5121ALE LQA function provides channel quality measurements in terms of signal-to-noise ratio (SNR) and bit error rate (BER) for each channel assigned to the call sign or network. The measurements are stored, ranked according to the link quality, and then used to select the best channel for link establishment. The LQA measurements can be performed automatically at regular time intervals or immediately before a call is placed to another HF station.

2. RF-5121ALE OPTION SYSTEM CONCEPTS

The following list summarizes the capabilities provided by the RF-5121ALE option:

- Automatic selection of the best channel
- Selective calling and link establishment, using individual, net, all, and selective allcall types
- Receive capability for group, any, selective any, and wildcard call types
- Channel scanning at five channels per second
- Station addresses up to 15 characters long (used to identify one station or a group of stations to be called)
- Up to 100 channels; ten channel groups, each containing from one to 100 channels
- Up to 20 local call signs (self addresses)
- Up to 100 target station call signs (individual addresses)
- Up to 20 network addresses
- Up to ten separate timed LQAs (net or individual addresses, for LQA sounds or exchanges)
- Key-to-call (using microphone push-to-talk button)
- Listen before transmit
- Digital squelch
- Channel programming groups
- Programmable system parameters (clock time, antenna coupler tune time, number of channels scanned by the target stations)
- RF-5000 System remote control capability

2.1 Channel Scanning

In normal operation, the RF-5121ALE Automatic Link Establishment Option scans channels for incoming signals whenever it is not linked in communication with another station or when a call is not being placed or received. The ALE option scans up to 100 radio channels at a scan rate of 5 channels per second.

2.2 Automatic/Manual Channel Selection

When placing an Automatic Call, the ALE option automatically selects the channel on which the call is to be placed. This selection is based on the received signal quality score obtained from previous calls and LQA tests. The operator, however, can override this feature and select a channel manually.

2.3 Call Placement

2.3.1 Individual Calls

Any station may contact another station by placing an Individual Call. Each station has one or more addresses by which it can be called. An operator at a local station calls a target station by placing a call to one of the target station's addresses. The local station's ALE option automatically selects the best frequency on which to call.

An Individual Call consists of a three-way message exchange. The station placing the call transmits a signal containing the address of the target station it is calling. When the target station receives this signal, it responds by transmitting a signal back to the calling station. The calling station acknowledges receipt of this response signal by transmitting another signal to the target station. The calling station and target station are then linked on the same frequency, ready to pass voice or data traffic.

2.3.2 Net Calls

Stations which communicate frequently can be configured as members of the same communications Net. Each member of the Net has the same Net address (which is different from the Individual address described in paragraph 2.3.1). When placing a Net Call, a single station may link with multiple stations which are members of the Net. The size of the Net and the members of the Net must be programmed before placing a Net Call. To place a Net Call, the operator selects the Net address. The ALE option automatically selects the best frequency on which to call.

A Net Call is similar to the three-way exchange used in an Individual Call (see paragraph 2.3.1). It differs in that all members of the Net respond to a call in preprogrammed time slots. The station placing a call transmits a signal containing the address of the Net being called. When the target stations receive the signal, they respond by transmitting a response signal back to the calling station during their specific preprogrammed time slot. Once the calling station has collected the responses, it acknowledges the receipt of the response signals by transmitting another signal to the target stations. The calling station and target stations are then linked on the same frequency, ready to pass voice or data traffic.

2.3.3 Group Calls (Receive Only)

The RF-5121ALE option can receive Group Calls, but cannot initiate them. The Group Call feature allows communication with collections of stations which are not members of a preprogrammed Net. The individual Group members' addresses must be programmed before placing a Group Call. Unlike a Net Call, the target members of a Group Call do not require a preprogrammed response arrangement.

A Group call is similar to the three-way exchange used in a Net Call (see paragraph 2.3.2). It differs in that the members of the Group respond to calls in an order specified by the calling station in the calling signal. The station placing the call transmits a signal containing the Individual addresses of the members of the Group being called. When the target stations receive the signal, they each respond by transmitting a response signal back to the calling station in the order specified in the calling station's signal. Once the calling station has collected the responses, it acknowledges the receipt of the responses by transmitting another signal to the target stations. The calling station and target stations are then linked on the same frequency, ready to pass voice or data traffic.

2.3.4 Allcalls and Selective Allcalls

Any station can contact all target stations simultaneously by placing an Allcall. An Allcall is a one-way broadcast. The calling station transmits a calling signal, with no response signals required from the target stations. All stations receiving the Allcall signal stop scanning. All stations are then linked on the same frequency, ready to pass voice or data traffic.

A subset of all stations can be contacted by placing a Selective Allcall. An operator placing a Selective Allcall specifies the last character in the target stations' addresses. All stations which have addresses ending in this character stop scanning and accept the call.

2.3.5 Anycalls, Selective Anycalls, and Double Selective Anycalls (Receive Only)

The RF-5121ALE option can receive Anycalls, Selective Anycalls, and Double Selective Anycalls, but cannot initiate them. Anycalls, Selective Anycalls, and Double Selective Anycalls contact stations whose identity has not been programmed into the calling station. The three types of Anycalls request responses without identifying the specific stations being called. Unlike Allcalls, stations initiating Anycalls expect responses from the target stations. When stations receive an Anycall, they respond in randomly chosen time slots. If one or more responses are received within the allotted time interval, the calling station acknowledges the responses by transmitting a confirmation signal to the stations that respond to the call.

A subset of all stations can be contacted by placing Selective Anycalls or Double Selective Anycalls. An operator placing a Selective Anycall specifies the last character in the target stations' addresses. All stations which have addresses ending in this character accept and respond to the call. An operator placing a Double Selective Anycall specifies the last two characters in the target stations' addresses. All stations which have addresses ending in these two characters accept and respond to the call.

2.4 LQA

The ALE circuit measures and evaluates received signal quality and automatically selects the best frequency for required operation based on channel measurement and evaluation. This signal measurement technique is called Link Quality Analysis (LQA).

2.4.1 Sounding (One-Way) LQA

Sounds are short, one-way messages sent by the calling station on all channels programmed for one of its self addresses. The sound message contains the addresses of the sending station. target stations receive the Sound LQA message and temporarily stop scanning to measure, analyze, and store the received signal quality for each channel on which the sound is recieved.

2.4.2 Bidirectional (Two-Way) LQA Exchange

The Bidirectional LQA method involves a three-way message exchange during which two or more stations measure and exchange received signal quality information. A bidirectional LQA may be performed between two individual stations, a Net member station and other members of the same Net, or a Group member and other members of the same Group.

2.5 RF-5120AFC/RF-5121ALE Interoperability

RF-5000 Systems equipped with RF-5120AFC adaptive controllers communicate with each other in a different manner than do RF-5000 Systems equipped with RF-5121ALE adaptive controllers. The RF-5121ALE option cannot interoperate with systems equipped with RF-5120AFC or RF-7110 controllers.

2.6 Send Message/Automatic Message Display (AMD) Calls (Receive Only)

Send Message or AMD Calls are used to send a short (up to 87 ASCII characters) orderwire message to an Individual, Net, or Group. The RF-5121ALE option can receive AMD Calls, but cannot initiate them. The units link, the message, however, is not displayed.

2.7 Wildcard Calls (Receive Only)

The RF-5121ALE option can receive Wildcard Calls, but cannot initiate them. Wildcard Calls are used to contact stations with similar addresses. Wildcard Calls are similar to Anycalls except that Wildcard Calls can contact a more specific group of stations. For example, a local station operator can contact all stations whose six-character addresses begin with UNIT by entering the Wildcard address UNIT?? where ?? are Wildcard characters which substitute for any two-character combination following UNIT. All stations with six-character addresses with UNIT as the first four characters accept this Wildcard Call and transmit responses in randomly-chosen time slots. If one or more responses are received within the allotted time interval, the calling station transmits an acknowledgement signal to each responding station. The calling station and all responding target stations are linked on the same frequency and are ready for voice or data communications.

2.8 Listen-Before-Transmit

The Listen-Before-Transmit feature allows the ALE module to automatically sample or check a radio channel for ALE activity before initiating a call or LQA on that channel. This is done to prevent a calling station from interfering with traffic already in progress. If a channel has ALE traffic on it when sampled, the controller skips over that channel and goes on to the next channel in sequence.

2.9 Radio Silence

The Radio silence feature prevents the ALE from transmitting in response to an incoming call or LQA request. Automatic LQA initiation is also inhibited when the Radio Silence feature is enabled.

2.10 Tune Time

Antenna coupler tune time is a programmable system configuration parameter (see paragraph 4.6.2). This sets the length of time the calling station waits for the target station to tune its antenna coupler and respond to the call. this parameter should be set to the maximum coupler tune time for any station which may be called. For target stations which use the RF-5121ALE option, the calling station should use the times shown in table 1, based on which coupler the RF-5000 is configured to use, see paragraph 4.5.4.2 in the Programming section.

Table 1. Antenna Coupler Tune Times

Antenna Coupler Used	Tune Time (Seconds)
RF-382	4
RF-2601	8
RF-5030PA/CU-20	4

3. INSTALLATION

When ordered with an RF-5020R/T, the RF-5121ALE is installed and tested at the factory.

The RF-5121ALE module is installed in the A5 Module location (see figure 6-1 in the Maintenance section) of the RF-5020R/T chassis as follows:

a. Remove power from the RF-5020R/T by turning the front-panel FUNCTION control to the PWR OFF position.

b. Disconnect the cable from the power amplifier control connector (J6) located on the rear panel of the R/T chassis.

c. Loosen the six screws (captive hardware) securing the top cover of the R/T and remove the top cover.

d. The RF-5121ALE module has two card clamps, one on each side of the module. To install or remove the module, the lever on the top of both clamps MUST be in the up (vertical) position.

CAUTION

The levers on the clamps must be in the up (vertical) position when installing or removing any module. The clamps expand when the levers are in the down (horizontal) position, mechanically clamping the module to the chassis. Physical damage to the module may result if the module is forced into position.

e. Position the module so that the underside of the full-sized printed wiring board (PWB) is toward the front of the R/T chassis and the half-sized PWB is toward the rear of the chassis.

f. With the clamp levers in the up (vertical) position, insert the module into the A5 slot until it is fully seated.

g. Move the clamp levers to the down (horizontal) position.

h. Replace the top cover and carefully tighten all six screws. Care should be taken to ensure the cover gasket is properly seated.

i. Reattach the power amplifier control cable to J6 of the R/T chassis.

No external connections are required for interface or operation of the RF-5121ALE.

4. PROGRAMMING

The RF-5121ALE Option is programmed via the front panel or the remote control interface and uses the same programming procedures as the RF-5020R/T. The RF-5121ALE option may be programmed when the R/T function switch is in either the AUTOLINK® position or in the RMT (remote) position. If in remote, the remote controller must activate the ALE option before programming is allowed. Paragraph 6. covers remote-control operation.

When the R/T function switch is in the AUTOLINK® position, the R/T can be scanning the programmed channels for an incoming call, STOPPED on a single channel, or linked in a call with one or more distant HF stations. When the R/T is scanning, the word SCANNING appears on the bottom line of the front-panel display. When the R/T is STOPPED, the word STOP appears on the bottom line of the front-panel display. When the R/T is linked, the word LINK appears, along with the address of the linked station.

While SCANNING, press the CLR button to stop the R/T from scanning. While STOPPED, press the CLR button to resume scanning. While either STOPPED or SCANNING, press PRGM to enter the top-level programming menu. While in the top-level programming menu, press CLR to return to the previous condition (either STOPPED or SCANNING).

Programming operations can be performed only when the radio is SCANNING or STOPPED. Programming is not permitted while LINKED. Operator error messages displayed while programming do not time out. They remain until the CLR key is pressed.

During programming, various prompts, menus, and messages are displayed in order to assist in the selection of operating parameters. Two programming menu levels are used. The FIRST LEVEL menu, accessible by pressing the CLR PRGM key sequence, presents the following programming parameter groups, each displayed one at a time on its own screen:

- Channel Groups
- Add Addresses
- Link Quality Analysis (LQA)
- Remove Addresses
- Configure
- Zeroize

4.1 Accessing Program Groups and Operating Parameters

There are three ways to access program groups and operating parameters:

- Access via Access Number/Program Group – CLR PRGM

a. While either STOPPED or SCANNING, press the PRGM key. This causes the 45 CHANNEL GROUP display to appear.

b. Each subsequent press of the PRGM key advances the display to the next program group.

c. To access the displayed program group's operating parameters, press the ENTR key.

- Direct Access via Access Number – Access Number [N] PRGM

  With an RX display on the R/T display(either STOPPED or SCANNING), press the access number [N] followed by the PRGM key. This causes the specified parameter to appear in the display.

- Repeat Access – PRGM

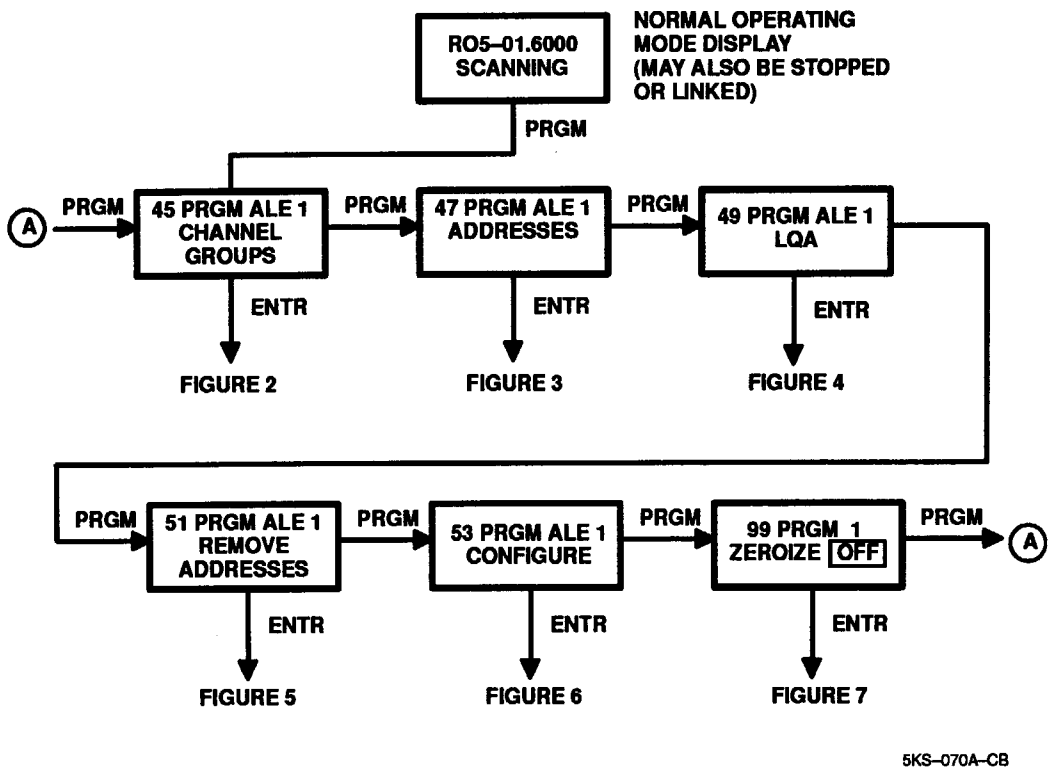
  After an operating parameter has been selected and entered and the LCD display has returned to the RX DISPLAY, pressing the PRGM key causes the last accessed PRGM function to appear in the display.

NOTE

Throughout this section, a box around a character or a group of characters in a front-panel display illustration indicates that those charactrers ar flashing.

4.1.1 Accessing/Exiting Program Levels

Figure 1 illustrates the general key sequence for accessing and exiting program levels.

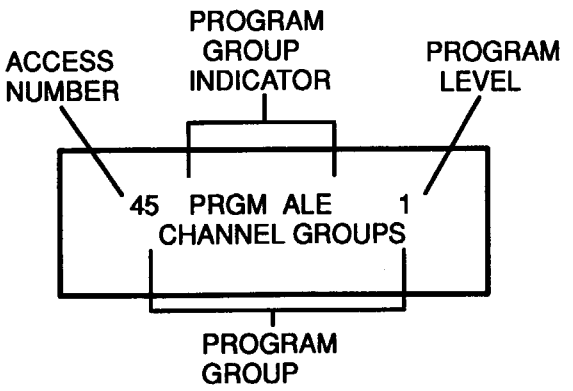


NOTE: IN THIS FIGURE AND OTHERS TO FOLLOW, A WORD OR CHARACTER WHICH HAS BOX DRAWN AROUND IT INDICATES IT IS FLASHING.

Figure 1. Top Level ALE Programming Menu

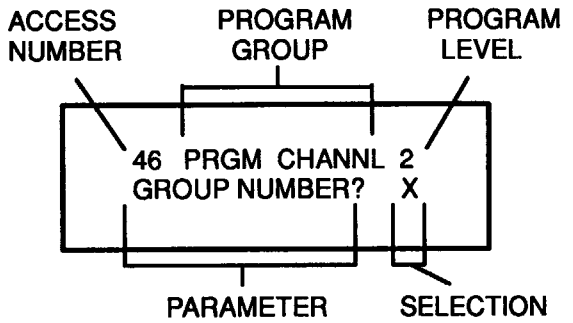
4.1.2 Making Programming Selections

The PROGRAM display occurs when the PRGM key is pressed. Repeatedly pressing the PRGM key causes the display to scroll through the program groups. Pressing the ENTR key selects the displayed group and the first programmable parameter is displayed. An example of a first-level program group display is shown below:



ACCESS NUMBER	–	Number used to directly access a programmable parameter
PROGRAM LEVEL	–	Level of program sequence
GROUP	–	Program group

To access the SECOND LEVEL menu, press the ENTR key:



PARAMETER	–	Operating parameter
SELECTION	–	Value or statement of parameter to be selected

To select a different operating parameter, use the ARROW keys (or keypad, if appropriate) to scroll through the selections and then press the ENTR key. To store the displayed selection in memory and return to the RX display, press the ENTR key.

For your convenience, a programming worksheet for establishing a net is provided at the end of this section.

4.2 45 PRGM – CHANNEL GROUP PROGRAMMING

The RF-5121ALE option collects channels into channel groups to simplify the programming process. Channels must be programmed into these groups before proceeding to other programming functions. All later programming steps which request the entry of channels require selection of a programmed channel group.

To access the channel group programming function, press ENTR when the top-level programming menu displays CHANNEL GROUPS.

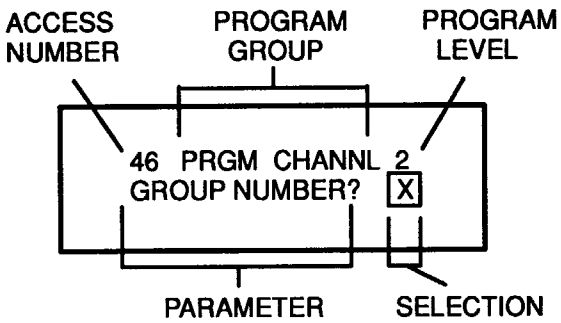
Up to ten channel groups, each containing up to 100 channels, may be programmed. To access the channel group programming function, press ENTR when the top-level programming menu displays CHANNEL GROUPS. Figure 2 is a channel group programming flowchart which illustrates adding and deleting channels from any of the ten channel groups. To program channel groups, press the ENTR key when the following top level ALE programming menu screen is displayed:

```
45 PRGM ALE 1
CHANNEL GROUPS
```

4.2.1 46 PRGM – GROUP NUMBER

This program function allows channels to be assigned to channel groups. This is done by first selecting a channel group. Individual channels can then be added to or deleted from the group.

After the ENTR key is pressed, the R/T displays the following menu screen:



The digit on the bottom right flashes, to prompt entry of the channel group number (from 0 to 9) to be programmed. After selecting the channel group number, press the ENTR key again. The R/T displays the following screen:

```
CHANNEL GROUP X
ADD CHANNEL —
```

where X is the selected channel group. The word ADD flashes, to prompt selection of either ADD or DEL, to add or delete a channel from the group. Press the up or down arrow keys to toggle between ADD and DEL. When the desired operation is displayed, press the ENTR key.

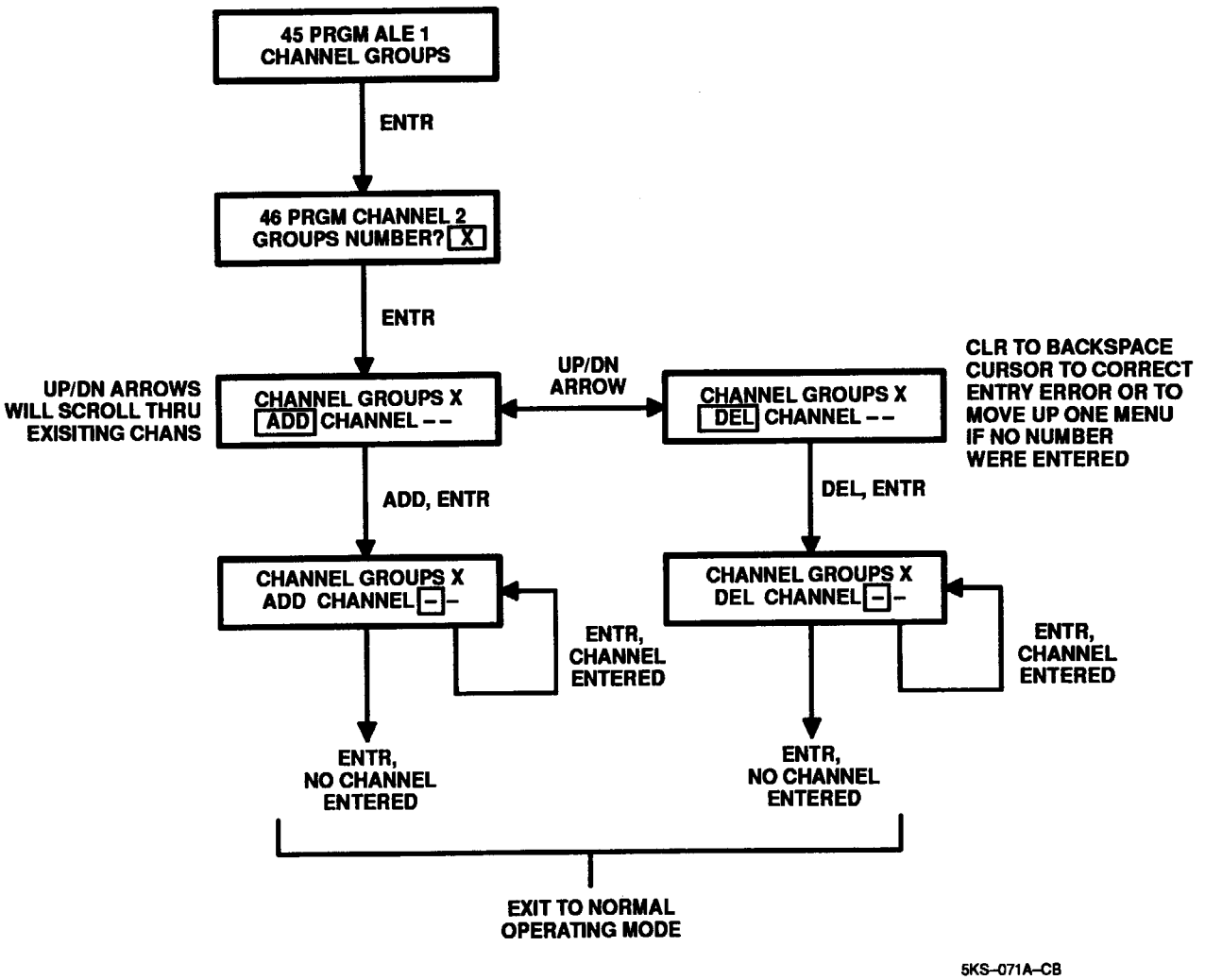
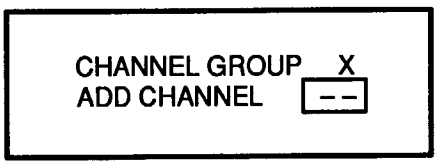


Figure 2. Channel Group Flow Chart

The R/T displays one of the following, depending on the operation chosen:



The X represents the selected channel group number. Channels to be deleted may be selected with either the up and down arrow keys or with the numeric keypad. Channels to be added are selected with the numeric keypad.

Press the arrow keys to scroll through the channels currently in the selected group. Use of the arrow keys is recommended when deleting channels. Press the arrow to scroll to the channel to be deleted, then press ENTR to delete the channel from the group.

When adding channels, the arrow keys are useful in checking the current contents of a channel group. To add a new channel, press any numeric key. The number appears in the left-most digit position followed by a flashing dash in the right-most position. The flashing dash prompts for entry of the second digit of the channel number. Press the CLR key to correct any mistakes. After entering the second digit, press the ENTR key to add the selected channel.

NOTE

The CLR key is a multifunction button. If an incorrect number is entered, press CLR to back space the cursor to the digit to be corrected. However, if no number was entered or the cursor is at the left-most position, pressing the CLR key exits the current menu and returns to the previous menu. For menus where no alphanumeric entries are required, pressing the CLR key always moves back one menu.

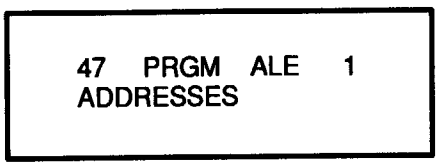
Pressing the ENTR key without first entering a channel number causes the display to return to the top-level ALE menu SCANNING or STOP screen. Entering a channel number which is already in the group or deleting a channel which is not in the group does not generate an error message.

Only numeric characters are accepted. Channel numbers lower than 10 must be preceded by a leading zero. Pressing ENTR with only the first digit entered does not enter the digit and does not generate an error message.

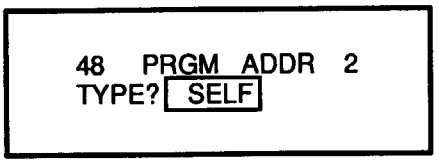
4.3 47 PRGM – ADDRESSES

An RF-5020R/T equipped with an RF-5121ALE Option has storage capacity for 20 self addresses, 100 individual addresses, and 20 net addresses. To access the Add Addresses programming function, press ENTR when the top-level programming menu displays ADD ADDRESSES. Figure 3 is an Add Addresses group programming flowchart which details the programming steps to add self, individual, and net addresses.

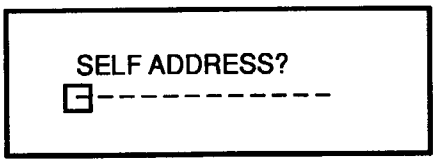
To add addresses, press the ENTR key when the R/T displays the following top-level ALE programming menu:

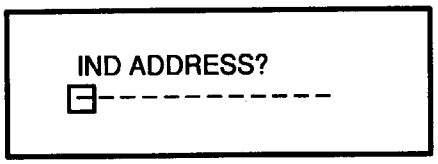


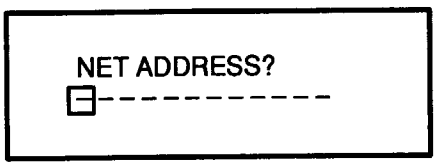
After ENTR is pressed, the R/T displays the following:



The word SELF flashes, to prompt entry of the type of address to be programmed. Press the up or down arrow keys to scroll through the three address types: self, individual, and net. When the desired address type is displayed, press the ENTR key. The R/T will display one of the following, depending on the address type selected:







The left-most dash flashes to prompt for entry of an address. To exit the Addresses programming operation and return to the SCANNING or STOP screen, press the ENTR key before entering an address. Press the CLR key before entering any address to return to the previous programming menu.

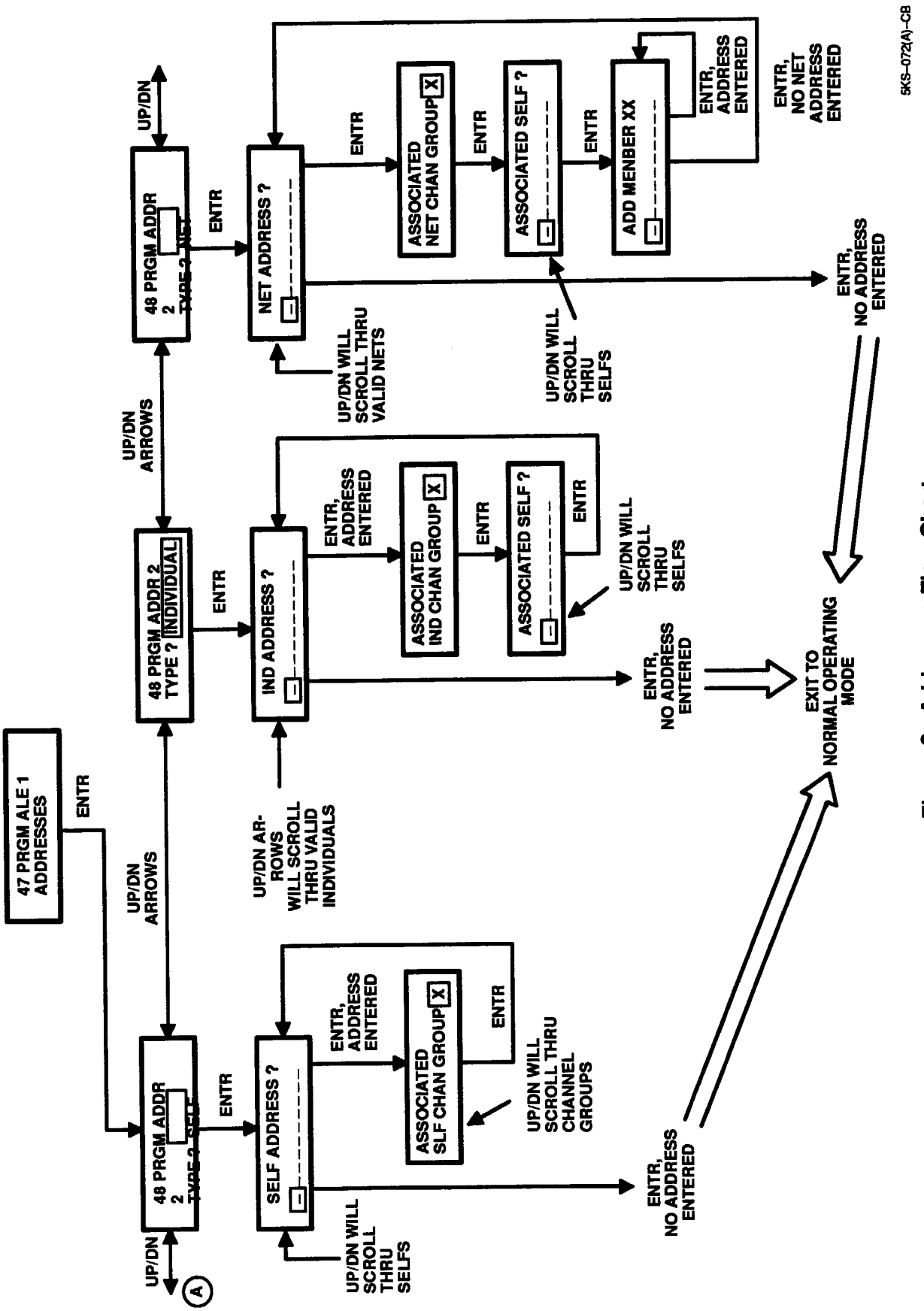


Figure 3. Addresses Flow Chart

Enter an address by either pressing the up and down arrow keys to scroll through previously-programmed addresses, or by using the alphanumeric keypad, as described below.

Each of the number keys (except 0 and 9) has one number and three letters. The 9 key has two letters and a hyphen which is used in placing Selective Allcalls. To enter an address, repeatedly press the appropriate number/letter key until the desired alphanumeric character appears. Each time the key is pressed, the next character shown on the key is displayed. When the desired letter or number is shown, press either ENTR or the next number or letter to be entered. The use of ENTR is required when the next character is on the same key as the previous character. This enters the selected letter or number and advances the cursor to the next address position.

To scroll through a subset of possible addresses, use the keypad to enter part of the address and use the arrow keys to scroll through all addresses which begin with that partial address.

When the full address has been entered (limited to 15 characters), press ENTR to advance to the next programming screen. Pressing ENTR when no address has been entered causes the R/T to exit the Add Addresses programming operation, and return to SCANNING or STOPPED.

Before pressing ENTR, press the CLR key to correct any errors made during entry of an address. CLR backspaces the cursor over the characters. If no character was changed or the cursor is at the left-most position, the CLR key exits the current menu and returns to the previous menu.

If an incorrect address has been entered, it must be deleted (see paragraph 4.5), and the correct one entered.

To check if an address is already programmed, press the up and down arrow keys to scroll through all existing addresses. While scrolling, pressing any alphanumeric key causes the display to change to all dashes except for the left-most character position, which displays the letter or number just entered. Entering a partial address and then pressing the up or down arrow key scrolls the display through all addresses which start with the partial address entered.

Entering an existing self or individual address causes the R/T to display:

```
XXX ADDRESS?
ADDRESS EXISTS
```

where XXX in the above example is replaced with NET, SELF, or IND. The message remains until the CLR key is pressed.

Any alphanumeric string to a limit of 15 characters, except ALL, may be used for self, individual, and net call signs. The string ALL is reserved and is used to place an allcall. An attempt to program the address ALL results in the error message:

```
<ALL>  RESTRICTED
```

An allcall is a unidirectional broadcast to all stations which are scanning the channel on which the call is made, regardless of their address. Since an allcall is a broadcast call, the initiator has no way of knowing the identity of the stations which are linked. Refer to MIL-STD-188-141A for further details of an allcall. Refer to paragraph 5.5 for instructions on placing calls.

NOTE

The first self address entered (known as the default self address) can be no more than three characters long. The second through twentieth self addresses may be up to 15 characters long. An attempt to enter a default self address longer than three characters long for the first self address results in the following error message:

```
SELF ADDRESS?
INV DEFAULT SELF
```

The sizes of the self, individual, and net address tables are limited to 20, 100, and 20, respectively. Any attempt to add addresses in excess of these limits causes the R/T to temporarily display one of the following error messages, depending on the type of address being programmed:

```
SELF ADDRESS?
SELF TABLE FULL
```

```
IND ADDRESS?
IND TABLE FULL
```

```
NET ADDRESS?
NET TABLE FULL
```

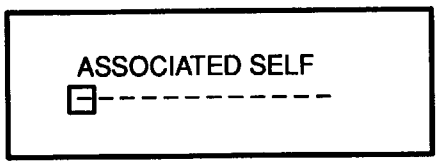
After entering an address, the channels on which stations with that address can be called must be entered. This is done by channel groups. After each address is entered, the R/T displays one of the following, depending on the type of address being programmed, where X represents the channel group number:

The group number flashes to prompt for entry of a channel group number. Press any numeric key, followed by ENTR, to select a group.

NOTE

No error message is displayed if the channel group entered contains no channels. An empty channel group is a valid group.

The next programming step depends on the type of address being entered. For self addresses, the next menu screen returns to the SELF ADDRESS prompt for entry of the next self address. For net or individual addresses, the R/T displays:



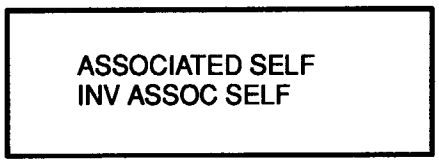
The left-most dash flashes to prompt for entry of the SELF address to be associated with the net or individual address.

NOTE

The associated self address is used to inform a called station of the identity (or self address) of the calling station. For example, if station 1 calls station 2 with address ABC, and station 1's ABC individual address is programmed with an associated self of XYZ, then when station 2 links, it indicates the call is from XYZ. Refer to MIL-STD-188-141A Appendix A for more details on self addresses.

Associated self addresses are entered in the same way as are net or individual addresses, using the up and down arrow keys to scroll through all valid self addresses or using the alphanumeric key pad.

If an invalid (i.e. non-existent) associated self address is entered, the R/T displays the following until the CLR key is pressed:



The next programming step depends on the type of address being entered. For individual addresses, the R/T returns to the IND ADDRESS? prompt, awaiting the entry of the next new individual address.

For net addresses, the R/T displays:

This prompts for entry of the individual addresses of the members of the net being created. The XX in the display indicates the number of the next net member being added. Address entry is done as is described in paragraph 4.3. The R/T continues to prompt for new addresses until the ENTR key is pressed without entering an address. It is valid (although not useful) to program a net with no members. This ends net member entry, and returns the R/T to the NET ADDRESS? menu, prompting for entry of more nets. Duplicate net members are not allowed. If a duplicate is entered, the R/T displays a DUPLICATE MEMBER error message.

NOTE

Net member order must be the same for all stations in a net. That is, the same number of members must be programmed into each R/T in exactly the same order and with the same number of characters in each net member station address (call sign). Failure to maintain this order among net members results in net call linking failures. See MIL-STD-188-141A Appendix A for details.

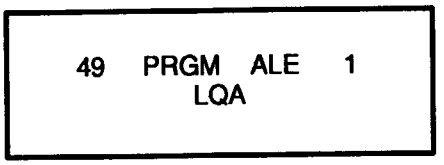
4.4 49 PRGM – LQA

To access the LQA programming function, press ENTR when the top-level programming menu displays LQA.

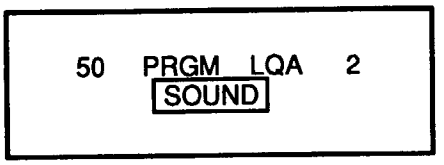
The RF-5121ALE Option supports both unidirectional and bidirectional types of LQA, as required by MIL-STD-188-141A. This document uses sound when referring to unidirectional LQA and exchange when referring to bidirectional LQA.

The menus covered in this section allow the user to setup an LQA sound or exchange, or to remove a sound or exchange from the LQA queue. Figure 4 is an LQA group programming flowchart which details the LQA programming process.

Starting from the top-level ALE programming menu window, repeatedly press the PRGM key until the R/T displays:



Press ENTR to access the LQA programming menu:



The word SOUND flashes to prompt for selection of one of the following options: add a sound, add an exchange, or remove sound/exchange. Press the up or down arrow key to scroll among these choices, and press ENTR when the desired operation is displayed.

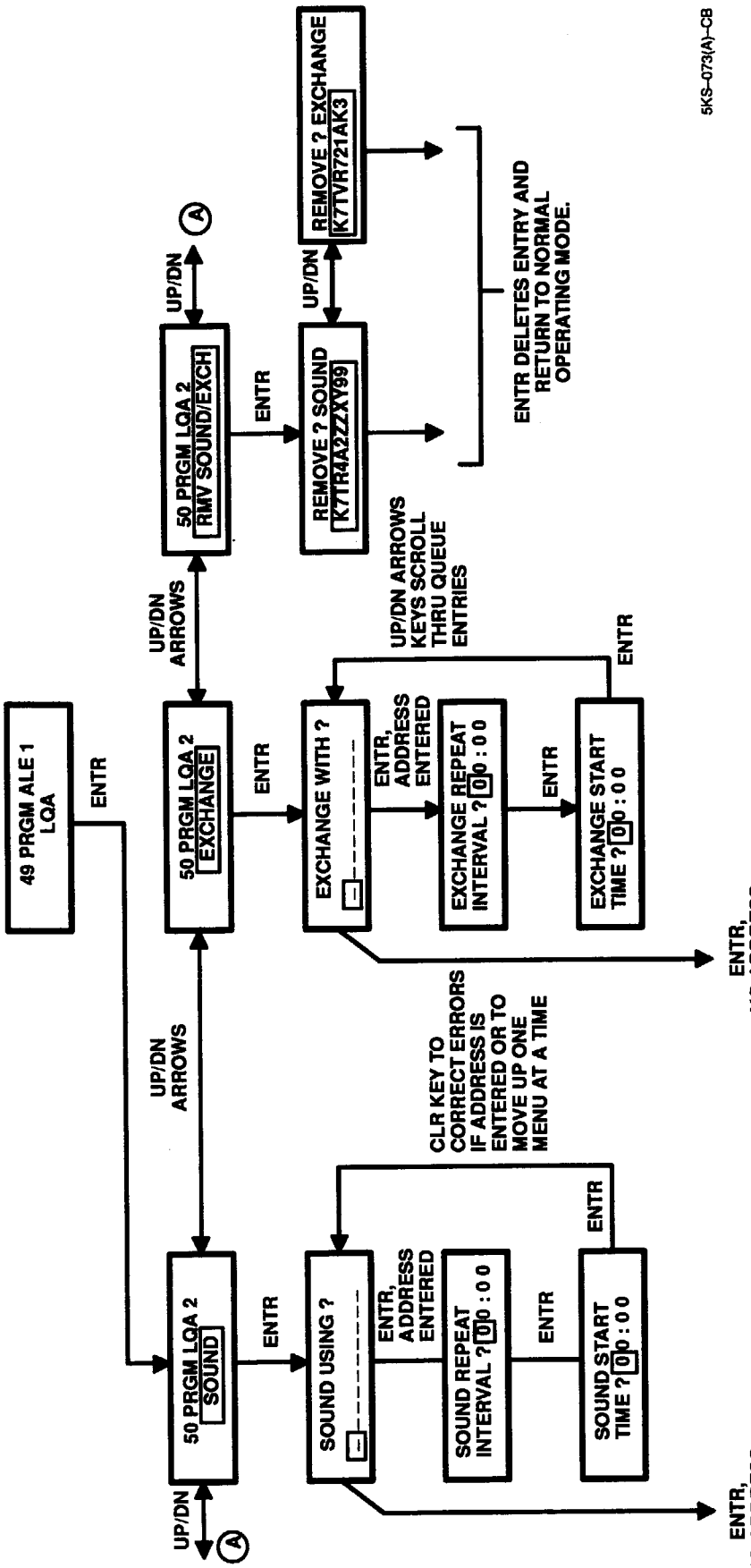
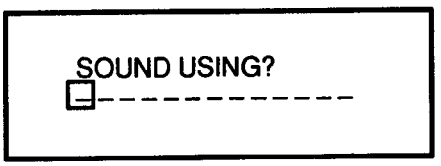


Figure 4. LQA Group Flow Chart

4.4.1 50 PRGM – SOUND

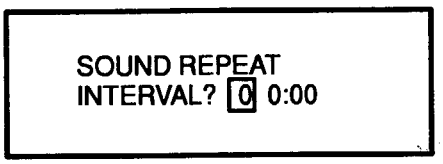
Pressing ENTR while SOUND is displayed, causes the R/T to display:



The left-most dash flashes to prompt for entry of the self address to transmit while sounding. Address entry follows the same procedure used to enter any alphanumeric address (see paragraph 4.3). Press the up or down arrow keys to scroll through the valid self addresses, or use the keypad to directly enter the self address. Use the CLR key to correct any mistakes.

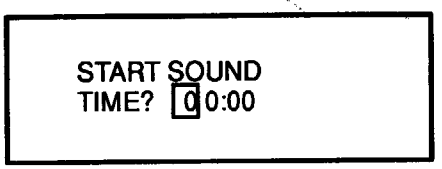
If the LQA queue is full (10 sounds or exchanges already queued), the R/T displays:

If the entered address is valid and there is room in the LQA queue for more entries, the R/T displays:



The left-most 0 flashes to prompt for entry of the repeat interval of the sound, starting with the tens of hours digit. Enter the time in the 24-hour format (no AM or PM entry is possible). Complete the entry by pressing ENTR. Enter 00:00 to send the sound only once, rather than at regular intervals. Entry of numbers greater than 2 in the tens-of-hours position or greater then 5 in the tens-of-minutes position is prohibited. As each digit is entered the cursor moves one place to the right. Use the CLR key to correct mistakes.

After the desired repeat time has been entered, the R/T displays:



The left-most 0 flashes to prompt for entry of the start time for the sound. Time entry follows the same procedure as described for entering the sound repeat interval. Enter 00:00 to start the sound immediately. Press ENTR to add the sound request to the LQA queue.

After the last ENTR is pressed, the R/T returns to the SOUND USING menu, requesting another self address for another sound. If no further sound requests are desired, press ENTR with no address entered. If another sound with a different self address is desired, enter it and the start and interval times accordingly. If an attempt is made to use the same self address again for another LQA, the R/T displays:

```
SOUND USING?
ADDR ALREADY QUED
```

If an invalid address is entered, the R/T displays the following until the CLR key is pressed:

```
SOUND USING?
ADDR NOT PROGRMD
```

If a valid address is entered, but it is not a self address, the R/T displays the following until the CLR key is pressed:

```
SOUND USING?
INV ADDRESS TYPE
```

Once all the sounds are queued, the LQA sound process begins at the specified time (or immediately if a start time of 00:00 is specified). The sounds repeat at the interval time specified. Sounds are transmitted on all the channels in the channel group associated with the self address used by the sound.

4.4.2 50 PRGM – EXCHANGE

If an LQA exchange is desired, press the up or down arrow key, as described in paragraph 4.4 , to move to the EXCHANGE menu (see figure 4). When the following menu is displayed:

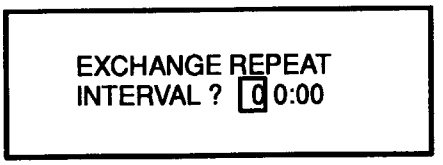
```
50  PRGM  LQA   2
      EXCHANGE
```

press the ENTR key to access the EXCHANGE programming menu. The R/T displays:

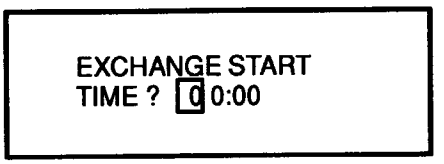
```
EXCHANGE WITH?
[ ]----------
```

The left-most dash flashes to prompt for entry of the individual or net address with which to perform the exchange. Address entry follows the same procedure used to enter any alphanumeric address (see paragraph 4.3). Press the up or down arrow keys to scroll through the valid addresses, or use the keypad to directly enter the address. Use the CLR key to correct any mistakes.

After a valid address is entered the R/T displays:

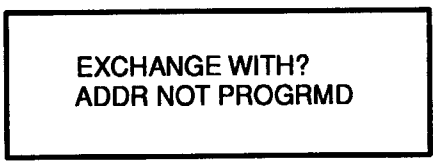


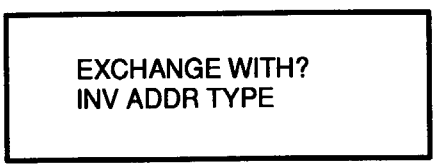
The left most 0 flashes to prompt for entry of the repeat interval of the exchange, starting with the tens of hours digit. Enter the time in the 24-hour format (no AM or PM entry is possible). Complete the entry by pressing ENTR. Enter 00:00 to send the exchange only once, rather than at regular intervals. Entry of numbers greater than 2 in the tens-of-hours position or greater then 5 in the tens-of-minutes position is prohibited. As each digit is entered, the cursor moves one place to the right. Use the CLR key to correct mistakes. After the entry is complete, the R/T displays:



The left-most 0 flashes to prompt for entry of the start time for the exchange. Time entry follows the same procedure as described for the exchange repeat interval. Enter 00:00 to start the exchange immediately. Press ENTR to add the exchange request to the LQA queue.

If an invalid address is entered, the R/T displays one of the following, as appropriate, until the CLR key is pressed:





Otherwise, after pressing ENTR, the R/T returns to the EXCHANGE WITH? menu, awaiting entry of another LQA exchange.

When an exchange occurs, the initiating station identifies itself by using the self address associated with the address specified in the EXCHANGE WITH? menu and uses the channels in the channel group associated with the individual or net address with which the exchange is performed. If a net address is specified in the EXCHANGE WITH? menu, the exchange uses the channels specified in the associated channel group (see paragraph 4.3) with all the members in the net.

For example, if individual ABCD is programmed to use channel group 1, and channel group 1 contains channels 10, 11, and 12, an exchange with ABCD performs an LQA on channels 10, 11, and 12.

Similarly, suppose net MYNET is programmed to contain individual stations ABCD, XYZZY, and HQ and is programmed to use channel group 2. If channel group 2 contains channels 5, 12, 13, and 25, an exchange with MYNET performs a net LQA with ABCD, XYZZY, and HQ on channels 5, 12, 13, and 25.

4.4.3 50 PRGM – RMV SOUND/EXCH

Use the RMV SOUND/EXCH menu to remove timed sounds or exchanges from the LQA queue. Press the up or down arrow key to move to the RMV SOUND/EXCH menu, (see figure 4). When the R/T displays the following menu:

```
50  PRGM  LQA   2
RMV SOUND/EXCH
```

Press ENTR to advance to the remove sound/exchange function. The display shows:

```
REMOVE?
------------
```

Press the up or down arrows to scroll through the programmed LQAs or enter the address from the keypad.

If there are no sounds or exchanges on the LQA queue, the R/T temporarily displays the following error message:

```
REMOVE?
NO ADDR ON QUE
```

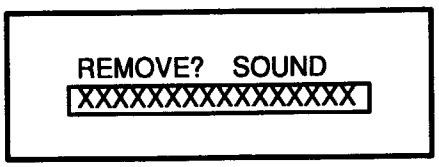
If the specified address is not programmed, the R/T displays the following error message:

```
REMOVE?
ADDR NOT PRGRMD
```

If the specified address is programmed, but is not on the queue, the R/T displays the following error message:

```
REMOVE?
NO ADDR ON QUE
```

If a valid address is specified, the R/T displays one of the following, depending on the type of LQA:



where XXXXXXXXXXXXXXX is either the sound's self address or the exchange's individual or net address. The address field flashes, to prompt the user to either press the ENTR key to delete the displayed sound/ exchange, or press the up or down arrow keys to scroll through the LQA queue until the desired address is displayed. As each address is displayed, the top line displays SOUND or EXCHANGE, as appropriate. When the desired address is found, press ENTR to remove the address. The R/T returns to the REMOVE? display. To exit, press ENTR again. The R/T then returns to the top-level ALE screen(SCANNING or STOPPED). To remove any other addresses, repeat the above procedure.

4.5 51 PRGM – REMOVE ADDRESSES

To access the remove address programming function, press ENTR when the top-level programming menu displays REMOVE ADDRESSES. Figure 5 is a remove addresses group flowchart which details the programming steps to delete self, individual, and net addresses.

To remove addresses, press the ENTR key when the R/T displays the following top level ALE programming menu:

After ENTR is pressed, the R/T displays the following:

The left-most dash flashes to prompt for entry of the address to delete. Address entry follows the same procedure used to enter any alphanumeric address (see paragraph 4.3). Press the up or down arrow keys to scroll through the valid addresses, or use the keypad to directly enter the address. Use the CLR key to correct any mistakes. If an invalid address is entered, the R/T displays the following until the CLR key is pressed:

```
REMOVE ADDRESS?
INVALID ADDRESS
```

Once a valid address is specified, press ENTR to remove it. The R/T then returns to the top-level ALE menu.

NOTE

Exercise caution when removing addresses. If a self address is removed and it is associated with an individual or net address (see paragraph 4.3), an error does not occur until that individual or net is used in an LQA exchange or a call, at which time the R/T displays INV ASSOC SELF.

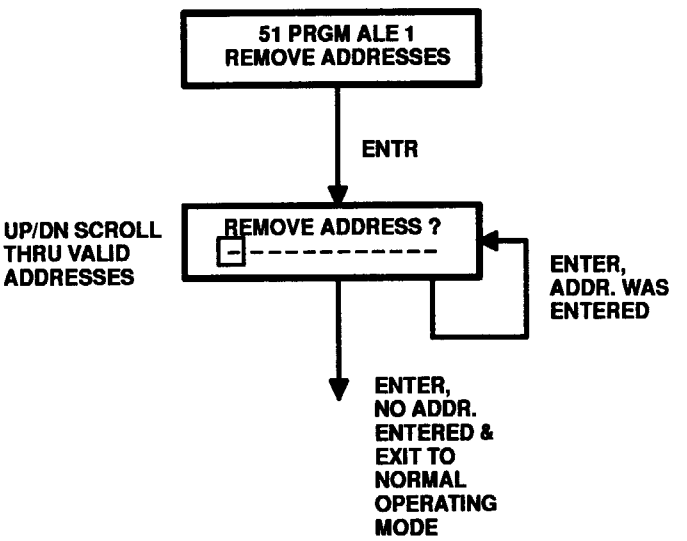


Figure 5. Remove Addresses Group Flow Chart

4.6 53 PRGM – CONFIGURE

To access the configuration programming function, press ENTR when the top-level programming menu displays CONFIGURE.

This series of menus deals with the following configuration parameters used during normal operation:

- Call Preamble Length
- Antenna and power amplifier tune time
- Enable/disable listen-before-transmit
- Enable/disable key-to-call

Figure 6 is a configure group flowchart which details programming steps for configuration programming operation.

To access the configuration programming function, press the ENTR key when the R/T displays the following top-level programming menu:

```
53  PRGM  ALE   1
    CONFIGURE
```

After ENTR is pressed, the R/T displays the following:

```
54  PRGM        2
MAX SCAN CH? [Y]YY
```

Repeatedly pressing PRGM causes the R/T to scroll through the following remaining configuration programming menus, returning to MAX SCAN CH:

```
55  PRGM        2
TUNE TIME? [Y]Y
```

```
56  PRGM        2
LSTN–B–XMIT[OFF]
```

```
57  PRGM        2
KEY_TO_CALL[OFF]
```

To select one of the above menus, press ENTR when the desired option is displayed. Operation of each of these options is explained in the paragraphs below.

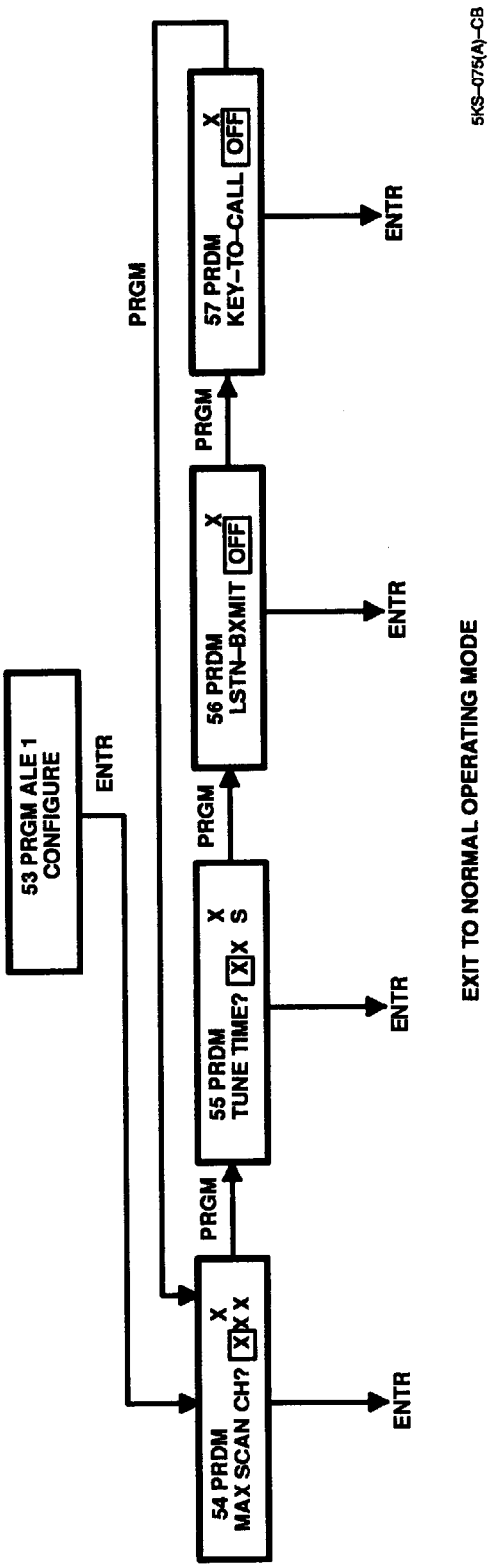
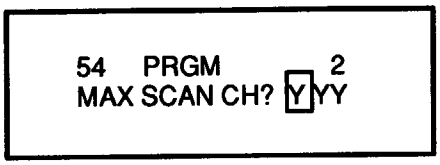


Figure 6. Configure Group Flow Chart

4.6.1 54 PRGM – MAX SCAN CH

When placing a call or performing an LQA, the RF-5121ALE option transmits a preamble to the destination station to capture the station's scanning receiver. The length of the preamble depends on the number of channels being scanned by the destination station. The MAX SCAN CH menu permits programming of this parameter:

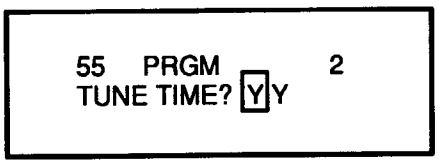


The first character in the YYY field flashes to prompt for entry of a value from 1 to 100. This represents the number of channels being scanned by the destination station. This number should be set to the maximum number scanned by any station which may be called. The larger this number, the longer it will take to perform calls and LQAs. Setting the number smaller than the number of channels scanned by the target stations decreases the probability of linking with target stations.

Press the CLR key to correct any mistakes. After a valid channel number is entered, press ENTR to load the new value and return to the top-level ALE display.

4.6.2 55 PRGM – TUNE TIME

This parameter tells the RF-5121ALE Option how much time the destination station requires to tune its antenna coupler, see paragraph 2.10. The ALE option uses this information to determine how long to wait for a response from the called station. This time is set by use of the TUNE TIME menu:

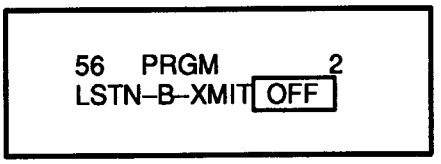


The first character in the YY field flashes to prompt for entry of the tune time of the coupler. This time is in seconds, with an allowable range of 01 to 60. Press CLR to correct mistakes. Complete the entry by pressing ENTR. The R/T returns to the top-level ALE display.

4.6.3 56 PRGM – LSTN_B_XMIT

The RF-5121ALE Option is able to listen for ALE signaling on a channel before using that channel for an LQA or a CALL. If the channel is in use, the RF-5121ALE controller advances to the next best channel and listens again, continuing until it finds an unoccupied channel.

Activate or deactivate the listen-before-transmit option from the LISTN-B-XMIT menu:

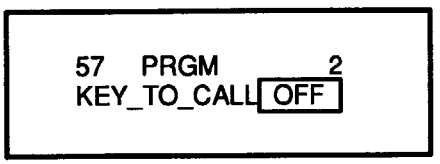


The word OFF (or ON if the option is already enabled) flashes to prompt for selection of the desired operation. Press the up or down arrow keys to toggle the flashing field between OFF and ON. When the desired operation is displayed, press ENTR. The R/T returns to the top-level ALE display.

4.6.4 57 PRGM – KEY TO CALL

The RF-5121ALE Option is able to perform call operations directly from the transmitter (microphone) key switch. In performing a key-to-call operation, the R/T repeats a call to the last address called. Key-to-call operation is available only when the R/T is SCANNING.

Activate or deactivate the key-to-call option from the KEY TO CALL menu:



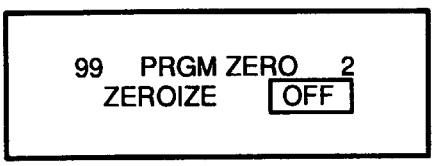
The word OFF (or ON if the option is already enabled) flashes to prompt for selection of the desired operation. Press the up or down arrow keys to toggle the flashing field between OFF and ON. When the desired operation is displayed, press ENTR. The R/T returns to the top-level ALE display.

4.7 99 PRGM – ZEROIZE

If the need arises, the configured contents of the RF-5020R/T, including all its option cards, can be cleared while in ALE operation. Zeroizing clears not only all configurations maintained by the R/T itself but also all self, individual, and net addresses, the LQA queue, and all other ALE options to OFF. The ZEROIZE command causes the RF-5020R/T to erase all of the programmed channel parameter and option settings.

The ZEROIZE option available while in the ALE mode of operation performs exactly the same function as the ZEROIZE operation while in SSB mode or HOP mode. It is duplicated to permit the zeroizing capability to be performed while in AUTOLINK® mode.

To access the zeroize programming function, press ENTR when the top-level programming menu displays ZEROIZE.



NOTE

The ZEROIZE command should be used with caution. Once erased, settings cannot be recovered.

To initiate the ZEROIZE command sequence:

a. Press ENTR to advance to the ZEROIZE command.

b. Use the arrow keys to scroll the display between OFF and ON.

c. Select ON and press the ENTR key to zeroize the RF-5020R/T.

or

Select OFF and press the ENTR key to terminate the zeroize sequence (or press the CLR key).

NOTE

The RF-5020R/T must be reprogrammed after a ZEROIZE sequence has been performed.

When the RF-5121ALE is zeroized while in AUTOLINK® mode, the R/T displays two messages in sequence: ALE MEMORY LOST followed by NO DEFAULT SELF. The second message remains until a self address is programmed. Other fault messages are then displayed and must be corrected before the RF-5121ALE option can operate normally. Refer to paragraph 5.8 for details on what steps to take after zeroizing the RF-5020R/T.

5. OPERATION

This section details the operation of the RF-5020R/T when equipped with the RF-5121ALE Option. It assumes some familiarity with RF-5020R/T operation and with MIL-STD-188-141A automatic link establishment concepts. This section is divided into subsections covering various aspects RF-5121ALE option operation:

- Error Messages
- Controlling Options in AUTOLINK® Operation
- LQA Sound or Exchange
- Radio Silence
- Placing Calls
- Scanning and Manual Operation
- Link Termination
- Initial Operation, Memory Fault Recovery, and Zeroization

5.1 Error Messages

Several operator error messages may appear on the front-panel display of the RF-5020R/T during the use of the ALE option. Table 2 summarizes RF-5121ALE Option error messages and table NO TAG summarizes RF-5121ALE Option remote control error messages. The following subsections provide detailed information on the error messages, as appropriate. Normally, the messages are displayed for a few seconds, at which time the display returns to the screen displayed before the error occurred. While programming or calling, however, they remain displayed until the CLR key is pressed.

Table 2. RF-5121ALE Option Front Panel Error Messages

Error Message	Description
NO LAST CALL	A CALL was attempted which did not specify a target address; no previous CALL has been attempted specifying a target address.
ADDRESS EXISTS	An attempt was made to reprogram the same SELF, INDIVIDUAL, or NET address.
INVALID ADDRESS	Address entered does not exist (was never programmed into the R/T), or more than 15 characters were entered, or a non–alphanumeric character was entered.
SELF TABLE FULL	An attempt was made to program more than 20 SELF addresses into the R/T.
IND TABLE FULL	An attempt was made to program more than 100 INDIVIDUAL addresses into the R/T.
NET TABLE FULL	An attempt was made to program more than 20 NET addresses into the R/T.
ADR ALREADY QUED	An attempt was made to queue an LQA SOUND or EXCHANGE request using a target address which is already queued.
LQA QUEUE FULL	An attempt was made to queue more than 10 LQA SOUNDs or EXCHANGEs.
INV CHAN GROUP	INValid CHANnel GROUP, a non–existent channel group was specified during a programming operation.
INV ASSOC SELF	INValid ASSOCiated SELF, a non–existent self address was specified during a programming operation.
INV SELF ADDRESS	An attempt was made to enter a self address with more than 15 characters or with non–alphanumeric characters.
INV IND ADDRESS	An attempt was made to enter a individual address with more than 15 characters or with non–alphanumeric characters.
INV NET ADDRESS	An attempt was made to enter a net address with more than 15 characters or with non–alphanumeric characters.
INV ADDRESS TYPE	An attempt was made to do an LQA SOUND with an individual or net address or to do an LQA EXCHANGE with a self address type.
INV CALL TARGET	An attempt was made to call an address which has not been programmed or to call an address which has no associated self.
NO CHANS IN GRP	An attempt was made to call an individual or net address whose associated channel group was empty.
<ALL> RESTRICTED	An attempt was made to program the reserved address ALL as a self, individual, or net.
INV MEMBER ADDR	An attempt was made to add to a net an address which was not a preprogrammed, self, or individual.
INV SELF MEMBER	An attempt was made to add to a net a self address which is not the associated self for the net.
DUPLICATE MEMBER	An attempt was made to enter the same self or individual address to a net a second time.
ADDR NOT PROGMD	An attempt was made to add or delete a non–existent self, net, or individual address.

Table 2. RF-5121ALE Option Remote Control Error Messages (Cont.)

Error Message	Description
ERROR	A command was entered at the remote control port which does not exist or is invalid for the current R/T mode (this error applies to the remote control port only).
INTRVAL TIME ERR	An attempt was made to enter an invalid time value interval (this error applies to the remote control port only).
START TIME ERROR	An attempt was made to enter an invalid start time value (this error applies to the remote control port only).
INV TIME OF DAY	An attempt was made to program a time of day greater than 23:59 (this error applies to the remote control port only).
INV CHAN NUMBER	An attempt was made to enter a channel number greater than 99 (this error applies to the remote control port only).
INV MAX SCAN	An attempt was made to enter a value greater than 100 for the number of scan channels (this error applies to the remote control port only).
INV TUNE TIME	An attempt was made to enter a coupler tune time less than 1 or greater than 60 (this error applies to the remote control port only).

5.2 Controlling Options In AUTOLINK® Operation

When the RF-5020R/T function switch is in the AUTOLINK® position, a subset of RF-5020R/T options can be activated by use of the MODE key on the front-panel KEYPAD. These options include:

- 39-Tone Modem
- Digital Voice
- Encryption
- Link Quality Analysis
- Radio Silence

All of the above options can be accessed while STOPPED, LINKED, or SCANNING. The first three require the installation of the appropriate option hardware assemblies into the R/T. The first three are also disabled while the ALE module is placing or receiving a call. The flowchart in figure 7 illustrates the use of the MODE key while in AUTOLINK® operation.

NOTE

The RF-5020R/T front panel contains both a MODE switch and a MODE key. The MODE switch must be in the AUTOLINK® position to activate the RF-5121 option. The MODE key activates the other options described above.

While the MODE switch is in the AUTOLINK® position, repeatedly press the MODE key to scroll through the available options. While SCANNING, STOPPED, or LINKED, the LQA and RADIO SILENCE options are available. If the appropriate hardware options are installed, MODEM 39 TONE, DIGITAL VOICE, and ENCRYPTION are available while STOPPED, SCANNING, or LINKED.

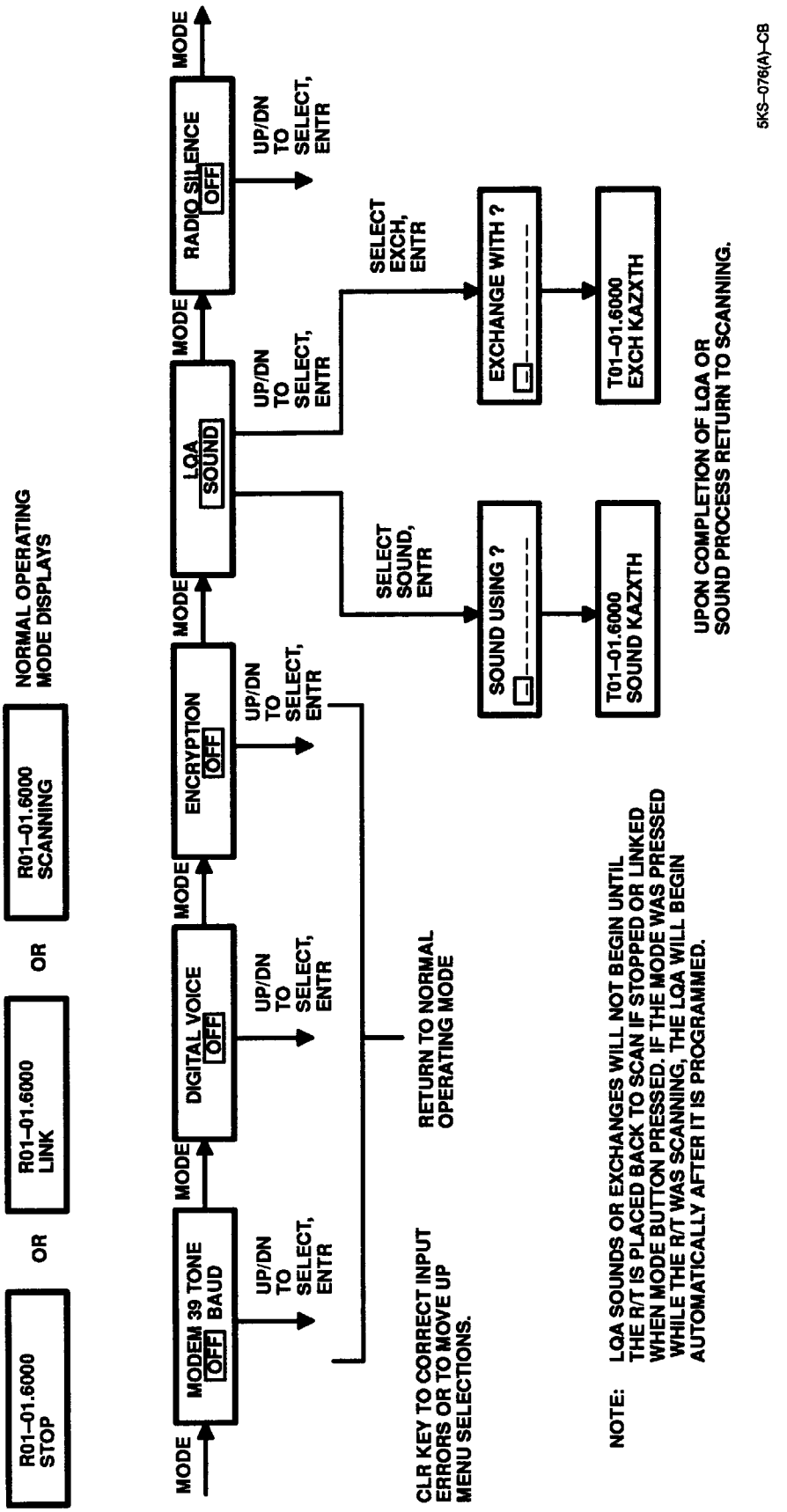
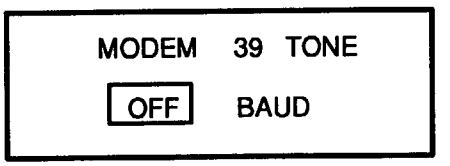


Figure 7. Mode Key Selection while in AUTOLINK® Mode

5.2.1 39-Tone Modem and Baud Rate Selection

When the RF-5020R/T MODE switch is in the AUTOLINK® position, the 39-tone modem can be turned on and off and baud rates can be set. Other modem settings must have been previously configured while in SSB mode.

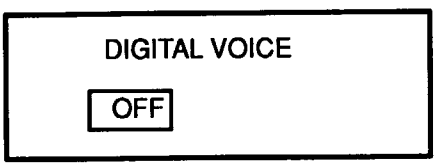
While SCANNING, STOPPED or LINKED, repeatedly press the MODE key until the R/T displays:



The word OFF (or a baud rate value if the MODEM is already ON) flashes, to prompt an entry. This menu is used in the same way as when the MODE switch is in the SSB position. Press the up or down arrow keys to select ON or OFF and to select a baud rate from 75 to 2400. The selection of any value except OFF turns the MODEM ON at the selected baud rate. When the desired MODEM configuration parameter is displayed, press ENTR to load the parameter and return to the top level ALE menu (the STOPPED, SCANNING, or LINKED screen).

5.2.2 Digital Voice Selection

While SCANNING, STOPPED or LINKED, repeatedly press the MODE key until the R/T displays:



The word OFF (or ON if digital voice is already ON) flashes, to prompt an entry. This menu is used in the same way as when the MODE switch is in the SSB position. Press the up or down arrow keys to select ON or OFF. Press ENTR to load the selection and return to the top level ALE menu (LINKED, SCANNING, or STOPPED).

5.2.3 Encryption Selection

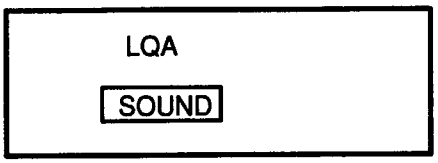
While SCANNING, STOPPED or LINKED, repeatedly press the MODE key until the R/T displays:

The word OFF (or ON if encryption is already ON) flashes, to prompt an entry. This menu is used in the same way as when the MODE switch is in the SSB position. Press the up or down arrow keys to select ON or OFF. Press ENTR to load the selection and return to the top level ALE menu (LINKED, SCANNING, or STOPPED).

5.3 LQA Sound and Exchange Selection

In addition to the automatic timed method described in the Operation section, LQAs and sounds can be initiated manually. Manually initiated LQAs are sent only once, upon command, as described below.

While SCANNING or STOPPED, repeatedly press the MODE key until the R/T displays:

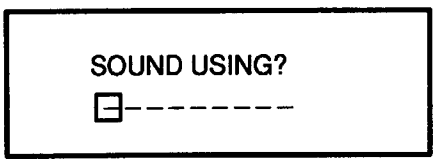


The word SOUND flashes, to prompt a selection of either SOUND or EXCHANGE by use of the up/down arrow keys. Press ENTR to load the selection. The R/T returns to its previous condition (SCANNING or STOPPED).

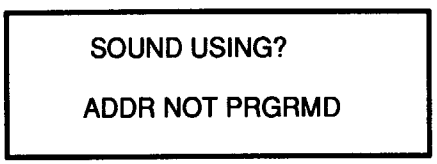
The sound or exchange is not sent until the R/T begins scanning. If it is STOPPED, press CLR to return to SCANNING. The R/T then sends the sound or exchange.

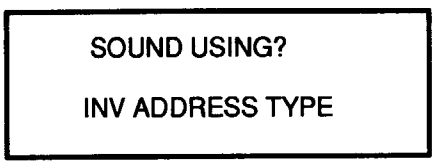
5.3.1 LQA Sounds

If the ENTR key is pressed when the LQA SOUND menu is selected, the R/T displays:

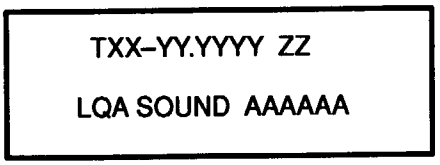


The left-most dash flashes, to prompt entry of the self address to transmit while sounding. Entry of an address is identical to the entry of an address for a timed (queued) LQA sound (see paragraph 4.4.1). Press the up or down arrow keys to scroll through the valid self addresses, or use the keypad to directly enter the self address. Use the CLR key to correct any mistakes. If an invalid address is entered, the R/T temporarily displays one of the following:





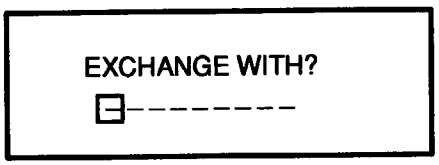
After entering a valid address, press ENTR. The R/T displays:



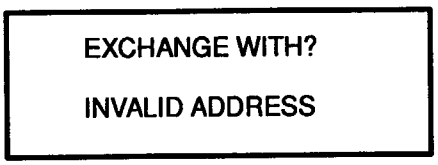
where TXX indicates the R/T is to transmit on channel XX. YY.YYYY indicates the transmit frequency, ZZ indicates the transmit power level, and AAAAAA indicates the first six letters of the self address transmitted in the sound. If the address is greater than six characters, a + is displayed after the sixth character. The sounding process continues until all channels in the associated channel group for the selected self are used. When the sound is complete, the display returns to the top level ALE status screen (SCANNING or STOPPED).

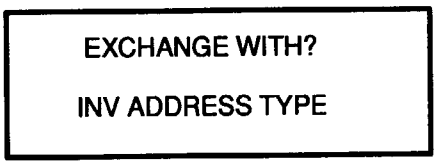
5.3.2 LQA EXCHANGES

If the ENTR key is pressed when the LQA EXCHANGE menu is selected, the R/T displays:

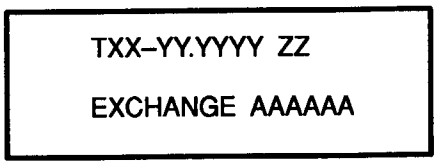


The left-most dash flashes to prompt for entry of the address of the station with which to perform an LQA exchange. Address entry is identical to that for a timed (queued) LQA exchange (see paragraph 4.4.2). Press the up or down arrow keys to scroll through the valid individual or net addresses, or use the keypad to directly enter the address. Use the CLR key to correct any mistakes. If an invalid address is entered, the R/T temporarily displays one of the following:





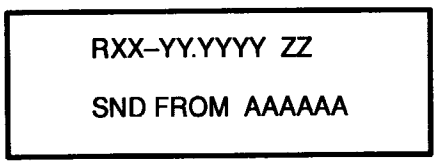
After entering a valid address, press ENTR. The R/T displays:



where TXX indicates the R/T transmits on channel XX. YY.YYYY specifies the transmit frequency, ZZ indicates the transmit power level, and AAAAAA indicates the first six letters of the individual or net to perform the exchange with. The exchange process continues until all channels in the associated channel group for the selected individual or net have been used. When the exchange is complete, the display returns to the top level ALE status screen, STOPPED or SCANNING.

5.3.3 Receiving LQA Sounds or Exchanges

The R/T indicates reception of an LQA sound with the following display:



where RXX indicates the R/T receives on channel XX. YY.YYYY specifies the receive frequency, ZZ specifies the signal strength (S meter indication), and AAAAAA specifies the first six letters of the individual or net from which the LQA is received. This display remains until the LQA is completed. At that time the R/T returns to its previous condition before receiving the LQA.

The R/T indicates reception of an LQA exchange in the same manner as when receiving a call. It first displays SIGNAL RECEIVED, followed by RECEIVING CALL. At the completion of the exchange, the R/T returns to STOPPED or SCANNING.

NOTE

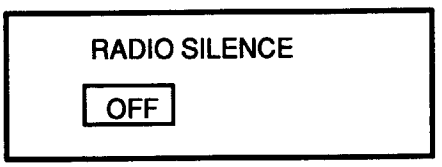
The R/T can receive LQAs whenever it is SCANNING or STOPPED. However, if it is STOPPED, it can receive LQAs only on the channel on which it is stopped.

5.4 Radio Silence Selection

Radio silence prohibits the RF-5121ALE from responding to incoming calls or LQA exchanges. Even though the RF-5121ALE option does not respond to LQA exchanges or calls from distant stations, it does continue to evaluate received signals to determine channel quality and continues to update channel scores. Therefore, an R/T in radio silence does not link with incoming calls which require a response. It does link with calls which do not require a response (i.e. Allcalls). Because the R/T cannot transmit a response when in radio silence, it cannot send channel scores to the calling station, as it would in non-silent operation.

The R/T does not initiate sounds or exchanges while in radio silence. This includes both automatic time-queued and manually-initiated (from either the front panel or remote control) LQAs. This prevents automatic time-queued sounds or exchanges from violating the radio silence. During radio silence, the radio operator is permitted to manually initiate a call.

To activate radio silence, while SCANNING, STOPPED, or LINKED, repeatedly press the MODE key until the R/T displays:



As with the digital voice and encryption menus, the up/down arrow keys toggle the flashing OFF (or ON if radio silence is active) between OFF and ON. When the R/T displays the desired function, press ENTR to execute the operation. After the operation is complete, the R/T returns to the top-level ALE menu (SCANNING, STOPPED, or LINKED).

5.5 Placing Calls

The RF-5121ALE Option can initiate the following types of calls:

- Manual and automatic individual calls
- Manual and automatic net calls
- Manual and automatic allcalls and selective allcalls

In a manual call the operator specifies the channel on which the call is to be placed. In an automatic call the RF-5121ALE selects the best channel on which to place the call, based on the latest LQA information.

The R/T cannot receive calls or LQAs while in the call-placement menus. It must be SCANNING to receive them. To terminate a call attempt after it has started, press the CLR key while the CALLING xxxxxx message is displayed.

During the placement, reception, and termination of a call or other operation of the RF-5020R/T with the RF-5121ALE Option, the R/T displays various status messages on the front-panel display and sends them to the remote port if the R/T is being remotely operated. Table 3 summarizes these status messages. Other error and fault messages which may appear on the display are summarized in paragraph 4.

Table 4 summarizes the messages which appear on the front-panel display during calling and LQAs, at both the initiating and target stations. When more than one message appears, they are listed sequentially. Calls which cannot be initiated are marked N/A in the initiating site's column.

Table 3. Run Time Status Messages

Message	Description
NO RESPONSE	Target station did not respond to a CALL
SIGNAL RECEIVED	Signal synchronization has been received. This message will appear anytime ALE traffic is monitored on a channel.
TERMINATING LINK	Originating or target station is terminating a LINK.
SND FROM xxxxxx	R/T is receiving a sound from station "xxxxxx".
RSP FROM xxxxxx	R/T is receiving a response to a net call or an LQA exchange from station xxxxxx.
CALLING xxxxxx	R/T is attempting a Manual or Automatic call to station xxxxxx.
RYY xxxxxx LINK xxxxxx	R/T is linked to station xxxxxx on channel YY, with signal strength ZZZ.
SCANNING	R/T is scanning self and net channels.
STOP	R/T is in Manual ALE mode (not scanning).
RECEIVING CALL	A call is being received.
SOUND xxxxxx	R/T is attempting an LQA sound using self address xxxxxx.
EXCHANGE xxxxxx	R/T is attempting an LQA exchange with station xxxxxx.
CHANNEL BUSY	A call was attempted on a busy channel.

Meaning of notations in table 4.

1. TXX-YY.YYYY ZZ – Transmitting on channel XX, frequency YY.YYYY MHz, power level ZZ watts.
2. RXX-YY.YYYY BB – Receiving on channel XX, frequency YY.YYYY MHz, S-meter reading of BB
3. CCCCCC – Address of the calling station
4. AAAAAA – Address of the called station

Table 4. Front Panel Display While Calling

Call Type	Initiating Site	Destination Site
Calling Individual	TXX–YY.YYYY ZZ CALLING AAAAAA+	RXX–YY.YYYY BB SIGNAL RECEIVED
		RXX–YY.YYYY BB RECEIVING CALL
Linked	RXX AAAAAA BB LINK	RXX CCCCCC BB LINK
Calling Net	TXX–YY.YYYY ZZ CALLING AAAAAA+	RXX–YY.YYYY BB RECEIVING CALL
	RXX–YY.YYYY BB RSP FROM DDDDDD	
Linked	RXX AAAAAA BB LINK	RXX CCCCCC BB LINK

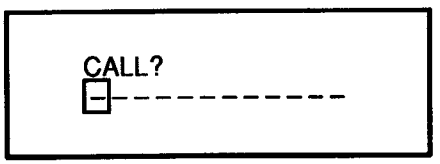
Table 4. Front Panel Display While Calling (Cont.)

Call Type	Initiating Site	Destination Site
Calling Group	N/A	RXX–YY.YYYY BB RECEIVING CALL
Linked		RXX CCCCCC BB LINK
Calling Allcall	TXX–YY.YYYY ZZ CALLING ALL	RXX–YY.YYYY BB RECEIVING CALL
Linked	RXX ALL BB LINK	RXX CCCCCC BB LINK
Selective Allcall	TXX–YY.YYYY ZZ CALLING ALL–X	RXX–YY.YYYY BB RECEIVING CALL
Linked	RXX ALL–X BB LINK	RXX CCCCCC BB LINK
Anycall	N/A	RXX–YY.YYYY BB RECEIVING CALL
Linked	N/A	RXX CCCCCC BB LINK
Selective Anycall	N/A	RXX–YY.YYYY BB RECEIVING CALL
Linked	N/A	RXX CCCCCC BB LINK
Wildcard	N/A	RXX–YY.YYYY BB RECEIVING CALL
Linked	N/A	RXX CCCCCC BB LINK
Individual LQA Sound	TXX–YY.YYYY ZZ SOUND CCCCCC	RXX–YY.YYYY BB SIGNAL RECEIVED
		RXX–YY.YYYY BB SND FROM CCCCCC
Net LQA Sound	TXX–YY.YYYY ZZ SOUND CCCCCC	RXX–YY.YYYY BB SIGNAL RECEIVED
		RXX–YY.YYYY BB SND FROM CCCCCC
Group LQA Sound	N/A	RXX–YY.YYYY BB SIGNAL RECEIVED
		RXX–YY.YYYY BB SND FROM CCCCCC
Individual LQA Exchange	TXX–YY.YYYY ZZ EXCHANGE AAAAAA	RXX–YY.YYYY BB SIGNAL RECEIVED
	RXX–YY.YYYY BB RSP FROM AAAAAA	RXX–YY.YYYY BB CALL RECEIVED

Table 4. Front Panel Display While Calling (Cont.)

Call Type	Initiating Site	Destination Site
Net LQA Exchange	TXX–YY.YYYY ZZ EXCHANGE AAAAAA	RXX–YY.YYYY BB SIGNAL RECEIVED
	RXX–YY.YYYY BB RSP FROM AAAAAA	RXX–YY.YYYY BB CALL RECEIVED
Group LQA Exchange	N/A	RXX–YY.YYYY BB SIGNAL RECEIVED
		RXX–YY.YYYY BB SND FROM CCCCCC
AMD	N/A	SIGNAL RECEIVED RECEIVING CALL LINKED CCCCCC

Figure 8 is a flowchart for the calling process. To begin the calling process, press the CALL button while SCANNING or STOPPED. After the CALL button is pressed, the R/T displays the following:



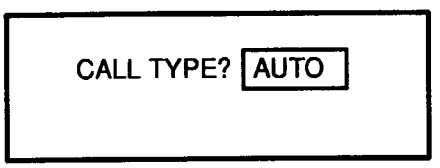
The left-most dash flashes to prompt for entry of the address of the station to call. Address entry follows the same procedure used to enter any alphanumeric address (see paragraph 4.3). Press the up or down arrow keys to scroll through the valid addresses or use the keypad to directly enter the address. Use the CLR key to correct any mistakes. If an invalid address is entered, the R/T temporarily displays an INVALID ADDRESS error message and returns to the CALL? prompt.

To place an allcall, enter ALL as the address. To place a selective allcall, enter the address ALL–x, where x represents the last character in the subset of stations to be called.

NOTE

The dash character after the word ALL is required. It is entered by pressing the 9 key four times.

After entering the address, the R/T displays:



The word AUTO flashes to prompt for selection of either an automatic or manual call. Press the up or down arrow keys to toggle between AUTO and MAN. When the desired call type is displayed, press ENTR.

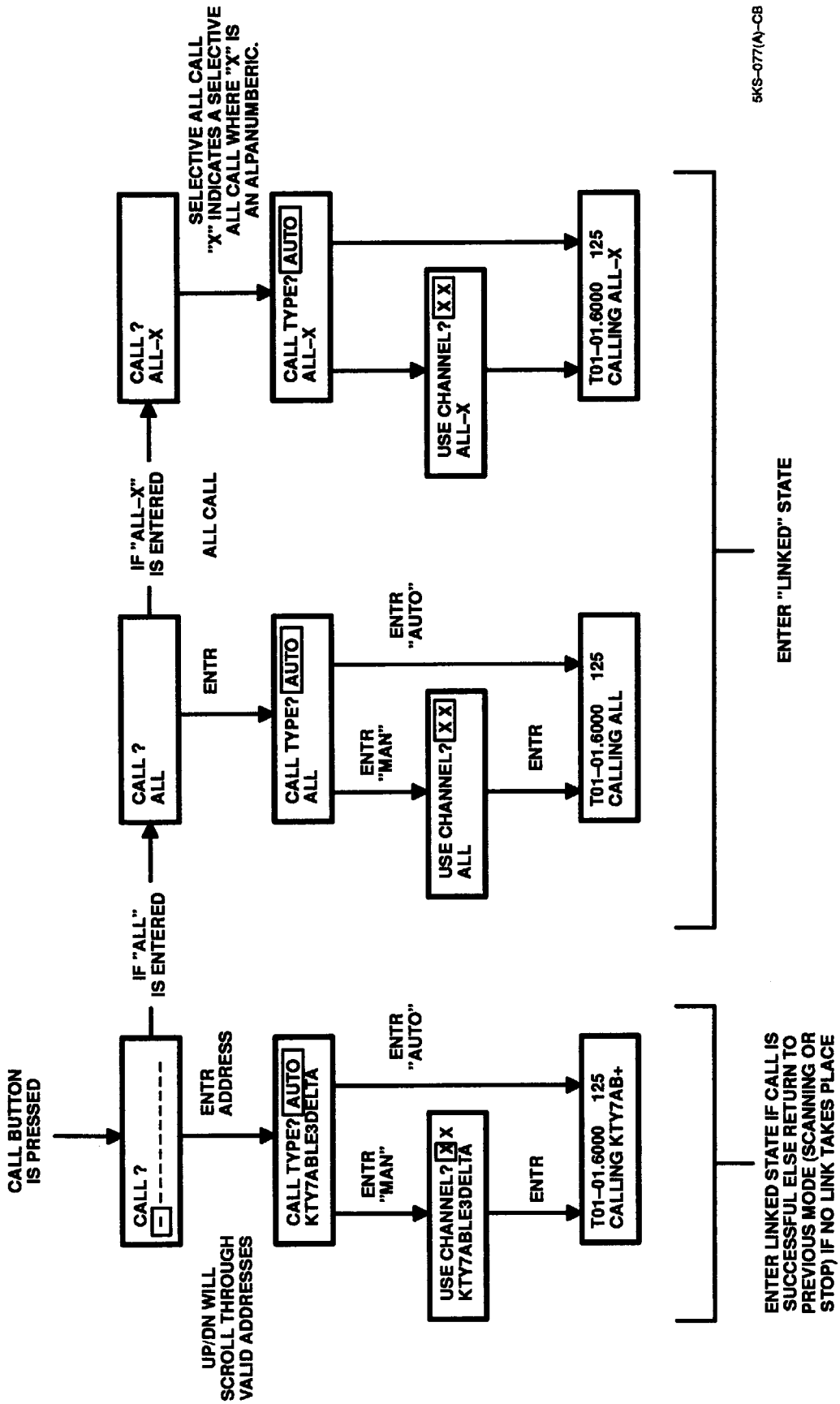
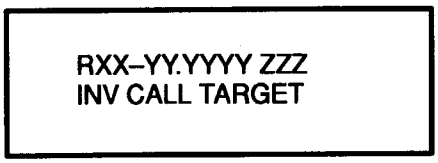


Figure 8. Calling Process Flow Chart

If a manual call is selected, the R/T displays:

The first X flashes to prompt for entry of a channel number. Enter any number from 0 to 99, then press ENTR.

If an invalid address is selected, one of the following is displayed, as appropriate, until the CLR key is pressed:



These messages indicate a call attempt was made to an address which was not programmed into the R/T, or to an address which had no associated self programmed (see paragraphs 4.3 and 4.5).

After selecting a valid address (and channel, for a manual call) and pressing ENTR, the R/T displays:

Where XX is the channel on which the call is to be placed, YY.YYYY is the transmit frequency of the channel, and ZZ is the transmit power. If this is an AUTO call, information in the top line changes as each channel is attempted until a link is established. For each channel attempted, the R/T temporarily displays a NO RESPONSE status message on the bottom line if no link is made. For a manual call, the R/T displays the selected channel. AAAAAAA represents the first six characters of the individual or net address being called (a + will appear in the right-most position if the address is more than six characters long), or the word ALL for an allcall, or ALL-X for a selective allcall.

After linking, the R/T displays:

where RXX indicates the R/T is linked on channel XX at an S meter received signal strength of ZZZ. AAAAAA indicates the six most-significant characters of the address of the station or net linked to (followed by a + sign if there are more than six characters are in the address). For allcalls and selective allcalls, the AAAAA indicates either ALL or ALLL-X where X is the last character in the address of the desired subgroup of target stations as entered earlier.

To view the frequency of the linked channel, press FREQ. The display returns to the previous display after a few seconds.

Additional status information appears to the right of the word LINK if modem, digital voice, or encryption options are installed and in use. MDM indicates the modem is on, DV indicates digital voice is on, and DE indicates encryption is on.

If a link does not occur, the R/T temporarily displays the status message NO RESPONSE, and returns to SCANNING or STOPPED, depending on the condition before the call was attempted.

If a manual call is attempted on a channel which is in use for ALE signalling and listen-before-transmit is enabled (see paragraph 4.6.3), the R/T temporarily displays the message CHANNEL BUSY and returns to SCANNING or STOPPED, depending on the condition before the call was attempted.

If key-to-call is enabled (see paragraph 4.6.4) and a call has been previously made as described above, a call to the same address can be initiated again by keying the transmitter while in SCANNING. If a call has not been made previously using the above procedure and a key-to-call is attempted, the R/T temporarily displays the error message NO LAST CALL.

5.6 Scanning and Manual Operation

As described in paragraph 5.2, the R/T is most often in one of three states: SCANNING, STOPPED, or LINKED. All other states are transitional and deal with placing or receiving calls or various programming, setup, or configuration activities.

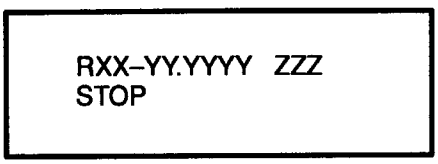
Activate the RF-5121ALE Option by either placing the front-panel function switch in the AUTOLINK® position or by issuing an ALE command from the remote controller (see paragraph 6.). This causes the R/T to enter the ALE mode and to begin scanning its preprogrammed channels. However, if the R/T is LINKED when taken out of ALE mode (by either moving the front-panel function switch out of the AUTOLINK® position or by sending the SSB command to the remote control port), it returns to the LINKED state when the ALE mode is later reentered. This happens even though the R/T is no longer actually linked. Do not exit the ALE mode while linked. Always terminate the link first as described later in this section.

The R/T scans the union of all the channels associated with the programmed net and self addresses. That is, all channels are scanned on which it can receive a call.

While scanning, the R/T displays the following:

where RXX indicates receiving on channel XX which is tuned to YY.YYYY MHz. This top line changes at the rate of five channels per second and advances through all channels programmed in the associated channel groups for all selfs and nets. As long as no call is received for any of the selfs or nets, the word SCANNING appears on the second line of the display.

To stop scanning, press CLR. The R/T stops on the last scanned channel and displays the channel number, its frequency and the S meter reading. The bottom line displays the word STOP and the status of the modem, digital voice, and encryption options, if installed, as described earlier:



To change channels when STOPPED, turn the front panel NET switch or press the up or down arrow keys to scroll through the channels in the scan list. The arrow keys select the channels in the radio's scan list, while the NET switch selects channels programmed into the radio nets.

NOTE

The front-panel NET switch does not refer to ALE nets, but to the channels programmed into each switch position while in SSB mode. In ALE, the front-panel NET switch is a channel-select switch which tunes the radio to one of the programmed channels. For normal ALE operation, leave the NET switch in the M position.

Calls may be received while SCANNING or STOPPED. If the radio is SCANNING and ALE signaling is detected, the receiver stops scanning when it detects ALE signaling. If the receiver acquires synchronization with the received signal, it displays SIGNAL RECEIVED as shown below:

After the R/T determines the incoming call is addressed to it, the display changes to:

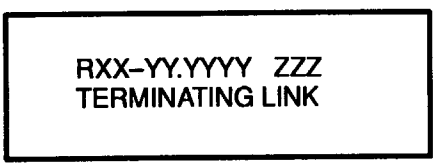
If the radio then successfully links, the display changes to:

where AAAAAAA are the six most-significant characters (a + appears in the right-most position if the address is over six characters) of the address of the individual station or net to which the R/T is linked. The top line displays the channel, frequency, and the strength of the signal received. The R/T also issues several audible beeps when a successful link is established.

The R/T can also receive a call while STOPPED and behaves in much the same way in the presence of received ALE signalling as described above for SCANNING. If a call from another station is received on the channel on which the R/T is STOPPED, it links with the calling station. If ALE signaling is detected on the channel and synchronization occurs, the messages SIGNAL RECEIVED, then RECEIVING CALL is displayed until a LINK occurs.

5.7 Link Termination

Link termination causes the R/Ts on both ends of a link to resume scanning. Link termination commands can be sent by either the initiating or target station of a call by pressing the CLR key on the RF-5020R/T front panel while all stations are LINKED on the same channel. A link-termination command cannot be sent by a target station in multistation calls (net or allcalls). Only the initiating station of a multistation call can terminate the links to the other stations. A link termination does not work if the R/T is in CW mode. When the link is being terminated, the R/T displays:



where the first line shows the receive (or transmit, for the station transmitting the termination) channel, frequency, and S meter value for the channel on which the call was placed (or the power level for the station transmitting the termination). When termination is complete, the R/T returns to the SCANNING or STOPPED state, depending on its condition before the call was placed.

5.8 Initial Operation, Memory Fault Recovery, and Zeroization

If the R/T has never been programmed or if it has been zeroized, additional first-time programming is necessary. Under these circumstances, the R/T displays fault messages until a minimum amount of required information is programmed. This section explains these fault messages and how to clear them.

If the ALE option hardware is not installed in the R/T, the front panel displays the following when the front-panel function switch is placed in the AUTOLINK® position:

If the above message appears, even though the ALE option is installed, test the R/T by placing the front-panel function switch in the TST position to execute the built-in-test procedure.

If the RF-5121ALE option is installed, but has been zeroized or has never been programmed, the front panel displays:

At this point, at least one self address, one individual address, and one channel group must be programmed before ALE operation can begin. If any of these items is not programmed, the R/T prompts for entry, in the required sequence, until they are programmed. After all are entered, the R/T begins scanning the programmed channels.

If the default self address is not programmed, the R/T displays:

After entering the default self address (see paragraph 4.3) if at least one individual address is not programmed, the R/T display:

After entering a self and individual address, if at least one channel group is not programmed, the R/T displays:

At this point, the channel group associated with the self address programmed above must be entered. If a channel group other than one assigned to the self is entered, the above fault message is displayed again. After entering the channel group, the R/T begins scanning and is ready for ALE operation.

6. REMOTE CONTROL OPERATION

The RF-5020R/T supports full remote control operation and programming of the RF-5121ALE option.This section details the RF-5121ALE specific additions to the RF-5020R/T remote interface as well as the standard SSB mode commands which are available while the ALE option is activated.

Since the remote interface uses ASCII text commands and responses, either a standard ASCII terminal or personal computer can be used for the remote control terminal. With a standard ASCII terminal, remote control commands are entered with the keyboard, and the R/T's status and responses are displayed on the screen. A personal computer offers the advantage of being able to create a text file containing complete programming information and downloading it into the R/T, thereby simplifying the programming process.

To activate ALE option at the remote-control port, place the front-panel function switch in the RMT position. The prompt SSB > appears on the remote-control terminal, indicating the R/T has defaulted to the SSB mode. To enter ALE mode, type ALE after the SSB > prompt. The R/T responds with an ALE > prompt, indicating the ALE option is active. This transaction is illustrated below, with the commands typed by the operator in boldface type:

SSB> **ALE**

ALE>

Table 5 lists the additional ALE-specific commands and responses which are available. In these tables, the required parameters are in [brackets]. Optional parameters are in {braces}. Table 6 shows the abbreviations used in tables 5.

Table 5. Summary of ALE Remote Commands Allowed In ALE Mode

Command	Parameters	Description
ADDCH	[Chan Group][Chan]	Add Channel
DELCH	[Chan Group][Chan]	Delete Channel
SLFADDR	[Addr][Chan Group]	Program Self Address
INDADDR	[Addr][Chan Group][Assoc Self]	Program Indiv Address
NETADDR	[Addr][Chan Group][Assoc Self]	Program Net Address
DELADDR	[Addr]	Delete Address
ADDMEMB	[Net Name][Member Addr]	Add Net Member
SOUND	[START | STOP][Addr]{Interv}{Start}	Program Sound
SOUND		List Queued LQAs
EXCHANGE	[START | STOP][Addr]{Interv}{Start}	Program Exchange
EXCHANGE		List Queued LQAs
CALL	[Addr][Chan]	Initiate Manual Call
CALL	[Addr]	Initiate Automatic Call
CALL		Initiate Key–To–Call
CALL ALL	[Sel Char][Chan]	Initiate Allcall
SCAN		Start Scan
STOP		Stop Scan

Table 5. Summary of ALE Remote Commands Allowed In ALE Mode (Cont.)

Command	Parameters	Description
INC		Next Channel
DEC		Previous Channel
MAXCH	[1 – 100]	Program Max Scan Chans
TUNETIME	[1 – 99]	Set Coupler Tune Time
LSTN	[ON | OFF]	Listen Before Transmit
KEY_T	[ON | OFF]	Key to Call
RAD_SILEN	[ON | OFF]	Radio Silence
ERASE		Erase RF–5121 Option Programming
ZERO		Zeroize All R/T Programming
MODEM	[Modem command]	Control Modem
DV	[ON | OFF]	Digital Voice
ENCRYPT	[ON | OFF]	Encryption

Table 6. Abbreviations Used In ALE Commands

Abbreviation	Meaning
Chan	Channel Number (from 1 to 99)
Chan Group	Channel Group (from 0 to 9)
Addr	Station Address (up to 15 alphanumeric characters)
Interv	Time interval (in hh:mm format)
Start	Start time (in hh:mm format)
Assoc Self	Associated Self Address (same format as Addr)
Sel Char	Selective Character (to select an Address subset)

6.1 SHOW Menu

Entering ALE > SHOW while in ALE mode provides a status listing of the RF-5121ALE Option and general RF-5020R/T status. Use this command to monitor ALE operation and to confirm configuration settings. The net listed in the status is the net being scanned or used at the time when the command is issued. A typical SHOW menu is shown below. Exact results depend on specific radio configuration details.

```
ALE> sho
Scan Stopped
LSTN on
KEY_TO_CALL off
RAD_SIL on
MAXCH 0012
TUNETIM 24
Net 04
Mode USB
RxFr 01600000 TxFr 01600000
Key off
Modem off
Modem Baud 2400
DV off
Encrypt off
```

6.2 HELP Menu

Entering ALE > HELP displays a list of the RF-5121ALE remote control commands and syntax. A typical HELP menu is shown below.

```
ALE > help
Embedded Adaptive commands consist of:
ADDCH       – (Channel Group) (chan)
DELCH       – (Channel Group) (Chan)
SLFADDR     – (Address) (Channel Group)
INDADDR     – (Address) (Channel Group) (Associated Self)
NETADDR     – (Address) (Channel Group) (Associated Self)
ADDMEMB     – (Name) (Member Address)
SOUND       – (STArt, STOp) (Address) (interval hh:mm) (start hh:mm)
EXCHANGE    – (STArt, STOp) (Address) (interval hh:mm) (start hh:mm)
CALL        – (Address) (Chan)
ALLCALL     – (Character if Selective) (Chan)
SCAN        – start scanning        STOP          – manual scanning
INC         – up through scan list  DEC           – down through scan list
DELADDR     – (Address)             MAXCH         – (1 – 100)
TUNETIME    – (1 – 99)              LSTN_BEFORE   – (ON, OFF)
KEY_TO_CALL – (ON, OFF)             RAD_SILENCE   – (ON, OFF)
ERASE       – Clear ALE Callsigns and channels
ZERO        – Clear all ALE memory
The following are valid when NOT Scanning:
MODEM       – (Modem command)       DV            – Dig Voice (ON, OFF)
ENCRYPT     – Dig ENcryption (ON, OFf)
```

6.3 Remote Control Programming

Table 7 is an example of a data file that can be used to program basic RF-5020R/T operation and to program the RF-5121ALE controller. The data file first places the RF-5020R/T into the SSB mode of operation. Channel parameters are then entered and the RF-5110MD High-Speed Modem settings are set for each channel.

Table 7. Remote Control Programming

Comment	File Contents
Set SSB Mode	SSB
Enter channel data for four different channels	NET 01 FREQ 04143600 MODE USB AGC SLOW MODEM TYPE 39 TONE MODEM ASYNC MODEM BAUD 300 MODEM INTER LONG NET 02 FREQ 06223100 MODE USB AGC SLOW
Configuration data	POWER_AMP 125W MDM_INST RF5110 AUTO_INST RF5121
Power amp set	POWER 125
Activate ALE	ALE
Add chans 1–3 to group 1	ADDC 1 01 ADDC 1 02 ADDC1 03
Chans 3–5 to group 2	ADDC 2 03 ADDC 2 04 ADDC 2 05
Chans 5–7 to group 3	ADDC 3 05 ADDC 3 06 ADDC 3 07
Add self address	SLFAD ALPHA 1
Add self address	SLFAD DOBIE 2
Add indiv addr	INDAD BAKER 2 ALPHA
Add net address	NETAD CHARLIE 1 DOBIE
Add members to net	ADDM CHARLIE GEORGE ADDM CHARLIE TIM ADDM CHARLIE KATIE ADDM CHARLIE HQ

The above remote control file performs the following:

Configuration data is entered to enable the internal self test to check installed options against the desired configuration. The power amplifier is set to the 125-watt output setting.

The RF-5020R/T is then placed in ALE mode. Three of the ten possible channel groups are programmed. Channel group 1 is programmed with channels 1, 2, and 3; channel group 2 is programmed with channels 3, 4, and 5; and channel group 3 is programmed with channels 5, 6, and 7.

Next, self, individual, and net addresses are entered. Self address ALPHA, using channel group 1, and self address DOBIE, using channel group 2, are added. Next, individual BAKER, using channel group 2, and self ALPHA are added. Then, net CHARLIE, using channel group 1, and self DOBIE are added. When this station calls individual BAKER it uses channels 3 through 5 and identifies the call as coming from ALPHA. When this station calls net CHARLIE it uses channels 1 through 3, and identifies the call as coming from DOBIE.

Finally, members GEORGE, TIM, KATIE, and HQ are added to net CHARLIE. If not already SCANNING, the R/T begins scanning all channels in all channel groups associated with all self addresses and net addresses which are programmed (i.e. channel groups 1 and 2, or channels 1 through 5). Note that, although channel group 3 is programmed, it is not used in any self or net addresses and, therefore, is not scanned.

6.4 Scan Operation From Remote Control

After the RF-5121ALE Option is programmed, it automatically begins scanning. The word SCANNING is sent to the remote-control device along with other status information. To stop SCANNING and put the R/T into manual operation mode, at the ALE > prompt type:

ALE > STOP

The R/T enters the STOPPED ALE mode. To start scanning again, type after the ALE > prompt:

ALE > SCAN

6.5 Calling From Remote Control

To place a manual ALE call from the remote port, use the CALL command as follows:

ALE > CALL BAKER 3

The above command string places a Manual Call on channel 3 to individual BAKER. To place an automatic call to BAKER:

ALE > CALL BAKER

The ALE option calls individual BAKER using the channels in channel group 2 (channels 3, 4, and 5 as programmed earlier). Assuming a previous LQA to BAKER was performed, the RF-5121ALE Option selects the best of the three channels to call BAKER. If that channel doesn't link, it tries the second best, and finally the third best, if necessary. If more channels were programmed into channel group 2, it would try each of them until a link is made. If a previous LQA was not performed, the LQA option tries the channels in order of highest to lowest frequency.

Finally, the CALL command can be used without any arguments as follows:

ALE > CALL

A CALL command with no arguments calls the last address to which a call was attempted. In the example above, this is a call to BAKER.

In the examples above, a variety of status messages may be sent to the remote terminal, informing the operator of the state of the radio or the call which was placed, such as NO RESPONSE, LINK, NO LAST CALL, etc. When a link is established, an audible tone is heard at both the initiating and destination stations.

Any operator error message or run-time fault message that is displayed on the front panel is also displayed on the remote control terminal. In addition, several other remote-only messages (see table 2) may appear.

6.6 Initiating a Link Quality Analysis

Both LQA SOUNDs and EXCHANGEs can be started and stopped from the remote port. A typical SOUND START command string from the remote port is:

ALE > **SOU STA ALPHA 00:00 10:00**

The above string queues a sound request to start at 10:00. It does not repeat since the specified interval time is zero. If repetition of the sound is required, a non-zero interval time should be specified. If the sound is to be done immediately, both the start time and interval time should be specified as zero.

A typical LQA exchange command string from the remote port is:

ALE > **EXCH STA CHARLIE 02:00 11:00**

This queues an LQA exchange with all the members of net CHARLIE, starting at 11:00 and repeating every 2 hours. Channel quality for all channels used by all members of the net is evaluated. To do the exchange only once at 11:00, specify the interval time as 00:00. To do an immediate, one-time exchange, set both the interval and start times to 00:00.

To stop a queued sound to CHARLIE, use:

ALE > **SOU STO CHARLIE**

To stop a queued Exchange to CHARLIE, use:

ALE > **EXCH STO CHARLIE**

To report the current LQA programming, type at the ALE > prompt:

ALE > **SOU**

or

ALE > **EXCH**

Both provide the same information. It is not possible to view LQA channel scores.

7. BUILT-IN TEST EQUIPMENT (BITE)

To initiate a Built-In-Test (BIT), place the front-panel function switch in the TST position, or enter the TEST command from the remote–control terminal. Wait until either a fault is found or a TEST PASSED message appears. BIT takes about 5 seconds to complete. Table 8 explains the BIT failure codes.

In addition to BIT, the R/T continuously monitors for run-time faults during normal operation. Table 9 lists the run–time fault messages. Run-time faults can occur at any time, and are usually recoverable, although some may be caused by hardware problems which can be identified by running BIT.

Table 8. RF-5121ALE Option BIT Failure Codes

Module Number	Failure Code	Description
A05	1	Communications. RF–5121ALE Module does not respond to any command sent to it over the RF–5020R/T communication bus.
	2	8051 Microprocessor (internal RAM failure)
	3	8051 Code ROM failure, invalid checksum
	4	8051 External RAM failure
	5	8051 to 80186 Dual–Port RAM failure (8051 side)
	6	80186 to 8051 Dual–Port RAM failure (80186 side)
	7	Communications failure between 8051 and 80186. 8051 is unable to communicate with 80186.
	8	General TLC32044 AIC failure (U10)
	9	General TMS320C25 DSP failure (U6)
	10	80186 External RAM failure
	11	Signal Processor BIT Timeout failure. DSP processor failed to complete BIT in allotted time.

Table 9. RF-5121ALE Option Run-Time Fault Messages

Fault Message	Description
ALE MEMORY LOST	Indicates the battery–backed ALE tables are corrupted or have been ZEROIZED. Stored data must be reentered.
NO CHANS TO SCAN	Scanning was attempted but no channels were entered into the Channel Groups associated with the programmed selfs and nets.
NO DEFAULT SELF	The required default self address was not programmed as the first self address.
IND NOT PROGRMD	There are no individual addresses programmed.

8. GLOSSARY

The following is a list of terms and abbreviations used in this section.

Term or Abbreviation	Description
Adaptive Controller	A generic name for a device which automatically chooses the best channel for communications.
Address	A group of alphanumeric characters used to identify individual stations, Nets, or Groups. An address can be any string (except ALL) from one to 15 characters in length.
Allcall	A unidirectional broadcast made to all stations scanning on a given channel in which no response signals are required from the Target Stations.

Term or Abbreviation	Description (Cont.)
Anycall	A call made to all stations scanning on a given channel in which responses are required from the Target Stations.
Associated Self	A Self Address used in programming a Net.
Automatic Call	A call in which the best available channel is selected by the ALE.
Automatic Frequency Control (AFC)	(As in the RF-5120AFC) A technique that uses binary FSK signalling to automatically establish communications on the best available channel among two or more stations.
Automatic Link Establishment (ALE)	(As in the RF-5121ALE) A technique that uses MIL-STD-188-141A-specified octal FSK signalling to automatically establish communications on the best available channel among two or more stations.
Automatic Message Display (AMD)	An engineering orderwire message, up to 87 ASCII characters in length, sent to an Individual, Net or Group.
Bidirectional LQA	An LQA technique which involves two-way messages sent between two stations on all common channels. Channel rankings are established based on received signal quality.
Bit Error Rate (BER)	An evaluation of the ability of a channel to pass error-free data information.
Calling Station	The station initiating a call to a Target Station.
Channel	A programmed combination of frequency and mode of transmission.
Channel Group	A programmed collection of channels. Up to ten Channel Groups can be programmed, each containing up to 100 channels.
Channel List	A list of channels a given station is programmed to scan.
Channel Score	A rating of overall channel quality.
DSP	Digital signal processor.
Double Selective Anycall	An Anycall made to all stations whose addresses end in the same two characters.
Data Text Message (DTM)	An engineering orderwire text message sent to a Target Station using an automatic repeat (ARQ) protocol to ensure error-free reception of the message.
Exchange	An LQA technique which involves two-way messages sent between two stations on all common channels. Channel rankings are established based on received signal quality.
Group	A programmed collection of stations. The programming of the Group is done only at the calling station. It is not necessary for Target Stations to know they are members of a Group.

Term or Abbreviation	Description (Cont.)
Group Address	An address used to refer to a Group.
Group Call	A call from an individual station to members of a Group. Group members respond in the order in which they are called by the initiating station.
Group LQA	A Group Call in which the originating and Target Stations exchange link quality information. The originating station obtains bidirectional LQA information. Target Stations get information only on their receive paths.
Individual Address	An address used to identify a single Target Station. The same character string is used as the Self Address when acting as a Calling Station.
Individual Call	A call placed to a single Target Station using an Individual Address. Each station must be programmed with the Address and Channel List of the other station before initiating the call.
Link Quality Analysis (LQA)	A signal measurement technique used to establish the best channel for communication on the basis of SINAD and Bit Error Rate.
Listen Before Transmit (LBT)	A feature which samples the incoming signal before transmitting. If ALE traffic is detected, the unit steps to the next logged channel without transmitting.
Manual Call	A call in which the channel is selected by the user.
Net	A programmed collection of stations. The Net must be similarly programmed in all Net members.
Net Address	An address used to identify members of a Net.
Net Call	A call from an individual station to members of a Net. Each Net member is assigned a response slot. All stations in the Net must be programmed with Network information.
Net LQA	A Net Call in which the originating and Target Stations exchange link quality information. The originating station obtains bidirectional LQA information. Target Stations get information only on their receive paths.
Queued LQA	An Individual, Net, or Group LQA which is repeated at operator-specified intervals.
Radio Silence	A feature which prevents response to incoming calls or LQA requests.
Score	A rating of overall channel quality.
Selective Allcall	An Allcall made to all stations whose addresses end in the same character.
Selective Anycall	An Anycall made to all stations whose addresses end in the same character.

Term or Abbreviation	Description (Cont.)
Selective Calling	Calls made to a subset of the stations in a system. See Selective Allcall, Selective Anycall, Double Selective Anycall, and Wildcard Call.
Self Address	An address used to identify a Calling Station. A station may have more than one Self Address. The same character string is used as the Individual Address when receiving calls as a Target Station.
SINAD	A ratio of (signal + noise + distortion) to (noise + distortion) used to measure the signal quality of a communication channel. SINAD is commonly used to evaluate the ability of a channel to pass voice traffic.
Sounding	An LQA technique which involves sending a one-way message on all channels programmed for a Self Address. Target Stations establish channel rankings based on received signal quality.
Target Station	A station called by a Calling Station.
Wildcard Call	A feature which allows substitution of a wildcard character (?) for alphanumeric characters in Addresses used in making Selective Anycalls. Wildcard Calls permit Selective Calling based on Address similarities other than the last or last two characters.
Zeroize	A command sequence which erases all programmed channel parameter and option settings.

Programming Worksheet for Establishing a Net

NET	NET ADDRESS	CHANNEL GROUP	ASSOCIATED SELF	NET MEMBERS (INDIVIDUAL ADDRESSES)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

RF-5130LPC OPTION

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RF–5130LPC DIGITIZED VOICE OPTION

1. GENERAL

The RF–5130LPC Digitized Voice plug–in option provides digital voice capability in both single–channel and frequency–hopping modes. Speech is digitized using the U.S. DOD LPC–10E (Version 52) 2400–bit–per–second algorithm. In the frequency–hopping mode, the 2400–bps data rate is reduced to 800 bps using vector quantization, resulting in a slight voice quality degradation.

Digital voice operation requires an H–250 handset, as well as the RF–5110MD. The RF–5140FH Frequency Hopping Module option is required for digital voice operation in the frequency hopping mode.

2. INSTALLATION

When ordered with the RF–5020R/T, the RF–5130LPC (linear predictive coding) Module is installed at the factory, and the user must only enable or disable the option via front–panel control or remote control.

2.1 Unpacking and Inspection

The RF–5030LPC Module, shown in figure 6–1, is installed in the A9 module location of the RF–5020R/T chassis as follows:

a. Remove power from the RF–5020R/T by turning the front–panel FUNCTION control to the PWR OFF position.

b. Disconnect the cable from the power amplifier control connector (J6) located on the rear panel of the R/T chassis.

c. Loosen the six screws (captive hardware) securing the top cover of the R/T and remove the top cover.

d. Disconnect the ribbon cable connecting the Interface Module (A8) and the rear–panel filter board.

e. The RF–5030LPC module has two card clamps, one on each side of the module. To install or remove the module, the lever on the top of both clamps MUST be in the up (vertical) position.

CAUTION

The levers on the clamps must be in the up (vertical) position when installing or removing any module. The clamps expand when the levers are in the down (horizontal) position mechanically clamping the module to the chassis. Physical damage to the module may result if the module is forced into position.

f. Slowly insert the RF–5030LPC Module in the A9 slot with the metal plate facing the rear of the RF–5020R/T chassis.

g. With the clamp levers in the up (vertical) position, insert the module into the A9 slot until it is fully seated.

h. Move the clamp levers to the down (horizontal) position.

i. Carefully attach the RF–5030LPC connector to the RF–5020R/T motherboard connector.

j. Replace the top cover and carefully tighten all six screws. Care should be exercised to ensure the cover gasket is properly seated.

k. Reattach the power amplifier control cable to J6 of the R/T chassis.

l. Turn on the RF–5020R/T by placing the FUNCTION control in the SSB position.

m. On the RF–5020R/T's front panel, enter "50 PRGM" and enable the RF–5130LPC installation using the up ARROW key.

n. Press the ENTER key to return to the normal display and complete the installation.

3. DIGITIZED VOICE OPERATION

After proper installation, digitized voice can be turned on and off by pressing the front–panel MODE key until the "DV" option appears in the display. Use the up (or down) ARROW key to select the proper "DV" mode and press the ENTER key to activate the selection and return to the normal display.

The Digitized Voice Option requires that either the RF–5110MD or the RF–5140FH option be installed in the RF–5020R/T. Enabling Digitized Voice mode as described above automatically programs the modem for digitized voice operation.

The R/T is now ready to transmit digitized voice generated at either the front–panel microphone or the rear–panel auxiliary 600–ohm port. After the radio is keyed, two beeps are generated signifying that the radio is achieving digitized voice synchronization. The operator must wait for the second "beep" before beginning the voice message. A 0.75–second voice throughput delay is introduced by the transmitting and receiving Modem and Digitized Voice modules. The operator must wait slightly longer for a response from the remote operator. Experienced operators easily overcome the slightly longer delay.

3.1 Digitized Voice Performance

The RF–5130LPC algorithm provides intelligible speech in random bit error rates up to two percent. A synchronization pattern embedded in the transmitted data allows the receiving digitized voice module to detect severe bit error rate conditions and squelch the audio output, rather than provide the objectionable audio that results from high bit error rates. **Squelch breaking should not be misconstrued as an RF–5130LPC module fault.**

The H–250 handset should always be used when operating with the RF–5130LPC. The handset should be held such that the microphone is not more than 2.5 cm (1 inch) from the speaker's mouth. A greater distance affects digitized voice quality.

3.2 Digital Squelch

The RF–5130LPC option allows the possibility of a digital squelch, which is enabled or disabled by pressing the RF–5020R/T's front–panel MODE key until "SQUELCH ON/OFF" appears in the display. The up or down ARROW key is used to select ON or OFF, and pressing the ENTER key activates the selection.

With the Digitized Voice Option enabled, enabling the squelch option mutes the audio output until a valid digitized voice message is being received. This eliminates the objectionable noise rushing that occurs in SSB analog voice mode when the AGC circuits attack on the noise after the end of message.

Disabling the squelch option allows reception of either normal SSB audio or digitized voice; however, the beginning of each digitized voice message reception is marked by the modem preamble. A potential application of this mode is automatic cipher text or plain text audio reception.

3.3 Built–In–Test

The RF–5130LPC module provides full built–in test capability that is compatible with the other RF–5020R/T modules. Faults display as A9 faults.

RF-5140FH OPTION

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RF-5140FH FREQUENCY-HOPPING OPTION

1. GENERAL

The RF-5140FH Frequency-Hopping Module provides frequency hopping in programmable bands up to 2-MHz wide. The hopping bandwidth is programmable using a dedicated hop set list (LIST), a center frequency (narrow-band), or a programmable frequency range (wide band). In the ECCM mode, transmission of computer data up to 300 bps with error correction is supported.

When the RF-5020 R/T FUNCTION control is placed in the HOP position, the RF-5140FH ECCM Frequency Hopping module is enabled. This mode is disabled by moving the FUNCTION control out of the HOP position. The Frequency Hopping Module may also be enabled or disabled by remote control.

2. PROGRAMMING - HOPPING PARAMETERS

This section discusses programming frequency-hopping parameters from the RF-5020R/T front panel. Programming by remote control is discussed later in this section.

NOTE

Before programming frequency-hopping parameters, verify that the bandwidth of all antenna systems to be used within a net are able to support the programmed net bandwidth.

Similar to SSB, there are two main programming levels in the HOP sequence: program group and operating parameter.

The PROGRAM GROUPS for frequency hopping are:

- HOP NETS - Allows nets 0 through 9 (10 nets) to be set for wide-band or narrow-band frequency hopping or allows settings from a frequency list.
- EXCLUSION BANDS - Specifies a range of frequencies that cannot be used during hopping.
- HOP CONFIG - Allows for selecting a data port mode, output power level, and encryption key.
- ZEROIZE - Allows operator to zeroize (erase) all programmed settings for all modes.

NOTE

The ZEROIZE command should be used with caution. Once erased, setting cannot be recovered.

Table 1 lists the program groups and operating parameters for frequency hopping programming.

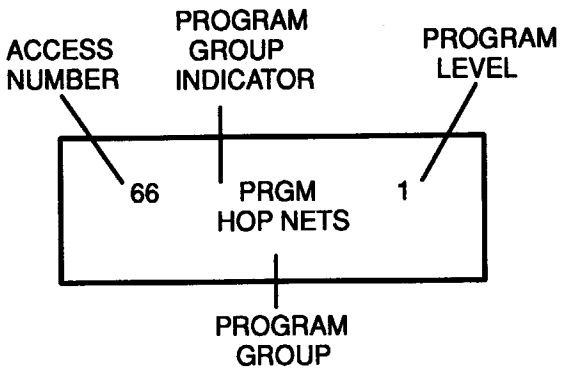
Table 1. Frequency Hopping Program Levels

Program Group (First Level)	Access No.	Operating Parameter	Access No.
HOP NETS	66		
		Delete Net	67
		Net ID	68
		Hop Type	69
		Hop Frequency	70
EXCLUSION BANDS	71		
		Delete All	72
		Exclusion Band	73
		Delete Band	74
		Exclusion Program	75

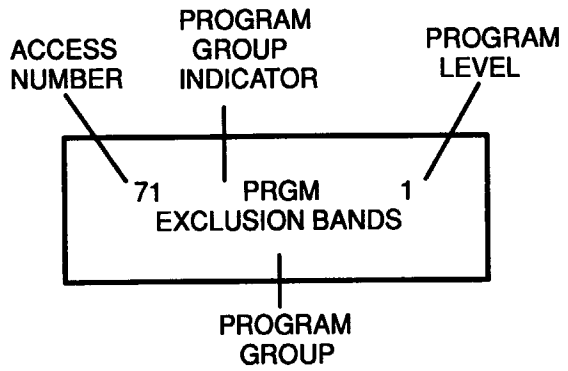
Table 1. Frequency Hopping Program Levels (Cont.)

Program Group (First Level)	Access No.	Operating Parameter	Access No.
HOP CONFIG	76		
		Data Port	77
		Power	78
		Select Key	79
ZEROIZE	99		99

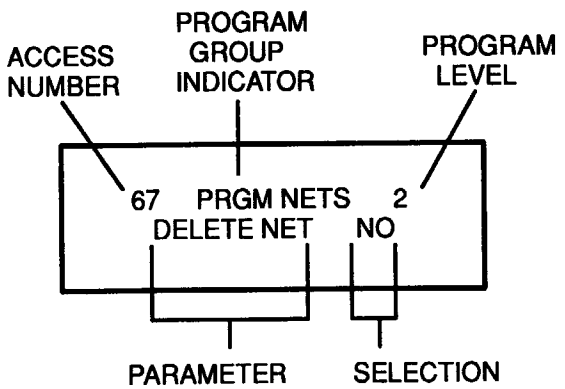
In summary, while the RF–5020 R/T is in HOP mode, repeatedly pressing the PRGM key causes the display to scroll through the program groups. An example of a first–level program group display is shown below.



To advance the display to the next program group, press the PRGM key.



To access the second–level menu of a program group, press the ENTR key.



To select a different operating parameter, use the arrow keys (or keypad, if appropriate) to scroll through the selections and then press the ENTER key. This stores the displayed value and advances the display to the next programmable parameter.

2.1 66 PRGM – HOP NETS

The HOP NETS parameters allow an operator to establish the characteristics which define the net. These include:

- Deleting a Net
- Selecting Net ID
- Choosing a Hopping Type
- Selecting the Frequencies

All of the HOPNETS parameters need to be programmed at one time and cannot be programmed individually.

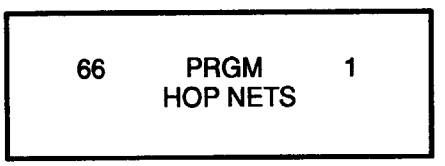
HOP NETS are numbered 0, 1, 2 . . 9 with Net 0 referring to the M position on the NET control. All of the HOP NETS programming functions are discussed below.

When determining the parameters that define a net, it is important to remember that all radios in a net must have the same:

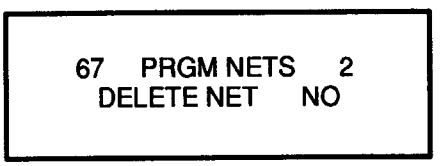
- Net ID
- Hop Type
- Frequency Range
- Exclusion Bands

a. With the FUNCTION control in the HOP position, set the NET control to the desired net (M, 1, 2, . . . 9).

b. Press PRGM until the following display appears:



c. Press ENTR until DELETE NET NO appears on the display. (Use the ARROW keys to toggle between DELETE NET YES and DELETE NET NO.)



d. Press the ENTR key and NET 0 appears on the display.

The NET ID is an eight–digit code that determines the pseudorandom hopping patterns. All radios on a net must have the same NET ID.

```
68  PRGM NETS  2
  NET ID 00000000
```

e. Use the numeric keypad to enter the eight–digit NET ID.

f. Press the ENTR key and HOP TYPE appears.

```
69  PRGM NETS  2
  HOP TYPE = NB
```

Each net can be set for one of the following HOP TYPES:

- Wide Band (WB)
- Narrow Band (NB)
- Frequency List (LIST)

NOTE

When an antenna coupler is in use, only narrow band hopping nets may be programmed.

Use the arrow keys to scroll through the selections until the appropriate HOP TYPE appears, and then press ENTR.

For wide–band nets follow this procedure.

a. With WB selected as the HOP TYPE, press ENTR.

b. Use the numeric keypad to select the lower–limit frequency. For example, to hop in the band between 2 MHz and 3 MHz, enter 02.000 as the lower–limit frequency.

NOTE

The selection can be made anywhere in the 1.6 to 30 MHz range, but must always be in multiples of 5 kHz; i.e., 01.605, 01.610, etc.

c. Press ENTR:

```
70  PRGM NETS  2
  HI LIMIT = 00.0000
```

d. Use the numeric keypad to enter the upper limit of the frequency for the hop band. In the example listed above, 03.000 is the upper limit frequency.

e. Press ENTR.

Note that the hop band must be at least 140-kHz wide. If exclusion bands affect any part of the hop band, it may be necessary to make the hop band wider since the usable frequency range must be adequate to allow for 15 frequencies at 10-kHz spacing. (See exclusion band programming, paragraph 2.2.)

The maximum size of the hop band is 2 MHz.

For narrow-band nets follow this procedure.

a. With NB selected as the HOP TYPE, press ENTR:

```
70  PRGM NETS  2
HOP FREQ = 00.0000
```

b. Use the numeric keypad to select the center frequency for the hop band. The selection of the center frequency must always be in multiples of 5 kHz with the minimum allowable frequency being 1.650 MHz.

c. Press ENTR.

Follow this procedure for LIST HOP Nets.

a. With LIST selected as the HOP TYPE, press ENTR:

```
69  PRGM NETS  2
HOP TYPE =  LIST
```

b. Press ENTR:

```
70  PRGM NETS  2
ADD FREQ = 00.0000
```

c. Enter the specific list of frequencies, using the ENTR key after each selection to add the frequency to the list.

d. When the list is complete, press PRGM. The display then returns to normal hopping operation.

NOTE

LIST HOP frequencies must be in multiples of 5 kHz. 2 MHz is the maximum frequency range. A minimum of 15 and maximum of 100 frequencies can be entered.

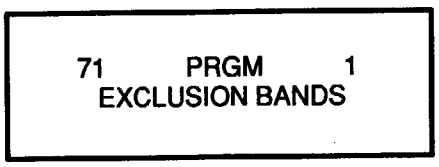
The order in which frequencies are entered is not important since they are sorted when they are stored. Duplicate frequencies are automatically removed from the list.

2.2 71 PRGM – Exclusion Bands

An exclusion band specifies a range of frequencies that cannot be used during hopping mode. Each exclusion band affects all wide band nets. Exclusion bands do not affect narrow band or list nets. A maximum of ten exclusion bands (0, 1, 2, . . . 9) can be programmed.

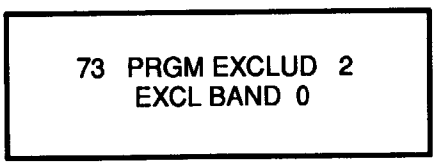
To program an exclusion band:

a. Press PRGM until the following display appears:



b. Press ENTR:

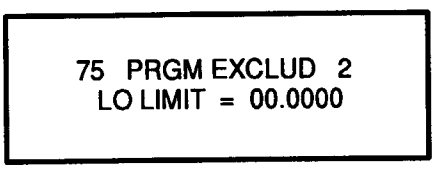
c. Press ENTR:



d. Use the numeric keypad or the up/down arrows to select the number of the exclusion band (0, 1, 2, . . . 9) to be programmed. The band number appears in the lower right corner of the display.

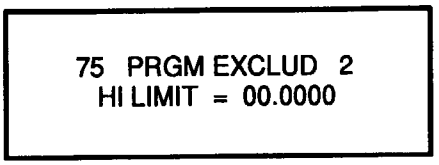
e. Press ENTR:

f. Press ENTR:



g. Use the numeric keypad to enter the lower–limit frequency of the exclusion band (in multiples of 5–kHz steps).

h. Press ENTR:



i. Use the numeric keypad to enter the upper–limit frequency of the exclusion band (in multiples of 5–kHz steps).

j. Press ENTR. Programming of this exclusion band is now complete and the display returns to normal hopping operating mode.

2.2.1 72 PRGM – Deleting All Exclusion Bands

The DELETE ALL command allows removal of all programmed exclusion bands. To delete all exclusion bands:

a. Press the PRGM key until the following display occurs.

b. Press ENTR:

c. Use the ARROW keys to toggle between DELETE ALL YES and DELETE ALL NO.

d. To delete all exclusion bands, press the ENTR key when DELETE ALL YES displays.

2.2.2 74 PRGM – Delete Band

The DELETE BAND command allows the removal of an exclusion band.

a. To delete a band, press the PRGM key until the EXCLUSION BANDS display occurs.

b. Press ENTR three times.

c. Enter the exclusion band number and press the ENTR key. The band number appears in the lower right–hand corner of the display.

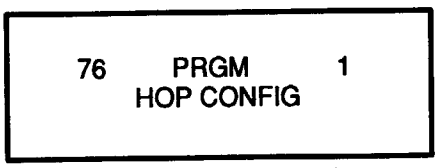
d. Press enter and DELETE BAND NO appears.

e. Use the ARROW keys to toggle between DELETE BAND YES and DELETE BAND NO.

f. To delete a band, press the ENTR key when DELETE BAND YES displays.

2.3 76 PRGM – HOP CONFIG

The parameters that can be programmed under the HOP CONFIG menu are: data port mode (synchronous or asynchronous), output power level (only if a PA is connected), and encryption key.



2.3.1 77 PRGM – DATA PORT

The DATA PORT command allows synchronous and asynchronous data terminal equipment to be connected to the radio.

a. Press PRGM until HOP CONFIG displays.

b. Press the ENTR key until DATA PORT appears on the display.

c. Use the ARROW keys to toggle between SYNC and ASYNC.

d. When the desired data port mode is displayed, press the ENTR key.

2.3.2 78 PRGM – POWER

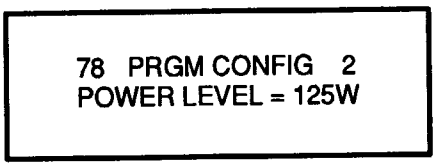
a. Press PRGM until HOP CONFIG displays.

b. Press ENTR.

c. Press PRGM until the POWR LEVEL appears on the display.

d. Use the ARROW keys to select the power level.

e. When the desired power level is shown on the display, press the ENTR key.



For units with both the RF–5140FH Frequency Hopping Module and the RF–5150DE Digital Encryption Module installed, refer to the Digital Encryption section for more details.

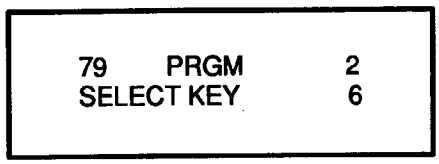
2.3.3 79 PRGM – SELECT KEY

Six encryption keys can be programmed into the unit via the front panel in SSB mode or via the Field Code Programmer. While in HOP mode, one of the six keys can be selected as the current key.

a. Press PRGM until HOP CONFIG displays.

b. Press ENTR.

c. Press PRGM until KEY NUMBER displays.

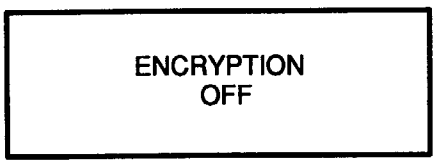


d. Enter the desired key number (1 through 6) on the numeric keypad. The number is displayed on the right side of the lower line of the display.

e. When the desired key number is shown on the display, press ENTR.

2.4 Activating/Deactivating Encryption

To activate or deactivate the encryption mode:

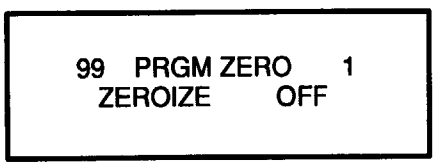


a. Press the MODE key until the top line of the display reads ENCRYPTION.

b. Use the arrow keys to toggle between ON and OFF.

c. When the desired encryption mode is displayed, press the ENTR key.

2.5 99 PRGM – ZEROIZE



The ZEROIZE command causes the RF–5020R/T to erase all of the programmed channel parameter and option settings. To minimize the chance of an accidental erasure, a command sequence is required:

To cancel the ZEROIZE command sequence.

a. Press PRGM to advance the display to the AUTOLINK GROUP.

b. Press CLR to return to the normal hopping operating mode.

To initiate the ZEROIZE command sequence.

a. Press PRGM repeatedly to advance to the ZEROIZE command.

b. Use the ARROW keys to scroll the display between OFF and ON.

c. Select ON and press the ENTR key to zeroize the RF– 5020R/T.

d. Select OFF and press the ENTR key to terminate the zeroize sequence (or press the CLR key).

NOTE

The RF–5020 R/T must be reprogrammed after a ZEROIZE sequence has been performed.

3. COMMUNICATING IN HOPPING MODE

If one or more nets have been properly programmed, the system is ready to operate in hopping mode. The following subparagraphs discuss initial synchronization (forming a net), sending and receiving data and voice traffic, late net entry, and dissolving the net.

3.1 Initial Synchronization: Forming A Net

Moving the FUNCTION control into the HOP position puts the system in hopping mode. The system uses parameters that have been programmed for the net that is currently selected by the NET control. In order for two or more units to communicate, each must be operating using identical net parameters.

When the FUNCTION control is first moved into the HOP position or when the NET control is first moved into a new position, the top line of the display reads NO SYNC. Whenever NO SYNC is displayed, the unit must go through the initial synchronization process before it can communicate with other units. The initial sync process is the method by which two or more units are synchronized and form a net. It is also the method by which a unit is synchronized with other units which are already part of an existing net (see Late Net Entry, paragraph 3.3).

NOTE

If a coupler is used in the system, it is tuned at this time to the center frequency of the net.

One operator should be designated the net coordinator. (This designation is left to the operators. Any R/T system can be operated as a net coordinator at any time without any programming required.) The initial synchronization process is as follows:

a. In order to enter a net, the operator first presses the SYNC button. At this time the R/T transmits a Sync Request message and displays SENDING SYNC REQ. The Sync Request message is two seconds long and can be received by all units which are in Hop mode and operating with the identical net parameters as those used by the unit which sent the request.

b. If the Sync Request is received properly by a unit, SYNC REQUEST RCV is displayed and speaker tones are sounded to alert the operator.

c. At this time, it is the responsibility of the net coordinator to respond to the Sync Request. The net coordinator must push the SYNC button within five seconds of the receipt of the Sync Request.

d. When the net coordinator pushes the SYNC button, the R/T unit displays the message SENDING SYNC RSP and, seven seconds from the time the Sync Request was received, starts transmitting a Sync Response Message. The Sync Response message is 20 seconds long.

e. If the entire Sync Response is properly received, IN SYNC is displayed. A net has now been formed and the operators can pass traffic. If the Sync Response is not received, SYNC FAILED displays. The net coordinator always assumes that the Sync Response is received by the R/T and displays IN SYNC. The entire process must be repeated if the units fail to sync.

The system also has a feature called Passive Sync. This allows other units to synchronize simultaneously with these first two units without operator intervention. During the process described above, any other unit which is in hop mode and operating with the same net parameters acquires sync and enters the net if it receives the Sync Request and Sync Response messages sent by the first two units. No action is required by the operators of these passive units.

After 24 hours, the unit will declare sync loss and display NO SYNC. Therefore, to remain constantly in sync, the initial synchronization process must be repeated once per day. This is discussed in paragraph 3.6, Dissolving the Net.

3.2 Loss of Net Synchronization: Reforming the Net

If the unit displays IN SYNC, but communication with other units is not working, the units may no longer be in sync. Other units may have declared sync loss for various reasons (see paragraph 3.6). If this is the case, the initial sync process must be executed again. The unit must first be taken out of sync by moving the NET control out of the current position and then back into that position (see paragraph 3.6). Now the operator can initiate the sync process by pressing SYNC (see paragraph 3.1, Initial Synchronization).

3.3 Late Net Entry

Once two or more units have acquired sync and formed a net, additional units can enter the net by executing the identical initial sync sequence (see paragraph 3.1). That is, the operator who wishes to enter the net presses SYNC to initiate transmission of the Sync Request and the net coordinator operator responds by pressing SYNC to initiate transmission of the Sync Response.

3.4 Sending and Receiving Data Messages

Once two or more units have formed a net, data messages can be sent using the same method as is used in single-channel operation. The only selectable data rates for hopping mode are 75, 150, and 300 bps. When the RTS input to the unit is activated, the transmitter is keyed and accepts data from the DTE for transmission. At the receive end, the unit automatically determines that the message is a data message and detects the data rate. The receive unit outputs the demodulated data to the DTE. There are no long preamble or synchronization delays associated with these messages.

3.5 Sending and Receiving Voice Messages

Once two or more units have formed a net, voice messages can be sent and received if they are equipped with Digital Voice Modules. At the transmit end, when the mic keyline or the audio keyline is activated, the unit assumes that a digitized voice message is being sent. The mic or audio input is digitized and transmitted. At the receive end, the unit automatically determines that the message is a digitized voice message and demodulates it accordingly. There are no long preamble or synchronization delays associated with these messages.

3.6 Dissolving the Net

When a unit is in a net and displaying IN SYNC, it declares loss of sync and displays NO SYNC as a result of any of the following occurrences:

a. A time period of 24 hours has elapsed since the unit entered the net. Since different units may enter the net at various times, other units may still display IN SYNC; however, these other units are not able to pass traffic with the unit displaying NO SYNC. Sync loss is declared after 24 hours because the accuracy of the unit's internal clock does not guarantee synchronization beyond this interval.

b. The NET control position is changed. When the NET control position changes, the unit assumes that new net parameters are to be used and it loses sync with the previous net.

c. The FUNCTION control position is changed. When the switch position changes, the unit assumes that hopping communications have been terminated and it loses sync with the previous net.

d. The unit is powered off. When the unit is again powered up in HOP mode, it is no longer in sync .

4. SYSTEM MESSAGES

When the unit is in HOP mode (and not in PRGM mode), the top line of the display shows one of the following messages. The first two, IN SYNC and NO SYNC, are operational messages. The remaining messages indicate error conditions.

- IN SYNC — The unit has entered a net.
- NO SYNC — The unit is in HOP mode, but has not been synchronized with other units and entered a net.
- NO HOPSET* — This display occurs when no frequency parameters have been programmed for the net number that is currently selected.

*When this error message displays, initial net synchronization cannot be initiated.

- NO NET ID* — This display occurs if a Net ID has not been programmed for the net number that is currently being selected.
- WB INVALID* or LIST INVALID* — One of these displays occurs if the currently selected net is a wide band or list net and an antenna coupler is currently part of the system. (Only narrow band nets can be operated with an antenna coupler.)
- BAD HOPSET* — This display occurs if the frequency parameters programmed for the currently selected net number are invalid.

  Wide Band Nets: The usable frequency range must provide for 15 frequencies at 10–kHz spacing. With no exclusion bands, this means that, at a minimum, a 140–kHz band is required. BAD HOPSET also displays if the difference between the upper and lower boundary frequencies is greater than 2 MHz (independent of exclusion bands).

  Frequency List: This error message occurs if fewer than 15 frequencies are programmed or if the difference between the highest and lowest frequencies in the list is greater than 2 MHz.

*When this error message displays, initial net synchronization cannot be initiated.

5. REMOTE CONTROL OPERATION

Full remote control operation and programming of the frequency hopping module is supported by the RF–5020 R/T. The remote control commands, menus, status, and HELP screen are similar to those used in single channel (SSB) operation.

5.1 SHOW Menu

Entering SHOW provides a status listing of the RF–5140FH ECCM Frequency Hopping module. The command can be used to monitor frequency hopping operation and to confirm system configuration. A typical SHOW menu is shown below.

```
HOP > SHOW

HOP > Net 01
Key Off

HOP > NetID  01  11223344
Hoptype 01 WB
Hopset 01 020000  030000
Hopnum 0101
Cur_key 99*
No_Sync
Exclusions**
```

* Displayed if RF–5150DE Digital Encryption Option is installed.
** Displayed if exclusion band(s) present.

5.2 HELP Menu

Entering HELP provides a status listing of the RF–5140FH remote control command and the structure of the commands. A typical HELP menu is shown below.

```
HOP > HOP HELP

RF–5000 Hopping remote control commands consist of:

ALE      –  adaptive HF mode                          AUDio     –  (0DBm, –10DBm)
DISplay  –  display all nets, (0..9)  display one net
ENCR     –  (on/off) encryption                       ENC_KEY   –  (1..6)  (12 digit key)
EXClude  –  (0..9) (lower limit) (upper limit)
EXClude  –  (0..9) DELete removes one exclusion band
EXClude  –  DELete removes all exclusion bands
HElp     –  display this message
HOPList  –  (0..9) (ADD) (freq) (freq) ...            ** List **
HOPList  –  (0..9) (DELete) (freq)                    ** List **
HOPSet   –  (0..9) (lower limit) (upper limit)        ** WB **
HOPSet   –  (0..0) (center freq)                      ** NB **
HOPSet   –  (0..9) DELete
HOPType  –  (0..9) (WB/NB/LIst)
MODEM    –  (ASYnc/SYnc) (BAud (75/150/300))
NET      –  (0..9)
NETID    –  (0..9) ( 8 digit code)                    POWer     –  (5..1K)
SHow     –  show status                               SSB       –  single channel mode
SYnc     –  send sync request or sync response
TIme     –  (hh:mm:ss)                               USE_KEY   –  (1..6) encrypt key
ZERO     –  clear channel memory
```

5.3 Enter/Exit HOP Mode

To enter HOP mode, type HOP. To exit, at the HOP prompt, type SSB (for single channel), ALE (for Automatic Link Establishment).

5.4 Net Selection and Display

To select a net, enter the NET command followed by the two–digit net number.

HOP>net 04

To display the currently selected net, enter NET. The two–digit net number displays:

HOP>net

NET 04

5.5 Programming Nets

5.5.1 Programming Net ID

To program the Net ID, enter the NETID command, followed by the two–digit net number, and finally the eight–digit Net ID:

HOP>netid 01 12345678

5.5.2 Displaying Net ID

To display the Net ID parameter currently programmed for a net, use the same command as is used to program the Net ID except do not specify the Net ID. The system responds by displaying the current Net ID as shown:

HOP>netid 04

NET ID 04 12345678

5.5.3 Programming Hop Type

To program HOPTYPE, enter the HOPTYPE command followed by the two–digit net number and the hop type:

HOP>hoptype 04 WB

5.5.4 Programming Frequency Parameters (HOPSET) for Wide–Band Net

To program frequency parameters for a wide–band net, enter HOPSET followed by the two–digit net number. The second parameter is the lower boundary frequency followed by the upper boundary frequency. (Trailing zeros can be omitted so that 02 is interpreted as 2 MHz and 2 is interpreted as 20 MHz.)

HOP>hopset 04 03005 04000

5.5.5 Programming Frequency Parameters (HOPSET) for Narrow–Band Net

To program frequency parameters for a narrow–band net, enter HOPSET followed by the two–digit net number. The second parameter is the center frequency. (Trailing zeros can be omitted so that 02 is interpreted as 2 MHz and 2 is interpreted as 20 MHz.)

HOP>hopset 06 04555

5.5.6 Programming Frequencies (HOPLIST) for Frequency List Net

To add a frequency to the HOPLIST for a frequency list net, enter HOPLIST, followed by the two–digit net number. This is followed by the ADD command and the frequency to be added.

HOP>hoplist 08 add 01600

5.5.7 Removing Frequencies from a Frequency List Net

To delete a frequency from the HOPLIST for a frequency list net, enter HOPLIST, followed by the two–digit net number. This is followed by the DELETE command and the frequency to be deleted.

HOP>hoplist 08 delete 01600

5.5.8 Displaying Frequencies (HOPLIST) for Frequency List Net

To display the frequencies in the HOPLIST for a frequency list net, enter HOPLIST, followed by the two–digit net number. If the net number is omitted in the command, the currently selected net number is used. The next parameters displayed are the frequencies currently in the list.

HOP>hoplist 08

HOPLIST 08 01600 01605 01610 01615 01620 01625 01630 01635 01640
01645 01650 10655 01660 01665 01670

5.5.9 Displaying Net Parameters

To display currently programmed net parameters, enter DISPLAY followed by the two–digit net number. If the net number is not specified, information is displayed for all ten nets.

HOP>display 04

NET ID 04 12345678

HOPTYPE 04 WB

HOPSET 04 02000 03000

The NET ID is shown in the same way as it is displayed as the result of a NET ID command.

HOPTYPE is specified as WB, NB, or LIST

HOPSET specifies the net number followed by the lower and upper limit frequencies for wide band or by the net number followed by the center frequency for narrow band. If the specified net is a Frequency List net, the current HOPLIST appears.

5.5.10 Deleting Nets

To delete a net, enter HOPSET, followed by the two–digit net number and DELETE. Upon receiving this command, the parameters currently programmed for the specified net are erased.

HOP>hopset 04 delete

5.6 Exclusion Bands

5.6.1 Programming Exclusion Bands

To program an exclusion band, enter EXCLUDE followed by the two–digit exclusion band number. The second parameter is the lower boundary frequency and the third is the upper boundary frequency.

HOP>exclude 04 03005 03030

5.6.2 Deleting Exclusion Bands

To delete an exclusion band, enter EXCLUDE, then the two–digit exclusion band number, followed by the DELETE command.

HOP>exclude 04 delete

5.6.3 Displaying Exclusion Bands

To display exclusion bands, enter EXCLUDE. Parameters are displayed for all of the ten exclusion bands that are currently programmed. For each band, the first parameter displayed is the number of the exclusion band. The second parameter displayed is the lower boundary frequency. The third parameter displayed is the upper boundary frequency.

HOP>EXCLUDE

EXCLUDE 04 03005 03030

EXCLUDE 05 04900 05000

5.7 Modem Commands for Hopping

5.7.1 Modem Baud Rate

To select the modem baud rate, enter MODEM BAUD followed by one of the following baud rate parameters: 75, 150, and 300.

HOP>modem baud 300

5.7.2 Modem Sync/Async

To put the modem into synchronous or asynchronous mode, enter MODEM SYNC or MODEM ASYNC.

HOP> modem sync

or

HOP> modem async

5.7.3 Display Modem Setup Parameters

To show the current modem setup parameters, enter MODEM SHOW.

HOP> modem show

MODEM BAUD 300

MODEM SYNC

5.8 Encryption Commands

Use these commands when the RF–5150DE option is installed.

5.8.1 Activating/Deactivating Encryption

To turn encryption on or off enter ENCRYPT ON or ENCRYPT OFF.

HOP> encr on

HOP> encr off

5.8.2 Selecting Encryption Key

To select an encryption key, enter USE KEY followed by the two–digit key number (01 to 06)

HOP> USE KEY 03

If a valid key is stored for the selected key number, CUR KEY XX displays (XX = 01–06). If no valid key is stored for the selected key number, the current key is not changed and INVKEY is displayed.

5.9 Synchronization Sequence

To initiate the sync sequence, the operator types SYNC at the HOP> prompt. SENDING SYNC REQ is then displayed at the remote control terminal. After sending the message, AWAITING SYNC is displayed.

When a sync request is received, SYNC REQUEST RCV is displayed at the remote control terminals of all receiving units. The net coordinator then has five seconds to type the SYNC command causing the R/T to send a Sync Response message. While the message is sent, SENDING SYNC RSP is displayed at the net coordinator's terminal. After the message transmission is completed, IN SYNC is displayed at the net coordinator's terminal.

If the Sync Response is received correctly by the slave unit, IN SYNC is displayed. Otherwise, SYNC FAILED is displayed.

5.10 Keying

5.10.1 Keying and Unkeying Data Transmission

When the modem is in synchronous mode, the system is keyed/unkeyed for data transmission by activating/ deactivating the Request To Send (RTS) signal. The system must be IN SYNC to be keyed. In this case, the system accepts data for transmission from the synchronous data input port.

To key the system for data transmission, when the modem is in asynchronous mode, type B at the remote control terminal. The system must be IN SYNC to be keyed. In this case, the system accepts data from the remote control terminal for transmission. All characters received from the terminal following a B are interpreted as data for transmission until a C is typed. When the C is received, the transmission is completed and then the system is unkeyed.

5.10.2 Keying and Unkeying Voice Transmission

For voice transmission, the system can be keyed and unkeyed via the Audio Keyline or the MIC keyline. The system accepts voice audio for transmission from the rear–panel audio input connections when the Audio Keyline is used. The audio source is the MIC, if the MIC Keyline is used.

It can also be keyed or unkeyed by entering the KEY ON or KEY OFF command from the remote terminal. (These can be abbreviated K ON and K OF.) In this case, the system accepts voice audio for transmission from the front panel MIC input.

RF–5150DE OPTION

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RF–5150DE DIGITAL ENCRYPTION OPTION

1. INTRODUCTION

The RF–5000 Transceiver is able to perform digital encryption with installation of the RF–5150DE Option. Encrypted digital voice or modem data may be sent in either single–channel or frequency–hopping modes. Up to six encryption key variables may be stored in the transceiver at any given time. An encryption key variable is a 12–digit numeric string used by the encryption module for modem data or digital voice encryption.

This section discusses the steps used to program encryption key variables into the RF–5000 Transceiver using the front–panel keypad or a remote control terminal. Also included are steps to enable and disable encryption and load the RF–5000 radio using the RF–5961 Field Code Programmer (also called the Fill Gun). See the RF–5960/RF–5961 Operations Manual (P/N 10326–4091) for further details about the RF–5961.

2. KEY MANIPULATION

The RF–5000 accepts encryption key information via the front–panel keypad or a remote control terminal. (Refer to paragraph 5. of these instructions for remote control procedures.) The radio can also be loaded with encryption data using the RF–5961 Fill Gun. (Refer to paragraph 4. for Fill Gun procedures.) The flow diagram in figure 1 provides an overview of RF–5000 encryption operation, including keypad commands and typical LCD displays.

Paragraph 2.1provides step–by–step procedures for entering key variables directly from the RF–5000 front–panel keypad. Procedures for keypad deletion and selection of key variables are covered in paragraphs 2.2 and 2.3, respectively.

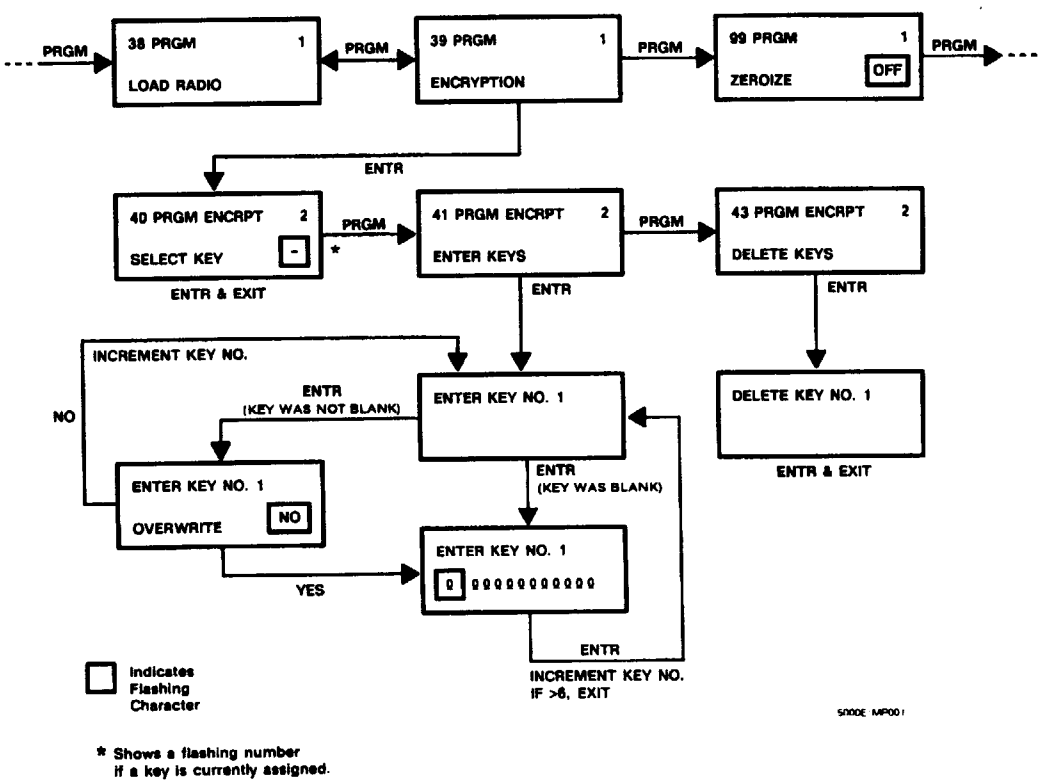
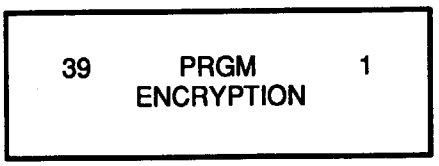


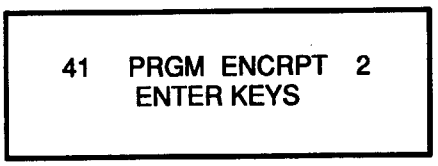
Figure 1. Encryption Operation Flow Diagram

2.1 Keypad Entry of Key Variables

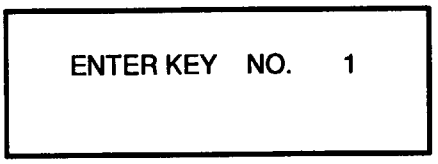
a. Press CLR key, then PRGM key until the display appears as follows:



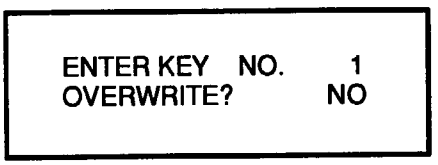
b. Press ENTR to select Encryption, then press PRGM to show the following display:



c. Press ENTR. The display appears as shown below with the key number flashing.

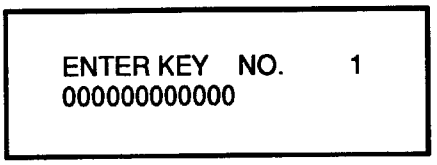


d. Press ENTR. The next display depends on whether a key variable is currently assigned to the key number. If a key variable is not assigned, the display in step e appears. In this case, proceed to step e for instructions. If a key variable is assigned, the following display results:



In the display above, the NO flashes. If overwrite of this key variable is desired, press the up arrow key to change the display to YES.

e. The following display appears:



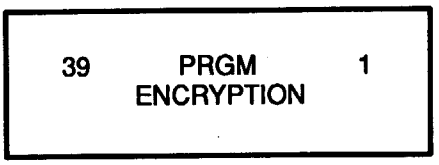
Enter 1 to 12 digits for a key variable. If an error is made during entry, press the CLR key to back space the cursor as necessary and reenter the number(s). When entry is complete, press ENTR. The display shown in step d reappears requesting the next key number until all key numbers have been entered. After all key numbers have been entered, the transceiver exits the program mode and returns to the normal operating display.

NOTE

Once ENTR is pressed, the key variable is hidden and can no longer be viewed. However, it may be changed by reprogramming the key as described in the procedure above.

2.2 Keypad Deletion of Key Variables

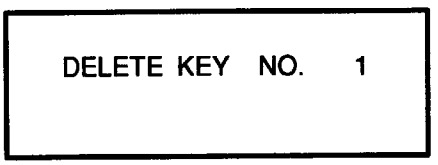
a. Press CLR key, then PRGM key until the display appears as follows:



b. Press ENTR to show the SELECT KEY display as shown below, where X is the current key number.

c. Press the PRGM key twice to get to the DELETE KEYS display as shown below:

d. Press ENTR. The following display appears with the key number flashing:



e. Select the key number to be deleted using the up/down arrows or by pressing the desired key number on the keypad. Press ENTR to delete the displayed key number. This command also exits the program mode and returns the transceiver to the normal operating mode.

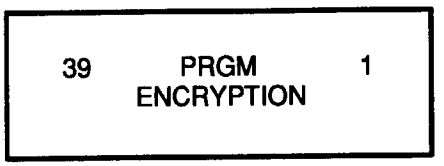
NOTE

If a key variable which is currently active is deleted, Encryption is turned off (NO KEY, ENCR OFF error message). To turn Encryption back on, select a different key and enable Encryption, as described in paragraph 3. (Enabling and Disabling Encryption).

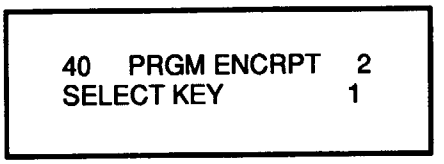
f. Repeat steps a through e above for any other keys that are to be deleted.

2.3 Keypad Selection of a Key Variable

a. To select the desired key, press CLR key, then PRGM key until this display appears:



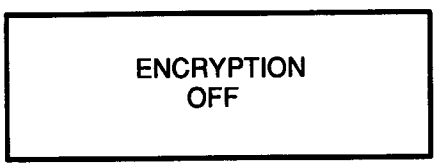
b. Press ENTR to advance one program level. The display shown below appears with the current key number flashing if one exists, or a flashing dash if a current key does *not* exist. If a key other than the one flashing is desired, change the display using the up/down arrows or enter the desired number from the keypad.



c. Press the ENTR key. Provided the key has been entered using the procedure in paragraph 2.1(or loaded from the Fill Gun as described in paragraph 4.), the displayed key is selected and the transceiver exits the program mode, returning to the normal operating display. If the key selected does not exist in the transceiver, an INVALID ENCR KEY error message appears (refer to paragraph 2.1 – Entry of Key Variables).

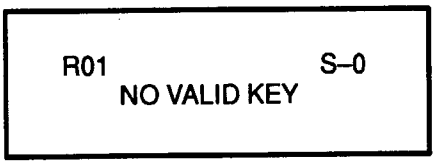
3. ENABLING AND DISABLING ENCRYPTION

a. After the encryption key variables have been entered properly and a valid key number has been selected, press the MODE key on the RF–5000 keypad until the following display appears:



This display can be changed between OFF and ON using the up/down arrows. To turn encryption ON, use the up arrow to change the display to ON.

b. If no key variable has been selected, turning on encryption displays this error message:



When this display is shown, refer to paragraph 2.3for instructions on selecting a key variable.

NOTE

Digital Encryption is used to encrypt either voice data or modem data. One of these modes must be enabled along with Digital Encryption as follows:

DV indicates Digital Voice data

MDM indicates Digital Modem data

If a valid key has been selected, encryption is turned on and one of the following displays is shown depending on whether DV (digital voice) or MDM (modem data) is enabled.

```
R01   1.60000   S–1
USB   DV        DE
```

The above display indicates the radio is set to Encrypted Voice mode.

```
R01   1.60000   S–1
USB     MDM     DE
```

The above display indicates the radio is set to Encrypted Data mode.

Once the desired mode is selected, the transceiver is ready for normal use. Refer to the Operation section for operating procedures.

NOTE

A receiving transceiver must have Encryption enabled AND have the same key selected as the transmitting radio if encrypted Digital Voice or encrypted Modem data communications are to be possible.

4. PROGRAMMING THE RF–5000 TO ACCEPT RF–5961 INPUT

In addition to entering key variables using the RF–5000 keypad, the transceiver may also be loaded with encryption data using the RF–5961 Field Code Programmer (also referred to as the Fill Gun). The Fill Gun is loaded by an RF–5960 Master Code Programmer. Both of these units are shown in figure 2. Refer to the RF–5960/RF–5961 Operations Manual for details on these units.

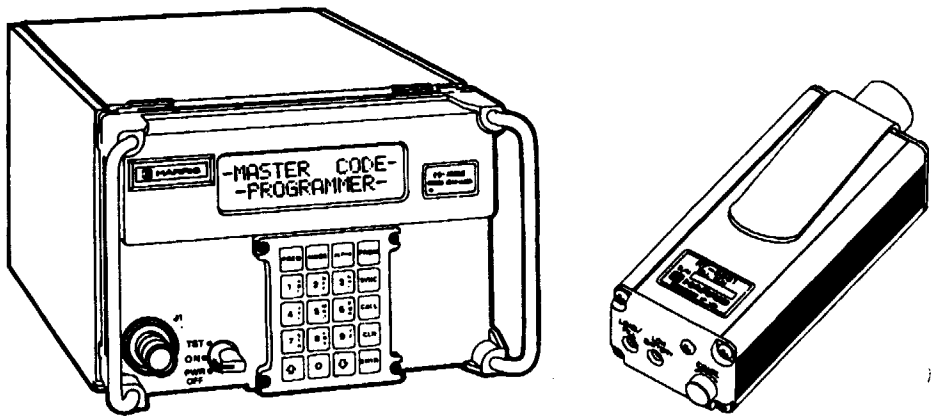


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Figure 2. RF–5960 Master Code Programmer and RF–5961 Field Code Programmer (Fill Gun)

In order to retrieve the encryption key variables stored in the Fill Gun, the RF–5000 Transceiver must be properly programmed to accept the input.

The following procedure outlines loading of the RF–5000 Transceiver using the RF–5961 Fill Gun.

4.1 Loading the RF–5000

a. Be sure the MODE switch on the RF–5000 Transceiver is set to SSB. The operating mode of the transceiver will have a display similar to:

```
R01    1.60000    S–0
USB
```

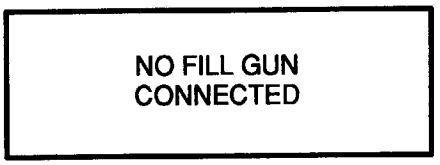
b. Press CLR key, then PRGM key until the following display appears:

```
38  PRGM              1
    LOAD RADIO
```

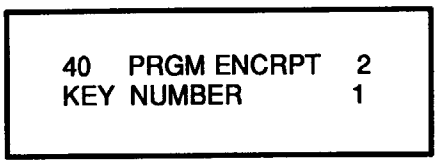
c. Press the ENTR key to select this function and the following display appears:

```
ATTACH
FILL DEVICE
```

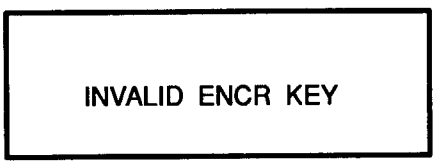
d. Attach the RF–5961 Fill Gun to the J2 connector on the RF–5000 front panel and press ENTR to load the radio. If the Fill Gun is empty (erased) or is malfunctioning, the following display appears:



If the fill was successful, the following display appears:



The current Key Number flashes in this display. Enter the desired Key Number (1 through 6) by using the up/down arrows or by entering it on the keypad. If the entered key location is empty, the error message shown below appears for 3 seconds before the transceiver returns to the normal operating display shown in step a. If this display appears, it indicates the key selected has not been loaded (refer to paragraph 2.3 – Keypad Selection of a Key Variable).



e. If the radio is loaded properly, and the key selection is successful, the radio returns to the normal operating display shown in step a. Refer to the RF–5000 operating instructions for procedures.

NOTE

If at any time the RF–5961 red low battery LED lights during loading or filling, the data transferred is suspect to error. Replace the internal 9–volt battery as soon as possible to avoid faulty encryption variables. Refer to the RF–5960/RF–5961 Operations Manual for battery replacement procedure.

5. RF–5000 REMOTE CONTROL COMMANDS FOR DIGITAL ENCRYPTION

Table 1 lists the encryption–related remote control commands and their functions.

If the USE_KEY function is entered during remote operation and the key variable has not been defined, an error message similar to that shown below appears on the remote terminal, and the last valid key variable entered is displayed. If no key variables are defined, CUR_KEY 99 is displayed with the following error message:

INVALID ENCR KEY
CUR KEY 99

Table 1. RF–5000 Remote Control Commands

Command	Function
ENCR ON	Digital encryption on
ENCR OFF	Digital encryption off
USE_KEY X	Selects key variable (X denotes the desired key)
ENC_KEY X YYYYYYYYYYYY	Enters key variable (X denotes the desired key, Y denotes the 12–digit encryption number)
ENC_KEY X CLEAR	Deletes key variable (X denotes the desired key)

6. ERROR MESSAGES

When an invalid keypad function is attempted, an error message appears at the RF–5000 front–panel display window. Table 2 is a listing of encryption–related error messages and their causes.

Table 2. RF–5000 Encryption Error Messages

Error Message	Explanation
NO VALID KEY	Tried turning on encryption without first selecting 1 of 6 encryption keys.
INVALID ENCR KEY	Tried to select a key that has not been previously entered.
NO KEY, ENCR OFF	Current key was deleted causing encryption to be turned off.

APPLICATION NOTE A

APPLICATION NOTE A

RF–5000 DATA TRANSMISSION

A.1 INTRODUCTION

This application note provides instructions for controlling an RF–5000 System using PROCOMM PLUS™ communications software and an IBM–compatible PC. This note assumes that the operator has previous working knowledge of the RF–5000 System, RF–5110 High–Speed Modem, PROCOMM PLUS™ communications software, and MS–DOS software.

A.1.1 Software Conventions

Commands are given in PROCOMM PLUS™ by pressing the ALT key and a second key at the same time. For example, the command ALT–F is done by holding down the ALT key while pressing the F key. Some other instructions in this note require control (Ctrl) key combinations. For example, Ctrl–C is done by holding down the Ctrl key while pressing the C key.

The following is a brief listing of the most common commands used with the PROCOMM PLUS™ program:

- ALT–A – Loads PCEDIT program for editing files
- ALT–C – Clears the screen in Terminal Mode
- ALT–F – Shows listing of current files
- ALT–L – Toggles data output to printer
- ALT–V – Allows contents of a file to be viewed
- ALT–Z – Brings up Help menu
- ALT–F1 – Toggles log file open and closed
- ALT–F4 – DOS Gateway for copying, deleting, and printing files

To get help while in PROCOMM PLUS™, type ALT–Z at any time. To exit help press the ESC key. The ESC key provides escape from any window in PROCOMM PLUS™, returning to the Terminal Mode. The RF–5000 transmit keyline is activated (Transmit mode) by the PC using a Ctrl–B combination. To unkey the unit (Receive mode) use Ctrl–C.

A.2 SOFTWARE SET UP

Various displays in the PROCOMM PLUS™ set up are shown below. These parameters must not be changed from the values shown. If the parameters are accidentally altered, the set up displays can be used to restore the correct values.

A.2.1 Line/Port Settings

The Line/Port settings are displayed by pressing ALT–P (see figure A–1). Line/Port settings should be set at 2400 baud, 8 data bits, no parity, and 1 stop bit.

A.2.2 Setup Menu

Pressing ALT–S runs the set up menu. See figures A–2 through A–5 for the various screens of the set up menu.

CURRENT SETTINGS: 2400, N, 8, 1, COM2 (OR COM1)

BAUD RATE	PARITY	DATA BITS	STOP BITS	PORT
1) 300	N) NONE	Alt-7) 7	Alt-1) 1	F1) COM1
2) 1200	E) EVEN	Alt-8) 8	Alt-2) 2	F2) COM2
3) 2400	O) ODD			F3) COM3
4) 4800	M) MARK			F4) COM4
5) 9600	S) SPACE			F5) COM5
6) 19200				F6) COM6
7) 38400				F7) COM7
8) 57600	Alt-N) N/8/1			F8) COM8
9) 115200	Alt-E) E/7/1			
Esc) Exit	Alt-S) Save and Exit		YOUR CHOICE:_____	

Figure A–1. Line/Port Settings Screen

PROCOMM PLUS SETUP UTILITY — MODEM OPTIONS

A– Initialization command .....
B– Dialing command .....
C– Dialing command suffix .....
D– Hangup command .....
E– Auto answer command .....
F– Wait for connection ..... 45 seconds
G– Pause between calls ..... 4 seconds
H– Auto baud detect ..... OFF
I– Drop DTR to handup ..... YES
J– Send init if CD high ..... YES

Alt–Z: HELP	Press the letter of the option to change:	ESC: Exit

Figure A–2. Modem Options Screen

PROCOMM PLUS SETUP UTILITY		TERMINAL OPTIONS
A– Terminal emulation ..... VT102 B– Duplex ..... HALF C– Software flow control (XON/XOFF) ON D– Hardware flow control (RTS/CTS) .. OFF E– Line wrap ..... ON F– Screen scroll ..... ON G– CR translation ..... CR/LF H– BS translation ..... DESTRUCTIVE I– Break length (milliseconds) ..... 350 J– Enquiry (ENQ) ..... OFF		
Alt–Z: HELP	Press the letter of the option to change:	ESC: Exit

Figure A–3. Terminal Options Screen

PROCOMM PLUS SETUP UTILITY		GENERAL OPTIONS
A– Exploding windows ..... OFF B– Sound effects ..... OFF C– Alarm sound ..... ON D– Alarm time ..... 5 seconds E– Translation table ..... OFF F– Pause character ..... ~ G– Transmit pacing ..... 25 milliseconds H– Call logging ..... OFF I– Filename lookup ..... OFF J– Menu line ..... OFF	K– Menu line key ..... ' L– Snow removal ..... OFF M Remote commands ..... OFF N– Enhanced KB speedup ..... ON O– ANSI compatibility 3.X	
Alt–Z: Help	Press the letter of the option to change:	ESC: Exit

Figure A–4. General Options Screen

PROCOMM PLUS SETUP UTILITY		ASCII TRANSFER OPTIONS	
A– Echo locally	YES	K– Strip 8th bit	NO
B– Expand blank lines	NO		
C– Expand tabs	NO		
D– Character pacing (millisec)	1		
E– Line pacing	1		
F– Pace character	0		
G– CR translation (upload)	NONE		
H– LF translation (upload)	STRIP		
I– CR translation (download)	ADD LF		
J– LF translation (download)	NONE		
Alt–Z: Help	Press the letter of the option to change:		ESC: Exit

Figure A–5. ASCII Transfer Options Screen

A.3 INITIALIZING

If a printer is to be used, turn the power on. Turn on the computer. Create a new bootable diskette following the procedures outlined in the MS–DOS manual. Insert the new disk in the A: drive and the PROCOMM PLUS™ master disk in the B: drive. Copy all files from B: to A: to create a working PROCOMM PLUS™ disk. Do not delete or change any of the files on the master disk. Use the working copy while storing the original in a safe place. In this way, another working copy can be made from the original if the copy becomes damaged.

Invoke PROCOMM PLUS™ by typing PCPLUS <CR>. The status line at the bottom of the screen always indicates OFF LINE when the PROCOMM PLUS™ program is running. Disregard this message as the modem is always connected when this program is used.

A.3.1 Formatting a Blank Floppy Disk

New floppy disks must be formatted before files can be copied to them. To do so, use the DOS Gateway (press ALT–F4) from within PROCOMM PLUS™. At the DOS prompt A:\FILES> type FORMAT B: and press the ENTER key. Follow the instructions printed on the screen. When finished, type EXIT to return to the PROCOMM PLUS™ program.

CAUTION

Any information contained on a disk is lost when it is formatted. Before formatting any disk confirm that it is blank or one which contains no important files. The DIR B: command can be used to check the list of files on a disk in drive B:.

A.4 LOGGING

Pressing ALT–L selects data output to the printer. (Pressing ALT–L again deselects data output to the printer.) The status line at the bottom of the page indicates Printer On. Ensure that the printer is on line.

After entering PROCOMM PLUS™, LOG OPEN is displayed on the status line. This means that all data sent or received in Terminal Mode is stored in a log file called RF–5000.LOG. This occurs regardless of whether data output to a printer is toggled on or off.

Data displayed in Terminal Mode does not go directly into the RF–5000.LOG file. The data is stored in the computer's RAM until a log–off command is generated using ALT–F1. The ALT–F1 command should be occasionally toggled off then on to update the log file to prevent loss of data during a power failure. Each time the log file is toggled off, data is appended to the previous data. It does not overwrite the previous data.

NOTE

When opening the log file, press ENTER when the window appears. This selects RF–5000.LOG as the default file name. Any other file name can be typed in at this time.

The RF–5000.LOG file can be used, edited, or deleted as described in paragraph A.6, or transmitted as described in paragraph A.7 .

A.5 DOWNLOADING A FILE

To receive a message and store it as a file for later use, follow this procedure.

a. Establish contact with the other station.

b. Inform the other station that a file is to be downloaded and request the name of the file. It is not necessary to use the original file name; another name can be selected.

c. Press the Page Down (or PgDn) key to display a menu requesting the type of protocol to be used. Press the 4 key to select ASCII protocol.

NOTE

ASCII protocol must always be used. Use of any other type of protocol produces unpredictable results.

d. Type the name assigned to the incoming file and press the ENTER key. Tell the other station to begin transmitting the message. The transmission appears on the screen as it is received.

NOTE

The system must be in Receive mode (unkeyed) before a file can be received. See keying and unkeying commands in paragraph A.1.

e. After the incoming message has ended, press ESC to write the file to disk. Then press ALT–F and the ENTER key to verify that the message is saved.

This file can be used, edited, transmitted, or deleted as described in paragraph A.6. After a number of files have been saved the disk may become full. All unnecessary files should be deleted or copied to another disk as described in paragraph A.6.2 .

A.6 FILE MANAGEMENT

A.6.1 Editing Files Using PC Edit

Press 2 from the opening menu or ALT–A while in the PROCOMM PLUS™ program. At the ENTER FILENAME prompt, type the name of the file to be created (if a new file) or edited (if a current file). When creating a new file using PCEDIT, any file name may be used from one to eight characters long, no spaces allowed. To further define a file, a period can be added followed by up to a three–letter extension. For example: WEATHER.RPT (RPT = report) or LETTER.TXT (TXT = text) are acceptable. It is best to use a file name which is descriptive of the contents of the file. This helps in locating a particular file from a list of file names. Press the ENTER key. The file can now be edited.

A.6.2 Copying, Printing, and Deleting Files

To copy, delete, or print files, it is necessary to return to the DOS operating system which runs the computer. To do this while running PROCOMM PLUS™, press ALT–F4 (DOS Gateway). This presents the DOS prompt A:\FILES>. To return to PROCOMM PLUS™ type EXIT and press the ENTER key.

A.6.2 .1 Copying Files

To copy a file to a disk in drive B:, at the DOS prompt A:\FILES>:

a. Type COPY.

b. Follow with a space, then the name of the file to be copied.

c. Follow with a space, then type B:.

d. Press the ENTER key.

This results in the file being copied to the disk in drive B:. For example, typing COPY WEATHER.RPT B: copies the file WEATHER.RPT to a disk in drive B. Typing DIR B: shows a list of files on the disk in drive B:.

To copy a file from the disk in drive B:, at the DOS prompt A:\FILES>:

a. Type COPY B:.

b. Type the name of the file on the disk in drive B: to be copied. Do **not** put a space between the B: and the file name.

c. Press the ENTER key.

This results in the file being copied to the disk in drive A:. For example, typing COPY B:NEWFILE copies the file NEWFILE from the disk in drive B: to the A:\FILES directory. Use the DIR command to verify that the file has been added.

A.6.2 .2 Deleting Files

To delete a file from the disk in drive B:, at the DOS prompt A:\FILES>:

a. Type DIR B: then press the ENTER key. This causes a list of current files on the disk in drive B: to be displayed.

b. Type DEL B: followed by the name of the file to be deleted. Do **not** put a space between the B: and the file name.

c. Press the ENTER key.

For example, typing DEL B:WEATHER.RPT deletes the file WEATHER.PRT from the disk in drive B:.

CAUTION

Deleted files cannot be recovered. Be sure that the correct file name is used with the DEL command.

A.6.2 .2.1 Deleting the Log File

Follow this procedure to delete the RF–5000.LOG file:

a. Close the log using the ALT–F1 command. The status line then indicates LOG CLOSED.

b. Type ALT–F4 to use the DOS Gateway.

c. Delete the file as described in paragraph A.6.2 .2.

d. Return to PROCOMM PLUS™ by typing EXIT and pressing the ENTER key.

e. Reopen the log using the ALT–F1 command.

A.6.2 .3 Printing a File

To print a file, at the DOS prompt A:\FILES>:

a. Type PRINT followed by a space and the file name.

b. Press the ENTER key. The prompt appears: NAME OF LIST DEVICE [PRN]:.

c. Press the ENTER key again.

The file is then printed. For example, typing PRINT WEATHER.RPT causes the file WEATHER.RPT to print.

To print a file from the disk in drive B:, at the DOS prompt A:\FILES>:

a. Type PRINT B: followed by the file name. Do **not** put a space between the B: and the file name.

b. Press the ENTER key. The prompt appears: NAME OF LIST DEVICE [PRN]:.

c. Press the ENTER key again.

The file is then printed. For example, typing PRINT B: WEATHER.RPT causes the file WEATHER.RPT from the disk in drive B: to print.

A.7 TRANSMITTING A FILE

Follow this procedure to transmit a file.

a. Determine the correct name of the file to be transmitted.

   1. Press ALT–F followed by the ENTER key to see a listing of current files.

   2. Press the ESC key to return to the Terminal Mode.

   3. Press ALT–V from the Terminal Mode and then type the name of the file to view the contents of a file and verify the actual text.

   4. Press the ESC key to return to the Terminal Mode.

b. Key the system using the Ctrl–B sequence.

NOTE

The system automatically returns to Receive Mode after 30 seconds if there is no further data port activity.

c. Once the correct file name is determined press the Page Up (or PgUp) key. A menu appears requesting the type of protocol to be used.

d. Press 4 to select the ASCII protocol.

NOTE

The ASCII protocol must always be used. The use of any other protocol produces unpredictable results.

e. Type the name of the file to be sent and press the ENTER key. The message appears on the screen as it is sent.

f. When the file is finished being sent, unkey the system using the CTRL–C sequence.

Follow this procedure to send a file from a disk in drive B:.

a. Press the Page Up (PgUp) key. A prompt appears: NAME OF FILE TO SEND.

b. Type B: followed by the name of the file to be sent. Do **not** include a space between the B: and the file name.

For example, typing B:WEATHER.RPT sends the file WEATHER.RPT from the disk in drive B.

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