APPENDIX 5

OPERATOR'S MANUAL

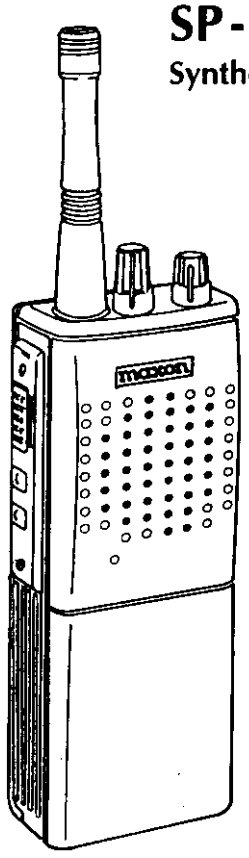
SIXTEEN (16) PAGE OPERATOR'S MANUAL FOLLOWS THIS SHEET

maxon

150

SP-130/140 Series

Synthesized Scanning Radio



Operating
Instructions

About Your SP-130/140 Series Radio

Maxon's SP-130/140 Series radios feature 4/16 channel operation with superior performance and reliability. Operation and functions for Maxon's SP-130/140 Series radios are described in this manual.

We urge you to thoroughly read this manual before operating the radio.

Application of some of the functions described in this manual is determined by the system you use. Your Maxon Dealer will program your radio so that you have the greatest number of functions possible relative to your needs.

Should you have questions regarding the operation of the radio, please consult your Maxon Dealer.

About Maxon America, Inc.

Maxon America, Inc. designs and manufactures professional FM two-way radio equipment to serve a wide variety of communication needs. Maxon produces equipment for the Land Mobile Radio and Specialized Mobile Radio markets (business, industrial, government and public safety).

Table of Contents

Safety Information

The Federal Communications Commission (FCC), with its action in General Docket 79-144, March 13, 1985, has adopted a safety standard for human exposure to Radio Frequency (RF) electromagnetic energy emitted by FCC regulated equipment. Maxon subscribes to the same safety standard for the use of its products. Proper operation of this radio will result in user exposure far below the Occupational Safety and Health Act and Federal Communications Commission limits.

WARNING - DO NOT hold the radio in such a manner that the antenna is next to, or touching, exposed parts of the body, especially the face or eyes, while transmitting.

WARNING - DO NOT allow children to operate transmitter - equipped radio equipment.

CAUTION - DO NOT operate the radio near unshielded electrical blasting caps or in an explosive atmosphere unless it is a type especially designed and qualified for such use.

CAUTION - DO NOT press and hold the transmit switch (P-T-T) when not actually wishing to transmit.

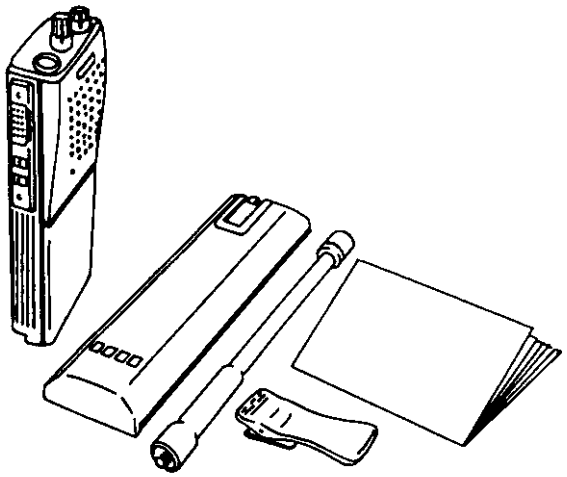
NOTE: This radio operates in FCC regulated frequency bands. All radios must be licensed by the FCC before use. Because this radio contains a transmitter, Federal law prohibits unauthorized use or adjustments of this radio.

Unpacking Information

Remove and carefully inspect the contents of your package(s) for the following items:

Radio
Battery Pack
Antenna
Spring Belt Clip
Operating Instructions

If any items are missing, please contact your Dealer or Maxon.

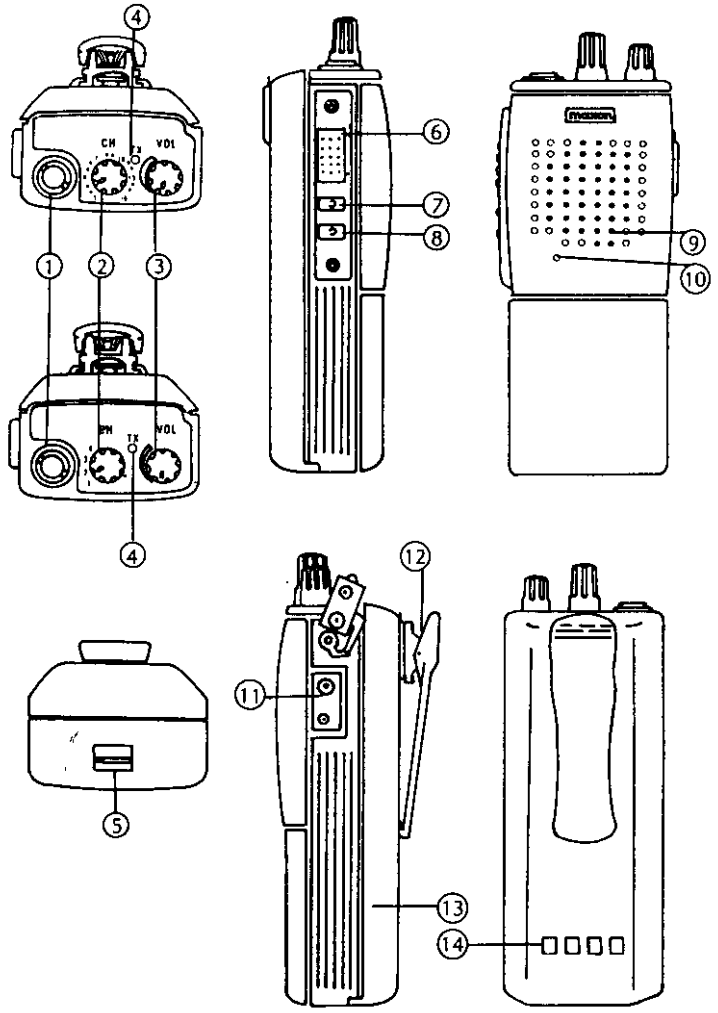


SP-130/140 Series Features

- Wideband frequency separation
- 1/5 Watts programmable output power
- Programmable 12.5/25 kHz channel spacing
- Channel scan
- Priority channel scan
- Look back channel
- CTCSS/DCS tone signalling
- Busy channel lockout
- Time-out timer

Description of Radio Components

1) Antenna Receptacle
2) Channel Selector Knob
3) On/Off - Volume Control
4) Busy/TX/BT Indicator
5) Battery Latch
6) Push-To-Talk (PTT)
7) Monitor Button
8) Option Button
9) Speaker
10) Microphone
11) Accessory Connector
12) Belt Clip
13) Battery
14) Battery Charge Contacts

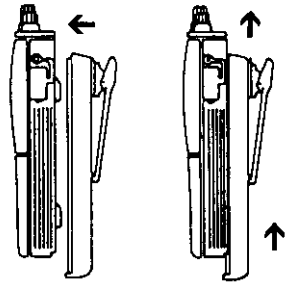


Antenna Installation

Fasten the antenna to the radio by turning the antenna clockwise into the receptacle on top of the radio.

Installing and Removing the Battery Pack

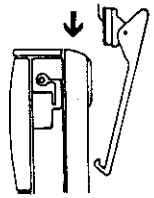
To Install:
Position the guides of the battery in line with the radio battery guide rails and slide the battery into position until a click is heard.



To Remove:
Holding radio in one hand, slide and hold battery latch. With the other hand, push the battery in downward direction.

Attaching and Removing the Belt Clip

To Install:
Install belt clip on back of battery until it clicks into place.



To Remove:
Pull release tab outward and push belt clip up.

Battery Charging and Care

To ensure peak performance from your radio, the battery pack must be fully charged. Proper care and charging will allow maximum performance and life of your battery pack.

The optional QPA-1135 Pedestal Charger provides a slow overnight charge of 12-16 hours.

The optional QPA-1125 Desktop Charger provides 1.5 hours charging and normal "slow" charging to one radio and one battery.

See accompanying instructions included with these chargers for more information.

To receive maximum performance from your radio and battery pack, periodically completely discharge and recharge the battery pack.

SP-130/140 Series Operations

Power On-Volume
Turn the radio on by rotating the on/off - volume control clockwise until you hear a click and the self test "alert" tone.

Transmit

CAUTION
OPERATION OF THE TRANSMITTER WITHOUT A PROPER ANTENNA INSTALLED MAY RESULT IN PERMANENT DAMAGE TO THE RADIO

1) Press the monitor button to monitor the channel for activity. To avoid interrupting another user, make sure the channel is clear before you begin transmitting.

NOTE: Federal Communications Commission Rules and Regulations require that you monitor a channel for activity before transmitting.

NOTE: The tri-color LED located on the top panel can help with channel monitoring. It will glow amber if RF activity is present; or green if the transmission has a CTCSS or DCS tone that matches a tone programmed for receive in your radio. When this LED is not illuminated, the radio is indicating a "clear" channel.

2) When the channel is clear, hold the radio upright with the antenna vertical and the front microphone area about 2-3 inches from the mouth, keeping the antenna away from the face and eyes. Press and hold the P-T-T bar on the side of the radio, and speak slowly and clearly into the microphone area.

NOTE: The LED will glow red when transmitting. This indicator should be on continuously while the P-T-T bar is being pressed and the radio is transmitting. Should the red LED be "flashing", the battery needs to be recharged and transmission will cease. Recharge the battery before attempting more than one transmission.

Receive
When you have finished transmitting, release the P-T-T bar to receive.

Power Off
When finished transmitting, receiving, monitoring, etc., turn the radio off by rotating the on/off-volume control fully counter-clockwise, to the detent position.

Status Indicators and Audible Alert Tones

Your SP-130/140 Series has a sophisticated microprocessor control which provides a series of audible alert tones.

Upon initial power up, a quick melody indicates that the self-test of the microprocessor functions has been completed satisfactorily. A series of tones may be sounded with any of the following conditions:

- Attempt to transmit on a channel set for receive only
- Attempt to transmit on a channel that is already in use when busy channel lockout has been programmed into the radio *
- Transmitting time has exceeded time-out timer programmed length *
- Low battery condition
- Selecting a channel with no programmed frequency

* Indicates a function that is initially programmed into the radio by your Maxon Dealer.

NOTE: All audible tones can be programmed off for silent operation.

STATUS	DESCRIPTION	LED COLOR	AUDIBLE TONE
NORMAL	Power On - Ready	N/A	Melody
	Busy	Amber	N/A
	Correct Call	Green	N/A
	Transmit	Red	N/A
	Busy Lock	Amber, Flashing	Single Tone
IN SCAN	Scan is initiated	Green, Flashing	N/A
WARNING	Time-Out Timer	N/A	Single Tone
	Battery Low	Red, Flashing	Four Tone, Repeated
ERROR	EEPROM Error	Red, Flashing	Single Tone, Repeated
	PLL Error	Red, Flashing	Double Tone, Repeated
	Filtering Error	Red, Flashing	Three Tone, Repeated

Scan Modes

Scanning is a Dealer programmable feature that allows you to monitor a number of channels. Your Dealer will help you define a channel "scan list" to be programmed into a scan channel (any channel, 1-4 on model SP-130) or (any channel, 1-16 on model SP-140). Once that channel location is selected, scan is initiated.

Normal Channel Scan
Once the scan list is programmed you can initiate scan. Simply move the channel selector knob to the scan channel position and the radio will start to scan. The top panel LED can be programmed to flash green as the radio is scanning.

If a conversation is detected on any of the channels in the scan list, the radio will stop on that channel and you will be able to hear the conversation. If programmed for normal scan TX you will be able to transmit on that active channel during the programmable scan delay time. The scan delay time is the amount of time the radio will stay on that channel once activity has ceased (Dealer programmable, 4-7 seconds is typical). The radio will resume scanning once the scan delay time has expired. Scanning will continue until the channel is changed.

Priority Channel Scan
A single channel may be programmed as the "Priority" channel. The radio will constantly monitor this channel while scanning and when the radio has stopped on an active channel. If a call is detected on the "Priority" channel, the radio will automatically move to, and remain on, the "Priority" channel for as long as the priority conversation takes place. "Priority" channel activity takes precedence over all other conversations.

NOTE: "Priority" channel scan and "look back" require that the radio leave the active channel for a fraction of a second (at regular intervals) to check the priority channel for a message. Depending upon how the radio is programmed (scan speed, etc.) this may or may not be noticeable as "breaks" on the active channel for that same fraction of a second.

Other Scanning Features

- **Look Back:** Any channel, when not in the scan mode, can be programmed to "look back" at the "Priority" channel. This feature is ideal for those who do not need scan as defined above, but want to make sure that they never miss a call on the "Priority" channel if another channel has been selected. Once a "look back" channel has been selected, the radio will periodically "look back" at the "Priority" channel. If activity is detected on the "Priority" channel, the radio will move to that channel for as long as it remains active.

- **Scan Channel Delete:** To temporarily delete a channel from the scan list, simply press the monitor button while scanning and stop on the channel to be deleted. This will remove that channel from the scan list until the channel is changed or the radio's power is reset. When power is restored or the scan list channel position is again selected, the original Dealer programmed scan list will be activated.

- **CTCSS/DCS Scanning:** The SP-130/140 can be programmed by your Dealer to scan for tone. This will help block out unwanted calls.

- **Normal Scan TX:** Allows a transmission only after a call is received, depending on the programmed scan delay time. After the scan resumes, and a transmission is made, the radio will sound an alarm (two beeps) and will not allow a transmission.

- **Priority Scan TX:** Allows a transmission after a call is received depending on programmed scan delay time. The transmission will be made on the channel that the call was received. After the scan resumes, if a transmission is made, the radio will transmit on the programmed priority channel.

- **Priority Only TX:** Allows a transmission on the priority channel when scanning and not stopped on an active channel. It can also be programmed to always transmit on the priority channel if scanning or stopped on an active channel.

- **Receive Only Scan:** This allows only reception. If a transmission is made at any time, the radio will sound an alarm (two beeps) and will not allow the transmission.

Licensing and Service Information

FCC Licensing
The Federal Communications Commission requires that the operator of this radio be properly licensed under the applicable Part and/or Parts of the FCC Rules and Regulations.

Consult with your Maxon Dealer, or contact the nearest FCC Field Office for information about obtaining a license.

Service
Do not tamper with internal adjustments. Damage to the equipment and/or improper operation may result. There are no user serviceable items inside the radio.

It is recommended that you return your radio to a qualified Maxon Dealer for any service or repairs.

Recycling/Disposal of Batteries

The U.S. Environmental Protection Agency (EPA) classifies used Ni-Cd batteries as hazardous waste, unless certain exemptions apply.

The battery should be recycled at the end of its useful life. Under various state or local laws, such batteries must be recycled or disposed of properly and cannot be dumped in landfills or incinerators.

Maxon America, Inc. fully endorses and encourages the recycling of Ni-Cd batteries. A national program to collect and recycle used Ni-Cd batteries is being implemented by the Rechargeable Battery Recycling Corporation (RBRC™). This program is being funded through the use of license fees paid by the battery and product manufacturers to place the RBRC™ Seal on the batteries.

The following is a list of facilities where the batteries can be shipped to be recycled. Contact these facilities for proper packaging and shipping guidelines.

INMETCO
245 Portersville Road
Ellwood City, PA 16117
TEL: (412) 758-2800
FAX: (412) 758-2842

Kinsbursky Brothers Inc.
1314 N. Lemon Street
Anaheim, CA. 92801
TEL: (714) 738-8516
FAX: (714) 441-0857
(800)-548-8797

Software Copyrights

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Maintenance

Your SP-130/140 Series Radio is designed to be maintenance free. To keep your radio in good working condition:

Clean external surfaces with a clean cloth dampened in a solution of dishwasher detergent diluted in water. Apply the solution sparingly to avoid any moisture leaking into cracks and crevices. Do not submerge the radio. Use a non-metallic brush to dislodge stubborn particles, if necessary. Dry the surface thoroughly with a soft, lint free cloth.

DO NOT use solvents or spirits for cleaning - they may permanently damage the housing

Clean the battery contacts on the back of the radio with a lint free cloth to remove dirt, grease, or other foreign material that may impede good electrical contact

Limited Warranty

Maxon America, Inc. ("Maxon") warrants the Maxon Product manufactured by it against defects in material and workmanship under normal use and service for a period of two (2) years from the date of delivery to the original end user, provided that the user has complied with the requirements stated herein. This warranty is not assignable or transferable. Maxon is not responsible for any ancillary equipment which is attached or used in connection with this product.

Maxon shall have no obligation to make repairs or to cause replacement required which result from normal wear and tear or necessitated in whole or in part by catastrophe, fault or negligence of the user, improper or unauthorized alterations, repairs to the Product, use of the Product in a manner for which it was not designed, or by causes external to the Product. This warranty is void if the serial number is altered, defaced or removed.

Maxon's sole obligation hereunder shall be to repair or replace the Product covered in the above warranty.

To receive warranty service, deliver or send the Product, transportation and insurance prepaid, to the place of purchase along with your proof of purchase. Alternatively, call 1-800-821-7848 for other locations or authorization to return the product directly to Maxon.

THE EXPRESS WARRANTIES CONTAINED HEREIN ARE IN LIEU OF ALL OTHER WARRANTIES, EITHER EXPRESSED OR IMPLIED OR STATUTORY, INCLUDING, WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

FOR ANY PRODUCT WHICH DOES NOT COMPLY WITH THE WARRANTY SPECIFIED, THE SOLE REMEDY WILL BE REPAIR OR REPLACEMENT. IN NO EVENT WILL MAXON BE LIABLE TO THE BUYER OR ITS CUSTOMERS FOR ANY DAMAGES, INCLUDING ANY SPECIAL, INCIDENTAL, INDIRECT OR CONSEQUENTIAL DAMAGES, OR FOR THE LOSS OF PROFIT, REVENUE OR DATA ARISING OUT OF THE USE OF OR THE INABILITY TO USE THE PRODUCT.

This warranty is void for sales and deliveries outside of the United States.

APPENDIX 6

TRANSMITTER ALIGNMENT

THREE (3) PAGE ALIGNMENT PROCEDURE FOLLOWS THIS SHEET

ALIGNMNET PROCEDURE

The SP-150 is broad band by design covering UHF (440 to 470 MHz) and VHF (148-174MHz). All alignments to the radio are done through the maintenance software program. No hardware pots need to be adjusted. Perform all alignments at lowest power setting.

1. *TCXO CENTER FREQUENCY*

Program=>Test Mode Options => TX TCXO Center Frequency.

- Use the up and down arrow keys to modify the Voltage and Count values. The value will automatically be sent to the radio. Otherwise, enter a number between 0 and 255 in the Count field and press F10 to send the value to the radio.
- Measure TCXO frequency offset from center (14.95 MHz).
- Adjust Voltage or Count values to achieve a center frequency of $f_o \pm 100$Hz.

2. *TX BALANCE TONE* (radio and channel specific)

Program=>Test Mode Options => TX Balance Tone.

- Set the frequency range to 440 - 470 Mhz (UHF) and set the frequency to the high end of the band (i.e. 470 MHz).
- Inject a 1 kHz tone to the microphone input and set PTT.
- Press the Tab key to switch between TCXO (50Hz) or VCO (300 Hz) tones. Use the up and down arrow keys to adjust the TCXO (TXTRIM3) and VCO (TXTRIM2) values for 3 kHz deviation until there is a flat response and no significant variation between the two.
- Measure the response for each channel across the band (at least 16 values). Adjust TCXO (TXTRIM3) up by one binary count (0.25 dB) for each 3% change in frequency. Save TXTRIM2,3 to EEPROM.

3. *TX VCO RANGE ADJUST*

Program=>Test Mode Options => TX VCO Range.

- Read TX VCO Range (440 - 470 Mhz).
- Select lowest channel. Adjust TX VCO for 2.0v tuning voltage at TP1. Ensure lock.
- Select highest channel. Measure TX VCO tuning voltage at TP1. Ensure lock.

4. *RX VCO RANGE ADJUST*

Program=>Test Mode Options => RX VCO Range.

- Read RX VCO Range (440 - 470 Mhz).
- Select lowest channel. Adjust RX VCO for 2.0v tuning voltage at TP1. Ensure lock.
- Select highest channel. Measure RX VCO tuning voltage at TP1. Ensure lock.

5. ***SET TX CHANNEL***

Program=>Test Mode Options => Set TX Channel.

- Choose Frequency Band from 100, 400, 750, or 800 Mhz.
- Choose Reference Frequency: 5 or 6.25 kHz.
- Choose Power Level: Lo or Hi Power
- Choose TX Frequency: xxx.xxxxxx Mhz (i.e. - 455.000000 MHz)
- Measure Current and Power at six points across the band for flatness.

6. ***SET RX CHANNEL***

Program=>Test Mode Options => Go To RX Channel.

- Choose Frequency Band from 100, 400, 750, or 800 Mhz.
- Choose Reference Frequency: 5 or 6.25 kHz.
- Choose Channel Spacing: 12.5 or 25.0 kHz
- Choose IF Frequency: 45.0 or 45.3 MHz
- Choose RX Frequency: xxx.xxxxxx Mhz (i.e. - 455.000000 MHz)

7. ***SET ASIC CONTROLS***

Program=>Test Mode Options => ASIC Controls.

- Use arrows to adjust values of ASIC registers: ASW1, INTRIM, ASW2, RXVOL, ASW4, VXCLPF, SATRIM2, AMP, LIMM, SATRIM1, ASW3, VLPF, TXTRIM1, TXSUM, ATTN, TXTRIM2, TXTRIM3.
- Select "Read Values" to read contents of ASIC.
- Select "Write Values" to write new values to ASIC.

8. ***SET DATA RATE***

Program=>Test Mode Options => Data Rate.

- Generate LTR data at full rated deviation through SATTRIM.
- Measure baud rate.

9. ***SET RX AUDIO LEVEL***

Program=>Test Mode Options => RX Audio Output Level.

- Set/Calibrate RX Volume for normal RX audio output level.

10. ***RX SQUELCH & RSSI*** (radio and channel specific)

Program=>Test Mode Options => RX Squelch & RSSI.

- Select RX, lowest channel.
- Input -47 dBm. Read RSSI level. Measure audio distortion. Audio distortion should be less than 5%, but 3% is the failure threshold. There is a possibility of using a RX warp on the TCXO to improve audio distortion. If distortion is above 3%, investigate RX TCXO warping.
- Set input level for minimum desired SINAD reading (12dB) on HP8920.

- Read RSSI and determine squelch open and close values.
- Repeat N times across the band.
- Save data to EEPROM.

11. *SPUR SEARCH*

Program=>Test Mode Options => Spur Search.

- Set radio and HP8920 for RX frequency. (if 12.5kHz, then 1.5kHz deviation) (if 25.0kHz, then 3.0kHz deviation).
- Set HP8648 RF OFF.
- Adjust RF on HP8920 for 12dB SINAD ~~ -110 dB (Add 3dB).
- Set 8648 to 90 dBm greater ~~ -20dBm and 400 Hz modulation (with same deviation as above).
- Set frequency of 8648 to MIN frequency and step 6.25 kHz for 12.5kHz spacing or 12.5 kHz for 25.0kHz spacing.
- Record frequency that degrades SINAD below 12.0 dB.
- After testing from 100kHz to 1 GHz and listing problem, go back to frequency in list.
- Change RF level of HP8648 to get back to 12 dB SINAD.
- Increment frequency UP/DOWN in 1 kHz steps to find frequency that degrades SINAD the most and the level of RF that yielded 12 dB SINAD.

12. *SET TX POWER*

Program=>Test Mode Options => TX Power.

- Toggle Power setting for Low Power or High Power.
- Enter Power Level as a value between 0 and 255.
- Hit F3 to Toggle PTT.
- Press F4 to send new values to the radio.

13. *SET TX SUB-AUDIBLE DEVIATION*

Program=>Test Mode Options => TX Sub-Audible Deviation Set.

- Adjust SATTRIM1,2 for sub-audible tone deviation.
- Not necessary to align across band

14. *SET TX TONE DEVIATION*

Program=>Test Mode Options => TX Tone Deviation Set.

- Input 1 kHz audio tone into microphone input (IN2) to force limiting.
- Adjust TXTRIM1 for 3 kHz deviation. TXTRIM1 varies by 1 count for each 3% change in TX frequency.
- Set PTT. Measure deviation at 3 places across the band for UHF (more for VHF).
- Measure North American ModBalance test on HP8920.

15. *SET TX CHANNEL and POWER ADJUST*

Program=>Test Mode Options => TX Channel & Power Adjust.

- Enter Alignment Frequency and Power Level (0 to 255).
- Press F3 to Toggle PTT.
- Press F4 to send frequency and power values to the radio.

APPENDIX 7

CIRCUITS AND DEVICES TO STABILIZE FREQUENCY

A 14.95 MHz referenced TCXO PLL circuit establishes and stabilizes output frequency.

APPENDIX 8

CIRCUITS TO SUPPRESS SPURIOUS RADIATION, LIMIT MODULATION AND CONTROL POWER

TWO (2) PAGE DESCRIPTION OF AUDIO, RF LOW PASS FILTER AND POWER CONTROL FOLLOWS THIS SHEET

The volume is controlled by the VR1 potentiometer. Its analog output is read by the ASIC AD2 port (U400-6) where it is converted to digital and read by the microprocessor through the serial port.

2.7. External Speaker/Mic Control Circuit

The external microphone is connected to W401 on the right side of the radio. When an external microphone accessory is attached, it pulls the MIC_DISABLE line (W401-10) to ground which un-biases the internal microphone element. When an external speaker accessory is attached, it pulls the SPKR_DSBL line (W401-6) to ground which breaks the path to the internal speaker.

2.8. Low-Battery Detect Circuit

The low-battery detect circuit applies a voltage (determined by $V_{BATTERY}$ * (R408/[R408+R409])) to the AD3 port of the ASIC (U400-7). The ASIC converts this analog voltage to a digital byte which the microprocessor reads through the ASIC serial data path. The threshold for low-battery detect is programmable by software. When the value of AD3 falls below this threshold, the microprocessor disables the transmitter and enables the low-battery LED (LED400) and tone alerts.

2.9. Subaudible (LTR/CTCSS/DCS) Decode Circuits

Discriminator audio from the IF chip, U750-9 (TA31136), passes through a 3rd order 500-Hz Bessel low-pass filter with a gain of 2.5 to pass and amplify the subaudible data (U772A and associated components). The filter output goes into the Audio ASIC, U400-3 (XRC5640B), as RX data input. The data exits the ASIC at U400-23 (FLTOUT) and passes through a 3rd order 500-Hz Chebyshev low pass filter to strip out switch-cap clock noise (U772B and associated components).

For CTCSS, the RX data is fed back into the ASIC comparator (COMPIN-) port (U400-22). The ASIC DAC2 output (U400-10) sets the dc average to drive the comparator (COMPIN+) port (U400-20). The comparator output (U400-21) then feeds the microprocessor (U401-71) input capture port for CTCSS decoding.

For DCS and LTR, the RX data on the ASIC Filter Output (U400-23) is directly decoded by the microprocessor's A-to-D port (U401-25). The microprocessor determines whether the data matches a preset value and then controls the speaker output based on the squelch data results.

2.10. Subaudible (LTR/CTCSS/DCS) Encode Circuits

During TX encode, the subaudible tone signals are generated on the TXSAT pulse-width port of the microprocessor (U401-3). They pass through a 500 Hz low-pass filter and are sent to the TDIN port of the ASIC (U400-4). The TX data exits the ASIC at U400-23 (FLTOUT) and is then fed back into the ASIC comparator (COMPIN-) port (U400-22) where it is summed with the TX audio.

DTMF, Two-Tone, or Sel-Call data is generated by the microprocessor pulse-width port U401-2 and passes through a 4.5-kHz low-pass filter. The subaudible data then enters the ASIC DTMF port (U400-25) where it is routed through the TX Audio path.

2.11. RX Audio

Discriminator audio from the IF chip U750-9 (TA31136) is fed into the RXAUDIN port of the ASIC (U400-30). The RXAUDOUT exits the ASIC at U400-28 and is amplified by U490 and U491 in a balanced audio bridge-amp to generate up to 1 W through an 8 Ω speaker.

2.12. TX Audio and Filter Circuits

The TX audio from the internal or external microphone is fed into the ASIC MICAUDIN port (U400-29). The combined TX audio and data exits the ASIC at the MOD1 (U400-1) and MOD2 (U400-31) output ports to directly control the VCO and TCXO FM modulation.

3. RF CIRCUITS

3.1. TRANSMITTER

3.1.1. Buffer

The VCO output level of -6 dBm is amplified to +10 dBm (UHF) or +6 dBm (VHF). The buffer includes Q41 and Q42 for isolation and gain.

3.1.2. PA Module

The PA Module is a three stage amplifier. Q501 amplifies the TX signal from +10 dBm to 100 mW and Q502 amplifies it further by 7 dB to 0.5 W. Finally, Q503 amplifies it by 10 dB to 5 W and matches it to 50 Ω using an LC network, reducing the harmonics to > 30 dBc.

3.1.3. Low-Pass Filter

L101 to L103 and C102 to C108 make up a 6th order Elliptic 550-MHz (UHF) Low-Pass Filter suppressing unwanted harmonics by ≥ -63 dBc below carrier.

3.1.4. Antenna Switch

In transmit, pin diodes D100 and D101 are forward biased and enable the RF signal to pass to the antenna. D101 is shorted to ground and inhibits the RF signal to the Front End.

3.1.5. Automatic Power Control (APC)

The APC keeps the current constant to the final PA buffer stage (Q503). The current into Q503 is sensed across resistor R61. The voltage difference across R61 is amplified through U51A by the ratio of R56 to R60. The U51B Op Amp acts as a lead/lag loop filter comparing the U51A output to the radio's output power setting from the ASIC DA2 port (U400-10). The U52 Op Amp mimics a VCO as an integrator and the U53 Op Amp is a voltage follower which generates the supply current to the 2nd stage amplifier in the PA (Q502).

3.2. PLL SYNTHESIZER

3.2.1. 14.95-MHz TCXO

The UHF 14.95-MHz Temperature Compensated Crystal Oscillator (TCXO1) provides the reference to the PLL, has a frequency stability of ±1.5 ppm, and a frequency adjust of ±12.5 ppm.

3.2.2. PLL IC Dual-Modulus Pre-Scaler

The MC145190 divides the 14.95-MHz TCXO input frequency at pin U1-20 down to 5 or 6.25 kHz by the reference counter R at the Phase-Frequency Detector f_{REF} input. The VCO output, f_{VCO}, enters U1-11 and is divided by 64, A, and N until the feedback frequency, f_{FDBK}, entering the Phase-Frequency Detector equals 5 or 6.25 kHz. If f_{FDBK} is leading f_{REF}, then current-sinking pulses are output on PD_{OUT} (U1-6) to the passive low-pass filter (C12,13, R9,10) to lower the frequency of the VCO. If f_{FDBK} is lagging f_{REF}, then current-sourcing pulses are output on PD_{OUT} to increase the frequency of the VCO. The LPF settling time (when the VCO frequency is within 1 kHz of the RF frequency) is ≤10 ms. This reduces the residual side-band noise for the best signal-to-noise ratio.

To obtain the TX or RX VCO frequency, the A, N, and R counters are programmed into the PLL by serial data from the microprocessor. Output port U1-1 (OSO) is used to generate the ASIC clock by $f_{TCXO}/4$ = 14.95 MHz/4 = 3.7375 MHz. Output port U1-16 (OUTA) is used as an APC TX enable pin.

3.2.3. DC to DC Converter

The MAX860 (U900) is a switched-capacitor voltage converter that converts +5 V at U900-3 up to +10 V at U900-8. Q900 and R903 are configured as an emitter follower to generate a stable +9 V at the VPD input of the PLL (U1-5) to power the internal phase-frequency detectors.

APPENDIX 9

TRANSIENT FREQUENCY BEHAVIOR (90.214) TEST PROCEDURE

TWO (2) PAGES FOLLOW THIS SHEET

90.214 REQUIREMENTS: In the 450 - 500 MHz frequency band, transient frequencies must be within the maximum frequency difference limits during the time interval indicated below for 25, 12.5 and 6.25 kHz channels:

12.5 kHz:

Time Interval	Maximum Frequency	Mobile Radios 450 - 500 MHz
t_1	±12.5 kHz	10.0 ms
t_2	±6.25 kHz	25.0 ms
t_3	±12.5 kHz	10.0 ms

25.0 kHz

Time Interval	Maximum Frequency	Mobile Radios 450 - 500 MHz
t_1	±25.0 kHz	10.0 ms
t_2	±12.5 kHz	25.0 ms
t_3	±25.0 kHz	10.0 ms

TEST PROCEDURE: TIA/EIA TS603, PARA. 2.219, the levels were set as follows:

1. Using the variable attenuator, the transmitter level was set to 40 dB below the test receivers maximum input level, then the transmitter was turned off.

2. With the transmitter off, the signal generator was set 20 dB below the level of the transmitter in the above step (this level was maintained with the signal generator throughout the test).

3. Attenuation between the transmitter and the RF detector was reduced by 30 dB.

4. The transient frequency behavior was observed and recorded using a TEK TDS360 DSO.

Para. 2.995(a)(b)(d) Frequency stability

90.214 Transient Frequency Behavior
(continued)