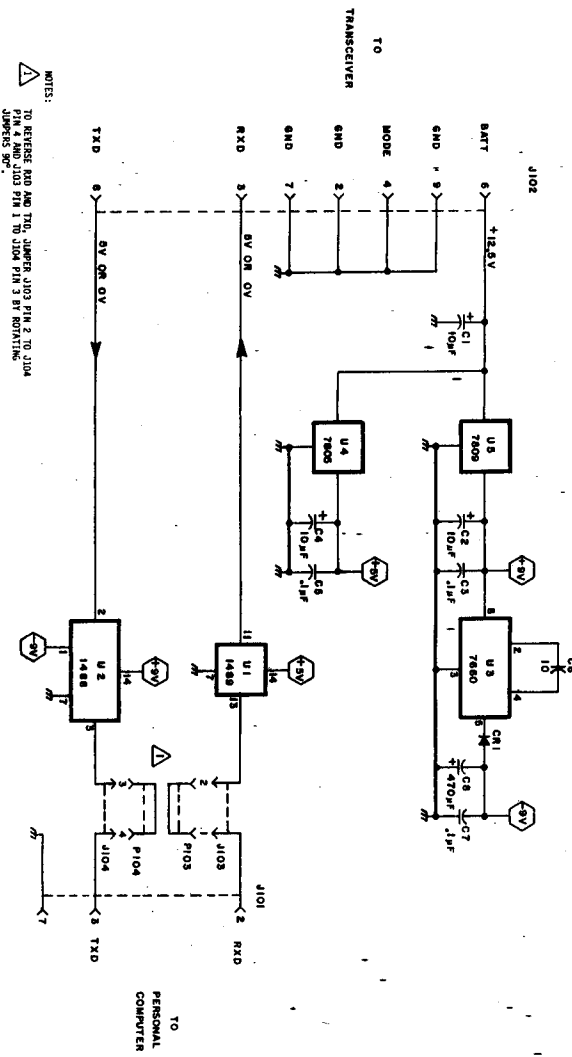


AUDIO/LOGIC BOARD TOP VIEW

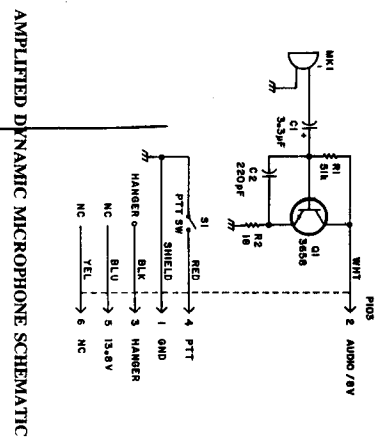
The following information is an aid to locating components on the main PC board. Refer to the grid around the component layout on pages 8-7 and 8-8 to determine the location of the following components.

MAIN BOARD COMPONENT LOCATOR GUIDE

COMP LOC	TOP OR		COMP LOC	TOP OR		COMP LOC	TOP OR				
	LOC	BOTTOM		LOC	BOTTOM		LOC	BOTTOM			
C101	C3	B	C227	E8	B	C538	G1	T	C838	M9	T
C102	B3	B	C228	A5	T	C539	F1	T	C840	M8	B
C103	E4	B	C229	B4	T	C540	F2	T	C841	L7	B
C104	E4	B	C230	A4	B	C541	F2	T	C842	G9	B
C105	E4	B	C231	A1	B	C542	D1	T	C843	F12	B
C107	E5	T	C232	B1	B	C543	D1	T	C844	G12	B
C108	K6	B	C233	B5	T	C544	D2	T	C845	J11	B
C109	K6	B	C234	A6	B	C545	D2	T	C846	J9	T
C110	L6	B	C235	A6	T	C546	L5	B	C847	J9	T
C111	G4	B	C236	D7	B	C547	M7	T	C848	J9	T
C112	F4	B	C237	F8	B	C548	L3	B	C849	J9	T
C113	D5	B	C238	A7	B	C549	L1	B	C850	J10	T
C114	C8	T	C239	E7	B	C801	G11	B	C851	J10	B
C115	A9	B	C250	F7	T	C802	H11	B	C852	N10	B
C116	D5	B	C501	M8	B	C803	H11	B	C853	H8	B
C117	E3	B	C502	N7	B	C804	H10	B	C854	G8	B
C118	A10	T	C503	M7	T	C805	G10	B	C855	M11	B
C119	A11	T	C504	L7	B	C806	H11	B	C856	M13	T
C120	A12	B	C505	M7	B	C807	G9	B	C857	M12	T
C121	A11	B	C506	N6	B	C808	H11	T	CR101	F4	B
C122	A13	B	C507	L6	B	C809	H9	T	CR102	F4	T
C123	A13	B	C508	M6	B	C810	G11	B	CR103	B7	T
C124	E12	B	C509	M6	B	C811	J13	B	CR104	B10	B
C125	D12	B	C510	M6	B	C812	K13	B	CR105	E4	B
C126	J5	B	C511	M6	B	C813	J12	B	CR201	F6	B
C201	F6	T	C512	M4	B	C814	K9	B	CR802	K12	B
C202	G6	T	C513	L5	B	C815	K9	B	CR804	K13	B
C203	G5	B	C514	L5	B	C816	K11	B	CR805	N12	B
C204	G6	B	C515	L6	B	C817	K12	B	CR806	G10	T
C205	F7	B	C517	N3	B	C818	L13	B	CR807	L9	B
C206	G6	B	C518	N3	B	C819	L13	B	CR808	L8	B
C207	C5	B	C519	M4	B	C820	K12	B	CR809	H9	B
C208	F6	B	C520	N2	B	C821	L11	B	EP101	D4	T
C209	J6	B	C521	M2	B	C822	L10	B	EP102	C5	T
C210	H7	T	C522	L3	B	C823	L12	B	EP103	C5	T
C212	E7	B	C523	L4	B	C824	L12	B	EP901	L2/D4/F4	T
C213	E8	B	C524	L4	B	C825	K11	B	EP502	M3	T
C214	D7	B	C525	M1	B	C826	M11	B	F101	B7	T
C215	E8	B	C526	L1	B	C827	M12	B	F102	F5	T
C216	D8	B	C527	K1	B	C828	N12	B	F102	B2	T
C217	C8	B	C528	K3	B	C829	N11	B	J102	B2	T
C218	C8	T	C529	J3	B	C830	L10	B	J105	A1	T
C220	C10	B	C530	H3	B	C831	L11	B	K101	E3	T
C221	D10	T	C531	H4	T	C832	L12	B	L204	F5	T
C222	D10	T	C532	H4	T	C833	M10	B	L205	G5	T
C223	C9	B	C533	J1	T	C834	K9	B	L209	H7	T
C224	E11	T	C534	H1	T	C835	L10	B	L212	F8	T
C225	E10	T	C535	H1	T	C836	L9	B	L501	M6	T
C226	F10	T	C537	G2	T	C837	M9	B	L502	M4	T



REMOTE PROGRAMMING INTERFACE (RPI) SCHEMATIC
(Part No. 023-5800-000)



AMPLIFIED DYNAMIC MICROPHONE SCHEMATIC

PARTS LIST (CONT.)

SYMBOL NUMBER	DESCRIPTION	PART NUMBER	SYMBOL NUMBER	DESCRIPTION	PART NUMBER
S401	Molded switch	032-0791-025	U 400	Microcomputer w/software 8051	023-9998-131
S402	Molded switch	032-0791-025	U 401	EEPROM, 512 x 8 2404	544-5001-403
S403	Molded switch	032-0791-025	U 402	Analog switch (quad) 4066	544-3014-066
TP401	Jack, vertical black "	105-2203-211	U 403	Buffer (hex) 74C906	544-3714-906
TP402	Jack, vertical brown	105-2208-211	U 404	Buffer (hex) 4049	544-3014-049
TP403	Jack, vertical orange	105-2206-211	U 405	Buffer (hex) 4050	544-3014-050
TP404	Jack, vertical yellow	105-2207-211	U 406	Display driver, 20-bit 5812	544-2027-009
U 300	Regulator, 5V 1.5A 7805	544-2003-016	X 400	40-pin IC socket	515-5008-019
U 301	Op amp (quad) hi rel 3303	545-2020-003	X 401	10-pin IC socket	515-5008-250
U 302	Op amp (quad) hi rel 3303	545-2020-003			
U 303	Op amp (quad) hi rel 3303	545-2020-003	Y 400	Crystal, 11.0590 MHz	521-0011-059

CHANGES MADE TO TRANSCEIVER MAIN BOARD WHEN ENHANCED AUDIO/LOGIC BOARD IS USED

The following are factory changes made to the transceiver to improve performance when the enhanced audio/logic board is used.

7151/7152 TRANSCEIVERS

- a. C814 and C816 in synthesizer near the Balance Adjust potentiometer changed from .001 μ F to 220 pF, Part No. 510-3602-221
- b. A 100k ohm resistor, Part No. 569-0115-104, was added in the receiver from U202, pin 10 to ground.

7170/7171/7172 TRANSCEIVERS

- a. A 100k ohm resistor, Part No. 569-0115-104, was added in the receiver from U202, pin 10 to ground.
- b. A 0.1 μ F capacitor, Part No. 510-3607-104, was added in the receiver near Squelch Adjust potentiometer R220. This capacitor was installed in series in the trace between the junction of R218/W104, pin 14 and the wiper of R220.

ALIGNMENT PROCEDURE CHANGE

With VHF transceivers, delete step d of Section 6.6.2 in which T209 is adjusted for 4.8V at TP405.

With UHF transceivers, delete step e of Section 6.6.2 in which T213 is adjusted for 4.5V at TP405.

**ALAMO COMMUNICATIONS
& ELECTRONICS**
3060 Bechelli Lane
Redding, CA. 96002
Bus. (916) 221-0256 Res. 365-7671

SECTION 3 PARTS LIST

SYMBOL NUMBER	DESCRIPTION	PART NUMBER	SYMBOL NUMBER	DESCRIPTION	PART NUMBER
ENHANCED AUDIO/LOGIC BOARD PART NO. 023-7175-200			C 413	.001 μ F \pm 10% X7R 50V cer smd	510-3606-102
A 001	Display board assembly	023-7175-210	C 414	.001 μ F \pm 10% X7R 50V cer smd	510-3606-102
C 300	.0068 μ F \pm 5% 63V polyester	510-1033-682	CR300	UHF/VHF band switch diode	523-1504-012
C 301	.015 μ F \pm 5% 63V polyester	510-1033-153	CR301	UHF/VHF band switch diode	523-1504-012
C 302	.001 μ F \pm 5% 63V polyester	510-1033-102	CR302	Hot carrier diode	523-1504-016
C 303	.0068 μ F \pm 5% 63V polyester	510-1033-682	CR303	Hot carrier diode	523-1504-016
C 304	.0068 μ F \pm 5% 63V polyester	510-1033-682	CR304	1N4448 Si diode	523-1500-883
C 305	.15 μ F \pm 5% 63V polyester	510-1033-154	CR401	LED, green	549-4001-122
C 306	.001 μ F \pm 5% 63V polyester	510-1033-102	CR402	LED, red	549-4001-120
C 307	.01 μ F \pm 5% 63V polyester	510-1033-103	CR403	LED, yellow	549-4001-121
C 308	.22 μ F \pm 5% 63V polyester	510-1033-224	CR404	LED, green	549-4001-122
C 310	.018 μ F \pm 5% 63V polyester	510-1033-183	CR405	3.9V 400 mW zener	523-2505-399
C 311	.039 μ F \pm 5% 63V polyester	510-1033-393	CR410	Switching diode	523-1504-002
C 312	.0018 μ F \pm 5% 63V polyester	510-1033-182	DS401	Display, 7-seg .3" green	549-4002-020
C 313	.082 μ F \pm 5% 63V polyester	510-1033-823	DS402	Display, 7-seg .3" green	549-4002-020
C 314	.001 μ F \pm 5% 63V polyester	510-1033-102	EP001	Edge clip, hybrid	515-9034-002
C 315	.0027 \pm 5% 63V polyester	510-1033-272	EP400	Foam tape, double sided	574-3002-015
C 316	10 μ F 16V tantalum smd	510-2625-100	HW300	Screw, 4-40 PH slot nylon	575-4504-008
C 318	.01 μ F \pm 5% 63V polyester	510-1033-103	HW301	Nylon 4-40 nut	560-4104-008
C 319	.01 μ F \pm 5% 63V polyester	510-1033-103	J 403	Connector, 18-pin male	515-5012-018
C 320	.01 μ F \pm 5% 63V polyester	510-1033-103	MP300	Standoff	013-1188-007
C 321	.0047 μ F \pm 5% 63V polyester	510-1033-472	PC001	PC board, display	035-7175-210
C 322	.1 μ F \pm 5% 63V polyester	510-1033-104	PC200	PC board, audio/logic	035-7175-200
C 323	.0012 μ F \pm 10% 63V polyester	510-1033-122	Q 400	Si NPN amplifier SOT-23	576-0003-658
C 324	.0047 μ F \pm 5% 63V polyester	510-1033-472	Q 401	Si NPN amplifier SOT-23	576-0003-658
C 325	.001 μ F \pm 5% 63V polyester	510-1033-102	Q 402	Si NPN amplifier SOT-23	576-0003-658
C 326	47 μ F 25V alum electrolytic	510-4225-470	Q 404	Si NPN amplifier SOT-23	576-0003-658
C 327	.1 μ F \pm 10% X7R 50V ax cer	510-3554-104	Q 405	Si NPN amplifier SOT-23	576-0003-658
C 328	.01 μ F \pm 10% X7R 50V cer smd	510-3606-103	Q 406	Si NPN amplifier SOT-23	576-0003-658
C 329	.01 μ F \pm 10% X7R 50V cer smd	510-3606-103	Q 407	Si NPN low-noise amp SOT-23	576-0001-300
C 330	.1 μ F \pm 10% X7R 50V ax cer	510-3554-104	Q 408	Si PNP low-noise amp SOT-23	576-0003-657
C 331	220 μ F 25V alum electrolytic	510-4225-221	Q 409	Si NPN amplifier SOT-23	576-0003-658
C 332	47 μ F 25V alum electrolytic	510-4225-470	Q 410	Si PNP low-noise amp SOT-23	576-0003-657
C 333	10 μ F 25V alum electrolytic	510-4125-100	Q 411	Si PNP low-noise amp SOT-23	576-0003-657
C 334	47 μ F 25V alum electrolytic	510-4225-470	Q 412	Si PNP low-noise amp SOT-23	576-0003-657
C 400	.0047 μ F \pm 10% X7R 50V cer	510-3606-472	Q 413	Si NPN amp/switch SOT-23	576-0003-600
C 402	.1 μ F \pm 10% X7R 50V ax cer	510-3554-104	Q 414	Si PNP low-noise amp SOT-23	576-0003-657
C 403	.1 μ F \pm 10% X7R 50V ax cer	510-3554-104	R 300	36k ohm \pm 5% 1/8W smd	569-0115-363
C 404	47 μ F 10V alum electrolytic	510-4003-004	R 301	36k ohm \pm 5% 1/8W smd	569-0115-363
C 405	22 μ F 25V alum electrolytic	510-4125-220	R 302	560k ohm \pm 5% 1/8W smd	569-0115-564
C 406	30 pF \pm 5% NPO 50V cer smd	510-3602-300	R 303	180k ohm \pm 5% 1/8W smd	569-0115-184
C 407	30 pF \pm 5% NPO 50V cer smd	510-3602-300	R 304	27k ohm \pm 5% 1/8W smd	569-0115-273
C 408	.001 μ F \pm 10% X7R 50V cer smd	510-3606-102			
C 409	120 pF \pm 5% NPO 50V cer smd	510-3602-121			
C 410	120 pF \pm 5% NPO 50V cer smd	510-3602-121			
C 411	.001 μ F \pm 10% X7R 50V cer smd	510-3606-102			
C 412	.001 μ F \pm 10% X7R 50V cer smd	510-3606-102			

Priority channels are periodically scanned while listening to a nonpriority channel and if a message is detected on a priority channel, the nonpriority message is immediately dropped and the message on the priority channel is heard. When the priority message is finished, the transceiver waits for whatever scan resume delay has been programmed and then returns to the nonpriority channel. If a carrier and the correct Call Guard tone or code (if programmed) is detected on the nonpriority channel, any remaining message is heard.

There is a priority message beep that can be enabled by dealer programming to sound whenever a message is received on a priority channel. Note that priority channels are available only when the transceiver is programmed for scanning and only when the scan mode is selected. Priority channels are not scanned while transmitting.

First and Second Priority Channels

Both a first and second priority channel can be programmed. The main difference between first and second priority channels is in how often they are scanned. The first priority channel is scanned every 500 milliseconds and also in the normal scan sequence. The second priority channel is scanned as a regular channel until a carrier is detected on a nonpriority channel. It is then scanned every 2 seconds. The first priority channel is scanned while listening to the second priority channel but not vice versa.

When the priority channel is scanned while listening to a nonpriority channel, an interruption or "hole" occurs in the audio signal. This interruption is only 45 milliseconds when the first priority channel is scanned and is heard as a brief "tick". The time required to scan the second priority channel is also 45 milliseconds when only a carrier is detected and up to 750 milliseconds when Call Guard squelch is detected. Refer to "Detecting Call Guard Squelch on Priority Channels" for more information.

Programming Priority Channels

Priority channels can be programmed in the following ways:

- a. Either priority channel can be the selected channel. The priority channel is then the channel that was selected when the scan mode is entered and changes whenever a different channel is selected. The other priority channel can be dealer programmed or not used at all.

- b. One or both priority channels can be fixed channels programmed by the dealer. Channel selection then does not affect priority channels.

- c. Priority channels can be disabled entirely by dealer programming.

If a priority channel is dealer programmed, the priority status is flashed in the display when the channel is first displayed such as when the selected channel is changed, the scan mode is exited, or transceiver power is turned on. "P1" indicates the first priority channel, and "P2" indicates the second priority channel. Refer to Section 2.9.2 for more information on the channel display.

Detecting Call Guard Squelch on Priority Channels

Call Guard squelch is not detected on a first priority channel. The reason is that with the sampling frequency used (500 milliseconds) and the amount of time required to detect Call Guard squelch (up to 750 milliseconds), major parts of a nonpriority message would not be heard.

Call Guard squelch or an external decoder can be detected on the second priority channel. When this is done, a first priority channel is not available because if detection of Call Guard squelch on the second priority channel is interrupted to scan the first priority channel, proper detection would not occur.

When the second priority channel is scanned for Call Guard squelch, the channel is scanned every 500 milliseconds for a carrier. This causes only a 45 millisecond interruption of the audio signal on a nonpriority channel. If a carrier is detected, the channel is then checked for Call Guard squelch. If a correct Call Guard tone or code is detected, the message is heard. If the tone or code is incorrect or if none is detected, the channel is scanned every 2 seconds for Call Guard squelch. When no carrier is again detected, the 500 millisecond scan rate resumes.

Scanning a channel for only a carrier results in a 45 millisecond interruption of the audio signal on the nonpriority channel. Scanning for Call Guard squelch results in a 125-750 millisecond interruption. The shortest time (125 ms) is when no Call Guard tone or digital code is detected and the longest time (750 ms) is when a wrong digital code must be detected. If an external decoder is used, an interruption occurs that is as long as the programmed scan delay (refer to Section 2.4.2).

The Busy indicator remains functional in the scan mode. If the Busy indicator lights but the audio does not unscquelch, a message was probably detected that did not contain the correct Call Guard tone or code. If an external decoder is being used, there may be a delay period before the audio unscquelches, (refer to Section 2.4.2).

The scan rate when no carrier is detected is 43 channels per second. Locked out or unprogrammed channels are not scanned and therefore do not affect the scan rate. When channels are programmed with Call Guard squelch, the scan rate decreases as the number of channels with the wrong Call Guard tone or code increases. In the worst case when the wrong tone or code is detected on all channels, the scan rate is 3-8 channels per second. (The lower rate applies to digital codes which take longer to decode.) If an external decoder is installed and channels programmed for this decoder are scanned, the scan rate of these channels is determined by the scan delay that is programmed.

2.8.2 SCAN RESUME DELAY

After a message is received when scanning, there is a programmable delay after loss of carrier before scanning resumes. This delay is dealer programmable in steps from 0-4 seconds. This delay allows a response to be made to a message without changing channels and also prevents scanning from resuming during momentary signal fades or conversation gaps.

There is also a 5 second delay after transmitting that can be enabled by dealer programming. This delay ensures that a response from the other party is heard. Without this delay, scanning resumes when the push-to-talk switch is released and a message on another channel may be detected that would prevent the response from being heard. If a first priority channel has been programmed, it is scanned during these delay periods (refer to Section 2.8.6).

2.8.3 SELECTING CHANNELS IN THE SCAN MODE

NOTE: In the scan mode, "selected channel" refers to the channel displayed when the scan mode is entered or exited. This channel can be changed only by the channel select switches. Transmitting or receiving on another channel when in the scan mode does not change the selected channel.

The channel select switches remain active in the scan mode to permit the selected channel to be changed. Pressing either switch once halts scanning and displays the selected channel along with the priority and lockout status (if any). If a switch is pressed again within 2 seconds, the selected channel is increased or decreased as described in Section 2.1.2. Scanning resumes 2 seconds after a channel is selected.

2.8.4 TRANSMITTING WHEN IN THE SCAN MODE

General

Transmitting is allowed while scanning. However, the type of operation which occurs depends on how several options are programmed by the dealer. Two of these options are Transmit On Selected Channel Only, and Stop Scan When Microphone Is Off-Hook. These options can be enabled or disabled in any combination desired. The next two sections describe operation when these two options are disabled and enabled.

"Transmit On Selected Channel Only" Disabled

If this option is disabled and a message is received on any scanned channel, a response can be made to that message without exiting the scan mode or changing the selected channel. However, the transmitter must be keyed during the delay period before scanning resumes. This delay period is programmable in steps from 0-4 seconds as described in Section 2.8.2.

If no message has been received (dashes are present in the channel display), transmission occurs on the selected channel. However, taking the microphone off-hook disables Call Guard squelch or the external decoder (except if scanning for an open channel as described in a later section). Any message occurring on a scanned channel may then be received and transmission occurs on that channel (if the transmitter is keyed before scanning resumes). To transmit on the selected channel in this situation, the scan mode must be exited by pressing the Scan switch. If the Stop Scan When Microphone Is Off-Hook option is enabled, some messages occurring on any scanned channel may still be received before scanning stops.

"Transmit On Selected Channel Only" Enabled

This option can be enabled to ensure that transmission always occurs on the selected channel. Although this prevents problems associated with transmitting on the wrong channel, it requires that the channel be manually changed when responding to a message not on the

2.3 MONITOR, CALL, BUSY, AND TRANSMIT INDICATORS

2.3.1 MONITOR INDICATOR (GREEN)

The green MONITOR indicator lights whenever the transceiver is in the monitor mode. The monitor mode is used to disable Call Guard squelch or an external decoder (if any) so that the channel can be monitored before transmitting. The monitor mode is enabled by taking the microphone off-hook or pressing the Monitor switch (if programmed).

There is one exception when the monitor mode is not enabled by taking the microphone off-hook. It is when the Scan For An Open Channel function is programmed. However, the Monitor switch (if programmed) still enables monitoring. Refer to Section 2.8.4 for more information.

Since the front-panel option switches are the momentary type, the position of the switch button does not indicate the mode that is currently selected. To determine the mode selected by the Monitor switch, observe the Monitor indicator with the microphone on-hook. The Monitor switch still toggles the monitor function when the microphone is off-hook even though the Monitor indicator is always lighted. When power is turned on, the Monitor switch returns to the previously-selected mode.

2.3.2 CALL INDICATOR (YELLOW)

The Call indicator is functional even if a front panel Call switch is not programmed for that function. The microphone must be on-hook for the Call indicator to function, and it lights if the transceiver is unsquelched continuously for 2 seconds. Since the correct Call Guard tone or code must be detected (if programmed) for the transceiver to unsquelch, Call Guard squelch is detected with the Call indicator. The Call indicator is reset by taking the microphone off-hook, turning the transceiver off and then on, or pressing the Call switch (if programmed).

In the scan mode when there is a priority channel, the Call indicator functions on only the priority channel. If there are two priority channels, it functions on only the first priority channel.

2.3.3 BUSY INDICATOR (GREEN)

The Busy indicator lights whenever a carrier is detected on the selected channel. If the Busy indicator turns on but the transceiver does not unsquelch, Call

Guard squelch or an external decoder is probably being used on the channel, and the proper tone or code was not detected. The Busy indicator can be used as a visual indication that the selected channel is busy. The squelch control must be properly adjusted for this indicator to operate correctly.

2.3.4 TRANSMIT INDICATOR (RED)

The transmit indicator lights whenever the transmitter is keyed. All front-panel switches are nonfunctional in the transmit mode.

2.4 CALL GUARD AND EXTERNAL DECODER SQUELCH CONTROL

2.4.1 CALL GUARD SQUELCH CONTROL

Tone, digital, or inverted digital Call Guard squelch can be programmed in any combination desired on each channel. For example, a channel can be programmed so that a Call Guard tone is transmitted and a Call Guard digital code is received. The monitor mode disables Call Guard squelch so that the channel can be monitored before transmitting (refer to Section 2.3.1).

Tone-type Call Guard squelch can be programmed so that the reverse burst is not transmitted. The reverse burst eliminates the "squelch tail" in the receiving transceiver. It is a 180 degree phase reversal of the tone signal for a period determined by the tone frequency.

Digital-type Call Guard squelch can be programmed as either normal or inverted. The only difference is that the data signal is inverted when inverted is specified. The inverted type may need to be programmed if the signal is inverted by a repeater or another mobile transceiver. If the Call Guard squelch does not function, try changing this parameter. Refer to Section 4.6 of the transceiver service manual for more information on Call Guard squelch.

2.4.2 EXTERNAL ENCODERS AND DECODERS

Decoder Reset

The enhanced audio/logic board supports most kinds of external encoders and decoders that may be installed. Two examples are two-tone and DTMF decoders. Decoders can be installed so that DC power to the decoder is from the auxiliary power output on the audio/logic board (wireout 1 or collector of Q408). Then when

- Scan can be programmed to halt when the microphone is taken off-hook (refer to Section 2.8.4).
- The function to transmit on selected channel only while scanning can be programmed without preconditions such as a priority channel (refer to Section 2.8.4).
- Channels locked out of scanning by the lockout switch can be either saved or not saved in memory. If saved, they will remain locked out when power is turned back on (refer to Section 2.8.5).
- When external decoders are used and EXT+/EXT- is programmed, a scan delay can be programmed in steps from 0-60 seconds. This permits scanning to be used with external decoders that have a relatively long detect time (refer to Section 2.4.2).
- The reverse burst can be disabled when Call Guard tone-controlled squelch is programmed.
- Both option switches can be disabled.
- When the Transmit Disable On Busy feature is programmed, there is an option to allow transmission when a carrier is detected if the correct Call Guard tone or code is detected. Otherwise, transmission is disabled whenever a carrier is detected (refer to Section 2.6).

1.3 TRANSCEIVER PROGRAMMING

New programming software is required to program the enhanced logic. The Tandy Model 100/102, IBM PC and compatibles, and Commodore 64 computers will be supported. The programming procedure is similar to that previously used with the addition of several questions. The transceiver is still programmed using a programming jack accessible from the back panel. The new programming software cannot be used to program the older transceivers.

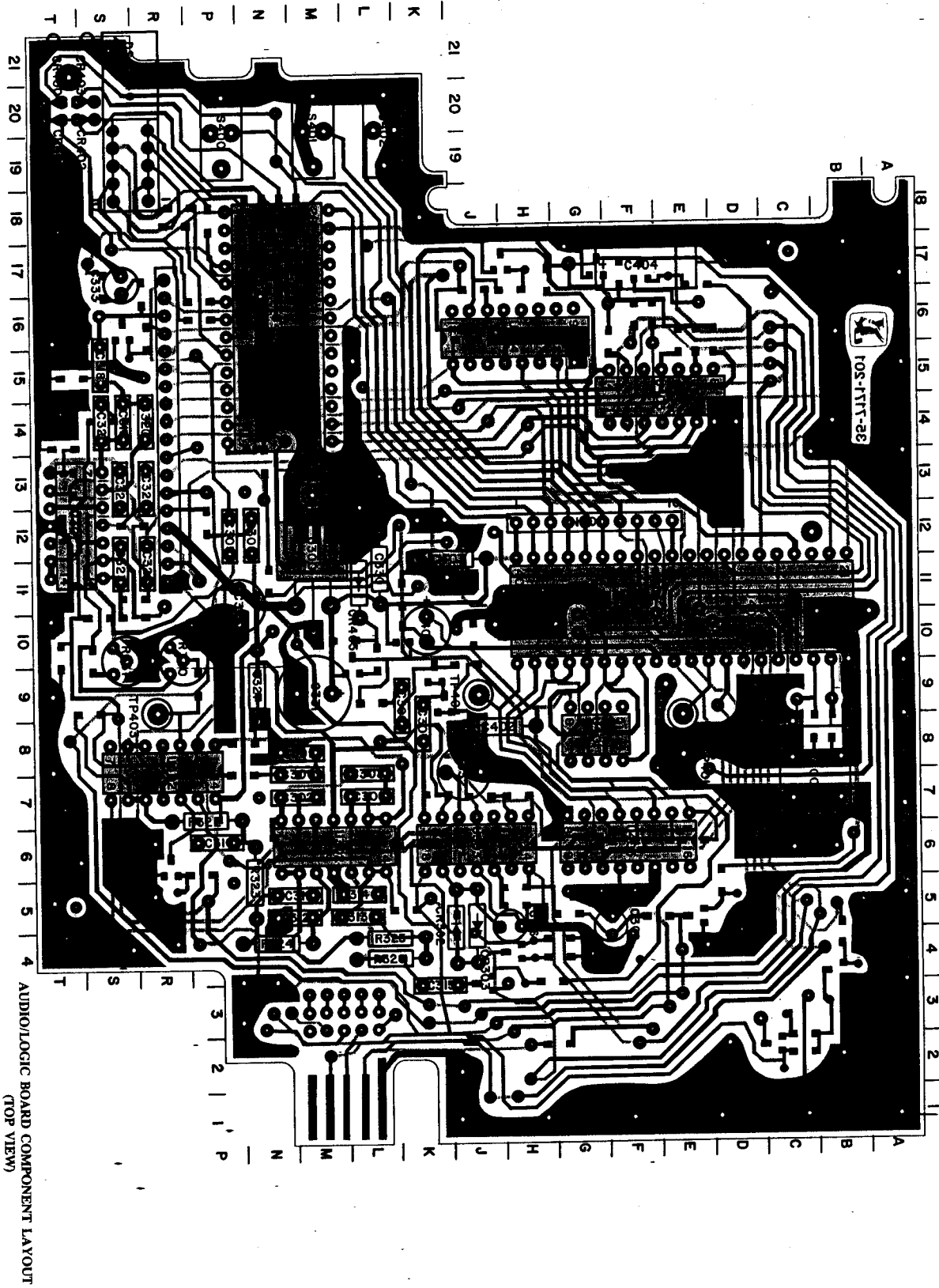
The following information is an aid to locating components on the audio board. Refer to the grid around the component layout on pages 8-11 and 8-12 to determine the location of the components.

AUDIO/LOGIC BOARD COMPONENT LOCATOR GUIDE

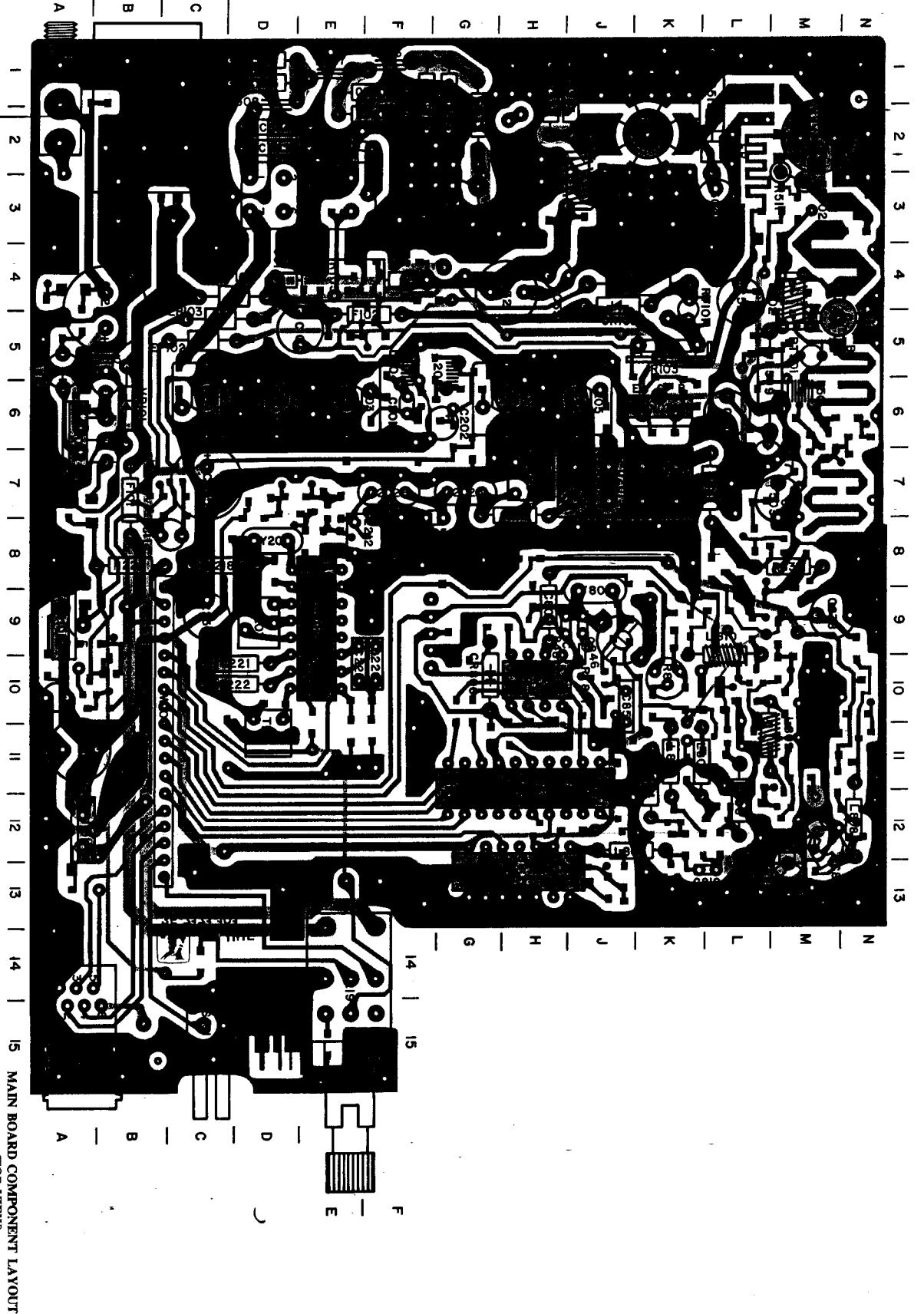
COMP	LOC	TOP OR BOTTOM	COMP	LOC	TOP OR BOTTOM	COMP	LOC	TOP OR BOTTOM	COMP	LOC	TOP OR BOTTOM
C300	M8	T	CR400	T20	T	R325	L4	T	R419	N18	B
C301	M8	T	CR401	T20	T	R326	L4	T	R420	M16	B
C302	M7	T	CR402	S20	T	R327	L4	B	R421	N18	B
C303	L8	T	CR404	S20	T	R328	J5	B	R422	D5	B
C304	L7	T	CR405	L11	T	R329	P9	B	R423	F16	B
C305	P12	T	DS400	S21	T	R330	R10	T	R424	P6	B
C306	N12	T	J403	R14	T	R331	K6	B	R425	P7	B
C307	K8	T	Q301	H4	B	R332	T15	B	R426	H3	B
C308	K9	T	Q400	E5	B	R333	R14	B	R428	J16	B
C309	F5	T	Q401	R6	B	R334	S14	B	R429	J17	B
C310	P6	T	Q402	J3	B	R335	T13	B	R430	H17	B
C311	N5	T	Q404	H17	T	R336	T14	B	R431	H17	B
C312	N5	T	Q405	G17	B	R337	S10	T	R432	F17	B
C313	L5	T	Q406	F17	B	R338	S10	B	R433	E17	B
C314	L5	T	Q407	B4	B	R339	S11	B	R434	J10	B
C315	K4	T	Q408	C2	B	R340	S11	B	R435	B4	B
C316	H5	T	Q409	S16	B	R341	S12	B	R436	C2	B
C318	S15	T	Q410	L9	T	R342	S10	B	R437	C2	B
C319	S14	T	Q411	K10	T	R343	T10	B	R438	R16	B
C320	R14	T	R300	P8	B	R344	S17	B	R439	L10	T
C321	S14	T	R301	M7	B	R345	R17	B	R440	L10	T
C322	S13	T	R302	N6	B	R346	K5	B	R441	L9	T
C323	S11	T	R303	M6	B	R347	G4	B	RN400	G12	T
C324	R12	T	R304	L7	B	R348	G4	B	S400	P20	T
C325	R13	T	R305	P8	B	R349	K6	B	S401	M20	T
C326	P11	T	R306	R8	B	R400	F11	B	S402	L20	T
C327	N9	T	R307	P12	B	R401	N11	B	TP401	E8	T
C328	N9	B	R308	K7	B	R402	E16	B	TP402	E9	T
C329	K11	B	R309	J9	B	R403	E16	B	TP403	R9	T
C330	L11	T	R310	J6	B	R404	F16	B	TP404	J9	T
C331	M9	T	R311	H5	B	R405	F16	B	U300	M12	T
C332	J8	T	R312	H5	B	R406	D16	B	U301	T12	T
C333	S17	T	R313	G5	B	R407	F11	B	U302	M6	T
C400	N13	B	R314	F5	B	R408	H2	B	U303	J6	T
C402	J8	T	R315	S9	B	R409	N14	B	U400	F10	T
C403	J12	T	R316	F6	B	R410	R18	B	U401	G8	T
C404	F17	T	R317	E6	B	R411	N16	B	U402	R8	T
C405	K10	T	R318	E6	B	R412	P16	B	U403	F14	T
C406	B8	B	R319	G6	B	R413	P16	B	U404	H16	T
C407	C8	B	R320	J7	B	R414	R18	B	U405	F6	T
CR300	K9	B	R321	H7	B	R415	P18	B	U406	N16	T
CR301	K9	B	R322	P7	T	R416	N18	B	Y400	C7	T
CR302	J5	T	R323	N5	T	R417	M16	B			
CR303	J5	T	R324	N4	T	R418	M18	B			

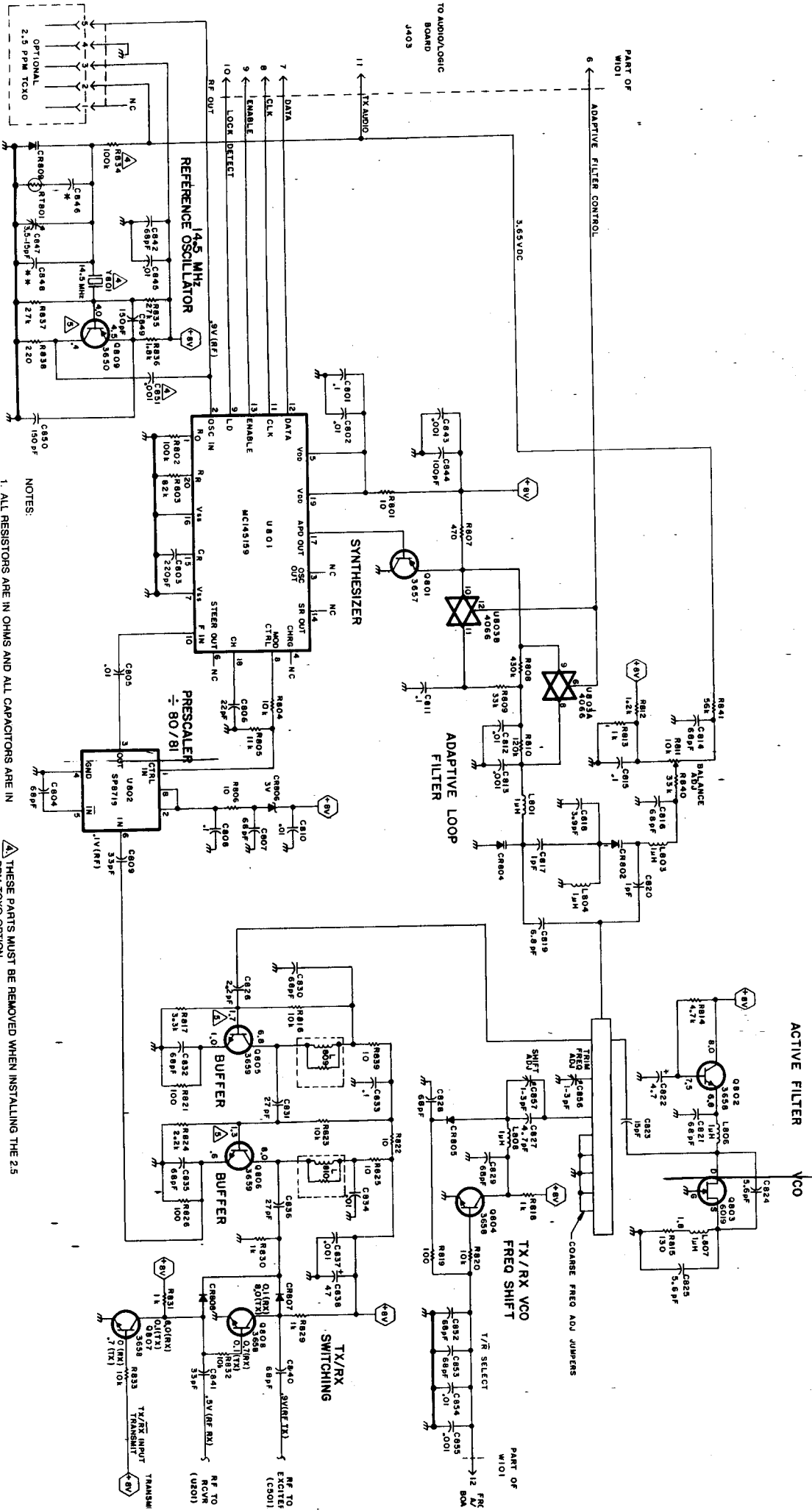
The following guide can be used to aid in locating parts on the audio/logic board. Refer to the grid around the component layout to determine the location of a component.

AUDIO/LOGIC BOARD COMPONENT LOCATION GUIDE											
COMP	LOC	TOP OR BOTTOM	COMP	LOC	TOP OR BOTTOM	COMP	LOC	TOP OR BOTTOM	COMP	LOC	TOP OR BOTTOM
C 300	B2	T	CR304	D3	T	R 333	D1	B	R 428	E3	B
C 301	B2	T	CR401	E1	T	R 334	D1	B	R 429	E3	B
C 302	B2	T	CR402	E1	T	R 335	D1	B	R 430	E3	B
C 303	B2	T	CR403	E1	T	R 337	C1	T	R 431	E4	B
C 304	B2	T	CR404	E1	T	R 338	D1	B	R 432	E4	B
C 305	D2	T	CR405	C2	T	R 339	D1	B	R 433	E4	B
C 306	D2	T	CR410	A5	T	R 340	D1	B	R 434	C3	B
C 307	C3	T	DS401	F1	T	R 341	D1	B	R 435	B5	B
C 308	C3	T	DS402	F1	T	R 342	C1	B	R 436	B5	B
C 310	B1	T	J 403	D1	T	R 343	C1	B	R 437	B5	B
C 311	B2	T	Q 400	A4	T	R 344	E1	B	R 438	E1	B
C 312	B2	T	Q 401	B1	T	R 345	E1	B	R 439	C2	B
C 313	B2	T	Q 402	A3	T	R 350	C1	B	R 440	C2	B
C 314	B2	T	Q 404	E3	T	R 352	C3	B	R 441	C3	B
C 315	B3	T	Q 405	E4	T	R 353	B1	B	R 442	A5	B
C 316	A3	B	Q 406	E4	T	R 354	B3	B	R 443	A5	B
C 318	E1	T	Q 407	B5	T	R 355	C1	B	R 444	B5	B
C 319	D1	T	Q 408	B5	T	R 356	C1	B	R 445	B5	B
C 320	D1	T	Q 409	E1	T	R 357	C1	B	R 446	D2	B
C 321	D1	T	Q 410	C2	T	R 358	B1	B	R 447	E2	B
C 322	C1	T	Q 411	C3	T	R 359	B1	B	R 448	E2	B
C 324	D1	T	Q 413	A5	T	R 361	C3	B	R 450	D2	B
C 325	D1	T	Q 414	B5	T	R 362	B3	B	R 451	E1	B
C 326	C2	T	R 300	B2	T	R 400	C4	B	R 452	E1	B
C 327	C2	T	R 301	B2	T	R 401	D3	B	R 453	E1	B
C 328	C2	T	R 302	B2	T	R 402	E4	B	R 454	E1	B
C 329	D2	T	R 303	B2	T	R 403	E5	B	R 455	A2	B
C 330	C2	T	R 304	B2	T	R 404	D4	B	R 456	A4	B
C 331	C2	T	R 305	B2	T	R 405	E4	B	RM400	D4	T
C 332	B3	T	R 306	C1	T	R 406	D4	B	RT301	B3	T
C 333	E1	T	R 307	D1	T	R 407	C4	B	RT302	B3	T
C 334	C1	T	R 308	B3	T	R 408	A4	B	TP401	B4	T
C 400	D1	T	R 309	C3	T	R 409	D2	B	TP402	C4	T
C 402	C3	T	R 310	B3	T	R 410	E2	B	TP403	C1	T
C 403	C3	T	R 311	B3	T	R 411	F1	B	TP404	C3	T
C 404	E4	T	R 312	B3	T	R 412	F1	B	U 300	D2	T
C 405	C3	T	R 316	B4	T	R 413	F1	B	U 301	D1	T
C 406	C3	T	R 317	B4	T	R 414	E2	B	U 302	R2	T
C 407	C5	B	R 318	B4	T	R 415	E2	B	U 303	B3	T
C 408	C3	T	R 319	B3	T	R 416	D2	B	U 400	C4	T
C 409	C3	T	R 322	B1	T	R 417	F1	B	U 401	B4	T
C 410	C3	T	R 323	B2	T	R 418	F1	B	U 402	B1	T
C 411	C3	T	R 324	A2	T	R 419	F1	B	U 403	D4	T
C 412	F2	B	R 325	A2	T	R 420	F1	B	U 404	E3	T
C 413	F2	B	R 326	A2	T	R 421	F1	B	U 405	E4	T
C 414	F2	B	R 327	A2	T	R 422	B4	B	U 406	F2	T
CR300	C3	B	R 328	B3	T	R 423	D4	B	Y 400	B5	T
CR301	C3	B	R 330	C1	T	R 424	B1	B			
CR302	C3	B	R 331	B3	T	R 425	B1	B			
CR303	B3	B	R 332	E1	T	R 426	A3	B			



AUDIO/LOGIC BOARD COMPONENT LAYOUT
(TOP VIEW)





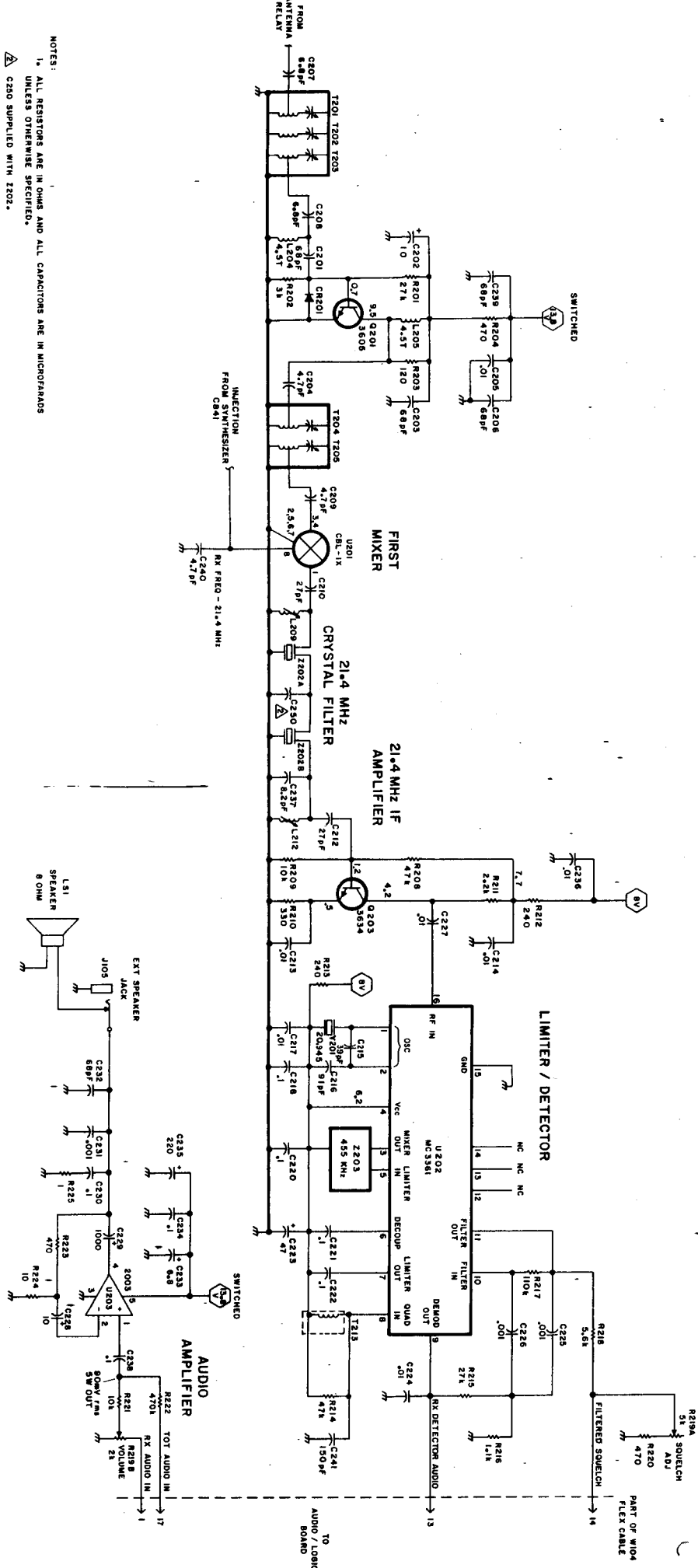
NOTES:

1. ALL RESISTORS ARE IN OHMS AND ALL CAPACITORS ARE IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
2. ". * ." DESIGNATES COMPENSATION CAPACITOR (THE VALUE IS STAMPED ON CRYSTAL Y801).
3. ". * * ." DESIGNATES FACTORY SELECTED VALUE TO SET THE ADJUSTMENT RANGE OF C947.

△ THESE PARTS MUST BE REMOVED WHEN INSTALLING THE 2.5 PPM TCXO OPTION.
 △ Q805, Q806, and Q809 DC VOLTAGES MEASURED WITH NO RF PRESENT.

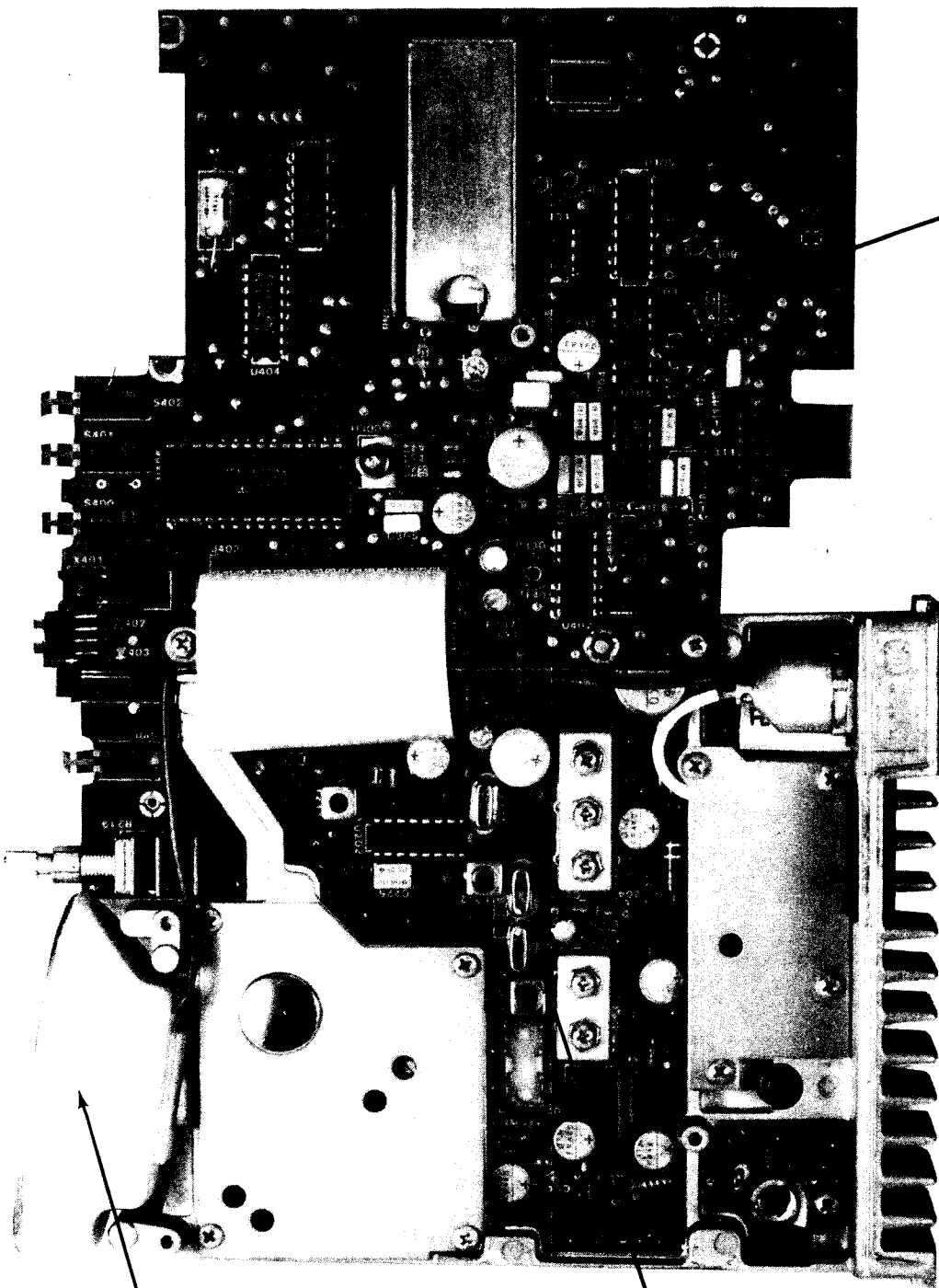
SYNTHESIZER

(Transmitter on Next Page)



NOTES:
 1. ALL RESISTORS ARE IN OHMS AND ALL CAPACITORS ARE IN MICROFARADS
 2. UNLESS OTHERWISE SPECIFIED.
 3. C250 SUPPLIED WITH 2202.

RECEIVER SCHEMATIC



AUDIO /
LOGIC
BOARD

SPEAKER
ASSEMBLY

MAIN
BOARD

TRANSCEIVER TOP VIEW

PARTS LIST (CONT.)

SYMBOL NUMBER	DESCRIPTION	PART NUMBER	SYMBOL NUMBER	DESCRIPTION	PART NUMBER
<p align="center">AMPLIFIED DYNAMIC MICROPHONE Part No. 250-0740-300</p>			MP004	Cartridge gasket	032-0429-075
			MP005	Blast filter	018-1033-002
			MP006	Switch bracket	017-1885-030
C001	3.3 μ F 20V tantalum chip	510-2606-339	MP007	Hanger button	013-1216-005
C002	220 pF \pm 5% 50V NPO cer chip	510-3602-221	MP008	Crimp retainer	017-2222-005
EP001	Contact .038" dia.	586-9008-100	MP009	Rubber bumper	018-0798-009
EP002	Mic cord w/mod connector	597-2002-111	MP010	Backing plate	015-0876-026
EP004	Terminal (hanger)	022-0069-011	NP001	Johnson nameplate	559-0039-025
HW001	Screw, 4-20 x 1/2 Phillip	575-5604-016	PC001	PC board	035-0441-020
HW002	Screw, 4-20 x 5/16 Phillip	575-5604-010	Q001	NPN amplifier SOT-23	576-0003-658
MK001	Dynamic mic cartridge	589-1011-003	R001	51k ohm \pm 5% 1/8W chip	569-0115-513
MP001	Case front (black)	032-0426-100	R002	18 ohm \pm 5% 1/8W chip	569-0115-180
MP002	Case back (black)	032-0427-100	S001	Leaf switch SPST	583-1004-031
MP003	Actuator (black)	032-0428-050			

PARTS LIST (CONT.)

SYMBOL NUMBER	DESCRIPTION	PART NUMBER	SYMBOL NUMBER	DESCRIPTION	PART NUMBER
R507	390 ohm ±5% 1/8W chip	569-0115-391	S101	Molded switch	032-0791-025
R508	68 ohm ±5% 1/8W chip	569-0115-680	S400	Molded switch	032-0791-025
R509	15 ohm ±10% 1/2W CC	569-1504-150	S401	Molded switch	032-0791-025
R510	820 ohm ±5% 1/8W chip	569-0115-821	S402	Molded switch	032-0791-025
R511	56 ohm ±5% 1/4W CF	569-0513-560			
R512	33 ohm ±5% 1/8W chip	569-0115-330	T201	Helical coil	592-5022-043
R513	150 ohm ±10% 1/2W CC	569-1504-151	T202	Helical coil	592-5022-044
R801	10 ohm ±5% 1/8W chip	569-0115-100	T203	Helical coil	592-5022-043
R802	100k ohm ±5% 1/8W chip	569-0115-104	T204	Helical coil	592-5022-043
R803	82k ohm ±5% 1/8W chip	569-0115-823	T205	Helical coil	592-5022-043
R804	10k ohm ±5% 1/8W chip	569-0115-103	T213	455 kHz IF transformer	592-5020-002
R805	11k ohm ±5% 1/8W chip	569-0115-113			
R806	10 ohm ±5% 1/8W chip	569-0115-100	TP401	Jack, vertical BLK	105-2203-211
R807	470 ohm ±5% 1/8W chip	569-0115-471	TP402	Jack, vertical BRN	105-2208-211
R808	430k ohm ±5% 1/8W chip	569-0115-434	TP403	Jack, vertical ORN	105-2206-211
R809	33k ohm ±5% 1/8W chip	569-0115-333	TP404	Jack, vertical YEL	105-2207-211
R810	120k ohm ±5% 1/8W chip	569-0115-124			
R811	10k ohm pot	562-0114-103			
R812	1.2k ohm ±5% 1/8W chip	569-0115-122	U101	Regulator +8V 1.5A 7808	544-2003-009
R813	1k ohm ±5% 1/8W chip	569-0115-102	U201	Dbl balance mixer CBL-1X	544-0007-008
R814	4.7k ohm ±5% 1/8W chip	569-0115-472	U202	FM IF system, low pwr 3361	544-2026-007
R815	130 ohm ±5% 1/8W chip	569-0115-131	U203	Audio amp 10W TDA2003	544-2006-015
R816	10k ohm ±5% 1/8W chip	569-0115-103	U300	Regulator 5V 1.5A 7805	544-2003-016
R817	3.3k ohm ±5% 1/8W chip	569-0115-332	U301	Op amp (quad) hi rel 3303	545-2020-003
R818	1k ohm ±5% 1/8W chip	569-0115-102	U302	Op amp (quad) hi rel 3303	545-2020-003
R819	100 ohm ±5% 1/8W chip	569-0115-101	U303	Op amp (quad) hi rel 3303	545-2020-003
R820	10k ohm ±5% 1/8W chip	569-0115-103	U400	Microcomputer w/software 8051	023-9998-060
R821	100 ohm ±5% 1/8W chip	569-0115-101	U401	EEPROM (serial) 64x16 9346E	544-5001-402
R822	10 ohm ±5% 1/8W chip	569-0115-100	U402	Analog switch (quad) 4066	544-3014-066
R823	10k ohm ±5% 1/8W chip	569-0115-103	U403	Buffer (hex) 74C906	544-3714-906
R824	2.2k ohm ±5% 1/8W chip	569-0115-222	U404	Buffer (hex) 4049	544-3014-049
R825	10 ohm ±5% 1/8W chip	569-0115-100	U405	Buffer (hex) 4050	544-3014-050
R826	100 ohm ±5% 1/8W chip	569-0115-101	U406	Display driver, 20-bit 5812	544-2027-009
R829	1k ohm ±5% 1/8W chip	569-0115-102	U801	Synthesizer 145159	544-3014-159
R830	1k ohm ±5% 1/8W chip	569-0115-102	U802	Prescaler ÷ 80/81 8719	544-3954-012
R831	1k ohm ±5% 1/8W chip	569-0115-102	U803	Analog switch (quad) 4066	544-3014-066
R832	10k ohm ±5% 1/4W CF	569-0513-103			
R833	10k ohm ±5% 1/8W chip	569-0115-103	VR101	Transient suppressor 600W	523-2901-001
R834	100k ohm ±5% 1/8W chip	569-0115-104			
R835	27k ohm ±5% 1/8W chip	569-0115-273	W104	Flexible cable 18-conductor	597-0016-011
R836	1.8k ohm ±5% 1/8W chip	569-0115-182			
R837	27k ohm ±5% 1/8W chip	569-0115-273	X400	IC socket 40-pin	515-5008-110
R838	220 ohm ±5% 1/8W chip	569-0115-221			
R839	10 ohm ±5% 1/8W chip	569-0115-100	X401	IC socket 10-pin	515-5008-250
R840	33k ohm ±5% 1/8W chip	569-0115-333			
R841	56k ohm ±5% 1/8W chip	569-0115-563	Y201	20.945 MHz crystal	519-0009-006
RN400	6.8k ohm 9 res network	569-6000-010	Y400	11.0590 MHz crystal	521-0011-059
RT101	500 ohm thermistor	569-3001-005	Y801	14.50 MHz crystal	521-4014-502
RT301	8k ohm thermistor	569-3001-001			
RT501	500 ohm thermistor	569-3001-005	Z202	21.4 MHz crystal filter	532-0005-002
RT801	200 ohm thermistor	569-3001-003	Z203	455 kHz ceramic filter	532-2004-001

PARTS LIST (CONT.)

SYMBOL NUMBER	DESCRIPTION	PART NUMBER	SYMBOL NUMBER	DESCRIPTION	PART NUMBER
L803	1.0 μ H choke	542-4004-109	Q400	NPN amplifier SOT-23	576-0003-658
L804	1.0 μ H RF choke	542-3508-109	Q401	NPN amplifier SOT-23	576-0003-658
L806	1.0 μ H choke	542-4004-109	Q402	NPN amplifier SOT-23	576-0003-658
L807	1.0 μ H RF choke	542-3508-109	Q404	NPN amplifier SOT-23	576-0003-658
L808	1.0 μ H RF choke	542-3508-109	Q405	NPN amplifier SOT-23	576-0003-658
L809	.047 μ H RF choke	542-3509-001	Q406	NPN amplifier SOT-23	576-0003-658
L810	.047 μ H RF choke	542-3509-001	Q407	NPN low-noise amp SOT-23	576-0001-300
LS1	Speaker assembly includes:	023-7171-906	Q408	PNP low-noise amp SOT-23	576-0003-657
	Speaker wire harness	023-7171-801	Q409	NPN amplifier SOT-23	576-0003-658
	Speaker 3x2 8 ohm 3W	589-1015-003	Q410	PNP low-noise amp SOT-23	576-0003-657
	3x2 speaker cup	032-0791-030	Q411	PNP low-noise amp SOT-23	576-0003-657
MP	Transceiver cover assembly includes:	023-7171-901	Q501	NPN low-noise amp SOT-23	576-0003-628
	Speaker gasket assembly	023-7171-905	Q502	NPN medium power RF amp	576-0003-063
	Foam tape, dbl side	574-3002-013	Q503	NPN 3W UHF amp TO-39	576-0004-092
	Grille cloth	018-1134-101	Q504	NPN 10W 470 MHz amp	576-0004-086
	Speaker grille spacer	018-1134-102	Q801	PNP low-noise amp SOT-23	576-0003-657
	Foam speaker gasket	018-1134-103	Q802	NPN amplifier SOT-23	576-0003-658
	Plastic transceiver housing	032-0791-006	Q803	N-channel JFET	576-0006-019
	Front plate	032-0791-010	Q804	NPN amplifier SOT-23	576-0003-658
	Lens, LED/display	032-0791-015	Q805	NPN RF amp/switch	576-0003-659
	Keypad	032-0791-019	Q806	NPN RF amp/switch	576-0003-659
MP	Knob, inner	032-0791-021	Q807	NPN amplifier SOT-23	576-0003-658
MP	Knob, outer	032-0791-023	Q808	NPN amplifier SOT-23	576-0003-658
MP001	Chassis	015-0910-301	Q809	PNP low-noise amp SOT-23	576-0003-650
MP002	PA shield (bottom of bd)	017-2225-502	R101	1.2k ohm \pm 5% 1/8W chip	569-0115-122
MP004	Transistor nut (short)	013-1396-002	R102	220 ohm \pm 10% 1/2W CC	569-1504-221
MP	VCO shield (bottom of bd)	023-7171-902	R103	2k ohm 1/8WPC trim pot	562-0004-202
MP007	VCO cavity cover plate	017-2225-505	R104	27 ohm \pm 5% 1/8W chip	569-0115-270
MP008	PA cavity cover plate	017-2225-507	R105	.1 ohm \pm 10% 2W WW	569-2004-108
MP009	TO-39 heat sink	017-2225-513	R106	220 ohm \pm 5% 1/8W chip	569-0115-221
MP010	Microprocessor shield	017-2225-515	R107	1k ohm \pm 5% 1/8W chip	569-0115-102
MP201	Helical casting, 3-cavity	015-0910-332	R108	10k ohm \pm 5% 1/8W chip	569-0115-103
MP202	Helical casting, 2-cavity	015-0910-322	R109	10k ohm \pm 5% 1/8W chip	569-0115-103
MP300	Standoff	013-1188-007	R110	1k ohm \pm 5% 1/8W chip	569-0115-102
MP302	LED guide (front of EP400)	018-0817-062	R111	1.5k ohm \pm 5% 1/8W chip	569-0115-152
PC101	PC board, main RF	035-7171-101	R112	1k ohm \pm 5% 1/8W chip	569-0115-102
PC300	PC board, audio/logic	035-7171-201	R201	27k ohm \pm 5% 1/8W chip	569-0115-273
Q101	PNP low-noise amp SOT-23	576-0003-657	R202	3k ohm \pm 5% 1/8W chip	569-0115-302
Q102	PNP low-noise amp SOT-23	576-0003-657	R203	120 ohm \pm 5% 1/8W chip	569-0115-121
Q103	PNP power 80V 7A T0220	576-0002-021	R204	470 ohm \pm 5% 1/8W chip	569-0115-471
Q104	NPN amplifier SOT-23	576-0003-658	R208	47k ohm \pm 5% 1/8W chip	569-0115-473
Q105	NPN amp/switch	576-0003-600	R209	10k ohm \pm 5% 1/8W chip	569-0115-103
Q106	PNP power 80V 7A T0220	576-0002-021	R210	330 ohm \pm 5% 1/8W chip	569-0115-331
Q201	NPN RF amp SOT-23	576-0003-605	R211	2.2k ohm \pm 5% 1/8W chip	569-0115-222
Q203	NPN VHF/UHF amp SOT-23	576-0003-634	R212	240 ohm \pm 5% 1/8W chip	569-0115-241
Q301	NPN amplifier SOT-23	576-0003-658	R213	240 ohm \pm 5% 1/8W chip	569-0115-241
			R214	47k ohm \pm 5% 1/8W chip	569-0115-473
			R215	27k ohm \pm 5% 1/8W chip	569-0115-273
			R216	1.1k ohm \pm 5% 1/8W chip	569-0115-112
			R217	110k ohm \pm 5% 1/8W chip	569-0115-114
			R218	5.6k ohm \pm 5% 1/8W chip	569-0115-562

PARTS LIST (CONT.)

SYMBOL NUMBER	DESCRIPTION	PART NUMBER	SYMBOL NUMBER	DESCRIPTION	PART NUMBER
C402	.1 μ F \pm 10% 50V X7R ax cer	510-3554-104	C546	68 pF \pm 5% 50V NPO cer chip	510-3602-680
C403	.1 μ F \pm 10% 50V X7R ax cer	510-3554-104	C547	6.8 μ F \pm 20% 35V tantalum	510-2245-689
C404	47 μ F 10V alum electrolytic	510-4003-004	C548	68 pF \pm 5% 50V NPO cer chip	510-3602-680
C405	22 μ F 25V alum electrolytic	510-4125-220	C549	11 pF \pm 5% 50V NPO cer chip	510-3602-110
C406	30 pF \pm 5% 50V NPO cer chip	510-3602-300	C801	.1 μ F \pm 10% 50V X7R cer chip	510-3607-104
C407	30 pF \pm 5% 50V NPO cer chip	510-3602-300	C802	.01 μ F \pm 10% 50V X7R cer chip	510-3606-103
C501	4.7 pF \pm 5% 50V NPO cer chip	510-3602-479	C803	220 pF \pm 5% 50V NPO cer chip	510-3602-221
C502	15 pF \pm 5% 50V NPO cer chip	510-3602-150	C804	68 pF \pm 5% 50V NPO cer chip	510-3602-680
C503	47 μ F 25V alum electrolytic	510-4225-470	C805	.01 μ F \pm 10% 50V X7R cer chip	510-3606-103
C504	1000 pF \pm 10% 50V X7R cer chip	510-3606-102	C806	22 pF \pm 5% 50V NPO cer chip	510-3602-220
C505	68 pF \pm 5% 50V NPO cer chip	510-3602-680	C807	68 pF \pm 5% 50V NPO cer chip	510-3602-680
C506	.01 μ F \pm 10% 50V X7R cer chip	510-3606-103	C808	.1 μ F \pm 10% 50V X7R cer chip	510-3607-104
C507	68 pF \pm 5% 50V NPO cer chip	510-3602-680	C809	33 pF \pm 5% 50V NPO ax cer	510-3514-330
C508	56 pF \pm 5% 50V NPO cer chip	510-3602-560	C810	.01 μ F \pm 10% 50V X7R cer chip	510-3606-103
C509	9.1 pF \pm 5% 50V NPO cer chip	510-3602-919	C811	.1 μ F \pm 10% 50V X7R cer chip	510-3607-104
C510	22 pF \pm 5% 50V NPO cer chip	510-3602-220	C812	.01 μ F \pm 10% 50V X7R cer chip	510-3606-103
C511	5.6 pF \pm 5% 50V NPO cer chip	510-3602-569	C813	1000 pF \pm 10% 50V X7R cer chip	510-3606-102
C512	.01 μ F \pm 10% 50V X7R cer chip	510-3606-103	C814	68 pF \pm 5% 50V NPO cer chip	510-3602-680
C513	68 pF \pm 5% 50V NPO cer chip	510-3602-680	C815	.1 μ F \pm 10% 50V X7R cer chip	510-3607-104
C514	1000 pF \pm 10% 50V X7R cer chip	510-3606-102	C816	68 pF \pm 5% 50V NPO cer chip	510-3602-680
C515	68 pF \pm 5% 50V NPO cer chip	510-3602-680	C817	1.0 pF \pm 5% 50V NPO cer chip	510-3602-109
C517	56 pF \pm 5% 50V NPO cer chip	510-3602-560	C818	3.9 pF \pm 5% 50V NPO cer chip	510-3602-399
C518	8.2 pF \pm 5% 50V NPO cer chip	510-3602-829	C819	6.8 pF \pm 5% 50V N330 cer	510-3118-689
C519	68 pF \pm 5% 50V NPO cer chip	510-3602-680	C820	1.0 pF \pm 5% 50V NPO cer chip	510-3602-109
C520	22 pF 250V mini mica	510-0019-220	C821	68 pF \pm 5% 50V NPO cer chip	510-3602-680
C521	.1 μ F \pm 10% 50V X7R cer chip	510-3607-104	C822	4.7 μ F 15V tantalum chip	510-2605-479
C522	.1 μ F \pm 10% 50V X7R cer chip	510-3607-104	C823	15 pF \pm 5% 50V NPO cer chip	510-3602-150
C523	1000 pF \pm 10% 50V X7R cer chip	510-3606-102	C824	5.6 pF \pm 5% 50V NPO cer chip	510-3602-569
C524	47 μ F 25V alum electrolytic	510-4225-470	C825	5.6 pF \pm 5% 50V NPO cer chip	510-3602-569
C525	27 pF \pm 5% 50V NPO cer chip	510-3602-270	C826	2.2 pF \pm 5% 50V NPO cer chip	510-3602-229
C526	8.2 pF \pm 5% 50V NPO cer chip	510-3602-829	C827	4.7 pF \pm 5% 50V NPO cer chip	510-3602-479
C527	47 pF 250V mini mica	510-0019-470	C828	68 pF \pm 5% 50V NPO cer chip	510-3602-680
C528	47 pF 250V mini mica	510-0019-470	C829	68 pF \pm 5% 50V NPO cer chip	510-3602-680
C529	56 pF \pm 5% 50V NPO cer chip	510-3602-560	C830	68 pF \pm 5% 50V NPO cer chip	510-3602-680
C530	.01 μ F \pm 10% 50V X7R cer chip	510-3606-103	C831	27 pF \pm 5% 50V NPO cer chip	510-3602-270
C531	6.8 μ F \pm 20% 35V tantalum	510-2245-689	C832	68 pF \pm 5% 50V NPO cer chip	510-3602-680
C532	100 μ F 25V alum electrolytic	510-4225-101	C833	.1 μ F \pm 10% 50V X7R cer chip	510-3607-104
C533	10 pF \pm 5% 50V NPO ax cer	510-3514-100	C834	.01 μ F \pm 10% 50V X7R cer chip	510-3606-103
C534	8.2 pF \pm 10% 50V NPO ax cer	510-3514-829	C835	68 pF \pm 5% 50V NPO cer chip	510-3602-680
C535	1.2-6.8 pF variable	187-0106-005	C836	27 pF \pm 5% 50V NPO cer chip	510-3602-270
C537	33 pF \pm 5% 50V NPO ax cer	510-3514-330	C837	1000 pF \pm 10% 50V X7R cer chip	510-3606-102
C538	3.3 pF \pm 10% 50V NPO ax cer	510-3514-339	C838	47 μ F 25V alum electrolytic	510-4225-470
C539	4.7 pF \pm 10% 50V N220 ax cer	510-3518-479	C840	68 pF \pm 5% 50V NPO cer chip	510-3602-680
C540	4.7 pF \pm 10% 50V N220 ax cer	510-3518-479	C841	33 pF \pm 5% 50V NPO ax cer	510-3514-330
C541	5.6 pF \pm 10% 50V NPO ax cer	510-3514-569	C842	68 pF \pm 5% 50V NPO cer chip	510-3602-680
C542	5.6 pF \pm 10% 50V NPO ax cer	510-3514-569	C843	1000 pF \pm 10% 50V X7R cer chip	510-3606-102
C543	4.7 pF \pm 10% 50V N220 ax cer	510-3518-479	C844	100 pF \pm 5% 50V NPO cer chip	510-3602-101
C544	2.2 pF \pm 10% 50V NPO ax cer	510-3514-229	C845	.01 μ F \pm 10% 50V X7R cer chip	510-3606-103
C545	2.2 pF \pm 10% 50V NPO ax cer	510-3514-229			

6.3 SYNTHESIZER VCO ADJUSTMENT

- a. Turn the transceiver power on. With multichannel transceivers, select the center channel.
- b. Remove the hole plug and connect a DC voltmeter to U801, pin 17. Key the transmitter and tune C856 for a meter reading of 3.7 volts \pm 0.1 volt. If C856 tunes properly, proceed to step c. If not, proceed as follows:

The adjustment range of C856 can be changed by cutting or reconnecting jumpers on the PC board. Turn off transceiver power and access these jumpers by removing the plate covering the synthesizer cavity.

If the voltage is too low, cut additional jumpers as needed (alternate from side to side). If the voltage is too high, reconnect jumpers as needed by soldering in a small wire.

- c. Unkey the transmitter and tune C857 for a meter reading of 3.7 volts \pm 0.1 volt. Replace the hole plug.

6.4 REFERENCE OSCILLATOR ADJUSTMENT

6.4.1 PRELIMINARY

The reference oscillator frequency should be adjusted with the ambient temperature near the calibration reference of 25°C (77°F). This ensures that the frequency stays within tolerance at the temperature extremes.

Capacitor C846 is a compensating capacitor that is specially selected for each crystal. The value of this capacitor is printed on a small sticker on the crystal case. Do not change the crystal without making sure that compensation capacitor C846 is the correct value.

6.4.2 FREQUENCY ADJUSTMENT

- a. Set a frequency monitor to the channel frequency and key the transmitter.
- b. Adjust C847 for the correct frequency.

NOTE: If the correct frequency cannot be obtained, range adjust capacitor C848 can be changed to one of the values shown in Table 6-3. Increasing the value decreases the adjustment range and vice versa.

**TABLE 6-3
C848 VALUES**

Value	Part Number
4.7 pF \pm 5% NPO submin cer	510-3113-479
10 pF \pm 5% NPO submin cer	510-3113-100
15 pF \pm 5% NPO submin cer	510-3113-150

6.5 TRANSMITTER TUNEUP

6.5.1 POWER OUTPUT ADJUSTMENT

- a. Preset power adjust R103 for maximum power output (rotate index away from chassis).
- b. Tune C535 for maximum power output.
- c. Adjust R103 for desired power output (7.5 watts minimum, 15 watts maximum). If R103 was adjusted for less than 15 watts, adjustment is complete, proceed to Section 6.5.2. If adjusting for 15 watts, proceed to next step.
- d. Retune C535 for maximum power output (towards more capacitance). Then readjust R103 for 15 watts power output.
- e. Check the power output on the lowest and highest frequencies. Tune C535 to balance the power output on these frequencies.
- f. If necessary, readjust R103 for 15 watts maximum power output on any channel.

6.5.2 BALANCE AND DEVIATION ADJUSTMENT

Proceed as follows:

- a. Turn off transceiver power. Preset R337 (deviation), R330 (Call Guard), and R811 (balance) to midrange.
- b. Connect a jumper from TP401 to TP402.
- c. Connect a nonpolarized capacitor with a value of 22 μ F or greater between TP403 and TP404 on the audio/logic board. *NOTE: A nonpolarized capacitor can be formed by connecting two 44 μ F or larger capacitors in series with like signs connected together.*



5.6.2 RESISTANCE MEASUREMENTS

Resistance measurements can be used to detect shorted components. The power cable should be unplugged. Connect the negative ohmmeter lead to chassis ground and connect the positive lead to the point indicated.

Measurement Point	Meter Reading (Ohms)
Q501 Base	760
Q501 Collector	150
Q502 Base	50
Q502 Collector	Infinity
Q503 Base	30
Q503 Collector	Infinity
Q504 Base	0
Q504 Collector	Infinity

5.6.3 OTHER TROUBLESHOOTING HINTS

- a. A transistor that is producing output power should be warm to the touch. After transmitting for a short time, unkey the transmitter and touch the transistor to determine if it is warm.

CAUTION

DO NOT TOUCH A TRANSISTOR WHILE TRANSMITTING BECAUSE RF BURNS MAY RESULT.

- b. If the power control voltage (Q103C) is higher than the normal range of 7.5 volts \pm 2 volts, no input from the synthesizer or a defective stage in the transmitter may be indicated. If this voltage is near 0 volts, the power control circuit may be defective.

5.7 AUDIO/LOGIC BOARD

5.7.1 GENERAL

To isolate a defective audio component on the audio/logic board, measure the DC and AC voltages shown on the schematic diagram. If a problem is suspected with microcomputer U400, the measurements in the next section can be made. If these measurements do not indicate a problem, the simplest thing to do may be to replace the microcomputer to determine if it is the cause of the problem. Proper programming of EEPROM U401 can be checked as described in Programming Manual, Part No. 004-7100-021.

Before proceeding with troubleshooting, check the following supply voltages:

- 5 V Supply - U300, pin 3
- 8 V Supply - U300, pin 1
- VREF (3.6 V) - U301, pin 5

5.7.2 MICROCOMPUTER TROUBLESHOOTING

Because of its dynamic operation, specialized equipment and an understanding of the software is required to thoroughly test the microcomputer. However, checks can be made with standard test equipment to verify several inputs and outputs. These tests are as follows:

CLOCK

ALE (Pin 30) = 1.843 MHz

LOGIC SQUELCH (PIN 25)

When a channel programmed with Call Guard is selected and the correct Call Guard code is not being received, this pin should be high (5 volts). If a correct Call Guard is received or if no Call Guard is programmed, this pin should be low (near 0 volts).

SQUELCH INPUT (PIN 26)

When the receiver is unsquelched, this input should be low. When the receiver is squelched, it should be high.

CALL GUARD ROUTING (PIN 3)

When Call Guard is being transmitted, this output should be high. When Call Guard is received, it should be low.

RESET (PIN 9)

When power is turned on, this input should remain high for a least 100 milliseconds after the 5 volt supply appears. If the 5 volt supply drops below approximately 4.3 volts, this pin should go high until the 5 volt supply returns to normal.

CALL GUARD FILTER CONTROL (PIN 4)

This output should be low for tone Call Guards above 100 Hz and when the tone Call Guard reverse burst and digital Call Guard turn-off code is transmitted. This output should be high for tone Call Guards less than or equal to 100 Hz and for all digital Call Guard codes (except the turn-off code).

5.4.6 PRESCALER U802 TROUBLESHOOTING

Checking Prescaler Divide Number

If the VCO is out-of-lock, its frequency is probably continuously changing as is the prescaler input frequency. To obtain a stable VCO output frequency, two different methods can be used:

Method 1

Short the U803 pins and connect the power supply as described in step c of the "VCO Frequency Check" in Section 5.4.5.

Method 2

Cut the PC board trace between the emitter of Q806 and C809 and connect a signal generator to the input of C809. The generator output level should be about 0 dBm and the frequency can be any frequency near 450 MHz.

To determine if the prescaler is dividing properly, proceed as follows:

- Connect a frequency counter to U801, pin 10.
- Short U802, pin 1 to pin 2 to make the modulus control input high. The output frequency should be the input frequency \div 80. Example: 455.200 MHz \div 80 = 5.690 MHz.
- Remove the short to pin 2 and short pin 1 to pin 4 to make the modulus control input low. The output frequency should be the input frequency \div 81. Example: 455.200 MHz \div 81 = 5.61975 MHz.
- Remove the short from pin 1 to pin 4. Measure the output level. It should be approximately 8 volts peak-to-peak at U801, pin 10.

NOTE: This test setup may also be used to perform tests in Section 5.4.7.

If any of the preceding measurements are incorrect, the prescaler is probably defective.

Determining Prescaler Divide Number

Prescaler operation can also be checked with the modulus control output (pin 8) of synthesizer U801 controlling the divide number. The prescaler divide number

is between 80 and 81 and is controlled by the divide numbers of the N and A counters in U801. The N and A counter divide numbers are derived as described in Section 5.4.2. Calculate the prescaler divide number as follows:

$$\text{Prescaler Divide Number} = 80 + \frac{A}{N}$$

Example: For a transmit frequency of 455.200 MHz,

$$\text{Prescaler Divide No.} = 80 + \frac{32}{910} = 80.03516$$

Select the channel used to calculate the divide number and check the output frequency to determine if the prescaler is dividing by the correct number. If not, either the prescaler or U801 could be defective.

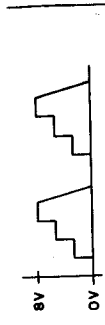
5.4.7 SYNTHESIZER U801 TROUBLESHOOTING

Preliminary

The simplest thing to check first is the reference frequency as described in Section 5.4.4. If this signal is correct, various U801 outputs can be checked as follows:

VCO Frequency Control Signal (U801, pin 17)

When the VCO is locked on frequency, U801, pin 17 is a constant DC voltage between 1.5 and 6.3 volts. When the VCO is unlocked, this signal should be similar to the stepped waveform shown below. The frequency of this signal is equal to the difference between the fr and fv inputs to the phase detector in U801.



To determine if this signal changes to a constant DC level when the VCO is oscillating at the correct frequency, proceed as follows:

- Use Method 1 or Method 2 in Section 5.4.6 to control the VCO frequency (Method 2 is preferred).
- Monitor the waveform at U801, pin 17. As the VCO or signal generator frequency is slowly swept toward the correct VCO frequency for the channel and mode (transmit or receive) selected, the pulses on pin 17 should gradually decrease in frequency.

- As the signal is slowly swept past the correct frequency, a momentary DC voltage between 1 and 6 volts should appear before the out-of-lock pulses return again.

If this signal appears on pin 17, the phase detector and modulus control sections of U801 are probably operating properly and the correct data is getting loaded into the synthesizer. The synthesizer problem could then be with another part of the synthesizer such as the VCO or adaptive filter.

If the correct signal does not appear on pin 17, U801 may be defective or it may be getting programmed incorrectly because of improper transmitter programming or a problem with the control logic.

Lock Detect Signal

The microcomputer monitors the signal output on U801, pin 9 to determine if the VCO is locked on frequency. This signal should be as follows:

VCO Locked — 8 volts DC (not pulsing)

VCO Unlocked — Square-wave signal at a frequency approximately equal to the difference between the fr and fv inputs to the phase detector in U801.

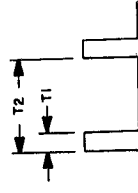
If it is determined that the VCO is locked on the correct frequency by other testing and that an unlocked indication is being produced on pin 9, U801 may be defective.

Modulus Control Signal (U801, pin 8)

The frequency of the modulus control signal on U801, pin 8 should be equal to the programmed channel spacing (usually 6.25 kHz or 10 kHz).

The duty cycle of the modulus control signal determines the divide number of the prescaler. The correct duty cycle ($T1/T2$) for the selected channel should be as follows:

$$\frac{T1}{T2} = \frac{A \text{ Counter Divide Number}}{N \text{ Counter Divide Number}}$$



If the frequency or duty cycle is not correct, there may be a problem with transmitter programming, U801, or the control logic.

5.5 RECEIVER SERVICING

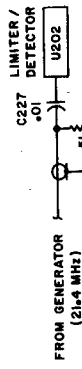
5.5.1 PRELIMINARY

To isolate a receiver problem to a defective section, start by checking the DC voltages shown on the schematic diagram. If this does not indicate a problem, perform the tests which follow. A hardline-type coaxial cable is recommended to inject the signal, and chip parts should not be reused if they are removed. If the synthesizer is out-of-lock, the receiver is probably not functional either.

NOTE: Typical transmitter current in the receive mode with the receiver squelched is 400 milliamps.

5.5.2 LIMITER/DETECTOR (U202)

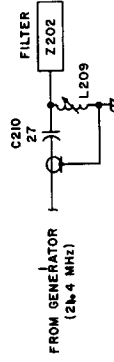
Connect the circuit shown below. C227 must be removed or the trace between C230 and R211 cut to do this test. Also required are a 50 ohm loading resistor and (if C227 was removed) a .01 microfarad coupling capacitor.



With a 21.4 MHz signal (modulated with 1 kHz at \pm 3 kHz deviation) injected at this point, 12 dB SINAD sensitivity should be 3-4 microvolts.

5.5.3 CRYSTAL FILTER (Z202)

Connect the circuit shown below. Lift the input side of C210 which is an axial component.



With a 21.4 MHz signal (modulated with 1 kHz at \pm 3 kHz deviation) injected at this point, 12 dB SINAD sensitivity should be .15-.30 microvolts.

When the VCO is out-of-lock, the microcomputer generates continuous filter control pulses until a locked indication is detected on the lock detect line (Section 5.4.7). Therefore, when the VCO is out-of-lock, continuous pulses should appear on U803, pins 6 and 12.

5.4.5 VCO TROUBLESHOOTING

VCO Output Level

Check the RF level at the junction of C836 and R830. The level at this point should be approximately +8 dBm. If not, troubleshoot VCO Q803 and buffers Q805/Q806. The output signal to the receiver or transmitter that is switched by Q807 and Q808 should be approximately as shown on the schematic.

Trimmer Capacitor Adjustment

An out-of-lock VCO can be caused by an improperly adjusted C856 and/or C857. If the VCO is unlocked in both the receive and transmit mode, C856 could be misadjusted. If it is unlocked only in the receive mode, C857 may be misadjusted. To determine if these capacitors are properly adjusted, proceed as follows:

- a. Connect a DC voltmeter to U801, pin 17. With multichannel transceivers, select a channel near the center of the operating range. Connect a load to the antenna jack and note the positions of C856 and C857.
- b. Refer to Section 6.3 and adjust C856 and C857 as described. If these capacitors were out of adjustment, a stable voltage should be obtained and the VCO should lock on frequency (display not flashing).
- c. Check the high and low channels. The VCO control voltage should remain steady and be between 1.5 and 6.3 volts DC.
- d. If a locked VCO cannot be achieved by adjusting these capacitors, they were probably not the cause of the unlocked VCO. Readjust them to the original setting noted in step "a" and proceed with other tests.

VCO Frequency Check

If the VCO is locked, the VCO frequency should be stable. If it is unlocked, the VCO frequency is usually changing between the high and low ends of its frequency range because of the changing control voltage. Proceed as follows:

- a. Connect a frequency counter to the junction of C836 and R830 using a coupling capacitor of approximately 33 pF.
- b. If the VCO frequency is stable, it should be 21.4 MHz below the transmit frequency in the receive mode and the transmit frequency in the transmit mode. Proceed to other tests.
- c. If the VCO frequency is not stable or is at the high or low end of its operating range, it can be controlled as follows:

Ground U803, pins 6 and 12. Connect the negative output of a variable DC power supply to chassis ground and connect the positive output to the junction of R810 and L801.

- d. Key the transmitter (with a load connected to the antenna jack) and vary the power supply voltage between 1.5 and 6.3 volts. The VCO frequency should vary approximately 15 MHz between 450 and 470 MHz (or whatever band the transceiver is designed to operate on). If the 15 MHz band is slightly out of this range, adjusting C856 should move the 15 MHz band into the proper range.
- e. In the receive mode, the frequency should vary approximately 15 MHz in a band 21.4 MHz below the 450-470 MHz range (or whatever band the transceiver is operating on). If the proper frequency was obtained in step d, adjusting C857 should move the 15 MHz band into the proper range if it is slightly out of range.

If the proper frequencies are not obtained using the preceding procedure, troubleshoot VCO Q803. If the proper frequency is obtained in the transmit mode but not the receive mode, troubleshoot frequency shift Q804. If the proper output level is not achieved, also check buffers Q805 and Q806. Remove the power supply and then the short on U803, pins 6 and 12 unless performing the prescaler check in the next section.

**TABLE 5-1
APPROXIMATE LOGIC LEVELS**

Device	Input Level		Output Level	
	Logic Low (Max)	Logic Low (Min)	Logic Low (Max)	Logic High (Min)
CMOS				
5V supply	1.5V	3.5V	0.05V	4.95V
10V supply	3.0V	7.0V	0.05V	9.95V
ECL	3.5V	3.9V	3.4V	4.0V

5.3.2 SERVICING TECHNIQUES

When troubleshooting operational amplifiers functioning as buffers or amplifiers, measure the input and output signals to determine if the levels are correct. Buffers and amplifiers usually have one of the inputs biased at half supply voltage. Operational amplifiers functioning as comparators have an output voltage which is near the supply voltage or 0 volts, depending on which input voltage is higher. Troubleshooting operating digital circuits (such as microcomputer U400 on the audio/logic board) usually requires a storage oscilloscope to check the various output signals. Even then troubleshooting may be difficult because of the dynamic operation of this device.

Table 5-1 shows approximate logic levels for CMOS and ECL integrated circuits. ECL devices (U802 in the synthesizer) run warm and have a relatively small logic swing.

5.4 SYNTHESIZER SERVICING

5.4.1 GENERAL

When there is a synthesizer malfunction, the VCO is usually not locked on frequency. An unlocked VCO is indicated in the receive mode when the display is flashing; in the transmit mode an unlocked VCO is indicated when the display is flashing and a beep is sounding.

When the display is flashing in the receive mode, an unlocked synthesizer is always indicated. When the display is flashing and a beep is sounding in the transmit mode, any of the following three conditions may be indicated:

- a. An unlocked synthesizer
- b. A busy channel when the Transmit Disable When Channel Is Busy function is programmed.
- c. Transmitting on a channel programmed for receive-only.

Before starting to troubleshoot the synthesizer, conditions b and c should be eliminated as a cause. The time-out timer was not included in this list because when it disables the transmitter, the warning tone is a steady tone instead of a beeping tone.

When the VCO is unlocked, the lock detect output on U801, pin 9 should be a pulsing waveform instead of a steady 8 volt DC signal. When this unlocked indication is detected by the microcomputer, it disables transmitter keying to prevent the transmission of an improper frequency. It also begins producing continuous adaptive filter pulses on pin 22 until a locked indication is again detected.

The f_R and f_V inputs to the phase detector are usually not in phase when the VCO is unlocked. The VCO control voltage on U801, pin 17 then should be a pulsing signal instead of a steady DC level. This pulsing signal causes the VCO frequency to be continuously changing. The f_R and f_V inputs to the phase detector in U801 cannot be monitored externally.

As shown in Figure 5-1, a loop is formed by VCO Q803, prescaler U802, and the "N" counter and phase detector in U801. Therefore, if any of these components or others in the loop begin operating improperly, incorrect frequencies appear throughout the loop. Since the loop frequency is usually constantly changing when the VCO is unlocked, the loop may have to be interrupted in order to obtain the stable input and output frequencies required for troubleshooting. The troubleshooting flowchart in Figure 5-2 and information which follows in this section suggest tests that can be made to help localize a problem to a specific section of the synthesizer.

5.4.2 U801 PROGRAMMING

Channels are selected by programming the N, A, and R counters in U801 (refer to Figure 4-3 in Section 4) to divide by some number. These counters are programmed



CIRCUIT DESCRIPTION

From the Call Guard filter, the transmit Call Guard signal is fed through gate U402B to splatter filter U301A in the transmit audio circuit. Potentiometer R330 adjusts the Call Guard deviation.

4.5.8 TRANSMIT AUDIO PROCESSING (U301A-U301D)

High-Pass Filter (U301B)

The transmit audio circuit provides amplification, filtering, and limiting of the microphone audio signal. U301B and several resistors and capacitors form a high-pass filter with a -3 dB frequency of approximately 300 Hz. This filter attenuates frequencies which could cause interference with Call Guard frequencies. Q409 on the input of this filter grounds the microphone audio output in the receive mode to prevent modulation of the receive frequency. R344 and R345 provide power to a microphone amplifier when one is used. C333, R344, and R345 provide filtering and also isolate the 8 volt supply from microphone audio.

Limiter (U301C)

C321 and R334 on the input of limiter U301C provide pre-emphasis of the transmit audio signal. U301C is an amplifier which limits by saturating. The function of this stage is to prevent overmodulation caused by high input levels from the microphone.

Splatter Filter (U301A, U301D)

U301A, U301D, and several resistors and capacitors form a low-pass filter. This filter attenuates frequencies above 3 kHz generated by amplitude limiting. This prevents adjacent channel interference. C322 on the input provides DC blocking, and potentiometer R337 adjusts the audio deviation level. Since the output of this filter is direct coupled to the reference oscillator in the synthesizer, a variation in the bias voltage (shown on the schematic as V_{REF}) can cause a change in the synthesizer frequency. Therefore, a well regulated voltage source must be used for biasing.

4.5.9 PTT CONTROL (Q404, Q405, Q406)

The purpose of the PTT (push-to-talk) control circuit is to prevent the transmitter from being keyed by a logic failure and also to permit the microcomputer to disable the transmitter. The transmitter may be disabled if the synthesizer is out-of-lock or if either the time-out timer or Transmit Disable When Channel Is Busy feature is used.

The microphone PTT signal is inverted by U404C and then applied to the P0.4 input of the microcomputer. The signal at this point is high in the transmit mode and low in the receive mode. A high on this input tells the microcomputer to reprogram the synthesizer for the transmit frequency and also to transmit Call Guard if it is programmed on the selected channel.

The microphone PTT signal is also applied to Q404 and Q405. These transistors delay transmitter turnoff so that the digital Call Guard turnoff code or the tone Call Guard reverse burst can be sent. When the microphone PTT switch is released, Q404 turns off and C404 begins charging through R431. This delays the turn on of Q405 which keeps the transmitter keyed for a short time after the PTT switch is released. However, this delay is longer than the time required to send this information, so the transmitter is actually turned off by the microcomputer as described in the next paragraph.

The microcomputer disables the transmitter by making the P2.7 output high. This turns Q406 on which effectively grounds the CPTT (controlled PTT) line. The CPTT line controls Q105 on the main board which switches the transmit 8 volt supply.

4.6 CALL GUARD DESCRIPTION

4.6.1 INTRODUCTION

The purpose of the Call Guard is to eliminate distracting messages intended for others using the channel. A message is not heard unless the correct Call Guard is decoded.

When a message is transmitted, a tone or digital code is also transmitted with the voice. That tone or code must then be decoded by the transceiver receiving the message or its squelch will not open. If Call Guard is not used or is disabled in the transceiver receiving the message, then the tone or code is ignored and the transceiver operates normally. A Call Guard is required in both the transmitting and receiving transceivers. The tone or digital code is not heard because it is in the subaudible range and also is attenuated by a filter. The following is a description of tone and digital Call Guards.

4.6.2 TONE CALL GUARD

A tone Call Guard utilizes one of 33 standard subaudible tones from 67-210.7 Hz. There are 38 tones actually assigned, but the top five tones are normally not used

CIRCUIT DESCRIPTION

4.5.3 EEPROM (U401)

EEPROM U401 is an electrically erasable programmable read-only memory (EEPROM). This type of device can be reprogrammed over and over again by the microcomputer. Since it is also a nonvolatile memory, battery backup is not required to maintain the data contents. This device can store 64 16-bit words (1024 bits). It is enabled by a high on the CS (chip select) input, and data is fed in and out serially by a low to high transition on the CLK input.

This device can execute the following instructions:

Instruction	Op Code	Address
Read	10	Register
Write	01	Register
Erase (register)	11	Register
Erase (chip)	00	11xxxx
Erase/Write Enable	00	00xxxx
Erase/Write Disable.	00	10xxxx

An instruction consists of a "1" start bit, two op code bits, and six address bits. In the first three instructions listed, the address bits contain the address of one of the sixteen registers; in the last three instructions, two address bits identify the instruction and the other four bits are not used. If an operation is a data write, the data being written follows the nine-bit instruction on the DI (data input) pin. If an operation is a data read, the addressed data appears on the DO (data output) pin after the instruction is clocked in.

4.5.4 SHIFT REGISTER/LED DRIVER (U406)

U406 is a 20-bit shift register and LED driver. Data on the SERIAL DATA INPUT pin is clocked into the shift register by a low to high transition on the CLK input. Data in the shift register is latched when the STROBE input is high. A high loaded into a particular location causes that output to go to 8 volts. This lights the desired indicator (CR400-CR403) and segments in DS400.

4.5.5 RECEIVE AUDIO PROCESSING (U302B, U302A, U402A)

The detected audio signal is applied to a low-pass filter formed by U302B and various resistors and capacitors. This filter provides de-emphasis of the receive audio signal and also attenuates harmonics above 3 kHz. The signal is then fed to a high-pass filter formed by

U302A and several capacitors and resistors. This filter attenuates Call Guard frequencies and other signals below approximately 300 hertz.

U402A is an analog switch functioning as a squelch gate. This gate is controlled by the output signal of Schmitt trigger U303D in the squelch circuit. When the control input (pin 13) of U402A is high, the audio signal is passed to the audio amplifier in the receiver. Conversely, when the control input is low, the audio signal is blocked which squelches the receiver.

4.5.6 SQUELCH CIRCUIT (U303B, U303D, Q400)

The squelch circuit is controlled by the amount of noise present in the receive audio signal. When no signal or a weak signal is received, there is a large amount of noise present; conversely, when a strong signal is received, there is very little noise present.

The receive audio signal, including voice, Call Guard, and noise, is applied to a bandpass filter in limiter/detector U202 in the receiver (refer to Section 4.3.3). This filter attenuates voice and Call Guard frequencies and passes only noise frequencies from 13.5 to 16.5 kHz. The output from this filter is applied to squelch amplifier U303B on the audio/logic board. This stage provides a gain of about 35. The front panel squelch control adjusts the input level to U303B which controls the squelch threshold level. C306 on the input of U303B causes a rolloff in the amplification of frequencies below approximately 12 kHz. RT301 provides temperature compensation.

The noise signal is then rectified by CR300 and CR301. C308 charges through CR301 and discharges through R309. Diode CR300 provides a discharge path for C307. When the DC level on pin 13 of Schmitt trigger U303D rises above the reference level on pin 12, the output on pin 14 goes low. Feedback through R312 provides hysteresis to the triggering level which is approximately 1.7 and 2.6 volts. CR304 and R352 charge C308 whenever a different channel is selected. When scanning and listening to a nonpriority channel, this minimizes the time required to scan a priority channel that is not busy. If this charging did not occur when the priority channel was scanned, the squelch circuit would initially indicate that the priority channel was busy.

The output of Schmitt trigger U303D controls squelch gate U402A and is also fed to the microcomputer through inverter U404A. The signal applied to the microcomputer has a fast attack and release time of 20-30 milliseconds to allow the microcomputer to quickly determine if a carrier is present. If a carrier is

CIRCUIT DESCRIPTION

4.5.2 MICROCOMPUTER (U400)

Memory

A microcomputer differs from a microprocessor in that it has internal ROM (read-only memory) for storing the operating program. This ROM is part of the microcomputer chip and is mask programmed when the microcomputer is manufactured. The 8051 microcomputer used in this transceiver has a 4K x 8 ROM.

Information which changes from transceiver to transceiver such as channels, Call Guard, and operating features is stored in EEPROM U401 (electrically erasable programmable read-only memory). This device is erased and reprogrammed by the microcomputer. Refer to Section 4.5.3 for more information.

Timing

The operating speed of the microcomputer is established by 11.059 MHz crystal Y400. XTAL 1 is the input of an internal oscillator and XTAL 2 is an output which provides feedback to maintain oscillation. The 11.059 MHz crystal frequency is divided down by internal counters to establish a machine cycle time of 1.08 microseconds. Most instructions are executed in one machine cycle and none require more than four machine cycles. The clock frequency can be monitored by checking the frequency of the ALE output. This output is one-sixth the clock frequency or 1.843 MHz.

Reset (RST)

The microcomputer is initialized when the transceiver power is turned on and when the 5 volt supply drops below about 4.3 volts. Initialization clears several registers in the microcomputer and starts the program over from the beginning. Initialization is performed when the RST (reset) input is held high for a short time with power applied to the microcomputer.

When power is applied to the transceiver, Q410 immediately turns on which turns Q411 off. C405 then charges through R434 which holds the RST input high for a short time. If the 5 volt supply drops below approximately 4.3 volts, Q410 turns off and Q411 turns on. This holds the RST input high until the 5 volt supply returns to normal. Zener diode CR405 is biased at approximately 3.9 volts by R440. Low-voltage reset prevents improper operation of the microcomputer during low-voltage conditions such as when the vehicle is started.

Data Input/Output Ports

The internal eight-bit data bus of the microcomputer has four input/output ports. These ports have eight lines each, giving a total of 32 input/output lines. Port 3 lines can be used for special functions such as RxD or TxD or they can be used as general purpose inputs and outputs. The four ports are designated P0, P1, P2, and P3. Since there are no external memory chips, data and address lines are not required.

The functions of the input/output lines of the microcomputer are as follows:

P0.0 – A low input indicates that the front panel channel step up switch is depressed.

P0.1 – A low input indicates that the front panel channel step down switch located on the main board is depressed.

P0.2 – A low input indicates that front panel option switch 1 is depressed. Depending on transceiver programming, this switch may be used to select the scan, call light disable, monitor, channel lockout, or auxiliary functions. It may also be disabled.

P0.3 – A low input indicates that front panel option switch 2 is depressed. This switch may be programmed to select the same functions described in "P0.2".

P0.4 – A high input indicates that the push-to-talk switch is depressed. This tells the microcomputer to begin executing transmit mode functions such as loading the synthesizer and transmitting Call Guard.

P0.5 – A high input indicates that the microphone has been removed from its hanger. This tells the microcomputer to perform such functions as enabling the noise squelch if Call Guard is being used or turn off the CALL indicator.

P0.6 – This is used as an input from an optional decoder board. The action taken by the microcomputer when a level change is detected on this input is determined by transceiver programming.

P0.7 – A low on this input tells the microcomputer to enter the programming mode. This input is pulled low by the RPI (Remote Programming Interface) when it is plugged into the transceiver programming jack. Since the status of this line is read only during the power up sequence, the transceiver power must be turned on after the RPI is connected.

CIRCUIT DESCRIPTION

4.3.2 MIXER (U201), CRYSTAL FILTER (Z202), IF AMPLIFIER (Q203)

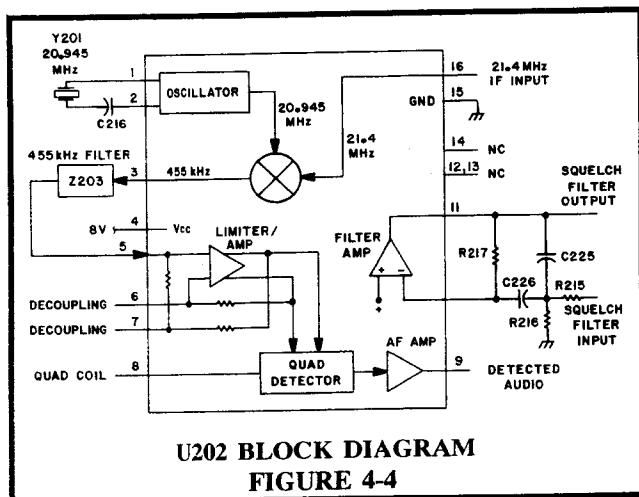
U201 is a double-balanced mixer. This type of mixer provides good isolation between the input and output ports with minimum conversion loss. It also has good spurious rejection and harmonic suppression.

The output of the double-balanced mixer is matched to crystal filter Z202 by C210 and L209. This is a four-pole 21.4 MHz filter with passband of 15 kHz at the -3 dB points. It attenuates wideband noise, adjacent channels, frequencies resulting from intermodulation, and other undesired frequencies close to the receive channel. Dots on the case indicate which pins connect together when the filter is installed. C250 is a matching capacitor included with the filter. Matching between Z202 and IF amplifier Q203 is provided by C237, L212, and C212. The IF amplifier produces about 20 dB of gain.

4.3.3 MIXER, LIMITER/DETECTOR (U202)

U202 contains second mixer, limiter, detector, audio amplifier, and squelch filter stages (refer to the block diagram in Figure 4-4). The 21.4 MHz first IF frequency is mixed with the 20.945 MHz signal produced by crystal Y201 and the internal oscillator. The value of C216 can be changed slightly to pull the crystal on frequency.

The 455 kHz output of the internal double-balanced mixer is fed out of U202 on pin 3 and filtered by ceramic filter Z203. This filter attenuates wideband noise present in the 455 kHz signal. The 455 kHz signal is then applied to the limiter/amplifier stage in U202. This circuit amplifies the 455 kHz signal and then limits it to a specific value. This tends to clip off noise riding on the 455 kHz signal. C221 and C222 decouple the 455 kHz signal.



U202 BLOCK DIAGRAM
FIGURE 4-4

From the limiter stage the signal is fed to the quadrature detector. An external phase-shift network connected to pin 8 shifts the phase of one of the detector inputs 90 degrees at 455 kHz (the other inputs are unshifted in phase). When modulation occurs, the frequency of the IF signal changes at an audio rate as does the phase of the shifted input. The detector, which has no output with a 90 degrees phase shift, converts this phase shift into an audio signal. T213 is tuned to provide maximum undistorted output from the detector. From the detector the audio signal is applied to an amplifier stage and then fed out of U202 on pin 9.

The audio signal on pin 9 includes voice frequencies and also high-frequency noise. This signal is fed to the audio/logic board and also to a squelch filter in U202. This is a bandpass filter which attenuates audio frequencies so that only noise from 13.5 kHz to 16.5 kHz is passed. This noise is used to control the squelch circuit on the audio/logic board. The amount of noise in the detector output tends to increase as the receive signal strength decreases. R215, R216, R217, C225 and C226 are part of the active filter. Potentiometer R219A adjusts the noise level which controls the squelch threshold level.

4.3.4 AUDIO AMPLIFIER (U203)

The detected audio output on pin 9 of U202 is fed to the audio/logic board and processed by de-emphasis and Call Guard filter stages. The signal is then fed through volume control R219 to audio amplifier U203 located on the main board. U203 provides about 2 watts of power to 8 ohm front panel speaker LS1 or 5 watts to a 3 ohm external speaker connected to J105. The gain of U203 is set by R223 and R224 which control the amount of feedback coupled through C228 to pin 2. Capacitor C230 and resistor R225 prevent self oscillation, C231 and C232 bypass RF signals, C238 and C229 provide DC blocking, and R222 sets the level of the time-out timer warning tone and beep tone applied to U203.

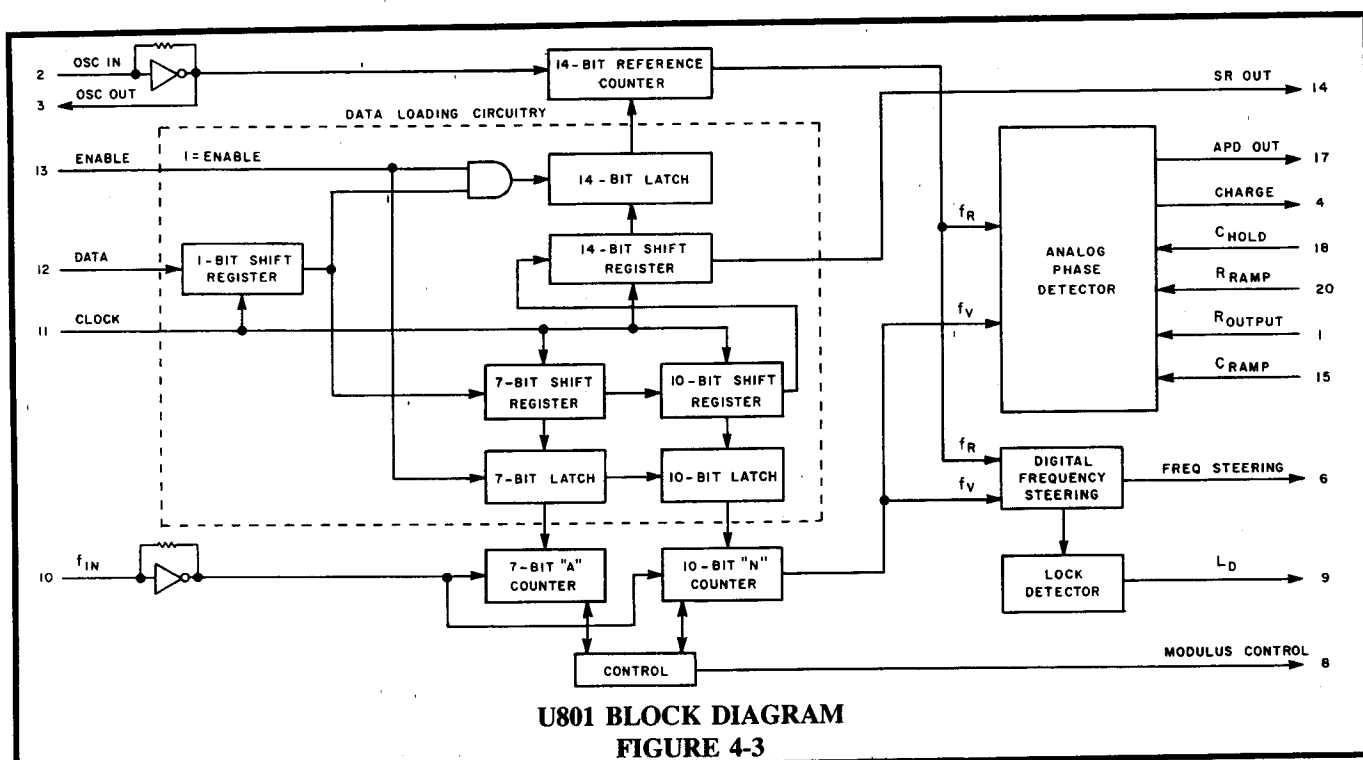
4.4 TRANSMITTER CIRCUIT DESCRIPTION

NOTE: A transmitter block diagram is located in Figure 4-2.

4.4.1 AMPLIFIER (Q501), PREDRIVER (Q502)

The input signal to first amplifier Q501 is from buffer Q806 in the synthesizer. The impedance at the output of C840 is 50 ohms and the power at this point is approximately 4 milliwatts. C501, C502, and two sections of microstrip* provide impedance matching with Q501.

CIRCUIT DESCRIPTION



The f_R input is produced by dividing down the 14.50 MHz reference oscillator frequency. The f_R input is usually 6.25 kHz because it divides exactly into most VCO frequencies. The f_R input must divide exactly into the VCO frequency because the prescaler and N counter can divide by whole numbers only. The reference counter is usually programmed to divide by 2320 (14.5 MHz \div 2320 = 6.25 kHz).

The VCO frequency is divided by the N counter and prescaler U802 to produce the f_V input to the phase detector. As stated in Section 4.2.4, the prescaler divides by 80 or 81. The number of pulses counted in each mode is controlled by the A and N counters. Both the A and N counter begin counting down from the number they are programmed with. When the A counter reaches zero, it halts until the N counter reaches zero. Both counters then reset and the cycle is repeated (the A counter always divides by a smaller number than the N counter). While the A counter is counting down, the modulus control output (pin 8) is low and the prescaler divides by 81. Then when the A counter is halted, this output is high and the prescaler divides by 80.

To illustrate the operation of the prescaler, N, and A counters, the following example will be used. Assume transmit frequency 455.200 MHz is selected. For the

synthesizer to produce this frequency, the counters can be programmed to divide by the following numbers:

$$\text{Reference} = 2320 \quad N = 910 \quad A = 32$$

Both the N and A counters begin counting down from the number they are programmed with. To determine the overall divide number of the prescaler and N counter, the number of prescaler input pulses required to produce one N counter output pulse can be counted. In this example, the prescaler divides by 81 for 81×32 or 2,592 input pulses. It then divides by 80 for $80 \times (910 - 32)$ or 70,240 input pulses. The overall divide number K is therefore $70,240 + 2,592$ or 72,832. The VCO frequency of 455.200 MHz divided by 72,832 equals 16.5 kHz which is the f_R input to the phase detector. The overall divide number can also be determined by the following formula:

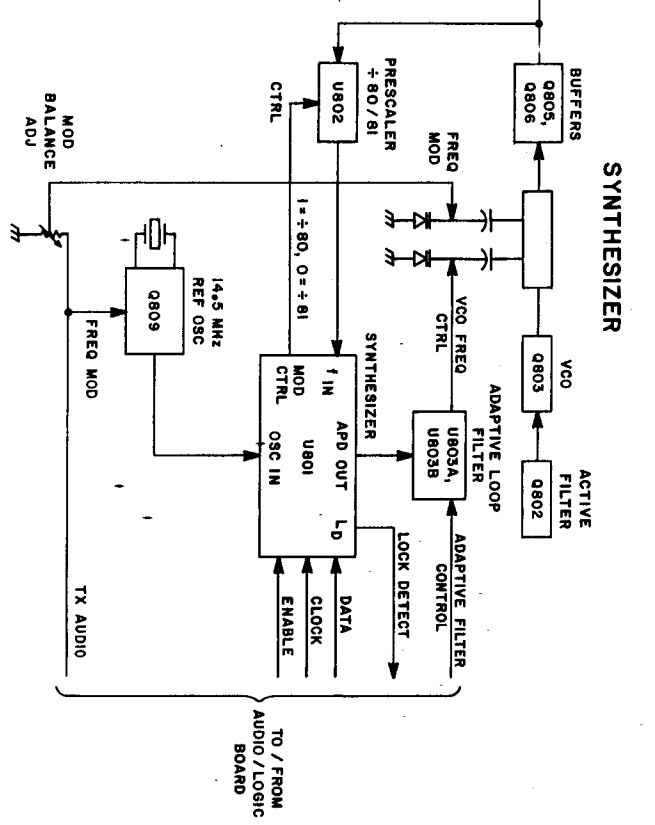
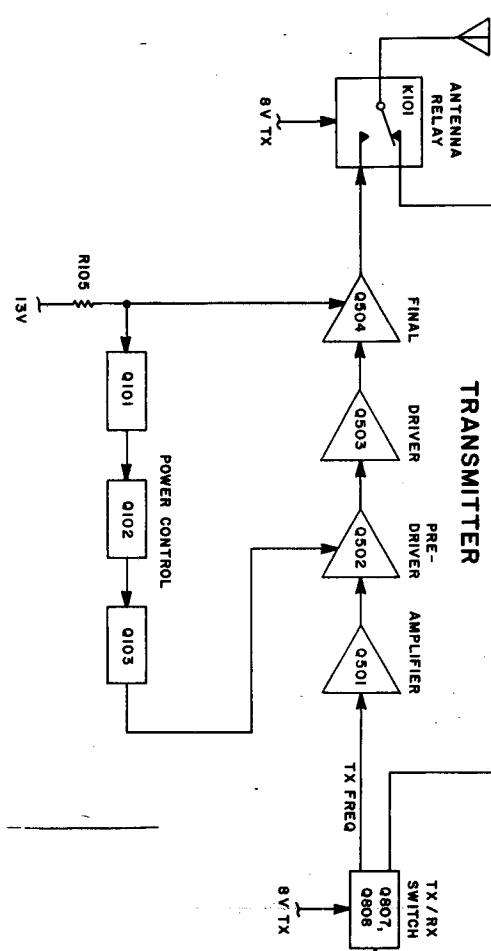
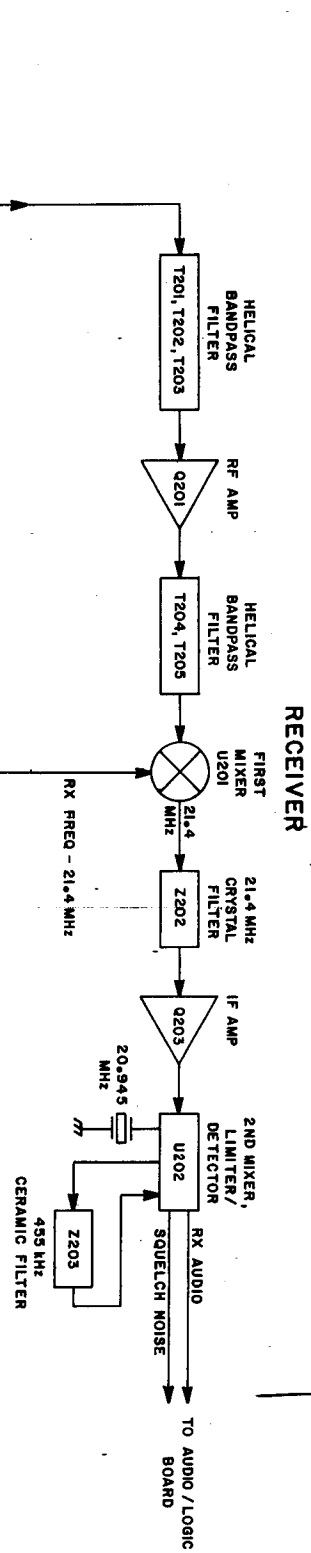
$$K = 80N + A$$

(N = N counter divide number, A = A counter divide number)

Lock Detect (LD) Output

The lock detect output (pin 9) is high when the synthesizer is locked and pulsed low when the synthesizer is unlocked. The pulse rate is approximately equal to the

CIRCUIT DESCRIPTION



MAIN BOARD BLOCK DIAGRAM
FIGURE 42

4.2 SYNTHESIZER CIRCUIT DESCRIPTION

4.2.1 INTRODUCTION

A simplified synthesizer block diagram is located in Figure 4-1 and a more detailed block diagram is located in Figure 4-2. The synthesizer output signal is the VCO (voltage-controlled oscillator) frequency. This frequency is the transmit frequency in the transmit mode and the first injection frequency in the receive mode.

The VCO frequency is controlled by a DC voltage applied across a varactor diode. This DC voltage is controlled by the phase detector in synthesizer U801. This phase detector senses the phase and frequency of two input signals and causes the VCO control voltage to increase or decrease if they are not the same. This changes the VCO frequency until both inputs are synchronized. The VCO is then "locked" on frequency.

One input to the phase detector is the reference frequency (f_R). This frequency is the 14.50 MHz reference oscillator frequency divided down by the reference counter in U801. The reference frequency is normally 6.25 kHz (refer to Section 4.2.5 for more information). The stability of the reference frequency determines the stability of the synthesizer output frequency. Reference oscillator Q809 is temperature compensated to provide a frequency stability of ± 5 PPM from -30 degrees C to $+60$ degrees C. There is also an optional TCXO (temperature-compensated crystal oscillator) available that provides a frequency stability of ± 2.5 PPM.

The other input to the phase detector (f_V) is derived from the VCO signal. The VCO frequency is divided down by prescaler U802 and by the N counter in U801. These counters are programmed for each channel to divide by a number which results in an input to the phase detector that is the same as the reference frequency when the VCO is operating on the correct frequency. Note that the VCO, prescaler, N counter, and phase detector form a loop. Therefore, if any component in this loop is defective, improper signals appear throughout the loop.

4.2.2 VOLTAGE-CONTROLLED OSCILLATOR

Oscillator (Q803)

Q803 is an N-channel JFET configured as a common-gate oscillator. The gate is biased negative with respect to the source by R815. RF flow through R815 is blocked by RF choke L807. An AC voltage divider formed

by C823, C824, and C825 provides feedback to maintain oscillation and also matches Q803 to the tank circuit.

The oscillator tank circuit consists of C856, C857, CR802, CR804, several other capacitors, and a section of microstrip. The microstrip is a shortened quarter-wave line with series inductance and shunt capacitance similar to a transmission line. C856 is used to set the oscillator frequency at the center of the band when the control voltage is at its midpoint.

VCO Frequency Control and Modulation

The VCO frequency is controlled by changing the DC voltage applied across varactor diode CR804. As the DC voltage across a varactor diode increases, the capacitance of the diode decreases and vice versa. This causes the VCO frequency to increase as the control voltage increases.

The VCO is frequency modulated in a similar manner. The transmit audio signal is applied across varactor diode CR802 to vary the VCO frequency at an audio rate. L804 provides a DC ground on the anode of CR802, and C818 provides an AC ground. CR802 is biased at approximately 3.6 volts by R812 and R813. The modulation line is isolated from tank circuit RF by L803, C816, and C814. Balance adjust potentiometer R811 balances the modulating signals applied to the VCO and reference oscillator (refer to Section 4.2.8 for more modulation information).

A compensation network formed by C817, C818, C819, and C820 ensures that modulation remains constant over the entire 12 MHz bandwidth of the VCO. This compensation is required because modulation tends to increase as the capacitance of CR804 decreases (VCO frequency gets higher).

Transmit/Receive Frequency Shift

A circuit formed by Q804, CR805, and several other components decreases the resonant frequency of the tank circuit in the receive mode by approximately 21.4 MHz. This is done to keep the VCO control voltage in the middle of its range. The resonant frequency is decreased by switching in additional capacitance.

The frequency shift circuit operates as follows: When the push-to-talk switch is released, the voltage at the junction of R819 and R820 goes to 0 volts. Q804 then turns off and CR805 is forward biased by the current flow through R819, L808, and R818. This effectively

3.3.2 CHANNEL INFORMATION

Numbers from 1-8 indicate the selected channel number. An "L" or "P" may also be flashed in the display when a channel is selected. The meaning of these letters is as follows:

- L - Indicates that the selected channel is locked out of scanning by dealer programming or by the operator (refer to "Channel Lockout").
- P - Indicates that the selected channel is a priority channel (refer to "Scan"). When programming the transceiver, a constant 'P' indicates the programming mode.

3.3.3 OPTION SWITCH FUNCTIONS

The channel display flashes information indicating the position of some option switches when they are pressed. The following information may be displayed:

- C - Indicates that the call function is enabled (refer to "Call").
- (-) - Indicates that the scan mode is selected (refer to "Scan").
- A - Indicates that an auxiliary function is enabled (refer to "Auxiliary").

3.3.4 ERROR CONDITIONS

A flashing display indicates one of the following error conditions:

Out-of-Lock Synthesizer - If the display flashes in the receive mode or when the push-to-talk switch is pressed, the synthesizer may be out-of-lock. When the synthesizer is out-of-lock, the transceiver does not transmit and a warning beep sounds when the push-to-talk switch is pressed. In addition, the transceiver probably does not receive. To attempt to clear this condition, change channels, turn power off and then on again, or press the push-to-talk switch. If the condition persists, troubleshoot the synthesizer.

Time-Out Timer Expired - This is the only error condition in which a steady tone sounds. Refer to Section 3.2.7.

Transmitter Keyed on a Channel Not Programmed for Transmit - Receive-only channels can be programmed. If transmitting is attempted on a receive-only channel, the display flashes, a warning beep sounds, and the transmitter is disabled.

Channel Busy When Transmitter Keyed - Refer to Section 3.2.8.

selected channel, this indicator shows that the channel is busy without having to take the microphone off-hook or having to press the MONITOR switch (if programmed). The squelch control must be properly adjusted for this indicator to operate correctly.

3.2.7 TIME-OUT TIMER

The time-out timer disables the transmitter if it is continuously keyed for longer than the programmed time. In addition, a continuous warning tone sounds and the display flashes. The timer is reset by releasing the push-to-talk switch. This timer can be programmed for 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, or 5.0 minutes or it can be disabled entirely.

3.2.8 TRANSMIT DISABLE WHEN CHANNEL IS BUSY

This feature automatically prevents the transmitter from keying if the selected channel is busy. Some, none, or all channels can be programmed with this feature. If the channel is busy when the push-to-talk switch is pressed, the transmitter does not key, the display begins flashing, and a warning beep sounds. The push-to-talk switch must be released and then pressed again to make another attempt. (It is not possible to access a busy channel by holding down the push-to-talk switch until the channel is no longer busy.)

3.2.9 KEY ACKNOWLEDGE BEEP

When this function is enabled by dealer programming, a 1 kHz, 30 millisecond tone sounds whenever a CHANNEL STEP or option switch is pressed. If a switch is pressed when it is disabled such as when transmitting, no tone sounds.

3.2.10 SCAN

Introduction

When the scan mode is enabled by a front-panel switch, a dash (-) appears in the channel display. A channel number is displayed only when a message is received. All programmed channels are scanned unless locked out as described in "Locking Channels Out of Scanning" which follows. When scanning is enabled by dealer programming, additional functions such as channel lockout and priority channels also become available.

If a channel is programmed for Call Guard, then the channel is also checked for correct Call Guard (if the microphone is on-hook and the MONITOR switch off).

An exception is priority channels which are not checked for Call Guard. The BUSY indicator lights in the scan mode when a carrier is detected. If the BUSY indicator lights but no signal is received, a wrong Call Guard has been detected.

The scan rate when no carrier is present on any channel is sixteen channels per second. When scanning channels with Call Guard, the scan rate decreases as the number of channels with the wrong Call Guard increases. For the worst case when all channels are busy with the wrong Call Guard, the scan rate is between three and eight channels per second depending on the type of Call Guard being used.

After a message is received while scanning, there is a 2-second delay after the carrier is lost before scanning resumes. This delay allows the user to respond to the message on that channel or to lock out that channel (refer to "Channel Lockout" section). This 2-second delay also prevents missed messages caused by signal fades and conversation gaps. There is also a 5-second delay before scanning resumes after transmitting. This delay allows the other party to respond to the transmission. If a message on the priority channel is detected during these delay periods, it is received.

Locking Channels Out of Scanning

Channels can be locked out of scanning by dealer programming or by the user if an option switch has been programmed for the channel lockout function (refer to "Channel Lockout" description). A locked out channel is indicated by an "L" flashed in the channel display when the channel is selected.

Scanning Priority Channels

Priority channels can be dealer programmed to be fixed channels, the channel selected when not scanning, or not used at all. Assigning a priority channel ensures that a message occurring on the priority channel during scanning is not missed while listening to a message on another channel. If a message is detected on the priority channel, the nonpriority message is immediately dropped and the transceiver switches to the priority channel. The priority channel is scanned at least two times per second in the scan mode except when transmitting. When the priority channel is scanned while listening to a nonpriority channel, an interruption of approximately 45 milliseconds occurs in the audio signal. This interruption is not noticeable by the user.

data, programming the transceiver, and printing and saving programming data. Complete information on this software is included in Programming Manual, Part No. 004-7100-021.

NOTE: It is not possible to program one transceiver with another by connecting them together as with the 5861 handheld transceivers.

3.1.4 EEPROM DATA STORAGE

When a transceiver is programmed, the programming data is stored by the microprocessor in EEPROM U401 on the audio/logic board. Other information such as the last channel selected is also stored in this device. Since an EEPROM (electrically eraseable programmable read-only memory) is nonvolatile, data is stored indefinitely by this device without the need for a constant power supply. Therefore, battery backup is not required and the transceiver can be removed from the vehicle without affecting programming. Since an EEPROM is also reprogrammable, a new device is not required if reprogramming of the transceiver is required.

3.2 TRANSCEIVER OPERATION

3.2.1 INTRODUCTION

This transceiver has several standard operating functions which are selectable when programming the transceiver. Some are always available since they do not

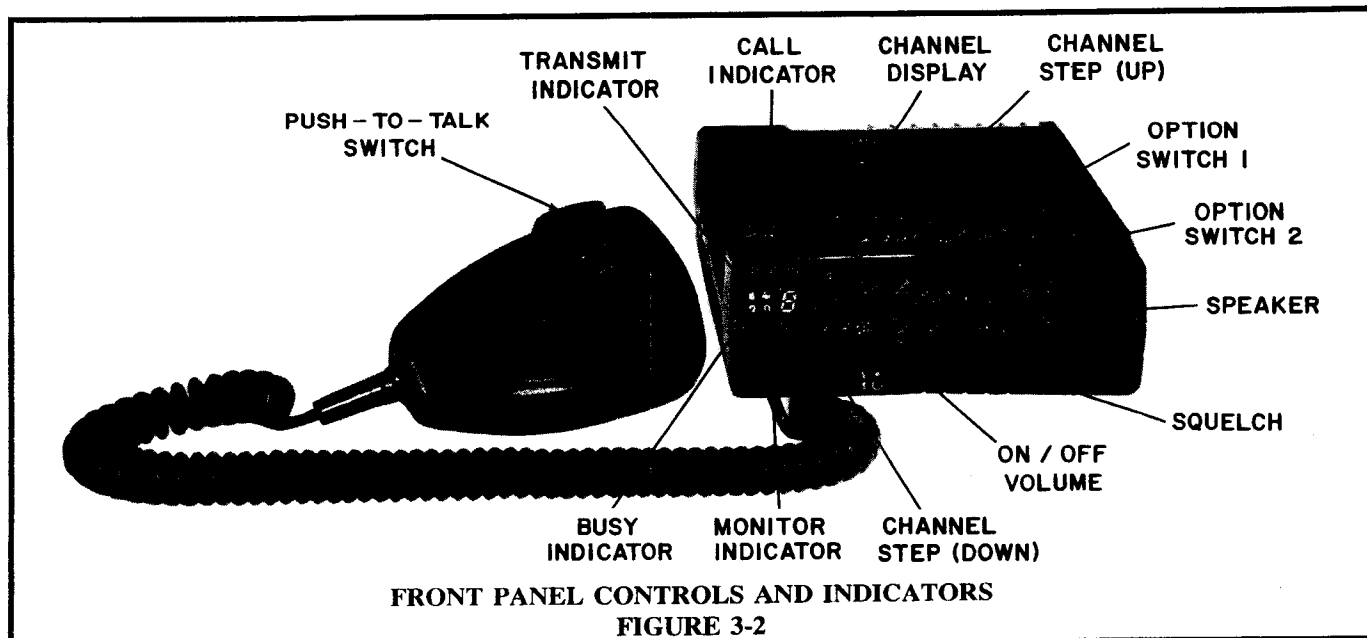
require an option switch and some require one of the two available front-panel option switches. The following functions are always available:

Function	Section
8-Channel Operation	3.2.2
Call Guard	3.2.3
Monitor Indicator	3.2.4
Call Indicator	3.2.5
Busy Indicator	3.2.6
Transmit Disable When Channel Is Busy	3.2.8
Key Beep	3.2.9

The following functions require an option switch, so any two are available:

Function	Section
Scan	3.2.10
Call Function On/Off	3.2.5
Monitor	3.2.4
Channel Lockout	3.2.11
Auxiliary	3.2.12

Refer to the indicated section for additional information on the particular function listed. A photo showing the various front-panel controls and indicators is located in Figure 3-2.



INSTALLATION

Performance testing is recommended to ensure that the transceiver has not been damaged during shipment. Performance tests are located in Sections 6.6 and 6.7. Alignment may also be required if the transceiver was not factory programmed. Transceivers that are not factory programmed (stocking transceivers) are factory aligned for the frequency bands shown in Section 6.1. If a channel is programmed outside these bands, the realignment described in Section 6 must be performed.

2.2 MOBILE INSTALLATION

NOTE: This transceiver is designed for installation in vehicles with a 12 volt negative ground electrical system. Others require a voltage converter.

Hardware and Cable Kit, Part No. 023-7171-918, includes a 10-foot power cable, a microphone hanger, a ground wire, and all the screws normally required for installation. These components and the standard and low-profile mounting brackets are shown in the installation diagram in Figure 2-1. Install the transceiver as follows:

- a. Select a convenient mounting location under the dash or elsewhere and mount the transceiver as shown in Figure 2-1.
- b. Mount the microphone hanger in a convenient location using either the sheet metal or plastic mounting screws. The hanger must be connected to chassis ground for proper Call Guard and Call indicator operation. If necessary, use the included ground wire to connect the hanger to ground.

- c. Disconnect the negative battery cable to prevent damage from accidental short circuits.
- d. Route the 10-foot power cable through the firewall using an existing hole or cut a new one if necessary. The hole must be large enough to clear the fuseholder or power connector and it should be sealed when the installation is complete.

NOTE: It is recommended that the power cable not be connected to the ignition switch or fuse block because increased interference from the vehicle's electrical system may result.

- e. Connect the red power cable to the positive (+) battery terminal.
- f. Connect the blue power cable to a good chassis ground point on the vehicle. Make sure there is a good ground return to the negative battery cable.
- g. Plug the power cable into the transceiver and reconnect the negative battery cable.
- h. Install the antenna according to the instructions included with the antenna. Check the antenna VSWR. Reflected power should be less than 4% of forward power (VSWR less than 1.5 to 1).



GENERAL INFORMATION

1.5 ACCESSORIES

Table 1-1 lists the accessories that are available for the 7171 transceiver. A brief description of some of these accessories follows.

Mounting Brackets, Power Cable

Refer to Section 2 for more information.

Microphones and Speakers

The amplified dynamic microphone is the microphone shown on the front cover. The external speaker has a power rating of 15 watts and includes a 6-foot cable.

Remote Programming Interface and Cables

The Remote Programming Interface (RPI) is required to interface a computer to the transceiver. The -000 RPI is used with the Radio Shack, IBM, and Apple computers shown in Table 1-1. The -090 RPI is used by the Commodore computer. The cable between the RPI and transceiver is included with the RPI but the cable between the RPI and computer is not included. Refer to Section 3.1.2 for more information.

Programming Software

Johnson programs are available for the personal computers listed in Table 1-1. These programs allow the dealer to program the Johnson Challenger 7171 and 5861 transceivers. To simplify operation and lessen the chance of programming errors, menus are displayed and questions are asked. Besides programming the transceiver, these programs read the programming already in the radio, and edit, print, and save programming information.

2.5 PPM TCXO Kit

This kit includes a TCXO (temperature-compensated crystal oscillator) which is installed in the main board when this transceiver is used as a base station.

**TABLE 1-1
7171 ACCESSORIES**

Accessory	Part Number
Standard Mounting Bracket	023-7171-908
Low-Profile Mounting Bracket	023-7171-909
Power Cable, 8 ft	023-4143-002
Microphone, Amplified Dynamic	250-0740-300
Speaker, 5" Remote (Blk)	250-0151-005
Remote Programming Interface (Ex C-64)	023-5800-000
Remote Programming Interface, C-64	023-5800-090
Cable, DB-25 to DB-25 M to M	023-5800-016
Cable, DB-25 to DB-25 M to F	023-5800-017
Radio Shack Model 100/200 Programming Software	
Cassette Tape	023-5800-021
Disk	023-5800-026
IBM PC Programming Software (Disk)	023-5800-031
Apple IIe Programming Software (Disk)	023-5800-041
Commodore 64 Programming Software (Disk)	023-5800-051
2.5 PPM TCXO Kit	023-7171-810

1.6 PRODUCT WARRANTY

The warranty statement for the 7171 transceiver is available from your product supplier or from the E.F. Johnson Company, 299 Johnson Avenue, Waseca MN 56093. Phone (507) 835-6222.

1.7 FACTORY CUSTOMER SERVICE

The Product Service Department of E.F. Johnson Company provides customer assistance on technical problems and the availability of local and factory repair facilities. If you write to the Product Service Department, please include all information that may be helpful in solving your problem.

Contact: E.F. Johnson Company
Product Service Department
299 Johnson Avenue
Waseca, MN 56093
Phone: (507) 835-6367

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