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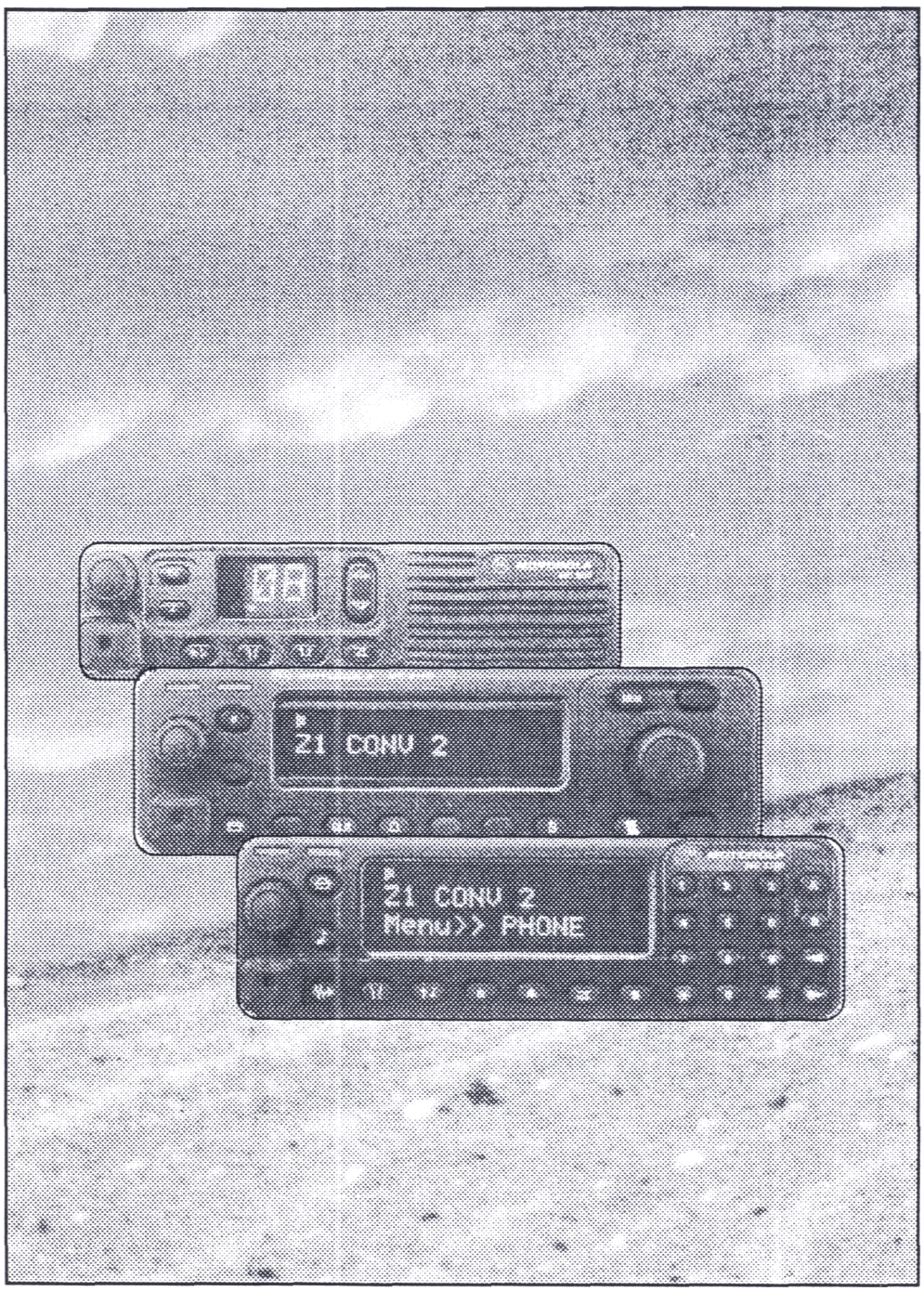
Colin Hinson
In the village of Blunham, Bedfordshire, UK.

MOTOROLA

Mobile Radiotelephones
66 - 88, 136 - 174 & 403 - 470 MHz
Technical Manual



- MC900
- GM900
- GM1100
- GM1200
- GM2000
- MCX1200
- MCS2000
- MCX2000
- MC2100

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MOTOROLA

Additional Manuals:

- **68P02058U20:**
  Installation Manual

Publication No.: 68P02058U21-C

LIST OF MODELS

CONVENTIONAL SYSTEMS RADIOS MC900/GM900 Model Family					
MODEL NUMBER	**Frequency Range**	**Power Level**	**Control Head**	**Channel Spacing**	**No. of Freq.**
M01FHK9AN3AN	66 - 88 MHz	1-25 watts	B (N3)	25/20/12.5 kHz	16
M01KHK9AN3AN	136 - 174 MHz	1-25 Watts	B (N3)	25/20/12.5 kHz	16
M01RFK9AN3AN	403 - 470 MHz	1-10 Watts	B (N3)	25/20/12.5 kHz	16
M01RHK9AN3AN	403 - 470 MHz	10-25 Watts	B (N3)	25/20/12.5 kHz	16
M01KHK9AN3BN	136 - 174 MHz	1-25 Watts	Remote Mount	25/20/12.5 kHz	16
M01RFK9AN3BN	403 - 470 MHz	1-10 Watts	Remote Mount	25/20/12.5 kHz	16
M01RHK9AN3BN	403 - 470 MHz	10-25 Watts	Remote Mount	25/20/12.5 kHz	16
MC2100 Model Family					
M01FHL9AN4AN	66 - 88 MHz	1-25 watts	C (N4)	25/20/12.5 kHz	250
M01FHM9AN5AN	66 - 88 MHz	1-25 watts	I (N5)	25/20/12.5 kHz	250
M01FHN9AN8AN	66 - 88 MHz	1-25 watts	J (N8)	25/20/12.5 kHz	250
M01KHL9AN4AN	136 - 174 MHz	1-25 watts	C (N4)	25/20/12.5 kHz	250
M01KHM9AN5AN	136 - 174 MHz	1-25 Watts	I (N5)	25/20/12.5 kHz	250
M01KHN9AN8AN	136 - 174 MHz	1-25 Watts	J (N8)	25/20/12.5 kHz	250
M01RFL9AN4AN	403 - 470 MHz	1-10 Watts	C (N4)	25/20/12.5 kHz	250
M01RFM9AN5AN	403 - 470 MHz	1-10 Watts	I (N5)	25/20/12.5 kHz	250
M01RFN9AN8AN	403 - 470 MHz	1-10 Watts	J (N8)	25/20/12.5 kHz	250
M01RHL9AN4AN	403 - 470 MHz	10-25 Watts	C (N4)	25/20/12.5 kHz	250
M01RHM9AN5AN	403 - 470 MHz	10-25 Watts	I (N5)	25/20/12.5 kHz	250
M01RHN9AN8AN	403 - 470 MHz	10-25 Watts	J (N8)	25/20/12.5 kHz	250
M01KHM9AN5BN	136 - 174 MHz	1-25 Watts	Remote Mount	25/20/12.5 kHz	250
M01KHN9AN8BN	136 - 174 MHz	1-25 Watts	Remote Mount	25/20/12.5 kHz	250
M01RFM9AN5BN	403 - 470 MHz	1-10 Watts	Remote Mount	25/20/12.5 kHz	250
M01RFN9AN8BN	403 - 470 MHz	1-10 Watts	Remote Mount	25/20/12.5 kHz	250

MPT SHARED SYSTEMS RADIOS MCX1200/GM1200 Model Family					
MODEL NUMBER	**Frequency Range**	**Power Level**	**Control Head**	**Channel Spacing**	**No. of Freq.**
M01KHL9CK4AN	136 - 174 MHz	1-25 Watts	C (K4)	25/20/12.5 kHz	N.A.
M01KHM9CK5BN	136 - 174 MHz	1-25 Watts	I (K5)	25/20/12.5 kHz	N.A.
M01RFL9CK4AN	403 - 470 MHz	1-10 Watts	C (K4)	25/20/12.5 kHz	N.A.
M01RFM9CK5BN	403 - 470 MHz	1-10 Watts	I (K5)	25/20/12.5 kHz	N.A.
M01RHL9CK4AN	403 - 470 MHz	10-25 Watts	C (K4)	25/20/12.5 kHz	N.A.
M01RHM9CK5BN	403 - 470 MHz	10-25 Watts	I (K5)	25/20/12.5 kHz	N.A.

SAFETY INFORMATION

Every radio, when transmitting, radiates energy into the atmosphere which may, under certain conditions, cause the generation of a spark.
All users of vehicles fitted with radios should be aware of the following warnings:

Do not operate radio near inflammable liquids or in the vicinity of explosive devices

During normal use, the radio will subject you to radio energy substantially below the level where any kind of harm is reported.
To ensure personal safety, please observe the following simple rules:

- **DO NOT** transmit when the antenna is very close to, or touching, exposed parts of the body, especially the face and eyes.
- **DO NOT** hold the transmit (PTT) key in when not actually desiring to transmit.
- **DO NOT** operate radio whilst driving. It should also be noticed that the use of a hand held microphone while driving could constitute an offence under the Road Traffic Regulation.

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INTRODUCTION

SERVICE POLICY

This family of mobile radios uses manufacturing technologies that requires a different maintenance and service strategy than used today. The high complexity radio and controller circuitry is built on multi-layer boards with surface mounted components. This manufacturing technology is relatively cheap and gives high quality which drastically will reduce the repair cycle time for customers, and also reduce the spare part inventory which will consist of boards and accessory items only.

The high Mean Time Between Failure (MTBF) means that maintenance and service is based on a "Field Replaceable Unit" (FRU) strategy.
Defective FRUs will be returned to a central repair shop in the factory for evaluation. The defective FRUs will, during the warranty period (one year), be exchanged with factory produced boards at special exchange prices. The advantage is fast feedback of quality problems to the manufacturing plant, maintain a high level of repair quality, and fulfill the customer satisfaction program for quality repairs.

Motorola Service Shops/Dealers and National Service Centers

The Motorola Service Shop/Dealer will perform a failure diagnosis of the radio to find the defective board and then swap the board while the customer is waiting. The radio software personality will be copied and reprogrammed by means of the RSS.The repair policy is as detailed in the Maintenance and Repair Procedures.
The swap strategy implies that the service shop/dealer will hold a stock of spare boards. Field Replaceable Units which are software programmable, will be preprogrammed with the firmware when shipped from the factory repair shop, leaving only programming of the radio personality to be done by the shop or dealer.
Spare accessories, ordered from Parts, will be held by the shop/dealer in the normal way.
The National Service Centre (NSC) will receive defective boards from local service shops/dealers, attach a tag with the fault description/symptom, and send them to the factory repair shop for exchange.

The Factory Repair Shop

The returned Field Replaceable Units will be replaced by new boards during the warranty period. Defective boards will be investigated by factory quality engineers for evaluation of repair possibilities. Normally, defective boards will be scrapped after technical investigation and registration. The factory will deliver new boards corresponding to received boards to the National Service Centers.

MAINTENANCE AND REPAIR PROCEDURES

The User

The user/customer performs normal preventive maintenance as described in the radio user guide.
Defective radios are delivered to the dealer or Motorola Service Shop.

Motorola Service Shop/Dealer Service Procedures

The Motorola Service Shop/Dealer is responsible for warranty repairs, initial trouble-shooting, minor mechanical repairs, board swapping, RSS programming and replacing of defective accessories.

TEST MODE FOR OPEN ARCHITECTURE RADIOS

GENERAL

The test mode allows the technician to monitor a set of radio parameters, to configure the radio hardware in a number of predefined ways, and have access to a number of test procedures.

Two basic areas of functionality are provided by the Test Mode:

- RF test mode - allows the RF functionality of the radio to be tested.
- CU (Control Unit) test mode - allows the radio display, buttons and switches to be tested.

The purpose of the test mode is to test the radio unit and its interfaces, but not to test the various accessories. However the mobile radio is incapable of operating in isolation without a minimum set of accessories. The following accessories are assumed:

- Keypad or noise cancelling microphone
- External speaker
- Control head C, I or J

If an accessory is subsequently connected to the radio after the test mode application has already been invoked, the radio will ignore any resulting power up messages received on the serial bus.

TEST MODE FEATURES

On entering Test Mode the radio will be in an idle state, all indicators are extinguished and the 'RF TST' Mode Select menu message will be displayed.

Test mode control is provided by a set of menus (left-hand flushed) which may be scrolled through and selected.

The dedicated keys are used to scroll through and select these menus:

Button 1:	Scroll Key
Button 2:	Select key

ON ALL MENUS:

- CLEAR will clear the display.
- END will return the radio to the RF TST/CU TST Mode Select level.
- All selections are confirmed by a short bip.

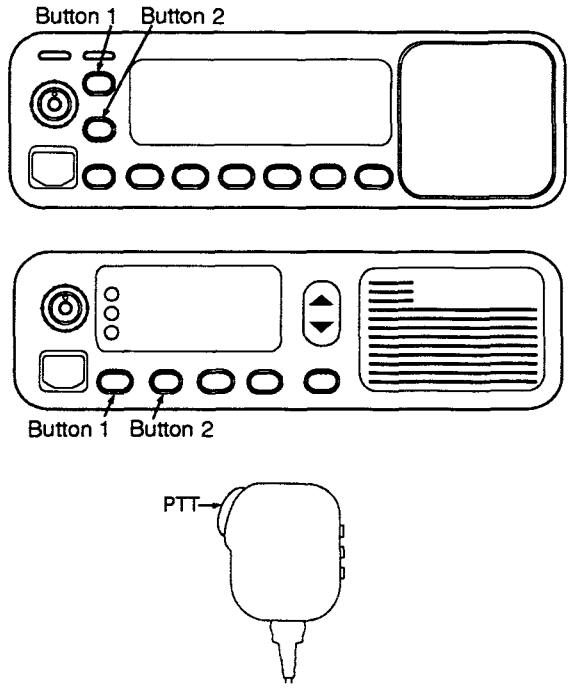
TEST MODE ENTRY

- Turn the radio on.
- Within ten seconds after power on press the PTT five (5) times, ensuring that the first press is within one second after power on.
- On entry, the "SERVICE" test mode message is displayed for 2 seconds. Following this, each of the following is displayed in sequence:
  - radio software part number
  - radio model number
  - radio serial number

  Each of these "temporary messages" lasts for 2 seconds. After the radio serial number has been displayed for 2 seconds, the display is blanked.
- Pressing Button 1 while one of the above "temporary messages" is displayed, cancels the display sequence and directly blanks the radio display.
- Within 6 seconds after the display is blanked the test mode entry password must be entered. The password is as follows:

  - 1 time Button 1
  - 2 times Button 2
  - 1 time Button 1
  - PTT

  The password must be entered correctly the first time, no re-tries are allowed. If an incorrect password is entered, turn off the radio and repeat the power up sequence.
- If the correct password is entered the radio enters test mode and the "RF TST" test mode message is displayed.



Note: *In earlier radio software versions no password is required to enter service mode, i. e. after the "temporary messages" the radio enters service mode and the "RF TST" test mode message is displayed.*

TO EXIT either the RF Test Mode or the CU Test Mode turn the radio off.

RF/CU TEST MODE SELECT

Pressing the scroll key alternates between the two Mode Select menus 'RF TST' and 'CU TST'. To select either the RF or CU test menu press the dedicated select key while the desired menu is being displayed.

RF Test Mode

On entry into the RF test mode the radio hardware will be configured for the default carrier squelch (CSQ) test mode environment, and the test mode application will examine the following parameters contained in the personality area of the radio codeplug:

- Frequency Range (Midband, VHF or UHF)
- Channel Step Size (5 or 6.25)
- Tx Channel Number.
- Rx Channel Number.
- Transmit Deviation (0, 2.5, 4 or 5 kHz).
- Channel Bandwidth (12.5, 20 or 25 kHz).
- Transmitter Power Level (1st, 2nd, 3rd or 4th).

When the radio is in RF test mode the PTT button is used to key and de-key the transmitter. Whenever the transmitter keys up, the test mode application illuminates the front panel red LED and whenever the transmitter keys down the application extinguishes the front panel red LED.

Test Mode Environments

When the RF menu message **ENVIRO** is displayed, press the select key to gain access to the RF test mode environments:

CSQ (Carrier Squelch) . . . (Default)
UNSQ (Unsquelch)
TPL (Tone Private Line)
DTMF (Dual Tone Modulation Frequency)
RC DPL (Radiocom 2000 Digital Public)
RC TR (Radiocom 2000 Trunking)
MPT TR (MPT 1327 Trunking)
SEL 5 (Select 5)

When the appropriate environment is selected the test mode application will configure the radio hardware for this environment.

Channel Numbers

From the RF menu select **CHAN** to gain access to the Channel Number menu messages: 1, 2, ...n and CLEAR (n is the highest channel number specified by the Tx/Rx pairs field). The test mode application will examine the number of Tx/Rx pairs field contained in the personality area of the radio codeplug in order to determine how many different channel number menu messages to display. Selecting one of the channel numbers will reconfigure the radio hardware with the specific transmit/receive frequency.

The resulting frequencies will be as follows:

- Transmit frequency: Offset frequency + (Tx channel number #n * Channel step size).
- Receive frequency: Offset frequency + (Rx channel number #n * Channel step size).

The Rx/Tx channel number #n and Channel step size values are extracted from the personality area of the radio codeplug and the offset frequency is derived from the offset frequency calculation performed on entry into RF test mode.

Transmit Power Levels

From the RF menu select **POWER** to gain access to the Transmit power levels: 1st, 2nd...nth (n is the highest power level specified by the highest power level field). The test mode application will examine the highest supported power level field contained in the personality area of the radio codeplug in order to determine how many different power level messages to display. Selecting one of the power levels will reconfigure the radio hardware with the specific power level.

Channel Bandwidth

From the RF menu select **B/W** to gain access to the Channel Bandwidth menu messages: 12.5, 20, 25 and CLEAR. Selecting any one of the bandwidths will reconfigure the radio hardware with the specific channel bandwidth.

CU Test Mode

On entry into the Control Unit test mode, all front panel indicators and display segments are displayed for a period of 5 seconds, and then extinguished.

When the radio is in Control Unit test mode, all front panel momentary button presses/releases (apart from the dedicated scroll and select keys and the volume control), static switch activations and free revolving rotary activations are monitored. When any one of these is detected a short 'bip' will be heard and the associated button code (in decimal) and state will be displayed on the front panel.

TRUNKED MPT 1327 DIAGNOSTICS MODE

GENERAL

The diagnostics mode allows the technician to monitor system and radio parameters. The diagnostics mode may be entered at any time during the radio's trunked mode operation. The trunked mode will continue to operate, e.g. if the radio was active on a traffic channel then it will be able to transmit and receive as normal.

The diagnostics mode may also be entered when the radio is powered up with no personality programmed. Only a subset of the features will be supported in this case.

Alert tones will continue to be sounded by the radio and the diagnostics display will be briefly overwritten by trunked mode messages.

Note:
Calls which would normally make use of the numeric keypad may not be made whilst in diagnostics mode as the keypad has an alternative use whilst in this mode. Only trunked mode options that do NOT require use of the numeric keypad may be used (i.e. calls to units from the calls in absence list, last number redial calls, dedicated call button calls, emergency calls, and rotary switch calls can all be made), but the display will not provide the usual information associated with these calls when made in trunked mode.

DIAGNOSTICS MODE FOR 14 CHARACTER DISPLAY MODELS

DIAGNOSTICS MODE ENTRY

Note:
A keypad microphone is required to run the MPT diagnostics mode on a mobile radio.

The diagnostics mode is entered by pressing the keys **120#** followed by the required facility number 0 – 9. If the radio is not in the idle state when diagnostics mode entry is attempted the keys 120# must be pressed with less that one second between each key press, and the keys pressed will not be shown on the display but the key click will sound as each key is pressed.

Note:
Not all diagnostic displays can be supported from control and traffic channels. If the information to be displayed is inconsistent with the channel type or hunting state then the fields will be replaced with "".*

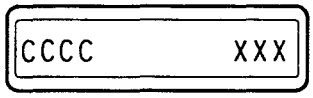
When in diagnostics mode, the user may move to another feature by pressing the required feature number 0 – 9. If an attempt is made to enter a mode which is not defined then the error tone will sound. and the input will be ignored. Note that no error message will be displayed.

FEATURES

The following features are available in the diagnostics mode by entering the corresponding feature number 0 – 9.

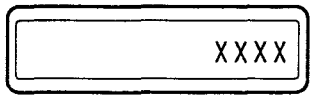
Feature No. 1

Display current Channel Number (CCCC) and decimal representation of the RSSI level (XXX). Available on traffic and control channels.



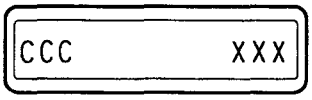
Feature No. 2

Display of the System Identity last decoded (XXXX) in hexadecimal. Available on control channels only.



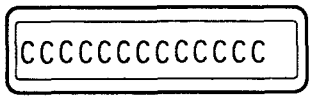
Feature No. 3

Display number of Correct Codewords received (CCC) and number received with an Error (XXX). Samples for the correct and errored codeword counts will be taken over a 5 second period of time. Available on control channels while not hunting.



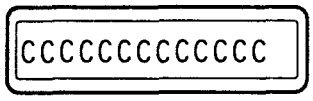
Feature No. 4

Display radio's Software Version number. Available on traffic and control channels and when no personality is programmed.



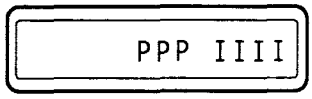
Feature No. 5

Display radio's Personality Format number. Available on traffic and control channels and when no personality is programmed.



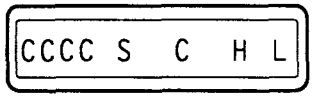
Feature No. 6

Display radio's own MPT1327 Prefix (PPP) and Identity (IIII) as stored in the radio's current personality. Available on traffic and control channels.



Feature No. 7

Display Channel number (CCCC), Hunting Status (S), Carrier Status (C), Hunt Level (H) and L2 Exceeded (L). Available on control channels only.



The hunting status will be S when the radio is hunting or '–' when not hunting. The carrier status will be C when carrier is detected by the radio and '–' when no carrier is detected.

The hunt level will be a number 0, 2 or '–' defining the current level of the channel hunt, i.e. L0, L2 or no hunt currently active. The L2 exceeded flag will be L when L2 is exceeded and '-' otherwise.

Note: *When the radio is hunting the scan rate is slowed down to check one control channel every 2 seconds. This display will be updated every time a channel is selected. When not hunting this display is updated every 5 seconds.*

Feature No. 8

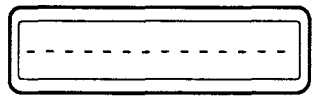
Display of Electronic Serial Number consisting of Manufacturers Code (CCC), Model Number (MM) and Serial Number (SSSSSS). Available on control and traffic channels and when no personality is programmed.

Feature No. 9

Display the date and time that the internal codeplug was last programmed, last digit of the year (YY), month (MM), day of the month (DD), hour of programming in 24 hour clock format (HH) and minutes of programming time (MM).

Feature No. 0

Return to trunked mode. This display will be overwritten by the next trunked mode display update.

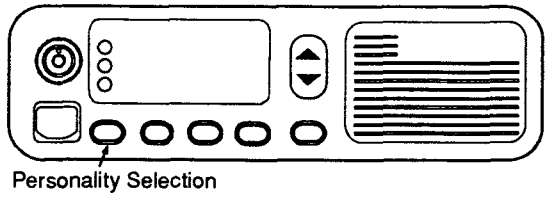


DIAGNOSTICS MODE FOR 8 CHARACTER DISPLAY MODELS

DIAGNOSTICS MODE ENTRY

Diagnostics mode is entered by pressing the **PTT** on the microphone whilst holding down the **Personality Selection** button. Diagnostics mode can be selected when the radio is in the idle state and also when the radio does not have a personality. If diagnostics mode is selected when the radio does not have a personality, fewer features are available to the user. The features which are available in diagnostics mode are presented to the user in a predefined sequence. The sequence may be stepped through by pressing the **PTT** key.

Note: *Due to the reduced size of the 8 character display, the information associated with each feature is shown over several displays. This information is then presented as a rotating display to the user.*



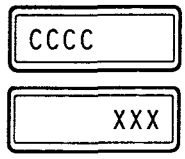
FEATURES

The following features are available in the diagnostics mode sequence:

1. Channel Number and RSSI Level

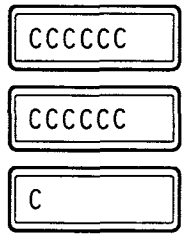
This is the only display which is available in trunked mode. The other displays can only be seen in diagnostics mode where trunked mode operation is not available.

The current Channel Number (CCCC) and decimal representation of the RSSI level (XXX) are available on traffic and control channels. This is the only display which changes operationally. The displays will be updated when diagnostics information is received. This information is not available when the radio does not have a personality.



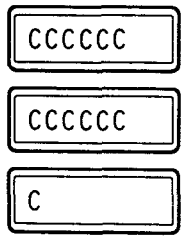
2. Software version number

The radio's software version number is available when the radio does not have a personality.



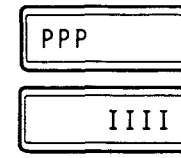
3. Personality Format Number

The radio's personality format number is available when the radio does not have a personality.



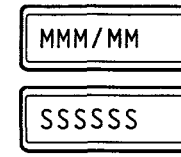
4. Prefix and Identity

The radio's own MPT1327 prefix (PPP) and identity (IIII) as stored in the radios current personality is only available when the radio has a personality.



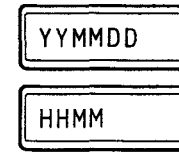
5. Serial / Manufacturer / Model Numbers

The Electronic Serial Number, manufacturers number (MMM), model number (MM) and the serial number (SSSSSS) is available when the radio does not have a personality.



6. Last programming Time and Date

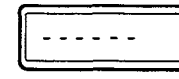
The date and time that the internal codeplug was last programmed, last digits of the year (YY), month (MM), day of the month (DD), hour of programming in 24 hour clock format (HH) and minutes of programming time (MM). This is available when the radio does not have a personality.



DIAGNOSTICS MODE EXIT

In order to exit from diagnostics mode, the user must press the **personality selection** key twice when the radio is displaying channel information and RSSI level information (feature 1) and once when any of the other features are being displayed.

Upon exiting from diagnostics mode the following display will be seen.



RECOMMENDED AND REQUIRED TEST EQUIPMENT, SERVICE AIDS, AND TOOLS LIST

RECOMMENDED TEST EQUIPMENT

The list of equipment contained in the table below includes all of the standard test equipment required for servicing two-way mobile radios, as well as several unique items designed specifically for servicing the radio. Battery-operated test equipment is recommended when available. The "Characteristics" column is included so that equivalent equipment may be substituted; however, when no information is provided in this column, the specific Motorola model listed is either a unique item or no substitution is recommended.

MODEL NUMBER	DESCRIPTION	CHARACTERISTICS	APPLICATION
R2000 Series	System Analyzer	This monitor will substitute for items with an asterisk (*)	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment
*R1150C	Code Synthesizer		Injection of audio and digital signalling codes
*S1053D *HM-203-7 *SKN6008A *SKN6001A	220 VAC Voltmeter 110 VAC Voltmeter Power Cable for Meter Test Leads for Meter	1mV to 300V, 10-Mohm input impedance	Audio voltage measurements
*S1350C *ST1213B (VHF) *ST1223B (UHF)	Watt Meter Plug-in Element RF Dummy Load	50 ohm, ±5% accuracy 10 Watts, maximum 0-1000 MHz, 300W	Transmitter power output measurements
R1065A	Load Resistor	10-watt Broadband	For use with Wattmeter
S1339A	RF Millivolt Meter 10kHz to 1.2 GHz	100µV to 3V rf	RF level measurements
*R1013A	SINAD Meter		Receiver sensitivity measurements
S1347D or S1348D (programmable)	DC Power Supply	0-20Vdc, 0-5 Amps	Bench supply for 7.5Vdc current limited

* Any of the R2000 Series system analyzers will substitute for items with an asterisk (*)

Recommended Test Equipment

SERVICE AIDS AND RECOMMENDED TOOLS

Refer to the "SERVICE AIDS" and "RECOMMENDED TOOLS LIST" for a listing and description of the service aids and tools designed specifically for servicing the radio, as well as the more common tools required to disassemble and properly maintain the radio. These kits and/or parts are available from Motorola.

FIELD PROGRAMMING

The radio can be aligned and programmed in the field. This requires specific equipment and special instructions. Refer to the "Radio Service Software User's Manual" for complete field programming information.

The following table lists service aids recommended for working on the radio. While all of these items are available from Motorola, most are standard shop equipment items, and any equivalent item capable of the same performance may be substituted for the item listed.

PART NUMBER	DESCRIPTION	APPLICATION
GTF373A	Test Box Cable	Connects radio to GTF180a test box.
GTF372A	Combined Interface Cable	Connects radio to RLN4008B RIB.
HKN4191A	DC Power Cable for radio	Interconnects radio to power supply
GTF180A	Test Box	Enables connection to the universal connector. Allows switching for radio testing.
RLN4008B	Radio Interface Box	Enables communications between the radio and the computer's serial communications adapter.
EPN4040A	Power Supply	Used to supply power to the RIB (240 VAC).
EPN4041A	Power Supply	Used to supply power to the RIB (220 VAC).
3080369B72	Computer Interface Cable	Connects the computer's serial communications adapter to the RIB.
3080369B71	Computer Interface Cable	Connects the computer's asynchronous communications adapter to the RIB.
GVN6007	MPT1327 1200 Series	Radio Service Software, 3 1/2" floppy disc, English
GVN6008	MPT1327 1200 Series	Radio Service Software, 3 1/2" floppy disc, German
GVN6009	MPT1327 1200 Series	Radio Service Software, 3 1/2" floppy disc, French
GVN6011	2100 Series	Radio Service Software, 3 1/2" floppy disc, English
GVN6012	2100 Series	Radio Service Software, 3 1/2" floppy disc, German
GVN6013	2100 Series	Radio Service Software, 3 1/2" floppy disc, French
GVN6015	2100 Series	Radio Service Software, 3 1/2" floppy disc, Spanish
EVN4140	900 Series	Radio Service Software, 3 1/2" floppy disc, English
EVN4143	900 Series	Radio Service Software, 3 1/2" floppy disc, German
EVN4144	900 Series	Radio Service Software, 3 1/2" floppy disc, French
EVN4145	900 Series	Radio Service Software, 3 1/2" floppy disc, Spanish

Service Aids

The following table lists the tools recommended for working on the radio; these also are available from Motorola. Note that the R-1070A workstation requires the use of a specific "heat focus head" for each of the components on which this item is used. Each of these heat focus heads must be ordered separately. The individual heat focus heads (and the components on which they are used) are listed at the end of the table.

PART NUMBER	DESCRIPTION	APPLICATION
6680387A59	Extractor, 2 contact	Removal of discrete surface-mounted devices
6680387A64	Heat controller with safety stand, or	
6680387A65	Safety stand only	
0180382A31	Portable desoldering unit	
6680375A74	0.025 replacement tip, 5/pk	For 0180382A31 portable desoldering unit
0180386A81	Miniature digital readout soldering station (incl. 1/64" micropoint tip)	
0180386A78	Illuminated magnifying glass with lens attachment	
0180386A82	Anti-static grounding kit	Used during all radio assembly and disassembly procedures
6684253C72	Straight prober	
6680384A98	Brush	
1010041A86	Solder (RMA type), 63/37, 0.020" diameter- 1 lb. spool	
1080370B43	RMA liquid flux	
R-1070A	Shields and surface-mounted component - IC removal/rework station (order all heat focus heads separately)	Removal of surface-mounted integrated circuits

HEAT FOCUS HEADS	INSIDE DIMENSIONS OF HEADS	
6680334B49	0.410" x 0.410"	U601, U702
6680334B50	0.430" x 0.430"	U4, U5, U713
6680334B51	0.492" x 0.492"	U3
6680334B52	0.572" x 0.572"	U701, U705
6680334B53	0.670" x 0.790"	* metal shields B, C, E, and F
6680370B51	0.475" x 0.475"	U204
6680370B54	0.710" x 0.710"	U710
6680370B57	0.245" x 0.245"	U2, U201
6680370B58	0.340" x 0.340"	U101, U102
6680370B66	0.180" x 0.180"	U101, U102
6680371B15	0.460" x 0.560"	* metal shields A, D, G, H, and I
6680371B74	0.470" x 0.570"	U203

* Refer to the SHIELDS LOCATION DETAIL and Shields Parts List in the rear of this manual to match the shield with the proper heat focus head

Recommended Test Tools

MAINTENANCE

INTRODUCTION

This section of the manual describes preventive maintenance, safe handling of CMOS devices, and repair procedures and techniques. Each of these topics provides information vital to the successful operation and maintenance of your radio.

PREVENTIVE MAINTENANCE

The radios do not require a scheduled preventive maintenance program; however, periodic visual inspection and cleaning is recommended.

Inspection

Check that the external surfaces of the radio are clean, and that all external controls and switches are functional. A detailed inspection of the interior electronic circuitry is not needed or desired.

Cleaning

The following procedures describe the recommended cleaning agents and the methods to be used when cleaning the external and internal surfaces of the radio. External surfaces include the front cover, housing and assembly. These surfaces should be cleaned whenever a periodic visual inspection reveals the presence of smudges, grease, and/or grime. Internal surfaces should be cleaned only when the radio is disassembled for servicing or repair.

The only recommended agent for cleaning the external radio surfaces is a 0.5% solution of a mild dishwashing detergent in water. The only factory recommended liquid for cleaning the printed circuit boards and their components is isopropyl alcohol (70% by volume).

Caution:
The effects of certain chemicals and their vapors can have harmful results on certain plastics. Aerosol sprays, tuner cleaners, and other chemicals should be avoided.

a. Cleaning External Plastic Surfaces

(The detergent-water solution should be applied sparingly with a stiff, non-metallic, short-bristled brush to work all loose dirt away from the radio. A soft, absorbent, lint-free cloth or tissue should be used to remove the solution and dry the radio. Make sure that no water remains entrapped near the connectors, cracks, or crevices.

b. Cleaning Internal Circuit Boards and Components

Isopropyl alcohol may be applied with a stiff, non-metallic, short-bristled brush to dislodge embedded or caked materials located in hard-to-reach areas. The brush stroke should direct the dislodged material out and away from the inside of the radio.

Alcohol is a high-wetting liquid and can carry contamination into unwanted places if an excessive quantity is used. Make sure that controls or tuneable components are not soaked with the liquid. Do not use high-pressure air to hasten the drying process, since this could cause the liquid to puddle and collect in unwanted places.

Upon completion of the cleaning process, use a soft, absorbent, lint-free cloth to dry the area. Do not brush or apply any isopropyl alcohol to the frame, front cover, or back cover.

Note:
Always use a fresh supply of alcohol and a clean container to prevent contamination by dissolved material (from previous usage).

SAFE HANDLING OF CMOS DEVICES

Complementary metal-oxide semiconductor (CMOS) devices are used in this family of radios. While the attributes of CMOS are many, their characteristics make them susceptible to damage by electrostatic or high voltage charges. Damage can be latent, resulting in failures occurring weeks or months later. Therefore, special precautions must be taken to prevent device damage during disassembly, troubleshooting, and repair. Handling precautions are mandatory for CMOS circuits, and are especially important in low humidity conditions. DO NOT attempt to disassemble the radio without first referring to the CMOS CAUTION paragraph in the Disassembly and Reassembly section of the manual.

REPAIR PROCEDURES AND TECHNIQUES

Refer to the Disassembly and Reassembly section of the manual for pertinent information prior to replacing and substituting parts.

General

a. Parts Replacement and Substitution

Special care should be taken to be as certain as possible that a suspected component is actually the one at fault. This special care will eliminate unnecessary unsoldering and removal of parts, which could damage or weaken other components or the printed circuit board itself.

When damaged parts are replaced, identical parts should be used. If the identical replacement component is not locally available, check the parts list for the proper Motorola part number and order the component from the nearest Motorola Communications Parts office.

b. Rigid Circuit Boards

This family of radios uses bonded, multi-layer, printed circuit boards. Since the inner layers are not accessible, some special considerations are required when soldering and unsoldering components. The printed-through holes may interconnect multiple layers of the printed circuit. Therefore, care should be exercised to avoid pulling the plated circuit out of the hole.

When soldering near the module socket pins, use care to avoid accidentally getting solder in the socket. Also, be careful not to form solder bridges between the module socket pins. Closely examine your work for shorts due to solder bridges. When removing modules with metal enclosures, be sure to desolder the enclosure ground tabs as well as the module pins.

DISASSEMBLY AND REASSEMBLY

DISASSEMBLY TO TRANSCEIVER BOARD LEVEL

Remove the control head

1. Insert a small blade screw driver or like instrument in the side groove at the interface between the control head and the transceiver. (see Figure 1). Press until the control head side releases and then repeat the operation on the opposite side.

2. Pull the control head straight off of the transceiver.

Warning:
The control head must be removed before removing the top cover.

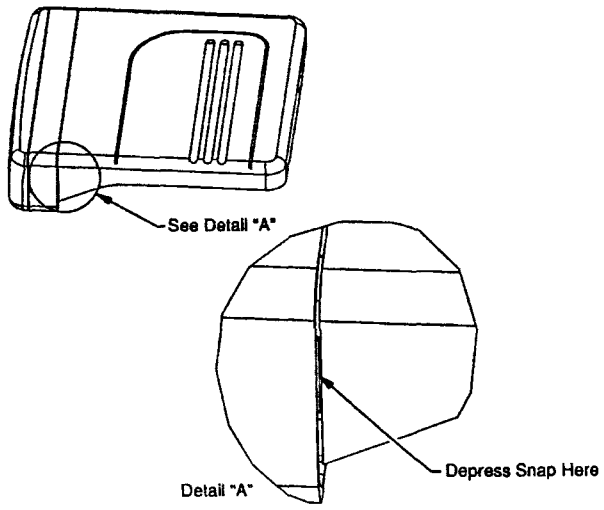


Figure 1

Remove the top cover (see Figure 2)

1. Insert a small flat blade screwdriver or like instrument in the recess area between the cover and the chassis on the back surface of the radio between the antenna and power connectors.

2. Pry the bottom of the chassis free from the cover by pushing the screwdriver down and rotating the handle of the screwdriver over and behind the back of the radio. This will disengage the snap between the cover and chassis.

3. Rotate the chassis out and away from the cover until it is completely free of the cover.

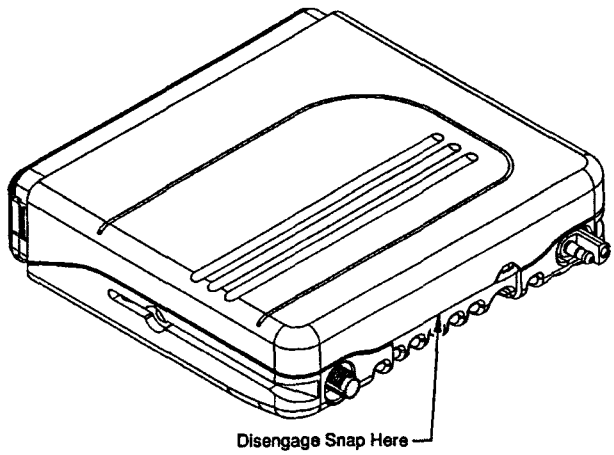


Figure 2

Remove the cavity shield (see Figure 3)

Note:
Eight tabs hold the cavity shield to the chassis. The cavity shield is the retaining device for the transceiver board and also provides the pressure to heat dissipating devices attached to the chassis.

1. Remove the cover gasket from the chassis.
2. Loosen the cavity shield by prying each of the eight tabs away from the chassis. Release the four tabs on one side first and then repeat the operation on the other. Be careful not to pry the tabs anymore than is necessary to free them from their respective retaining posts.
3. Pull straight up on the cavity shield.

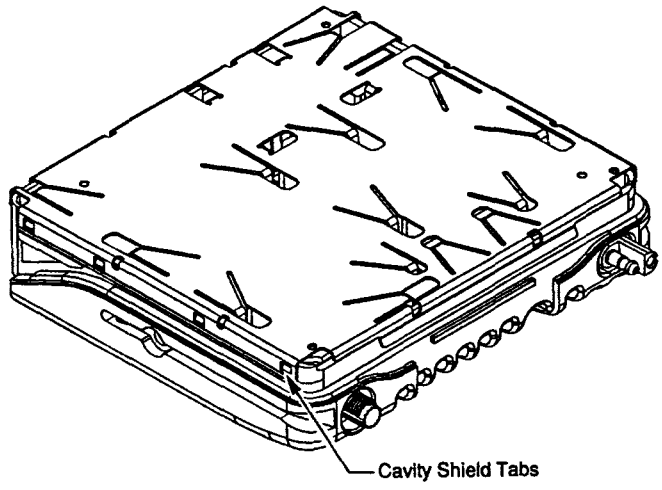


Figure 3

Remove the transceiver Borad (see Figure 4)

1. Remove the power and antenna connector retaining clips by inserting a small flat blade screwdriver between the clip and the top of the cavity wall and gently prying the clip upwards. Remove screws using a T-8 TORX driver.

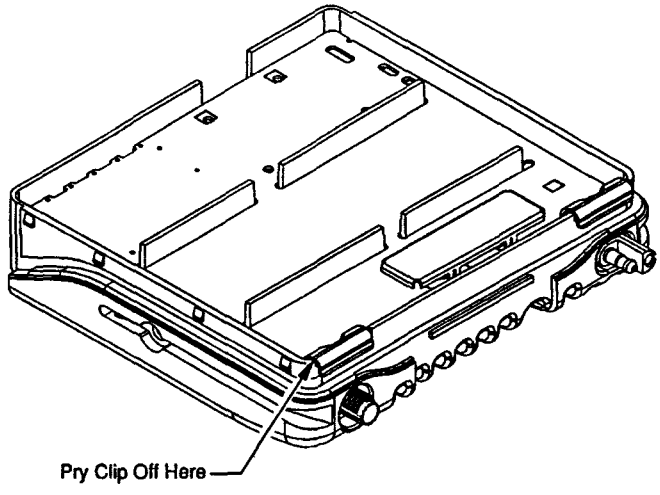


Figure 4

2. Carefully remove the transceiver board by rotating it out of the chassis. Slowly lift the board on the front edge — the side with the connect that mates with the control head — and gently pulling toward the front of the radio. Note that the thermal grease can act as an adhesive and cause the leads of the heat dissipating devices to be over stressed if the board is lifted too quickly.

DISASSEMBLY OF THE CONTROL HEAD

Model "B"

1. Remove the internal spacer by inserting a small flat blade screwdriver into the eight recesses around the perimeter of the spacer. After inserting the screwdriver, rotate it so that the spacer deflects in and the tab disengages from control head housing. Release the tabs one side at at time, starting with the long sides.

2. Pull the control head board straight out from the control head housing, removing the control head board and speaker together.

3. Remove the keypad from the board by pulling straight up on the keypad. Care is required in removing the keypad from around the volume potentiometer and the microphone connector to keep from over stressing the leads. Care should be taken not to touch or get other contaminants on the conductive pads on the under side of the keypad.

4. Disconnect the speaker from the control head board.

Models "I" & "J"

1. Remove the back housing by inserting a small flat blade screwdriver into the recesses on the exterior of the short sides, taking care not to mar the surface. After inserting the screwdriver, rotate it so that the tab deflects out and disengages from the control head housing. Repeat this operation on the opposite side and pull the back housing straight off.

   Note: PCB retainer 460210U01 may fall out when the back houding is removed. Note its location for reinstallation.

2. For Model "I" only, remove the rotary knob on the right side of the unit by pulling straight up.

3. Pull the control head board straight out from the control head housing. Carefully remove the board from the housing. Gently pull the board straight up so not to damage the volume potentiometer and the microphone connector leads.

4. The light pipe can be removed by prying back on its plastic snaps from the recesses in the control head housing.

5. With the light pipe removed, the keypad can be pulled from the housing. Care should be taken not to touch or get other contaminants on the conductive pads on the under side of the keypad.

REASSEMBLY

Reassembly is the reverse of the disassembly.

CONTROL HEAD ASSEMBLY

Model "B"

1. Place the keypad onto the board assembly, making sure the keypad is flush with the board.

2. Make sure that both the volume knob and potentiometer are both fully in the counter clockwise position before assembling the board into the housing.

3. During the installation of the internal spacer, be sure that all eight snaps are engaged.

Models "I" & "J"

1. Place keypad into control head housing.

2. Snap light pipe into housing.

3. Make sure that both the volume knob and potentiometer are both fully in the counter clockwise position before assembling the board into the housing.

4. Snap the board assembly into the housing.

5. For model "I" only, attach the large rotary knob.

6. Instal PCB retainer and snap on back housing.

TRANSCEIVER ASSEMBLY

1. Inspect and reapply as necessary thermal grease to the heatsinking pads in the chassis.

2. Install screws with 4-6 in lbs (0.4 - 0.7 N M) of torque using a T-8 TORX driver.

3. Before installing the connector retaining clips or cavity shield, be sure that the board is sitting flush on the chassis mounting surface.

RADIO TUNING PROCEDURE

The recommended hardware platform is a 386 or 486 PC (personal computer) with 8 MByte RAM and RSS (Radio Service Software) are required to align the radio. Refer to your RSS Manual for installation and setup procedures for the software.

To perform the alignment procedures, the radio must be connected to the PC, RIB (Radio Interface Box), and Universal Test Set as shown in figure 1.

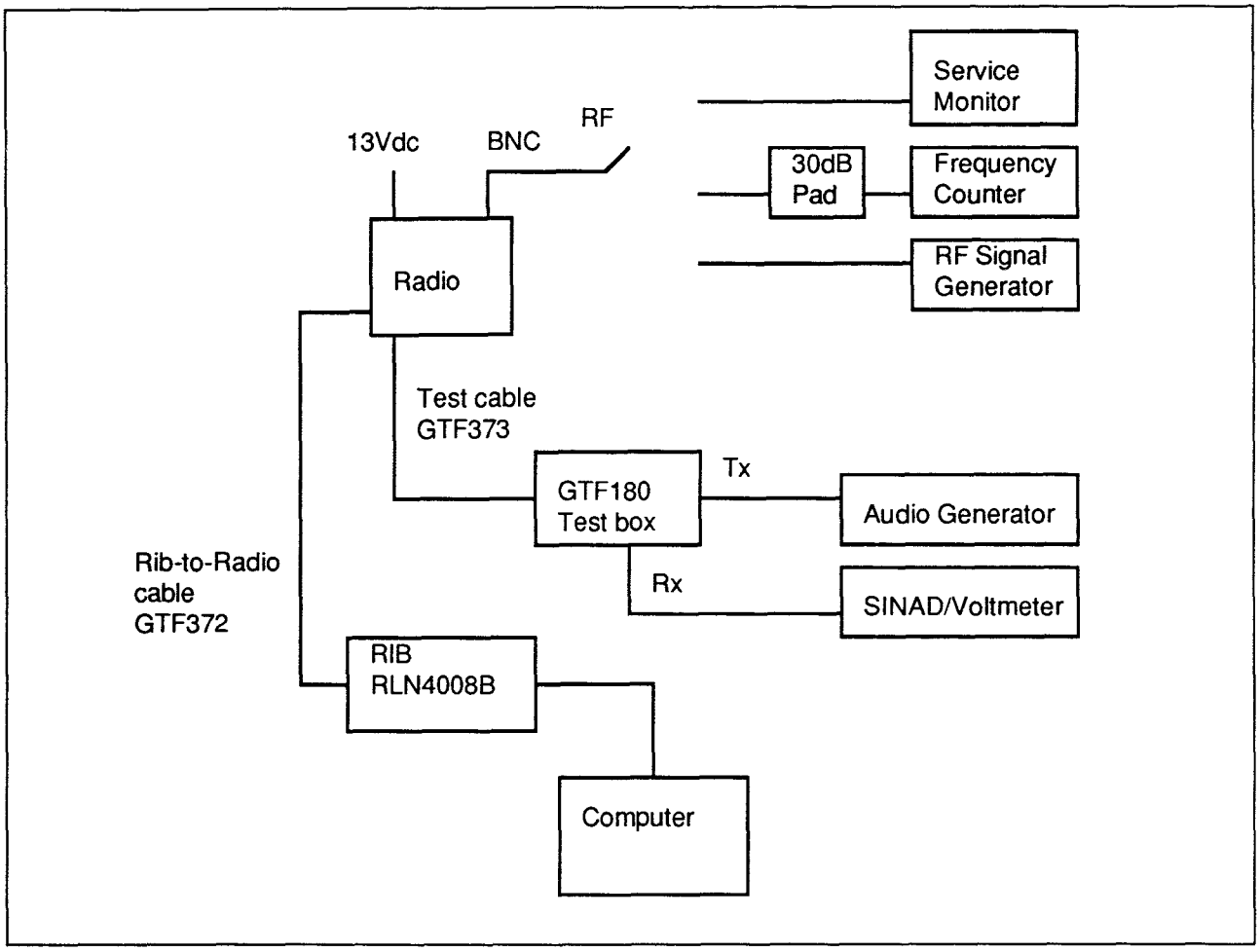


Figure 1. Radio Alignment Test Setup

All service and tuning procedures are performed from the SERVICE menu, which is selected by pressing F2 from the MAIN MENU. Figure 2 illustrates how the RSS SERVICE screens are organized.

Before going into the Service Aids menu, the radio must first be read using the GET/SAVE/PROGRAM Radio Data menu (if the radio has just been programmed with data loaded from disk or from a newly created codeplug, then it must still be read so that the RSS will have the radio's actual tuning values).

On 1200 and 2100 Series Two-way radios, to enter the tuning menu section: from the main menu, press F2 to select SERVICE AIDS. Then press F5 to select Tune Radio.

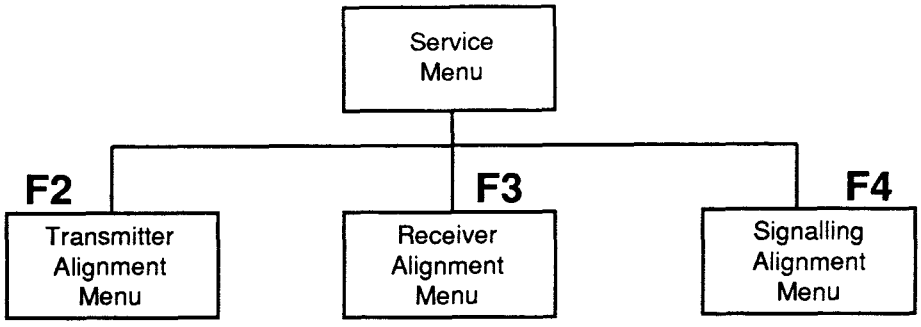


Figure 2. RSS Service Menu Structure

All SERVICE screens read and program the radio codeplug directly; you do NOT have to use the RSS GET/SAVE functions to program new tuning values.

Caution
Do NOT switch radios in the middle of any SERVICE procedure. Always use the EXIT key to return to the MAIN menu screen before disconnecting the radio. Improper exits from the SERVICE screens may leave the radio in an improperly configured state and result in seriously degraded radio or system performance.

The SERVICE screens introduce the concept of the "Softpot", an analog SOFTware controlled POTentiometer used for adjusting all transceiver alignment controls.

Each SERVICE screen provides the capability to increase of decrease the 'softpot' value with the keyboard UP/DOWN arrow keys respectively. A graphical scale is displayed indicating the minimum, maximum, and proposed value of the softpot, as shown in figure 3.

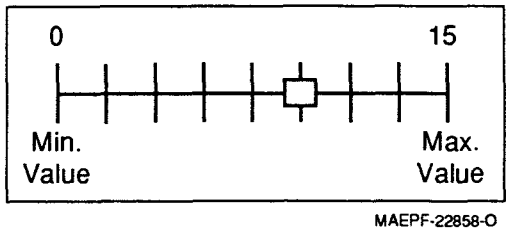


Figure 3. Softpot Concept

Adjusting the softpot value sends information to the radio to increase (or decrease) a DC voltage in the corresponding circuit. For example, pressing the UP arrow key at the Reference Oscillator screen instructs the radio microprocessor to increases the voltage across a varactor in the reference oscillator to increase the frequency.

In ALL cases, the softpot value is just a relative number corresponding to a D/A (Digital-to-Analog) generated voltage in the radio. All standard measurement procedures and test equipment are similar to previous radios.

PERFORM THE FOLLOWING PROCEDURES IN THE SEQUENCE INDICATED

REFERENCE OSCILLATOR ALIGNMENT

Adjustment of the reference oscillator is critical for proper radio operation. Improper adjustment will not only result in poor operation, but also a misaligned radio that will interfere with other users operating on adjacent channels. For this reason, the reference oscillator should be checked every time the radio is serviced. The frequency counter used for this procedure must have a stability of 0.1 ppm (or better).

1. From the SERVICE menu, press F2 to select TRANSMITTER alignment.
2. Press F2 again to select the REFERENCE OSCILLATOR softpot.
3. Press F6 to key the radio. The screen will indicate that the radio is transmitting.
4. Measure the transmit frequency on your frequency counter.
5. Use the UP/DOWN arrow keys to adjust the reference oscillator per the targets shown in table 1.

Band	Target
Midband	±150 Hz
VHF	±150 Hz
UHF	±150 Hz

Table 1. Reference Oscillator Alignment

6. Press F6 again to dekey the radio and then press F8 to program the softpot value.
7. Press F10 to return to SERVICE menu.

FRONT-END PRE-SELECTOR

Alignment of the front-end pre-selector is not required on these radios.

RATED AUDIO

1. Set test box (GTF180B) meter selection switch to the "AUDIO PA" position and the speaker load switch to the "MAXAR" position. Connect an AC voltmeter to the test box meter port.
2. Press F3 to select the RATED AUDIO softpot. The screen will indicate the receive test frequency to be used.
3. Set the RF test generator to the receive test frequency, and set the RF level to 1mVolt modulated with a 1 kHz tone at 3.0 kHz deviation.
4. Press F8, then adjust the UP/DOWN arrow key to obtain rated audio (as close to 3.74 Vrms) into a speaker (28 ohms) or equivalent resistive load.
5. Press F8 to program the softpot value
6. Press F10 to return to the RECEIVER menu.

SQUELCH

The squelch softpots set the signal to noise ratio at which the squelch opens. The 25/30 kHz squelch value needs to be set at 7 frequencies across the frequency range. For some models, the 20 kHz and 12.5 kHz values are then set at one frequency and the other frequency settings are calculated by the radio software. For other models (including MPT1327 Signalling model), the 20 kHz and 12.5 kHz squelch settings are also tuned for all 7 frequencies across the band.

1. Set the test box (GTF180B) meter selection switch to the "Audio PA" position and connect a SINAD meter to the "METER" port. Press the function key to select the SQUELCH 25 kHz softpot. The screen will indicate the receive test frequencies to be used.
2. Select the first test frequency shown, and adjust the UP/DOWN arrow key to the minimum squelch value.
3. Set the RF test generator to the test frequency and modulate the signal generator at 3.0 kHz deviation, 1 kHz tone. Adjust the generator for a 8-10 dB SINAD level.
4. Adjust the UP/DOWN arrow key until the squelch just closes.
5. Monitor for squelch chatter; if chatter is present, repeat step 4.
6. When no chatter is detected, press F8 to program this value. Press "ENTER" to select next softpot adjustment.
7. Repeat steps 3 - 6 for all test frequencies shown on the screen.
8. Press F10 to return to the Receiver Alignment menu.
9. Press the function key to select the SQUELCH 20 kHz softpot.
10. Adjust the UP/DOWN arrow key to the minimum squelch value.
11. Change the signal generator modulation to 2.4 kHz deviation, 1 kHz tone. Adjust the generator for an 8-10dB SINAD level.
12. Adjust the UP/DOWN arrow key until the squelch just closes.
13. Monitor for squelch chatter, if chatter is present repeat step 12.
14. When no chatter is detected, press F8 to program this value. If applicable, repeat steps 10 - 14 for the 6 remaining frequencies. Press F10 to return to the Receiver Alignment menu.
15. Press the function key to select the SQUELCH 12.5 kHz softpot.
16. Adjust the UP/DOWN arrow key to the minimum squelch value.
17. Change the signal generator modulation to 1.5 kHz deviation, 1 kHz tone. Adjust the generator for an 8-10 dB SINAD level.
18. Adjust the UP/DOWN arrow key until the squelch just closes.
19. Monitor for squelch chatter, if chatter is present repeat step 18.
20. When no chatter is detected, press F8 to program this value. If applicable, repeat steps 16 - 20 for the 6 remaining frequencies.Press F10 twice to return to the Service menu.

TRANSMITTER POWER

The radio requires two power level adjustments, a high power or rated power adjustment, and a low power adjustment.

Note: *After POWER tuning, measure and note the DC current to the radio on each channel in the high power level. These values are needed for the Current Limit tuning.*

1. From the SERVICE menu, press F2 to select TRANSMITTER alignment.
2. Press F3 to select the TRANSMIT POWER softpot. The screen will indicate the transmit test frequencies to be used.

3. Press F6 to key the radio, and use the UP/DOWN arrow keys to adjust the transmit power per the value shown in table 2.
4. Press F6 to dekey the radio, and then press F8 to program the value. Press ENTER to select next softpot frequency.
5. Repeat steps 4 - 5 for the remaining test frequencies.
6. Press F10 to return to the TRANSMIT menu.

Midband	Power Level	Test Frequencies 68 –88 MHz
	25 Watt	25 – 28 Watts
VHF	Power Level	Test Frequencies 136 –174 MHz
	25 Watt	25 – 28 Watts
	5 Watt	5 – 7 Watts
UHF	Power Level	Test Frequencies 403 – 470 MHz
	25 Watt	25 – 28 Watts
	5 Watt	5 – 7 Watts

Table 2: Transmit Power Setting

Note:
The larger the softpot values, the lower the transmit power.

TRANSMIT DEVIATION BALANCE (COMPENSATION)

Compensation alignment balances the modulation sensitivity of the VCO and reference modulation (synthesizer low frequency port) lines. Compensation algorithm is critical to the operation of signalling schemes that have very low frequency components (e.g. DPL) and could result in distorted waveforms if improperly adjusted.

1. Press F4 to select the TRANSMIT DEVIATION BALANCE softpot. The screen will indicate the transmit test frequencies to be used.
2. Begin with the lowest test frequency shown on the screen.
3. Set the Test Box (GTF180B) meter selector switch to the "GEN" position, and inject a 80 Hz tone at 140 mVrms into the "Audio In" port. Connect an AC meter to the meter port to insure the proper input signal level.
4. Press F6 to key the radio, then press F8 and measure deviation.
5. Press F6 again to dekey the radio, and change the input tone to 3 kHz, 140 mVrms.
6. Press F6 to key the radio, then press F8 and use the UP/DOWN arrow keys to adjust the deviation to within ±2% of the value recorded in step 4.
7. Press F6 to dekey the radio, and press F8 to program the softpot value. Press ENTER to move to next softpot value.
8. Repeat steps 3 - 7 for the remaining test frequencies.
9. Press F10 to return to the TRANSMIT menu.

Note:
The step size change for step 6 is approximately 2.5% softpot value.

TRANSMIT DEVIATION LIMIT

The transmit deviation limit softpot sets the maximum deviation of the carrier.

1. Press F5 to select the TRANSMIT DEVIATION LIMIT softpot. The screen will indicate the transmit test frequencies to be used.
2. Begin with the lowest test frequency shown on the screen.
3. With the meter selector switch (GTF180B) set to GEN, inject a 1 kHz tone, 400 mVrms as measured on the METER port.
4. Press F6 to key the radio, and use the UP/DOWN arrow keys to adjust the deviation to between 4.3 kHz and 4.6 kHz.
5. Press F6 to dekey the radio, and press F8 to program the softpot value. Press ENTER to move to the next softpot value.
6. Repeat steps 3 - 5 for the remaining frequencies shown on the screen.
7. Press F10 to return to the TRANSMIT menu.

TRANSMIT DEVIATION LIMIT 12.5/20 kHz

Note:
This procedure is required for Midband, VHF and UHF models with 20 kHz or 12.5 kHz channel spacing.

These softpots set the deviation reduction ratio to transmit at 20 kHz or 12.5 kHz channel spacing.

1. Press F6 to select the TRANSMIT DEVIATION LIMIT 12.5/20 kHz softpot.
2. With the meter selector switch (GTF180B) set to GEN, inject a 1 kHz tone, 400 mVrms as measured on the AC/DC MTR port.
3. Press F6 to key the radio, then press F8 and use the UP/DOWN arrow keys to adjust the deviation per table 3. below:

Channel Spacing	Deviation
20 kHz	3.40 - 3.60 kHz
12.5 kHz	2.20 - 2.30 kHz

Table 3: Transmit Deviation Limit Reference

4. Press F6 to dekey the radio, and press F8 to program the softpot value. Press Enter to move to next softpot value.
5. Repeat steps 2 - 4 for the remaining channel spacings.
6. Press F10 to return to the TRANSMIT menu.

Note:
For SELECT 5 radios it is currently ESSENTIAL that the programming of the 25/30 kHz channel spacing is the last action before exiting this menu. The limit is 4.3 - 4.6 kHz and although the softpot value will not normally need adjusting the value must be programmed using the F8 key.

TRANSMIT CURRENT LIMIT

900 Series

Note:
After POWER tuning, measure and note the DC current to the radio on each channel in the high power level. These values are needed for the Current Limit tuning.

1. Press F7 to select the Current Limit softpot. The screen will indicate the transmit test frequencies to be used.
2. Select the frequency with the highest DC current drain as measured during the power tuning procedure.
3. Press F6 to key the radio and use the UP/DOWN arrow keys to adjust the transmit Current Limit until the power has reached the maximum nominal power of the radio (25 Watts or 10 Watts). If the value cannot be exactly tuned set the output power one step above the nominal value.
4. On VHF radios increase the current limit by three steps.
   On UHF radios leave the value as tuned in step 3.
5. Press F6 to dekey the radio.
6. Press F8 to program the value. (The six other softpot values do not need tuning because only one Current Limit value is held in the radio).

TRANSMIT VOLTAGE LIMIT

900 Series

1. Set the supply voltage to 15.6 V.
2. Press F8 to select the Voltage Limit softpot. The screen will indicate the transmit test frequencies. Select the first frequency shown.
3. Press F6 to key the radio, and use the UP/DOWN arrow keys to adjust the transmit Voltage Limit until the RF power has reached the values shown in the table below:

Max. nominal RF Power of the radio	Output Power to be tuned by Voltage Limit tuning
10 W	12.5 W
25 W'	31.5 W

4. Press F6 to dekey the radio, and then press F8 to program the value
5. Repeat steps 3 - 5 for the remaining test frequencies.
6. Set the supply votage back to 13.6 V.
7. Press F10 to return to the TRANSMIT menu.

SIGNALLING ALIGNMENTS

MPT1327 TRANSMIT DEVIATION

1200 Series

The MPT1327 Deviation Softpot is used to tune the FFSK signalling deviation. Tuning is performed at one frequency and for 25 kHz channel spacing. The radio generates an alternating bit pattern for tuning. Values for other frequencies and channel spacings are calculated by the radio software.

Note:
Deviation Limit must be tuned before tuning MPT1327 Transmit Deviation.

1. From the Radio Tuning menu, press F4 to select SIGNALLING alignment.
2. Press F2 again to select the MPT softpot.
3. Press F6 to key the radio on the test frequency. The screen will indicate that the radio is transmitting.
4. Measure the MPT deviation on your service monitor.
5. Use the UP/DOWN arrow keys to adjust the FFSK signalling deviation to be within 2.80 - 3.20 kHz.
6. Press F6 again to dekey the radio.
7. Press F8 to program the softpot value; press F10 to return to the SIGNALLING menu.

MPT RSSI THRESHOLD LEVEL SETTING

1200 Series

1. From the SIGNALLING Menu press F3 to select RSSI Threshold Level Setting.
2. Apply a -80 dBm RF signal to the antenna connector and press the function key F3 to set the RSSI level.
3. Apply a -94 dBm RF signal to the antenna connector and press the function key F4 to set the RSSI level.

DTMF TRANSMIT DEVIATION

900 and 2100 Series

The DTMF Deviation Softpot is used to tune the FFSK signalling deviation. Tuning is performed at one frequency and for 25 kHz channel spacing. The radio generates a DTMF signal for tuning. Values for other frequencies and channel spacings are calculated by the radio software.

1. From the SERVICE menu, press F4 to select SIGNALLING alignment.
2. Press F2 again to select the DTMF softpot.
3. Press F6 to key the radio on the test frequency. The screen will indicate that the radio is transmitting.
4. Measure the DTMF deviation on your service monitor.
5. Use the UP/DOWN arrow keys to adjust the DTMF deviation to be within 3.05 and 3.45 kHz.
6. Press F6 again to dekey the radio.
7. Press F8 to program the softpot value; press F10 to return to the SIGNALLING menu.

SELECT 5 TRANSMIT DEVIATION

900 and 2100 Series

The Select 5 Deviation Softpot is used to tune the FFSK signalling deviation. Tuning is performed at one frequency and for 25 kHz channel spacing. The radio generates a Select 5 signal for tuning. Values for other frequencies and channel spacings are calculated by the radio software.

Note:
Alignment of the Transmit Deviation Limit Reference MUST immediately PRECEDE the Select 5 Alignment Procedure.

1. From the SERVICE menu, press F4 to select SIGNALLING alignment.
2. Press F3 again to select the Select 5 softpot.
3. Press F6 to key the radio on the test frequency. The screen will indicate that the radio is transmitting.
4. Measure the Select 5 deviation on your service monitor.
5. Use the UP/DOWN arrow keys to adjust the Select 5 deviation between 3.30 and 3.70 kHz.
6. Press F6 again to dekey the radio.
7. Press F8 to program the softpot value; press F10 to return to the SIGNALLING menu.

THEORY OF OPERATION
MIDBAND, VHF & UHF

OVERVIEW

The main radio is a single board design, consisting of the transmitter, receiver, and controller circuits.

The main board is designed to accept 2 additional option boards. These may provide functions such as secure voice/data or DTMF decoder. The Midband main board also contains provision for a noise blanker.

A control head is either mounted directly on the front of the radio or connected by an extension cable. The control head contains the On/Off/Volume knob, display, and buttons which provide the user with interface control over the various features of the radio.

In addition to the power cable and antenna cable, an accessory cable can be attached to a connector on the bottom of the radio. This accessory cable provides the necessary connections for items such as external speaker, emergency switch, foot operated PTT, and ignition sensing.

CONTROLLER SECTION

GENERAL

The radio controller consists of 4 main subsections. These are: digital control, audio processing, power control, and voltage regulation.

The digital control section of the radio board is designed to accept parts for either of two configurations, open architecture controller, or closed architecture controller. The audio processing, power control, and voltage regulation sections are the same for either configuration.

The digital section consists of a microprocessor, support memory, support logic, signal MUX ICs, the On/Off circuit, and General Purpose Input/Output circuitry.

The open architecture controller is based on the Motorola 68HC11F1 microprocessor (U0103). In addition to the microprocessor, the open architecture controller has 3 external memory devices, signal MUX IC (U0105), and a Support Logic IC (SLIC IV, U0104). The 3 memory devices consist of a 32 Kbyte EEPROM (U0100), 32 Kbyte SRAM (U0101), and a 256 Kbyte FLASH EEPROM (U0102).

The closed architecture controller uses the Motorola 68HC11K4 (U0003), instead of the 68HC11F1. In this configuration, all of the memory (RAM, ROM, EEPROM) necessary for radio operation is contained within the microprocessor itself. There are no external memory devices in the closed architecture. In addition, the SLIC IV (U0104) is not used, and signal MUX IC U0002 is used instead of MUX U0105.

Note: From this point on the 68HC11F1 microprocessor will be referred to as F1µP, and the 68HC11K4 microprocessor will be referred to as the K4µP. Where the text refers to either microprocessor, the reference will be µP.

VOLTAGE REGULATORS

Voltage regulation for the controller is provided by 4 separate devices; U0500 (LM2925) +5V, U0501 (LM2941) +9.3 V, U0502 +8V, and UNSW 5V (a combination of R0004 and VR0001). Additional regulators are located in the RF section and the control head/handset.

Voltage regulation providing 5V for the digital circuitry is done by U500. Input and output capacitors (C0500/0501 and C0503/0504) are used to reduce high frequency noise and provide proper operation during battery transients. This regulator provides a reset output (pin 5) that goes to 0 volts if the regulator output goes out of regulation. This is used to reset the controller to prevent improper operation. C0502 sets the duration of this reset signal to a minimum of about 10 msecs.

Regulator U0501 is used to generate the 9.3 volts required by some audio circuits, the RF circuitry and power control circuitry. Input and output capacitors (C0505/0506 and C0508/0509) are used to reduce high frequency noise. R0503/R0504 sets the output voltage of the regulator. If the voltage at pin 1 is greater than 1.3 volts the regulator output decreases and if the voltage is less than 1.3 volts the regulator output increases. This regulator output is electronically disabled by a 0 volt signal on pin 2. Q0500 and associated circuitry (R0500/0501/0502 and C0507) are used to disable the regulator when the radio is turned off.

Regulated 8V is provided by U0502. It provides a separate supply to the microphone circuitry. The microphone cannot be supported directly from A+/SWB+ because any fluctuation on A+ would be impressed on the mic line and affect transmitted audio. The mic circuitry can not be connected to the other regulators because, there is a function which allows the radio to be switched on by momentarily grounding the mic line (see Electronic On/Off).

UNSW 5V is only used in a few areas which draw low current and requires 5 V while the radio is off.

ELECTRONIC ON/OFF

Unlike older radios whose on/off feature was controlled only by the mechanical on/off switch, this radio has circuitry which allow radio software and/or external triggers to turn the radio on or off without direct user action. Some examples of this usage are 1) automatic turn on when emergency switch is engaged; 2) automatic turn on when ignition is sensed and off when ignition is off; 3) radio deaffiliation, with certain features the radio can be programmed to stay on for a brief period after the user has "turned it off". During this "extra on" period the radio may transmit a signal to a base station letting the station know that the radio has been turned off.

Q0511 is used to provide SW B+ to the various radio circuits. Q0511 acts as an electronic on/off switch where pin 4 acts as the control pin. The switch is on when pin 4 is low and off when pin 4 is high. When the radio is off Q0510 is cutoff and the voltage at Q0511-4 is at A+. This effectively prevents current flow through Q0511 from pins 2/3 to 5/6/7/8. When the radio is turned on the voltage at the base of Q0510 is high (at least above 3V) and Q0510 switches on (saturation) and pulls down the voltage at Q0511-4 to ~0.07V. With FET Q0511 now "enabled" current flows through the device. This path has a very low impedance (less than 1 ohm) from pins 2/3 to 5/6/7/8. This effectively provides the same voltage level at SWB+ as at A+.

The electronic on/off circuitry can be enabled by the microprocessor, the emergency switch, the mechanical On/Off switch on the control head, or the ignition sense circuitry. If any of the 4 paths leading to the base of Q0510 provides a high voltage through diodes CR0510 or CR0511, the electronic "ON" is engaged.

EMERGENCY

The emergency switch, when not engaged, normally grounds the base of Q0414. When the emergency switch is pressed this connection is opened and the base of Q0414 is pulled high by R0437. This causes the collector of transistor Q0414 to go low (.2V), thereby setting the EMERGENCY IN input of U0510 low. U0510 is a dual 555 timer configured as two "pulse stretchers", one for the Emergency input to electronically turn on the radio and the other for the mechanical On/Off switch on the control head to cause the radio to electronically switch on.

With regard to emergency, when U0510-8 EMERGENCY IN is above 1/3 of the supply voltage at U0510-14, that causes the device to internally ground U0510-13, which in turn holds capacitor C0513 in a discharged state. The device also keeps U0510-9 EMER TRIG at a low voltage. When EMERGENCY IN goes below 1/3 of the device supply voltage, U0510 disables the discharge mechanism at pin 13 allowing the capacitor C0513 to charge through R0513. The charging rate is set by the values of R0513 and C0513. When the voltage at pin 12 goes above 2/3 supply voltage, the device sets pin 9 EMER TRIG high which in turn switches on Q0510 enabling the radio to turn on to begin emergency operation. U0510 will keep pin 12 high for a period set by R0513 and C0513 which for 200K/1 uF equals 220 ms.

While SW B+ is on for 220 ms, the microprocessor starts execution, reads that the emergency input is active, and sets the B+ CNTL output to a logic high. This high will keep Q0510 switched on through CR0510 beyond the 220 ms period after which U0510-9 will return to a low level. This operation allows a momentary press of the emergency switch to power up the radio. When the microprocessor has finished processing the emergency press, it sets the B+ CNTL output to a logic 0. This turns off Q0511 and the radio turns off. Notice that EMER TRIG also goes to U0104-D5 and U0003-F2. This is where the appropriate microprocessor is alerted to the emergency condition. If the radio was already on when emergency was triggered then B+ CTRL would already be high and EMER TRIG going high due to the emergency condition would have no effect on Q0510, i.e. switching on Q0511 when it is already on.

Mechanical On/Off

This refers to the typical on/off switch, located on the control head, and which turns the radio on and off.

U0502 is fed by A+, and is therefore always on and providing 8 V on MIC VOLTAGE. When the Mechanical on/off switch is pressed, the MIC VOLTAGE line is momentarily grounded setting the ON/OFF input of U0510-6 low.

Similar to the emergency operation described previously, when U0510-6 ON/OFF is above 1/3 of the supply voltage at U0510-14, it will cause the device to internally ground U0510-1, which in turn holds capacitor C0511 in a discharged state. The device also keeps U0510-5 SW B+ SENSE at a low voltage. When ON/OFF goes below 1/3 of the device supply voltage, U0510 disables the discharge mechanism at pin 1 allowing the capacitor C0511 to charge through R0512. The charging rate is set by the values of R0512 and C0511. When the voltage at pin 2 goes above 2/3 supply voltage, the device sets pin 5 SW B+ SENSE high which in turn switches on Q0510 enabling the radio to turn on to begin operation. U0510 will keep pin 5 high for a period set by R0512 and C0511 which for 200K/1 uF equals 220 ms.

While SW B+ SENSE is on for 220 ms, the microprocessor starts execution, reads that the SW B+ SENSE is active, and sets the B+ CNTL output to a

logic high to keep Q0510 switched on through CR0510 beyond the 220 ms period. After this U0510-5 will return to a low level. This operation allows a momentary press of the Mechanical on/off switch to power up the radio. Notice that SW B+ SENSE also goes to U0104-B4 or U0003-H2. This is where the appropriate microprocessor is alerted to the turn on/off condition.

If the radio is already on when the switch was pressed then B+ CTRL is already high and SW B+ SENSE going high due to the switch being pressed will have no effect on Q0510. However, since SW B+ SENSE also goes to U0104-B4 or U0003-H2, the software can detect the line changing from low to high state momentarily, indicating that the radio must now turn off. In this case the software asserts B+ CTRL low which switches off Q0510 and Q0511, turning off the radio.

Resistor R0518 and capacitor C0518 form a filter to roll off any audio on the line. This prevents audio signal swing on the MIC IN line from triggering the on/off function at U0510-6.

IGNITION

Ignition sense is used to prevent the radio from draining the vehicle's battery because the engine is not running. The radio can be programmed to keep the unit entirely off, preventing RX and TX; or programmed to only prevent TX, while the vehicle's engine is off.

When the IGNITION input goes above 6 volts Q0430 turns on. This turns Q0517 off and turns Q0519 on, turning on SW B+ by directly forcing Q0511-4 low. The logic 0 output of Q0430 also turns on Q0431 providing an input to the microprocessor. The microprocessor starts execution, reads that the Ignition input is active and sets the B+ CNTL output to a logic 1 to latch on SW B+. If the software determines that the radio should not be operating, it will set the CLEAR output to a logic 1 and the B+ CNTL output to a logic 0. This sets a latch composed of Q0514 - Q0517, R0519 and R0521. The latch output (at the collector of Q0517) will go to a logic 0 (at Q0517) and turn off Q0519, which allows R0514 to pull Q0511-4 high, switching the FET off. The latch output will remain at a logic 0 state until the IGNITION input has gone below 6 volts. The next time the IGNITION input goes above 6 volts the above process will be repeated. The microprocessor uses the ignition sense input along with codeplug data to determine if the radio is allowed to transmit.

MICROPROCESSOR CLOCK SYNTHESIZER

The clock source for the microprocessor system is generated by the ASFIC (U0200). Upon power-up the synthesizer (U5801) generates a 2.1 MHz waveform that is routed from the RF section (via C0403) to the ASFIC (on U0200-E1) and the option connectors (J401-3 and J408-3). At the option connectors the 2.1 MHz may be used as a reference for any option boards that are attached. For the main board controller the ASFIC uses 2.1 MHz as a reference input clock signal for its internal synthesizer. The ASFIC, in addition to audio circuitry, has a programmable synthesizer which can generate a synthesized signal ranging from 1200 Hz to 32.769 MHz in 1200 Hz steps.

When power is first applied, the ASFIC will generate its default 3.6864 MHz CMOS square wave µP CLK (on U0200-D1) and this is routed to the microprocessor (U0103-A6/U0003-E3) and SLIC (U0104-A3). After the microprocessor starts operation, it reprograms the ASFIC clock synthesizer to a higher µP CLK frequency (usually 7.3728 or 14.7456 MHz) and continues operation.

The ASFIC may be reprogrammed to change the clock synthesizer frequencies at various times depending on the software features that are executing. In addition, the clock frequency of the synthesizer is changed in small amounts if there is a possibility of harmonics of this clock source interfering with the desired radio receive frequency.

The ASFIC synthesizer loop uses C0208, C0209 and R0204 to set the switching time and jitter of the clock output. If the synthesizer cannot generate the required clock frequency it will switch back to its default 3.6864 MHz output.

Because the ASFIC synthesizer and the µP system will not operate without the 2.1 MHz reference clock it (and the voltage regulators) should be checked first in debugging the system.

SERIAL PERIPHERAL INTERFACE (SPI)

In both open and closed architecture configurations the µP communicates to many of the IC's through its SPI port. This port consists of SPI TRANSMIT DATA (U0103-J6/U0003-B2), MISO (U0103-H6/U0003-B1), CLK (U0103-G5/U0003-A2) and chip select lines going to the various IC's, connected on the SPI PORT (BUS). This BUS is a synchronous bus, in that the timing clock signal CLK is sent while SPI data (SPI TRANSMIT DATA or MISO) is sent. Therefore, whenever there is activity on either SPI TRANSMIT DATA or MISO there should be a uniform signal on CLK. The SPI TRANSMIT DATA is used to send serial from a µP to a device, and MISO is used to send data from a device to a µP.

On the controller there are 2 ICs on the SPI BUS, ASFIC (U0200-F2) and D/A (U0551-6). In the RF sections there are 3 ICs on the SPI BUS, ZIF (U3201-21), Pendullum (Reference Oscillator U5800-24) and Synthesizer (U5801-4). The SPI TRANSMIT DATA and CLK lines going to the RF section are filtered by L0400 and L0401 to minimize noise.

There are 2 chip select lines going to each of the 2 Option boards (J401-21 and J401-23 and J408-21 and J408-23).

The SPI BUS is also used for the control head which goes with the closed architecture radio, with SPI TRANSMIT DATA, CLK, and select on lines J405-6, J405-5, and J405-12, respectively.

When the µP needs to program any of these IC's it brings the chip select line for that IC to a logic 0 and then sends the proper data and clock signals. The amount of data sent to the various IC's are different, for example the ASFIC can receive up to 21 bytes (168 bits) while the ZIF can receive up to 5 bytes (40 bits). After the data has been sent the chip select line is returned to a logic 1.

The Option board interfaces are different in that the µP can also read data back from devices connected. Two additional interrupt lines are provided to each of the 2 option boards ASN INT (J401-22 and J408-22) and JABBA INT(J401-20 J408-20) are provided to allow an option to signal the µP that there is data to transfer.

The timing and operation of this interface is specific to the option connected, but generally follows the pattern 1) an option board device generates the interrupt, 2) main board asserts a chip for that option board device, 3) the main board µP generates the CLK, and 4) when data transfer is complete the main board terminates the chip select and CLK activity.

SB9600 SERIAL INTERFACE

The SB9600 serial interface allows the radio to communicate with external radio options (like a control head, not the version on the closed architecture radio) and Radio Service Software (RSS). This interface connects to both the Control Head connector (J405) and the Accessory connector (J403) and comprises BUS+ (J405-15/J403-6), BUS- (J405-4/J403-18), BUSY (J405-14/J403-5) and RESET (J405-3/J403-17). All of these lines are bi-directional, meaning that either the radio or an option can drive the line.

When the radio needs to send a message (for example to update the Control Head display) it first checks BUSY IN (U0103-J2/U0003-A4) to make sure the interface is not currently being used. If this input is a logic 1 the interface is available and the µP will change BUSY OUT (U0104-G4/U0003-E8) to a logic 0. This drives the BUSY line to a logic 1 through buffer transistor Q0406 informing the radio and all connected devices that a data transmission is starting.

The radio's µP then starts sending serial data on SCI TX (U0103-G6/U0003-C2). This data is buffered by Q0402 and drives the differential bus signals (BUS+/BUS-) through Q0401 and Q0400. The BUS+ line normally sits at +5 volts because of pull-up resistor R0407. The BUS- line normally sits at 0 Volts because of pull-down resistor R0412.

While the radio is sending serial data on SCI TX it receives an "echo" of the same data on the SCI RX (U0103-J7/U0003-C3) line. The BUS-, BUS+ lines go to U401 which acts as a comparator. When the BUS+ voltage is greater than the BUS- voltage the output (at U401-7) is a logic 1. If it is less, the output is a logic 0. This is routed through U0105 to F1µP (U0103) on open architecture controllers. Note that the SCI SELECT input to U0105-11 is at a logic 1 to allow the routing to the open controller on BUS SCI (U0105- 13).

For the closed controller version BUS SCI is routed from U0401-7 to the K4µP SCI RX (U0023-C3) through R0021 and R0020.

A total of 5 bytes of data are sent for each standard message. After the data is sent the BUSY line is released to its default state (a logic 0). Other devices are now free to use the interface to send data.

The same method of operation occurs when an option sends data to the radio on this interface. The data is received through U401 and U0105 (or R0020/R0021) to the SCI RX input of the µP.

The sender receives back an "echo" of each byte and compares this to what was sent. If the echo does not agree then the transmission is repeated at a later time.

If excessive transmission errors occur, the µP will reset the interface by setting the RESET OUT (U0104-B7/U0003-J6) line to a logic 0. This drives the RESET line to a logic 1 through buffer transistor Q0408 resetting all SCI devices connected.

An option can reset the radio by driving the LH RESET line to a logic 1. For the open controller, this gets buffered by Q0409 and Q0425 and goes to the reset input of SLIC (U0104-A8). This then causes the reset input of the F1µP (U0103-E5) RESET* to go to a logic 0 resulting in the F1µP restarting operation.

For the closed controller LH RESET gets buffered by Q0409 and goes to the input of transmission gate U0005-1. The transmission gate is normally conductive (U0005 pin 4 is a logic 1) so the output of Q0409 causes the reset input of the K4µP (U0003-D2) to go to a logic 0 resulting in the K4µP restarting operation. The radio will disable the transmission gate (by asserting U0005-4 to logic 0) whenever it needs to drive RESET. When the radio releases the RESET line, it then enables the transmission gate.

GENERAL PURPOSE INPUT/OUTPUT

Five general purpose I/O lines (GP I/O 2 through GP I/O 6) are provided to interface to external options. Each of these lines is configured under software control to be either an input or an "open collector" output. To make an I/O line an input the corresponding output

line is set to a logic 0; for example to make GP I/O 6 (J403-7) an input pin, OUT 6 (U0104-K8/U0003-C9) is set to a logic 0. This turns off Q0423 and allows an external device to either turn on or off Q0424 which is sensed by U0104-H2/U0003-36 IN6/RTSB.

The GP I/O 2 line is different to the other 4 GP I/O lines. The output transistor (Q0425) can drive an external relay (HLN4435 or similar) for use with the vehicle horn or lights. This can also drive a non relay device, but the device must be designed to take a SW B+ input.

Selected GP I/O lines have secondary functions. If the line is used for the secondary function then it can not be used as an I/O line. The following secondary functions are supported (not all radio models support the RS-232 function, refer to the description for your radio).

I/O line	Secondary Function
GP I/O 2	External Alarm Output
GP I/O 3	Bootstrap Vpp Input
GP I/O 4	RS-232 TX Data or Bootstrap Data In
GP I/O 5	RS-232 CTS
GP I/O 6	RS-232 RTS

The 470 pF and 10 nF capacitors serve to filter out any AC noise which may ride on the GPIO lines.

NORMAL MICROPROCESSOR OPERATION (OPEN CONTROLLER)

Microprocessor

For this radio, the F1μP is configured to operate in 1 of 2 modes, expanded and bootstrap. In expanded mode the F1μP uses external memory devices to operate, whereas in bootstrap operation the F1μP uses only its internal memory. In normal operation of the radio the F1μP is operating in expanded mode as described below. See bootstrap microprocessor operation for bootstrap information.

In expanded mode on this radio, the F1μP (U0103) has access to 3 external memory devices; U0100 (EEPROM), U0101 (SRAM) U0102 (FLASH EEPROM). In addition the F1μP has access to U0104 (SLIC). Also, within the F1μP there are 1 Kbytes of internal RAM and 512 bytes of internal EEPROM, as well as logic to select external memory devices.

The external EEPROM (U0100) as well as the F1μP's own internal EEPROM space contain the information in the radio which is customer specific, referred to as the codeplug. This information consists of items such as: 1)what band the radio operates in, 2)what frequencies are assigned to what channel, and 3) tuning information. In general, tuning information and other more frequently accessed items are stored in the internal EEPROM (space within the 68HC11F1), while the remaining data is stored in the external EEPROM. (See the particular device subsection for more details.)

The external SRAM (U0101) as well as the F1μP's own internal RAM space are used for temporary calculations required by the software during execution. All of the data stored in both of these locations is lost when the radio powers off (See the particular device subsection for more details).

The FLASH EEPROM contains the actual Radio Operating Software. This software is common to all open architecture radios within a given model type. For example Securenet radios may have a different version of software in the FLASH ROM than a non-secure radio (See the particular device subsection for more details).

The F1μP provides an address bus of 16 address lines (A0-A15), and a data bus of 8 data lines (D0-D7). There are also 5 control lines; CSPROG (U0103-E6), CSGEN (U0103-F8), CSI01 (U0103-G8), E CLK (U0103-A5), and RWBIN (U0103-B6). CSPROG and CSI01 are used to chip select the SLIC, CSGEN is used to chip select the SRAM. E CLK and RWBIN are used to generate the proper timed control signals to the memory devices. E CLK is generated by the 68HC11F1 based on μP CLK and is always 1/4 the frequency of μP CLK, e.g. if μP CLK is 7.3728 MHz, then E CLK will be 1.8432 MHz.

When the F1μP is functioning normally, the address and data lines should be toggling at CMOS logic levels. Specifically, the logic high levels should be between 4.8 and 5.0 V, and the logic low levels should be between 0 and 0.2 V. No other intermediate levels should be observed, and the rise and fall times should be <30 ns.

The low-order address lines (A0-A4) and the data lines (D0-D7) should be toggling at a high rate, e. g. , you should set your oscilloscope sweep to 1 us/div. or faster to observe individual pulses. High speed CMOS transitions should also be observed on the F1μP control lines.

On the F1μP the lines XIRQ (U0103-E8), BOOTSTRAP (U0103-H6) and RESET (U0103-E5) should be high at all times during normal operation. Whenever a data or address line becomes open or shorted to an adjacent line, a common symptom is that the RESET line goes low periodically, with the period being in the order of 20 msecs. In the case of shorted lines you may also detect the line periodically at an intermediate level, i.e. around 2.5 V when 2 shorted lines attempt to drive to opposite rails.

The MODA (U0103-C5) and MODB (U0103-B5) inputs to the F1μP must be at a logic 1 for it to start executing correctly. After the F1μP starts execution it will periodically pulse these lines. While the Central Processing Unit (CPU) is running, this signal is an open-drain CMOS output which goes low whenever the F1μP begins a new instruction (an instruction typically requires 2-4 external bus cycles, or memory fetches). However, since it is an open-drain output, the waveform rise assumes an exponential shape similar to an RC circuit.

There are 8 analog to digital converter ports (A/D) on U0103. They are labeled within the device block as PE0-PE7. These lines sense the voltage level ranging from 0 to 5 V of the input line and convert that level to a number ranging from 0 to 255 which can be read by the software to take appropriate action.

For example U0103-B2 is the battery voltage detect line. R0417 and R0416 form a resistor divider on SWB+. With 68K and 22K and a voltage range of 11 V to 17 V, that A/D port would see 2.68 V to 4.15 V which would then be converted to ~136 to 211 respectively.

U0103-A4 is the high reference voltage for the A/D ports on the F1μP. Resistor R0112 and capacitor C0104 filter the +5 V reference. If this voltage is lower than +5 V the A/D readings will be incorrect. Likewise U0103-B4 is the low reference for the A/D ports. This line is normally tied to ground. If this line is not connected to ground, the A/D readings will be incorrect.

Capacitor C0105 serves to filter out any AC noise which may ride on +5V at U0103.

Support Logic IC (SLIC IV)

The SLIC provides 3 primary functions, I/O port expansion, memory address expansion, and some signalling decoding.

There are 32 I/O lines within the SLIC which are under F1μP control. They are grouped in 4 blocks of 8 and labeled as SLIC ports H, J, K, and L. Ports J, K, and L each have a DDR memory register and a "value" register. Port H only has a "value" register. These ports are accessed by the F1μP by placing the correct address for the I/O registers on the address bus and either reading or writing the data on the data bus. Changing bits in the DDR registers configures specific port bits to be either input sensors or output drivers. The "value" registers either report the state of the sensed input or provide the logic level to be driven on a line configured as an output.

Since the 68HC11F1 only has 16 address lines (A0-A15), it can only directly address 64 Kbytes(=2^16) of external memory. The radio architecture is designed to accommodate over 2 Mbytes of memory. The SLIC contains logic which allows addressing of the memory which would otherwise be unavailable to the F1μP on its own. The SLIC monitors address lines A0, A1, A2, A3, A4, A14, and A15. Depending on what combinations appear on those lines, the SLIC may or may not assist the F1μP with addressing. When the F1μP is addressing a device on its own then address lines A0-A15 are used and valid. If instead the SLIC is assisting with the addressing then address lines A0-A13 from the F1μP are valid, but the upper order address lines A14 OUT, A15 OUT, A16, A17, A18, and if necessary A19 are provided from the SLIC. There is no conflict with A14 and A14 OUT or with A15 and A15 OUT. Notice for example that SRAM U0101 uses A14 meaning that line is always provided from the F1μP directly. Notice also that EEPROM U0100 and FLASH ROM U0102 use A14 OUT, meaning that their address lines come from the SLIC. On the SLIC itself, line A14 going to A14IN and A15 going to A15IN are address input lines TO the SLIC. Whereas A14 OUT and A15 OUT are address output lines FROM the SLIC.

The SLIC also generates chip select signals UV CS for U0102 and EE CS for U0101, as well as memory timing signals MEMRWB and OE.

The circuitry in the SLIC is reset when either the RESET IN (U0104-A6) is a logic 1, or RESET* (U0104-E4) is a logic 0, or PWR RST is a logic 0. These lines must be in the opposite logic state for the SLIC to function normally.

The SLIC supports hardware signalling decoding for certain signalling standards such as MPT 1327 and Trunking (OSW). There are different versions of SLIC each having a different decoder. Currently there are no SLIC devices which have more than 1 decoder.

The incoming data received by the radio and filtered by the ASFIC exits the ASFIC at U0200-G4 RX DATA, and enters the SLIC at U0104-B6. Based on the data the SLIC updates internal status registers which the F1μP can read using the address and data bus, and act upon it.

Notice that RX data also goes to U0103-G3 U0003-C5. This implies that the radio can be configured to perform software decoding if desired, even if the radio has a SLIC with a hardware decoder in it.

Capacitor C0108 serves to filter out any AC noise which may ride on +5V at U0104.

FLASH Electronically Erasable Programmable Memory (FLASH EEPROM)

The FLASH EEPROM (U0102) contains the radio's operating software. This software is common to all open architecture radios within a given model type. For example Securenet radios may have a different version of software in the FLASH ROM than a non-secure radio. This is, as opposed to the codeplug information stored in EEPROM (U0100) which could be different from one user to another in the same company.

In normal operating mode, this memory is only read, not written to. The memory access signals (UV CS, OE and MEMRWB) are generated by the SLIC. Depending on the controller kit this part may be a 256 Kbyte part, 512 Kbyte part, or a 1 Mbyte part. Some radio kits may even have 2 FLASH devices placed on the same board, depending on the memory requirements. In the 256 K version there is no need for address A18 or higher. With the 256 K part, jumper R0107 is placed connecting MEMRWB to U0102-7,

and R0108 is not placed. For certain 512 K parts which come in a matching foot print to the Intel 256 K part, pin 7 becomes A18. In that case, jumper R0107 is not placed and R0108 is placed.

To upgrade/reprogram the FLASH software, the F1μP must be set in bootstrap operating mode, and the FLASH device pin (U0102-9) Vpp must be between 11.4 and 12.6 V.

Taking diode CR0105 into account, the voltage at J403-21 to enable FLASH programming may range between 12.1 and 13.1 V. Resistor divider pair R0104 and R0105 set up 4.1 V on U0102-9 which reduces the chance of logic transitions on I/O3 used as a GPIO from affecting the FLASH Vpp port. The FLASH device may be reprogrammed 1,000 times without issue. It is not recommended to reprogram the FLASH device at a temperature below 0°C.

(See bootstrap operation for further details on reprogramming FLASH EEPROM)

Capacitor C0102 serves to filter out any AC noise which may ride on +5V at U0102, and C0107 filters out any AC noise on Vpp.

Electrically Erasable Programmable Memory (EEPROM)

The EEPROM (U0100) contains the radio's operating parameters such as operating frequency and signalling features, commonly know as the codeplug. It is also used to store radio operating state parameters such as current mode and volume. U0100 is a 32 Kbyte device. This memory can be written to in excess of 100,000 times and will retain the data when power is removed from the radio. The memory access signals (EE CS, OE and MEMRWB) are generated by the SLIC.

Additional EEPROM is contained in the F1μP (U0103). This EEPROM is used to store radio tuning and alignment data. Like the external EEPROM this memory can be programmed multiple times and will retain the data when power is removed from the radio.

Note: the external EEPROM plus the 512 bytes of internal EEPROM in the 68HC11F1 comprise the complete codeplug.

Static Random Access Memory (SRAM)

The SRAM (U0101) contains temporary radio calculations or parameters that can change very frequently, and which are generated and stored by the software during its normal operation. The information is lost when the radio is turned off. The device allows an unlimited number of write cycles. SRAM accesses are indicated by the CSGEN signal U101-20 (which comes from U103-PG6) going low. U0101 is commonly referred to as the external RAM as opposed to the internal RAM which is the 1 K (1024) bytes of RAM which is part of the 68HC11F1. Both RAM spaces serve the purpose. However, the internal RAM is used for the calculated values which are accessed most often.

Resistors R0100, R0101, and R0102 allow the board to be configured to accept either an 8 K or 32 K byte EEPROM. For a 32 K device, R0100 is placed, and R0102 and R0101 are NOT placed. For an 8 K device R0100 is NOT placed, and R0102 and R0101 are placed.

Capacitor C0100 serves to filter out any ac noise which may ride on +5 V at U0101

NORMAL MICROPROCESSOR OPERATION (CLOSED CONTROLLER)

The K4 μP (U0003) contains internal 24 Kbytes ROM, 768 bytes SRAM and 640 bytes EEPROM.

The K4 μP RAM is always powered to maintain parameters such as the last operating mode. This is archived by maintaining 5 V at U0003-D3. Under normal conditions, when the radio is off UNSW 5V is formed by A+ CONT running to VR0001. C0027 allows the battery voltage to be disconnected for a couple of minutes without losing RAM parameters. Diode CR0001 prevents radio circuitry from discharging this capacitor.

Multiplexer IC U0002 routes control head signals PTT/BUS- (J404-4), MON/BUSY (J404-3) and AUX/BUS+ (J404-15) to the proper place depending on the device connected to the control head microphone connector. The setting of the 3 switches X, Y, and Z, are controlled by U0002-9/10/11 which are tied together and to signal C OPT SW B+ SENSE/O BUSY. This signal goes to J405-14. When this line is logic 1 the 3 switches are connected to X1, Y1, Z1. When logic 0, then they are set to X0, Y0, Z0.

With a microphone, or a similar device connected, the signals are routed to PTT, MON and AUX. If a "smart" accessory is connected, the signals are routed to BUS-, BUSY and BUS+ and allow SB9600 communications between the accessory and the radio.

The AUX input is used to sense additional buttons (besides PTT and Monitor) on the microphone. With none of the additional buttons pressed (or a microphone without additional buttons present) the AUX input is biased to +5 volts by R0006. When a button is pressed, the resistance in series with it forms a voltage divider with R0006 to provide an analog voltage to the K4μP A/D input (U0003-G6). Capacitor C0010 reduces noise input and provides button debounce.

This same method is used to sense control head buttons inputs on C CTRL HD1/O DVP WE (J405-10) and C CTRL HD2/O KEY/FAIL (J405-11). R0046 and R0047 are the pull-up resistors.

U0003-H4 is the high reference voltage for the A/D ports on the K4µP. Resistor R0001 and capacitor C0001 filter the +5 V reference . If this voltage is lower than +5 V the A/D readings will be incorrect. Likewise U0003-H5 is the low reference for the A/D ports. This line is normally tied to ground. If this line is not connected to ground, the A/D readings will be incorrect. (See Open Controller A/D section for more details.)

The MODB (U0003-80) input of the K4µP must be at a logic 1 for it to start executing correctly. The XIRQ (U0003-E6) and the IRQ pins should also be at a logic 1.

An additional SPI connection is provided to write data to the control head display. The SPI TRANSMIT DATA and CLK are shared and an additional select line, CH EN/O KID (J405-13) is provided.

The closed architecture hardware supports electronic on/off ignition sense and emergency in the same way as the open controller.

Optional external EEPROM (U0001) is available on some radio models. The external EEPROM is accessed through a serial connection. The K4µP generates a CP CLK (U0003-K3) and CP DATA (U0003-G5) message to read or write EEPROM. On a read of EEPROM the K4µP continues generating the clock and the EEPROM places the requested data on the CP DATA line. On a write the message is followed by the data to be written to the EEPROM.

CONTROLLER BOARD AUDIO AND SIGNALLING CIRCUITS

AUDIO SIGNALLING FILTER IC (ASFIC)

The ASFIC has 4 functions;

1) RX/TX audio shaping, i.e. filtering, amplification, attenuation
2) RX/TX signalling, PL/DPL/HST/MDC/MPT
3) Squelch detection
4) Microprocessor clock signal generation (see Microprocessor Clock Synthesizer Description Block).

The ASFIC is programmable through the SPI BUS (U0200-E3/F1/F2), normally receiving 21 bytes. This programming sets up various paths within the ASFIC to route audio and/or signalling signals through the appropriate filtering, gain and attenuator blocks. The ASFIC also has 6 General Control Bits GCB0-5 which are CMOS level outputs. In this radio all, except GCB2 used for AUX TX IN2 (see Aux TX), are used to control the Hear Clear IC. (See Hear Clear Description Block for details).

AUDIO GROUND

VAG is the dc bias used as an audio ground for the op-amps that are external to the Audio Signalling Filter IC (ASFIC). U0201 forms this bias by dividing 9.3 V with R0206 and R0207 and buffering the 4.65 V result with a voltage follower. VAG emerges at pin 1 of U0201. C0235 is a bypass capacitor for VAG. The ASFIC generates its own 2.5 V bias for its internal circuitry. C0210 is the bypass for the ASFIC's audio ground dc bias. Note that while there are ASFIC VAG, BOARD VAG (U0201), and Hear Clear VAG, each of these are separate. They do not connect together.

TRANSMIT AUDIO CIRCUITS

(Refer to Figure 1 for reference for the following sections)

The radio supports 2 distinct microphone paths known as internal and external mic. The microphones used for the radio require a DC biasing voltage provided by R0222 and R0223 for internal, and R0231 and R0230 for external. These two microphone audio input paths enter the ASFIC at U0200-A7 (external mic) and U0200-B8 (internal mic). Following the internal mic path; the microphone is plugged into the radio control head and is connected to the controller board via J405-9.

From here the signal is routed to R0224. R0222 and R0223 provide the 9.3 VDC bias and R0224 provides input protection for the CMOS amplifier input. R0223 and C0219 provide a 560 ohm AC path to ground that sets the input impedance for the microphone and determines the gain based on the emitter resistor in the microphone's amplifier circuit.

Filter capacitor C0224 provides low-pass filtering to eliminate frequency components above 3 kHz, and C0218 serves as a DC blocking capacitor. C0427 bypasses RF interference which may couple onto the line to ground. The audio signal at U0200-B8 should be approximately 80 mV to achieve 60% of maximum system deviation..

The ASFIC has an internal AGC that can control the gain in the mic audio path. The AGC can be disabled/enabled by the µP. Another feature that can be enabled or disabled in the ASFIC is the VOX. This circuit, along with C0205, provides a DC voltage that can allow the µP to detect microphone audio. The ASFIC can also be programmed to route the microphone audio to the speaker for public address operation.

External Mic Path

The external microphone signal enters the radio on accessory connector J403 pin 23. It is then routed to the ASFIC through resistor R0229 and capacitors C0223 and C0221, with DC bias provided by R0231/R0230.

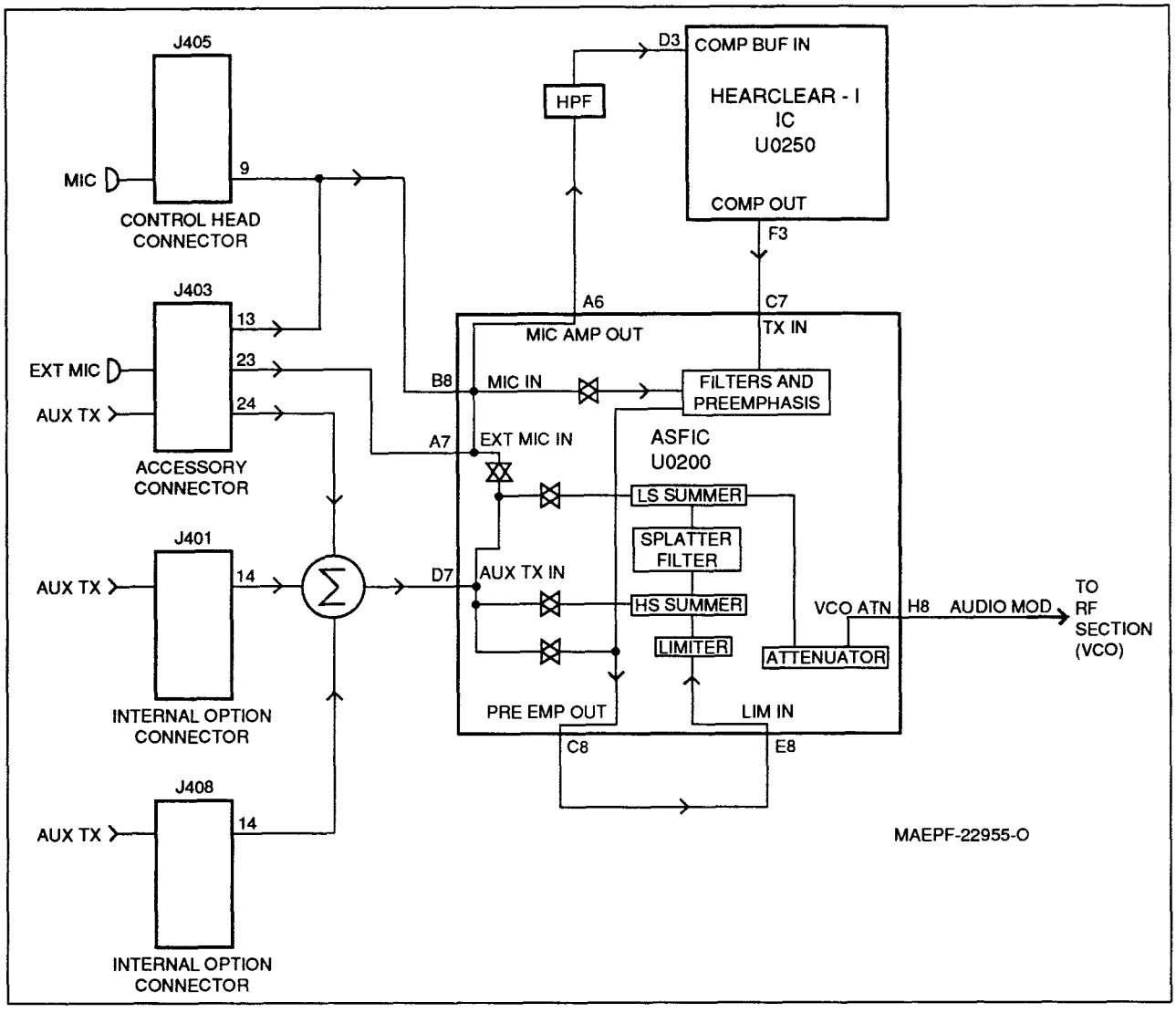


Figure 1. Transmit Audio Paths

PTT Sensing and TX Audio Processing

Mic PTT is sensed via SB9600 for open architecture radios and via the K4µP for closed architecture radios. An external PTT can be generated by programming one of the digital I/O lines on the accessory connector for PTT and grounding that pin. When microphone PTT is sensed, the µP will always configure the ASFIC for the "internal" mic audio path, and external PTT will result in the external mic audio path being selected.

Inside the ASFIC, the mic audio is filtered to eliminate components outside the 300-3000 Hz voice band, and pre-emphasized if pre-emphasis is enabled. The capacitor between ASFIC pre-emphasis out U0200-C8 and ASFIC limiter in U0200-E8 AC couples the signal between ASFIC blocks and prevents the DC bias at the ASFIC output U0200-H8 from shifting when the ASFIC transmit circuits are powered up. The signal is then limited to prevent the transmitter from over deviating. The limited mic audio is then routed through a summer, used to add in signalling data, and then to a splatter filter to eliminate high frequency spectral components that could be generated by the limiter. The audio is then routed to two attenuators, which are tuned in the factory or the field to set the proper amount of FM deviation. The TX audio emerges from the ASFIC at U0200-H8 AUDIO MOD, at which point it is routed to the RF section.

Auxiliary TX Audio Paths

There are three auxiliary transmit audio inputs that are routed to the auxiliary transmit path in the ASFIC. These are AUX TX IN1, AUX TX IN2, and AUX TX IN3. The 3 paths, only one of which can be active at a time, are buffered by U0202.

AUX TX IN2 is special in that it can "change" input impedance. The "voltage mode" signal to U0400 is 9.3 V if the source for the auxiliary transmit audio from J0403 is a current source. The "voltage mode" signal is 0 V if the auxiliary transmit source is a voltage source. The difference being R0219 is bypassed by the transmission gate or not. Typically current source mode will apply for SB9600 based devices.

C0217 sets the lower frequency (high pass) signal of

approximately 1 Hz. The processing of the signal on the auxiliary transmit path depends on how the ASFIC is configured. It can bypass filters, pre-emphasis, limiter, and/or splatter filter.

TX Secure Audio (AUX TX IN1 and AUX TX IN3)

The audio follows the normal transmit audio processing until it emerges from the ASFIC pre-emphasis out pin (U0200-C8), which is fed to the secure board residing at either option connector J401-7 / J403-7. The Secure board contains circuitry to amplify, digitize, encrypt, and filter the audio. The encrypted signal is then fed back from J401-14 / J408-14 to the AUX TX buffer through R0217 or R0218, and then to the ASFIC AUX TX input (U0200-D7). The signal level at this pin should be about 1 Vp-p. The signal is then routed through the AUX TX path in the ASFIC (which bypasses everything before including the ASFIC splatter filter) and summed into the main modulation path. After the summer, it runs through the modulation attenuator and then to the AUDIO MOD port U0200-H8.

TRANSMIT SIGNALLING CIRCUITS

(Refer to Figure 2 for reference for the following sections)

From a hardware point of view, there are 3 types of signalling:

1 sub-audible data (PL/DPL/Connect Tone) that gets summed with transmit voice or signalling,

2 DTMF data for telephone communication in trunked and conventional systems, and

3 Audible signalling including Select 5, MPT-1327, MDC, High speed Trunking

Sub-audible Data (PL/DPL)

Sub-audible data implies signalling whose bandwidth is below 300 Hz. PL and DPL waveforms are used for conventional operation and connect tones for trunked voice channel operation. The trunking connect tone is simply a PL tone at a higher deviation level than PL in a conventional system. Although it is referred to as "sub-audible data," the actual frequency spectrum of these waveforms may be as high as 250 Hz, which is audible to the human ear. However, the radio receiver filters out any audio below 300 Hz, so these tones are never heard in the actual system.

Only one type of sub-audible data can be generated by U0200 at any one time. The process is as follows, using the SPI BUS, the µP programs the ASFIC (U0200) to set up the proper low-speed data deviation and select the PL or DPL filters. The µP then generates a square wave which strobes the ASFIC PL/DPL encode input PL CLK U0200-C3 at twelve times the desired data rate. For example, for a PL frequency of 103 Hz, the frequency of the square wave would be 1236 Hz.

This drives a tone generator inside U0200 which generates a staircase approximation to a PL sine wave or DPL data pattern. This internal waveform is then low-pass filtered and summed with voice or data. The resulting summed waveform then appears on U0200-H8 (AUDIO MOD), where it is sent to the RF board as previously described for transmit audio. A trunking connect tone would be generated in the same manner as a PL tone.

High Speed Data

High speed data refers to the 3600 baud data waveforms, known as Inbound Signalling Words (ISWs) used in a trunking system for high speed communication between the central controller and the radio. To generate an ISW, the uP first programs the ASFIC (U0200) to the proper filter and gain settings. It then begins strobing U0200-G1 (TX DATA) with a pulse

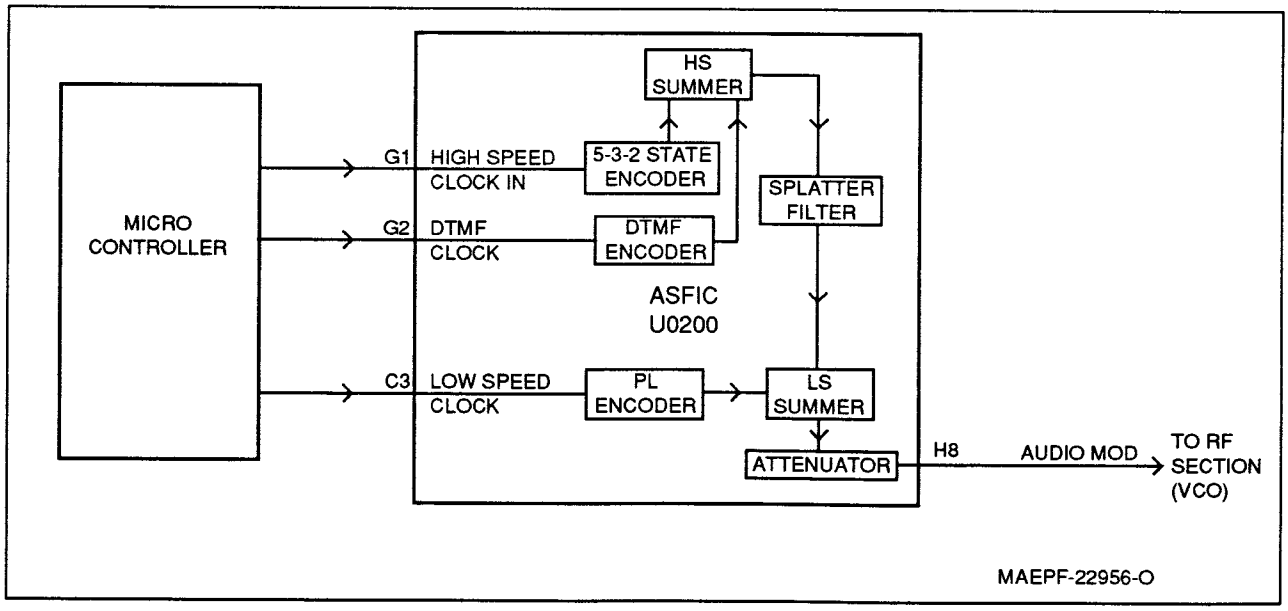


Figure 2. Transmit Signalling Paths

when the data is supposed to change states. U0200's 5-3-2 State Encoder (which is in a 2-state mode) is then fed to the post-limiter summer block and then the splatter filter. From that point it is routed through the modulation attenuators and then out of the ASFIC to the RF board. MPT 1327 and MDC are generated in much the same way as Trunking ISW. However, in some cases these signals may also pass through a data pre-emphasis block in the ASFIC. Also these signalling schemes are based on sending a combination of 1200 Hz and 1800 Hz tones only. Microphone audio is muted during High Speed Data signalling.

Dual Tone Multiple Frequency (DTMF) Data

DTMF data is a dual tone waveform used during phone interconnect operation. It is the same type of tones which are heard when using a "Touch Tone" telephone.

There are seven frequencies, with four in the low group (697, 770, 852, 941 Hz) and three in the high group (1209, 1336, 1477 Hz).

The high-group tone is generated by the µP (U0103-H4/U0003-B4) strobing U0200-G1 at six times the tone frequency for tones less than 1440 Hz or twice the frequency for tones greater than 1440 Hz. The low group tone is generated by the µP (U0103-J4/U0003-C4) strobing U0200-G2 (DTMF CLOCK) at six times the tone frequency. Inside U0200 the low-group and high-group tones are summed (with the amplitude of the high group tone being approximately 2 dB greater than that of the low group tone) and then pre-emphasized before being routed to the summer and splatter filter. The DTMF waveform then follows the same path as was described for high-speed data.

RECEIVE AUDIO CIRCUITS

(Refer to Figure 3 for reference for the following sections)

Squelch Detect

The radio's RF circuits are constantly producing an output at the discriminator. In addition to the raw discriminator signal DISC (IF1-3-2-1), the RF board's Zero IF IC also provides a separate buffered version of the discriminator signal that is dedicated to the ASFIC's squelch detect circuitry SQUELCH (IF1-2-17-1). This signal enters the controller board and is routed to the ASFIC on U0200-H7. All of the squelch detect circuitry is contained within the ASFIC. Therefore from a user's point of view, SQUELCH enters the ASFIC, and the ASFIC produces to CMOS logic outputs based on the result. They are CH ACT (U0200-H1) and SQ DET (U0200-H1).

The squelch signal entering the ASFIC is amplified, filtered, attenuated, and rectified. It is then sent to a comparator to produce an active high signal on CH ACT. A squelch tail circuit is used to produce SQ DET (U0200-H1) from CH ACT. The state of CH ACT and SQ DET is high (logic 1) when carrier is detected, otherwise low (logic 0) .

Both CH ACT and SQ DET are routed to the K4uP (U0003-J2/K2) for the closed controller. For the open controller version CH ACT and SQ DET are routed to the SLIC (U0104-F4/H1).

SQ DET is used to determine all audio mute/unmute decisions except for Conventional Scan. In this case CH ACT is a pre-indicator as it occurs slightly faster than SQ DET.

Audio Processing and Digital Volume Control

The signal enters the controller section from the ZIF on DISC (IF1-3-2-1) and passes through RC filter R0245 and C0236 which filters out ZIF sampling noise. The signal is AC coupled by C0202 and enters the ASFIC via the PL IN pin U0200-J7. Inside the IC, the signal goes through 2 paths in parallel.

The audio path has a programmable amplifier, whose setting is based on the channel bandwidth being received, then a LPF filter to remove any frequency components above 3000 Hz and then an HPF to strip off any sub-audible data below 300 Hz. Next, the recovered audio passes through a de-emphasis filter if it is enabled (to compensate for Pre-emphasis which is used to reduce the effects of FM noise). The IC then passes the audio through the 8-bit programmable attenuator whose level is set depending on the value of the volume control. Finally the filtered audio signal passes through an output buffer within the ASFIC. The audio signal exits the ASFIC at RX AUDIO (U0200-J4).

The µP programs the attenuator, using the SPI BUS, based on either the value of the volume control knob (closed architecture) or SB9600 messages from the control head (open architecture). The minimum /maximum settings of the attenuator are set by codeplug parameters.

Since sub-audible signalling is summed with voice information on transmit, it must be separated from the voice information before processing. Any sub-audible signalling enters the ASFIC from the ZIF at PL IN U0200-J7. Once inside it goes through the PL/DPL path. The signal first passes through one of 2 low pass filters, either PL low pass filter or DPL/LST low pass filter. Either signal is then filtered and goes through a limiter and exits the ASFIC as PL RX (U0200-A4). At this point the signal will appear as a square wave version of the sub-audible signal which the radio received. This signal then goes to the either the SLIC (U0104-E7) (open controller) or the 68HC11K4 (U0003-B5) (closed controller). The K4 will decode the signal directly to determine if it is the tone/code which is currently active on that mode. The

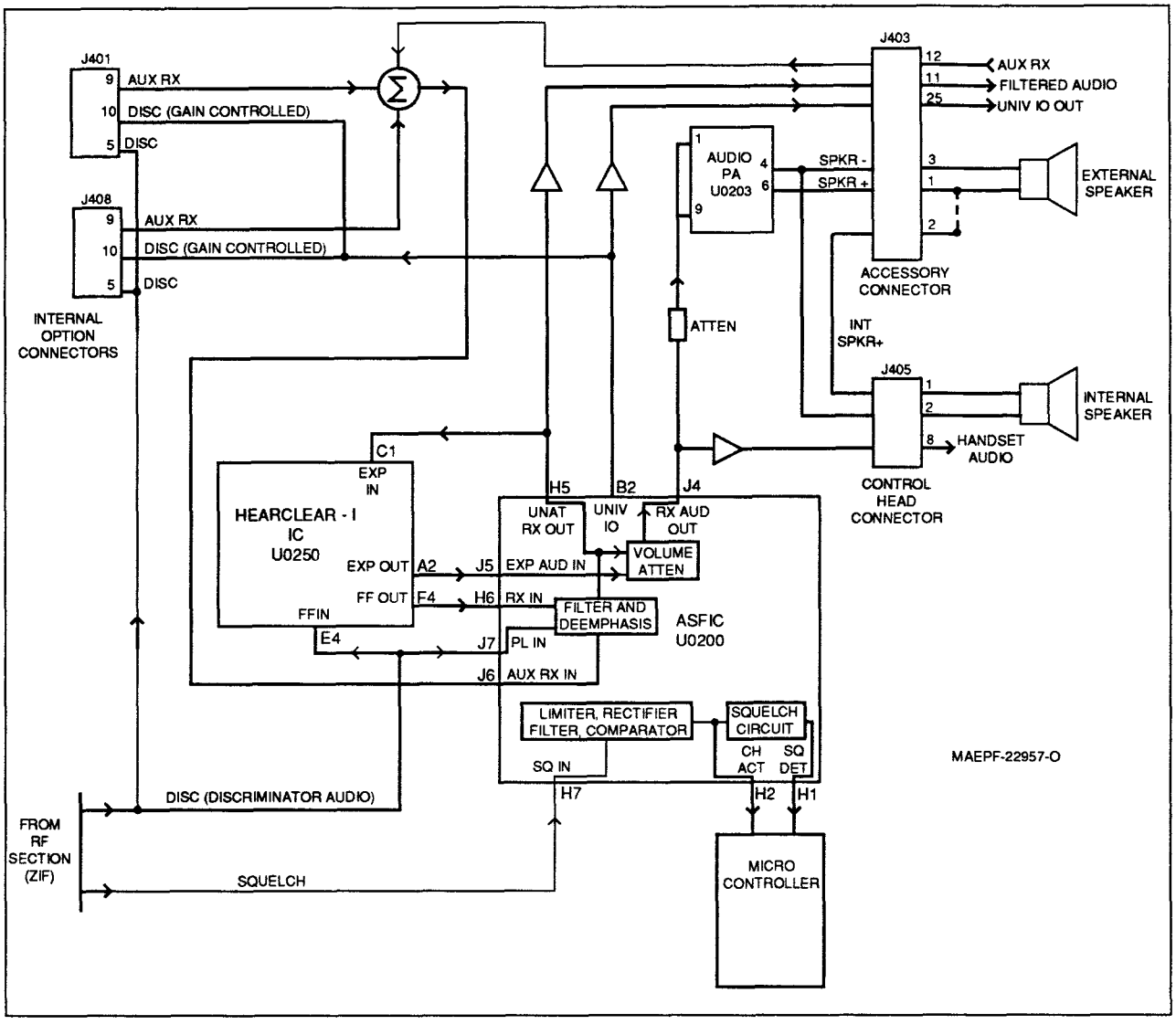


Figure 3. Receive Audio Paths

SLIC must be poled periodically by the 68HC11F1 to determine the state of bit 0 for port L (see SLIC description block for details). The F1 will then use that information to decode the signal.

Note these paths are somewhat different for radios using Hear Clear (See Hear Clear description block for details).

Audio Amplification Speaker (+) Speaker (-)

The output of the ASFIC's digital volume pot, U0204-J4 is routed through a voltage divider formed by R0234 and R0235 to set the correct input level to the audio PA (U0203). This is necessary because the gain of the audio PA is 46 dB, and the ASFIC output is capable of overdriving the PA unless the maximum volume is limited.

The audio then passes through C0240 which provides AC coupling and low frequency roll-off. C0242 provides high frequency roll-off as the audio signal is routed to pins 1 and 9 of the audio power amplifier U0203.

The audio power amplifier has one inverted and one non-inverted output that produces the differential audio output SPK+/SPK- (U0203-4/6). The inputs for each of these amplifiers are pins 1 and 9 respectively; these inputs are both tied to the received audio. The audio PA's DC biases are not activated until the audio PA is enabled at pin 8.

The audio PA is enabled via AUPA EN signal from the µP (U0003-A8) (closed architecture) or SLIC (open architecture) (U0104-F7). When the base of Q0200 is low, the transistor is off and U0203-8 is high, using pull up resistor R0236 — Audio PA is ON. The U0203-8 must be above 8.5 VDC to properly enable the device. If the voltage is between 3.3 and 6.4 V, the device will be active but has its input (U0203-1/9) off. This a mute condition which is not employed in this radio design. R0202 ensures that the base of Q0202 is high on power up. Otherwise there may be an audio pop due to R0236 pulling U0203-8 high before the software can switch on Q0200.

The SPK+ and SPK- outputs of the audio PA have a DC bias which varies proportionately with A+ CONT

(U0200-7). A+ CONT of 11 V yields a DC offset of 5 V, and A+ CONT of 17 V yields a DC offset of 8.5 V. If either of these lines is shorted to ground, it is possible that the audio PA will be damaged. SPK+ and SPK- are routed to the accessory connector (J403-1 and 3). Only the SPK- is routed to the control head. For the internal (control head) speaker to be enabled, a jumper must be placed on the accessory connector between pins 1 and 3; this connects SPK+ to the control head's INT SPK+.

Handset Audio

Certain hand held accessories have a speaker within them which require a different voltage level than that provided by U0203. For those devices RX HI is available at J405-8.

The received audio from the output of the ASFIC's digital volume attenuator is also routed to U0202 pin 6 where it is amplified 15 dB; this is set by the 10k/68k combination of R0238 and R0237. This signal is routed directly from the output of the op amp U202 pin 7 to J405-8. The control head sends this signal directly out to the microphone jack. The maximum value of this output is 6.6 Vp-p. If the handset is Off-Hook, the audio PA (U0203) is disabled. C0434 is for RF bypass and VR0418 is for static protection.

Filtered Audio

This signal sources receive audio or Public Address audio to a large Siren PA accessory.

The ASFIC has an audio whose output at U0200-H5 has been filtered and de-emphasized, but has not gone through the digital volume attenuator. This signal is buffered with an op amp with a gain of 0 dB, within the ASFIC. The maximum level for this signal is 1.06 Vp-p. From ASFIC U0200-H5 the signal is AC coupled to U0201-6 by capacitor C0214. R0209 and R0203 being equal value set up the op amp as a unity gain device, i.e. a buffer. The output at U0201-7 is then routed to J403-11 FIL AUD OUT. Note that any volume adjustment of the signal on this path must be done by the accessory.

Discriminator Audio (Unfiltered)

Note that discriminator audio DISC from the ZIF, in addition to being routed to the ASFIC, is also routed to the Hear Clear (U0250) and both option connectors J408-5 and J401-5 (See Hear Clear and Secure Rx description blocks for further information).

Auxiliary RX Audio Paths

There are three auxiliary receive audio inputs that are buffered by U202 and routed to the auxiliary receive path in the ASFIC U0200-J6. The processing for this input is identical to that of normal received audio or it can bypass the filtering and de-emphasis. The auxiliary inputs come from the two option connectors J408-9 and J401-9 and from the accessory connector J403-15. The "voltage mode" signal to U0400 is 9.3 V if the source for the auxiliary receive audio from J0403 is a current source. The "voltage mode" signal is 0 V if the auxiliary receive source is a voltage source. Typically current source mode will apply for SB9600 based devices. Note that the enable line for transmission gate U0400-12/10 is the same line VOLTAGE MODE as that which controls the Auxiliary TX path AUX TX IN2. The VOLTAGE MODE line is driven by Q0202 which is turned on and off by ASFIC GCB2. In order to change the state of VOLTAGE MODE the ASFIC (U0200) must be programmed by the SPI BUS to do so.

Secure Receive Audio

Discriminator audio, which is now coded audio, enters the ASFIC at U0200-J7. Inside the ASFIC a path is set up to route the coded audio to a programmable 7 bit attenuator, where the signal level is adjusted, and then out of the ASFIC at UNIV IO (U0200-B2). This path bypasses the ASFIC RX filtering and De-emphasis. From U0200-B2 the coded audio goes to Option connectors J401-10 / J408-10.

On the secure board, the coded signal is converted back to analog format, and then fed back through (J401-9 / J408-9) to the Aux Rx buffer U0202. The clear audio signal is then routed to the ASFIC pin U0200-J6; from then on it follows a path identical to conventional receive audio, where it is filtered (300-3 kHz) and de-emphasized.

RECEIVE SIGNALLING CIRCUITS

(Refer to Figure 4 for reference for the following sections)

The ASFIC (U0200) is used to filter and limit all received data. The data enters the ASFIC at U0200-J7. Inside U0200 the data is filtered according to data type (HS or LS), then it is limited to a 0-5 V digital level. The MDC and trunking high speed data appear at U0200-G4, where it connects to the µP

1) U0003-C5, closed controller-software decoder,
2) U0103-G3, open controller-software decoder,
3) U0104-B8, open controller-hardware decoder (see SLIC description block for further details)

The low speed limited data output (PL, DPL, and trunking LS) appears at U0200-A4, where it connects to the SLIC (open architecture) or the K4uP (closed architecture). While receiving low speed data, the µP may output a sampling waveform, depending on the sampling technique, to U0200-C3 of between 1 and 2 kHz.

The low speed data is read by the uP at twice the frequency of the sampling waveform; a latch configura-

tion in the ASFIC stores one bit every clock cycle. The external capacitors C0211, C0212, and C0203 set the low frequency pole for a zero crossings detector in the limiters for PL and HS data. The hysteresis of these limiters is programmed based on the type of received data. Note that during HS data the µP may generate a sampling waveform seen at U0200-G1.

Alert Tone Circuits

When the software determines that it needs to give the operator an audible feedback (for a good key press, or for a bad key press), or radio status (trunked system busy, phone call, circuit failures), it sends an alert tone to the speaker.

It does so by sending SPI BUS data to U0200 which sets up the audio path to the speaker for alert tones. The alert tone itself can be generated in one of two ways: internally by the ASFIC, or externally using the µP and the ASFIC.

The allowable internal alert tones are 304, 608, 911, and 1823 Hz. In this case a code contained within the SPI BUS load to the ASFIC sets up the path and determines the tone frequency, and at what volume level to generate the tone. (It does not have to be related to the setting of the volume knob).

For external alert tones, the µP can generate any tone within the 100-3000 Hz audio band. This is accomplished by the µP generating a square wave which enters the ASFIC at U0200-C3.

Inside the ASFIC, this signal is routed to the alert tone generator; the output of the generator is summed into the audio chain just after the RX audio de-emphasis block. Inside U0200 the tone is amplified and filtered, then passed through the 8-bit digital volume attenuator, which is typically loaded with a special value for alert tone audio. Note that the Hear Clear expander is bypassed even if U0250 is present. The tone exits at U0200-J4, then is routed to the audio PA like receive audio.

Hear Clear IC

The Hear Clear (HC) is typically used for 900 MHz radios. The HC has 3 main circuit blocks within the IC which are used by this radio; 1) Compressor, 2) Flutter Fighter, and 3) Expander circuits. There are 6 enable lines on the Hear Clear IC which determine its mode of operation. The IC ENAB line U0250-C4 is tied to SW B+, so whenever the IC is placed it is always active. The remaining 5 lines are controlled by the ASFIC General Control Bit lines, GCB0, GCB1, GCB3, GCB4, and GCB5. The table below summarizes their logic states.

Hear Clear Enable Lines Configuration

			LOGIC STATE			
Name	Ref. Des	Set By	TX1	RX1	TX2	RX2
IC Enable	U0250-C4	SW B+	1	1	X	1
Flut. Fight.Enable	U0250-E3	U0200-B5	X	1	X	0
LO Clamp Disable	U0250-A5	U0200-B3	1	1	X	1
HI Clamp Enable	U0250-C2	U0200-C4	0	0	X	0
HCI Disable	U0250-B6	U0200-A3	1	1	X	1
Compander Enable	U0250-D1	U0200-A2	1	1	X	0

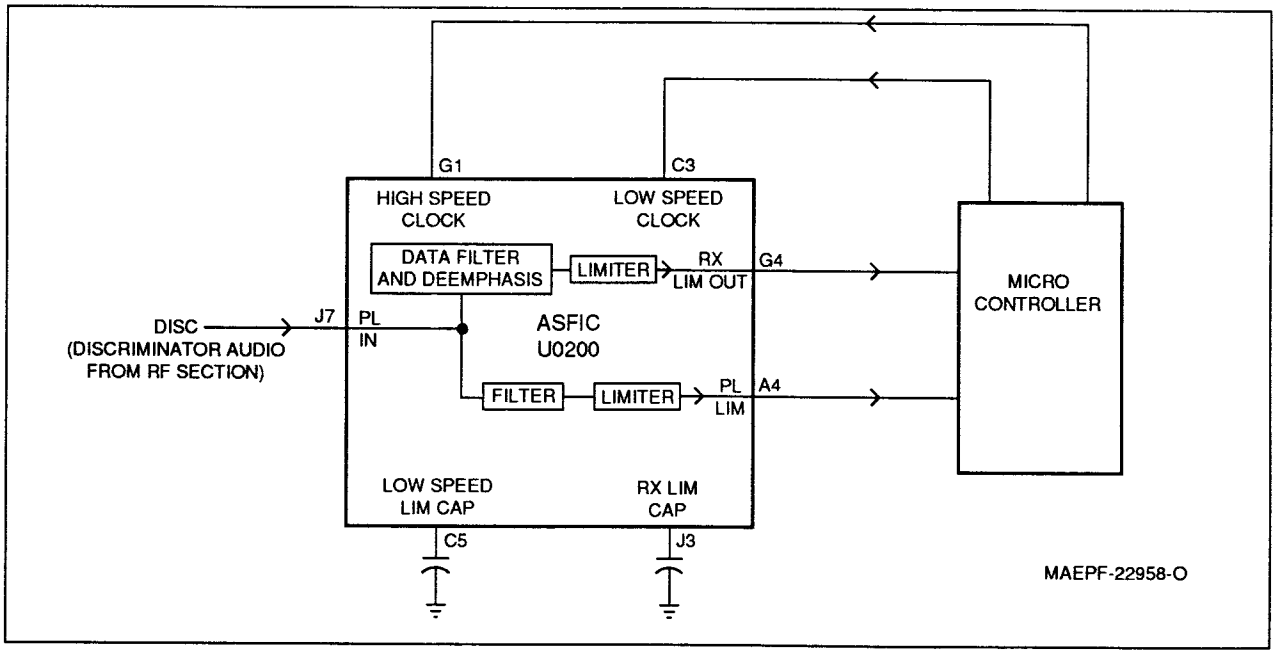


Figure 4. Receive Signalling Paths

TX1: transmit mode with carrier squelch, PL or DPL.

RX1: receive voice with carrier squelch, PL or DPL.

TX2: transmit mode with all other data HST/MDC/MPT/DTMF etc.

RX2: refers to receive mode with all other data HST/MDC/MPT/DTMF

Logic State "**X**" means either 1 or a 0, i.e. "don't care".

Transmit Path for Radios with Hear Clear

For transmit, the signal comes from the appropriate microphone and enters the ASFIC at U0200-A7 or U0200-B6 as would standard TX audio. After entering the ASFIC, the signal is internally routed to U0200-A6 ASFIC MIC AMP OUT, where it leaves the ASFIC and enters the Hear Clear compressor at U0250-D3. The signal then exits the compressor at U0250-F3, where it is routed back to the ASFIC (U0200-C7). C0261 provides AC coupling. Inside the ASFIC the signal goes through an LPF and HPF which band limit the signal between 300 - 3 kHz. The signal is then pre-emphasized and exits the ASFIC at U0250-C8, passes through a coupling cap and enters the ASFIC at U0200-E8. Again inside the ASFIC the signal goes through a limiter, splatter filter, and a pair of attenuators which set the amplitude (deviation level) of the signal.

The Compressor is used in transmit mode. The purpose of this circuit is twofold; 1) improve S/N ratio for low level audio, and 2) maintain the same dynamic range of a 12.5 kHz bandwidth channel as is obtained in a 25 kHz bandwidth channel.

The compressor raises low level signals and lowers high level signals. The compressor circuit produces a signal whose output voltage (U0250-F3) is based on the input voltage level (U0200-A6) of the signal. It is NOT a function of frequency (as is pre-emphasis). The voltage transfer function is:

COMPOUT == SQRT[80*ASFICMICAUDOUT]

Notice that 80 mV in yields 80 mV out. Some example levels are:

20 mV input == 40 mV output
80 mV input == 80 mV output
150 mV input == 110 mV output

Receive Path for Radios with Hear Clear

The audio signal enters the controller from the ZIF on DISC. The discriminated audio DISC enters the Hear Clear Flutter Fighter through C0200 and C0267. C0200 connects the signal to FF IN (U0250-E4). C0267 is the beginning of a noise sampling circuit consisting of components C0267, R0256, R0253, C0264, C0263, R0254, R0255, R0257, and C0265; and Hear Clear ports Clip Ref, Noise Filter In, and Noise Filter Out, Noise Hold.

After exiting the HC at FF OUT (U0250-F4), the signal enters the ASFIC at RX IN (U0200-H6). Within the ASFIC the signal passes through a low pass filter and a high pass filter limiting the audio band width to 300-3 kHz. It then goes through de-emphasis and exits the ASFIC at U0200-H5 FILTERED AUDIO.

Upon exiting the ASFIC at FILTERED AUDIO, the signal passes through capacitor C0250, which provides AC coupling. The signal then enters the Hear Clear at EXP IN (U0250-C1) and exits the Hear Clear Expander at EXP OUT (U0250-A2). The normalized signal is the routed back to the ASFIC through C0260 for volume adjustment, entering at U0200-J5 and exiting the ASFIC at U0200-J4 as RX AUDIO. The audio is then routed to the Audio PA in the same manner as standard receive audio.

The Flutter Fighter is for receive only. It samples the amount of Noise in the receive audio between 10 kHz and 20 kHz, using the Noise filter in (U0250-B5), Noise filter out (U0250-C6), and Noise hold (U0250-D5) ports. In addition, it monitors the rate of change of RSSI (Receive Signal Strength In) (U0250-F5). The discriminated audio DISC enters the HC at FF IN (U0250-E4) and the circuit then reduces the amount of popping Noise associated with fading. The improved audio exits the IC at FF OUT (U0250-F4).

The Expander is used after de-emphasis but before the ASFIC volume attenuator.
The purpose of the expander is to transpose compressed audio back to "normal" audio. As with the compressor circuit, the expander circuit adjusts the amplitude of a signal based upon its input amplitude, NOT its frequency.

The voltage transfer function is: EXPOUT= $0.41*(EXPIN/0.28)^2$.
The importance here is to notice that an input signal of 191 mV will exit as 191 mV. A smaller signal will be made even smaller and a signal larger than 191 mV will exit EXP OUT even larger.

Example: 100 mV EXP IN == 52 mV EXP OUT
191 mV EXP IN == 191 mV EXP OUT
250 mV EXP IN == 327 mV EXP OUT

Again this operation is NOT A FUNCTION OF FREQUENCY between 300 Hz and 3 kHz.

Hear Clear Routing of Data/Signalling

All signaling for transmit enters the transmit stream after the Hear Clear Compressor and therefore does not pass through the compressor.

In receive, subaudible signaling PL/DPL goes through the Flutter Fighter along with audio, and is unaffected by the Flutter Fighter operation. After the Flutter Fighter, upon entering the ASFIC, the sub-audible signaling is separated from the audio and decoded. Subaudible signaling never passes through the expander.

In receive, for all other signaling HST/MDC/MPT etc. (not sub-audible), the Flutter Fighter is set to "Pass Through Mode". In this mode the Flutter Fighter passes signals from FF IN to FF OUT without any adjustment.

RECEIVER

The receiver covers the Midband range from 66 to 88 MHz. It consists of the following sections.

Front-End band-pass filter

A 10 section elliptical bandpass filter preselects the incoming signal to reduce spurious effects to following stages. A bandstop is provided at approximately 109 MHz to isolate the first IF at 109.65 MHz and also to improve rejection from the FM broadcast band.

In TX mode the input signal is reduced by PIN diodes CR2642 and CR2643 which are part of the RX/TX switch. Another pin diode (CR2254) also limits any inband signal to 10 dBm to prevent damage to the pre-amplifier.

In RX modeSchottky diode CR2653 also limits high level received signals to prevent damage to the pre-amplifier.

Pre-amplifier

The RF preamp (Q2251) is an SMD device with emitter and collector base feedback to stabilize gain, impedance, and intermodulation. To provide optimum transistor current drain it is actively biased by a collector current sense circuit (Q2250 and associated components) which is also used to bias the RX series PIN diode CR2642 and CR2643 (in the PA section) in RX mode via the decoupled emitter path.

The collector current is set to approximately 17 mA at an emitter voltage of about 1.7 volts. The combined preamp and PIN diode bias circuit is controlled by the K 9V1 line from the controller.

Intermediate band-pass filter

A dual 10 section elliptical band-pass with a further bandstop at approximately 109 MHz to suppress the first IF frequency and FM broadcast band is added after the preamp. It provides signal transmission over the Midband range, wideband spur suppression and preamp to mixer matching.

Mixer

Q2252 is a double balanced active GaAs mixer. Its three ports are matched for incoming Midband signal conversion to the 109.65 MHz IF using high side injection. The mixer bias is set by R2280 to approximately 20 mA with Pinj = 5 dBm.

IF selection

The mixer IF output signal is fed through T2252 and its impedance is transformed to the Y2375 two pole crystal filter. A diplexer shunt circuit matches the mixer's output impedance for optimum half IF stability.

The filter output in turn is matched to the following IF amplifier.

The IF amplifier Q2380 is stabilized and biased similar to RF preamp. The collector current is set to approximately 10 mA.

The IF amplifier is succeeded by matching networks into and out of the second crystal filter Y2377.

ZIF isolation amplifier

To obtain proper operation of the ZIF IC (U2201) an isolation amplifier combined with an IF AGC and a hard harmonic notch low-pass filter follows. The collector path of Q2203 is loaded with a PIN diode (CR2203) in shunt configuration. Its control voltage is generated by a bias circuit with CR2204 in conjunction with the voltage out of U2201-4. This configuration provides an AGC dynamic range of maximum 30 dB and isolates the sensitiveZIF IC from an overdriving IF level. Additionally the signal is filtered to suppress non-linear effects within the ZIF IC.

ZIF IC (U2201)

Within the ZIF IC the 109.65 MHz IF signal is mixed in two quadrature paths down to baseband filters, then processed and FM demodulated. The conversion process to baseband is performed by using a second LO circuitry consisting of Q2201, inductor L2204 and several capacitors that, in combination with the varactor diode CR2201 and a loop filtered steering line from U2201-18, closes the PLL.

The demodulated audio comes out of the ZIF IC at pin 28 and is applied to the Audio Signalling Filter IC (ASFIC), which is located in the command and control section of the radio.

Code plug data is used to program the ZIF IC to the relevant handwidths for differing channel spacings.

POWER AMPLIFIER (PA)

Introduction

The radio's PA is a three stage amplifier used to amplify the output from the injection string to the radio transmit level. It consists of three stages in the lineup. The first (Q2521) is a bipolar stage that is controlled via the PA control line. It is followed by two MOS FET devices, Q2541 and Q2561.

Devices Q2521 and Q2541 are surface mounted. To channel heat from Q2541, the surface mounted heat spreader on the opposite side of the PCB provides thermal contact of the transistor to the heat sink. Transistor Q2561 is directly attached to the heat sink.

Operation

PA Stages

The MOSFET devices Q2541 and Q2561 are enhancement mode N-Channel MOSFETS. These devices require a positive gate bias and a quiescent current flow with no drive for proper operation. To achieve this result, the gates are biased through the network consisting of R2582, R2525, and R2526 for Q2541 and similarly R2585, R2544, and R2545 for Q2561. The actual value of the voltage at this gate is device dependent and determined by trim in the factory when the radio is built.

With TX drive disabled and PA-CNTRI line held at 9.1 volts, the current in Q2541 is set to approximately 100 mA and Q2561 to approximately 1 amps.

The output of Q2561 goes through the matching network consisting of four transmission lines, inductors and capacitors to the directional coupler.

Directional Coupler, RX-TX Switch and Harmonic Filter

The forward power detector is a microstrip printed circuit which couples a small amount of the forward energy off and sends it to diode CR2671 where it is rectified. The rectified signal forms the V detect voltage, which is proportional to the rectified RF energy appearing across the diode. The power control circuit senses this voltage and adjusts the drive power via the power control circuit to hold this voltage constant, thus ensuring the forward power out of the radio to be held to a constant value.

The antenna switch is switched synchronously with the keyed 9.1 voltage. In transmit mode, the K 9V1 line is high and the current turns on the PIN diode CR2641. The receiver preamp transistor Q2251, also turned off by the keyed 9.1 voltage, cuts off the current through the PIN diodes CR2642, CR2643 and turns off transistor Q2641.

In receive mode the K 9V1 line is low. This turns off the PIN diode CR2641 and turns on the receiver preamp transistor Q2251. The current through Q2251 turns on the PIN diode CR2642, CR2643 and transistor Q2641. Q2641 shorts R2644 to increase the collector emiter voltage of Q2251.

Harmonics of the transmitter are attenuated by the harmonic filter. The harmonic filter is formed by the inductors and capacitors. This network forms a low-pass filter to attenuate harmonic energy of the transmitter to specifications level. R2650 performs an electrostatic protection for the power amplifier.

Temperature Sense

In the PA compartment R2610, a 100 k thermistor, senses temperature of the MOS devices Q2541 and Q2561. This signal is fed back into the power control circuit to protect the power amplifier against over temperature conditions. The power control circuit senses the voltage drop across the shunt resistor R2615 which is determined by the magnitude of the drain current in Q2561. This is a limit mechanism whereby the power control will limit the magnitude of current that can be drawn by Q2561 to protect the device from over dissipation.

Reverse Polarity

Reverse polarity protection for the transmitter is provided by the diode CR2601. This diode is soldered to the board as well as being pressed against a member in the chassis heat sink so under reverse polarity conditions to the radio this diode will conduct and protect the radio from damage. This diode also provides transient over-voltage protection by breaking down when the supply voltage to the radio exceeds 25 volts.

Power control

The power control circuit consists of the control amplifier, the control voltage limiter U0202, the detector voltage buffer/amplifier U0550-12, -13, -14, the PA temperature sense circuit U0550-1, -2, -3, and the current limit circuit U0550-5, -6, -7, Q2601 and Q2501.

The detector voltage coming from the RF PA is amplified by U0550-12, -13, -14. For low power radios the amplification can be increased by applying a high level to the base of Q0554 thus reducing the feedback voltage at the operational amplifier's inverting input.

The output voltage is added to the PA power set voltage at the inverting input of the control amplifier (U0550-9). Its noninverting input is set to a fixed voltage of 4.65 volts. As long as there is a differential input voltage at the control amplifier's input, the output voltage (PA control voltage) is altered. This in turn causes a change of the RF output power level and the detector voltage which leads to a changing differential input voltage. When the control loop is in steady state the voltages at both the inverting and the noninverting input are equal.

To obtain higher RF output levels the power set voltage generated by the D/A U0551-2 is reduced. This causes a lower level at the summing point U0550-9. The control loop compensates this difference by increasing RF power and detector voltage until balance between the two control amplifier inputs is obtained again. Reducing the power level works vice versa.

Q2601 and Q2501 form a current source to control the power output of Q2521. As the PA control line voltage increases, Q2601 turns on harder causing increased current to flow in its collector and a higher voltage drop across R2606. This results in more current to be drawn by Q2501 so that the base current on Q2521 is increased. This in turn causes higher collector current to flow through Q2521. The collector cur-

rent settles when the voltage across the parallel configuration of the resistors R2530-R2533 equals the voltage across R2606 minus V_{BE} of Q2501.

By controlling the output power of Q2521 and in turn the input power of the following stages the ALC loop is able to regulate the output power of the transmitter.

Opamp U0202 performs as an integrator which controls via Q0556 the control voltage slope during key up and dekey.

During RX operation Q0556 pulls R0590 down, the output of U0202 is at its maximum level, Q0555 conducts and the output of U0550 is at its minimum output level.

After pressing PTT transistor Q0556 switches off. Capacitor C0552 is charged via R0584 and R0590. In turn the output voltage of U0202 decreases which causes an increase of the voltage at the non-inverting input of U550. This increases the PA control voltage. The loop is closed via R0591 and R0592. This feedback causes an exponential like rising edge of the control voltage. Such a smoothed keyup leads to an improved adjacent channel power reduction during TX keyup compared with a linear ramp.

After keyup the circuit does not effect the performance of the power control circuit as long as the control voltage does not increase over a certain value defined by R0591/R0592 and the voltage applied to R0584 by the D/A output U0055-13. If this occurs the control voltage will be limited to the predefined value and the PA prevented from being damaged.

If the radio switches from TX to RX, transistor Q0556 pulls R0590 down and C0552 is charged via R0590. This causes the output of U0202 to go up, saturate Q0555 and tie down the noninverting input of U0550. This effectively disables the control voltage PA CNTRL and hence the transmitter.

The protection features in the power control operate by raising the non-inverted input to the operational amplifier above the reference voltage which has the same effect as a larger input from the coupler. The thermal shutback circuit works when the temperature of R2610 decreases its resistance, the output at pin 1 of U0550 increases. When that voltage rises above the reference voltage at pin 10 of U0550, the control voltage of the PA is decreased lowering the power output. The current limiting circuit measures the voltage drop across R2615 causing an adjustable offset to the voltage controlled by the D to A output for current limit set. The difference of that is amplified at pin 7 of U0550. When the voltage exceeds the reference at pin 10 of U0550, then current limit starts to engage reducing power output.

FREQUENCY SYNTHESIS

Synthesizer circuitry

The complete synthesizer subsystem consists of the Reference Oscillator (U2800), the Fractional-N Synthesizer (U2801), the Voltage Controlled Oscillator (U2803), the buffer stage (U2804) and the feedback amplifier (Q2774).

The Reference Oscillator (U2800) contains a temperature compensated crystal oscillator with a frequency of 16.8 MHz. This oscillator is tuned by a temperature referenced 5 bit analog-to-digital (A/D) converter. The output of the oscillator (pin 10 on U2800) is applied to pin 14 (XTAL1) on U2801 via C2754 and R2750.

The VCO Module U2803 contains two voltage controlled oscillators, one for TX operation and one for RX operation. The frequency ranges are 66 - 88 MHz for transmit mode and 175.65 - 197.65 MHz for receive mode. The TX VCO is enabled by pulling U2803-21 (TX BIAS) to 8.7 V. The RX VCO is on when 8.7 V is applied to U2803-16 (RX BIAS). The oscillator frequency is proportional to the applied control voltage (2 - 11 VDC).

The buffer stage (U2804) and the feedback amplifier (Q2774) provide the necessary gain and isolation for the synthesizer loop. The FRACN synthesizer IC (U2801) consists of a prescaler, a programmable loop divider, control divider logic, a phase detector, a charge pump, an A/D converter for low frequency digital modulation, a balance attenuator to balance the high frequency analog modulation and low frequency digital modulation, a 13 V positive voltage multiplier, a serial interface for control, and finally a super filter for the regulated 9.3 volts. Q2770 is used as a current amplifier for the super filter. The super filter voltage drops from 9.3 V dc (emitter of Q2770) to about 8.6 V dc (collector of Q2770). This filtered 8.6 V dc supplies the VCO B+ (U2803), VCO modulation bias circuit (R2766), the TX/RX VCO switching transistors (Q2783 and Q2786), feedback amplifier (Q2774), synthesizer charge pump resistor network (R2752-R2754; R2756-R2758) and synthesizer SUPFOUT pin 19 (U2801).

The synthesizer supply voltage is provided by the 5 V regulator (U2802). In order to generate a high voltage to supply the phase detector (charge pump) output stage at pin VCP (U2801-36), a voltage of 13 V dc is being generated by the positive voltage multiplier circuitry (CR2750, C2759, C2760) at pin 1 of CR2750. This voltage multiplier is basically a diode capacitor network driven by two (1.05 MHz) 180 degrees out of phase signals (U2801-8 and -9).

The serial interface (SRL) is connected to the microprocessor via the data line (U2801-2), clock line (U2801-3), and chip enable line (U2801-4).

synthesizer Operation

The complete synthesizer subsystem works as follows. The output of the VCO, pin 20 (RF OUT) on U2803, is fed into the buffer input port of U2804 (pin 1) through an attenuator network (R2774-R2776). The output of the buffer (U2804-5) is applied to the input of the feedback amplifier (Q2774) through an attenuator network (R2771-R2773). To close the synthesizer loop, the collector of Q2774 is connected to the PREIN port of synthesizer U2801 (pin 21). The buffer output (U2804-5) also provides signal for the receiver LO injection and transmit injection string circuit.

The prescaler in the synthesizer (U2801) is basically a dual modulus prescaler with selectable divider ratios. This divider ratio of the prescaler is controlled by the loop divider, which in turn receives its inputs via the SRL. The output of the prescaler is applied to the loop divider. The output of the loop divider is connected to the phase detector, which compares the loop divider's output signal with the reference signal. The reference signal is generated by dividing down the signal of the reference oscillator (U2800). The output signal of the phase detector is a pulsed DC signal which is routed to the charge pump. The charge pump outputs a current at pin 32 (I OUT of U2801). The loop filter (which consists of R2760-R2762, C2775-C2780) transforms this current into a voltage that is applied to pins 7 and 10 of the VCO (U2803) and alters its output frequency.

The current can be set to a value fixed in the FRACN IC or to a value determined by the currents flowing into CPBIAS 1 (U2801-29) or CPBIAS 2 (U2801-28). The currents are set by the values of R2752/R2753 or R2756/R2757 respectively. The selection of the three different bias sources is done by software programming.

To reduce synthesizer lock time when new frequency data has been loaded into the synthesizer the magnitude of the loop current is increased by enabling the I ADAPT line (U2801-34) for a certain software programmable time (Adapt Mode). Additionally the loop current is increased by bypassing R2752/R2753 with Q2750 and R2756/R2757 with Q2751. Bypassing starts when the FRACN CE line changes from high to low and ends a certain delay time after the low to high transient. The adapt mode timer and the bypassing delay are both started by a low to high transient of the FRACN CE line. The adapt time is programmed to be somewhat shorter than the bypassing delay time which is hardware dependent. This causes two different current levels during frequency acquisition of the loop. When the synthesizer is within the lock range the current is determined only by the resistors connected to CPBIAS 1, CPBIAS 2, or the internal current source.

In order to modulate the PLL the two spot modulation method is utilized. Via pin 5 on U2801 the Audio signal is applied to both the A/D converter (low freq path) as well as the balance attenuator (high freq path). The A/D converter converts the low frequency analog modulating signal into a digital code that is applied to the loop divider, thereby causing the carrier to deviate. The balance attenuator is used to adjust the VCO's deviation sensitivity to high frequency modulating signals. The output of the balance attenuator is present at the MODOUT port (U2801-30) and connected to the external VCO modulation port MOD INPUT (U2803-22).

Transmit Injection String

The transmit injection string consists of two amplifier stages (Q2801 and Q2804) whose main purpose is to maintain a constant output to drive the RF PA and provide isolation. The first stage (Q2801) is passively biased. The second stage (Q2804) is actively biased through a current source (Q2796). The TX injection string is powered by K 9V1 only during the transmit mode. The output power to the PA is approximately +13 dBm.

VHF SPECIFIC CIRCUIT DESCRIPTION

RECEIVER

The receiver covers the VHF range from 136 to 174 MHz. It consists of the following sections.

Varactor tuned band-pass filter

A two pole filter tuned by the dual varactor D3302 preselects the incoming signal to reduce spurious effects to following stages. The tuning voltage ranging from 2.5 volts to 7.5 volts is controlled by a D/A IC in the controller section. Three bandstops, approximately at 45 MHz for the first IF, 95 MHz for broadcast frequencies (made up by C3303, L3302), and at RX frequency plus 50 MHz for the injection improve the specific spur performance.
In TX mode the input signal is reduced by PIN diode D3330, which is part of the RX/TX switch. A dual hot carrier diode (D3303) limits any inband signal to 10 dBm to prevent damage to the pre-amplifier.

Pre-amplifier

The RF preamp (Q3302) is an SMD device with emitter and collector base feedback to stabilize gain, impedance, and intermodulation. To provide optimum transistor current drain it is actively biased by a collector current sense circuit (Q3301 and associated components) which is also used to bias the RX series PIN

diode D3641 (in the PA section) in RX mode via the decoupled emitter path.

The collector current is set to approximately 22 mA at an emitter voltage of about 2 volts. The combined preamp and PIN diode bias circuit is driven by the K 9V1 line from the controller.
To stabilize output impedance the preamp is followed by a 3dB pad.

Fixed tuned band-pass filter

A five pole band-pass with two bandstops (both at approximately 220 MHz to suppress image frequencies) is added after the preamp. It provides signal transmission over the VHF range, wideband spur suppression and preamp to mixer matching.

Mixer

Q3303 is a double balanced active GaAs mixer. Its three ports are matched for incoming VHF signal conversion to the 44.85 MHz IF using high side injection. The mixer bias is set by R3341 to approximately 24 mA with Pinj = 5 dBm.

IF first selection

The mixer IF output signal is fed through T3303 and its impedance is transformed to the Y3401 two pole crystal filter. A diplexer shunt circuit matches the mixer's output impedance for optimum half IF stability.

The filter output in turn is matched to the following IF amplifier.

IF amplifier

The IF amplifier Q3401 is an SMD device of the same type as the preamp. It is actively biased by a collector base feedback to a current drain off approximately 10 mA. Its output voltage swing is limited by a dual hot carrier diode (D3402) to reduce overdrive effects at RF input levels above -27 dBm.

IF second selection

The IF amplifier is succeeded by matching networks into and out of the second crystal filter Y3402. To change the filter's pass band a certain amount of signal is coupled from its input to its output to achieve a notch at the higher and lower adjacent channel. This improves the adjacent channel selectivity.

ZIF isolation amplifier

To obtain proper operation of the ZIF IC (U3201) an isolation amplifier combined with an IF AGC and a low-pass filter follows. The collector path of Q3203 is loaded with a PIN diode (D3203) in shunt configuration. Its control voltage is generated by a bias circuit with D3204 in conjunction with the voltage out of U3201-4. This configuration provides an AGC dynamic range of maximum 40 dBm and isolates the sensitive IC from an overdriving IF level. Additionally the signal is low-pass filtered to suppress non-linear effects within the ZIF IC.

ZIF IC (U3201)

Within the ZIF IC the 44.85 MHz IF signal is mixed in two quadrature paths down to baseband filters, then processed and FM demodulated. The conversion process to baseband is performed by using a second LO circuitry consisting of Q3201, inductor L3204 and several capacitors that, in combination with the varactor diode D3201 and a loop filtered steering line from U3201-18, closes the PLL.

The demodulated audio comes out of the ZIF IC at pin 28 and is applied to the Audio Signalling Filter IC (ASFIC), which is located in the command and control section of the radio.

25 W POWER AMPLIFIER (PA)

Introduction

The radio's 25 W PA is a three stage amplifier used to amplify the output from the injection string to the radio transmit level. It consists of three stages in the lineup. The first (Q3521) is a bipolar stage that is controlled via the PA control line. It is followed by two MOS FET devices, Q3541 and Q3561.

Devices Q3521 and Q3541 are surface mounted. To channel heat from Q3541 the surface mounted heat spreader on the opposite side of the PCB provides thermal contact of the transistor to the heat sink. Transistor Q3561 is directly attached to the heat sink.

Operation

PA Stages

The power out of Q3521 is proportional to its collector current. This current is adjusted by the PA Control Voltage (PA Control). If the PA Control line raises, the base voltage of Q3601 is also raised causing more current to flow to the collector of Q3601 and a higher voltage drop on R3606. This results in more current to be drawn by Q3501 so that the base current on Q3521 is increased. This in turn causes higher collector current to flow through Q3521. The collector current settles when the voltage over the parallel configuration of the resistors R3530-R3533 equals the voltage over R3606 minus V_{BE} of Q3501.

By controlling the output power of Q3521 and in turn the input power of the following stages the ALC loop is able to regulate the output power of the transmitter.

The MOSFET devices Q3541 and Q3561 are enhancement mode N-Channel MOSFETS. These devices require a positive gate bias and a quiescent current flow with no drive for proper operation. To achieve this result, the gates are biased through the network consisting of R3582, R3525, and R3526 for Q3541 and similarly R3585, R3544, and R3545 for

Q3561. The actual value of the voltage at this gate is device dependent and determined by trim in the factory when the radio is built.

The output of Q3561 goes through the matching network consisting of four transmission lines, inductor L3566, and several capacitors to the directional coupler.

Directional Coupler, RX-TX Switch and Harmonic Filter

The forward power detector is a microstrip printed circuit which couples a small amount of the forward energy off and sends it to diode D3671 where it is rectified. The rectified signal forms the V detect voltage, which is proportional to the rectified RF energy appearing across the diode. The power control circuit holds this voltage constant, thus ensuring the forward power out of the radio to be held to a constant value.

The antenna switch is switched synchronously with the keyed 9.1 voltage. In transmit mode, the K 9V1 line is high and the current turns on the PIN diode D3641. The receiver preamp transistor Q3302, also turned off by the keyed 9.1 voltage, cuts off the current through the PIN diode D3642 and turns off transistor Q3641.

In receive mode the K 9V1 line is low. This turns off the PIN diode D3641 and turns on the receiver preamp transistor Q3302. The current through Q3302 turns on the PIN diode D3642 and transistor Q3641. Q3641 shorts R3644 to increase the current through Q3302.

Harmonics of the transmitter are attenuated by the harmonic filter. The harmonic filter is formed by the inductors L3661 through L3663, and capacitors C3661 through C3664. This network forms a low-pass filter to attenuate harmonic energy of the transmitter to specifications level. L3664 performs an electrostatic protection for the power amplifier.

Temperature Sense

In the PA compartment R3610, a 100k thermistor, senses temperature of the MOS devices Q3541 and Q3561. This signal is fed back into the power control circuit to protect the power amplifier against over temperature conditions. The power control circuit senses the voltage drop across the shunt resistor R3615 which is determined by the magnitude of the drain current in Q3561. This is a limit mechanism whereby the power control will limit the magnitude of current that can be drawn by Q3561 to protect the device from over dissipation.

Power Control

The maximum value of the PA control line is similarly limited by R3601 and R3602 the resistor divider off of PA control. This inputs a signal back into the power control circuit that limits the magnitude of the voltage the PA control line can rise to. Reverse polarity protection for the transmitter is provided by the diode D3601. This diode is soldered to the board as well as being pressed against a member in the chassis heat sink so under reverse polarity conditions to the radio this diode will conduct and protect the radio from damage. This diode also provides transient over-voltage protection by breaking down when the supply voltage to the radio exceeds 25 volts.

The power control circuit consists of the control amplifier, the control voltage limiter U0202, the detector voltage buffer/amplifier U0550-12, -13, -14, the PA temperature sense circuit U0550-1, -2, -3 and the current limit circuit.

The detector voltage coming from the RF PA is amplified by U0550-12, -13, -14. For low power radios the amplification can be increased by applying a high level to the base of Q0554 thus reducing the feedback voltage at the operational amplifier's inverting input.

The output voltage is added to the PA power set voltage at the inverting input of the control amplifier (U0550-9). Its noninverting input is set to a fixed voltage of 4.65 volts. As long as there is a differential input voltage at the control amplifier's input, the output voltage (PA control voltage) is altered. This in turn causes a change of the RF output power level and the detector voltage which leads to a changing differential input voltage. When the control loop is in steady state the voltages at both the inverting and the noninverting input are equal.

To obtain higher RF output levels the power set voltage generated by the D/A U0551-2 is reduced. This causes a lower level at the summing point U0550-9. The control loop compensates this difference by increasing RF power and detector voltage until balance between the two control amplifier inputs is obtained again. Reducing the power level works vice versa.

Opamp U0202 performs as an integrator which controls via Q0556 the control voltage slope during key up and dekey.

During RX operation Q0556 pulls R0590 down, the output of U0202 is at its maximum level, Q0555 conducts and the output of U0550 is at its minimum output level.

After pressing PTT transistor Q0556 switches off. Capacitor C0552 is charged via R0584 and R0590. In turn the output voltage of U0202 decreases which causes an increase of the voltage at the non-inverting input of U550. This increases the PA control voltage. The loop is closed via R0591 and R0592. This feedback causes an exponential like rising edge of the control voltage. Such a smoothed keyup leads to an improved adjacent channel power reduction during TX keyup compared with a linear ramp.

After keyup the circuit does not effect the performance of the power control circuit as long as the control voltage does not increase over a certain value defined by R0591/R0592 and the voltage applied to R0584 by the D/A output U0055-13. If this occurs the control voltage will be limited to the predefined value and the PA prevented from being damaged.

If the radio switches from TX to RX transistor Q0556 pulls R0590 down and C0552 is discharged via R0590. This causes the output of U0202 to go up and tie down the noninverting input of U0550. The control voltage decreases controlled by the loop U0202, Q0555, and U0550.

The protection features in the power control operate by raising the non-inverted input to the operational amplifier above the reference voltage which has the same effect as a larger input from the coupler. The thermal shutback circuit works when the temperature of R3610 decreases its resistance, the output at pin 1 of U0550 increases. When that voltage rises above the reference voltage at pin 10 of U0550, the control voltage of the PA is decreased lowering the power output. The current limiting circuit measures the voltage drop across R3615 causing an adjustable offset to the voltage controlled by the D to A output for current limit set. The difference of that is amplified at pin 7 of U0550. When the voltage exceeds the reference at pin 10 of U0550, then current limit starts to engage reducing power output.

FREQUENCY SYNTHESIS

Synthesizer Circuitry

The complete synthesizer subsystem consists of the Reference Oscillator (U5800), the Fractional-N Synthesizer (U5801), the Voltage Controlled Oscillator (U5803), the buffer stage (U5804) and the feedback amplifier (Q5774).

The Reference Oscillator (U5800) contains a temperature compensated crystal oscillator with a frequency of 16.8 MHz. This oscillator is tuned by a temperature referenced 5 bit analog-to-digital (A/D) converter. The output of the oscillator (pin 10 on U5800) is applied to pin 14 (XTAL1) on U5801 via C5754 and R5750.

The VCO Module U5803 contains two voltage controlled oscillators, one for TX operation and one for RX operation. The frequency ranges are 136 - 174 MHz for transmit mode and 180.85 - 218.85 MHz for receive mode. The TX VCO is enabled by pulling U5803-23 (TX BIAS) to 8.7 V. The RX VCO is on when 8.7 V is applied to U5803-17 (RX BIAS). The oscillator frequency is proportional to the applied control voltage (2 - 11 VDC).

The buffer stage (U5804) and the feedback amplifier (Q5774) provide the necessary gain and isolation for the synthesizer loop. The FRACN synthesizer IC (U5801) consists of a prescaler, a programmable loop divider, control divider logic, a phase detector, a charge pump, an A/D converter for low frequency digital modulation, a balance attenuator to balance the high frequency analog modulation and low frequency digital modulation, a 13V positive voltage multiplier, a serial interface for control, and finally a super filter for the regulated 9.3 volts. Q5770 is used as a current amplifier for the super filter. The super filter voltage drops from 9.3 Vdc (emitter of Q5770) to about 8.6 Vdc (collector of Q5770). This filtered 8.6 Vdc supplies the VCO B+ (U5803), VCO modulation bias circuit (R5766), the TX/RX VCO switching transistors (Q5783 and Q5786), feedback amplifier (Q5774), synthesizer charge pump resistor network (R5752-R5754; R5756-R5758) and synthesizer SUPFOUT pin 19 (U5801).

The synthesizer supply voltage is provided by the 5V regulator (U5802). In order to generate a high voltage to supply the phase detector (charge pump) output stage at pin VCP (U5801-36), a voltage of 13 Vdc is being generated by the positive voltage multiplier circuitry (D5750, C5759, C5760) at pin 1 of D5750. This voltage multiplier is basically a diode capacitor network driven by two (1.05 MHz) 180 degrees out of phase signals (U5801-8 and -9).

The serial interface (SRL) is connected to the microprocessor via the data line (U5801-2), clock line (U5801-3), and chip enable line (U5801-4).

Synthesizer Operation

The complete synthesizer subsystem works as follows. The output of the VCO, pin 22 (RF OUT) on U5803, is fed into the buffer input port of U5804 (pin 1) through an attenuator network (R5774-R5776). The output of the buffer (U5804-5) is applied to the input of the feedback amplifier (Q5774) through an attenuator network (R5771-R5773). To close the synthesizer loop, the collector of Q5774 is connected to the PREIN port of synthesizer U5801 (pin 21). The buffer output (U5804-5) also provides signal for the receiver LO injection and transmit injection string circuit.

The prescaler in the synthesizer (U5801) is basically a dual modulus prescaler with selectable divider ratios. This divider ratio of the prescaler is controlled by the loop divider, which in turn receives its inputs via the SRL. The output of the prescaler is applied to the loop divider. The output of the loop divider is connected to the phase detector, which compares the loop divider's output signal with the reference signal. The reference signal is generated by dividing down the signal of the reference oscillator (U5800). The output signal of the phase detector is a pulsed DC signal which is routed to the charge pump. The charge pump outputs a current at pin 32 (I OUT of U5801). The loop filter (which consists of R5760-R5762, C5775-C5780) transforms this current into a voltage that is applied to pins 7 and 10 of the VCO (U5803) and alters its output frequency.

The current can be set to a value fixed in the FRACN IC or to a value determined by the currents flowing into CPBIAS 1 (U5801-29) or CPBIAS 2 (U5801-28). The currents are set by the values of R5752/R5753 or R5756/R5757 respectively. The selection of the three different bias sources is done by software programming.

To reduce synthesizer lock time when new frequency data has been loaded into the synthesizer the magnitude of the loop current is increased by enabling the I ADAPT line (U5801-34) for a certain software programmable time (Adapt Mode). Additionally the loop current is increased by bypassing R5752/R5753 with Q5750 and R5756/R5757 with Q5751. Bypassing starts when the FRACN CE line changes from high to low and ends a certain delay time after the low to high transient. The adapt mode timer and the bypassing delay are both started by a low to high transient of the FRACN CE line. The adapt time is programmed to be somewhat shorter than the bypassing delay time which is hardware dependent. This causes two different current levels during frequency acquisition of the loop. When the synthesizer is within the lock range the current is determined only by the resistors connected to CPBIAS 1, CPBIAS 2, or the internal current source.

In order to modulate the PLL the two spot modulation method is utilized. Via pin 5 on U5801 the Audio signal is applied to both the A/D converter (low freq path) as well as the balance attenuator (high freq path). The A/D converter converts the low frequency analog modulating signal into a digital code that is applied to the loop divider, thereby causing the carrier to deviate. The balance attenuator is used to adjust the VCO's deviation sensitivity to high frequency modulating signals. The output of the balance attenuator is present at the MODOUT port (U5801-30) and connected to the external VCO modulation port MOD INPUT (U5803-22).

Transmit Injection String

The transmit injection string consists of two amplifier stages (Q5801 and Q5804) whose main purpose is to maintain a constant output to drive the RF PA and provide isolation. The first stage (Q5801) is passively biased. The second stage (Q5804) is actively biased through a current source (Q5796). The TX injection string is powered by K 9V1 only during the transmit mode. The output power to the PA is approximately +13 dBm.

UHF SPECIFIC CIRCUIT DESCRIPTION

RECEIVER FRONT END

The signal input from the antenna switch in the transmitter comes from the transmitter and enters the first filter. The first filter is made up of several inductors and several capacitors and is a varactor tuned filter being tuned from 403 to 470 MHz. A control line from the control band which controls the voltage by a D/A IC. The DC voltage can be measured at the common node between R5250, C5251, C5252, and R5255. The voltage is applied to varactor diodes CR5250 through CR5253.

The varactor tuned filter is a poled 0 configuration which improves the selectivity for the 0.5 IF spur and image spur. The varactor tuned filter has a voltage range for the control voltage that goes to the varactors is nominally A through B (will supply voltages later).

After the varactor tuned filter, the signal is fed to a pair of hot carrier limiter diodes placed in front of the RF preamp to limit strong signals from overdriving the RF PA and damaging it. These hot carrier limiter diodes also help to prevent large signals from degrading intermodulation and basic receiver performance.

The RF preamp is a BJT device with emitter degeneration or emitter feedback resistors as well as collector base feedback to improve the third order intercept. This preamp is an actively biased preamp with the active bias circuit composed of Q5250 and associated resistors which set the collector voltage for the preamp Q5251 as well as the emitter current that Q5251 is pulling.

After the signal leaves the preamp, the signal goes into a four-pole fixed tuned band-pass filter. The band-pass filter is again fixed tuned from 403 to 470 MHz and is a discrete component. There is no tuning required and no voltages that need to be monitored.

Going out of this fixed tuned filter, the signal then goes into mixer Q5252. The mixer is a double balanced active gallium arsenide mixer. The RF signal is applied through transformer T5250 and the output of the mixer is a low side injection mixer and is 73.35 MHz below the RF signal which is the signal that comes into the mixer from the four-pole fixed tuned filter.

The IF out is at a frequency of 73.35 MHz and the bias for the active mixer is set by resistor R5265. With injection the voltage is 0.5 V and without injection the voltage is 1.0 V which is an indication of whether or not adequate LO is being supplied to the mixer.

Going out of the mixer is the signal at the IF frequency of 73.35 MHz and fed into the IF. The IF is a two-pole BJT crystal filter type. The first set of circuitry in the IF is a resistive pi pad which helps to stabilize the impedance presented to the output of the mixer as well as stabilize the impedance presented to the input of the first crystal filter.

After the pi pad are the matching elements which transform the output impedance of the mixer to the required impedance for the cyrstal filter. The crystal filter then follows that which in turn is followed by matching elements which takes the crystal filter impedance and transforms it to the impedance of the base of the IF amplifier. The IF amplifier is a BJT device similar to the RF preamp. The IF amplifier is Q5388 and is very similar to the RF preamp. It is an actively biased BJT amplifier using emitter and collector base feedback to help improve intercept point. It is also actively biased set to Q5382 and associated circuitry which sets the collector voltage and the emitter current of the IF amplifier Q5388.

Following the IF amplifier is a matching network which converts the IF amplifier output impedance to the impedance required for the second 73.35 MHz crystal filter. The matching network is followed by the second crystal filter which is then followed by matching elements to the ZIF circuitry.

From the ZIF circuitry coming out of the IF circuitry, the signal moves to a second IF amplifier Q3203. At the base of the IF amplifier are a pair of hot carrier limiter diodes placed in the circuit to help protect the zero IF IC from strong signal overload conditions. The output of IF amplifier Q3203 is then fed to a pin diode shunt AGC circuit CR3293. This pin diode attenuation is a function of the level which the internal AGC circuitry of the ZIF detects, and as the internal AGC circuitry of the ZIF detects more RF level CR3202 begins to turn on and begins to shunt IF power to ground helping attenuate the power which the zero IF IC is seeing.

At the output of the pin diode attenuator, there is a low-pass filter made up of components C3248, C3249, and C3250 and inductor L3207. These components are put in the circuit to help attenuate the third harmonic of the IF frequency improving the overload protection of the zero IF IC. The IC mixes to baseband and is a down converter to baseband, limiter, and demodulator. The mixing to baseband uses the second LO circuitry consisting of Q3201 and is a BJT oscillator which is part of a Phase Lock Loop (PLL).

The second LO PLL is internal to the ZIFIC and controls the frequency of the external oscillator Q3201 via control voltage coming from pin 18 of the zero IF and is across varactor CR3201 which controls the frequency of the oscillator.

The IF signal going to the ZIF is filtered, limited, and demodulated. The demodulated audio then comes out of the zero IF's IC from pin 28 and is then fed to the ASFIC audio signal filtering IC which is present in the command and control sections of the radio.

25 W POWER AMPLIFIER (PA)

Introduction

The radio's 25 W PA is a four stage amplifier used to amplify the output from the injection string to the radio transmit level. It consists of four stages in the lineup. The first two are, the two bipolar stages, Q5500 and Q5510 followed by two MOSFET devices, Q5530 and Q5540. Devices Q5500 and Q5510 are both plastic packages that are surface mounted and can be seen on the overlay. Transistors Q5530 and Q5540 are both attached to the heat sink.

Operation

The last three stages, Q5510, Q5530, and Q5540 all operate off the A+ supply voltage. The drive in transistor Q5510 is controlled from Q5500 via the PA control line. If the PA control line is raised, the base voltage on Q5502 is also raised causing more current to flow to the collector on Q5502. This in turn causes more current to be pulled through all of Q5502 turning on Q5501 harder and increasing current flow through Q5500. The power out of Q5500 is proportional to the current flowing on its collector so the rising control voltage on the PA control line causes rising collector current on Q5500. This causes more power out of the stage. Conversely, decreasing the control line will decrease the power delivered into the next stage. By controlling the drive power to Q5510 and the following stages in the power supply lineup, ALC loop is able to regulate the output power of the transmitter. Diode CR5500 in series with the base of Q5500 is used to decrease the amount of power coming out of the radio under the condition when the keyed 9.1 V line is high but V control has not begun to rise; in a transient condition, power is being turned on.

Near the collector of Q5510 are four resistors, R5513 through R5516. If device Q5510 is replaced, it is important that these four resistors are not cracked or are still installed in the circuit after the replacement of Q5510, R5510, R5511. The function of these resistors is to help channel heat from the collector of Q5510 to the ground plane surrounding the device. Notice that the base of Q5510 is biased to the resistor divider network consisting of R5510 and R5511. Under normal conditions with no drive applied, the base voltage should rise to about 0.25 volts. The MOSFET devices Q5530 are Q5540 are enhancement mode N-Channel MOSFETS. These devices require a positive gate bias and a quiescent current flow with no drive for proper operation. To achieve this result, the gates are biased through the network consisting of R5530 through R0553 for Q5530 and similarly R5540 through R5543 for Q5540. The actual value of the voltage at this gate is device dependent and determined by trim in the factory when the radio is built.

The output of Q5530 goes through the matching network consisting of four transmission lines and capacitors C5544, C5545, and C5546 to the antenna switch.

The antenna switch is switched synchronously with the keyed 9.1 voltage. In the transmit mode, this 9.1 voltage is high and current flow is through R5580 and R5581 on down through L5580 and turns on diodes CR5580 and CR5581. When these diodes are turned on, they form a load impedance to the RF transmit path and allow the signal to pass through. Diode CR5581 form a low impedance that is reflected up through L5582 to resonate around the transmit band with capacitances in front of the harmonic filter. In this way no power is delivered into the receiver. Diode CR5582 is also turned on in the transmit mode further isolating the receiver port from transmitter energy.

In the receive mode both of these diodes are off. Power coming in the receive mode is channelled down through L5582 and on out to the RX port.

Harmonics of the transmitter are attenuated by the harmonic filter. The harmonic filter is formed by components L5590 through L5592, and capacitors C5590 through C5593. This network forms a low-pass filter to attenuate harmonic energy of the transmitter to specifications level.

Following the harmonic filter is a forward power detector. This forward power detector is a microstrip printed circuit which couples a small amount of the forward energy off and sends it to diode CR5600 where it is rectified. This rectified signal combined with a slight DC bias applied through R5604 and R5600 forms the V detect voltage which the power control circuit holds constant. Holding this voltage constant which is proportional to the rectified RF energy appearing across the diode, ensures the forward power out of the radio is held to a constant value.

The power control loop regulates power with an automatic level control (ALC) loop and provides protection features against overcurrent, excessive control voltage, and high operating temperatures. Power and current limit are adjusted under microprocessor control using a Digital to Analog (D/A) converter (U0551). Control voltage limit is set by resistor ratio on the transmitter, or D/A output for those radios that must minimize adjacent channel splatter. The D/A adjustable control voltage limit increases transmitter rise time and reduces adjacent channel splatter as it is adjusted closer to the actual operating control voltage.

The microprocessor controls K9.1 enable (K9.1 ENB) to bias the PA and antenna switch, PA disable (PA DIS) to disable the PA control voltage, and power range (PWR RANGE) to adjust the number of D/A steps per watt.

Through an Analog to Digital (A/D) input (TEMP) the microprocessor can read the PA control voltage for adjusting the D/A control voltage limit during the tuning process.

The ALC loop regulates power by adjusting the PA control line PA CNTL to keep the forward power voltage VFORWARD at a constant level. VFORWARD is amplified with a gain of 3 and added to the PWR SET D/A output U0551 pin 2 through resistors R0577, R0553 and R0554. The result is connected to opamp inverting input U0550 pin 9 which is compared with a 4.6 volt reference present at noninverting input U0550 pin 10. The 4.6 volt reference is set by a divider circuit connected to ground and 9.3 volts by 47k 1% resistors R0587 and R0588.

The power range line PWR RANGE controls the gain of the VFORWARD amplifier. For operation at 6 watts and above PWR RANGE is set to zero volts for a gain near 3. For low power operation under 6 watts, PWR RANGE may be set high to increase gain to 5.4, increasing the number of D/A steps for a given change in power.

The PA disable line PA DIS prevents transmitter operation by keeping the PA control voltage PA CNTL near zero volts. On radios that are required to minimize adjacent channel splatter, a control voltage limit line PA CNTL LIM is pulled to ground by transistor Q0556 when PA disable is high. This effectively makes the control voltage limit equal to zero and pulls the 4.6 volt reference at noninverting input U0550 pin 10 to ground through transistor Q0551. The ALC opamp output at U0550 pin 8 is prevented from rising above zero since the noninverting input is grounded. On radios that are not required to minimize adjacent channel splatter the transmitter is disabled through transistor Q0551 which pulls the PA control voltage PA CNTL directly to ground.

During normal transmitter operation the voltages at the opamp inputs U0550 pins 9 and 10 should be equal to 4.6 volts and the PA control voltage output at pin 8 should be between 4 and 7 volts. If power falls below the desired setting, VFORWARD decreases, causing the inverting input at UO550 pin 9 to decrease, increasing the opamp output at U0550 pin 8 and increasing the PA control voltage PA CNTL until VFORWARD increases to the desired level. The power set D/A output voltage PA PWR SET at U0551 pin 2 adjusts power in 1 Watt steps by adjusting the required value of VFORWARD. As PA PWR SET decreases, transmitter power must increase to make VFORWARD larger and keep the inverting input U0550 pin 9 at 4.6 volts.

Loop frequency response is controlled by opamp feedback components R0570 and C0568 and the output lowpass filter R0571 and C0569.

Rise and fall time is controlled by the D/A adjustable control voltage limit circuit attached to the reference voltage at U0550 pin 10 via transistor Q0555. The reference voltage at U0550 pin 10 is pulled low by Q0555 when the PA control voltage approaches the limit set by the D/A output PA CNTL LIM, U0551 pin

13. The PA control voltage at U0550 pin 8 connects to opamp noninverting input U0202 pin 3 through the voltage divider formed by R0592 and R0591 and low-pass capacitor C0572. Control voltage limit is set by the D/A output PA CNTL LIM at U0551 pin 13 which connects to inverting input U0202 pin 2 through R0584, Q0556 and R0590. Transistor Q0556 is connected to the pa disable line, PA DIS which effectively pulls the control voltage limit to zero volts, and activates Q0555 to pull the reference voltage to zero when control voltage is greater than zero.

Protection features are provided to limit PA control voltage, limit final PA device temperature, and limit PA final device current. These features operate by adding current to the ALC loop inverting input at U0550 pin 9 through diodes CR0550 and CR0551 and decreasing the PA control voltage. When the voltage exceeds 5 volts at any cathode of diodes CR0550 and CR0551, current begins to flow into the ALC loop increasing the voltage at the inverting input U0550 pin 9. As a result the PA control voltage at U0550 pin 8 decreases in response to excessive PA control voltage, final device temperature, and final device current.

Thermal shutback limits the PA temperature by reducing the PA control voltage as temperature increases during extended periods of transmitter operation or high ambient temperatures.

PA temperature is sensed by negative temperature coefficient thermistor RT5610, located on the ground plane near the PA final device Q5540.

At 25°C the thermistor has a high resistance near 100000 ohms. At 85°C the resistance is near 9700 ohms. The thermistor attaches to ground in the PA section and the PA TEMP line which goes to the controller section. In the controller section PA TEMP connects to the 9.3 volt supply through resistors R0587 and R0588. As a result the voltage on PA TEMP drops as temperature increases.

PA TEMP connects to an inverting amplifier through resistor R0550 to inverting input U0550 pin 2. The noninverting input U0550 pin 3 is connected to a 4.6 volt reference formed by voltage divider resistors R0576 and R0582 which connect to ground and the 9.3 volt supply. The output of the inverting amplifier at U0550 pin 1 is the product of the amplifier gain as determined by the ratio of R0551 divided by R0550 and the difference between the amplifier inputs pins 2 and 3. When the PA TEMP input is greater than 4.6 volts the amplifier output is zero.

As temperature rises the voltage on PA TEMP falls, the inverting amplifier output at U0550 pin 1 rises, current begins to flow through R0552 and CR0550 into the ALC loop at the inverting input of U0550 pin 9, decreasing the PA control voltage PA CNTL and reducing transmitter output.

Current limit is provided to protect the PA final device Q5540 from overcurrent caused by low line voltage and/or mismatched antennas.

Current is measured by sensing the voltage drop across PA shunt resistor R5612 which is in series with the supply lead to the final device. As the current through the final device increases, so does the difference in voltage across R5612. The differential current sense amplifier must amplify the voltage difference and produce an output over 5 volts at maximum current to reduce the PA control voltage and protect the final device. The maximum current is adjusted by the D/A line CUR LIM SET.

The current sense lines CURRENT SENSE+ and CURRENT SENSE- are connected in shunt across R5612 to the supply and load sides, respectively. Voltage dividers on the current sense lines formed by resistors R0557, R0558, R0559, and R0560 protect the inputs of U0550 (pins 5 and 6) from excessive voltages. CURRENT SENSE+ connects to the noninverting input UO550 pin 5 through resistors R0557 and R0558. CURRENT SENSE- connects to the inverting input U0550 pin 6 through resistors R0559 and R0560. As current through the final device increases, voltage drop through R5612 increases and CURRENT SENSE- decreases with respect to CURRENT SENSE+, increasing the difference between inverting and noninverting inputs, causing the amplifier output at U0550 pin 7 to increase to over 5 volts. As the amplifier output increases to over 5 volts, the current through resistor R0556 and diode CR0550 becomes sufficient to reduce the PA control voltage reducing the PA device current.

The D/A line CUR LIM SET at U0551 pin 4 adjusts the maximum allowed current by creating an offset voltage at the non-inverting input U0550 pin 5 that is approximately equal to the voltage present at the inverting input during the maximum current voltage drop through R5612.

FREQUENCY SYNTHESIS

The complete synthesizer subsystem consists of the Reference Oscillator (U5800), the Fractional-N Synthesizer IC (U5801), the Voltage Controlled Oscillator (U5803), the buffer stage (U5804) and the feedback amplifier (Q5774).

The Reference Oscillator (U5800) contains a temperature compensated crystal with an oscillation frequency of 16.8 MHz. The output of the oscillator (pin 10 on U5800) is then applied to pin 14 (XTAL1) of synthesizer (U5801) via C5754 and R5750.

The VCO Module U5803 is the Voltage Controlled Oscillator which is varactor tuned. The Oscillator Frequency is controlled by the voltage applied to pins 7 and 10 of the VCO. This control voltage ranges from about 2 to 11 Vdc. The VCO module (U5803) is a

dual-band oscillator that covers the 329.65-396.65 MHz and 403-470 MHz frequency bands. The low band VCO (329.65-396.65 MHz) provides the first LO injection frequencies which are 73.35 MHz below the carrier frequency. The low band VCO is selected by pulling pin 16 high and pin 21 low on U5803. The high band VCO (403-470 MHz) provides the transmit frequencies and is selected by pulling pin 21 high and pin 16 low on U5803.

The buffer stage (U5804) and the feedback amplifier (Q5774) provide the necessary gain and isolation for the synthesizer loop.

The synthesizer IC, U5801, consists of a prescaler, a programmable loop divider, control divider logic, a phase detector, a charge pump, an A/D converter for low frequency digital modulation, a balance attenuator to balance the high and low frequency analog modulation, a 13 V positive voltage multiplier, a serial interface for control, and finally a super filter for the regulated 9.3 volts. Q5770 is used as a current Buffer for the super filter. The output voltage of the super filter (Collector of Q5770) drops from 9.27 V to about 8.3 V. This filtered 8.3 Vdc supplies the VCO B+ (U5803), VCO modulation bias circuit (R5765 & R5766), the TX/RX VCO switching transistors (Q5783 & Q5786), feedback amplifier (Q5774), synthesizer charge pump resistor network (R5752-R5754; R5756-R5758) and synthesizer SUPFOUT pin 19 (U5801). The synthesizer supply voltage is provided by the 5 V regulator (U5802). The 2.1 MHz Reference Signal (pin 10 of U5801) is generated by dividing down the signal of the Reference Oscillator U5800 after it is applied to pin 14 of U5801.

In order to generate a high voltage that supplies the charge pump output stage at pin VCP (pin 36 of U5801), 13 V is generated at pin 1 of CR5750 by the positive voltage multiplier circuitry (CR5750, C5759, C5760). This voltage multiplier is basically a diode capacitor network driven by two (1.05 MHz) 180 degrees out of phase signals (pins 8 and 9 of U5801).

The serial interface (SRL) is connected to the microprocessor via the data line (pin 2 of U5801), clock line (pin 3 of U5801), and chip enable line (pin 4 of U5801). Proper enabling of these lines should allow the microprocessor to load the synthesizer IC.

The output of the VCO (pin 20 of U5803) is fed into the buffer input port (pin 1) of U5804 through an attenuator network (R5774-R5776). The output of the buffer, pin 5 of U5804, is applied to the input of the feedback amplifier (Q5774) through an attenuator network (R5771-R5773). To close the synthesizer loop, the output of Q5774 is connected to the PREIN port (pin 21) of synthesizer U5801. The buffer output (pin 5 of U5804) also provides signal for the Receiver LO injection and Transmit Injection String circuit.

The charge pump outputs a current that is present at pin 31 of U5801. The loop filter (which consists of R5760 - R5762, C5775 - C5778) will then transform this current into a voltage that will in turn be applied to pins 7 and 10 of VCO (U5803) and alter the output frequency.

In order to modulate the PLL the two-spot modulation method is utilized. The Audio signal is applied to both the A/D converter (low freq path) as well as the balance attenuator (high freq path) via pin 5 on U5801. The A/D converter will convert the low frequency analog modulating signal into a digital code that will in turn be applied to the loop divider thereby causing the carrier to deviate. The balance attenuator is used to adjust the VCO's deviation sensitivity to high frequency modulating signals. The output of the balance attenuator is present at the MODOUT port (pin 30 of U5801). The audio signal from the MODOUT port (pin 30 of U5801) is connected to the external VCO modulation port (pin 22 of U5803).

Transmit Injection String

The transmit injection string consists of two amplifier stages (Q5801 and Q5804) whose main purpose is to maintain a constant output to drive the RFPA and provide isolation. The first stage (Q5801) is passively biased. The second stage (Q5804) is actively biased through (Q5796). The TX Injection String is only on during the transmit mode with TX 9.1 V.

CONTROL HEAD MODEL B

VOLUME ADJUSTMENT

Pin 13 of connector P600 is the volume adjustment line and varies the voltage from 0 to 5 V DC. It feeds into the A/D port PE1 of the controller microprocessor, U0003 pin 51.

Note:
5 V dc is the maximum volume setting and 0 V dc is the minimum setting.

LCD WRITE

The LCD driver will receive its clock pulses from the Serial Peripheral Interface (SPI) clock U0103 pin P600-5. The data pin P600-6 is positive edge triggered with bit 33 as the first bit in (driver has an internal serial shift register), chip select (pin P600-12) needs to be set high during data transfer.

KEYPAD READ

The keypad is read by two analog ports, PE7 and PE8 of the controller microprocessor U0003 pins 45 and 46 and fed through pins P600-10 and 11. Five volts at the two port means no keypad has been pressed. Note the following chart for more keypad readings:

P600-10	Reads 0.5 V:	Squelch Up
	Reads 1.5 V:	Squelch Down
	Reads 2.5 V:	Monitor Mode
	Reads 3.75 V:	Channel Selection
P600-11	Reads 0.5 V:	Address Selection
	Reads 1.5 V:	Scan Mode
	Reads 2.5 V:	Channel Down
	Reads 3.75 V:	Channel Up

INTERNAL/EXTERNAL SPEAKER

The selection of internal handset audio, or external speaker will be done only by hardware jumpers.

Handset Audio Mode

Unbalanced mode, audio is present only on pin 8 of the microphone connector (P601). Jumpers JU600 in and JU601 out.

Balanced Audio Mode

Audio present on pins 2 and 8 of the microphone connector (P600). Jumpers JU601 in and JU600 out.

9600 BUS-PTT-MONITOR-AUXILIARY

The radio will mux three lines of the microphone connector to be either the 9600 bus line (Busy/BUS-/BUS+) OR Normal mode (PTT/Monitor/Auxiliary).

Pin P600-14 will be the sense line that will activate the mux to switch from 9600 BUS to the normal mode. The switch command is given when current is sensed on pin 1 of microphone connector (P601). The three lines come pre-muxed from the controller on pins P600-4,3, and 15.

CONTROL HEAD MODELS I & J

INTRODUCTION

The Control Head forms the interface between the radio and the user. It contains an LCD display, on/off and volume switch, keypad and control keys. Control Head model I contains a rotary switch in place of a full keypad.

The microprocessor controlled Control Head interfaces to the radio control logic board J0650 via an 18-pin connector on the back of the unit. An external microphone/speaker is connected to the Control Head via the front mounted microphone connector P0651.

POWER SUPPLIES

Power supply A+ (pin 17) is routed directly from the radio battery and is used for LCD and keypad backlight LEDs and indicator LEDs.

Power supply B+ (pin 18) is routed from the radio battery via the radio on/off switch. It is routed to the microphone connector current sensor device (Q0664) and provides Vcc via regulator U0650.

Option SW B+ (pin 1) is the power supply output to the connected accessory. The current is monitored by the Control Head to operate the multiplexer. (Refer to Mode Select)

AUDIO CONFIGURATION

The Control Head can be configured for Handset audio or Speaker+ which is a balanced output from the radio. Handset audio is configured by inserting R0665 in the line from pin 8 to the microphone connector. Speaker + audio is configured by inserting R0664 in the line from pin 1 to the microphone connector. Note that only one resistor R0655 or R0644 must be fitted.

VOLUME CONTROL/ON-OFF

Front panel switch/potentiometer R0696 controls the volume via A/D converter PD0 (pin 14) in micro-controller (µC) U0653. The centre of the potentiometer is a push button switch used for microphone input and power on-off. When activated the microphone line (pin 9) is connected to ground.

MICRO-CONTROLLER

Micro-controller U0653 and Data Expander U0654 control the operation of the Control Head. The µC exchanges data with the radio via the SB9600 bus (TD0 and RD1) and monitors inputs from the microphone connector via the A/D port (PD0-PD7). In addition keypad and LCD data is processed via ports A,B and C. Both the µC and the Expander are reset by under voltage detector U0660 when Vcc drops below 4.6 V. Both devices can also be reset from the radio via the reset line (pin 3) and Q0655.

XTAL OSCILLATOR

The xtal oscillator is built using on chip oscillator gates of the micro-processor. The xtal is a standard 4 MHz ceramic resonator.

LCD

Backlight

The backlight consists of 36 LEDs in model I and 48 LEDs in model J. Light intensity is in 4 levels including off and is software controlled by bus commands via Expander U0654 (Q6, Q7). A temperature condition in the Control Head overrides the software commands such that on rising to 78°C or above the lowest light level or off is selected.

Controller

LCD controller U0651 contains the default character set. On Control Head model J the controller is expanded by the use of an LCD driver U0652. The LCD controller is connected to the µC via data bus PA0-PA7, while the control and read/write (R/W) lines are connected via PB5 and PB7 respectively.

Power Supplies

The LCD bias voltage drives the display segments. The bias voltage is divided into 5 levels by R0707 to R0711 and routed to the LCD controller (and LCD driver in Control Head model J) under µC control via U0655. The µC measures the bias voltage with respect to Vcc (TP3) at A/D port PD3. Another function of the bias voltage is temperature which is measured across R0742 at A/D port PD7. The µC calculates the correction to the bias voltage and adjusts the duty cycle of the PLMA output to U0655 accordingly.

Display

Display (H0650) is a double layer super twist LCD display. Control Head model I has one line of 14 characters with fixed symbols on top, six key-related symbols on the bottom and RSSI symbol on the right-hand side. Control Head model J is similar but has two lines of 14 characters. The presence of a rotary switch tells the software that the display is a one-line display.

Temperature Sensor

µC U0653 measures voltage on PD7 which is controlled by dividers R0741 and R0742. R0742 is an NTC resistor which is placed in close proximity to the LCD display. The temperature sensor protects the backlight LEDs from failure and is also used to com-

pensate the LCD bias voltage dependent on the LCD glass temperature. The protection temperature is 77°C ±6°C.

KEYPAD

Backlight

The backlight consists of 7 LEDs in model I and 13 LEDs in model J. The backlight can be switched on/off by the radio software, controlled via µC U0653 TCMP1 and TCMP2. A high pulse on TCMP1 turns on the backlight and a low pulse on TCMP2 turns it off. If the temperature rises above 78°C in the Control Head the µC turns off the backlight utilising the Temperature Sensor input.

Keypad

The keypad is a passive input scanning matrix such that each key has 3 poles. When a key is pressed a row and column are connected to ground and sensed by the µC (PB0-PB4/PC0-PC4). Only Control Head model J contains a full keypad.

ROTARY SWITCH

Rotary switch R0697 (Control Head model I only) is a double wiper continuous turn 16-step potentiometer.The two wipers are connected to two A/D inputs on the µC U0653 (PD1, PD2). One input covers 8 steps from 0° to 180° and the other the 8 steps from 180° to 360°. The switch function is software programmable and may be used for example to select shortform call numbers.

MODE SELECT

To reduce the number of pins on the microphone connector multiplexing is utilised to switch between the 3 different modes, Normal mode, SB9600 mode and Keyload mode.

Multiplexer Operation

The multiplexer comprises U0657, U0658 and U0659. Inputs to the multiplexer are from the microphone connector pins 3, 6 and 7. The multiplexer is switched either by a current sensing device (Q0664, Q0665), for Normal and SB9600 Bus modes, or by software for keyload mode. Pin 1 of the microphone connector carries the output current of the connected device.

When the output current is below 30 µA, the multiplexer is switched to the Normal mode.

When the connected device is an SB9600 device, the current is greater than 2 mA and the multiplexer is switched to SB9600 mode. Note that when an SB9600 device is self-powered, i.e. no current consumption from the microphone connector, a dummy load must be connected to pin 1 to ensure a minimum current of 2 mA and force the multiplexer into the SB9600 mode. A field programmer is an example of such a device.

In the Secure keyload mode, an A/D input on the µC U0653 (PD6) monitors the Speaker-output dc voltage. If the output is short circuit to ground for more than 1 second, the µC senses this via R0689/R0690 network and switches the multiplexer to keyload mode via U0654 (Q1). This action overrides the current sensor device.

Normal Mode

Typically a microphone with no microprocessor is connected to the microphone connector. Inputs in this mode include PTT, Monitor and Auxiliary. In Normal mode these inputs are routed via the multiplexer to the µC A/D port where the analogue voltage is measured and decoded for all four possible combinations of PTT/Monitor and the 4 Auxiliary levels.

SB9600 Bus Mode

Typically a control microphone, intelligent handset or field programmer is connected to the microphone connector. Inputs inlude Bus+, Bus- and Busy.

On selection of this mode Bus+ and Bus- are routed from the multiplexer via the bus comparator circuit (Q0660, Q0661 and U0656) to the µC bus interface (RD1/TD0). Busy is routed to the radio via the Busy line (pin 14).

Secure Mode

This is the secure keyload mode. The inputs in this mode include WE (Write Enable), KID (Keyload) and Key Fail. On selection of this mode these inputs are routed from the multiplexer to the radio via pin 10 (WE), pin 12 (KID) and pin 11(Key Fail).

CONTROL HEAD MODEL C

INTRODUCTION

The Control Head forms the interface between the radio and the user. It contains an LCD display, on/off and volume switch, keypad and control keys.

The microprocessor controlled Control Head interfaces to the radio control logic board J0650 via an 18-pin connector on the back of the unit. An external microphone/speaker is connected to the Control Head via the front mounted microphone connector P0651.

POWER SUPPLIES

Power supply A+ (pin 17) is routed directly from the radio battery and is used for LCD and keypad backlight LEDs and indicator LEDs.

Power supply B+ (pin 18) is routed from the radio battery via the radio on/off switch and provides Vcc via regulator U0654.

Option SW B+ (pin 1) is the power supply output to the connected accessory. The current is monitored by the Control Head to operate the multiplexer. (Refer to Mode Select)

AUDIO CONFIGURATION

The Control Head can be configured for Handset audio or Speaker+ which is a balanced output from the radio. Handset audio is configured by inserting R0676 in the line from pin 8 to the microphone connector. Speaker + audio is configured by inserting R0675 in the line from pin 1 to the microphone connector. Note that only one resistor R0676 or R0675 must be fitted.

VOLUME CONTROL/ON-OFF

Front panel switch/potentiometer R0698 controls the volume via A/D converter PD0 (pin 14) in micro-controller (µC) U0653. The centre of the potentiometer is a push button switch used for microphone input and power on-off. When activated the microphone line (pin 9) is connected to ground.

MICRO-CONTROLLER

Micro-controller U0653 controls the operation of the Control Head. The µC exchanges data with the radio via the SB9600 bus (TD0 and RD1) and monitors inputs from the microphone connector via the A/D port (PD0-PD7). The µC is reset from the radio via the reset line (pin 3) and Q0652.The µC is also reset by under voltage detector U0657 when Vcc drops below 4.6V.

XTAL OSCILLATOR

The xtal oscillator is built using on chip oscillator gates of the micro-processor. The xtal is a standard 4 MHz ceramic resonator.

LCD

Backlight

The backlight consists of 10 LEDs. Light intensity is in 3 levels including off and is software controlled by bus commands via µC U0653.

Driver

The LCD driver U0651 contains the default character set.. Its interface is a four line serial interface. The LCD driver is connected to the uC on pins PA0 - PA3. The driver has a built in oscillator with one external resistor, R0700, defining the clock frequency. The oscillator runs at approx. 25 kHz giving an LCD frame frequency of approx. 48 Hz.

Power Supplies

The LCD driver and bias voltages are powered either from 5.0 V or 5.7 V. The LCD bias voltage levels are created by the voltage divider R0701, R0702 and R0703. This gives four voltages: supply voltage (VDD), V1, V2 and V3=GND. The COM and SEG outputs from U061 jump between these 4 bias voltage levels, which create the on and off AC voltage for each LCD segment.

Resistors R0715 and R0716 prevent U0651 from going into test mode during power up.

The LCD supply voltage is controlled by the microcontroller U0653 PA6.

Display

Display (H0650) is a transmissive/reflective positive LCD display. The Control Head has one line of 8 characters with fixed symbols on top, four key-related symbols on the bottom and three colour indicators.

Colour Indicators

The three colour indicators are 4 LEDs D0679, D0680, D0681 and D0682. There are two yellow LEDs in order to increase the colour intensity.

KEYPAD

Backlight

The keypad backlight is turned on and controlled along with the LCD backlight.

Keypad

The keypad is a static input with 10 kohms pull-up resistors. There is no scanning, but simply one input for each key. Debouncing control is handled by the software.

MODE SELECT

To reduce the number of pins on the microphone connector multiplexing is utilised to switch between the 3 different modes, Normal mode, SB9600 mode and Keyload mode.

Multiplexer Operation

The multiplexer comprises U0655 and U0656. Inputs to the multiplexer are from the microphone connector pins 3, 6 and 7. The multiplexer is switched either by a current sensing device (Q0662, Q0663), for Normal and SB9600 Bus modes, or by software for keyload mode. Pin 1 of the microphone connector carries the output current of the connected device.

When the output current is below 30 µA, the multiplexer is switched to the Normal mode.

When the connected device is an SB9600 device, the current is greater than 2 mA and the multiplexer is switched to SB9600 mode. Note that when an SB9600 device is self-powered, i.e. no current consumption from the microphone connector, a dummy load must be connected to pin 1 to ensure a minimum current of 2 mA and force the multiplexer into the SB9600 mode. A field programmer is an example of such a device.

In the Secure keyload mode, an A/D input on the µC U0653 (PD6) monitors the Speaker-output dc voltage. If the output is short circuit to ground for more than 1 second, the µC senses this and switches to keyload mode (via PC7 output).

Normal Mode

Typically a microphone with no microprocessor is connected to the microphone connector. Inputs in this mode include PTT, Monitor and Auxiliary. In Normal mode these inputs are routed to the µC A/D port where the analogue voltage is measured and decoded for all possible combinations of PTT, Monitor and Auxiliary.

SB9600 Bus Mode

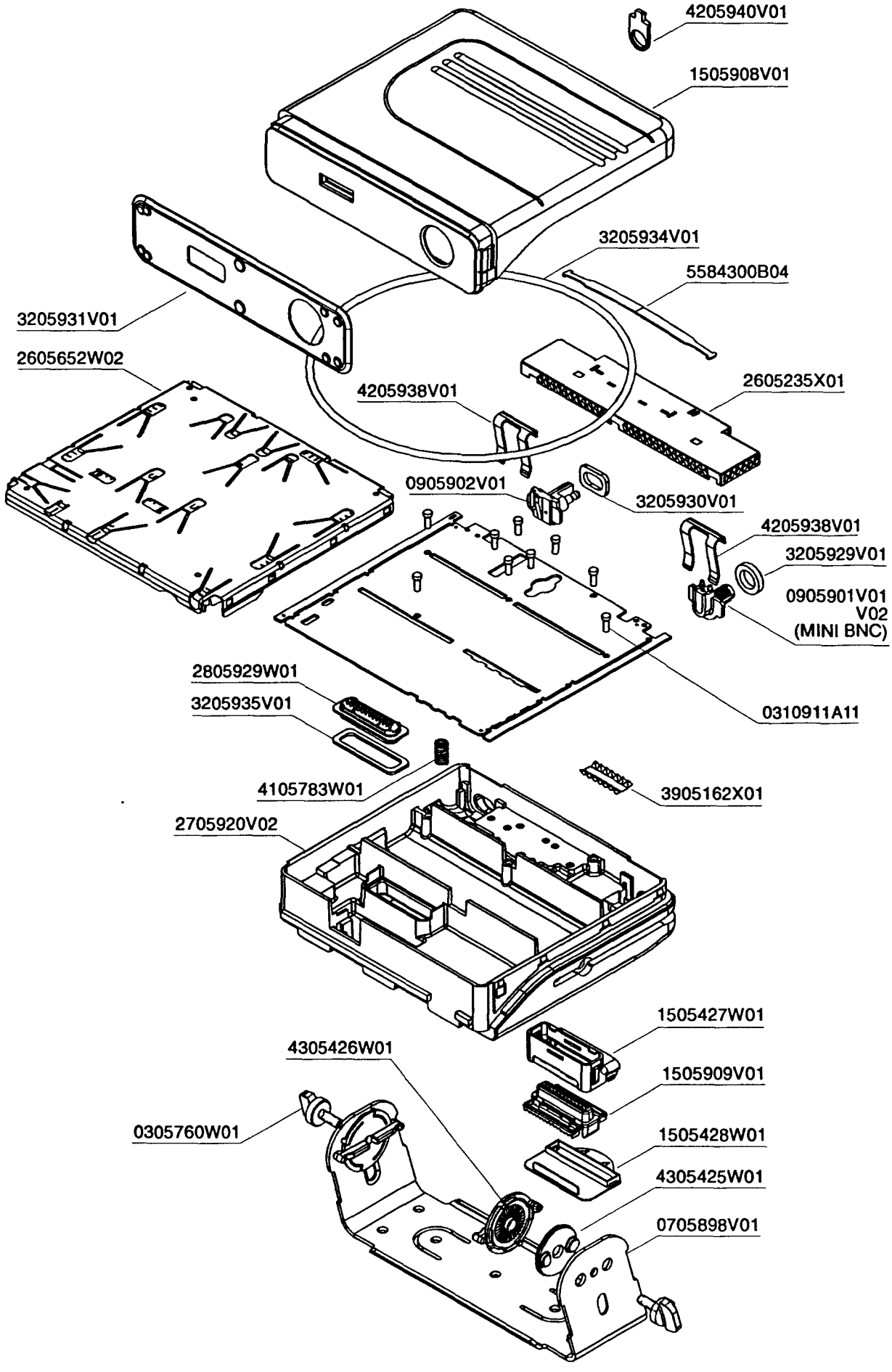
Typically a control microphone, intelligent handset or field programmer is connected to the microphone connector. Inputs inlude Bus+, Bus- and Busy.

On selection of this mode Bus+ and Bus- are routed from the multiplexer via the bus comparator circuit (Q0655, Q0656 and U0658) to the µC bus interface (RD1/TD0). Busy is routed to the radio via the Busy line (pin 14).

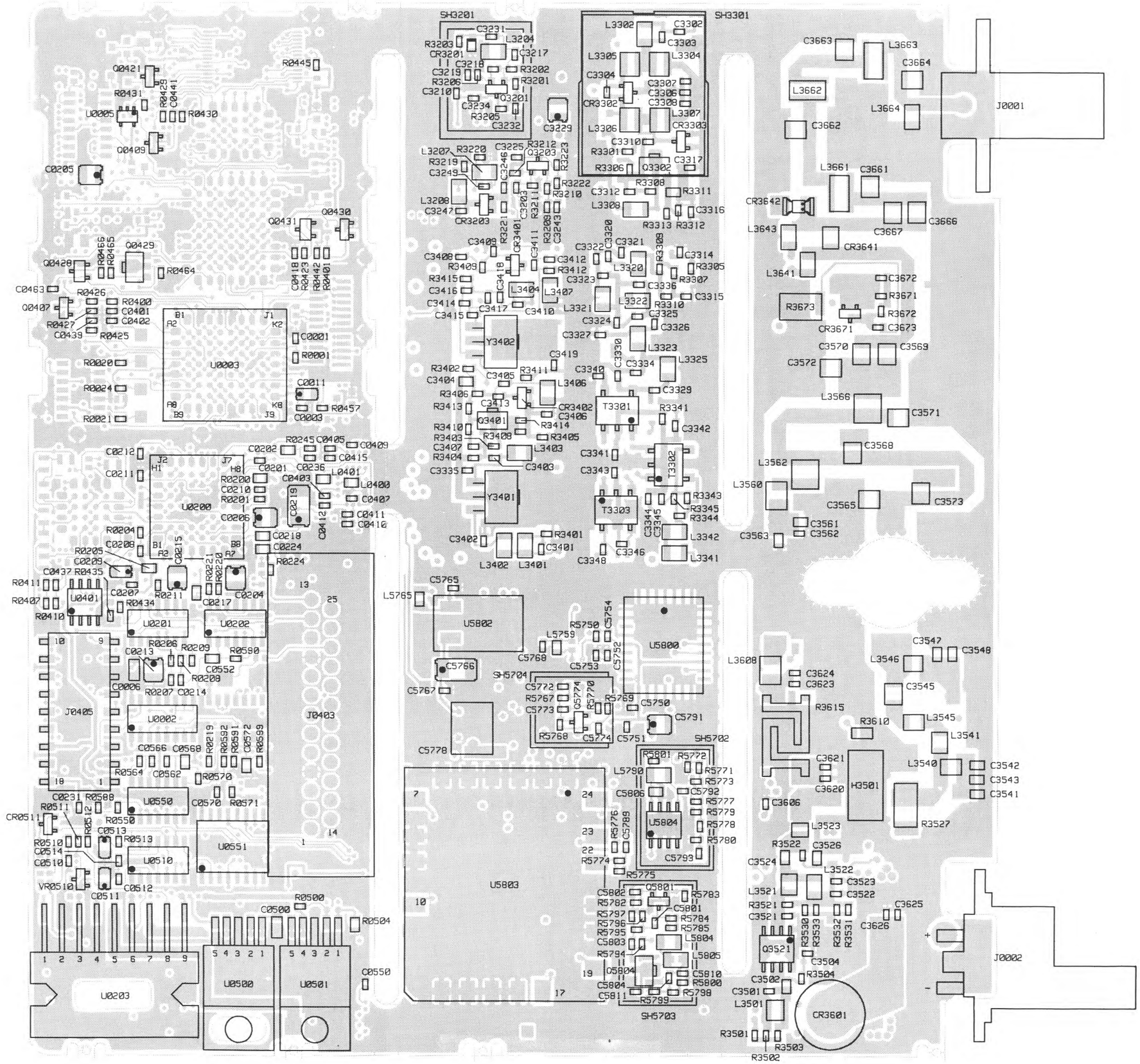
Secure Mode

This is the secure keyload mode. The inputs in this mode include WE (Write Enable), KID (Keyload) and Key Fail. On selection of this mode these inputs are routed from the multiplexer to the radio via pin 10 (WE), pin 12 (KID) and pin 11(Key Fail).

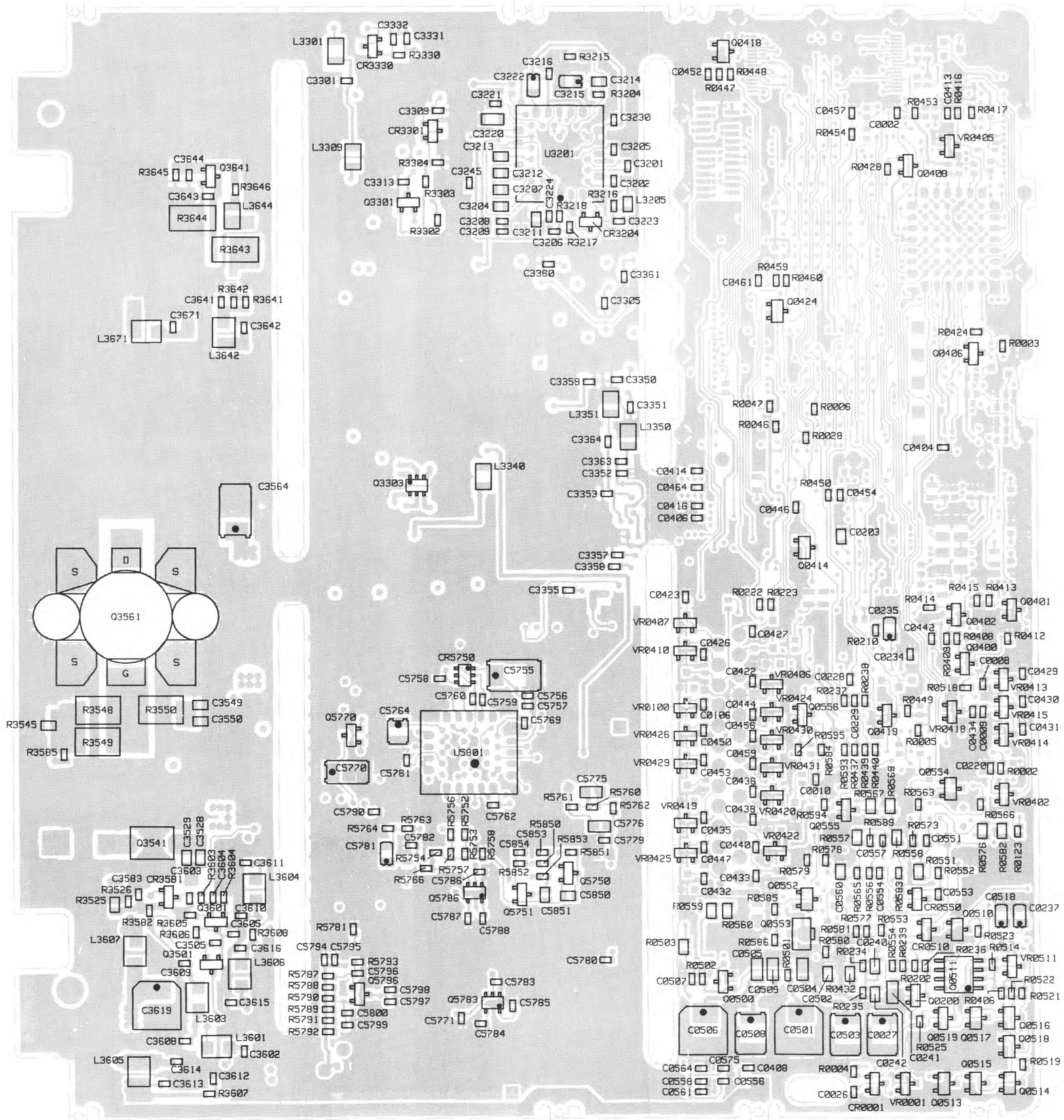
DIAGRAMS AND PARTS LISTS OVERVIEW



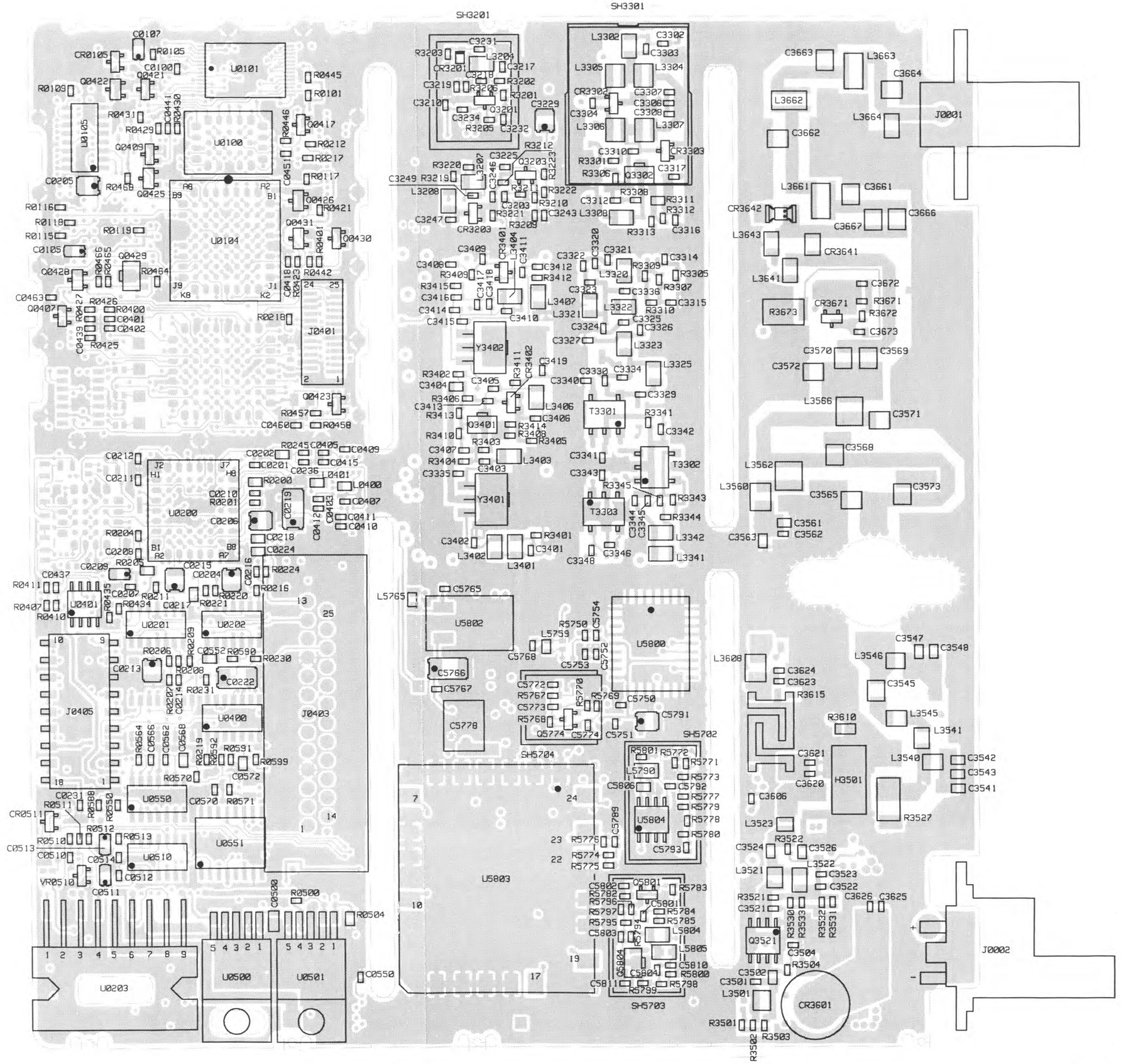
TRANSCEIVER EXPLODED VIEW DIAGRAM AND PART NUMBERS



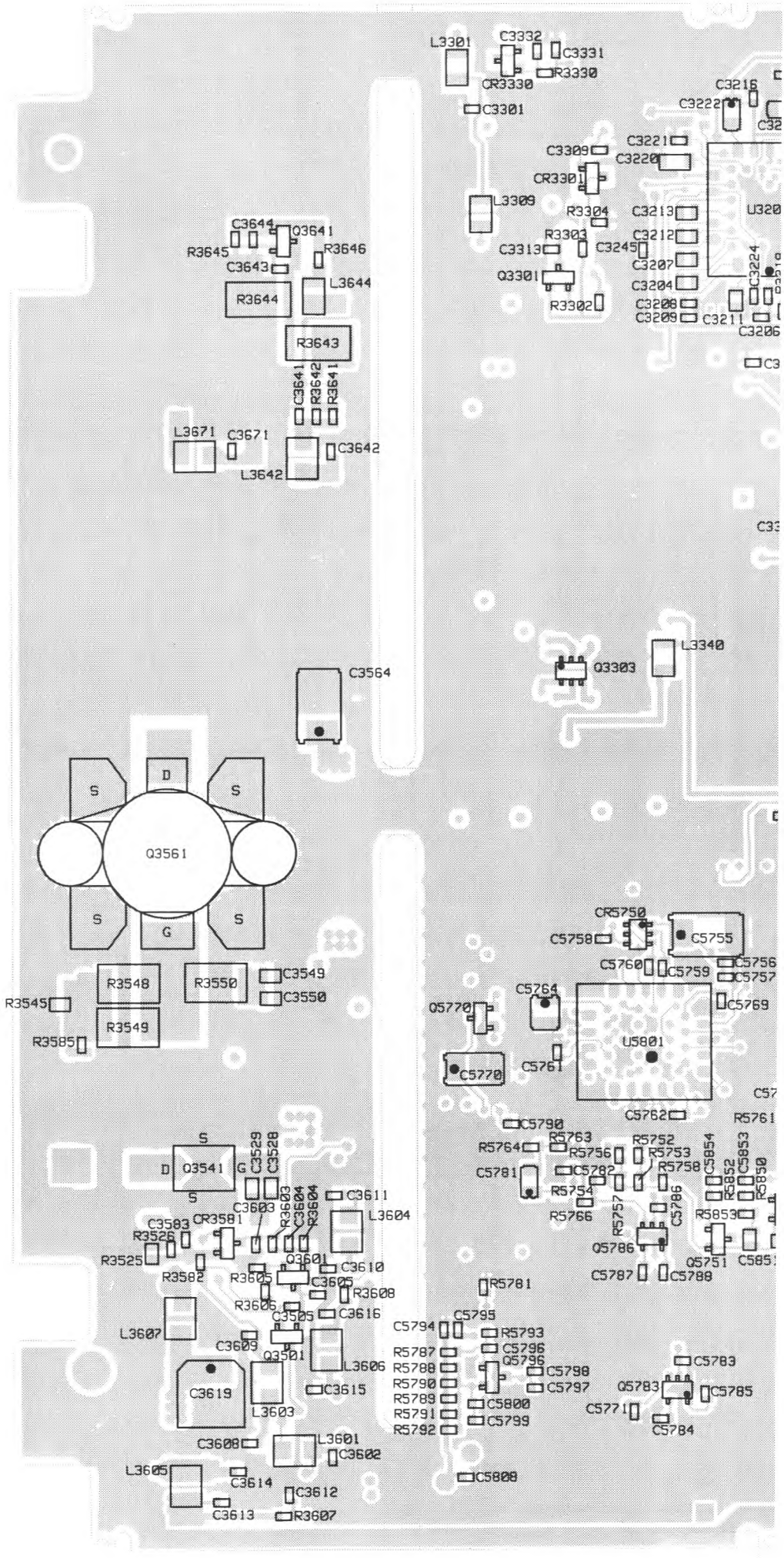
MAIN BOARD, VHF, CLOSED ARCHITECTURE
COMPONENT LOCATION DIAGRAM, SIDE 1



MAIN BOARD, VHF, CLOSED ARCHITECTURE
COMPONENT LOCATION DIAGRAM, SIDE 2



MAIN BOARD, VHF, OPEN ARCHITECTURE
COMPONENT LOCATION DIAGRAM, SIDE 1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C3332
C3331
CR3330
R3330
C3301
C3216
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C3309
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R3304
C3213
U320
R3303
C3212
C3313
C3245
C3207
Q3301
C3204
R3302
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Q3641
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C3642
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C3564
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G
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C5762
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C5781
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R5757
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Q3601
R3605
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C3605
R3608
R3606
C3616
C3505
L3607
C3609
Q3501
L3606
C3619
C3615
L3603
C3608
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C3602
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C3614
C3612
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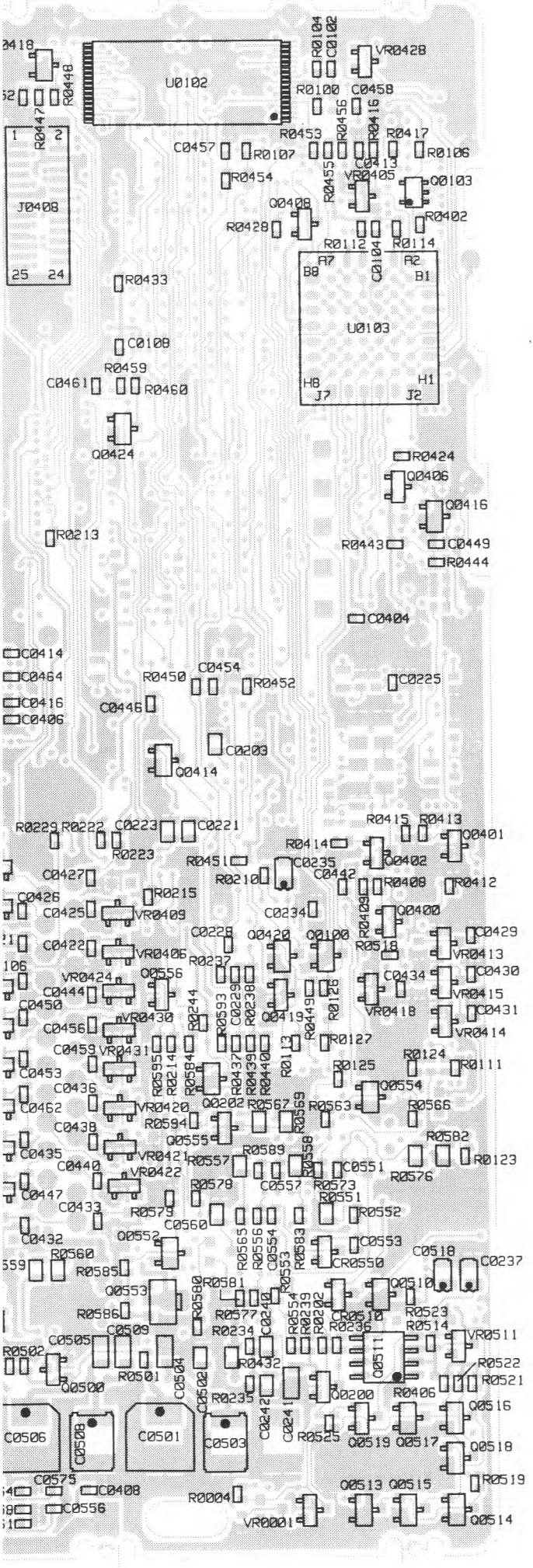
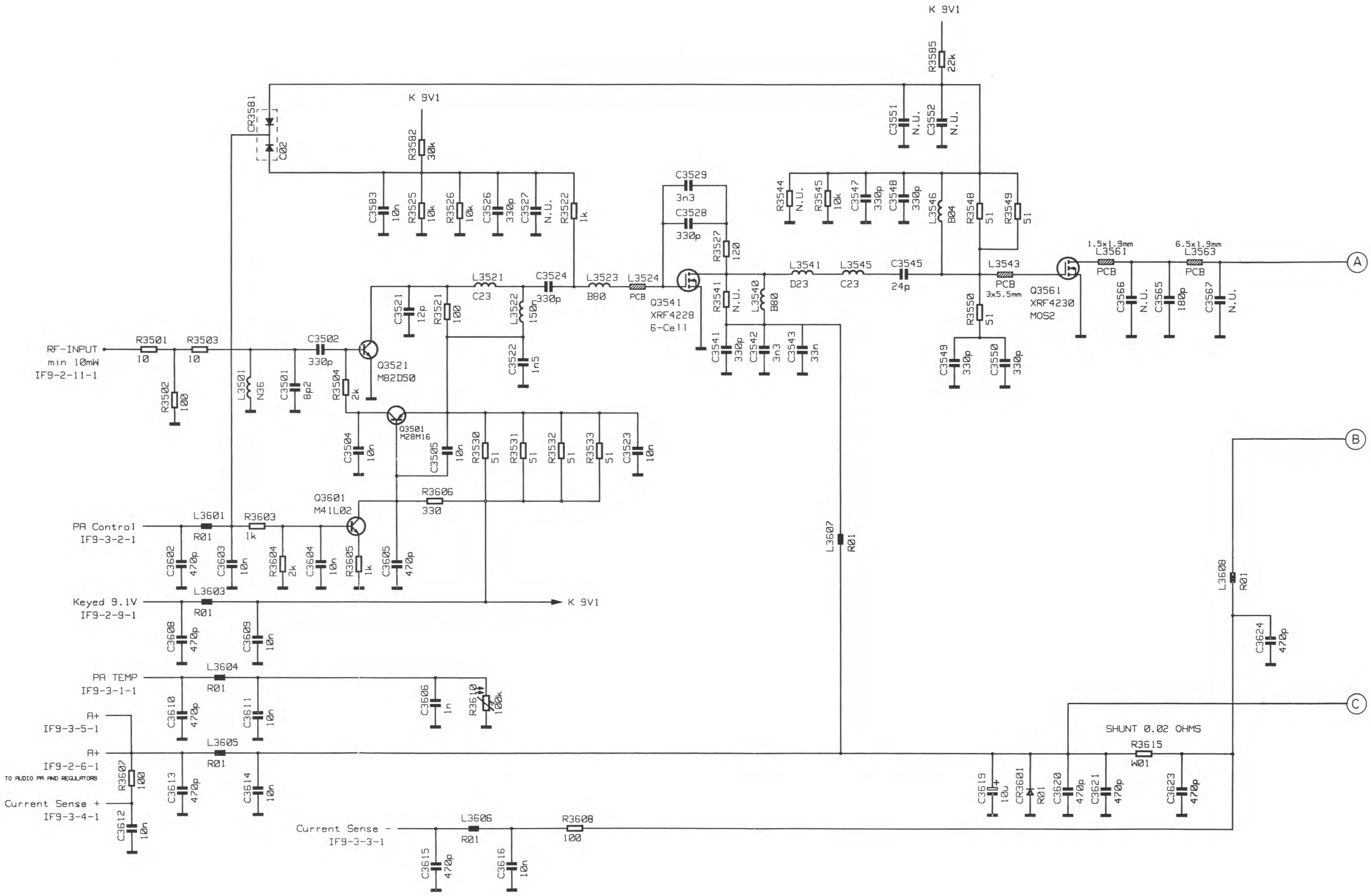
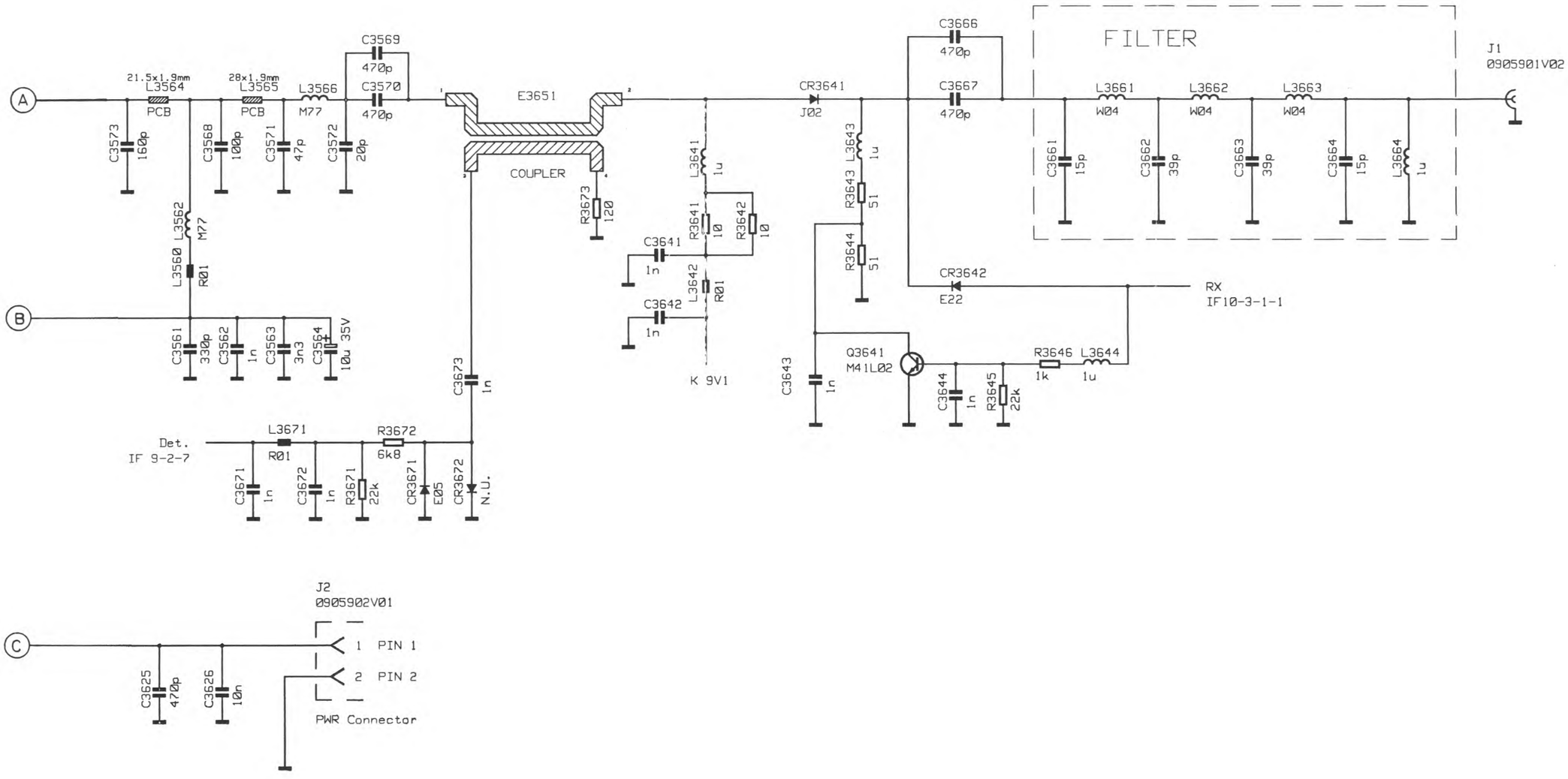
C5785
C5771
C5784



MAIN BOARD, VHF, OPEN ARCHITECTURE
COMPONENT LOCATION DIAGRAM, SIDE 2



POWER AMPLIFIER BOARD, 1-25 W, VHF
SCHEMATIC DIAGRAM, Page 1 of 2


A
B
C
21.5x1.9mm
L3564
PCB
28x1.9mm
L3565
PCB
L3566
M77
C3569
470p
C3570
470p
E3651
COUPLER
C3573
160p
C3568
100p
C3571
47p
C3572
20p
L3560
L3562
M77
R01
C3561
330p
C3562
1n
C3563
3n3
C3564
10u 35V
R3673
120
L3641
1u
R3641
10
R3642
10
C3641
1n
C3642
1n
L3642
R01
K 9V1
C3673
1n
CR3641
J02
C3666
470p
C3667
470p
R3643
51
L3643
1u
R3644
51
CR3642
E22
RX
IF10-3-1-1
FILTER
L3661
W04
L3662
W04
L3663
W04
C3661
15p
C3662
39p
C3663
39p
C3664
15p
L3664
1u
J1
0905901V02
C3643
1n
Q3641
M41L02
C3644
1n
R3645
22k
R3646
1k
L3644
1u
L3671
R01
R3672
6k8
Det.
IF 9-2-7
C3671
1n
C3672
1n
R3671
22k
CR3671
E05
CR3672
N.U.
J2
0905902V01
1 PIN 1
2 PIN 2
PWR Connector
C3625
470p
C3626
10n

ELECTRICAL PARTS LIST POWER AMPLIFIER BOARD, 1-25 W, VHF

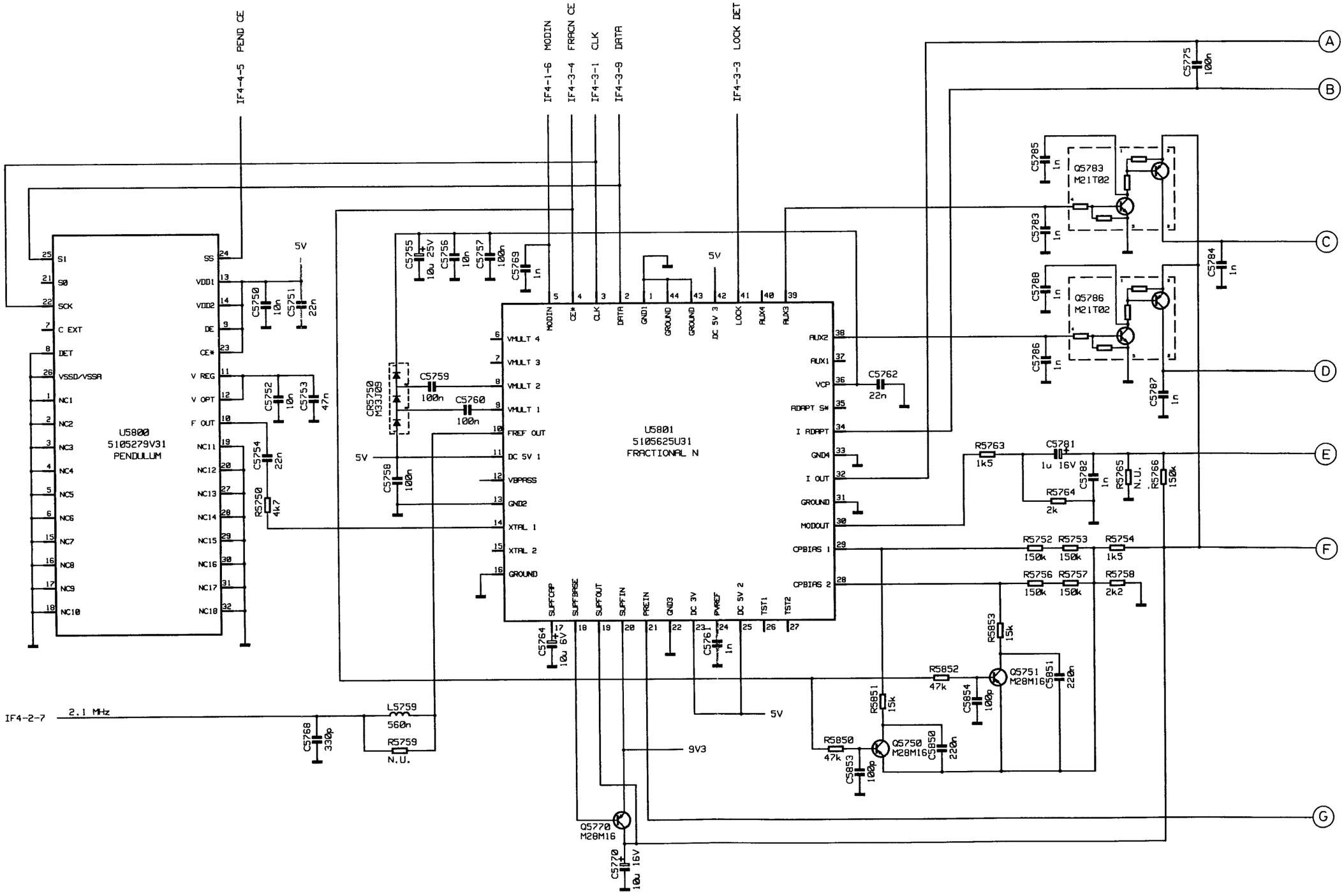
Ref.	Part/Kit No.	Description
	0102724B02	Part No. BD
C3501	2113740F25	CAP CHIP REEL CL1 +/-30 8.2
C3502	2113740A67	CAP CHIP REEL CL1 +/-30 330
C3504	2113741F49	CAP CHIP CL2 X7R REEL 10000
C3505	2113741F49	CAP CHIP CL2 X7R REEL 10000
C3521	2113740F29	CAP CHIP REEL CL1 +/-30 12
C3522	2113741F29	CAP CHIP CL2 X7R REEL 1500
C3523	2113741F49	CAP CHIP CL2 X7R REEL 10000
C3524	2113740A67	CAP CHIP REEL CL1 +/-30 330
C3526	2113740A67	CAP CHIP REEL CL1 +/-30 330
C3528	2113740A67	CAP CHIP REEL CL1 +/-30 330
C3529	2113741A33	CAP CHIP CL2 X7R REEL 3300
C3541	2113740A67	CAP CHIP REEL CL1 +/-30 330
C3542	2113741A33	CAP CHIP CL2 X7R REEL 3300
C3543	2113741A57	CAP CHIP CL2 X7R REEL 33000
C3545	2111078B23	CAP CHIP RF 24 5 NPO 100V
C3547	2113740A67	CAP CHIP REEL CL1 +/-30 330
C3548	2113740A67	CAP CHIP REEL CL1 +/-30 330
C3549	2113740A67	CAP CHIP REEL CL1 +/-30 330
C3550	2113740A67	CAP CHIP REEL CL1 +/-30 330
C3561	2113740A67	CAP CHIP REEL CL1 +/-30 330
C3562	2113741F25	CAP CHIP CL2 X7R REEL 1000
C3563	2113741A33	CAP CHIP CL2 X7R REEL 3300
C3564	2311049A45	CAP TANT CHIP 10 10 35
C3565	2111078B49	CAP CHIP RF 180 5 NPO 100V
C3568	2111078B42	CAP CHIP RF 100 5 NPO 100V
C3569	2111078B59	CAP CHIP RF 470 5 NPO 100V
C3570	2111078B59	CAP CHIP RF 470 5 NPO 100V
C3571	2111078B34	CAP CHIP RF 45 5 NPO 100V
C3572	2111078B21	CAP CHIP RF 20 5 NPO 100V
C3573	2111078B48	CAP CHIP RF 160 5 NPO 100V
C3583	2113741F49	CAP CHIP CL2 X7R REEL 10000
C3602	2113741F17	CAP CHIP CL2 X7R REEL 470
C3603	2113741F49	CAP CHIP CL2 X7R REEL 10000
C3604	2113741F49	CAP CHIP CL2 X7R REEL 10000
C3605	2113741F17	CAP CHIP CL2 X7R REEL 470
C3606	2113741F25	CAP CHIP CL2 X7R REEL 1000
C3608	2113741F17	CAP CHIP CL2 X7R REEL 470
C3609	2113741F49	CAP CHIP CL2 X7R REEL 10000
C3610	2113741F17	CAP CHIP CL2 X7R REEL 470
C3611	2113741F49	CAP CHIP CL2 X7R REEL 10000
C3612	2113741F49	CAP CHIP CL2 X7R REEL 10000
C3613	2113741F17	CAP CHIP CL2 X7R REEL 470
C3614	2113741F49	CAP CHIP CL2 X7R REEL 10000
C3615	2113741F17	CAP CHIP CL2 X7R REEL 470
C3616	2113741F49	CAP CHIP CL2 X7R REEL 10000
C3619	2380090M24	CAP ALU 10 20 50V SURF MT
C3620	2113741F17	CAP CHIP CL2 X7R REEL 470
C3621	2113741F17	CAP CHIP CL2 X7R REEL 470
C3623	2113741F17	CAP CHIP CL2 X7R REEL 470
C3624	2113741F17	CAP CHIP CL2 X7R REEL 470
C3625	2113741F17	CAP CHIP CL2 X7R REEL 470
C3626	2113741F49	CAP CHIP CL2 X7R REEL 10000
C3641	2113741F25	CAP CHIP CL2 X7R REEL 1000
C3642	2113741F25	CAP CHIP CL2 X7R REEL 1000
C3643	2113741F25	CAP CHIP CL2 X7R REEL 1000
C3644	2113741F25	CAP CHIP CL2 X7R REEL 1000
C3661	2111078B18	CAP CHIP RF 15 5 NPO 100V
C3662	2111078B32	CAP CHIP RF 39 5 NPO 100V
C3663	2111078B32	CAP CHIP RF 39 5 NPO 100V
C3664	2111078B18	CAP CHIP RF 15 5 NPO 100V
C3666	2111078B59	CAP CHIP RF 470 5 NPO 100V
C3667	2111078B59	CAP CHIP RF 470 5 NPO 100V

Ref.	Part/Kit No.	Description
C3671	2113741F25	CAP CHIP CL2 X7R REEL 1000
C3672	2113741F25	CAP CHIP CL2 X7R REEL 1000
C3673	2113741F25	CAP CHIP CL2 X7R REEL 1000
CR3581	4813833C02	DIODE DUAL 70V '5B' COMM CATH
CR3601	4880222R01	DIODE REVERSE POLARITY SPECTRA
CR3641	4802482J02	PIN DIODE SMD
CR3642	4880236E22	DIODE PIN 4880236E22
CR3671	4880236E05	DIODE HOT CAR SOT 23
J1	0905901V02	CONNECTOR ANTENNA BNC
J2	0905902V01	CONN PWR
L3501	2460591N36	COIL AIR WOUND INDUC43.67
L3521	2460591C23	COIL AIR WOUND INDUC 13.85
L3522	2462587T17	IND CHIP 150NH 5% LOW PRO
L3523	2460591B80	COIL AIR WOUND INDUC19.61
L3540	2460591B80	COIL AIR WOUND INDUC19.61
L3541	2460591D23	COIL AIR WOUND INDUC 17.24
L3545	2460591C23	COIL AIR WOUND INDUC 13.85
L3546	2460591B04	COIL AIR WOUND INDUC11.03
L3560	2484657R01	INDUCTOR BEAD CHIP
L3562	2460591M77	COIL AIR WOUND INDUC 38.13
L3566	2460591M77	COIL AIR WOUND INDUC 38.13
L3601	2484657R01	INDUCTOR BEAD CHIP
L3603	2484657R01	INDUCTOR BEAD CHIP
L3604	2484657R01	INDUCTOR BEAD CHIP
L3605	2484657R01	INDUCTOR BEAD CHIP
L3606	2484657R01	INDUCTOR BEAD CHIP
L3607	2484657R01	INDUCTOR BEAD CHIP
L3608	2484657R01	INDUCTOR BEAD CHIP
L3641	2462587T30	IND CHIP 1000NH 5% LOW PRO
L3642	2484657R01	INDUCTOR BEAD CHIP
L3643	2462587T30	IND CHIP 1000NH 5% LOW PRO
L3644	2462587T30	IND CHIP 1000NH 5% LOW PRO
L3661	2460591W04	COIL SQUARE RFD-022-16
L3662	2460591W04	COIL SQUARE RFD-022-16
L3663	2460591W04	COIL SQUARE RFD-022-16
L3664	2462587T30	IND CHIP 1000NH 5% LOW PRO
L3671	2484657R01	INDUCTOR BEAD CHIP
Q3501	4805128M16	TSTR SOT MMBT3906 (RH) 48G22
Q3521	4880182D50	TSTR SI SORF 4V 750MW 960MHZ
Q3541	4805847W01	TRANS RF PWR BB MOS4
Q3561	4805538W01	TRANS MOS 2 FET
Q3601	4880141L02	TSTR NPN SOT23 LO PROFILE TAPE
Q3641	4880141L02	TSTR NPN SOT23 LO PROFILE TAPE
R3501	0662057A01	CHIP RES 10 OHMS 5%
R3502	0662057A25	CHIP RES 100 OHMS 5%
R3503	0662057A01	CHIP RES 10 OHMS 5%
R3504	0662057A56	CHIP RES 2000 OMHS 5%
R3521	0662057A25	CHIP RES 100 OHMS 5%
R3522	0662057A49	CHIP RES 1000 OMHS 5%
R3525	0660081A73	RES CHIP TRIM 10K 20% 0805
R3526	0660081A73	RES CHIP TRIM 10K 20% 0805
R3527	0683962T51	RES CHIP 120 5-1
R3530	0662057A18	CHIP RES 51 OHMS 5%
R3531	0662057A18	CHIP RES 51 OHMS 5%
R3532	0662057A18	CHIP RES 51 OHMS 5%
R3533	0662057A18	CHIP RES 51 OHMS 5%
R3545	0660081A73	RES CHIP TRIM 10K 20% 0805
R3548	0680194M18	RES 51 OHMS 5% 1W
R3549	0680194M18	RES 51 OHMS 5% 1W
R3550	0680194M18	RES 51 OHMS 5% 1W
R3582	0662057A84	CHIP RES 30K OHMS 5%
R3585	0662057A81	CHIP RES 22K OMHS 5%
R3603	0662057A49	CHIP RES 1000 OMHS 5%
R3604	0662057A56	CHIP RES 2000 OMHS 5%

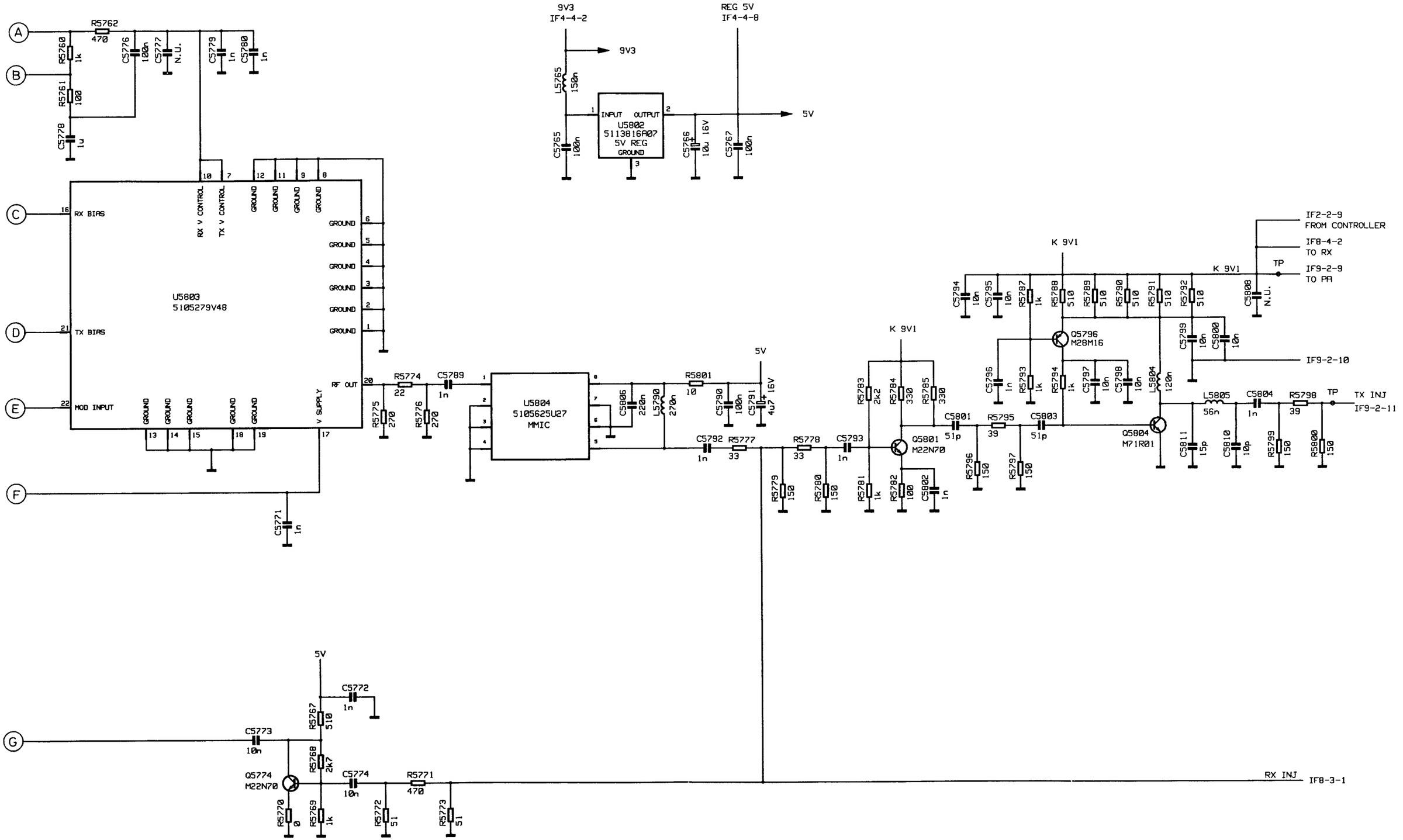
ELECTRICAL PARTS LIST POWER AMPLIFIER BOARD, 1-25 W, VHF

Ref.	Part/Kit No.	Description
R3605	0662057A49	CHIP RES 1000 OMHS 5%
R3606	0662057A37	CHIP RES 330 OHMS 5%
R3607	0662057A25	CHIP RES 100 OHMS 5%
R3608	0662057A25	CHIP RES 100 OHMS 5%
R3610	0680149M02	THERMISTOR CHIP 100K OHM
R3615	1705603W01	RES SMT SHUNT
R3641	0662057A01	CHIP RES 10 OHMS 5%
R3642	0662057A01	CHIP RES 10 OHMS 5%
R3643	0680194M18	RES 51 OHMS 5% 1W
R3644	0680194M18	RES 51 OHMS 5% 1W
R3645	0662057A81	CHIP RES 22K OMHS 5%
R3646	0662057A49	CHIP RES 1000 OMHS 5%
R3671	0662057A81	CHIP RES 22K OMHS 5%
R3672	0662057A69	CHIP RES 6800 OMHS 5%
R3673	0683962T51	RES CHIP 120 5-1
		NON REFERENCED ITEMS:
	2605913V01	HEAT SPREADER RF PA (H3501)

Ref.	Part/Kit No.	Description



SYNTHESIZER BOARD, VHF
SCHEMATIC DIAGRAM, Page 1 of 2



SYNTHESIZER BOARD, VHF
SCHEMATIC DIAGRAM, Page 2 of 2

Rev. 06.93

ELECTRICAL PARTS LIST FOR SYNTHESIZER BOARD, VHF

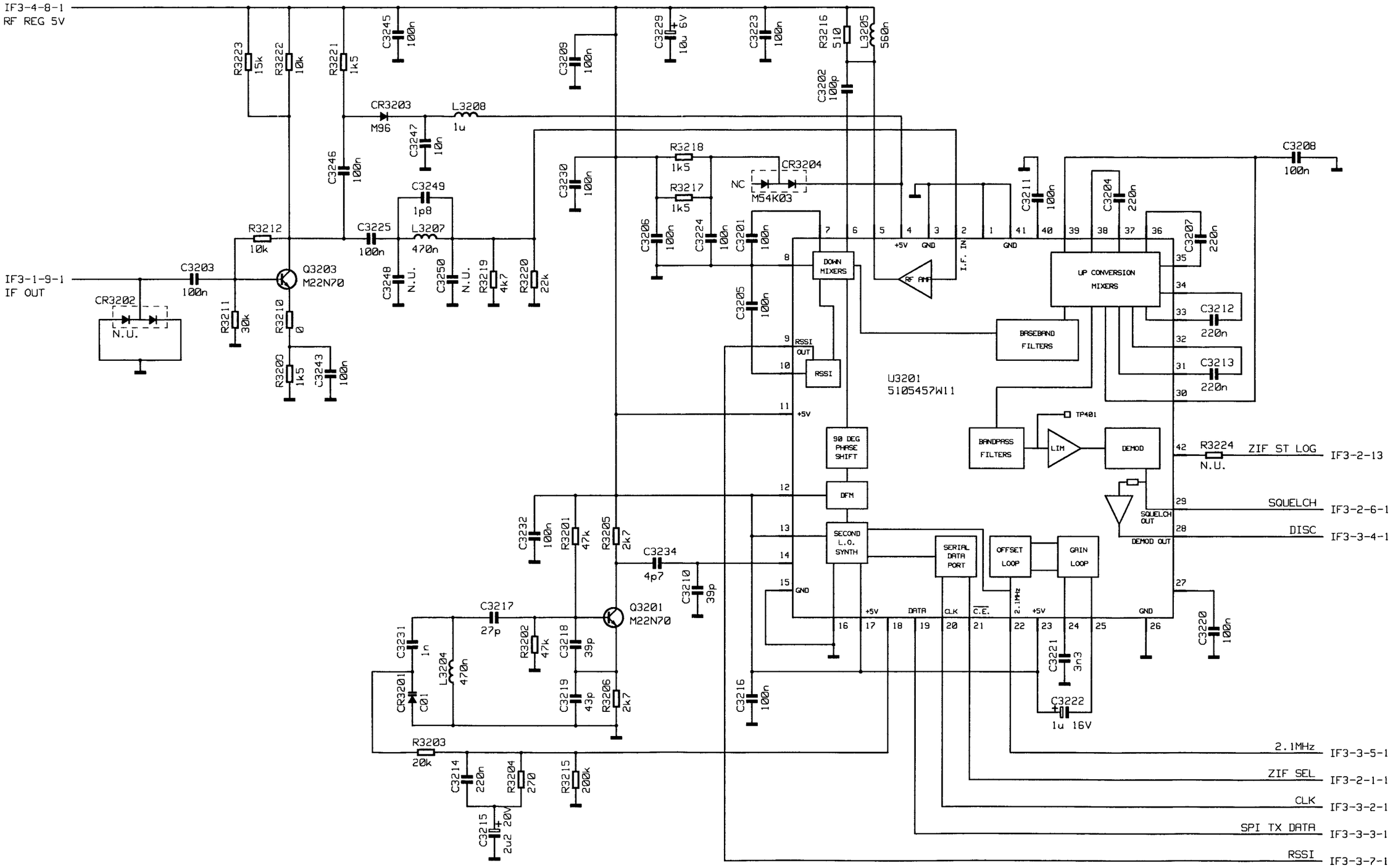
Ref.	Part/Kit No.	Description
	0102724B06	Part No. BD
C5750	2113741F49	CAP CHIP CL2 X7R REEL 10000
C5751	2113743E07	CER CHIP CAP .022UF
C5752	2113741F49	CAP CHIP CL2 X7R REEL 10000
C5753	2113743K07	CER CHIP CAP .047UF
C5754	2113743E07	CER CHIP CAP .022UF
C5755	2311049A19	CAP TANT CHIP 10 10 25 A/P
C5756	2113741F49	CAP CHIP CL2 X7R REEL 10000
C5757	2113743K15	CER CHIP CAP .100UF
C5758	2113743K15	CER CHIP CAP .100UF
C5759	2113743K15	CER CHIP CAP .100UF
C5760	2113743K15	CER CHIP CAP .100UF
C5761	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5762	2113743E07	CER CHIP CAP .022UF
C5764	2311049J23	CAP TANT CHIP 10 10 7
C5765	2113743K15	CER CHIP CAP .100UF
C5766	2311049J26	CAP TANT CHIP 10 20 16
C5767	2113743K15	CER CHIP CAP .100UF
C5768	2113741F13	CAP CHIP CL2 X7R REEL 330
C5769	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5770	2311049J26	CAP TANT CHIP 10 20 16
C5771	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5772	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5773	2113741F49	CAP CHIP CL2 X7R REEL 10000
C5774	2113741F49	CAP CHIP CL2 X7R REEL 10000
C5775	2109720D14	CAP CER CHIP LOW DIST .1 UF
C5776	2109720D14	CAP CER CHIP LOW DIST .1 UF
C5778	0811051A19	CAP MTLZ POLYEST 1.0 5 63V
C5779	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5780	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5781	2311049A07	CAP TANT CHIP 1 10 16 A/P
C5782	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5783	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5784	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5785	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5786	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5787	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5788	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5789	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5790	2113743K15	CER CHIP CAP .100UF
C5791	2311049J11	CAP TANT CHIP 4.7 10 16
C5792	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5793	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5794	2113741F49	CAP CHIP CL2 X7R REEL 10000
C5795	2113741F49	CAP CHIP CL2 X7R REEL 10000
C5796	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5797	2113741F49	CAP CHIP CL2 X7R REEL 10000
C5798	2113741F49	CAP CHIP CL2 X7R REEL 10000
C5799	2113741F49	CAP CHIP CL2 X7R REEL 10000
C5800	2113741F49	CAP CHIP CL2 X7R REEL 10000
C5801	2113740F44	CAP CHIP REEL CL1 +/-30 51
C5802	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5803	2113740F44	CAP CHIP REEL CL1 +/-30 51
C5804	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5806	2113743A23	CAP CHIP .220 UF 10% X7R
C5808	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5810	2113740F27	CAP CHIP REEL CL1 +/-30 10
C5811	2113740F31	CAP CHIP REEL CL1 +/-30 15
C5850	2113743A23	CAP CHIP .220 UF 10% X7R
C5851	2113743A23	CAP CHIP .220 UF 10% X7R
C5853	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5854	2113740F51	CAP CHIP REEL CL1 +/-30 100
CR5750	4802233J09	DIODE TRIPLE SOT143-RH

Ref.	Part/Kit No.	Description
L5759	2462587Q44	IND CHIP 560 NH 10%
L5765	2462587T17	IND CHIP 150NH 5% LOW PRO
L5790	2462587T20	IND CHIP 270NH 5% LOW PRO
L5804	2462587T16	IND CHIP 120NH 5% LOW PRO
L5805	2462587T12	IND CHIP 56NH 5% LOW PRO
Q5750	4805128M16	TSTR SOT MMBT3906 (RH) 48G22
Q5751	4805128M16	TSTR SOT MMBT3906 (RH) 48G22
Q5770	4805128M16	TSTR SOT MMBT3906 (RH) 48G22
Q5774	4882022N70	TRST NPN 22N70 AMPL
Q5783	4805921T02	XISTOR FMC2 RH
Q5786	4805921T02	XISTOR FMC2 RH
Q5796	4805128M16	TSTR SOT MMBT3906 (RH) 48G22
Q5801	4882022N70	TRST NPN 22N70 AMPL
Q5804	4882971R01	TSTR NPN 71R01 RF
R5750	0662057A65	CHIP RES 4700 OMHS 5%
R5752	0662057B02	CHIP RES 150K OHMS 5%
R5753	0662057B02	CHIP RES 150K OHMS 5%
R5754	0662057A53	CHIP RES 1500 OMHS 5%
R5756	0662057B02	CHIP RES 150K OHMS 5%
R5757	0662057B02	CHIP RES 150K OHMS 5%
R5758	0662057A57	CHIP RES 2200 OMHS 5%
R5760	0662057A49	CHIP RES 1000 OMHS 5%
R5761	0662057A25	CHIP RES 100 OHMS 5%
R5762	0662057A41	CHIP RES 470 OHMS 5%
R5763	0662057A53	CHIP RES 1500 OMHS 5%
R5764	0662057A56	CHIP RES 2000 OMHS 5%
R5766	0662057B02	CHIP RES 150K OHMS 5%
R5767	0662057A42	CHIP RES 510 OHMS 5%
R5768	0662057A59	CHIP RES 2700 OMHS 5%
R5769	0662057A49	CHIP RES 1000 OMHS 5%
R5770	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R5771	0662057A41	CHIP RES 470 OHMS 5%
R5772	0662057A18	CHIP RES 51 OHMS 5%
R5773	0662057A18	CHIP RES 51 OHMS 5%
R5774	0662057A09	CHIP RES 22 OHMS 5%
R5775	0662057A35	CHIP RES 270 OHMS 5%
R5776	0662057A35	CHIP RES 270 OHMS 5%
R5777	0662057A13	CHIP RES 33 OHMS 5%
R5778	0662057A13	CHIP RES 33 OHMS 5%
R5779	0662057A29	CHIP RES 150 OHMS 5%
R5780	0662057A29	CHIP RES 150 OHMS 5%
R5781	0662057A49	CHIP RES 1000 OMHS 5%
R5782	0662057A25	CHIP RES 100 OHMS 5%
R5783	0662057A57	CHIP RES 2200 OMHS 5%
R5784	0662057A37	CHIP RES 330 OHMS 5%
R5785	0662057A37	CHIP RES 330 OHMS 5%
R5787	0662057A49	CHIP RES 1000 OMHS 5%
R5788	0662057A42	CHIP RES 510 OHMS 5%
R5789	0662057A42	CHIP RES 510 OHMS 5%
R5790	0662057A42	CHIP RES 510 OHMS 5%
R5791	0662057A42	CHIP RES 510 OHMS 5%
R5792	0662057A42	CHIP RES 510 OHMS 5%
R5793	0662057A49	CHIP RES 1000 OMHS 5%
R5794	0662057A49	CHIP RES 1000 OMHS 5%
R5795	0662057A15	CHIP RES 39 OHMS 5%
R5796	0662057A29	CHIP RES 150 OHMS 5%
R5797	0662057A29	CHIP RES 150 OHMS 5%
R5798	0662057A15	CHIP RES 39 OHMS 5%
R5799	0662057A29	CHIP RES 150 OHMS 5%
R5800	0662057A29	CHIP RES 150 OHMS 5%
R5801	0662057A01	CHIP RES 10 OHMS 5%
R5850	0662057A89	CHIP RES 47K OMHS 5%
R5851	0662057A77	CHIP RES 15K OMHS 5%
R5852	0662057A89	CHIP RES 47K OMHS 5%

ELECTRICAL PARTS LIST FOR SYNTHESIZER BOARD, VHF

Ref.	Part/Kit No.	Description
R5853	0662057A77	CHIP RES 15K OMHS 5%
U5800	5105279V31	16.8 REF OSC MODE
U5801	5105625U31	IC SYNTHESIZER
U5802	5113816A07	REG 5V POS 500MA MC78M05BDTRK
U5803	5105279V48	HYBRID VHF VCO
U5804	5105625U27	IC MIMIC
		NON REFERENCED ITEMS:
	2602660J01	SHIELD, HARMONIC FILTER (SH5702)
	2602660J01	SHIELD, HARMONIC FILTER (SH5703)
	2605259V01	SHIELD, DIODE (SH5704)

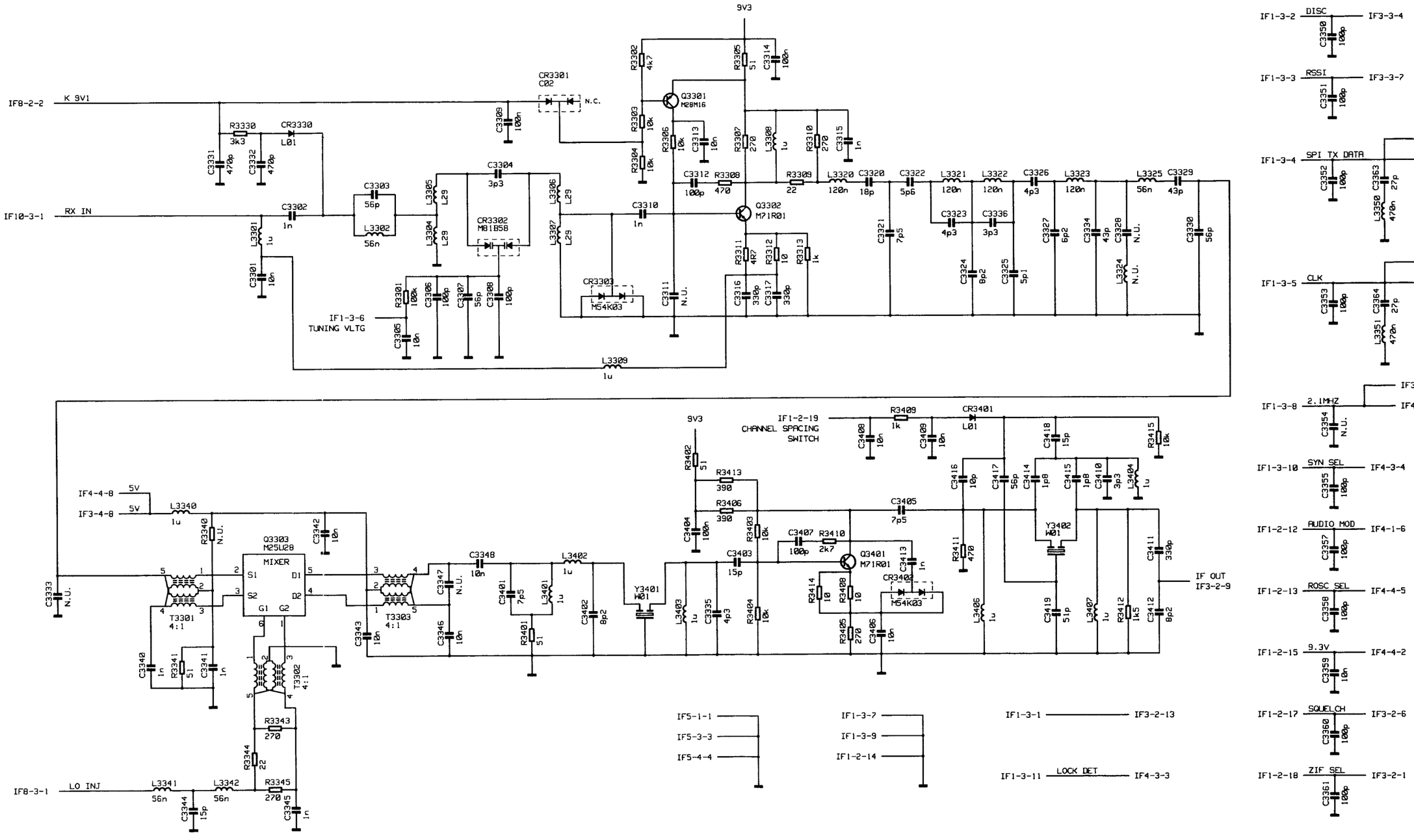
Ref.	Part/Kit No.	Description



ZIF 44.85 MHz, PART OF SYNTHESIZER BOARD, VHF
SCHEMATIC DIAGRAM

ELECTRICAL PARTS LIST FOR ZIF 44.85 MHz, PART OF SYNTHESIZER BOARD, VHF

Ref.	Part/Kit No.	Description
	0102724B04	Part No. BD
C3201	2113743K15	CER CHIP CAP .100UF
C3202	2113740F51	CAP CHIP REEL CL1 +/-30 100
C3203	2113743K15	CER CHIP CAP .100UF
C3204	2113743A23	CAP CHIP .220 UF 10% X7R
C3205	2113743K15	CER CHIP CAP .100UF
C3206	2113743K15	CER CHIP CAP .100UF
C3207	2113743A23	CAP CHIP .220 UF 10% X7R
C3208	2113743K15	CER CHIP CAP .100UF
C3209	2113743K15	CER CHIP CAP .100UF
C3210	2113740F41	CAP CHIP REEL CL1 +/-30 39
C3211	2113743A19	CAP CHIP .100 UF 10% X7R
C3212	2113743A23	CAP CHIP .220 UF 10% X7R
C3213	2113743A23	CAP CHIP .220 UF 10% X7R
C3214	2113743A23	CAP CHIP .220 UF 10% X7R
C3215	2311049A09	CAP TANT CHIP 2.2 10 20 A/P
C3216	2113743K15	CER CHIP CAP .100UF
C3217	2113740F37	CAP CHIP REEL CL1 +/-30 27
C3218	2113740F41	CAP CHIP REEL CL1 +/-30 39
C3219	2113740F42	CAP CHIP REEL CL1 +/-30 43
C3220	2109720D14	CAP CER CHIP LOW DIST .1 UF
C3221	2113741A33	CAP CHIP CL2 X7R REEL 3300
C3222	2311049A07	CAP TANT CHIP 1 10 16 A/P
C3223	2113743K15	CER CHIP CAP .100UF
C3224	2113743K15	CER CHIP CAP .100UF
C3225	2113743K15	CER CHIP CAP .100UF
C3229	2311049J23	CAP TANT CHIP 10 10 7
C3230	2113743K15	CER CHIP CAP .100UF
C3231	2113741F25	CAP CHIP CL2 X7R REEL 1000
C3232	2113743K15	CER CHIP CAP .100UF
C3234	2113740F19	CAP CHIP REEL CL1 +/-30 4.7
C3243	2113743K15	CER CHIP CAP .100UF
C3245	2113743K15	CER CHIP CAP .100UF
C3246	2113743K15	CER CHIP CAP .100UF
C3247	2113741F49	CAP CHIP CL2 X7R REEL 10000
C3249	2113740F09	CAP CHIP REEL CL1 +/-30 1.8
CR3201	4862824C01	DIODE VARACTOR
CR3203	4805129M96	DIODE DUAL BONDS RH
CR3204	4880154K03	DIODE DUAL SCHOTTKY MIXER
L3204	2462587T23	IND CHIP 470NH 5% LOW PRO
L3205	2462587Q44	IND CHIP 560 NH 10%
L3207	2462587T23	IND CHIP 470NH 5% LOW PRO
L3208	2462587T30	IND CHIP 1000NH 5% LOW PRO
Q3201	4882022N70	TRST NPN 22N70 AMPL
Q3203	4882022N70	TRST NPN 22N70 AMPL
R3201	0662057A89	CHIP RES 47K OMHS 5%
R3202	0662057A89	CHIP RES 47K OMHS 5%
R3203	0662057A80	CHIP RES 20K OMHS 5%
R3204	0662057A35	CHIP RES 270 OHMS 5%
R3205	0662057A59	CHIP RES 2700 OMHS 5%
R3206	0662057A59	CHIP RES 2700 OMHS 5%
R3209	0662057A53	CHIP RES 1500 OMHS 5%
R3210	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R3211	0662057A84	CHIP RES 30K OMHS 5%
R3212	0662057A73	CHIP RES 10K OMHS 5%
R3215	0662057B05	CHIP RES 200K OHMS 5%
R3216	0662057A42	CHIP RES 510 OHMS 5%
R3217	0662057A53	CHIP RES 1500 OMHS 5%
R3218	0662057A53	CHIP RES 1500 OMHS 5%
R3219	0662057A65	CHIP RES 4700 OMHS 5%
R3220	0662057A81	CHIP RES 22K OMHS 5%
R3221	0662057A53	CHIP RES 1500 OMHS 5%
R3222	0662057A73	CHIP RES 10K OMHS 5%
R3223	0662057A77	CHIP RES 15K OMHS 5%
U3201	5105457W11	57W11
		NON REFERENCED ITEMS:
	2605261V01	SHIELD ZIF (SH3201)



RX/RF, PART OF SYNTESIZER BOARD, VHF
SCHEMATIC DIAGRAM

ELECTRICAL PARTS LIST FOR RX/RF, PART OF SYNTESIZER BOARD, VHF

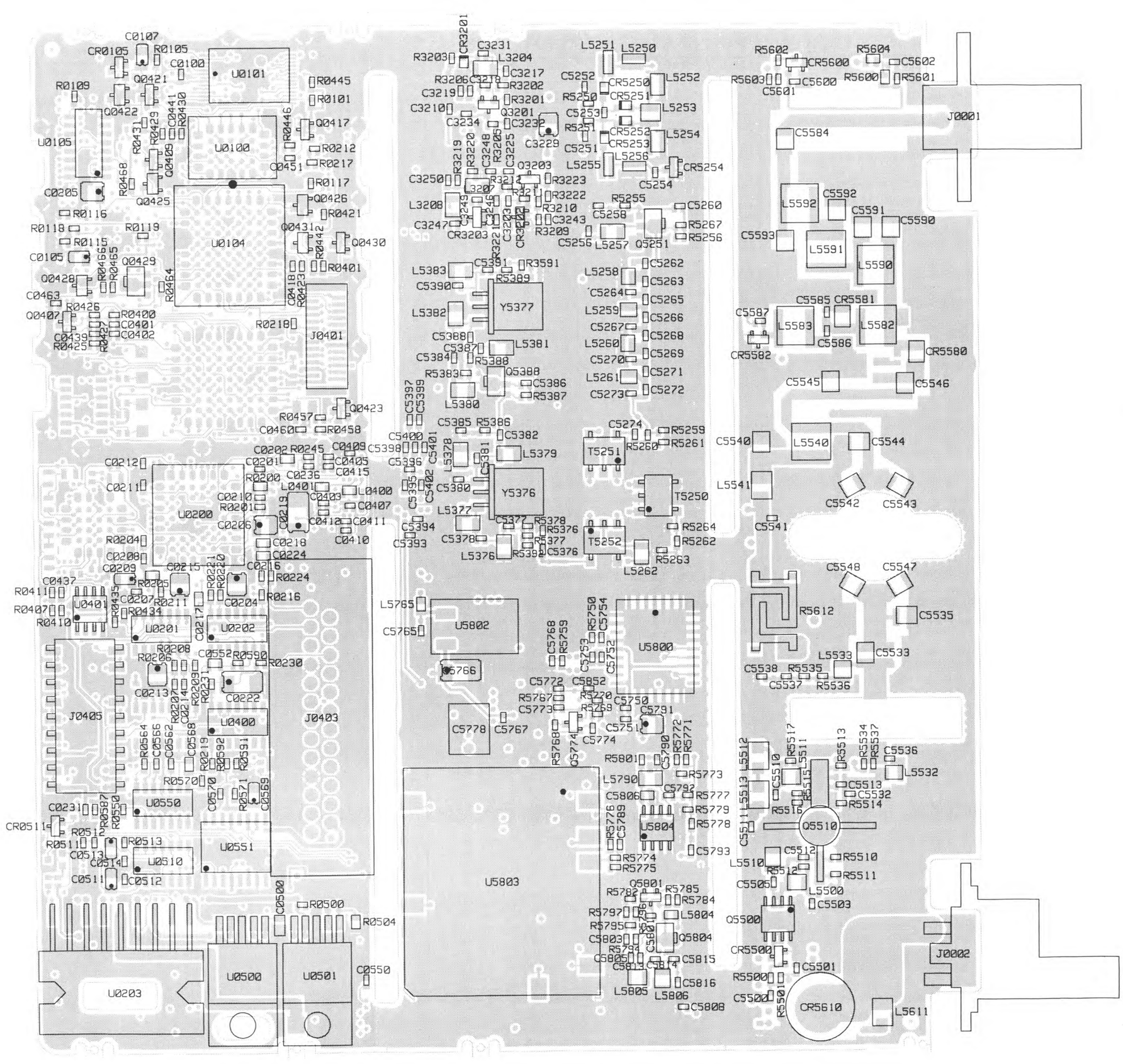
Ref.	Part/Kit No.	Description
	0102724B05	Part No. BD
C3301	2113741F49	CAP CHIP CL2 X7R REEL 10000
C3302	2113741F25	CAP CHIP CL2 X7R REEL 1000
C3303	2113740F45	CAP CHIP REEL CL1 +/-30 56
C3304	2113740F15	CAP CHIP REEL CL1 +/-30 3.3
C3305	2113741F49	CAP CHIP CL2 X7R REEL 10000
C3306	2113740F51	CAP CHIP REEL CL1 +/-30 100
C3307	2113740F45	CAP CHIP REEL CL1 +/-30 56
C3308	2113740F51	CAP CHIP REEL CL1 +/-30 100
C3309	2113743K15	CER CHIP CAP .100UF
C3310	2113741F25	CAP CHIP CL2 X7R REEL 1000
C3312	2113740F51	CAP CHIP REEL CL1 +/-30 100
C3313	2113741F49	CAP CHIP CL2 X7R REEL 10000
C3314	2113743K15	CER CHIP CAP .100UF
C3315	2113741F25	CAP CHIP CL2 X7R REEL 1000
C3316	2113741F13	CAP CHIP CL2 X7R REEL 330
C3317	2113741F13	CAP CHIP CL2 X7R REEL 330
C3320	2113740F33	CAP CHIP REEL CL1 +/-30 18
C3321	2113740F24	CAP CHIP REEL CL1 +/-30 7.5
C3322	2113740F21	CAP CHIP REEL CL1 +/-30 5.6
C3323	2113740F18	CAP CHIP REEL CL1 +/-30 4.3
C3324	2113740F25	CAP CHIP REEL CL1 +/-30 8.2
C3325	2113740F20	CAP CHIP REEL CL1 +/-30 5.1
C3326	2113740F18	CAP CHIP REEL CL1 +/-30 4.3
C3327	2113740F22	CAP CHIP REEL CL1 +/-30 6.2
C3329	2113740F42	CAP CHIP REEL CL1 +/-30 43
C3330	2113740F45	CAP CHIP REEL CL1 +/-30 56
C3331	2113741F17	CAP CHIP CL2 X7R REEL 470
C3332	2113741F17	CAP CHIP CL2 X7R REEL 470
C3334	2113740F42	CAP CHIP REEL CL1 +/-30 43
C3335	2113740F18	CAP CHIP REEL CL1 +/-30 4.3
C3336	2113740F15	CAP CHIP REEL CL1 +/-30 3.3
C3340	2113741F25	CAP CHIP CL2 X7R REEL 1000
C3341	2113741F25	CAP CHIP CL2 X7R REEL 1000
C3342	2113741F49	CAP CHIP CL2 X7R REEL 10000
C3343	2113741F49	CAP CHIP CL2 X7R REEL 10000
C3344	2113740F31	CAP CHIP REEL CL1 +/-30 15
C3345	2113741F25	CAP CHIP CL2 X7R REEL 1000
C3346	2113741F49	CAP CHIP CL2 X7R REEL 10000
C3348	2113741F49	CAP CHIP CL2 X7R REEL 10000
C3350	2113740F51	CAP CHIP REEL CL1 +/-30 100
C3351	2113740F51	CAP CHIP REEL CL1 +/-30 100
C3352	2113740F51	CAP CHIP REEL CL1 +/-30 100
C3353	2113740F51	CAP CHIP REEL CL1 +/-30 100
C3355	2113740F51	CAP CHIP REEL CL1 +/-30 100
C3357	2113740F51	CAP CHIP REEL CL1 +/-30 100
C3358	2113740F51	CAP CHIP REEL CL1 +/-30 100
C3359	2113741F49	CAP CHIP CL2 X7R REEL 10000
C3360	2113740F51	CAP CHIP REEL CL1 +/-30 100
C3361	2113740F51	CAP CHIP REEL CL1 +/-30 100
C3363	2113740F37	CAP CHIP REEL CL1 +/-30 27
C3364	2113740F37	CAP CHIP REEL CL1 +/-30 27
C3401	2113740F24	CAP CHIP REEL CL1 +/-30 7.5
C3402	2113740F25	CAP CHIP REEL CL1 +/-30 8.2
C3403	2113740F31	CAP CHIP REEL CL1 +/-30 15
C3404	2113743A19	CAP CHIP .100 UF 10% X7R
C3405	2113740F24	CAP CHIP REEL CL1 +/-30 7.5
C3406	2113741F49	CAP CHIP CL2 X7R REEL 10000
C3407	2113740F51	CAP CHIP REEL CL1 +/-30 100
C3408	2113741F49	CAP CHIP CL2 X7R REEL 10000
C3409	2113741F49	CAP CHIP CL2 X7R REEL 10000
C3410	2113740F15	CAP CHIP REEL CL1 +/-30 3.3
C3411	2113741F13	CAP CHIP CL2 X7R REEL 330

Ref.	Part/Kit No.	Description
C3412	2113740F25	CAP CHIP REEL CL1 +/-30 8.2
C3413	2113741F25	CAP CHIP CL2 X7R REEL 1000
C3414	2113740F09	CAP CHIP REEL CL1 +/-30 1.8
C3415	2113740F09	CAP CHIP REEL CL1 +/-30 1.8
C3416	2113740F27	CAP CHIP REEL CL1 +/-30 10
C3417	2113740F45	CAP CHIP REEL CL1 +/-30 56
C3418	2113740F31	CAP CHIP REEL CL1 +/-30 15
C3419	2113740F44	CAP CHIP REEL CL1 +/-30 51
CR3301	4813833C02	DIODE DUAL 70V '5B' COMM CATH
CR3302	4802081B58	DIODE DUAL SILCON (VARICAP)
CR3303	4880154K03	DIODE DUAL SCHOTTKY MIXER
CR3330	4880142L01	DIODE PIN SOT 23 MMBV 3401
CR3401	4880142L01	DIODE PIN SOT 23 MMBV 3401
CR3402	4880154K03	DIODE DUAL SCHOTTKY MIXER
L3301	2462587T30	IND CHIP 1000NH 5% LOW PRO
L3302	2462587T12	IND CHIP 56NH 5% LOW PRO
L3304	2460591L29	COIL AIR WOUND INDUC 16.03
L3305	2460591L29	COIL AIR WOUND INDUC 16.03
L3306	2460591L29	COIL AIR WOUND INDUC 16.03
L3307	2460591L29	COIL AIR WOUND INDUC 16.03
L3308	2462587T30	IND CHIP 1000NH 5% LOW PRO
L3309	2462587T30	IND CHIP 1000NH 5% LOW PRO
L3320	2462587T16	IND CHIP 120NH 5% LOW PRO
L3321	2462587T16	IND CHIP 120NH 5% LOW PRO
L3322	2462587T16	IND CHIP 120NH 5% LOW PRO
L3323	2462587T16	IND CHIP 120NH 5% LOW PRO
L3325	2462587T12	IND CHIP 56NH 5% LOW PRO
L3340	2462587T30	IND CHIP 1000NH 5% LOW PRO
L3341	2462587T12	IND CHIP 56NH 5% LOW PRO
L3342	2462587T12	IND CHIP 56NH 5% LOW PRO
L3350	2462587T23	IND CHIP 470NH 5% LOW PRO
L3351	2462587T23	IND CHIP 470NH 5% LOW PRO
L3401	2462587T30	IND CHIP 1000NH 5% LOW PRO
L3402	2462587T30	IND CHIP 1000NH 5% LOW PRO
L3403	2462587T30	IND CHIP 1000NH 5% LOW PRO
L3404	2462587T30	IND CHIP 1000NH 5% LOW PRO
L3406	2462587T30	IND CHIP 1000NH 5% LOW PRO
L3407	2462587T30	IND CHIP 1000NH 5% LOW PRO
Q3301	4805128M16	TSTR SOT MMBT3906 (RH) 48G22
Q3302	4882971R01	TSTR NPN 71R01 RF
Q3303	5105625U28	IC MIXER
Q3401	4882971R01	TSTR NPN 71R01 RF
R3301	0662057A97	CHIP RES 100K OHMS 5%
R3302	0662057A65	CHIP RES 4700 OMHS 5%
R3303	0662057A73	CHIP RES 10K OMHS 5%
R3304	0662057A73	CHIP RES 10K OMHS 5%
R3305	0662057A18	CHIP RES 51 OHMS 5%
R3306	0662057A73	CHIP RES 10K OMHS 5%
R3307	0662057A35	CHIP RES 270 OHMS 5%
R3308	0662057A41	CHIP RES 470 OHMS 5%
R3309	0662057A09	CHIP RES 22 OHMS 5%
R3310	0662057A35	CHIP RES 270 OHMS 5%
R3311	0662057C19	CHIP RES 4.7 OHMS 5%
R3312	0662057A01	CHIP RES 10 OHMS 5%
R3313	0662057A49	CHIP RES 1000 OMHS 5%
R3330	0662057A61	CHIP RES 3300 OMHS 5%
R3341	0662057A18	CHIP RES 51 OHMS 5%
R3343	0662057A35	CHIP RES 270 OHMS 5%
R3344	0662057A09	CHIP RES 22 OHMS 5%
R3345	0662057A35	CHIP RES 270 OHMS 5%
R3401	0662057A18	CHIP RES 51 OHMS 5%
R3402	0662057A18	CHIP RES 51 OHMS 5%
R3403	0662057A73	CHIP RES 10K OMHS 5%
R3404	0662057A73	CHIP RES 10K OMHS 5%

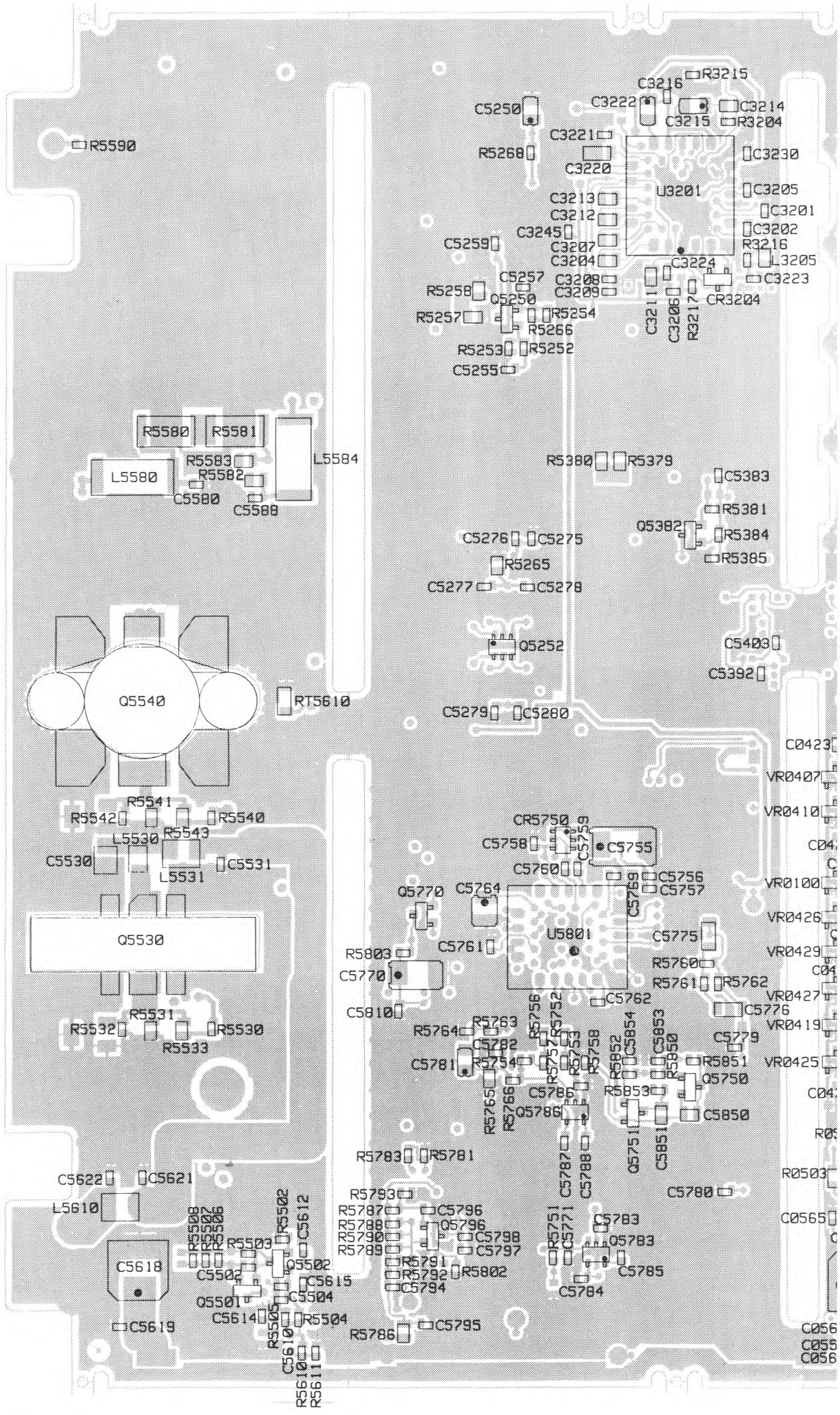
ELECTRICAL PARTS LIST FOR RX/RF, PART OF SYNTESIZER BOARD, VHF

Ref.	Part/Kit No.	Description
R3405	0662057A35	CHIP RES 270 OHMS 5%
R3406	0662057A39	CHIP RES 390 OHMS 5%
R3408	0662057A01	CHIP RES 10 OHMS 5%
R3409	0662057A49	CHIP RES 1000 OMHS 5%
R3410	0662057A59	CHIP RES 2700 OMHS 5%
R3411	0662057A41	CHIP RES 470 OHMS 5%
R3412	0662057A53	CHIP RES 1500 OMHS 5%
R3413	0662057A39	CHIP RES 390 OHMS 5%
R3414	0662057A01	CHIP RES 10 OHMS 5%
R3415	0662057A73	CHIP RES 10K OMHS 5%
T3301	2505515V03	XMFR MIXER 4:1
T3302	2505515V03	XMFR MIXER 4:1
T3303	2505515V03	XMFR MIXER 4:1
Y3401	4805846W01	XTAL FLTR HC45 44.85 MHZ 13KHZ
Y3402	4805846W01	XTAL FLTR HC45 44.85 MHZ 13KHZ
		NON REFERENCED ITEMS:
	2602474Y01	SHIELD (SH3301)

Ref.	Part/Kit No.	Description



MAIN BOARD, CLOSED ARCHITECTURE, UHF
COMPONENT LOCATION DIAGRAM, SIDE 1


R3215
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C3221
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C3220
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C3213
C3201
C3212
C3202
C3245
R3216
C5259
C3207
C3204
C3224
L3205
C5257
C3208
C3223
C3209
R5258
Q5250
C3211
C3206
R3217
CR3204
R5257
R5254
R5266
R5253
R5252
C5255
R5580
R5581
L5584
R5583
L5580
R5582
C5580
C5588
R5380
R5379
C5383
R5381
Q5382
R5384
C5276
C5275
R5385
R5265
C5277
C5278
Q5252
C5403
C5392
Q5540
RT5610
C5279
C5280
C0423
VR0407
VR0410
C04
R5541
R5542
R5540
CR5750
R5543
C5758
C5755
L5530
C5530
C5531
C5760
C5756
L5531
C5757
VR0100
Q5770
C5764
C5769
VR0426
U5801
C5775
Q5530
C5761
VR0429
R5803
R5760
C5770
R5761
R5762
C5762
VR0427
C5810
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C5779
C5782
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R5852
C5850
R5533
C5781
R5754
R5851
VR0425
R5765
R5766
C5786
Q5750
R5853
Q5786
C5850
C04
R0
R5783
R5781
C5622
C5621
C5787
C5788
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C5851
R0503
L5610
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C5780
R5787
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C055
C056
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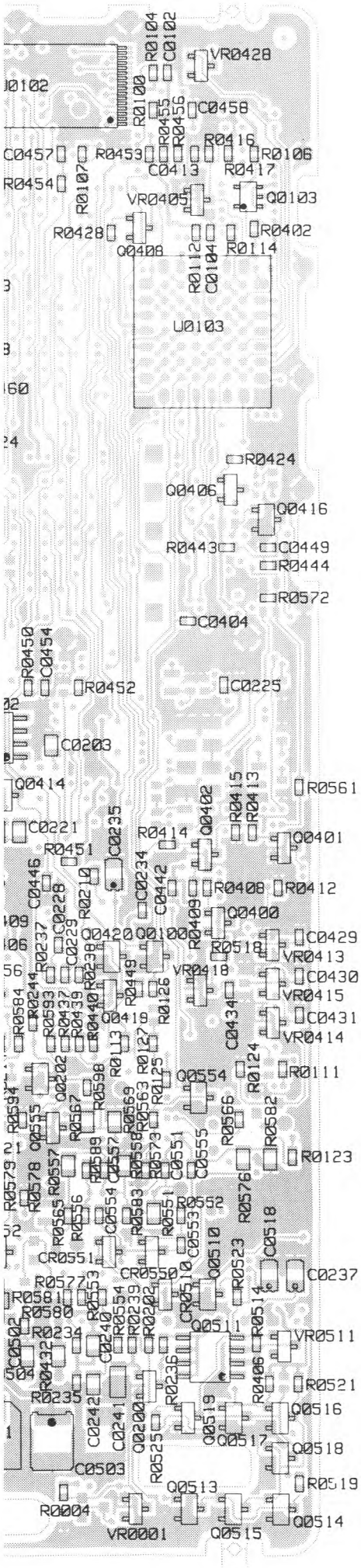
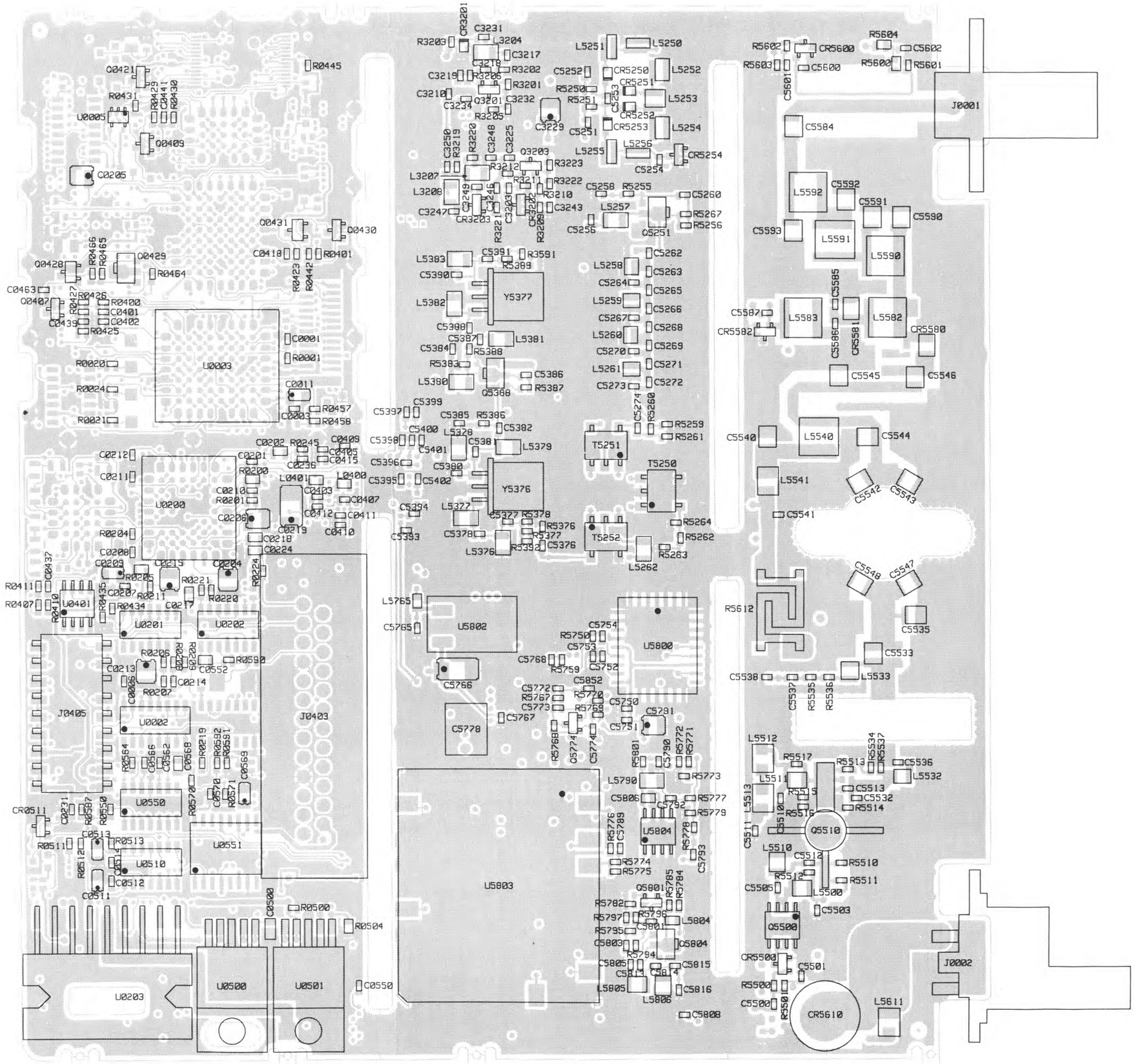
R5611

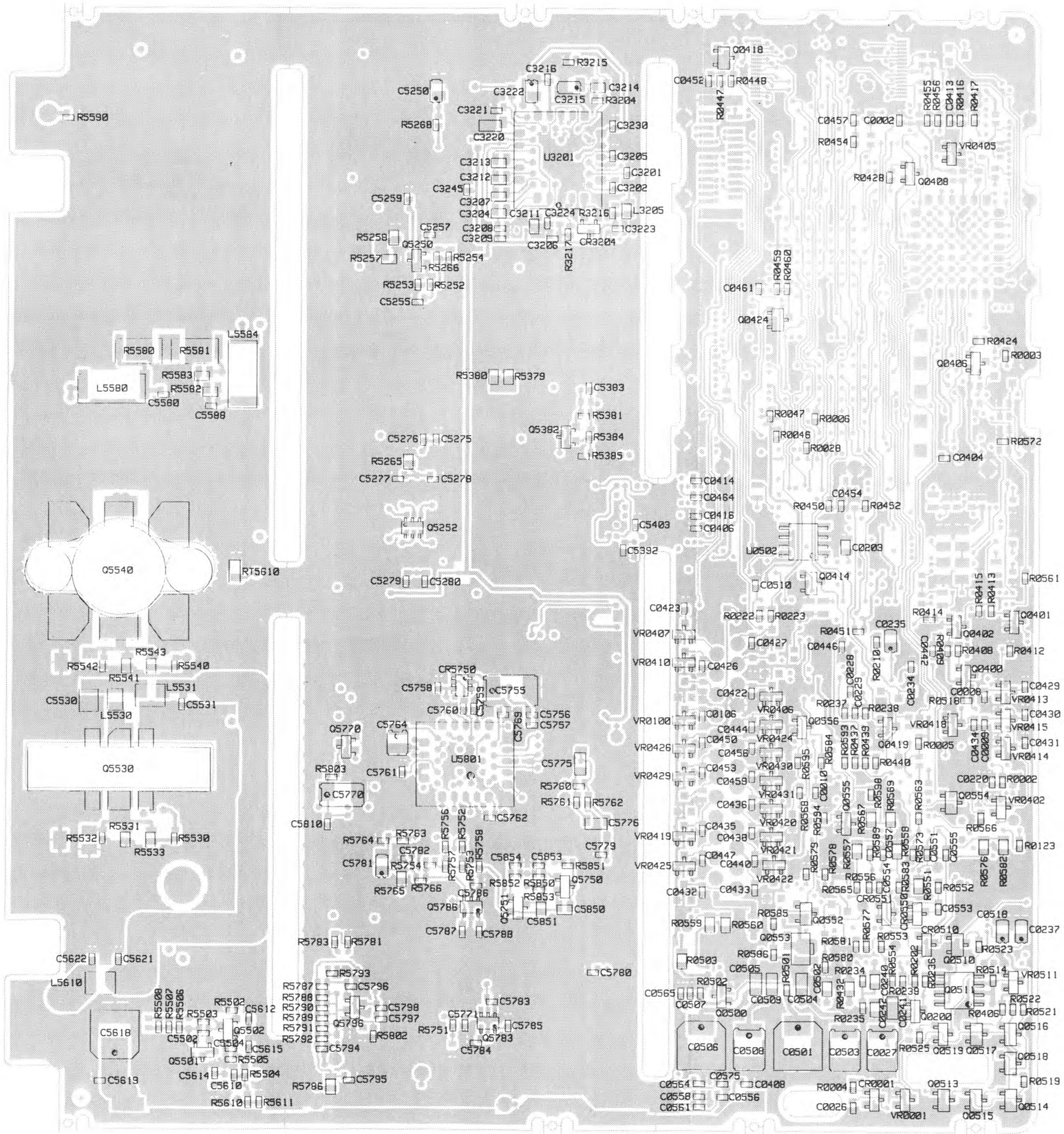
Rev. 06.93



MAIN BOARD, CLOSED ARCHITECTURE, UHF
COMPONENT LOCATION DIAGRAM, SIDE 2

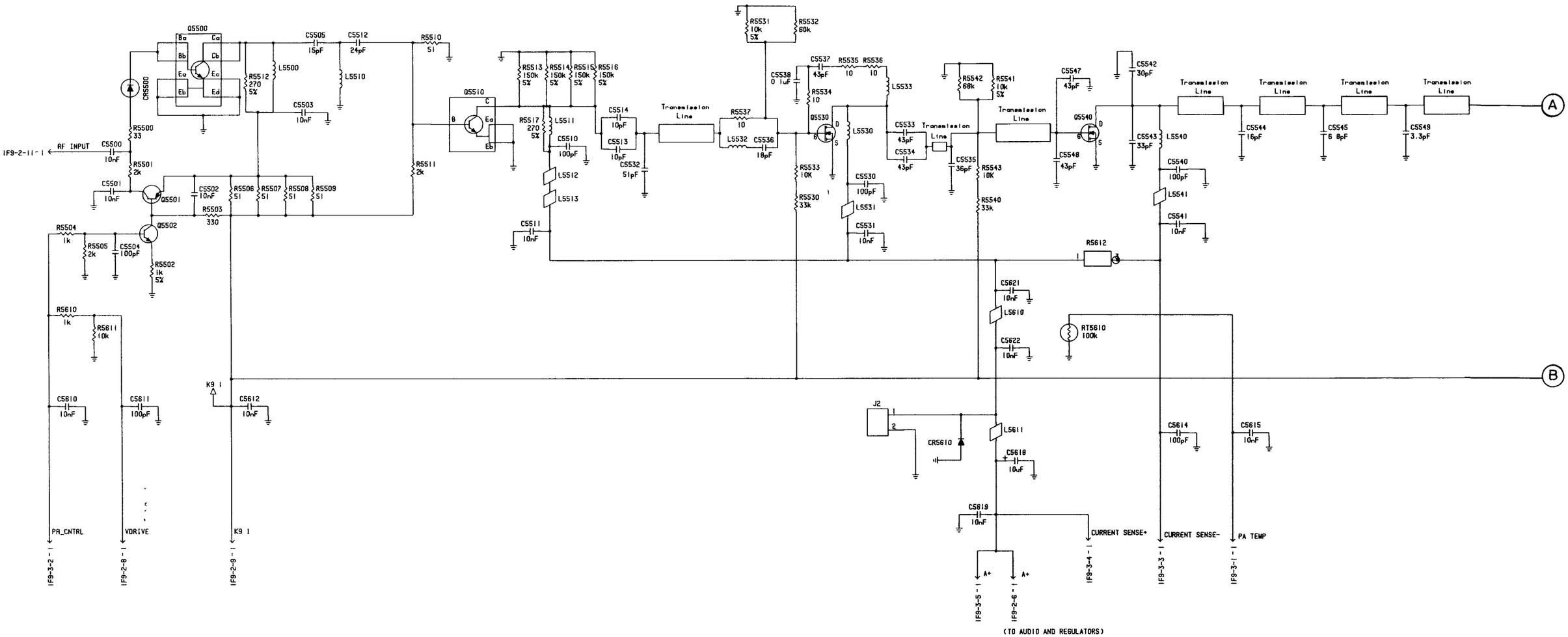


MAIN BOARD, OPEN ARCHITECTURE, UHF
COMPONENT LOCATION DIAGRAM, SIDE 1

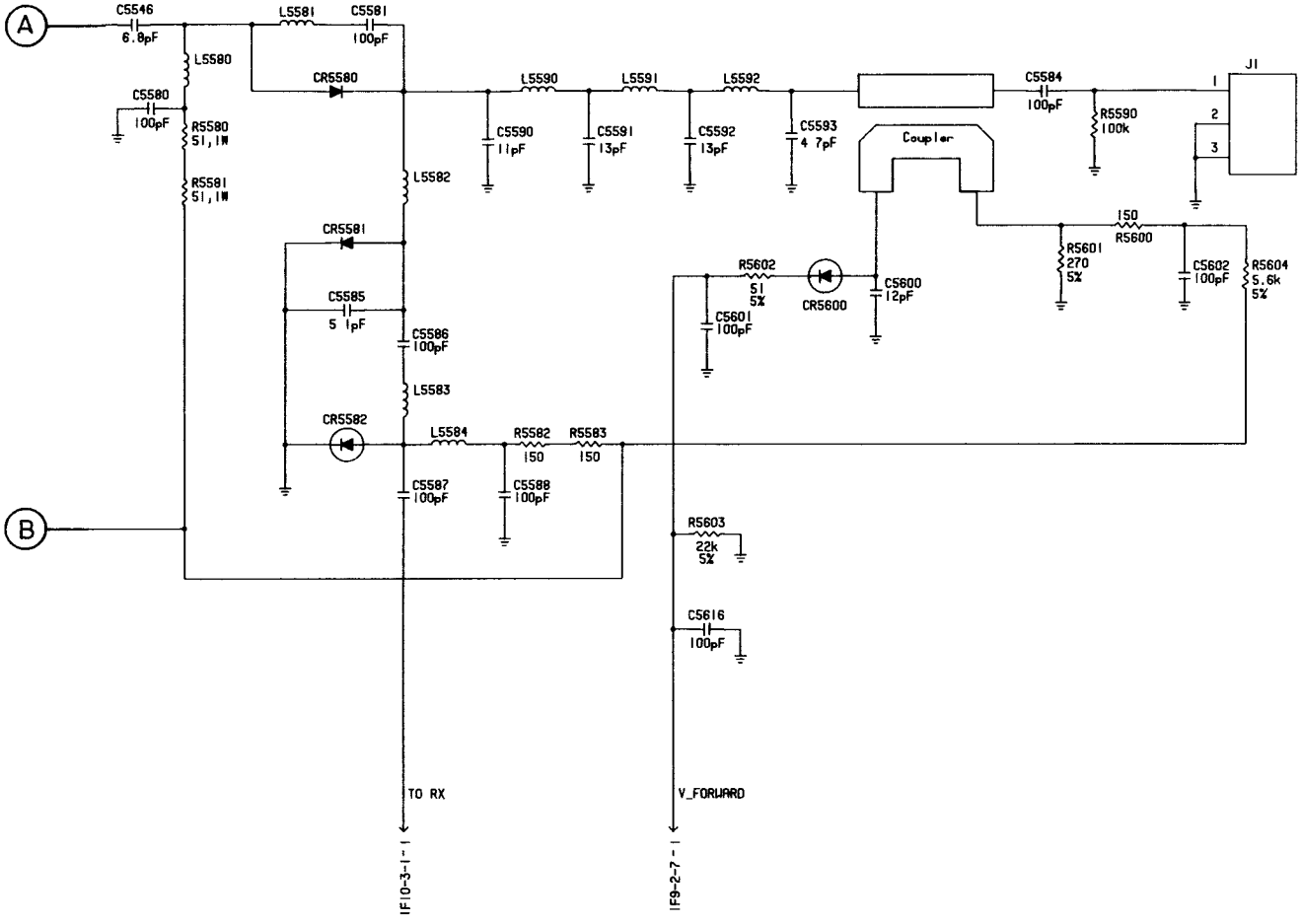


MAIN BOARD, OPEN ARCHITECTURE, UHF
COMPONENT LOCATION DIAGRAM, SIDE 2

Rev. 06.93



POWER AMPLIFIER BOARD, 25 W, UHF
SCHEMATIC DIAGRAM, Page 1 of 2

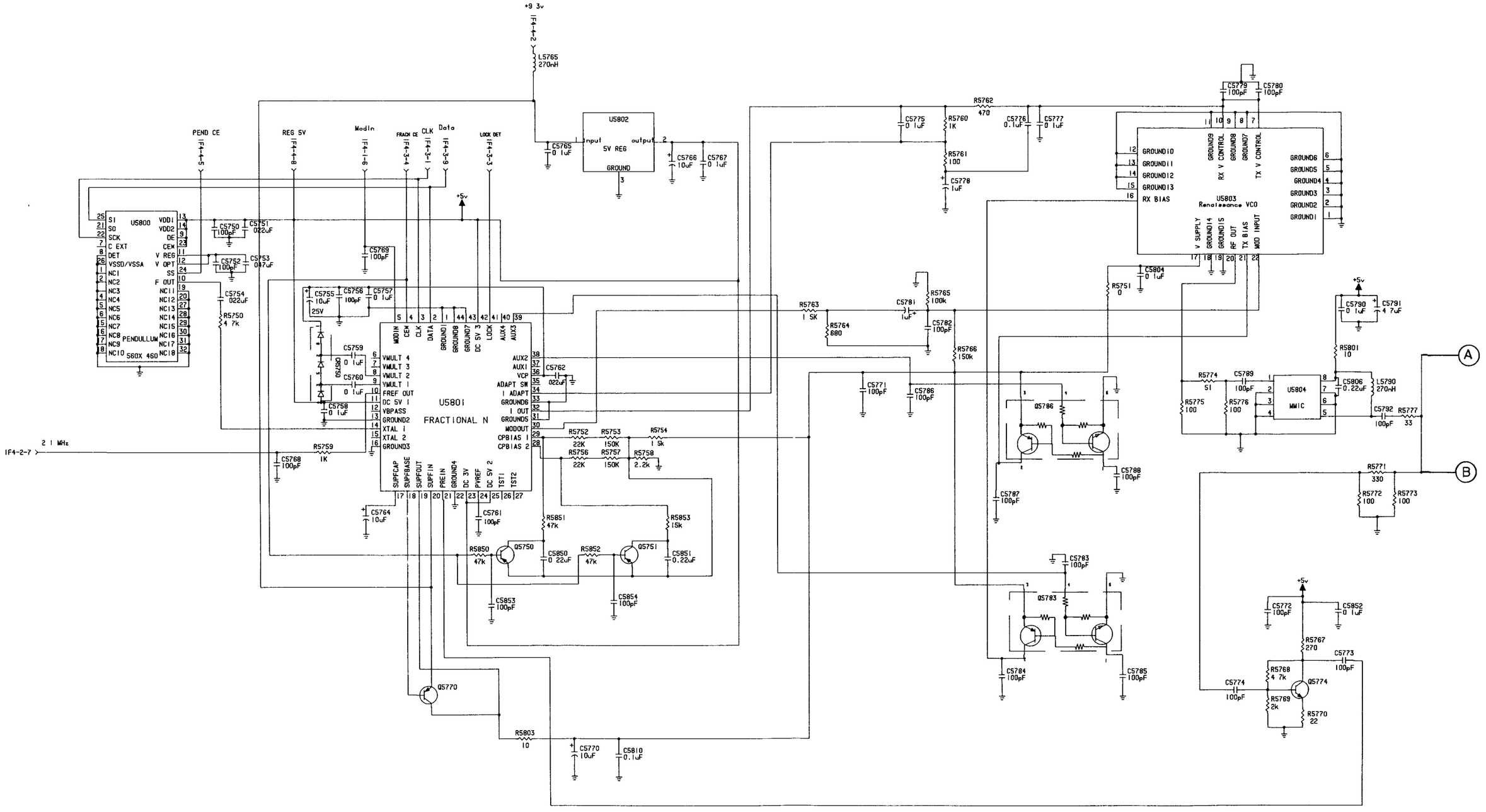


POWER AMPLIFIER BOARD, 25 W, U
SCHEMATIC DIAGRAM, Page 2 (

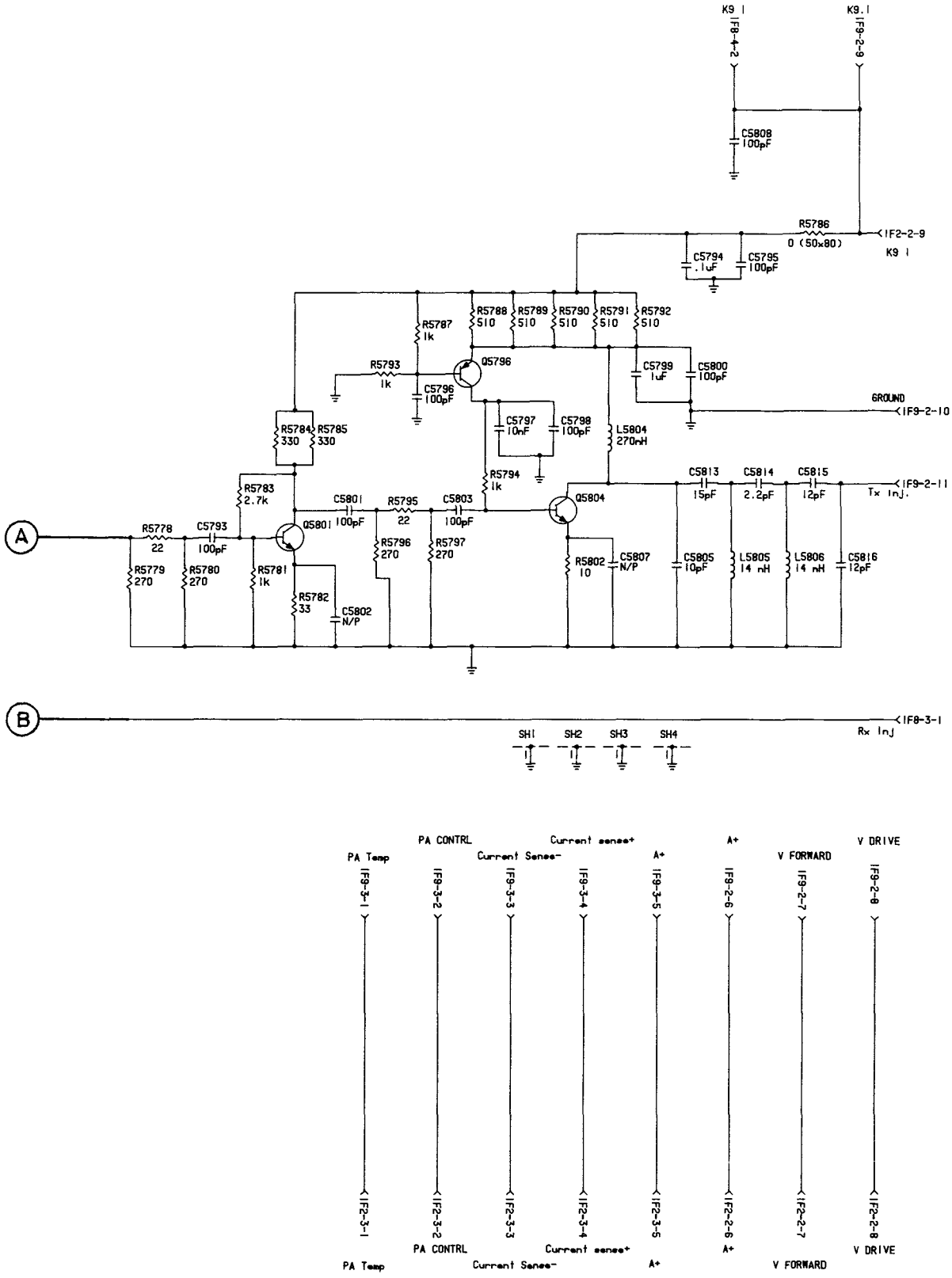
ELECTRICAL PARTS LIST FOR POWER AMPLIFIER BOARD, 25 W, UHF

Ref.	Part/Kit No.	Description
	0105958S56	Part No BD
C5500	2113741F49	CAP CHIP CL2 X7R REEL 10000
C5501	2113741F49	CAP CHIP CL2 X7R REEL 10000
C5502	2113741F49	CAP CHIP CL2 X7R REEL 10000
C5503	2113741F49	CAP CHIP CL2 X7R REEL 10000
C5504	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5505	2113740F31	CAP CHIP REEL CL1 +/-30 15
C5510	2113741F49	CAP CHIP CL2 X7R REEL 10000
C5511	2113741F49	CAP CHIP CL2 X7R REEL 10000
C5512	2113740F36	CAP CHIP REEL CL1 +/-30 24
C5513	2113740F31	CAP CHIP REEL CL1 +/-30 15
C5530	2111078B42	CAP CHIP RF 100 5 NPO 100V
C5531	2113741F49	CAP CHIP CL2 X7R REEL 10000
C5532	2113740F39	CAP CHIP REEL CL1 +/-30 33
C5533	2111078B42	CAP CHIP RF 100 5 NPO 100V
C5535	2111078B27	CAP CHIP RF 30 5 NPO 100V
C5536	2113740F33	CAP CHIP REEL CL1 +/-30 18
C5537	2113740F42	CAP CHIP REEL CL1 +/-30 43
C5538	2113743K15	CER CHIP CAP 100UF
C5540	2111078B42	CAP CHIP RF 100 5 NPO 100V
C5541	2113741F49	CAP CHIP CL2 X7R REEL 10000
C5542	2111078B27	CAP CHIP RF 30 5 NPO 100V
C5543	2111078B29	CAP CHIP RF 33 5 NPO 100V
C5544	2111078B19	CAP CHIP RF 15 5 NPO 100V
C5545	2111078B11	CAP CHIP RF 8 2 5 NPO 100V
C5546	2111078B08	CAP CHIP RF 6 2 25 NPO 100V
C5547	2111078B33	CAP CHIP RF 43 5NPO 100V
C5548	2111078B33	CAP CHIP RF 43 5NPO 100V
C5580	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5584	2111078B42	CAP CHIP RF 100 5 NPO 100V
C5585	2113740F20	CAP CHIP REEL CL1 +/-30 5 1
C5586	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5587	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5588	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5590	2111078B14	CAP CHIP RF 11 5 NPO 100V
C5591	2111078B16	CAP CHIP RF 13 5 NPO 100V
C5592	2111078B16	CAP CHIP RF 13 5 NPO 100V
C5593	2111078B05	CAP CHIP RF 4 7 25 NPO 100V
C5600	2113740F29	CAP CHIP REEL CL1 +/-30 12
C5601	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5602	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5610	2113741F49	CAP CHIP CL2 X7R REEL 10000
C5612	2113741F49	CAP CHIP CL2 X7R REEL 10000
C5614	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5615	2113741F49	CAP CHIP CL2 X7R REEL 10000
C5618	2380090M24	CAP ALU 10 20 50V SURF MT
C5619	2113741F49	CAP CHIP CL2 X7R REEL 10000
C5621	2113741F49	CAP CHIP CL2 X7R REEL 10000
C5622	2113741F49	CAP CHIP CL2 X7R REEL 10000
CR5500	4880142L01	DIODE PIN SOT 23 MMBV 3401
CR5580	4802482J02	PIN DIODE SMD
CR5581	4802482J02	PIN DIODE SMD
CR5582	4880142L01	DIODE PIN SOT 23 MMBV 3401
CR5600	4880236E05	DIODE HOT CAR SOT 23
CR5610	4880222R01	DIODE REVERSE POLARITY SPECTRA
L5500	2460591C23	COIL AIR WOUND INDUC 13 85
L5510	2460591A01	COIL AIR WOUND INDUC4 22
L5511	2460591A01	COIL AIR WOUND INDUC4 22
L5512	2484657R01	INDUCTOR BEAD CHIP
L5513	2484657R01	INDUCTOR BEAD CHIP
L5530	2460591E24	COIL AIR WOUND INDUC 23 75
L5531	2484657R01	INDUCTOR BEAD CHIP
L5532	2460591A11	COIL AIR WOUND INDUC 7 66

Ref.	Part/Kit No.	Description
L5533	2460591C23	COIL AIR WOUND INDUC 13 85
L5540	2460591X01	COIL AIR WOUND SQUARE 21 NH
L5541	2484657R01	INDUCTOR BEAD CHIP
L5580	2460591V77	COIL AIR WOUND INDUC 174 20
L5582	2460591X01	COIL AIR WOUND SQUARE 21 NH
L5583	2460591X01	COIL AIR WOUND SQUARE 21 NH
L5584	2460591V77	COIL AIR WOUND INDUC 174 20
L5590	2460591X01	COIL AIR WOUND SQUARE 21 NH
L5591	2460591X01	COIL AIR WOUND SQUARE 21 NH
L5592	2460591X01	COIL AIR WOUND SQUARE 21 NH
L5610	2484657R01	INDUCTOR BEAD CHIP
L5611	2484657R01	INDUCTOR BEAD CHIP
Q5500	4880182D50	TSTR SI SORF 4V 750MW 960MHZ
Q5501	4805128M16	TSTR SOT MMBT3906
Q5502	4813824A10	XSTR NPN 40V 2A
Q5510	4813827D03	TSTR G=9 0DB 870MHZ MRF557
RT5610	0680149M02	THERMISTOR CHIP 100K OHM
R5500	0662057A13	CHIP RES 33 OHMS 5%
R5501	0662057A56	CHIP RES 2000 OMHS 5%
R5502	0662057A49	CHIP RES 1000 OMHS 5%
R5503	0662057A37	CHIP RES 330 OHMS 5%
R5504	0662057A49	CHIP RES 1000 OMHS 5%
R5505	0662057A56	CHIP RES 2000 OMHS 5%
R5506	0662057A25	CHIP RES 100 OHMS 5%
R5507	0662057A25	CHIP RES 100 OHMS 5%
R5508	0662057A13	CHIP RES 33 OHMS 5%
R5510	0662057A18	CHIP RES 51 OHMS 5%
R5511	0662057A56	CHIP RES 2000 OMHS 5%
R5512	0662057A35	CHIP RES 270 OHMS 5%
R5513	0662057B02	CHIP RES 150K OHMS 5%
R5514	0662057B02	CHIP RES 150K OHMS 5%
R5515	0662057B02	CHIP RES 150K OHMS 5%
R5516	0662057B02	CHIP RES 150K OHMS 5%
R5517	0662057A35	CHIP RES 270 OHMS 5%
R5530	0662057A85	CHIP RES 33K OHMS 5%
R5531	0660081A73	RES CHIP TRIM 10K 20% 0805
R5532	0662057A93	CHIP RES 68K OMHS 5%
R5533	0660081A73	RES CHIP TRIM 10K 20% 0805
R5534	0662057A01	CHIP RES 10 OHMS 5%
R5535	0662057A01	CHIP RES 10 OHMS 5%
R5536	0662057A01	CHIP RES 10 OHMS 5%
R5537	0662057A01	CHIP RES 10 OHMS 5%
R5540	0662057A85	CHIP RES 33K OHMS 5%
R5541	0660081A73	RES CHIP TRIM 10K 20% 0805
R5542	0662057A93	CHIP RES 68K OMHS 5%
R5543	0660081A73	RES CHIP TRIM 10K 20% 0805
R5580	0680194M18	RES 51 OHMS 5% 1W
R5581	0680194M18	RES 51 OHMS 5% 1W
R5582	0662057C55	CHIP RES 150 0HMS 5%
R5583	0662057C55	CHIP RES 150 0HMS 5%
R5590	0662057A97	CHIP RES 100K OHMS 5%
R5600	0662057C55	CHIP RES 150 0HMS 5%
R5601	0662057A35	CHIP RES 270 OHMS 5%
R5602	0662057A18	CHIP RES 51 OHMS 5%
R5603	0662057A81	CHIP RES 22K OMHS 5%
R5604	0662057E49	CHIP RES 5600 OHMS 5%
R5610	0662057A53	CHIP RES 1500 OMHS 5%
R5611	0662057A65	CHIP RES 4700 OMHS 5%
R5612	1705603W01	RES SMT SHUNT
		NON REFERENCED ITEMS
	2605915V01	SHIELD PCB MOUNT 1 (SH5501)
	2605915V01	SHIELD PCB MOUNT 1 (SH5502)



SYNTHESIZER BOARD, UHF
SCHEMATIC DIAGRAM, Page 1 of 2



SYNTHESIZER BOARD, UHF
SCHEMATIC DIAGRAM, Page 2 of 2

ELECTRICAL PARTS LIST FOR SYNTHESIZER BOARD, UHF

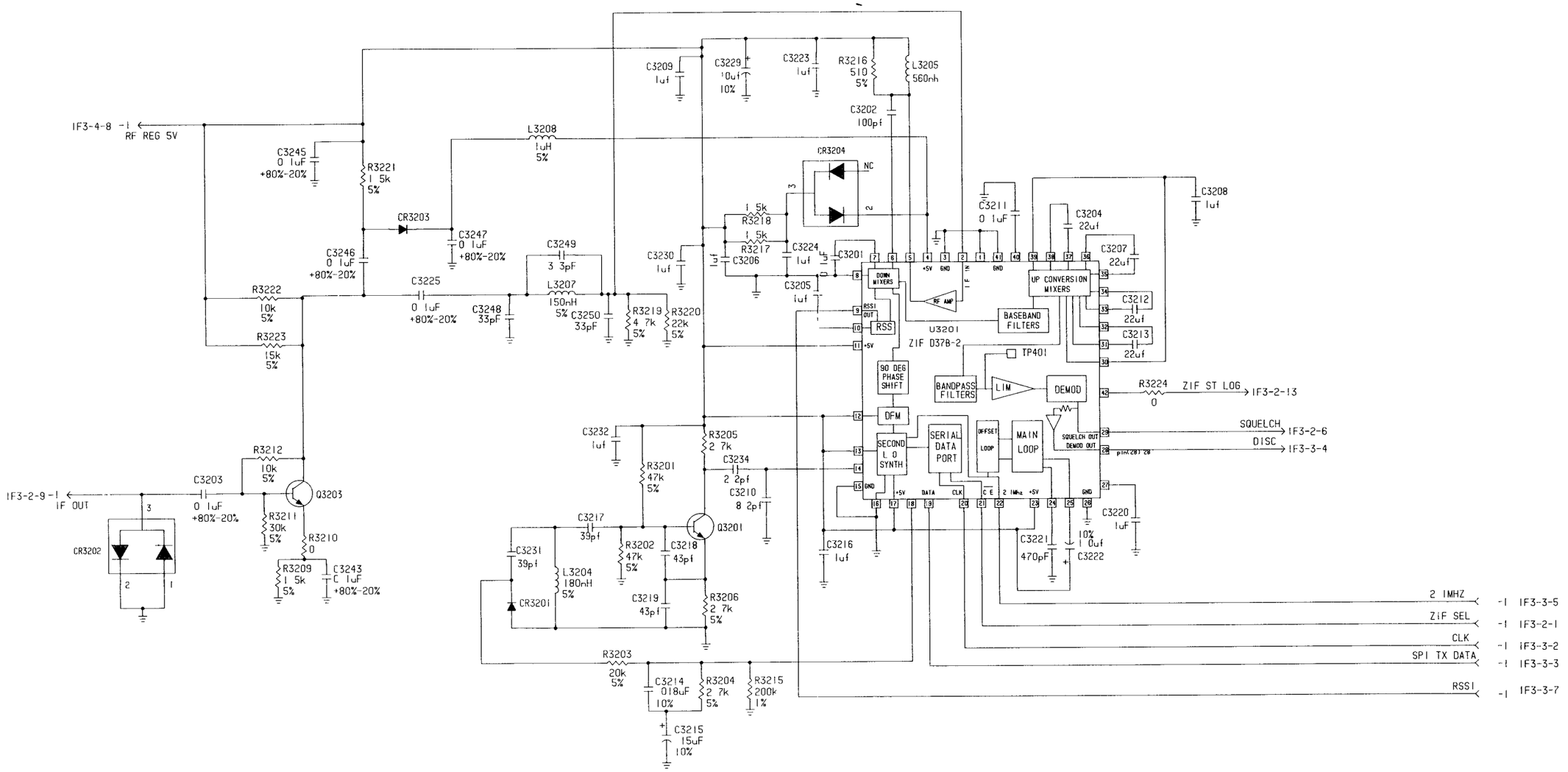
Ref.	Part/Kit No.	Description
		Part of RF board 0105958S55
C5750	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5751	2113743E07	CER CHIP CAP .022UF
C5752	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5753	2113743K07	CER CHIP CAP .047UF
C5754	2113743E07	CER CHIP CAP .022UF
C5755	2311049A19	CAP CHIP CL2 X7R REEL 510
C5756	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5757	2113743K15	CER CHIP CAP .100UF
C5758	2113743K15	CER CHIP CAP .100UF
C5759	2113743K15	CER CHIP CAP .100UF
C5760	2113743K15	CER CHIP CAP .100UF
C5761	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5762	2113743E07	CER CHIP CAP .022UF
C5764	2311049J23	CAP TANT CHIP 10 10 7
C5765	2113743K15	CER CHIP CAP .100UF
C5766	2311049J26	CAP TANT CHIP 10 20 16
C5767	2113743K15	CER CHIP CAP .100UF
C5768	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5769	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5770	2311049J26	CAP TANT CHIP 10 20 16
C5771	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5772	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5773	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5774	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5775	2109720D14	CAP CER CHIP LOW DIST .1 UF
C5776	2109720D14	CAP CER CHIP LOW DIST .1 UF
C5778	0811051A19	CAP MTLZ POLYEST 1.0 5 63V
C5779	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5780	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5781	2311049A07	CAP TANT CHIP 1 10 16 A/P
C5782	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5783	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5784	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5785	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5786	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5787	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5788	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5789	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5790	2113743K15	CER CHIP CAP .100UF
C5791	2311049J11	CAP TANT CHIP 4.7 10 16
C5792	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5793	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5794	2113743K15	CER CHIP CAP .100UF
C5795	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5796	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5797	2113743K15	CER CHIP CAP .100UF
C5798	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5801	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5803	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5805	2113740F25	CAP CHIP REEL CL1 +/-30 8.2
C5806	2113743A23	CAP CHIP .220 UF 10% X7R
C5808	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5810	2113743K15	CER CHIP CAP .100UF
C5813	2113740F29	CAP CHIP REEL CL1 +/-30 12
C5814	2113740F12	CAP CHIP REEL CL1 +/-30 2.4
C5815	2113740F29	CAP CHIP REEL CL1 +/-30 12
C5816	2113740F29	CAP CHIP REEL CL1 +/-30 12
C5850	2113743A23	CAP CHIP .220 UF 10% X7R
C5851	2113743A23	CAP CHIP .220 UF 10% X7R
C5852	2113743K15	CER CHIP CAP .100UF
C5853	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5854	2113740F51	CAP CHIP REEL CL1 +/-30 100

Ref.	Part/Kit No.	Description
CR5750	4802233J09	DIODE TRIPLE SOT143-RH
L5765	2462587Q40	IND CHIP 270 NH 10%
L5790	2462587T20	IND CHIP 270NH 5% LOW PRO
L5804	2462587Q44	IND CHIP 560 NH 10%
L5805	2460591C23	COIL AIR WOUND INDUC 13.85
L5806	2460591C23	COIL AIR WOUND INDUC 13.85
Q5750	4805128M16	TSTR SOT MMBT3906
Q5751	4805128M16	TSTR SOT MMBT3906
Q5770	4805128M16	TSTR SOT MMBT3906
Q5774	4882022N70	TRST NPN 22N70 AMPL
Q5783	4805921T02	XISTOR FMC2 RH
Q5786	4805921T02	XISTOR FMC2 RH
Q5796	4805128M16	TSTR SOT MMBT3906
Q5801	4882022N70	TRST NPN 22N70 AMPL
Q5804	4882971R01	TSTR NPN 71R01 RF
R5750	0662057A65	CHIP RES 4700 OMHS 5%
R5751	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R5752	0662057A81	CHIP RES 22K OMHS 5%
R5753	0662057B02	CHIP RES 150K OHMS 5%
R5754	0662057A53	CHIP RES 1500 OMHS 5%
R5756	0662057A81	CHIP RES 22K OMHS 5%
R5757	0662057B02	CHIP RES 150K OHMS 5%
R5758	0662057A57	CHIP RES 2200 OMHS 5%
R5759	0662057A49	CHIP RES 1000 OMHS 5%
R5760	0662057A49	CHIP RES 1000 OMHS 5%
R5761	0662057A25	CHIP RES 100 OHMS 5%
R5762	0662057A41	CHIP RES 470 OHMS 5%
R5763	0662057A53	CHIP RES 1500 OMHS 5%
R5764	0662057A45	CHIP RES 680 OHMS 5%
R5765	0662057G13	CHIP RES 100K OHMS 1%
R5766	0662057B02	CHIP RES 150K OHMS 5%
R5767	0662057A35	CHIP RES 270 OHMS 5%
R5768	0662057A65	CHIP RES 4700 OMHS 5%
R5769	0662057A56	CHIP RES 2000 OMHS 5%
R5770	0662057A09	CHIP RES 22 OHMS 5%
R5771	0662057A37	CHIP RES 330 OHMS 5%
R5772	0662057A25	CHIP RES 100 OHMS 5%
R5773	0662057A25	CHIP RES 100 OHMS 5%
R5774	0662057A18	CHIP RES 51 OHMS 5%
R5775	0662057A25	CHIP RES 100 OHMS 5%
R5776	0662057A25	CHIP RES 100 OHMS 5%
R5777	0662057A13	CHIP RES 33 OHMS 5%
R5778	0662057A09	CHIP RES 22 OHMS 5%
R5779	0662057A35	CHIP RES 270 OHMS 5%
R5781	0662057A49	CHIP RES 1000 OMHS 5%
R5782	0662057A13	CHIP RES 33 OHMS 5%
R5783	0662057A59	CHIP RES 2700 OMHS 5%
R5784	0662057A37	CHIP RES 330 OHMS 5%
R5785	0662057A37	CHIP RES 330 OHMS 5%
R5786	0662057C01	CHIP RES 0 OHMS+.050 OHMS
R5787	0662057A49	CHIP RES 1000 OMHS 5%
R5788	0662057A42	CHIP RES 510 OHMS 5%
R5789	0662057A42	CHIP RES 510 OHMS 5%
R5790	0662057A42	CHIP RES 510 OHMS 5%
R5791	0662057A42	CHIP RES 510 OHMS 5%
R5792	0662057A42	CHIP RES 510 OHMS 5%
R5793	0662057A49	CHIP RES 1000 OMHS 5%
R5794	0662057A49	CHIP RES 1000 OMHS 5%
R5795	0662057A09	CHIP RES 22 OHMS 5%
R5796	0662057A35	CHIP RES 270 OHMS 5%
R5797	0662057A35	CHIP RES 270 OHMS 5%
R5801	0662057A01	CHIP RES 10 OHMS 5%
R5802	0662057A01	CHIP RES 10 OHMS 5%
R5803	0662057A01	CHIP RES 10 OHMS 5%

ELECTRICAL PARTS LIST FOR SYNTHESIZER BOARD, UHF

Ref.	Part/Kit No.	Description
R5850	0662057A89	CHIP RES 47K OMHS 5%
R5851	0662057A89	CHIP RES 47K OMHS 5%
R5852	0662057A89	CHIP RES 47K OMHS 5%
R5853	0662057A77	CHIP RES 15K OMHS 5%
U5800	5105279V31	16.8 REF OSC MODE
U5801	5105625U31	IC SYNTHESIZER
U5802	5113816A07	REG 5V POS 500MA MC78M05BDTRK
U5803	5105279V47	HYBRID TEST/TRIM 79V47
U5804	5105625U27	IC MIMIC
		NON REFERENCED ITEMS:
	2602660J01	SHEILD, HARMONIC FILTER (E5701)
	2602658J01	SHIELD PENDULUM (SH5750)
	2602660J01	SHEILD, HARMONIC FILTER (SH5751)
	2602660J01	SHEILD, HARMONIC FILTER (SH5752)
	2605259V01	SHIELD DIODE (SH5753)

Ref.	Part/Kit No.	Description

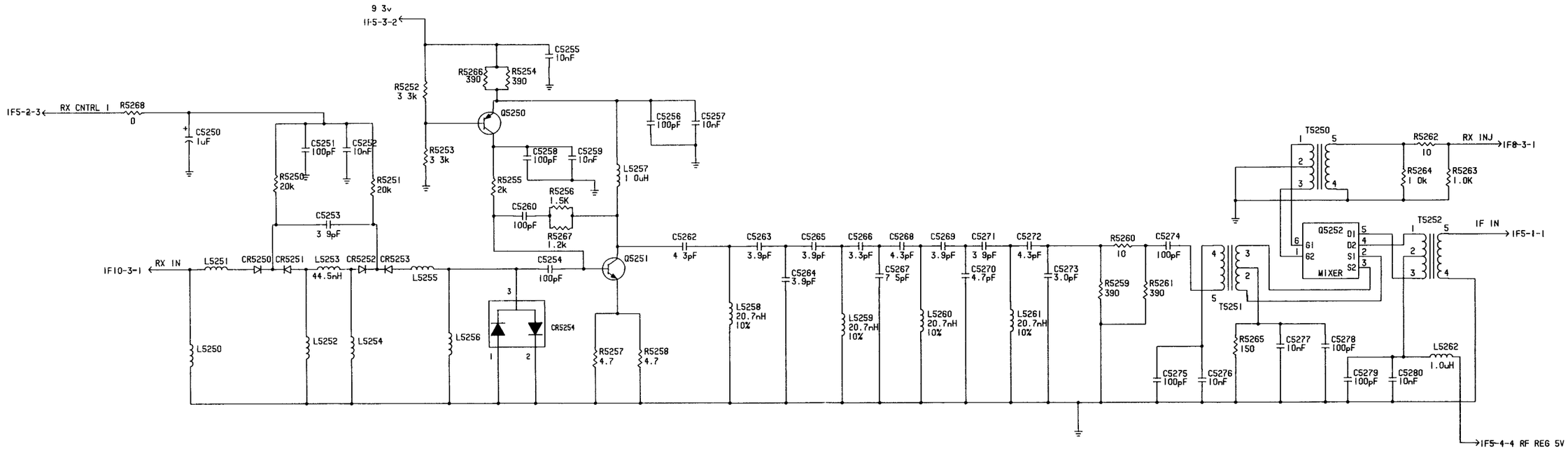


RECEIVER BACK END
PART OF SYNTHESIZER BOARD, UHF
SCHEMATIC DIAGRAM

ELECTRICAL PARTS LIST FOR RECEIVER BACK END, UHF

Ref.	Part/Kit No.	Description
		Part of RF board 0105958S55
C3201	2113743K15	CER CHIP CAP .100UF
C3202	2113740F51	CAP CHIP REEL CL1 +/-30 100
C3203	2113743K15	CER CHIP CAP .100UF
C3204	2113743A23	CAP CHIP .220 UF 10% X7R
C3205	2113743K15	CER CHIP CAP .100UF
C3206	2113743K15	CER CHIP CAP .100UF
C3207	2113743A23	CAP CHIP .220 UF 10% X7R
C3208	2113743K15	CER CHIP CAP .100UF
C3209	2113743K15	CER CHIP CAP .100UF
C3210	2113740F25	CAP CHIP REEL CL1 +/-30 8.2
C3211	2113743A19	CAP CHIP .100 UF 10% X7R
C3212	2113743A23	CAP CHIP .220 UF 10% X7R
C3213	2113743A23	CAP CHIP .220 UF 10% X7R
C3214	2113741A51	CAP CHIP CL2 X7R REEL 18000
C3215	2311049A02	CAP TANTCHIP A/P .1 5 10 35
C3216	2113743K15	CER CHIP CAP .100UF
C3217	2113740F41	CAP CHIP REEL CL1 +/-30 39
C3218	2113740F42	CAP CHIP REEL CL1 +/-30 43
C3219	2113740F42	CAP CHIP REEL CL1 +/-30 43
C3220	2109720D14	CAP CER CHIP LOW DIST .1 UF
C3221	2113741F18	CAP CHIP CL2 X7R REEL 510
C3222	2311049A07	CAP TANT CHIP 1 10 16 A/P
C3223	2113743K15	CER CHIP CAP .100UF
C3224	2113743K15	CER CHIP CAP .100UF
C3225	2113743K15	CER CHIP CAP 100UF
C3229	2311049J23	CAP TANT CHIP 10 10 7
C3230	2113743K15	CER CHIP CAP .100UF
C3231	2113740F41	CAP CHIP REEL CL1 +/-30 39
C3232	2113743K15	CER CHIP CAP .100UF
C3234	2113740F11	CAP CHIP REEL CL1 +/-30 2.2
C3243	2113743K15	CER CHIP CAP .100UF
C3245	2113743K15	CER CHIP CAP .100UF
C3246	2113743K15	CER CHIP CAP .100UF
C3247	2113743K15	CER CHIP CAP .100UF
C3248	2113740F39	CAP CHIP REEL CL1 +/-30 33
C3249	2113740F15	CAP CHIP REEL CL1 +/-30 3.3
C3250	2113740F39	CAP CHIP REEL CL1 +/-30 33
CR3201	4862824C01	DIODE VARACTOR
CR3202	4880154K03	DIODE DUAL SCHOTTKY MIXER
CR3203	4805129M96	DIODE DUAL BONDS RH
CR3204	4880154K03	DIODE DUAL SCHOTTKY MIXER
L3204	2462587T18	IND CHIP 180NH 5% LOW PRO
L3205	2462587Q44	IND CHIP 560 NH 10%
L3207	2462587T17	IND CHIP 150NH 5% LOW PRO
L3208	2462587T30	IND CHIP 1000NH 5% LOW PRO
Q3201	4882022N70	TRST NPN 22N70 AMPL
Q3203	4882022N70	TRST NPN 22N70 AMPL
R3201	0662057A89	CHIP RES 47K OMHS 5%
R3202	0662057A89	CHIP RES 47K OMHS 5%
R3203	0662057A80	CHIP RES 20K OMHS 5%
R3204	0662057A59	CHIP RES 2700 OMHS 5%
R3205	0662057A59	CHIP RES 2700 OMHS 5%
R3206	0662057A59	CHIP RES 2700 OMHS 5%
R3209	0662057A53	CHIP RES 1500 OMHS 5%
R3210	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R3211	0662057A84	CHIP RES 30K OMHS 5%
R3212	0662057A73	CHIP RES 10K OMHS 5%
R3215	0662057B05	CHIP RES 200K OHMS 5%
R3216	0662057A42	CHIP RES 510 OHMS 5%
R3217	0662057A53	CHIP RES 1500 OMHS 5%
R3219	0662057A65	CHIP RES 4700 OMHS 5%
R3220	0662057A81	CHIP RES 22K OMHS 5%

Ref.	Part/Kit No.	Description
R3221	0662057A44	CHIP RES 620 OHMS 5%
R3222	0662057A73	CHIP RES 10K OMHS 5%
R3223	0662057A77	CHIP RES 15K OMHS 5%
R3591	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
U3201	5105457W11	57W11
		NON REFERENCED ITEMS:
	2605261V01	SHLD ZIF (SH3250)

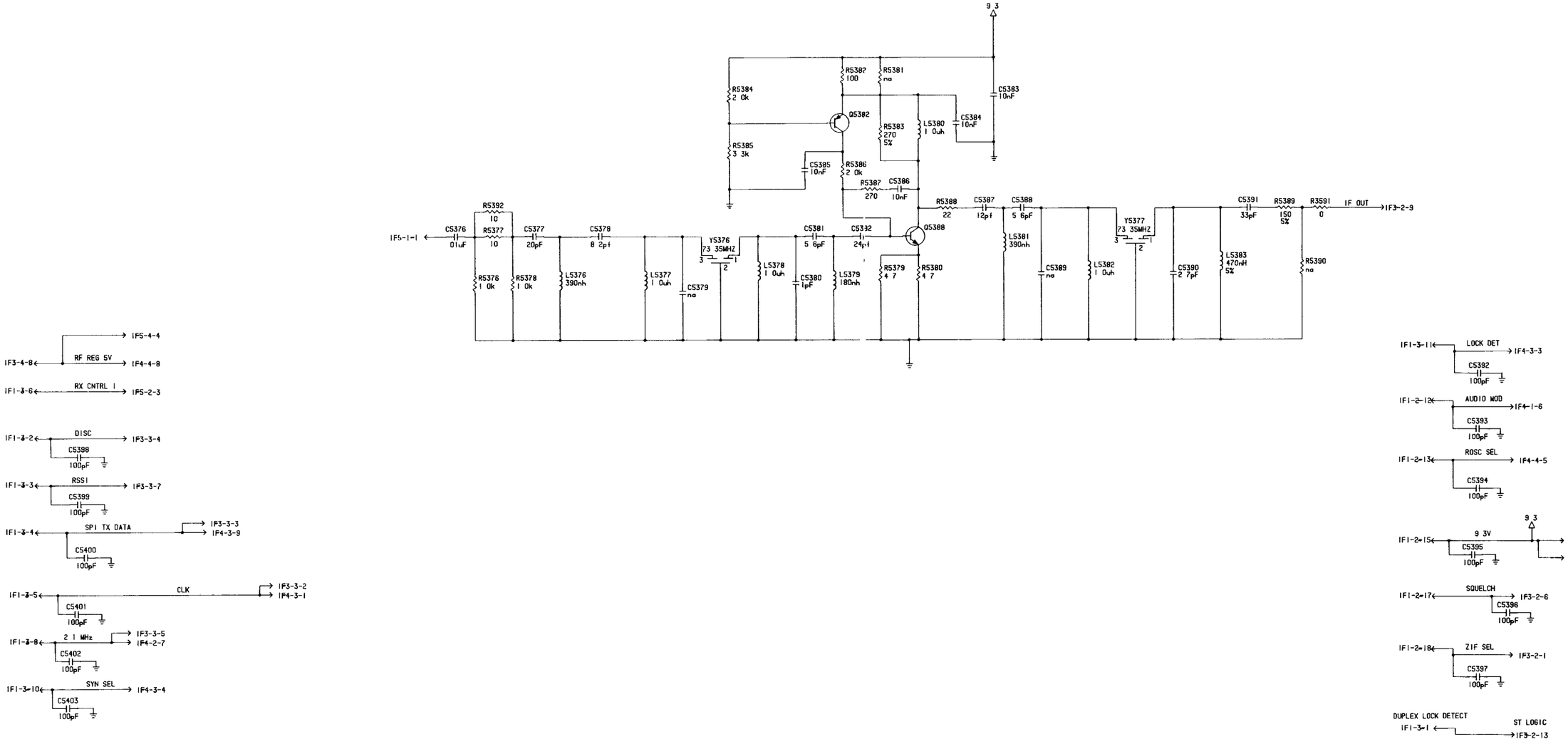


RECEIVER FRONT END
PART OF SYNTHESIZER BOARD, UHF
SCHEMATIC DIAGRAM

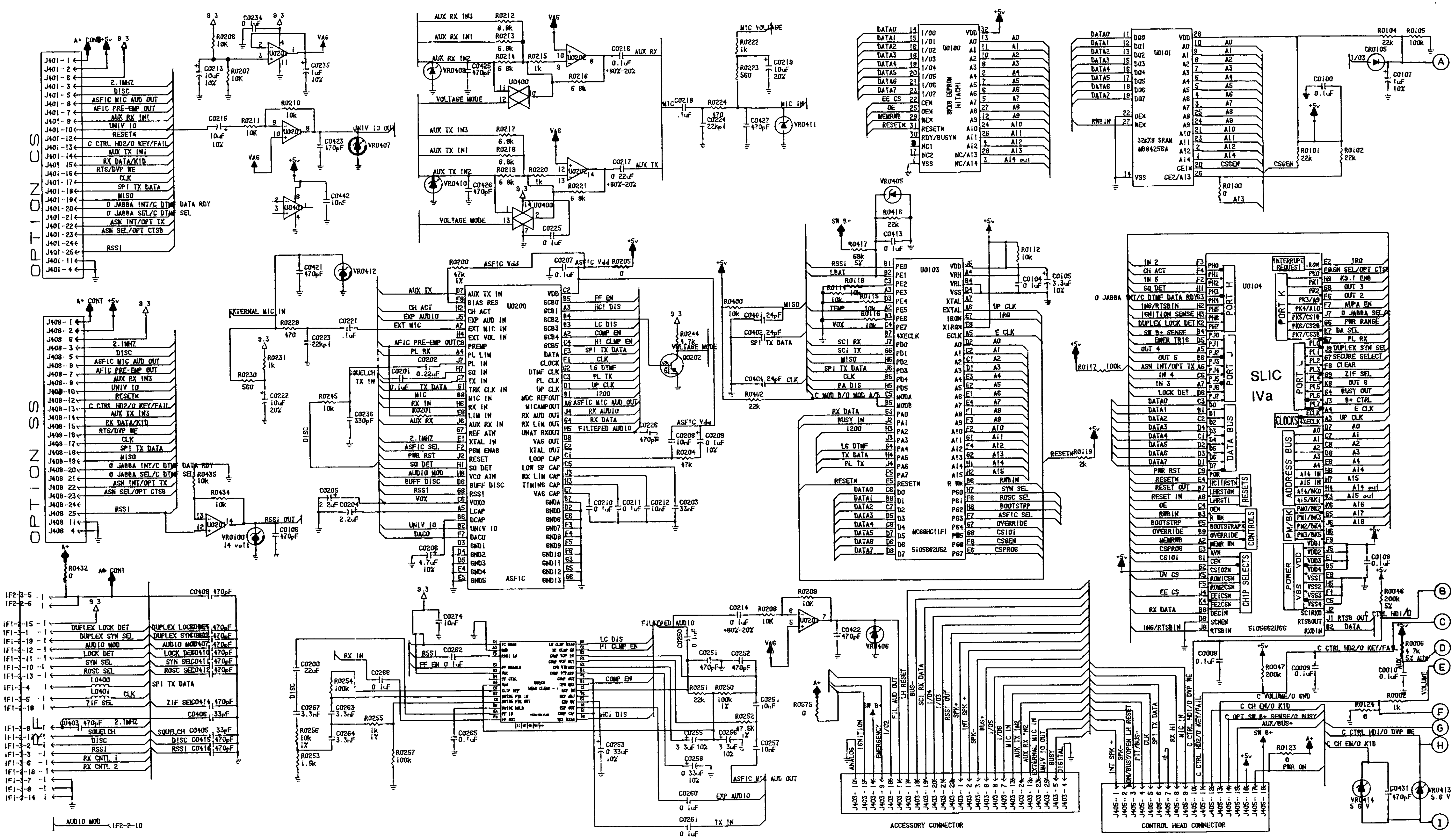
ELECTRICAL PARTS LIST FOR RECEIVER FRONT END

Ref.	Part/Kit No.	Description
		Part of RF board 0105958S55
C5250	2311049A07	CAP TANT CHIP 1 10 16 A/P
C5251	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5252	2113741F49	CAP CHIP CL2 X7R REEL 10000
C5253	2113740F17	CAP CHIP REEL CL1 +/-30 3.9
C5254	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5255	2113741F49	CAP CHIP CL2 X7R REEL 10000
C5256	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5257	2113741F49	CAP CHIP CL2 X7R REEL 10000
C5258	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5259	2113741F49	CAP CHIP CL2 X7R REEL 10000
C5260	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5262	2113740F18	CAP CHIP REEL CL1 +/-30 4.3
C5263	2113740F17	CAP CHIP REEL CL1 +/-30 3.9
C5264	2113740F17	CAP CHIP REEL CL1 +/-30 3.9
C5265	2113740F17	CAP CHIP REEL CL1 +/-30 3.9
C5266	2113740F15	CAP CHIP REEL CL1 +/-30 3.3
C5267	2113740F24	CAP CHIP REEL CL1 +/-30 7.5
C5268	2113740F18	CAP CHIP REEL CL1 +/-30 4.3
C5269	2113740F17	CAP CHIP REEL CL1 +/-30 3.9
C5270	2113740F19	CAP CHIP REEL CL1 +/-30 4.7
C5271	2113740F17	CAP CHIP REEL CL1 +/-30 3.9
C5272	2113740F18	CAP CHIP REEL CL1 +/-30 4.3
C5273	2113740F14	CAP CHIP REEL CL1 +/-30 3.0
C5274	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5275	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5276	2113741F49	CAP CHIP CL2 X7R REEL 10000
C5277	2113741F49	CAP CHIP CL2 X7R REEL 10000
C5278	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5279	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5280	2113741F49	CAP CHIP CL2 X7R REEL 10000
CR5250	4862824C01	DIODE VARACTOR
CR5251	4862824C01	DIODE VARACTOR
CR5252	4862824C01	DIODE VARACTOR
CR5253	4862824C01	DIODE VARACTOR
CR5254	4880154K03	DIODE DUAL SCHOTTKY MIXER
L5250	2460591W03	COIL AIR WOUND INDUCTOR
L5251	2460591W03	COIL AIR WOUND INDUCTOR
L5252	2460591L05	COIL AIR WOUND INDUC 10.12
L5253	2460591N36	COIL AIR WOUND INDUC43.67
L5254	2460591L05	COIL AIR WOUND INDUC 10.12
L5255	2460591W03	COIL AIR WOUND INDUCTOR
L5256	2460591W03	COIL AIR WOUND INDUCTOR
L5257	2462587T30	IND CHIP 1000NH 5% LOW PRO
L5258	2460591B80	COIL AIR WOUND INDUC19.61
L5259	2460591B80	COIL AIR WOUND INDUC19.61
L5260	2460591B80	COIL AIR WOUND INDUC19.61
L5261	2460591B80	COIL AIR WOUND INDUC19.61
L5262	2462587T30	IND CHIP 1000NH 5% LOW PRO
Q5250	4805128M16	TSTR SOT MMBT3906
Q5251	4882971R01	TSTR NPN 71R01 RF
Q5252	5105625U28	IC MIXER
R5250	0662057A80	CHIP RES 20K OMHS 5%
R5251	0662057A80	CHIP RES 20K OMHS 5%
R5252	0662057A61	CHIP RES 3300 OMHS 5%
R5253	0662057A61	CHIP RES 3300 OMHS 5%
R5254	0662057A39	CHIP RES 390 OHMS 5%
R5255	0662057A56	CHIP RES 2000 OMHS 5%
R5256	0662057A53	CHIP RES 1500 OMHS 5%
R5257	0662057C19	CHIP RES 4.7 OHMS 5%
R5258	0662057C19	CHIP RES 4.7 OHMS 5%
R5259	0662057A39	CHIP RES 390 OHMS 5%
R5260	0662057A01	CHIP RES 10 OHMS 5%

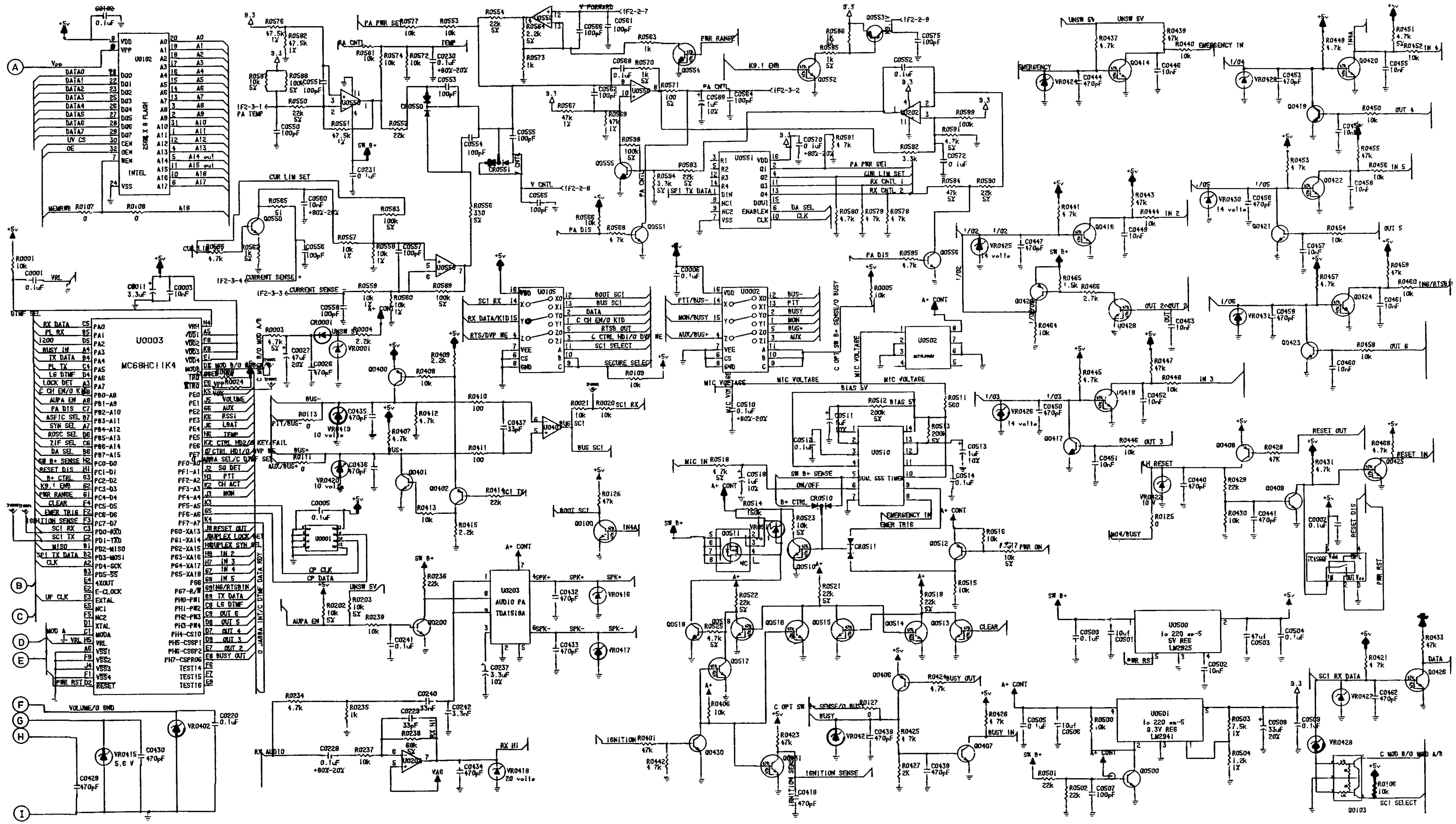
Ref.	Part/Kit No.	Description
R5261	0662057A39	CHIP RES 390 OHMS 5%
R5262	0662057A01	CHIP RES 10 OHMS 5%
R5263	0662057A49	CHIP RES 1000 OMHS 5%
R5264	0662057A49	CHIP RES 1000 OMHS 5%
R5265	0662057C55	CHIP RES 150 OHMS 5%
R5266	0662057A39	CHIP RES 390 OHMS 5%
R5267	0662057A51	CHIP RES 1200 OHMS 5%
R5268	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
T5250	2505515V03	XMFR MIXER 4:1
T5251	2505515V04	XMFR MIXER 5:1
T5252	2505515V07	XMFR MIXER 25:1
		NON REFERENCED ITEMS:
	2605915V01	SHIELD PCB MOUNT 1 (SH5250)
	2605915V01	SHIELD PCB MOUNT 1 (SH5251)
	2605915V01	SHIELD PCB MOUNT 1 (SH5252)
	2605259V01	SHIELD DIODE (SH5253)



IF INJECTION STRING
PART OF SYNTHESIZER BOARD, UHF
SCHEMATIC DIAGRAM



CONTROLLER BOARD
CLOSED AND OPEN ARCHITECTURE, VHF & UHF
SCHEMATIC DIAGRAM, Page 1 of 2



CONTROLLER BOARD
CLOSED AND OPEN ARCHITECTURE, VHF & UHF
SCHEMATIC DIAGRAM, Page 2 of 2

ELECTRICAL PARTS LIST FOR CLOSED ARCHITECTURE CONTROLLER BD, VHF/UHF

Ref.	Part/Kit No.	Description
	HUD4009A	**VHF, Closed Architecture**
C0572	2113741A57	CAP CHIP CL2 X7R REEL 33000
R0000	0662057A97	CHIP RES 100K OHMS 5%
R0563	0662057A29	CHIP RES 150 OHMS 5%
R0564	0662057A49	CHIP RES 1000 OMHS 5%
R0570	0662057A49	CHIP RES 1000 OMHS 5%
R0573	0662057A65	CHIP RES 4700 OMHS 5%
R0584	0662057A57	CHIP RES 2200 OMHS 5%
R0588	0662057A69	CHIP RES 6800 OMHS 5%
R0590	0662057A77	CHIP RES 15K OMHS 5%
R0592	0662057A61	CHIP RES 3300 OMHS 5%
R553	0662057A65	CHIP RES 4700 OMHS 5%
R591	0662057A65	CHIP RES 4700 OMHS 5%
	HUE4009A	**UHF, Closed Architecture**
C0571	2109720D14	CAP CER CHIP LOW DIST .1 UF
C0572	2113743K15	CER CHIP CAP .100UF
R0553	0662057R60	RES CHIP 10K .1W 1%
R0556	0662057A65	CHIP RES 4700 OMHS 5%
R0563	0662057A49	CHIP RES 1000 OMHS 5%
R0564	0662057A57	CHIP RES 2200 OMHS 5%
R0570	0662057C01	CHIP RES 0 OHMS +.050 OHMS
R0573	0662057A49	CHIP RES 1000 OMHS 5%
R0584	0662057A73	CHIP RES 10K OMHS 5%
R0588	0662057A73	CHIP RES 10K OMHS 5%
R0590	0662057A81	CHIP RES 22K OMHS 5%
R0591	0662057A73	CHIP RES 10K OMHS 5%
R0592	0662057A65	CHIP RES 4700 OMHS 5%
	0105958S54	**VHF & UHF, Closed Architecture**
C0001	2113743K15	CER CHIP CAP .100UF
C0002	2113743K15	CER CHIP CAP .100UF
C0003	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0006	2109720D14	CAP CER CHIP LOW DIST .1 UF
C0008	2113743K15	CER CHIP CAP .100UF
C0009	2113743K15	CER CHIP CAP .100UF
C0010	2113743K15	CER CHIP CAP .100UF
C0011	2311049A42	CAP TANT CHIP 3.3 10 6
C0026	2113741F17	CAP CHIP CL2 X7R REEL 470
C0027	2311049J44	CAP TANT CHIP 47 20 10
C0106	2113741F17	CAP CHIP CL2 X7R REEL 470
C0201	2113743K15	CER CHIP CAP .100UF
C0202	2113743F08	R CHIP CAP .220UF
C0203	2113741A57	CAP CHIP CL2 X7R REEL 33000
C0204	2311049A09	CAP TANT CHIP 2.2 10 20 A/P
C0205	2311049A09	CAP TANT CHIP 2.2 10 20 A/P
C0206	2311049J11	CAP TANT CHIP 4.7 10 16
C0207	2113743K15	CER CHIP CAP .100UF
C0208	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0209	2311049A01	CAP TANT CHIP A/P .1 10 35
C0210	2113743K15	CER CHIP CAP .100UF
C0211	2113743K15	CER CHIP CAP 100UF
C0212	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0213	2311049J23	CAP TANT CHIP 10 10 7
C0214	2113743K15	CER CHIP CAP .100UF
C0215	2311049J23	CAP TANT CHIP 10 10 7
C0217	2113743F08	R CHIP CAP .220UF
C0218	2113743A19	CAP CHIP .100 UF 10% X7R
C0219	2311049J26	CAP TANT CHIP 10 20 16
C0220	2113743K15	CER CHIP CAP .100UF
C0224	2113741M53	CAP CHIP CL2 X7R 10% 22000
C0228	2113743K15	CER CHIP CAP .100UF
C0229	2113740F39	CAP CHIP REEL CL1 +/-30 33
C0231	2113743K15	CER CHIP CAP .100UF

Ref.	Part/Kit No.	Description
C0234	2113743K15	CER CHIP CAP .100UF
C0235	2311049A07	CAP TANT CHIP 1 10 16 A/P
C0236	2113741F13	CAP CHIP CL2 X7R REEL 330
C0237	2311049A42	CAP TANT CHIP 3.3 10 6
C0240	2113741A57	CAP CHIP CL2 X7R REEL 33000
C0241	2109720D14	CAP CER CHIP LOW DIST .1 UF
C0242	2113741A33	CAP CHIP CL2 X7R REEL 3300
C0401	2113740F36	CAP CHIP REEL CL1 +/-30 24
C0402	2113740F36	CAP CHIP REEL CL1 +/-30 24
C0403	2113741F17	CAP CHIP CL2 X7R REEL 470
C0404	2113740F36	CAP CHIP REEL CL1 +/-30 24
C0405	2113740F39	CAP CHIP REEL CL1 +/-30 33
C0406	2113740F39	CAP CHIP REEL CL1 +/-30 33
C0407	2113741F17	CAP CHIP CL2 X7R REEL 470
C0408	2113741F17	CAP CHIP CL2 X7R REEL 470
C0409	2113741F17	CAP CHIP CL2 X7R REEL 470
C0410	2113741F17	CAP CHIP CL2 X7R REEL 470
C0411	2113741F17	CAP CHIP CL2 X7R REEL 470
C0412	2113741F17	CAP CHIP CL2 X7R REEL 470
C0413	2113743K15	CER CHIP CAP .100UF
C0414	2113741F17	CAP CHIP CL2 X7R REEL 470
C0415	2113741F17	CAP CHIP CL2 X7R REEL 470
C0416	2113741F17	CAP CHIP CL2 X7R REEL 470
C0418	2113741F17	CAP CHIP CL2 X7R REEL 470
C0422	2113741F17	CAP CHIP CL2 X7R REEL 470
C0423	2113741F17	CAP CHIP CL2 X7R REEL 470
C0426	2113741F17	CAP CHIP CL2 X7R REEL 470
C0427	2113741F17	CAP CHIP CL2 X7R REEL 470
C0429	2113741F17	CAP CHIP CL2 X7R REEL 470
C0430	2113741F17	CAP CHIP CL2 X7R REEL 470
C0431	2113741F17	CAP CHIP CL2 X7R REEL 470
C0432	2113741F25	CAP CHIP CL2 X7R REEL 1000
C0433	2113741F25	CAP CHIP CL2 X7R REEL 1000
C0434	2113741F17	CAP CHIP CL2 X7R REEL 470
C0435	2113741F17	CAP CHIP CL2 X7R REEL 470
C0436	2113741F17	CAP CHIP CL2 X7R REEL 470
C0437	2113740F39	CAP CHIP REEL CL1 +/-30 33
C0438	2113741F17	CAP CHIP CL2 X7R REEL 470
C0439	2113741F17	CAP CHIP CL2 X7R REEL 470
C0440	2113741F17	CAP CHIP CL2 X7R REEL 470
C0441	2113741F17	CAP CHIP CL2 X7R REEL 470
C0442	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0444	2113741F17	CAP CHIP CL2 X7R REEL 470
C0446	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0447	2113741F17	CAP CHIP CL2 X7R REEL 470
C0450	2113741F17	CAP CHIP CL2 X7R REEL 470
C0452	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0453	2113741F17	CAP CHIP CL2 X7R REEL 470
C0454	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0456	2113741F17	CAP CHIP CL2 X7R REEL 470
C0457	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0459	2113741F17	CAP CHIP CL2 X7R REEL 470
C0461	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0463	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0464	2113741F17	CAP CHIP CL2 X7R REEL 470
C0500	2109720D14	CAP CER CHIP LOW DIST .1 UF
C0501	2380090M24	CAP ALU 10 20 50V SURF MT
C0502	2113741A45	CAP CHIP CL2 X7R REEL 10000
C0503	2311049J44	CAP TANT CHIP 47 20 10
C0504	2109720D14	CAP CER CHIP LOW DIST .1 UF
C0505	2109720D14	CAP CER CHIP LOW DIST .1 UF
C0506	2380090M24	CAP ALU 10 20 50V SURF MT
C0507	2113740F51	CAP CHIP REEL CL1 +/-30 100
C0508	2311049J40	CAP TANT CHIP 33 20 16

ELECTRICAL PARTS LIST FOR CLOSED ARCHITECTURE CONTROLLER BD, VHF/UHF

Ref.	Part/Kit No.	Description
C0509	2109720D14	CAP CER CHIP LOW DIST .1 UF
C0510	2113743K15	CER CHIP CAP .100UF
C0511	2311049A07	CAP TANT CHIP 1 10 16 A/P
C0512	2113743K15	CER CHIP CAP .100UF
C0513	2311049A07	CAP TANT CHIP 1 10 16 A/P
C0514	2113743K15	CER CHIP CAP .100UF
C0518	2311049A07	CAP TANT CHIP 1 10 16 A/P
C0550	2113740F51	CAP CHIP REEL CL1 +/-30 100
C0551	2113740F51	CAP CHIP REEL CL1 +/-30 100
C0552	2113743A19	CAP CHIP .100 UF 10% X7R
C0553	2113740F51	CAP CHIP REEL CL1 +/-30 100
C0554	2113740F51	CAP CHIP REEL CL1 +/-30 100
C0555	2113740F51	CAP CHIP REEL CL1 +/-30 100
C0556	2113740F51	CAP CHIP REEL CL1 +/-30 100
C0557	2113740F51	CAP CHIP REEL CL1 +/-30 100
C0558	2113740F51	CAP CHIP REEL CL1 +/-30 100
C0561	2113740F51	CAP CHIP REEL CL1 +/-30 100
C0562	2113740F51	CAP CHIP REEL CL1 +/-30 100
C0564	2113740F51	CAP CHIP REEL CL1 +/-30 100
C0566	2113740F51	CAP CHIP REEL CL1 +/-30 100
C0570	2113743K15	CER CHIP CAP .100UF
C0575	2113740F51	CAP CHIP REEL CL1 +/-30 100
CR0001	4813833C02	DIODE DUAL 70V '5B'
CR0510	4813833C02	DIODE DUAL 70V '5B'
CR0511	4813833C02	DIODE DUAL 70V '5B'
CR0550	4813833C02	DIODE DUAL 70V '5B'
J403	2805429W01	CONN SEALED 25 POS MINI D
J405	0905904V01	CONN CONTROL HEAD RA
L0400	2462587Q40	IND CHIP 270 NH 10%
L0401	2462587Q40	IND CHIP 270 NH 10%
Q0200	4813824A10	XSTR NPN 40V .2A
Q0400	4805128M16	TSTR SOT MMBT3906
Q0401	4813824A10	XSTR NPN 40V .2A
Q0402	4805128M16	TSTR SOT MMBT3906
Q0406	4805128M16	TSTR SOT MMBT3906
Q0407	4813824A10	XSTR NPN 40V .2A
Q0408	4805128M16	TSTR SOT MMBT3906
Q0409	4813824A10	XSTR NPN 40V .2A
Q0414	4880048M01	TSTR NPN DIG 47K/47K
Q0418	4880048M01	TSTR NPN DIG 47K/47K
Q0419	4813824A10	XSTR NPN 40V .2A
Q0421	4813824A10	XSTR NPN 40V .2A
Q0424	4880048M01	TSTR NPN DIG 47K/47K
Q0428	4880048M01	TSTR NPN DIG 47K/47K
Q0429	4805128M27	TSTR SOT89 BSR33 (LH)
Q0430	4813824A10	XSTR NPN 40V .2A
Q0431	4880048M01	TSTR NPN DIG 47K/47K
Q0500	4813824A10	XSTR NPN 40V .2A
Q0510	4880048M01	TSTR NPN DIG 47K/47K
Q0511	4805718V02	MOSFET P-CHAN ENHANCE
Q0513	4880048M01	TSTR NPN DIG 47K/47K
Q0514	4880048M01	TSTR NPN DIG 47K/47K
Q0515	4880048M01	TSTR NPN DIG 47K/47K
Q0516	4880048M01	TSTR NPN DIG 47K/47K
Q0517	4880048M01	TSTR NPN DIG 47K/47K
Q0518	4880048M01	TSTR NPN DIG 47K/47K
Q0519	4813824A10	XSTR NPN 40V .2A
Q0552	4880048M01	TSTR NPN DIG 47K/47K
Q0553	4805128M27	TSTR SOT89 BSR33 (LH)
Q0554	4880048M01	TSTR NPN DIG 47K/47K
Q0555	4813824A10	XSTR NPN 40V .2A
Q0556	4813824A10	XSTR NPN 40V .2A
R0001	0662057A73	CHIP RES 10K OMHS 5%
R0002	0662057A49	CHIP RES 1000 OMHS 5%
R0003	0662057A65	CHIP RES 4700 OMHS 5%
R0004	0662057A57	CHIP RES 2200 OMHS 5%
R0005	0662057A73	CHIP RES 10K OMHS 5%
R0006	0662057A65	CHIP RES 4700 OMHS 5%
R0020	0662057A73	CHIP RES 10K OMHS 5%
R0021	0662057A73	CHIP RES 10K OMHS 5%
R0024	0662057A65	CHIP RES 4700 OMHS 5%
R0028	0662057A89	CHIP RES 47K OMHS 5%
R0046	0662057B05	CHIP RES 200K OHMS 5%
R0047	0662057B05	CHIP RES 200K OHMS 5%
R0123	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R0200	0662057R92	RES CHIP 10K .1W 1%
R0201	2113741F49	CAP CHIP CL2 X7R REEL 10000
R0202	0662057A73	CHIP RES 10K OMHS 5%
R0204	0662057A89	CHIP RES 47K OMHS 5%
R0205	0662057C01	CHIP RES 0 OHMS+.050 OHMS
R0206	0662057A73	CHIP RES 10K OMHS 5%
R0207	0662057A73	CHIP RES 10K OMHS 5%
R0208	0662057A73	CHIP RES 10K OMHS 5%
R0209	0662057A73	CHIP RES 10K OMHS 5%
R0210	0662057A73	CHIP RES 10K OMHS 5%
R0211	0662057A73	CHIP RES 10K OMHS 5%
R0219	0662057A69	CHIP RES 6800 OMHS 5%
R0220	0662057A49	CHIP RES 1000 OMHS 5%
R0221	0662057A69	CHIP RES 6800 OMHS 5%
R0222	0662057A49	CHIP RES 1000 OMHS 5%
R0223	0662057A43	CHIP RES 560 OHMS 5%
R0224	0662057A41	CHIP RES 470 OHMS 5%
R0234	0662057A65	CHIP RES 4700 OMHS 5%
R0235	0662057A49	CHIP RES 1000 OMHS 5%
R0236	0662057A81	CHIP RES 22K OMHS 5%
R0237	0662057A73	CHIP RES 10K OMHS 5%
R0238	0662057A93	CHIP RES 68K OMHS 5%
R0239	0662057A73	CHIP RES 10K OMHS 5%
R0245	0662057A73	CHIP RES 10K OMHS 5%
R0400	0662057A73	CHIP RES 10K OMHS 5%
R0401	0662057A89	CHIP RES 47K OMHS 5%
R0406	0662057A73	CHIP RES 10K OMHS 5%
R0407	0662057A65	CHIP RES 4700 OMHS 5%
R0408	0662057A73	CHIP RES 10K OMHS 5%
R0409	0662057A57	CHIP RES 2200 OMHS 5%
R0410	0662057A25	CHIP RES 100 OHMS 5%
R0411	0662057A25	CHIP RES 100 OHMS 5%
R0412	0662057A65	CHIP RES 4700 OMHS 5%
R0413	0662057A73	CHIP RES 10K OMHS 5%
R0414	0662057A81	CHIP RES 22K OMHS 5%
R0415	0662057A57	CHIP RES 2200 OMHS 5%
R0416	0662057A81	CHIP RES 22K OMHS 5%
R0417	0662057A93	CHIP RES 68K OMHS 5%
R0423	0662057A89	CHIP RES 47K OMHS 5%
R0424	0662057A65	CHIP RES 4700 OMHS 5%
R0425	0662057A65	CHIP RES 4700 OMHS 5%
R0426	0662057A65	CHIP RES 4700 OMHS 5%
R0427	0662057A56	CHIP RES 2000 OMHS 5%
R0428	0662057A89	CHIP RES 47K OMHS 5%
R0429	0662057A81	CHIP RES 22K OMHS 5%
R0430	0662057A73	CHIP RES 10K OMHS 5%
R0431	0662057A65	CHIP RES 4700 OMHS 5%
R0432	0662057C01	CHIP RES 0 OHMS+.050 OHMS
R0434	0662057A73	CHIP RES 10K OMHS 5%
R0435	0662057A73	CHIP RES 10K OMHS 5%
R0437	0662057A65	CHIP RES 4700 OMHS 5%
R0439	0662057A89	CHIP RES 47K OMHS 5%
R0440	0662057A73	CHIP RES 10K OMHS 5%

ELECTRICAL PARTS LIST FOR CLOSED ARCHITECTURE CONTROLLER BD, VHF/UHF

Ref.	Part/Kit No.	Description
R0442	0662057A65	CHIP RES 4700 OMHS 5%
R0445	0662057A65	CHIP RES 4700 OMHS 5%
R0447	0662057A89	CHIP RES 47K OMHS 5%
R0448	0662057A49	CHIP RES 1000 OMHS 5%
R0450	0662057A73	CHIP RES 10K OMHS 5%
R0451	0662057A65	CHIP RES 4700 OMHS 5%
R0452	0662057A49	CHIP RES 1000 OMHS 5%
R0454	0662057A73	CHIP RES 10K OMHS 5%
R0455	0662057A89	CHIP RES 47K OMHS 5%
R0456	0662057A49	CHIP RES 1000 OMHS 5%
R0457	0662057A65	CHIP RES 4700 OMHS 5%
R0458	0662057A73	CHIP RES 10K OMHS 5%
R0459	0662057A89	CHIP RES 47K OMHS 5%
R0460	0662057A73	CHIP RES 10K OMHS 5%
R0464	0662057A73	CHIP RES 10K OMHS 5%
R0465	0662057A53	CHIP RES 1500 OMHS 5%
R0466	0662057A59	CHIP RES 2700 OMHS 5%
R0500	0662057A73	CHIP RES 10K OMHS 5%
R0501	0662057A81	CHIP RES 22K OMHS 5%
R0502	0662057A81	CHIP RES 22K OMHS 5%
R0503	0660076E70	RES CHIP FILM 7500 1 1/8
R0504	0660076E51	RES CHIP FILM 1200 1 1/8
R0511	0662057A43	CHIP RES 560 OHMS 5%
R0512	0662057B05	CHIP RES 200K OHMS 5%
R0513	0662057B05	CHIP RES 200K OHMS 5%
R0514	0662057B02	CHIP RES 150K OHMS 5%
R0518	0662057A65	CHIP RES 4700 OMHS 5%
R0519	0662057A81	CHIP RES 22K OMHS 5%
R0521	0662057A81	CHIP RES 22K OMHS 5%
R0522	0662057A81	CHIP RES 22K OMHS 5%
R0523	0662057A73	CHIP RES 10K OMHS 5%
R0525	0662057A65	CHIP RES 4700 OMHS 5%
R0550	0662057A81	CHIP RES 22K OMHS 5%
R0551	0662057R92	RES CHIP 10K .1W 1%
R0554	0662057A81	CHIP RES 22K OMHS 5%
R0557	0662057R60	RES CHIP 10K .1W 1%
R0558	0662057R60	RES CHIP 10K .1W 1%
R0559	0662057R60	RES CHIP 10K .1W 1%
R0560	0662057R60	RES CHIP 10K .1W 1%
R0565	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R0566	0662057A73	CHIP RES 10K OMHS 5%
R0567	0662057R92	RES CHIP 10K .1W 1%
R0568	0662057A65	CHIP RES 4700 OMHS 5%
R0569	0662057R92	RES CHIP 10K .1W 1%
R0571	0662057A25	CHIP RES 100 OHMS 5%
R0576	0662057R92	RES CHIP 10K .1W 1%
R0577	0662057A73	CHIP RES 10K OMHS 5%
R0578	0662057A65	CHIP RES 4700 OMHS 5%
R0579	0662057A65	CHIP RES 4700 OMHS 5%
R0580	0662057A65	CHIP RES 4700 OMHS 5%
R0581	0662057A65	CHIP RES 4700 OMHS 5%
R0582	0662057R92	RES CHIP 10K .1W 1%
R0583	0662057A97	CHIP RES 100K OHMS 5%
R0585	0662057A49	CHIP RES 1000 OMHS 5%
R0586	0662057A49	CHIP RES 1000 OMHS 5%
R0589	0662057A97	CHIP RES 100K OHMS 5%
R0593	0662057A81	CHIP RES 22K OMHS 5%
R0594	0662057A61	CHIP RES 3300 OMHS 5%
R0595	0662057A65	CHIP RES 4700 OMHS 5%
U0002	5113806A20	IC MUX/DEMUX,TRIPLE 2-CHNL
U0003	5105625U67	IC MICROP HC11K4 RENAISS MASK
U0005	5105750U28	IC CMOS BILATERAL SW
U0200	5105835U14	CC C/51R05191W23 ASFIC DIE
U0201	5183222M49	IC AMP __3403_ SING SPLY
U0202	5183222M49	IC AMP __3403_SING SPLY
U0203	5105457W10	CC AUDIO PA LER
U0401	5113818A03	IC HIGH PERFORMANCE SING SPLY
U0500	5105625U24	IC 5V REG 2925
U0501	5105625U25	IC 9.3V REG 2941
U0502	5113816A04	REG 8V POS 10MA MC78L0ABDR2
U0510	5105625U26	IC DUAL 555 TIMER
U0550	5183222M49	IC AMP __3403_SING SPLY
U0551	5113811G02	IC D/A CONV 6BIT 4CHAN W/SPI
VR0001	4813830A14	DIODE 5.1V 5% 225MW
VR0100	4813830A27	DIODE 14V 5% 225MW
VR0402	4813830A15	DIODE 5.6V 5% 225MW
VR0405	4813830A15	DIODE 5.6V 5% 225MW
VR0406	4813830A27	DIODE 14V 5% 225MW
VR0407	4813830A27	DIODE 14V 5% 225MW
VR0410	4813830A27	DIODE 14V 5% 225MW
VR0413	4813830A15	DIODE 5.6V 5% 225MW
VR0414	4813830A15	DIODE 5.6V 5% 225MW
VR0415	4813830A15	DIODE 5.6V 5% 225MW
VR0418	4813830A27	DIODE 14V 5% 225MW
VR0419	4813830A23	DIODE 10V 5% 225MW
VR0420	4813830A23	DIODE 10V 5% 225MW
VR0421	4813830A23	DIODE 10V 5% 225MW
VR0422	4813830A23	DIODE 10V 5% 225MW
VR0424	4813830A27	DIODE 14V 5% 225MW
VR0425	4813830A40	SOC23 AUTO SDN
VR0426	4813830A27	DIODE 14V 5% 225MW
VR0429	4813830A27	DIODE 14V 5% 225MW
VR0430	4813830A27	DIODE 14V 5% 225MW
VR0431	4813830A15	DIODE 5.6V 5% 225MW
VR0511	4813830A27	DIODE 14V 5% 225MW

ELECTRICAL PARTS LIST FOR OPEN ARCHITECTURE CONTROLLER BD, VHF/UHF

Ref.	Part/Kit No.	Description
	HUD4011A	**VHF, Open Architecture**
C0572	2113741A57	CAP CHIP CL2 X7R REEL 33000
R0000	0662057A97	CHIP RES 100K OHMS 5%
R0563	0662057A29	CHIP RES 150 OHMS 5%
R0564	0662057A49	CHIP RES 1000 OMHS 5%
R0570	0662057A49	CHIP RES 1000 OMHS 5%
R0573	0662057A65	CHIP RES 4700 OMHS 5%
R0584	0662057A57	CHIP RES 2200 OMHS 5%
R0588	0662057A69	CHIP RES 6800 OMHS 5%
R0590	0662057A77	CHIP RES 15K OMHS 5%
R0592	0662057A61	CHIP RES 3300 OMHS 5%
R0553	0662057A65	CHIP RES 4700 OMHS 5%
R0591	0662057A65	CHIP RES 4700 OMHS 5%
	HUE4011A	**UHF, Open Architecture**
C0571	2109720D14	CAP CER CHIP LOW DIST .1 UF
C0572	2113743K15	CER CHIP CAP .100UF
R0553	0662057R60	RES CHIP 10K .1W 1%
R0556	0662057A65	CHIP RES 4700 OMHS 5%
R0563	0662057A49	CHIP RES 1000 OMHS 5%
R0564	0662057A57	CHIP RES 2200 OMHS 5%
R0570	0662057C01	CHIP RES 0 OHMS +.050 OHMS
R0573	0662057A49	CHIP RES 1000 OMHS 5%
R0584	0662057A73	CHIP RES 10K OMHS 5%
R0588	0662057A73	CHIP RES 10K OMHS 5%
R0590	0662057A81	CHIP RES 22K OMHS 5%
R0591	0662057A73	CHIP RES 10K OMHS 5%
R0592	0662057A65	CHIP RES 4700 OMHS 5%
	0105958S53	**VHF & UHF, Open Architecture**
C0100	2113743K15	CER CHIP CAP .100UF
C0102	2113743K15	CER CHIP CAP .100UF
C0104	2113743K15	CER CHIP CAP .100UF
C0105	2311049A42	CAP TANT CHIP 3.3 10 6
C0106	2113741F17	CAP CHIP CL2 X7R REEL 470
C0107	2311049A07	CAP TANT CHIP 1 10 16 A/P
C0108	2113743K15	CER CHIP CAP .100UF
C0201	2113743K15	CER CHIP CAP .100UF
C0202	2113743F08	R CHIP CAP .220UF
C0203	2113741A57	CAP CHIP CL2 X7R REEL 33000
C0204	2311049A09	CAP TANT CHIP 2.2 10 20 A/P
C0205	2311049A09	CAP TANT CHIP 2.2 10 20 A/P
C0206	2311049J11	CAP TANT CHIP 4.7 10 16
C0207	2113743K15	CER CHIP CAP .100UF
C0208	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0209	2311049A01	CAP TANT CHIP A/P .1 10 35
C0210	2113743K15	CER CHIP CAP .100UF
C0211	2113743K15	CER CHIP CAP .100UF
C0212	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0213	2311049J23	CAP TANT CHIP 10 10 7
C0214	2113743K15	CER CHIP CAP .100UF
C0215	2311049J23	CAP TANT CHIP 10 10 7
C0216	2113743K15	CER CHIP CAP .100UF
C0217	2113743F08	R CHIP CAP .220UF
C0218	2113743A19	CAP CHIP .100 UF 10% X7R
C0219	2311049J26	CAP TANT CHIP 10 20 16
C0221	2113743A19	CAP CHIP .100 UF 10% X7R
C0222	2311049J26	CAP TANT CHIP 10 20 16
C0223	2113741M53	CAP CHIP CL2 X7R 10% 22000
C0224	2113741M53	CAP CHIP CL2 X7R 10% 22000
C0225	2113743K15	CER CHIP CAP .100UF
C0228	2113743K15	CER CHIP CAP .100UF
C0229	2113740F39	CAP CHIP REEL CL1 +/-30 33
C0231	2113743K15	CER CHIP CAP .100UF

Ref.	Part/Kit No.	Description
C0234	2113743K15	CER CHIP CAP .100UF
C0235	2311049A07	CAP TANT CHIP 1 10 16 A/P
C0236	2113741F13	CAP CHIP CL2 X7R REEL 330
C0237	2311049A42	CAP TANT CHIP 3.3 10 6
C0240	2113741A57	CAP CHIP CL2 X7R REEL 33000
C0241	2109720D14	CAP CER CHIP LOW DIST .1 UF
C0242	2113741A33	CAP CHIP CL2 X7R REEL 3300
C0401	2113740F36	CAP CHIP REEL CL1 +/-30 24
C0402	2113740F36	CAP CHIP REEL CL1 +/-30 24
C0403	2113741F17	CAP CHIP CL2 X7R REEL 470
C0404	2113740F36	CAP CHIP REEL CL1 +/-30 24
C0405	2113740F39	CAP CHIP REEL CL1 +/-30 33
C0406	2113740F39	CAP CHIP REEL CL1 +/-30 33
C0407	2113741F17	CAP CHIP CL2 X7R REEL 470
C0408	2113741F17	CAP CHIP CL2 X7R REEL 470
C0409	2113741F17	CAP CHIP CL2 X7R REEL 470
C0410	2113741F17	CAP CHIP CL2 X7R REEL 470
C0411	2113741F17	CAP CHIP CL2 X7R REEL 470
C0412	2113741F17	CAP CHIP CL2 X7R REEL 470
C0413	2113743K15	CER CHIP CAP .100UF
C0414	2113741F17	CAP CHIP CL2 X7R REEL 470
C0415	2113741F17	CAP CHIP CL2 X7R REEL 470
C0416	2113741F17	CAP CHIP CL2 X7R REEL 470
C0418	2113741F17	CAP CHIP CL2 X7R REEL 470
C0421	2113741F17	CAP CHIP CL2 X7R REEL 470
C0422	2113741F17	CAP CHIP CL2 X7R REEL 470
C0423	2113741F17	CAP CHIP CL2 X7R REEL 470
C0425	2113741F17	CAP CHIP CL2 X7R REEL 470
C0426	2113741F17	CAP CHIP CL2 X7R REEL 470
C0427	2113741F17	CAP CHIP CL2 X7R REEL 470
C0429	2113741F17	CAP CHIP CL2 X7R REEL 470
C0430	2113741F17	CAP CHIP CL2 X7R REEL 470
C0431	2113741F17	CAP CHIP CL2 X7R REEL 470
C0432	2113741F25	CAP CHIP CL2 X7R REEL 1000
C0433	2113741F25	CAP CHIP CL2 X7R REEL 1000
C0434	2113741F17	CAP CHIP CL2 X7R REEL 470
C0435	2113741F17	CAP CHIP CL2 X7R REEL 470
C0436	2113741F17	CAP CHIP CL2 X7R REEL 470
C0437	2113740F39	CAP CHIP REEL CL1 +/-30 33
C0438	2113741F17	CAP CHIP CL2 X7R REEL 470
C0439	2113741F17	CAP CHIP CL2 X7R REEL 470
C0440	2113741F17	CAP CHIP CL2 X7R REEL 470
C0441	2113741F17	CAP CHIP CL2 X7R REEL 470
C0442	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0444	2113741F17	CAP CHIP CL2 X7R REEL 470
C0446	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0447	2113741F17	CAP CHIP CL2 X7R REEL 470
C0449	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0450	2113741F17	CAP CHIP CL2 X7R REEL 470
C0451	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0452	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0453	2113741F17	CAP CHIP CL2 X7R REEL 470
C0454	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0456	2113741F17	CAP CHIP CL2 X7R REEL 470
C0457	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0458	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0459	2113741F17	CAP CHIP CL2 X7R REEL 470
C0460	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0461	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0462	2113741F17	CAP CHIP CL2 X7R REEL 470
C0463	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0464	2113741F17	CAP CHIP CL2 X7R REEL 470
C0500	2109720D14	CAP CER CHIP LOW DIST .1 UF
C0501	2380090M24	CAP ALU 10 20 50V SURF MT

ELECTRICAL PARTS LIST FOR OPEN ARCHITECTURE CONTROLLER BD, VHF/UHF

Ref.	Part/Kit No.	Description
C0502	2113741A45	CAP CHIP CL2 X7R REEL 10000
C0503	2311049J44	CAP TANT CHIP 47 20 10
C0504	2109720D14	CAP CER CHIP LOW DIST .1 UF
C0505	2109720D14	CAP CER CHIP LOW DIST .1 UF
C0506	2380090M24	CAP ALU 10 20 50V SURF MT
C0507	2113740F51	CAP CHIP REEL CL1 +/-30 100
C0508	2311049J40	CAP TANT CHIP 33 20 16
C0509	2109720D14	CAP CER CHIP LOW DIST .1 UF
C0510	2113743K15	CER CHIP CAP .100UF
C0511	2311049A07	CAP TANT CHIP 1 10 16 A/P
C0512	2113743K15	CER CHIP CAP .100UF
C0513	2311049A07	CAP TANT CHIP 1 10 16 A/P
C0514	2113743K15	CER CHIP CAP .100UF
C0518	2311049A07	CAP TANT CHIP 1 10 16 A/P
C0550	2113740F51	CAP CHIP REEL CL1 +/-30 100
C0551	2113740F51	CAP CHIP REEL CL1 +/-30 100
C0552	2113743A19	CAP CHIP .100 UF 10% X7R
C0553	2113740F51	CAP CHIP REEL CL1 +/-30 100
C0554	2113740F51	CAP CHIP REEL CL1 +/-30 100
C0556	2113740F51	CAP CHIP REEL CL1 +/-30 100
C0557	2113740F51	CAP CHIP REEL CL1 +/-30 100
C0558	2113740F51	CAP CHIP REEL CL1 +/-30 100
C0561	2113740F51	CAP CHIP REEL CL1 +/-30 100
C0562	2113740F51	CAP CHIP REEL CL1 +/-30 100
C0564	2113740F51	CAP CHIP REEL CL1 +/-30 100
C0566	2113740F51	CAP CHIP REEL CL1 +/-30 100
C0570	2113743K15	CER CHIP CAP .100UF
C0575	2113740F51	CAP CHIP REEL CL1 +/-30 100
CR0105	4813833C02	DIODE DUAL 70V '5B'
CR0510	4813833C02	DIODE DUAL 70V '5B'
CR0511	4813833C02	DIODE DUAL 70V '5B'
CR0550	4813833C02	DIODE DUAL 70V '5B'
J401	0913915A11	RECP SMT LOPRO 25 POS
J403	2805429W01	CONN SEALED 25 POS MINI D
J405	0905904V01	CONN CONTROL HEAD RA
J408	0913915A11	RECP SMT LOPRO 25 POS
L0400	2462587Q40	IND CHIP 270 NH 10%
L0401	2462587Q40	IND CHIP 270 NH 10%
Q0100	4880048M01	TSTR NPN DIG 47K/47K
Q0103	4805921T09	XSTR DUAL ROHM FMG8
Q0200	4813824A10	XSTR NPN 40V .2A
Q0202	4880048M01	TSTR NPN DIG 47K/47K
Q0400	4805128M16	TSTR SOT MMBT3906
Q0401	4813824A10	XSTR NPN 40V .2A
Q0402	4805128M16	TSTR SOT MMBT3906
Q0406	4805128M16	TSTR SOT MMBT3906
Q0407	4813824A10	XSTR NPN 40V .2A
Q0408	4805128M16	TSTR SOT MMBT3906
Q0409	4813824A10	XSTR NPN 40V .2A
Q0414	4880048M01	TSTR NPN DIG 47K/47K
Q0416	4880048M01	TSTR NPN DIG 47K/47K
Q0417	4813824A10	XSTR NPN 40V .2A
Q0418	4880048M01	TSTR NPN DIG 47K/47K
Q0419	4813824A10	XSTR NPN 40V .2A
Q0420	4880048M01	TSTR NPN DIG 47K/47K
Q0421	4813824A10	XSTR NPN 40V .2A
Q0422	4880048M01	TSTR NPN DIG 47K/47K
Q0423	4813824A10	XSTR NPN 40V .2A
Q0424	4880048M01	TSTR NPN DIG 47K/47K
Q0425	4880048M01	TSTR NPN DIG 47K/47K
Q0426	4880048M01	TSTR NPN DIG 47K/47K
Q0428	4880048M01	TSTR NPN DIG 47K/47K
Q0429	4805128M27	TSTR SOT89 BSR33 (LH)
Q0430	4813824A10	XSTR NPN 40V .2A

Ref.	Part/Kit No.	Description
Q0431	4880048M01	TSTR NPN DIG 47K/47K
Q0500	4813824A10	XSTR NPN 40V .2A
Q0510	4880048M01	TSTR NPN DIG 47K/47K
Q0511	4805718V02	MOSFET P-CHAN ENHANCE
Q0513	4880048M01	TSTR NPN DIG 47K/47K
Q0514	4880048M01	TSTR NPN DIG 47K/47K
Q0515	4880048M01	TSTR NPN DIG 47K/47K
Q0516	4880048M01	TSTR NPN DIG 47K/47K
Q0517	4880048M01	TSTR NPN DIG 47K/47K
Q0518	4880048M01	TSTR NPN DIG 47K/47K
Q0519	4813824A10	XSTR NPN 40V .2A
Q0552	4880048M01	TSTR NPN DIG 47K/47K
Q0553	4805128M27	TSTR SOT89 BSR33 (LH)
Q0554	4880048M01	TSTR NPN DIG 47K/47K
Q0555	4813824A10	XSTR NPN 40V .2A
Q0556	4813824A10	XSTR NPN 40V .2A
R0004	0662057A57	CHIP RES 2200 OMHS 5%
R0100	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R0101	0662057A81	CHIP RES 22K OMHS 5%
R0104	0662057A81	CHIP RES 22K OMHS 5%
R0105	0662057A97	CHIP RES 100K OHMS 5%
R0106	0662057A73	CHIP RES 10K OMHS 5%
R0107	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R0109	0662057A73	CHIP RES 10K OMHS 5%
R0111	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R0112	0662057A73	CHIP RES 10K OMHS 5%
R0113	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R0114	0662057A73	CHIP RES 10K OMHS 5%
R0115	0662057A73	CHIP RES 10K OMHS 5%
R0116	0662057A73	CHIP RES 10K OMHS 5%
R0117	0662057A97	CHIP RES 100K OHMS 5%
R0118	0662057A73	CHIP RES 10K OMHS 5%
R0119	0662057A56	CHIP RES 2000 OMHS 5%
R0123	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R0124	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R0125	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R0126	0662057A89	CHIP RES 47K OMHS 5%
R0127	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R0200	0662057R92	RES CHIP 10K .1W 1%
R0201	2113741F49	CAP CHIP CL2 X7R REEL 10000
R0202	0662057A73	CHIP RES 10K OMHS 5%
R0204	0662057A89	CHIP RES 47K OMHS 5%
R0205	0662057C01	CHIP RES 0 OHMS+.050 OHMS
R0206	0662057A73	CHIP RES 10K OMHS 5%
R0207	0662057A73	CHIP RES 10K OMHS 5%
R0208	0662057A73	CHIP RES 10K OMHS 5%
R0209	0662057A73	CHIP RES 10K OMHS 5%
R0210	0662057A73	CHIP RES 10K OMHS 5%
R0211	0662057A73	CHIP RES 10K OMHS 5%
R0212	0662057A69	CHIP RES 6800 OMHS 5%
R0213	0662057A69	CHIP RES 6800 OMHS 5%
R0214	0662057A69	CHIP RES 6800 OMHS 5%
R0215	0662057A49	CHIP RES 1000 OMHS 5%
R0216	0662057A69	CHIP RES 6800 OMHS 5%
R0217	0662057A69	CHIP RES 6800 OMHS 5%
R0218	0662057A69	CHIP RES 6800 OMHS 5%
R0219	0662057A69	CHIP RES 6800 OMHS 5%
R0220	0662057A49	CHIP RES 1000 OMHS 5%
R0221	0662057A69	CHIP RES 6800 OMHS 5%
R0222	0662057A49	CHIP RES 1000 OMHS 5%
R0223	0662057A43	CHIP RES 560 OHMS 5%
R0224	0662057A41	CHIP RES 470 OHMS 5%
R0229	0662057A41	CHIP RES 470 OHMS 5%
R0230	0662057A43	CHIP RES 560 OHMS 5%

ELECTRICAL PARTS LIST FOR OPEN ARCHITECTURE CONTROLLER BD, VHF/UHF

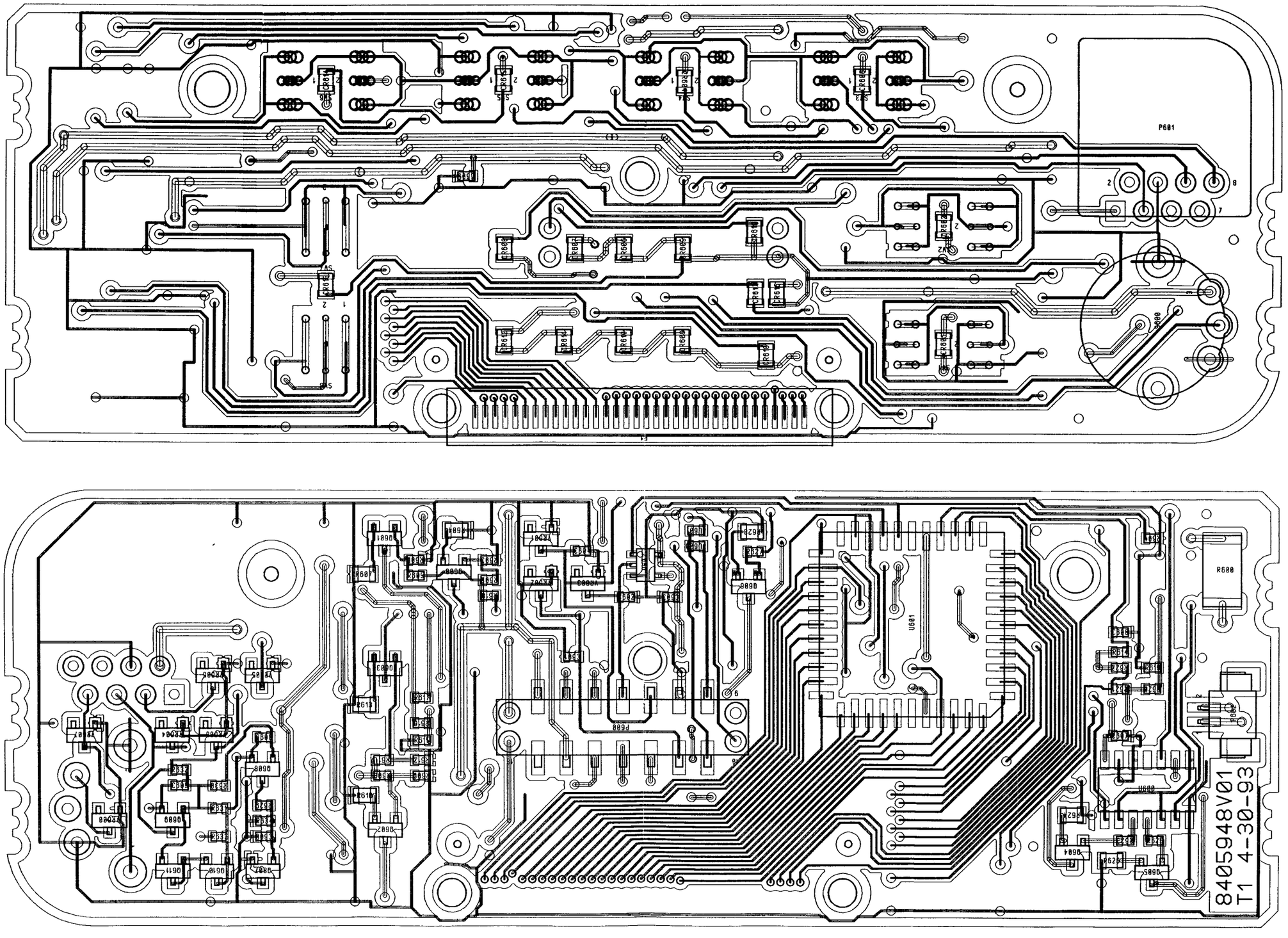
Ref.	Part/Kit No.	Description
R0231	0662057A49	CHIP RES 1000 OMHS 5%
R0234	0662057A65	CHIP RES 4700 OMHS 5%
R0235	0662057A49	CHIP RES 1000 OMHS 5%
R0236	0662057A81	CHIP RES 22K OMHS 5%
R0237	0662057A73	CHIP RES 10K OMHS 5%
R0238	0662057A93	CHIP RES 68K OMHS 5%
R0239	0662057A73	CHIP RES 10K OMHS 5%
R0244	0662057A65	CHIP RES 4700 OMHS 5%
R0245	0662057A73	CHIP RES 10K OMHS 5%
R0400	0662057A73	CHIP RES 10K OMHS 5%
R0401	0662057A89	CHIP RES 47K OMHS 5%
R0402	0662057A81	CHIP RES 22K OMHS 5%
R0406	0662057A73	CHIP RES 10K OMHS 5%
R0407	0662057A65	CHIP RES 4700 OMHS 5%
R0408	0662057A73	CHIP RES 10K OMHS 5%
R0409	0662057A57	CHIP RES 2200 OMHS 5%
R0410	0662057A25	CHIP RES 100 OHMS 5%
R0411	0662057A25	CHIP RES 100 OHMS 5%
R0412	0662057A65	CHIP RES 4700 OMHS 5%
R0413	0662057A73	CHIP RES 10K OMHS 5%
R0414	0662057A81	CHIP RES 22K OMHS 5%
R0415	0662057A57	CHIP RES 2200 OMHS 5%
R0416	0662057A81	CHIP RES 22K OMHS 5%
R0417	0662057A93	CHIP RES 68K OMHS 5%
R0421	0662057A65	CHIP RES 4700 OMHS 5%
R0423	0662057A89	CHIP RES 47K OMHS 5%
R0424	0662057A65	CHIP RES 4700 OMHS 5%
R0425	0662057A65	CHIP RES 4700 OMHS 5%
R0426	0662057A65	CHIP RES 4700 OMHS 5%
R0427	0662057A56	CHIP RES 2000 OMHS 5%
R0428	0662057A89	CHIP RES 47K OMHS 5%
R0429	0662057A81	CHIP RES 22K OMHS 5%
R0430	0662057A73	CHIP RES 10K OMHS 5%
R0431	0662057A65	CHIP RES 4700 OMHS 5%
R0432	0662057C01	CHIP RES 0 OHMS+.050 OHMS
R0433	0662057A89	CHIP RES 47K OMHS 5%
R0434	0662057A73	CHIP RES 10K OMHS 5%
R0435	0662057A73	CHIP RES 10K OMHS 5%
R0437	0662057A65	CHIP RES 4700 OMHS 5%
R0439	0662057A89	CHIP RES 47K OMHS 5%
R0440	0662057A73	CHIP RES 10K OMHS 5%
R0442	0662057A65	CHIP RES 4700 OMHS 5%
R0443	0662057A89	CHIP RES 47K OMHS 5%
R0444	0662057A73	CHIP RES 10K OMHS 5%
R0445	0662057A65	CHIP RES 4700 OMHS 5%
R0446	0662057A73	CHIP RES 10K OMHS 5%
R0447	0662057A89	CHIP RES 47K OMHS 5%
R0448	0662057A73	CHIP RES 10K OMHS 5%
R0449	0662057A65	CHIP RES 4700 OMHS 5%
R0450	0662057A73	CHIP RES 10K OMHS 5%
R0451	0662057A65	CHIP RES 4700 OMHS 5%
R0452	0662057A73	CHIP RES 10K OMHS 5%
R0453	0662057A65	CHIP RES 4700 OMHS 5%
R0454	0662057A73	CHIP RES 10K OMHS 5%
R0455	0662057A89	CHIP RES 47K OMHS 5%
R0456	0662057A73	CHIP RES 10K OMHS 5%
R0457	0662057A65	CHIP RES 4700 OMHS 5%
R0458	0662057A73	CHIP RES 10K OMHS 5%
R0459	0662057A89	CHIP RES 47K OMHS 5%
R0460	0662057A73	CHIP RES 10K OMHS 5%
R0464	0662057A73	CHIP RES 10K OMHS 5%
R0465	0662057A53	CHIP RES 1500 OMHS 5%
R0466	0662057A59	CHIP RES 2700 OMHS 5%
R0468	0662057A65	CHIP RES 4700 OMHS 5%

Ref.	Part/Kit No.	Description
R0500	0662057A73	CHIP RES 10K OMHS 5%
R0501	0662057A81	CHIP RES 22K OMHS 5%
R0502	0662057A81	CHIP RES 22K OMHS 5%
R0503	0660076E70	RES CHIP FILM 7500 1 1/8
R0504	0660076E51	RES CHIP FILM 1200 1 1/8
R0511	0662057A43	CHIP RES 560 OHMS 5%
R0512	0662057B05	CHIP RES 200K OHMS 5%
R0513	0662057B05	CHIP RES 200K OHMS 5%
R0514	0662057B02	CHIP RES 150K OHMS 5%
R0518	0662057A65	CHIP RES 4700 OMHS 5%
R0519	0662057A81	CHIP RES 22K OMHS 5%
R0521	0662057A81	CHIP RES 22K OMHS 5%
R0522	0662057A81	CHIP RES 22K OMHS 5%
R0523	0662057A73	CHIP RES 10K OMHS 5%
R0525	0662057A65	CHIP RES 4700 OMHS 5%
R0550	0662057A81	CHIP RES 22K OMHS 5%
R0551	0662057R92	RES CHIP 10K .1W 1%
R0554	0662057A81	CHIP RES 22K OMHS 5%
R0557	0662057R60	RES CHIP 10K .1W 1%
R0558	0662057R60	RES CHIP 10K .1W 1%
R0559	0662057R60	RES CHIP 10K .1W 1%
R0560	0662057R60	RES CHIP 10K .1W 1%
R0565	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R0566	0662057A73	CHIP RES 10K OMHS 5%
R0567	0662057R92	RES CHIP 10K .1W 1%
R0568	0662057A65	CHIP RES 4700 OMHS 5%
R0569	0662057R92	RES CHIP 10K .1W 1%
R0571	0662057A25	CHIP RES 100 OHMS 5%
R0576	0662057R92	RES CHIP 10K .1W 1%
R0577	0662057A73	CHIP RES 10K OMHS 5%
R0578	0662057A65	CHIP RES 4700 OMHS 5%
R0579	0662057A65	CHIP RES 4700 OMHS 5%
R0580	0662057A65	CHIP RES 4700 OMHS 5%
R0581	0662057A65	CHIP RES 4700 OMHS 5%
R0582	0662057R92	RES CHIP 10K .1W 1%
R0583	0662057A97	CHIP RES 100K OHMS 5%
R0585	0662057A49	CHIP RES 1000 OMHS 5%
R0586	0662057A49	CHIP RES 1000 OMHS 5%
R0589	0662057A97	CHIP RES 100K OHMS 5%
R0593	0662057A81	CHIP RES 22K OMHS 5%
R0594	0662057A61	CHIP RES 3300 OMHS 5%
R0595	0662057A65	CHIP RES 4700 OMHS 5%
U0100	5105662U58	HYBRID CC BUMPED TEST 62G65
U0101	5105662U54	HYBRID 32KX8 SRAM TEST
U0102	5105329V30	ROM FLASH 256K TSOP
U0103	5105662U52	HYBRID CC BUMPED TEST 27R02
U0104	5102103U01	OMPAC CONTAINING 03U01 TESTED
U0105	5113806A20	IC MUX/DEMUX,TRIPLE 2-CHNL
U0200	5105835U14	CC C/51R05191W23 ASFIC DIE
U0201	5183222M49	IC AMP __3403_ SING SPLY
U0202	5183222M49	IC AMP __3403_ SING SPLY
U0400	5184704M61	IC CMOS 04M61 QUAD SW
U0401	5113818A03	IC HIGH PERFORMANCE SING SPLY
U0502	5113816A04	REG 8V POS 10MA MC78L0ABDR2
U0510	5105625U26	IC DUAL 555 TIMER
U0550	5183222M49	IC AMP __3403_ SING SPLY
U0551	5113811G02	IC D/A CONV 6BIT 4CHAN W/SPI
U0203	5105457W10	CC AUDIO PA LER
U0500	5105625U24	IC 5V REG 2925
U0501	5105625U25	IC 9.3V REG 2941
VR0001	4813830A14	DIODE 5.1V 5% 225MW
VR0100	4813830A27	DIODE 14V 5% 225MW
VR0405	4813830A15	DIODE 5.6V 5% 225MW
VR0406	4813830A27	DIODE 14V 5% 225MW

ELECTRICAL PARTS LIST FOR OPEN ARCHITECTURE CONTROLLER BD, VHF/UHF

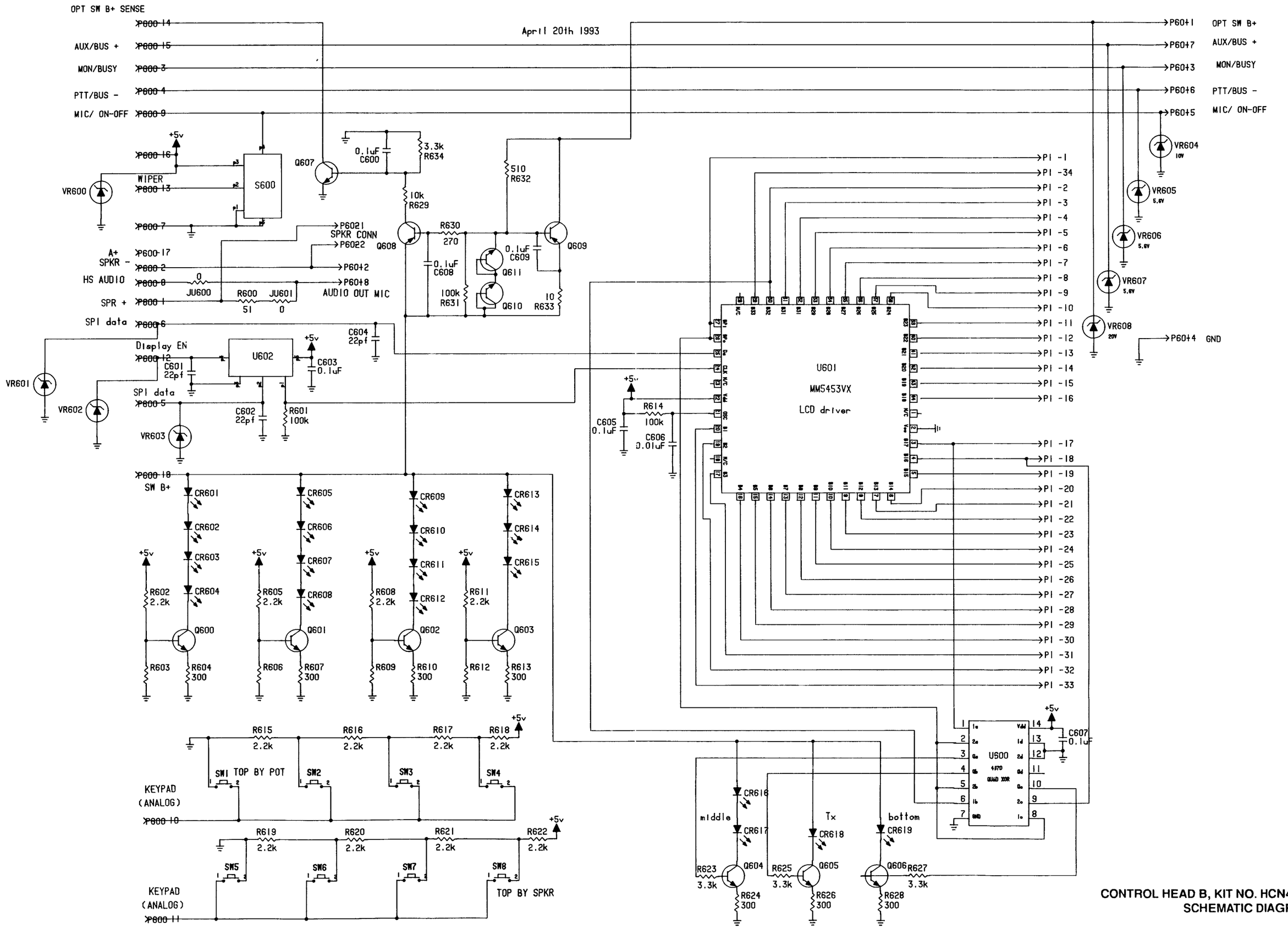
Ref.	Part/Kit No.	Description
VR0407	4813830A27	DIODE 14V 5% 225MW
VR0409	4813830A27	DIODE 14V 5% 225MW
VR0410	4813830A27	DIODE 14V 5% 225MW
VR0413	4813830A15	DIODE 5.6V 5% 225MW
VR0414	4813830A15	DIODE 5.6V 5% 225MW
VR0415	4813830A15	DIODE 5.6V 5% 225MW
VR0418	4813830A27	DIODE 14V 5% 225MW
VR0419	4813830A23	DIODE 10V 5% 225MW
VR0420	4813830A23	DIODE 10V 5% 225MW
VR0421	4813830A23	DIODE 10V 5% 225MW
VR0422	4813830A23	DIODE 10V 5% 225MW
VR0424	4813830A27	DIODE 14V 5% 225MW
VR0425	4813830A40	SOC23 AUTO SDN
VR0426	4813830A27	DIODE 14V 5% 225MW
VR0427	4813830A27	DIODE 14V 5% 225MW
VR0428	4813830A23	DIODE 10V 5% 225MW
VR0429	4813830A27	DIODE 14V 5% 225MW
VR0430	4813830A27	DIODE 14V 5% 225MW
VR0431	4813830A15	DIODE 5.6V 5% 225MW
VR0511	4813830A27	DIODE 14V 5% 225MW

Ref.	Part/Kit No.	Description



CONTROL HEAD B, KIT NO. HCN4048
COMPONENT LOCATION DIAGRAM

April 20th 1993

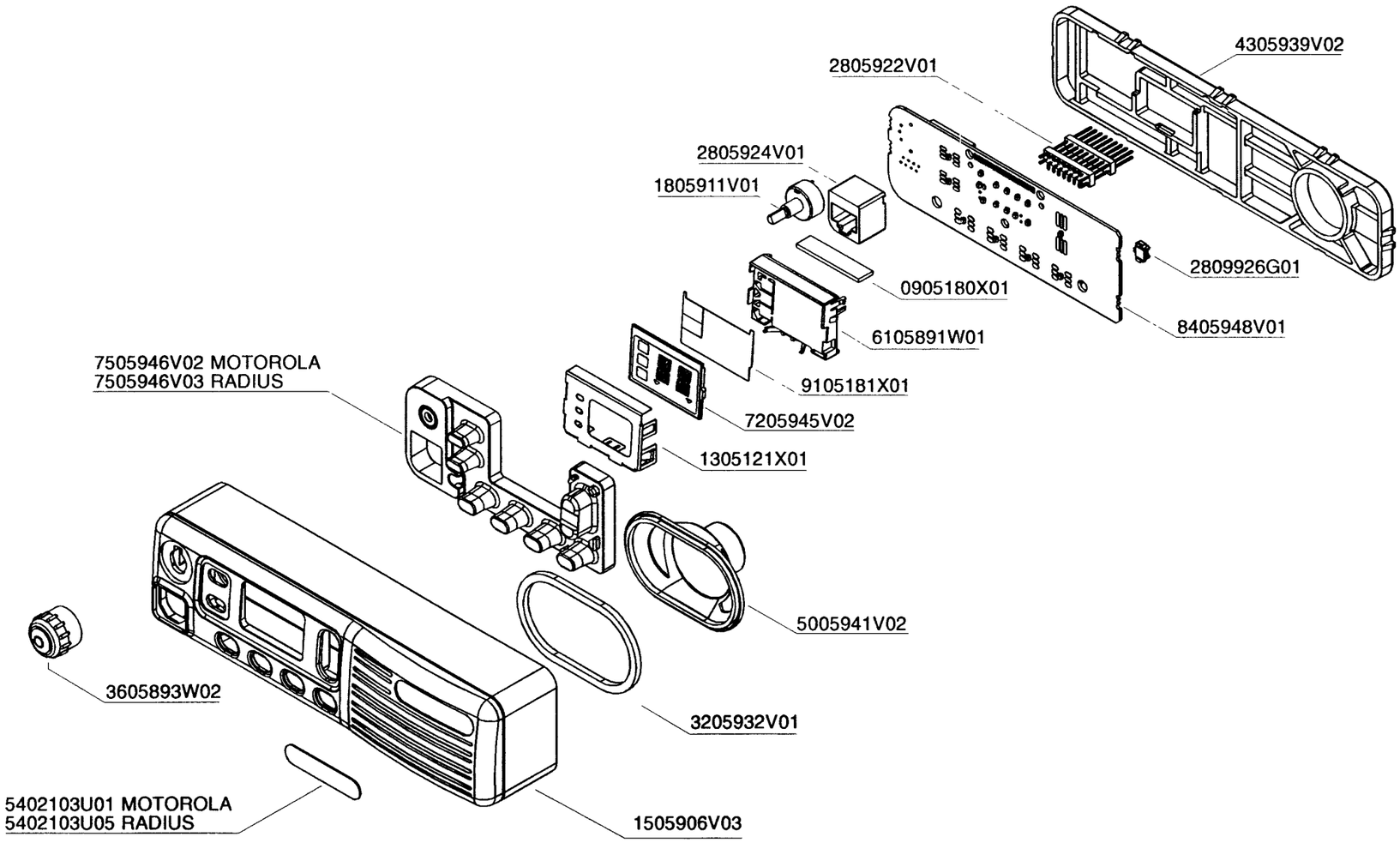


CONTROL HEAD B, KIT NO. HCN4048
SCHEMATIC DIAGRAM

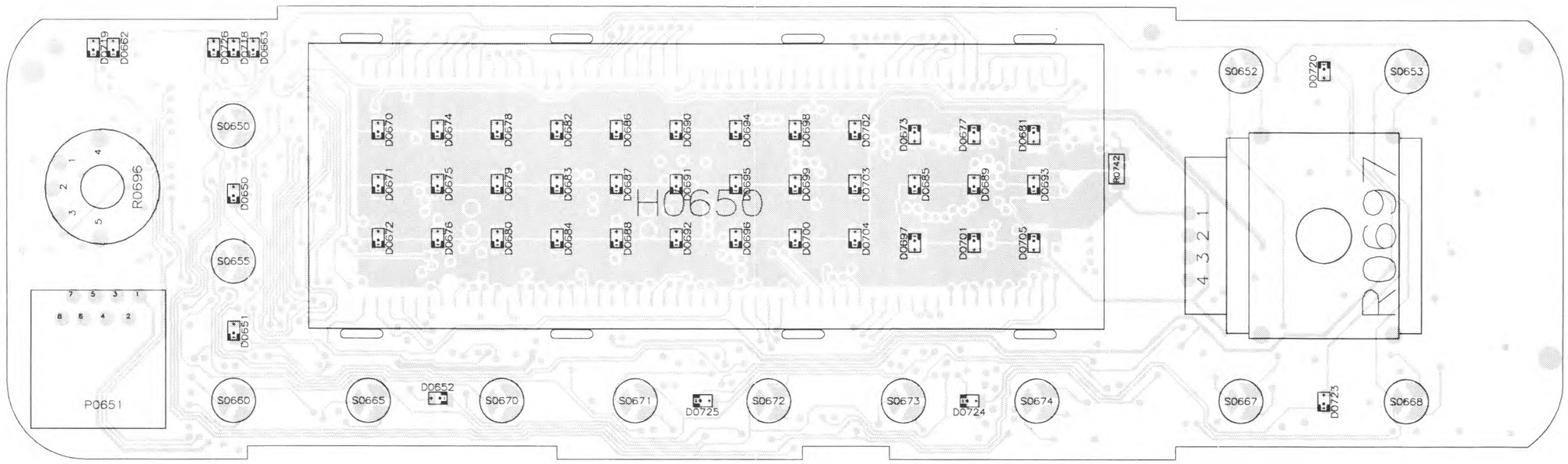
ELECTRICAL PARTS LIST FOR CONTROL HEAD B, KIT NO. HCN4048

Ref.	Part/Kit No.	Description
	0105960S02	
CR601	4805729G66	LED YELLOW/GREEN CL170YG
CR602	4805729G66	LED YELLOW/GREEN CL170YG
CR603	4805729G66	LED YELLOW/GREEN CL170YG
CR604	4805729G66	LED YELLOW/GREEN CL170YG
CR605	4805729G66	LED YELLOW/GREEN CL170YG
CR606	4805729G66	LED YELLOW/GREEN CL170YG
CR607	4805729G66	LED YELLOW/GREEN CL170YG
CR608	4805729G66	LED YELLOW/GREEN CL170YG
CR609	4805729G66	LED YELLOW/GREEN CL170YG
CR610	4805729G66	LED YELLOW/GREEN CL170YG
CR611	4805729G66	LED YELLOW/GREEN CL170YG
CR612	4805729G66	LED YELLOW/GREEN CL170YG
CR613	4805729G66	LED YELLOW/GREEN CL170YG
CR614	4805729G66	LED YELLOW/GREEN CL170YG
CR615	4805729G66	LED YELLOW/GREEN CL170YG
CR616	4805729G65	LED YELLOW CL170Y
CR617	4805729G65	LED YELLOW CL170Y
CR618	4805729G64	LED RED CL170UR
CR619	4805729G66	LED YELLOW/GREEN CL170YG
C600	2113743K15	CER CHIP CAP 100UF
C601	2113740F36	CAP CHIP REEL CL1 +/-30 24
C602	2113740F36	CAP CHIP REEL CL1 +/-30 24
C603	2113743K15	CER CHIP CAP 100UF
C604	2113740F36	CAP CHIP REEL CL1 +/-30 24
C605	2113743K15	CER CHIP CAP 100UF
C606	2113741F49	CAP CHIP CL2 X7R REEL 10000
C607	2113743K15	CER CHIP CAP 100UF
C608	2113743K15	CER CHIP CAP 100UF
C609	2113743K15	CER CHIP CAP 100UF
JU600	0662057B47	CHIP RES 0 OHMS +- 050 OHMS
JU601	0662057B47	CHIP RES 0 OHMS +- 050 OHMS
P600	2805922V01	PLUG CONTROL HEAD VERT
P601	2805924V01	CONNECTOR MIC
P602	2809926G01	CONN 1 25MM CTR SUR MT HDR
Q600	4813824A10	XSTR NPN 40V 2A
Q601	4813824A10	XSTR NPN 40V 2A
Q602	4813824A10	XSTR NPN 40V 2A
Q603	4813824A10	XSTR NPN 40V 2A
Q604	4813824A10	XSTR NPN 40V 2A
Q605	4813824A10	XSTR NPN 40V 2A
Q606	4813824A10	XSTR NPN 40V 2A
Q607	4813824A10	XSTR NPN 40V 2A
Q608	4805128M16	TSTR SOT MMBT3906 (RH) 48G22
Q609	4805128M16	TSTR SOT MMBT3906 (RH) 48G22
Q610	4813824A10	XSTR NPN 40V 2A
Q611	4813824A10	XSTR NPN 40V 2A
R600	0680194M18	RES 51 OHMS 5% 1W
R601	0662057A97	CHIP RES 100K OHMS 5%
R602	0662057A57	CHIP RES 2200 OMHS 5%
R604	0660076A35	RES CHIP 270 5 1/8
R605	0662057A57	CHIP RES 2200 OMHS 5%
R607	0660076A35	RES CHIP 270 5 1/8
R608	0662057A57	CHIP RES 2200 OMHS 5%
R610	0660076A35	RES CHIP 270 5 1/8
R611	0662057A57	CHIP RES 2200 OMHS 5%
R613	0660076A35	RES CHIP 270 5 1/8
R614	0662057A97	CHIP RES 100K OHMS 5%
R615	0662057A57	CHIP RES 2200 OMHS 5%
R616	0662057A57	CHIP RES 2200 OMHS 5%
R617	0662057A57	CHIP RES 2200 OMHS 5%
R618	0662057A57	CHIP RES 2200 OMHS 5%
R619	0662057A57	CHIP RES 2200 OMHS 5%

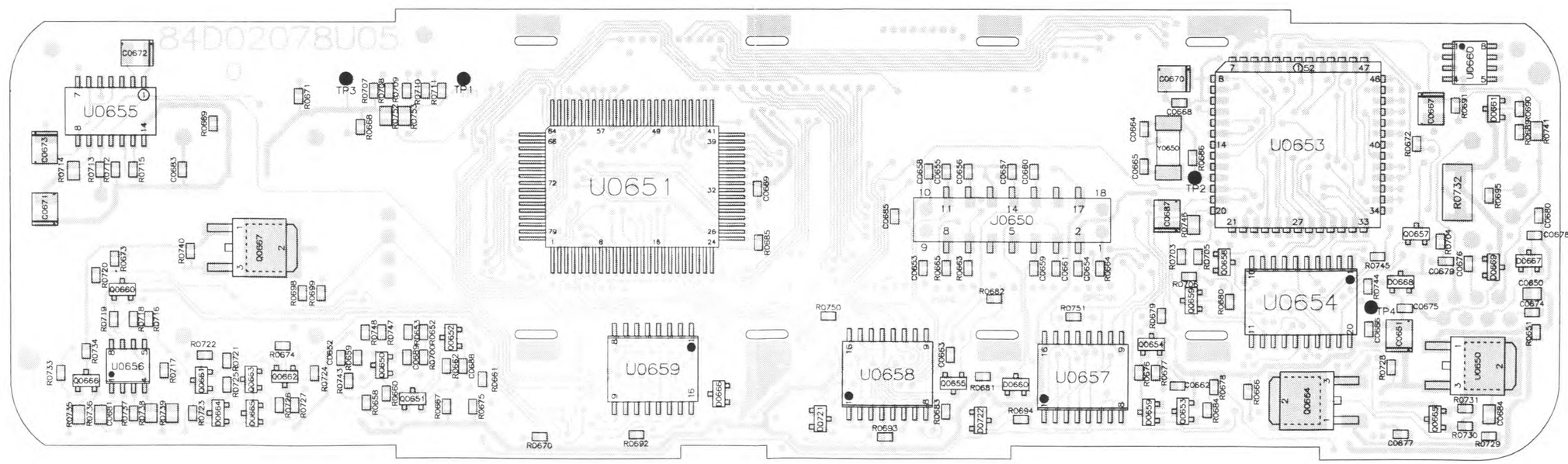
Ref.	Part/Kit No.	Description
R620	0662057A57	CHIP RES 2200 OMHS 5%
R621	0662057A57	CHIP RES 2200 OMHS 5%
R622	0662057A57	CHIP RES 2200 OMHS 5%
R623	0662057A61	CHIP RES 3300 OMHS 5%
R624	0660076A35	RES CHIP 270 5 1/8
R625	0662057A61	CHIP RES 3300 OMHS 5%
R626	0660076A35	RES CHIP 270 5 1/8
R627	0662057A61	CHIP RES 3300 OMHS 5%
R628	0660076A35	RES CHIP 270 5 1/8
R629	0662057A73	CHIP RES 10K OMHS 5%
R630	0662057A35	CHIP RES 270 OHMS 5%
R631	0662057A97	CHIP RES 100K OHMS 5%
R632	0662057A42	CHIP RES 510 OHMS 5%
R633	0662057A01	CHIP RES 10 OHMS 5%
R634	0662057A61	CHIP RES 3300 OMHS 5%
S600	1805911V01	POT VOL
U600	5105625U62	IC XOR QUAD 2-INPUT
U601	5105625U61	IC LCD DRIVR 33 SEGMENT STATIC
U602	5105750U28	IC CMOS BILATERAL SW
VR600	4813830A15	DIODE 5 6V 5% 225MW
VR605	4813830A15	DIODE 5 6V 5% 225MW
VR606	4813830A15	DIODE 5 6V 5% 225MW
VR607	4813830A15	DIODE 5 6V 5% 225MW
	8405948V01	PWB


4305939V02
2805922V01
2805924V01
1805911V01
2809926G01
0905180X01
8405948V01
6105891W01
9105181X01
7505946V02 MOTOROLA
7505946V03 RADIUS
7205945V02
1305121X01
5005941V02
3605893W02
3205932V01
5402103U01 MOTOROLA
5402103U05 RADIUS
1505906V03

FRONT SIDE

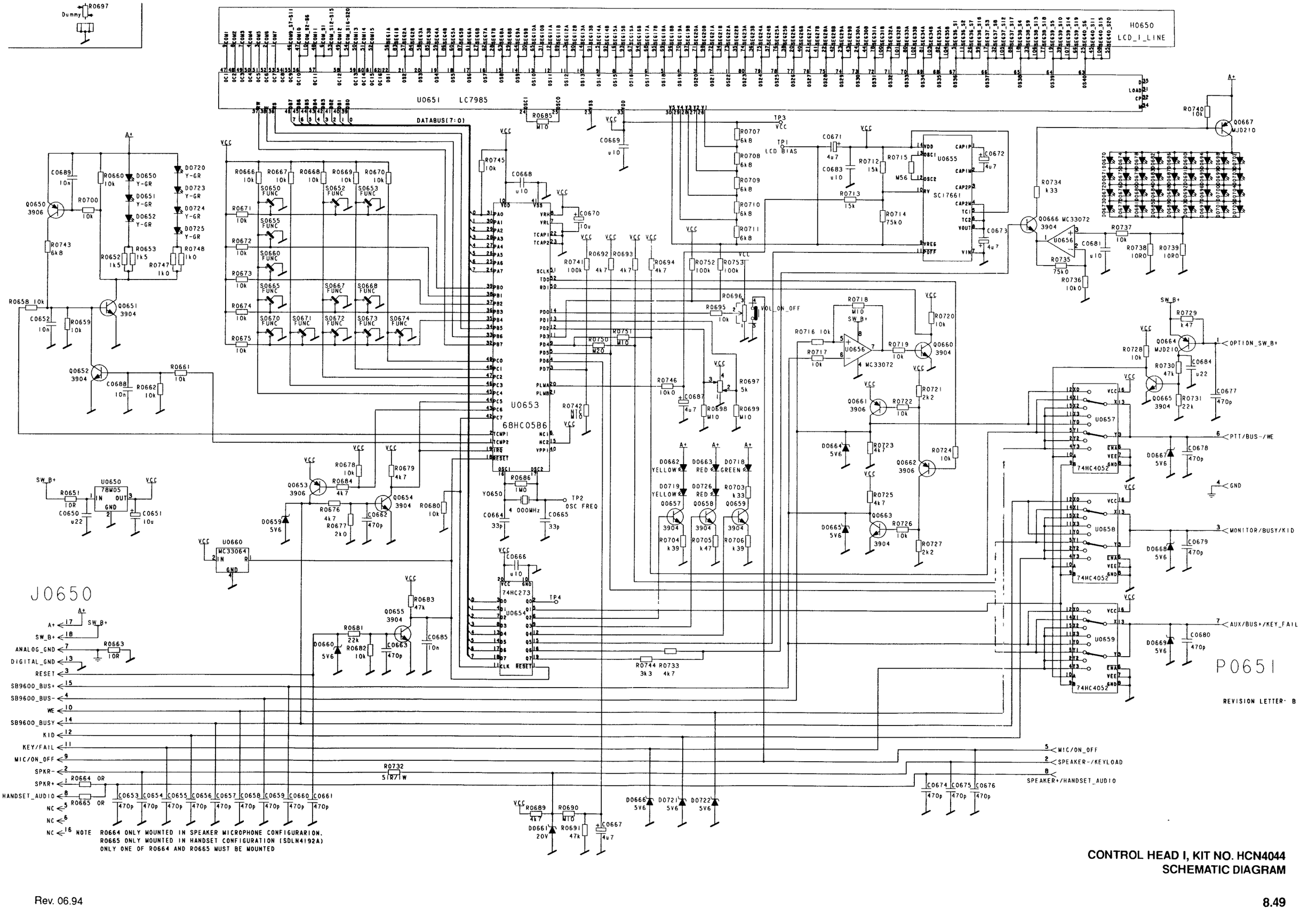


BACK SIDE



Note:
R0664 ONLY MOUNTED IN SPEAKER MICROPHONE CONFIGURATION.
R0665 ONLY MOUNTED IN HANDSET CONFIGURATION.
ONLY ONE OF R0664 AND R0665 MUST BE MOUNTED.

CONTROL HEAD I, KIT NO. HCN4044
COMPONENT LOCATION DIAGRAM



CONTROL HEAD I, KIT NO. HCN4044
SCHEMATIC DIAGRAM

ELECTRICAL PARTS LIST FOR CONTROL HEAD I, KIT NO. HCN4044

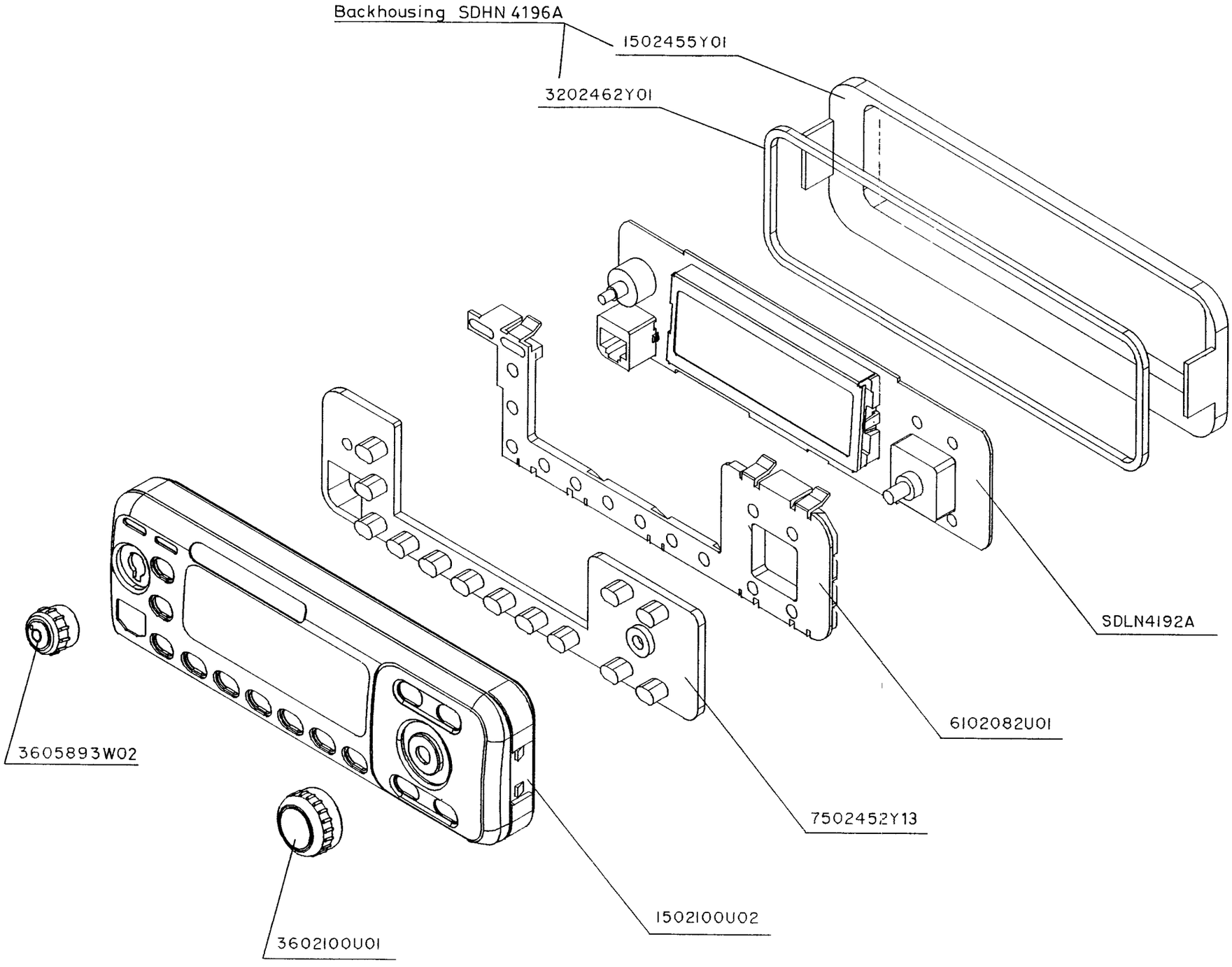
Ref.	Part/Kit No.	Description
	SDLN4192A	
C0650	2113743A23	CAP CHIP 220 UF 10% X7R
C0651	2311049J23	CAP TANT CHIP 10 10 7
C0652	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0653	2113741F17	CAP CHIP CL2 X7R REEL 470
C0654	2113741F17	CAP CHIP CL2 X7R REEL 470
C0655	2113741F17	CAP CHIP CL2 X7R REEL 470
C0656	2113741F17	CAP CHIP CL2 X7R REEL 470
C0657	2113741F17	CAP CHIP CL2 X7R REEL 470
C0658	2113741F17	CAP CHIP CL2 X7R REEL 470
C0659	2113741F17	CAP CHIP CL2 X7R REEL 470
C0660	2113741F17	CAP CHIP CL2 X7R REEL 470
C0661	2113741F17	CAP CHIP CL2 X7R REEL 470
C0662	2113741F17	CAP CHIP CL2 X7R REEL 470
C0663	2113741F17	CAP CHIP CL2 X7R REEL 470
C0664	2113740F37	CAP CHIP REEL CL1 +/-30 27
C0665	2113740F37	CAP CHIP REEL CL1 +/-30 27
C0666	2113743K15	CER CHIP CAP 100UF
C0667	2311049J12	CAP TANT CHIP 4 7 20 16
C0668	2113743K15	CER CHIP CAP 100UF
C0669	2113743K15	CER CHIP CAP 100UF
C0670	2311049J23	CAP TANT CHIP 10 10 7
C0671	2311049J12	CAP TANT CHIP 4 7 20 16
C0672	2311049J12	CAP TANT CHIP 4 7 20 16
C0673	2311049J12	CAP TANT CHIP 4 7 20 16
C0674	2113741F17	CAP CHIP CL2 X7R REEL 470
C0675	2113741F17	CAP CHIP CL2 X7R REEL 470
C0676	2113741F17	CAP CHIP CL2 X7R REEL 470
C0677	2113741F17	CAP CHIP CL2 X7R REEL 470
C0678	2113741F17	CAP CHIP CL2 X7R REEL 470
C0679	2113741F17	CAP CHIP CL2 X7R REEL 470
C0680	2113741F17	CAP CHIP CL2 X7R REEL 470
C0681	2113743K15	CER CHIP CAP 100UF
C0683	2113743K15	CER CHIP CAP 100UF
C0684	2113740F15	CAP CHIP REEL CL1 +/-30 3 3
C0685	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0686	2113741F25	CAP CHIP CL2 X7R REEL 1000
C0687	2311049J12	CAP TANT CHIP 4 7 20 16
C0688	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0689	2113741F49	CAP CHIP CL2 X7R REEL 10000
D0659	4813830A15	DIODE 5 6V 5%
D0660	4813830A15	DIODE 5 6V 5%
D0661	4813830A33	DIODE 20V 5%
D0664	4813830A15	DIODE 5 6V 5%
D0665	4813830A15	DIODE 5 6V 5%
D0666	4813830A15	DIODE 5 6V 5%
D0667	4813830A15	DIODE 5 6V 5%
D0668	4813830A15	DIODE 5 6V 5%
D0669	4813830A15	DIODE 5 6V 5%
D0721	4813830A15	DIODE 5 6V 5%
D0722	4813830A15	DIODE 5 6V 5%
H0650	7202076U02	DSTN-LCD GLAS
J0650	2805922V01	PLUG CONTROL HEAD VERT
L0650	2462587T30	IND CHIP 1000NH 5% LOW PRO
L0651	2462587K26	CHIP IND 33000 NH 10%
P0651	2805924V01	CONNECTOR MIC
Q0650	4813824A17	XSTR PNP40V 2A
Q0651	4813824A10	XSTR NPN 40V 2A
Q0652	4813824A10	XSTR NPN 40V 2A
Q0653	4813824A17	XSTR PNP40V 2A
Q0654	4813824A10	XSTR NPN 40V 2A
Q0655	4813824A10	XSTR NPN 40V 2A
Q0656	4813824A07	XSTR NPN 30V VHF MIXER
Q0657	4813824A10	XSTR NPN 40V 2A

Ref.	Part/Kit No.	Description
Q0658	4813824A10	XSTR NPN 40V 2A
Q0659	4813824A10	XSTR NPN 40V 2A
Q0660	4813824A10	XSTR NPN 40V 2A
Q0661	4813824A17	XSTR PNP40V 2A
Q0662	4813824A17	XSTR PNP40V 2A
Q0663	4813824A10	XSTR NPN 40V 2A
Q0664	4813822A08	TSTR PNP 25V 5A MJD210T4
Q0665	4813824A10	XSTR NPN 40V 2A
Q0666	4813824A10	XSTR NPN 40V 2A
Q0667	4813822A08	TSTR PNP 25V 5A MJD210T4
R0650	0662057A01	CHIP RES 10 OHMS 5%
R0651	0662057A01	CHIP RES 10 OHMS 5%
R0652	0662057A53	CHIP RES 1500 OHMS 5%
R0653	0662057A53	CHIP RES 1500 OHMS 5%
R0658	0662057A73	CHIP RES 10K OHMS 5%
R0659	0662057A73	CHIP RES 10K OHMS 5%
R0660	0662057A73	CHIP RES 10K OHMS 5%
R0661	0662057A73	CHIP RES 10K OHMS 5%
R0662	0662057A73	CHIP RES 10K OHMS 5%
R0663	0662057A01	CHIP RES 10 OHMS 5%
R0665	0662057B47	CHIP RES 0 OHMS +- 050 OHMS
R0666	0662057A73	CHIP RES 10K OHMS 5%
R0667	0662057A73	CHIP RES 10K OHMS 5%
R0668	0662057A73	CHIP RES 10K OHMS 5%
R0669	0662057A73	CHIP RES 10K OHMS 5%
R0670	0662057A73	CHIP RES 10K OHMS 5%
R0671	0662057A73	CHIP RES 10K OHMS 5%
R0672	0662057A73	CHIP RES 10K OHMS 5%
R0673	0662057A73	CHIP RES 10K OHMS 5%
R0674	0662057A73	CHIP RES 10K OHMS 5%
R0675	0662057A73	CHIP RES 10K OHMS 5%
R0676	0662057A65	CHIP RES 4700 OHMS 5%
R0677	0662057A56	CHIP RES 2000 OHMS 5%
R0678	0662057A73	CHIP RES 10K OHMS 5%
R0679	0662057A65	CHIP RES 4700 OHMS 5%
R0680	0662057A73	CHIP RES 10K OHMS 5%
R0681	0662057A81	CHIP RES 22K OHMS 5%
R0682	0662057A73	CHIP RES 10K OHMS 5%
R0683	0662057A89	CHIP RES 47K OHMS 5%
R0684	0662057A65	CHIP RES 4700 OHMS 5%
R0685	0662057A97	CHIP RES 100K OHMS 5%
R0686	0662057B05	CHIP RES 200K OHMS 5%
R0687	0662057A57	CHIP RES 2200 OHMS 5%
R0688	0662057A73	CHIP RES 10K OHMS 5%
R0689	0662057A65	CHIP RES 4700 OHMS 5%
R0690	0662057A97	CHIP RES 100K OHMS 5%
R0691	0662057A89	CHIP RES 47K OHMS 5%
R0692	0662057A65	CHIP RES 4700 OHMS 5%
R0693	0662057A65	CHIP RES 4700 OHMS 5%
R0694	0662057A65	CHIP RES 4700 OHMS 5%
R0695	0662057A73	CHIP RES 10K OHMS 5%
R0696	1805911V01	POT VOL
R0697	1802100U01	POTM 5K2 WIPER NO STOP
R0698	0662057B16	CHIP RES 560K OHMS 5%
R0699	0662057B16	CHIP RES 560K OHMS 5%
R0700	0662057A73	CHIP RES 10K OHMS 5%
R0703	0662057A37	CHIP RES 330 OHMS 5%
R0704	0662057A41	CHIP RES 470 OHMS 5%
R0705	0662057A41	CHIP RES 470 OHMS 5%
R0706	0662057A41	CHIP RES 470 OHMS 5%
R0707	0662057A69	CHIP RES 6800 OHMS 5%
R0708	0662057A69	CHIP RES 6800 OHMS 5%
R0709	0662057A69	CHIP RES 6800 OHMS 5%
R0710	0662057A69	CHIP RES 6800 OHMS 5%

ELECTRICAL PARTS LIST FOR CONTROL HEAD I, KIT NO. HCN4044

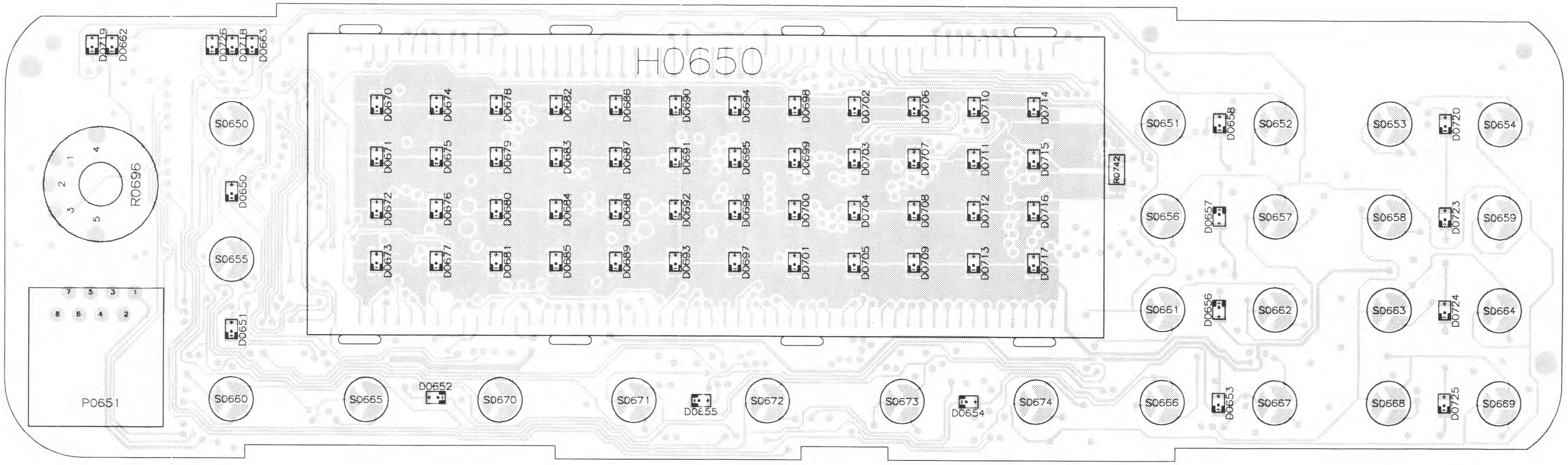
Ref.	Part/Kit No.	Description
R0711	0662057A69	CHIP RES 6800 OHMS 5%
R0712	0662057A77	CHIP RES 15K OHMS 5%
R0713	0662057A77	CHIP RES 15K OHMS 5%
R0714	0662057G07	CHIP RES 75K OHMS 5%
R0715	0662057B16	CHIP RES 560K OHMS 5%
R0716	0662057A73	CHIP RES 10K OHMS 5%
R0717	0662057A73	CHIP RES 10K OHMS 5%
R0718	0662057A97	CHIP RES 100K OHMS 5%
R0719	0662057A73	CHIP RES 10K OHMS 5%
R0720	0662057A73	CHIP RES 10K OHMS 5%
R0721	0662057A57	CHIP RES 2200 OHMS 5%
R0722	0662057A73	CHIP RES 10K OHMS 5%
R0723	0662057A65	CHIP RES 4700 OHMS 5%
R0724	0662057A73	CHIP RES 10K OHMS 5%
R0725	0662057A65	CHIP RES 4700 OHMS 5%
R0726	0662057A73	CHIP RES 10K OHMS 5%
R0727	0662057A57	CHIP RES 2200 OHMS 5%
R0728	0662057A73	CHIP RES 10K OHMS 5%
R0729	0662057A41	CHIP RES 470 OHMS 5%
R0730	0662057A73	CHIP RES 10K OHMS 5%
R0731	0662057A73	CHIP RES 10K OHMS 5%
R0732	0680194M18	RES 51 OHMS 5% 1W
R0733	0662057A65	CHIP RES 4700 OHMS 5%
R0734	0662057A37	CHIP RES 330 OHMS 5%
R0735	0662057G07	CHIP RES 75K OHMS 1%
R0736	0662057R60	RES CHIP 10K 1W 1%
R0737	0662057A73	CHIP RES 10K OHMS 5%
R0738	0662057R02	RES CHIP 10 1W 1%
R0739	0662057R02	RES CHIP 10 1W 1%
R0740	0662057A73	CHIP RES 10K OHMS 5%
R0741	0662057G13	CHIP RES 100K OHMS 1%
R0742	0680149M02	THERMISTOR CHIP 100K OHM
R0743	0662057A69	CHIP RES 6800 OHMS 5%
R0744	0662057A61	CHIP RES 3300 OHMS 5%
R0745	0662057A73	CHIP RES 10K OHMS 5%
R0746	0662057R60	RES CHIP 10K 1W 1%
R0747	0662057A49	CHIP RES 1000 OHMS 5%
R0748	0662057A49	CHIP RES 1000 OHMS 5%
R0749	0662057B05	CHIP RES 200K OHMS 5%
R0750	0662057B05	CHIP RES 200K OHMS 5%
R0751	0662057A97	CHIP RES 100K OHMS 5%
R0752	0662057G13	CHIP RES 100K OHMS 1%
R0753	0662057G13	CHIP RES 100K OHMS 1%
U0650	5113816A07	REG 5V POS 500MA MC78M05BDTRK
U0651	5102101U01	LCD CONTROLLER IC
U0653	5102100U02	IC MICROCONTR 68HC05 MASK
U0654	5113805A60	IC OCT D W/COM CLKRS HC273
U0655	5105461G54	IC DC/DC COVERTER 14PIN SOP
U0656	5113818A03	IC HIGH PERFORMANCE SING SPLY
U0657	5113805A84	IC MUX/DEMUX DUAL 4-CH ANALOG
U0658	5113805A84	IC MUX/DEMUX DUAL 4-CH ANALOG
U0659	5113805A84	IC MUX/DEMUX DUAL 4-CH ANALOG
U0660	5113815A02	IC UNDERVOLT SENSIN G CKT
Y0650	4802100U01	XTAL SMD 4 000 MHZ
		NON REFERENCED ITEMS
	0702101U02	FRAME
	1302100U01	BEZEL
	2802102U01	CONNECTOR ELASTOMERIC
	2802101U01	CONNECTOR ELASTOMERIC

Ref.	Part/Kit No.	Description

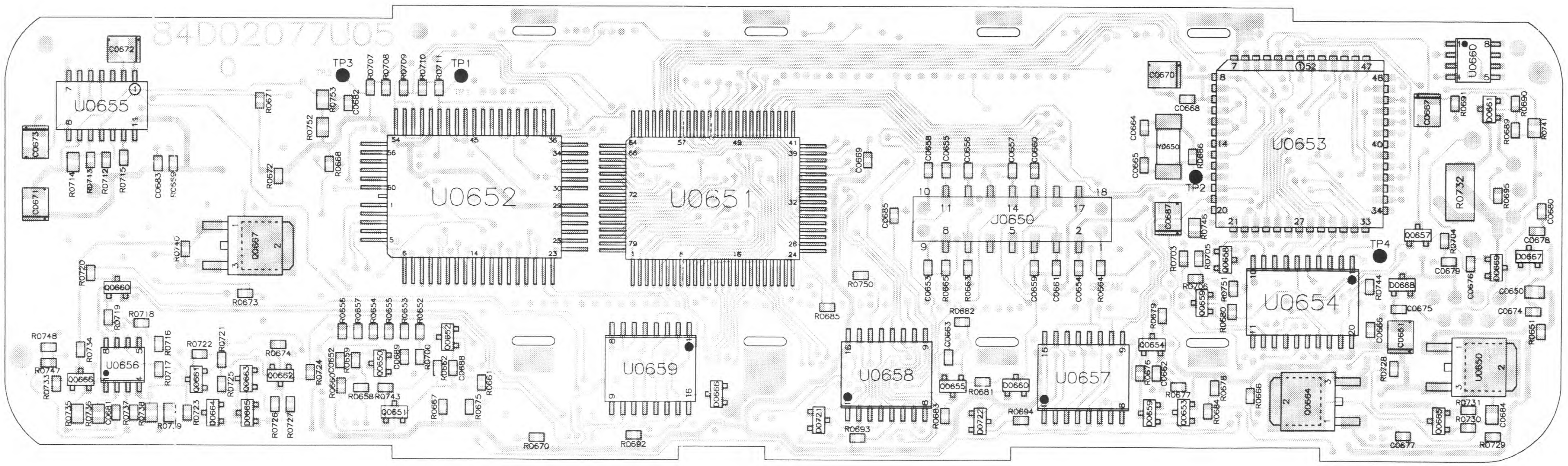


CONTROL HEAD I, KIT NO. HCN4044
EXPLODED VIEW DIAGRAM AND PART NUMBERS

FRONT SIDE

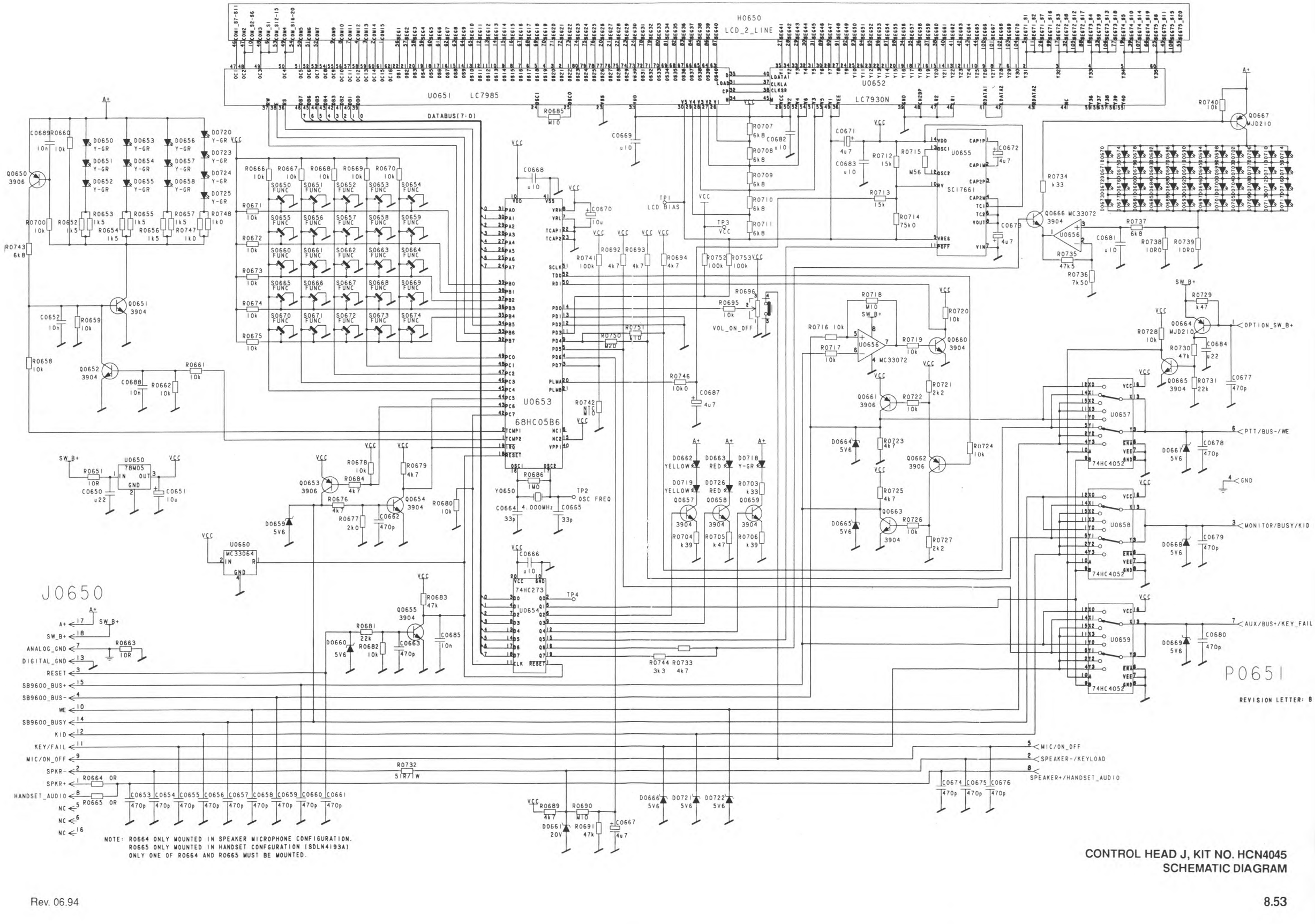


BACK SIDE



NOTES:
R0664 ONLY MOUNTED IN SPEAKER MICROPHONE CONFIGURATION.
R0665 ONLY MOUNTED IN HANDSET CONFIGURATION (SDLN4193A).
ONLY ONE OF R0664 AND R0665 MUST BE MOUNTED.

CONTROL HEAD J, KIT NO. HCN4045
COMPONENT LOCATION DIAGRAM



CONTROL HEAD J, KIT NO. HCN4045
SCHEMATIC DIAGRAM

ELECTRICAL PARTS LIST FOR CONTROL HEAD J, KIT NO. HCN4045

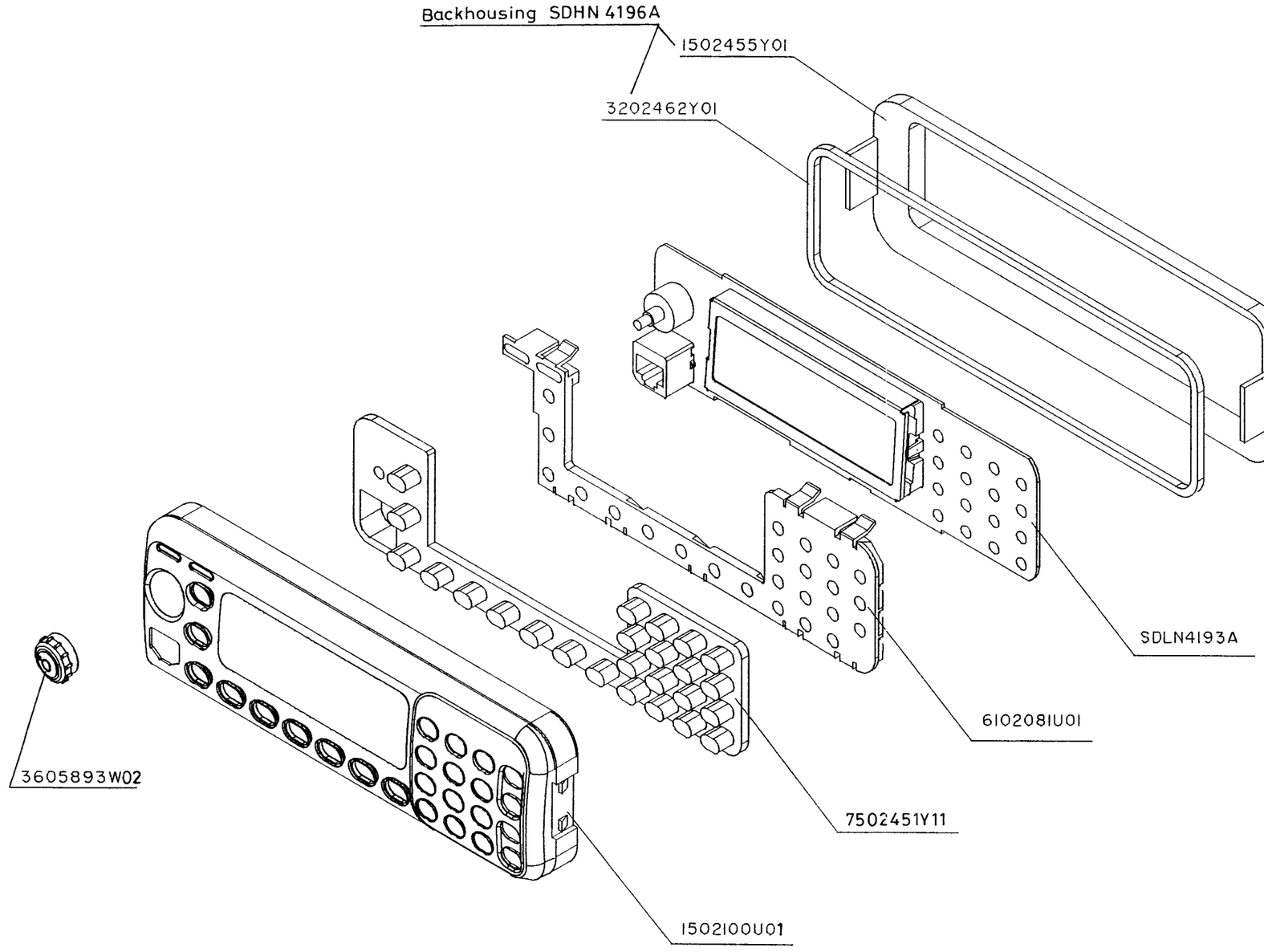
Ref.	Part/Kit No.	Description
	SDLN4193A	
C0650	2113743A23	CAP CHIP 220 UF 10% X7R
C0651	2311049J23	CAP TANT CHIP 10 10 7
C0652	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0653	2113741F17	CAP CHIP CL2 X7R REEL 470
C0654	2113741F17	CAP CHIP CL2 X7R REEL 470
C0655	2113741F17	CAP CHIP CL2 X7R REEL 470
C0656	2113741F17	CAP CHIP CL2 X7R REEL 470
C0657	2113741F17	CAP CHIP CL2 X7R REEL 470
C0658	2113741F17	CAP CHIP CL2 X7R REEL 470
C0659	2113741F17	CAP CHIP CL2 X7R REEL 470
C0660	2113741F17	CAP CHIP CL2 X7R REEL 470
C0661	2113741F17	CAP CHIP CL2 X7R REEL 470
C0662	2113741F17	CAP CHIP CL2 X7R REEL 470
C0663	2113741F17	CAP CHIP CL2 X7R REEL 470
C0664	2113740F37	CAP CHIP REEL CL1 +/ 30 27
C0665	2113740F37	CAP CHIP REEL CL1 +/-30 27
C0666	2113743K15	CER CHIP CAP 100UF
C0667	2311049J12	CAP TANT CHIP 4 7 20 16
C0668	2113743K15	CER CHIP CAP 100UF
C0669	2113743K15	CER CHIP CAP 100UF
C0670	2311049J23	CAP TANT CHIP 10 10 7
C0671	2311049J12	CAP TANT CHIP 4 7 20 16
C0672	2311049J12	CAP TANT CHIP 4 7 20 16
C0673	2311049J12	CAP TANT CHIP 4 7 20 16
C0674	2113741F17	CAP CHIP CL2 X7R REEL 470
C0675	2113741F17	CAP CHIP CL2 X7R REEL 470
C0676	2113741F17	CAP CHIP CL2 X7R REEL 470
C0677	2113741F17	CAP CHIP CL2 X7R REEL 470
C0678	2113741F17	CAP CHIP CL2 X7R REEL 470
C0679	2113741F17	CAP CHIP CL2 X7R REEL 470
C0680	2113741F17	CAP CHIP CL2 X7R REEL 470
C0681	2113743K15	CER CHIP CAP 100UF
C0682	2113743K15	CER CHIP CAP 100UF
C0683	2113743K15	CER CHIP CAP 100UF
C0684	2113740F15	CAP CHIP REEL CL1 + 30 3 3
C0685	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0686	2113741F25	CAP CHIP CL2 X7R REEL 1000
C0687	2311049J12	CAP TANT CHIP 4 7 20 16
C0688	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0689	2113741F49	CAP CHIP CL2 X7R REEL 10000
D0659	4813830A15	DIODE 5 6V 5%
D0660	4813830A15	DIODE 5 6V 5%
D0661	4813830A33	DIODE 20V 5% 6 2MA 350 MW
D0664	4813830A15	DIODE 5 6V 5%
D0665	4813830A15	DIODE 5 6V 5%
D0666	4813830A15	DIODE 5 6V 5%
D0667	4813830A15	DIODE 5 6V 5%
D0668	4813830A15	DIODE 5 6V 5%
D0669	4813830A15	DIODE 5 6V 5%
D0721	4813830A15	DIODE 5 6V 5%
D0722	4813830A15	DIODE 5 6V 5% 2
H0650	7202076U01	DSTN LCD GLASS
J0650	2805922V01	PLUG CONTROL HEAD VERT
L0650	2462587T30	IND CHIP 1000NH 5% LOW PRO
L0651	2462587K26	CHIP IND 33000 NH 10%
P0651	2805924V01	CONNECTOR MIC
Q0650	4813824A17	XSTR PNP40V 2A
Q0651	4813824A10	XSTR NPN 40V 2A
Q0652	4813824A10	XSTR NPN 40V 2A
Q0653	4813824A17	XSTR PNP40V 2A
Q0654	4813824A10	XSTR NPN 40V 2A
Q0655	4813824A10	XSTR NPN 40V 2A
Q0656	4813824A07	XSTR NPN 30V VHF MIXER

Ref.	Part/Kit No.	Description
Q0657	4813824A10	XSTR NPN 40V 2A
Q0658	4813824A10	XSTR NPN 40V 2A
Q0659	4813824A10	XSTR NPN 40V 2A
Q0660	4813824A10	XSTR NPN 40V 2A
Q0661	4813824A17	XSTR PNP40V 2A
Q0662	4813824A17	XSTR PNP40V 2A
Q0663	4813824A10	XSTR NPN 40V 2A
Q0664	4813822A08	TSTR PNP 25V 5A MJD210T4
Q0665	4813824A10	XSTR NPN 40V 2A
Q0666	4813824A10	XSTR NPN 40V 2A
Q0667	4813822A08	TSTR PNP 25V 5A MJD210T4
R0650	0662057A01	CHIP RES 10 OHMS 5%
R0651	0662057A01	CHIP RES 10 OHMS 5%
R0652	0662057A53	CHIP RES 1500 OHMS 5%
R0653	0662057A53	CHIP RES 1500 OHMS 5%
R0654	0662057A53	CHIP RES 1500 OHMS 5%
R0655	0662057A53	CHIP RES 1500 OHMS 5%
R0656	0662057A53	CHIP RES 1500 OHMS 5%
R0657	0662057A53	CHIP RES 1500 OHMS 5%
R0658	0662057A73	CHIP RES 10K OHMS 5%
R0659	0662057A73	CHIP RES 10K OHMS 5%
R0660	0662057A73	CHIP RES 10K OHMS 5%
R0661	0662057A73	CHIP RES 10K OHMS 5%
R0662	0662057A73	CHIP RES 10K OHMS 5%
R0663	0662057A01	CHIP RES 10 OHMS 5%
R0665	0662057B47	CHIP RES 0 OHMS + 050 OHMS
R0666	0662057A73	CHIP RES 10K OHMS 5%
R0667	0662057A73	CHIP RES 10K OHMS 5%
R0668	0662057A73	CHIP RES 10K OHMS 5%
R0669	0662057A73	CHIP RES 10K OHMS 5%
R0670	0662057A73	CHIP RES 10K OHMS 5%
R0671	0662057A73	CHIP RES 10K OHMS 5%
R0672	0662057A73	CHIP RES 10K OHMS 5%
R0673	0662057A73	CHIP RES 10K OHMS 5%
R0674	0662057A73	CHIP RES 10K OHMS 5%
R0675	0662057A73	CHIP RES 10K OHMS 5%
R0676	0662057A65	CHIP RES 4700 OHMS 5%
R0677	0662057A56	CHIP RES 2000 OHMS 5%
R0678	0662057A73	CHIP RES 10K OHMS 5%
R0679	0662057A65	CHIP RES 4700 OHMS 5%
R0680	0662057A73	CHIP RES 10K OHMS 5%
R0681	0662057A81	CHIP RES 22K OHMS 5%
R0682	0662057A73	CHIP RES 10K OHMS 5%
R0683	0662057A89	CHIP RES 47K OHMS 5%
R0684	0662057A65	CHIP RES 4700 OHMS 5%
R0685	0662057A97	CHIP RES 100K OHMS 5%
R0686	0662057B05	CHIP RES 200K OHMS 5%
R0687	0662057A57	CHIP RES 2200 OHMS 5%
R0688	0662057A73	CHIP RES 10K OHMS 5%
R0689	0662057A65	CHIP RES 4700 OHMS 5%
R0690	0662057A97	CHIP RES 100K OHMS 5%
R0691	0662057A89	CHIP RES 47K OHMS 5
R0692	0662057A65	CHIP RES 4700 OHMS 5%
R0693	0662057A65	CHIP RES 4700 OHMS 5%
R0694	0662057A65	CHIP RES 4700 OHMS 5%
R0695	0662057A73	CHIP RES 10K OHMS 5%
R0696	1805911V01	POT VOL
R0700	0662057A73	CHIP RES 10K OHMS 5%
R0703	0662057A37	CHIP RES 330 OHMS 5%
R0704	0662057A41	CHIP RES 470 OHMS 5%
R0705	0662057A41	CHIP RES 470 OHMS 5%
R0706	0662057A41	CHIP RES 470 OHMS 5%
R0707	0662057A69	CHIP RES 6800 OHMS 5%
R0708	0662057A69	CHIP RES 6800 OHMS 5%

ELECTRICAL PARTS LIST FOR CONTROL HEAD J, KIT NO. HCN4045

Ref.	Part/Kit No.	Description
R0709	0662057A69	CHIP RES 6800 OHMS 5%
R0710	0662057A69	CHIP RES 6800 OHMS 5%
R0711	0662057A69	CHIP RES 6800 OHMS 5%
R0712	0662057A77	CHIP RES 15K OHMS 5%
R0713	0662057A77	CHIP RES 15K OHMS 5%
R0714	0662057G07	CHIP RES 75K OHMS 1%
R0715	0662057B16	CHIP RES 560K OHMS 5%
R0716	0662057A73	CHIP RES 10K OHMS 5%
R0717	0662057A73	CHIP RES 10K OHMS 5%
R0718	0662057A97	CHIP RES 100K OHMS 5%
R0719	0662057A73	CHIP RES 10K OHMS 5%
R0720	0662057A73	CHIP RES 10K OHMS 5%
R0721	0662057A57	CHIP RES 2200 OHMS 5%
R0722	0662057A73	CHIP RES 10K OHMS 5%
R0723	0662057A65	CHIP RES 4700 OHMS 5%
R0724	0662057A73	CHIP RES 10K OHMS 5%
R0725	0662057A65	CHIP RES 4700 OHMS 5%
R0726	0662057A73	CHIP RES 10K OHMS 5%
R0727	0662057A57	CHIP RES 2200 OHMS 5%
R0728	0662057A73	CHIP RES 10K OHMS 5%
R0729	0662057A41	CHIP RES 470 OHMS 5%
R0730	0662057A73	CHIP RES 10K OHMS 5%
R0731	0662057A73	CHIP RES 10K OHMS 5%
R0732	0680194M18	RES 51 OHMS 5% 1W
R0733	0662057A65	CHIP RES 4700 OHMS 5%
R0734	0662057A37	CHIP RES 330 OHMS 5%
R0735	0662057R92	RES CHIP 47 5K 1W 1%
R0736	0662057R55	RES CHIP 7500 1W 1%
R0737	0662057A69	CHIP RES 6800 OHMS 5%
R0738	0662057R02	RES CHIP 10 1W 1%
R0739	0662057R02	RES CHIP 10 1W 1%
R0740	0662057A73	CHIP RES 10K OHMS 5%
R0741	0662057G13	CHIP RES 100K OHMS 1%
R0742	0680149M02	THERMISTOR CHIP 100K OHM
R0743	0662057A69	CHIP RES 6800 OHMS 5%
R0744	0662057A61	CHIP RES 3300 OHMS 5%
R0746	0662057R60	RES CHIP 10K 1W 1%
R0747	0662057A49	CHIP RES 1000 OHMS 5%
R0748	0662057A49	CHIP RES 1000 OHMS 5%
R0749	0662057B05	CHIP RES 200K OHMS 5%
R0750	0662057B05	CHIP RES 200K OHMS 5%
R0751	0662057A97	CHIP RES 100K OHMS 5%
R0752	0662057G13	CHIP RES 100K OHMS 1%
R0753	0662057G13	CHIP RES 100K OHMS 1%
U0650	5113816A07	REG 5V POS 500MA MC78M05BDTRK
U0651	5102101U01	LCD CONTROLLER IC
U0652	5102102U01	LCD DRIVER IC
U0653	5102100U02	IC MICROCONTR 68HC05 MASK
U0654	5113805A60	IC OCT D W/COM CLKRS HC273
U0655	5105461G54	IC DC DC COVERTER 14PIN SOP
U0656	5113818A03	IC HIGH PERFORMANCE SING SPLY
U0657	5113805A84	IC MUX/DEMUX DUAL 4-CH ANALOG
U0658	5113805A84	IC MUX/DEMUX DUAL 4 CH ANALOG
U0659	5113805A84	IC MUX/DEMUX DUAL 4 CH ANALOG
U0660	5113815A02	IC UNDERVOLT SENSIN G CKT
Y0650	4802100U01	XTAL SMD 4 000 MHZ
		NON REFERENCED ITEMS
	0702084U01	FRAME
	1302085U01	BEZEL LCD
	2802102U01	CONNECTOR ELASTOMERIC
	2802101U01	CONNECTOR ELASTOMERIC

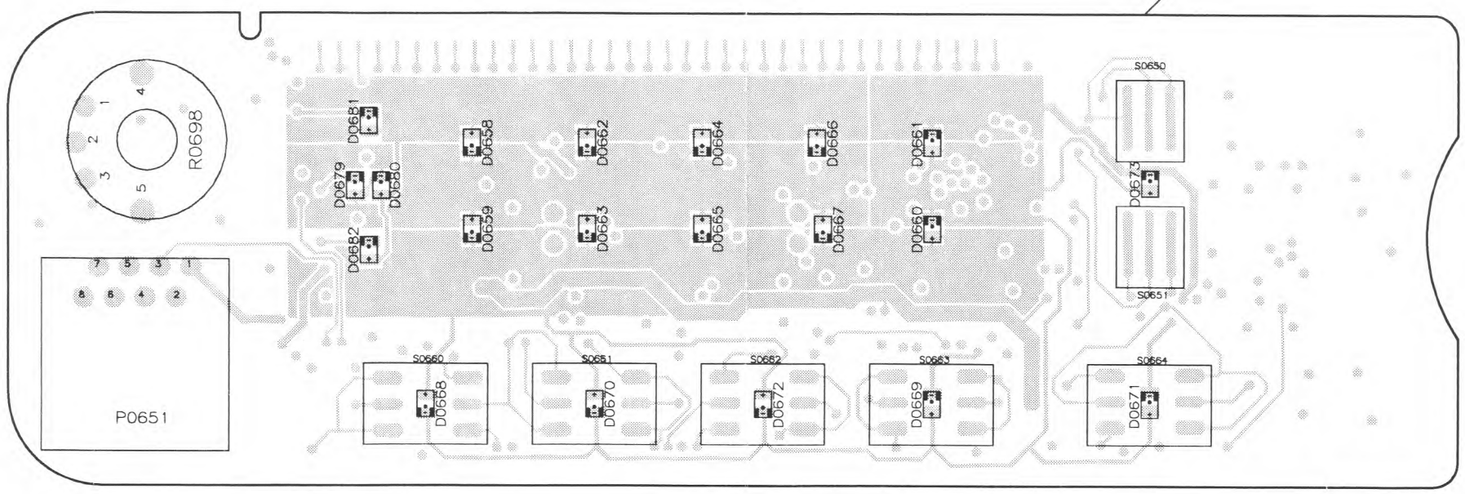
Ref.	Part/Kit No.	Description

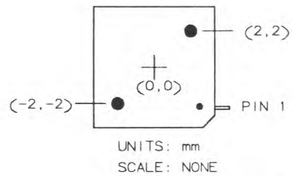


CONTROL HEAD J, KIT NO. HCN4045A
EXPLODED VIEW DIAGRAM AND PART NUMBERS

BOARD VIEWED FROM FRONT SIDE

ITEM 1

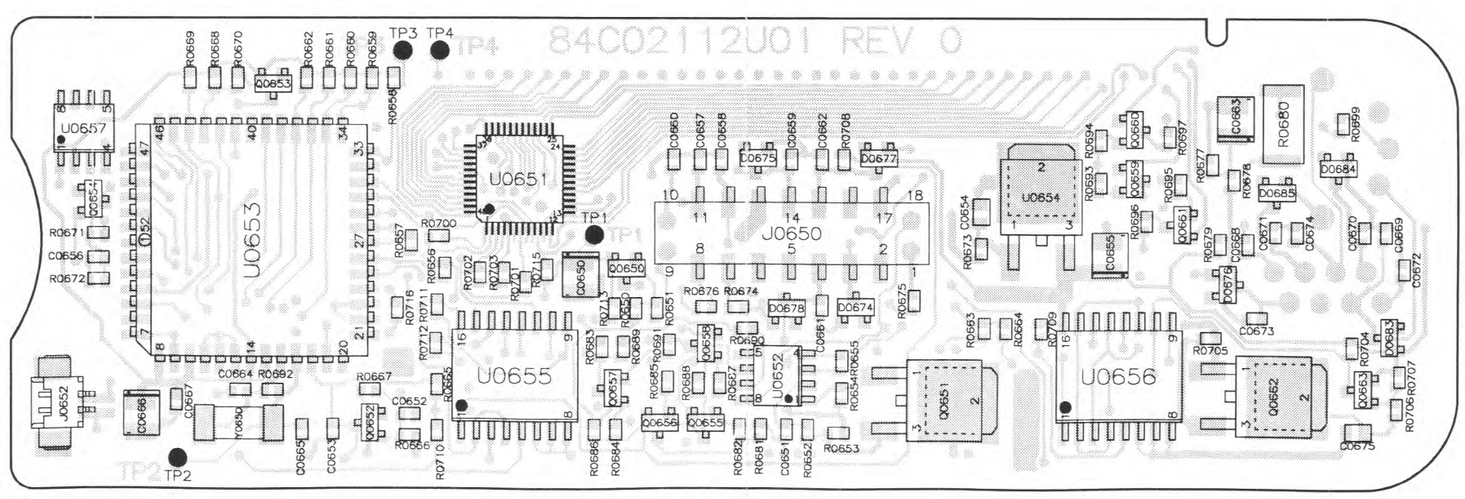




UNITS: mm
SCALE: NONE

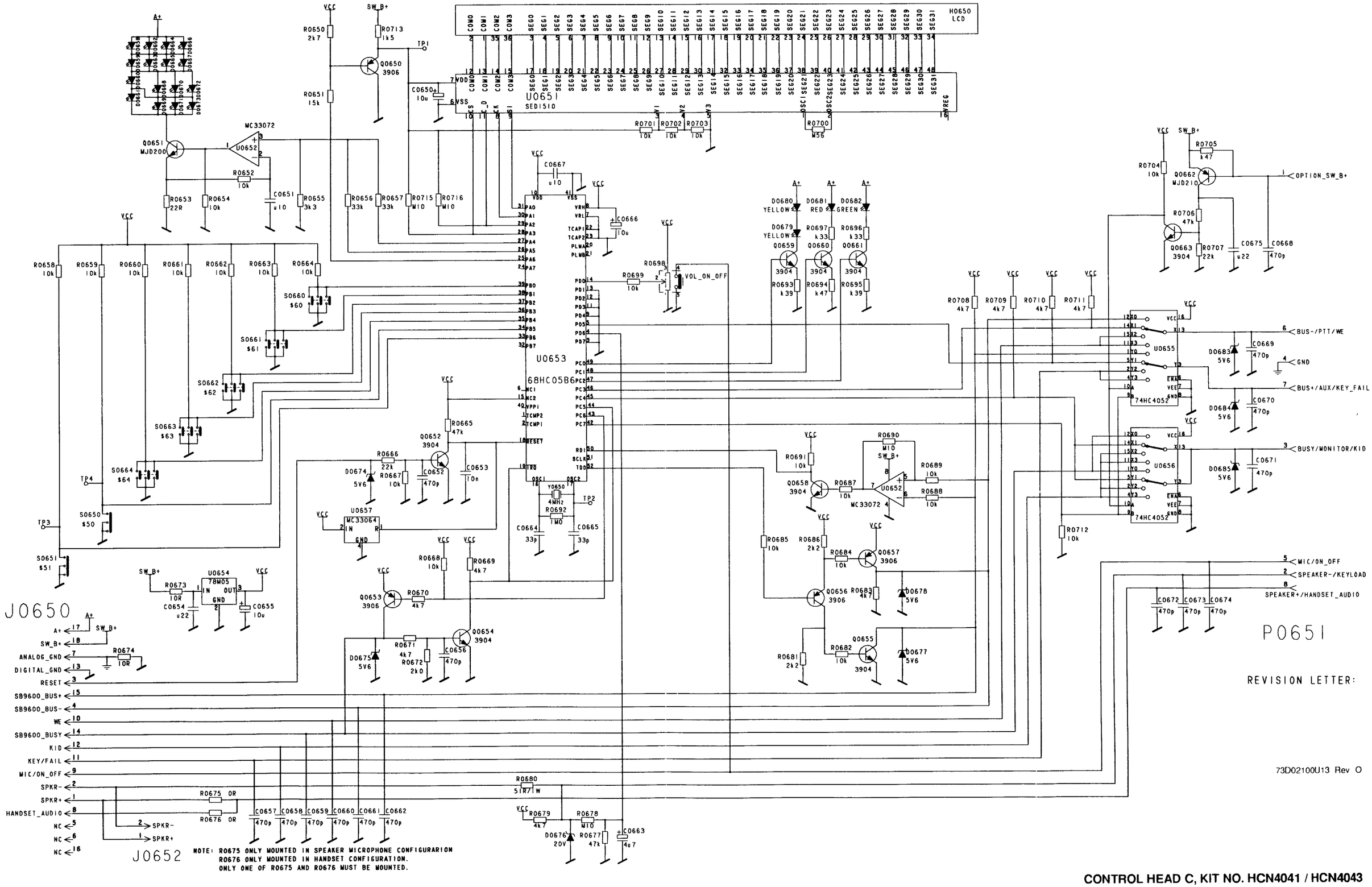
OFFSET OF FIDUCIALS UNDER FINE PITCH QFP48

BOARD VIEWED FROM BACK SIDE



NOTE:
R0675 ONLY MOUNTED IN SPEAKER MICROPHONE CONFIGURATION.
R0676 ONLY MOUNTED IN HANDSET CONFIGURATION.
ONLY ONE OF R0675 AND R0676 MUST BE MOUNTED.

CONTROL HEAD C, KIT NO. HCN4041 / HCN4043
COMPONENT LOCATION DIAGRAM



REVISION LETTER:

73D02100U13 Rev O

CONTROL HEAD C, KIT NO. HCN4041 / HCN4043
SCHEMATIC DIAGRAM

ELECTRICAL PARTS LIST FOR CONTROL HEAD C, KIT NO. HCN4041 / HCN4043

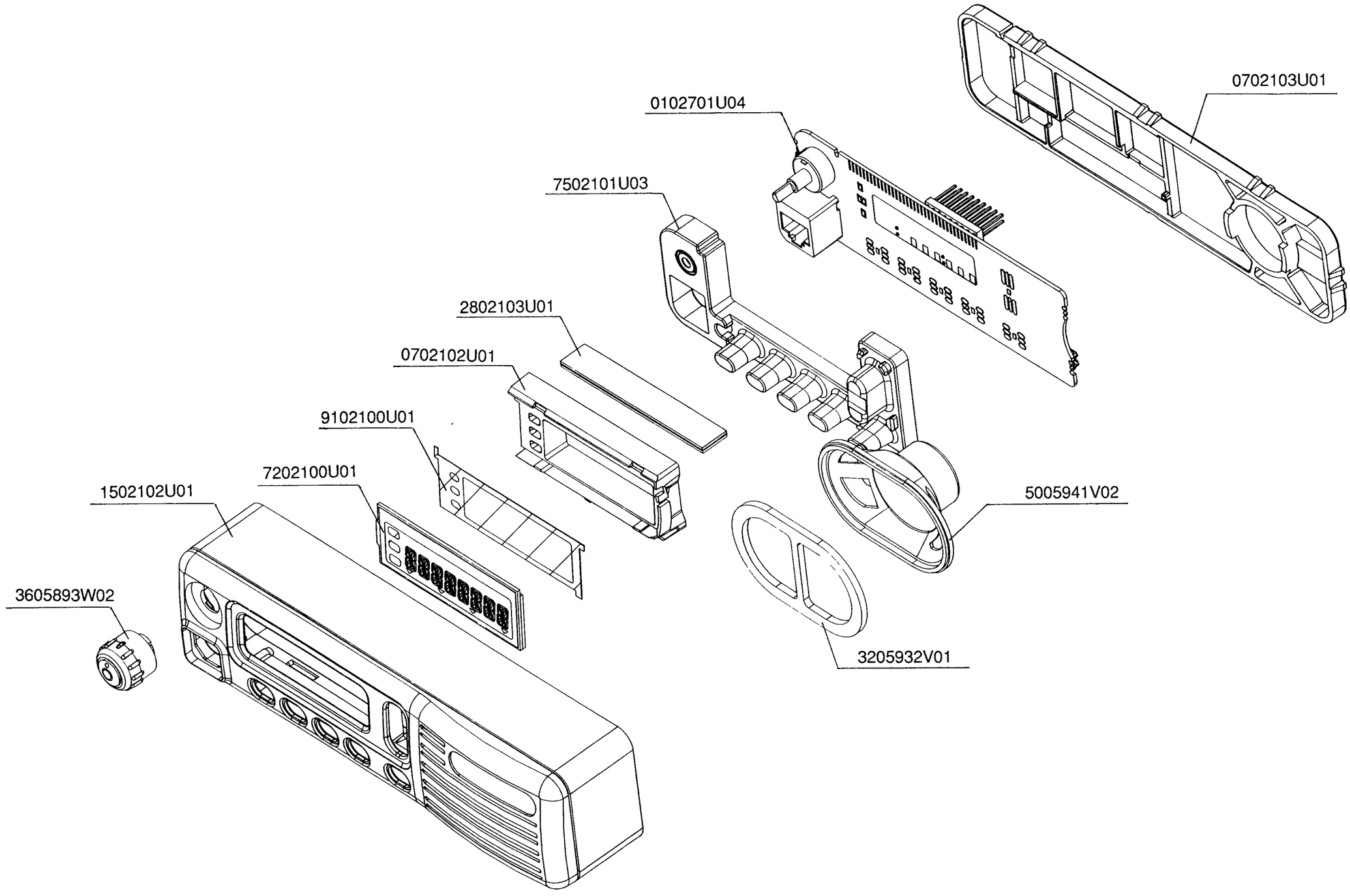
Ref.	Part/Kit No.	Description
	0102701U04	
C0650	2311049J23	CAP TANT CHIP 10 10 7
C0651	2113743K15	CER CHIP CAP .100UF
C0652	2113741F17	CAP CHIP CL2 X7R REEL 470
C0653	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0654	2113743A23	CAP CHIP 220 UF 10% X7R
C0655	2311049J23	CAP TANT CHIP 10 10 7
C0656	2113741F17	CAP CHIP CL2 X7R REEL 470
C0657	2113741F17	CAP CHIP CL2 X7R REEL 470
C0658	2113741F17	CAP CHIP CL2 X7R REEL 470
C0659	2113741F17	CAP CHIP CL2 X7R REEL 470
C0660	2113741F17	CAP CHIP CL2 X7R REEL 470
C0661	2113741F17	CAP CHIP CL2 X7R REEL 470
C0662	2113741F17	CAP CHIP CL2 X7R REEL 470
C0663	2311049J12	CAP TANT CHIP 4.7 20 16
C0664	2113740F39	CAP CHIP REEL CL1 +/-30 33
C0665	2113740F39	CAP CHIP REEL CL1 +/-30 33
C0666	2311049J23	CAP TANT CHIP 10 10 7
C0667	2113743K15	CER CHIP CAP .100UF
C0668	2113741F17	CAP CHIP CL2 X7R REEL 470
C0669	2113741F17	CAP CHIP CL2 X7R REEL 470
C0670	2113741F17	CAP CHIP CL2 X7R REEL 470
C0671	2113741F17	CAP CHIP CL2 X7R REEL 470
C0672	2113741F17	CAP CHIP CL2 X7R REEL 470
C0673	2113741F17	CAP CHIP CL2 X7R REEL 470
C0674	2113741F17	CAP CHIP CL2 X7R REEL 470
C0675	2113743A23	CAP CHIP 220 UF 10% X7R
C0681	4805729G74	LED SMT RED HP
D0658	4805729G75	LED SMT GREEN HP
D0659	4805729G75	LED SMT GREEN HP
D0660	4805729G75	LED SMT GREEN HP
D0661	4805729G75	LED SMT GREEN HP
D0662	4805729G75	LED SMT GREEN HP
D0663	4805729G75	LED SMT GREEN HP
D0664	4805729G75	LED SMT GREEN HP
D0665	4805729G75	LED SMT GREEN HP
D0666	4805729G75	LED SMT GREEN HP
D0667	4805729G75	LED SMT GREEN HP
D0668	4805729G75	LED SMT GREEN HP
D0669	4805729G75	LED SMT GREEN HP
D0670	4805729G75	LED SMT GREEN HP
D0671	4805729G75	LED SMT GREEN HP
D0672	4805729G75	LED SMT GREEN HP
D0673	4805729G75	LED SMT GREEN HP
D0674	4813830A15	DIODE 5.6V 5%
D0675	4813830A15	DIODE 5.6V 5%
D0676	4813830A33	DIODE 20V 5%
D0677	4813830A15	DIODE 5.6V 5%
D0678	4813830A15	DIODE 5.6V 5%
D0679	4805729G73	LED SMT YEL HP
D0680	4805729G73	LED SMT YEL HP
D0682	4805729G75	LED SMT GREEN HP
D0683	4813830A15	DIODE 5 6V 5%
D0684	4813830A15	DIODE 5 6V 5%
D0685	4813830A15	DIODE 5.6V 5%
J0650	2805922V01	PLUG CONTROL HEAD VERT
J0652	2809926G01	CONN 1 25MM CTR SUR MT HDR
P0651	2805924V01	CONNECTOR MIC
Q0650	4813824A17	XSTR PNP40V 2A
Q0651	4813822A20	TSTR NPN 25V 5A
Q0652	4813824A10	XSTR NPN 40V 2A
Q0653	4813824A17	XSTR PNP40V .2A
Q0654	4813824A10	XSTR NPN 40V 2A
Q0655	4813824A10	XSTR NPN 40V 2A

Ref.	Part/Kit No.	Description
Q0656	4813824A17	XSTR PNP40V .2A
Q0657	4813824A17	XSTR PNP40V .2A
Q0658	4813824A10	XSTR NPN 40V .2A
Q0659	4813824A10	XSTR NPN 40V 2A
Q0660	4813824A10	XSTR NPN 40V 2A
Q0661	4813824A10	XSTR NPN 40V 2A
Q0662	4813822A08	TSTR PNP 25V 5A MJD210T4
Q0663	4813824A10	XSTR NPN 40V .2A
R0650	0662057A59	CHIP RES 2700 OHMS 5%
R0651	0662057A77	CHIP RES 15K OHMS 5%
R0652	0662057A73	CHIP RES 10K OHMS 5%
R0653	0662057A09	CHIP RES 22 OHMS 5%
R0654	0662057A73	CHIP RES 10K OHMS 5%
R0655	0662057A61	CHIP RES 3300 OHMS 5%
R0656	0662057A85	CHIP RES 33K OHMS 5%
R0657	0662057A85	CHIP RES 33K OHMS 5%
R0658	0662057A73	CHIP RES 10K OHMS 5%
R0659	0662057A73	CHIP RES 10K OHMS 5%
R0660	0662057A73	CHIP RES 10K OHMS 5%
R0661	0662057A73	CHIP RES 10K OHMS 5%
R0662	0662057A73	CHIP RES 10K OHMS 5%
R0663	0662057A73	CHIP RES 10K OHMS 5%
R0664	0662057A73	CHIP RES 10K OHMS 5%
R0665	0662057A89	CHIP RES 47K OHMS 5%
R0666	0662057A81	CHIP RES 22K OHMS 5%
R0667	0662057A73	CHIP RES 10K OHMS 5%
R0668	0662057A73	CHIP RES 10K OHMS 5%
R0669	0662057A65	CHIP RES 4700 OHMS 5%
R0670	0662057A65	CHIP RES 4700 OHMS 5%
R0671	0662057A65	CHIP RES 4700 OHMS 5%
R0672	0662057A56	CHIP RES 2000 OHMS 5%
R0673	0662057A01	CHIP RES 10 OHMS 5%
R0674	0662057A01	CHIP RES 10 OHMS 5%
R0676	0662057B47	CHIP RES 0 OHMS +- 050 OHMS
R0677	0662057A89	CHIP RES 47K OHMS 5%
R0678	0662057A97	CHIP RES 100K OHMS 5%
R0679	0662057A65	CHIP RES 4700 OHMS 5%
R0680	0680194M18	RES 51 OHMS 5% 1W
R0681	0662057A57	CHIP RES 2200 OHMS 5%
R0682	0662057A73	CHIP RES 10K OHMS 5%
R0683	0662057A65	CHIP RES 4700 OHMS 5%
R0684	0662057A73	CHIP RES 10K OHMS 5%
R0685	0662057A73	CHIP RES 10K OHMS 5%
R0686	0662057A57	CHIP RES 2200 OHMS 5%
R0687	0662057A73	CHIP RES 10K OHMS 5%
R0688	0662057A73	CHIP RES 10K OHMS 5%
R0689	0662057A73	CHIP RES 10K OHMS 5%
R0690	0662057A97	CHIP RES 100K OHMS 5%
R0691	0662057A73	CHIP RES 10K OHMS 5%
R0692	0662057B22	CHIP RES 1 0 MEG OHMS 5%
R0693	0662057A39	CHIP RES 390 OHMS 5%
R0694	0662057A41	CHIP RES 470 OHMS 5%
R0695	0662057A39	CHIP RES 390 OHMS 5%
R0696	0662057A37	CHIP RES 330 OHMS 5%
R0697	0662057A37	CHIP RES 330 OHMS 5%
R0698	1805911V01	POT VOL
R0699	0662057A73	CHIP RES 10K OHMS 5%
R0700	0662057B16	CHIP RES 560K OHMS 5%
R0701	0662057A73	CHIP RES 10K OHMS 5%
R0702	0662057A73	CHIP RES 10K OHMS 5%
R0703	0662057A73	CHIP RES 10K OHMS 5%
R0704	0662057A73	CHIP RES 10K OHMS 5%
R0705	0662057A41	CHIP RES 470 OHMS 5%
R0706	0662057A89	CHIP RES 47K OHMS 5%

ELECTRICAL PARTS LIST FOR CONTROL HEAD C, KIT NO. HCN4041 / HCN4043

Ref.	Part/Kit No.	Description
R0707	0662057A81	CHIP RES 22K OHMS 5%
R0708	0662057A65	CHIP RES 4700 OHMS 5%
R0709	0662057A65	CHIP RES 4700 OHMS 5%
R0710	0662057A65	CHIP RES 4700 OHMS 5%
R0711	0662057A65	CHIP RES 4700 OHMS 5%
R0712	0662057A73	CHIP RES 10K OHMS 5%
R0713	0662057A53	CHIP RES 1500 OHMS 5%
R0715	0662057A97	CHIP RES 100K OHMS 5%
R0716	0662057A97	CHIP RES 100K OHMS 5%
U0651	5102109U01	IC LCD SEGMENT DRIVER
U0652	5113818A03	IC HIGH PERFORMANCE SING SPLY
U0653	5102112U01	IC UP 68HC05 MASK CH C
U0654	5113816A07	REG 5V POS 500MA MC78M05BDTRK
U0655	5113805A84	IC MUX/DEMUX DUAL 4-CH ANALOG
U0656	5113805A84	IC MUX/DEMUX DUAL 4-CH ANALOG
U0657	5113815A02	IC UNDERVOLT SINSING CKT
Y0650	4880065M01	RESONTR CERAMIC 4.00 MHZ

Ref.	Part/Kit No.	Description



CONTROL HEAD C, KIT NO. HCN4041A/HCN4043A
EXPLODED VIEW DIAGRAM AND PART NUMBERS

RADIO FAULTS FOR TRUNKED MPT1327 RADIOS

When the radio enters the fail mode the display will show:

RADIO FAULT NN

where the NN represents a 2 digit number indicating the failure type as shown below:

Displayed Error Number or Message	Failure Type
01	Invalid channel spacing: The channel spacing value programmed into the radio from the network file (via the RSS) is not within the range of valid values.
02	EEPROM checksum invalid (personality fields): Memory corruption has occured in either the internal EEPROM (factory initialised memory) or the external EEPROM (RSS programmed memory).
03	Synthesizer out of lock: The radio's synthesiser has failed.
04	Invalid RF configuration: The radio model number is inconsistent with the RX/TX base frequencies programmed into the radio, or the model number is invalid.
05	RAM test failed: The radio's internal RAM check has failed.
06	Invalid personality data: Invalid parameters in the current personality. Either the dialling plan or radio configuration bytes specified via the network file are incompatible with the radio.
10	Flash EEPROM checksum invalid: The Flash EEPROM area of memory containing the radio application has been corrupted.
12	Hardware test failure: An invalid SLIC IVa chip has been detected in the radio hardware or one of the attached radio accessories has failed.
NO PERSONALITY	The radio does not have any personality data loaded via the RSS, or the last stored personality number has been corrupted.

PL(CTCSS) CODES

SELF-QUIETING FREQUENCIES

Self-quieting frequencies are frequencies that are also generated by the radio and cause internal interference. On these frequencies, the interference caused by the self-quieter spurs is great enough that a radio will not meet its receiver sensitivity specification. These are, respectively:

VHF 151.2 and 168.0 MHz,

UHF 403.2, 420.0, 436.8, 440.1 and 453.6.

ALLOWABLE PL CODES

The following PL codes have been tested and are acceptable for programming into any transmit or receive frequency.

GROUP A	
CODE	FREQ.
XZ	67
XB	77
YB	88.5
1Z	100
1B	107.2
2A	114.8
3Z	123
3B	131.8
4A	141.3
5Z	151.4
6A	173.8
7Z	186.2
M1	203.5
M3	218.1

GROUP B	
CODE	FREQ.
XA	71.9
YZ	82.5
ZA	94.8
1A	103.5
2Z	110.9
2B	118.8
3A	127.3
4Z	136.5
4B	146.2
5A	156.7
6Z	167.9
6B	179.9
7A	192.8
M2	210.7

GROUP C	
CODE	FREQ.
WZ	69.3
WA	74.4
WB	79.7
YA	85.4
ZZ	91.5
ZB	97.4
5B	162.2
8Z	206.5

GLOSSARY OF TERMS

ALC: Automatic level control; a circuit in the transmit RF path that controls RF power amplifier output, provides levelling over frequency and voltage, and protects against high vswr.

ASF IC: Audio signalling filter integrated circuit.

closed architecture: refers to the controller; the firmware operating system is a masked program, configured one time only in the manufacturing process (the microcomputer of the controller includes its own preprogrammed memory, which cannot be reprogrammed) See "open architecture" description.

DPL: Digital Private-Line™ .

firmware: software or a software/hardware combination of computer programs and data, with a fixed logic configuration stored in a read-only memory; information can not be altered or reprogrammed.

FLASHport™ : is a Motorola term that describes the ability of a radio to change memory. Every FLASHport radio contains a FLASHport EEPROM memory chip that have software written and rewritten to, again and again.

hardware: physical equipment used in data processing.

IF SEL: I-F select line; it activates the I-F module when low.

IM: Inter-modulation; unwanted frequencies produced in the mixer.

LSH: Low speed handshake; digital data sent to the radio during trunked operation at 150 baud while receiving modulation.

message time-out timer: A timer in the system central controller that maintains a channel allocation for calling parties (The timer may be programmed to time out the channel allocation within 0 to 6 seconds after de-key).

MRTI: Microprocessor Radio-Telephone Interconnect; a Motorola system that provides a repeater connection to the telephone network (The MRTI allows the radio to access the telephone network when the proper access code is received).

NF: Noise Figure; is a ratio of total noise power at the output to the input noise power.

OMPAC: Acronym for Over-Molded Pad Array Carrier, a Motorola custom package, distinguished by the presence of solder balls on the bottom pads.

open architecture: refers to the controller (The operating system can be completely changed; for example, a conventional radio could be reconfigured into a trunked radio.) Although the microprocessor of the controller contains on-board memory, the controller includes a separate FLASHport EEPROM memory chip.

OSW: Outbound signalling word; central controller transmissions to radios in the field.

PC Board: Printed circuit board. Radios contain an transceiver board, a controller board, and a front cover board (front cover board, telephone interconnect models only). The latter is a simple fibreglass two-sided board, while the others are multi-layered boards.

PL: Private-Line® tone squelch; a continuous subaudible tone that is transmitted along with the carrier (A radio that has PL on the receive frequency will require both the presence of carrier and the correct PL tone before it will unmute). Also, if there is PL on the transmit frequency, all transmissions by the radio will be modulated with the PL tone. Modulation will be continuous.

PLL: Phase locked loop; a circuit in which an oscillator is kept in phase with a reference, usually after passing through a frequency divider.

PTT: Push-to-talk; the switch located on the left side of the radio which, when pressed, causes the radio to transmit.

registers: Short term data storage circuits within the microcontroller.

repeater: Remote transmit/receive facility that re-transmits received signals in order to improve communications range and coverage.

RESET: Reset line; an input to the microcontroller that restarts execution following a negative pulse.

RF PA: Power amplifier module, located on the transceiver board.

RSSI: Received signal strength indicator; a dc voltage proportional to the received rf signal strength.

RPT/TA: Repeater/Talk-around.

RX DATA: Recovered digital data line; inputs to the microcontroller.

SCI IN: Serial communication interface input line.

SLIC IV: Acronym for Support Logic IC, a custom gate array used to provide I/O and memory expansion for the microcontroller module

softpot: Software potentiometer; a computer-adjustable electronic attenuator

software: computer programs, procedures, rules, documentation, and data pertaining to the operation of a system.

SPI (clock and data lines): Serial Peripheral Interface; how the microcontroller communicates to modules and ICs through the CLOCK and DATA lines.

squelch: Automatic receiver quieting accomplished by muting audio circuits when received signal levels fall below a pre-determined value.

SRAM: Static RAM, memory chip used for scratchpad memory.

standby mode: An operating mode whereby the radio is muted but still continues to receive data.

SYN SEL: Synthesizer select line; activates the synthesizer when low.

system central controller: Main control unit of the trunked dispatch system; handles ISW and OSW messages to and from radios in the field (See ISW and OSW).

system select: The act of selecting the desired operating system with the system select switch (also, the name given to this switch).

Talk group: A collection of radios using the same communication path.

TSOP: Acronym for Thin Small-Outline Package, a new package being used for memory modules, typically less than .060" thick.

transmission time-out-timer: A timer that limits the length of a transmission made over a channel.

µC: microcontroller.

VCO Voltage-controlled oscillator: an oscillator whereby the frequency of oscillation can be varied by changing a control voltage.

VCOB IC: Voltage-controlled oscillator buffer integrated circuit.