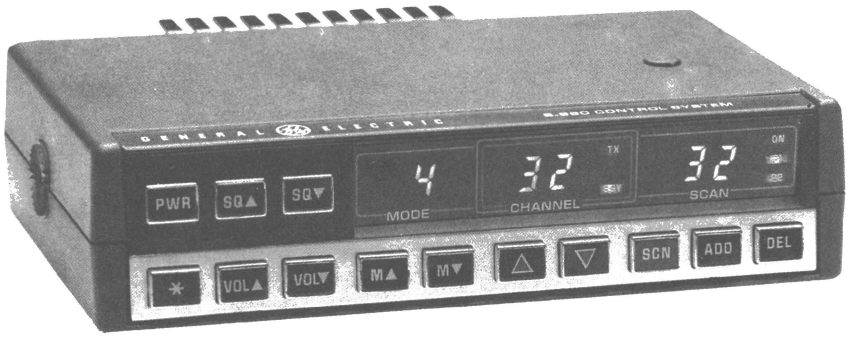
MOBILE RADIO

MAINTENANCE MANUAL

S-990 CONTROL UNIT

(19B801390P1)



Maintenace Manual LBI 31528

S-990 CONTROL UNIT

SPECIFICATIONS*

Controls	Power	(PWR)
	Squelch	(SQ▲ SQ▼)
	Volume	(VOL▲ VOL▼)
	Mode	(M▲ M▼)
	Channel	(▲ ▼)
	Scan	(SCN)
	Add	(ADD)
	Delete	(DEL)
	Auxiliary	(*)
Indicators	Power	(DISPLAY)
	Mode	(DISPLAY)
	Channel	(DISPLAY)
	Scan	(DISPLAY)
	Transmit	
	Busy	
	Scan ON	
	Priority-1	
	Priority-2	

GENERAL ELECTRIC

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DESCRIPTION

The S-990 Control Unit is an attractively styled, highly functional unit. It is enclosed in a two-piece molded plastic resin housing for durability and ease of disassembly. The control unit can be mounted to the dash, hump or overhead using a multi-position mounting bracket.

The control unit contains four four-layer printed circuit boards; the Display/Control board, the Input/Output (I/O) board, the Microcomputer board and the Backplane Connector board. All external interconnecting jacks are at the rear of the unit.

The Display/Control board and the Input/Output board are electrically and mechanically (soldered) connected to . form one composite assembly. Likewise, the Microcomputer board and the Backplane Connector board are similarly assembled in a Tee-shaped configuration. The two assemblies are connected electrically by four circuit board plugs and jacks. There are no interconnecting wires in the control unit, other than to the power switch.

All controls are front mounted, push-button type with back lighting of legends for night time visability. All indicators are Light Emitting Diodes or Seven Segment Displays, providing long life, low power consumption and high reliability.

FUNCTIONS

The S-990 Control Unit is a highly versatile, software-controlled unit providing numerous functions and options including:

- Dual Priority Scan
- Digital Volume Control
- Digital Squelch Control
- Type 90 or 99 Encode Tones
- GE-STAR Identification
- 128 Channels in -
  8 Modes of 16 Channels each
  or
  4 Modes of 32 Channels each
- Carrier Control Timer (per mode basis)*
- Channel Guard - Tone or Digital*
- Channel Frequencies*
- Home Channel Revert
- Auxiliary Relay Control
- LED Intensity Control

* These functions are actually performed in the radio. If you have downloaded, the data is held in the control unit.

PROGRAMMING

The various functions and options must be programmed into the S-990 Control Unit. The TQ2310 Universal Radio Programmer equipped for the S-990 Control Unit is required. The S-990 PROM is indentified as TQ2329 [includes both Control and I/O PROMs (19A148766G3)] and the programmer cable is TQ2322 (19B234413G15). Plug P2 of the programming cable connects to J2 on top of the Data I/O Module in the TQ2310 programmer and plug P7 connects to J6 on the back of the control unit. Refer to the S-990 Control Unit Programming Instructions LBI31380 for detailed procedures. The TG2322 DELTA-S Cable, provided separately as ordered, is used for connecting the S-990 Control Head to the Universal Radio Programmer during programming. The following procedure is recommended.

1. Connect the 9-pin connector of the cable to the mating connector of the Programmer's Data I/O Module. Press the locking lever on the cable connector to facilitate installation and removal. Connect the other end of 6-pin connector to J6 on the rear of the S-990 control Unit.

2. If the control unit is connected to a radio via the power/control cable, turn on the control unit with 13.8 VDC present. If CG hookswitch is present, make sure microphone is hook. (CG DSBL lead is one of programming leads.)

3. If programming a control unit only, connect ignition cable to J1 on rear of control unit. Also must connect J2-2 (Analog Gnd) to J1-1 (A-). With the control unit ON, apply 13.8 VDC.

Custom Programming

A0 - TEST PROG.
The control unit is shipped with the following test program and requires field programming. If attached to the radio it will operate as a normal control unit and does not download any channel information. Channel control is set up for four modes of 32 channels. There is no HOME channel and the offhook scan is OFF. Scan resume is programmed for 2 seconds with front panel programmable scan. No CG tone or GE-STAR is provided. Variable squelch is standard. In Mode 4, Channel 32, a 1000 Hz, Type 90 tone is programmed for signal by the auxiliary push-button switch. Tone signalling duration is set for 300 milli-seconds.

A1 - CUSTOM PROG. NO DOWNLOAD
The control unit is programmed for options as ordered, such as Scan or encode tones. The control unit operates the radio using the radio's internal channel programming (does not download channel information). Channel control is set to agree with the radio. Dual Priority Scan is set for Priority 1 to be front panel programmable unless a "G" option is ordered. No tone or GE-STAR is provided unless 'CA' is ordered. The auxiliary button will activate a field installed relay. If an 'E' option is ordered the auxiliary button will perform the required function and activate the relay, if installed. Variable squelch is standard.

A2 - CUSTOM PROG. WITH DOWNLOAD ON NARROWBAND RADIO
The control unit is programmed for options and channel information. The

number of modes and channels is set by channel information on the worksheet. The radio is reprogrammed by the S-990 each time a new mode is selected (does download). Dual Priority Scan is set for Priority 1 to be front panel programmable unless a "G" option is ordered. No tone or GE-STAR is provided unless 'CA' is ordered. The auxiliary button will activate a field installed relay. If an 'E' option is ordered the auxiliary button will perform the required function and activate the relay if installed. Variable squelch is standard. CCT is set up 1 min. on all channels Option A2 is used for DELTA-S radios.

A3 - CUSTOM PROG. WITH DOWNLOAD ON WIDEBAND RADIO
This is the same as A2, Except that A3 is used for DELTA-SX wideband radios.

INSTALLATION

Refer to the radio installation manual for the proper connections to the mobile combination. Refer to the accessories manual for installation & connection of the external tone cables.

OPERATION

(Refer to Operator's Manual LBI31526)

Power to the S-990 Control Unit and to the radio is controlled by the power (PWR) on/off switch. In is ON - out is OFF. The radio and the control unit are operated by the front push-button controls.

TO RECEIVE A MESSAGE

1. Turn the radio and control unit on by pressing the power switch. This lights the CHANNEL and MODE indicators.

2. Set squelch by coming off hook with the microphone and pressing SQUELCH down button until noise is heard. Then press SQUELCH up button until noise disapears.

> NOTE
> If Fixed Squelch has been programmed, you cannot set the squelch level. To check the squelch level, first push the "up" button then the "down" button. Noise should be heard when "down" button is pushed.

3. Set the desired volume level by pressing VOLUME up or down button. If no carrier is present, tone BEEP will be heard that is proportional to the audio level.

4. If more than one frequency is available, select the proper channel by pressing the MODE up or down button and then the CHANNEL up or down button.

5. The radio is now ready to receive messages from other radios in the system. If the channel digit fails to light, the radio failed to download.

TO TRANSMIT A MESSAGE

1. If more than one frequency is available, select the proper channel as in step 4 above.

2. Check the CHANNEL BUSY indicator to make sure the channel is not being used.

3. Pick up microphone and press Push-To-Talk (PTT) switch. The red Transmit light will turn on. Speak across the microphone in a normal voice. Always release PTT switch when message is completed and listen for an answer.

MAINTENANCE

DISASSEMBLY

1. To gain access to the inside of the control unit, remove the two screws, lock washers and flat washer holding the top and bottom covers together, then remove the covers.

2. Remove the single screw (center of board) holding the I/O Board and Microcomputer Board together.

3. Carefully separate the I/O and Microcomputer boards.

4. To gain access to the Display/Control board, remove the six screws and carefully remove the front panel & keypad.

> CAUTION
> Avoid touching conductive rubber contacts on keypad to prevent contamination with body oils. To clean contacts use alcohol.

5. Note that the I/O and Display boards are soldered together in a Tee configuration. The same is true for the Microcomputer and Back Connector board. Do not exert undue stress on these electrical circuit connections.

REASSEMBLY

1. After servicing the boards, carefully connect the I/O and Microcomputer boards together. Pay careful attention to the alignment of the connector pins and sockets. Do not force the connectors together.

2. Lock the assembly together with the single screw and lockwasher (located in the approximate center of the boards).

3. Place the assembled boards in the bottom cover. Be certain the front and back boards and front panel are in the cover slots.

4. Carefully fit the top cover on. When properly aligned, fasten with the two screws flat washers and lock washers.

REPLACING CHIP COMPONENTS

Replacement of chip capacitors should always be done with a temperature-controlled soldering iron, using a controlled temperature of 700°F (371°C). However, do not touch black metal film of the resistors or the ceramic body of capacitors with the soldering iron.

NOTE

The metalized end terminations of the parts may be touched with the soldering iron without causing damage.

REMOVING CHIP COMPONENTS

1. Grip the component with tweezers or needle nose pliers.
2. Alternately heat each end of the chip in rapid succession until solder flows, and then remove and discard the chip.
3. Remove excess solder with a vacuum solder extractor or Solder-wick®
4. Carefully remove the epoxy adhesive and excess flux to prevent damage to the printed board.

TO REPLACE CHIP COMPONENTS

1. Using as little solder as possible, "tin" one end of the component and one of the pads on the printed wiring board.
2. Place the "tinned" end of the component on the "tinned" pad on the board and simultaneously touch the component and the pad with a well "tinned" soldering iron while pressing the component down on the board.
3. Place the "tinned" soldering iron on the other end of the component and the pad simultaneously. Apply solder to the top of the end of the component until the solder starts to flow. Use as little solder as possible while getting a good joint.
5. After the component has cooled, remove all flux from the component and printed wiring board area with alcohol.

REMOVING IC'S

Removing IC's (and all other soldered-in components) can be easily accomplished by using a de-soldering tool such as a SOLDAoPULLT® or equivalent. To remove an IC, heat each lead separately on the solder side and remove the old solder with the de-soldering tool.

CAUTION

The CMOS Integrated Circuit devices used in this equipment can be destroyed by static discharges. Before handling one of these devices, the serviceman should discharge himself by touching the case of a bench test instrument that has a 3-prong power cord connected to an outlet with a known good earth ground. When soldering or desoldering a CMOS device, the soldering iron should also have a 3-prong power cord connected to an outlet with a known good earth ground. A battery-operated soldering iron may be used in place of the regular soldering iron.

TEST CABLES

Test cables are available for checking the individual boards when the unit is disassembled. All cables are 15 inches in length.

TROUBLESHOOTING

- Test Cable Kit (19B234583P9) - Contains one each of the following test cables.
- Test Cable (19B234583P4) - Connects J8 to P8.
- Test Cable (19B234583P5) - Connects J9 to P9.
- Test Cable (19B234583P6) - Connects J10 to P10.
- Test Cable (19B234583P7) - Connects J11 to P11.
- Test Cable (19B234583P8) - Connects J13 to P13.

SELF TEST

The tests described in this section are designed to check out all S-990 functions. If this series of tests is passed and the radio is operating in a normal manner, the control unit may be assumed to perform its normal functions. The tests should be of special value in locating failures and as an aid in trouble shooting.

Test Requirements

These tests require the following conditions to be met before starting:

1. The control unit should be correctly connected to a working radio.
2. The control unit/radio are connected to a 13.8 volt supply capable of powering the transmitter.
3. All normal microphone, speaker and hookswitch connections have been made.
4. A voltmeter/scope is available to monitor control lines and circuit leads.
5. A 10,000 ohm pull up resistor to 13.8 volts has been connected to External Relay output J1-8.
6. Control unit is initially turned OFF.

Enter Self Test

1. The control unit must be OFF.
2. The microphone must be ON HOOK.
3. Press SCN/ADD/DEL buttons simulaneously.
4. Turn the control unit ON. The control unit is now in the Self Test mode.

RAM/ROM/EEPROM Test

All displays will be momentarily blank while the computer checks RAM/ROM/EEPROM.

1. If ROM failed the display will show 1.
2. If RAM failed the display will show 2.
3. If EEPROM failed the display will show 3.
4. If all tests pass the display will show 0 and an alert tone will sound for 5 seconds.

The test will stop after any failed condition.

Upon completion of the alert tone the tests will automatically resume.

Display Test

All seven segment-displays will light with 8. All individual LED's will light.

Tone Test/Deviation Set

Press the * button to enter this test.

Press SCN/ADD/DEL to skip this test and proceed to switch test.

This test places the radio in a normal operating mode in all respects except Tone/GE-STAR encoding.

After entering this mode, go to the channel/mode on which you want to set deviation. Initiate a signalling sequence using the method the radio is programmed to (PTT, hookswitch, or auxiliary). The radio will transmit the first tone in the sequence or a 1600 Hz tone if GE-STAR and hold that tone. Pressing the * button advances to the second tone in the sequence or, if T-90 or GE-STAR is present, removes the modulation. If T-99 is present pressing the * button a second time removes modulation and returns the radio to the mode allowing you to select a channel.

Once this test mode has been selected, the control unit must be turned off and back on to resume normal operation.

Switch Tests

All displays will be off except the channel display which will indicate the button depressed. If a button is stuck closed or pressed for over 5 seconds an alert tone will sound.

BUTTON PRESSED	CHAN. DISPLAY	OTHER ACTION
*	1	Ext Relay out low
VOL UP	2	Alert tone/mid volume
VOL DN	3	Alert tone/low volume
SQ UP	4	Ramp SO. UP
SQ DN	5	Decrement Squelch Level
MODE UP	6	
MODE DN	7	
CHN UP	8	
CHN DN	9	
SCN	10	
ADD	11	
DEL	12	

Press SCAN/ADD/DEL simultaneously to advance to the next test.

External Inputs

The channel display should show 00.

BUTTON	CH DISPLAY	ACTION
PTT	77	TX LED on Radio Keyed, MIC audio on
CG DISABLE	66	CG DIS to radio low
PTT+CG DIS	55	TX LED on, Radio Keyed.CG DIS low. Alert tone to mic high
GE-STAR	44	Radio reset low
CAS HIGH	33	CAS Light on
FAST SQ HIGH	22	
CAS/FAST SQ HI	32	33/22 are not useful while connected to a radio. CAS light will be on.
RX MUTE HIGH	11	

Fast Squelch may be taken high by feeding a carrier into the radio. If more than one action is taken the highest numbered function will be performed. The radio reverts to the idle state after each input is completeted.

Press SCN/ADD/DEL to continue.

Radio Test

(To exit turn power off).

Displays are all off. Checks radio ID.

ID Failed displays 1

ID Passed, but wrong radio 2

ID Passed, display 0

Press SCN/ADD/DEL to continue.

CAUTION

THIS TEST MAY DESTROY THE EEPROM CONTENTS IF A FAILURE OCCURS DURING THIS TEST.

Display are all off. Write a 00 then FF to PROM location 00. Then restore PROM to original contents.

0 Passed

1 Failed

Press SCN/ADD/DEL a second time to continue.

This completes the self test diagostics. The radio will exit self test and "hang" until the watchdog timer causes a reset to the operating mode.

Operate the radio on channel 1, 2, 4, 8 and ensure it receives on the appropriate frequency.

The control unit is now completely tested.

CIRCUIT DESCRIPTION

Refer to the control unit Block Diagram and to the Schematic Diagrams for identification of the various circuits and functions as described in this section.

Shielding is used on PWB to eliminate RF Interference.

POWER CIRCUTS

External Battery A+ (13.8 VDC nominal) is applied to Backplane connector J1-11. A- is applied through J1-1. DC power is controlled by Power Switch S113 as shown on Schematic Diagram, Sh. 3. When S113 is closed, Switched A+ is applied back through the internal power cable to the Backplane Connector board and to Tee junction M to the Microcomputer Board. The +13.8 volts is applied to 8-volt linear U10 and through P10-15/J10-15 to the I/O Board.

+5 Volts

The 5-volt linear voltage regulator U9 and 5-watt dropping resistor R52 (on Backplane Connector board) provide +5 VDC for main Microcomputer power and for memory and digital logic circuit power.

The +5 VDC (Vcc) goes through Tee junction 15 to the Microcomputer board. It is applied through P11-3/J11-3 to the I/O board. Computer controlled (U102) switched Vcc is applied through J11-1/P11-1 to switch Q4. This is used to energize EEPROM U4 and is a power conservation device.

+8 Volts

The 8-volt linear voltage regulator U10 and filter capacitors C14, C16 (on Microcomputer board) provide +8 VDC for the analogue circuits on the I/O board. The 8 volts allows sufficient voltage swing to prevent audio clipping. The +8 VDC is applied through P10-16/J10-16 to the I/O board.

MICROCOMPUTER

The U1 microcomputer is an 8031 device having no real internal momory capacity for specific data. Instead a program memory EPROM U2 and a personality memory EEPROM U4 are used. The EEPROM contains all of the personality and variable data.

An input multiplexer U12 is used to provide additional input capacity to U1. Fast Squelch, CAS, RX Mute, PTT, CG Disable and the keyboard outputs are brought into the microcomputer through this multiplexing gate. U1-1, -2 and -3 are the control lines for U12. Input data is from U12-3 to U1-8.

FAST SQUELCH

OPAMP U6 and associated components make up the Fast Squelch circuit. The circuit filters receiver noise and removes the low frequency components and rectifies the resultant signal. If the noise level drops below the level set by R16 and R17, the circuit indicates a carrier is present by grounding Q1 base. The circuit is designed to detect carrier presence within a millisecond after the carrier appears. Resistor R25 is used to set the Fast Squelch response level and is normally set to operate squelch on a -15 dBm or stronger signal.

I/O EXPANDERS

The U101 and U102 I/O Expanders assist the microcomputer in maintaining functional control and display. U101 multiplexes the keyboard and the displays and controls the U105 and U106 display drivers and Q101-Q104 display switches. The microcomputer controls U101 and U102 through chip select signals CS1 and CS2.

I/O Expander U102 controls the Vcc Switch used to energize EEPROM U4. Volume level control is provided by Volume Multiplexer U107 and the associated network resistors. The volume control provides 16 steps of 3 dB each via U113 and R155. The Squelch Multiplexer U107 is driven by U102. U107 and the associated network resistors provide 8 steps of squelch level.

AUDIO GATES & BUFFERS

Bilateral switch U113 and buffer U112 provide gating and buffering of alert and signalling tones. One section of U112 provides a low noise bias output (U112-14) of 4 volts for the other amplifiers and audio circuits.

TONES

Tones are generated inside the microcompter as square waves or as 2-bit Walsh function (depending on frequency). They are applied through U1-14 and -15 and scaling resistors R24 and R26 to summing amplifier U112. The transmit deviation level is set by resistor R165. Frequencies below 500 Hz are generated as 2-bit Walsh function and frequencies above 500 Hz are generated as a square wave.

OPTIONS

Refer to radio installation manual.

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MAINTENANCE

FUNCTIONAL PROBLEMS	CHECKS
UNIT ON - NO DISPLAYS	1. Power source, cables and connections. 2. 5-Volt and 8-volt regulators and circuits. Check power on the I/O Board. 3. Microcomputer clock - 6 MHz at U1-18,19. 4. Program Memory EPROM U2,Personality Memory EEPROM U4, I/O Expanders U101 and U102. 5. Enter Self Test routine for RAM, and ROM and EEPROM Functional check.This does not check EEPROM Program. Look for a ZERO in the mode display. (See Self Test).
INCORRECT DISPLAYS NO display change or incorrect display when buttons are pushed.	1. Stuck buttons (feel). 2. Display drivers - shorted or shorted lines. U101-13,14,15,16 are multiplexed outputs. 3. Multiplexers. 4. LED's - shorted or open. 5. Enter Self Test routine and run Button test. (See Self Test).
SOME DISPLAYS NOT LIGHTED All tens or ones digits do not light. (6 instead of 16) No LED's	1. Display divers U105-U106. 2. Display Switches Q101-Q104 Mode -Q101 Channel -Q102 Search -Q103 LED's -Q104
SQUELCH LEVELS	LEVER BINARY INPUTS P5.0 P5.1 P5.2 pin 1 23 22 (U102 Output) 1 0 0 0 (MIN SQ) 2 0 0 1 3 0 1 0 4 0 1 1 5 1 0 0 6 1 0 1 7 1 1 0 8 1 1 1 (MAX SQ) pin 9 10 11 (U108 Input) (Will be inverted) J16 in B position
RADIO WILL NOT UNSQUELCH ON SOME CHANNELS	1 On Open channel? Squelched. 2 Locked Synthesizer. 3 Radio problem?

MAINTENANCE

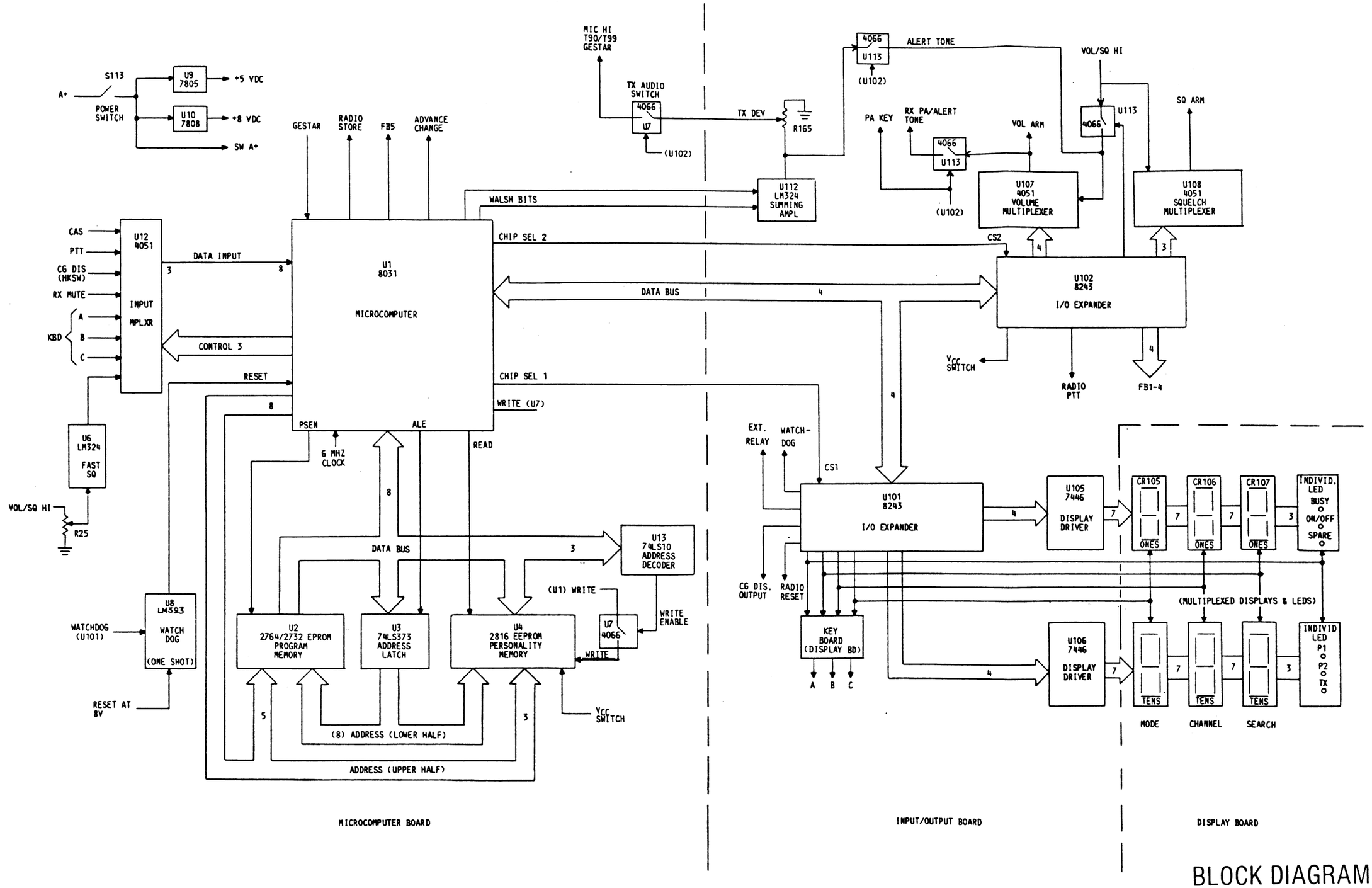
FUNCTIONAL PROBLEMS	CHECKS
RADIO STAYS KEYED	1 PTT shorted -U11-9, 10 short to A-. 2 Input Multiplexer U12. 3 Radio PTT J10-1 from U102 LO = TX, HI = RX
BUTTONS DON'T WORK or strange things happen	!. Stuck buttons (feel). 2. Input Multiplexer U12 - button scanning 3. I/O Expander U101-13, 14, 15, 16, defective. U101 through switches through J9-2, 3, 4, to input. Multiplexer U12-13, 14, 15. Keyboard A reads S103, S106, S109, S112. Keyboard B reads S102, S105, S108, S111. Keyboard C reads S101, S104, S107, S110. 4. Tee joint connections.
NO RECEIVE AUDIO	1. PA KEY shorted to A-. If PA KEY is grounded, a bilateral switch in the radio is turned off preventing VOL ARM audio from going through. Check PA KEY circuit. 2. VOL/SQ HI open or shorted. Check VOL/SQ HI from radio through bilateral switch U133, resistor network, multiplexer U107 to I/O Expander U102. Also check VOL ARM circuit. 3. Multiplexer U107 defective. See Volume Level 4, U112 OPAMP defective. check U112-5,10,3,14, bias for 4 volts
VOLUME LEVELS	LEVER BINARY INPUTS P4.0 P4.1 P4.2 P4.3 Pin 2 3 4 5 (U102 Output) 1 1 1 1 1 (MIN LEVEL) 2 1 1 1 0 3 1 1 0 1 4 1 1 0 0 5 1 0 1 1 6 1 0 1 0 7 1 0 0 1 8 1 0 0 0 9 0 1 1 1 10 0 1 1 0 11 0 1 0 1 12 0 1 0 0 13 0 0 1 1 14 0 0 1 0 15 0 0 0 1 16 0 0 0 0 (MAX LEVEL) Pin 9 10 11 (U107 Input) (Will be inverted)

MAINTENANCE

FUNCTIONAL PROBLEMS	CHECKS
POWER DOWN MEMORY FAILURE Radio turned on/off/on should retain Mode, Channel, Volume and Squelch Data.	1. Defective EEPROM U4- Enter Self Test (See Self Test) A 3 indicates a EEPROM write failure. 2. Defective Vcc Switch Q4 - Enter Self Test. Check Vcc control from U102-18 through U111 buffer to Vcc switch Q4. Change channel and monitor U4-24 with scope. Short Q4C-E. 3. Write line U1-16 to U4-21 problem check circuit. Pin U11-14 should be HI in static condition. If LO, channel memory will not work. 4. Address decoder U13-U7) or lines defective. Use TQ2310 Programmer and try to download. If successful, check for defective address decoder U13. If unsuccessful, U4 is Probably defective.
TONE FAILURE - T90/T99/GE-STAR	1. U4 EEPROM may be incorrectly programmed. Use the TQ2310 Programmer to read EEPROM and get printout. 2. Transmit Deviation level may be incorrect. Check setting of R165 on I/O board. 3. Defective bilateral tone switch U7. Control is from U102-17 to J9-5/P9-5 to U7-12. TX Tone goes to U7-11 and on to MIC HI. U7 is switched by +5 v. 4. Walsh Function - Check U1-14 and 15 and summing resistors to P8-2/J8-2. Monitor U112-1 and operate Tone Button (S101). If tones appear, they are getting through OPAMP U112.
INCORRECT CHANNEL FREQUENCY	1. U4 EEPROM may be incorrectly programmed. Read the EEPROM with the TQ2310 Programmer and get a printout. 2. If downloading is programmed, check FB1-FB5 lines for open or short. FB1-FB4 are from I/O expander U102-13, 14, 15 and 16. Also check diodes CR112-CR119. FB5 is from U1-10 and should be HI for Channel 1-16 and LO for Channel 17-32. 3 Check radio for necessary PROMS.
SCAN NOT WORKING Most Scan problems are related to personality PROM data. Check control unit programming before beginning equipment tests.	1. Check hookswitch. No scan or OFF HOOK if unit is so programmed. 2. Operate SCN button. See that Scan Indicator turns on and off. 3. Check with a scope for Advance change pulse at U1-11. Also check Fast Squelch at U12-5.

MAINTENANCE

FUNCTIONAL PROBLEMS	CHECKS
SCAN NOT WORKING (CON'T)	4. Check Channel Guard operation. CG input is the RX Mute line through U11-4,5 to U12-2. RX Mute LO indicates incorrect tone. RX Mute HI indicates correct tone or not programmed for tone. 5. Check to see that the radio synthesizer is locked. 6. Check to be sure channels are not blank or open channels.
LOUD NOISE WHEN COMING OFF PRIORITY (squelch noise)	1. Check VOL/SQ HI circuit with acope. If voice is observed after Advance Chance Change Pulse, the radio is not returning to channel fast enough. 2. Check for Advance change pulse from U1-11 to the radio (P1-32). 3. Check radio for defective squelch.
ID ERROR when downloading from programmer	1. Check that power is on and mic/handset is on hook. (Gives ID: 0,0). check that all cables are properly con nected. The following line are used in programming: LATCH (CG DIS. INPUT) (U12-4) DATA (FB5) (U1-11) CU STORE (U11-11) A- CU RESET (U1-9) CLOCK (ADV. CHNG) (U1-11) ID 255, 255
READ BUT NO WRITE with programmer If programmer can read control that indicates serial loading routine is working	1. Check that control unit is hooked to radio and that J2-2 is grounded. If radio is not connected, J2-2 must be jumpered to unit, A- (battery negative). 2. Check CU STORE through circuit to U7-13. The programmer grounds CU STORE and puts a HI on pin 13. U7 is turned on and connects Write line (U1-16) to the EEPROM (U4-21). If the circuit is open, write failure will occur.
RADIO DOWNLOAD FAILURE Incorrect programming Channel capacity exceeded faulty circuits or cables. Indicated by channel display going blank and staying blank after power on or mode change. To make control unit active after a download failure, depress the HOME button.	1. Check radio and control unit programming compatibility - NB or WB. 2. If more than 16 channels are being programmed, the second EEPROM must be present in the radio for downloading. 3. Check radio with TQ2310 programmer to be certain it can be programmed. 4. If radio is good, check cables, cables modification it can all programming circuits in the control unit.



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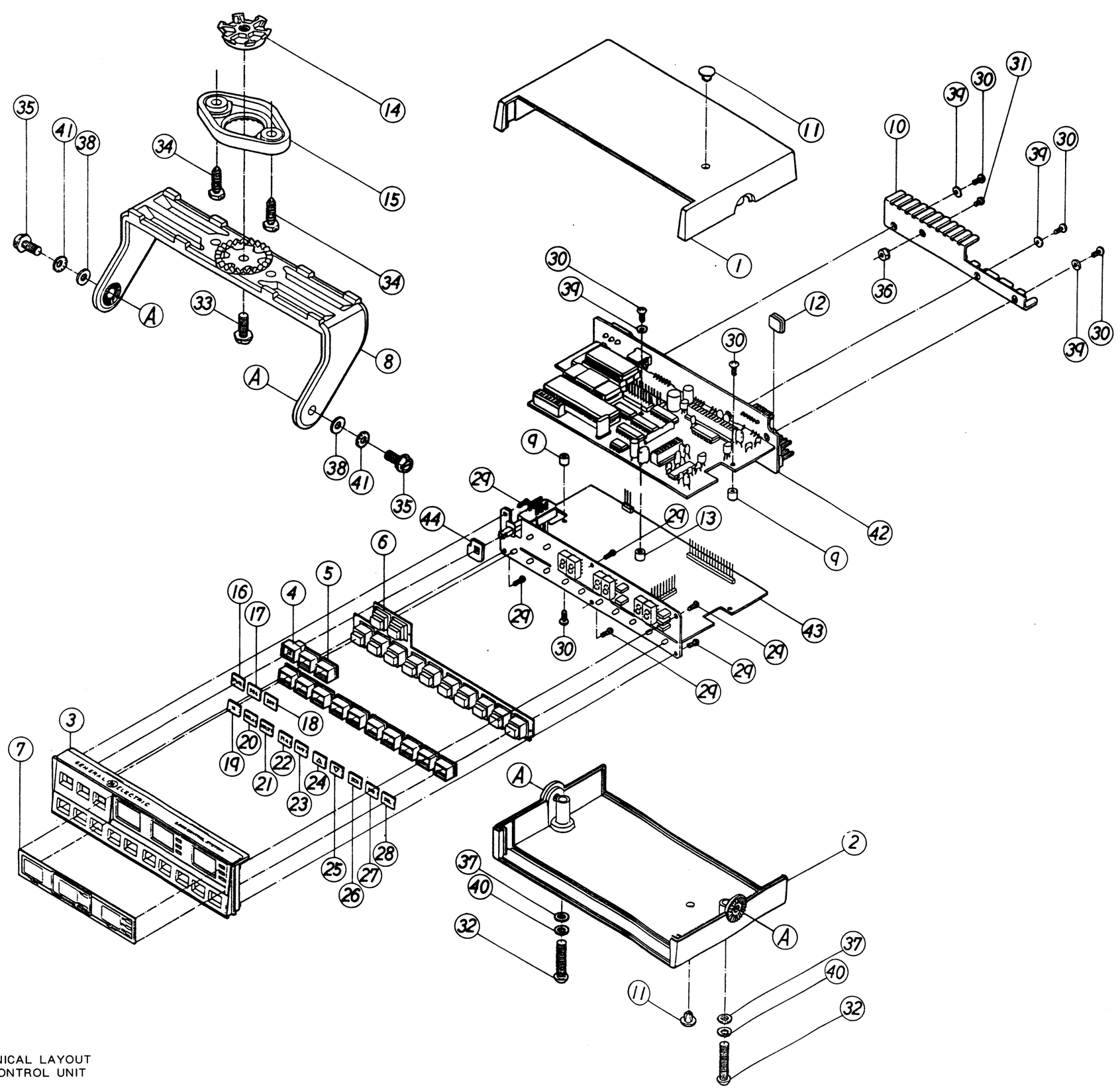
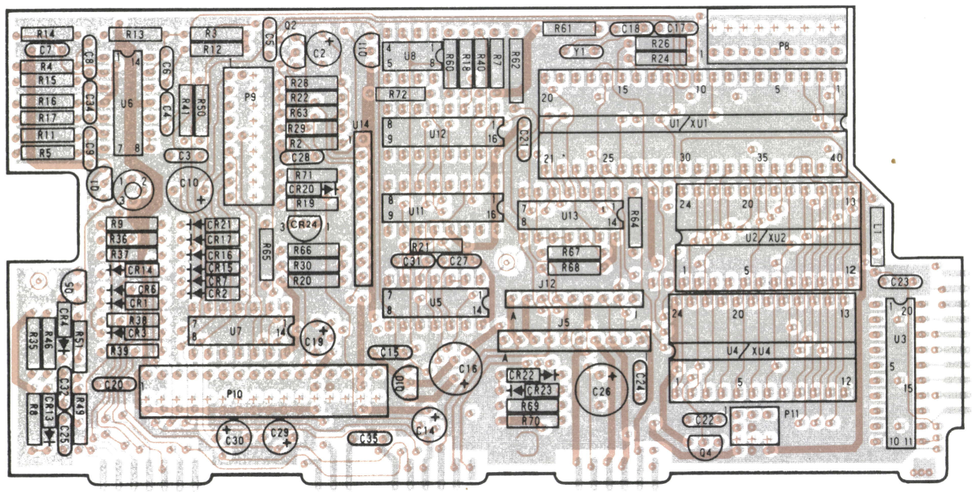
BLOCK DIAGRAM

S-990 CONTROL UNIT

Issue 1



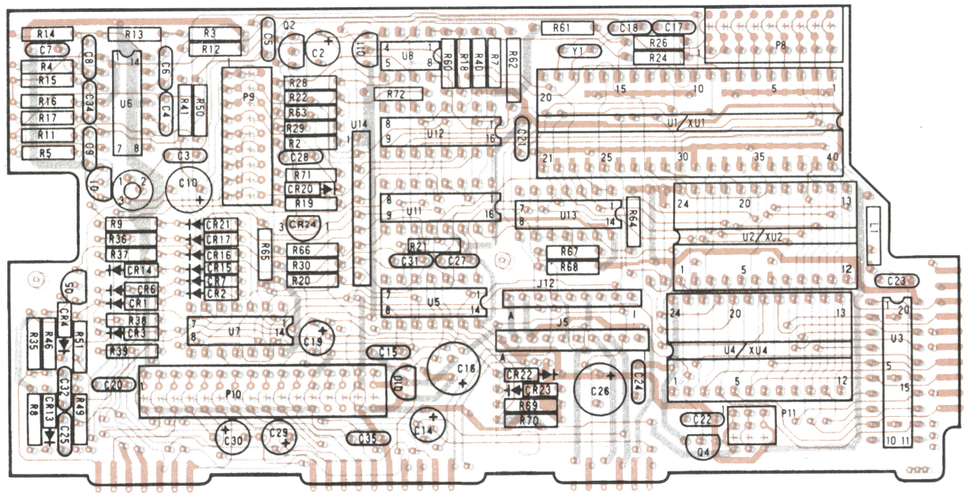
MECHANICAL LAYOUT
S-990 CONTROL UNIT



B310
MICRO-COMPUTER

(B310)
Layer One (B310)
Layer Two (B310)

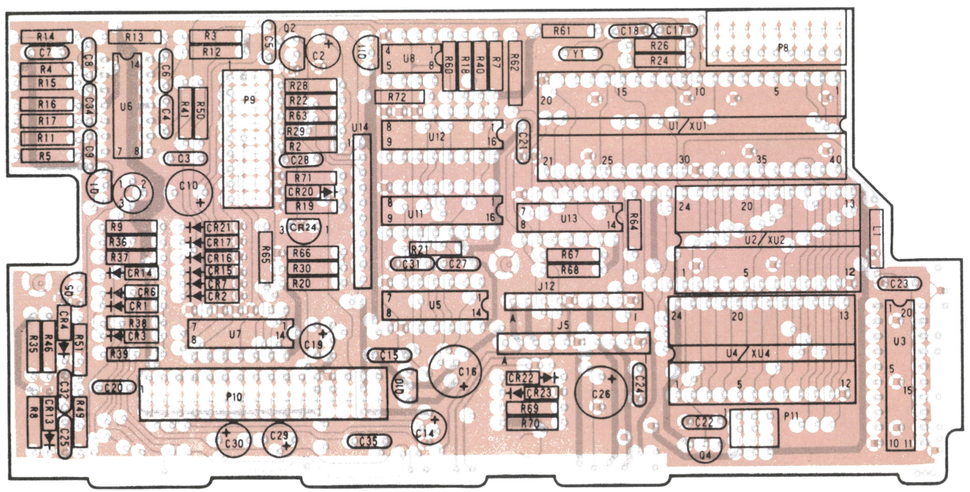
RUNS ON LAYER ONE
RUNS ON BOTH LAYERS
RUNS ON LAYER TWO



B310
MICRO-COMPUTER

(B310)
Layer Two (B310)
Layer Four (B310)

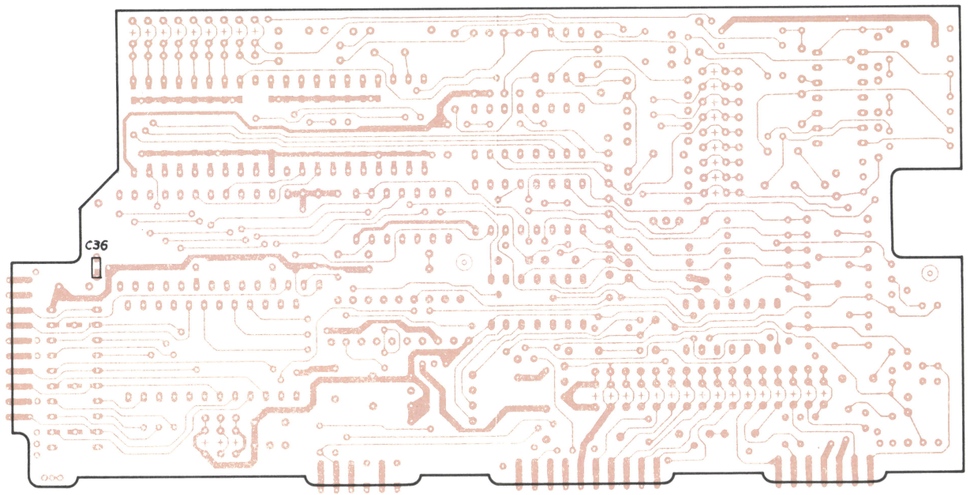
RUNS ON LAYER TWO
RUNS ON BOTH LAYERS
RUNS ON LAYER FOUR



B310
MICRO-COMPUTER

(B310)
Layer Two (B310)
Layer Three (B310)

RUNS ON LAYER TWO
RUNS ON BOTH LAYERS
RUNS ON LAYER THREE

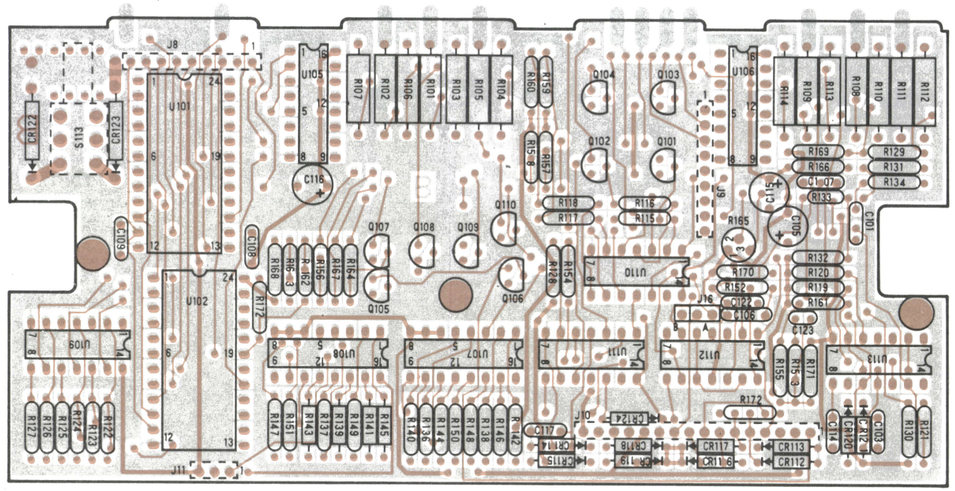


(B310)
Layer Four (B310)

OUTLINE DIAGRAMS

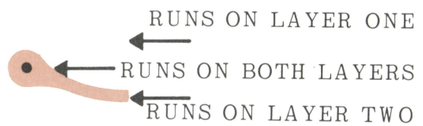
MICROCOMPUTER BOARD

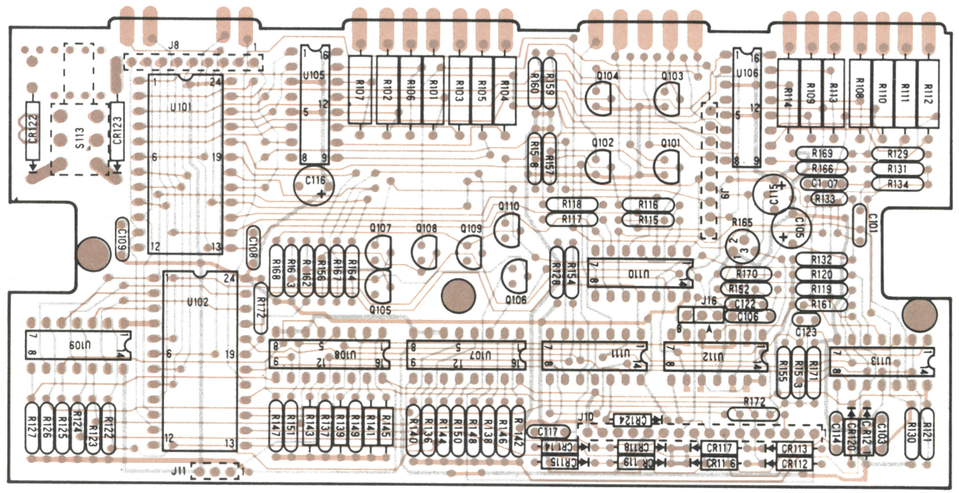
Issue 2



B313 I/O BOARD

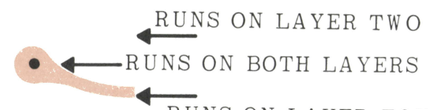
(B313)
Layer One (B313)
Layer Two (B313)

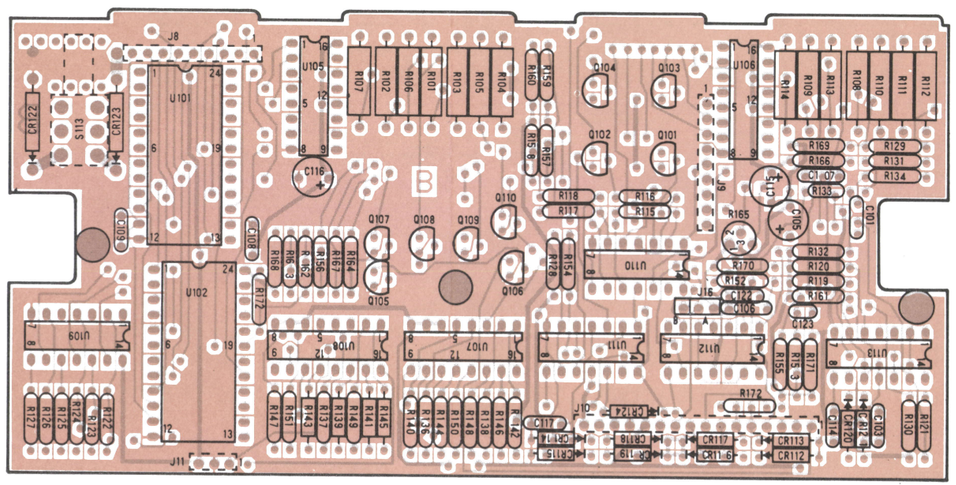




B313 I/O BOARD

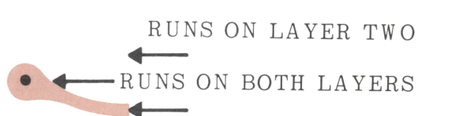
(B313)
Layer Two (B313)
Layer Four (B313)

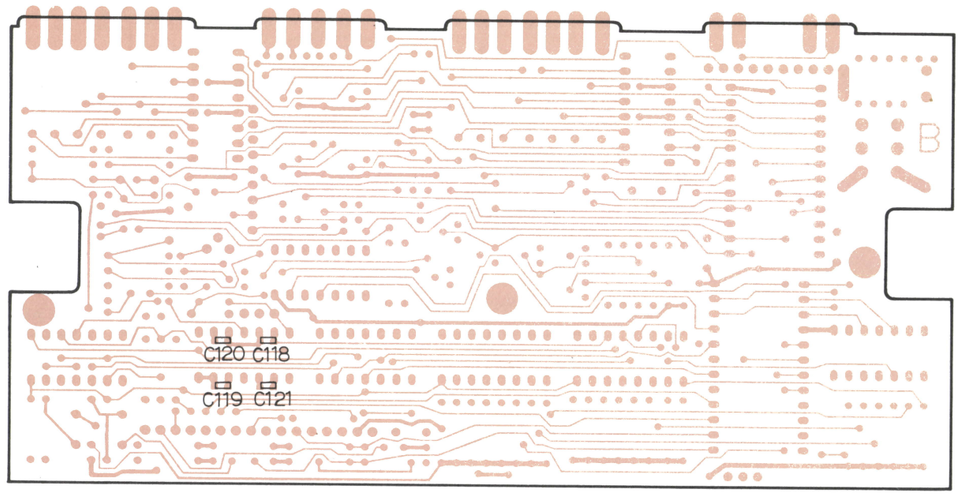




B313 I/O BOARD

(B313)
Layer Two (B313)
Layer Three (B313)

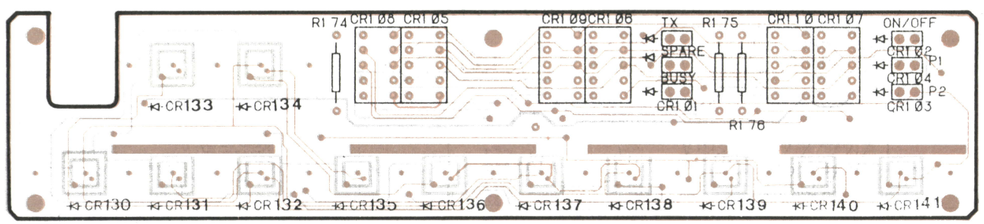




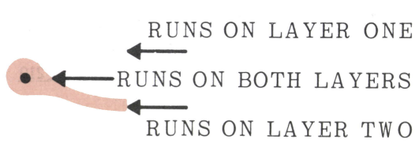
(B313)
Layer Four (B313)

OUTLINE DIAGRAMS

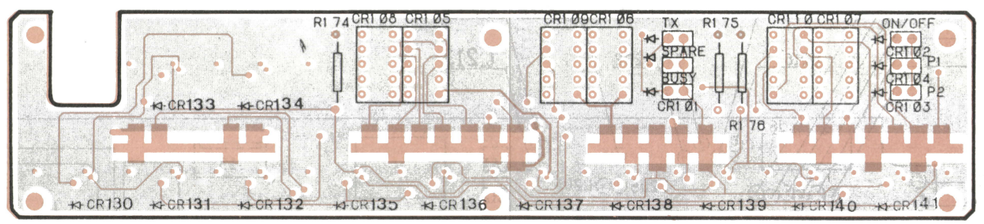
INPUT/OUTPUT BOARD



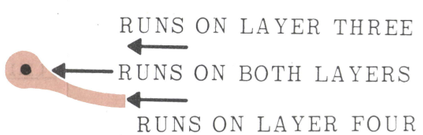
(B321)
Layer One (B321)
Layer Two (B321)

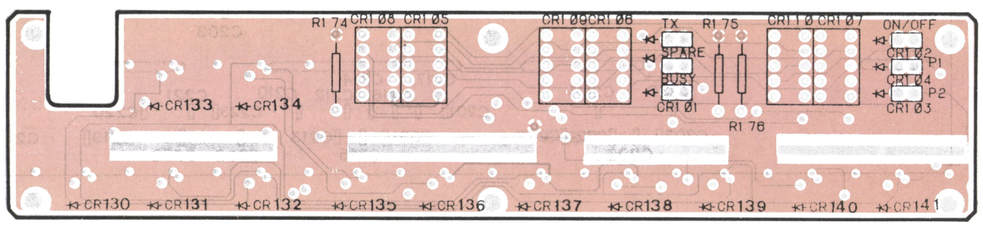


REAR VIEW

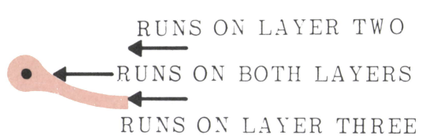


(B321)
Layer Three (B321)
Layer Four (B321)



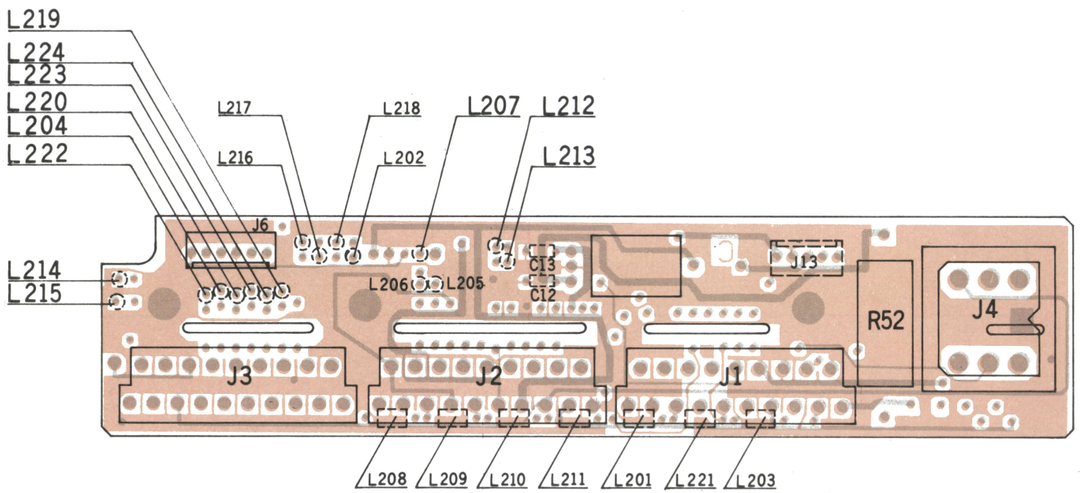


Layer Two(B321)
Layer Three (B321)

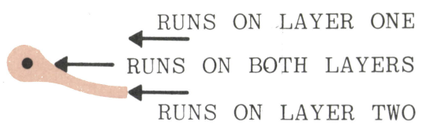


OUTLINE DIAGRAMS

DISPLAY/CONTROL BOARD

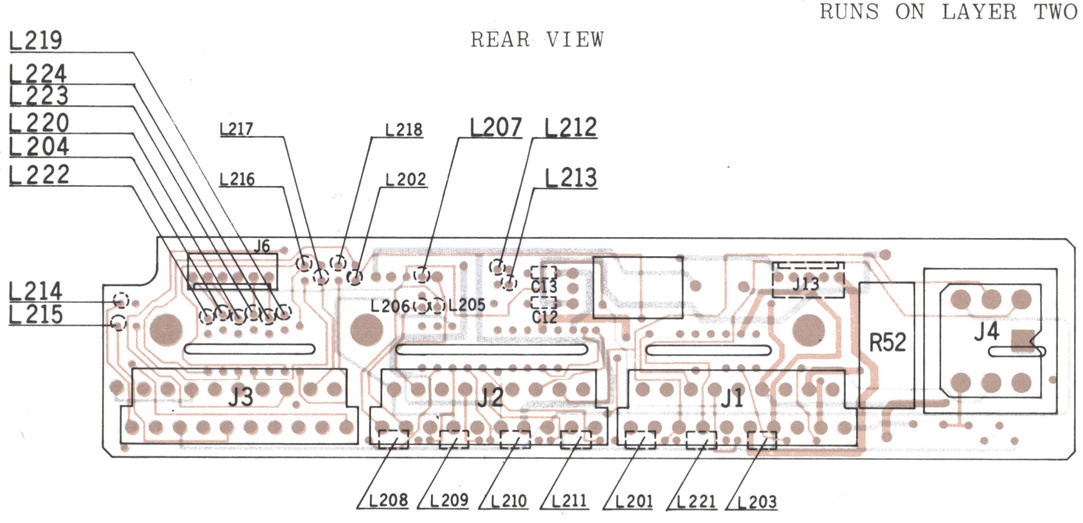


(B318)
Layer One (B318)
Layer Two (B318)

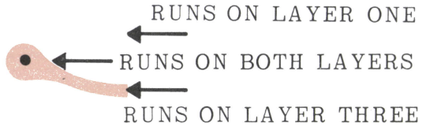


L219

REAR VIEW

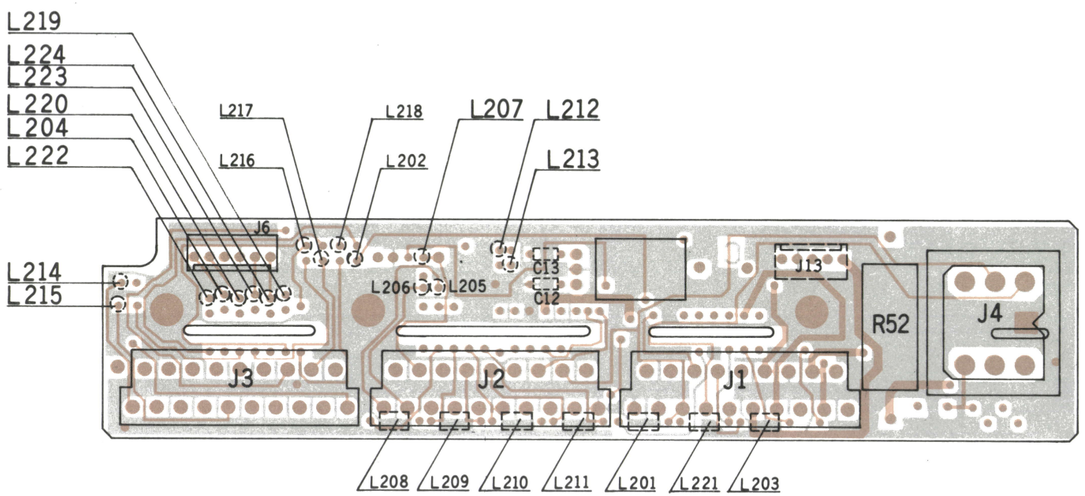


(B318)
Layer One (B318)
Layer Three (B318)

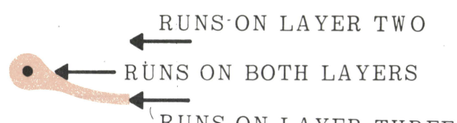


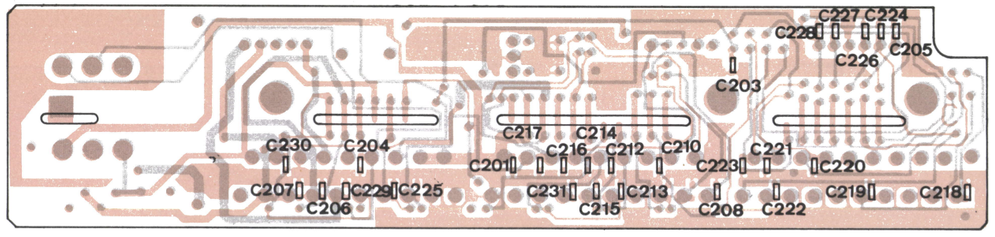
OUTLINE DIAGRAM

BACKPLANE BOARD

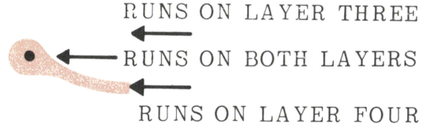


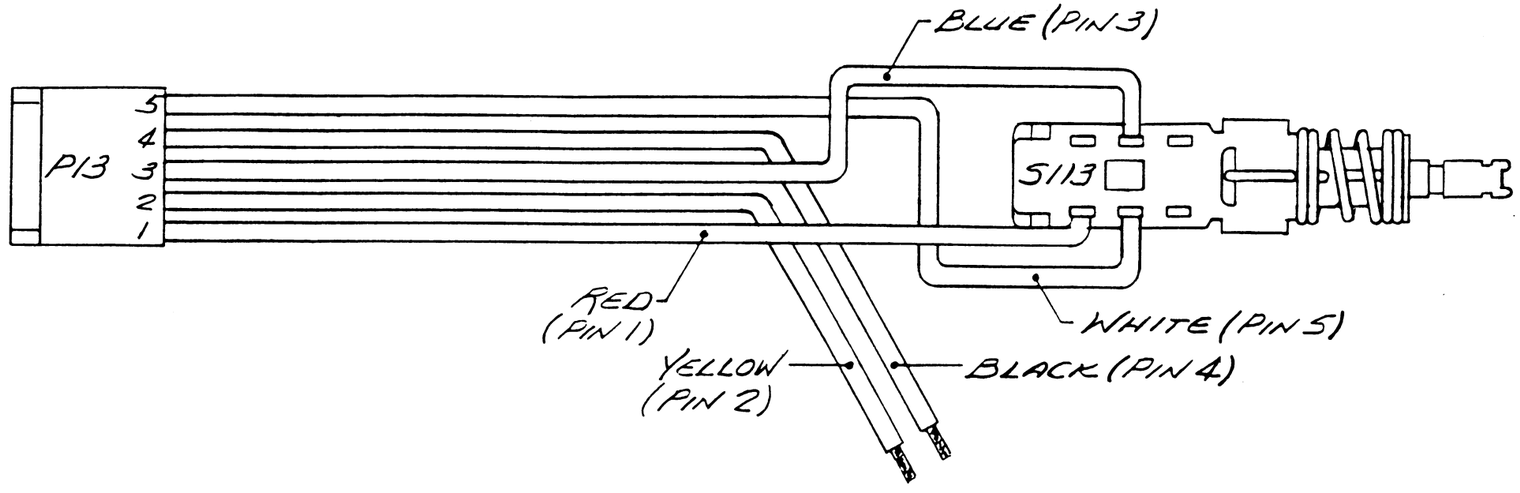
(B318)
Layer Two (B318)
Layer Three (B318)





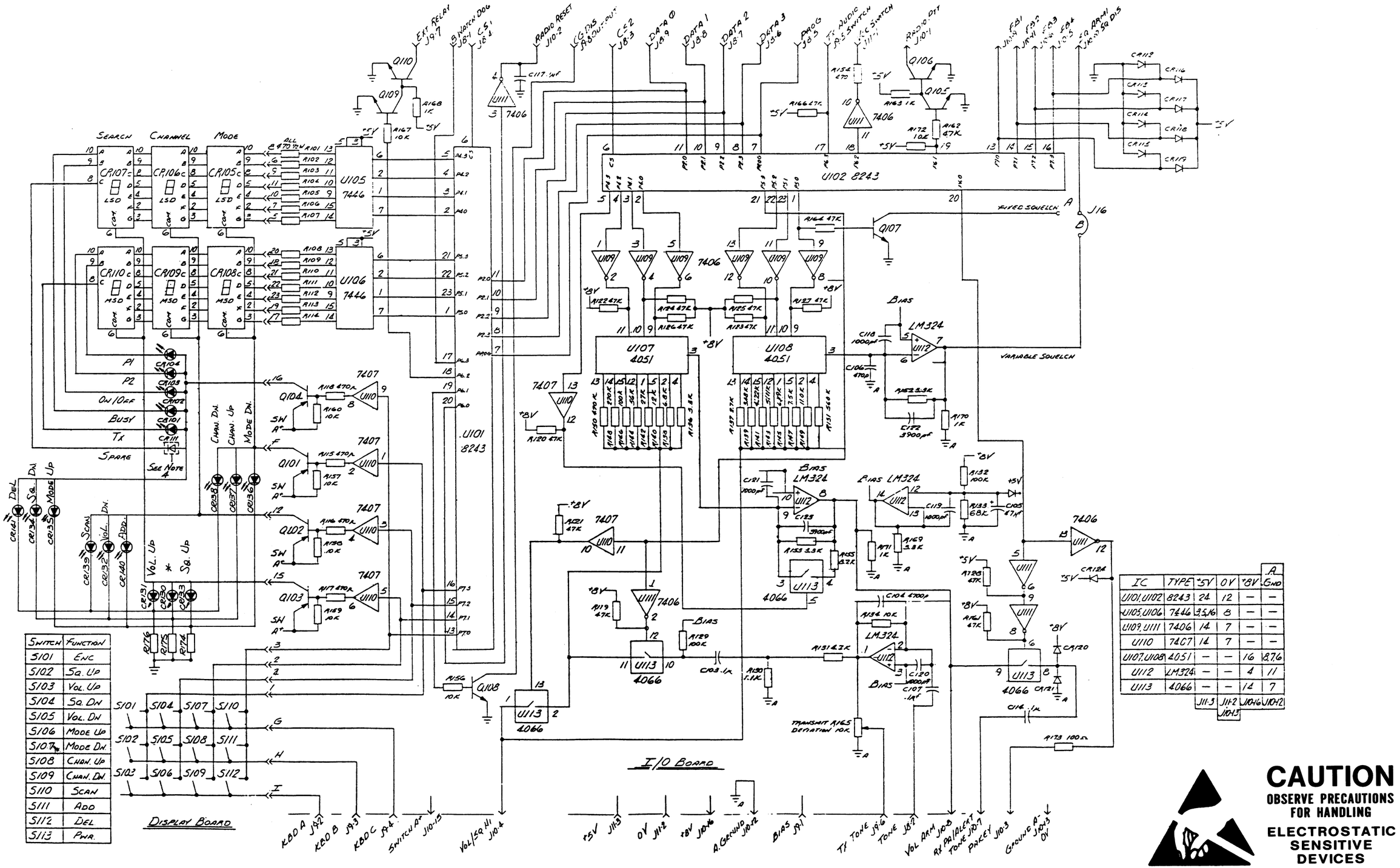
(B318)
Layer Three (B318)
Layer Four (B318)





OUTLINE DIAGRAM

POWER SWITCH ASSEMBLY



SWITCH	FUNCTION
S101	ENC
S102	SQ. UP
S103	VOL. UP
S104	SQ. DN
S105	VOL. DN
S106	MODE UP
S107	MODE DN.
S108	CHAN. UP
S109	CHAN. DN.
S110	SCAN
S111	ADD
S112	DEL
S113	PWR.

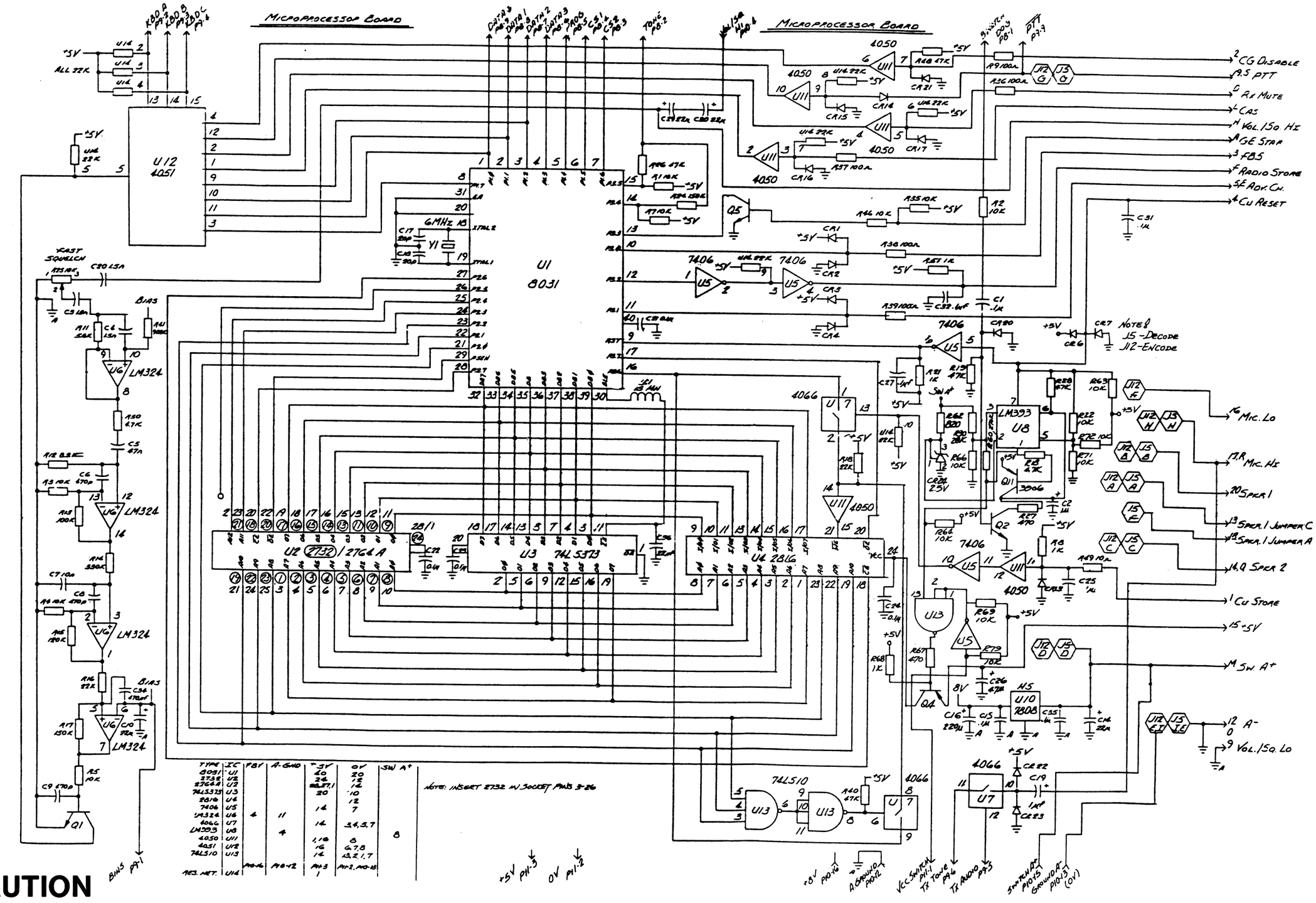
IC	TYPE	+5V	0V	+8V	A GND
U101, U102	8243	24	12	—	—
U105, U106	7446	13,16	8	—	—
U109, U111	7406	14	7	—	—
U110	7407	14	7	—	—
U107, U108	4051	—	—	16	8,7,6
U112	LM324	—	—	4	11
U113	4066	—	—	14	7

J11-3, J11-2, J10-16, J10-12, J10-13

CAUTION
OBSERVE PRECAUTIONS FOR HANDLING ELECTROSTATIC SENSITIVE DEVICES

SCHEMATIC DIAGRAM

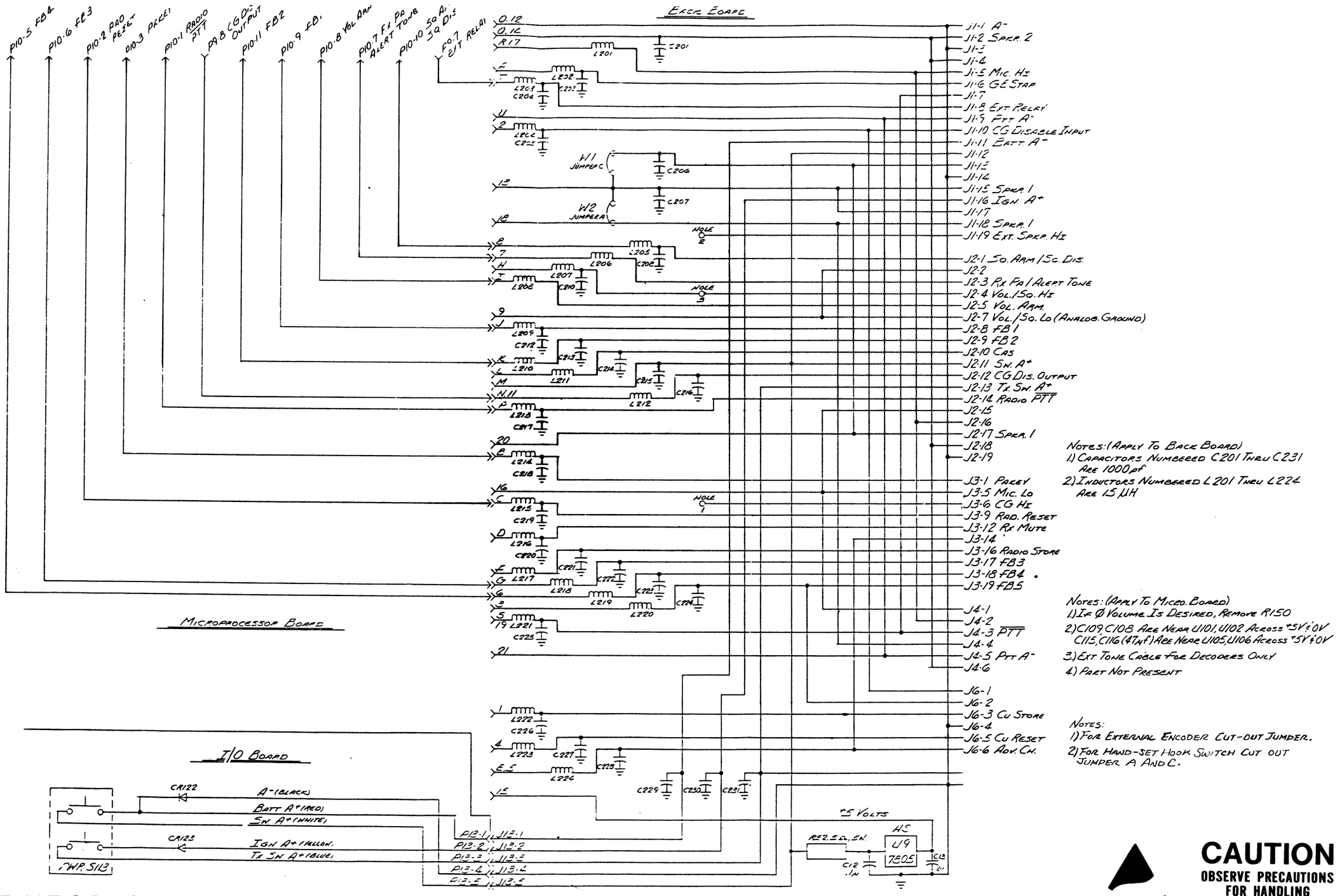
S-990 CONTROL UNIT



SCHEMATIC DIAGRAM

S-990 CONTROL UNIT

Issue 2



NOTES: (APPLY TO BACK BOARD)
1) CAPACITORS NUMBERED C201 THRU C231 ARE 1000 pF
2) INDUCTORS NUMBERED L201 THRU L224 ARE 15 μH

NOTES: (APPLY TO MICRO. BOARD)
1) IF Ø VOLUME IS DESIRED, REMOVE R150
2) C109, C108 ARE NEAR U101, U102 ACROSS +5V & 0V
C115, C116 (47μf) ARE NEAR U105, U106 ACROSS +5V & 0V
3) EXT TONE CABLE FOR DECODERS ONLY
4) PART NOT PRESENT

NOTES:
1) FOR EXTERNAL ENCODER CUT-OUT JUMPER.
2) FOR HAND-SET HOOK SWITCH CUT OUT JUMPER A AND C.

CAUTION
OBSERVE PRECAUTIONS FOR HANDLING ELECTROSTATIC SENSITIVE DEVICES

SCHEMATIC DIAGRAM

S-990 CONTROL UNIT

S990 PARTS LIST

(19B801390P1)

SYMBOL	GE PART NO.	DESCRIPTION
	TE-MA-B310B318	MICROPROCESSOR/BACK BOARD
A1		Microprocessor Board
		----------CAPACITORS----------
C1	19A116192P14	Ceramic: 0.1uF +-20%, 50VDCW
C2	19A703314P6	Electrolytic: 1uF -10 +50% tol, 50VDCW
C3	T644ACP210K	Polyester: 1000pF +-10%, 50VDCW
C4	T644ACP215K	Polyester: 1500pF +-10%, 50VDCW
C5	19A702250P111	Polyester: 0.047uF +-10%, 50VDCW
C6	19A700233P5	Ceramic: 470pF +-20%, 50VDCW
C7	T644ACP310K	Polyester: 0.01uF +-10%, 50VDCW
C8 and C9	19A700233P5	Ceramic: 470pF +-20%, 50VDCW
C10	315A6047P226N	Tantalum: 22uF +-20%, 16VDCW
C14	19A703314P5	Electrolytic: 22uF -10+50% tol, 25VDCW
C15	19A116192P14	Ceramic: 0.1uF +-20%, 50VDCW
C16	19A703314P2	Electrolytic: 220uF -10+50%, 10VDCW
C17 and C18	19A701624P15	Ceramic: 20pF +-50%, 50VDCW
C19	315A6047P105U	Tantalum: 1uF +-20%, 350VDCW
C20	T644ACP215K	Polyester: 1500pF +-10%, 50VDCW
C21 thru C25	19A116192P14	Ceramic: 0.1uF +-20%, 50VDCW
C26	315A6047P476M	Tantalum: 47uF +-20%, 6.3VDCW
C27 and C28	19A116192P14	Ceramic: 0.1uF +-20%, 50VDCW
C29 and C30	315A6047P225U	Tantalum: 2.2uF +-20%, 35VDCW
C31 and C32	19A116192P14	Ceramic: 0.1uF +-20%, 50VDCW
C34	19A700233P5	Ceramic: 470pF +-20%, 50VDCW
C35	19A116192P14	Ceramic: 0.1uF +-20%, 50VDCW
C36	19A702061P21	Ceramic: 22pF +-5%, 50VDCW
		---------- DIODES ----------
CR1 thru CR7	19A700028P1	Silicon, fast recovery; sim, to Type 1N4148
CR13 thru CR17	19A700028P1	Silicon, fast recovery; sim, to Type 1N4148
CR20 and CR21	19A700028P1	Silicon, fast recovery; sim, to Type 1N4148
CR22 thru CR23	19A134134P2	Rectifier, Silicon; sim, to 1N4001
CR24	19A700025P2	Silicon, Zener, TL431CLP
		----------JACKS----------
J5	TE-51-110SS-00H	Printed wire: 10 contacts
J12	TE-51-109SS-00H	Printed wire: 10 contacts
		----------COILS----------
L1	19A700024P27	Coil, RF: 15uH +-10%
		----------PLUGS----------
P8 and P9	TE-51-009SS-00H	Receptacle: Bottom entry, 9 Pin
P10	TE-51-016SS-00H	Receptacle: Bottom entry, 16 pin
P11	TE-51-003SS-00H	Receptacle: Bottom entry, 3 pin
		----------TRANSISTORS----------
Q1 and Q2	19A700023P1	Silicon, NPN; sim, to Type 2N3904
Q4	19A134960P1	Silicon, PNP; sim, to Type 2N4403
Q5	19A700023P1	Silicon, NPN; sim, to Type 2N3904
Q11	19A134850P1	Silicon, PNP; sim, to Type 2N3906
		----------RESISTORS----------
R2 thru R5	H212CRP310C	Carbon film: 10K ohms +-5%, 1/4w
R7	H212CRP310C	Carbon film: 10K ohms +-5%, 1/4w
R8	H212CRP210C	Carbon film: 1K ohms +-5%, 1/4w
R9	H212CRP110C	Carbon film: 100 ohms +-5%, 1/4w
R11	H212CRP256C	Carbon film: 5.6K ohms +-5%, 1/4w
R12	H212CRP282C	Carbon film: 8.2K ohms +-5%, 1/4w
R13	H212CRP410C	Carbon film: 0.1M ohms +-5%, 1/4W
R14	H212CRP433C	Carbon film: 0.33 ohms +-5%, 1/4W
R15	H212CRP412C	Carbon film: 0.12M ohms +-5%, 1/4w
R16	H212CRP312C	Carbon film: 22K ohms +-5%, 1/4w
R17	H212CRP415C	Carbon film: 0.15M ohms +-5%, 1/4w
R18	H212CRP247C	Carbon film: 4.7K ohms +-5%, 1/4w
R19	H212CRP347C	Carbon film: 47K ohms +-5%, 1/4W
R21	H212CRP210C	Carbon film: 1K ohms +-5%, 1/4w
R22	H212CRP310C	Carbon film: 10K ohms +-5%, 1/4w
R24	H212CRP415C	Carbon film: 0.15M ohms +-5%, 1/4w
R25	19A700016P4	Variable cermet: 10K ohms +-10%, 1/2W
R26	H212CRP347C	Carbon film: 47K ohms +-5%, 1/4W
R27	H212CRP147C	Carbon film: 470 ohms +-5%, 1/4W
R28	H212CRP347C	Carbon film: 47K ohms +-5%, 1/4w
R29	H212CRP147C	Carbon film: 470 ohms +-5%, 1/4w
R30	H212CRP328C	Carbon film: 28K ohms +-1%, 1/4w
R35	H212CRP310C	Carbon film: 10K ohms +-5%, 1/4w
R36 thru R39	H212CRP110C	Carbon film: 100 ohms +-5%, 1/4w
R40	H212CRP347C	Carbon film: 47K ohms +-5%, 1/4w
R41	19A701250P393	Metal film: 90.9K ohms +-1%, 1/4w
R46	H212CRP310C	Carbon film: 10K ohms +-5%, 1/4w
R49	H212CRP010C	Carbon film: 10 ohms +-5%, 1/4w
R50	H212CRP247C	Carbon film: 4.7K ohms +-5%, 1/4w
R51	H212CRP210C	Carbon film: 1K ohms +-5%, 1/4w
R60	H212CRP127C	Carbon film: 270 ohms +-5%, 1/4w
R61	H212CRP310C	Carbon film: 10K ohms +-5%, 1/4w
R62	19A700113P66	Composition: 820 ohms +-5%, 1/2w
R63 and R64	H212CRP310C	Carbon film: 10K ohms +-5%, 1/4w
R65	H212CRP347C	Carbon film: 47K ohms +-5%, 1/4W
R66	H212CRP310C	Carbon film: 10K ohms +-5%, 1/4w
R67	H212CRP147C	Carbon film: 470 ohms +-5%, 1/4w
R68	H212CRP210C	Carbon film: 1K ohms +-5%, 1/4w
R69 thru R72	H212CRP310C	Carbon film: 10K ohms +-5%, 1/4w
		----------INTEGRATED CIRCUITS----------
U1	19A703104P1	Microcomputer: 8031
U2	19A704309P3	EPROM 64K
U3	19A700037P415	Digital: 74LS373
U4	19A703952P1	Digital: 2K x 8 EEPROM 2816
U5	19A116180P75	Digital: 7406
U6	19A701789P1	Linear: LM324
U7	19A700029P44	Digital: 4066
U8	19A701865P1	Comparator: LM393
U10	19A704073P1	Linear: 8V Regulator
U11	19A700029P35	Digital: 4050
U12	19A700029P36	Digital: 4051
U13	19A700037P309	Digital: 74LS10
U14	19A701630P8	Resistor Network: 22K
		----------SOCKETS----------
XU1	19A700156P5	IC: 40 pin
XU2	19A700156P3	IC: 28 pin
XU4	19A700156P1	IC: 24 Pin
		----------CRYSTALS----------
Y1	19A702511G3	Crystal unit: 6 MHz
		----------MISCELLANEOUS----------
A2	19A701516P1	Insulator Backboard
		----------CAPACITORS----------
C12	T644ACP310K	Polyester: 0.01uF +-10%, 50VDCW
C13	19A116192P14	Ceramic: 0.1uF +-20%, 50VDCW
C201 thru C231	19A702052P5	Ceramic: 1000pF +-10%, 50VDCW
		----------JACKS----------
J1 thru J3	19A116659P35	Connector, Printed wiring:
J4	19B219627G1	Connector, 6 contacts
J6	TE-51-106SS-00H	Printed wire: 6 contacts
J13	TE-51-105SS-00H	Printed wire: 5 contacts
P6	HE-51-006SS-00F	Plug
		----------COILS----------
L201 thru L224	19A700024P27	Coil, RF: 15uH +-10%
		----------RESISTORS----------
R52	5493035P1	Wire wound: 5 ohms +-5%, 5 watt
		----------INTEGATED CIRCUTITS----------
U9	19A134717P1	Linear: 5 volt Regulator
		----------CABLES----------
W1 and W2	19A702028P1	Jumper
		----------MISCELLANEOUS----------
	TE-MA-B313B321	INPUT-OUTPUT/FRONT BOARD
A3		Input-Output Assembly
		----------CAPACITORS----------
C103	19A116192P14	Ceramic: 0.1uF +-20%, 50VDCW
C104	19A116192P12	Ceramic: 4700pF +-10%, 50VDCW
C105	315A6047P476M	Tantalum: 47uF +-20%, 6.3VDCW
C106	19A700233P5	Ceramic: 470pF +-20%, 50VDCW
C107 thru C109	19A116192P14	Ceramic: 0.1uF +-20%, 50VDCW
C114	19A116192P14	Ceramic: 0.1uF +-20%, 50VDCW
C115 and C116	315A6047P476M	Tantalum: 47uF +-20%, 6.3VDCW
C117	19A116192P14	Ceramic: 0.1uF +-20%, 50VDCW
C118 thru C121	19A702052P5	Ceramic: 1000pF +-10%, 50VDCW
C122 and C123	19A116192P5	Ceramic: 3900pF +-10%, 50VDCW
		----------DIODES----------
CR112 thru CR121	19A700028P1	Silicon, fast recovery; sim, to Type 1N4148
CR122 and CR123	19A700025P9	Rectifier, silicon; sim, to 1N4001
CR124	19A700047P2	Schockly 15V Breakdown
CR125	19A700028P1	Silicon, fast recovery; sim, to Type 1N4148
		----------JACKS----------
J8 and J9	TE-51-109SS-00H	Header: 9 pin
J10	TE-51-116SS-00H	Header: 16 pin
J11	TE-51-103SS-00H	Header: 3 pin
J16	TE-51-103SS-00H	Header: 3 pin
		----------TRANSISTORS----------
Q101 thru Q104	19A134960P1	Silicon, PNP; sim, to type 2N4403
Q105	19A700023P1	Silicon, NPN; sim, to Type 2N3904
Q106	19A134959P1	Silicon, NPN; sim, to Type 2N4401
Q107 thru Q110	19A700023P1	Silicon, NPN; sim, to Type 2N3904
		----------RESISTORS----------
R101 thru R114	19A700113P55	Composition: 470 ohms +-5%, 1/2w
R115 thru R118	H212CRP147C	Carbon film: 470 ohms +-5%, 1/4w
R119 thru R128	H212CRP347C	Carbo film: 47K ohms +-5%, 1/4w
R129	H212CRP410C	Carbon film: 0.1M ohms +-5%, 1/4w
R130	H212CRP210C	Carbon film: 1K ohms +-5%, 1/4w

SYMBOL	GE PART NO.	DESCRIPTION
R131	H212CRP247C	Carbon film: 4.7K ohms +-5%, 1/4w
R132	H212CRP410C	Carbon film: 0.1M ohms +-5%, 1/4w
R133	H212CRP368C	Carbon film: 68K ohms +-5%, 1/4w
R134	H212CRP310C	Carbon film: 10K ohms +-5%, 1/4w
R136	H212CRP233C	Carbon film: 3.3K ohms +-5%, 1/4w
R137	H212CRP227C	Carbon film: 2.7K ohms +-5%, 1/4w
R138	H212CRP268C	Carbon film: 6.8K ohms +-5%, 1/4w
R139	19A701250P253	Metal film: 3.48K ohms +-1%, 1/4w
R140	H212CRP312C	Carbon film: 12K ohms +-5%, 1/4W
R141	19A701250P261	Metal film: 4.22K ohms +-1%, 1/4W
R142	H212CRP327C	Carbon film: 27K ohms +-5%, 1/4w
R143	19A701250P269	Metal film: 5.11K ohms +-1%, 1/4w
R144	H212CRP356C	Carbon film: 56K ohms +-5%, 1/4w
R145	19A701250P277	Metal film: 6.19 ohms +-1%, 1/4w
R146	H212CRP410C	Carbon film: 0.1M ohms +-5% 1/4w
R147	19A701250P285	Metal film: 7.5K ohms +-5%, 1/4w
R148	H212CRP422C	Carbon film: 0.22M ohms +-5%, 1/4w
R149	19A701250P305	Metal film: 11K ohms +-1%, 1/4w
R150	H212CRP447C	Carbon film: 0.47M ohms +-5%, 1/4w
R151	H212CRP456C	Carbon film: 0.56M ohms +-5%, 1/4w
R152 and R153	H212CRP233C	Carbon film: 3.3K ohms +-5%, 1/4w
R154	H212CRP147C	Carbon film: 470 ohms +-5%, 1/4w
R155	H212CRP282C	Carbon film: 8.2K ohms +-5%, 1/4w
R156 thru R160	H212CRP310C	Carbon film: 10K ohms +-5%, 1/4w
R161	H212CRP347C	Carbon film: 47K ohms +-5%, 1/4w
R162	H212CRP247C	Carbon film: 4.7K ohms +-5%, 1/4w
R163	H212CRP210C	Carbon film: 1K ohms +-5%, 1/4w
R164	H212CRP347C	Carbon film: 47K ohms +-5%, 1/4w
R165	19A700016P4	Variable, cermet: 10K ohms +-5%, 1/4w
R166	H212CRP347C	Carbon film: 47K ohms +-5%, 1/4w
R167	H212CRP310C	Carbon film: 10K ohms +-5%, 1/4w
R168	H212CRP210C	Carbon film: 1K ohms +-5%, 1/4w
R169	H212CRP233C	Carbon film: 3.3K ohms +-5%, 1/4w
R170 and R171	H212CRP210C	Carbon film: 1K ohms +-5%, 1/4w
R172	H212CRP310C	Carbon film: 10K ohms +-5%, 1/4w
R173	H212CRP110C	Carbon film: 100 ohms +-5%, 1/4w
R174 thru R176	19A7001113P55	Composition: 470 ohms +-5%, 1/4w
		----------SWITCHES----------
S113	19B800563P7	Switch, Push
		----------PLUGS----------
P13		Connector
	19A700041P31	Shell
	19A700041P25	Contact
		----------MISCELLANEOUS----------
		Push Button
		----------INTEGRATED CIRCUITS----------
U101 and U102	19J706028P1	Digital: 8243
U105 and U106	19A116180P60	Digital: 7446
U107 and U108	19A700029P36	Digital: 4051
U109	19A116180P75	Digital: 7406
U110	19A116180P56	Digital: 7407
U111	19A116180P75	Digital: 7406
U112	19A701789P1	Linear: LM324
U113	19A700029P44	Digital: 4066
A4		Front Board
		----------DIODES----------
CR101	TE-25-24YY4-SLB	Optoelectronic: Yellow
CR102	TE-25-24VR2-SLB	Optoelectronic: Red
CR103	TE-25-24MG5-SLB	Optoelectronic: Green
CR104	TE-25-24YY4-SLB	Optoelectronic: Yellow
CR105 thru CR110	TE-27-75012-000	Optoelectronic: Red
CR111	TE-25-24VR2-SLB	Optoelectronic: Red
CR130 thru CR136	TE-25-20GD5-000	Optoelectronic: Green
CR137 and CR138	TE-25-20HD2-000	Optoelectronic: Red
CR139 thru CR141	TE-25-20GD5-000	Optoelectronic: Green
		----------MISCELLANEDUS----------
		Refer To Mechanical Layout
1 *	TE-ME-0S990-001	Upper case
2 *	TE-ME-0S990-002	Lower case
3 *	TE-ME-0S990-003	Front case
4 *	TE-ME-0S990-004	Key top (PWR)
5 *	TE-ME-0S990-005	Key top
6	TE-MD-0S990-006	Rubber key
7	TE-MS-0S990-007	Name plate
8	TE-ME-0S990-009	Mounting bracket
9	TE-ML-0S990-018	Supportor (NYLON)
10	TE-MP-0S990-020	Heat sink
11	TE-ME-0S990-021	Cap (NYLON)
12	TE-MD-0S990-022	Back board cover
13	TE-ML-0S990-031	Supportor 2 (BRASS)
14	TE-ME-0S990-032	Breakaway device
15	TE-ME-0S990-033	Retainer mounting
16	TE-MS-0S990-101	Key plate (PWR)
17	TE-MS-0S990-102	Key plate (SQ. UP.)
18	TE-MS-0S990-103	Key plate (SQ. DN.)
19	TE-MS-0S990-104	Key plate (*)
20	TE-MS-0S990-105	Key plate (VOL. UP)
21	TE-MS-0S990-106	Key plate (VOL. DN.)
22	TE-MS-0S990-107	Key plate (M. UP)
23	TE-MS-0S990-108	Key plate (M. DN.)
24	TE-MS-0S990-109	Key plate (UP)
25	TE-MS-0S990-110	Key plate (DN.)
26	TE-MS-0S990-111	Key plate (SCN)
27	TE-MS-0S990-112	Key plate (ADD)
28	TE-MS-0S990-113	Key plate (DEL)
29	TE-77PA-020-006	Screw, 2x6LG. pan head tapping screw (seecure DC-IO board assy' / front panel)
30	TE-77PA-130-006	Screw, M3x6LB, pan head machine screw (screw heat sink / CPU-back board assy') Screw, M3x6LG, pan head machine screw) (secure DC-IO/ CPU-back board assy')
31	TE-81PA-1N4-006	Screw,#4-40UNCx6LG, pan head machine screw (secure heat sink / 5V regulator)
32	TE-77PA-140-025	Screw, M4x25LG. pan head machine screw (secure lower case / upper case)
33	TE-81HF-3N8-016	Bolt, #10-32UNFx16LG, hex. head with slot (secure mounting bracket /breakaway device)
34	TE-77HF-048-020	Bolt, 4.8x20LG. hex. head with solt
	TE-77HF-048-040	Bolt, 4.8x40LG. hex. head with solt
35	TE-77HF-150-012	Machine bolt, M5x12LG, hex. head with solt (secure mounting bracket / lower case)
36	TE-83HX-1N4-040	Nut, #4-40UNC hex. nut with external tooth washer (secure heat sink / 5V regulator)
37	TE-79FL-040-100	Flat washer, 4mm inside diameter) (secure lower case / upper case)
38	TE-79FL-050-120	Flat washer, 5mm inside diameter (secure mounting bracket / lower case)
39	TE-79ET-030-065	External tooth washer, 3mm inside diameter (secure heat sink / CPU-BACK board assy') External tooth washer, 3mm inside diameter (secure DC-IO / CPU-BACK board assy')
40	TE-791T-040-090	Internal tooth washer, 4mm inside diameter (secure lower case / upper case)
41	TE-79ET-050-100	External tooth washer, 5mm inside diameter (secure mounting bracket / lower case)
42	TE-MA-B310B318	CPU / BACK board assembly
43	TE-MA-B313B321	IO / DC board assembly
44	TE-MD-0S990-028	Dust Seal (PWR)

* See production changes Rev. "C"

SERVICE PARTS

TE-MK-0S990-001	Hardware Kit containing 2 pcs of each screw & nut used in the S990.	
	Case ket containing replacement.	
	Upper Case	TE-ME-0S990-023
	Lower Case	TE-ME-0S990-024
	Front Panel	TE-ME-0S990-025
	Key Tops	ITEM 16 - 28
	Rubber Key	TE-ME-0S990-006
TE-MK-0S990-002	Mounting screw hardware kit containing 2 pcs of each screw & washer.	
	M5x12Lg, Machine bolt	TE-77HF-150-012
	M5 Flat Washer	TE-79FL-050-120
	M5 External Tooth Washer	TE-70ET-050-100
TE-MK-0S990-003	Mounting breakaway hardware kit containing 1 pcs of each mounting hardware and 3 pcs of each mounting screw & washer.	
	Mounting Bracket	TE-ME-0S990-009
	Breakaway Device	TE-ME-0S990-032
	Retainer Mounting	TE-ME-0S990-033
	4.8x20lg, Bolt	TE-77HF-048-020
	4.8x40lg, Bolt	TE-77HF-048-040
	M5 Flat Washer	TE-79FL-050-120

PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter," which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revision. Refer to the Parts List for description of parts affected by these revesion.

REV. A - CONTROL UNIT 19B801390P1

	SYMBOL	NEW PARTS NO.	OLD PARTS NO.
New 7 segment display	CR105 thru CR110	TE-27-75012-000	TEC-27-A301-OBL
New software 1986 Copyright		TE-MS-0S990-036	TEC-CD-S990-035
New Microprocessor reset circuit			

REV. B - CONTROL UNIT 19B801390P1

	SYMBOL	NEW PARTS NO.	OLD PARTS NO.
New indicator LEDs	CR101 and CR104	TE-25-24YY4-SLB	TEC-26-0523-YDT
	CR102 and CR111	TE-25-24VR2-SLB	TEC-26-0523-HDT
	CR103	TE-25-24MG5-SLB	TEC-26-0523-GDT
New nameplate	ITEM 7	TE-MS-0S990-007	TEC-CD-S990-008

REV. C - CONTROL UNIT 19B801390P1

NEW TOOLING

	SYMBOL	NEW PARTS NO.	OLD PARTS NO.
Uper case	ITEM 1	TE-ME-0S990-023	TEC-CD-S990-001
Lower case	ITEM 2	TE-ME-0S990-024	TEC-CD-S990-002
Front panel	ITEM 3	TE-ME-0S990-025	TEC-CD-S990-003
Key top (PWR)	ITEM 4	TE-ME-0S990-026	TEC-CD-S990-004
Key top	ITEM 5	TE-ME-0S990-027	TEC-CD-S990-005
Dust-seal (PWR)	ITEM 44	TE-MD-0S990-028	----------

ADDENDUM NO 1 TO LBI-31528
(PCS9)

This addendum provides a new part number for Integrated Circuit Comparator U8. The correct part number should be: 19A134764P2.

ADDENDUM NO 2 TO LBI-31528
(PCS9)

PARTS LIST CHANGES

The prefix of Service Parts replacement vendor part numbers listed in the various Parts Lists included in this maintenance manual have been changed from "TE-" to "T19/". All other characters remain the same as displayed. When this manual is next reprinted, all replacement vendor parts lists will show only the "T19/" prefix.

When ordering replacement vendor parts listed in this manual from the GE Mobile Communications Service Parts Operation, please use only the "T19/" prefix. The "T19/" prefix will be the only one shown in any future SERVICE PARTS PRICE LIST.

All standard GE part numbers will remain the same as displayed. Standard GE part numbers include numbers such as: 19A700025P9, H212CRP347C, 315A6047P476M, 5493035P1, etc.

ADDENDUM NO 3 TO LBI-31528
(PCS9)

This addendum adds the following part numbers to this publication. When ordering, use the appropriate part numbers for each board.

PWB NAME	PART NUMBER
MICROCOMPUTER BOARD	T19/ASS990001A
INPUT/OUTPUT BOARD	T19/ASS990002A
DISPLAY/CONTROL BOARD	T19/ASS990003A
BACKPLANE BOARD	T19/ASS990004A