

MAINTENANCE MANUAL

FOR

MODE EXPANDER BOARD 19D901219G1

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SPECIFICATIONS

Input Voltage	5.0 Volts DC $\pm 10\%$
Input Current	70 Milliamperes maximum
EEPROM Voltage	
Off	0.6 Volts DC maximum
On	4.5 Volts DC minimum

DESCRIPTION

The mode expander board is used with PHOENIX-SX radios to provide additional channel capacity. The expander board is used in radios with the 16 channel dual priority scan option to provide up to 128 channels.

The mode expander may be equipped with up to seven EEPROMs (Electrically Erasable PROMs) with 16 channels for each EEPROM. Each EEPROM is considered a "mode" to provide up to eight modes when used in conjunction with the EEPROM in the radio.

Each mode provides 16 independent transmit and receive frequencies as well as 16 independent tone frequencies.

The different modes are selected by a MODE increment switch on the front of the radio. A seven segment display indicates the mode selected. The MODE display is located on the dual priority scan board.

The mode display increments at the same rate as the channel display, and can

be programmed to wrap around to "1" from the maximum number of modes. In addition, the number of channels can be programmed differently for each mode so that the channel display will also wrap around to "1" from the last channel in each mode.

Three different versions of scan are used in the 16 channel priority scan system. The different versions are:

- Front programmable priority
- Fixed priority - set in EEPROM
- Fixed priority - set by channel selection

Each mode can be programmed for a different version of scan. Only one mode is scanned at a time, so that up to 16 channels in any of the modes can be scanned as desired.

The scanning channels and priority channels may be programmed differently in each mode, and the channels selected are not erased when power is removed from the radio.

## CIRCUIT ANALYSIS

The mode expander board consists of seven indicator LED's, a latch/decoder IC, and up to seven EEPROMs as shown in Figure 1. The mode expander board connects to the scan display board through cable W1, and to the radio interconnect/synthesizer board through cable A1-W1. The cable between the mode expander board and the scan display board (W1) provides an interface between the 8749 microcomputer (on the synthesized board) and the scan display board. The mode expander does not actually directly interface with the scan display board, but is on a common bus controlled by the 8749 microcomputer. S1, S2, and S3 (if present) are not used.

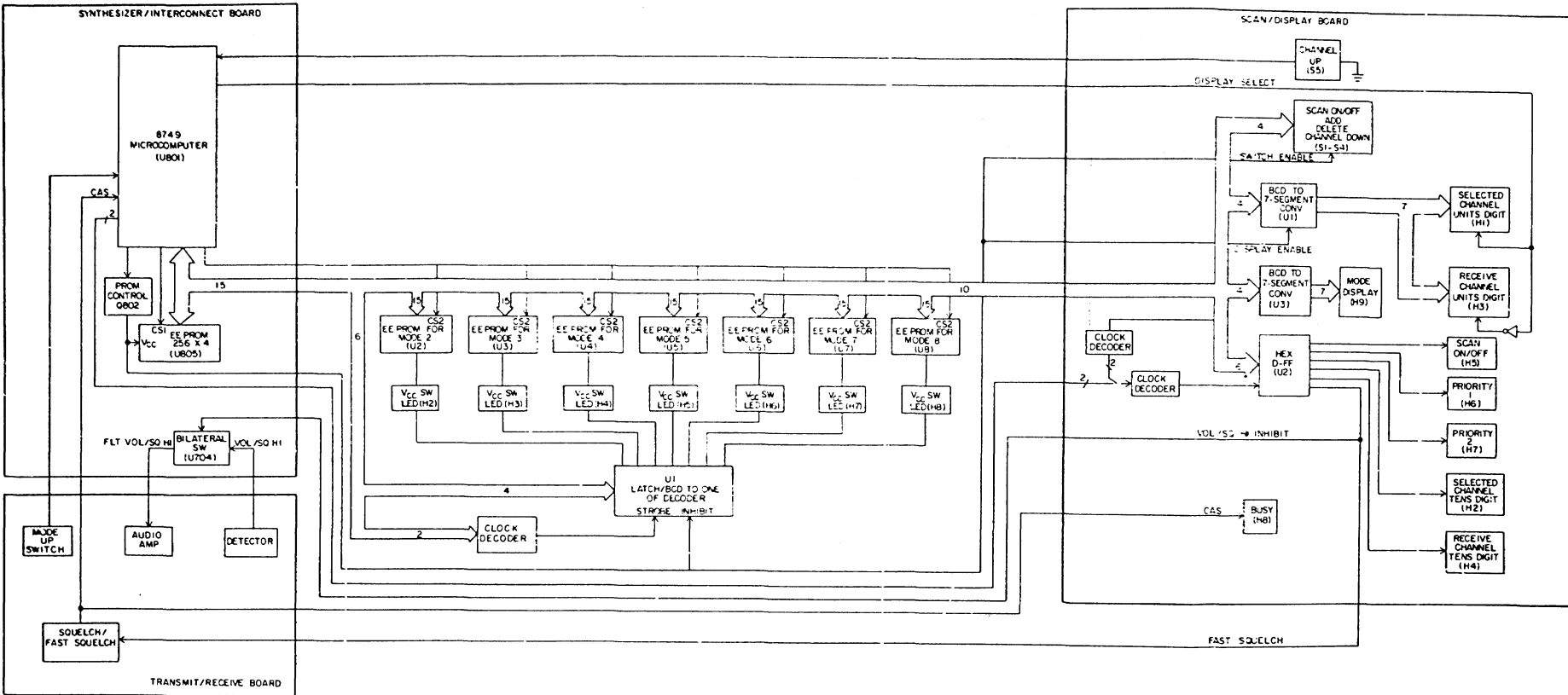
The EEPROM on the radio synthesizer/interconnect board contain the RF frequencies, channel guard, and CCT for mode one. It also provides the number of modes present, number of channels, scan option, and priority channel (if fixed priority) for modes one through eight. Therefore this EEPROM must always be present for the radio to function properly. The EEPROMs on the mode expander board contain the RF frequencies, channel guard, and CCT for modes 2 through 8, where U2 contains the information for mode two, U3 contains the information for mode three, etc. If any mode is not being used then it is not necessary for the EEPROM associated with that mode to be present. For example, if only modes one through six are desired then U7 and U8 which are the EEPROMs used for mode seven and eight are not required to be on the board. However, if they are present (programmed or unprogrammed) they will not be accessed by the 8749 microcomputer, nor will they effect the operation of the radio.

The address lines (A7 - A0), input/output lines (I/O 3 - I/O 0), array recall (AR), write enable (WE), and store (ST) lines of the eight EEPROMs are all tied on a common bus and connected to the 8749 microcomputer. Chip select one (CS1) is connected to the EEPROM on the synthesized/interconnect and is generated from the microcomputer (U801-31). Chip select two (CS2) is connected to the EEPROMs on the mode expander board and is generated from the microcomputer (U801-30). When the radio is turned on the microcomputer applies +5VDC to the EEPROM on the synthesizer/interconnect

board through Q802. The I/O lines on the EEPROM are tri-stated until chip select is pulled low. The microcomputer then pulls chip select one (CS1) low so that it can read the EEPROM on the synthesizer/interconnect board. At this point the microcomputer loads in the number of modes, number of channels, and the scan option for each mode. Upon power up first time the microcomputer initializes the radio to mode one channel one. Therefore the RF frequencies, channel guard, and CCT will be determined from the EEPROM on the synthesizer/interconnect board.

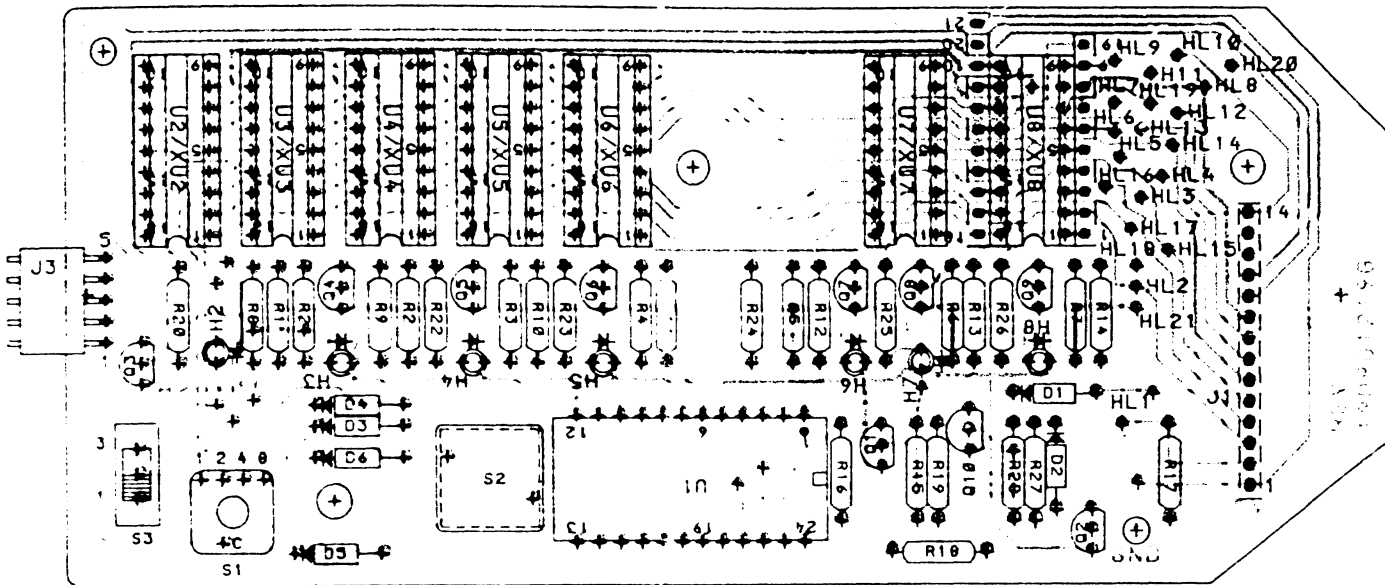
When the mode button is pressed the microcomputer advances the mode from one to two and takes the following action. First it writes a binary code two to the lower half of the data bus (U801-15 through U801-12). The lower half of the data bus is connected to the BCD to seven segment display decoder/driver (U3) on the scan display board and is also connected to the latch/decoder (U1) on the mode display board. This code is clocked into both the display driver and latch decoder by pulling D7 (U801-19) high and momentarily strobing P17 (U801-34) low and then back high. This pulse is very narrow and is in the order of about 5 usec. At this point the number two will appear on the mode display and +5VDC will be applied to the EEPROM used for mode two (U2) through Q3 on the mode expander board. This is done because the latch/decoder selects line S2 (U1-10) by pulling it low. Note at this point the EEPROM on the synthesizer/interconnect board and the EEPROM for mode two (U2) has been turned on. Now the microcomputer can read the EEPROM for mode 2 by grounding chip select two (U801-30). Although this selects EEPROMs two through eight, only the EEPROM for mode two is on, and therefore the others will have no effect on the input/output lines. Once the microcomputer has loaded the information needed from the mode two EEPROM it turns both EEPROMs off by switching Q802 off. By switching Q802 off, Q1 on the mode expander board is turned off, thus causing the inhibit line (U1-23) to go to +5VDC. By inhibiting the latch/decoder all outputs S2 through S8 go high causing all EEPROMs on the mode expander to be turned off regardless of which one is selected. Modes three through eight are accessed by the microcomputer in the same way mode 2 is using select lines S3 through S8 on the latch/decoder (U1), respectively.

CIRCUIT ANALYSIS

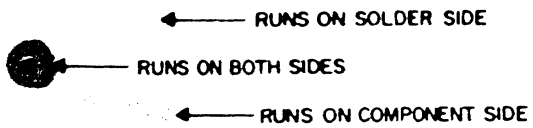


RC 4959

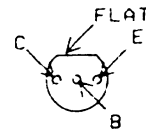
Figure 1 - MODE EXPANDER BLOCK DIAGRAM



1-A7-01217, Pkt. 2  
 1-A7-01218, Pkt. 2, Pkt. 3  
 1-A7-01219, Pkt. 2, Pkt. 3

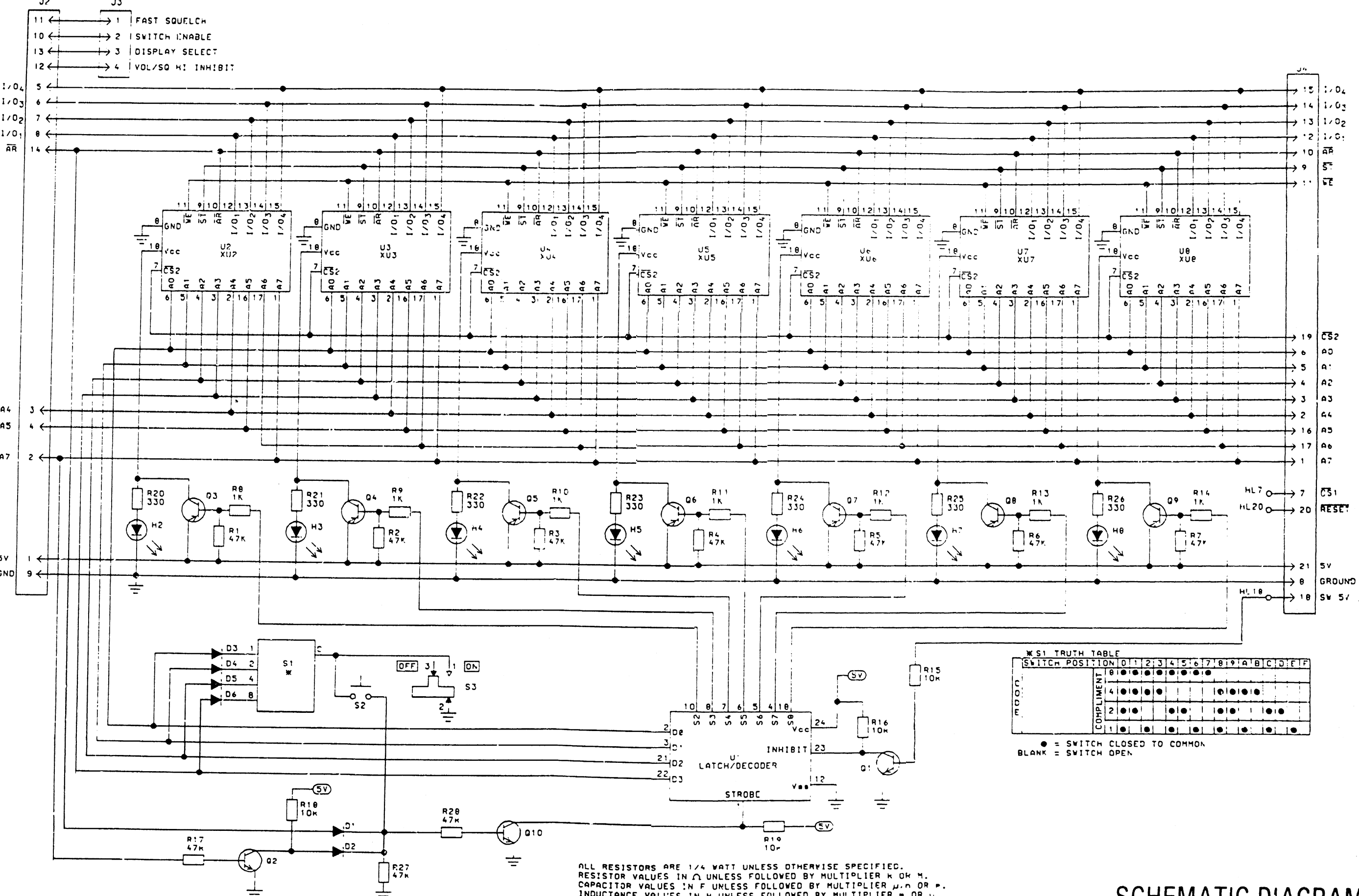


LEAD IDENTIFICATION  
 FOR Q1-Q10



IN-LINE  
 TOP VIEW

NOTE: CASE SHAPE IS DETERMINING  
 FACTOR FOR LEAD IDENTIFICATION.



- 11 ← → 1 FAST SQUELCH
- 10 ← → 2 SWITCH ENABLE
- 13 ← → 3 DISPLAY SELECT
- 12 ← → 4 VOL/SQ HI INHIBIT

\*S1 TRUTH TABLE

SWITCH POSITION	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
COMPLIMENT	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
0	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
1	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

● = SWITCH CLOSED TO COMMON  
 BLANK = SWITCH OPEN

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED.  
 RESISTOR VALUES IN Ω UNLESS FOLLOWED BY MULTIPLIER K OR M.  
 CAPACITOR VALUES IN F UNLESS FOLLOWED BY MULTIPLIER μ, n OR p.  
 INDUCTANCE VALUES IN H UNLESS FOLLOWED BY MULTIPLIER m OR μ.

# SCHEMATIC DIAGRAM

Mode Expander  
 19D901.234

LBI31304  
ASSOCIATED ASSEMBLIES

MODE EXPANDER BOARD  
10DB901219G1  
10DB901219G2 (GOLD CONTACTS)

ISSUE 2

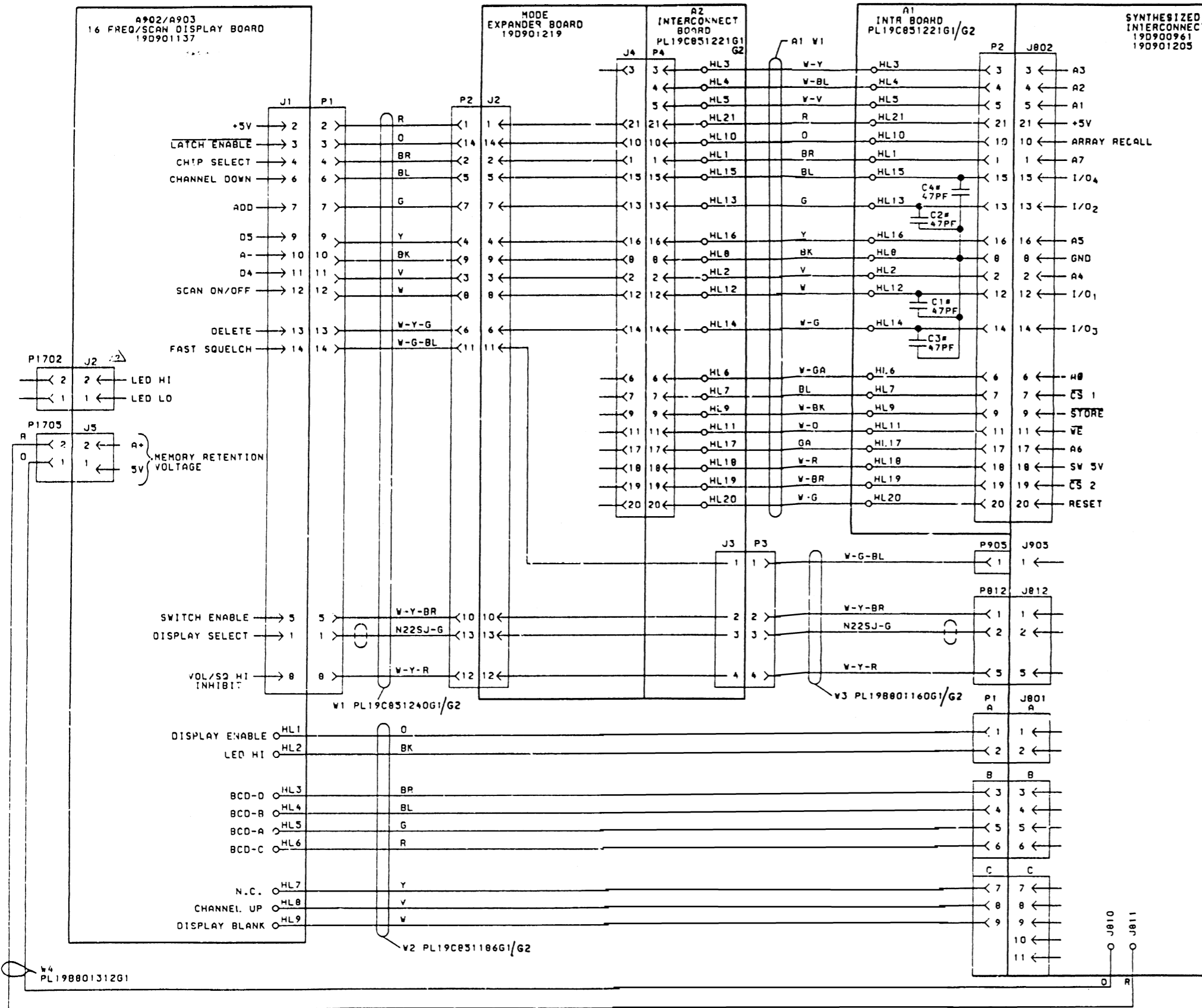
SYMBOL	GE PART NO.	DESCRIPTION
A1W1		INTERCONNECT CABLE 19C851221G1
A1 and A2		INTERCONNECT BOARD 19C851215G1
		----- CAPACITORS -----
C1 thru C4	19A702041P45	Ceramic: 47 pF $\pm 5\%$ , 50 VDCW, temp coef 0 $\pm 30$ PPM.
		----- PLUGS -----
P1	19A704335P1	Contact, electrical, rated 3 amps; sim to AMP 85632-3.
W1		SCAN INTERCONNECT CABLE 19C851230G1
		----- PLUGS -----
P1 and P2		Connector. Includes:
	19A700041P40	Shell.
	19A700041P26	Contact: sim to Molex 08-50-0113. (Quantity 14 each).
W2		CABLE ASSEMBLY 19C851180G1
		----- PLUGS -----
P1A		Connector. Includes:
	19A700041P28	Shell.
	19A700041P26	Contact: sim to Molex 08-50-0113. (Quantity 2).
P1B		Connector. Includes:
	19A700041P30	Shell.
	19A700041P26	Contact: sim to Molex 08-50-0113. (Quantity 4).
P1C		Connector. Includes:
	19A700041P31	Shell.
	19A700041P26	Contact: sim to Molex 08-50-0113. (Quantity 7).
W3		MODE EXPANDER CABLE 19B851160G1
		----- PLUGS -----
P3		Connector. Includes:
	19A700041P31	Shell.
	19A700041P26	Contact: sim to Molex 08-50-0113. (Quantity 4).
P812		Connector. Includes:
	19A700041P31	Shell.
	19A700041P26	Contact: sim to Molex 08-50-0113. (Quantity 3).
P905		Connector. Includes:
	19A700041P28	Shell.
	19A700041P26	Contact: sim to Molex 08-50-0113. (Quantity 1).

SYMBOL	GE PART NO.	DESCRIPTION
		NOTE: WHEN REPLACING BOARDS CARE SHOULD BE TAKEN TO ASSURE BOARDS WITH GOLD CONTACTS ARE NOT INTERMIXED WITH BOARDS HAVING TIN CONTACTS. REPLACE ONLY WITH SAME GROUP NUMBER AS THE ORIGINAL.
		----- DIODES -----
D1 thru D6	19A700028P1	Silicon, fast recovery; fwd current 75 mA, 75 PIV; sim to Type 1N4148.
H2 thru H8	19A703505P3	Optoelectronic: green; sim to Hewlett Packard HLMP-1540
		----- JACKS -----
J1	19A70324RP2	Contact, electrical. (Quantity 14).
J3	19A700072P135	Printed wire: 5 contacts rated at 2.5 amps; sim to Molex 22-05-3051. (Group 1).
J3	19A704852P135	Printed wire: 5 contacts rated at 2.5 amps. (Gold Contacts). (Group 2 only).
J4	19A70324RP2	Contact, electrical. (Quantity 21). (Group 1).
J4	19A70324RP12	Contact, electrical. (Gold Contacts). (Group 2 only).
		----- TRANSISTORS -----
Q1 and Q2	19A700023P2	Silicon, NPN: sim to 2N3904.
Q3 thru Q9	19A700022P2	Silicon, PNP: sim to 2N3906.
Q10	19A700023P2	Silicon, NPN: sim to 2N3904.
		----- RESISTORS -----
R1 thru R7	H212CRP347C	Deposited carbon: 47K ohms $\pm 5\%$ , 1/4 w.
RR thru R14	H212CRP210C	Deposited carbon: 1K ohms $\pm 5\%$ , 1/4 w.
R15 and R16	H212CRP310C	Deposited carbon: 10K ohms $\pm 5\%$ , 1/4 w.
R17	H212CRP347C	Deposited carbon: 47K ohms $\pm 5\%$ , 1/4 w.
R18 and R19	H212CRP310C	Deposited carbon: 10K ohms $\pm 5\%$ , 1/4 w.
R20 thru R26	H212CRP133C	Deposited carbon: 330 ohms $\pm 5\%$ , 1/4 w.
R27 and R28	H212CRP347C	Deposited carbon: 47K ohms $\pm 5\%$ , 1/4 w.
		----- SWITCHES -----
S1	19R800981P2	Rotary: 15 positions, contacts rated 10 mA @ 10 VDC; sim to Copal Electronics S-1030.
S2	19A701324P1	Push: contacts rated 1 mA at 10 volts; sim to IEE/Schadown 210091.
S3	19A13470RP2	Slide: 1/4 amp @ 125 VAC; sim to UID No. MA-012-4-CE-P-22W.
		----- SOCKETS -----
XU2 thru XU8	19A700156P11	Integrated circuit.
		ASSOCIATED ASSEMBLIES
U1	19A700029P207	Digital: 4 to 16 Line Decoder.
U2 thru U8	19A703072P2	Digital: sim to XICOR X2212D1.

\*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

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PHOENIX SX PRIORITY SCAN WITH MODE EXPANDER

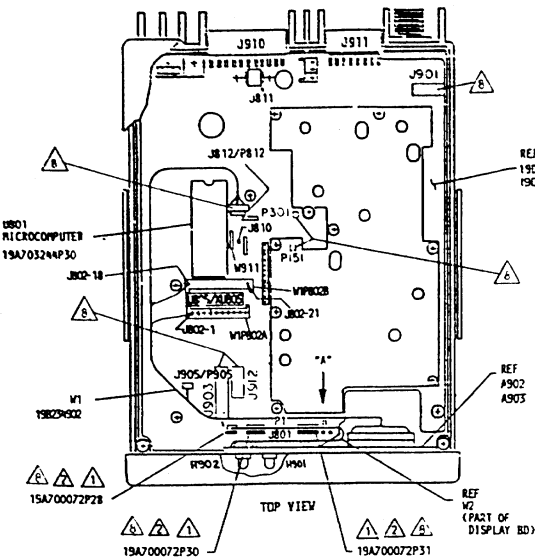


- NOTE:
1. ALL WIRES ARE SF24 UNLESS OTHERWISE NOTED.
  2. # DENOTES CHIP COMPONENT.
  3. SOLDER WIRES AT J810, J811 TO SQUARE PINS.
  4. REMOVE W911 ON SYNTHESIZED INTERCONNECT BOARD.

INTERCONNECTION DIAGRAM

Mode Expander  
19D901058

(19D901058, Sh. 4, Rev. 5)



31 1-16 FREQ. DISPLAY/SCAN

NOTES:

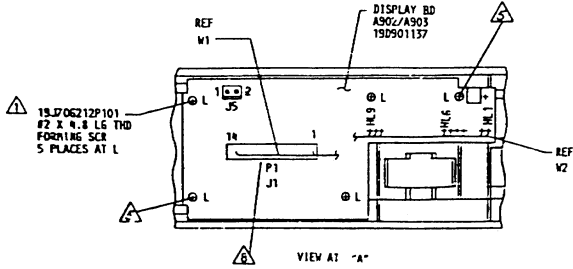
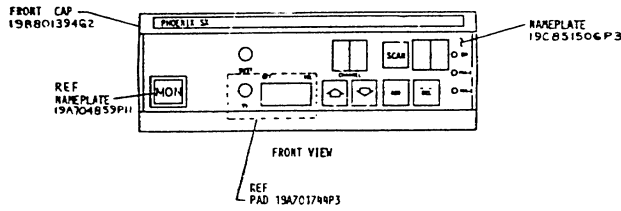
- ⚠ PART OF HARDWARE KIT 19A70363A
- 2 ⚠ SOLDER TO REARMOST HOLES OF J801 AS SHOWN PRIOR TO CONNECTION OF W2

4. DISCARD FOLLOWING ITEMS OF HARDWARE KIT 19A70152209:

- PAD 19A70174P1
- SPACER 19A70132SP1
- BUSHING 19B232859P1 (QTY 3)

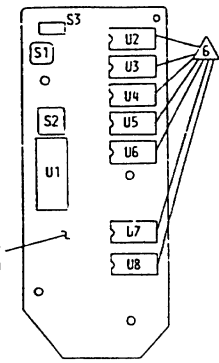
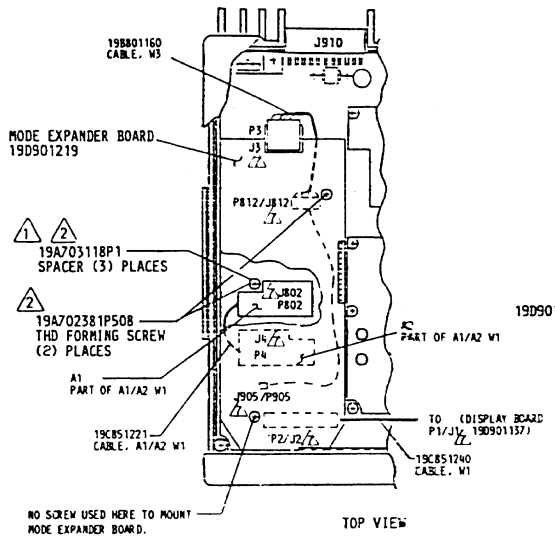
⚠ ASSEMBLE THESE 2 SCREWS FIRST TO LOCATE BOARD.

6. ⚠ LUBRICATE J801, J802, J901, J905, J912, J812, J1, J905, P301, P151 PER PROCESS PGA-EA122 WITH 19A704532P1.

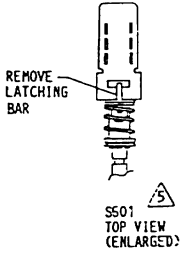
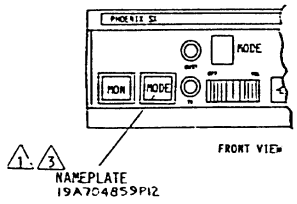


### MECHANICAL LAYOUT

Mode Expander  
19D901052



NO SCREW USED HERE TO MOUNT MODE EXPANDER BOARD.



32 MODE EXPANDER

NOTES:

- 1 ⚠ PART OF HARDWARE KIT 19A70363A.
- 2 ⚠ INSTALL SPACERS 19A703118P1 IN PLACE OF SCREWS 19A702381P508 AND USE THE SCREWS TO SECURE MODE EXPANDER BD. TAP HOLES USING SCREW BEFORE MOUNTING THE SPACERS.
- 3 ⚠ REMOVE EXISTING NAMEPLATE 19A704859P13 AND INSTALL NAMEPLATE 19A704859P12.
- 4. FROM LABELING FOR FIRST PRON ON NAMEPLATE 19C850828P1 (P) MUST BE MOUNTED INSIDE TOP COVER AS SPECIFIED BY 19D901052P1. LABELING FOR ALL ADDITIONAL PRONS ON NAMEPLATES 19C850828P1 (H) MUST BE PACKAGED FOR SHIPMENT WITH RADIO.
- 5 ⚠ S601 (19B800563P1) PART OF T/R BOARD ASSEMBLY (19D901002 OR 19D901003). CHANGE FROM PUSH-PUSH SWITCH TO MOMENTARY, AS SHOWN.
- 6 ⚠ INSTALL PRON 19A70237P2 AS FOLLOWS:  
OPTION K2 IN POSITION U2.  
OPTION K3 IN POSITIONS U2 & U5, ETC.
- 7 ⚠ LUBRICATE J1, J2, J3, J4, J812, J802, J905 PER PROCESS PGA-EA122 WITH 19A704532P1.



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