MOTOROLA

SYNTOR X 9000

High Band ~~and~~, UHF, Radios

(AND 800MHZ)

Greenville P.D. 7/88

ERROR CODES FOUND IN MTC + TROUBLESHOOTING Page 3

Supplement to Instruction Manuals 68P80100W45 and 68P81060E05

Instruction Manual

68P80100W94-O

MOTOROLA
Mobile Products Division

SYNTOR X 9000
High Band, UHF, and 800 MHz Radios Supplement

Contents

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Foreword

1. Scope of Manual

This manual is intended for the use of experienced technicians familiar with this general type of equipment. In it you should be able to find all the information you will need for installing and servicing the equipment it covers. It is current as of the publication date, and incorporates changes that have occurred since then in the form of instruction manual revisions (WMR's). (WMR's that cover production or engineering changes to the circuitry usually include corrected schematics and circuit board diagrams.)

2. Model and Kit Identification

Each Motorola product has an identifying model number stamped on its nameplate. In most cases, assemblies and kits that make up the product also have identifying kit numbers stamped on them. Schematics and circuit board diagrams for such kits show this same identifying number prominently in the lower lefthand or righthand corner.

3. Service

Motorola's national service organization maintains one of the finest nation-wide installation and maintenance programs available to users of communication equipment. The administrative staff of this organization consists of national, area, and district service managers, all of whom are Motorola employees dedicated to giving our customers the best possible service. The organization has about 900 authorized Motorola Service Stations (MSS's) throughout the United States, each manned by one or more trained, FCC-licensed technicians.

Motorola selected each one of these independently owned and operated MSS's to service its customers. They offer Motorola maintenance either by the job (priced by time and material), or on a service contract at a fixed periodic fee.

To buy a service contract for your Motorola equipment, contact your Motorola Service Representative or write to:

National Service Manager
Motorola Communications and Electronics, Inc.
1303 E. Algonquin Road
Schaumburg, Illinois 60196

4. Ordering Replacement Parts

Motorola maintains a number of area parts offices throughout the United States. These facilities have skilled staff to process orders for parts, identify part numbers, and otherwise assist in the maintenance and repair of Motorola Communications Sector products.

Order manuals and all parts except crystals, active filters, channel elements, and *Vibrasender* and *Vibrasponder* resonant reeds from the nearest area parts office.

When ordering replacement parts or requesting information about equipment, include the complete identification numbers. This applies to all components, kits, and chassis. If you do not know the part number for a component, include the part number of the chassis or kit of which it is a part, and identify the component with a full and accurate description.

Send orders for crystals, channel elements, active filters, and reeds to the Component Product Sales & Service Office (address on next page). When ordering crystals and channel elements, specify the type number, the crystal and carrier frequencies, and the model number of the chassis in which the part is used.

When ordering active filters and *Vibrasender* and *Vibrasponder* resonant reeds, specify the type by number and the frequency, identify the owner or operator of the system in which these items are to be used, and give any serial numbers stamped on the components to be replaced.

Component Product Sales & Service Office

All Mail Orders:
Motorola, Inc.
Component Product Sales & Service
P.O. Box 66191
O'Hare International Airport
Chicago, IL 60666

Correspondence:
Motorola, Inc.
Component Product Sales & Service
2553 N. Edgington Street, Franklin Park, IL 60131
Phone 312-451-1297, TWX 910-227-0799
Telex 433-0067

Area Parts Offices

Western Area Parts
1170 Chess Drive, Foster City, CA 94404
Phone 415-349-8621, TWX 910-375-3877

Rocky Mountain Area Parts
20 Inverness Place East, Englewood, CO 80112
Phone 303-790-2323, TWX 920-935-0785

Pacific-Southwestern Area Parts
P.O. Box 85036, San Diego, CA 92138
Street Address:
9980 Carroll Canyon Road, San Diego, CA 92131
Phone 619-578-8030, TWX 910-335-1516

Southwestern Area Parts
P.O. Box 34290
3320 Belt Line Road, Dallas, TX 75234
Phone 214-620-8511, TWX 910-860-5505

Midwest Area Parts
1313 E. Algonquin Road, Schaumburg, IL 60196
Phone 312-576-7430, TWX 910-693-0869

Southeastern Area Parts
P.O. Box 368, Decatur, GA 30031
Street Address:
5096 Panola Industrial Blvd., Decatur, GA 30032
Phone 404-987-2232, TWX 810-766-0876

Gulf States Area Parts
P.O. Box 73115
1140 Cypress Station, Houston, TX 77090
Phone 713-537-3636, TWX 910-881-6392

East Central Area Parts
12955 Snow Road, Parma, OH 44130
Phone 216-433-1560, TWX 810-427-9424

Eastern Area Parts
85 Harristown Road, Glen Rock, NJ 07452
Phone 201-447-4000, TWX 710-988-5614

Mid-Atlantic Area Parts
7230 Parkway Drive, Hanover, MD 21076
Phone 301-796-8763, TWX 710-862-1941

National Accounts
Railroads, Airlines, and Telephone Sales
1313 E. Algonquin Road, Schaumburg, IL 60196
Phone 312-576-6512, TWX 910-693-0869

All Canadian Orders
Motorola, Ltd., National Parts Department
3125 Steeles, Ave. E., Willowdale, Ontario M2H 2H6
Phone 416-499-1441, TWX 610-491-1032
Telex 06-526258

National Data Services

1711 West 17th Street, Tempe, AZ 85281
Phone 602-994-6472, TWX 910-951-1334

All Countries Except U.S. & Canada

Motorola, Inc., International Parts Department
1313 E. Algonquin Road
Schaumburg, IL 60196, U.S.A.
Phone 312-576-7241, TWX 910-693-0869
Telex 722443, Cable MOTOL PARTS

Safe Handling of CMOS Integrated-Circuit Devices

Many of the integrated-circuit devices used in communications equipment are of the CMOS (Complementary Metal Oxide Semiconductor) type. Because of their high open-circuit impedance, CMOS IC's are vulnerable to damage from static charges. Everyone involved in handling, shipping, and servicing them must be extremely careful not to expose them to such damage.

CMOS IC's do have internal protection, but it is effective only against overvoltages in the hundreds of volts, such as those that could occur during normal operations. Overvoltages from static discharge can be in the thousands of volts.

When a CMOS IC is installed in a system, the system's circuit elements distribute static charges and load the CMOS circuits. This decreases the vulnerability of the IC's to static discharge, but improper handling will probably cause static damage even when the IC's are so installed.

To avoid damaging CMOS IC's, take the following precautions when handling, shipping, and servicing them.

1. Before touching a circuit module, particularly after having moved around in the service area, touch *both* hands to a bare metal earth-grounded surface. This discharges any static charge you may have accumulated.

Note

Wear a conductive wrist strap (Motorola Part No. RSX-4015A) to minimize the buildup of static charges on your person while you are servicing CMOS equipment.

Warning

When wearing a conductive wrist strap, be careful near sources of high voltage. By grounding you thoroughly, the wrist strap also increases the danger of lethal shock from accidental contact with such a source.

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2. Whenever possible, avoid touching any electrically conductive parts of the circuit module with your hands.

3. Check the INSTALLATION and MAINTENANCE sections of the service manual and the notes on the schematic to find out whether or not you can insert or remove circuit modules with power applied to the unit, and act accordingly.

4. When servicing a circuit module, avoid carpeted areas, dry environments, and the wearing of static-generating clothing.

5. Be sure that all electrically powered test equipment is grounded. *Attach* the ground lead from the test equipment to the circuit module *before* connecting the test probe. Similarly, *disconnect* the test probe *before* removing the ground lead.

6. When you remove a circuit module from the system, lay it on a sheet of aluminum foil or other conductive surface connected to ground through 100,000 ohms of resistance.

Warning

If the aluminum foil is connected directly to ground, you may get a shock if you touch it and another electrical circuit at the same time.

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7. When soldering, be sure the soldering iron is grounded.

8. Before connecting jumpers, replacing circuit components, or touching CMOS pins (if this becomes necessary during the replacement of an integrated-circuit device), be sure to discharge any static buildup on your person (see Procedure 1, above). Because you can have a voltage difference across your body, you should use only one hand if you must touch the board wiring or any of the pins on the CMOS device.

9. When replacing a CMOS integrated-circuit device, leave the device in its metal rail container or conductive foam until you are ready to insert it into the pronged circuit module.

10. Connect any low-impedance test equipment such as a pulse generator to CMOS device inputs after you have applied power the CMOS circuitry. Similarly, disconnect such low-impedance equipment before turning off the power.

11. Wrap CMOS modules in conductive material when transporting them from one area to another, even within the same room. Use wrapping material similar to that in which replacement modules are wrapped when they arrive from the factory. (You can also use aluminum foil.) *Never use nonconductive material for packaging these modules.*

Model Chart for High-Band *SYNTOR X 9000* Radio
Range 1: 136-154.4 MHz
Range 2: 150.8-174 MHz

CODE:

● = ONE ITEM SUPPLIED

■ = INDICATES BREAKDOWN IN SEPARATE CHART

MODEL	T73KEJ7J04AK	T43KEJ7J04AK	T43KEJ7J04AK				ITEM	DESCRIPTION
DESCRIPTION	32-MODE, 100-50 W	32-MODE, RANGE 1, 30 W	32-MODE, RANGE 2, 40-30 W					
	●						■HUD1675B	UNIFIED CHASSIS, NON-PREAMP, 150–174 MHz
		●					■HUD1690A	UNIFIED CHASSIS, NON-PREAMP, 136–154.4 MHz
			●				■HUD1694B	UNIFIED CHASSIS, NON-PREAMP, 150.8–174 MHz
	●	●	●				HCN1033C	CONTROL UNIT
	●	●	●				HKN4241A	17' POWER CABLE, NEGATIVE GROUND
	●	●	●				HKN4051A	POWER CABLE AND FUSE
	●	●	●				HLN4111A	INSTALLATION KIT
	●	●	●				HLN4262A	TUNING TOOL
	●	●	●				HLN4666A	MOUNTING TRAY
	●	●	●				HLN4243A	BOTTOM COVER
	●	●	●				HLN4263A	TOP COVER
	●	●	●				HLN4921A	TRUNNION
	●	●	●				HLN4952A	FUSE KIT FOR GREEN AND ORANGE LEADS
	●	●	●				HLN4979A	NAMEPLATE
	●	●	●				HLN5095A	BLANK BUTTONS
	●	●	●				HLN5096A	BLANK PLUG
	●	●	●				HLN5105A	HANDLE AND SHIELD
	●	●	●				HLN4983A	*SYSTEMS 9000* BUTTONS
	●	●	●				HLN5027A	*SYSTEMS 9000* SOFTWARE
	●	●	●				HLN5028A	*SYSTEMS 9000* EEPROM
	●	●	●				HLN5064A	*SYSTEMS 9000* CONTACT REMOVAL TOOL
	●	●	●				HLN5066A	*CHANNEL SCAN* PUSHBUTTON
	●	●	●				HMN1031A	*SYSTEMS 9000* MICROPHONE
	●	●	●				HSN4018A	*SYSTEMS 9000* SPEAKER
	●		●				HAD4002A	BROADBAND ANTENNA, R2
		●					HAD4003A	BROADBAND ANTENNA, R1

Model Chart for High Band *SYNTOR X 9000* Radio Unified Chassis

CODE: ● = ONE ITEM SUPPLIED

ITEM	DESCRIPTION	HUD1675B	*HUD16877B	HUD1690A	*HUD17000A	HUD16948	*HUD16928
	MODEL	UNIFIED CHASSIS, NON-PREAMP, 100-50 W	UNIFIED CHASSIS, PREAMP, 100-50 W	UNIFIED CHASSIS, NON-PREAMP, 30 W R1	UNIFIED CHASSIS, PREAMP, 30 W R1	UNIFIED CHASSIS, NON-PREAMP, 40-20 W R2	UNIFIED CHASSIS, PREAMP, 40-20 W R2
HLD1218A	INTERNAL CASTING ASSEMBLY, NON-PREAMP	●				●	
HLD1219A	INTERNAL CASTING ASSEMBLY, PREAMP		●				●
HLD1071A	INTERNAL CASTING ASSEMBLY, NON-PREAMP			●			
HLD1614A	INTERNAL CASTING ASSEMBLY, PREAMP				●		
HKN4066A	CABLE KIT		●	●	●		●
HLD4108A	FIRST MIXER	●	●	●	●	●	●
HLN4251A	VCO INTERCONNECT	●	●	●	●	●	●
HLN4260A	INTERNAL CASTING HARDWARE	●	●	●	●	●	●
HLN4490A	INTERNAL CASTING			●	●		
HLN4261A	INTERNAL CASTING		●				●
HLN4912A	INTERNAL CASTING HARDWARE	●				●	
HLN4318A	VCO, RANGE 2	●	●			●	●
HLD4133A	VCO, RANGE 1			●	●		
HLN1053A	VCO BUFFER	●	●			●	●
HLN1116A	VCO BUFFER			●	●		
HLN4250A	LOW PASS FILTER	●				●	
HLN4491A	LOW PASS FILTER			●			
HLD4123A	PREAMP		●				●
HLD4316A	PREAMP				●		
HLD4067A	PA POWER TRANSISTORS, 100-50 W	●	●				
HLD4063A	PA POWER TRANSISTORS, 30 W			●	●		
HLD4125A	PA POWER TRANSISTORS, 40-20 W					●	●
HLD4076A	PA BOARD	●	●				
HLD4134A	PA BOARD			●	●		
HLD4314A	PA BOARD					●	●
HLN4245A	PA HARDWARE, 100-50 W	●	●				
HLN4167A	PA HARDWARE, 30 W			●	●		
HLN5109A	PA HARDWARE, 40-20 W					●	●
HLN4246A	CHASSIS HARDWARE	●	●			●	●
HLN4529A	CHASSIS HARDWARE			●	●		
HLN5169A	RF BOARD	●	●			●	●
HLN4492A	RF BOARD			●	●		
HLN4925D	PERSONALITY BOARD	●	●	●	●	●	●
HLN4906B	COMMON CIRCUITS BOARD	●	●	●	●	●	●
HLN4242A	DIRECTIONAL COUPLER	●	●	●	●	●	●
HLN4247A	IPA BOARD	●	●	●	●	●	●
HLN4244A	IPA FEEDTHRU PLATE	●	●	●	●	●	●
HLN4046A	PA FEEDTHRU PLATE	●	●	●	●	●	●
HKN4225A	INTERCONNECT CABLE	●	●	●	●	●	●
HLN4241A	ANTENNA SWITCH	●	●	●	●	●	●
HLN4259A	FRONT HARDWARE	●	●	●	●	●	●
HLN4248B	BUSS WIRES	●	●	●	●	●	●
HLN4994A	TRANSFORMER BRACKET	●	●	●	●	●	●

*USED WITH W12 OPTION (PREAMP MODELS)

Model Chart for *SYNTOR X 9000* UHF Radios

Range 1: 406–420 MHz
Range 2: 450–470 MHz
Range 3: 470–488 MHz
Range 4: 482–500 MHz
Range 5: 494–512 MHz

CODE:

● = ONE ITEM SUPPLIED

ITEM	DESCRIPTION	T74KEJ7J044AK 32 MODE, 100W RANGE 1	T74KEJ7J044AK 32 MODE, 100-50W RANGE 2	T64KEJ7J044AK 32 MODE, 78-39W RANGE 3	T64KEJ7J044AK 32 MODE, 78-39W RANGE 4	T64KEJ7J044AK 32 MODE, 78-39W RANGE 5	T34KEJ7J044AK 32 MODE, 30-15W RANGE 3	T34KEJ7J044AK 32 MODE, 30-15W RANGE 4	T34KEJ7J044AK 32 MODE, 30-15W RANGE 5			
	UNIFIED CHASSIS (SEE SEPARATE CHART)	●	●	●	●	●	●	●	●			
HCN1033C	CONTROL UNIT	●	●	●	●	●	●	●	●			
HKN4051A	POWER CABLE AND FUSE	●	●	●	●	●	●	●	●			
HKN4241A	17' POWER CABLE, NEGATIVE-GROUND	●	●	●	●	●	●	●	●			
HLN4111A	INSTALLATION KIT	●	●	●	●	●	●	●	●			
HLN4243A	BOTTOM COVER	●	●	●	●	●	●	●	●			
HLN4262A	TUNING TOOL	●	●	●	●	●	●	●	●			
HLN4263A	TOP COVER	●	●	●	●	●	●	●	●			
HLN4666A	MOUNTING TRAY	●	●	●	●	●	●	●	●			
HLN4921A	TRUNNION	●	●	●	●	●	●	●	●			
HLN4952A	FUSE KIT FOR GREEN AND ORANGE LEADS	●	●	●	●	●	●	●	●			
HLN4979A	NAMEPLATE	●	●	●	●	●	●	●	●			
HLN4983A	*SYNTOR X 9000* BASIC BUTTONS	●	●	●	●	●	●	●	●			
HLN5027A	*SYNTOR X 9000* RADIO SOFTWARE	●	●	●	●	●	●	●	●			
HLN5028A	*SYNTOR X 9000* EEPROM	●	●	●	●	●	●	●	●			
HLN5064A	*SYNTOR X 9000* CONTACT REMOVAL TOOL	●	●	●	●	●	●	●	●			
HLN5066A	*CHANNEL SCAN* PUSHBUTTON	●	●	●	●	●	●	●	●			
HLN5095A	BLANK PUSHBUTTONS	●	●	●	●	●	●	●	●			
HLN5096A	BLANK PLUGS	●	●	●	●	●	●	●	●			
HLN5105A	HANDLE AND SHIELD	●	●	●	●	●	●	●	●			
HMN1031A	*SYNTOR X 9000* MICROPHONE	●	●	●	●	●	●	●	●			
HSN4018A	*SYNTOR X 9000* SPEAKER	●	●	●	●	●	●	●	●			
TAE6051A	ROOFTOP ANTENNA, RANGE 1	●										
TAE6052A	ROOFTOP ANTENNA, RANGE 2		●									
TAE6054A	ROOFTOP ANTENNA, RANGES 3–5			●	●	●	●	●	●			

Model Chart for UHF *SYNTOR X 9000* Radio Unified Chassis Ranges 1–5

CODE: ● = ONE ITEM SUPPLIED

ITEM	DESCRIPTION	HUE2029A/2031A* NON-PREAMP/PREAMP, 100–50 W, RANGE 1	HUE2025A/2027A* NON-PREAMP/PREAMP, 100–50 W, RANGE 2	HUE2050A/2051A* NON-PREAMP/PREAMP, 30–15 W, RANGE 2	HUE2041A/2042A* NON-PREAMP/PREAMP, 78–39 W, RANGE 3	HUE2052A/2053A* NON-PREAMP/PREAMP, 30–15 W, RANGE 3	HUE2043A/2044A* NON-PREAMP/PREAMP, 78–39 W, RANGE 4	HUE2054A/2055A* NON-PREAMP/PREAMP, 30–14 W, RANGE 4	HUE2045A/2046A* NON-PREAMP/PREAMP, 78–39 W, RANGE 5	HUE2056A/2057A* NON-PREAMP/PREAMP, 30–15 W, RANGE 5
HLE1081A/HLE1603A*	INTERNAL CASTING, RANGE 1	●								
HLE1082A/HLE1087A*	INTERNAL CASTING, RANGE 2		●	●						
HLE1083A/HLE1088A*	INTERNAL CASTING, RANGE 3				●	●				
HLE1084A/HLE1089A*	INTERNAL CASTING, RANGE 4						●	●		
HLE1085A/HLE1090A*	INTERNAL CASTING, RANGE 5								●	●
HLN4759A	LOW LEVEL AMPLIFIER INTERFACE BOARD, RANGE 1, 100 W	●								
HLN4466A	LOW LEVEL AMPLIFIER INTERFACE BOARD, RANGE 2, 100 W		●							
HLN4336A	LOW LEVEL AMPLIFIER INTERFACE BOARD, 78 W				●		●		●	
HLN5119A	LOW LEVEL AMPLIFIER INTERFACE BOARD, 30 W			●			●		●	●
HLN4354A	LOW LEVEL AMPLIFIER, RANGE 1, 100 W	●								
HLE4189A	LOW LEVEL AMPLIFIER, RANGE 2, 100 W		●							
HLE4395A	LOW LEVEL AMPLIFIER, 78 AND 30 W			●	●	●	●	●	●	●
HLE4356A	PREDRIVER SUBSTRATE, RANGE 1, 100 W	●								
HLE4179A	PREDRIVER SUBSTRATE, 100 AND 78 W		●		●		●		●	
HLE4409A	PREDRIVER SUBSTRATE, 30 W			●		●		●		●
HLE4355A	DRIVER SUBSTRATE, RANGE 1, 100 W	●								
HLE4074A	DRIVER SUBSTRATE, 100 AND 78 W		●		●		●		●	
HLE4421A	DRIVER SUBSTRATE, 30 W			●		●		●		●
HLE4357A	SPLITTER SUBSTRATE, RANGE 1	●								
HLE4070A	SPLITTER SUBSTRATE, RANGES 2–5		●		●		●		●	
HLE4155A	COMBINER SUBSTRATE, RANGE 1	●								
HLE4065A	COMBINER SUBSTRATE, RANGES 2 AND 3		●		●					
HLE4066A	COMBINER SUBSTRATE, RANGES 4 AND 5						●		●	
HLE4345A	POWER DISTRIBUTION BOARD, 100 AND 78 W	●	●		●		●		●	
HLE4405A	POWER DISTRIBUTION BOARD, 30 W			●		●		●		●
HLE4168A	PA POWER TRANSISTORS, RANGES 1–3	●	●		●					
HLE4420A	PA POWER TRANSISTORS, RANGES 4 AND 5						●		●	
HLE4401A	PA POWER TRANSISTORS, RANGES 2 AND 3, 30 W			●		●				
HLE4403A	PA POWER TRANSISTORS, RANGES 4 AND 5, 30 W							●		●
HLN4770A	PA HARDWARE, RANGE 1, 100 W	●								
HLN4465A	PA HARDWARE, RANGE 2, 100 W		●							
HLN5014A	PA HARDWARE, RANGE 3, 78 W				●					
HLN5015A	PA HARDWARE, RANGE 4, 78 W						●			
HLN4939A	PA HARDWARE, RANGE 5, 78 W								●	
HLN5016A	PA HARDWARE, RANGE 2, 30 W			●						
HLN5017A	PA HARDWARE, RANGE 3, 30 W					●				
HLN5018A	PA HARDWARE, RANGE 4, 30 W							●		
HLN5019A	PA HARDWARE, RANGE 5, 30 W									●
HFE4015A	HARMONIC FILTER, RANGE 1	●								
HFE4013A	HARMONIC FILTER, RANGES 2–4		●		●		●			
HFE4016A	HARMONIC FILTER, RANGE 5								●	
HFE4017A	HARMONIC FILTER, RANGES 2–5, 30 W			●		●		●		●
HLN4040A	CAPACITOR KIT, RANGE 2, 100 W		●							
HKN4130A	INTERCONNECT CABLE	●	●	●	●	●	●	●	●	●
HLE4175A	DIRECTIONAL COUPLER	●	●	●	●	●	●	●	●	●
HLN4046A	FEEDTHROUGH PLATE	●	●	●	●	●	●	●	●	●
HLN4259A	FRONT HARDWARE	●	●	●	●	●	●	●	●	●
HLN4459A	CHASSIS HARDWARE	●	●	●	●	●	●	●	●	●
HLN4460B	ANTENNA SWITCH	●	●	●	●	●	●	●	●	●
HLN4462B	RF BOARD	●	●	●	●	●	●	●	●	●
HLN4925D	PERSONALITY BOARD	●	●	●	●	●	●	●	●	●
HLN4905B	COMMON CIRCUIT BOARD 100 W, 78 W	●	●		●		●		●	
HLN5152B	COMMON CIRCUIT BOARD 30 W			●		●		●		●
HLN4994A	TRANSFORMER BRACKET	●	●	●	●	●	●	●	●	●
TRN8857B	BUSS WIRES	●	●	●	●	●	●	●	●	●

*USED WITH W12 OPTION (PREAMP MODELS)

Model Chart for *SYNTOR X 9000* Conventional 800-MHz Radio

CODE:

● = ONE ITEM SUPPLIED

■ = INDICATES BREAKDOWN IN SEPARATE CHART

MODEL						DESCRIPTION
	T45KEJ7J04AK					CONVENTIONAL 800-MHz, 35-WATT
ITEM						DESCRIPTION
■HUF1029C	●					UNIFIED CHASSIS, PREAMP
HCN1033C	●					CONTROL UNIT
HKN4241A	●					POWER CABLE, 17' NEGATIVE-GROUND
HLN4921A	●					TRUNNION
HLN4111A	●					INSTALLATION KIT
HLN4243A	●					BOTTOM COVER
HLN4262A	●					TUNING TOOL
HLN4263A	●					TOP COVER
HLN4666A	●					MOUNTING TRAY
HMN1031A	●					*SYNTOR X 9000* MICROPHONE
HSN4018A	●					*SYNTOR X 9000* SPEAKER
HLN4978A	●					NAMEPLATE
HBN4002A	●					PACKING
HLN4952A	●					FUSE KIT FOR GREEN AND ORANGE LEADS
HLN5066A	●					*CHANNEL SCAN* PUSHBUTTON
HLN5027A	●					*SYNTOR X 9000* SOFTWARE
HLN5028A	●					*SYNTOR X 9000* EEPROM
TAF6041A	●					ONE-QUARTER WAVE ANTENNA
HKN4051A	●					CABLE AND FUSE
HLN4983A	●					*SYNTOR X 9000* BASIC PUSHBUTTONS
HLN5064A	●					*SYNTOR X 9000* TOOLS
HLN5095A	●					BLANK PUSHBUTTON
HLN5096A	●					BLANK PLUG
HLN5105A	●					HANDLE AND SHIELD

Model Chart for *SYNTOR X 9000* Conventional 800-MHz Radio Unified Chassis

CODE:

● = ONE ITEM SUPPLIED

	MODEL	DESCRIPTION
	HUF1029C	UNIFIED CHASSIS, 800-MHz
ITEM		DESCRIPTION
HLN1253A	●	INTERNAL CASTING
HLN5356A	●	800 VCO TALKAROUND
TRN8868A	●	HYBRID PREAMP
TRN8869A	●	VCO BUFFER
TRN8871D	●	HYBRID MIXER
TRN8872A	●	VCO INTERCONNECT
TRN8873B	●	INTERNAL CASTING HARDWARE
HLN4246A	●	CHASSIS HARDWARE
HLN4925D	●	PERSONALITY BOARD
HKN4155A	●	35-WATT INTERCONNECT CABLE
HLN4217A	●	PA FEEDTHRU PLATE
HRN4000B	●	RF BOARD
HLN4971C	●	COMMON CIRCUITS BOARD
TRN4734A	●	ANTENNA SWITCH
TRN8856A	●	HYBRID DIRECTIONAL COUPLER
TRN8858A	●	PA HARDWARE
TRN8857B	●	BUSS WIRES
HLN4259A	●	FRONT HARDWARE
TRN8853A	●	HYBRID DRIVER SUBSTRATE
TRN8852A	●	HYBRID PREDRIVER SUBSTRATE
TRN8851A	●	HYBRID IPA
TRN8854A	●	FINAL POWER AMPLIFIER
TRN8850A	●	HYBRID HARMONIC FILTER
TRN8855B	●	METERING BOARD
HLN4994A	●	TRANSFORMER BRACKET KIT

Options Chart

Options	Description
W11	Time-Out Timer (60 seconds)
W12	RF Preamplifier
W20	DTMF Microphone
W54	Positive-Ground cable, 22'
W70	Omit Antenna, VHF
W71	Omit Microphone
W87	Omit Speaker
W90	Omit Accessories
W101	Negative-Ground Cable, 22'
W123	3.5dB Gain UHF Antenna
W124	5.0dB Gain UHF Antenna
W268	*Securenet* Code Storage Battery
W269	Electronic Siren/PA
W290	Optional Select Coded Squelch
W303	*Securenet* Dual Code Select
W421	Dual Priority *Channel Scan*
W425	Repeater Talkaround
W427	"AND" Squelch
W428	Variable Time-Out Timer
W452	*MDC-600* ID and Emergency
W481	Data Inhibit
W495	Mode-Slaved *Channel Scan*
W496	Negative-ground Cable, 10'
W544	Base Loaded Rooftop VHF Antenna
W577	Coax Bumper Mount VHF Antenna
W578	Coax Side Mount VHF Antenna
W589	Public Address
W591	Auxiliary Switch Panel
W681	*MDC-600* Selective Call
W688	Hidden Emergency Pushbutton
W703	Talkback *Channel Scan*
W712	Mobile Voice Storage
W814	*MDC-600* ID sent at end of transmission only
W824	*MDC-600* Status
W825	*MDC-600* Message
W844	Plant Programming
W873	Emergency Button on Control Unit
W929	Omit *Channel Scan*
W930	64-Mode Operation
W940	*Securenet* Spare Encryption Module

VHF Systems 9000 Performance Specifications

General

Number of Modes	Models available in 32-mode configuration. Standard 64 modes optional.
Channel Resolution	Multiples of 5.0 kHz or 6.25 kHz
Squelch Options	*Private-Line* and *Digital Private-Line* coded squelch are standard and available in the same radio unit. Carrier squelch and multiple coded squelch are optional.
Primary Power	±12 V dc with a dc isolated floating ground system. Radio supplied for operation with negative-ground vehicles. Optional cable kit permits operation with positive-ground vehicles.
Radio Unit Dimensions	2.5″ H × 11.5″ W × 16.0″ L (63.5mm × 292mm × 406mm)
Radio Unit Weight	Approximately 22.5 lb (10.2 kg). Shipping weight approximately 37.5 lb (17 kg)
Metering	A single-scale 0–50 microampere meter or Motorola portable test set can be used to measure all circuits essential to checking and adjustments.

			Maximum Battery Drain (inc. std. accessories)		
Model (Series)	**Frequency (MHz)**	**Minimum RF Power Output**	**Standby @ 13.8 V**	**Receive at Rated Audio @ 13.8 V**	**Transmit @ Rated Power**
T73KEJ	150–174	100 W Variable to 55 W	1.2A	3.5A	27A
T43KEJ	150–174	40 W Variable to 20 W	1.2A	3.5A	14A

Transmitter

Output Impedance	50 ohms
Spurious and Harmonic Emissions	More than 70 dB below carrier (for EIA spec. RS152B)
Frequency Stability	±.0002% of reference frequency from −30° to +60°C ambient (+30°C reference)
Maximum Frequency Separation	24 MHz without degradation
Modulation	15F2 and 16F3, ±5 kHz for 100% @ 1000 Hz
Audio Sensitivity	0.080 V ±3 dB for 60% maximum deviation @ 1000 Hz
FM Hum and Noise EIA Method Companion Receiver Response RS152B Response	 −60 dB −50 dB
Audio Response	+1, −3 dB of 6 dB/octave pre-emphasis characteristic from 300 to 3000 Hz
Audio Distortion	Less than 2% @ 1000 Hz, 60% maximum deviation
FCC Designation	T73KEJ: CC3372—Licensable under FCC rules Parts 22, 74, and 90 for 15F2, 16F3, and 16F9 emission T43KEJ: ABZ89FT3688

Control Unit

Dimensions (excluding mounting bracket):	6½″ W × 3⅜″ H × 1 11/16″ D (166mm × 87mm × 42mm)
Weight	1 lb (456 g)
Current Drain	300 mA

Speaker

Dimensions (excluding mounting bracket)	5″ × 5″ × 2½″ (127mm × 127mm × 63mm)
Weight	1.5 lb (680 g)

VHF Systems 9000 Performance Specifications (continued)

Receiver

Input Impedance	50 ohms			
EIA Modulation Acceptance	±6.5 kHz minimum			
Frequency Stability	±.0002% of reference frequency from −30°C to +60°C ambient (±30°C reference)			
Maximum Frequency Separation	24 MHz without degradation			
Sensitivity	**With Pre-Amp**		**Without Pre-Amp**	
20 dB quieting	0.25 µV		0.50 µV	
EIA SINAD	0.175 µV		0.35 µV	
Intermodulation EIA SINAD	80 dB		85 dB	
Spurious & Image Rejection	85 dB		90 dB	
Selectivity EIA SINAD	**Adjacent Channel**	**Alternate Channel**	**4th Channel**	**±400 kHz**
30 kHz Ch.	90 dB	95 dB	100 dB	110 dB
25 kHz Ch.	85 dB	90 dB	95 dB	110 dB
Squelch Sensitivity	Carrier squelch (at threshold setting), tone-coded squelch (fixed), digital-coded squelch (fixed), are all 8 dB SINAD (0.25 µV maximum without preamp; 0.13 µV with preamp).			
Audio Output	15 watts @ less than 3% distortion into an 8-ohm load			
FCC Designation	T73KEJ—RC0291 T43KEJ—ABZ89FT3688			

UHF Systems 9000 Performance Specifications

General

Number of Modes	Models available in 32-mode configuration. Standard 64-mode optional.
Channel Resolution	Multiples of 5.0 kHz or 6.25 kHz
Squelch Options	*Private-Line* and *Digital Private-Line* coded squelch are standard and available in the same radio unit. Carrier squelch and multiple coded squelch are optional.
Primary Power	±12 V dc with a dc-isolated floating ground system. Radio supplied for operation with negative-ground vehicles. Optional cable kit permits operation with positive-ground vehicles.
Radio Unit Dimensions	2.65″ H × 11.5″ W × 16.0″ L (63.5mm × 292mm × 406mm)
Radio Unit Weight	Approximately 22.5 lb (10.2 kg). Shipping weight approximately 37.5 lb (17 kg)
Metering	A single-scale 0–50 microampere meter or Motorola portable test set can be used to measure all circuits essential to checking and adjustments.

			Maximum Battery Drain (inc. std. accessories)		
Model (Series)	**Frequency (MHz)**	**Minimum RF Power Output**	**Standby @ 13.8 V**	**Receive at Rated Audio @ 13.8 V**	**Transmit @ Rated Power**
T74KEJ	406–420	100 W	1.2A	3.5A	31A
T74KEJ	450–470	100 W Variable to 50 W	1.2A	3.5A	31A
T64KEJ	470–512	78 W Variable to 39 W	1.2A	3.5A	31A
T34KEJ	450–512	30 W Variable to 15 W	1.2A	3.5A	12A

Transmitter

Output Impedance	50 ohms
Spurious and Harmonic Emissions	More than 70 dB below carrier (for EIA spec. RS152B)
Frequency Stability	±.0002% of reference frequency from −30° to +60°C ambient (+30°C reference)
Maximum Frequency Separation	20 MHz without degradation for 450–470 radios, 14 MHz without degradation for 406–420 radios. 18 MHz without degradation for 470–512 MHz (3 ranges)
Modulation	15F2 and 16F3, ±5 kHz for 100% @ 1000 Hz
Audio Sensitivity	0.080 V ±3 dB for 60% maximum deviation @ 1000 Hz
FM Hum and Noise EIA Method Companion Receiver Response RS152B Response	 −60 dB −50 dB
Audio Response	+1, −3 dB of 6 dB/octave pre-emphasis characteristic from 300 to 3000 Hz
Audio Distortion	Less than 2% @ 1000 Hz, 60% maximum deviation
FCC Designation	T74KEJ: ABZ89FT4633—Licensable under FCC rules Parts 22, 74, and 90 for 15F2, 16F3, and 16F9 emission T64KEJ: ABZ89FT4666 T34KEJ: ABZ89FT4687

Control Unit

Dimensions (excluding mounting bracket)	6½″ W × 3⅜″ H × 1 11/16″ D (166mm x 87mm x 43mm)
Weight	1 lb (456 g)
Current Drain	300 mA

Speaker

Dimensions (excluding mounting bracket)	5″ × 5″ × 2½″ (127mm × 127mm × 63mm)
Weight	1.5 lb (680 g)

UHF Systems 9000 Performance Specifications (continued)

Receiver

Input Impedance	50 ohms			
EIA Modulation Acceptance	±7.0 kHz minimum			
Frequency Stability	±.0002% of reference frequency from −30°C to +60°C ambient (±30°C reference)			
Maximum Frequency Separation	Range 1: 14 MHz without degradation Range 2: 20 MHz without degradation Ranges 3–5: 18 MHz without degradation			
Sensitivity	With Pre-Amp		Without Pre-Amp	
20 dB quieting	0.25 µV		0.50 µV	
EIA SINAD	0.20 µV		0.35 µV	
Intermodulation EIA SINAD	80 dB		85 dB	
Spurious and Image Rejection	90 dB		95 dB	
Selectivity EIA SINAD	**Adjacent Channel**	**Alternate Channel**	**4th Channel**	**±400 kHz**
25 kHz Ch.	85 dB	90 dB	100 dB	110 dB
Audio Output	15 watts @ less than 3% distortion into an 8-ohm load			
FCC Designation	T74KEJ—ABZ89FT4633 T64KEJ—ABZ89FT4666 T34KEJ—ABZ89FT4687			

800-MHz Performance Specifications

GENERAL

No. of Modes	Frequency pairs are limited to five for any one licensee per FCC Rules and Regulations. 32-mode configurations are available to accommodate Mode-Select repeater talkaround and multiple repeater selection.
Squelch Options	*Private-Line* and *Digital Private-Line* coded squelch are standard and available within the same radio unit. Carrier squelch is optionally available.
Primary Power	12 Vdc negative or positive ground. Radio is supplied for operation with negative ground vehicles. Optional cable kit permits operation with positive ground vehicles.
Dimensions	2.5" H × 11.5" W × 16.0" L (63.5 mm × 292 mm × 406 mm)
Weight	Approximately 22.5 lbs. (10.2 kg). Shipping weight approximately 37.5 lbs. (17 kg).
Metering	A single scale 0–50 microampere meter or Motorola portable test set can be used to measure all circuits essential to checking and adjustments.

			Maximum Battery Drain		
Model Series	**Frequency MHz**	**Minumum RF Power Output**	**Standby @ 13.8V**	**Receive at Rated Audio @ 13.8V**	**Transmit @ Rated Power**
T45VBJ	TX: 806–825, 851–807 RX: 851–870	35W	1.2A	3.5A	13A

TRANSMITTER

Output Impedance	50 ohms
Spurious and Harmonic Emissions	More than 70 dB below carrier (for EIA spec., RS152B)
Frequency Stability	±.0002% reference frequency from −30°C to +60°C ambient (+30°C reference)
Maximum Frequency Separation	19 MHz within each of two groupings
Modulation	15F2 and 16F3, ±5 kHz for 100% @ 1000 Hz
Audio Sensitivity	0.080V ± 3 dB for 60% maximum deviation @ 1000 Hz
FM Hum and Noise EIA Method	Companion receiver response −55 dB RS152B response −45 dB
Audio Response	+1, −3 dB of 6 dB/octave pre-emphasis characteristic from 300 to 3000 Hz
Audio Distortion	Less than 2% @ 1000 Hz, 60% maximum deviation
FCC Designation	CC5023—Licensable under FCC rules Part 90 for 15F2, 16F3, and 16F9 emission

RECEIVER

Input Impedance	50 ohms
EIA Modulation Acceptance	±7.0 kHz minimum
Frequency Stability	±.0002% of reference frequency from 30°C to 60°C ambient (+30°C reference)
Maximum Frequency Separation	19 MHz
Sensitivity: 20 dB Quieting EIA Sinad	 0.35 μV 0.25 μV
Selectivity EIA Sinad	 ±25 kHz; 80 dB ±100 kHz; 90 dB
Intermodulation EIA Sinad	 80 dB
Spurious and Image Rejection	100 dB
Squelch Sensitivity	Carrier squelch (at threshold setting), Tone-Coded Squelch (fixed), Digital-Coded Squelch (fixed), are all 8 dBq.
Audio Output	15 watts @ less than 3% distortion into an 8 ohm load
FCC Designation	RC0246

CONTROL UNIT

Dimensions (Excluding Mounting Bracket)	6½" W × 3⅜" H × 1 11/16" D (166 mm × 87 mm × 42 mm)
Weight	1 lb. (456 g)
Current Drain	300 mA

SPEAKER

Dimensions (Excluding Mounting Bracket)	5" × 5" × 2½" (127 mm × 127 mm × 63 mm)
Weight	1.5 lb. (680 g)

1. Description

This supplement affects the UHF/VHF *SYNTOR X* 9000 radios. In some cases, references in each section are to your existing Instruction Manuals. The information either replaces or adds to your manuals.

1.1 ALTERNATE MEMORY MODULE

This section follows section 2.1.7 in the Description and Operation section of your Instruction Manual.

The alternate memory module (HLN1125A) is used in *SYNTOR X* 9000 radios and is designed around a five-volt programmable 2k × 8 bit electrically erasable programmable read only memory (EEPROM). When installed in a *SYNTOR X* 9000 radio, the EEPROM is in a read only mode and operates exactly as the fusable link PROM memory modules (HLN1087 and 1088) do.

The EEPROM can be reprogrammed in excess of 10,000 times. The Epson HX-20 (Y1069) or IBM PC/XT/AT with the correct software may be used to reprogram part or all of the EEPROM. Modes and options are added or changed any time without purchasing a new memory module. The 2K EEPROM handles up to 32 modes. An optional 8k EEPROM is available for 64-mode operation (W930).

The Epson or IBM programmers interface to the radio through a remote interface box (RIB). This box does the level shifting necessary to communicate to the radio over the RS-422 serial bus. The bus connects to the radio front connector through a T-connector.

1.2 DIRECT ENTRY SWITCH PANEL

This section replaces section 2.2.8 in the Description and Operation section of your Instruction Manual.

The optional direct entry switch panel allows direct selection of certain features, eliminating scrolling through choices while in the configuration state. These features include selection of modes, operator-select PL codes, and status/message. The switch panel contains eight momentary pushbuttons and mounts with the control unit.

1.3 AUXILIARY SWITCH PANEL

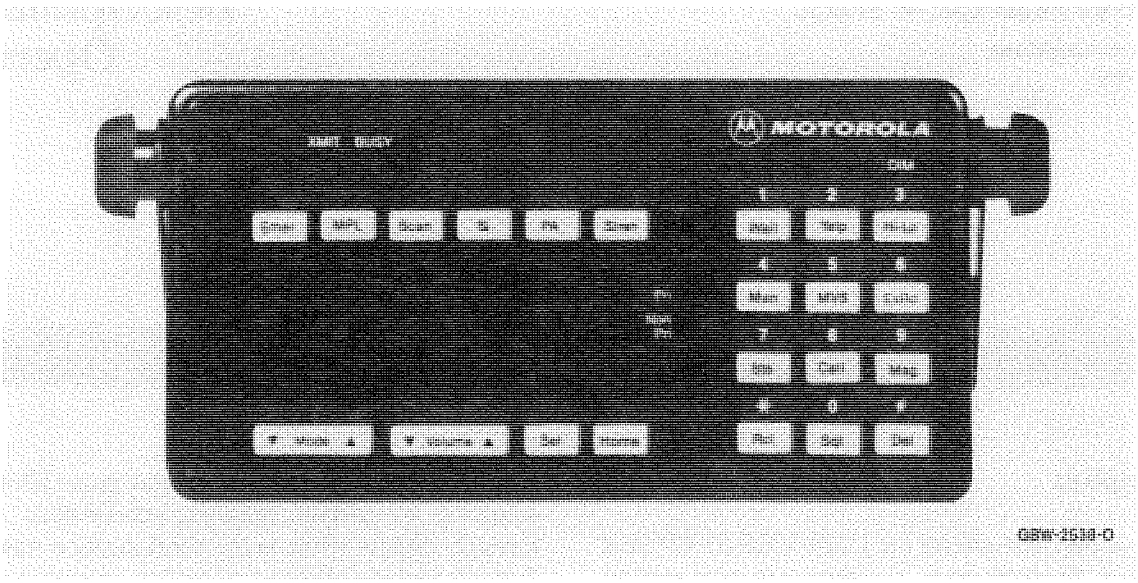
This section is in addition to your Instruction Manual and should be added after section 2.2.8 within Description and Operation.

The optional auxiliary switch panel is a supplemental bank of eight switches used to control any electrical functions in your vehicle.

1.4 RECEIVER

This paragraph replaces the second paragraph of section 3.2.3 in the Description and Operation section of your Instruction Manual.

The squelch circuit gives the microcomputer two signals (channel activity and squelch tail). Channel activity and squelch tail signals are normally in high and low states respectively. When an RF carrier appears, both signals switch states telling the microcomputer to enable the audio stages. The channel activity line is the preliminary indicator during channel scan operation, while the squelch tail line protects the audio signals against fading.



Typical SYNTOR X *9000 Control Unit*

2. Operation

2.1 INTRODUCTION

The *SYNTOR X* 9000 Control Unit has the following controls and indicators:

- Power on/off slide switch
- DIM button for display brightness
- Rocker switch volume control
- Rocker and keypad mode-select control
- Channel BUSY indicator light
- Transmit indicator light
- Priority channel indicator light
- Non-priority channel indicator light
- Squelch button to set volume and monitor channel activity
- Control buttons for Scan, Operator-Select MPL, and other radio options

2.2 TO RECEIVE

(1) Slide the power ON/OFF switch to the left until it locks in position. The Control Unit display comes on showing "SELF CHECK" for two to three seconds, then displays the current selected mode. If the radio system fails its diagnostics on power up, an error code displays. See the Maintenance and Troubleshooting section. If the failure is critical, the radio ceases operation.

(2) Select a mode on which to operate.

(3) For modes with PL/DPL turn squelch on.

(4) Adjust the volume level to a comfortable listening level during an incoming signal.

(5) To transmit, follow the steps in the next section. To turn off the power, slide the power ON/OFF switch to the right until it locks. The display goes off.

2.3. *SYNTOR X* 9000 MODES

The following replaces section 4.1 of the Operation section in your Instruction Manual.

The *SYNTOR X* 9000 modes are preprogrammed into the radio's memory at the factory in accordance with the user's requirements. Programming for up to 32 modes is standard. A 64-mode option (W930) is available. For example, a mode (depending on options used) may be programmed as follows:

- Mode: 1
- Receive frequency: XXXXXX
- Transmit frequency: XXXXXX
- Receive code: PL code 1A
- Transmit code: PL code 1A
- Time-out timer: one minute
- Opening squelch: AND
- Channel Scan: ON
- Internal list: Modes 7 and 8
- Highest-priority mode: Mode 1
- Second-highest-priority mode: Mode 4

1. Service

Should you wish to purchase a service contract for your Motorola equipment, contact your Motorola Service Representative, or write to:

National Service Manager
Motorola Communications Sector
1301 E. Algonquin Rd.
Schaumburg, IL 60196

2. FCC Requirements

See the FCC Requirements section in the *SYNTOR X* 9000 Two-Way Radio Instruction Manual.

3. Pre-Installation Tests

Perform pre-installation tests according to the instructions detailed in your Instruction Manual.

4. Installation Planning

Perform installation planning procedures according to the instructions detailed in your Instruction Manual, with one exception: the *SYNTOR X* 9000 control unit does not have microphone hangup clip holes on the control unit as outlined in the OPERATOR'S CONTROLS paragraph.

5. Cable Routing

(See Figures 1 and 2.)

(1) Determine the position that the radio will occupy in the trunk compartment and leave enough slack cable to permit the plug to be easily connected or disconnected from the radio.

(2) Work from the trunk space forward. In some cars there is enough room below the fiberboard trunk partition to admit the cables. If this is not the case, make an opening through the partition. Remove the back seat.

(3) If the vehicle is so equipped, run the cables in the wire troughs. Otherwise, route the cables under the floor covering alongside the drive shaft hump. Pull the cables into the back seat area, under the floor mats, under the front seat, and under the front mats, exiting up under the dash at the firewall. Pull the control unit end of the multi-conductor cable to the approximate location of the control unit. Route the red power cable into the engine compartment through any convenient hole in the firewall. If necessary, drill a ½-inch diameter hole elsewhere in the firewall, install a grommet, and route the cable through the hole.

(4) Pull the red power cable into the engine compartment. A cable fuse kit is supplied with a ring tongue lug on one end and an in-line fuseholder on the other. A small section of heat-shrinkable tubing is supplied with each cable. Trim any excess length of red cable. Slide the heat-shrinkable tubing over the red power lead from the radio. Slide the strapped portion of the red cable into the end of the in-line fuseholder and crimp the joint using a Burndy Model Y10B (indent "U" crimp). If this tool is not available, solder the joint.

(5) Slide the heat-shrinkable tubing over the connection and shrink the tubing with a Motorola Model ST697 Heat Gun or equivalent heated air source. Remove the fuse from the fuseholder and reconnect the holder. Fasten the ring-tongue lug on the end of the cable to the battery's ungrounded terminal or to some point directly connected to the ungrounded terminal of the battery (such as the starter solenoid). Move the in-line fuseholder to a convenient location on one of the sheet metal parts of the engine compartment. Center punch and drill a $\frac{7}{64}$" (.140") hole through the mounting surface. Then

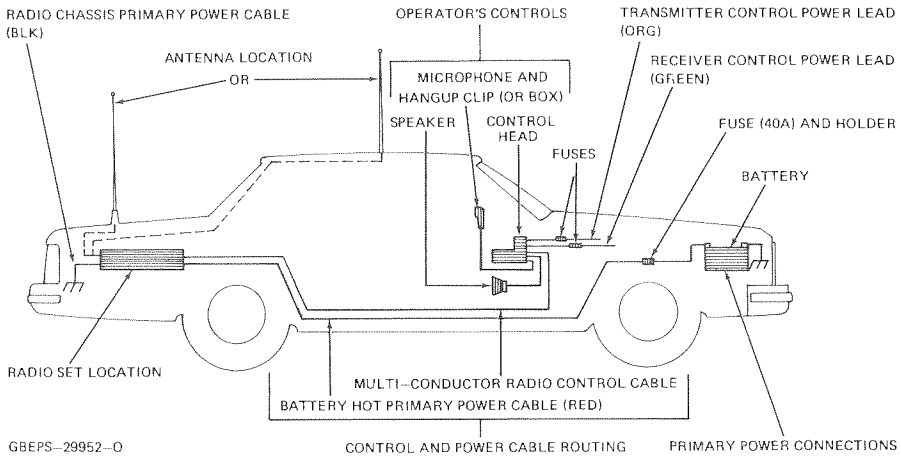


Figure 1. Installation Planning

mount the bracket with the #10-16 × ¾" self-tapping sheet metal screws. Do not install the fuse until the entire radio installation is complete.

(6) The control unit power cable kit contains two separate wires, one orange and the other green. The orange wire is 66 inches long and the green wire is 106 inches long. A fuse kit hardware bag is supplied with the radio. This bag contains crimp-on type ring tongue lugs and crimp-on type spade lugs. The spade lugs allow connection to hot leads at the fuse block of the vehicle and the ring tongue lugs permit attachment to screws of terminals. Determine from Table 1 which radio functions are to be switched through the vehicle ignition switch. A typical system is hooked up to allow the receiver to operate with the radio switched on while the ignition is off, but the transmitter will not operate unless the ignition is on. In this case, connect the orange wire to the accessory terminal of the ignition switch and the green wire to the ungrounded terminal of the battery or starter solenoid.

CAUTION

Do NOT connect either lead to the ungrounded terminal of the battery at this time.

(7) If either wire is to be connected in the engine compartment, pass the end of the wire through the same firewall hole that the red power cable uses. At this point, install a fuse in both wires.

(8) The following procedures apply to both the green and orange wires. (See Figure 8 for more information.) Cut the wires about 10 inches from the end. Strip the insulator from both sides so that about ⅛-inch of the wire is exposed. On the end still connected to the cable kit install the plastic insulator fuse holder cap. On the same wire, crimp one of the metal fuse clips onto the exposed wire and apply solder for a good connection. On the 10-inch loose wire, crimp another metal fuse clip onto the exposed wire and apply solder. Install the fuse (both are three-amp) into the fuse clips on both sides. Slide the spring on the wire to the fuse. Then slide the plastic insulated fuse-holder over the loose end of the wire so that the spring is inside the fuseholder. Now, screw the fuseholders until they lock together.

(9) On the loose ends of the green and orange wires, strip the insulator and crimp either the spade or ring tongue lug on the wire. Solder the crimped connection.

(10) Do not dress the wires at this time, but go to the next procedure.

6. Radio Installation

(See Figures 3 and 4.)

(1) Choose a location where the mounting screws are not directly above the fuel tank, fuel line, or other vital parts. The mounting tray of the radio must be installed permanently to a flat surface with a four-point mounting scheme or, if on an uneven surface, with a three-point mounting scheme. (Four-point mounting is strongly recommended over three-point, especially in vehicles subject to extreme vibrations.) The raised shelf in some car trunk compartments makes a good mounting place. Place the radio at one side to allow space for luggage. Leave at least eight inches in front of the radio so that the handle can be opened and the programming cable can be plugged into the radio. Locate the radio so that the black ground lead in the trunk can reach a good chassis ground point in the trunk. When the final position is determined, unlock the radio, open the handle and lift the radio assembly away from the mounting tray (pull forward and upward release the radio assembly). Use the mounting tray as a template to mark the location for drilling four mounting holes in the trunk floor. Use a #11 drill (.191). Mount the mounting tray as illustrated in Figures 3 and 4.

(2) When the radio is securely mounted to the trunk floor in some vehicles, the front panel may be pressing against the floor or floor cushioning. Also, in some vehicles where it is necessary to mount the radio directly over the fuel tank, the mounting screws could penetrate the tank. Always make a preliminary check to see how far the screws will extend below the trunk floor. If either condition exists, insert one of the thick spacer washers between the bottom of the mounting tray and the thin spacer washer at each of the four mounting holes. The washers help to keep the radio level, especially when the floor is covered with a "spongy" mat such as soft rubber. Replace the radio assembly by sliding the radio onto the tray at about the halfway point. Push straight back until the tray tabs enter the two window areas on the radio front and engage the handle tabs. Close by pushing the handle until it locks. The handle locks the radio to the mounting tray and conceals the top cover release button. Push the multi-conductor plug onto the male connector and rotate the thumbscrew clockwise to fully seat the connector. Reverse the procedure for removing the radio.

(3) Connect the black ground cable lug to a convenient location on the trunk floor. Thoroughly clean the trunk floor surface before proceeding. Center punch and drill a 3/16" (.187") hole through the mounting surface. Use the supplied #14 × ¾" self-tapping screw and ¼" lockwasher to mount the cable lug.

CAUTION

A good ground connection of the black cable is essential for radio operation and to prevent damage to the radio and cable kit. Grounding to the vehicle frame is desirable. On some late-model automobiles, the ground connection between the vehicle chassis and engine block is inadequate for good mobile radio operation. DO NOT compensate for this problem by connecting the radio ground directly to the battery. Connect a flexible metal ground strap between the engine block and a vehicle chassis point common to the radio ground. Be sure the strap is heavy enough to carry maximum transmitter supply current.

(4) All cables (including the antenna lead-in) should be dressed out of the way as much as possible to prevent damage, and the radio heatsink should be placed to have the largest available supply of air possible for cooling.

7. Control Unit

7.1 MOUNTING CONSIDERATIONS

Examine the vehicle to find a suitable mounting location within the operator's reach. Although the trunnion mounting bracket can be mounted to a plastic dashboard, all four trunnion mounting screws should penetrate the dashboard's supporting metal frame. If that is not possible, use a metal backing plate (not supplied) to strengthen the installation. The location should be convenient to the operator for viewing the display and operating the buttons and on-off switch, but vehicle operation should not be impaired and the driver's vision must not be obstructed.

The Model HLN4921A Trunnion Bracket Kit consists of two trunnions. The long trunnion is for hump mount applications and the short trunnion is for on-dash or under-dash applications.

If necessary, pull more cable into the dashboard area. Be sure all wires are clear of the instrument panel where holes are to be drilled.

7.2 INSTALLATION

(1) Mark the mounting location (see Figure 5) using the selected trunnion bracket as a template; drill four 5/32" holes. If mounting into a plastic surface, use a metal backing plate.

(2) Attach the trunnion bracket using *all* four #10-16 × ⅝" self-tapping screws supplied in the mounting kit.

Note

When the control unit is installed, it must not wobble or feel "spongy" when you press buttons. Use *all* four mounting screws and be sure they are tightly screwed into metal—either a dashboard support bracket or a backing plate.

(3) Plug in the radio cable connector and microphone cable connector in the proper location on the back of the control unit (see Figure 5). A "click" sounds when the connector snaps into place. Now connect the microphone cable "S" hook into the hole in the cable strain relief bracket on the back of the control unit.

(4) Plug in the Vehicle Interface Port (VIP) connector (see Figure 5) into the remaining location on the back of the control unit.

(5) Install the control unit to the trunnion bracket using the two wing screws. Rotate the control unit to the desired vertical position and tighten the wing screws.

8. Microphone Installation

8.1 GENERAL

The microphone bracket must be within arm's reach of the operator. Measure this distance before actually mounting the microphone bracket. Since the bracket has a positive detent action, the microphone can

be mounted in almost any position. After installation, connect the microphone plug to the receptacle on the control unit. Make sure that the clip on the control unit firmly engages the plug. Connect the microphone cable "S" hook to the proper hole in the strain relief clip on the rear of the control unit.

8.2 INSTALLATION PROCEDURE
(See Figure 6)

(1) Remove the hangup clip from its taped position on the microphone.

(2) Remove the two paper retainers and screws from the clip.

(3) Determine the location for installation.

(4) Using the clip as a template, mark the location of the two mounting holes.

(5) Center punch and drill a 0.144" diameter hole at each location.

(6) Mount the clip securely.

9. Speaker Installation

Install the speaker as instructed in your Instruction Manual. Details are illustrated in Figure 7.

10. Vehicle Interface Port (VIP)

10.1 GENERAL

The Vehicle Interface Port (VIP) allows the control unit to control outside circuits and to receive inputs from outside the control unit. There are three VIP outputs which are used for relay control. There are also three VIP inputs which accept inputs from switches. See the cable kit section for typical connections of VIP input switches and VIP output relays.

10.2 OUTPUT CONNECTIONS

The VIP output pins are located on the back of the control unit below the area labeled "VIP." These connections can be used to control relays. One end of the relay should be connected to switched B+, while the other side is connected to a software controlled ON/OFF switch inside the control unit. The relay can be normally-on or normally-off depending on how the VIP outputs are configured. The control unit provides for three of these VIP output connections. The following is a list of proper connections for relays:

VIP OUTPUT NUMBER	SWITCHED B+ PIN NO.	ON/OFF SWITCH PIN NO.
1	18	2
2	19	1
3	35	34

The function of these VIP outputs can be defined by field programming the control unit. Typical applications for VIP outputs are external horn/lights alarm and horn ring transfer relay control. For further information on VIP outputs, see the control unit programming manual. For information on installing relay connectors in the VIP connector, see Figure 5.

10.3 INPUT CONNECTIONS

The VIP input pins are located on the back of the control unit below the area labeled "VIP." These connections are used to accept inputs from switches. One side of the switch is connected to ground while the other side is connected to a buffered input to the control unit. The switch can be normally-closed or normally-open depending on how the VIP inputs are configured. The control unit permits three of these VIP input connections. The following is a list of proper connections for the switches:

VIP INPUT NUMBER	GROUND PIN NO.	ON/OFF SWITCH PIN NO.
1	20	4
2	21	3
3	36	37

The function of the VIP inputs can be defined by field programming the control unit. Typical applications for the VIP inputs are for a foot switch of a horn ring switch. For further information on VIP inputs, see the control unit programming manual. For information on installing switch connectors into the VIP connector (see Figure 5).

11. Power Connections
(See Figures 1 and 2.)

(1) Replace the fuse in the in-line fuseholder of the red power cable coming from the radio in the trunk. Connect the green (and/or orange) fused wire(s) coming from the control unit to the ungrounded terminal (or source) of the battery.

(2) Pull all excess cabling into the trunk. Clamp the cables to the vehicle body or chassis with the cable clamps supplied. Drill 1/8" mounting holes and then attach the clamps with four #8 × ⅜" tapping screws and four ¼" lockwashers. Finally, be sure all in-line fuses are installed.

12. Antenna Installation

A diagram and complete installation instructions are supplied with each antenna ordered. See those installation instructions for pertinent information.

13. Conclusion of Installation

(1) Be sure the control unit and microphone PTT switches are off. Install the 40-amp fuse in the red primary power cable in-line holder. Install the

three-amp fuse in the orange cable in-line holder. Install the 3-amp fuse in the green cable in-line holder.

Note

If alternator or other noise is present in the received signal or in the transmission, see Motorola publications Number 68P81109E33 "Reducing Noise Interference in Mobile Two-Way Radio Installations."

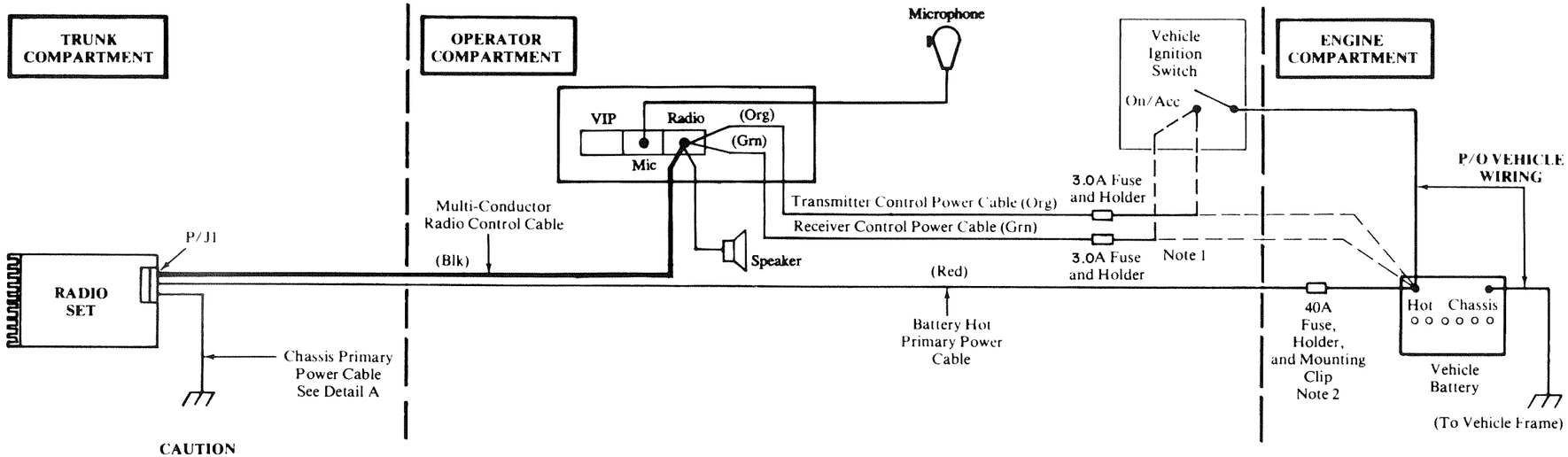
(2) Turn the radio on at the control unit and verify proper operation of all controls and indicators. (Radio operation in some installations requires turning on the ignition. See Table 1.) Perform a complete operational check of the radio.

(3) Dress the control and power cables out of the way to prevent damage (pull any excess cable into the trunk area) and secure them where necessary with the clamps and screws supplied. Replace the rear seat if it was removed for installing the cables.

Table 1. Radio Functions Connections

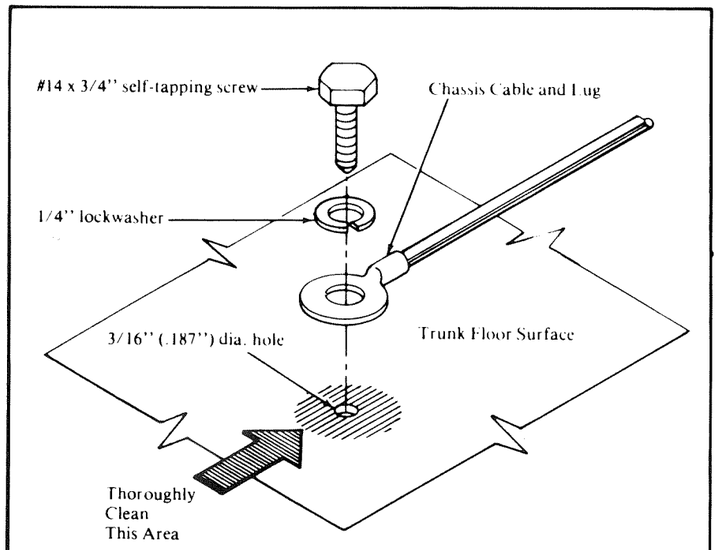
Conductor	Green	Orange	Green	Orange	Green	Orange
Connected to battery	•	•	•			
Connected to ignition switch				•	Note 1	•
Ignition switch controls	No ignition switch control		Xmtr ignition switch controlled		Complete radio ignition switch controlled	
In any application, trim and strip wires. Crimp on ring lug for battery connections. For ignition switch connections, crimp on ring or spade lug (whichever is required).						

Note: In cases where alternator whine or other interference is a problem, the green lead can be isolated with a relay (Motorola Part No. 59-813674).

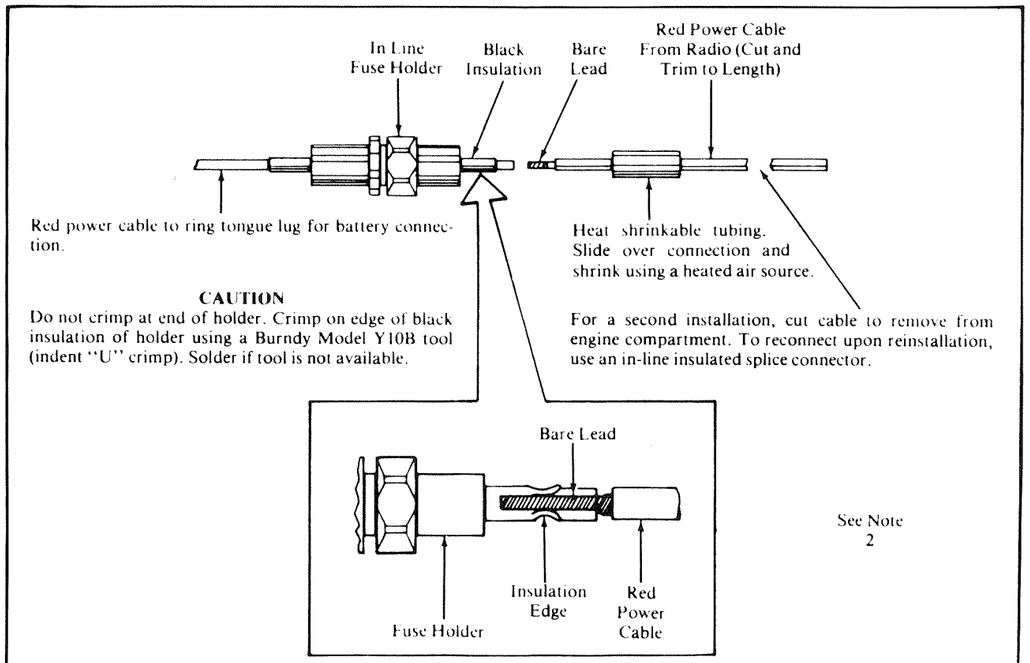


CAUTION

A good chassis connection via the black primary power cable is essential for radio operation and to prevent damage to the radio and cable kit. Connection to the vehicle frame is desirable.



DETAIL A
RADIO SET CHASSIS CONNECTION



CAUTION

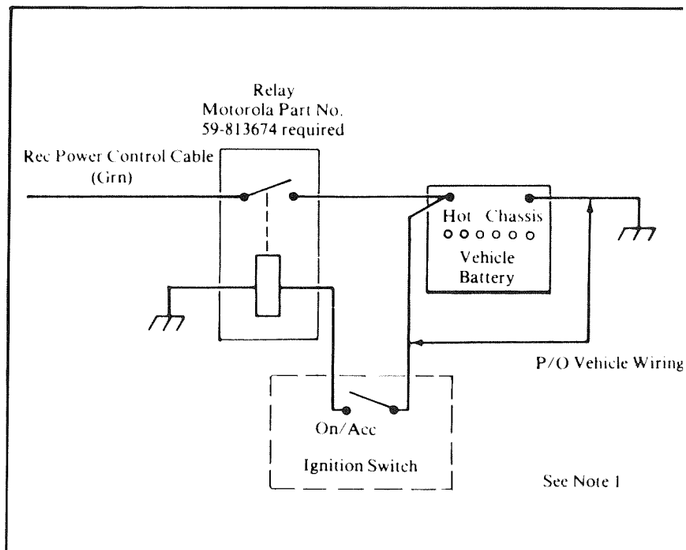
Do not crimp at end of holder. Crimp on edge of black insulation of holder using a Burndy Model Y10B tool (indent "U" crimp). Solder if tool is not available.

DETAIL B
BATTERY HOT IN-LINE FUSE INSTALLATION

NOTES:

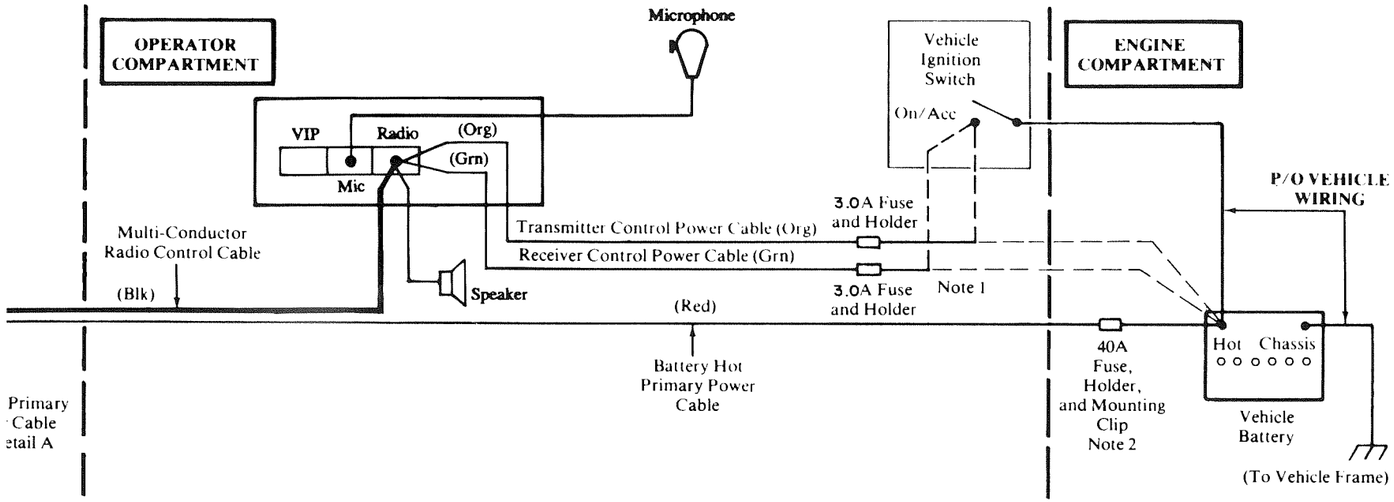
1. The transmitter power control cable (ORG) and the receiver power control cable (GRN) may be connected to the vehicle battery or to the ignition switch. The recommended configuration of these cables connects the receiver control cable (GRN) directly to the battery and the transmitter control cable to the ignition switch (at the ON/ACC terminal). In this configuration, the receiver is operable whenever the control head is turned on but the transmitter is operable only when the ignition switch is turned on (as well as the control head). If both cables are connected directly to the battery, the entire radio is operable (under control of the control head). If both cables are connected to the ignition switch, the radio is operable only when the ignition switch is turned on. In this configuration, alternator whine and other noise problems may occur in the receiver section. If this is the case, the receiver control cable may be isolated with a relay (Motorola number 59-813674 or equivalent) as shown in Detail C.
2. The radio battery hot primary power cable is supplied as two pieces, a red cable which is part of the radio control cable kit and another red cable with an in-line fuse on one end and a ring tongue lug on the other. After routing the radio power cable from the radio connector to the engine compartment, these cables are spliced as shown in Detail B. Refer to the cable routing procedure for further details.

GCW-3005-0



DETAIL C
RECEIVER POWER CONTROL ISOLATION

Figure 2. Ca



Primary
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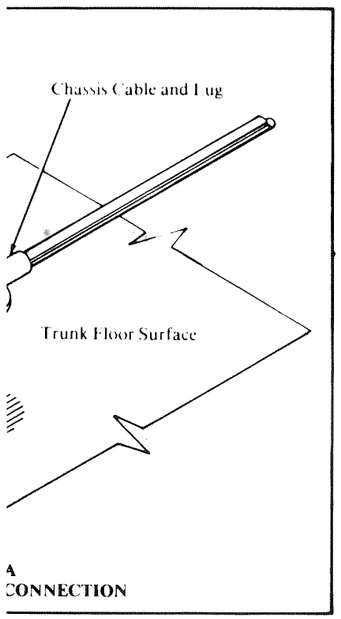
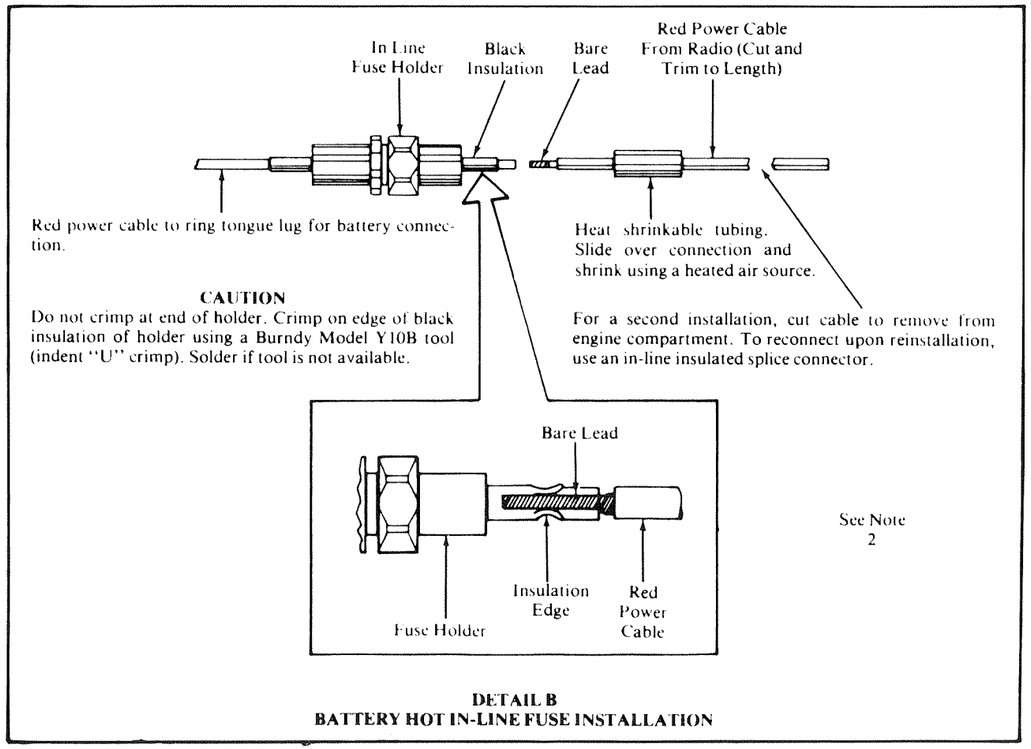


A
CONNECTION



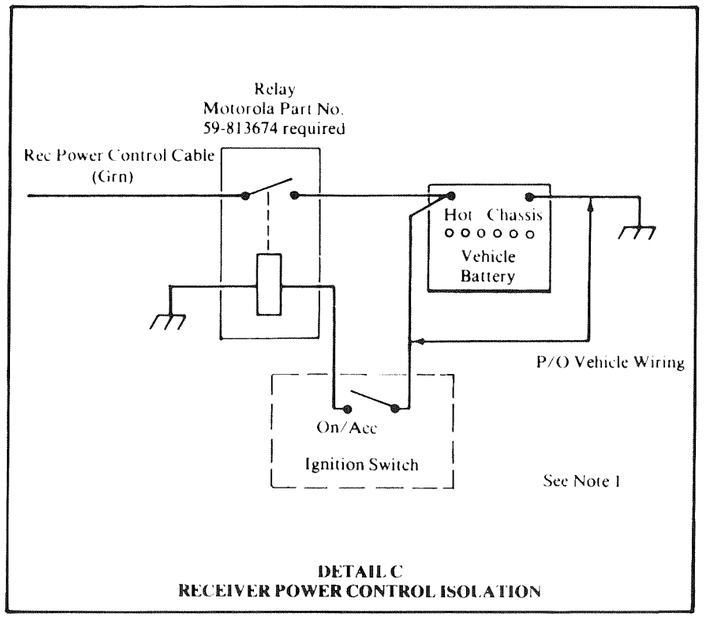
DETAIL B
BATTERY HOT IN-LINE FUSE INSTALLATION

NOTES:

1. The transmitter power control cable (ORG) and the receiver power control cable (GRN) may be connected to the vehicle battery or to the ignition switch. The recommended configuration of these cables connects the receiver control cable (GRN) directly to the battery and the transmitter control cable to the ignition switch (at the ON/ACC terminal). In this configuration, the receiver is operable whenever the control head is turned on but the transmitter is operable only when the ignition switch is turned on (as well as the control head). If both cables are connected directly to the battery, the entire radio is operable (under control of the control head). If both cables are connected to the ignition switch, the radio is operable only when the ignition switch is turned on. In this configuration, alternator whine and other noise problems may occur in the receiver section. If this is the case, the receiver control cable may be isolated with a relay (Motorola number 59-813674 or equivalent) as shown in Detail C.

2. The radio battery hot primary power cable is supplied as two pieces, a red cable which is part of the radio control cable kit and another red cable with an in-line fuse on one end and a ring tongue lug on the other. After routing the radio power cable from the radio connector to the engine compartment, these cables are spliced as shown in Detail B. Refer to the cable routing procedure for further details.

GCW-3005-0



DETAIL C
RECEIVER POWER CONTROL ISOLATION

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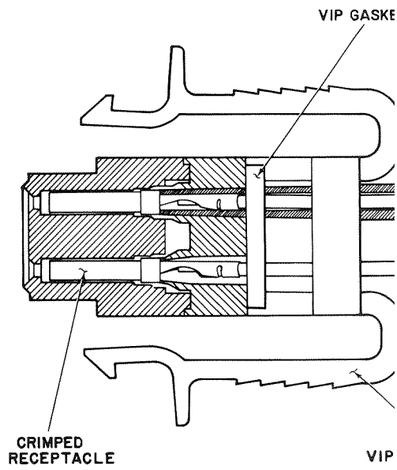

Figure 2. Cable Routing Details

ransmitter power control cable (ORG) and
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s connects the receiver control cable (GRN)
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control head). If both cables are connected
ignition switch, the radio is operable only
the ignition switch is turned on. In this con-
tion, alternator whine and other noise pro-
may occur in the receiver section. If this is
se, the receiver control cable may be isolated
a relay (Motorola number 59-813674 or
lent) as shown in Detail C.

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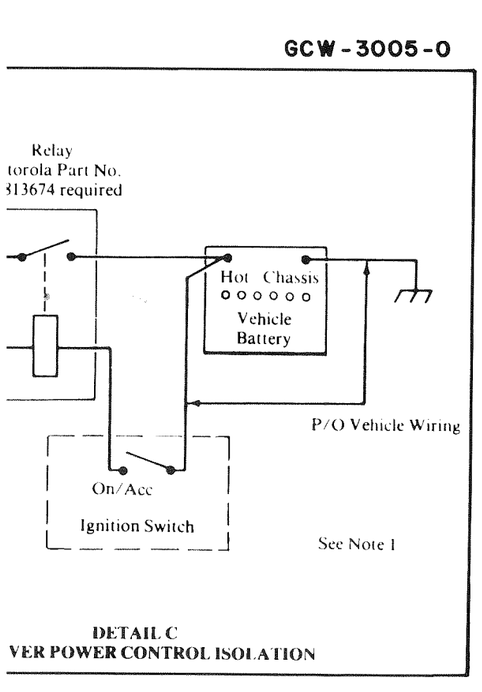
nt, these cables are spliced as shown in
B. Refer to the cable routing procedure for
details.



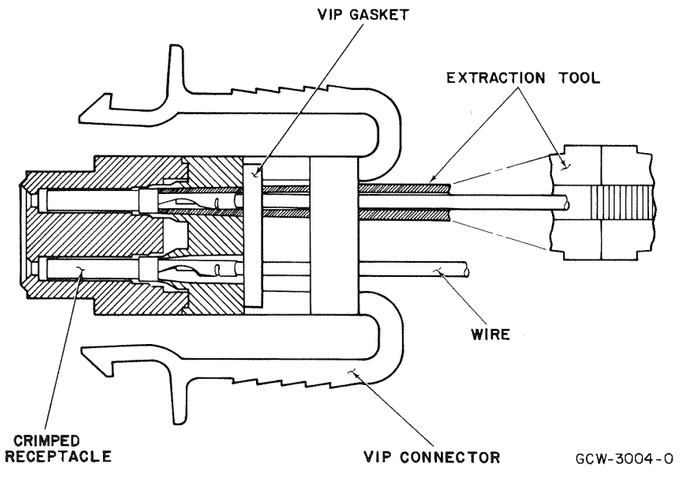


Figure 2. Cable Routing Details

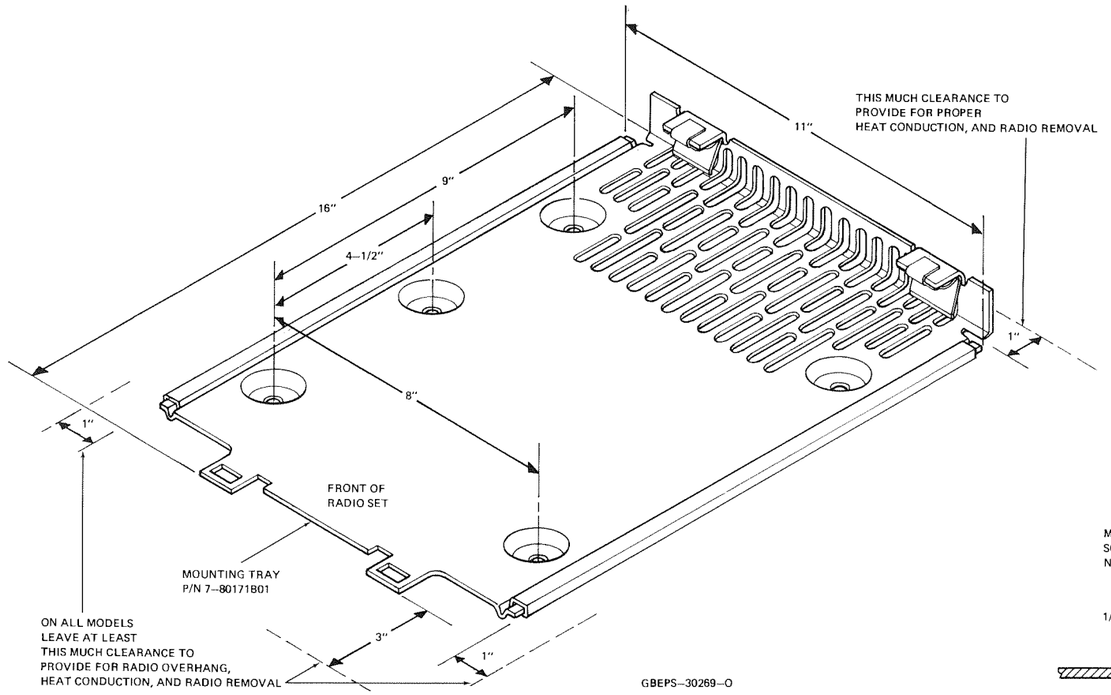


Figure 3. Mounting Tray

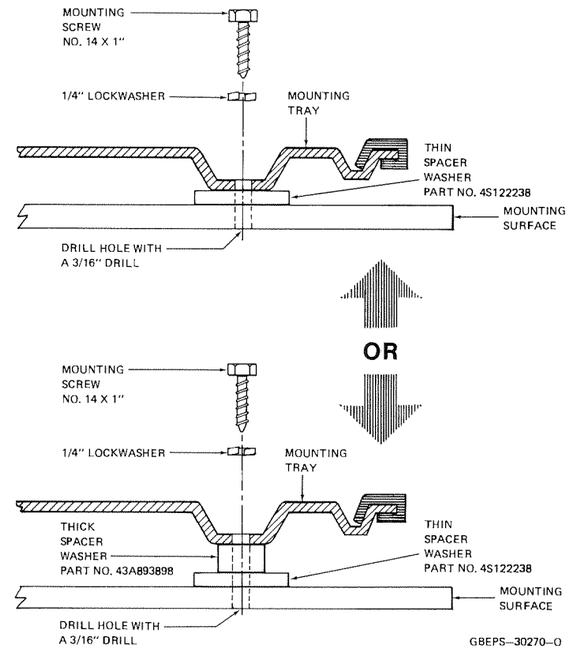


Figure 4. Mounting Tray Installation Detail

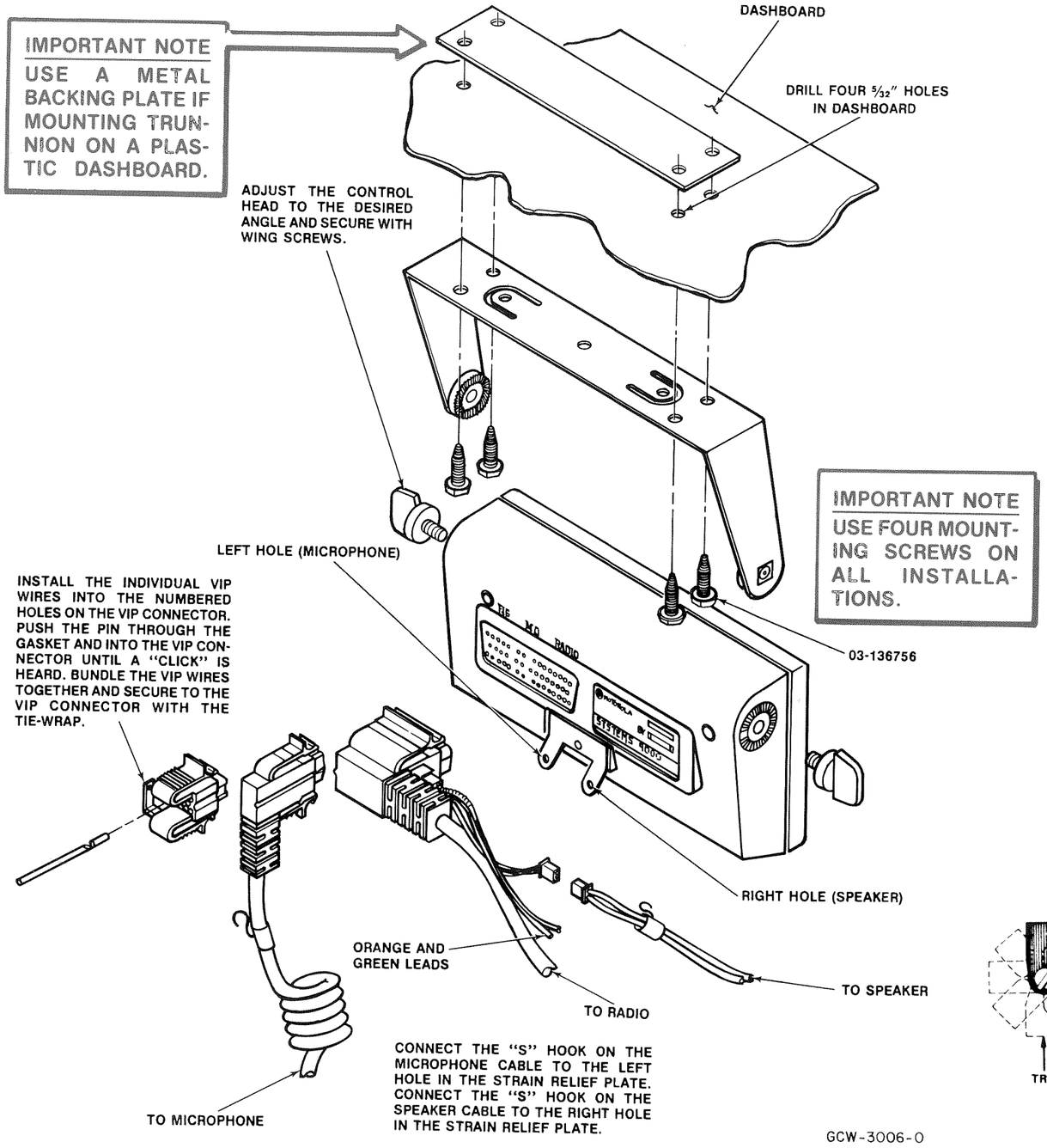


Figure 5. Control Head Installation Exploded View

Cable Routing Detail and
Radio Mounting Instructions
PEW-2423-O
(Sheet 2 of 2)
12/5/85

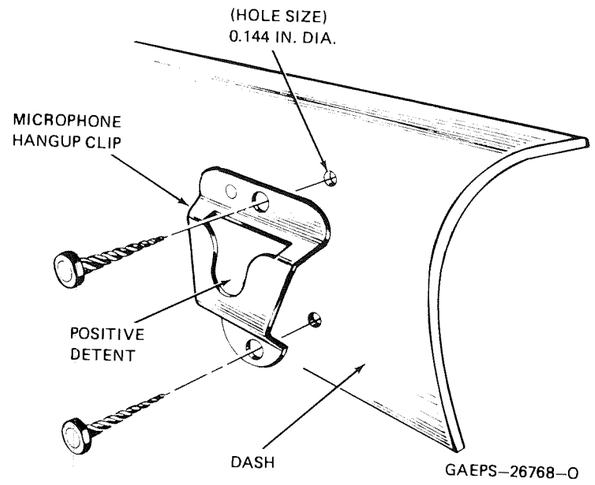


Figure 6. Microphone Accessory Installation

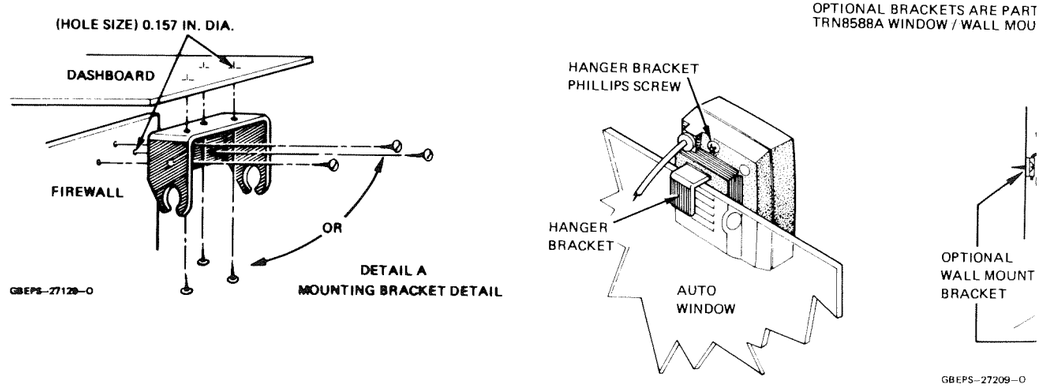


Figure 7. Speaker Installation Detail

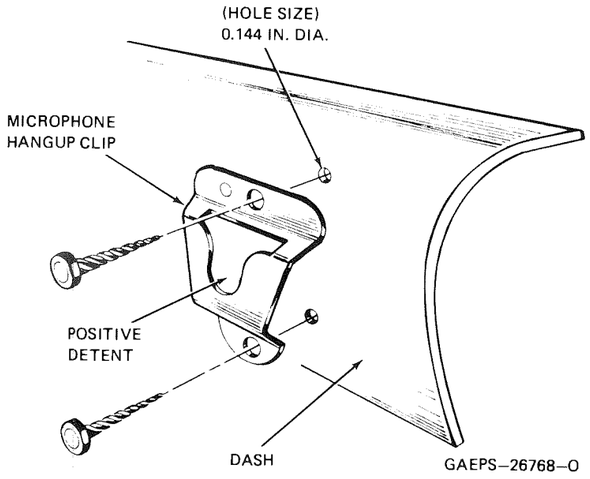


Figure 6. Microphone Accessory Installation

parts list

HLN4952A Fuse Kit for Green and Orange Leads MXW-2273-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	14-82882A01	insulator, fuse holder body
	14-82883A01	insulator, fuse holder cap
	29-00136968	lug
	29-00824456	ring tongue lug
	29-00865065	ring tongue lug
	41-82885A01	compression fuse spring
	42-82884A01	fuse clip
	65-00020404	3 amp fuse, 250V, 2 used

FUSE HOLDER
ORANGE/GREEN

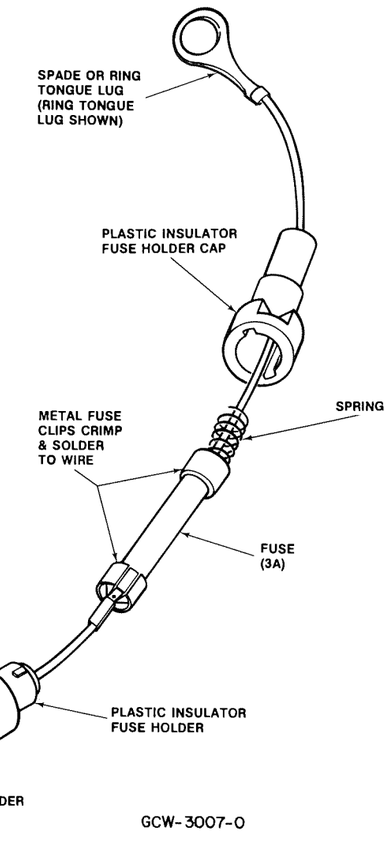
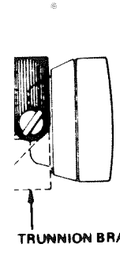
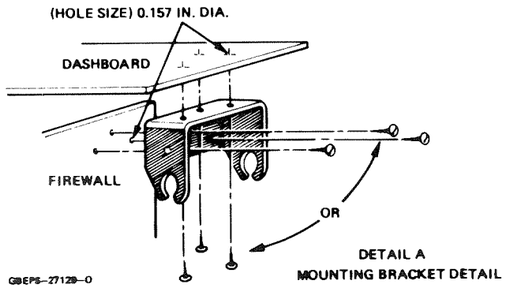
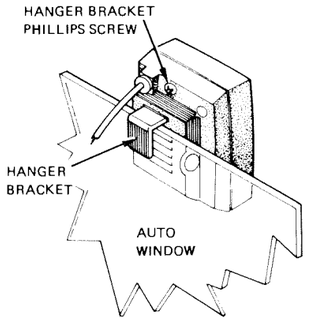


Figure 8. Fuse Assembly







NOTE
OPTIONAL BRACKETS ARE PART OF THE
TRN8588A WINDOW / WALL MOUNTING KIT.

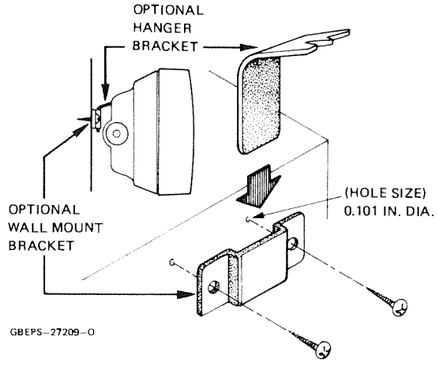
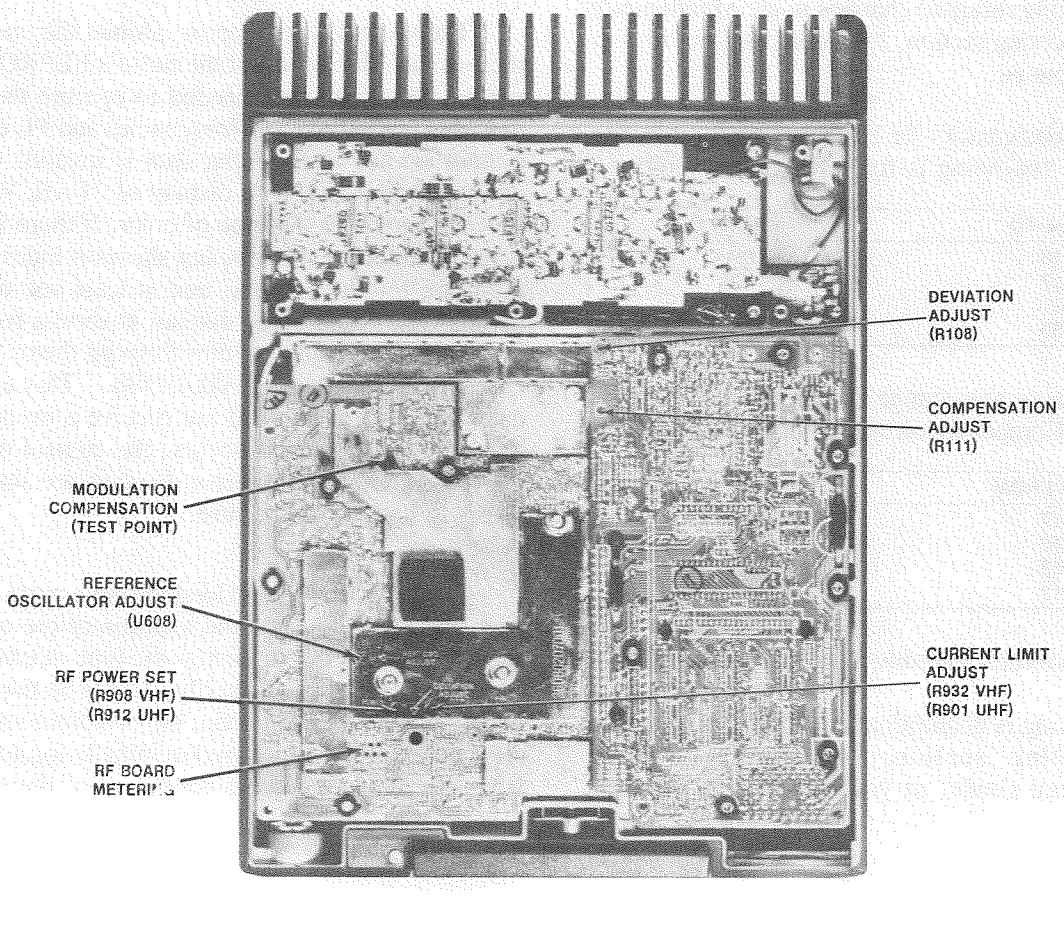


Figure 7. Speaker Installation Detail



Typical SYNTOR X *9000 Radio (Top View)*

1. General

All radio adjustments are accomplished from the TOP of the radio. See preceeding figure.

2. Oscillator Frequency

This replaces steps 1 and 2 in the Maintenance and Troubleshooting section of your Instruction Manual.

(1) When adjusting the oscillator frequency, it is necessary to use the mode rocker to set the radio on a carrier squelch transmit mode.

(2) Use the portable test set to key the transmitter without modulation.

3. Compensation

The following refers to changes in the Maintenance and Troubleshooting section, 2.4 Compensation, in your Instruction Manual.

Reference designators for UHF and VHF radios are changed. The following is for VHF radios only:

Change TO	FROM
R516	R111
R517	R108
R911	R908
R939	R932

The following are changes in sections 2.3 Deviation and 2.4 Compensation for UHF radios only:

Change FROM	TO
R517	R108
R516	R111
R908	R912
R917	R901

4. General System Troubleshooting Guide

The following is in addition to the Maintenance and Troubleshooting section, 4. General System Troubleshooting Guide, of your Instruction Manual.

4.1 SYSTEM SELF CHECK

When the radio system is turned on it displays "SELF CHECK." During this time each processor does a diagnostic check. This includes checking ROM, RAM, EEPROMs, and serial bus circuitry. If no errors are detected, the display shows the selected mode. If there are any errors, they are displayed for two seconds each, after the self check display.

There are two types of errors. The first type does not stop the system from operating. This error occurs if an option board is not communicating on the serial bus. In this case the display indicates "ERROR WX/YZ." WX/YZ specifies the error. When this display appears, the operator is alerted by a beep. The system continues to operate without the option.

The second type of error inhibits the operation of the system. This occurs if the radio's EEPROM is corrupted. Since the data needed to operate the radio is stored in the EEPROM (frequencies and PL codes) the system cannot work if that data is invalid. This type of error is indicated by a display of "FAIL WX/YZ." WX/YZ specifies the type of error. If there is a single error of this type, the display shows it indefinitely. If there are multiple errors, and at least one of them is of this type, each error display is shown for two seconds and the display cycles through them. A special case exists for error "FAIL 01/90." This error indicates the control unit did not receive a message from the radio. If this error occurs, the control unit resets the system after all the error displays are shown in an effort to correct the failure.

The error code is divided into two parts. The first part, "WX," indicates the location of the error. The second part, "YZ," indicates the type of error. While the problem is not necessarily located on the board indicated by the location code, the troubleshooting guide for that board should be used to initially locate the problem. See Table 1 for interpretation of these codes.

Table 1. General System Troubleshooting Guide

Display Shows:	Replace U500	Replace U501	Reprogram EEPROM or check J501/502	Action to be taken
FAIL 01/81		X		
FAIL 01/82			X	*Check jumpers. If FAIL after reprogramming, replace U502.
FAIL 01/83		X	X	*
FAIL 01/84			X	*
FAIL 01/85		X	X	*
FAIL 01/88	X			
FAIL 01/89	X	X		
FAIL 01/8A	X		X	*
FAIL 01/8B	X	X	X	*
FAIL 01/8C	X		X	*
FAIL 01/8D	X	X	X	*
FAIL 01/90		Serial Bus Failure		Check cable kit. See Personality, Control Unit trouble charts.
FAIL WX/90		Option #WX Serial Bus Failure		See option trouble chart.
ERROR WX/90		Option #WX Serial Bus Error		See option trouble chart.
ERROR WX/YZ		Option #WX Error		See option trouble chart.

*Jumper J501 must be in place for 2K EEPROM or Jumper J502 must be in place for 8K EEPROM.

#WX CODE	Option
08	Siren/PA
09	*Securenet*
0A	*MDC-600*
0B	*MDC-600*
0D	*MVS*

1. General

This section replaces the Microcomputer System Section of your Instruction Manual beginning with section 2. Theory of Operation, and continues to the end of Microcomputer System.

2. Theory of Operation

2.1 INTRODUCTION

The *SYNTOR X* 9000 personality board consists of two major sections; the digital section, and the analog section. The digital section is notated by the 500 series part designators. The analog section is notated by the 100, 200, 300, and 400 series part designators.

2.2 DIGITAL SECTION

The digital section communicates with the control head and the options over a serial bus link to receive and transmit information. This section also monitors parallel inputs from the radio. The digital section microprocessor uses both serial bus inputs and radio parallel inputs, to decide response to and control of the system. The digital section controls the radio since it controls the parallel outputs.

The outputs are controlled to perform various functions including:

1. audio routing
2. synthesizer programming
3. transmitter enables
4. audio volume level control
5. PL and DPL detection
6. PL and DPL generation
7. squelch level control
8. alert tone generation

The major blocks in the digital section are:

1. U500—microprocessor
2. U501—program ROM
3. U502—customer system/mode EEPROM
4. U503—synthesizer programming latch
5. U504—audio control latch
6. U506—address decoder
7. HY500—watchdog timer hybrid
8. U505 and supporting circuitry-serial bus transceiver

2.3 ANALOG SECTION

The personality board analog section contains all the non-RF analog circuitry in the radio, with the exception of the voltage regulators and the RF power control. The analog section circuitry is grouped by circuit designators as follows:

100 series	transmit audio circuitry
200 series	receive audio circuitry
300 series	circuitry common to receive and transmit
400 series	audio power amplifier

The analog section provides various audio and sub-audio filtering, summing, and amplifying functions that include:

1. receive audio switching
2. transmit audio switching
3. microphone pre-emphasis and deviation limiting
4. VCO compensation adjustment
5. discriminator de-emphasis filtering
6. received PL/DPL filtering and detection
7. PL/DPL D/A converter and filtering (PL/DPL generation)
8. RF carrier detect/undetect (squelch)
9. digitally controlled audio attenuator
10. audio power amplifier
11. option receive and transmit summing/buffering

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W10001S41-A
4/29/86

The major blocks of the analog section are:

1. U300—custom switched capacitor filter IC
2. 4 MHz crystal controlled oscillator (clocks U300)
3. U301—quad op-amp; microphone pre-emphasis/limiter; option RX and TX summer/buffer; bias voltage buffer
4. HY300—audio switching hybrid
5. HY301—squelch hybrid
6. U302—pre-amplifier (digitally controlled attenuator)
7. 400 series designator parts—audio power amplifier
8. jumper selections

3. Detailed Circuit Description

3.1 DIGITAL SECTION

3.1.1 Microprocessor System

The microprocessor (U500) with the program ROM (U501), the programmable EEPROM (U502), address decoder (U507), and output latches (U503 and U504) make up the microprocessor system.

The heart of the system is the high-speed CMOS microprocessor that runs at 1.2288 MHz. The processor uses Y500, a 4.9152 MHz crystal, for its time base. This oscillator is internally divided by four at the processor to obtain its operating frequency of 1.2288 MHz.

3.1.2 Address Decoding (U506)

The microprocessor controls the address lines, A14 and A15 output WR, to gain access to U501, U502, U503, and U504. The processor does this through the address decoder U506. The three inputs to U506 on Pins 2, 14, 3, 13, and 15 control U506 outputs to Pins 6, 7, 9, and 11. These signals, zero to five volt logic levels, are active low. When U506-6 is low, the processor is accessing U502 (EEPROM). When U506-7 is low, the processor is accessing U501 (program PROM). When U506-9 is low, U504 is accessed, and with U506-11 low, U503 is accessed.

3.1.3 Program Memory (U501)

The program that the processor executes is contained in the 16k by 8 UV-EEPROM. By manipulating the remaining 14 address lines (A13-A0), the processor can read the instructions stored permanently in the EEPROM. The address lines A14 and A15 are used for address decoding.

3.1.4 Customer Mode EEPROM (U502)

All radio mode information is stored in U502 (EEPROM). The standard EEPROM is 2k by 8 in a 24-pin package. This package is inserted in the rear 24 pins of the IC socket (Pins 1, 2, 27, and 28 are left open). The board design accepts an optional 8k by 8 EEPROM that is a 28-pin part. The EEPROM is reprogrammable, and is read from like the program memory IC (U501). It is also written to by the EEPROM programming mode, described later.

3.1.5 Synthesizer Programming Latch (U503)

The synthesizer programming latch is an eight-bit static latch whose outputs store the digital value (high or low) of its inputs when a low to high transition occurs on U503-11. To load data into the synthesizer, the latch stores correct data (D3–D0) from the customer mode EEPROM, and the corresponding address (A2–A0) with the strobe output high (U503-19). Then the latch stores the same address and data with the strobe output low. This clocks the four bits of data into the synthesizer. For valid programming to occur, this process is repeated for five sets of data with five different addresses. The synthesizer is continually updated to avoid corrupted data passing on a power supply transient condition. The update rate is approximately every 20 milliseconds.

3.1.6 Audio Control Latch (U504)

The audio control latch operates in the same manner as the synthesizer programming latch (U503). In addition, the audio control latch provides signals for five audio routing paths, both squelch level controls, and a control line for audio volume programming.

3.1.7 Watchdog Timer Hybrid (HY501)

The watchdog timer hybrid performs three functions. This hybrid circuit controls the system reset line, monitors the internal microprocessor reset line, and senses the system reset line.

The first function is performed on power-up of the radio system. The hybrid outputs a reset pulse approximately 30 milliseconds long to allow the crystal oscillators in the system to stabilize. The pulse is high on system reset (HY500-10).

Secondly, the watchdog timer monitors its input. The synthesizer strobe from U503-19 should toggle every 20 milliseconds. If the strobe pulse fails to toggle, the watchdog timer times out and initiates a 30-millisecond reset pulse. This is a failsafe in the event the radio's microprocessor gets lost due to a power supply transient.

The third function performed by the watchdog timer hybrid is its sensing of the system reset line. This line is bi-directional. If another processor in the system gets lost due to a transient, that processor initiates

a reset pulse to recover. If the system reset line is pulsed, the watchdog timer stretches the pulse to a 30-millisecond reset pulse.

3.1.8 Serial Bus Transceiver
(U505 and supporting circuitry)

Communication between processors in the system is handled by the serial bus at a data rate of 9600 bits per second. The signals generated are bus +, bus −, and busy. Bus + and bus − carry the same serial data. Bus − is bus + inverted (bus + high, bus − low). In using this pair of signals, the comparator U505 can differentiate between noise and valid data. In normal radio transmission, the radio microprocessor reads the line busy in (U500-9). If found to be HI, the processor pulls busy out high (busy in active LO, busy out active HI), and transmits as message out of TX data (U500-13). To further avoid a collision on the serial bus, the radio processor reads serial RX data (U500-12) as it transmits. If the processor does not read back the same data that it sent out, some error occurred and the radio processor attempts to re-transmit the message. When receiving a transmission, (example: control head transmitting), the radio processor would sense busy in (U500-9) going LO and process the incoming message from serial RX data (U500-12).

3.1.9 EEPROM Programming

The EEPROM (radio mode information) is programmed by communication over the serial bus. Special commands are sent to and from the radio microprocessor from the Epson serial bus programmer or the IBM PC programmer interface.

The EEPROM is equipped with an input called "write-enable" that is active LO (LO writes to the EEPROM). This input is at U502-23 for a 2k by 8 EEPROM or at U502-27 for an 8k by 8 EEPROM. To protect the contents of the EEPROM from being inadvertently written over, the write-enable line is held inactive by the microphone HI audio input. The line is protected to eliminate the possibility of corrupting the EEPROM data during power supply transients or other temporary battery supply conditions that could possibly alter the data. The microphone HI audio input is normally biased up to 9.6 volts while receiving, and pulled to approximately 4 volts when transmitting to power the active element microphone cartridge. When connected to either of the programmers, the microphone input is shorted to ground and allows access to the EEPROM write-enable line.

The microphone line is input to the digital section by R530 pulling the base of Q513 HI and forcing Q513 to pull the base of Q514 LO. With Q514 conducting, the input write-enable (U502-23 for 2k by 8 and U502-28 for 8k by 8) is held HI by Q514. Note that CR502 and CR503 protect the write-enable line in the same manner. The diode CR502 protects the EEPROM write line the instant the radio loses power (switched off) since this signal senses when the 9.6 volt supply falls off. The diode CR503 protects the EEPROM when the system is being reset due to power supply transients.

3.1.10 Power Down Sequence

With the power off, the radio microprocessor is put in its sleep mode. This mode requires to cut back the current drain on the unswitched five-volt regulator from 15 milli-amps to a few micro-amps. The unswitched five-volt regulator remains powered up while the radio is off so that the radio microprocessor retains its memory and powers up in the last mode used. The radio processor retains the last mode, volume level, squelch level, and other operator-selected functions. This eliminates the need for resetting all the controls every time the radio is turned on. For the radio processor to remember its last configuation, inputs are required that allow the processor to store this information before power is shut off to its memory and supporting circuitry (switched five volts turning off). The inputs NMI and STBY are generated to tell the processor that power is coming down.

The signals NMI and STBY are generated by the transistor circuits involving Q516 and Q517. Both signals are active LO, so when NMI is LO, the processor is put in the sleep mode (standby). The transistor Q516 remains off while the 9.6-volt supply is powered up. This is done through R542 that pulls the base of Q516 HI. When the 9.6 volt supply begins to fall off (radio is turned off), Q516 begins to conduct, since its emitter is connected to the unswitched five-volt supply (this supply remains powered). As Q516 begins to conduct, the base of Q517 is pulled HI, and the collector is pulled LO. The collector is connected to U500-8, the NMI input to the processor. The signal STBY is generated by the R-C circuit made by R547 and C521. This signal goes LO approximately 500 microseconds after the NMI signal goes LO. The STBY input is at U500-7.

3.1.11 Test Mode

The radio test mode allows finer audio volume steps to be input to the audio preamp. In standard operation, you can set volume in 30 discrete steps. These steps increment the audio level by approximately 3.2 dB. In the test mode, increments are approximately .4 dB. This allows setting the volume closer to rated audio, more accurately setting the audio volume level, and measuring receive parameters such as RX audio distortion, received FM hum and noise, squelch sensitivity, and other receive parameters.

Enter the test mode by shorting the two pins of jumper J500, and turn the radio on. The radio processor reads this input (U500-21). By shorting this input, the processor reads this port LO, enters the test mode, and enables the finer volume increments. Jumper J500

also disables the watchdog timer. This is useful for troubleshooting. If a malfunction causes the watchdog timer to time out, the timer sends out reset pulses until the system recovers. By shorting J500, the reset pulses stop and the system resumes operation. This allows you to troubleshoot and find the source of a problem without resetting the system.

3.2 ANALOG SECTION

The analog section of the personality board consists of four groups of circuitry. They are transmit audio, receive audio, common circuitry, and the audio power amplifier.

3.2.1 Transmit Audio Circuitry

To handle hardware options more efficiently, there are three possible paths for audio to pass through while transmitting.

The first, the normal microphone path, follows the standard pre-emphasis curve of +20 dB per decade from 300 Hz to 3 KHz, and rolls off sharply at frequencies above 3 KHz.

The second two transmit-audio routing paths are available for hardware options. Both of these paths are accessed through the option TX buffer at J301-12 or J1-3. The input at J301-12 provides for options internal to the radio, and J1-3 provides for options in the external options box. This input is the null port of the op-amp U301-1. The input allows summing of multiple option outputs without interference.

The first transmit audio route is TX splatter. This port, when enabled, displays a flat response from 300 Hz to 3 KHz, and rolls off sharply at frequencies above 3 KHz.

The other transmit route available to the options is TX flat. This port shows a flat response from approximately 2 Hz to above 6 KHz, and does not roll off sharply.

3.2.1.1 Microphone Transmit Audio

The microphone path enters the radio through J1-27. The resistors R101 and R102 with the capacitor C108 provide DC bias for the active microphone element. This signal is available as an input to the options at J301-11.

Microphone HI, after entering the radio, goes to C100. This capacitor blocks DC, and sets the pre-emphasis required to an 18-KHz high-pass corner. The high-pass filter provides the required +20 dB/decade pre-emphasis response. The microphone path is switched in or out by the transmission gate on HY300. The signal is input at HY300-6 and output at HY300-4. The control line to turn the microphone path on is at HY300-11, and microphone mute is active HI. HY300-6 and HY300-4 are the summing node of the op-amp U300-14 with the path closed, so no signal can be measured at HY300-6 unless the path is open (HY300-11 HI).

The microphone signal is amplified by U301 by a factor of 24 (at 1 kHz), so the nominal 80 mV input from the microphone almost sends the op-amp output into clip. A slightly stronger signal causes the output to clip. The signal can never be greater than the output swing of the op-amp. The output of the op-amp is attenuated by the deviation potentiometer R108. This adjustment is used to set deviation of the overall system to below 5 KHz.

After the microphone signal has been pre-emphasized, limited, and the level set through R108, the signal enters the splatter filter at U300-11. The splatter filter provides the sharp roll-off required to frequencies above 3 KHz. The output of the splatter filter (at U300-13) travels to the compensation potentiometer R111. The compensation potentiometer is used to adjust the sensitivity of the VCO modulation port to equal the reference modulation port.

The VCO modulation port response has a high-pass response, and the reference modulation port has a low-pass response. The compensation potentiometer sets the sensitivity of the VCO modulation port so that the overall response of the VCO is flat.

The correct tuneup procedure is to set the compensation potentiometer (R111) first, and then set the deviation potentiometer (R108).

Then the audio signal travels through the series FET (Q101) to the RF board where it is input to the VCO circuitry to modulate the RF carrier during transmit. The series FET (Q101) provides isolation to the VCO mode line during the VCO's receive mode of operation.

3.2.1.2 Option Transmit through Splatter

This option path is one of two paths that a hardware option is able to route audio to be transmitted. The path is enabled by the latch U504 from Pin 6. In normal operation, the port is enabled when the option sends a command over the serial bus. The radio processor then enables the port and keys the radio. The option (for example PTT-ID) enables its audio port to send an audio signal into TX audio. This audio signal is amplified by the op-amp U301-A. The output of U301-A at U301-3 appears at the switch input on U300-9. The switch on U300 functions as an analog transmission gate.

The switch control is at U300-10, and closes the switch when this input is low. The output of this switch is at U300-14. Once routed through this switch, the signal is input to the same limiter op-amp used by the microphone path (U301-D). The signal is amplified to almost clip the output at nominal levels (just as

the microphone path), but it is not pre-emphasized. The output of the op-amp follows the same path as the microphone path: through the deviation limit potentiometer, through the splatter filter, and then to the VCO modulation port through the compensation potentiometer.

3.2.1.3 Option Transmit Flat

This is the second of the TX audio paths available to the hardware options. It is enabled by commands over the serial bus in the same manner as the option transmit through splatter path. This port is enabled by the output of the latch U504-5.

This audio port is named the flat TX port due to the extended response it provides. The flat TX port displays a flat frequency response from approximately 2 Hz to above 6 KHz. This response is required for digital signaling schemes such as the *Securenet* option.

The audio for this path is input from the option the same as the TX splatter path (through U301-A). In this case, the splatter port is not enabled (the switch on U300-14 is open), and the flat port is enabled. The switch enables when the control at U300-22 is high. The audio input to the switch is at U300-21, and the output is at U300-15. The IC provides +7.5 dB of gain from input to output, and also sums with the IC's internal D/A converter.

The D/A converter is used to generates PL and DPL transmit signals with the data lines D3 through D0 at Pins 32, 31, 30 and 29 of U500. These outputs of the processor drive the inputs of the D/A on U300 at Pins 25, 26, 27, and 28. The D/A on U300 requires the reference voltage at U300-1 to function properly. The reference voltage is a resistive divider, formed by R307 and R308, and provides the required 1.3 volts DC to this input. The output of the D/A is at U300-15. As discussed in the option TX flat section, the D/A is summed with the TX flat path.

PL and DPL are used only when the microphone path or the option TX through the splatter path are enabled. The only signal present at U300-15 is a TX flat signal or a PL/DPL, but not both. The output of U300-16 is normally 500 mV above the analog ground voltage (Vag) at U300-7. The output, when generating PL or DPL, swings symmetrically about this normal voltage (Vag + 500 mV). The output at U300-15 follows the same paths as those described in the TX flat path section, and the signal is input to both the VCO modulation input and the reference modulation input to the RF board.

The output of the TX flat switch (U300-15) is routed to two different inputs to the VCO. The first is the VCO modulation port, and the second is the reference modulation port.

The TX flat signal routing to the VCO modulation port is from the output of the TX flat switch (U300-15). The signal is attenuated by R116 and R117. The attenuated signal is input to U300-8. The input is summed internally with the splatter filter input, and is output at U300-13. This summing node allows PL or DPL to be summed with normal audio from the microphone path, and, in this case, allows the TX flat audio to reach the VCO modulation port. The output of U300-13 travels to the VCO modulation port via the compensation adjust potentiometer. The TX flat signal routing to the reference modulation port is through resistive attenuators. The jumpers JU101, JU102, JU103, and JU104 select the proper attenuation required for low-band, VHF, UHF, and 800-MHz bands respectively. The TX flat signal passes through the DC blocking capacitor C105, and then to the reference modulation port. The transistor Q100 shunts the reference modulation port to ground when the radio is powered up, and allows the VCO to lock more quickly when first powered up.

Due to the high deviation required by *Securenet*, the transistor Q100 is removed from the circuit by removing JU100 on *Securenet* model radios. If not removed from the circuit, the transistor Q100 begins to conduct, and distorts the signal.

3.2.2 Receive Audio Circuitry

There are four paths in the receive audio circuitry for audio output through the speaker. These paths are the discriminator path, the option through receive audio filter path, the option through flat response path, and the alert tone path.

The discriminator path is the recovered audio output from an RF signal at the antenna input. This path exhibits a −20 dB/decade response from 300 Hz to 3 KHz. The response falls off sharply with frequencies below 300 Hz and above 3 KHz.

The Personality Board provides two inputs in the receive audio path for hardware options for the receive audio string. First is RX through received audio shaping that follows the same response as the discriminator path, −20 dB/decade from 300 Hz to 3 KHz. Second is the RX flat that displays frequency response from 200 Hz to 10 KHz. The final path in the receive audio string is the alert tone path. This path allows the radio microprocessor to sound alert tones through the speaker.

3.2.2.1 Discriminator Audio

The discriminator audio path is input to the personality board from the RF board via P601-3. The discriminator path is then input to the transmission gate hybrid (HY300) through C201. C201 provides DC blocking. The input to HY300 is at HY300-7, and the output is at HY300-8. The control line for disc mute is controlled by the output of U500-26. The control line is input to HY300-11, and is active HI (HI mutes the

audio). The output of HY300-8 inputs to the receive audio shaping filter on U300. The receive audio shaping filter input is at U300-20, and is not switched. An input between 300 and 3 KHz always causes an output at U300-17. The filter provides the standard de-emphasis response of −20 dB/decade from 300 to 3 KHz. The received audio shaping filter provides band-pass filtering. The pass band is approximately 270 Hz to 3.5 KHz. The filter exhibits a loss of −3 dB at 1 KHz.

The radio microprocessor decodes received PL or DPL, and determines if the proper code is present. The radio bases this decision on its input from the comparator on U300. The discriminator output from the RF board (P601-3) is input to the PL/DPL filter on U300 through C200. Input to the PL input filter is at U300-19. The PL filter has a low pass response, and changes its response when the selected mode is a PL mode or a DPL mode. The PL filter, when input PL/DPL is low (PL response), rolls off at approximately 250 Hz. When on a DPL mode (U300-23 is high), the PL filter rolls off at approximately 150 Hz. The output of the PL filter (U300-16) is averaged by R205 and C209 for PL, and R205 and C210 for DPL. The DC averaged signal is input to the negative input of the comparator on U300. The negative input is at U300-4 and the positive input is at U300-5. The PL filter output connects to the positive input of the comparator. This causes the output of the comparator (U300-3) to swing high when a positive going signal is output from the discriminator. The comparator output swings low when the discriminator output has a negative going signal. The output of the comparator attenuates by R208 and R209, and is read by the processor input at U500-24.

The output of the receive audio shaping filter inputs to the audio preamp (U302) through the audio summing node via R200. The audio summing node consists of R200, R201, R202, R203, and C202. The summing node provides attenuation for the receive audio shaping path, RX flat path, and the alert tone input. The summing node inputs to the audio preamplifier U302-15. The preamp is a digitally-controlled, variable gain buffer whose gain can vary from −70 to +18 dB. The gain is controlled by U500 and U503 through the control lines, UCS data, UCS write-enable, and UCS clock. The preamp gain is programmed with a serial data stream that controls the volume. The serial data appears on the UCS data line, and is clocked in bit by bit by the UCS clock when write-enable is low. The preamp has another control to force its output to mute at U302-13. The mute line is an output of U500-25, and is active LO (LO mutes the preamp). The output of U302 next feeds into the audio power amplifier through C400 that blocks DC. The audio power amplifier is a class A/B amplifier stage, and runs approximately 200 milli-amps of bias to the collectors of final output transistors (Q400 and Q401) while idling with no audio input. The audio power amplifier provides +34 dB of gain and presents an output impedence of 8 ohms to drive an 8-ohm speaker. At the nominal battery voltage of 13.8 volts, the power amp delivers over 15 watts of power with total harmonic distortion below 3%.

3.2.2.2 Option Play through Receive Audio Shaping

The first option path available to the hardware options is RX through receive audio shaping filter or RX-RAS. The internal options access the RX audio ports through J301-10, and the options residing in the external opitons box access the RX audio ports through J1-33. Both RX audio ports, RX-RAS and RX flat, are enabled in the same manner as TX audio ports, by commands over the serial bus.

The RX audio signals are input through J301-10 and/or J1-33, and are summed and buffered by the option RX buffer op-amp U301-C. The input is the null port at U301-8, and allows options access without interference. The output of the option RX buffer is connected to two inputs to HY300.

The input at HY300-9 is the input for RX-RAS. The control input for RX-RAS is at HY300-2, and comes from the output of U504-2. The control is active low (HI when the switch is open). With the control low, the RX-RAS enables, and the signal output drives the input of the receive audio shaping filter. The signal path follows the same path as the discriminator audio path discussed earlier.

3.2.2.3 Option Play Flat Response

The option play flat response is input to the option RX buffer, the same as the option play through RAS. The option RX buffer output (U301-10) connects to the RX flat switch (HY300-9). This switch is controlled by U504-5, and is active low (HI when the switch is open). The control line input to the hybrid is at HY300-13. When enabled (closed), the RX option buffer connects directly to the audio summing node by R201. The summing node sets the correct attenuation for the input to the audio preamplifier. The remainder of the path is the same for the discriminator audio path.

3.2.2.4 Alert Tones

The alert tones are generated by the radio microprocessor by toggling its output at U500-15. This output is AC coupled by C208, and is summed directly into the audio summing node through R202.

3.2.3 Power Amplifier

The power amplifier is biased to 5.0 volts at its positive input by resistors R400 and R401. The dual output op-amp U400 drives the pre-driver transistors (Q403 and Q402). The outputs of the op-amp are approximately 2.1 volts apart, and U400-4 is higher than

U400-1. The banded transistor pairs, Q403 and Q402, are graded NPN pairs and graded PNP pairs respectively. The pairs are graded to match base to emitter voltage drops. Ths transistors Q403-A and Q402- A form a current mirror into transistors Q403-B and Q402-B. The current is fixed through Q403-A and Q402-A by resistor R406.

When unmuted transistor Q404 is conducting, the bias current is higher than when muted. The mirrored current through Q403-B and Q402-B provides the base drive for the final output 6 transistors. The DC feedback for the op-amp U400 comes from the tap between R407 and R408. The feedback DC biases the entire feedback winding of the transformer (Pins 7, 8 of T400). The transformer input windings (Pins 1, 6; Pins 2, 5) are driven by the final output transistors Q401 and Q400 respectively. The output winding of the transformer is routed from J1-37 and J1-22 in the radio, through the cable kit, into the control head, and finally to the speaker.

3.3 SUPPORT CIRCUITRY COMMON TO RECEIVE AND TRANSMIT

Supporting circuitry appears throughout the analog section of the personality board. All of the 300 series designators provide functions such as supply bypassing, etc. Two of the supporting sections are worthy of special note, the 4-MHz oscillator and the analog ground buffer op-amp.

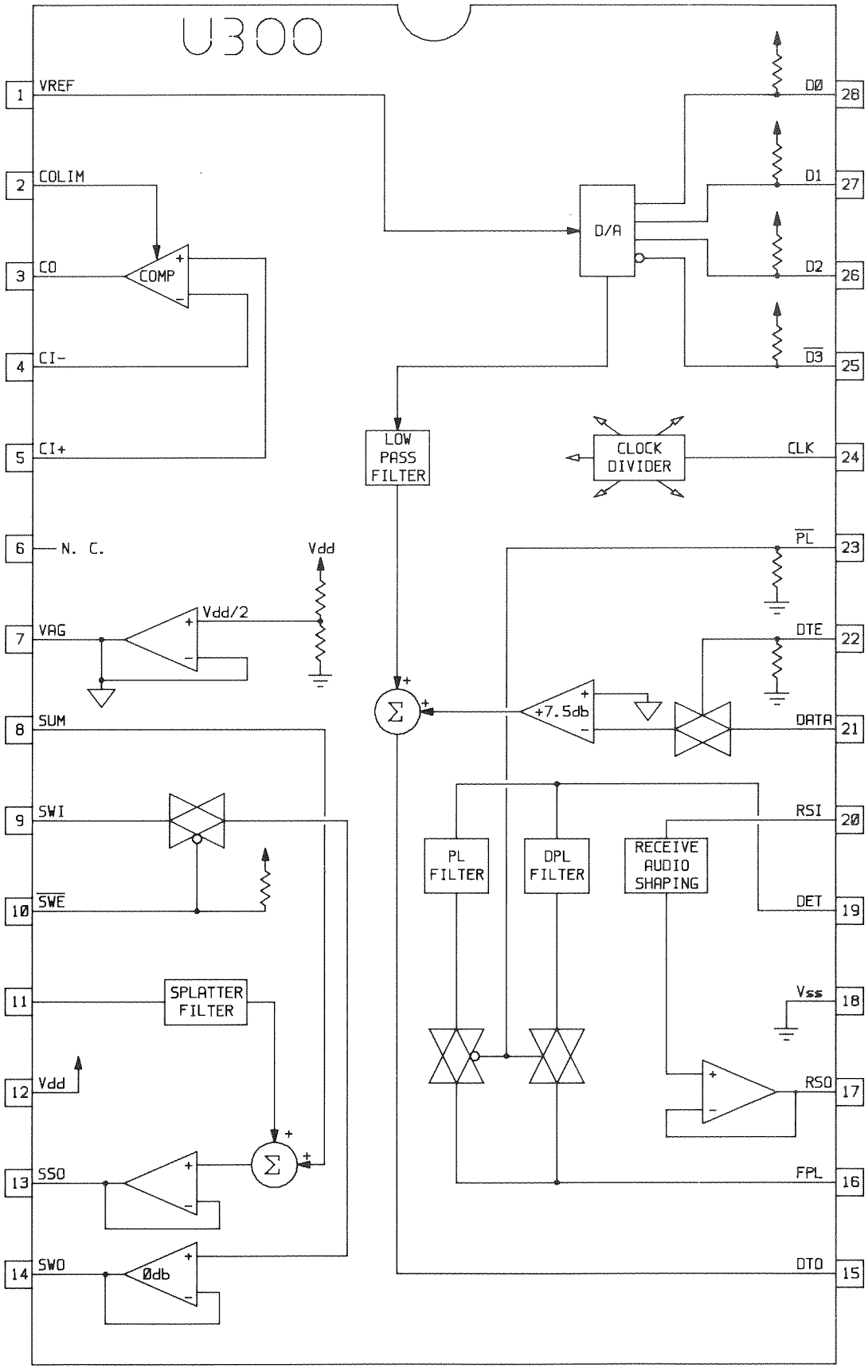
3.3.1 4-MHz Oscillator

The linear crystal oscillator provides the switched capacitor filter IC (U300) with its clocking rate. The oscillator provides a 4-MHz sine wave (distorted) at an amplitude of approximately 700 mV peak-to-peak to the clock input (U300-24). The oscillator uses Q300 and Y300 to produce the signal.

3.3.2 Analog Ground Voltage Buffer

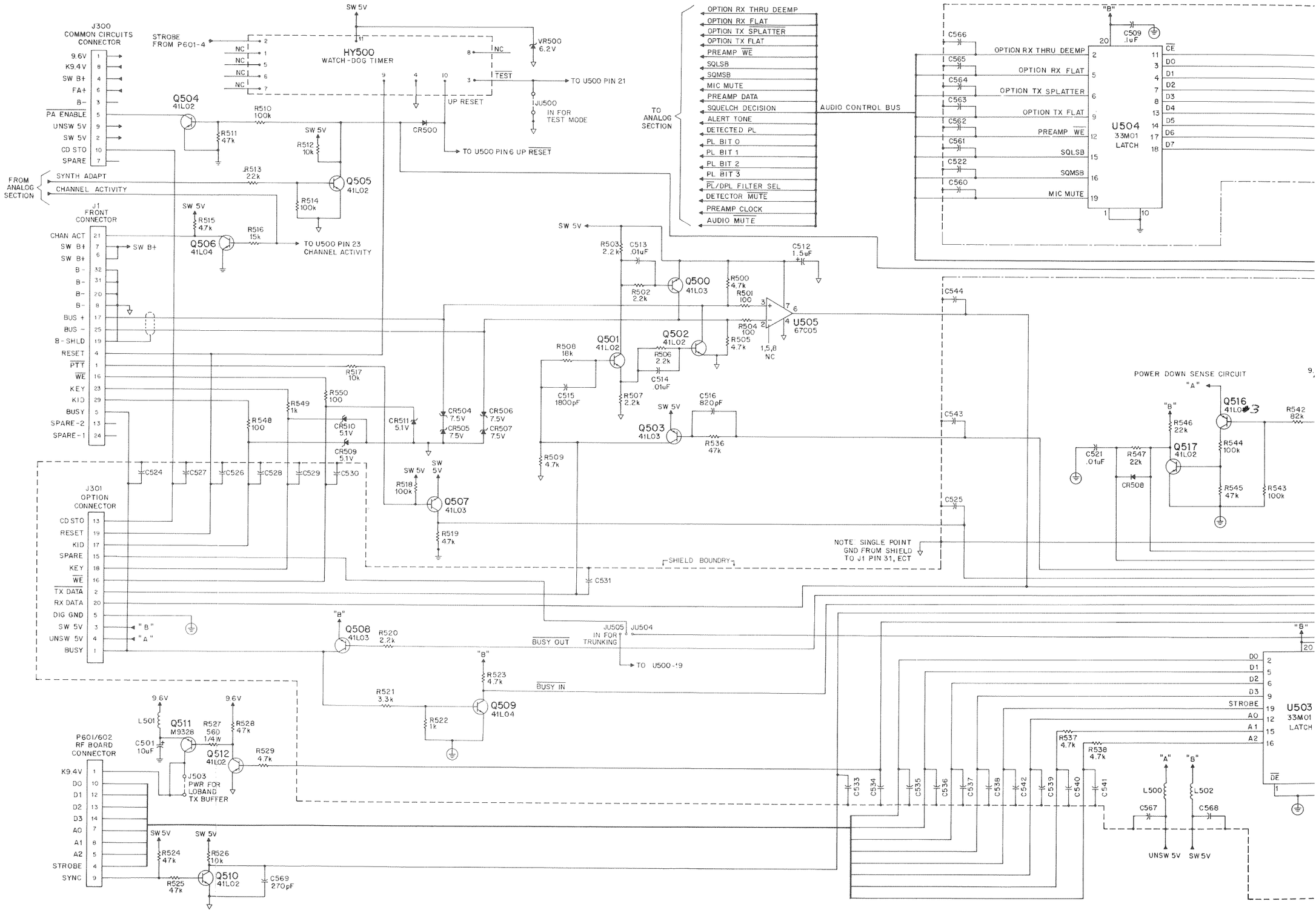
The op-amp U301-B is a unity gain voltage follower. The op-amp output buffers the output of the Vag reference output (U300-7). IC U300 biases internally to approximately half of its 9.6-volt supply. To reduce audio transients when switching an audio path in or out, the buffered analog ground voltage biases all audio circuitry except the audio power amplifier. The analog ground voltage is presented to the internal hardware options via J301-8, so the options can use this DC potential to bias their analog circuitry.

U300 BLOCK DIAGRAM



GCW-2585-O

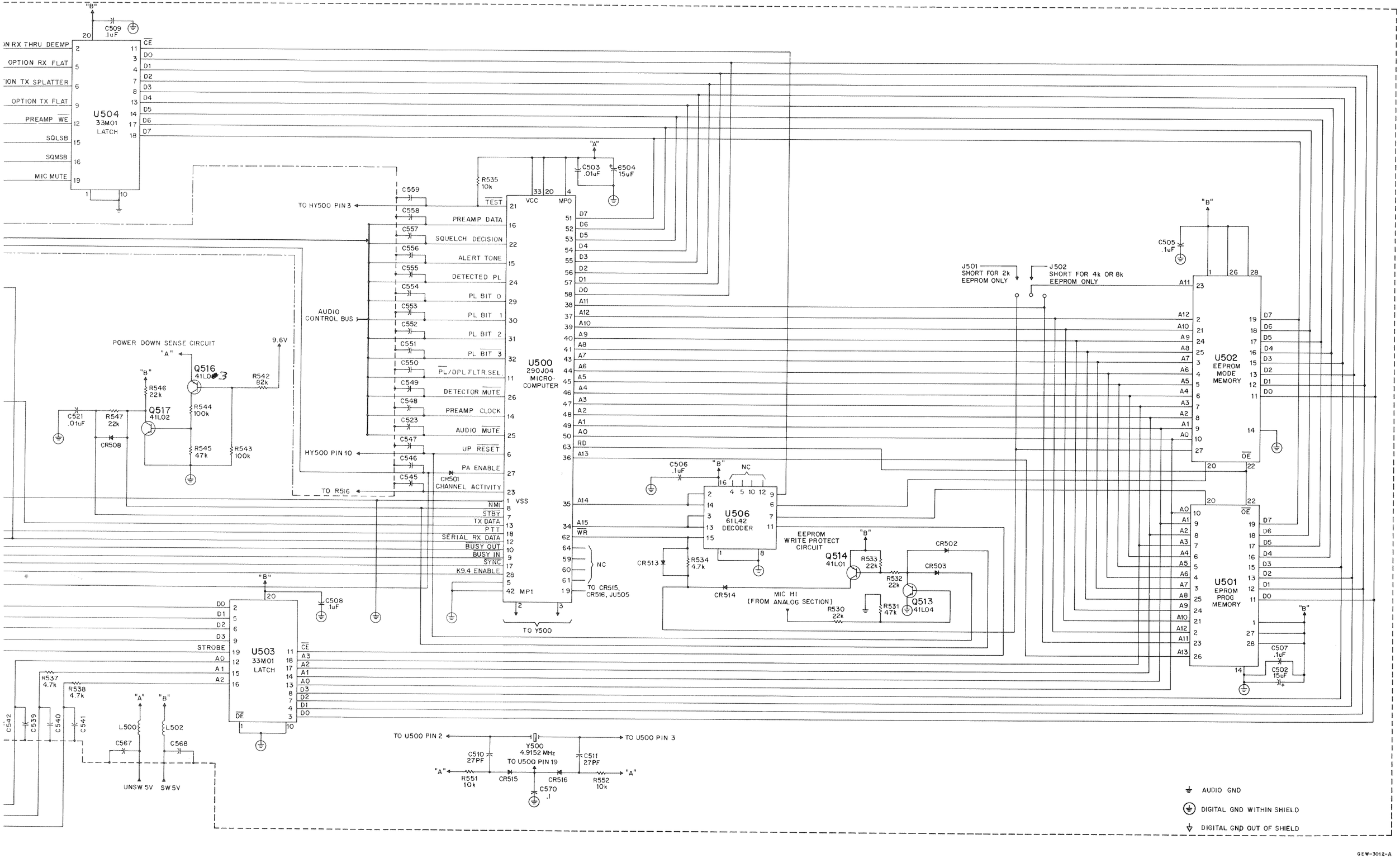
Schematic, Circuit Board Diagram
and Parts List for HLN4925D
Personality Board
PW-2586-C
(Sheet 1 of 4)
4/21/87



NOTE:

IF YOUR CIRCUIT BOARD IS A "D" VERSION, PINS 2, 4, 5, 7, 8 AND 9 OF P601/602 ARE CONNECTED TO SW 5V BY 220 pF CAPACITORS

Schematic, Circuit Board Diagram and Parts List for HLN4925D Personality Board
PW-2586-C
(Sheet 2 of 4)
4/21/87


U504 33M01 LATCH
U503 33M01 LATCH
U500 290J04 MICRO-COMPUTER
U501 EPROM PROG MEMORY
U502 EEPROM MODE MEMORY
U506 61L42 DECODER
ON RX THRU DEEMP
OPTION RX FLAT
ION TX SPLATTER
OPTION TX FLAT
PREAMP WE
SQLSB
SQMSB
MIC MUTE
STROBE
TO HY500 PIN 3
AUDIO CONTROL BUS
PREAMP DATA
SQUELCH DECISION
ALERT TONE
DETECTED PL
PL BIT 0
PL BIT 1
PL BIT 2
PL BIT 3
PL/DPL FLTR.SEL.
DETECTOR MUTE
PREAMP CLOCK
AUDIO MUTE
UP RESET
PA ENABLE
CHANNEL ACTIVITY
HY500 PIN 10
TO R516
NMI
STBY
TX DATA
PTT
SERIAL RX DATA
BUSY OUT
BUSY IN
SYNC
K9.4 ENABLE
MP1
TO Y500
NC
TO CR515, CR516, JU505
MIC HI (FROM ANALOG SECTION)
EEPROM WRITE PROTECT CIRCUIT
POWER DOWN SENSE CIRCUIT
9.6V
Q516 41L03
Q517 41L02
Q514 41L01
Q513 41L04
J501 SHORT FOR 2k EEPROM ONLY
J502 SHORT FOR 4k OR 8k EEPROM ONLY
Y500 4.9152 MHz
TO U500 PIN 2
TO U500 PIN 3
TO U500 PIN 19
UNSW 5V
SW 5V
AUDIO GND
DIGITAL GND WITHIN SHIELD
DIGITAL GND OUT OF SHIELD
GEW-3012-A

parts list

HLN4925D *Systems 9000* Personality Board — MXW-2486-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed, μF ±10%, 50V unless otherwise stated
C100	08-11051A07	.01 pF ±5%, 63V
C101	21-11031A49	270 pF ±5%
C102	21-11031A31	47 pF ±5%
C103	21-11032A21	.01
C104	08-11051A02	.0015 ±5%, 63V
C105	23-11048C11	10 pF ±20%, 35V, electrolytic
C106	21-11031A31	47 pF ±5%
C107	21-11031A47	220 pF ±5%
C108	23-11048C11	10 ±20%, 35V, electrolytic
C109	21-11031A64	.0015 ±5%
C200	21-11032B15	.22 +80, −20%
C201	08-11051A15	.22 ±5%, 63V
C202	08-11051A04	.0033 ±5%, 63V
C203	08-11051A15	.22 ±5%, 63V
C204	23-11013D55	4.7 ±20%, 20V, tantalum
C205	21-11031A31	47 pF ±5%
C206	21-11031A57	560 pF ±5%
C207	08-11051A17	.47 ±5%, 63V
C208	21-11032A21	.01
C209	21-11032A27	.033
C210	08-11051A17	.47 ±5%, 63V
C211	23-11048C11	10 ±20%, 35V, electrolytic
C212	23-11048C05	1 ±20%, 50V, electrolytic
C213	23-11048C06	2.2 ±20%, 50V, electrolytic
C214	21-11032A21	.01, 50V
C215	21-11031A31	47 pF ±5%
C216	08-11051A13	.1 ±5%, 63V
C217	23-11013C01	1.5, 5V, tantalum
C300	21-11032A09	.001
C301	21-11031A43	150 pF ±5%
C302	21-11032A09	.001
C303	21-11032B13	.1 +80, −20%
C304	21-11031A31	47 pF ±5%
C305	21-11032A27	.033
C306	21-11032A21	.01
C307	23-11013D55	4.7 ±20%, 20V, tantalum
C308	23-83210A08	100 +150, −10%, 25V, electrolytic
C309-316	21-11031A39	100 pF ±5%
C317	21-11031A47	220 pF ±5%
C400	08-11051A17	.47 ±5%, 63V
C401,402	21-11031A47	220 pF ±5%
C403	21-11031A64	.0015 ±5%
C404-409	21-11031A47	220 pF ±5%
C410	08-11051A15	.22 ±5%, 63V
C411	23-82747L01	330 +100, −10%, 20V, electrolytic
C412	08-11051A15	.22 pF ±5%, 63V
C414	23-11013C56	22 ±20%, 15V, tantalum
C415,416	21-11031A47	220 pF ±5%
C501	23-11048C11	10 ±20%, 35V, electrolytic
C502	23-11013C55	15 ±20%, 15V, tantalum
C503	21-11032A21	.01
C504	23-11013C55	15 ±20%, 15V, tantalum
C505-509	21-11032B13	.1 +80, −20%
C510,511	21-11031A25	27 pF ±5%
C512	23-11013C01	1.5 pF, 15V, tantalum
C513	21-11032A21	.01, 50V
C514	21-11032A21	.01
C515	21-11031A65	.0018 ±5%
C516	21-11031G61	820 pF ±5%
C521	21-11032A21	.01
C522-569	21-11032A02	270 pF
C570	21-1032B13	.1 +80, −20%
C571-576	21-11031A47	220 pF ±5%
		diode (see note)
CR100, 101	48-80007E02	zener ±5%, 12V, 400mW
CR200, 201	48-83654H01	silicon
CR202, 203	48-80007E02	zener ±5%, 12V, 400mW
CR300	48-80236E07	transient suppressor
CR301	48-82178A01	germanium
CR302	48-80008E01	rectifier
CR400	48-83654H01	silicon
CR500–503	48-83654H01	silicon
CR504–507	48-80140L11	zener, 7.5V
CR508	48-83654H01	silicon
CR509–511	48-80140L06	zener, 5.1V
CR513, 514	48-83654H01	silicon
CR515, 516	48-80013E02	contact
		hybrid (see note)
HY300	01-80739T59	transmission gate hybrid
HY301	01-80740T15	squelch hybrid
HY500	01-80739T60	watchdog timer hybrid
		connector receptacle
J100	28-84318M06	2-contact
J101	28-80085E24	8-contact
J200	28-84318M07	3-contact
J500, 501	28-84318M06	2-contact
J501	28-84318M07	3-contact
J504	28-84318M07	3-contact

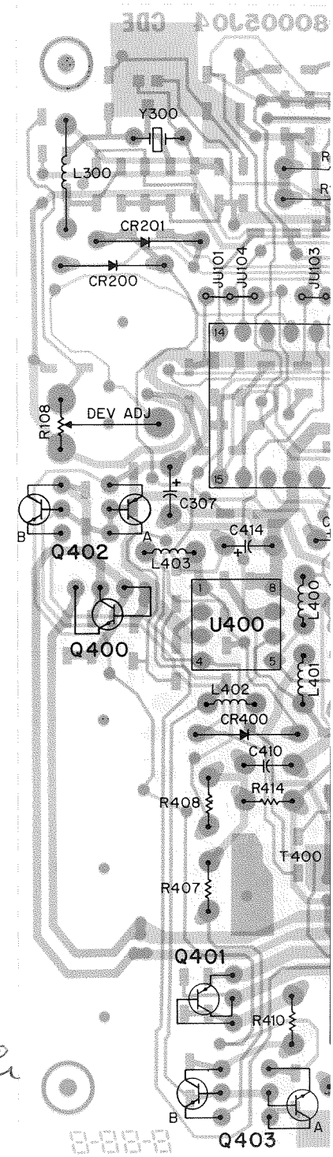
(WMR 0328) →

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		jumper
JU100, 101	09-84728L01	socket
JU200	09-84728L01	socket
JU501	09-84728L01	socket
JU504	09-84728L01	socket
		coil
L300	24-80293D02	ferrite, ½ turn
L400–402	24-80036A01	ferrite, ½ turn
L403	01-80741T98	standup ferrite with heat sink
L500–502	24-80138G04	5.6 μH ±5%, axial
L501	24-80239D02	ferrite, ½ turn
		connector plug
P300	28-80264K01	10-contact
P601, 602	28-82647K02	10-contact
		transistor (see note)
Q100	48-00869660	P-Chan, JFET
Q101	48-05128M66	N-Chan, JFET
Q200	48-80141L02	NPN
Q201	48-80141L03	PNP
Q202, 203	48-80141L02	NPN
Q300	48-80141L02	NPN
Q400	48-84413L06	NPN
Q401	48-84413L07	PNP
Q402	01-80734T95	PNP, transistors and clip
Q403	01-80734T96	NPN, transistors and clip
Q404	48-80141L02	NPN
Q500	48-80141L03	PNP
Q501, 502	48-80141L04	NPN
Q503	48-80141L03	PNP
Q504, 505	48-80141L02	NPN
Q506	48-80141L04	NPN
Q507, 508	48-80141L03	PNP
Q509	48-80141L04	NPN
Q510	48-80141L02	NPN
Q511	48-00869328	PNP
Q512, 513	48-80141L04	NPN
Q514	48-80141L01	PNP
Q516	48-80141L04	PNP
Q517	48-80141L02	NPN
		resistor, fixed, Ω ±5%, ⅛ W unless otherwise stated
R16	06-11024A33	220, ¼ W
R100	06-11024A01	10
R101	06-11024A43	560
R102	06-11024A49	1k
R103	06-11024A87	39k
R104	06-11049P94	1k ±1%, ¼ W
R105	06-11049R87	9.09k ±1%, ¼ W
R106	06-11024A87	39k
R107	06-11024A67	5.6k
R108	18-80087E08	10k potentiometer
R109	06-11024A67	5.6k
R110	06-11024A87	39k
R111	18-80087E08	10k potentiometer
R112	06-11024A82	24k
R113	06-11024A73	10k
R114	06-11024A62	3.6k
R115	06-11024A78	16k
R116	06-11024A84	30k
R117	06-11024A77	15k
R118	06-11024A25	100
R119	06-11024A81	22k
R120	06-11024A65	4.7k
R121	06-11024B02	150k
R122	06-11024A89	47k
R123	06-11024A72	9.1k
R124	06-11024A73	10k
R125	06-11024A83	27k
R126	06-11024A71	8.2k
R127	06-11024B04	180k
R200	06-11024A71	8.2k
R201	06-11024A78	16k
R202	06-11024B04	180k
R203	06-11024A59	2.7k
R204	06-11024A73	10k
R205	06-11024B04	180k
R206	06-11024A83	27k
R208, 209	06-11024A89	47k
R210	06-11024A25	100
R211	06-11024A78	16k
R212	06-11024A61	3.3k
R213	18-05500L17	1.5k ±20%, 100V, potentiometer
R214	06-11024A65	4.7k
R215–217	06-11024A89	47k
R218	06-11024A73	10k
R300	06-11024A71	8.2k
R301	06-11024A60	3k
R302	06-11024A93	68k
R303	06-11024A73	10k — 304
R304	06-11024A65	4.7k — 303
R305	06-11024A66	5.1k
R306	06-11024A73	10k
R307	06-11024A92	62k
R308	06-11024A73	10k
R400	06-11024A97	100k

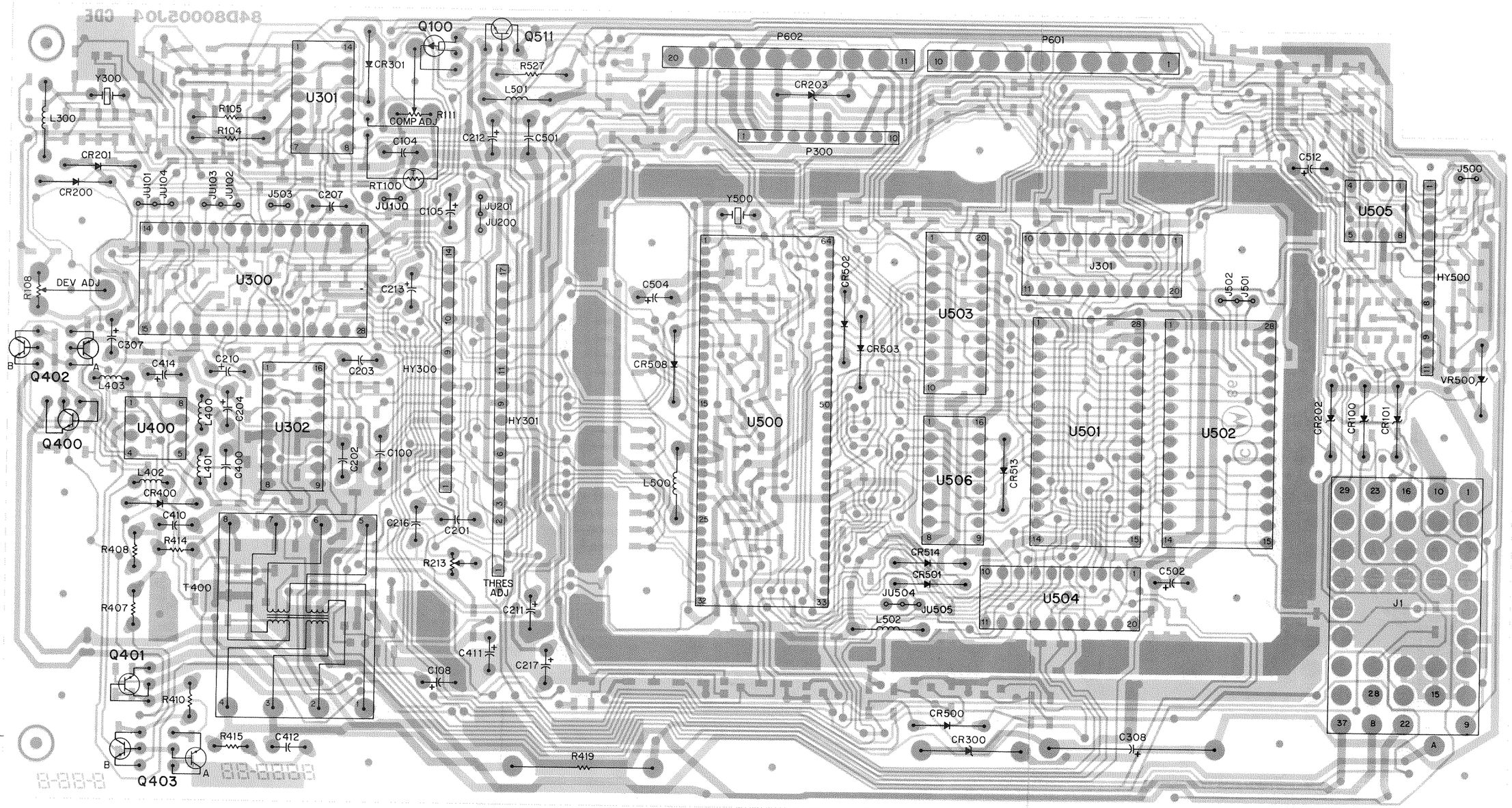
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R401	06-11024A98	110k
R402	06-11024A59	2.7k
R403, 404	06-11024A89	47k
R405	06-11024A83	27k
R406	06-11024A77	15k
R407, 408	06-11009E01	10, ¼ W
R409	06-11024A65	4.7k
R410	06-11009E15	39, ¼ W
R411	06-11024A65	4.7k
R412	06-11024A73	10k
R413	06-11024A33	220
R414, 415	06-11009E01	10, ¼ W
R417	06-11024A49	1k
R418	06-11024A73	10k
R419	17-82350A14	.08 ±20%, 1 W
R500	06-11024A65	4.7k
R501	06-11024A25	100
R502, 503	06-11024A57	2.2k
R504	06-11024A25	100
R505	06-11024A65	4.7k
R506, 507	06-11024A57	2.2k
R508	06-11024A79	18k
R509	06-11024A65	4.7k
R510	06-11024A97	100k
R511	06-11024A89	47k
R512	06-11024A73	10k
R513	06-11024A81	22k
R514	06-11024A97	100k
R515	06-11024A65	4.7k
R516	06-11024A77	15k
R517	06-11024A73	10k
R518	06-11024A97	100k
R519	06-11024A65	4.7k
R520	06-11024A57	2.2k
R521	06-11024A61	3.3k
R522	06-11024A49	1k
R523	06-11024A65	4.7k
R524, 525	06-11024A89	47k
R526	06-11024A73	10k
R527	06-11009A43	560, ¼ W
R528	06-11024A89	47k
R529	06-11024A65	4.7k
R530	06-11024A81	22k
R531	06-11024A89	47k
R532, 533	06-11024A81	22k
R534	06-11024A65	4.7k
R535	06-11024A73	10k
R536	06-11024A89	47k
R537, 538	06-11024A65	4.7k
R542	06-11024A95	82k
R543	06-11024A97	100k
R544	06-11024A97	100k
R545	06-11024A89	47k
R546, 547	06-11024A81	22k
R548	06-11024A25	100
R549	06-11024A49	1k
R550	06-11024A25	100k
R551, 552	06-11024A73	10k
		thermistor
RT100	06-80176D03	thermistor
		transformer
T400	25-84083B03	audio transformer
		integrated circuit (see note)
U300	51-80103E02	CMOS UCS switch-capacitor filter
U301	51-80067C04	quad op amp
U302	51-83977M60	variable gain pre-amp
U400	~~51-83629M02~~	~~bipolar op amp~~ 51-84621A14 quad line driver
U500	51-80290J04	microprocessor
U503, 504	51-05133M01	CMOS octal latch
U505	51-80067C05	bi-FET op amp
U506	51-84561L42	bipolar 2 to 4 line de-multiplexor
		voltage regulator (see note)
VR500	48-83696E07	zener 6.2V
		crystal (see note)
Y300	48-80173D01	4.0 MHz crystal
Y500	48-80113K03	4.9152 crystal
		mechanical parts
	75-05295B01	crystal base pad
	75-80144H01	vibration pad
	03-10905A05	machine screw (M3 × 0.5 × 8)
	04-84180C01	shoulder washer
	14-83820M02	thermoconductor insulator
	32-80219B01	gasket housing
	01-80708T20	heat sink with Q400 and Q401
	01-80740T26	handle and shield option, component side
	01-80741T22	handle and shield option, solder side
	07-80054D01	feedthru bracket
	09-80269B03	28-pin IC socket, 3 used
	09-80002K01	64-pin IC socket

4/12/87

note: For best performance, order diodes, transistors, and integrated circuits by Motorola part number.



SHOWN FROM CO

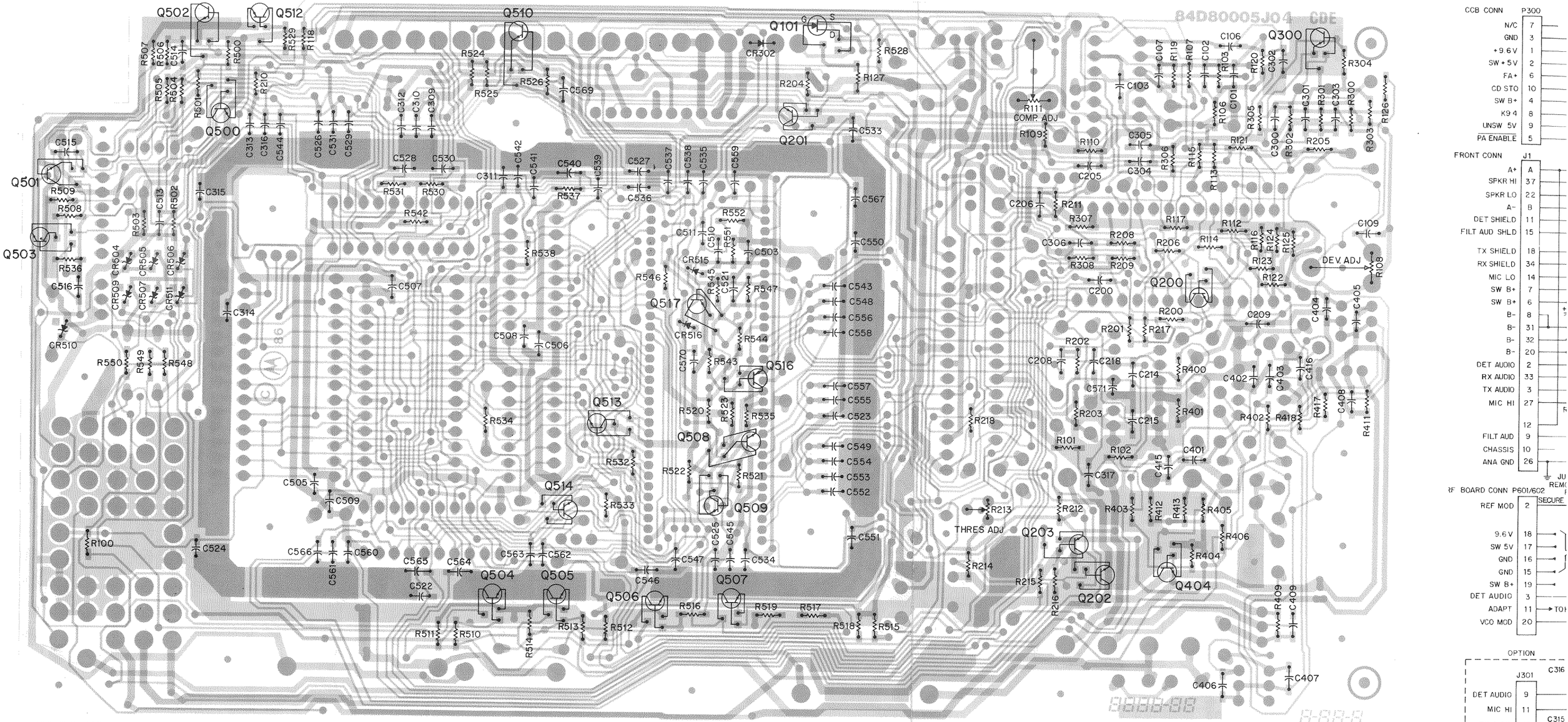


SHOWN FROM COMPONENT SIDE

SOLDER SIDE GEW-2477-B
COMPONENT SIDE GEW-2478-B
OVERLAY GEW-2480-B

Schematic, Circuit Board Diagram
and Parts List for HLN4925D
Personality Board
PW-2586-C
(Sheet 3 of 4)
4/21/87

t (see note)
ch-capacitor filter
-amp
de-multiplexor
r (see note)
13 × 0.5 × 8)
nsulator
00 and Q401
option, component side
option, solder side
3 used
4/12/87
integrated circuits by Motorola



CCB CONN P300

N/C	7
GND	3
+9.6V	1
SW+5V	2
FA+	6
CD STO	10
SW B+	4
K9 4	8
UNSW 5V	9
PA ENABLE	5

FRONT CONN J1

A+	A
SPKR HI	37
SPKR LO	22
A-	B
DET SHIELD	11
FILT AUD SHLD	15
TX SHIELD	18
RX SHIELD	34
MIC LO	14
SW B+	7
SW B+	6
B-	8
B-	31
B-	32
B-	20
DET AUDIO	2
RX AUDIO	33
TX AUDIO	3
MIC HI	27
	12
FILT AUD	9
CHASSIS	10
ANA GND	26

RF BOARD CONN P601/602

REF MOD	2
	SECURE
9.6V	18
SW 5V	17
GND	16
GND	15
SW B+	19
DET AUDIO	3
ADAPT	11
VCO MOD	20

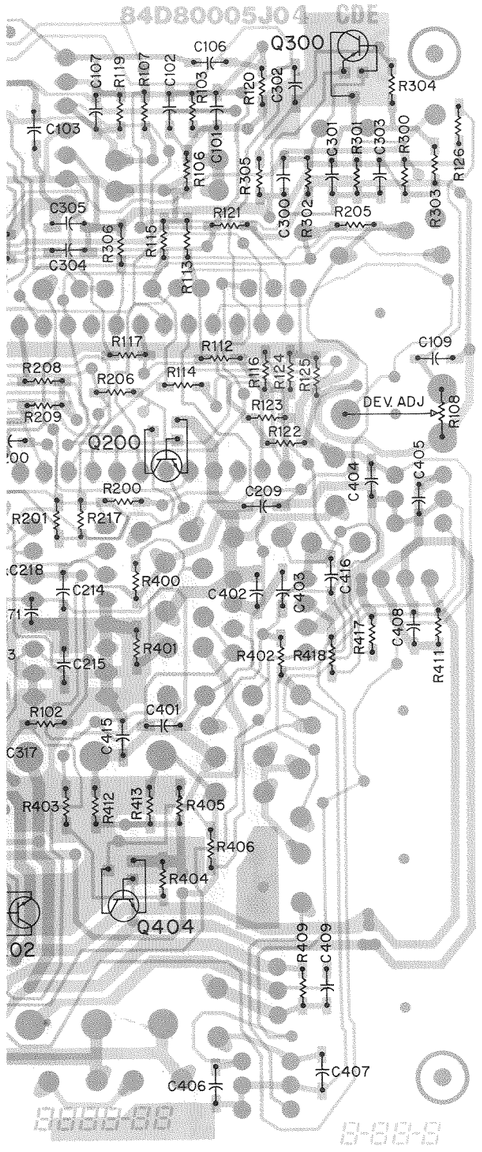
OPTION

J301

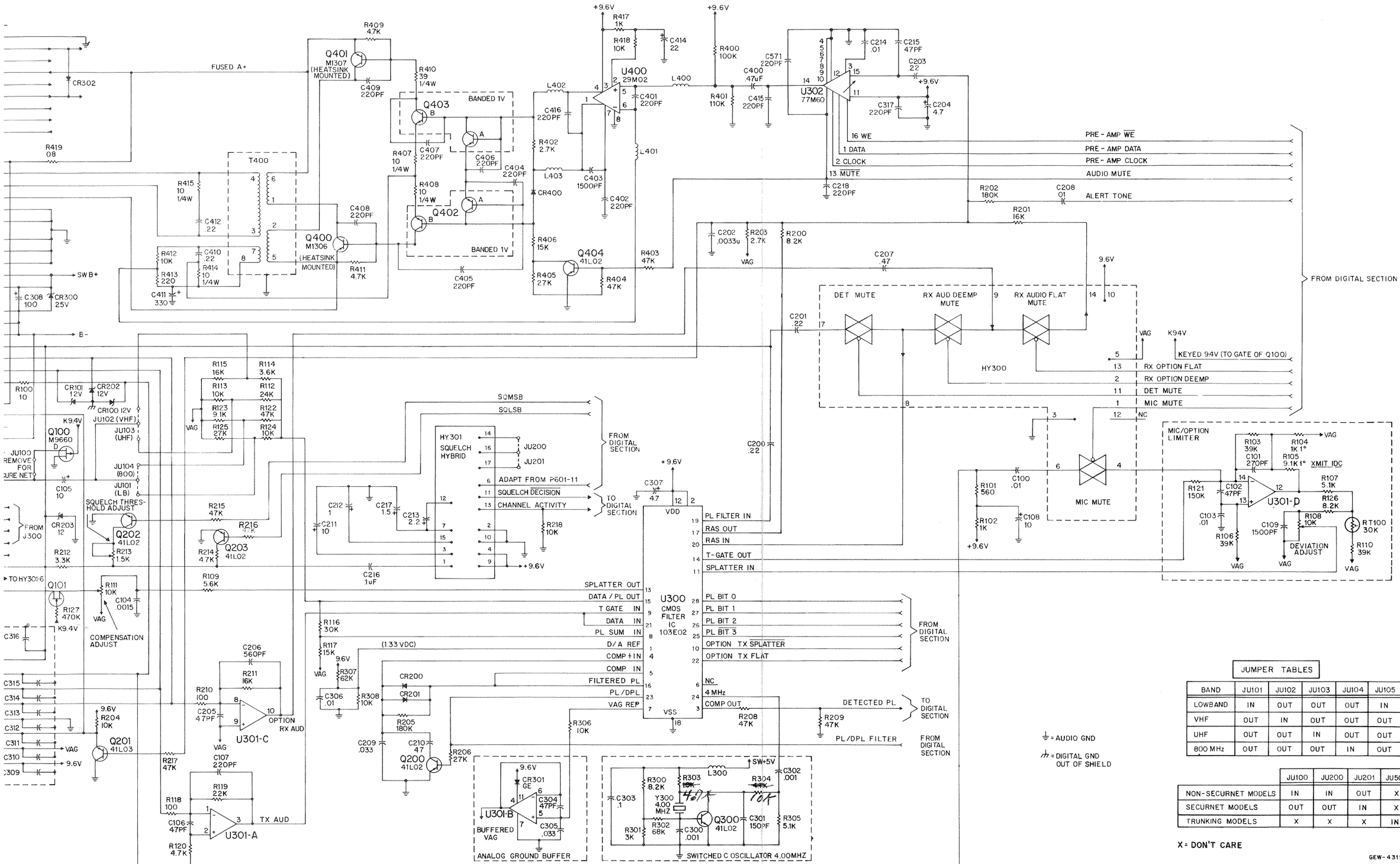
DET AUDIO	9
MIC HI	11
TX AUDIO	12
RX AUDIO	10
AUD GND	6
FLT AUD	14
VAG	8
9.6V	7

SHIELD BOUNDRY

Schematic, Circuit Board Diagram
and Parts List for HLN4925D
Personality Board
PW-2586-C
(Sheet 4 of 4)
4/21/87


84D80005J04 CDE
Q300
Q200
Q404
DEV. ADJ
C106
C107
R119
R107
C102
C103
R120
C302
R304
R106
C101
R305
C301
R301
C303
R300
R126
C305
R121
C300
R302
R205
R303
R306
R116
C304
R113
R117
R112
C109
R208
R206
R114
R116
R124
R125
R209
R123
R108
R122
C404
C405
R200
C209
R201
R217
C218
C214
R400
C402
C403
C416
R401
C215
R402
R418
R417
C408
C411
R102
C401
C317
C415
R403
R412
R413
R405
R406
R404
R409
C409
C406
C407

CCB CONN P300
N/C 7
GND 3
+9.6V 1
SW+5V 2
FA+ 6
CD STO 10
SW B+ 4
K9.4 8
UNSW 5V 9
PA ENABLE 5
CR302
FUSED A+
FRONT CONN J1
A+ A
SPKR HI 37
SPKR LO 22
A- 8
DET SHIELD 11
FILT AUD SHLD 15
TX SHIELD 18
RX SHIELD 34
MIC LO 14
SW B+ 7
SW B+ 6
B- 8
B- 31
B- 32
B- 20
DET AUDIO 2
RX AUDIO 33
TX AUDIO 3
MIC HI 27
FILT AUD 12
CHASSIS 9
ANA GND 10
26
SW B+
B-
R419 08
R100 10
C308 100
CR300 25V
CR101 12V
CR202 12V
CR100 12V
JU102 (VHF)
JU103 (UHF)
JU104 (800)
JU101 (LB)
JU100 REMOVED FOR SECURE NET
RF BOARD CONN P601/602
REF MOD 2
9.6V 18
SW 5V 17
GND 16
GND 15
SW B+ 19
DET AUDIO 3
ADAPT 11
VCO MOD 20
TO HY301-6
FROM J300
CR203 12
C105 10
K9.4V
Q100 M9660
SQUELCH THRESHOLD ADJUST
Q202 41L02
R213 1.5K
R212 3.3K
Q101
R127 470K
R111 10K
C104 .0015
VAG
COMPENSATION ADJUST
OPTION
J301
DET AUDIO 9
MIC HI 11
TX AUDIO 12
RX AUDIO 10
AUD GND 6
FLT AUD 14
VAG 8
9.6V 7
C316
C315
C314
C313
C312
C311
C310
C309
SHIELD BOUNDRY
R204 10K
Q201 41L03
R217 47K
C206 560PF
R211 16K
R210 100
C205 47PF
U301-C
OPTION RX AUD
C107 220PF
R119 22K
R118 100
C106 47PF
U301-A
TX AUD
R120 4.7K
R115 16K
R114 3.6K
R113 10K
R112 24K
R123 9.1K
R122 47K
R125 27K
R124 10K
R215 47K
R216 47K
Q203 41L02
R214 4.7K
R109 5.6K
T400
R415 10 1/4W
C412 .22
R412 10K
C410 .22
R413 220
R414 10 1/4W
C411 330
R411 4.7K
C408 220PF
Q400 M1306 (HEATSINK MOUNTED)
C405 220PF
Q401 M1307 (HEATSINK MOUNTED)
R409 4.7K
C409 220PF
R410 39 1/4W
Q403 B A
BANDED 1V
C407 220PF
C406 220PF
R407 10 1/4W
R408 10 1/4W
Q402 B A
BANDED 1V
C404 220PF
+9.6V
R417 1K
R418 10K
C414 22
U400 29M02
L402
C416 220PF
R402 2.7K
L403
C403 1500PF
CR400
R406 15K
Q404 41L02
R405 27K
R404 47K
C402 220PF
L401
L400
R403 47K
C401 220PF
R400 100K
R401 110K
C571 220PF
C400 47uF
C415 220PF
U302 77M60
C214 .01
C215 47PF
C203 .22
C317 220PF
C204 4.7
16 WE
1 DATA
2 CLOCK
13 MUTE
C218 220PF
R202 180K
C208 01
R201 16K
C202 .0033u
R203 2.7K
VAG
R200 8.2K
C207 .47
DET MUTE
RX AUD DEEMP MUTE
RX AUDIO FLAT MUTE
HY300
C201 .22
C200 .22
SQMS8
SQLS8
HY301 SQUELCH HYBRID
JU200
JU201
ADAPT FROM P601-11
SQUELCH DECISION
CHANNEL ACTIVITY
FROM DIGITAL SECTION
TO DIGITAL SECTION
R218 10K
C212 1
C211 10
C217 1.5
C213 2.2
C216 .1uF
+9.6V
C307 4.7
VDD
U300 CMOS FILTER IC 103E02
PL FILTER IN
RAS OUT
RAS IN
T-GATE OUT
SPLATTER IN
SPLATTER OUT
DATA / PL OUT
T GATE IN
DATA IN
PL SUM IN
D/A REF
COMP +IN
COMP IN
FILTERED PL
PL/DPL
VAG REF
VSS
PL BIT 0
PL BIT 1
PL BIT 2
PL BIT 3
OPTION TX SPLATTER
OPTION TX FLAT
NC
4 MHz
COMP OUT
FROM DIGITAL SECTION
R116 30K
R117 15K
(1.33 VDC)
R307 62K
R308 10K
C306 .01
CR200
CR201
R205 180K
C209 .033
C210 47
Q200 41L02
R206 27K
R306 10K
R208 47K
DETECTED PL
R209 47K
PL/DPL FILTER
TO DIGITAL SECTION
FROM DIGITAL SECTION
R101 560
C100 .01
R102 1K
C108 10
MIC
HY301 SQUELCH HYBRID
BUFFERED VAG
U301-B
CR301 GE
C304 47PF
C305 .033
ANALOG GROUND BUFFER
SW+5V
L300
C302 .001
C303 .1
R300 8.2K
R303 10K
R304 47K
Y300 4.00 MHZ
R301 3K
R302 68K
C300 .001
Q300 41L02
C301 150PF
R305 5.1K
SWITCHED C OSCILLATOR 4.00MHZ
= AUDIO GR
= DIGITAL
OUT OF



JUMPER TABLES

BAND	JU101	JU102	JU103	JU104	JU105
LOWBAND	IN	OUT	OUT	OUT	IN
VHF	OUT	IN	OUT	OUT	OUT
UHF	OUT	OUT	IN	OUT	OUT
800 MHz	OUT	OUT	OUT	IN	OUT

	JU100	JU200	JU201	JU505
NON-SECURNET MODELS	IN	IN	OUT	X
SECURNET MODELS	OUT	OUT	IN	X
TRUNKING MODELS	X	X	X	IN

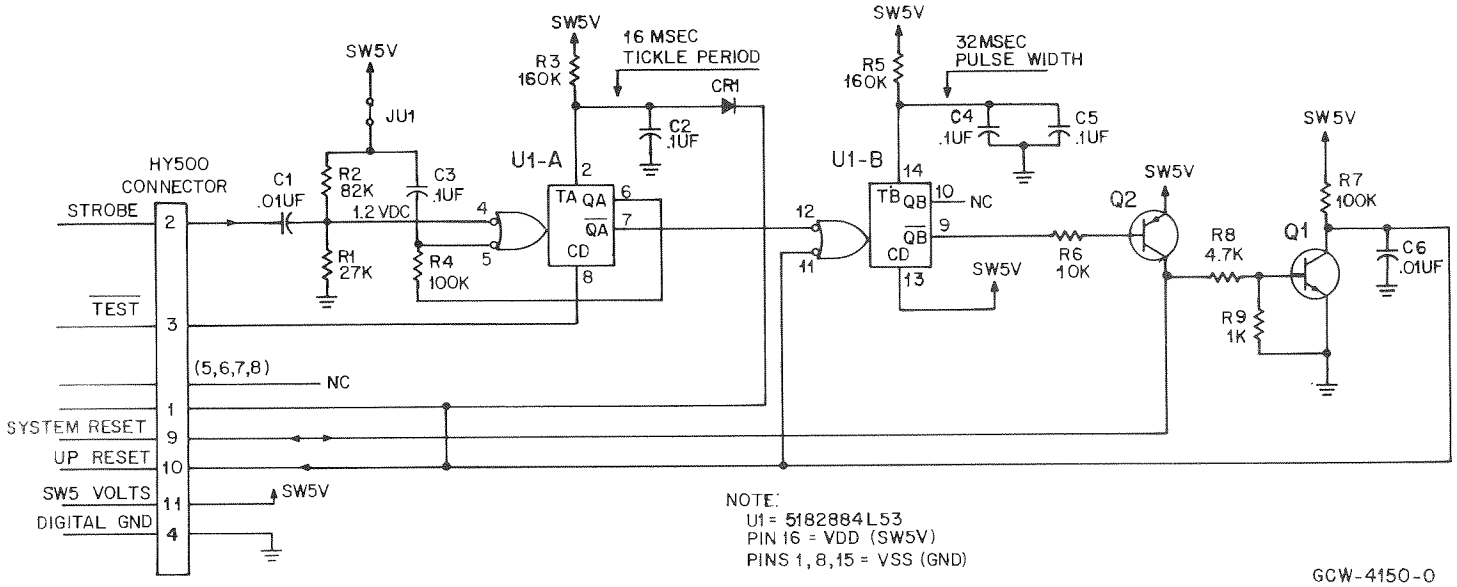
X = DON'T CARE

= AUDIO GND

= DIGITAL GND OUT OF SHIELD

GEW-4315-O

WATCHDOG TIMER HYBRID

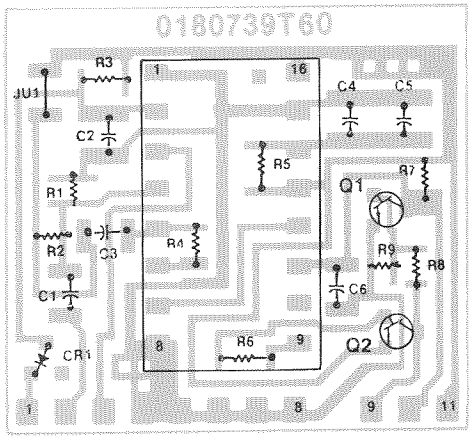


Watchdog Timer p/o HLN4925D Personality Board — MXW-4291-O

MOTOROLA REFERENCE	PART NUMBER	DESCRIPTION
HY500	01-80739T60	includes the following
		capacitor, fixed µF, ± 5%, 50V unless otherwise stated
C1	21-11032A21	.01 ± 10%
C2	21-84547A24	.1 ± 20%, 25V
C3	21-11032B13	.1 +80, -20%, electrolytic
C4,5	21-84547A24	.1 ± 20%, 25V
C6	21-11032A21	.01 ± 10%
		diode (see note)
CR1	48-80236E08	silicon
		jumper
JU1	06-11024B23	0 ohm
		transistor (see note)
Q1	48-80141L04	NPN
Q2	48-80141L03	PNP
		integrated circuit (see note)
U1	51-82884L53	monostable multivibrator

4/3/87

note: For best performance, order diodes, transistors, and integrated-circuit devices by Motorola part number.



SUBSTRATE — GAW-4358-O

OVERLAY — GAW-4359-O

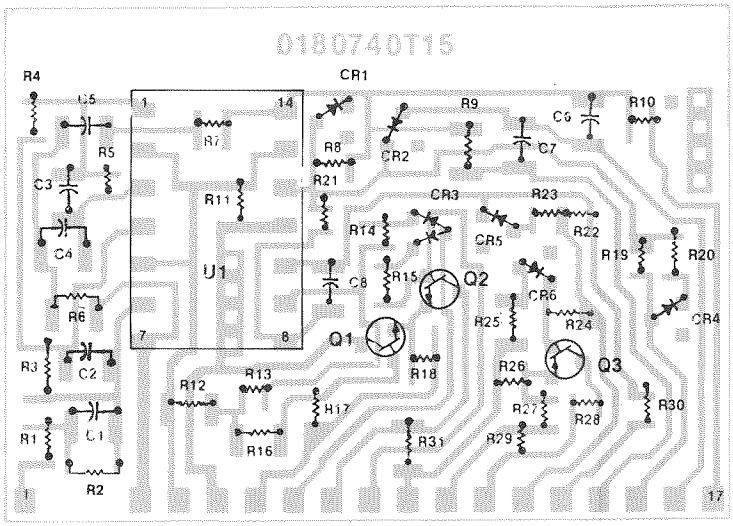
SQUELCH HYBRID

Squelch Hybrid p/o HLN4925D Personality Board — MXW-4290-O

MOTOROLA REFERENCE	PART NUMBER	DESCRIPTION
HY301	01-80740T15	includes the following
		capacitor, fixed µF, ± 5%, 50V unless otherwise stated
C1	21-11031A61	.001
C2	21-11031A47	220 pF
C3	21-11031A37	82 pF
C4	21-11032A21	.01 ± 10%
C5	21-11032A13	.0022
C6	21-11031A47	220 pF
C7	21-11032A17	.0047 ± 10%
C8	21-11032A21	.01
		diode (see note)
CR1-6	48-80236E08	silicon
		resistor, fixed ohm, ± 5%, ⅛ watt unless otherwise stated
R6	06-11024A33	220
R9	06-11024A89	47k
R12	06-11024A33	220
R16	06-11024A33	220
R25	06-11024B20	820k
R31	06-11024A73	10k
		transistor (see note)
Q1,2	48-80141L04	NPN
Q3	48-80141L01	PNP
		integrated circuit (see note)
U1	51-80067C06	quad opamp

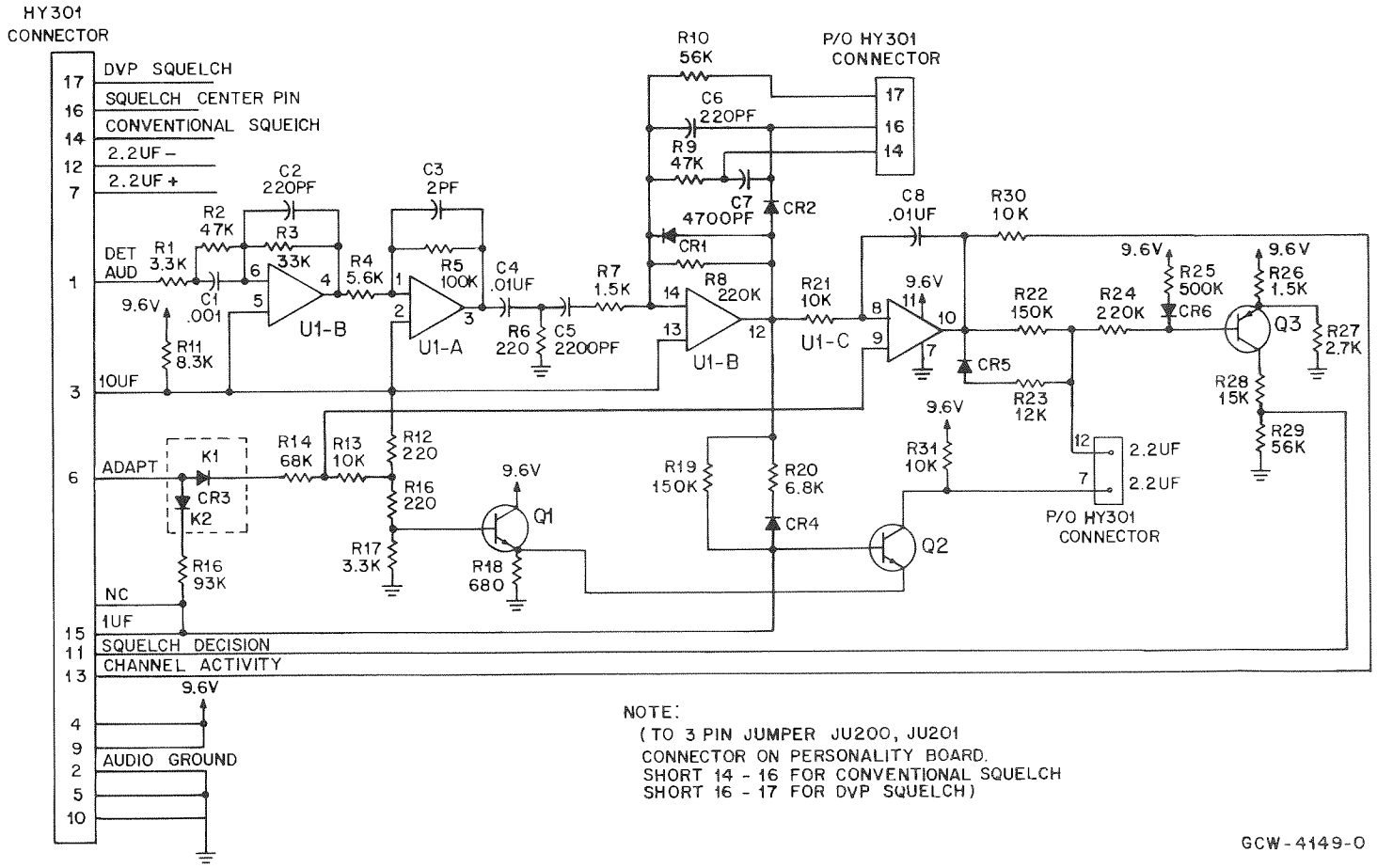
4/3/87

note: For best performance, order diodes, transistors, and integrated-circuit devices by Motorola part number.



SUBSTRATE — GAW-4356-O

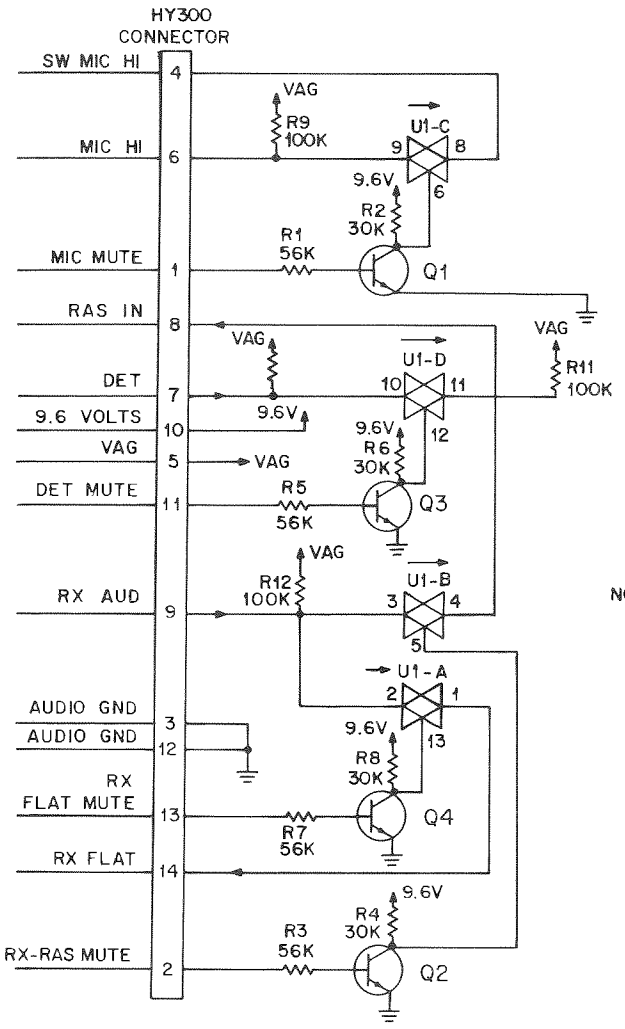
OVERLAY — GAW-4357



NOTE:
(TO 3 PIN JUMPER JU200, JU201 CONNECTOR ON PERSONALITY BOARD.
SHORT 14 - 16 FOR CONVENTIONAL SQUELCH
SHORT 16 - 17 FOR DVP SQUELCH)

GCW-4149-O

TRANSMISSION GATE HYBRID



NOTE:
U1 = 5180073C05
PIN 14 = VDD (9.6V)
PIN 7 = VSS (GND)

GCW-4148-O

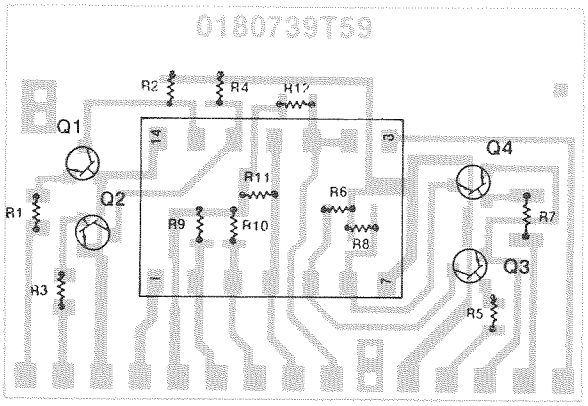
parts list

Transmission Gate p/o HLN4925D Personality Board — MXW-4289-O

MOTOROLA REFERENCE	PART NUMBER	DESCRIPTION
HY300	01-80739T59	includes the following
		resistor, fixed ohm, ± 5%, 1/8 watt unless otherwise stated
R7	06-11024A91	56k
		transistor (see note)
Q1-4	51-80141L02	NPN
		integrated circuit (see note)
U1	51-80073C05	analog t-gate

4/3/87

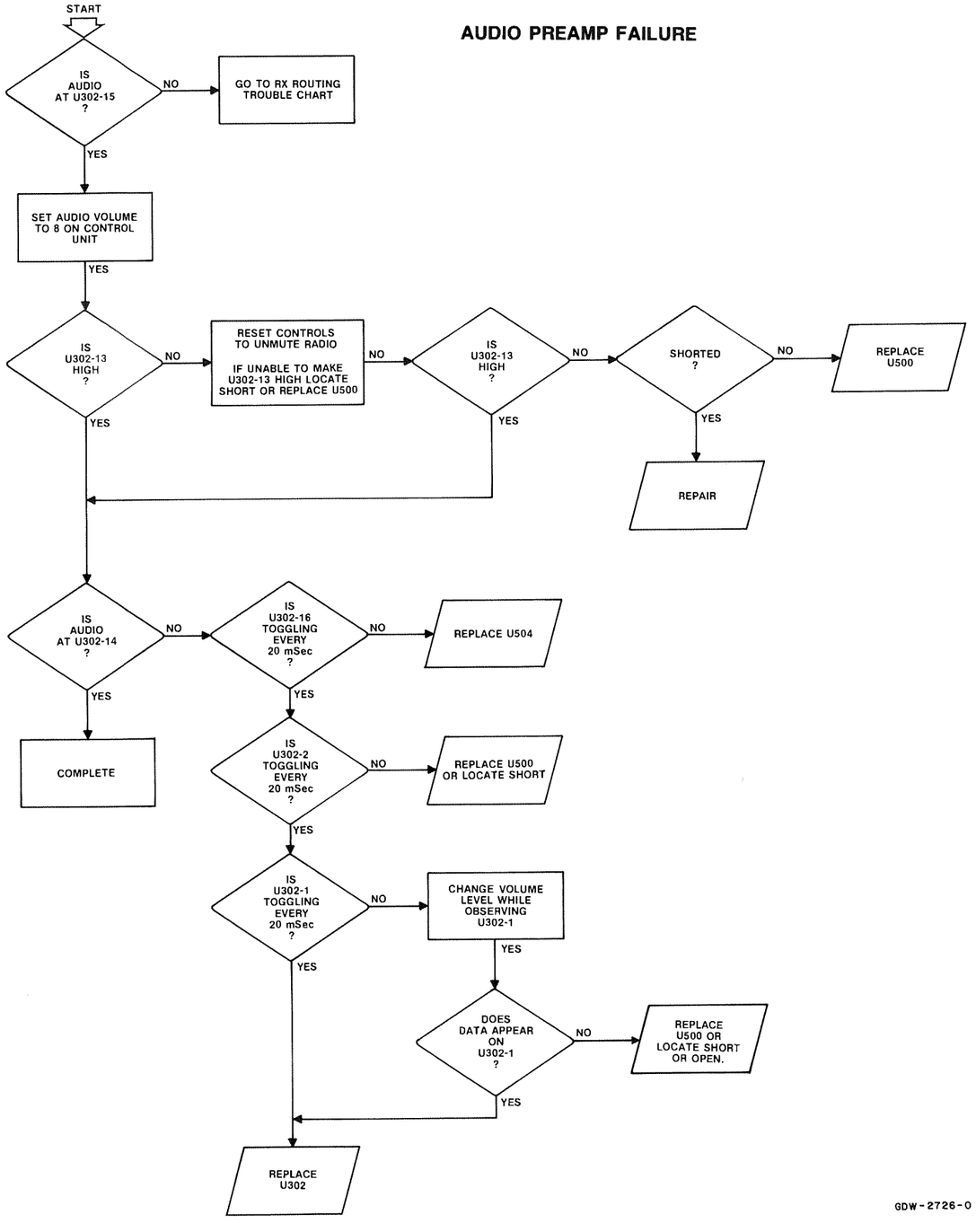
note: For best performance, order diodes, transistors, and integrated-circuit devices by Motorola part number.



SUBSTRATE — GAW-4354-O
OVERLAY — GAW-4355-O

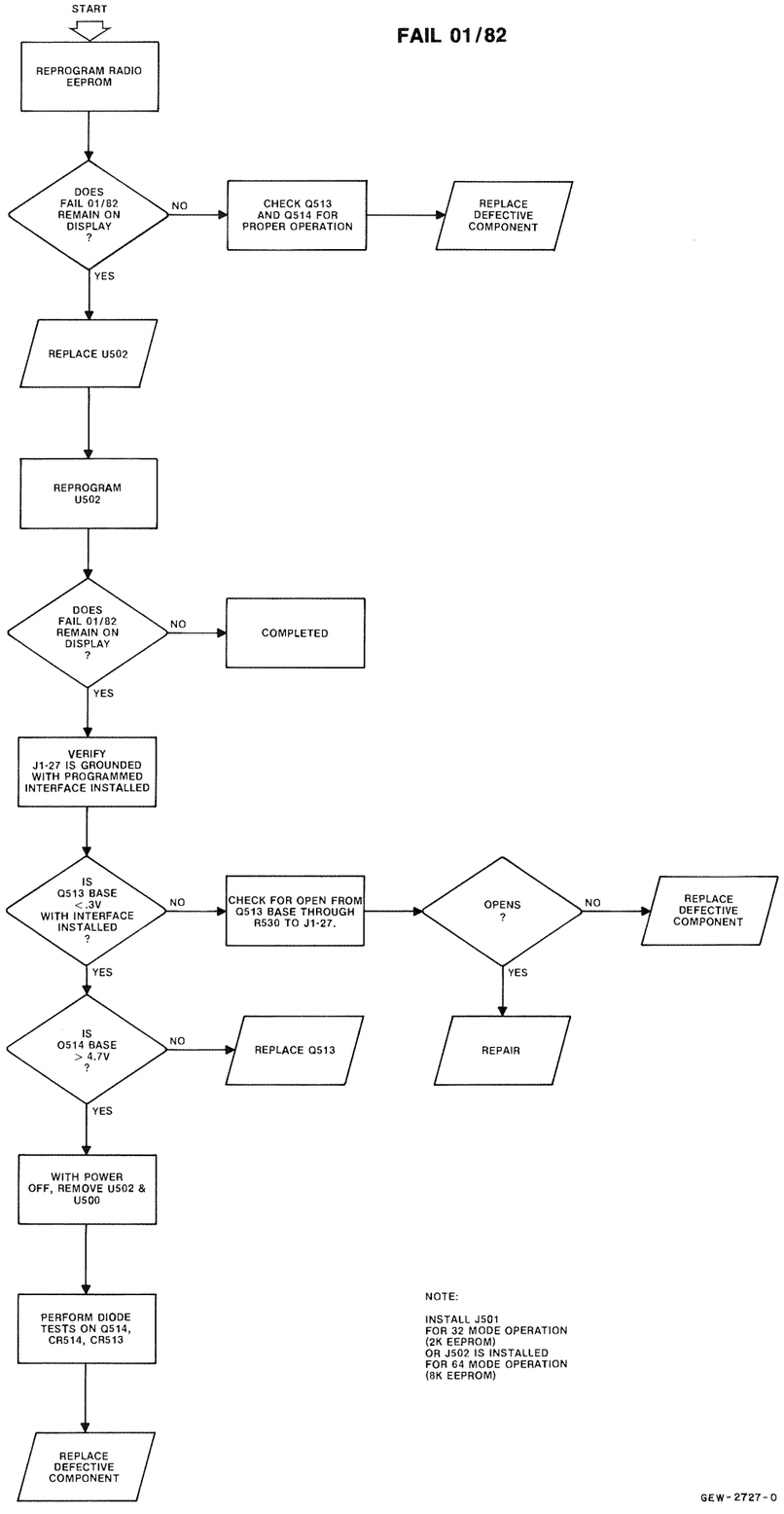
Schematics, Circuit Board Diagrams, and Parts Lists for the Transmission Gate, Squelch, and Watchdog Timer Hybrids on the HLN4925D Personality Board
PW-4350-0
4/21/87

AUDIO PREAMP FAILURE



GDW-2726-0

FAIL 01/82

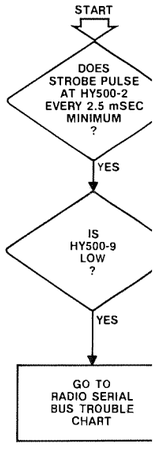


NOTE:

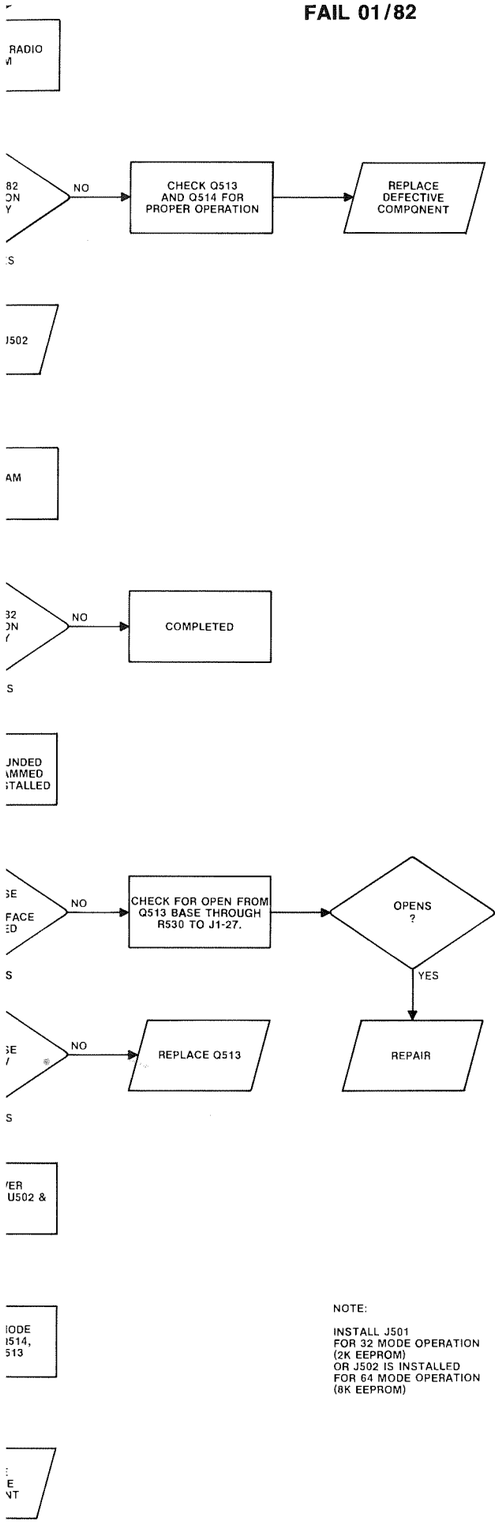
INSTALL J501
FOR 32 MODE OPERATION
(2K EEPROM)
OR J502 IS INSTALLED
FOR 64 MODE OPERATION
(8K EEPROM)

GEW-2727-0

WATCHDOG

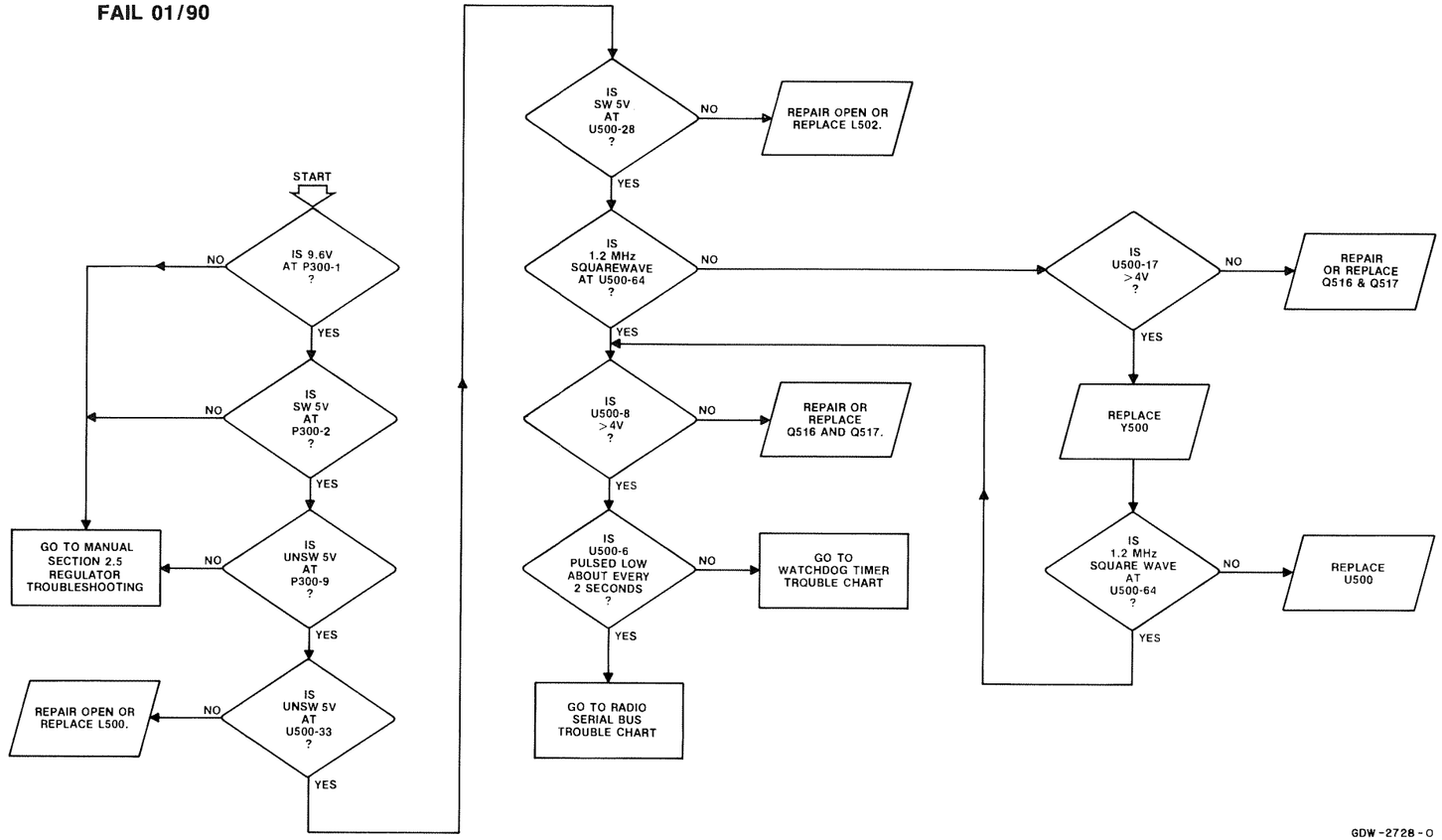


FAIL 01/82



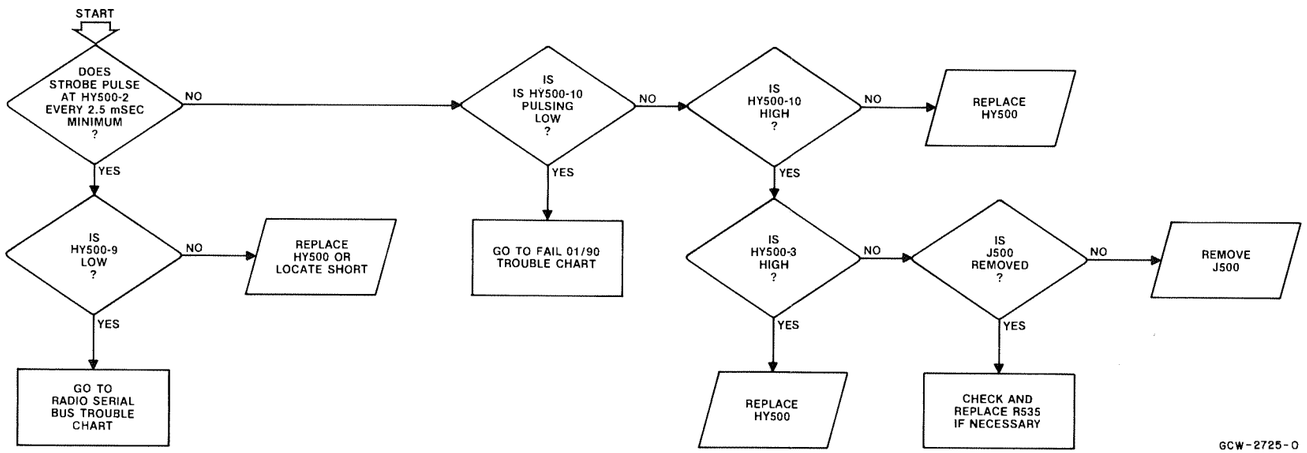
GEW-2727-0

FAIL 01/90



GDW-2728-0

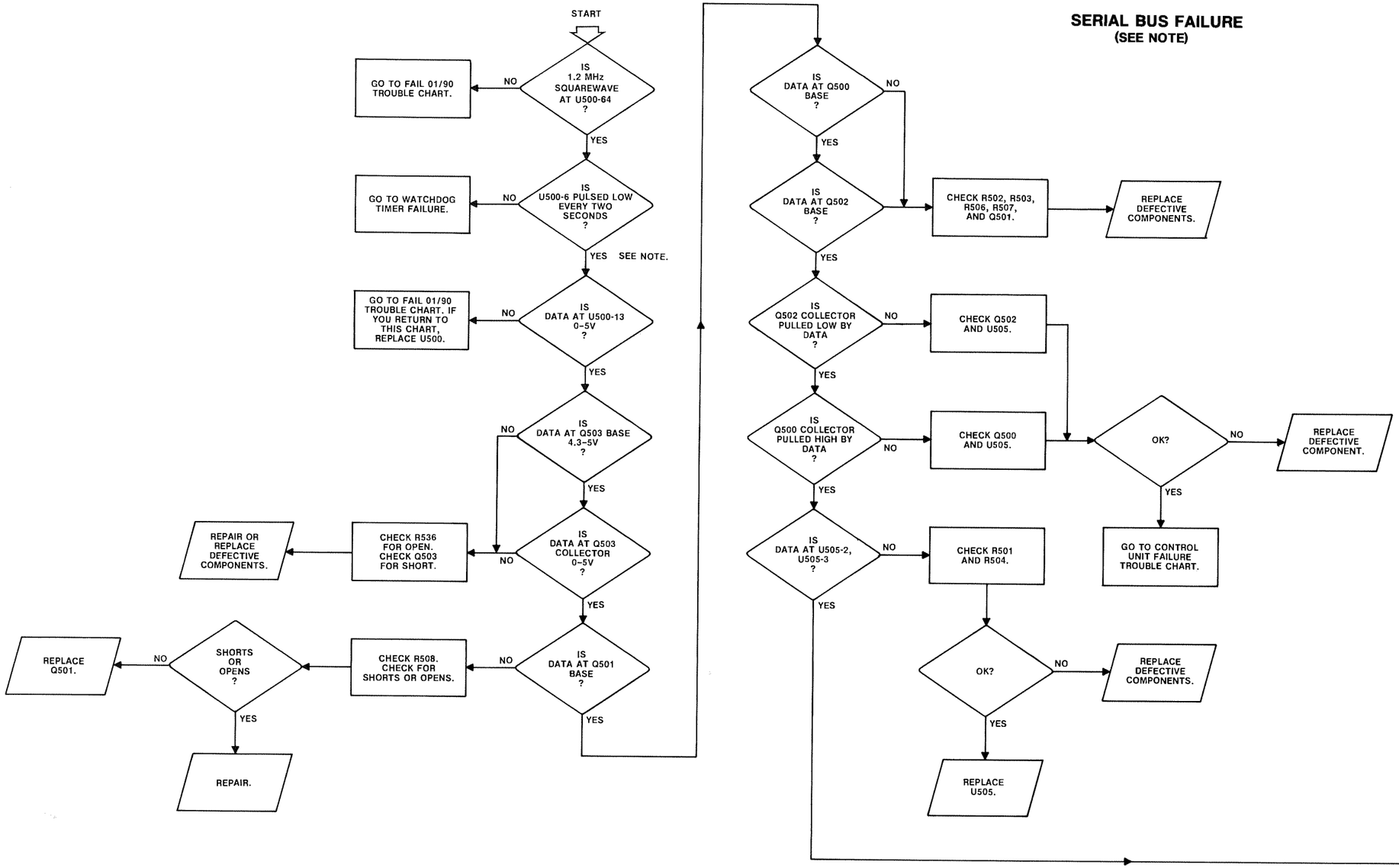
WATCHDOG TIMER FAILURE



GCW-2725-0

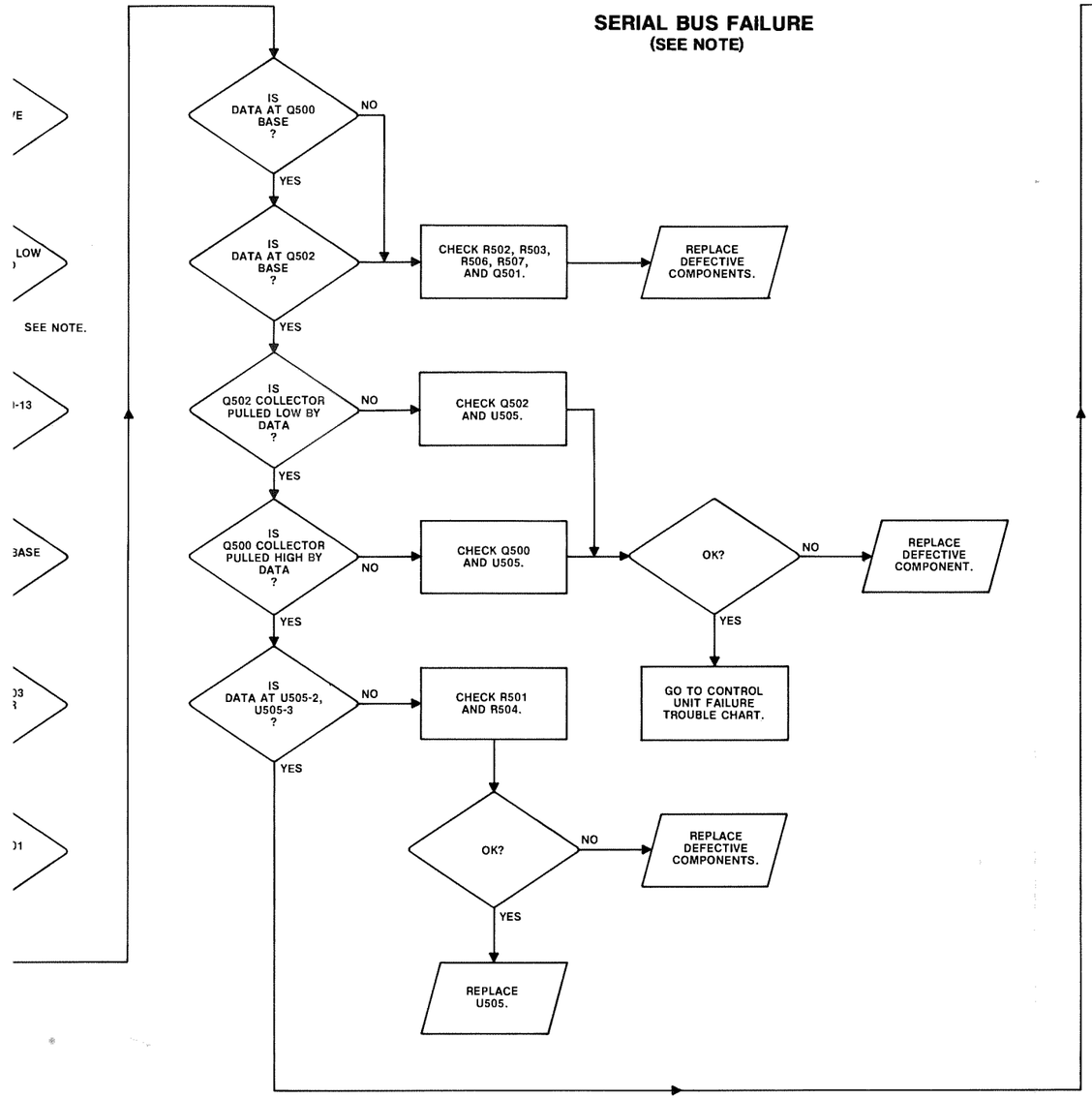
Troubleshooting Charts
for HLN4925 Personality Board
Audio Preamp Failure, FAIL 01/82,
FAIL 01/90 and Watchdog Timer Failure
PW-2768-A
9/22/86

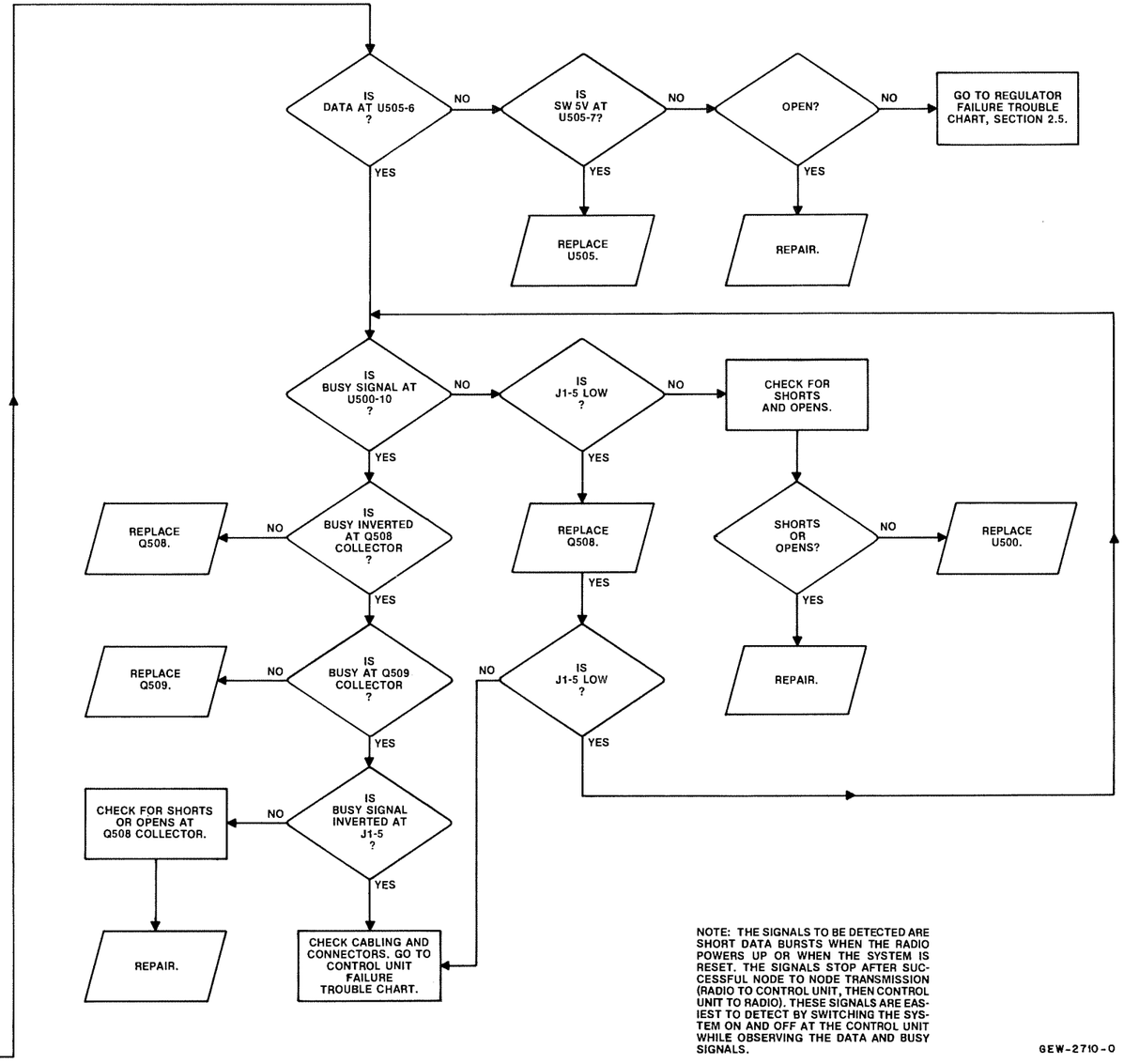
SERIAL BUS FAILURE
(SEE NOTE)



Troubleshooting Charts
for HLN4925 Personality Board
Serial Bus Failure and Audio Power Amp Failure
PW-2769-A
9/22/86

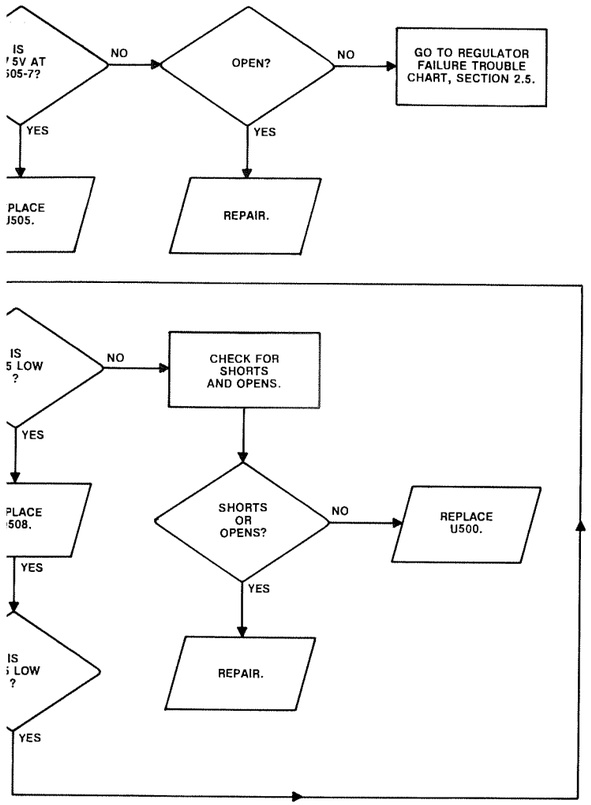
SERIAL BUS FAILURE
(SEE NOTE)





NOTE: THE SIGNALS TO BE DETECTED ARE SHORT DATA BURSTS WHEN THE RADIO POWERS UP OR WHEN THE SYSTEM IS RESET. THE SIGNALS STOP AFTER SUCCESSFUL NODE TO NODE TRANSMISSION (RADIO TO CONTROL UNIT, THEN CONTROL UNIT TO RADIO). THESE SIGNALS ARE EASIEST TO DETECT BY SWITCHING THE SYSTEM ON AND OFF AT THE CONTROL UNIT WHILE OBSERVING THE DATA AND BUSY SIGNALS.

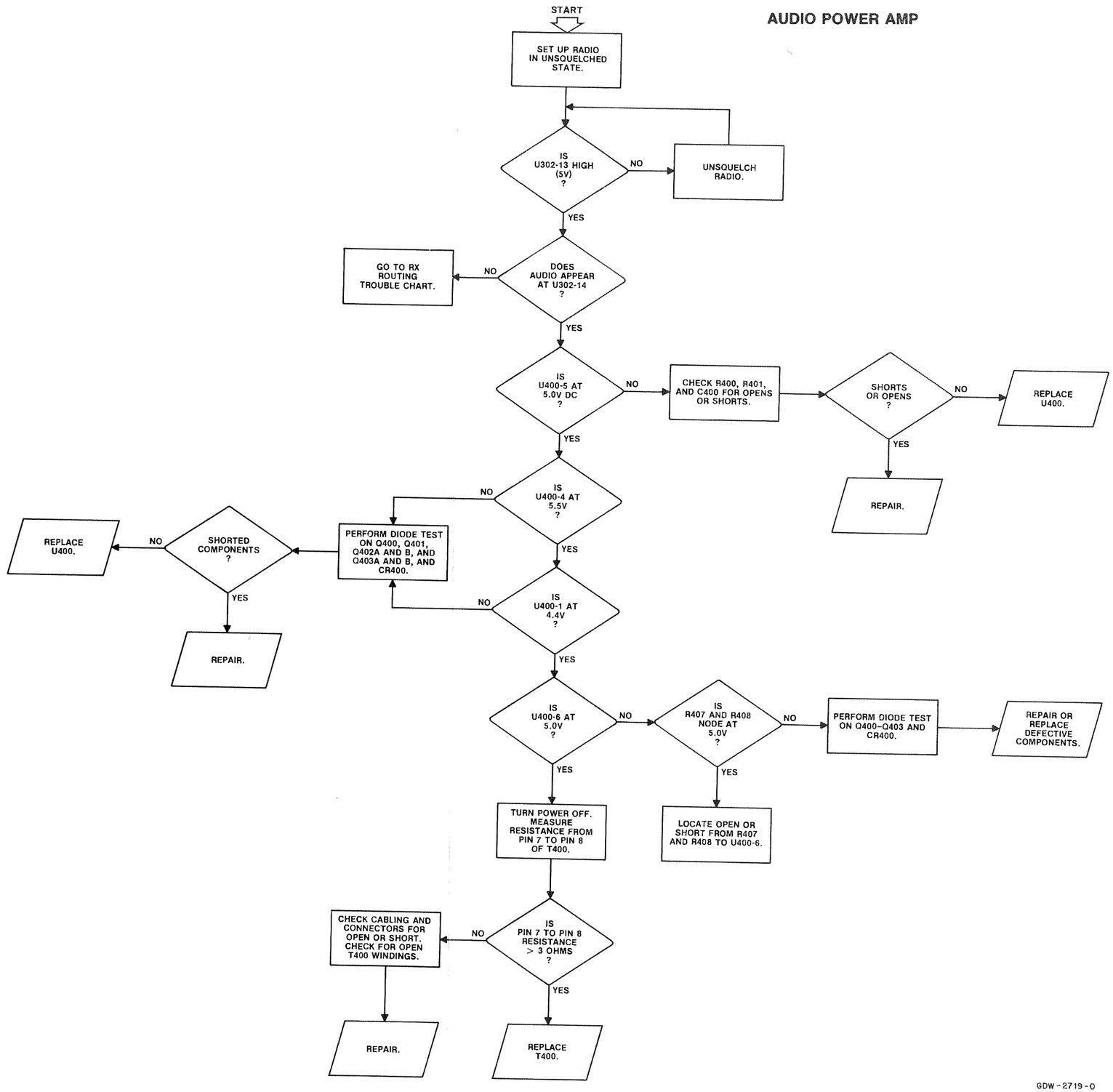
GEW-2710-0



NOTE: THE SIGNALS TO BE DETECTED ARE SHORT DATA BURSTS WHEN THE RADIO POWERS UP OR WHEN THE SYSTEM IS RESET. THE SIGNALS STOP AFTER SUCCESSFUL NODE TO NODE TRANSMISSION (RADIO TO CONTROL UNIT, THEN CONTROL UNIT TO RADIO). THESE SIGNALS ARE EASIEST TO DETECT BY SWITCHING THE SYSTEM ON AND OFF AT THE CONTROL UNIT WHILE OBSERVING THE DATA AND BUSY SIGNALS.

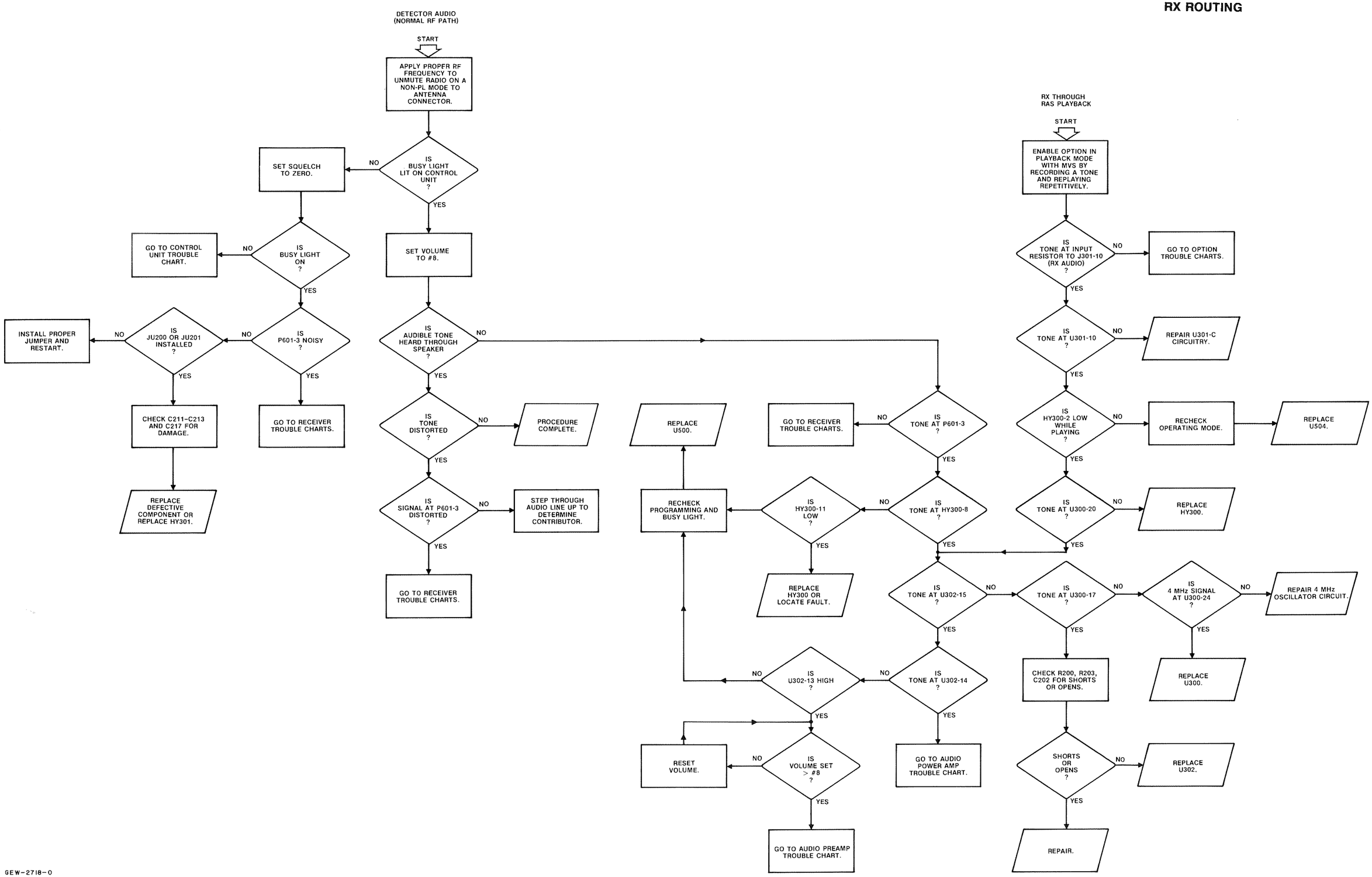
GEW-2710-O

AUDIO POWER AMP



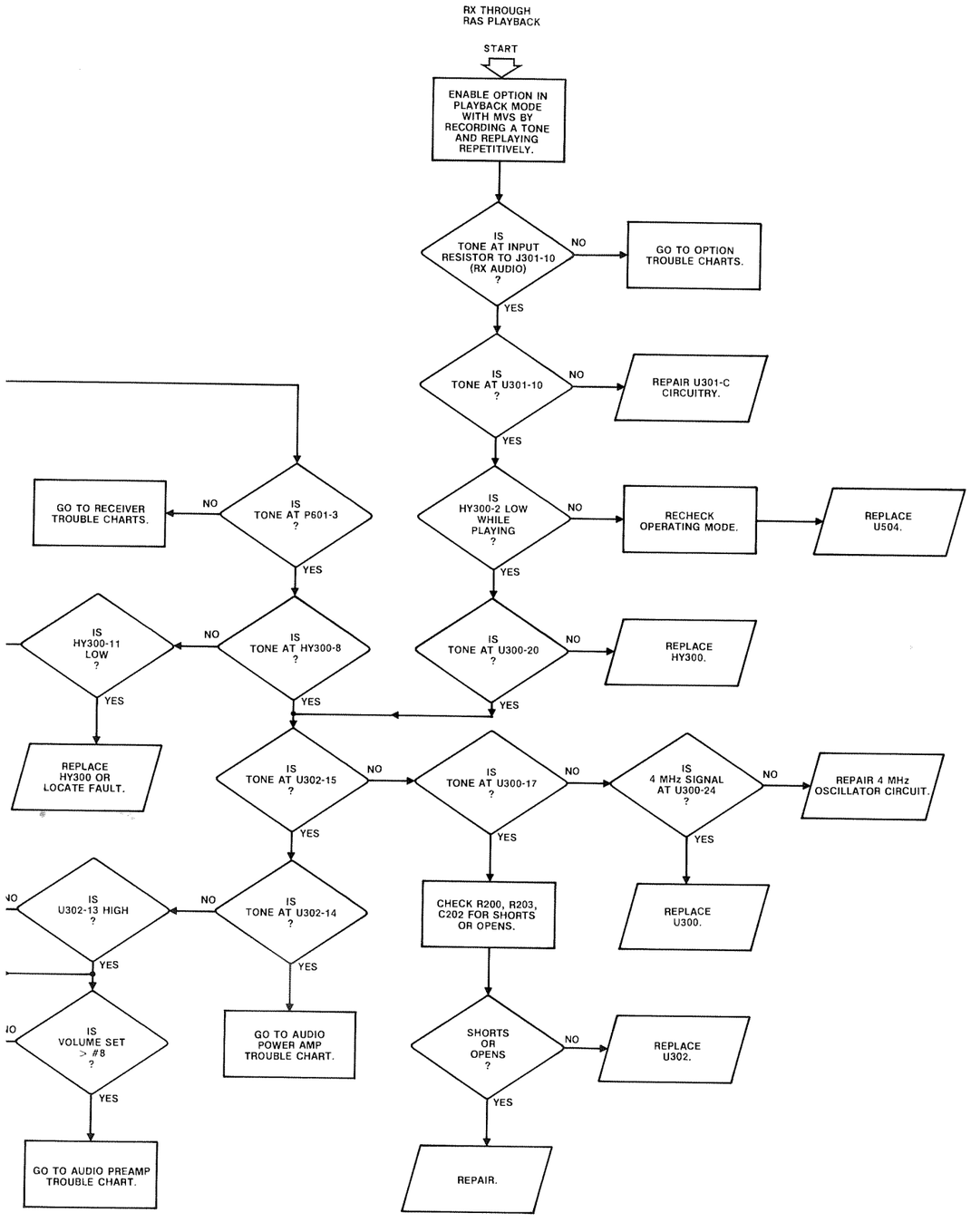
GDW-2719-O

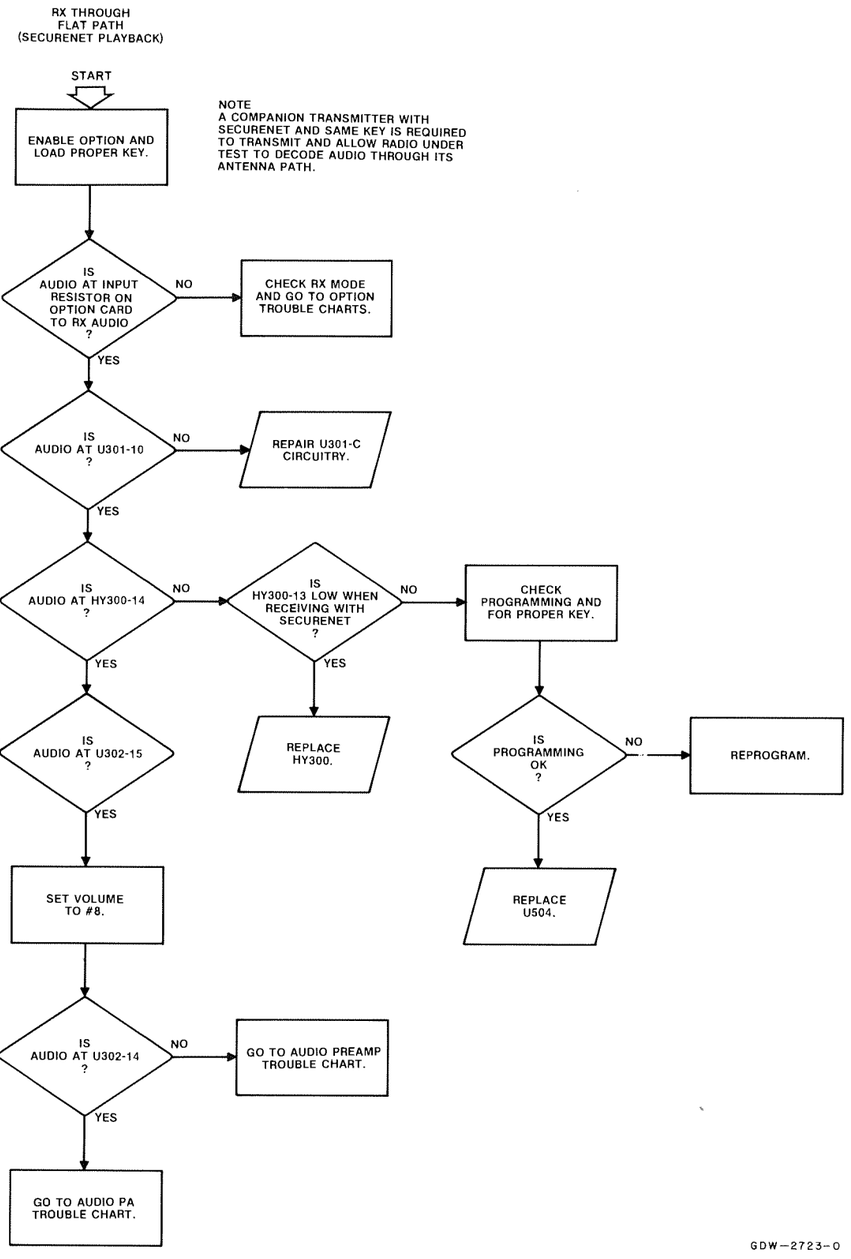
RX ROUTING



GEW-2718-0

RX ROUTING

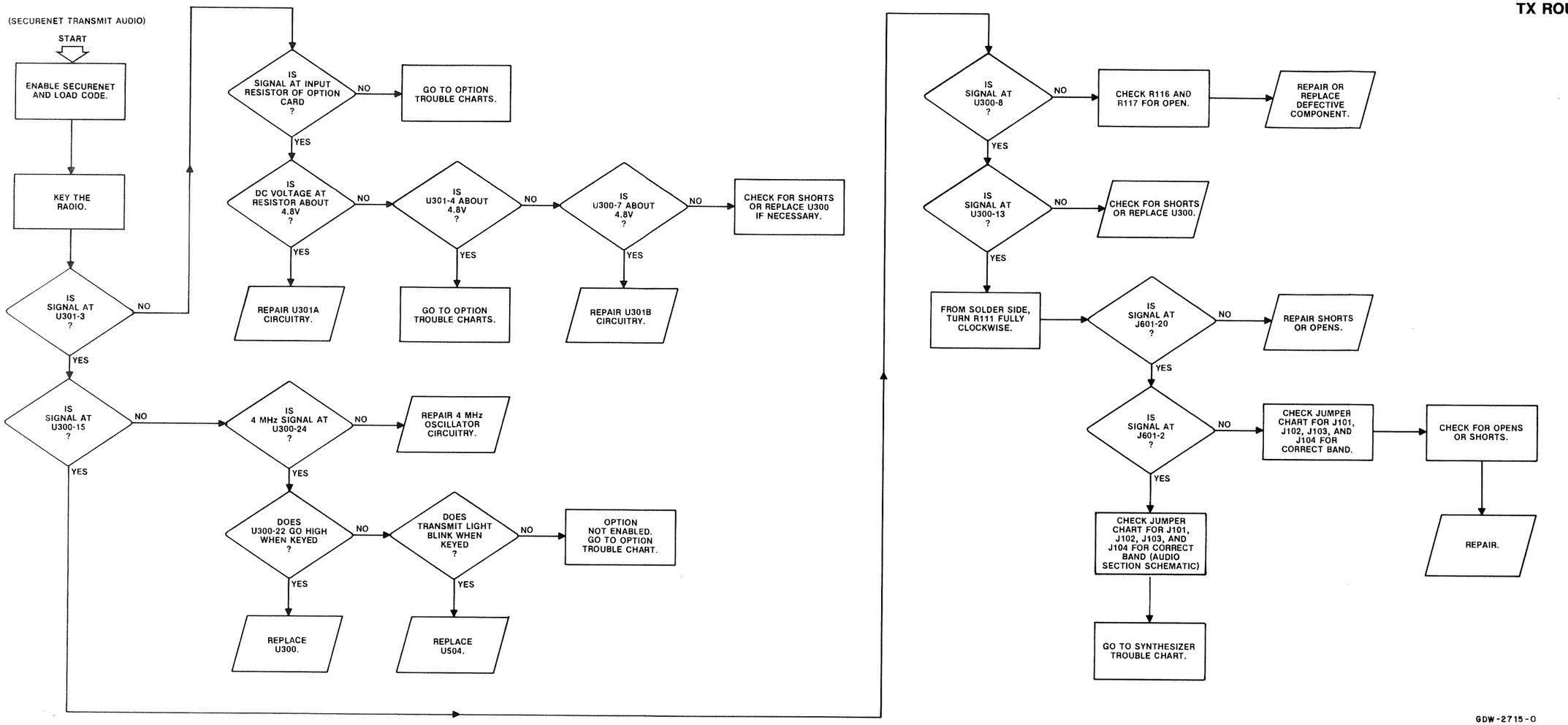




GDW—2723-O

Troubleshooting Charts
for HLN4925 Personality Board
Detector Audio, RX Through RAS Playback,
and RX Through Flat Path
PW-2770-A
9/22/86

TX ROUTING



GDW-2715-0

Troubleshooting Charts
for HLN4925 Personality Board
Securenet TX Audio, TX Flat Path,
and TX Microphone Path
PW-2771-A
9/22/86

TX ROUTING

REPAIR OR REPLACE DEFECTIVE COMPONENT.

NO

REPAIR SHORTS OR OPENS.

NO

CHECK JUMPER CHART FOR J101, J102, J103, AND J104 FOR CORRECT BAND.

CHECK FOR OPENS OR SHORTS.

REPAIR.

GDW-2715-O

MICROPHONE PATH

START

APPLY 1 kHz 200 mV RMS TONE THROUGH A 560 Ω RESISTOR IN SERIES WITH A 10 µF CAPACITOR.

IS SIGNAL AT HY300-6 IN RX MODE ?

NO

CHECK C100, R100, AND CR100. REPAIR AS NECESSARY.

YES

SHORT J1-1 TO B−. THIS WILL KEY THE RADIO.

IS SIGNAL AT U301-12 ?

NO

UNSOLDER U301-14.

YES

IS SIGNAL AT U301-14 ?

NO

FOR MIC PATH, REPLACE HY300.

FOR TX SPLATTER PATH, CHECK R121.

YES

REPAIR U301-D CIRCUITRY.

IS SIGNAL AT R126 AND R108 NODE ?

NO

CHECK FOR SHORTS OR OPENS. REPAIR AS NECESSARY.

YES

IS SIGNAL AT U300-11 ?

NO

IS DEV POT R108 FULLY CLOSED ?

NO

REPLACE R108 OR LOCATE OPEN.

YES

FROM SOLDER SIDE, TURN R108 FULLY CLOCKWISE.

YES

IS SIGNAL AT U300-13 ?

NO

IS 4 MHz SIGNAL AT U300-24 ?

NO

REPAIR 4 MHz OSCILLATOR CIRCUITRY.

YES

REPLACE U300.

YES

TO A

TX SPLATTER PATH (MDC-PTT/ID OPTIONS)

START

KEY AND DEKEY MICROPHONE TO PRODUCE OPTION SIGNALLING.

IS SIGNAL AT U300-9 ?

NO

IS SIGNAL AT INPUT RESISTOR OF OPTION CARD ?

NO

CHECK TX AUDIO CABLING. GO TO OPTION TROUBLE CHART IF NECESSARY.

YES

IS SIGNAL AT U300-14 ?

NO

REPAIR U301-A CIRCUITRY.

YES

DOES U300-10 GO LOW ?

NO

REPLACE U504.

YES

IS 4 MHz SIGNAL AT U300-24 ?

NO

REPAIR 4 MHz OSCILLATOR CIRCUITRY.

YES

REPLACE U300.

A

IS SIGNAL AT R111 AND R109 NODE ?

NO

CHECK FOR SHORTS OR OPENS. REPAIR AS NECESSARY.

YES

IS R111 FULLY COUNTERCLOCKWISE FROM SOLDER SIDE ?

NO

TURN R111 FULLY CLOCKWISE.

YES

GO TO THE SYNTHESIZER TROUBLE CHARTS.

GDW-2716-O

1. Transmitter (VHF/UHF)

1.1 DESIGNATOR CHANGES

The following changes must be made to the text in your Instruction Manual to accurately adjust and troubleshoot the VHF/UHF power controls.

1.1.1 VHF Radios Only

The following troubleshooting chart (Table 1) uses the new designators and does not require change.

This chart replaces Table 4 in your VHF Instruction Manual, Transmitter Section.

The text changes are as follows:

From	To	From	To
U901	U900	Q907	Q904
U901A	U900A	Q903	Q900
U901B	U900B	Q908	Q905
Q904	Q901	R911	R908
Q905	Q902	R939	R932
Q906	Q903		

Table 1. Troubleshooting Chart for VHF Transmitter Control and Protection Circuitry

Step	Symptom	Procedure	Normal Indication	If Normal	If Abnormal
1	No Meter 3 or 5 with all controls open (POWER SET clockwise and CURRENT LIMIT counterclockwise)	a. Disconnect exciter from synthesizer at J700. Check for keyed 9.5 V dc at Pin 8, U900.	9.5 V dc	Go to Step 1b.	a. Check PA ENABLE at J300-5. b. Check for synthesizer lock. c. Check Q906 (TX 9.5 V switch). d. Check PA ENABLE switch (Q5 and Q6).
		b. Measure output voltage of U900A, Pin 7.	> 3.3 V dc	Repair fault in control voltage amplifiers Q900 and Q901.	Go to Step 1c.
		c. Measure voltages to input of U900A, Pins 5 and 6.	Pin 5 > Pin 6	U900 defective.	Check for shorts or opens in resistive feed circuits to Pins 5 and 6.
2	Meter 3 reads max of about 10 μA with all controls fully open. Little or no output power.	a. Disconnect exciter from synthesizer at J700. Measure voltage of protection comparator output, Pin 1, U900B.	> 8 V dc	Troubleshoot Q902 circuit.	Go to Step 2b.
		b. Measure voltages to input of U900B, Pins 2 and 3.	Pin 3 > Pin 2	U900 defective.	Analyze and repair current limiter circuitry Q903, Q904, and Q905.
3	All controls inoperative and Meter 3 at 25 μA	a. Disconnect exciter from synthesizer at J1101. Observe Meter 3 in RX mode.	0 μA	Go to Step 3b.	Repair fault in control voltage amplifiers Q900 and Q901.
		b. Set all controls counterclockwise. Measure Pins 5 and 6, U900A in TX mode.	Pin 6 > Pin 5	U900 defective.	Look for defect in voltage reference network R905, R903, R902, R907, and R908.

Table 1. Continued

Step	Symptom	Procedure	Normal Indication	If Normal	If Abnormal
4	Control voltage limit (R908), current limit (R932), and reflected power (VSWR) protection inoperative	Q902 and associated resistors probably open. Analyze and repair.			
5	Current limit (R932) inoperative	Disconnect exciter from synthesizer at J700. Unsolder CURRENT SENSE line (ORG) from C887. Observe Meter 3.	15 μA	Check for short to A+ of current sense line.	Analyze fault in current limit circuit Q903, Q904, and Q905 and repair.
6	Reflected power (VSWR) protection inoperative	Check and repair defect in reflected power detector components R901, CR901, etc. on Directional Coupler Board.			
7	Thermal protection inoperative	Check and repair defect in thermal protection components R901, R900, and CR900 on Common Circuits Board.			
8	Power set (R908) inoperative.	Check and repair defect in forward power detector components R902, CR902, etc.			

1.1.2 UHF Radios only

The text changes are as follows:

From	To
R908 —	R912
R917 —	R901

The following charts (Tables 2 and 3) for troubleshooting your UHF transmitter contain the updated designators, and do not require changes. These charts replace the charts in your UHF Instruction Manual, Transmitter Section.

Table 2. UHF Transmitter Troubleshooting Procedure

Step	Symptom	Procedure	Normal Indication	If Normal	If Abnormal
1	Suspected Transmitter Failure	Measure RF output power at antenna connector.	Rated power	No transmitter malfunction	High Power—perform Transmitter Control and Protection Circuit Troubleshooting Procedure. No power—go to 2. Low power—go to 3.
2	No Output Power	a. Set R912 and R901 fully clockwise. Observe Meter 5.	Greater than 5 μA	Go to b.	Go to 3.
		b. Measure dc voltage across antenna relay coil during TX.	5 V	Go to c.	Check coil continuity (dc resistance approx. 160 ohms); if good, troubleshoot relay drive circuitry.
		c. Check reed switch continuity.	Continuous during TX	Go to d.	Replace switch.
		d. Check harmonic filter and output cable for shorts and discontinuities.	See schematic.	Go to 3.	Repair defect.
3	Low Output Power	a. Measure dc level at collector of Q802.	Greater than 11 V	Go to b.	Perform Transmitter Control and Protection Circuit Troubleshooting Procedure.
		b. Measure RF signal level at VCO buffer output.	+22 dBm min.	Perform Power Amplifier Troubleshooting Procedure.	Perform Synthesizer Troubleshooting Procedure.

Table 3. UHF Transmitter Control and Protection Circuitry Troubleshooting Chart

Step	Symptom	Procedure	Normal Indication	If Normal	If Abnormal
1	Little or no power with all controls open (POWER SET clockwise and CURRENT LIMIT clockwise).	a. Disconnect LLA from synthesizer at J700. Check for keyed 9.5 V dc at Pin 4, U900.	9.5 V dc	Go to Step 1b.	a. Check PA ENABLE at J300-5. b. Check for synthesizer lock. c. Check PA ENABLE switch (Q902).
		b. Measure output voltage of U900D, Pin 1.	> 5.0 V dc	Repair fault in control voltage amplifiers Q900 and Q901.	Go to Step 1c.
		c. Measure voltages to input of U900D, Pins 2 and 3.	Pin 3 > Pin 2	U900 defective.	Check for shorts or opens in resistive feed circuits to Pins 2 and 3 of J950.
2	All controls inoperative.	a. Disconnect LLA from synthesizer at J700.	3 V to 120 V	Go to Step 3b.	Repair fault in control voltage amplifiers Q900 and Q901.
		b. Set all controls clockwise. Measure Pins 9 and 10, U900B in TX mode.	Pin 10 > Pin 9	U900 defective.	Look for defect in VSWR shutback.
3	Current limit (R901) inoperative.	Disconnect exciter from synthesizer at J700. Unsolder current sense line (orange) from C887. Observe drain current.	10 A	Check for short to A+ of current sense line.	Analyze fault in current limit circuit U900C and repair.
4	Reflected power (VSWR) protection inoperative.	Check and repair defect in reflected power detector components U900B, CR902, etc.			
5	Thermal protection inoperative.	Check and repair defect in thermal protection components U900A, CR901, RT801, etc.			
6	Power set (R912) inoperative.	Check and repair defect in forward power detector components R902, CR902, etc. of directional coupler.			

Common Circuits Board

1. Description

Common board circuitry performs two functions. Voltage regulation and RF amplifier power control. The circuit description, theory of operation, and troubleshooting chart for the RF power control are contained in the transmitter section of your manual. The voltage regulators are covered in this section.

Note

This supplement also contains updated information about component designators in the Troubleshooting charts.

2. Theory of Operation
(regulators)

The voltage regulators consist of the 1000 series part designators. The regulator voltages are: switched 9.6 volts, switched 5.0 volts, and unswitched 5.0 volts. The switched supplies (9.6 and 5.0 volts) are controlled by the power switch at the control head. The unswitched 5.0 volt supply remains powered up provided that the A + lead to the radio is live, and the B – lead provides a ground return path.

2.1 9.6 VOLT REGULATOR

The 9.6 volt regulator obtains its reference from the zener diode on HY1000. The reference voltage input of U1000-B at Pin 5 is approximately 7.0 volts DC. The output of U1000-B at Pin 4 is the 9.6 volt reference. This reference voltage is amplified by U1000-C, Q1001, and the output transistor Q1000. The 9.6 volt regulator is protected against short circuits. If a short circuit occurs on the 9.6 volt supply line, the diode CR1001 forward biases, removes base drive to Q1001, and shuts down the regulator to prevent further damage.

2.2 UNSWITCHED 5.0 VOLT REGULATOR

The unswitched 5.0 volt regulator is contained in the TO220 packaged device U1001. The device generates its own reference, and is internally current limited and thermally protected. This 5.0 volt supply is used as reference for the switched 5.0 volt supply, so the two regulated voltages closely track each other.

2.3 SWITCHED 5.0 VOLT SUPPLY

The switched 5.0 volt supply obtains its reference voltage from the unswitched 5.0 volt supply. The switched 5.0 volt supply is protected against excessive output current drain. Excessive current drain is sensed by the output resistors R1021 and R1022. If the drop across these resistors is .6 volts or more, the transistor Q1005 begins to conduct. This begins starving base drive to the output Darlington transistor Q1006.

2.4 SHUTBACK CIRCUIT

Both the switched supplies (5.0 and 9.6 volt) switch on and off by the shutback circuit. The shutback circuit senses the SW B + line voltage, and turns the regulators off if line voltage is irregular. The shutback circuit senses over and under voltage conditions on the SW B + line. The 9.6 volt regulator shuts back through Q1002. The base of Q1002 normally pulls low through R1006 and allows a path for Q1001 emitter current. When shut back, the base of Q1002 is pulled high by Q1004 and turns the 9.6 volt regulator off. The switched 5.0 volt regulator is shut back in a similar manner. The 5.0 volt supply is shut back through the diode CR1003. The diode is normally reverse biased and has no effect on the circuit. When shut back, the diode conducts and forces the op-amp output (U1000-D) low. This causes the regulator to shut off completely. The shutback circuit senses the low-line shutback condition through the op-amp U1000-A. The op-amp compares the

unswitched 5.0 voltage on its positive input with the resistively divided SW B+ input on its negative input. The circuit shuts back the regulators when SW B+ falls to approximately 8.5 volts, and turns on when SW B+ is over 9.4 volts. The high line shutback is sensed by 18-volt zener diode VR1000. This diode is presented with the SW B+ line voltage by Q1003. VR1000 has no effect to the circuit until SW B+ reaches about 20.5 volts. The 18-volt zener then conducts and clamps the base voltage of Q1004 to 19 volts. As SW B+ rises, the transistor Q1004 conducts and shuts back the switched regulators at high SW B+ voltages.

3. Regulator Troubleshooting

The following situations are explained to help troubleshoot the regulators in the *SYNTOR X* 9000 radio.

- Failure of the switched 5.0 and 9.6 volt regulators
- Failure of the unswitched 5.0 volt regulator ONLY
- Failure of the 9.6 volt regulator ONLY
- Failure of the switched 5.0 volt regulator ONLY

3.1 FAILURE OF THE 5.0 AND 9.6 VOLT REGULATORS

(1) Inspect P300 and J1 and verify that they are properly installed.

(2) Measure SW B+ on the common circuits board. This voltage range is 10.7 to 16.2 volts. If SW B+ is outside of this range, the regulator shutback circuitry disables the regulators.

(3) Measure the voltage at the collector of Q1004. It should be .6 volts or less. If the collector is above .6 volts, repair the shutback circuit.

3.2 FAILURE OF THE UNSWITCHED 5.0 VOLT REGULATOR *ONLY*

(1) Measure the input to U1001 Pin 1. This range is 10.7 to 16.2 volts. If not, repair the open path A+ or B− to the common circuits board.

(2) Measure the resistance from U1001 Pin 2 to B on the personality board. This should be below .1 ohms. If not, locate the resistive path or connector and repair.

(3) Measure the output of U1001 Pin 3. If not between 4.75 to 5.25 volts, unsolder Pin 3 to determine if the supply is shorted. If the unconnected output is not five volts, replace U1001.

3.3 FAILURE OF THE 9.6 VOLT REGULATOR *ONLY*

(1) Measure the voltage at the emitter of Q1000. It should be between 10.7 to 16.2 volts. If not, find the open path supplying the collector.

(2) Check the op-amp output at U1000B Pin 4. It should be 6.65 to 7.35 volts. Next, check U1000 Pins 5 and 6. Reading should be 6.2 volts. If not, repair the reference circuit.

(3) Measure the base voltage on Q1001. This point is normally at 3.1 volts. If this point is below two volts or above six volts, repair the driving op-amp circuit involving U1000A.

(4) Measure the voltage on the base of Q1000 (output pass transistor). The base voltage should be .5 to .8 volts below the SW B+ voltage on the emitter of Q1000. If this voltage is out of range, repair the output driver involving Q1000 and Q1001.

3.4 FAILURE OF THE SWITCHED 5.0 VOLT REGULATOR *ONLY*

(1) Measure the input reference voltage at U1000D Pin 13, This should be 4.75 to 5.25 volts. If not, recheck the unswitched 5.0 volt regulator output. If the unswitched 5.0 supply is present, unsolder U1000 Pin 13 to check if U1000 is faulty.

(2) Check the collector voltage of Q1005. Acceptable range is 10.7 to 16.2 volts. If not, find the open path to the common circuits board.

(3) Measure the driving op-amp U1000 Pin 12 to determine if sufficient base drive is present for Q1006. U1000 Pin 12 should be 6.4 to 7 volts. If this voltage is more than seven volts, check the voltage drop across R1016. The drop is approximately .2 volts. If there is little or no drop across R1016, replace Q1006. If the voltage drop is excessive, remove Q1005 to disable the current shutback circuit, and recheck. Should the drop still be excessive, measure the drop across R1021. If R1021 drop is more than .7 volts, locate the fault on the switched 5.0-volt line. This fault is probably on another board in the radio. If the R1021 voltage drop is less than .7 volts, replace Q1006. If the voltage on U1000 Pin 12 is below 6.4 and Pin 14 is less than Pin 13 of U1000, replace U1000. If U1000 Pin 14 is more than Pin 13, check for an open R1017 or shorted CR1003.

parts list

HLN4906B SYNTOR X 9000
VHF Common Circuits Board

MXW–2485–A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
capacitor, fixed uF, ±5%, 63V (unless otherwise stated)		
C900	08–11051A07	.01
C901,902	21–11015B05	220 pF ±10% 100V
C903	08–11051A07	.01
C904	08–11051A09	.022
C905	23–11013D55	4.7 ±20% 20V, tantalum
C906,907	21–11015B05	220 pF ±10% 100V
C908	08–11044A34	.018
C909	08–11051A05	.0047
C910	23–11013F59	2.2 ±20% 35V, tantalum
C1000	08–11051A13	.1
C1001,1002	21–11015B05	220 pF ±10% 100V
C1003	23–11019A39	47 ±20% 16V, electrolytic
C1004	08–11051A10	.033
C1005	21–11014B47	82 pF 100V
C1006	21–11015B05	220 pF ±10% 100V
C1007	23–84538G29	47 ±20% 10V, tantalum
C1008	23–11048C11	10 ±20% 35V, electrolytic
C1009	23–84538G29	47 ±20% 10V, tantalum
C1010	21–11015B05	220 pF ±10% 100V
diode (see note)		
CR900,901	48–83654H01	silicon
CR1000–1007	48–83654H01	silicon
hybrid (see note)		
HY1000	01–80715D03	regulator
connector receptacle		
J950	28–84324M02	3 contact
J951	28–84647L05	7 pin
J952	09–84207B01	7 contact
RF coil		
L900	24–82835G08	2.6 uH, red blue gold
transistor (see note)		
Q900	48–00869642	NPN
Q902,903	48–00869643	PNP
Q904,905	48–00869642	NPN
Q906	48–00869649	PNP
Q1000	48–84413L05	PNP
Q1001	48–00869640	NPN
Q1002	48–00869649	PNP
Q1003,1004	48–00869643	PNP
Q1005	48–00869642	NPN
Q1006	48–84413L10	NPN, Darlington
resistor, fixed ohm, ±5%, 1/4 watt (unless otherwise stated)		
R900	06–11009A67	5.6k
R901	06–11009A66	5.1k
R902	06–11009A81	22k
R903	06–11009A35	270
R904	06–11009A89	47k
R905	06–11009A05	15
R906	06–11009A89	47k
R907	06–11009A23	82
R908	18–80087E08	10k potentiometer
R909	06–11009A85	33k

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R910	06–11009A49	1k
R911	06–11009A85	33k
R912	06–11009A71	8.2k
R913	06–11009A39	390
R914	06–11009A25	100
R915	06–11009A29	150
R916	06–11009A43	560
R917	06–11009A99	120k
R918,919	06–11009A49	1k
R920	06–11009A27	120
R921	06–11009A63	3.9k
R922	06–11009A65	4.7k
R923	06–11009A33	220
R924	06–11009A65	4.7k
R925	06–11009A35	270
R926	06–11009A59	2.7k
R927	06–11009A87	39k
R928	06–11009A33	220
R929	06–11009A71	8.2k
R930	06–11009A81	22k
R931	06–11009A63	3.9k
R932	18–80087E07	5k potentiometer
R933	06–11009A79	18k
R934	06–11009A51	1.2k
R935	06–11009A65	4.7k
R936	06–11009A89	47k
R1000	06–11009B14	470k
R1001	06–11009B06	220k
R1002	06–11009A49	1k
R1003,1004	06–11009A35	270
R1005	06–11045A20	62 1/2W
R1006	06–11009A43	560
R1007	06–11009A66	5.1k
R1008	06–11009A88	43k
R1009	06–11009A65	4.7k
R1010	06–11009A66	5.1k
R1011	06–11009A65	4.7k
R1012	06–11009A55	1.8k
R1013	06–11009A66	5.1k
R1014	06–11009A65	4.7k
R1015	06–11009A35	270
R1016	06–11009A45	680
R1017	06–11009A65	4.7k
R1018,1019	06–11009A59	2.7k
R1020	06–11009A35	270
R1021,1022	06–80037G07	1.8 1/2W
R1023	06–11009A65	4.7k
R1024,1025	06–11009A73	10k
integrated circuit (see note)		
U900	51–80067C03	dual opamp
U1000	51–80067C06	opamp
U1001	51–80068C02	voltage regulator
voltage regulator (see note)		
VR1000	48–82256C53	18V

01/06/88

note: For best performance, order diodes, transistors, and integrated–circuit devices by Motorola part number.

ist

SYNTOR X 9000
on Circuits Board MXW–2485–A

MOTOROLA PART NO.	DESCRIPTION
fixed uF, ±5%, 63V (unless otherwise stated)	
08–11051A07	.01
21–11015B05	220 pF ±10% 100V
08–11051A07	.01
08–11051A09	.022
23–11013D55	4.7 ±20% 20V, tantalum
21–11015B05	220 pF ±10% 100V
08–11044A34	.018
08–11051A05	.0047
23–11013F59	2.2 ±20% 35V, tantalum
08–11051A13	.1
21–11015B05	220 pF ±10% 100V
23–11019A39	47 ±20% 16V, electrolytic
08–11051A10	.033
21–11014B47	82 pF 100V
21–11015B05	220 pF ±10% 100V
23–84538G29	47 ±20% 10V, tantalum
23–11048C11	10 ±20% 35V, electrolytic
23–84538G29	47 ±20% 10V, tantalum
21–11015B05	220 pF ±10% 100V
note)	
48–83654H01	silicon
48–83654H01	silicon
note)	
01–80715D03	regulator
receptacle	
28–84324M02	3 contact
28–84647L05	7 pin
09–84207B01	7 contact
24–82835G08	2.6 uH, red blue gold
(see note)	
48–00869642	NPN
48–00869643	PNP
48–00869642	NPN
48–00869649	PNP
48–84413L05	PNP
48–00869640	NPN
48–00869649	PNP
48–00869643	PNP
48–00869642	NPN
48–84413L10	NPN, Darlington
ixed ohm, ±5%, 1/4 watt (unless otherwise stated)	
06–11009A67	5.6k
06–11009A66	5.1k
06–11009A81	22k
06–11009A35	270
06–11009A89	47k
06–11009A05	15
06–11009A89	47k
06–11009A23	82
18–80087E08	10k potentiometer
06–11009A85	33k

MXW–2485–A (2)

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R910	06–11009A49	1k
R911	06–11009A85	33k
R912	06–11009A71	8.2k
R913	06–11009A39	390
R914	06–11009A25	100
R915	06–11009A29	150
R916	06–11009A43	560
R917	06–11009A99	120k
R918,919	06–11009A49	1k
R920	06–11009A27	120
R921	06–11009A63	3.9k
R922	06–11009A65	4.7k
R923	06–11009A33	220
R924	06–11009A65	4.7k
R925	06–11009A35	270
R926	06–11009A59	2.7k
R927	06–11009A87	39k
R928	06–11009A33	220
R929	06–11009A71	8.2k
R930	06–11009A81	22k
R931	06–11009A63	3.9k
R932	18–80087E07	5k potentiometer
R933	06–11009A79	18k
R934	06–11009A51	1.2k
R935	06–11009A65	4.7k
R936	06–11009A89	47k
R1000	06–11009B14	470k
R1001	06–11009B06	220k
R1002	06–11009A49	1k
R1003,1004	06–11009A35	270
R1005	06–11045A20	62 1/2W
R1006	06–11009A43	560
R1007	06–11009A66	5.1k
R1008	06–11009A88	43k
R1009	06–11009A65	4.7k
R1010	06–11009A66	5.1k
R1011	06–11009A65	4.7k
R1012	06–11009A55	1.8k
R1013	06–11009A66	5.1k
R1014	06–11009A65	4.7k
R1015	06–11009A35	270
R1016	06–11009A45	680
R1017	06–11009A65	4.7k
R1018,1019	06–11009A59	2.7k
R1020	06–11009A35	270
R1021,1022	06–80037G07	1.8 1/2W
R1023	06–11009A65	4.7k
R1024,1025	06–11009A73	10k

integrated circuit (see note)

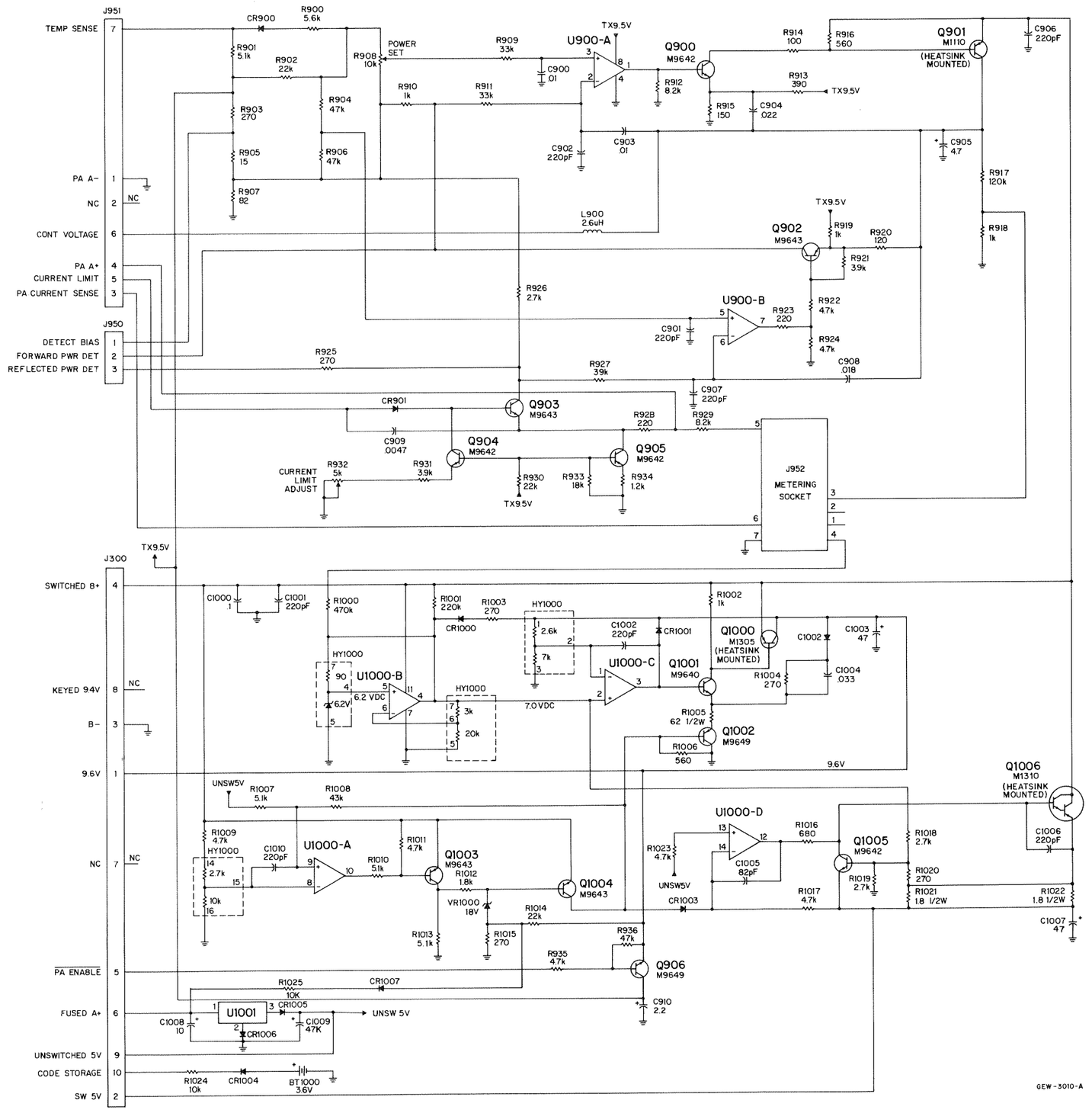
U900	51–80067C03	dual opamp
U1000	51–80067C06	opamp
U1001	51–80068C02	voltage regulator

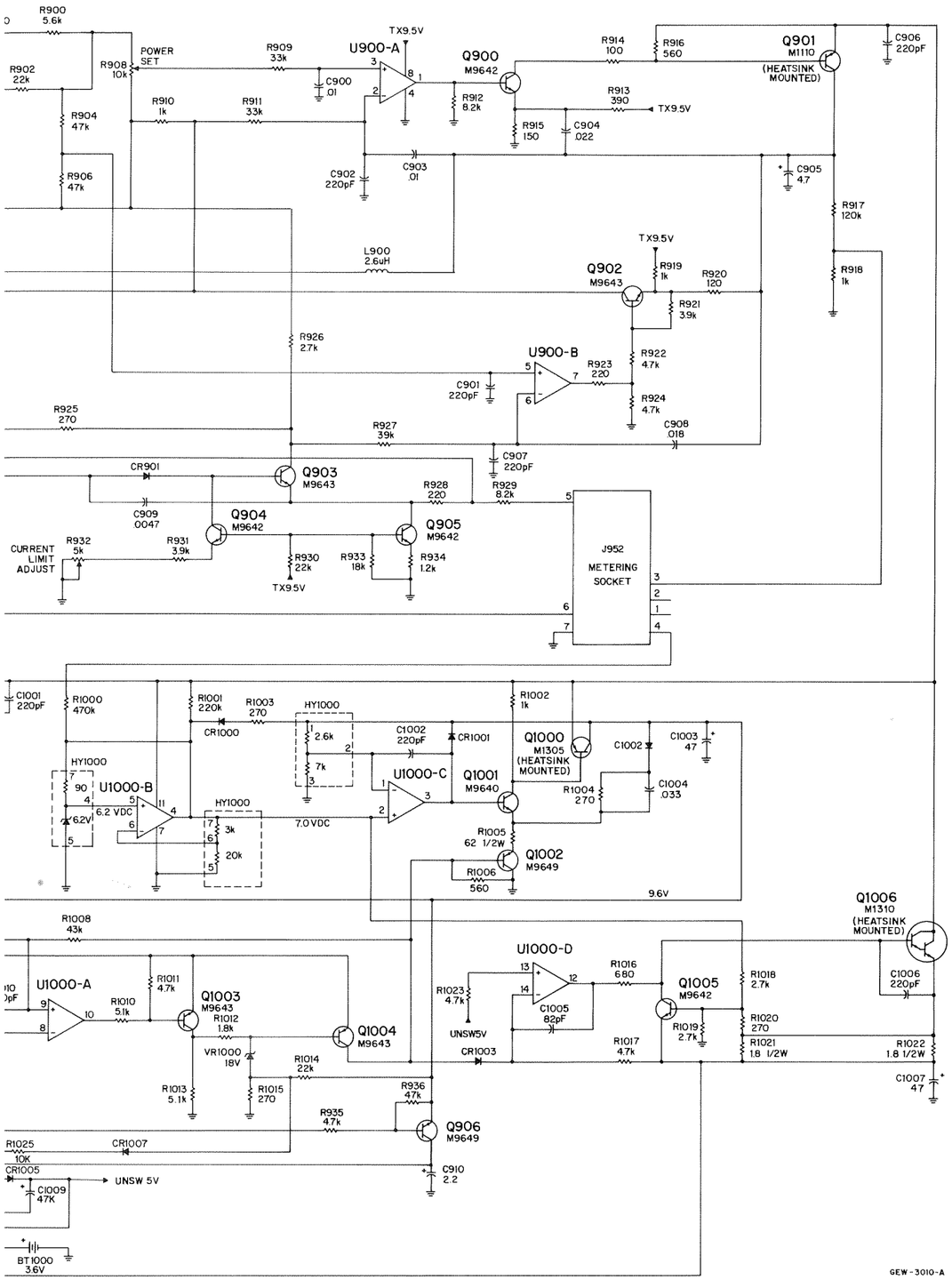
voltage regulator (see note)

VR1000	48–82256C53	18V

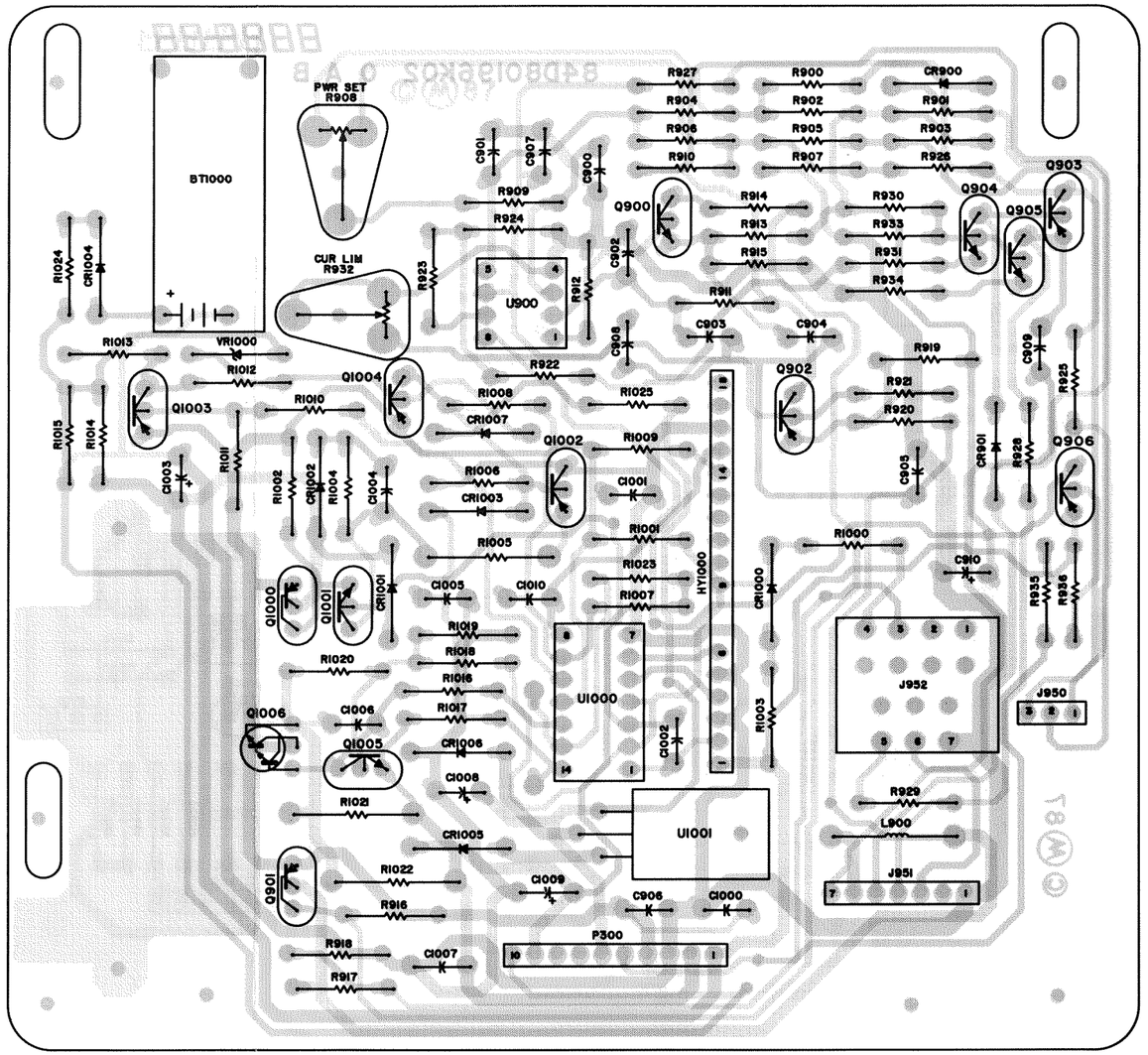
01/06/88

note: For best performance, order diodes, transistors, and integrated–circuit devices by Motorola part number.





VHF COMMON CIRCUIT BOARD



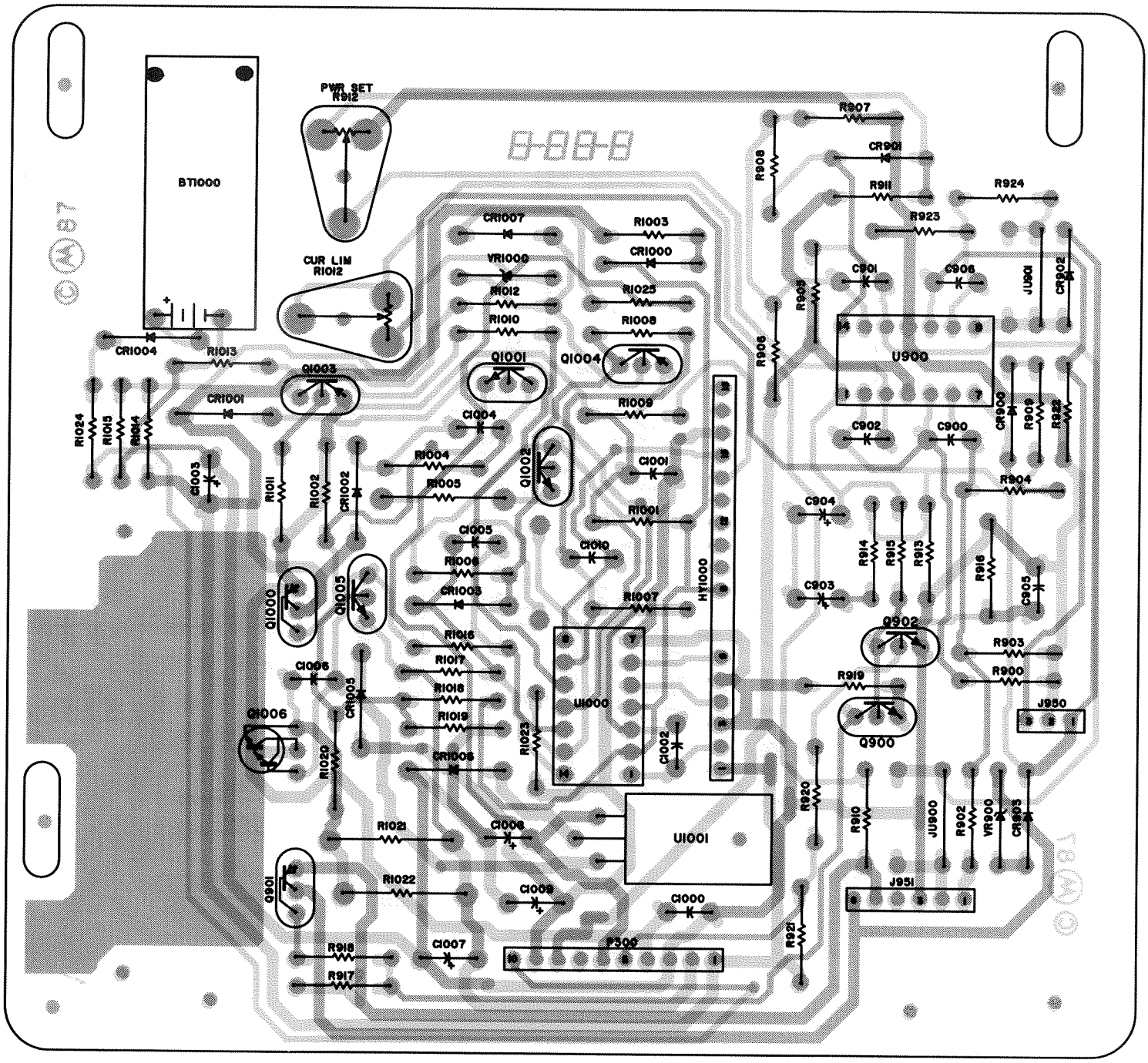
SOLDER SIDE GAW-2504-0

COMPONENT SIDE GAW-2503-0

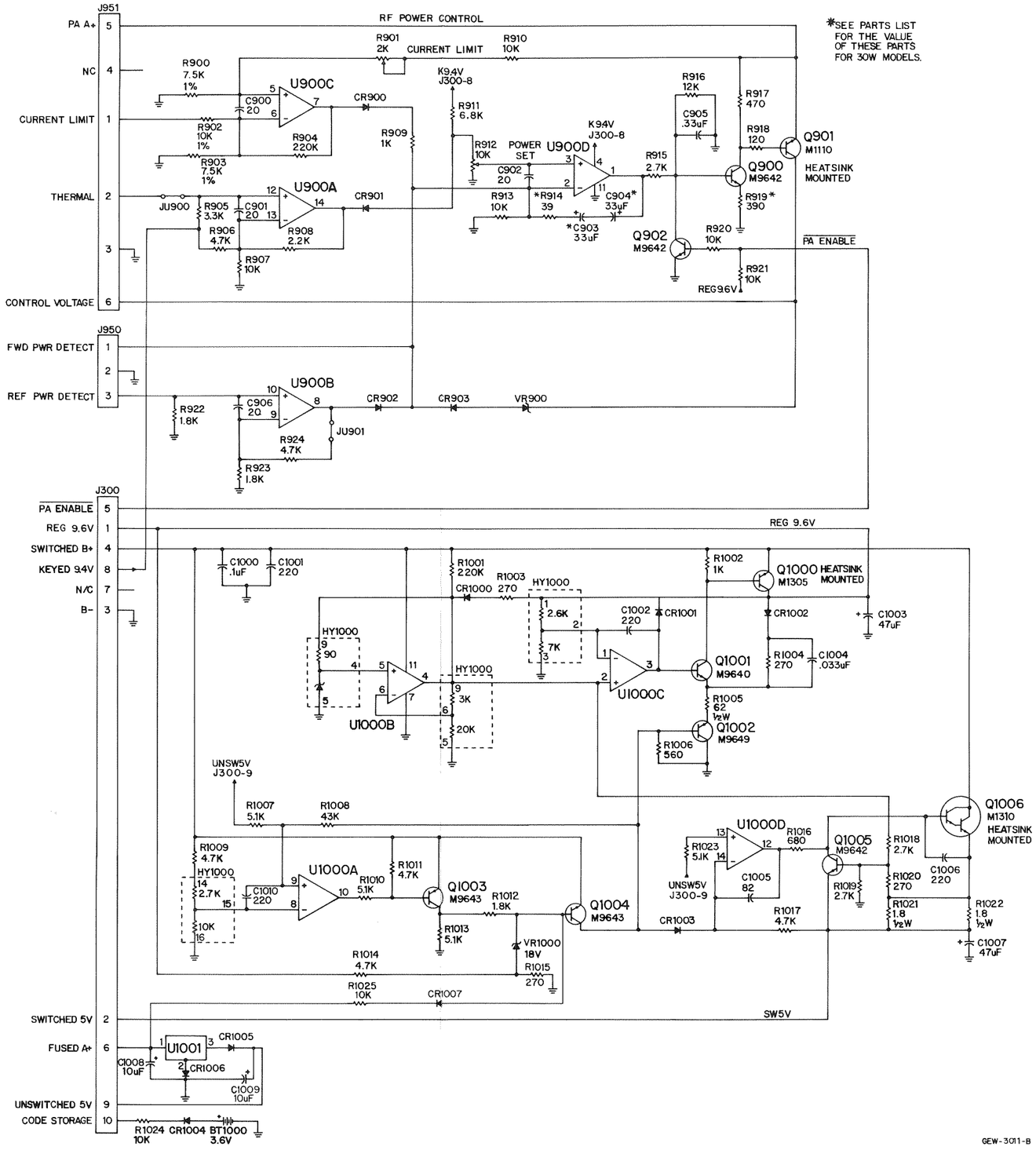
OVERLAY GXW-2507-0

Schematics, Circuit Board Diagrams, and
Parts Lists for VHF Common Circuits Boards
PW-2587-B
1/25/88

UHF COMMON CIRCUIT BOARD



Schematics, Circuit Board Diagrams, and
Parts Lists for UHF Common Circuits Boards
PW-5194-O
1/25/88



parts list

HLN4905B SYNTOR X 9000
UHF Common Circuits Board

MXW–2484–A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
capacitor, fixed uF, ±5%, 100V (unless otherwise stated)		
C900–902	21–11014H32	20 pF
C903,904	23–11013B11	33 ±10% 10V, tantalum
C905	08–11051A16	.33 63V
C906	21–11014H32	20 pF
C1000	08–11051A13	.1 63V
C1001,1002	21–11015B05	220 pF ±10%
C1003	23–11019A39	47 ±20% 16V, electrolytic
C1004	08–11051A10	.033 63V
C1005	21–11014B47	82 pF
C1006	21–11015B05	220 pF ±10%
C1007	23–84538G29	47 ±20% 10V, tantalum
C1008	23–11048C11	10 ±20% 35V, electrolytic
C1009	23–84538G29	47 ±20% 10V, tantalum
C1010	21–11015B05	220 pF ±10%
diode (see note)		
CR900–903	48–83654H01	silicon
CR1000–1007	48–83654H01	silicon
hybrid (see note)		
HY1000	01–80715D03	regulator
connector receptacle		
J950	28–84324M02	3 contact
J951	28–84647L04	6 pin
jumper		
JU900,901	06–11009B23	0 ohm
transistor (see note)		
Q900	48–00869642	NPN
Q902	48–00869642	NPN
Q1000	48–84413L05	PNP
Q1001	48–00869640	NPN
Q1002	48–00869649	NPN
Q1003,1004	48–00869643	PNP
Q1005	48–00869642	NPN
Q1006	48–84413L10	NPN, Darlington
resistor, fixed ohm, ±5%, 1/4 watt (unless otherwise stated)		
R900	06–11049C79	7.5k ±1%
R901	18–80087E05	2k potentiometer
R902	06–11049C91	10k ±1%
R903	06–11049C79	7.5k ±1%
R904	06–11009B06	220k
R905	06–11009A61	3.3k
R906	06–11009A65	4.7k

MXW–2484–A (2)

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R907	06–11009A73	10k
R908	06–11009A57	2.2k
R909	06–11009A49	1k
R910	06–11049C91	10k ±1%
R911	06–11009A69	6.8k
R912	18–80087E08	10k potentiometer
R913	06–11009A73	10k
R914	06–11009A15	39
R915	06–11009A59	2.7k
R916	06–11009A75	12k
R917	06–11009A41	470
R918	06–11009A27	120
R919	06–11009A39	390
R920,921	06–11009A73	10k
R922,923	06–11009A55	1.8k
R924	06–11009A65	4.7k
R1001	06–11009B06	220k
R1002	06–11009A49	1k
R1003,1004	06–11009A35	270
R1005	06–11045A20	62 1/2W
R1006	06–11009A43	560
R1007	06–11009A66	5.1k
R1008	06–11009A88	43k
R1009	06–11009A65	4.7k
R1010	06–11009A66	5.1k
R1011	06–11009A65	4.7k
R1012	06–11009A55	1.8k
R1013	06–11009A66	5.1k
R1014	06–11009A65	4.7k
R1015	06–11009A35	270
R1016	06–11009A45	680
R1017	06–11009A65	4.7k
R1018,1019	06–11009A59	2.7k
R1020	06–11009A35	270
R1021,1022	06–80037G07	1.8 1/2W
R1023	06–11009A66	5.1k
R1024,1025	06–11009A73	10k
integrated circuit (see note)		
U900	51–80067C01	opamp
U1000	51–80067C06	opamp
U1001	51–80068C02	voltage regulator
voltage regulator (see note)		
VR900	48–82256C12	5.6V
VR1000	48–82256C53	18V

01/06/88

note: For best performance, order diodes, transistors, and integrated–circuit devices by Motorola part number.

01/06/88

note: For best performance, order diodes, transistors, and integrated–circuit devices by Motorola part number.

INSUFFICIENT POWER OUTPUT
(SEE NOTE)

(SEE POWER CONTROL SECTION OF COMMON CIRCUITS BOARD)

START

BRIEFLY KEY TRANSMITTER SEE CAUTION

IS U950-4 = 9.4V ?
- NO → NO KEYED 9.4V. CHECK PERSONALITY BOARD.
- YES

IS MS2/MS1 > 0.46V ?
- NO
- YES → VSWR SHUTBACK. CHECK ANTENNA, CONNECTORS, ANTENNA SWITCH, CABLES, HARMONIC FILTER, AND DIRECTIONAL COUPLER FOR RF DISCONTINUITY. READ TRANSMITTER POWER MEASURING SECTION OF SYSTEM MAINTENANCE.

IS MS3 ≤ 0 µA ?
- NO → IS MS3 ≥ 39 µA ?
  - NO → IS P401-10 < 1V ?
    - NO → IMPROPER $\overline{PA\ ENABLE}$ VOLTAGE. CHECK PERSONALITY BOARD.
    - YES → UNPLUG J951.
      - IS U951-13 > 0.2V ?
        - NO → RECONNECT R951.
        - YES → REPLACE U951. IF CONDITION PERSISTS, REPLACE U950.
  - YES → PROBLEM IN PA. GO TO PA TROUBLE-SHOOTING CHART.
- YES

IS MS1 = 0 µA ?
- NO → CHECK U901 AND U950.
  - NO → REPLACE DEFECTIVE COMPONENTS.
- YES

IS P401-10 < 1V OR > 9V ?
- (HIGH) > 9V → NO $\overline{PA\ ENABLE}$. CHECK PERSONALITY BOARD.
- < 1V (LOW)

IS U950-14 ≥ 4V ?
- NO → IS U950-12 ≥ 0.1V ?
  - NO → IS U950-1 ≥ 8V ?
    - NO → DOES U950-2 = U950-3 ?
      - NO → REPLACE U950.
      - YES → FAULTY DIVIDER NETWORK, U950, Q950, Q951. CHECK U950, Q950, Q951, R986, R987, R984, R985.
    - YES → Q953 NOT CONDUCTING PROPERLY, OR FAULTY DIVIDER NETWORK FOR POWER SET VOLTAGE. CHECK Q953, R980, R981 FOR OPEN. CHECK POWER POT R979 FOR SHORT. CHECK RT950 AND RT850. (NOTE: RT850 IS ON FINAL PA.)
      - REPLACE DEFECTIVE COMPONENTS.
  - YES → REPLACE U950.
- YES

IS Q950 COLLECTOR ≥ 9.0V ?
- NO → REPLACE Q951.
- YES → Q950 NOT CONDUCTING PROPERLY OR Q951 SHORTED. CHECK Q950, R963, R962, AND Q951.
  - REPLACE DEFECTIVE COMPONENTS.

IS Q951 BASE ≥ 8.8V ?
- NO → REPLACE Q951.
- YES → Q957 NOT CONDUCTING PROPERLY. CHECK Q950 AND R962.
  - REPLACE DEFECTIVE COMPONENTS.

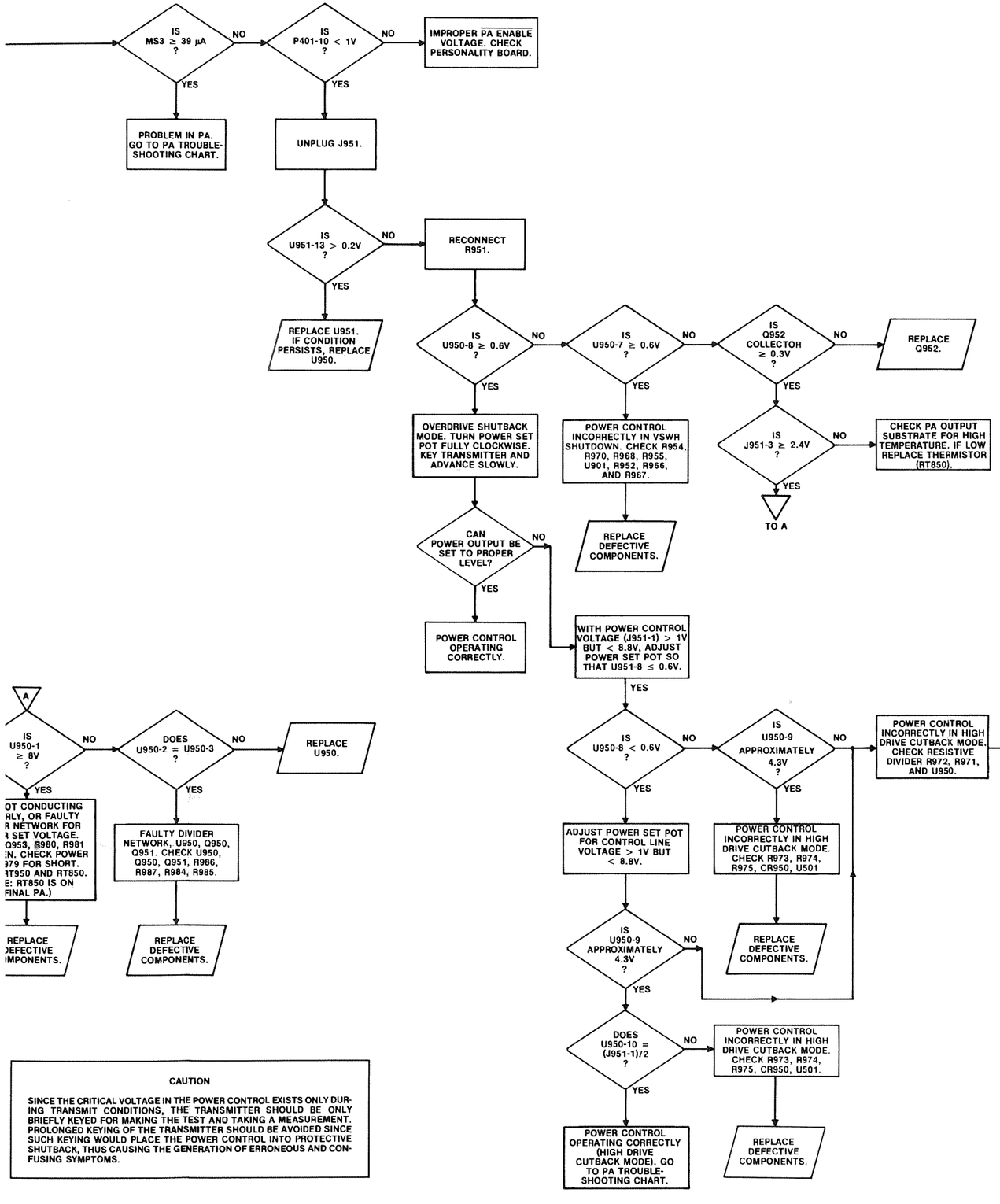
IS U950-8 ≥ 0.6V ?
- NO → IS U950-7 ≥ 0.6V ?
  - NO → IS Q952 COLLECTOR ≥ 0.3V ?
    - NO → REPLACE Q952.
    - YES → IS J951-3 ≥ 2.4V ?
      - NO → CHECK PA OUTPUT SUBSTRATE FOR HIGH TEMPERATURE. IF LOW REPLACE THERMISTOR (RT850).
      - YES → TO A
  - YES → POWER CONTROL INCORRECTLY IN VSWR SHUTDOWN. CHECK R954, R970, R968, R955, U901, R952, R966, AND R967.
    - REPLACE DEFECTIVE COMPONENTS.
- YES → OVERDRIVE SHUTBACK MODE. TURN POWER SET POT FULLY CLOCKWISE. KEY TRANSMITTER AND ADVANCE SLOWLY.

CAN POWER OUTPUT BE SET TO PROPER LEVEL?
- NO → WITH POWER CONTROL VOLTAGE (J951-1) > 1V BUT < 8.8V, ADJUST POWER SET POT SO THAT U951-8 ≤ 0.6V.
  - YES
  - IS U950-8 < 0.6V ?
    - NO → IS U950-9 APPROXIMATELY 4.3V ?
      - NO → POWER CONTROL INCORRECTLY IN HIGH DRIVE CUTBACK MODE. CHECK RESISTIVE DIVIDER R972, R971, AND U950.
        - REPLACE DEFECTIVE COMPONENTS.
      - YES → POWER CONTROL INCORRECTLY IN HIGH DRIVE CUTBACK MODE. CHECK R973, R974, R975, CR950, U501
        - REPLACE DEFECTIVE COMPONENTS.
    - YES → ADJUST POWER SET POT FOR CONTROL LINE VOLTAGE > 1V BUT < 8.8V.
      - IS U950-9 APPROXIMATELY 4.3V ?
        - NO → (back to IS U950-9 APPROXIMATELY 4.3V ?)
        - YES
        - DOES U950-10 = (J951-1)/2 ?
          - NO → POWER CONTROL INCORRECTLY IN HIGH DRIVE CUTBACK MODE. CHECK R973, R974, R975, CR950, U501.
            - REPLACE DEFECTIVE COMPONENTS.
          - YES → POWER CONTROL OPERATING CORRECTLY (HIGH DRIVE CUTBACK MODE). GO TO PA TROUBLE-SHOOTING CHART.
- YES → POWER CONTROL OPERATING CORRECTLY.

CAUTION

SINCE THE CRITICAL VOLTAGE IN THE POWER CONTROL EXISTS ONLY DURING TRANSMIT CONDITIONS, THE TRANSMITTER SHOULD BE ONLY BRIEFLY KEYED FOR MAKING THE TEST AND TAKING A MEASUREMENT. PROLONGED KEYING OF THE TRANSMITTER SHOULD BE AVOIDED SINCE SUCH KEYING WOULD PLACE THE POWER CONTROL INTO PROTECTIVE SHUTBACK, THUS CAUSING THE GENERATION OF ERRONEOUS AND CONFUSING SYMPTOMS.

GEW—2699—O

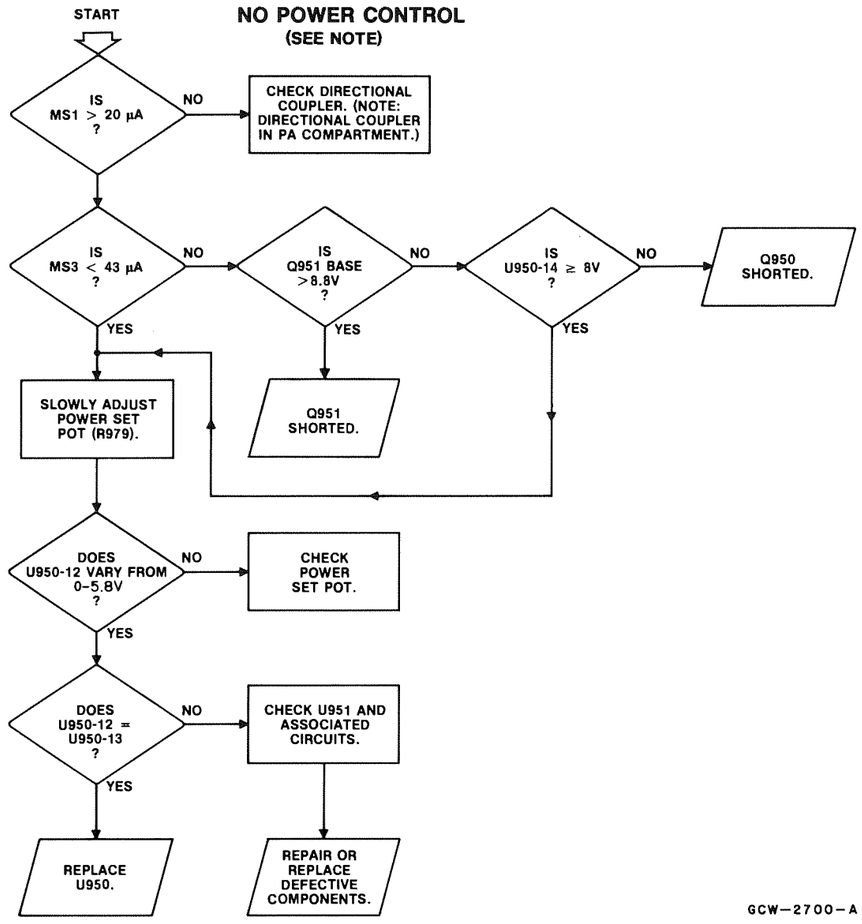


CAUTION

SINCE THE CRITICAL VOLTAGE IN THE POWER CONTROL EXISTS ONLY DURING TRANSMIT CONDITIONS, THE TRANSMITTER SHOULD BE ONLY BRIEFLY KEYED FOR MAKING THE TEST AND TAKING A MEASUREMENT. PROLONGED KEYING OF THE TRANSMITTER SHOULD BE AVOIDED SINCE SUCH KEYING WOULD PLACE THE POWER CONTROL INTO PROTECTIVE SHUTBACK, THUS CAUSING THE GENERATION OF ERRONEOUS AND CONFUSING SYMPTOMS.

GEW—2699—0

NO POWER CONTROL
(SEE NOTE)



GCW—2700—A

NOTE

WHEN THE POWER AMPLIFIER FAILS, IT IS VERY PROBABLE THAT THE POWER CONTROL PROTECTION FUNCTIONS ARE NOT OPERATING PROPERLY. CONSEQUENTLY, IT IS RECOMMENDED THAT THE FOLLOWING THREE CHECKS ILLUSTRATED ON THE FLOW CHART BE PERFORMED WHENEVER THE POWER AMPLIFIER FAILS.

(A) VSWR PROTECTION

(B) LOW-LINE CUTBACK

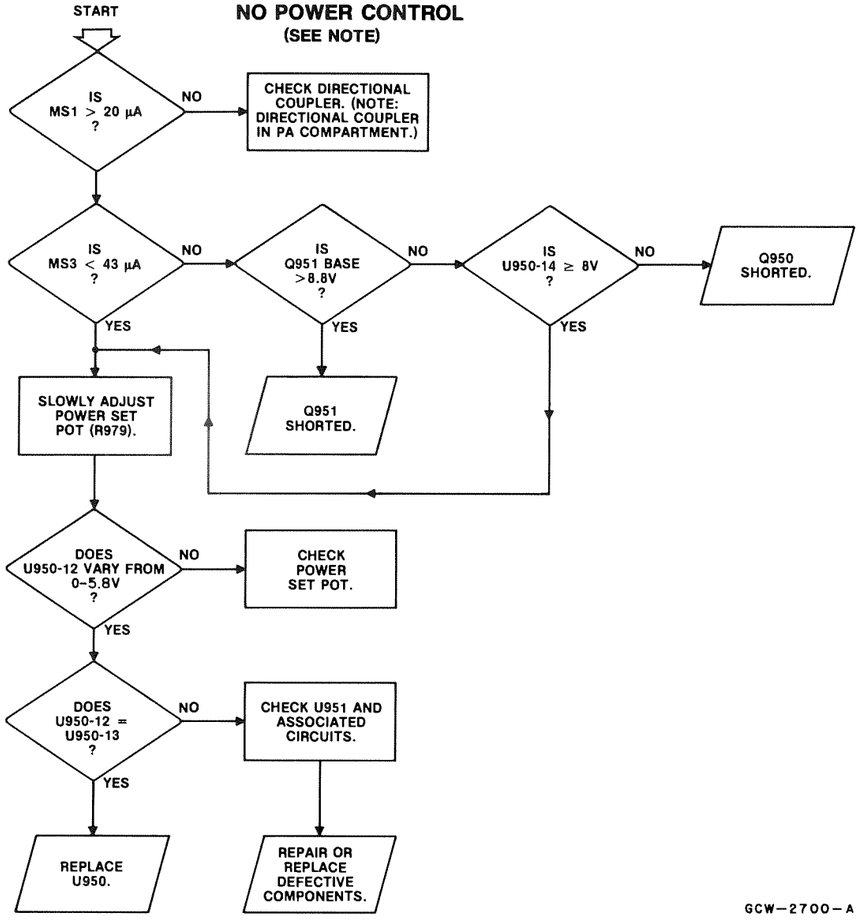
(C) HIGH-DRIVE PROTECTION

IT IS ALSO RECOMMENDED THAT THESE CHECKS BE PERFORMED AFTER COMPLETING EITHER OF THE TWO OTHER CHECKS, INSUFFICIENT POWER OUTPUT AND LACK OF POWER CONTROL.

NOTE

ALL VOLTAGE VALUES ARE REFERENCED TO A−.

NO POWER CONTROL (SEE NOTE)



GCW-2700-A

NOTE

WHEN THE POWER AMPLIFIER FAILS, IT IS VERY PROBABLE THAT THE POWER CONTROL PROTECTION FUNCTIONS ARE NOT OPERATING PROPERLY. CONSEQUENTLY, IT IS RECOMMENDED THAT THE FOLLOWING THREE CHECKS ILLUSTRATED ON THE FLOW CHART BE PERFORMED WHENEVER THE POWER AMPLIFIER FAILS.

(A) VSWR PROTECTION

(B) LOW-LINE CUTBACK

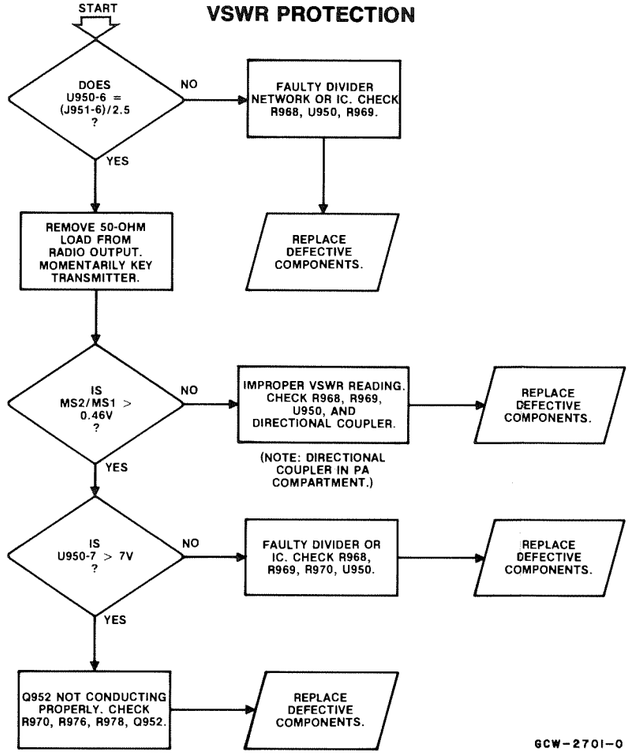
(C) HIGH-DRIVE PROTECTION

IT IS ALSO RECOMMENDED THAT THESE CHECKS BE PERFORMED AFTER COMPLETING EITHER OF THE TWO OTHER CHECKS, INSUFFICIENT POWER OUTPUT AND LACK OF POWER CONTROL.

NOTE

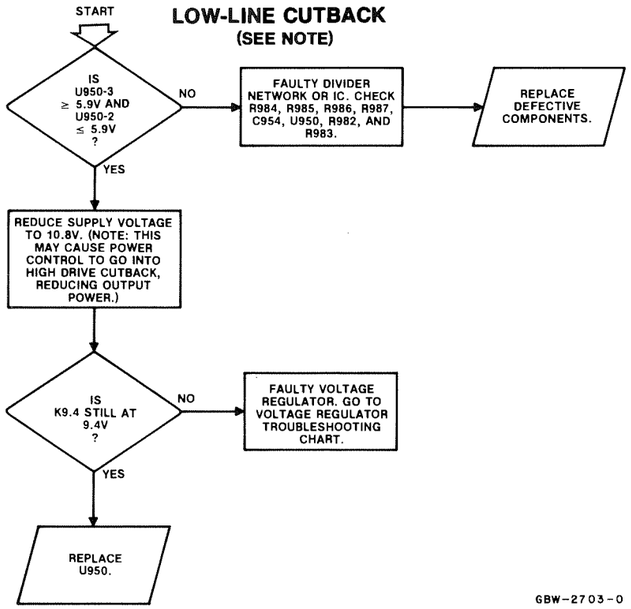
ALL VOLTAGE VALUES ARE REFERENCED TO A-.

VSWR PROTECTION



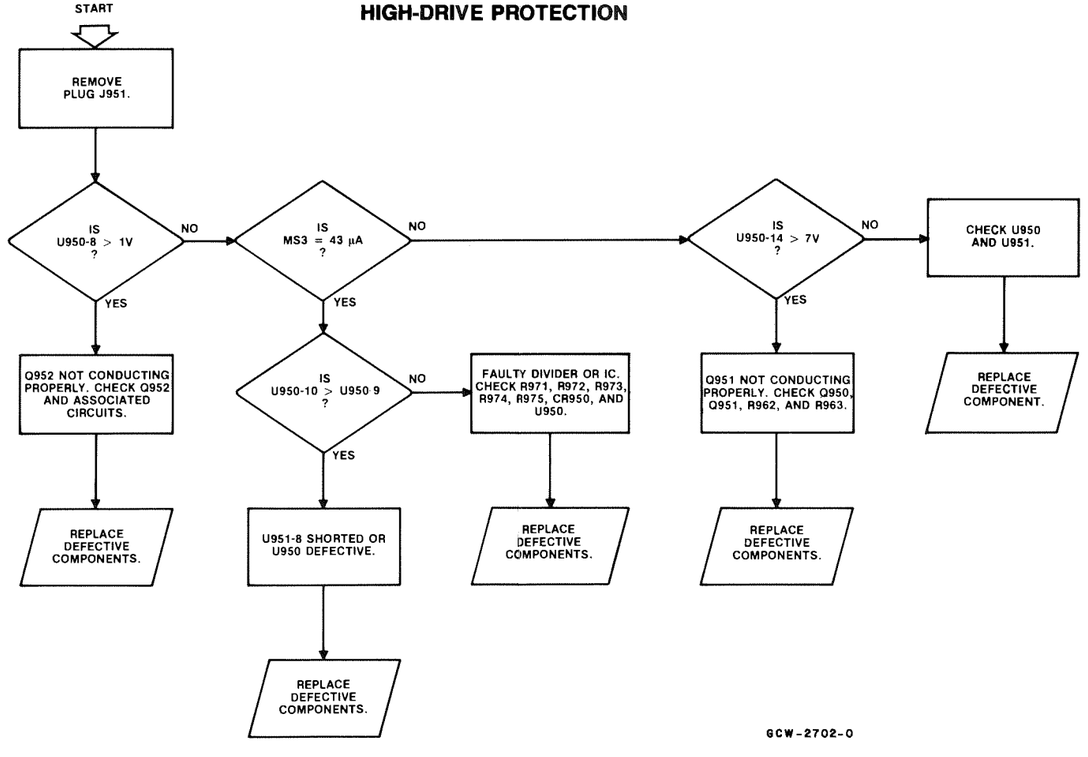
GCW-2701-0

LOW-LINE CUTBACK (SEE NOTE)



GBW-2703-0

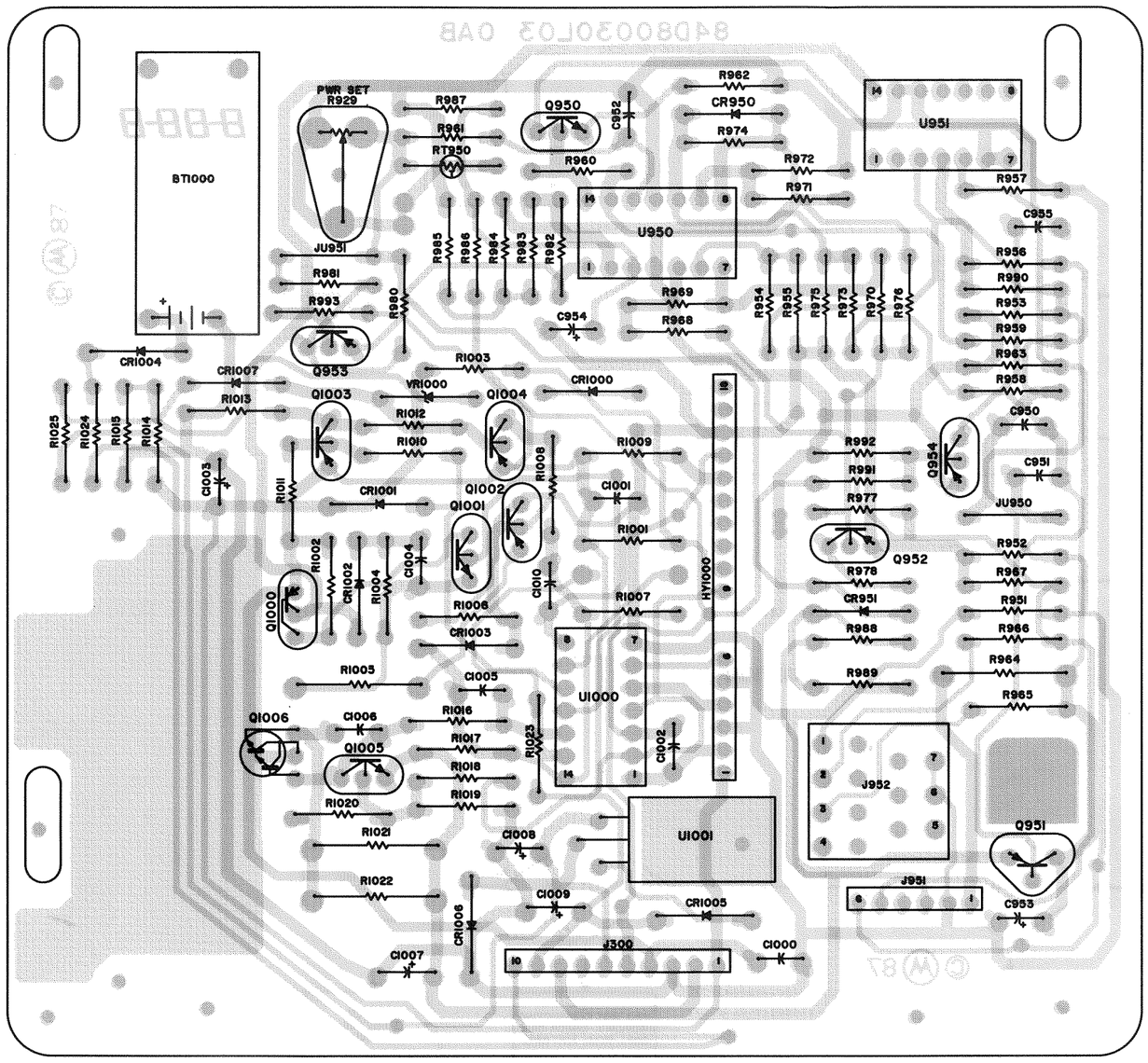
HIGH-DRIVE PROTECTION



GCW-2702-0

Troubleshooting Diagrams for
Common Circuits Board 800 MHz
PW-2767-A
1/29/88

800MHz COMMON CIRCUIT BOARD

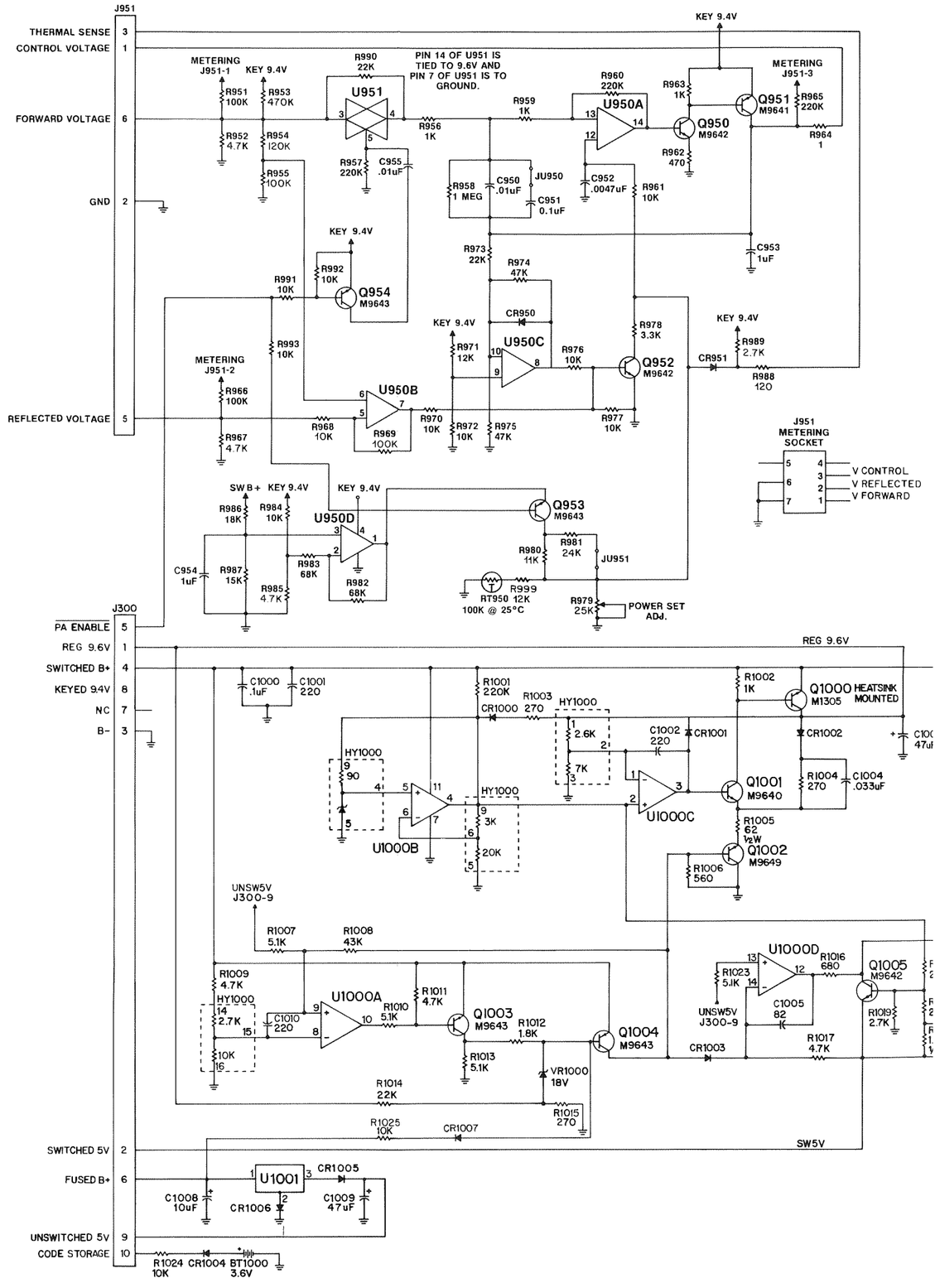


SOLDER SIDE GAW-2667-B

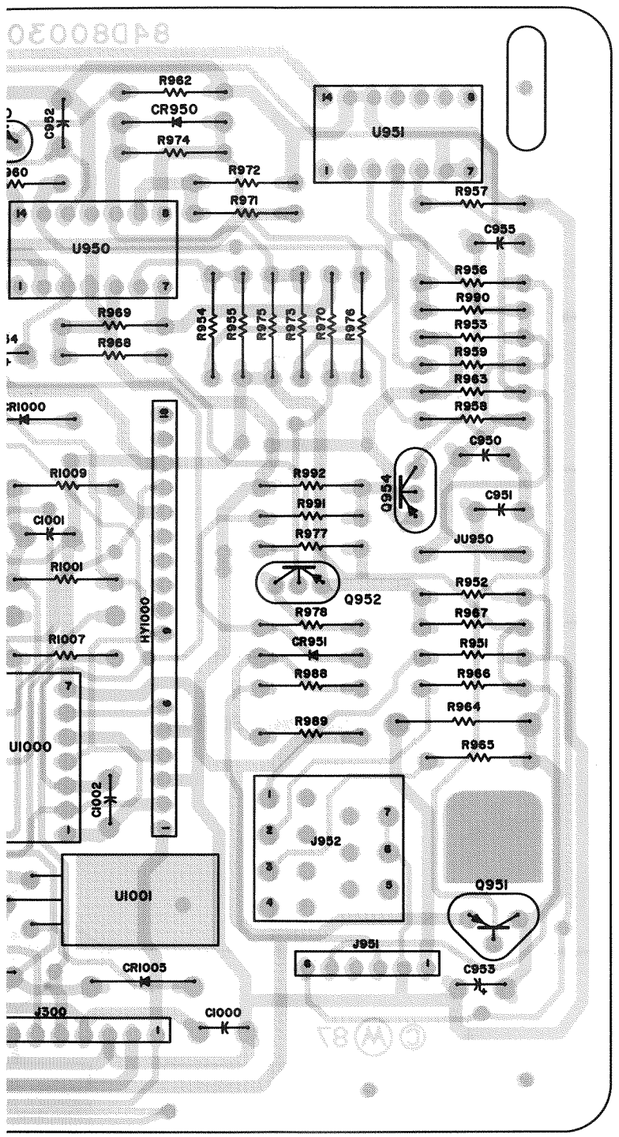
COMPONENT SIDE GAW-2666-B

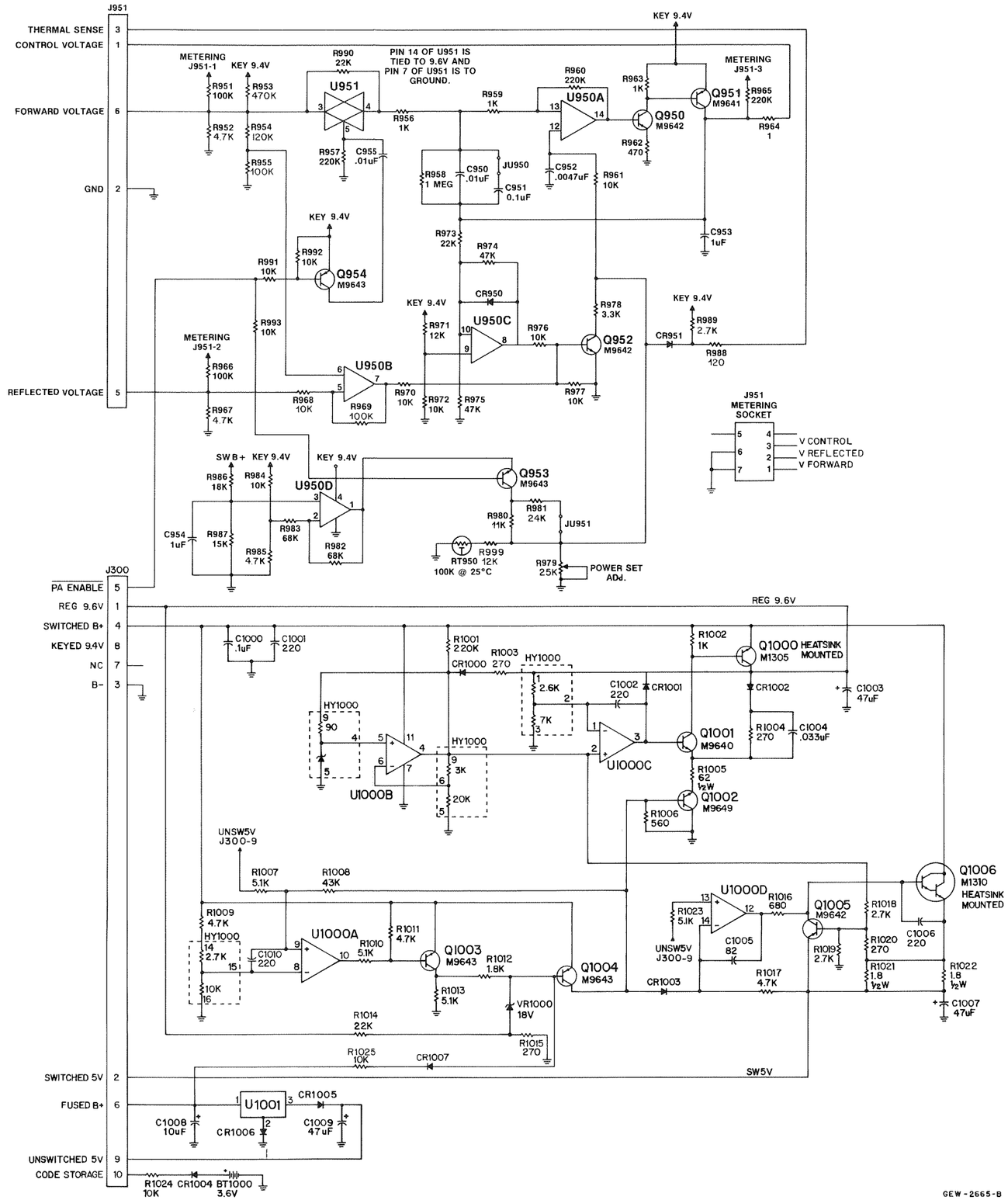
OVERLAY GXW-2668-B

Schematics, Circuit Board Diagram, and
Parts List for HLN4971C
Common Circuits Board (800 MHz)
PW-2766-B
1/25/88



CIRCUIT BOARD

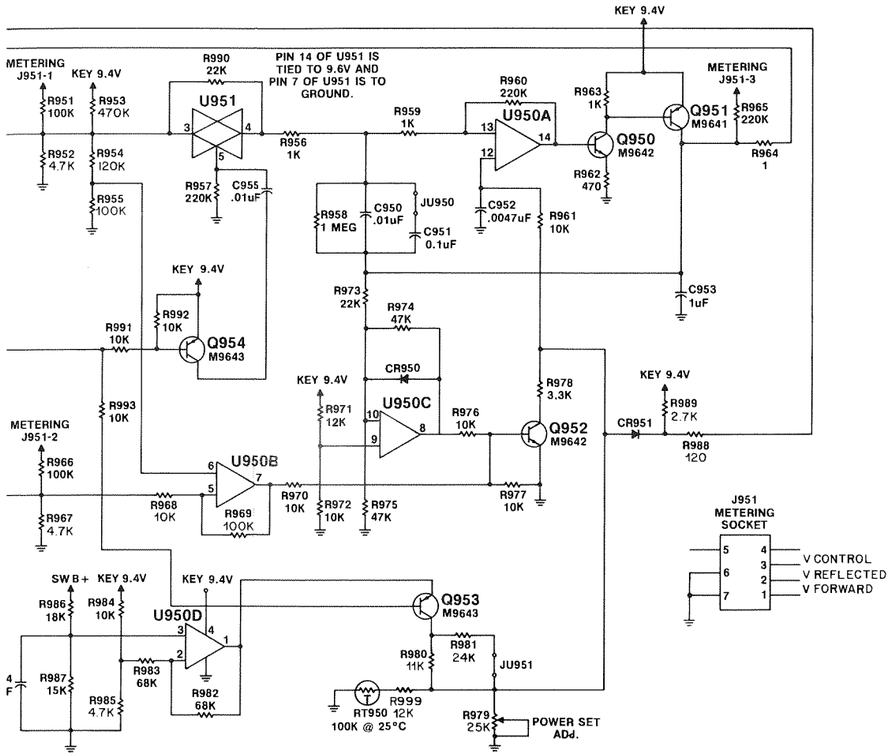




parts list

HLN4971C SYNTOR X 9000 800MHz Common Circuits Board

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
capacitor, fixed uF, ±5%, 63V (unless otherwise		
C950	08–11051A07	.01
C951	08–11051A13	.1
C952	08–11051A05	.0047
C953,954	23–11013F13	1 ±10% 35V, tanta
C955	08–11051A07	.01
C1000	08–11051A13	.1
C1001,1002	21–11015B05	220 pF ±10% 100
C1003	23–11019A39	47 ±20% 16V, ele
C1004	08–11051A10	.033
C1005	21–11014B47	82 pF 100V
C1006	21–11015B05	220 pF ±10% 100
C1007	23–84538G29	47 ±20% 10V, tan
C1008	23–11048C11	10 ±20% 35V, ele
C1009	23–84538G29	47 ±20% 10V, tan
C1010	21–11015B05	220 pF ±10% 100
diode (see note)		
CR950,951	48–83654H01	silicon
CR1000–1007	48–83654H01	silicon
hybrid (see note)		
HY1000	01–80715D03	regulator
connector receptacle		
J951	28–84647L04	6 pin
J952	09–84207B01	7 contact
jumper		
JU950,951	06–11009B23	0 ohm
transistor (see note)		
Q950	48–00869648	NPN
Q951	48–00869641	PNP
Q952	48–00869642	NPN
Q953,954	48–00869643	PNP
Q1000	48–84413L05	PNP
Q1001	48–00869640	NPN
Q1002	48–11043C08	PNP
Q1003,1004	48–00869643	PNP
Q1005	48–00869642	NPN
Q1006	48–84413L10	NPN, Darlington
thermistor		
RT950	06–80286D01	100k ±10%
resistor, fixed ohm, ±5%, 1/4 watt (unless othe		
R951	06–11009A97	100k
R952	06–11009A65	4.7k
R953	06–11009B14	470k
R954	06–11009A99	120k
R955	06–11009A97	100k
R956	06–11009A49	1k
R957	06–11009B06	220k
R958	06–11009B22	1 M
R959	06–11009A49	1k
R960	06–11009B06	220k
R961	06–11009A73	10k
R962	06–11009A41	470
R963	06–11009A49	1k



GEW-2665-B

parts list

HLN4971C SYNTOR X 9000 800MHz Common Circuits Board

MXW–2669–C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
capacitor, fixed uF, ±5%, 63V (unless otherwise stated)		
C950	08–11051A07	.01
C951	08–11051A13	.1
C952	08–11051A05	.0047
C953,954	23–11013F13	1 ±10% 35V, tantalum
C955	08–11051A07	.01
C1000	08–11051A13	.1
C1001,1002	21–11015B05	220 pF ±10% 100V
C1003	23–11019A39	47 ±20% 16V, electrolytic
C1004	08–11051A10	.033
C1005	21–11014B47	82 pF 100V
C1006	21–11015B05	220 pF ±10% 100V
C1007	23–84538G29	47 ±20% 10V, tantalum
C1008	23–11048C11	10 ±20% 35V, electrolytic
C1009	23–84538G29	47 ±20% 10V, tantalum
C1010	21–11015B05	220 pF ±10% 100V
diode (see note)		
CR950,951	48–83654H01	silicon
CR1000–1007	48–83654H01	silicon
hybrid (see note)		
HY1000	01–80715D03	regulator
connector receptacle		
J951	28–84647L04	6 pin
J952	09–84207B01	7 contact
jumper		
JU950,951	06–11009B23	0 ohm
transistor (see note)		
Q950	48–00869648	NPN
Q951	48–00869641	PNP
Q952	48–00869642	NPN
Q953,954	48–00869643	PNP
Q1000	48–84413L05	PNP
Q1001	48–00869640	NPN
Q1002	48–11043C08	PNP
Q1003,1004	48–00869643	PNP
Q1005	48–00869642	NPN
Q1006	48–84413L10	NPN, Darlington
thermistor		
RT950	06–80286D01	100k ±10%
resistor, fixed ohm, ±5%, 1/4 watt (unless otherwise stated)		
R951	06–11009A97	100k
R952	06–11009A65	4.7k
R953	06–11009B14	470k
R954	06–11009A99	120k
R955	06–11009A97	100k
R956	06–11009A49	1k
R957	06–11009B06	220k
R958	06–11009B22	1 M
R959	06–11009A49	1k
R960	06–11009B06	220k
R961	06–11009A73	10k
R962	06–11009A41	470
R963	06–11009A49	1k

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R964	06–80037G01	1 1/2W
R965	06–11009B06	220k
R966	06–11009A97	100k
R967	06–11009A65	4.7k
R968	06–11009A73	10k
R969	06–11009A97	100k
R970	06–11009A73	10k
R971	06–11009A75	12k
R972	06–11009A73	10k
R973	06–11009A81	22k
R974,975	06–11009A89	47k
R976,977	06–11009A73	10k
R978	06–11009A61	3.3k
R979	18–80087E01	25k potentiometer
R980	06–11009A74	11k
R981	06–11009A82	24k
R982,983	06–11009A93	68k
R984	06–11009A73	10k
R985	06–11009A65	4.7k
R986	06–11009A79	18k
R987	06–11009A77	15k
R988	06–11009A27	120
R989	06–11009A58	2.4k
R990	06–11009A81	22k
R991–993	06–11009A73	10k
R999	06–11009A75	12k
R1001	06–11009B06	220k
R1002	06–11009A49	1k
R1003,1004	06–11009A35	270
R1005	06–11045A20	62 1/2W
R1006	06–11009A43	560
R1007	06–11009A66	5.1k
R1008	06–11009A88	43k
R1009	06–11009A65	4.7k
R1010	06–11009A66	5.1k
R1011	06–11009A65	4.7k
R1012	06–11009A55	1.8k
R1013	06–11009A66	5.1k
R1014	06–11009A65	4.7k
R1015	06–11009A35	270
R1016	06–11009A45	680
R1017	06–11009A65	4.7k
R1018	06–11009A59	2.7k
R1019	06–11009A59	2.7k
R1020	06–11009A35	270
R1021,1022	06–80037G07	1.8 1/2W
R1023	06–11009A66	5.1k
R1024,1025	06–11009A73	10k
integrated circuit (see note)		
U950	51–83629M18	quad opamp
U951	51–84887K04	quad switch
U1000	51–80067C06	opamp
U1001	51–80068C02	voltage regulator
voltage regulator (see note)		
VR1000	48–82256C53	18V

01/06/88

note: For best performance, order diodes, transistors, and integrated–circuit devices by Motorola part number.

Control Unit, Cable Kits, and Accessories

Figure 1. Typical SYNTOR X *9000 Control Unit*

1. General

1.1 DESCRIPTION

The *SYNTOR X* 9000 control head is a microcomputer based unit that processes all the button inputs and displays used by the radio and the options. It also interfaces with the vehical via the vehical interface ports (VIP).

1.2 CONTROLS AND INDICATORS
(See Figure 1.)

1.2.1 Power Switch

The power switch is a slide switch on the bottom right surface of the control head. It turns the radio and its accessories on and off.

1.2.2 Display

The eleven-character vacuum fluorescent display's primary function is to display mode numbers, mode names, volume level, and the status of options. It also functions as an on-off indicator for the entire system, and plays an integral role in the operator's reconfiguration of options.

1.2.3 Option Buttons

Located above the display is a row of six buttons for turning options on and off. Below each is a small indicator light to show the status of the option.

1.2.4 XMIT and BUSY Indicators

Above the six option buttons are XMIT and BUSY indicators. The XMIT indicator lights when the radio is transmitting. The BUSY indicator lights when the selected channel is busy.

1.2.5 Scan Indicators

To the right of the display are the NON-PRI and PRI indicator lights. When scan operation detects activity on a non-priority (NON-PRI) channel, the NON-PRI light comes on. Activity on a second priority channel causes PRI to light. First priority channel activity causes PRI to flash.

1.2.6 Mode Rocker Switch

Located below the display, the Mode rocker increases the mode number when you push on the right side, and decreases the mode number when you push on the left. If you push and hold the switch, it scrolls the mode numbers up or down. The mode names appear on the display.

1.2.7 Volume Rocker Switch

Below the display, beside the Mode switch is the Volume rocker. Press and release to check volume setting. Your display shows "VOLUME __ __" and a number value (0–15). Push and hold the right side of the rocker to increase the volume setting. Push and hold the left side to decrease volume. The number value scrolls up or down to your desired level.

The volume rocker also controls the volume level of the public address (PA) and external radio speaker (ExRd) options when they are enabled. The display shows "PA VOL" when public address is selected and volume is pressed.

1.2.8 Home and Sel Buttons

Press the Home button to go to the radio's preprogrammed "Home" mode. You may use Home instead of Mode to change modes. Hold Home until a beep sounds to enter the configuration state. The display shows an entry prompt. Use the keypad to enter your new mode choice and press Home again. Your mode is now changed without scrolling.

Use the Sel button when configuring an option. See the descriptions of the options for more specific information.

1.2.9 DIM Button

Above the keypad, on the right side of the control head face, is the control for the brightness of the display and button backlighting. When you turn on the system, the display comes on at the highest level. Press DIM once to reduce the brightness of the display to medium level, and twice for low brightness level. Press DIM a third time to turn the display and button backlighting off. This is called the "surveillence" mode.

1.2.10 Keypad

The keypad is for changing the status of options and entering numbers to the display. See the Operator's Manual for a complete description of button operation.

2. Theory of Operation

2.1 GENERAL

The *SYNTOR X* 9000 Control Unit has solid state microprocessor circuitry that operates the standard and optional features built into the system. The compact control unit was designed for installation in even the smallest of down-sized vehicles. Systems that have many options simply require more control unit buttons, not more space consuming control units.

The control unit may be field programmed to alter the information stored in certain areas of its electronic memory. Some options are also added by field programming.

2.1.2 Display

The control unit has an eleven-character alphanumeric vacuum fluorescent display for indicating the following:

- Mode Names
- Squelch Level
- Volume Level
- Status Codes
- Message Codes
- Telephone Numbers
- Identification Numbers
- Alarm Displays
- Option Status

2.1.3 Controls and Indicators

A twelve button keypad contains the traditional alphanumeric keys that double as function keys for *SYNTOR X* 9000 options. All buttons are backlit to facilitate operation in low light. Six ON/OFF option buttons are arranged above the display and indicator lights to tell whether these options are on or off.

Other indicators include BUSY, TRANSMIT, PRIORITY, and NON-PRIORITY. BUSY lights when activity is detected on the channel. The XMIT (transmit) indicator lights when you are transmitting.

When activity occurs during a Scan sequence, the NON-PRI (non-priority) or PRI (priority) light is on. Should the detected activity be on a NON-PRI mode, the NON-PRI light is on. If the activity is on PRI mode the PRI indicator lights for second priority modes, and flashes for first priority modes.

2.2 CONTROL BOARD

The control board's 6301X Microprocessor (MPU) communicates on the serial bus, receives and interprets keypad data, and controls the volume. The MPU sends ASCII data to a decoder to control the display, and sends data to turn the LEDs on or off. The control board has a watchdog timer that senses the need for a system reset. The vehicle interface ports are also controlled on this board.

2.2.1 Microprocessor (MPU)

The 6301X MPU operates in mode 2 (expanded bus with internal ROM active). Table 1 gives jumper placements for different modes. The clock frequency is 4.9152 MHz that results in an internal operating frequency of 1288 kHz. The limited number of I/O ports is augmented by using a serial-to-parallel shift register (U3) to scan the keyboard, and to switch the VIP drivers (Q28, Q29, Q30, and Q33).

Table 1. Mode Jumper Placement

Microprocessor Mode	JU3	JU6
No. 1—Expanded mode with external ROM only	IN	OUT
No. 2—Expanded mode with internal ROM active	OUT	IN
No. 3—Single Chip	OUT	OUT

2.2.2 Watchdog Timer

The watchdog timer consists of U5 (LM2903 comparator) and Q4 (SCR). On system power-up, C06 pulls the inverting input of U5 high while R10 and R11 hold the non-inverting input at VCC/2. The output goes low and the microprocessor resets. As C06 charges through R14, the voltage on the inverting input drops below that of the non-inverting input, the output goes high, and the microprocessor can start operating. R14 is now pulling up on C06, and the inverting-input voltage begins to rise. During this interval, the processor generates tickle pulses to periodically fire Q4, preventing the inverting-input voltage from rising above the non-inverting input voltage and repeating the reset cycle. If the tickle pulses stop for more than 150 mSec, the reset cycle is repeated.

2.2.3 EEPROM

The EEPROM stores customer data including mode names, button functions, and VIP settings. The customer data can be altered only by enabling the "STORE" function (grounding the MIC HI line); an automatic function of the control unit programmer. Power strobing minimizes EEPROM power consumptions. Jumpers configure the EEPROM for the uses shown in Table 2.

Table 2. EEPROM Jumper Table

Jumper	Use/Placement
JU1	Used for future options
JU2	IN for 6301X Microprocessor
JU4	IN for 2K EEPROM; OUT for 8K EEPROM (option W930)
JU5	IN for 8K EEPROM (option W930) OUT for 2K EEPROM

2.2.4 Bus Transceiver

The serial bus transceiver consists of Q1, Q2, Q3, and U4 (CA3140). Q1, Q2, and Q3 transmit data on the bus while U4 acts as a comparator to receive data from the bus.

2.2.5 Vacuum Fluorescent Voltage Converter

Voltage for the vacuum fluorescent display is generated by a fixed frequency, variable-duty cycle driven, flyback voltage converter. Q31 and Q32 form an emitter-coupled astable multivibrator that runs at about 150 kHz. The square wave output from this circuit is integrated by R71 and C39 to form a triangle that is applied to the non-inverting input of half of U5 (LM2903). During start up, the inverting input is biased at 3.7 volts by R66 and R67. Q23 is on while the non-inverting input voltage is below 3.7 volts. This allows current to flow the T1, building a magnetic field. When the triangle wave exceeds 3.7 volts, Q23 turns off and the magnetic field collapses, inducing negative current in T1. This current flows through either CR13 or CR14, charging C27 and C28. As the voltage on C28 increases beyond -35 volts, CR13 begins to conduct, pulling U5's inverting input below 3.7 volts. This decreases the cycle time that Q23 is on to the time needed to produce -35 volts on C28. The -41 volt supply is not regulated, but it tracks the -35 volt supply. Similarily, the AC supply for the vacuum fluorescent filament is not regulated, but is controlled to within one volt by and inductor on the display board.

2.2.6 Vehicle Interface Ports (VIP)

The VIP outputs are driven by a serial-to-parallel shift register. Output transistors (Q28, Q29, Q30) can

sink 300 mA current. Primarily, these transistors control external relays. The relay is connected between the collector and switched B+.

Each VIP input transistor (Q25, Q26, Q27) is connected to a dedicated input port through transistors used for input protection. These VIP inputs are connected to ground with either normally-open or normally-closed switches.

2.2.7 Power Supplies

Both the +5 and the +9.4 volt supplies are linear regulators. The +9.4 supply is built with a discreet transistor (Q11). The regulation is provided by VR09. The +5 volt supply is a 7805, three-terminal regulator IC.

2.2.8 Ignition Sense Circuits

Q7 senses the vehicle ignition's state, disabling transmit when the ignition is off. For negative-ground systems, the orange lead is typically connected to the fuse box (+12V). For more information, see the cable kit section.

2.2.9 EEPROM Write-Protect Circuit

Q12, Q13, and associated circuitry guard against inadvertantly writing into the EEPROM. When MIC HI is grounded, Q21 (normally on) is turned off. A hot-carrier diode (CR24) ensures that Q21 turns off. CR24 is normally off so it does not interfere with the MIC HI line.

CR19 forces the system to be write-protected during reset; this is especially crucial during system power-up.

2.3 DISPLAY BOARD

This board contains the main operator interface points of the system, including the vacuum fluorescent display, the status indicator LEDs, and the user keypad.

2.3.1 U101 Vacuum Fluorescent Display Decoder Driver IC

This IC receives ASCII data from the controller board, decodes it into 14-segment display data, and then scans the display with the data. Once properly loaded into the driver, the displayed data is refreshed without any further processor action. The display driver is periodically reset by the actions of transistors Q118, Q119, and Q110 that watch the clock line from the processor to the display driver. When the clock line is held low for more than 600 µSec, the display driver resets and new display data follows.

2.3.2 Vacuum Fluorescent Display

The vacuum fluorescent (VF) display is an eleven digit, 14-segment display that needs three separate voltages to operate: the cathode needs −35 volts to accelerate electrons to the anode; the grid needs −40 volts to totally shut off current flow; the filament needs 3.8 volts AC at 80 mA. These voltages are obtained from the VF up-converter on the controller board.

2.3.3 −10 Volt Supply

The AC voltage present on Q23 of the controller board is used to obtain the −10 volts needed to run the display driver IC. This voltage is fed through L101 to limit the current and then rectified by CR107 and shunt regulated by CR108.

2.3.4 Status LEDs

These LEDs are driven by the display driver as though they were decimal points on the VF display. Level shifting transistors are required for this since the display driver uses 39 volts for control signals.

2.3.5 Backlight LEDs

The same microprocessor signal that turns the VF power supply on and off also operates the backlight LEDs. Q120 supplies base current to the individual LED driver transistors. The driver transistors act as constant current sources to the LEDs. Backlight LEDs CR115, CR116, CR117, and CR118 are connected to thermistor R163 by way of Q108. This circuit allows more current to flow through these LEDs at room temperature and reduces current as the temperature rises.

3. Control Unit Maintenance

3.1 DISASSEMBLY OF CONTROL UNIT (See Figure 2.)

Note

Before disassembling the control unit, make a note of the location of the labeled buttons.

Remove the two 30mm slotted screws that hold the front and back of the control unit together. The two halves separate at the top; at the bottom, they are held together by the flex cable that interconnects the circuit boards. Place the unit so the PC boards are facing up. Remove the five 8mm screws in the display board and carefully remove the front of the control unit housing. Keep the front housing parts as a complete unit (including the front housing, buttons, and display board light pipe). Always keep the front of the display housing face down when handling. Remove the two 16mm self-tapping screws on the control board. Remove the back

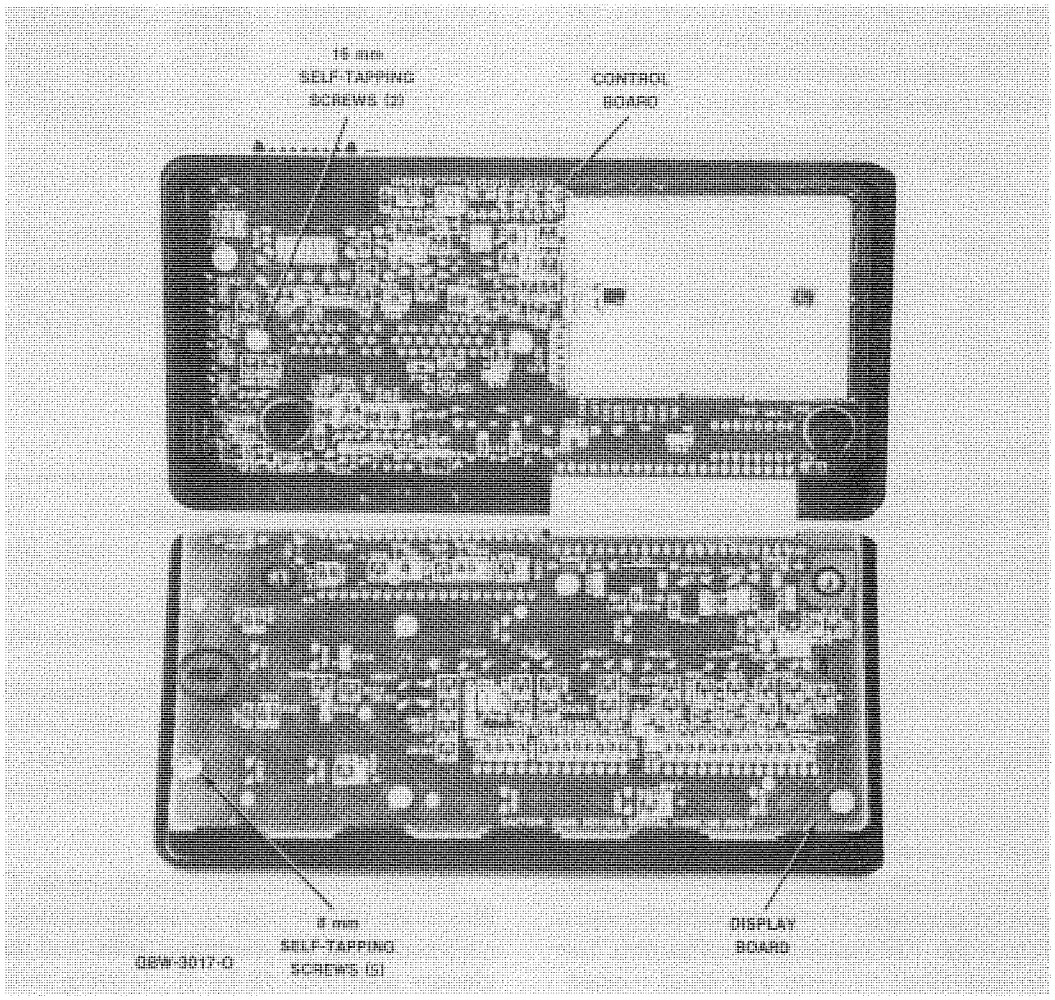


Figure 2. Disassembly of Control Unit

of the control unit housing. Remove the black gasket around the switch and set it aside. Remove the shields from the top and bottom of the control board. All components should be easily accessible.

Note

When working with chips and SOT parts, use extreme caution when heating. Never reuse a chip or SOT part; always replace with correct Mototola parts.

3.2 REASSEMBLY OF THE CONTROL UNIT

Be sure the orange gasket is still around the outside of the control cable "mini D" connector. If it was removed, replace it, ensuring a snug fit to the PC board. Replace the gasket around the power switch. Replace the shields on the top and bottom of the control board. Place the control board in the back housing, being careful to put the toggle switch arm in the proper position in the ON/OFF button actuator. Screw in the two 16mm self-tapping screws to 6-8 inch lbs. Also, be sure the ON/OFF actuator still slides back and forth easily. Carefully check to see that all buttons are still in place, then place the display board in the front housing. Screw in the five 8mm self-tapping screws to 6-8 inch lbs. Be sure the black gasket is around the outside groove of the front housing. When mating the front and back housings, make sure the flex cable slides behind the control board and is not pinched. Screw in the two 30mm slotted screw to 9-10 inch lbs.

4. Vehicle Interface Ports (VIP)

The VIP allows the control unit to control outside circuits and to receive inputs from outside the control unit. There are three VIP outputs that are used for relay control. There are also three VIP inputs that accept inputs from switches. See the cable kit section for typical connections of VIP input switches and VIP output relays.

4.1 VIP OUTPUT CONNECTIONS

The VIP output pins are located on the back of the control unit below the area labled "VIP." These connections are used to control relays. One end of the relay should be connected to switched B+, while the other side is connected to a software controlled ON/OFF switch inside the control unit. The relay can be

normally-on or normally-off depending on how the VIP outputs are configured. The control unit provides for three of these VIP output connections. The following is a list of proper connections for relays:

VIP OUTPUT NUMBER	SWITCHED B+ PIN NO.	ON/OFF SWITCH PIN NO.	DEFAULT FUNCTION – IS CHANGED WITH FIELD PROGRAMMER
1	18	2	HORN RELAY (ALARM)
2	19	1	LIGHT RELAY (ALARM)
3	35	34	SIREN-HORN TRANSFER

The function of these VIP outputs can be defined by field programming the control unit. Typical applications for VIP outputs are external horn/lights alarm and horn ring transfer relay control. For further information on VIP outputs, see the control unit programming manual.

4.2 VIP INPUT CONNECTIONS

The VIP input pins are located on the back of the control unit below the area labeled "VIP." These connections are used to accept inputs from switches. One side of the switch is connected to ground while the other side is connected to a buffered input to the control unit. The switch can be normally-closed or normally-open depending on how the VIP inputs are configured. The control unit permits three of these VIP input connections. The following is a list of proper connections for the switches:

VIP INPUT NUMBER	GROUND PIN NO.	ON/OFF SWITCH PIN NO.	DEFAULT FUNCTION – IS CHANGED WITH FIELD PROGRAMMER
1	20	4	SIREN; HORN RING
2	21	3	EMERGENCY (IF OPTION PRESENT)
3	36	37	NONE

The function of these VIP inputs is defined by field programming the control unit. Typical applications for the VIP inputs are for a foot switch or a horn ring switch. For further information on VIP inputs, see the control unit programming manual.

5. Power Connections

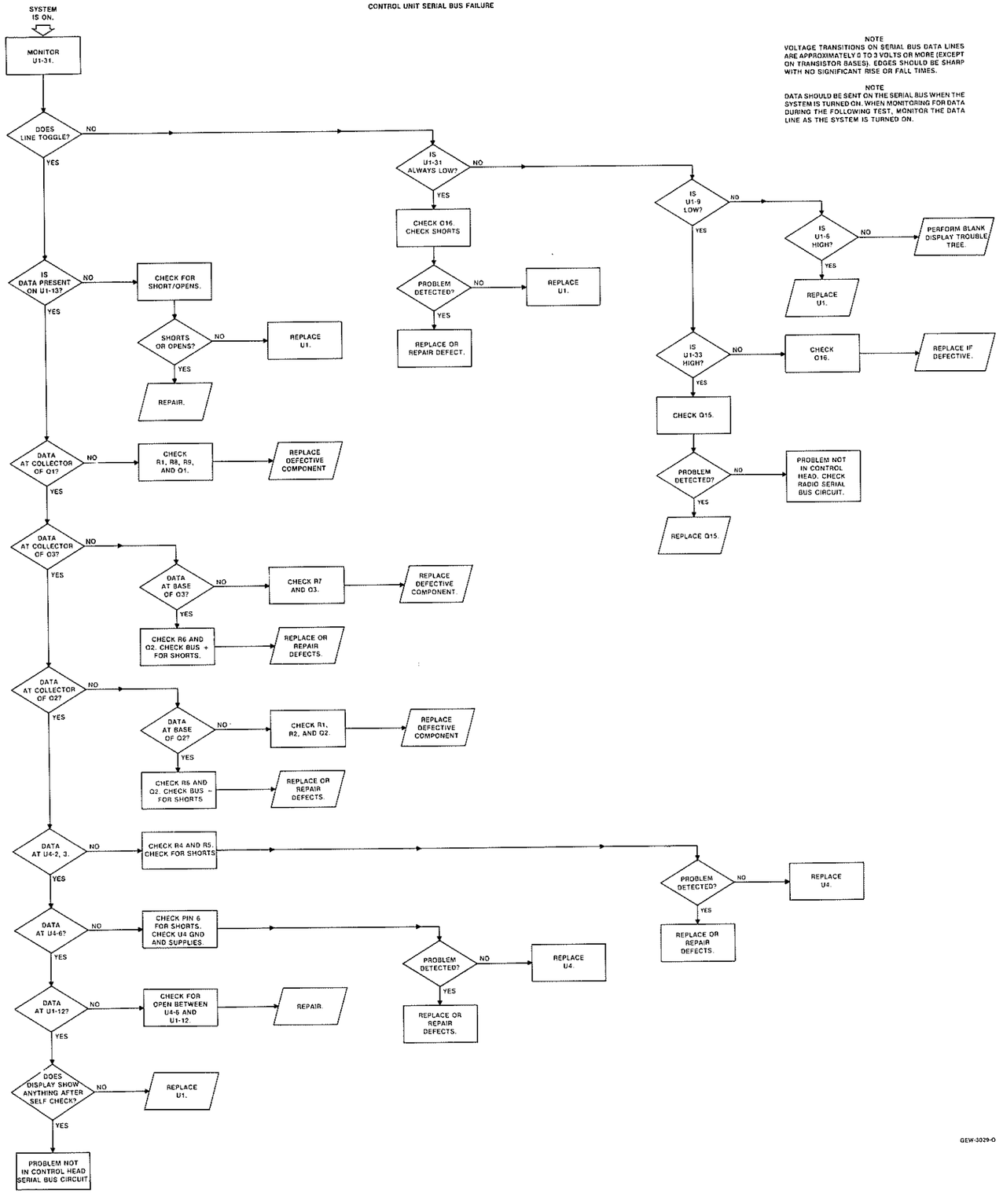
Caution

Use only *SYNTOR X* 9000 cable kits. Connection to other cable kits or control panels may cause electrical damage.

Replace the fuse in the in-line fuseholder of the red power cable coming from the radio in the trunk. Also connect the green (and/or orange) fused wire(s) coming from the control unit to the ungrounded terminal (or source) of the battery.

Pull all excess cabling into the trunk. Clamp the cables to the vehicle body or chassis with the cable clamps supplied. Drill ⅛" mounting holes and then attach the clamps with four #8 by ⅜" tapping screws and four ¼" lockwashers. Finally, be sure all in-line fuses are installed.

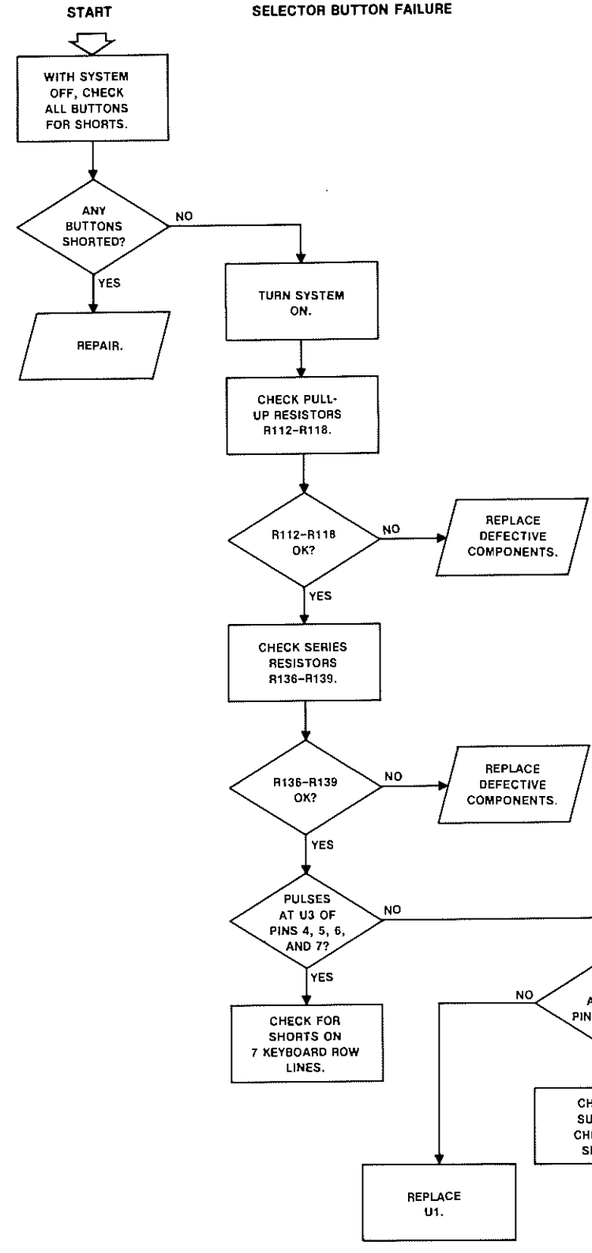
CONTROL UNIT SERIAL BUS FAILURE



NOTE
VOLTAGE TRANSITIONS ON SERIAL BUS DATA LINES ARE APPROXIMATELY 0 TO 3 VOLTS OR MORE (EXCEPT ON TRANSISTOR BASES). EDGES SHOULD BE SHARP WITH NO SIGNIFICANT RISE OR FALL TIMES.

NOTE
DATA SHOULD BE SENT ON THE SERIAL BUS WHEN THE SYSTEM IS TURNED ON. WHEN MONITORING FOR DATA DURING THE FOLLOWING TEST, MONITOR THE DATA LINE AS THE SYSTEM IS TURNED ON.

SELECTOR BUTTON FAILURE



NOTES:

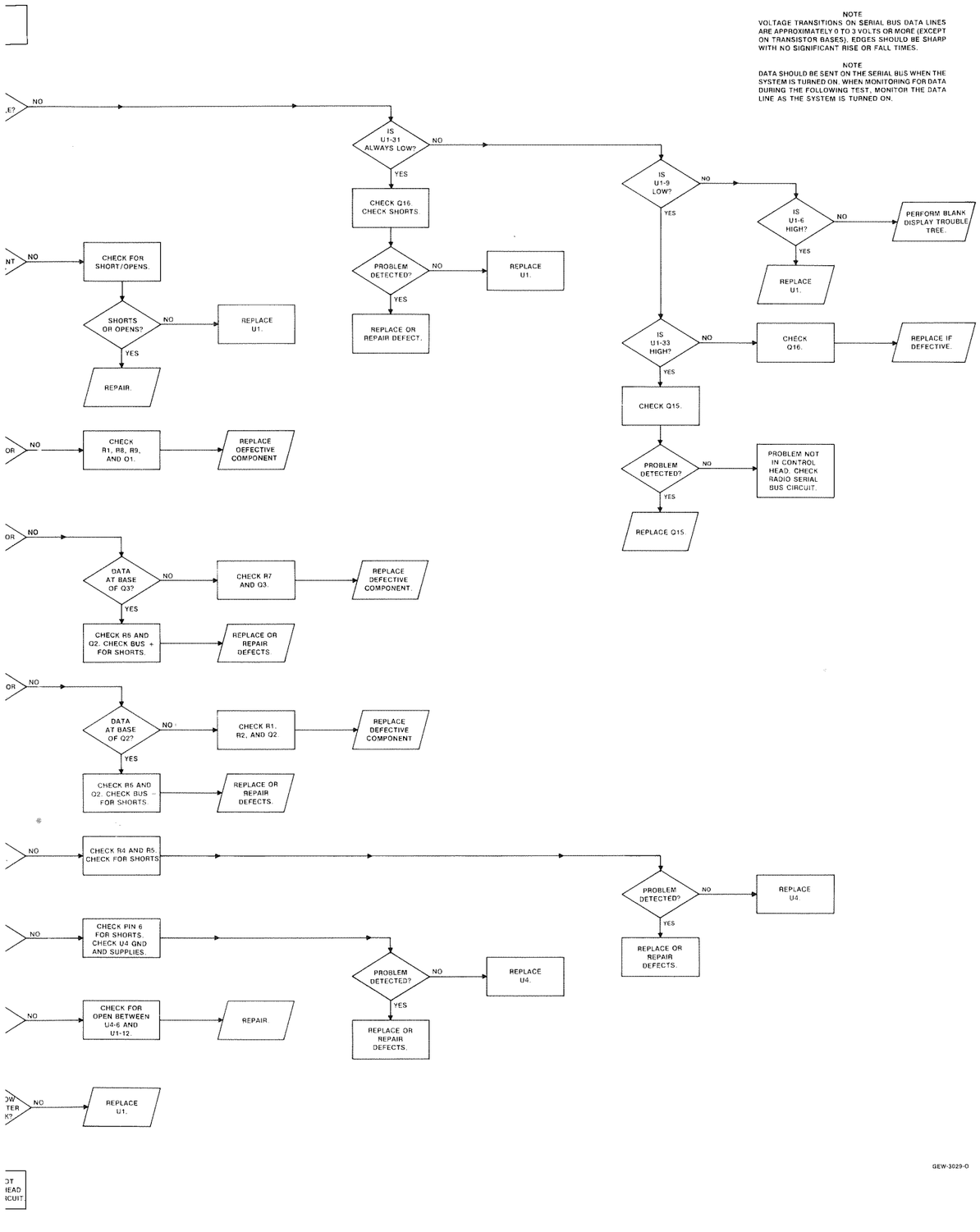
1. PERFORM
   DISPLAYE
2. ENSURE
   PROGRAM
   DO NOT V

GEW-3029-O

CONTROL UNIT SERIAL BUS FAILURE

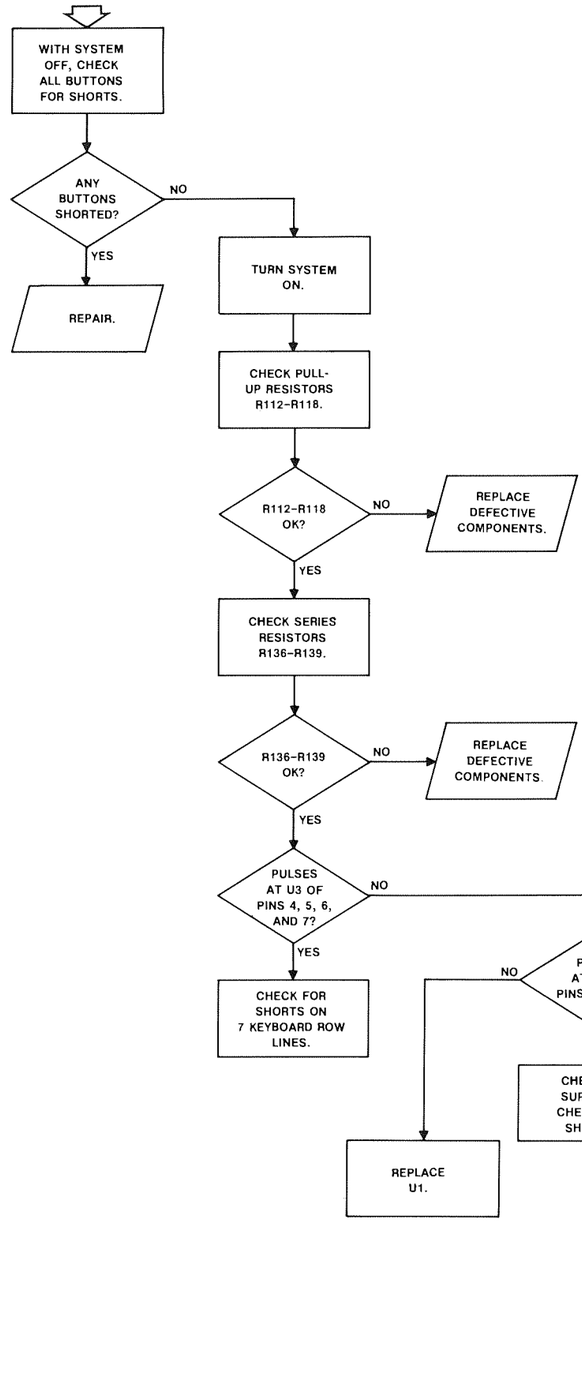
NOTE
VOLTAGE TRANSITIONS ON SERIAL BUS DATA LINES ARE APPROXIMATELY 0 TO 3 VOLTS OR MORE (EXCEPT ON TRANSISTOR BASES). EDGES SHOULD BE SHARP WITH NO SIGNIFICANT RISE OR FALL TIMES.

NOTE
DATA SHOULD BE SENT ON THE SERIAL BUS WHEN THE SYSTEM IS TURNED ON. WHEN MONITORING FOR DATA DURING THE FOLLOWING TEST, MONITOR THE DATA LINE AS THE SYSTEM IS TURNED ON.



GEW-3029-0

START — SELECTOR BUTTON FAILURE

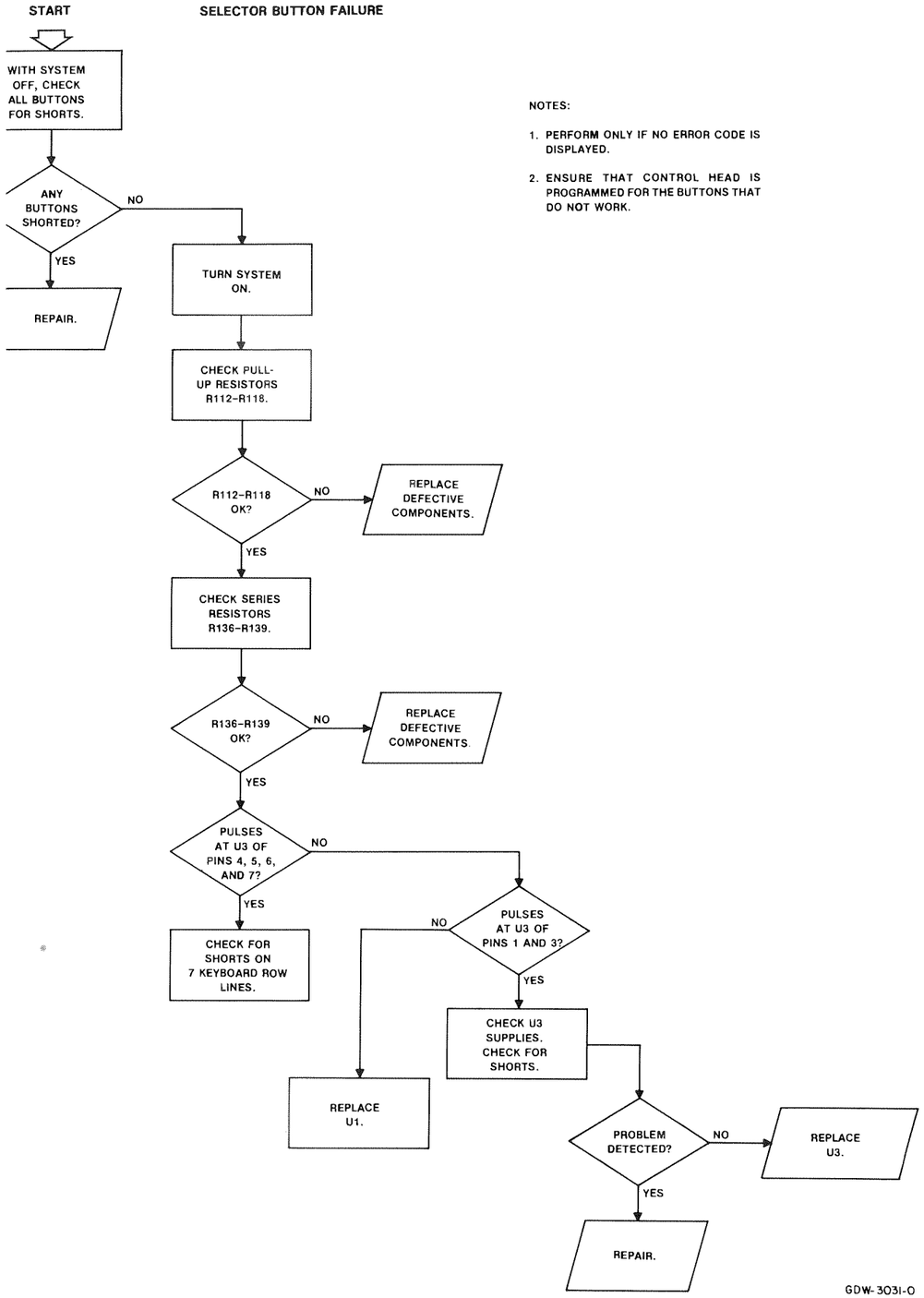


NOTES:

1. PERFORM ONLY IF NO ERROR CODE IS DISPLAYED.
2. ENSURE THAT CONTROL HEAD IS PROGRAMMED FOR THE BUTTONS THAT DO NOT WORK.

GDW-3031-0

SELECTOR BUTTON FAILURE

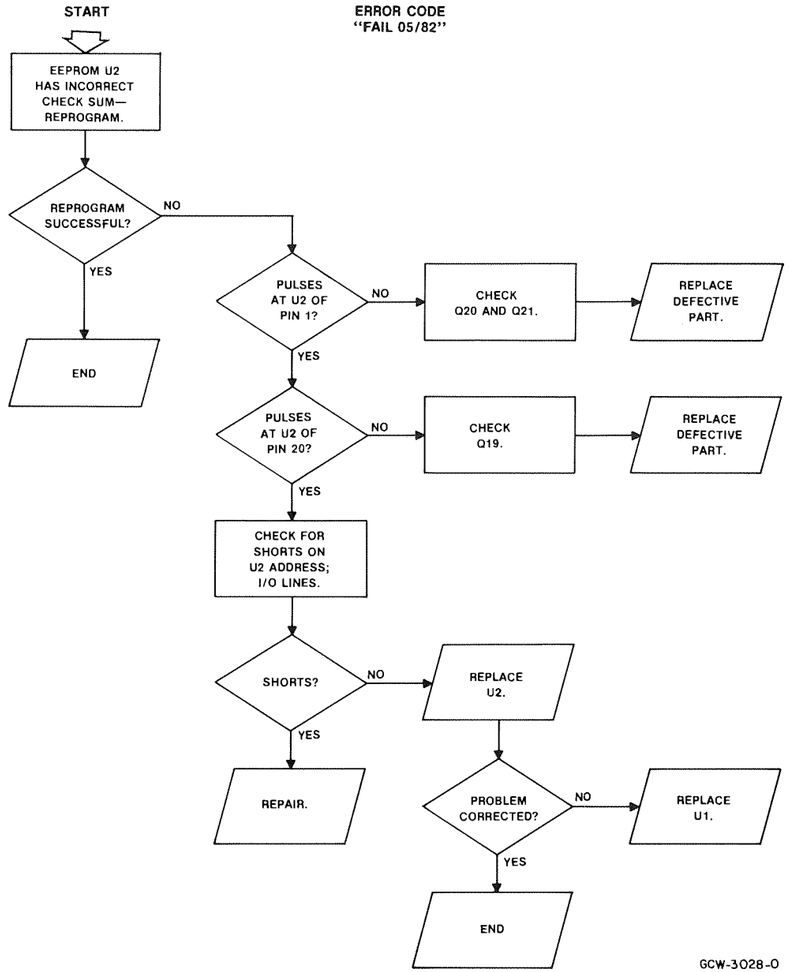


GDW-3031-0

NOTES:

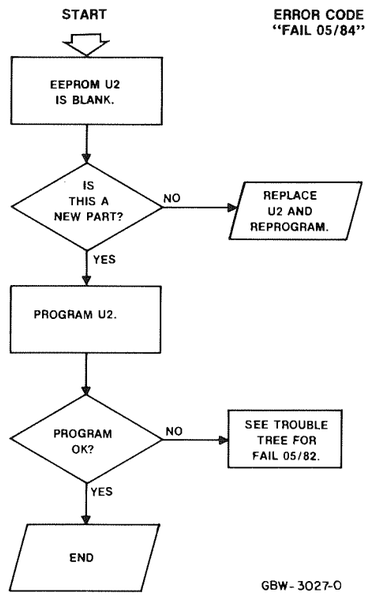
1. PERFORM ONLY IF NO ERROR CODE IS DISPLAYED.
2. ENSURE THAT CONTROL HEAD IS PROGRAMMED FOR THE BUTTONS THAT DO NOT WORK.

ERROR CODE "FAIL 05/82"



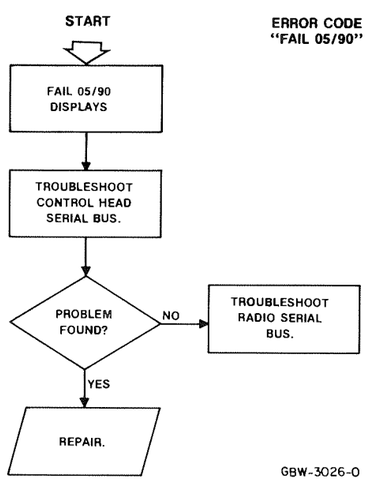
GCW-3028-0

ERROR CODE "FAIL 05/84"



GBW-3027-0

ERROR CODE "FAIL 05/90"



GBW-3026-0

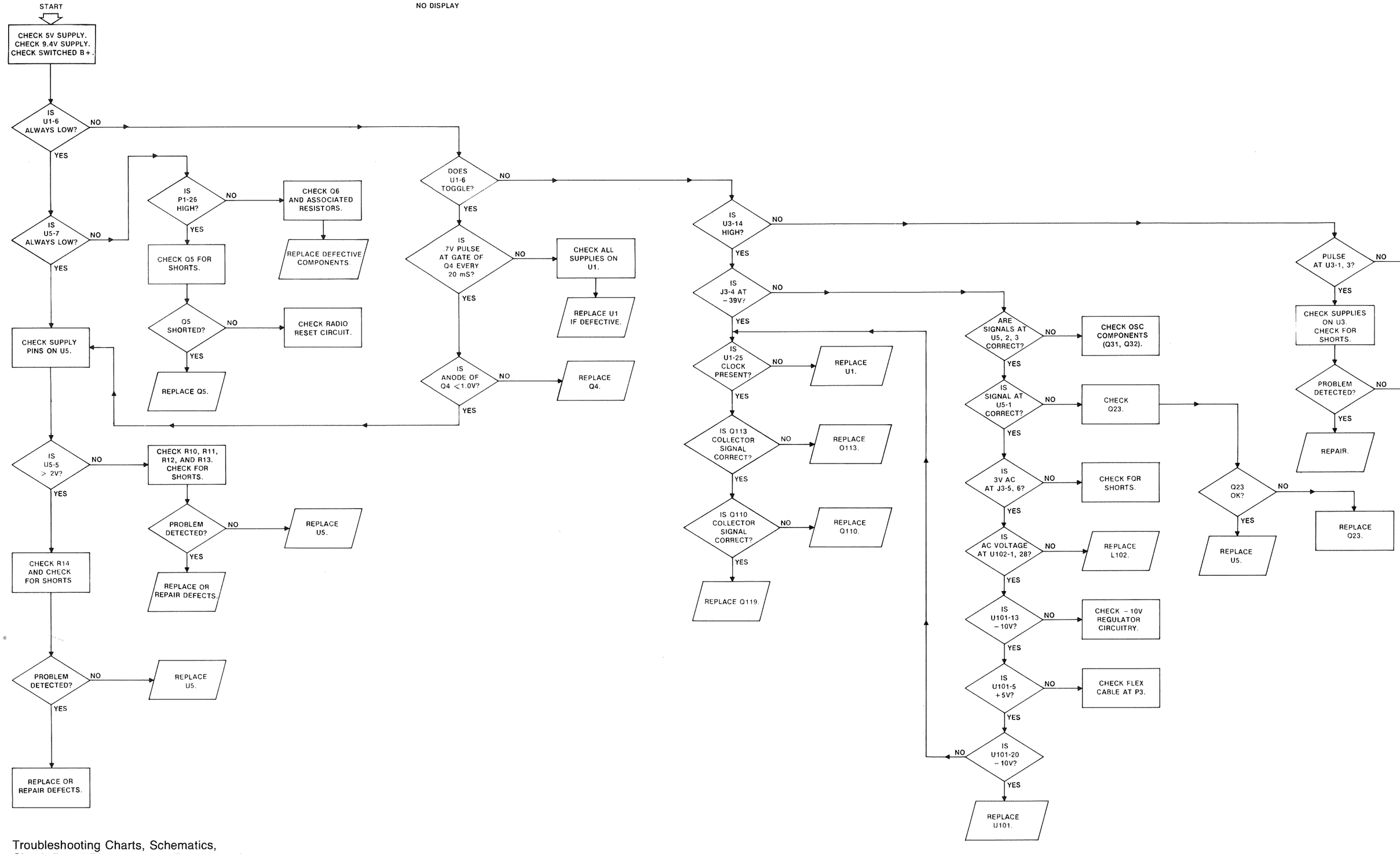
Troubleshooting Charts, Schematics, Circuit Board Diagrams, and Parts Lists for *SYNTOR X* 9000 Control Unit

PEW-2584-0 B

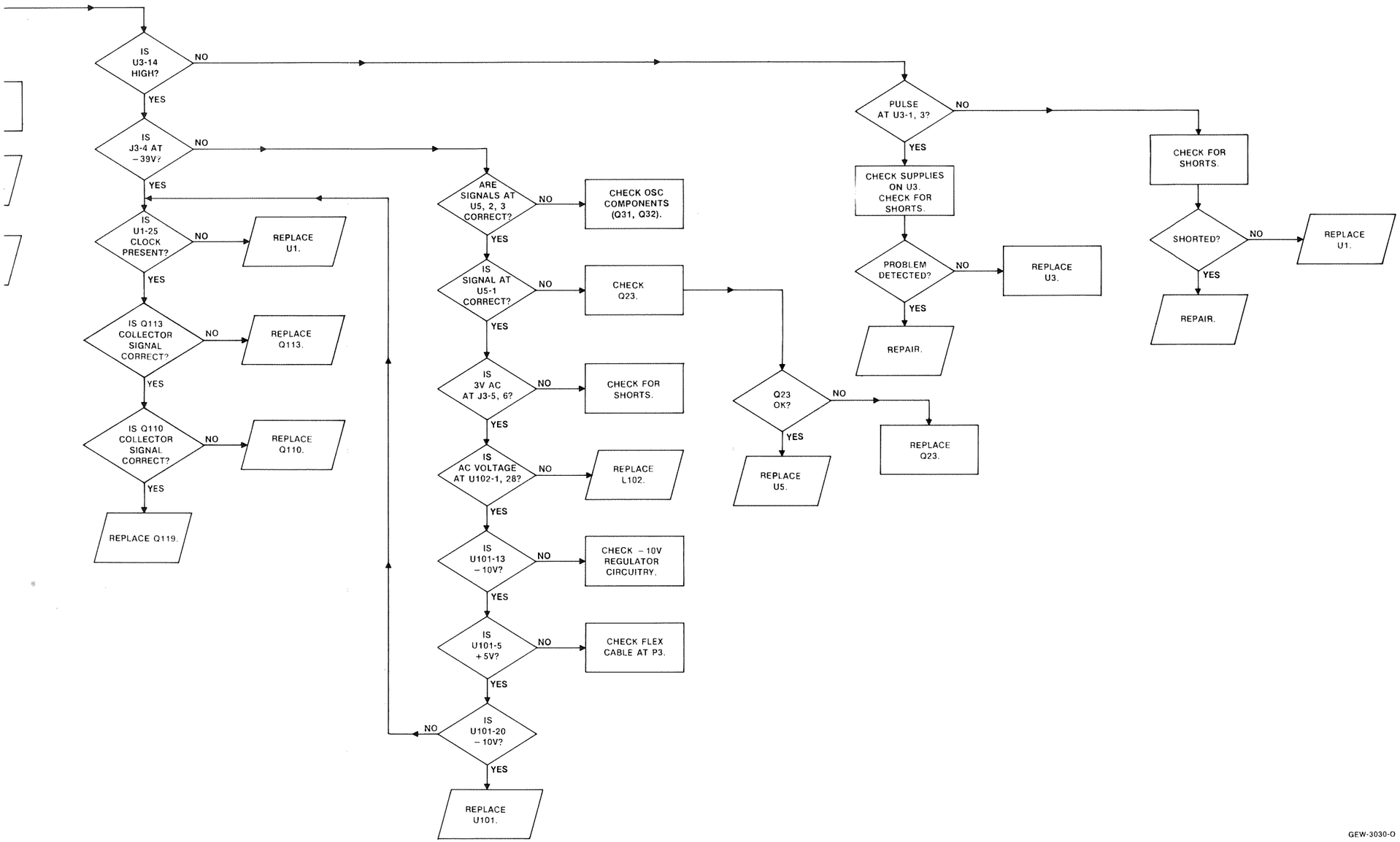
(Sheet 1 of 4)

2/17/86

NO DISPLAY

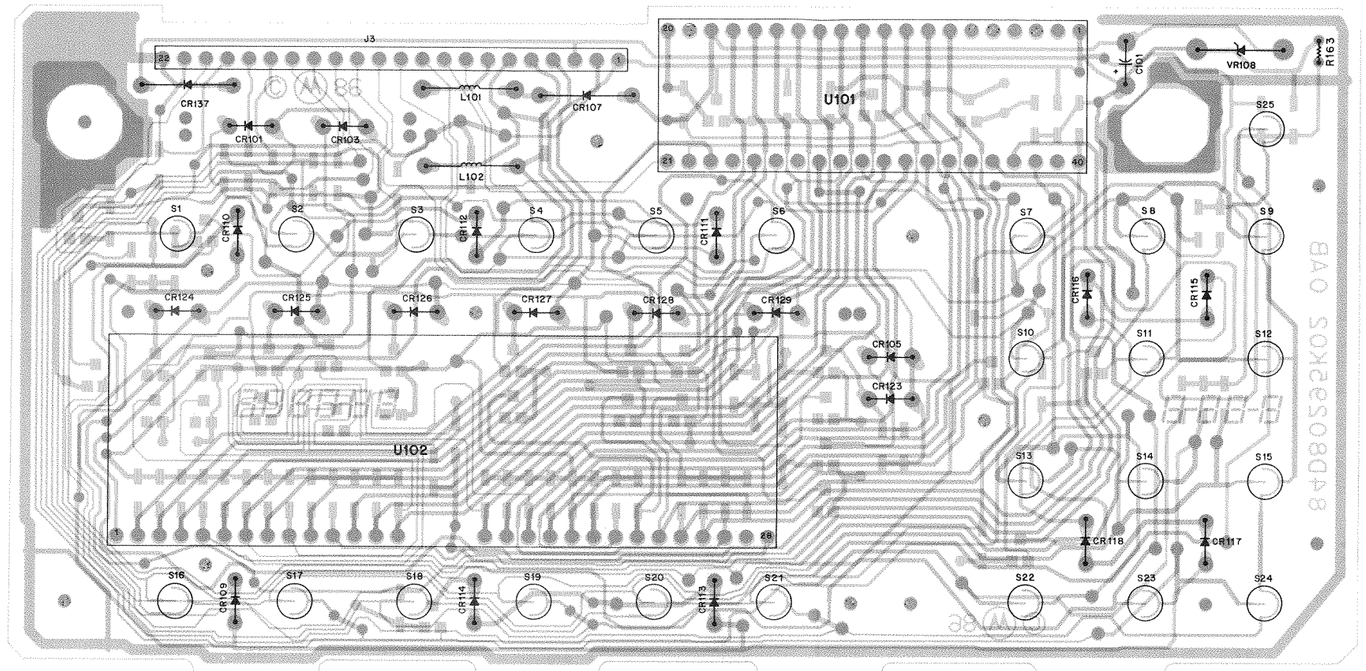


Troubleshooting Charts, Schematics,
Circuit Board Diagrams, and Parts Lists for
SYNTOR X 9000 Control Unit
PEW-2584-~~O~~ B
(Sheet 2 of 4)
2/17/86

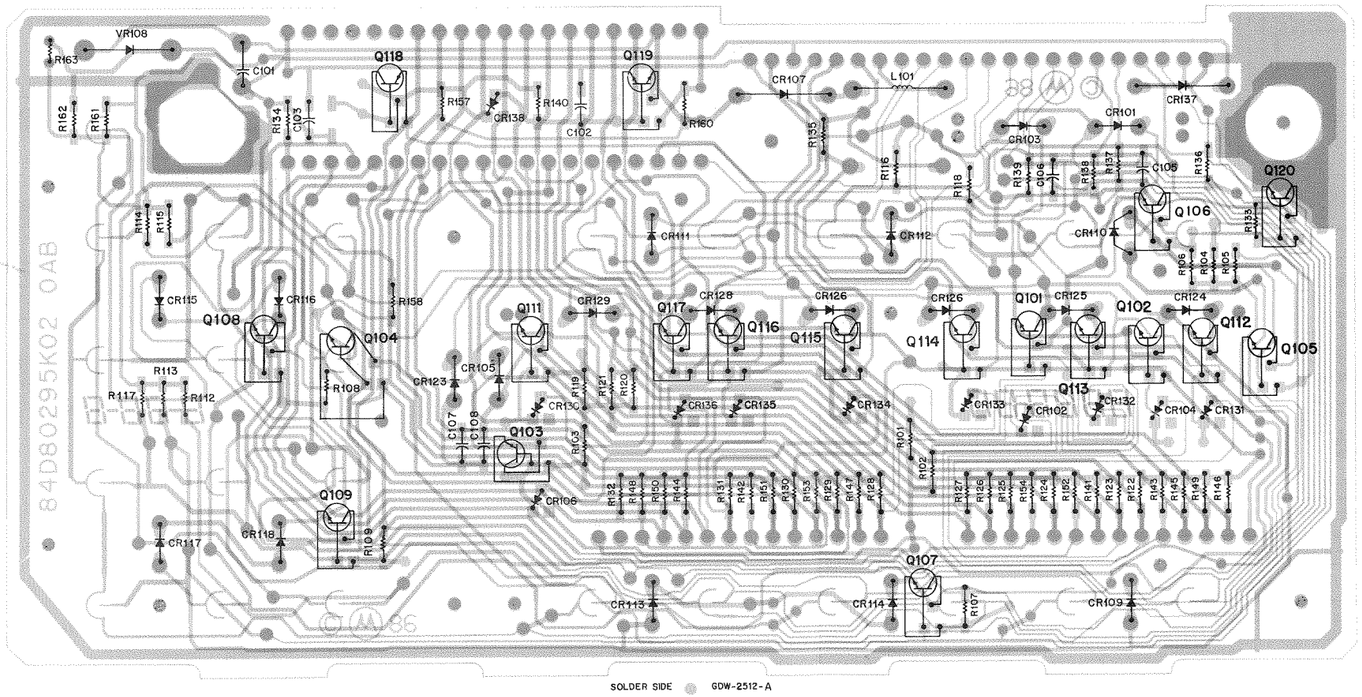

IS U3-14 HIGH?
NO
YES
IS J3-4 AT −39V?
NO
YES
IS U1-25 CLOCK PRESENT?
NO
REPLACE U1.
YES
IS Q113 COLLECTOR SIGNAL CORRECT?
NO
REPLACE Q113.
YES
IS Q110 COLLECTOR SIGNAL CORRECT?
NO
REPLACE Q110.
YES
REPLACE Q119.
ARE SIGNALS AT U5, 2, 3 CORRECT?
NO
CHECK OSC COMPONENTS (Q31, Q32).
YES
IS SIGNAL AT U5-1 CORRECT?
NO
CHECK Q23.
YES
IS 3V AC AT J3-5, 6?
NO
CHECK FOR SHORTS.
YES
IS AC VOLTAGE AT U102-1, 28?
NO
REPLACE L102.
YES
IS U101-13 −10V?
NO
CHECK −10V REGULATOR CIRCUITRY.
YES
IS U101-5 +5V?
NO
CHECK FLEX CABLE AT P3.
YES
IS U101-20 −10V?
NO
YES
REPLACE U101.
PULSE AT U3-1, 3?
NO
YES
CHECK SUPPLIES ON U3. CHECK FOR SHORTS.
PROBLEM DETECTED?
NO
REPLACE U3.
YES
REPAIR.
Q23 OK?
NO
REPLACE Q23.
YES
REPLACE U5.
CHECK FOR SHORTS.
SHORTED?
NO
REPLACE U1.
YES
REPAIR.

GEW-3030-O

DISPLAY BOARD



SHOWN FROM COMPONENT SIDE



SHOWN FROM SOLDER SIDE

parts list

p/o HLN4907C Control Unit (Display Board)
p/o HLN4896C Control Unit (Display Board) MXW-2568-B

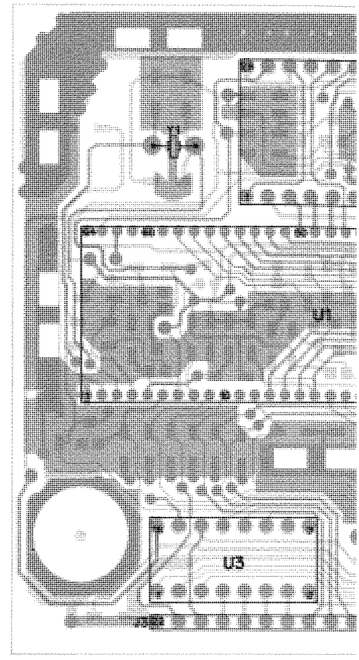
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed, μF ±20%, 50V unless otherwise stated
C101	23-11048C11	10, 35V, electrolytic
C102	21-11032A09	.001 ±10%
C103	21-11032B13	.1 +80, −20%
C105–108	21-11032B13	.1 +80, −20%
		diode (see note)
CR101	48-80246K01	red LED
CR102	48-80236E08	dual silicon, common anode
CR103	48-80246K02	yellow LED
CR104	48-80236E08	dual silicon, common anode
CR105	48-80246K01	red LED
CR106	48-80236E08	dual silicon, common anode
CR107	48-83654H01	silicon
CR109–118	48-80246K04	green LED
CR123	48-80246K02	yellow LED
CR124–129	48-80246K01	red LED
CR130–136	48-80236E08	dual silicon, common anode
CR137	48-48616A01	hot carrier
CR138	48-83654H01	silicon
		coil
L101	24-11047A44	390 μH
L102	24-80138G07	15 μH, ±5%
		transistor, SOT23 package unless otherwise noted (see note)
Q101–109	48-80141L02	NPN
Q111–117	48-80141L02	NPN
Q118	48-80141L01	PNP
Q119, 120	48-80141L02	NPN
		resistor, fixed, Ω ±5%, ⅛ W unless otherwise stated
R101–103	06-11024A25	100
R104	06-11024A65	4.7k
R105–107	06-11024A39	390
R108	06-11024A59	2.7k
R109	06-11024A11	27
R112–118	06-11024A97	100k
R119	06-11024A25	100
R120, 121	06-11024A32	200
R122–132	06-11024A97	100k
R133, 134	06-11024A73	10k
R135	06-11024A25	100
R136–139	06-11024A65	4.7k
R140–154	06-11024A97	100k
R157	06-11024A85	33k
R158	06-11024A45	680
R160	06-11024A85	33k
R161	06-11024A69	6.8k
R162	06-11024A67	5.6k
R163	06-83600K09	100k green thermistor
R164	06-11024A73	10k
		integrated circuit (see note)
U101	51-80236C04	display driver
U102	72-80242J01	vacuum fluorescent display
		voltage regulator (see note)
VR108	48-82256C67	10V zener, 1 W

9/19/86

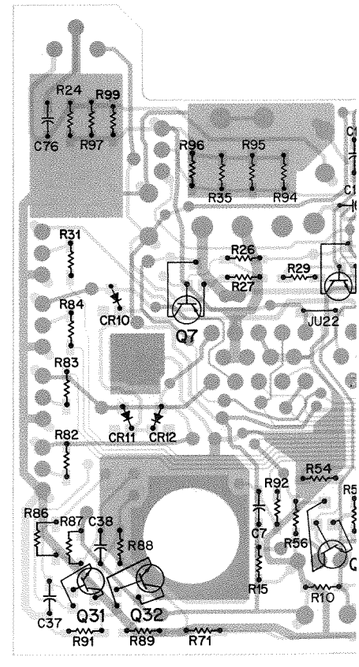
note: For best performance, order diodes, transistors, and integrated circuits by Motorola part number.

HKN4240A, HKN4241A and HKN4242A Cable Kits for *SYNTOR X* 9000 MXW-2529-O

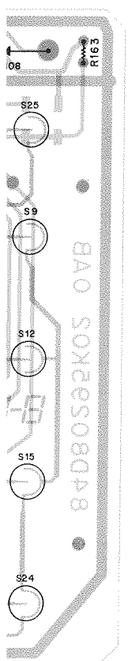
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		non-referenced items
	01-80739T53	22-foot cable
	01-80739T54	17-foot cable
	01-80739T55	10-foot cable
	01-80701T89	LD and lug, black, 66" high-power
	09-84151B03	contact receptacle
	09-84151B05	plated contact receptacle
	39-10184A44	contact receptacle
	15-10183A17	2-contact housing connector receptacle
	36-80220B06	connector knot
	03-00140079	tapping screw (6-19 × ½)
	42-80156B01	retainer ring
	09-80227B01	female contact
	15-80217K01	front cable housing
	15-80216B01	back housing connector
	32-83859M01	connector gasket



COMPONENT SIDE VIEW



SOLDER SIDE VIEW



parts list

p/o HLN4907C Control Unit (Display Board)
p/o HLN4896C Control Unit (Display Board) MXW-2568-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed, µF ±20%, 50V unless otherwise stated
C101	23-11048C11	10, 35V, electrolytic
C102	21-11032A09	.001 ±10%
C103	21-11032B13	.1 +80, −20%
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		diode (see note)
CR101	48-80246K01	red LED
CR102	48-80236E08	dual silicon, common anode
CR103	48-80246K02	yellow LED
CR104	48-80236E08	dual silicon, common anode
CR105	48-80246K01	red LED
CR106	48-80236E08	dual silicon, common anode
CR107	48-83654H01	silicon
CR109–118	48-80246K04	green LED
CR123	48-80246K02	yellow LED
CR124–129	48-80246K01	red LED
CR130–136	48-80236E08	dual silicon, common anode
CR137	48-48616A01	hot carrier
CR138	48-83654H01	silicon
		coil
L101	24-11047A44	390 µH
L102	24-80138G07	15 µH, ±5%
		transistor, SOT23 package unless otherwise noted (see note)
Q101–109	48-80141L02	NPN
Q111–117	48-80141L02	NPN
Q118	48-80141L01	PNP
Q119, 120	48-80141L02	NPN
		resistor, fixed, Ω ±5%, ⅛ W unless otherwise stated
R101–103	06-11024A25	100
R104	06-11024A65	4.7k
R105–107	06-11024A39	390
R108	06-11024A59	2.7k
R109	06-11024A11	27
R112–118	06-11024A97	100k
R119	06-11024A25	100
R120, 121	06-11024A32	200
R122–132	06-11024A97	100k
R133, 134	06-11024A73	10k
R135	06-11024A25	100
R136–139	06-11024A65	4.7k
R140–154	06-11024A97	100k
R157	06-11024A85	33k
R158	06-11024A45	680
R160	06-11024A85	33k
R161	06-11024A69	6.8k
R162	06-11024A67	5.6k
R163	06-83600K09	100k green thermistor
R164	06-11024A73	10k
		integrated circuit (see note)
U101	51-80236C04	display driver
U102	72-80242J01	vacuum fluorescent display
		voltage regulator (see note)
VR108	48-82256C67	10V zener, 1 W

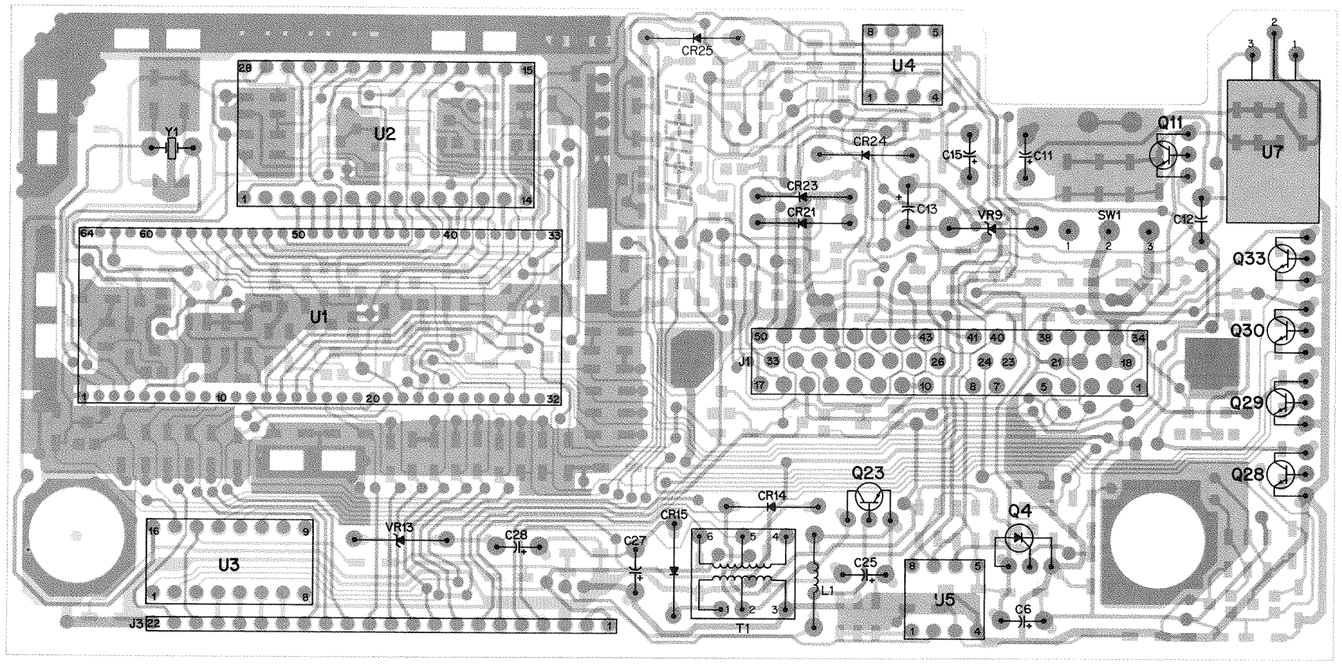
9/19/86

note: For best performance, order diodes, transistors, and integrated circuits by Motorola part number.

HKN4240A, HKN4241A and HKN4242A Cable Kits for *SYNTOR X* 9000 MXW-2529-O

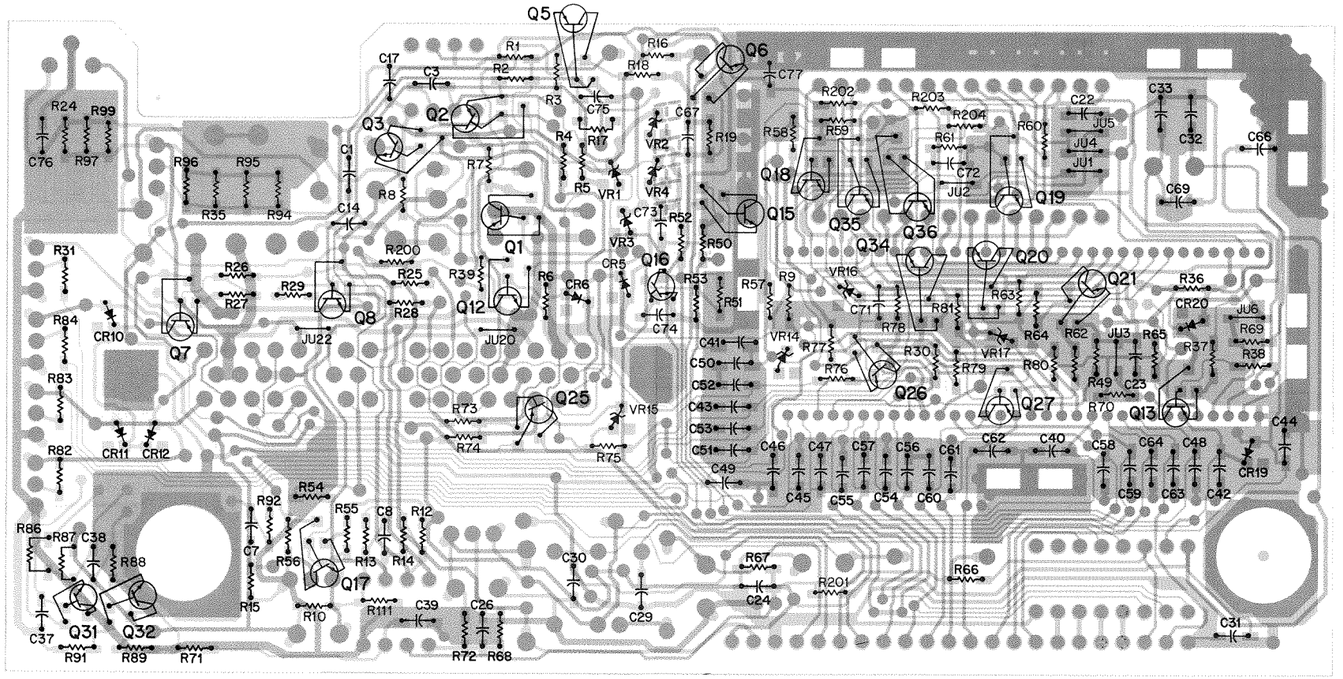
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		non-referenced items
	01-80739T53	22-foot cable
	01-80739T54	17-foot cable
	01-80739T55	10-foot cable
	01-80701T89	LD and lug, black, 66" high-power
	09-84151B03	contact receptacle
	09-84151B05	plated contact receptacle
	39-10184A44	contact receptacle
	15-10183A17	2-contact housing connector receptacle
	36-80220B06	connector knot
	03-00140079	tapping screw (6-19 × ½)
	42-80156B01	retainer ring
	09-80227B01	female contact
	15-80217K01	front cable housing
	15-80216B01	back housing connector
	32-83859M01	connector gasket

CONTROLLER BOARD



COMPONENT SIDE VIEW

SOLDER SIDE GDW-2516-A
COMPONENT SIDE GDW-2517-A
OVERLAY — GDW-2519-A



SOLDER SIDE VIEW

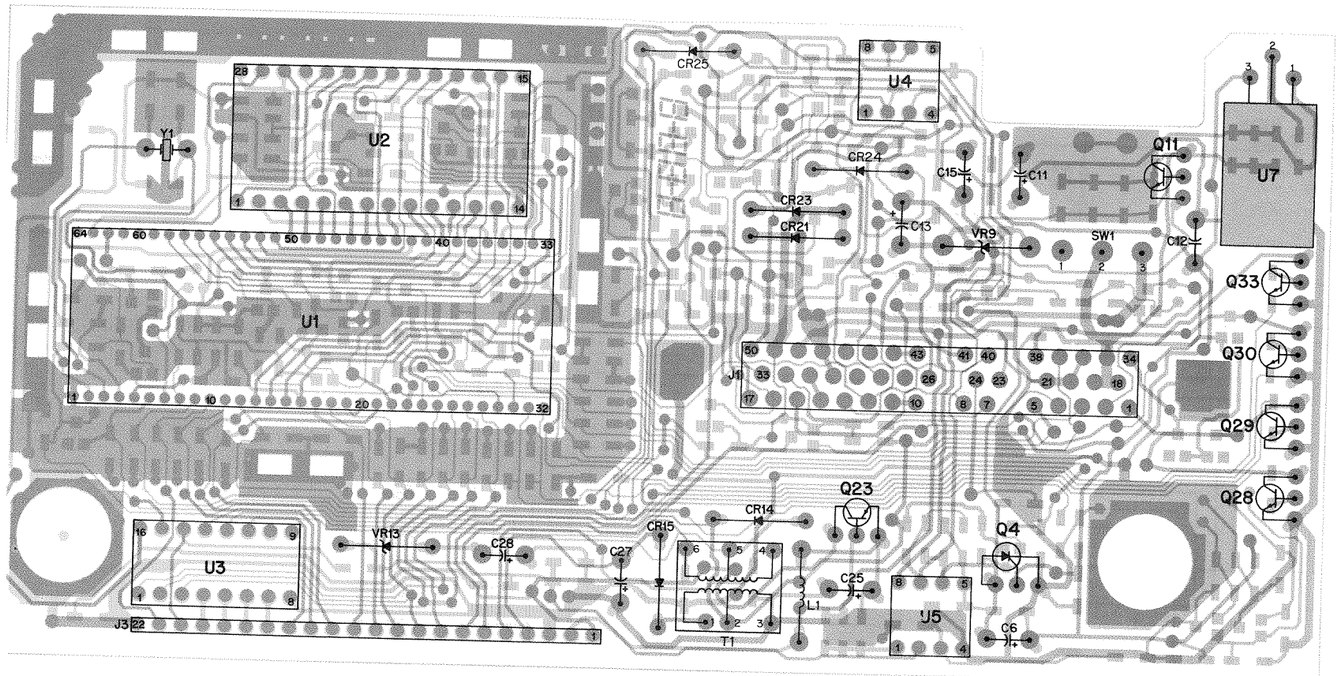
SOLDER SIDE GDW-2516-A
COMPONENT SIDE GDW-2517-A
OVERLAY — GDW-2518-B

parts list

HLN4907C Control Unit (Controller Board)

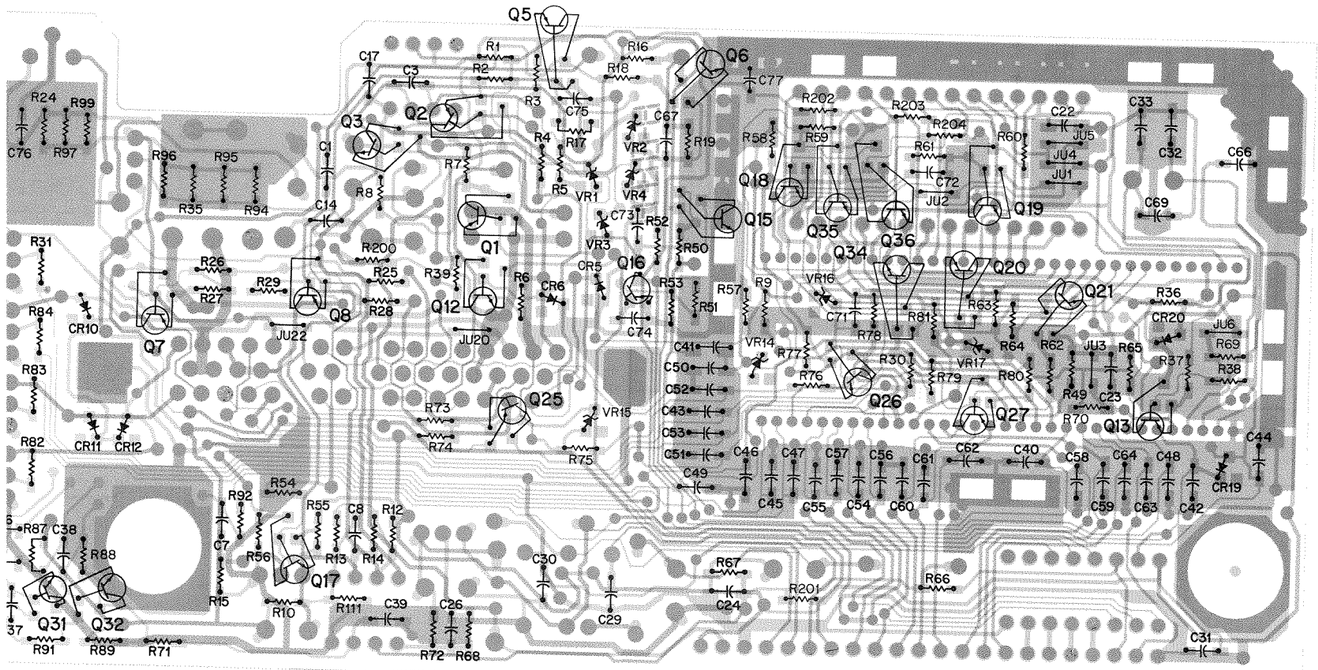
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIP
		capacitor unless ot
C1	21-11032B13	.1 +80,
C3	21-11031A29	39 pF ±5
C6	23-11048C05	1
C7	21-11032B01	.001 +80
C8	21-11031A47	220 pF ±
C11	23-11048C10	10, electr
C12, 13	23-11048C05	1, electro
C14	21-11031A47	220 pF ±
C15	23-11048C06	2.2, elect
C17	21-11032B13	.1 +80,
C22, 23	21-11032B13	.1 +80,
C24	21-11032B15	.22 +80,
C25	23-11013E57	10, 25V,
C26	21-11032B13	.1 +80,
C27, 28	23-11048C10	10, electr
C29, 30	21-11032B01	.001 +80
C31	21-11032B13	.1 +80,
C32	21-11031A24	24 pF ±5
C33	21-11031A21	18 pF ±5
C37, 38	21-11031A60	820 pF ±
C39–66	21-11031A50	300 pF ±
C67	21-11032A21	.01 ±10%
C69	21-11031A10	5.6 pF ±
C71	21-11032A21	.01 ±10%
C72	21-11031A29	39 pF ±5
C73–76	21-11031A47	220 pF ±
C77	21-11031A50	300 pF ±
		diode (se
CR5, 6	48-80236E08	dual silicc
CR10–12	48-80236E03	dual silicc
CR14, 15	48-83654H01	silicon rec
CR19, 20	48-80236E03	dual silicc
CR21	48-82466H18	silicon rec
CR23	48-84616A01	hot carrie
CR24	48-11031A12	hot carrie
CR25	48-81131A01	silicon rec
		connecto
J1	01-80740T38	D-type 50
		coil
L1	24-80138G04	5.6 µH, ±
		transistor unless ot
Q1	48-80141L01	PNP
Q2	48-80141L03	PNP
Q3	48-80141L04	NPN
Q4	48-80182D22	SCR, type
Q5	48-80141L03	PNP
Q6	48-80141L04	NPN
Q7	48-80141L03	PNP
Q8	48-80141L04	NPN
Q11	48-80182D11	NPN, type
Q12	48-80141L04	NPN
Q13	48-80141L01	PNP
Q15	48-80141L03	PNP
Q16	48-80141L04	NPN
Q17, 18	48-80141L03	PNP
Q19	48-80141L02	NPN
Q20	48-80141L03	PNP
Q21	48-80141L02	NPN
Q23	48-00869732	PNP, type
Q25–27	48-80141L03	PNP
Q28–30	48-80182D28	NPN, type
Q31, 32	48-80141L02	NPN
Q33	48-80182D08	NPN, type
Q34, 35	48-80141L04	NPN
Q36	48-80141L03	PNP
		resistor, f unless oth
R1	06-11024A57	2.2k
R2	06-11024A73	10k
R3	06-11024A65	4.7k
R4, 5	06-11024A25	100
R6	06-11024A65	4.7k
R7	06-11024A73	10K
R8	06-11024A57	2.2k
R9	06-11024A79	18k
R10, 11	06-11024B06	220k
R12	06-11024A65	4.7k
R13	06-11024A97	100k
R14	06-11024A85	33k
R15	06-11024A73	10k
R16	06-11024A65	4.7k
R17	06-11024A89	47k
R18	06-11024A85	33k
R19	06-11024A73	10k
R24	06-11024A11	27
R25	06-11024A49	1k
R26	06-11024A81	22k

CONTROLLER BOARD



COMPONENT SIDE VIEW

SOLDER SIDE GDW-2516-A
COMPONENT SIDE GDW-2517-A
OVERLAY — GDW-2519-A



SOLDER SIDE VIEW

SOLDER SIDE GDW-2516-A
COMPONENT SIDE GDW-2517-A
OVERLAY — GDW-2518-B

parts list

HLN4907C Control Unit (Controller Board) MXW-2528-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed, µF ±20%, 50V unless otherwise stated
C1	21-11032B13	.1 +80, −20%
C3	21-11031A29	39 pF ±5%
C6	23-11048C05	1
C7	21-11032B01	.001 +80, −20%
C8	21-11031A47	220 pF ±5%
C11	23-11048C10	10, electrolytic
C12, 13	23-11048C05	1, electrolytic
C14	21-11031A47	220 pF ±5%
C15	23-11048C06	2.2, electrolytic
C17	21-11032B13	.1 +80, −20%
C22, 23	21-11032B13	.1 +80, −20%
C24	21-11032B15	.22 +80, −20%
C25	23-11013E57	10, 25V, tantalum
C26	21-11032B13	.1 +80, −20%
C27, 28	23-11048C10	10, electrolytic
C29, 30	21-11032B01	.001 +80, −20%
C31	21-11032B13	.1 +80, −20%
C32	21-11031A24	24 pF ±5%
C33	21-11031A21	18 pF ±5%
C37, 38	21-11031A60	820 pF ±5%
C39–66	21-11031A50	300 pF ±5%
C67	21-11032A21	.01 ±10%
C69	21-11031A10	5.6 pF ±.5%
C71	21-11032A21	.01 ±10%
C72	21-11031A29	39 pF ±5%
C73–76	21-11031A47	220 pF ±5%
C77	21-11031A50	300 pF ±5%
		diode (see note)
CR5, 6	48-80236E08	dual silicon, common anode
CR10–12	48-80236E03	dual silicon, common anode
CR14, 15	48-83654H01	silicon rectifier
CR19, 20	48-80236E08	dual silicon, common anode
CR21	48-82466H18	silicon rectifier
CR23	48-84616A01	hot carrier
CR24	48-11031A12	hot carrier
CR25	48-81131A01	silicon rectifier
		connector receptacle
J1	01-80740T38	D-type 50-pin connector and face gasket
		coil
L1	24-80138G04	5.6 µH, ±5%
		transistor, SOT23 package unless otherwise stated (see note)
Q1	48-80141L01	PNP
Q2	48-80141L03	PNP
Q3	48-80141L04	NPN
Q4	48-80182D22	SCR, type M8222
Q5	48-80141L03	PNP
Q6	48-80141L04	NPN
Q7	48-80141L03	PNP
Q8	48-80141L04	NPN
Q11	48-80182D11	NPN, type M82D11
Q12	48-80141L04	NPN
Q13	48-80141L01	PNP
Q15	48-80141L03	PNP
Q16	48-80141L04	NPN
Q17, 18	48-80141L03	PNP
Q19	48-80141L02	NPN
Q20	48-80141L03	PNP
Q21	48-80141L02	NPN
Q23	48-00869732	PNP, type M9732
Q25–27	48-80141L03	PNP
Q28–30	48-80182D28	NPN, type M8228
Q31, 32	48-80141L02	NPN
Q33	48-80182D08	NPN, type M82D08
Q34, 35	48-80141L04	NPN
Q36	48-80141L03	PNP
		resistor, fixed, Ω ±5%, ⅛ W unless otherwise stated
R1	06-11024A57	2.2k
R2	06-11024A73	10k
R3	06-11024A65	4.7k
R4, 5	06-11024A25	100
R6	06-11024A65	4.7k
R7	06-11024A73	10K
R8	06-11024A57	2.2k
R9	06-11024A79	18k
R10, 11	06-11024B06	220k
R12	06-11024A65	4.7k
R13	06-11024A97	100k
R14	06-11024A85	33k
R15	06-11024A73	10k
R16	06-11024A65	4.7k
R17	06-11024A89	47k
R18	06-11024A85	33k
R19	06-11024A73	10k
R24	06-11024A11	27
R25	06-11024A49	1k
R26	06-11024A81	22k

MXW-2528-B (2)

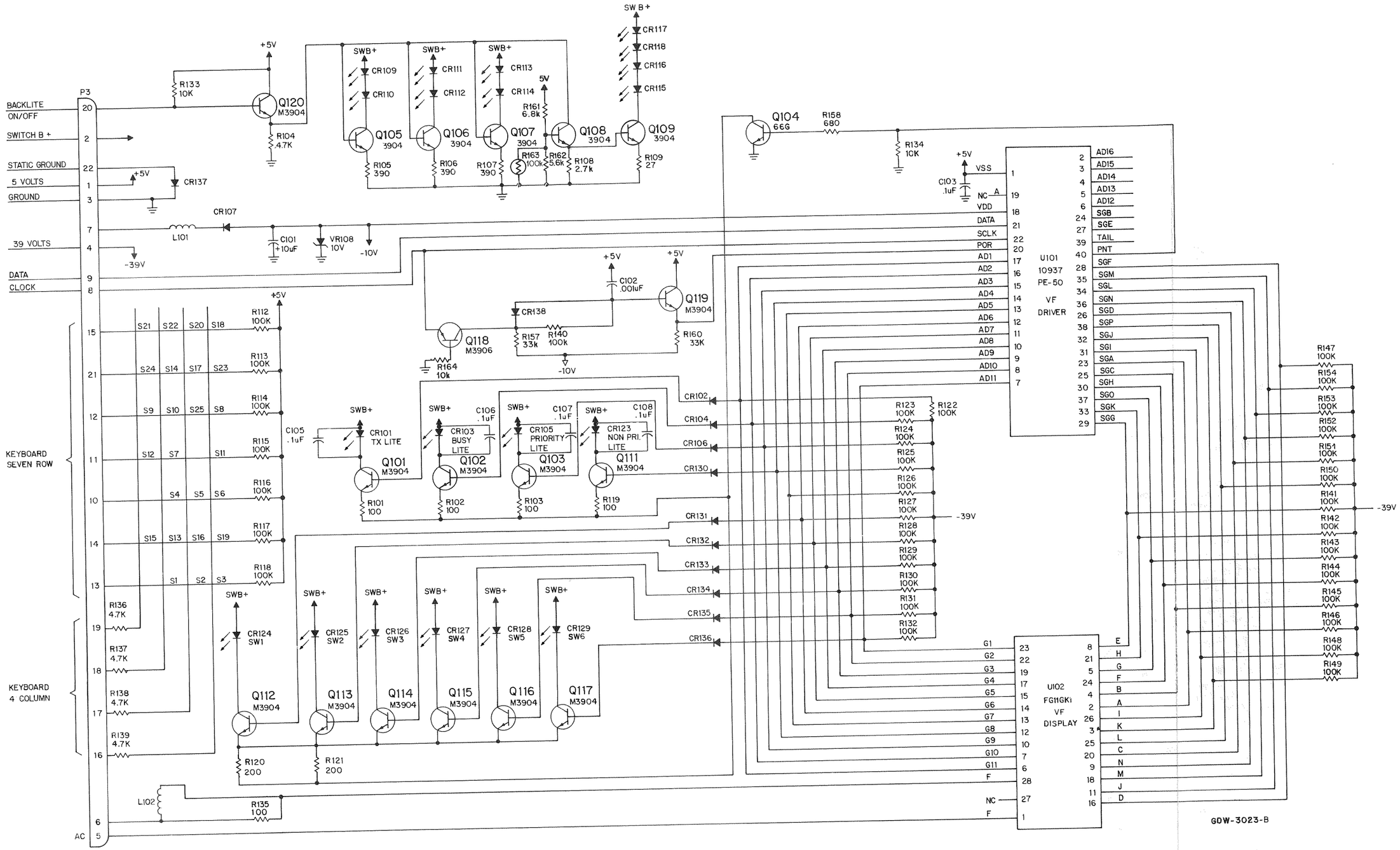
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R27	06-11024A73	10k
R28	06-11024A89	47k
R29	06-11024A65	4.7k
R30, 31	06-11024A85	33k
R35	06-11024A45	680
R36–39	06-11024A57	2.2k
R49	06-11024A89	47k
R50	06-11024A65	4.7k
R51	06-11024A61	3.3k
R52	06-11024A65	4.7k
R53	06-11024A49	1k
R54	06-11024A81	22k
R55	06-11024A73	10k
R56	06-11024A65	4.7k
R57, 58	06-11024A73	10k
R59	06-11024A89	47k
R60	06-11024A65	4.7k
R61, 62	06-11024A89	47k
R63	06-11024A73	10k
R64	06-11024A41	470
R65	06-11024A89	47k
R66	06-11024A69	6.8k
R67	06-11024A80	20k
R68	06-11024A49	1k
R69, 70	06-11024A89	47k
R71	06-11024A57	2.2k
R72	06-11024A49	1k
R73	06-11024A81	22k
R74	06-11024A73	10k
R75	06-11024A89	47k
R76	06-11024A81	22k
R77	06-11024A73	10k
R78	06-11024A89	47k
R79	06-11024A81	22k
R80	06-11024A73	10k
R81	06-11024A89	47k
R82–84	06-11024A85	33k
R86	06-11024A73	10k
R87	06-11024A59	2.7k
R88	06-11024A73	10k
R89	06-11024A59	2.7k
R91, 92	06-11024A49	1k
R94–96	06-11024A45	680
R97, 99	06-11024A11	27
R200	06-11041C65	1k
R201	06-11024A69	6.8k
		switch
S1	40-80033K01	toggle switch
		transformer
T1	25-80277J01	conversion voltage transformer
		integrated circuit (see note)
U1	01-80742T09	microcomputer
U2	01-80742T11	EEPROM 14B01
U3	51-83627M42	CMOS shift register
U4	51-80067C05	BI FET op amp
U5	51-80046K01	dual voltage comparator
U7	51-80068C02	voltage regulator
		voltage regulator (see note)
VR1–4	48-80140L11	7.5V zener
VR9	48-82256C67	10V zener, 1 W
VR13	48-80236E14	43V
VR15–17	48-80141L11	7.5V zener
		crystal (see note)
Y1	01-80740T36	4.9152 crystal and pad

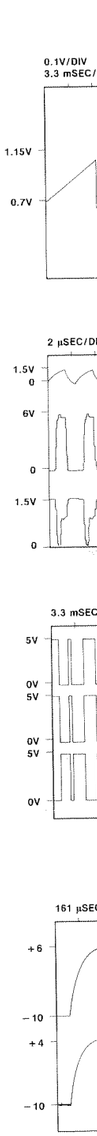
mechanical parts

	29-10134A68	bottom entry terminal
	29-80146B01	top entry terminal
	09-80002K01	64-contact socket
	09-80269B03	28-contact socket

9/19/86

note: For best performance, order diodes, transistors, and integrated circuits by Motorola part number.



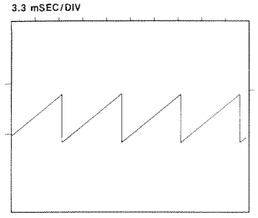


Troubleshooting Charts, Schematics, Circuit Board Diagrams, and Parts Lists for *SYNTOR X 9000* Control Unit
PW-2584-B
(Sheet 4 of 4)
9/22/86

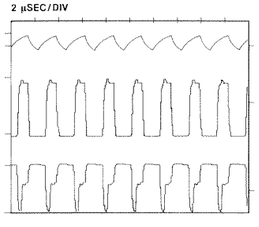
CONTROLLER BOARD

CONTROLLER BOARD WAVEFORMS

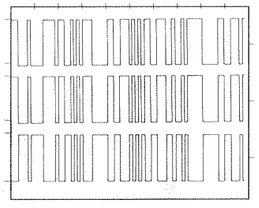
0.1V/DIV
3.3 mSEC/DIV



2 µSEC/DIV

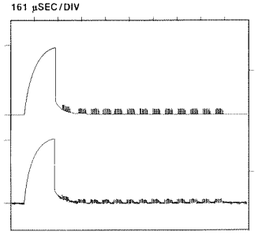


3.3 mSEC/DIV



DISPLAY BOARD WAVEFORM

161 µSEC/DIV



GBW-2588-O

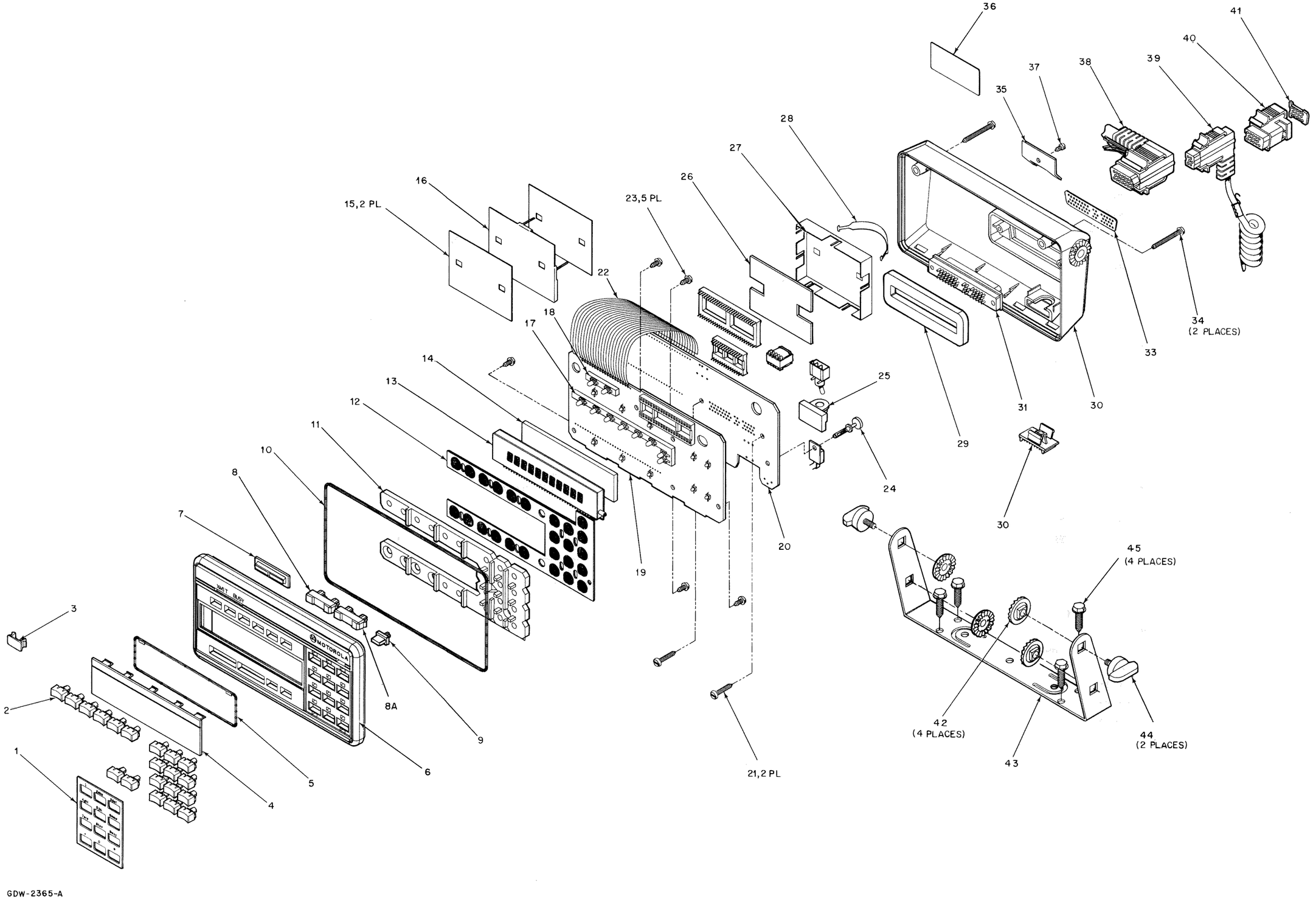
J1 PIN CONNECTIONS

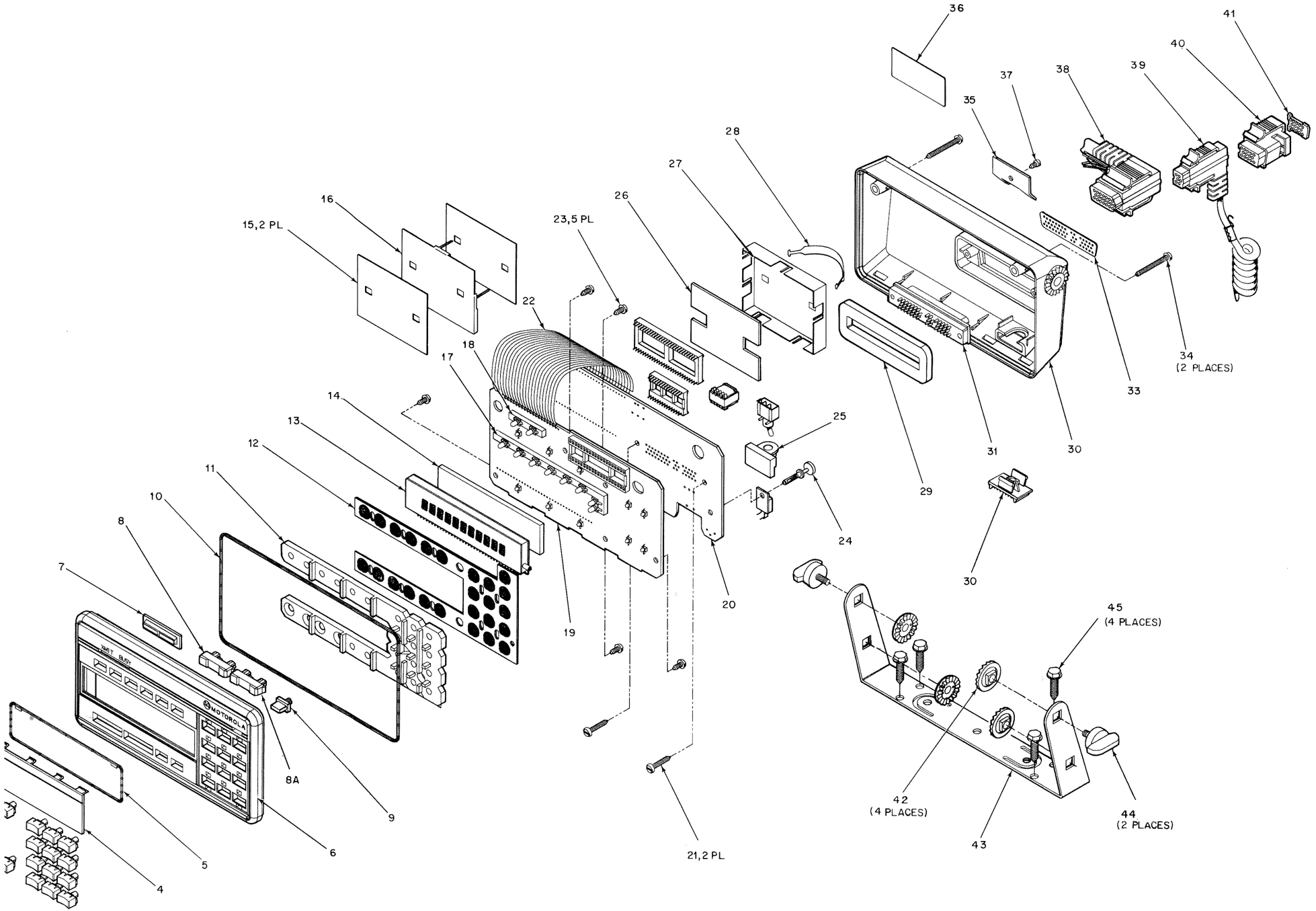
PINS	LABEL
10–17, 26–33, 43–50	TO RADIO
7, 8, 23, 24, 40, 41	TO MIC
1–5, 18–21, 34–38	TO VIP'S

JUMPER CHART

JUMPER	NORMAL CONNECTION	STATUS/ FUNCTION
JU1	OUT	—
JU2	IN	—
JU3	OUT	—
JU4	IN	OUT W930
JU5	OUT	IN W930
JU6	IN	—

GEW-3009-B


36
41
40
39
38
37
35
28
27
26
23,5 PL
16
15,2 PL
22
18
17
14
13
12
11
10
8
7
3
2
1
8A
9
6
5
4
19
20
21,2 PL
24
25
29
30
31
33
34
(2 PLACES)
45
(4 PLACES)
42
(4 PLACES)
43
44
(2 PLACES)
GDW-2365-A



parts list

Mechanical Parts List for *Systems 9000* Control Head — MXW-2293-A

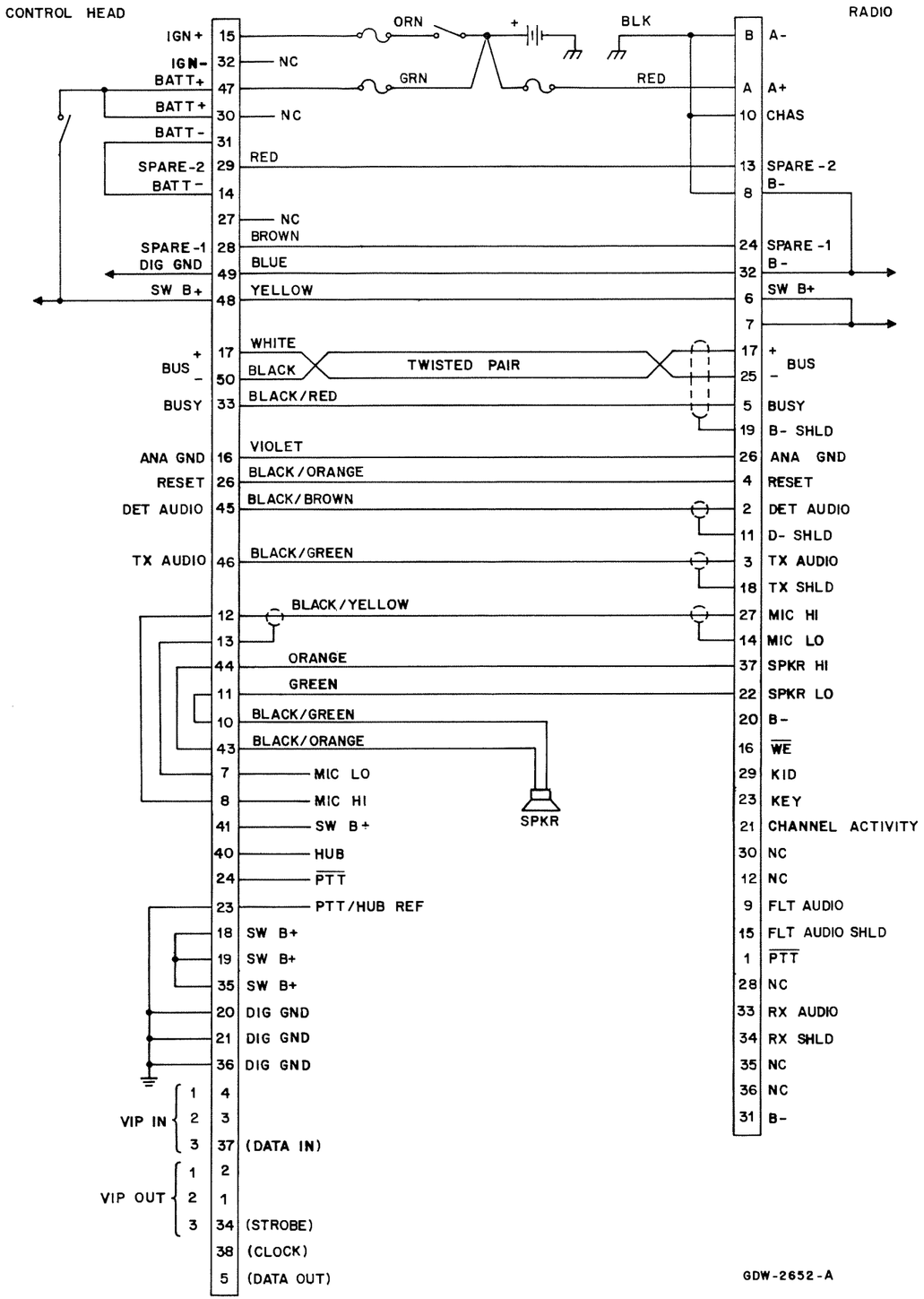
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
1	13-80087J01	escutcheon
2	38-80090J01	push-in key topper (specify legend required)
3	38-80253K01	plug key
4	61-80095J01	VF lens
5	32-80057K01	lens gasket
6	15-08088J01	front housing
7	61-80097J01	LED lens
8	38-80091J01	rocker key topper, mode
8A	38-80091J02	rocker key topper, volume
9	38-80092J01	dimmer key topper
10	32-80180J01	housing gasket
11	61-80185J01	keyboard lightpipe
12	75-80098J01	elastomeric keypad
13	72-80242J01	VF display
14	75-80184J01	VF shock pad
15	14-80269K01	insulator
16	26-80220K01	solder side shield
17	43-80011L01	LED 8-position spacer
18	43-80012L01	LED 2-position spacer
19	84-80117J01	PCB display
20	84-80104J01	PCB control
21	03-10945A14	*TORX* plastite slotted screw (M3.12 × P1.27 × 16)
22	30-80034K01	22-position flex cable
23	03-10945A11	*TORX* plastite slotted screw (M3.12 × P1.27 × 8)
24	05-80200K01	nylon rivet
25	32-80178J01	on-off gasket
26	75-80268K01	IC shock pad
27	26-80003K01	component side shield
28	55-84300B02	shield handle
29	32-80179J01	D connector gasket
30	38-80128J01	on-off key topper
31	28-80228J01	50-position D subminiature connector
32	15-80089J01	back housing
33	32-80181J01	connector face gasket
34	03-10908A33	*TORX* panhead slotted machine screw (M3.5 × 0.6 × 30) (2 used)
35	07-84323C01	strain relief bracket
36	54-80282J01	nameplate
37	03-10908A18	*TORX* panhead slotted machine screw (M3.0 × 0.5 × 6)
38	30-80222J01	radio cable
39	30-80223J01	microphone cable
40	15-80221K01	vehicle interface port connector
41	32-80275K01	VIP gasket
42	43-80127J01	trunnion spacer
43	07-80263L01	trunnion bracket
44	03-80160E01	wing screw (2 used)
45	03-00136756	mounting screw (4 used)

Exploded View and Parts List
for Control Head
PDW-2425-A
11/04/86

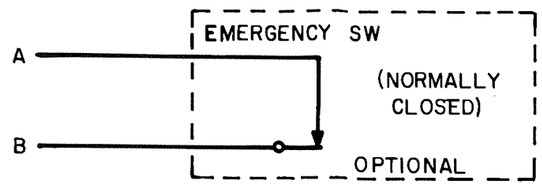
parts list

HKN4241A 17' Negative Ground Cable Kit — MXW-2046-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	01-80701T89	66" high-power black lead and lug
	09-84151B03	contact receptacle
	09-84151B05	plated contact receptacle
	39-10184A44	contact receptacle, 2 used
	15-10183A17	receptacle contact housing, 2-contact
	36-80220B06	connector knob
	03-00140079	tapping screw (6-19 × ½), 4 used
	42-10217A02	tie strap (.091 × 3.62), 2 used
	42-80156B01	retainer ring
	09-80227B01	power contact, female, 2 used
	15-80217K01	front cable housing
	15-80216B01	back cable housing
	32-83859M01	connector gasket
	54-80072G01	circuit board label
	54-84032M02	label



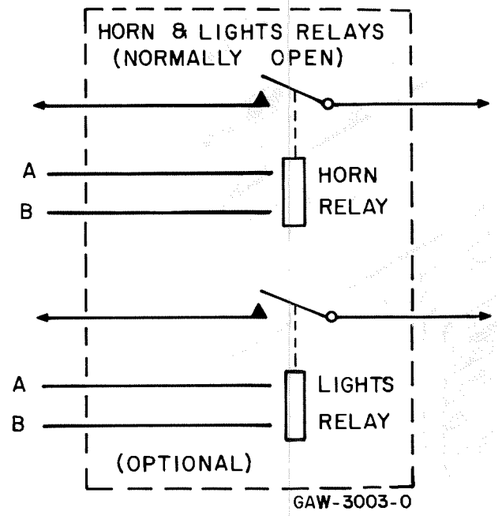
GDW-2652-A



NOTE:

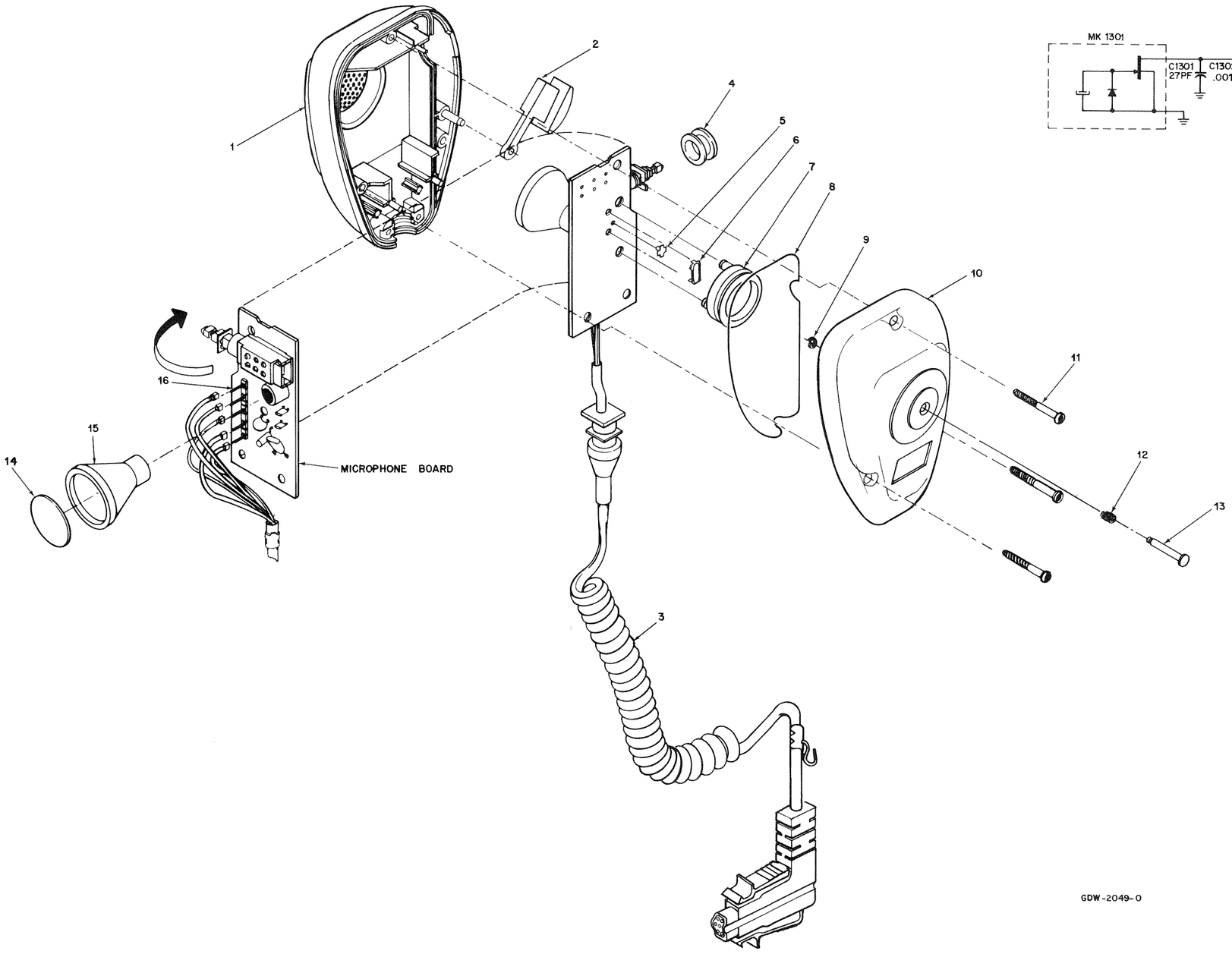
VIP INPUTS ARE PROGRAMMABLE. THIS MEANS VIP IN #1, VIP IN #2, OR VIP IN #3 COULD BE MADE AN EMERGENCY SWITCH DEPENDING ON HOW THE CONTROL HEAD IS PROGRAMMED.

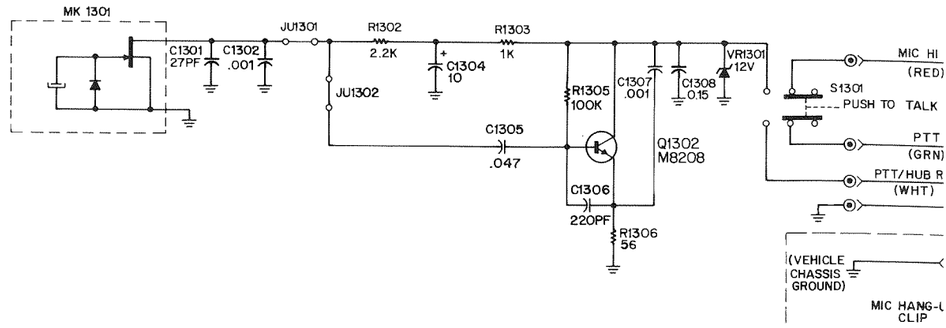
GAW-3002-A

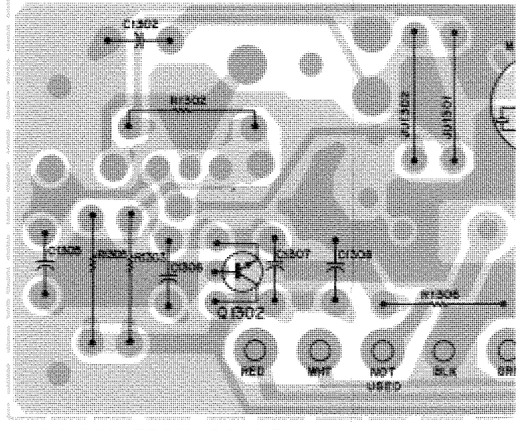


GAW-3003-0

Negative Ground Cable
Wiring Diagrams
PW-2779-A
11/11/86

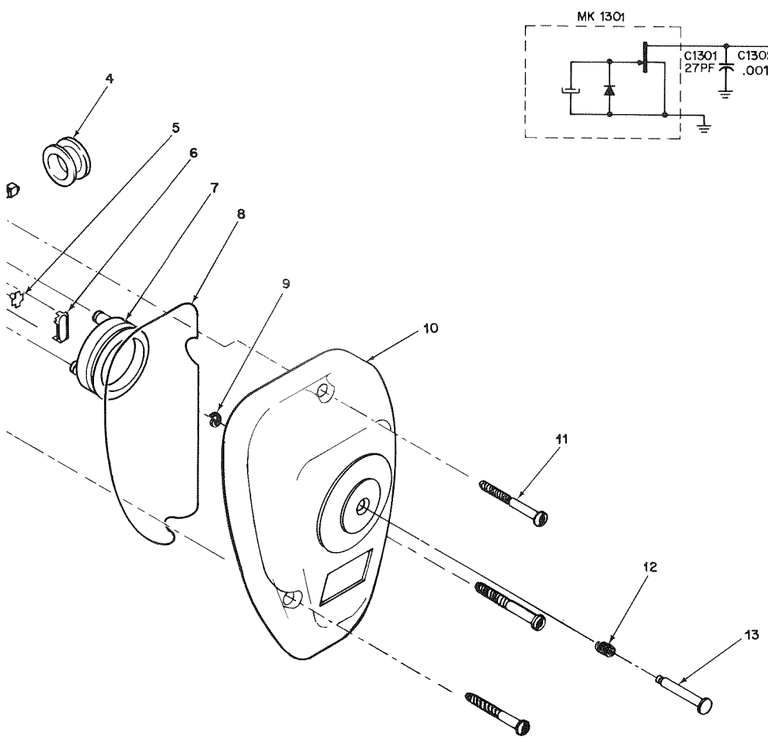


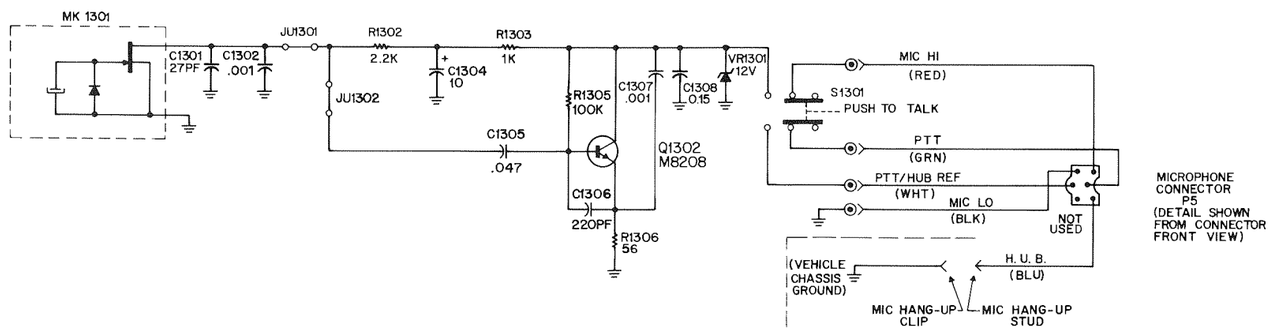




SHOWN FROM SOLDER SIDE

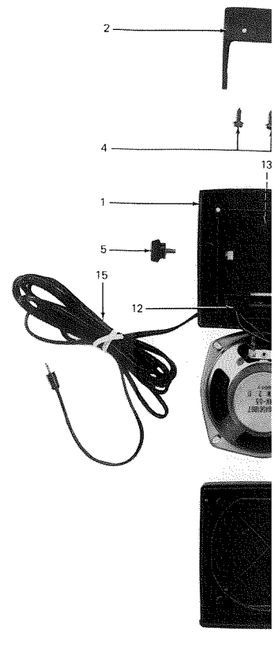
GDW-2049-0

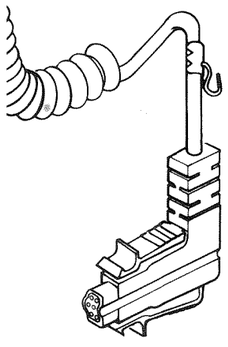




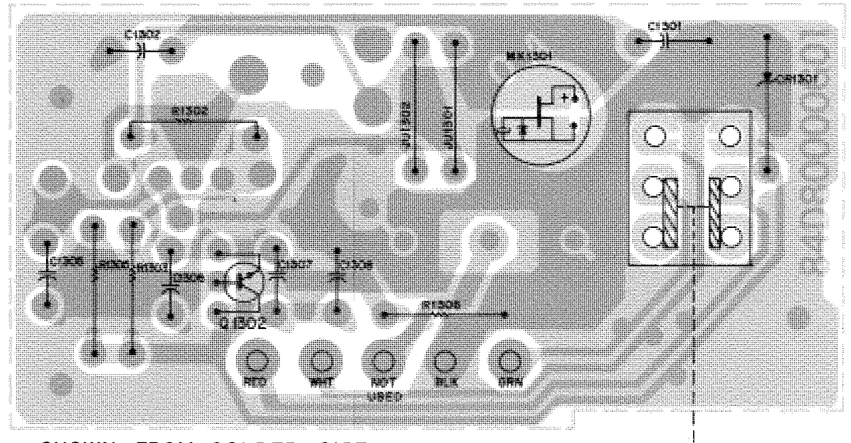
MICROPHONE
CONNECTOR
P5
(DETAIL SHOWN
FROM CONNECTOR
FRONT VIEW)

GCW-2050-O





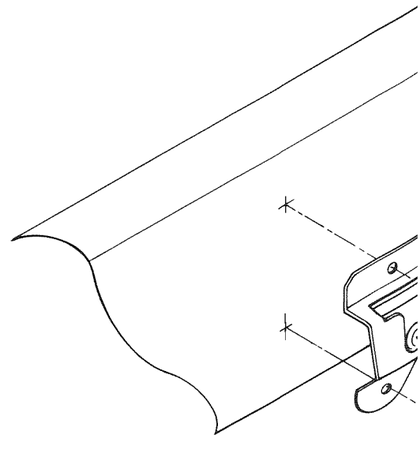
GDW-2049-O



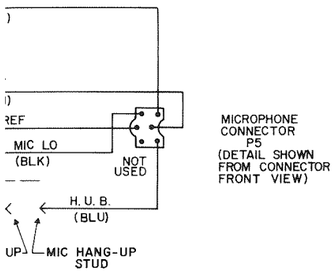
SHOWN FROM SOLDER SIDE

S1301
P.T.T.

COMPONENT SIDE 80-BEPS-37896-O
SOLDER SIDE 80-BEPS-37897-O
OL-BEPS-38385-O

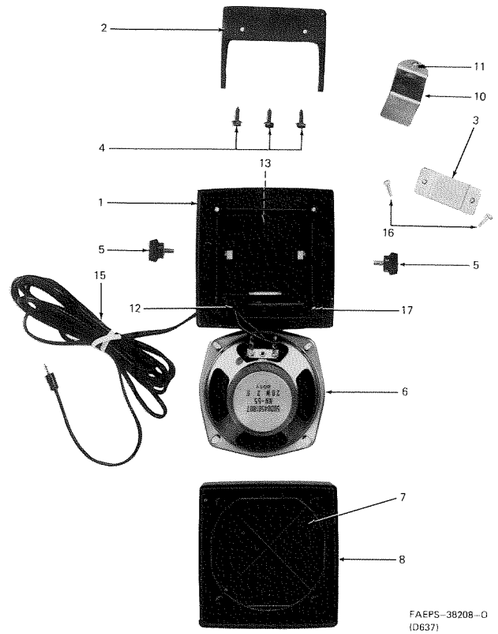


GBW-2274-O

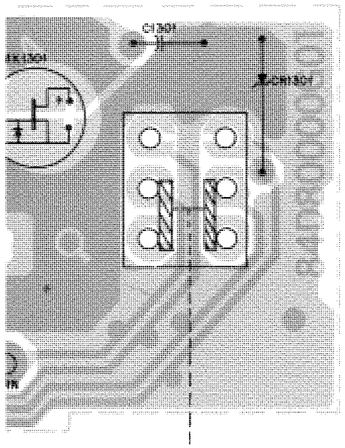


MICROPHONE
CONNECTOR
P5
(DETAIL SHOWN
FROM CONNECTOR
FRONT VIEW)

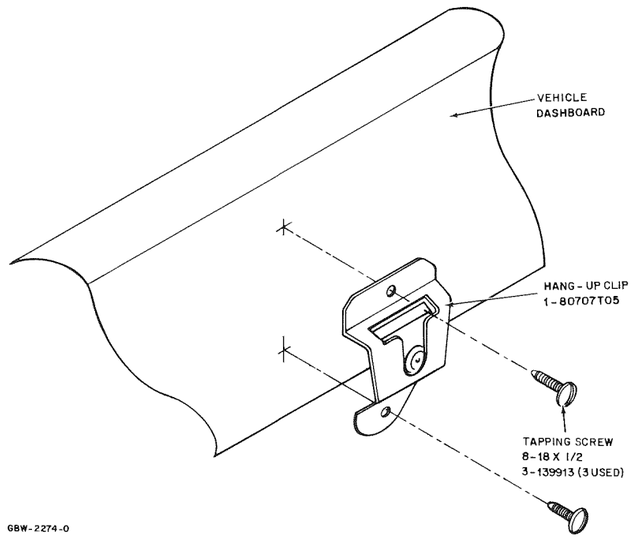
GCW-2050-O



FAEPS-38208-O
(D637)



COMPONENT SIDE ✻ BD-BEPS-37896-O
SOLDER SIDE ✻ BD-BEPS-37897-O
OL-BEPS-38385-O



GBW-2274-O

parts list

HLN4384B *Systems 9000* Microphone Board — MXW-2051-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed, µF ±5%, 50V unless otherwise stated
C1301	21-11038H35	27 pF
C1302	21-11039B13	.001 ±10%
C1304	23-11019A20	10 ±20%, 25V, electrolytic
C1305	08-11017A14	.047
C1306	21-11038P50	220 pF
C1307	21-11039B13	.001 ±10%
C1308	08-11051A14	.15, 63V
		diode (see note)
CR1301	48-82256C25	12V zener ±5%, 400mW
		connector receptacle
JU1301, 1302	06-11009B23	resistor jumper
		microphone
MK1301	50-80258E04	electret cartridge
		transistor (see note)
Q1302	48-80182D08	NPN, type M82D08
		resistor, fixed, Ω ±5%, ¼ W unless otherwise stated
R1302	06-11009C57	2.2k
R1303	06-11009C49	1k
R1305	06-11009C97	100k
R1306	06-11009C19	56
		switch
S1301	40-80652E02	momentary switch
		mechanical part
	14-84360C01	switch insulator

note: For best performance, order diodes, transistors, and integrated circuits by Motorola part number.

HLN4953A *Systems 9000* Microphone Hardware — MXW-2052-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
1	15-80137D05	microphone front housing
2	38-80144D02	microphone button
3	30-80223J01	6-conductor microphone cable
4	05-80221K01	PTT switch grommet
5	40-80252E02	monitor switch button
6	40-80252E01	monitor switch contact
7	32-80253E02	PL switch gasket
8	32-80058H03	housing gasket
9	42-80166E01	retaining ring
10	15-80137D03	rear microphone housing
11	03-80076E04	hi-lo metric screw, 3 used
12	41-80175A01	spring
13	46-80086E06	microphone hangup stud
14	35 80089D01	microphone felt baffle
15	05-80148D01	microphone cartridge grommet
16	39-10184A10	contact plug, 5 used
		non-referenced items
	04-80093E01	flat washer
	41-80096E02	microphone plunger spring
	45-80113D02	actuator plunger
	46-80281G01	microphone weight
	01-80738T96	microphone hangup clip
	01-80707T05	eyeleted spring and bracket
	03-00139913	tapping screw (8-18 × ½), 2 used
	05-80151D01	switch button grommet
	54-84962K01	safety tag
	33-80095E32	nameplate, HMN1031A

HSN4018A *Systems 9000* Speaker — MXW-2053-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	01-80702T45	speaker mounting hardware
	03-00136756	tapping screw (10-16 × ⅝)
	01-80740T18	*Systems 9000* speaker cable
	15-10183A18	connector housing plug, 2-contact
	39-10184A45	contact plug, 2 used
	42-82018H05	retainer cable
	42-84081A03	wire clamp with S-hook
	03-00140001	tapping screw (6-19 × ⅞), 4 used
	03-84244C03	black shadow wing screw, 2 used
	50-80135E01	speaker
	07-80200E01	black speaker trunnion bracket
	13-82671M04	bezel
	15-84981B07	speaker base cover
	32-84564B01	speaker gasket

FUNCTION

The palm microphone contains an amplifier to provide the radio with a high-level, noise-free audio input. The microphone also provides push-to-talk transmit control for the radio as well as off-hook channel monitoring (PL/DPL squelch disable) capability.

MOTOROLA
Mobile Products Division

instruction manual revision

GENERAL

This revision consists of changes that have occurred since your manual was printed. Please correct your manual accordingly.

INSTRUCTION MANUALS AFFECTED

68P80100W51-A	*SYNTOR X* Low Band, 31-50 MHz, 100 Watts
68P80101W95-O	*SYNTOR X 9000* Low Band Radio System, 100 Watts, 31-50 MHz
68P81060E05-B	*SYNTOR X* High Band Radio, 150-174 MHz
68P80100W45-B	*SYNTOR X* UHF Radio
68P81044E40-B	*SYNTOR X* FM Two-Way Radio, 806-970 MHz, 35 Watts
68P81066E80-A	Trunked *SYNTOR X Smartnet* Dual Operation FM Two-Way Radio
68P80101W62-O	*Systems 9000*E Dual Operation Radio System
68P81043E55-B	Trunked *SYNTOR X* FM Radio Control Station, 806-870 MHz, 10W
68P80100W94-O	*SYNTOR X 9000* High Band, UHF, and 800 MHz Radio Supplement
68P80100W89-O	*SYNTOR X 9000* Trunked *Smartnet* Dual Operation Supplement
68P80101W10-A	*Systems 9000* Siren/Public Address Option for *SYNTOR X 9000* Radios
68P81102E27-E	*Micor/Systems 90 "Quik-Call II"* Mobile Paging Decoder
68P81106E46-C	*Mitrek/Micor Systems 90, SYNTOR Systems 90*•S "Touch-Code" Mobile Selective Signalling Decoder
68P81045E65-O	*Mitrek* Two-Way FM Radio, 29.7-50 MHz, 60/110 Watts
68P81045E70-O	*Mitrek* Two-Way FM Radio, 135-164 MHz, 40/60/75/110 Watts
68P81045E75-A	*Mitrek* Two-Way FM Radio, 406-420 MHz and 450-512 MHz, 30 and 50; 75 and 100 Watts
68P81045E80-A	*Mitrek* Two-Way FM Radio, 806-816 MHz Transmit 851-861 MHz Receive, 12 and 35 Watts

REVISION

Change all occurrences of the following part numbers as follows. Most occurrences are in the Transmitter and/or Common Circuits Board sections of your manuals.

OLD NUMBER	NEW NUMBER	DESCRIPTION
51-80073C01	51-84887K04	quad switch
51-80073C01	51-84887K04	quad switch
48-84616A01	48-84616A11	hot carrier
48-11034A12	48-84616A25	hot carrier

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INSTRUCTION MANUAL AFFECTED

68P81060E05–B	*SYNTOR X* High Band Radios
68P81066E80–A	Trunked *SYNTOR X SMARTNET* Dual Operation
68P80100W45–B	*SYNTOR X* UHF Radios, Ranges 1–5
68P80100W51–A	*SYNTOR X* Low Band, 31–50 MHz, 100 Watts
68P80100W94–O	*SYNTOR X 9000* High Band and UHF Radios
68P80101W62–O	*Systems 9000E* Dual Operation
68P80101W95–O	*SYNTOR X 9000* Low Band Radio System
68P06907T09–O	Advanced Trunked *SYNTOR X* Control Station
68P06907T10–O	Advanced Trunked *SYNTOR X* Control Station

REVISIONS

1. Revise your manual per WMRs dated prior to 3/19/88.

2. Locate each and every occurrence of part number, **23–83210A08**. Change each to **23–84669A08.**

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