



**ESP504 / ESP520  
220-222 MHz TRANSCEIVER**

**INSTRUCTION MANUAL**

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**MAN-0504-01**  
**Rev C1**

***ESP504/520***

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## **1. INTRODUCTION**

Welcome to ACSB technology, the first generation of truly narrowband channel communication systems. This manual describes the SEA ESP504 and ESP520 Amplitude Compandored Single Sideband (ACSB) Land Mobile Transceivers.

SEA is a recognized leader in the design and manufacture of HF/SSB communications equipment. Since 1975, SEA products have been synonymous with state of the art technical innovations in marine communications and this same philosophy has been applied in SEA's ACSB products for land mobile applications. SEA's extensive experience with linear modulation technology is combined with a dedication to innovation and product reliability to assure you of excellent performance and product value.

We appreciate any comments you may have regarding this manual, SEA products, and ACSB operation in general.

## **2. FOREWORD**

### **2.1 SCOPE**

The purpose of this document is to aid in the installation, operation and maintenance of the SEA ESP504 and ESP520 220-222 MHz ACSB Transceiver.

Qualified technical personnel who are acquainted with similar mobile two-way communication equipment will find this manual particularly useful.

It is SEA's policy to continuously improve the performance of its line of amplitude compandored single-sideband (ACSB) radio equipment so changes will take place in the equipment and this manual from time to time. Manual revision sheets may accompany this manual upon delivery to the customer which are intended to replace outdated or revised sheets in this manual.

### **2.2 NOMENCLATURE**

The following is a description of SEA's models, assemblies, kits and parts numbering system, which is useful when ordering spare or replacement parts.

#### **2.2.1 Model Numbers**

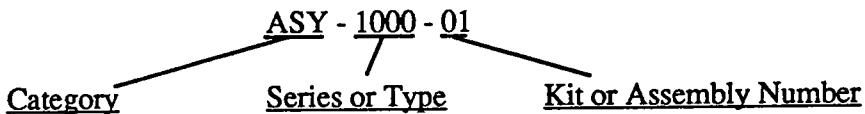
**ESP504**      4-Mode trunked/conventional 220-222 MHz  
dash-mount transceiver equipped with palm microphone

**ESP504-1**    ESP504 less palm microphone

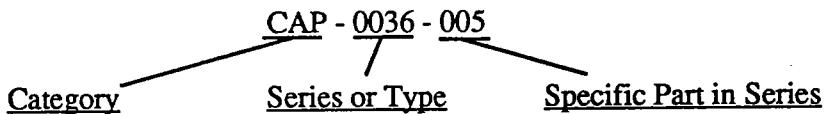
**ESP520**      20-Mode trunked/conventional 220-222 MHz  
dash-mount transceiver equipped with palm microphone

**ESP520-1**    ESP520 less palm microphone

## 2.2.2 Kit or Assembly Numbers



## 2.2.3 Part Numbers



## 2.3 SERVICE

For equipment maintenance assistance and repair service contact the SEA Service Manager at the address or phone below:

SEA Inc.  
7030 220th Street S.W.  
Mountlake Terrace, WA 98043  
(206) 771-2182  
FAX: (206) 771-2650

SEA's Service and Systems Engineering staffs are prepared to assist in the system planning, installation and troubleshooting stages of your system implementation. SEA has several application notes and instruction pamphlets to assist in the planning and optimization of your mobile radio system.

## 2.4 REPLACEMENT PARTS

When ordering replacement parts be sure to use the SEA part number (found in the parts list included in this manual) as described in Section 2.2.

If requesting replacement parts covered by warranty be sure to save the defective part as it may be requested to be returned to SEA for evaluation (depending on its value and apparent failure mode). Also please note the serial number of the unit requiring the warranted replacement part and provide it to SEA when ordering the part.

Operating manuals are provided with each radio and are useful for both technical personnel and users. The operating manual is a convenient glove-box size for keeping permanently in each radio-installed vehicle. Service manuals, like this one, can be ordered in the same manner as replacement parts, as can extra operating manuals.

### **3. SPECIFICATIONS FOR SEA ESP504 ACSB TRANSCEIVER**

#### **GENERAL**

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Frequency Range	TX: 220~222 MHz RX: 220~221 MHz		
Channel Spacing	5 kHz		
Frequency Generation	Synthesized		
Modes	ESP504: 4	ESP520: 20	
Dimensions (HxWxD)	in: 2.35 x 7.45 x 9.75 cm: 5.97 x 18.90 x 24.76		
Weight	lbs: 4.10	kg: 1.86	
Operating Temperature Range	-30°C to +60°C		
Input Voltage	13.6 VDC (negative ground)		
DC Current Drain at 13.6 V(max)	Transmit	Receive	Standby
	ESP504: 4 A	1 A	500 mA
	ESP520: 4.1 A	1.1 A	600 mA
Antenna Connector	Mini UHF		
FCC Type Acceptance ID	BZ68RIESP504		
FCC Compliance	Parts 15 and 90		

#### **TRANSMITTER**

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RF Power Output	20 Watts Peak Envelope Power
Output Impedance	50 ohms
Spurious and Harmonic Emissions	>70 dB
Frequency Stability	+/- 0.00015% / -30°C to +60°C (1.5 ppm)
FM Hum & Noise	-34 dB
Emission Designator	4K00J3E
Audio Distortion	<5% at 1 kHz
Modulation	single (upper) sideband suppressed carrier with pilot tone above band
Pilot Carrier	3900 Hz *
Data Carrier	1950 Hz *

<b>Microphone Type</b>	Low impedance dynamic
<b>Microphone Output</b>	11mV/100 microbars
<b>Audio Response</b>	+2,-6 dB of 6 dB/octave preemphasis (300-2900Hz standard bandwidth)
<b>Frequency Separation</b>	2 MHz
<b>ALC Response</b>	Developed PEP does not exceed rated PEP by more than 1 dB.

\* When referenced to the suppressed carrier.

## **RECEIVER**

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<b>Audio Output Power</b>	4 Watts at 3.2 ohm load
<b>Audio Distortion</b>	<5%
<b>Input Impedance</b>	50 ohms
<b>Modulation Bandwidth</b>	4 kHz
<b>Frequency Stability</b>	+/- 0.00015% / -30°C to +60°C
<b>Sensitivity</b>	12 dB SINAD: .35uV max
<b>Spurious and Image Rejection</b>	>70 dB
<b>AGC Range</b>	less than 10dB audio level change for 100dB RF level change
<b>Intermodulation Rejection</b>	>70 dB
<b>Adjacent Channel Rejection (5 kHz)</b>	>60 dB
<b>Audio Response</b>	+2,-6dB of 6dB/octave de-emphasis (350 - 2900Hz)

**SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE**

#### 4. MODEL CHART

##### ESP504 ACSB MOBILE TRANSCEIVER

<u>QUANTITY</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>
ESP504	ESP504-1	
2	2	ASY-0500-15 COVER W/ FELT
1	1	ASY-0500-21 ASSY, POWER CABLE, 500
1	1	ASY-0500-22 KIT, MOUNTING
1	0	ASY-0500-23 ASSY, MICROPHONE PALM
1	1	ASY-0500-26 CABLE, ACCESSORY
1	1	ASY-0500-30 MIC HANGER KIT
1	1	ASY-0505-11 SPEAKER BEZEL ASSY
1	1	ASY-0505-14 RADIO, BASIC
1	1	BOX-0500-01 OUTER CONTAINER ESP500
1	1	FOM-0500-02 2# CUT FOAM
2	2	FOM-0500-03 1# FLAT FOAM
1	1	LBL-0009-003 FCC LABEL, ESP500
1	1	MAN-0504-02 OPERATING MANUAL
1	1	OPS-0504-U2 SOFTWARE REV.
1	1	OPS-0504-U6 SOFTWARE REV.

##### ASY-0505-14 RADIO BASIC

<u>QUANTITY</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>
1	ASY-0500-10	CHASSIS
1	ASY-0505-01	MAINBOARD, ESP/DSP
1	ASY-0505-02	PERSONALITY, ESP/DSP
1	CAB-0501-001	MINI COAX CABLE, 50 MM
1	CAB-0501-002	MINI COAX CABLE, 127 MM
1	FAB-0500-08	SHIELD, FLAT

## ESP520 ACSB MOBILE TRANSCEIVER

<u>QUANTITY</u>		<u>PART NO.</u>	<u>DESCRIPTION</u>
ESP520	ESP520-1		
2	2	ASY-0500-15	COVER W/ FELT
1	1	ASY-0500-21	ASSY, POWER CABLE, 500
1	1	ASY-0500-22	KIT, MOUNTING
1	0	ASY-0500-23	ASSY, MICROPHONE PALM
1	1	ASY-0500-26	CABLE, ACCESSORY
1	1	ASY-0500-30	MIC HANGER KIT
1	1	ASY-0520-14	RADIO, BASIC 520
1	1	BOX-0500-01	OUTER CONTAINER ESP500
1	1	FOM-0500-02	2# CUT FOAM
1	1	FOM-0500-03	1# FLAT FOAM
1	1	LBL-0009-003	FCC LABEL, ESP500
1	1	MAN-0520-02	OPERATING MANUAL
1	1	OPS-0520-U2	SOFTWARE REV.
1	1	OPS-0520-U6	SOFTWARE REV.
1	1	ASY-0520-12	DISPLAY BEZEL ASSY.
1	1	SPE-0500-23	EXTERNAL SPEAKER

### ASY-0520-14 RADIO BASIC

<u>QUANTITY</u>		<u>PART NO.</u>	<u>DESCRIPTION</u>
1		ASY-0500-10	CHASSIS
1		ASY-0505-01	MAINBOARD, ESP/DSP
1		ASY-0520-02	PERSONALITY, ESP/DSP
1		CAB-0501-001	MINI COAX CABLE, 50 MM
1		CAB-0501-002	MINI COAX CABLE, 127 MM
1		FAB-0500-08	SHIELD, FLAT

## **5. IMPORTANT INFORMATION**

### **5.1 FCC AUTHORIZATIONS**

Your SEA ESP504 or ESP520 equipment must have a station authorization (license) before transmissions are permissible. An operator does not require a license, but the station licensee is responsible for the proper use and maintenance of the equipment.

SEA recommends that this equipment be maintained and repaired only by qualified technical personnel or under such supervision.

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### **IMPORTANT**

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FCC regulations specifically state that:

1. The RF power output of a transmitter shall be no more than that required for satisfactory technical performance considering the conditions and the local area to be covered. In the 220-222 MHz frequency band, mobile units are limited to an output power of no greater than 50 watts ERP (+47 dBm). Since both the ESP504 and ESP520 output a rated 20 watts PEP (+43 dBm), the maximum antenna gain should be no greater than 4 dB for any given mobile installation.
  2. The frequency accuracy, modulation and power output of a mobile transmitter must be maintained within specified permissible limits. Therefore, it is recommended that these parameters be checked before installation and operation.
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### **5.2 IMPORTANT FCC INFORMATION**

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### **NOTE**

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This device complies with Part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference.

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## NOTE

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This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
  - Increase the separation between the equipment and the receiver.
  - Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
  - Consult the dealer or an experienced radio/TV technician for help.
- 

### 5.3 GENERAL SAFETY INFORMATION

The United States Department of Labor, through the provisions of the Occupational Safety and Health Act of 1970 (OSHA), has established an electromagnetic energy safety standard which applies to the use of this equipment. The following precautions are recommended to minimize exposure to electromagnetic energy:

**DO NOT** operate the transmitter of a mobile radio when someone outside the vehicle is within two feet (0.6 meter) of the antenna.

**DO NOT** operate the transmitter of a fixed radio (base station or microwave RF equipment) or marine radio when someone is within two feet (0.6 meter) of the antenna.

**DO NOT** operate the transmitter of any radio unless all RF connectors are secure and any open connectors are properly terminated.

In addition, **DO NOT** operate this equipment near electrical blasting caps or in an explosive atmosphere.

All equipment must be properly grounded according to SEA installation instructions for safe operations.

All equipment should be serviced only by a qualified technician.

## 6. INSTALLATION

### NOTE

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Refer to the operating manual packed with each ESP504 and ESP520 mobile transceiver for specific operating instructions.

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### 6.1 INTRODUCTION

#### 6.1.1 Radio Description

The ESP504 and ESP520 are microprocessor-controlled dash mount transceivers designed for 220-222 MHz operation. The units employ Amplitude Compandored Single Sideband (ACSB) modulation, a narrowband technique which allows for more efficient use of the radio spectrum than conventional frequency modulation (FM).

The transmitter and receiver sections are frequency synthesized and may be programmed for operation on any authorized frequency in its tuning range by the proper programming of internal memory chips. The mobiles are provided complete with palm microphone, power cable, accessory cable, and underdash mounting kit. An external speaker is provided with the ESP520 and available as an option with the ESP504 for use in high ambient noise conditions. The unit may be operated as a desktop control station using an AC power supply and desktop microphone.

### NOTE

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As soon as possible after delivery of any radio equipment, be sure to inspect for any possible damage due to shipment. If the equipment has been damaged in any way, contact the transport company immediately.

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#### 6.1.2 Definitions of functions

- a) **DTL trunking channel access:** A radio channel trunking system employing low-speed data transmitted simultaneously with voice. Each repeater operates as a control channel, so this system is said to employ distributed control channel operation.
- b) **Mode:** A mode is a system/group ID combination. For instance, the ESP504 is a 4-mode radio, so it can operate on up to 4 systems but with only 1 group ID

for each system. Conversely, the ESP504 can operate using up to 4 distinct IDs if programmed to operate on a single trunked system. A mode can also be the system/group ID code used to access a conventional repeater. Each trunked mode includes one (1) encode ID, two (2) priority decode IDs, one (1) block (contiguous) of decode IDs (up to 250), one (1) home channel, and one (1) area bit (1 or 0). Decode ID is programmable to cause the horn honk, transpond, transmit inhibit functions to be enabled or disabled. The revert mode has programmable weighting for scan drop-out purposes. Each parameter is dealer programmable.

- c) **Scan:** A unit will automatically search through all or some of the four pre-programmed modes during scan operation, looking for channel activity and a valid ID. The dealer may disable this function through programming.
- d) **Revert Mode:** The Revert Mode is the Mode used by the transmitter upon operation of PTT switch while the unit is scanning. The revert mode is also selected when exiting scan or taking the microphone off hook while scanning. See the specific radio operating manual for a description of how the Revert Mode is selected for the two types of revert, Float Revert and Fixed Revert.
- e) **Off hook:** A unit is said to be "off hook" when the microphone is removed from the microphone hanger bracket. This is an important function for controlling the operation of the radio when scanning. When the microphone is taken off hook while scanning, the unit will cease scanning for a pre-programmed interval.
- f) **Scan list programming:** A user may delete modes from the scan list. The dealer may disable this feature through programming.
- g) **Interval scan:** The unit will resume scanning automatically after a preprogrammed period of time (interval scan delay period) once the microphone is off hook. This delay period is dealer programmable.
- h) **Scan resume delay period:** When a message directed to a scanning mobile is received, the unit ceases scanning and pauses for this programmable period of time. This pause allows the receiving party to respond on the mode received.
- i) **Interconnect operation:** (Optional DTMF microphone required) Interconnect operation is the ability to make and/or receive telephone calls through the trunked system. To make an interconnect call on a given system requires the selection of a mode reserved for that purpose.
- j) **Free system ringback (FSRB):** When enabled, free system ringback provides an audible indication that a repeater is now available. Pressing PTT and pushing AUX while the busy or intercept tone is sounding enables FSRB. Dealer programmable.

k) **Courtesy tone (beep):** The courtesy tone is heard after pressing the PTT to prompt the user to begin to speak. It indicates that a successful "handshake" has taken place between the mobile and the trunked system, and that a channel has been assigned for use. The dealer may disable the courtesy tone. Level is controlled with Volume control. Not available when programmed for conventional operation.

l) **Horn Alert Hailing:** The user may enable the unit to cause the vehicle horn to honk when a transmission directed at the mobile operator is detected.

## 6.2 INSTALLATION

### 6.2.1 Preinstallation Tests

Even though your ESP transceiver was thoroughly tested and inspected prior to shipment, it is recommended that the transmitter frequency and power output be checked before installation. Refer to Section 12 of this manual.

### 6.2.2 Installation Tips

Plan your installation before mounting the radio or routing cables.

Place your cables in locations where they will not be pinched, kinked, crushed or overheated.

Use a rubber grommet when routing cables through metal walls.

Plan to ground the transceiver on the vehicle chassis using the shortest length of ground cable possible. Be sure the connection point is clean of dirt and corrosion.

Mount the transceiver in a location that will provide sturdy mounting and adequate ventilation.

### 6.2.3 Power Requirements and Wiring

The primary power cable should be connected directly to the vehicle battery. The red lead is connected to the positive (+) terminal and the black lead is connected to the vehicle chassis (battery -).

#### NOTE

If extra length is required for extension of the B+ (red) lead to the battery/power supply, an extra length of wire may be added provided it is (1) at least 14 AWG, (2) no more than 6 feet long, and (3) the splice is soldered (no wire nuts).

## **CAUTION**

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This transceiver is constructed for use in negative ground electrical systems only.

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### **6.2.4    Antenna Connection Requirements**

Use only high-quality antennas for your installations.

The antenna connector on the back of the transceiver is a mini-UHF female receptacle. The thread pitch on the bushing is 3/8" diameter, 24 threads per inch. SEA recommends the following mating connectors to install on the antenna cable (RG-58) during installation.

Amphenol 81-115 crimp type  
Amphenol 81-103 clamp type \*

\* requires no special tools

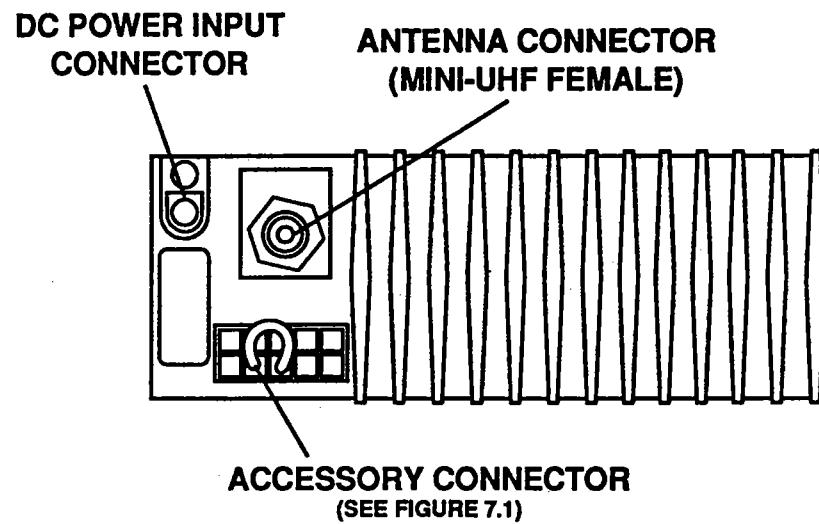
**Table 6.1 Recommended Mini-UHF Plugs for RG-58 cable**

Most mobile antenna manufacturers offer mini-UHF connectors for the termination of their antenna cables, as well as the crimping tools necessary for installation. Be sure to select the proper connector for the cable you are using.

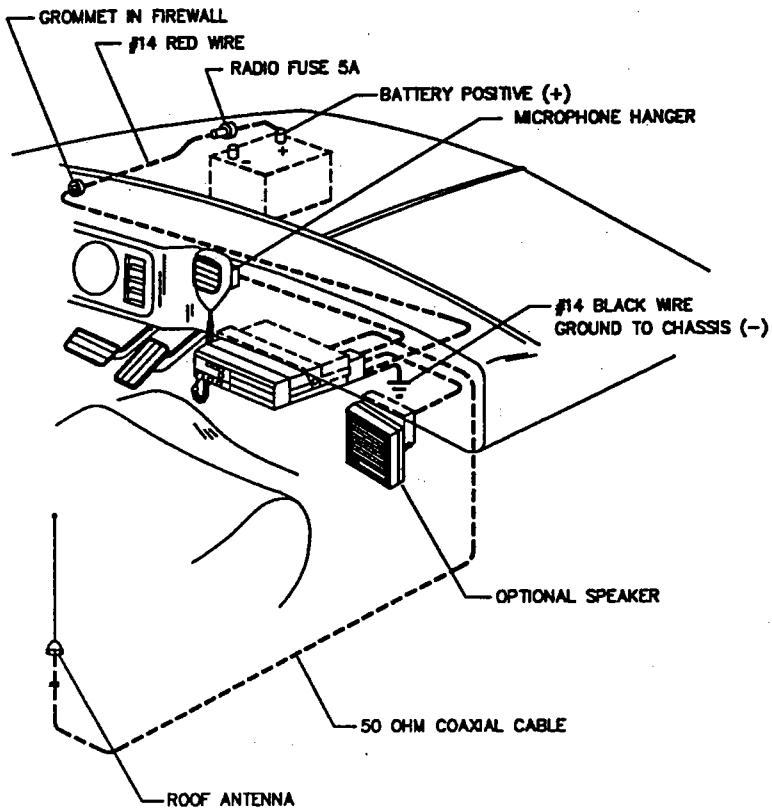
The installer will need to be able to connect a thru-line wattmeter between the transceiver and antenna being installed to check for power out and VSWR. The following adapters, or their equivalents, will be found useful during installation:

Mini-UHF female to BNC male   Cambridge CP-AD517  
Mini-UHF male to BNC female   Cambridge CP-AD509

**Table 6.2 Useful Mini-UHF Adapters for installation procedure**



**Figure 6.1** Radio Rear View



**Figure 6.2** Vehicle installation

#### 6.2.5 Vehicular Installation

Step 1: Mount the antenna according to the manufacturer's instructions. Route the antenna cable to the transceiver location. Attach a mini-UHF male connector (plug) to coaxial antenna cable for hook-up to transceiver. (See Table 6.1)

Step 2: Install the power cable and attached accessories (speaker, microphone hanger bracket). Route the power cable the shortest distance possible to the battery connection points. Attach the power cable to the battery terminals using (installer-provided) wire lugs with secure hardware.

#### NOTE

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If extra length is required for extention of the B+ (red) lead to the battery/power supply, an extra length of wire may be added provided it is (1) at least 14 AWG, (2) no more than 6 feet long, and (3) the splice is soldered (no wire nuts).

---

Step 3: Mount the trunnion bracket underneath the dashboard or on the transmission hump of the vehicle.

Step 4: Make sure the volume/on-off control is in the fully counter-clockwise position (off). Connect the rear power connector to the transceiver.

Step 5: Check the installation VSWR using an in-line wattmeter. Connect the wattmeter between the radio antenna connector and the installed antenna cable. Using a 5 watt slug, confirm a forward power level of about 4 watts by pressing the PTT button but not speaking into the mic. Reflected power under these conditions should be less than 1.5:1, or less than 160 mW.

Step 6: Remove the wattmeter and connect the antenna cable directly to the radio antenna connector.

Step 7: Install the transceiver into the trunnion mounting bracket using the gimbal knobs supplied.

Step 8: Dress all loose cables with strain reliefs and plastic tie wraps.

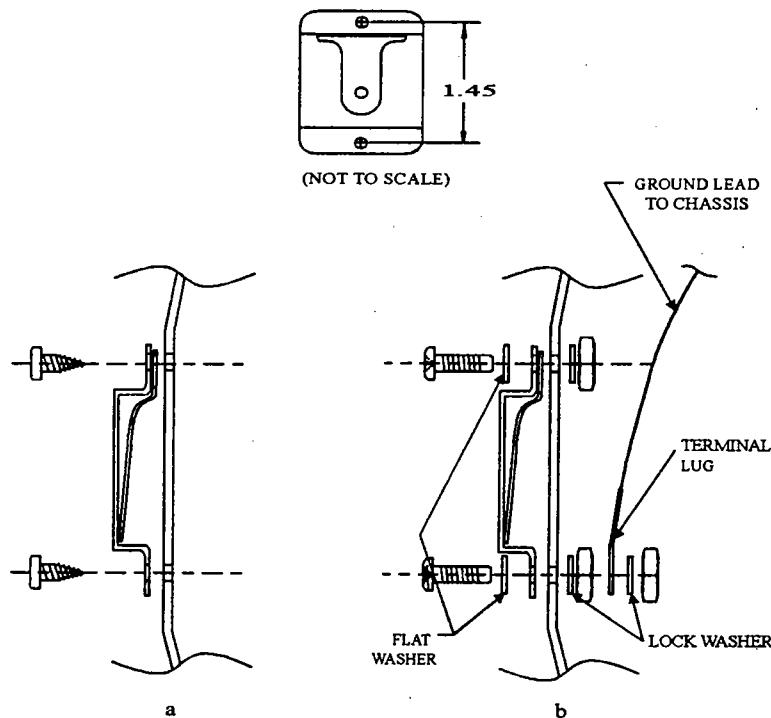


Figure 6.3 Microphone Hanger Installation

## 6.3 MICROPHONE HANGER INSTALLATION

A properly installed microphone hanger keeps the microphone accessible to the operator while minimizing interference with vehicle controls.

Essential to the performance of the radio's scan function, the microphone hanger status will control the "scan resume" and "scan stop" functions. When the microphone is in the hanger, the term "on-hook" is used. When the microphone is removed from the hanger, it is said to be "off-hook".

If the microphone is taken off-hook while the radio is scanning, the radio will stop scanning and return to its revert mode, ready for the operator to make or answer a call. When the microphone is placed on-hook, the radio will start scanning its programmed scan list.

Scan stop and scan resume are controlled by the microphone hanger button connecting to ground, which is returned to the radio through the microphone coil cord. The proper mounting hardware is provided with the microphone hanger to insure the hanger provides a proper and reliable ground for the microphone hanger button.

### 6.3.1 Installation of ASY-0500-30 Mic Hanger Kit

If the mounting surface will provide a reliable ground, the hanger can be mounted with the two self-tapping #6 sheet metal screws (FIGURE 6.3a).

If the mounting surface is plastic or nonconductive, the hanger can be mounted by drilling two .14 inch (#27 drill) diameter holes. The included #6-32 machine screws are then used to mount the hanger in the pre-drilled holes (FIGURE 6.3b). The terminal lug on the ground lead is placed on one of the machine screws and secured with the extra lock washer and nut. The ground lead is then connected to an adequate chassis ground. A 48" ground lead is enclosed with the installation hardware.

## 6.4 IGNITION SENSE AND HORN ALERT INSTALLATION

This section explains how to install optional wiring for the radio ignition sense input and horn relay output. Connection of the ESP504 ignition sense input to the vehicle ignition switch is required for proper operation of the battery saving Ignition Delay feature and/or the Horn Alert feature.

### 6.4.1 Horn Alert with Ignition Sense

When the rear panel J1 Accessory Connector IGNITION SENSE input (J1 pin 1) is high (+13 V), Horn Alert is disabled, regardless of any other radio settings.

When the Ignition Sense line is held low (0 V) or open circuited, the front panel HRN button is depressed, and the radio receives an ID programmed for Horn Alert, the HORN OUT line (J1 pin 4) will pull to ground for three consecutive one-second periods. This activates the horn relay, which in turn causes the vehicle horn to honk.

#### **6.4.2 Battery-Saver Ignition Delay**

This feature is convenient for providing Horn Alert capability for a limited time period while the vehicle ignition is off and the operator is not attending the vehicle. The radio must first be programmed to enable the Ignition Sense feature and with a desired Ignition Delay period before this feature can be used. In this configuration, the rear panel IGNITION SENSE input must be high (+13 V) and the front panel power switch must be turned ON to power up the radio. When the IGNITION SENSE line goes low (0 V), the radio remains powered until the Ignition Delay period ends or the user turns the front panel power switch OFF.

#### **CAUTION**

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DO NOT enable Ignition Sense during programming of the radio if the unit is not to be installed with the IGNITION SENSE line hooked up to the vehicle ignition.

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#### **6.4.3 Installation of Ignition Sense and Horn Alert (Refer to Figure 6.5)**

To perform this installation, you will need the following:

- 1) ASY-0500-26 Accessory Connector, including spare pins
- 2) Amp "Fast-on" or equivalent connecting terminals (4 required)
- 3) appropriate terminals for hookup to battery and horn
- 4) a horn honk relay (Bosch p/n 0 332 204 150)
- 5) a 1N4004 or equivalent diode for HORN OUT output transistor protection
- 6) a 1A fused lead for hookup between the radio and ignition
- 7) a lead for hookup between the radio and the horn honk relay
- 8) a wire for hookup between the horn honk relay and the vehicle horn
- 9) a fused lead<sup>1</sup> for hookup between the horn relay and the vehicle battery

#### **NOTE**

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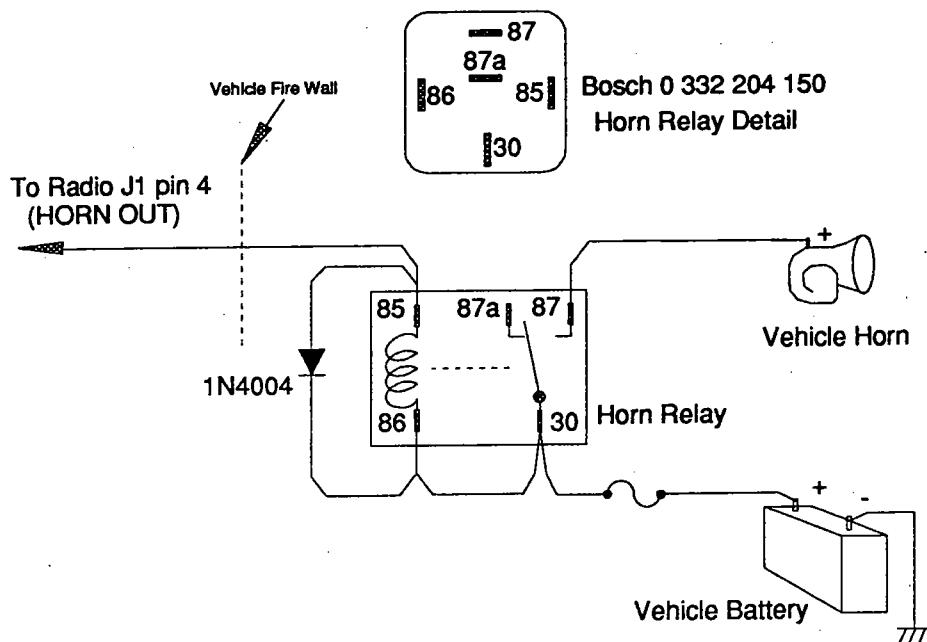
DO NOT hookup the radio Horn Relay line directly to the horn relay installed in the vehicle for honking the horn from the steering wheel horn button.

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<sup>1</sup> Fuse should be rated for approximately 200% of the sum of the nominal coil current of the relay (150 mA) and the current requirement of the horn. Fuse rating should not exceed 10A.

## **CAUTION**

Failure to install 1N4004 diode as instructed will result in damage to the radio.



**Figure 6.4 Horn Relay Wiring**

Step 1: Locate an appropriate location for and install the horn relay.

Step 2: Install 1 amp fused lead in accessory connector ASY-500-26 IGNITION SENSE circuit (J1 pin 1). The wire must be long enough to reach between the radio rear and the ignition line.

Step 3: Install lead in accessory connector ASY-500-26 HORN RELAY (J1 pin 4). The wire must be long enough to reach between the radio rear and the location of the horn relay (through fire wall). Hookup opposite end to horn relay as shown in Figure 6.4.

Step 4: Install fused wire between battery and horn relay.

Step 5: Install lead between relay and horn.

## **7. ACCESSORIES AND OPTIONS**

### **7.1 POWER CABLE, ASY-0500-21 (SEE FIGURE 7.1)**

The ASY-0500-21 Power cable is an 8' long fused power cable with molded-on connector for reliable power connection to the transceiver. The fuse is rated is 5A, 32 V.

### **7.2 ACCESSORY CABLE, ASY-0500-26 (SEE FIGURE 7.1)**

The ASY-0500-26 Accessory cable is primarily a connector with wire loop-backs to and from the transceiver. The accessory cable provides hookup capability for the microphone hanger clip, an external speaker, and ignition sense.

### **7.3 MICROPHONE HANGER CLIP, ASY-0500-30**

The ASY-0500-30 microphone hanger clip accessory is used to hang the microphone in a convenient location for the operator. It also is electrically connected to the vehicle ground so when the microphone is "hung-up" the mobile senses this condition via the microphone cable. This feature controls certain actions of the transceiver while scanning. (See Section 6.4 for additional information)

### **7.4 MOBILE PALM MICROPHONE, ASY-0500-23 (SEE FIGURE 7.2)**

The ASY-0500-23 mobile microphone is used to control and modulate the ESP504 transmitter. It connects to the radio unit via the front panel 8-pin modular jack adjacent to the VOL control. When the micophone connector/boot is inserted into the modular jack, a "snap" may be heard or felt indicating the plug is secure. To remove the mic connector from the jack, pressing the leftmost bulge on the boot with the end of the thumb will disengage the latch lever on the connector so it may be pulled out.

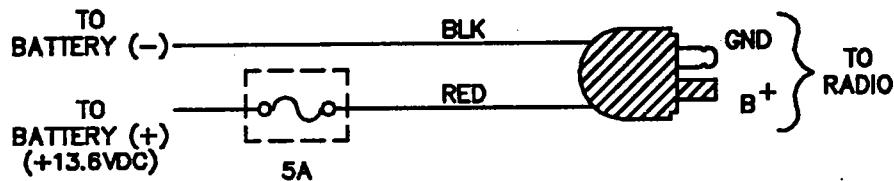
### **7.5 EXTERNAL SPEAKER, SPE-0500-23 (SEE FIGURE 7.1)**

### **7.6 PROGRAM INTERFACE UNIT, PIU500**

Refer to the ESP500 Series Programming Manual for a complete description of the PIU500.

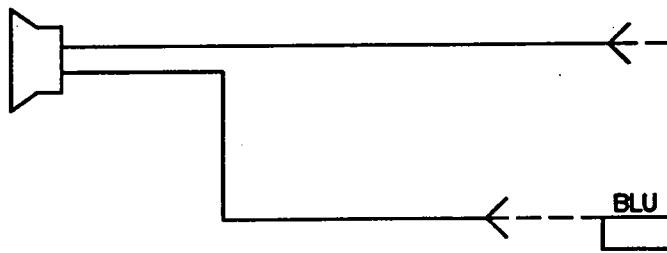
### **7.7 DESKTOP MICROPHONE, MIC-0500-02**

The MIC-0500-02 Desktop Microphone is intended for desktop control station applications. The microphone has a built-in stand for resting on the desktop and includes a lockable PTT switch. The desktop microphone connects to the ESP504 identically to the mobile palm microphone.



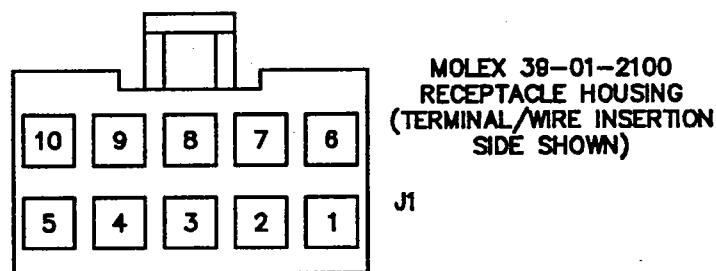
**ASY-0500-21**  
**ESP500 POWER CABLE**

EXTERNAL  
SPEAKER SPE-0500-23  
(OPTIONAL)



- J1 ASY-0500-26**
- 1 IGNITION SENSE
  - 2 SPKR (-)
  - 3 GROUND
  - 4 HORN OUT
  - 5 SPARE 1
  - 6 SPARE 2
  - 7 SPKR (+)
  - 8 INTERNAL SPKR
  - 9 HUB
  - 10 AUX OUT

**EXTERNAL SPEAKER HOOK-UP  
TO ACCESSORY CABLE**

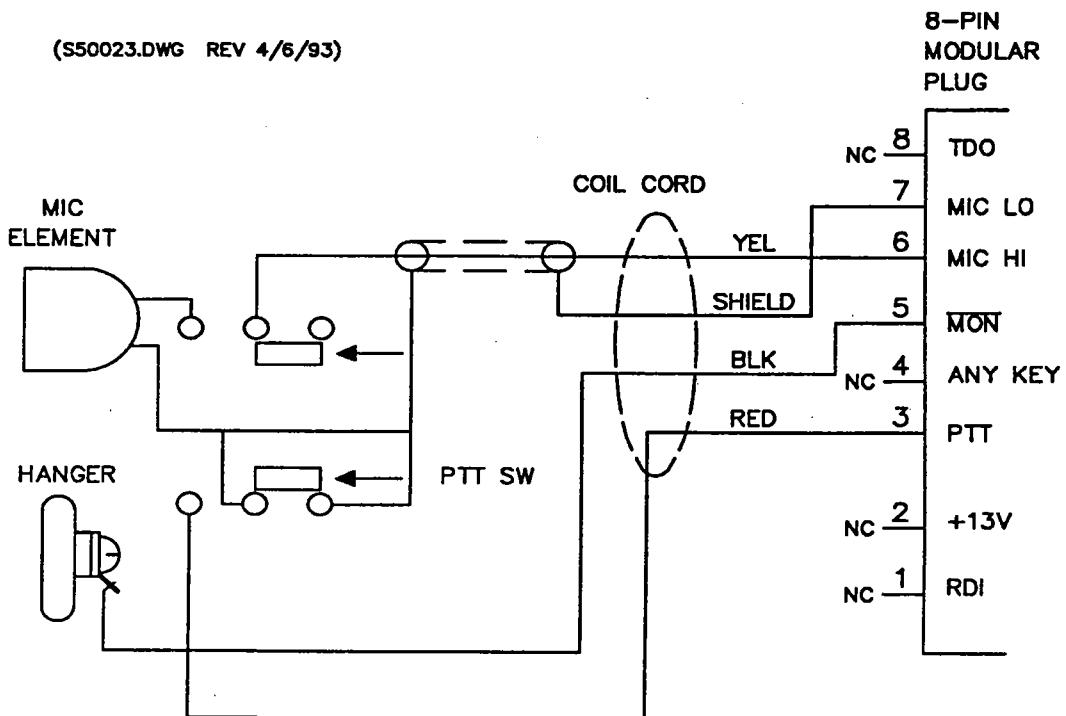


**ASY-0500-26**  
**ACCESSORY CABLE**

FIG7-1.DWG REV 10/18/94

**Figure 7.1 Power Cable, Accessory Cable, External Speaker**

(S50023.DWG REV 4/6/93)



ASY-0500-23  
PALM MICROPHONE

Figure 7.2 Palm Microphone Schematic

## **8. ELECTRICAL DESCRIPTION**

### **8.1 TRANSMITTER**

The transmitter audio processing is primarily accomplished using a digital signal processor (DSP) to perform filtering, audio band splitting and limiting, as well as pilot and data carrier generation. Compressed mic audio and trunking data are input to the DSP system. The resultant audio is converted to the IF frequency with a balanced modulator where the signal passes through a 10-pole crystal filter. The signal is mixed to the rf channel frequency with a balanced mixer, where it is filtered by a 3-section helical filter. There it is input to the rf power amplifier, where the signal reaches the 20 watt PEP level. The output signal that is applied to the antenna connector is sampled and fed back to an rf mixer. There the sampled signal is mixed down to the IF frequency. This IF signal is processed and applied to a differential amplifier in the forward IF path. This application of feedback reduces the overall gain of the loop by about 40 dB. Since the fed back signal includes undesired intermodulation distortion products, these products are significantly reduced when compared to an open loop transmitter. The net result is an extremely linear narrowband output.

### **8.2 RECEIVER**

The receiver utilizes a combination of helical filtering and low noise monolithic amplifiers in the rf front end. The desired signal is mixed down to the IF via an rf mixer. The signal is amplified and passed through the 10-pole crystal filter. FBAGC-controlled IF amplifiers amplify the signal which is then input to a product detector, which outputs the baseband audio signal. This audio is routed on two paths: pilot filtering for feedback AGC generation, and DSP processing of the voice audio, AFC, and trunking data.

The DSP system filters and discriminates the pilot signal to create a digital representation of the correct voltage to apply to the voltage-controlled temperature-compensated crystal oscillator (VCTCXO). This tunes the receiver to the precise frequency required to receive the audio correctly.

This digital frequency data is also used to tune the transmitter "on the fly" so the mobile transmitter will have frequency accuracy on the order of 0.25 ppm required to receive the audio correctly. Trunking data is output digitally from the DSP to the radio microprocessor for decoding. The audio signal is converted to the analog domain where it is filtered, expanded and input to the audio power amplifier.

### 8.3 SYNTHESIZER

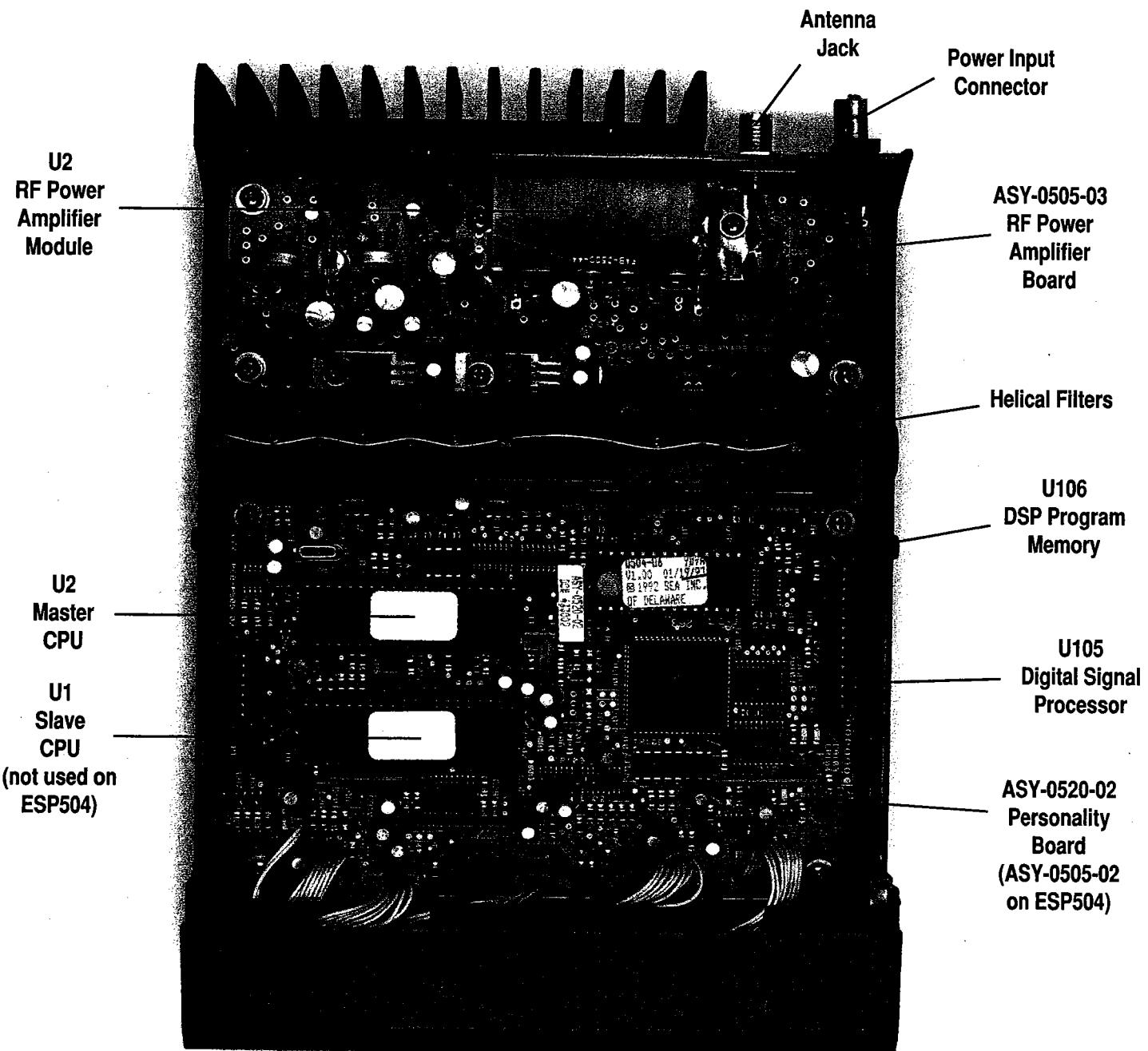
The synthesizer generates the high-side injection local oscillator (l.o.) signal used for transmitter up-conversion, feedback down-conversion and receiver down conversion. The single-loop synthesizer includes a 1.5 ppm frequency stability VCTCXO which operates at 10.275 MHz. (The frequency accuracy of the system is improved to 0.25 ppm as described above.)

The rf voltage-controlled oscillator and synthesizer loop filter have been optimized for low synthesizer noise output and high switching speeds. The 10.275 MHz oscillator is buffered to drive the product detector and balanced modulator.

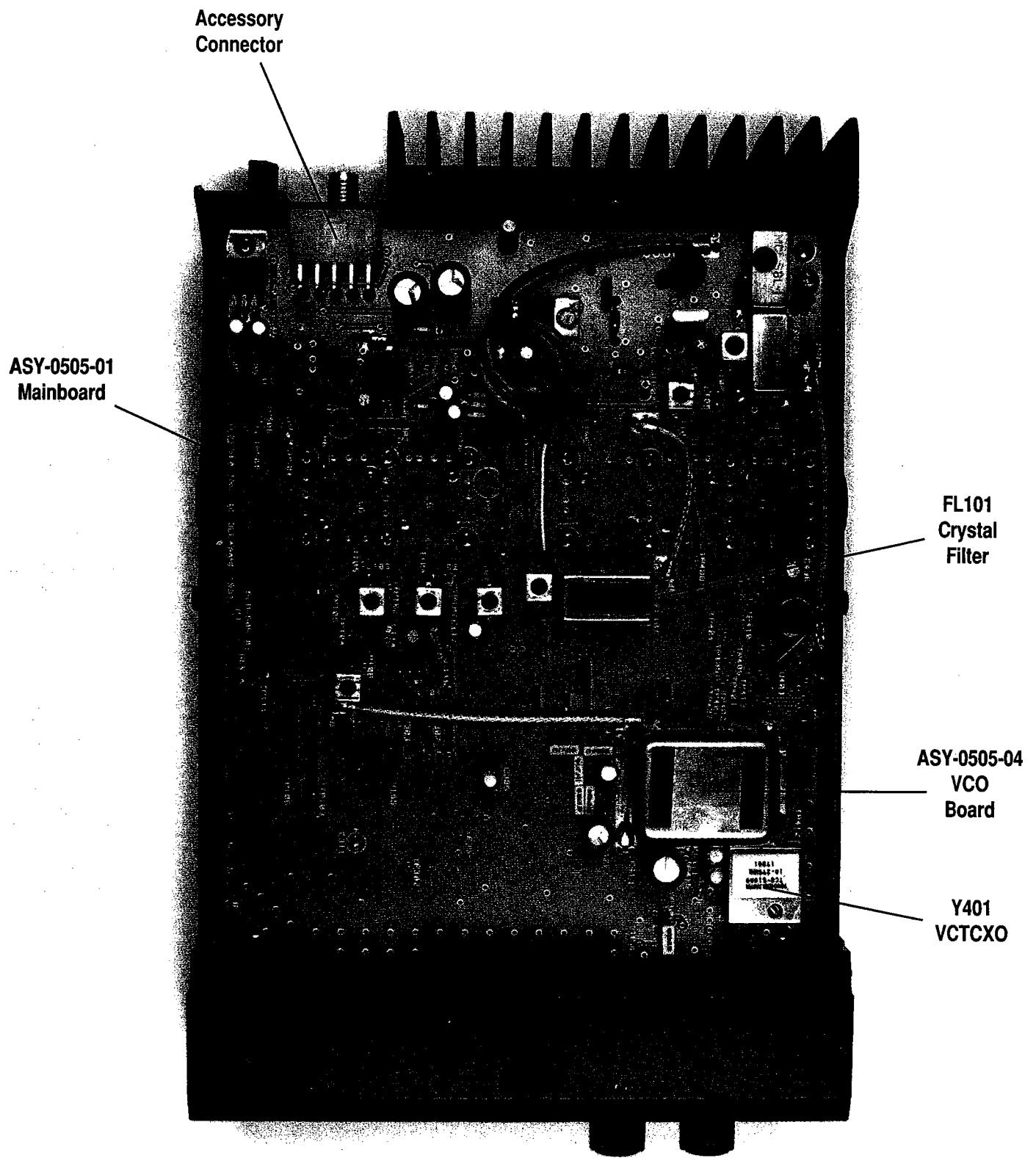
### 8.4 COMPUTER SYSTEM

The computer system is based on a 68HC705 family central processing unit (CPU). The CPU connects directly to the mode switch, PTT, and an external (mic jack) serial port. Internally, the CPU connects to EEPROM, power control, DSP data, status and reset, and a serial control bus. The serial peripheral interface provides CPU communication with the front panel controls and indicators, DSP system, eight-channel analog-to-digital converter, and frequency synthesizer.

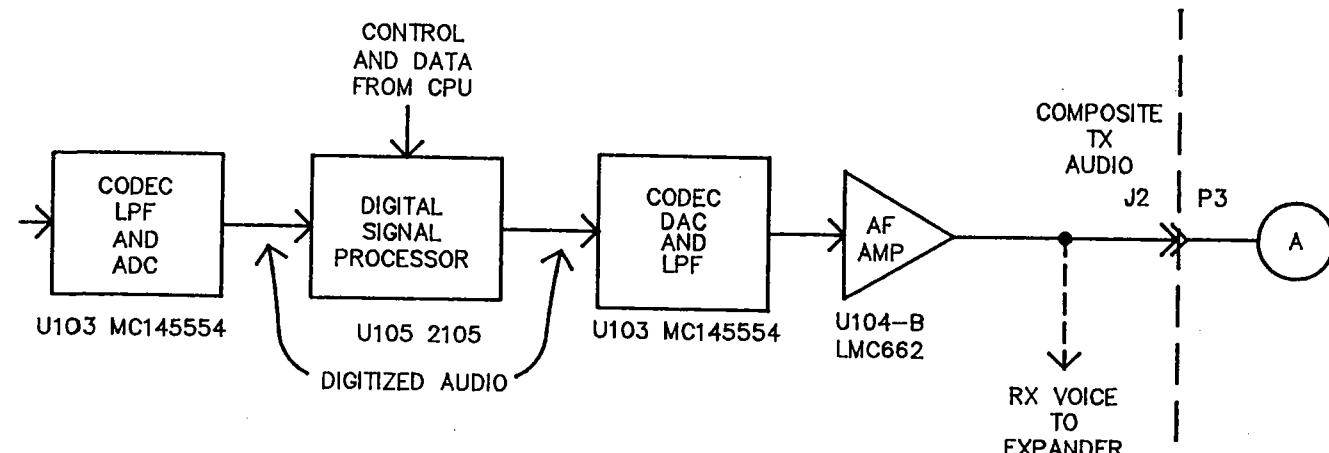
## 9. PHYSICAL DESCRIPTION



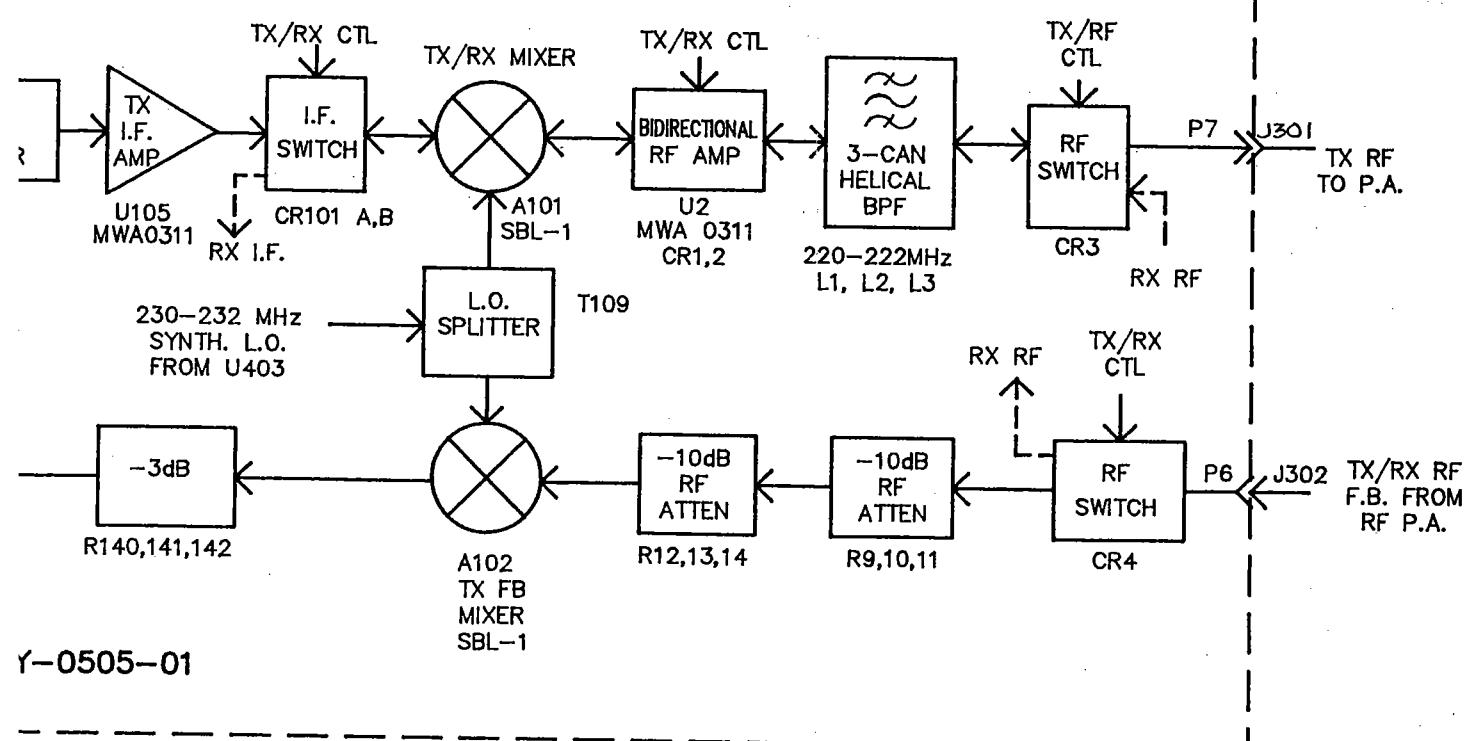
**Figure 9.1** Top View of ESP504/ESP520 with Covers Removed



**Figure 9.2** Bottom View of ESP504/ESP520 with Covers Removed

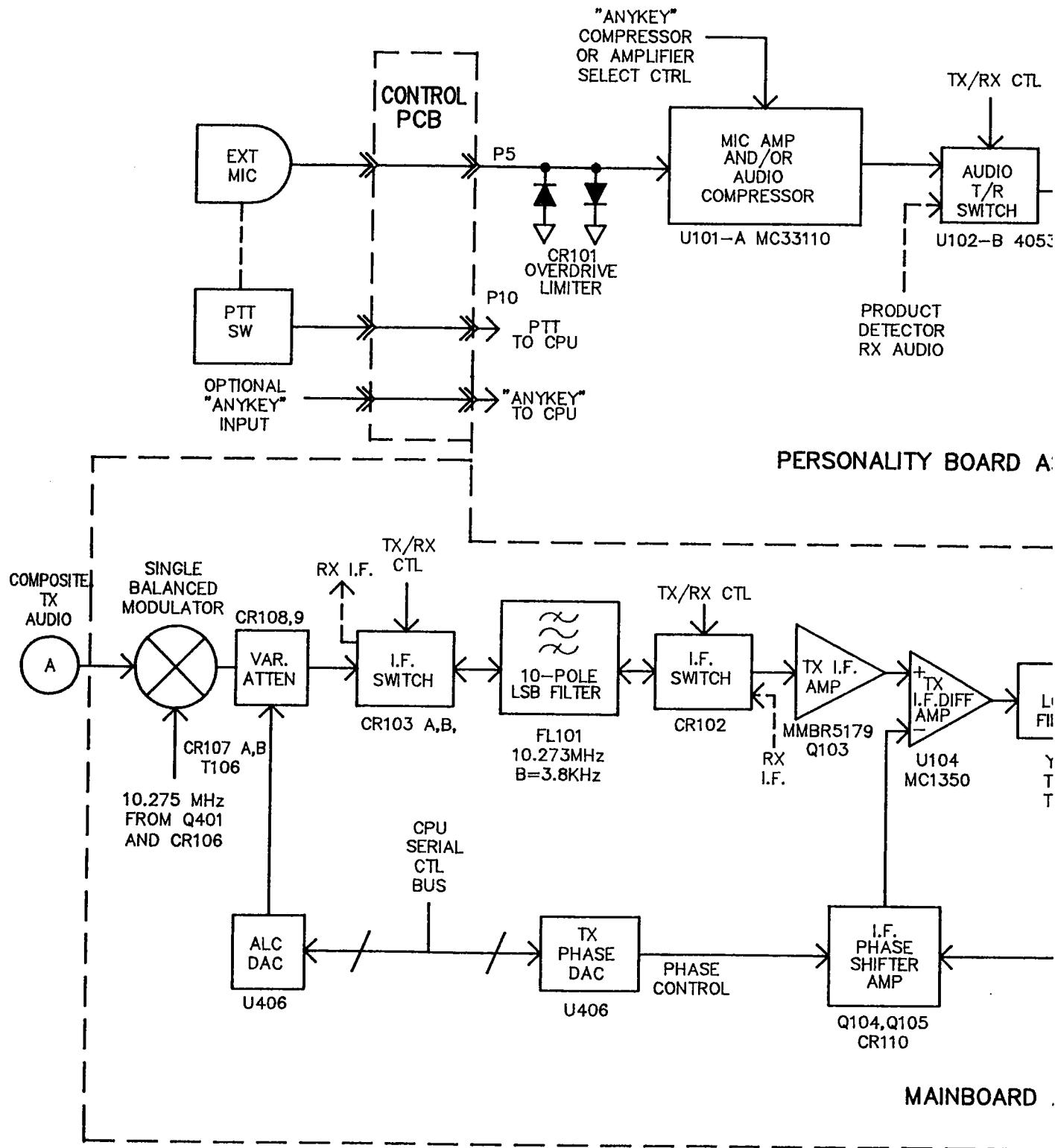


-0505-02

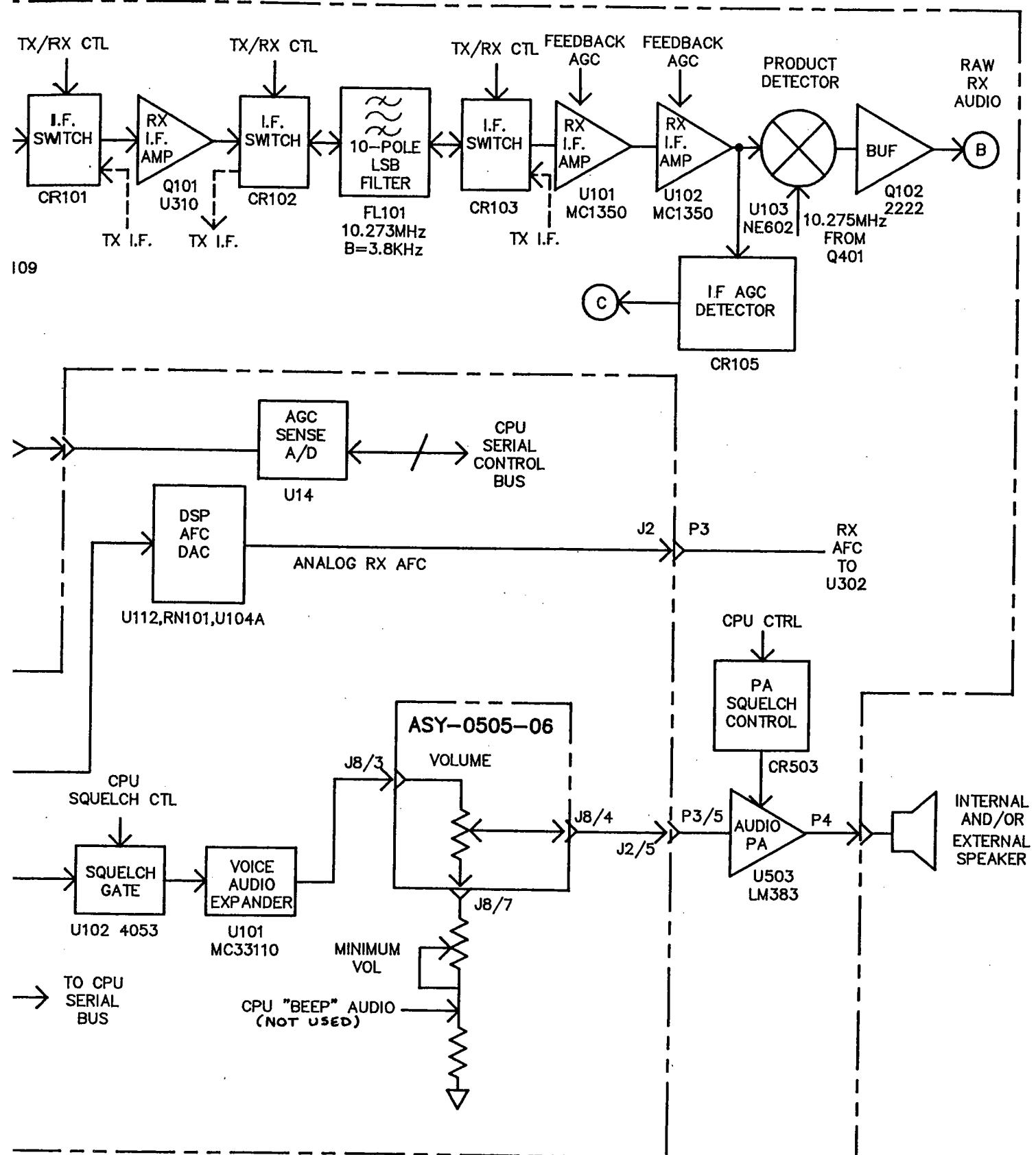


Y-0505-01

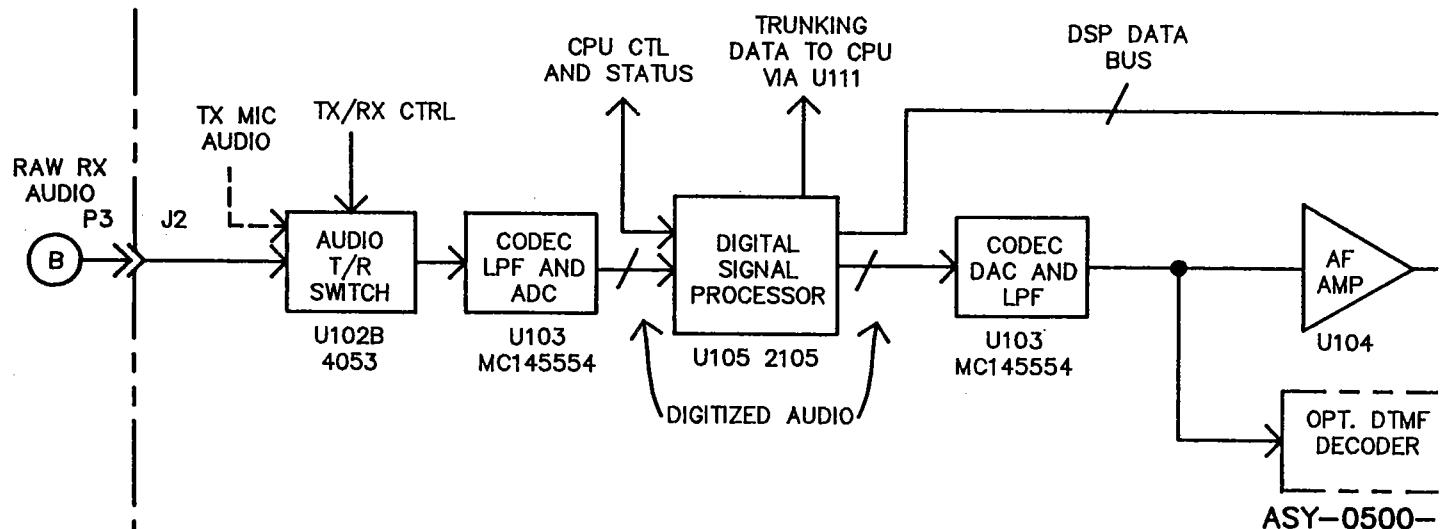
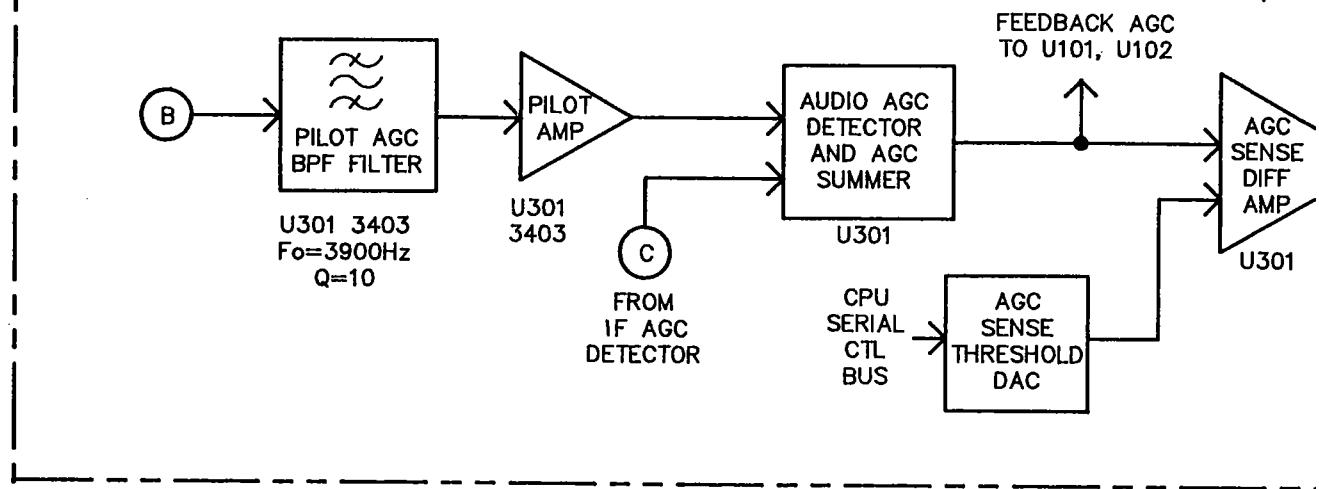
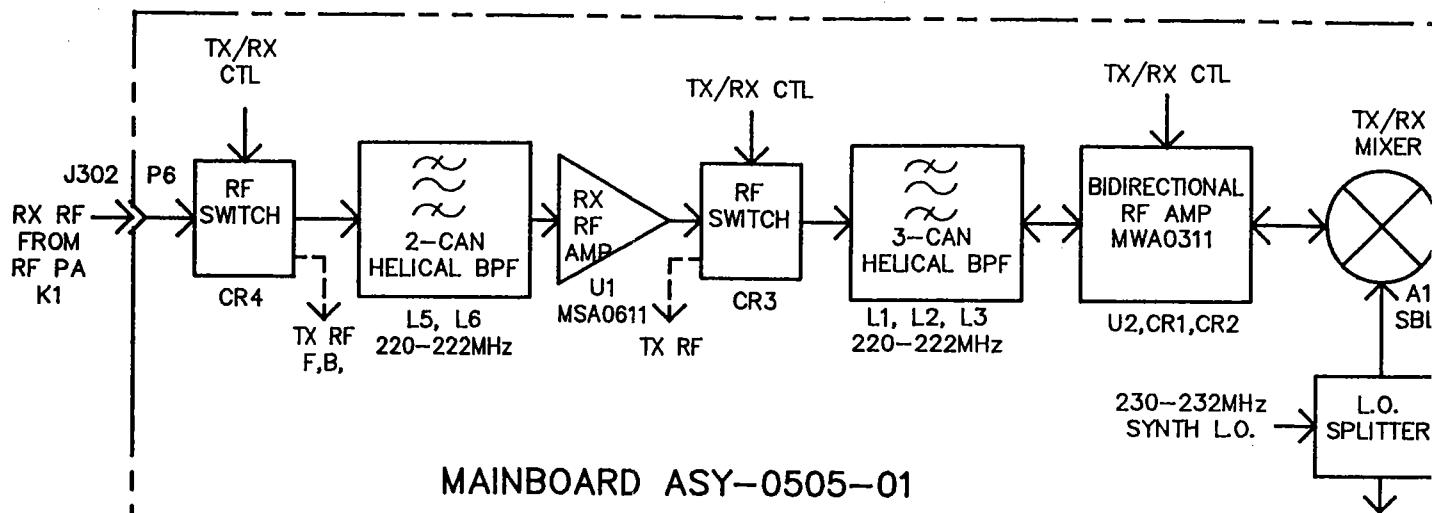
**Figure 10.1**  
Low Level Transmit Block Diagram  
ESP500 Series



NOTE: DASHED LINES REPRESENT RECEIVE PATHS

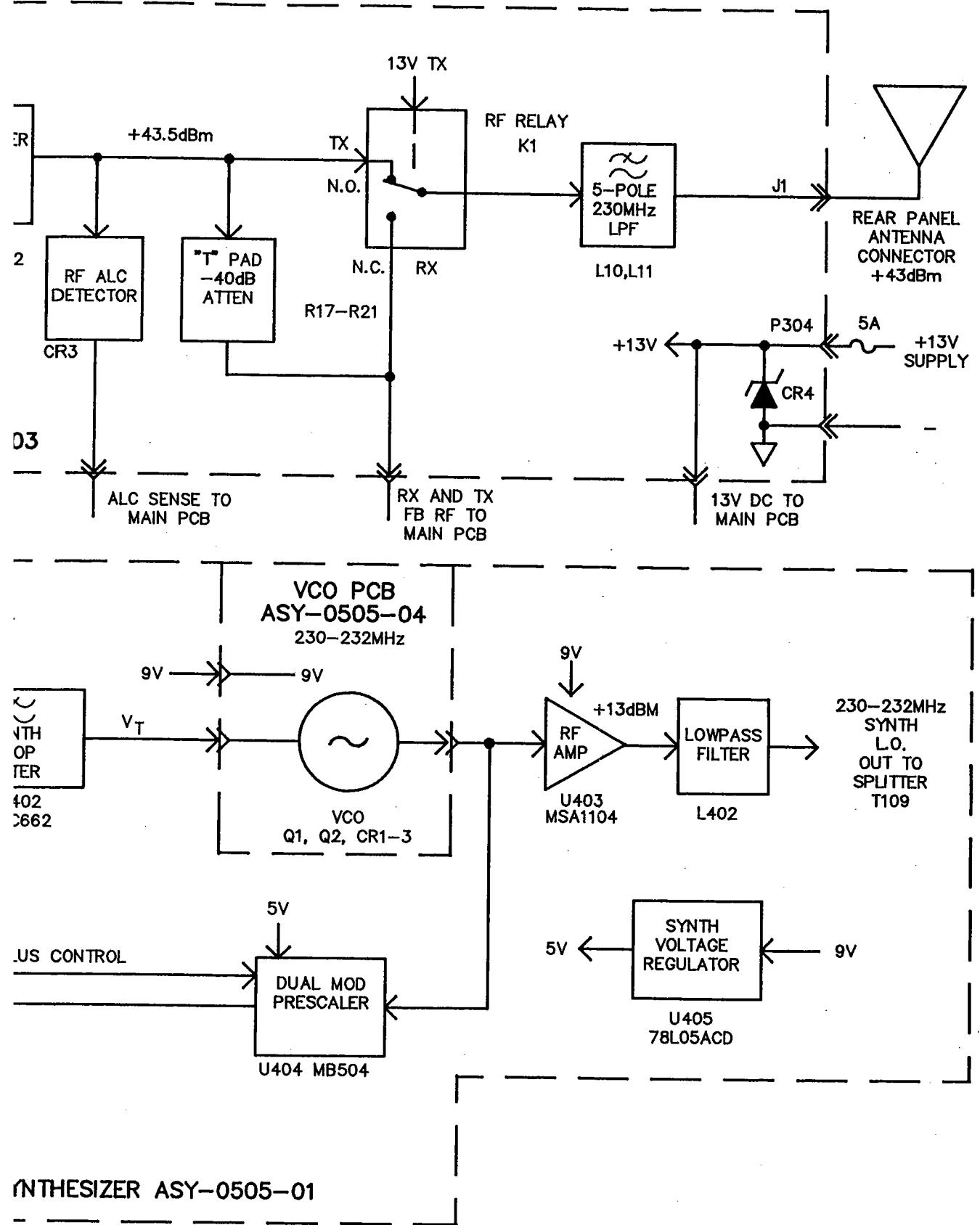


**Figure 10.2**  
Receiver Block Diagram  
ESP500 Series

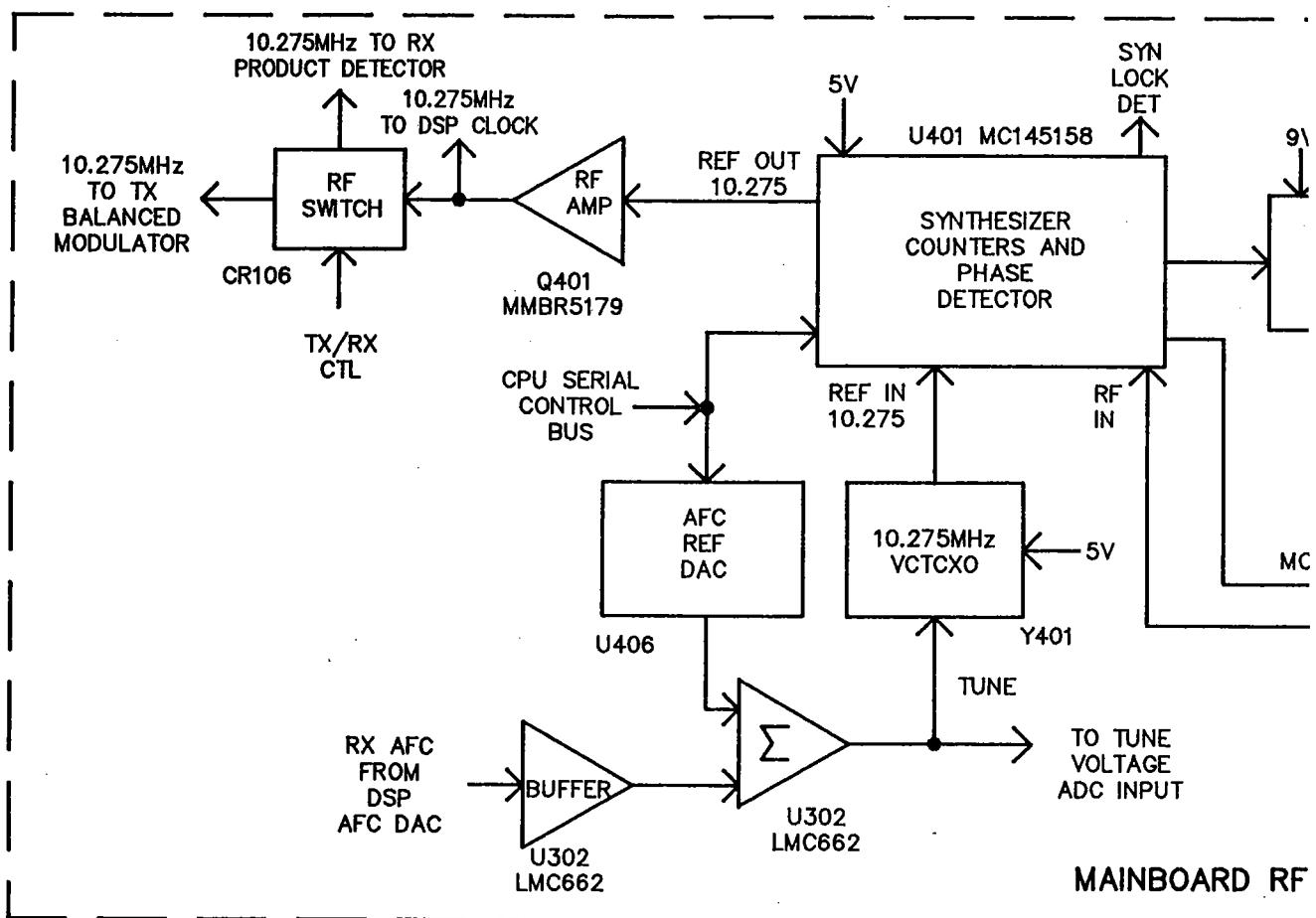
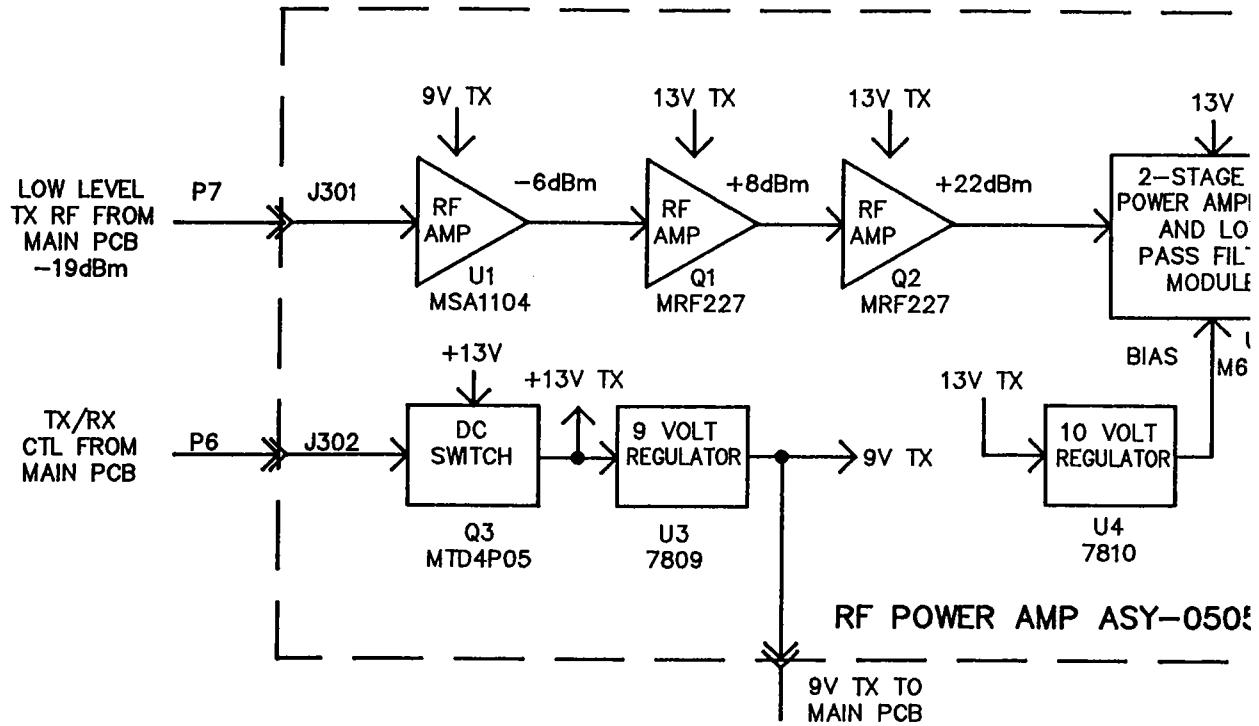


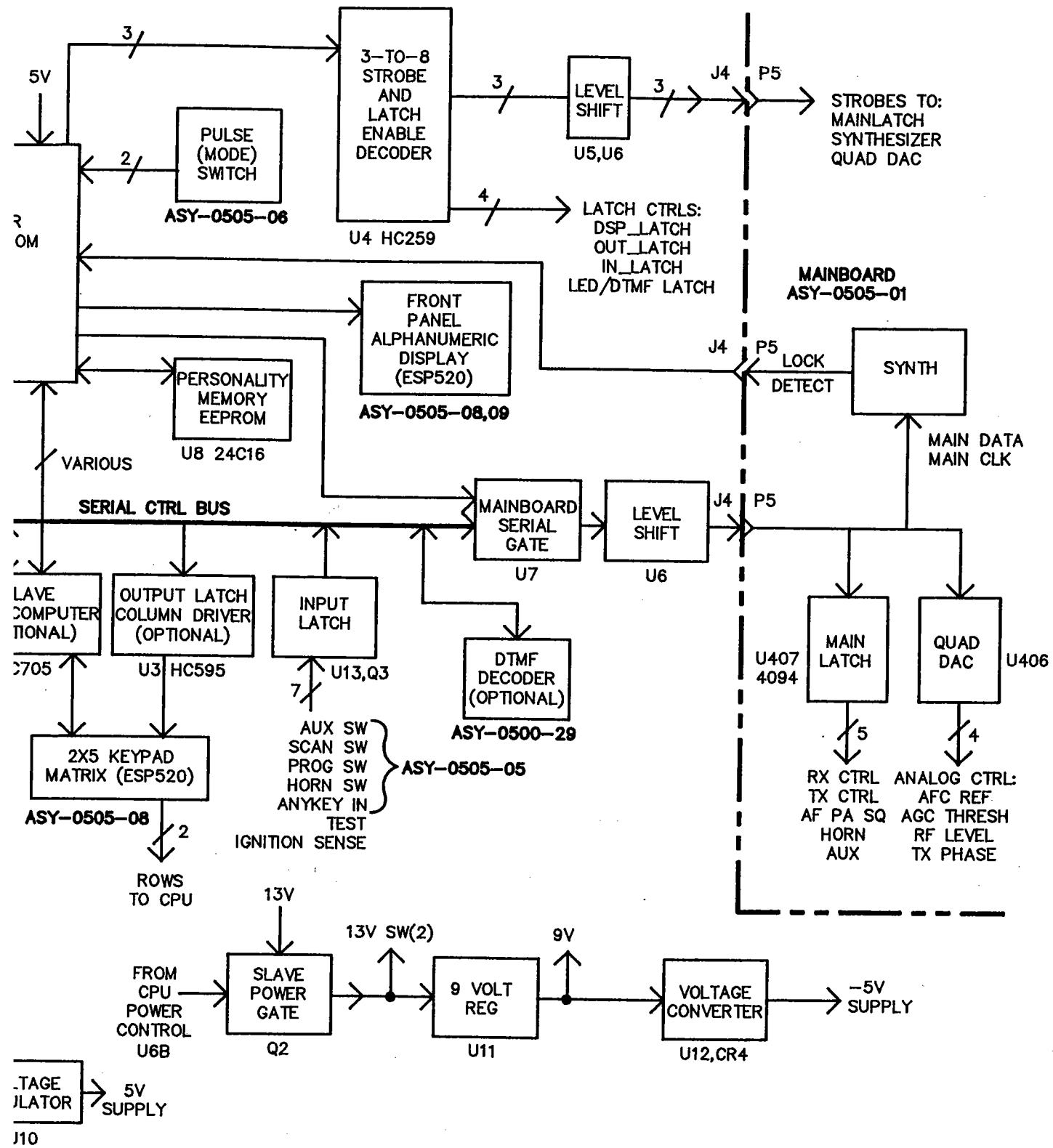
PERSONALITY BOARD ASY-0505-02

NOTE: DASHED LINES REPRESENT TRANSMIT SIGNAL PATHS -----

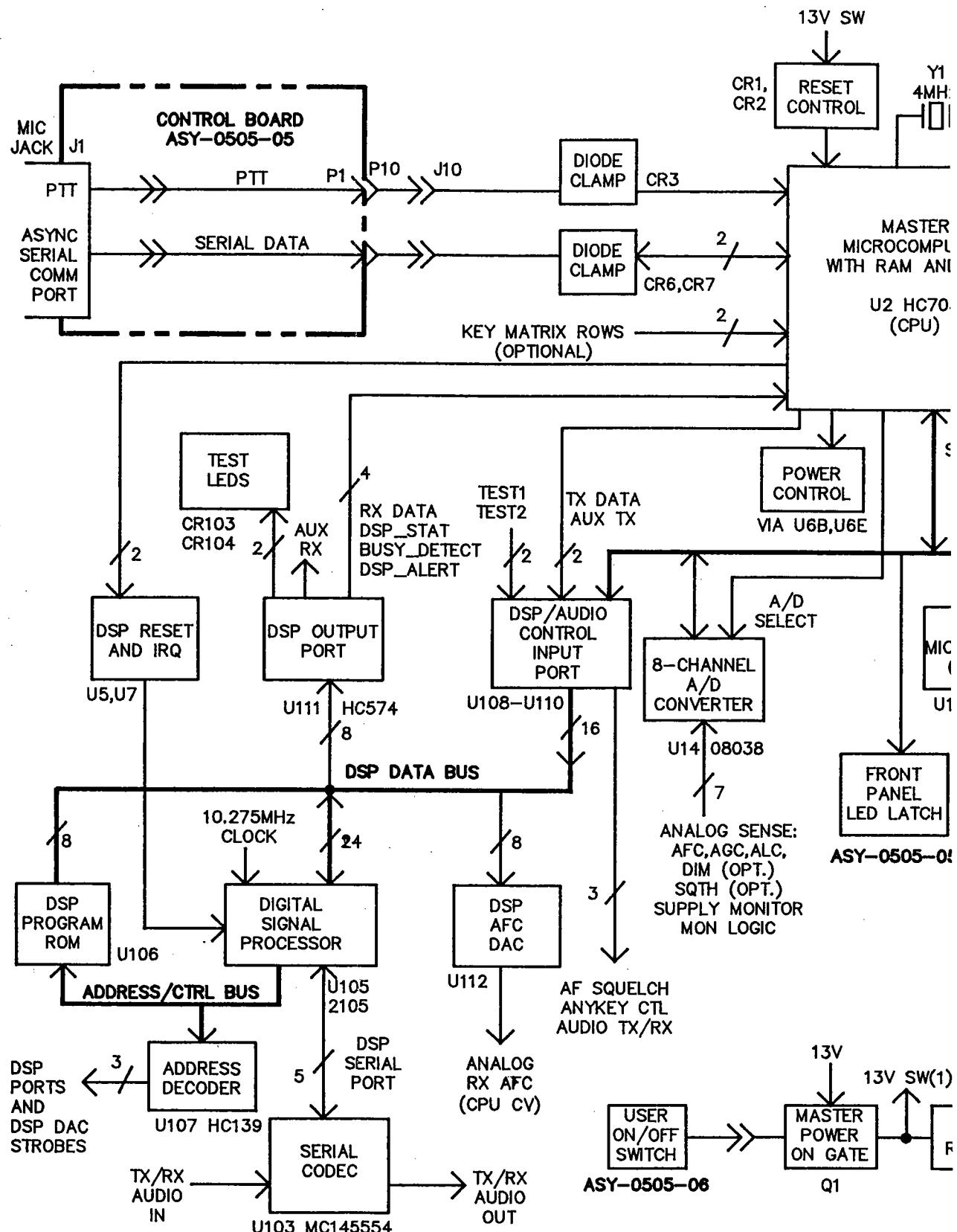


**Figure 10.3**  
**RF Power Amplifier and**  
**RF L.O. Synthesizer**  
**Block Diagrams**  
**ESP 500 Series**





**Figure 10.4**  
Computer Control and  
DSP Systems Block Diagram  
ESP500 Series



## **11. FUNCTIONAL DESCRIPTION OF CIRCUITS**

### **11.1 TRANSMITTER SIGNAL PROCESSING CIRCUITS (Refer to Figure 10.1)**

#### **11.1.1 Microphone Audio and Compression**

The microphone audio signal developed at the microphone element is input to the U101-A audio compressor. The compressor's gain is controlled by the level of its output. As the output level increases the device gain decreases, creating amplitude compression. This function is the inverse of the expansion in the receiver provided by U101-B.

#### **11.1.2 Audio Switch**

Audio from the compressor is next input to a switch circuit, U102-B, which provides a path for the audio to the Codec circuit. When the unit is transmitting, this path is enabled. During reception of a signal, this switch inputs receiver audio to the codec.

#### **11.1.3 Codec**

The U103 Codec is a combination of lowpass filters, analog-to-digital converter and digital-to-analog converter. The filter portion is in the a/d path. The audio signal is bandlimited and then converted to a pulse code modulation (PCM) data stream.

#### **11.1.4 Digital Signal Processor (DSP)**

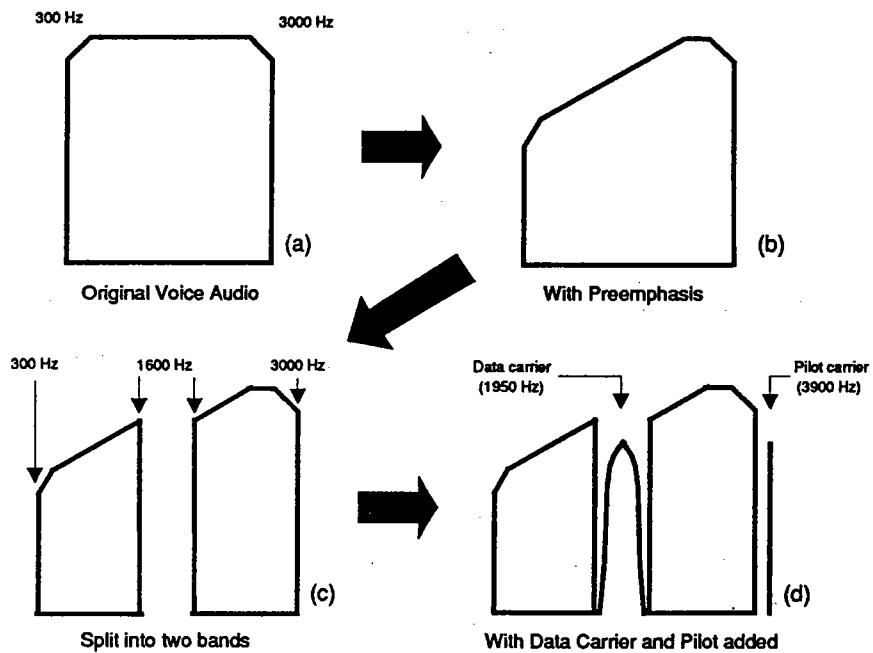
The DSP is input the PCM audio data, performs functions such as filtering and tone generation, and outputs processed PCM audio data. Specifically, the DSP performs the following functions in the transmit audio path:

- > 6 dB per octave Pre-Emphasis
- > Audio Limiting
- > Audio band splitting and filtering. The 300 Hz to 3000 Hz audio bandwidth is split into two bands; the 300-1600 Hz portion is kept intact while the 1600-3000 Hz portion is shifted up to 2300-3700 Hz. The result is a gap between 1600 and 2300 Hz. This is where the 1950 Hz data carrier is inserted.
- > 3900 Hz Pilot carrier generation and insertion
- > 1950 Hz Data carrier generation and insertion

> Frequency modulation of the data carrier with signaling data

> Second stage of 2:1 Compression

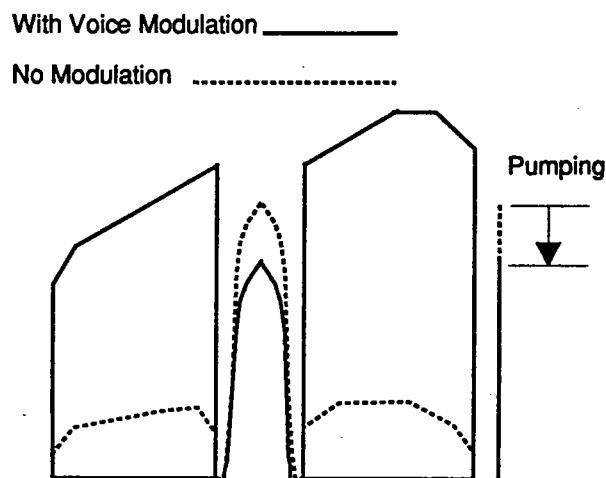
The data carrier is frequency modulated with signaling data for trunking system or conventional repeater control. The ESP504 is designed to operate on a trunked system using the DTL control and signaling protocol. Refer to the SEA 220-222 MHz System Guide (MAN-0500-01) for details on how this system works.



**Figure 11.1** Audio spectrum graphs with various levels of processing

Figure 11.1 illustrates the affect of each of the most significant processing steps on the audio signal. Keep in mind that, since all of this processing is taking place in the digital domain, of these only the (a) and (d) analog spectra appear in the radio circuits.

The second stage of compression is applied to the entire audio signal which is a composite of voice, pilot and data carrier. The effect of amplitude compression on the pilot and data carriers is a reduction of amplitude during voice syllables. This is known as “pumping”, a process which is used in the receiver to control the first stage of audio expansion.



**Figure 11.2 Effect of Pumping on Data and Pilot Carriers**

The DSP is loaded with transmit program data from off-chip ROM during the PTT-initiated transition from the receive state.

The processed audio PCM data stream output from the DSP chip is re-converted from its digital state to an analog signal by the U103 Codec.

#### 11.1.5 Balanced Modulator

T106 and dual diode CR107 make up a single balanced modulator. Input to one port of the modulator is the processed audio and input to another is a 10.275 MHz signal. The modulator mixes the two signals to create a double sideband signal with the 10.275 MHz carrier largely suppressed. The amount of balance provided in this circuit determines the carrier suppression at this point.

#### 11.1.6 ALC Variable Attenuator

A resistive attenuator network controlled by pin diodes CR108 and CR109 serves as the Automatic Level Control (also referred to as RF Power Control). The circuit attenuation is controlled by the Master CPU via a digital-to-analog converter. The ALC circuit prevents overdrive of IF and rf circuits which could result in poor transmitter performance such as the generation of out-of-band emissions.

### **11.1.7 IF Switch**

Since the 10-pole crystal filter is shared in both the transmit and receive signal paths, the CR103 IF switch circuit is used to switch these two paths into and out of the common circuits.

### **11.1.8 10.275 MHz Crystal Filter**

FL101 is a ten-pole lower sideband bandpass crystal filter. This is the same filter used in the receiver. The double sideband signal generated by the balanced modulator is input to the filter which then sharply attenuates all signal components except those between about 4 kHz below the carrier and 300 Hz below the carrier. The upper sideband components are, for the most part, completely removed.

A second IF switch, CR102, is used for transmit/receive path switching. Q103 provides amplification of the lower sideband ACSB signal.

### **11.1.9 IF Processing in the Forward Path of the Linearization Feedback Loop**

The ESP500 series transmitter use feedback techniques in order to obtain an exceptionally linear rf output signal. This high performance is required to meet FCC emission requirements.

The lower sideband IF ACSB signal is applied to the non-inverting input of differential amplifier U104. The feedback signal, sensed from the transmitter rf power amplifier output and processed for the purpose of feedback, is applied to the inverting input. The output of an open-loop transmitter, i.e. one without feedback, would normally be more distorted than the low level IF signal applied to the non-inverting input. The differential amplifier essentially subtracts the (distorted) feedback signal from the (undistorted) forward signal. This results in a "predistorted" forward signal which is compensated to suffer the impairments of the ensuing non-linearities of the stages leading to the transmitter output.

The predistorted IF signal is then applied to the narrow bandpass filter network Y101 that serves to limit the feedback system bandwidth. This signal is amplified by U105 and applied to the rf mixer via IF switch CR101.

### **11.1.10 RF Mixer**

U101 is a double balanced rf mixer. The predistorted ACSB signal at 10.275 MHz is input at one port while the local oscillator, 10.275 MHz above the desired rf frequency, is input at the rf injection port. The output includes many mixer products including the desired rf ACSB signal on the rf channel fre-

quency. This signal is amplified by bi-directional rf amplifier U2 prior to rf filtering.

#### **11.1.11 RF Filters and Exciter**

An rf filter composed of helical filter elements L1, L2, and L3 provides attenuation of mixer products other than the desired ACSB rf signal. Of primary importance is attenuation of the local oscillator frequency which is 10.275 MHz above the channel frequency and the image frequency which is 20.55 MHz above the channel frequency. The rf bandpass filter is approximately 3 MHz wide. The low level rf ACSB signal is applied to Mainboard TX RF Output connector P7 via an rf transmit/receive path switch CR3.

#### **11.1.12 Transmitter RF Power Amplifier (Refer to Figure 10.3)**

The rf exciter output signal is input to the RF Power Amplifier board via J301. Three stages of amplification by linear amplifiers U1, Q1 and Q2 are provided prior to the input of the signal to the Class AB power amplifier module U2. The rf power "brick" provides about 22 dB gain and develops over 20 watts PEP. The PA output is switched to a 5-pole lowpass filter via T/R relay K1. K1 switches the antenna port connection between the P.A. output and the receiver input. The relay outputs the signal to the rear panel antenna connector J1.

The ALC sense signal is acquired from the output of the U2 rf power module. This signal is routed from the PA Board (J303) to the Mainboard (P2) and amplified. The amplified ALC sense signal is then routed to the Personality Board via J3/P2 where it is input to the U14 8-channel A/D converter (Refer to Figure 10.4). The digitized ALC sense signal is then used by the radio master CPU to determine the proper attenuation to set at the low level transmitter IF stage described in section 11.1.6.

The output of the rf power module is sensed by the 40 dB "T" pad which routes the signal to the low level rx signal path, bypassing the rf relay. The attenuated signal is routed back to the Mainboard for linearization feedback processing.

#### **11.1.13 RF and IF Feedback Signal Processing (Refer to Figure 10.1)**

Via rf switch CR4, the rf feedback signal is attenuated and input to rf signal mixer A102. Here the signal is mixed with the split l.o. signal and converted down in frequency to the 10.275 MHz IF. After further attenuation, the feedback signal is shifted in phase by an IF phase shifting amplifier, with the fine phase shift controlled by the Master CPU via the serial bus and TX Phase DAC U406. Fine tuning of the feedback phase ensures transmitter stability and optimal

feedback performance. The phase shift data is factory programmed into the memory of the radio.

## 11.2 RECEIVER SIGNAL PROCESSING CIRCUITS (Refer to Figure 10.2)

### 11.2.1 General

Note from Figure 10.2 that the receiver circuits are distributed over three circuit boards. The received rf signal is input from the antenna port and processed on the RF Power Amplifier board and Mainboard. The IF signal is processed on the mainboard, as is the analog pilot signal. All digital audio (DSP) and digital control (Master CPU) processing takes place on the Personality board. Audio power amplification takes place on the mainboard

### 11.2.2 RF Front End

The receiver front end is composed of a five-pole 230 MHz LPF (part of the RF Power Amplifier Board ASY-0505-03, see Figure 10.3), five sections of bandpass helical filter, a wideband rf monolithic amplifier (U1), an rf mixer (A101), a post-mixer amplifier (Q101), and associated matching networks.

The first two sections of bandpass helical filtering pass an approximate 2 MHz bandwidth (220-222 MHz) to the input of the U1 amplifier. The output of U1 drives the input of the three-section helical filter, which is also tuned for 220-222 MHz operation. U1 has input and output impedances of 50 ohms and the helical filters have approximate 50 ohms input and output impedances. The net effect of the helical filters is to greatly reduce energy outside the 220-222 MHz band including image (240-242 MHz) and TV channel 13 (211 MHz). The output of the three-section helical filter drives the rf port of mixer A101. The mixer L.O. port is driven by the local oscillator, which is high-side injected (230-232 MHz).

The Q101 post mixer amp source terminates the IF port of the mixer at 50 ohms.

### 11.2.3 IF Circuits

The intermediate frequency (IF) section of the receiver consists of a two automatically gain controlled (AGC) amplifier stages, a ten-pole crystal filter and a product detector. The IF amplifiers gains are controlled by the AGC circuit which is discussed in sections 11.2.4. and 11.4 (CPU operation).

The drain of Q102 drives the ten-pole bandpass crystal filter which attenuates undesired off-channel energy including that in the adjacent channels.

The AGC'd amplifiers U101 and U102 keep the IF signal amplitude inside a

limited dynamic range. The output of U102 is sensed and detected to provide additional AGC control (RF AGC).

The product detector (U103) mixes the received IF signal down to baseband. The IF injection is delivered from the buffered reference oscillator in the synthesizer circuit. The desired audio output components of the product detector include:

- >Voice, data or signaling audio (split into two spectral segments)
- >Trunking data carrier (1950 Hz)
- >Pilot tone carrier (3900 Hz)

#### 11.2.4 Audio Circuits: AGC

The output to the product detector is buffered by emitter-follower circuit Q102.

The AGC signal is derived from the received 3900 Hz pilot tone. Once the received signal is reduced to baseband (audio frequency), the pilot tone is bandpass filtered by active filter U301B. The filtered pilot is input to the U301C gain amplifier then is rectified by precision rectifier/AGC amplifier U301A. This circuit converts the ac pilot tone signal and the RF AGC signal to a dc voltage. This dc voltage is the AGC voltage that controls the gain of the two IF amplifiers described in 11.2.3. As the signal gets weaker the pilot level decreases, the output of AGC amplifier decreases, increasing the gain in the IF amplifiers.

The output of U301A is input to differential amplifier U301D where the signal is compared with the AGC Sense Threshold signal. The output of U301D is routed to eight-channel A/D converter U14 on the Personality Board. The signal is digitized and sent to the Master CPU U2 via the Serial Control Bus. The computer uses this value to determine the relative signal strength of the received signal.

#### 11.2.5 Audio Circuits: A/D Conversion

The output of the Q102 product detector is also routed to codec U103, located on the Personality board. The codec includes lowpass filtering and analog-to-digital conversion of the received audio signal. The output of the codec is a pulse code modulation (PCM) signal which is input to the DSP chip U105.

#### 11.2.6 Audio Circuits: AFC

One of the functions of the received pilot tone is to control the tuning of the

receiver frequency. The automatic frequency control (AFC) uses the received pilot frequency information to tune the synthesizer to the precise frequency necessary to recover correct audio frequency translation at the receiver output. For this function, the digitized AFC signal is output on the DSP data bus and DSP AFC DAC U104A converts the signal to analog and tunes the synthesizer VCTCXO via the U302 Buffer/Summer (see Figure 10.3).

#### 11.2.7 Audio Recovery and Digital Signal Processing

The output of product detector U103 contains voice and data audio information as well as the pilot tone. Once the baseband signal has been converted to the digital domain by Codec U103, the DSP U105 performs the following functions:

- > Extracts the pilot tone
- > Extracts the data carrier
- > Reconstructs the original voice spectrum

Once the reconstructed audio and the pilot tone are available, the two components are digitally mixed to produce a multiplication product. This feedforward technique is a synchronous detection of the audio using the pilot tone as a carrier. The purpose of this process is to minimize the phase distortion induced on the audio by multipath fading and eliminate the effects of small tuning errors. This process also quickens the overall attack time of the receiver which would otherwise be limited due to the AFC feedback system.

In addition to phase compensation of the audio signal, the DSP also provides amplitude compensation. This is essentially a feedforward pilot-controlled gain function which greatly reduces the amplitude fluctuations of the signal caused by multipath. This stage also serves as the inverse function to the transmitter's pilot pumping, which results in approximately 2:1 expansion. The DSP also provides deemphasis.

The DSP filters the data carrier and demodulates the data used for trunked system operation or conventional repeater control. This data is output serially to the Master CPU via latch U111 for signaling decoding.

The DSP outputs the PCM audio signal to the U103 Codec for D/A conversion.

#### 11.2.8 Analog Audio Processing

The Codec outputs the recovered analog audio signal. Audio amplifier U104-B buffers the signal and inputs it to the U101 amplitude expander, which provides 2:1 audio amplitude expansion. As the audio input level increases, the gain of

the device increases. The effect is to keep the receiver quiet during pauses in speech while reproducing the voice dynamic range that was input at the transmitter microphone. There is an increase in the perceived signal to noise ratio at the receiver due to this process. Expansion makes no SNR improvement to static signals, such as signaling tones.

The fully expanded audio signal is then routed through the receiver squelch gate, U102-A, which is controlled by the Master CPU. From here the signal is routed to the externally-operable volume control. Provision is made for an internally-settable minimum volume control.

The wiper of the volume control is connected to the input of the U503 audio power amplifier, located on the Mainboard. A second squelch gate is accomplished by CPU control of the audio power amplifier, via CR503. The output of the power amp is connected to the internal speaker via P4, and may be connected to an external speaker via rear accessory connector P1.

### 11.3 FREQUENCY SYNTHESIZER (Refer to Figure 10.3)

The synthesizer circuit consists of LSI PLL chip U401, synthesizer loop filter U402, a voltage controlled oscillator (VCO) ASY-0505-04, dual modulus prescaler U404 and voltage-controlled temperature compensated crystal oscillator (VCTCXO) Y401.

The low-noise VCO is a JFET oscillator. The tuning voltage from the loop filter is applied to the CR1 varactor tuning network. The output of the VCO is the local oscillator frequency which is about 10.2755 MHz above the channel frequency. The output of the VCO is buffered by RF Amp U403, filtered and then input to the L.O. Splitter circuit.

The output of the VCO is also connected to the Dual Modulus Prescaler, U404. The Prescaler divides the frequency of the VCO output by 64 or 65, depending on the modulus control selection of the PLL chip.

The output of the Prescaler is fed to the N and A dividers of the U401 PLL chip. The N and A divider values are set by the Master CPU via the CPU Serial Control Bus. The total division of the rf signal (including prescaler) results in a 5 kHz signal which is phase compared with the 10.275 MHz reference signal after division by 2055. The phase detector output is applied to the loop filter which filters the noise and distortion out of the phase detector output voltage. This filtered signal is input to the control voltage input of the VCO, which completes the phase locked loop.

The 10.275 MHz reference signal is provided by VCTCXO Y401. The reference signal is buffered by the U401 PLL chip which outputs the signal the Q401

buffer amp. The buffer amp drives the product detector and balanced modulator IF inputs via the T/R rf switch CR106.

The VCTCXO is tuned for transmit operation by the CPU via the AFC reference DAC U406 and summing amp U302. The CPU determines the exact tuning voltage based on tuning data acquired during reception from an ESP1000 repeater station. In this way the mobile transmit accuracy can approach that of the repeater, i.e. 0.1 ppm. The VCTCXO is tuned differently during receiver operation, which is covered in an earlier section.

#### 11.4 COMPUTER SYSTEM (Refer to Figure 10.4)

The U2 Master Microcomputer chip is the central processing unit (CPU) for digital radio functions. The device is an MC68HC705C8 which includes 178 bytes of RAM and 7740 bytes of ROM on board. The ROM portion contains the radio operating system software program. The device is equipped with integral serial communications interface (SCI) and serial peripheral interface (SPI). The master CPU clock is derived from 4 MHz crystal Y1.

The CPU power supply originates from +5 volt regulator U10, which is sourced from the continuous +13.6 volt supply input at the rear of the radio via Master Power On switch Q1. Q1 is enabled by the front panel Volume on/off control.

Microcomputer system data and radio configuration data memory is held in EEPROM chip U8. Data is recorded or read via a serial bus.

Mode selection control is provided by direct hookup between the front panel mode pulse switch and the CPU. Other direct connections to the CPU include the lock detect signal from the frequency synthesizer circuit, the external PTT control, and the asynchronous serial communications bus (SCI), the latter two provided from the front panel mic jack. Mainboard power supply control is provided from the CPU via line driver U6E which controls Mainboard switch Q503. The same CPU control enables Personality board power via U6B and switch Q2.

The SPI serves as the Serial Control Bus for controlling and communicating with most radio subsystems, such as front panel LED indicators and push buttons, audio gating circuits, system analog signal level monitoring circuits (via 8-channel A/D converter U14), and optional DTMF decoder.

The frequency synthesizer PLL is loaded with frequency data from the Serial Control Bus via serial gate U7C and level shift inverter U6A through J4/P5 to the Mainboard. Data input to the PLL is enabled via 3-to-8 decoder U4, which also enables several other latches and DACs. Other registers controlled by U4 outputs include the Mainboard's U406 Quad DAC and U407 Main Latch (trans-

mit and receive circuits power control). Data on these latches originate from the Serial Control Bus, as well.

The Serial Control Bus branches into a 16-bit wide DSP Data Bus via serial-to-parallel shift registers U109 and U110 and tri-state line driver U108. Multiplexed on the DSP Data Bus are the DSP program data read from the U106 EPROM, serial communications between the Master CPU and the DSP chip, status and control signals (including received trunking data) via tri-state latch U111 (Output Port), and AFC control data routed to the CPU via the U112 AFC DAC (CPU CV). The CPU controls the DSP reset via U7A and U5B.

## **12. FIELD TESTING AND TUNE-UP**

### **12.1 INTRODUCTION**

Avoid making unnecessary adjustments. The frequency and RF power output of each mobile is carefully calibrated at the SEA factory. After the mobile is properly programmed to operate on the desired local repeater system, no internal adjustments will normally be necessary. If the mobile experiences difficulty accessing the repeater base station, proceed as described below.

The mobile's temperature-compensated crystal oscillator (TCXO) is designed to provide the required FCC frequency stability of +/-1.5 ppm over the -30 to +60 degree C temperature range. Additionally, the ESP504 has the capability to automatically track the highly precise base station frequency of the repeater system(s) on which it is programmed to operate. The mobile updates frequency compensation information in its RAM and non-volatile memory as needed during the course of normal operation to match its absolute frequency within 60 Hz of the base station. The nonvolatile memory is not updated when operating simplex (talkaround) with other mobiles.

### **12.2 FIELD TEST MODES**

**General:** Field test modes are helpful for providing additional operating frequencies and/or capabilities not used in normal operation. This section outlines how the radio works when the internal test jumper JU5 (located on the personality board) is installed or the front panel mic jack serial port lines are shorted together.

#### **12.2.1 Entering Field Test Modes**

- a. Turn off radio.
- b. Remove top cover and install jumper JU5 on personality board (PCB-0505-02) or install plug in mic jack which shorts Txd to Rxd (pins 1 and 8).
- c. Turn on radio. (Field test modes can be entered only at power-up.)
- d. The ESP520 will display an "\*" in the first character portion of the display.

#### **12.2.2 Exiting Field Test Mode:**

- a. Turn off radio power. (Field test modes are exited only when radio power is turned off.)
- b. Remove jumper JU5 or remove shorting plug from mic jack.

### **12.3.5 RF Output Power and ALC Sensitivity Calibration**

1. Perform steps 1 through 3 of the procedure in Section 12.3.4.
2. Transmit on the desired channel and check for 17 to 20 watts transmitter power output using the JU104 test tone. If necessary, adjust potentiometer R155 on the main board for 20 watts output.

#### **CAUTION**

---

If power output is set higher than 20 watts, FCC emission limits will be exceeded and mobile performance will be degraded.

---

3. Remove jumper JU104 and key the transmitter. Wattmeter should read approximately 3 to 4 watts without voice modulation. Check for approximately 2.7 volts dc alc voltage at TP506 on the main board. If necessary, adjust R512 near the back of the main board for this value. Note: Antenna loads other than 50 ohms resistive will cause this voltage to vary.

### **12.3.6 Finishing Up**

1. Before replacing the top and bottom covers, insure that shorting jumpers JU4, JU5 and JU104 have been removed. Insure that the covers fit tightly to the radio chassis and all screws have been replaced and tightened.
2. If the radio was significantly off frequency before calibration, the receiver should be allowed to monitor the home repeater on each of its normal modes for a few minutes in order for the automatic base station tracking to adjust itself to the new calibration. This is a gradual process which may require receipt of several turnoff codes from the home repeater on each mode.
3. If the mobile continues to exhibit difficulty accessing system repeaters, contact the SEA Service Department.

## **12.4 TROUBLESHOOTING TIPS**

### **12.4.1 Busy Tone Heard**

If busy tone is heard continuously when radio power is applied, the radio's normal modes need to be programmed using the ESP Data Manager and PIU. The ESP520 will display "NO MODES" on the vacuum fluorescent display.

### **12.4.2 Fault Tone Heard**

Antenna Fault: If the fault tone occurs as a result of keying the radio on a normal

mode, it is often due to a mismatch at the antenna connector. This causes excessive rf output voltage which exceeds the ALC fault threshold (approx. 7 volts dc or greater at TP506 on main board). The transmitter is automatically disabled until radio power is cycled. Temporarily attach a 50 ohm resistive load to the antenna connector. Cycle power to the radio and press PTT. If the radio transmits normally (attempts connection in trunked modes), then the fault is in the antenna system. This fault system is disabled when the radio is operated in field test modes.

Other Fault Tone causes: Improper power supply voltage. Excessive rf drive level or ALC threshold misadjusted (see Transmitter Tune-up). Internal rf PA coaxial jumper cable unplugged or loose.

Synthesizer Fault: If the fault tone is heard immediately after cycling radio power or if the antenna fault test above fails, rf synthesizer unlock is indicated. The synthesizer lock detect voltage at main board TP413 is normally 4 volts when locked and less than 2 volts when unlocked. The vco tuning voltage, measured with a high impedance dc voltmeter at main board TP414, should be a steady voltage in the range from 1.5 to 5.5 volts. Higher voltages indicate higher frequencies.

#### 12.4.3 Fuse Blows

If the 5A power supply fuse opens as a result of keying the radio, this often indicates a mismatch at the antenna connector. Under certain mismatch conditions, the transmitter will draw in excess of 5 amps from the power supply. Temporarily attach a 50-ohm resistive load to the antenna connector to determine if radio then transmits normally.

If the fuse opens immediately when power is connected to the radio, the radio may have been subjected to overvoltage or reverse voltage. Protective MOV CR4 on the power amplifier board may be shorted.

#### 12.4.4 Internal LEDs

These LEDs are controlled by the DSP. Correct operation of these LEDs requires that most of the radio subsystems such as TCXO, Synthesizer, receiver front end and I.F., CPU and DSP are functioning to a major extent.

Red LED: During reception, this LED is normally lit solid when receiving a good pilot carrier (1.9 kHz above channel center) and blinks only occasionally when there is no carrier. During normal transmission it blinks during the repeater handshake sequence but is otherwise off. It is lit when transmitting the center channel 2 kHz cw test tone with JU104 installed.

Green LED: This LED monitors the trunking data stream and blinks randomly when receiving noise. It blinks at a steady rate when DTL data is being received or transmitted.

#### **12.4.5 ESP520 Displays "NO PROG "**

The "NO PROG " is displayed when the radio's software is corrupted. This is often due to the EE-PROM failure. The radio will require a full factory alignment if the EE-PROM is replaced or its data is lost.

### **12.5 ESP520 SPECIAL DISPLAYS**

**General:** The ESP520 will display the radio's serial number, the software version and the name and date of the Data Manager data file that was used to program the radio. This section outlines how to cause the radio to display this information.

#### **12.5.1 Entering Special Display Mode**

- a. Turn off radio.
- b. Press and hold the "H" key on the front of the radio.
- c. Turn on radio. (Continue to hold the "H" key in until the end of the check.)
- d. The radio will now display the radio's serial number.
- e. Turn the Mode knob one click clockwise.
- f. The radio will now display the radio's software version number.
- g. Turn the Mode knob one click clockwise.
- h. The radio will now display the name and date of the file that was used to program the radio.
- i. Release the "H" key. The radio will revert to normal operation.

### **12.6 MINIMUM PREINSTALLATION TEST**

**General:** Even though your ESP504 or ESP520 was thoroughly tested and inspected prior to shipment, it is recommended that the transmitter frequency, transmitter output power and the receiver be checked before installation.

#### **12.6.1 Test Set Up**

Before testing, troubleshooting, or any repair of the transceiver, connect the radio set per Figures 12.1 and 12.2.

#### **NOTE**

Unless otherwise specified, all tests are to be performed at an ambient temperature of +25 C using a power supply voltage of +13.6 VDC.

mode, it is often due to a mismatch at the antenna connector. This causes excessive rf output voltage which exceeds the ALC fault threshold (approx. 7 volts dc or greater at TP506 on main board). The transmitter is automatically disabled until radio power is cycled. Temporarily attach a 50 ohm resistive load to the antenna connector. Cycle power to the radio and press PTT. If the radio transmits normally (attempts connection in trunked modes), then the fault is in the antenna system. This fault system is disabled when the radio is operated in field test modes.

Other Fault Tone causes: Improper power supply voltage. Excessive rf drive level or ALC threshold misadjusted (see Transmitter Tune-up). Internal rf PA coaxial jumper cable unplugged or loose.

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If the fuse opens immediately when power is connected to the radio, the radio may have been subjected to overvoltage or reverse voltage. Protective MOV CR4 on the power amplifier board may be shorted.

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Green LED: This LED monitors the trunking data stream and blinks randomly when receiving noise. It blinks at a steady rate when DTL data is being received or transmitted.

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- c. Turn on radio. (Continue to hold the "H" key in until the end of the check.)
- d. The radio will now display the radio's serial number.
- e. Turn the Mode knob one click clockwise.
- f. The radio will now display the radio's software version number.
- g. Turn the Mode knob one click clockwise.
- h. The radio will now display the name and date of the file that was used to program the radio.
- i. Release the "H" key. The radio will revert to normal operation.

### **12.6 MINIMUM PREINSTALLATION TEST**

**General:** Even though your ESP504 or ESP520 was thoroughly tested and inspected prior to shipment, it is recommended that the transmitter frequency, transmitter output power and the receiver be checked before installation.

#### **12.6.1 Test Set Up**

Before testing, troubleshooting, or any repair of the transceiver, connect the radio set per Figures 12.1 and 12.2.

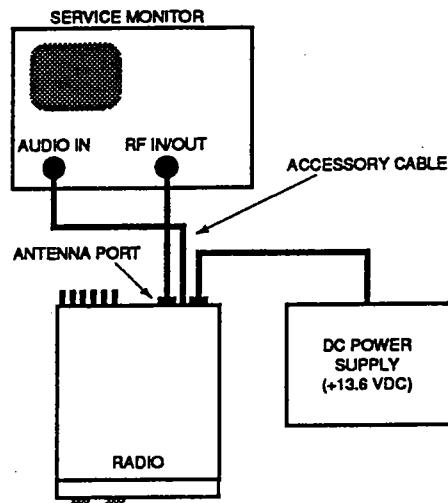
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#### **NOTE**

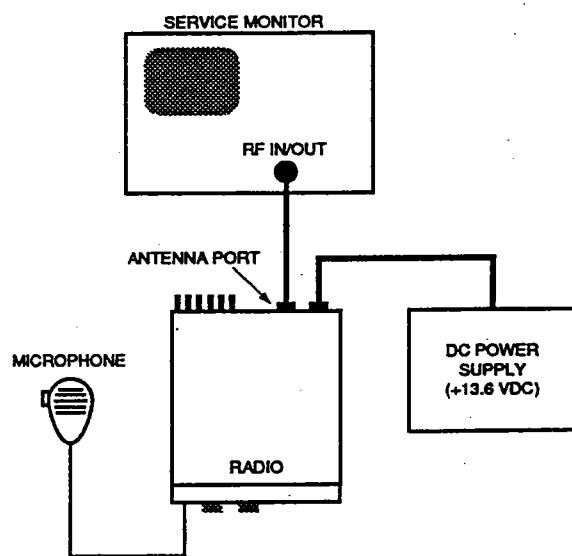
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Unless otherwise specified, all tests are to be performed at an ambient temperature of +25 C using a power supply voltage of +13.6 VDC.

---



**Figure 12.1** Receiver Test Set Up



**Figure 12.2** Transmitter Test Set Up

### **12.6.2 Preliminary Test**

- a. Turn radio off.
- b. Install plug in mic jack which shorts TXd to RXd (pins 1 and 8) OR remove top cover and install jumper JU5 on personality board (PCB-0505-02).
- c. Turn radio on.
- d. On ESP504 verify that Mode 1 LED is ON and there is no busy or fault tone from the radio.
- e. On ESP520 verify that the display says “\*MODE 01” and there is no busy or fault tone from the radio.

### **12.6.3 Receiver Tests**

The receiver tests to be performed are listed below:

- 12 dB SINAD Sensitivity
- Squelch Sensitivity
- AFC Lock Range

#### **12.6.3.1 Definition: Standard Receiver Test Modulation (SRTM)**

The SRTM setting on the service monitor is as follows:

- Modulation Type: AM
- RF Frequency: 220.0015 MHz OR Radio assigned frequency minus 1000 Hz.
- Modulation Frequency: 2.9 KHz
- Modulation Level: 63% AM

#### **12.6.3.2 12 dB SINAD Sensitivity**

- a. Unsquelch the receiver by pressing the “HRN” key in.
- b. With no RF signal applied to the rf input, adjust the volume control for a 1 volt rms noise level measured at the speaker terminals on P1 (+ = P1/7 - = P1/3).
- c. Turn on the RF signal from the service monitor. The monitor should be set to SRTM.
- d. Reduce the rf signal level until 12 dB SINAD is measured at the speaker terminals. Note: The rf level should be less than .35uV (-116 dBm) on all channels.

#### 12.6.3.3 Squelch Sensitivity

- a. Set the mobile to carrier squelch by pressing the "HRN" key out and pressing the "SCN" key in. Note: The squelch will open intermittently. There is NO adjustment for this.
- b. Set the service monitor as follows:
  - RF Output: OFF
  - RF Level: .02uV (-140 dBm)
  - Modulation Type: OFF
  - RF Frequency: 220.0044 MHz OR Radio assigned frequency plus 1.9 KHz.
- c. Turn the rf output on. Increase the rf level until the speaker just unmutes. Note: RF level should be less than .08 uV (-129 dBm).

#### 12.6.3.4 AFC Lock Range

- a. Set the mobile to carrier squelch by pressing the "HRN" key out and pressing the "SCN" key in. Note: The squelch will open intermittently. There is NO adjustment for this.
- b. Set the service monitor as follows: SRTM
  - RF Output: OFF
  - Modulation Type: AM
  - RF Frequency: 220.0018 MHz OR Radio assigned frequency minus 700 Hz.  
(300 Hz above SRTM)
  - RF Level: .35 uV (-116 dBm)
  - Modulation Frequency: 2.9 KHz
  - Modulation Level: 63% AM
- c. Turn the rf output on. The radio should lock (on to frequency), squelch should open, received audio frequency should be 1000 Hz.
- d. Repeat steps a. through c. with the rf frequency set to 220.0012 MHz OR radio assigned frequency minus 1300 Hz (300 Hz below SRTM). All other settings remain unchanged.

#### 12.6.4 Transmitter Tests

The transmitter test to be performed are listed below:

- Full Transmitter Power Output, No Modulation
- Transmitter RF Frequency

#### 12.6.4.1 Test Set Up

- a. Connect the radio as per figure 12.2. Connect the radio's rf output to the service monitor's input.

#### 12.6.4.2 Full Transmitter Power Output, No Modulation

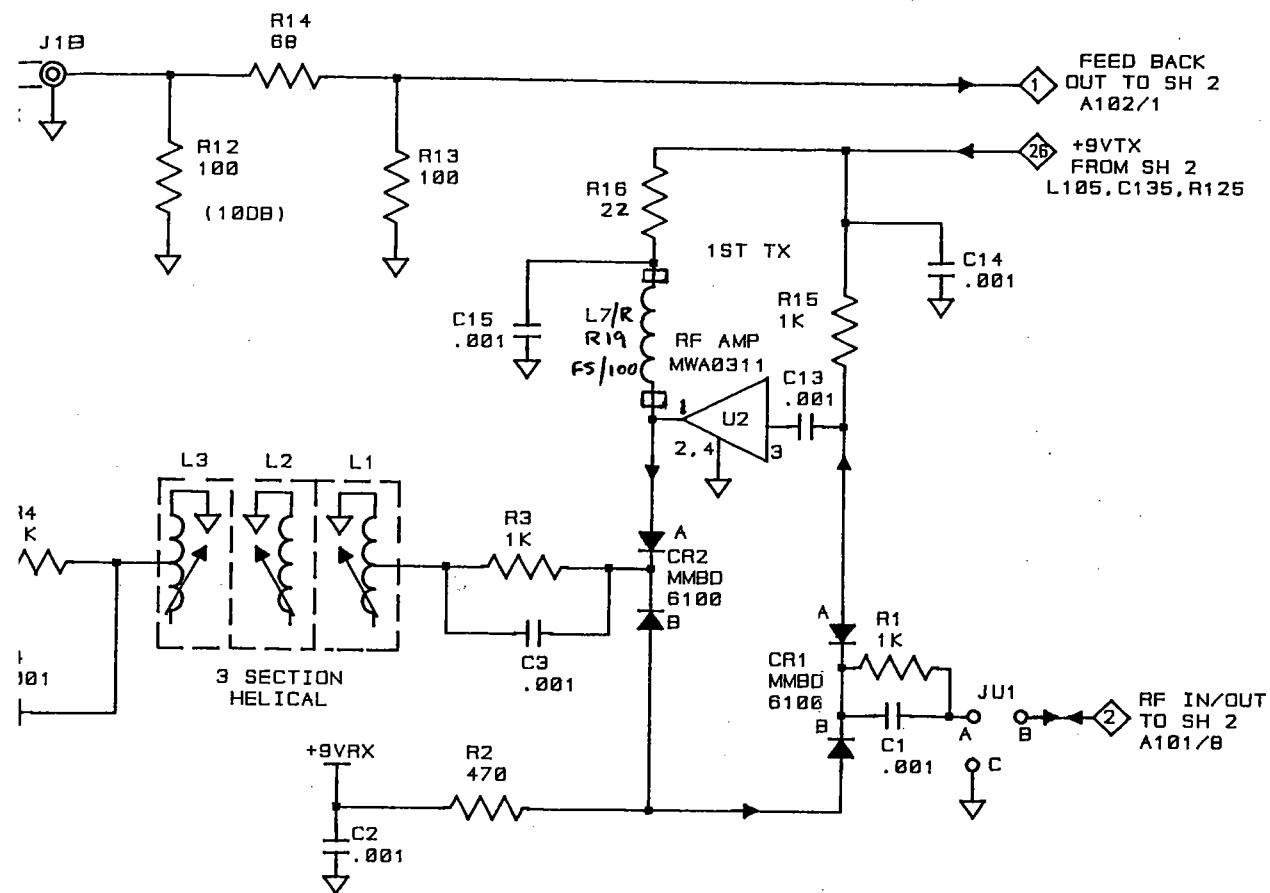
- a. Set the mobile to 1 KHz test tone by pressing the "PGM" key in. Note: The mobile will now transmit a calibrated 1 kHz test tone when the mic's PTT is pressed.
- b. Depress PTT switch on the microphone. (The radio will transmit.)
- c. Set the mobile to 2 kHz full power test tone by pressing and releasing the "AUX" key while the radio is in transmit.
- d. Check the service monitor for 18 to 22 watts transmitter power output. For power output alignment refer to section 12.3. Note: The 2 kHz full power test tone will be reset to off as soon as the radio stops transmitting.

#### 12.6.4.3 Transmitter RF Frequency

- a. Set the mobile to 1 kHz test tone by pressing the "PGM" key in.  
Note: The mobile will now transmit a calibrated 1 kHz test tone when the mic's PTT is pressed.
- b. Set the mobile to talk around by pressing and releasing the "AUX" key. On the ESP504 the channel LED will blink. On the ESP520 the display will alternate between "\*MODE 01" and "TALKARND".
- c. Depress PTT switch on the microphone. (The radio will transmit.)
- d. Set the mobile to 2 kHz full power test tone by pressing and releasing the "AUX" key while the radio is in transmit.
- e. Check the service monitor for a frequency of 220.0025 MHz OR Radio assigned frequency +/- 100 Hz. For frequency alignment refer to section 12.3.

#### NOTE

Due to the frequency accuracy required (.1 ppm) the service monitor must be calibrated. It is recommended that the monitor first be used with a known good repeater set to Test Mode 'TESTMOD1'. This signal from the repeater is then used to calibrate the service monitor with an offset. If a repeater is not locally available to calibrate the service monitor then refer to section 12.3.3 for recommended frequency calibration method.



550501-1.RV2 2/18/92 REV A  
 550501-1.RV3 ECN 5016 9/14/92  
 550501.SH1 ECN 5378 9/8/93 REV C

NOTES: UNLESS OTHERWISE SPECIFIED  
 1. RESISTORS ARE IN OHMS, 1/4 W, 5%  
 2. CAPACITORS ARE IN MICROFARADS  
 3. DIODES ARE MMBD7000  
 4. INDUCTORS ARE IN MICRO HENRYS

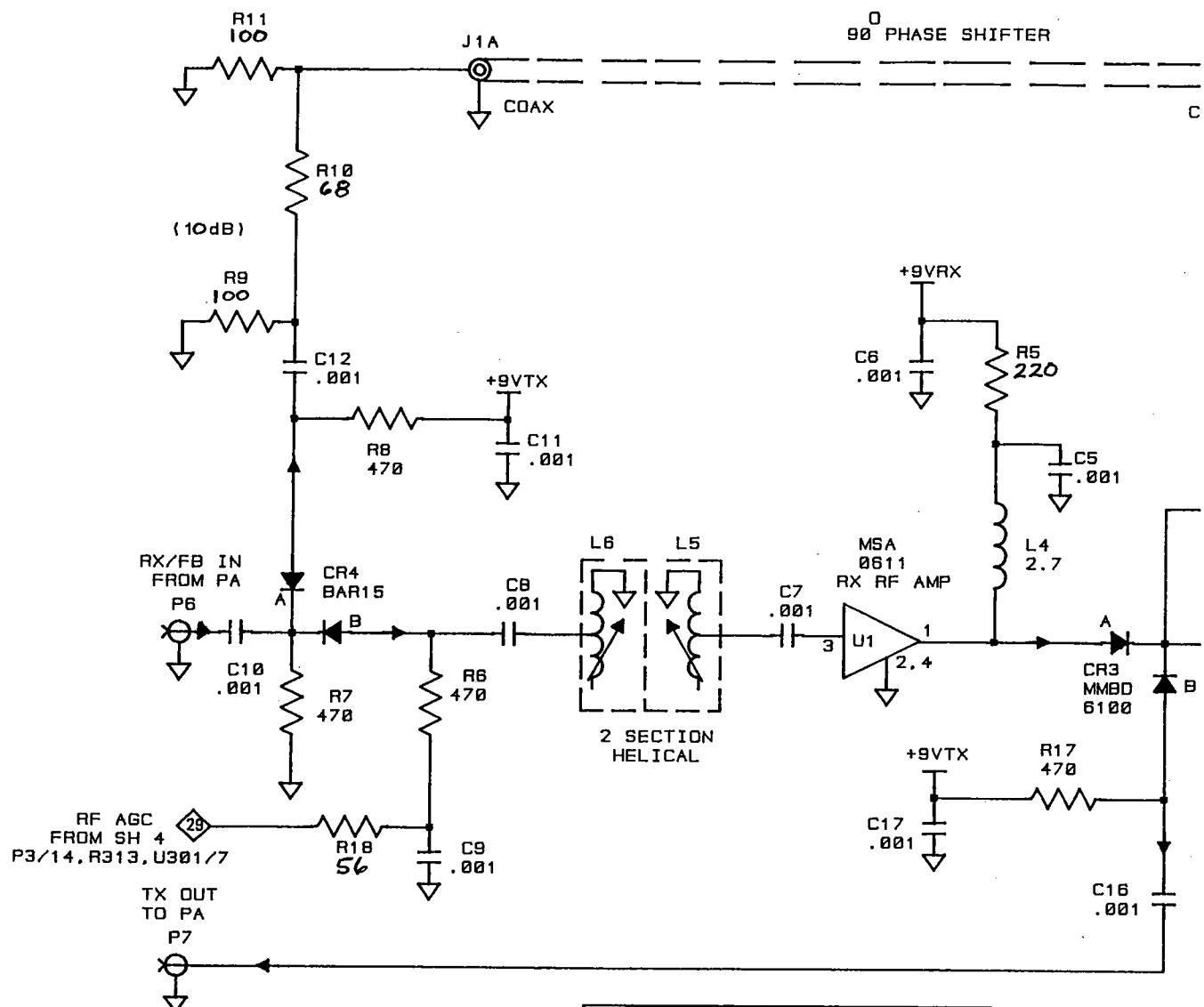
LAST REFERENCE DESIGNATORS USED:

C17, CR4, J4, JU1, L7, P7, R20, U2

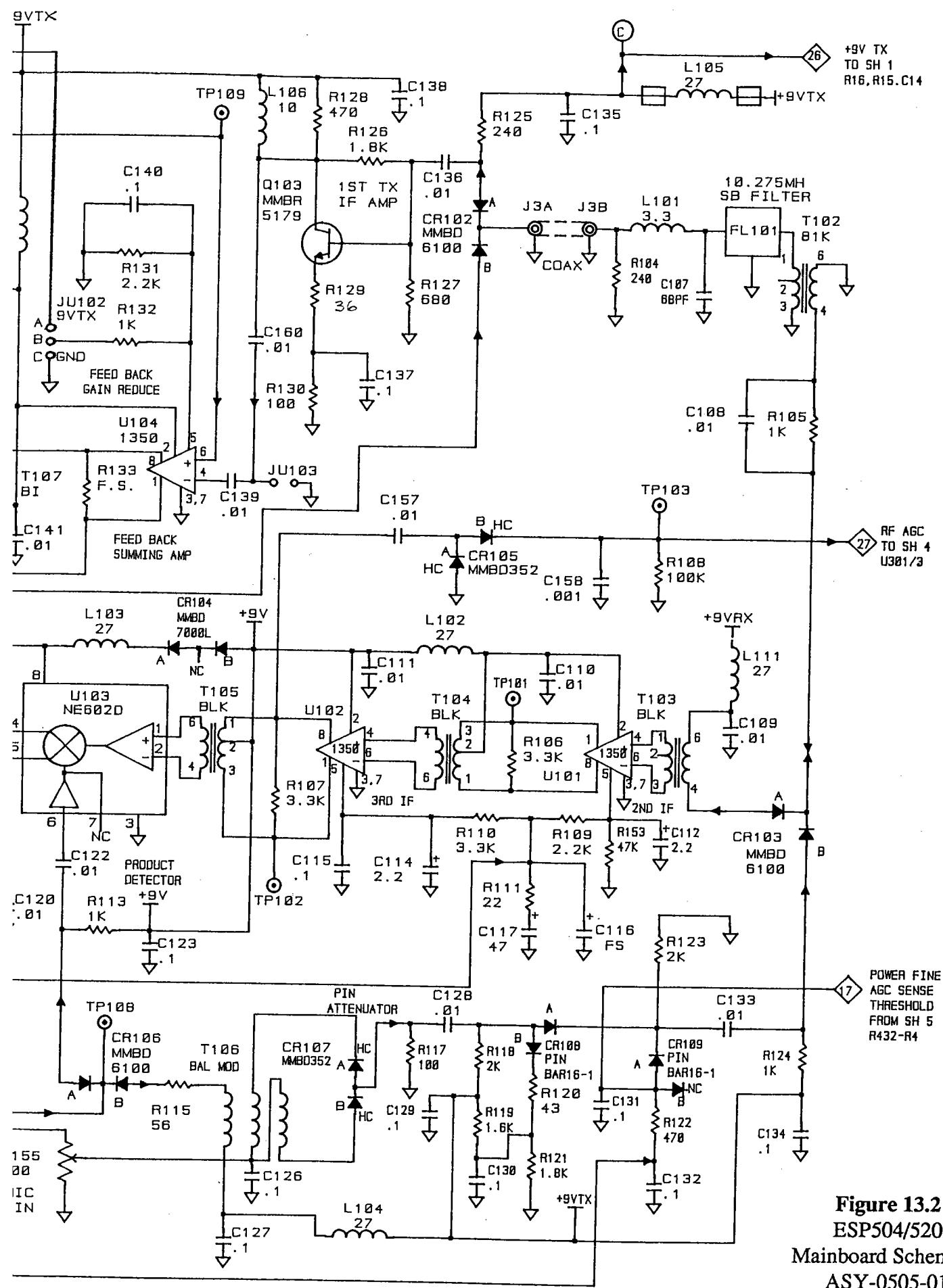
REFERENCE DESIGNATORS NOT USED:

ECN 5587 3/4/94  
 ECN 5597 3/15/94  
 ECN 5655 4/7/94  
 ECN 5708 5/11/94  
 ECN 5719 5/19/94

**Figure 13.1**  
**ESP504/520**  
**Mainboard Schematic**  
**ASY-0505-01**  
**RF**  
**Sheet 1 of 5**

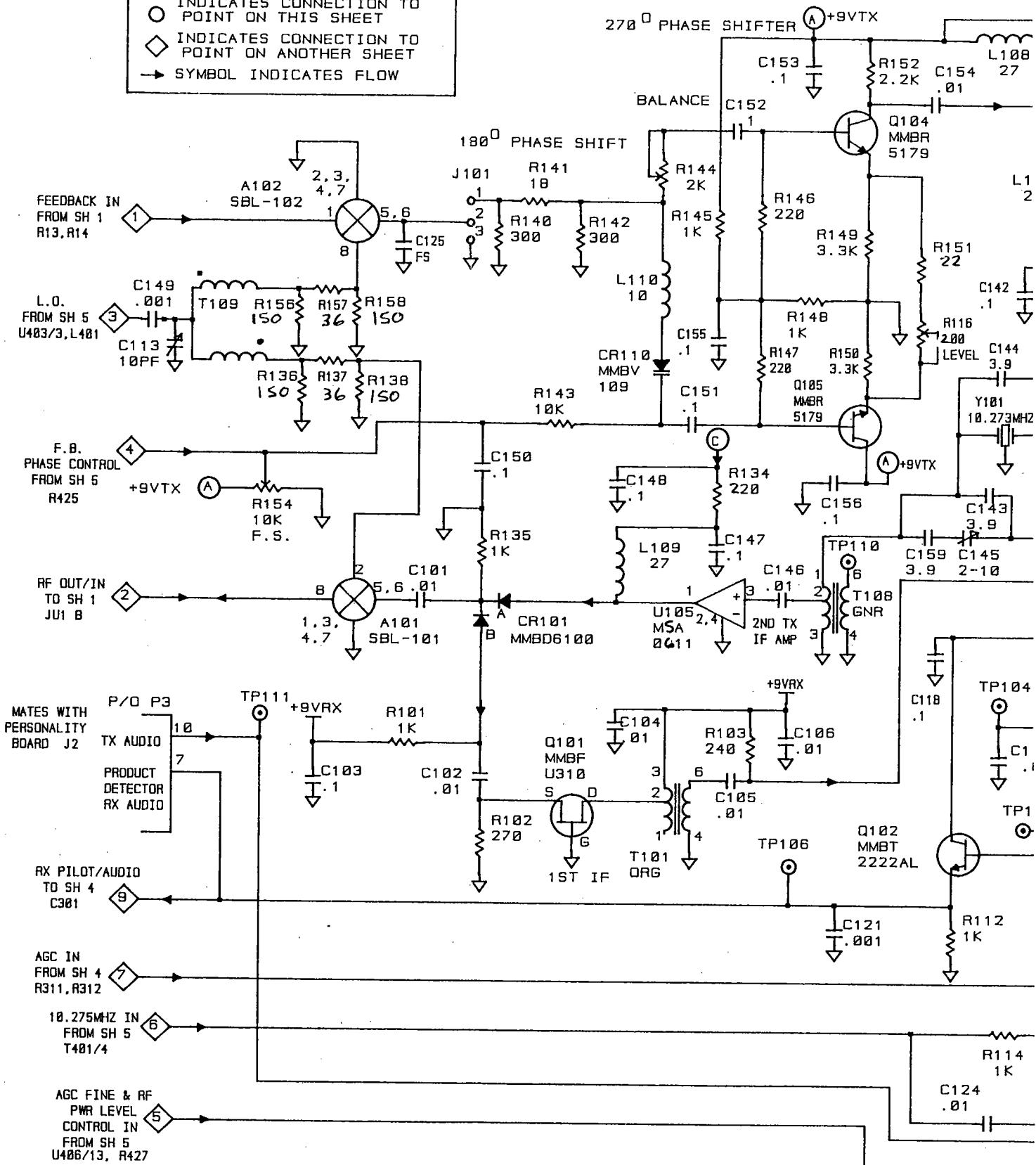


◊ INDICATES CONNECTION TO  
 POINT ON ANOTHER SHEET  
 → SYMBOL INDICATES FLOW



**Figure 13.2**  
**ESP504/520**  
**Mainboard Schematic**  
**ASY-0505-01**  
**I.F.**  
Sheet 2 of 5

○ INDICATES CONNECTION TO  
 POINT ON THIS SHEET  
 ◇ INDICATES CONNECTION TO  
 POINT ON ANOTHER SHEET  
 → SYMBOL INDICATES FLOW



NOTES: UNLESS OTHERWISE SPECIFIED  
 1. RESISTORS ARE IN OHMS, 1/4 W, 5%  
 2. CAPACITORS ARE IN MICROFARADS  
 3. DIODES ARE MMBD7000  
 4. INDUCTORS ARE IN MICRO HENRYS

LAST REFERENCE DESIGNATORS USED:

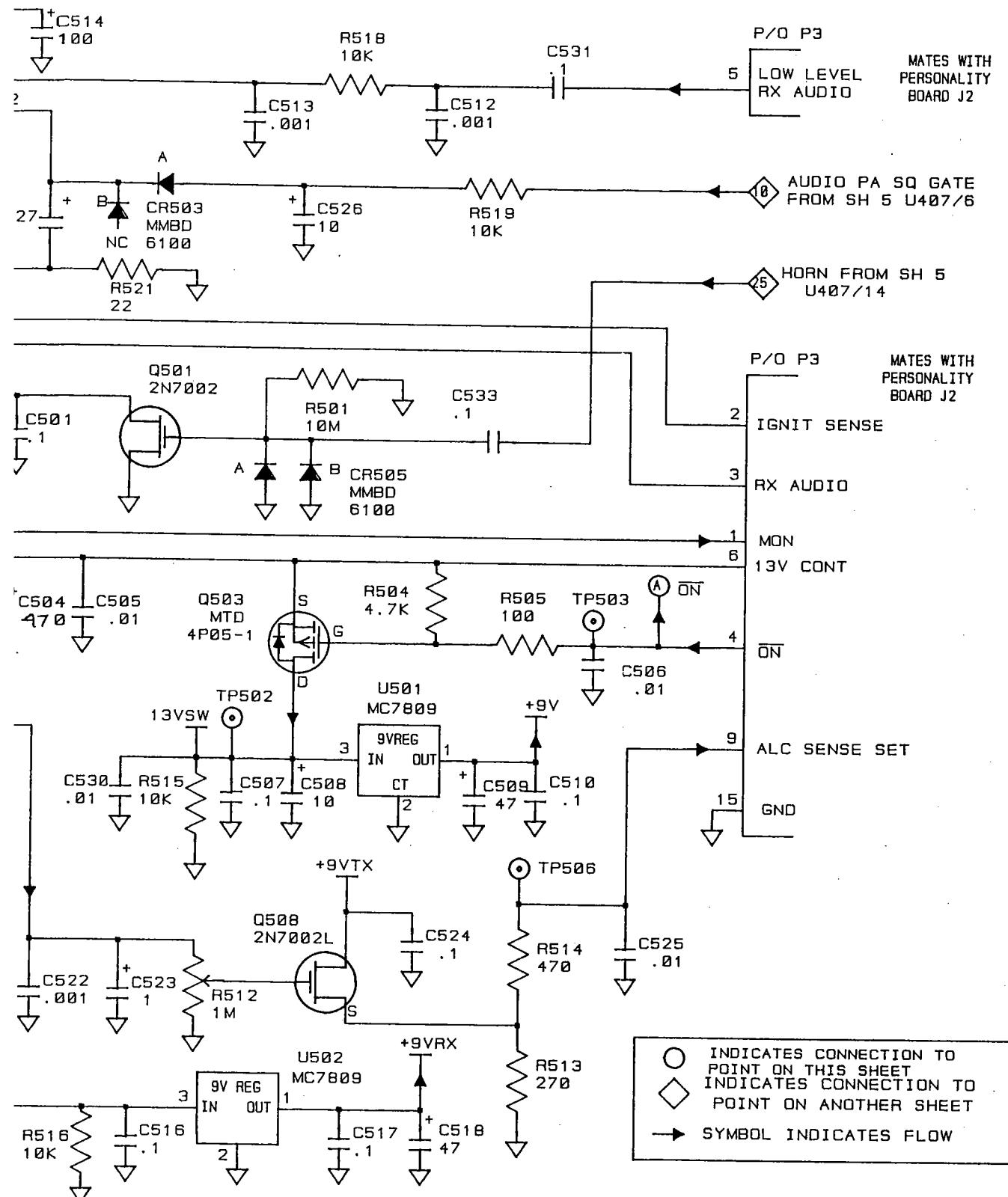
A102	C159	CR110	FL101	JU102	L111
Q105	R158	TP111	T109	U105	Y101

REFERENCE DESIGNATORS NOT USED:

JU4, R139

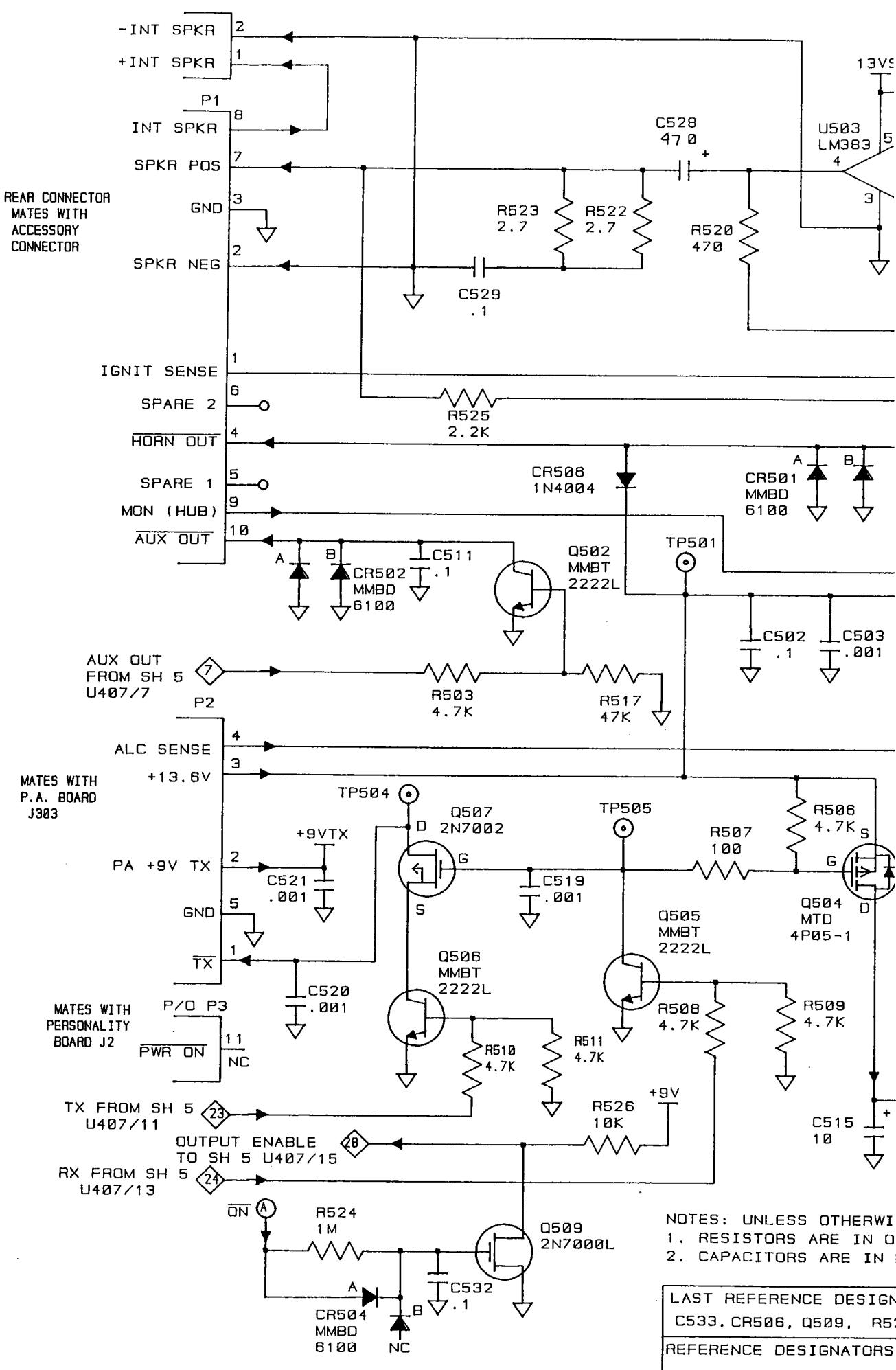
S50501-2.RV3 ECN 4918 6/10/92 REV A  
 S50501-2.RV4 ECN 5006 8/24/92  
 S50501-2.RV5 ECN 5098 12/2/92  
 S50501.SH1 ECN 5181 2/11/93  
 S50501.SH2 ECN 5369 8/23/93

ECN 5587 & 5578 3/4/94  
 ECN 5655 4/7/94  
 ECN 5708 5/11/94



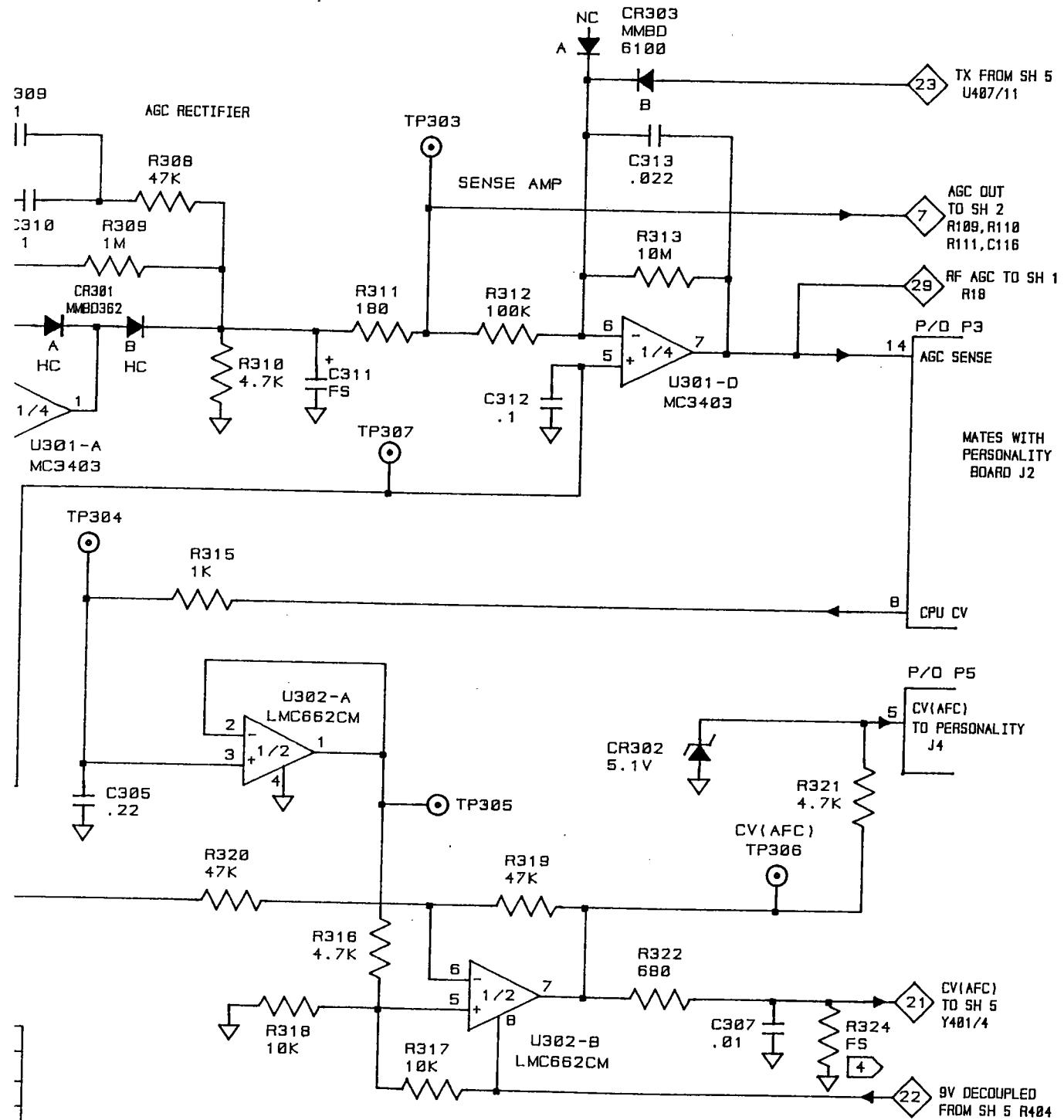
**Figure 13.3**  
**ESP504/520**  
**Mainboard Schematic**  
**ASY-0505-01**  
**Power Control**  
**Sheet 3 of 5**

50501-3.RV1 12/17/91  
50501-3.RV2 2/18/92 REV A  
50501-3.RV3 ECN 5004 8/24/92  
50501-3.RV4 ECN 5016 9/14/92  
50501.SH3 ECN 5159, 5174 2/4/93  
ECN 5943 3/14/95



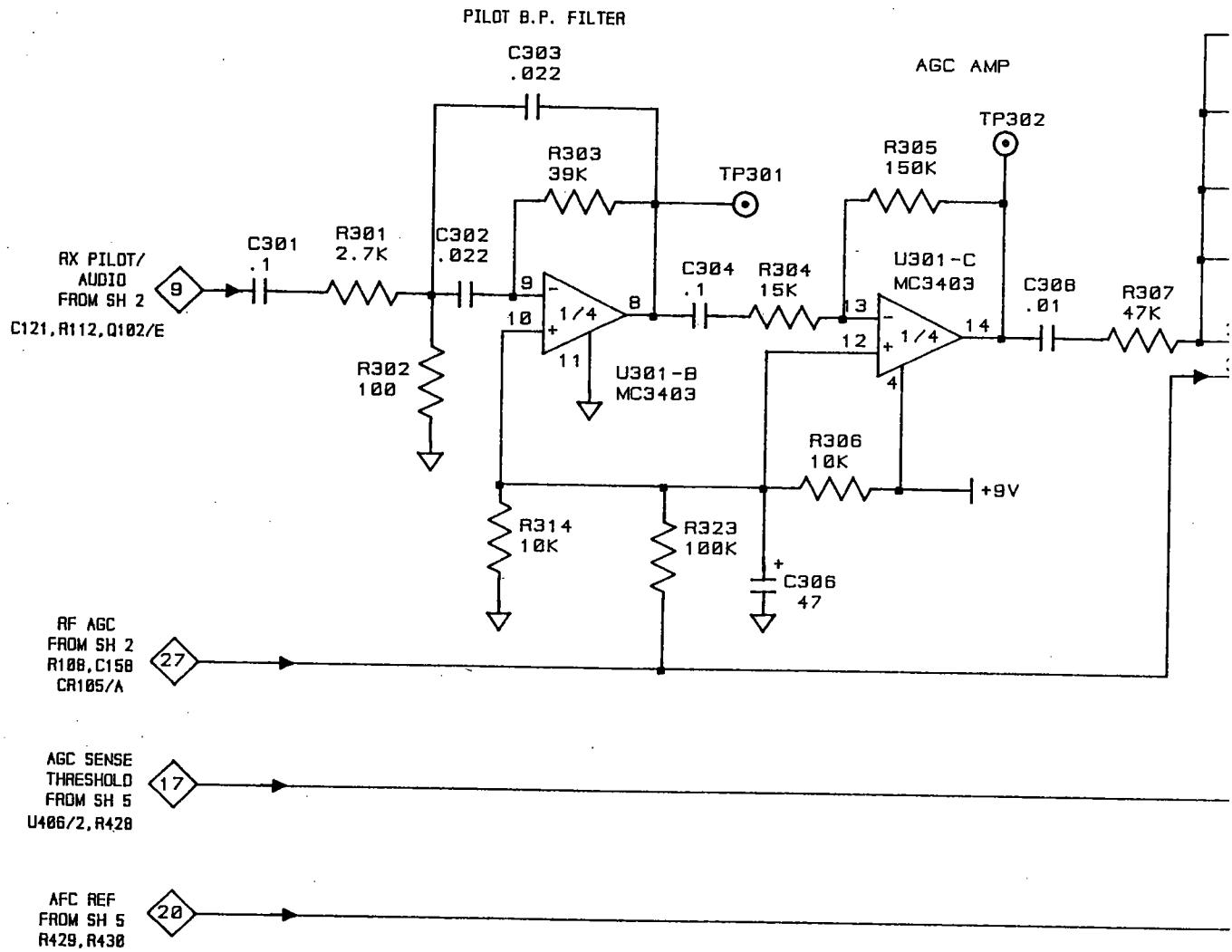
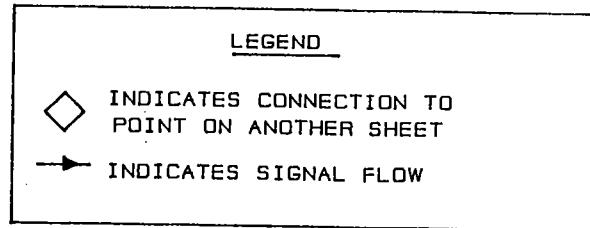
NOTES: UNLESS OTHERWISE  
1. RESISTORS ARE IN OHMS  
2. CAPACITORS ARE IN MICROFARADS

LAST REFERENCE DESIGN  
C533, CR506, Q509, R53  
REFERENCE DESIGNATORS  
R502



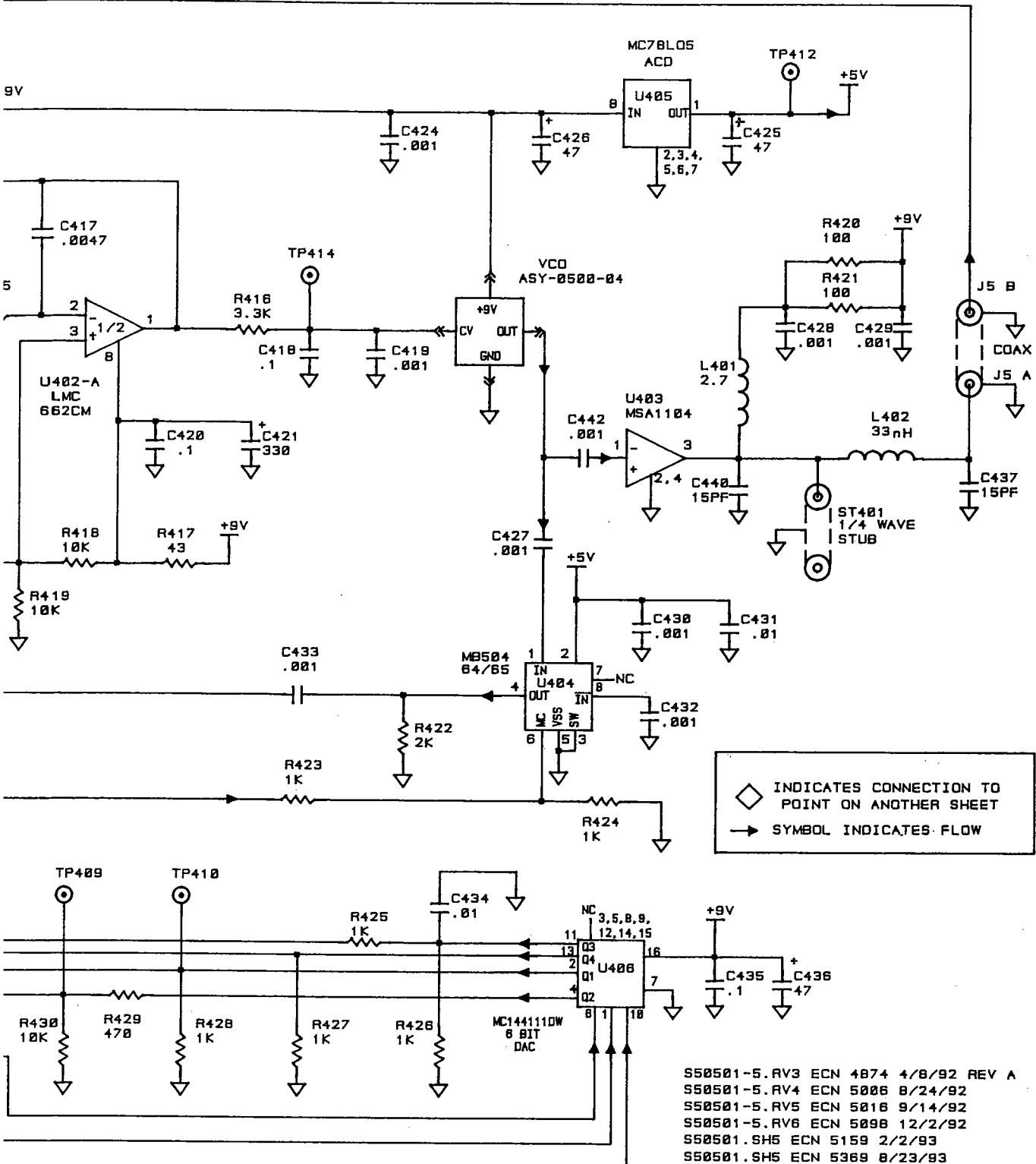
S50501-4. RV4 ECN 5098 12/2/92  
 S50501.SH4 ECN 5174 2/3/93  
 S50501.SH4 ECN 55377&5378 9/8/93 REV C  
 S50501.SH4 ECN 5402 9/29/93  
 S50501.SH4 ECN 561B 3/25/94

**Figure 13.4**  
**ESP504/520**  
**Mainboard Schematic**  
**ASY-0505-01**  
**AGC, AFC, Recovered Pilot**  
**Sheet 4 of 5**



NOTES: UNLESS OTHERWISE SPECIFIED  
 1. RESISTORS ARE IN OHMS, 1/4W, 5%.  
 2. CAPACITORS ARE IN MICROFARADS.  
 3. DIODES ARE MMBD7000.  
 4. R324 IS MATCHED WITH Y401'S TUNING RATE.

LAST DESIGNATOR USED:
C313, CR303, R324, TP307, U30
DESIGNATOR NOT USED:



S50501-5.RV3 ECN 4874 4/8/92 REV A  
 S50501-5.RV4 ECN 5006 8/24/92  
 S50501-5.RV5 ECN 5016 9/14/92  
 S50501-5.RV6 ECN 5098 12/2/92  
 S50501.SH5 ECN 5159 2/2/93  
 S50501.SH5 ECN 5368 8/23/93  
 S50501.SH5 ECN 5379&5376 9/7/93 REV C  
 S50501.SH5 ECN 5502 1/14/94  
 ECN 5819 9-16-94

LAST REFERENCE DESIGNATORS USED:

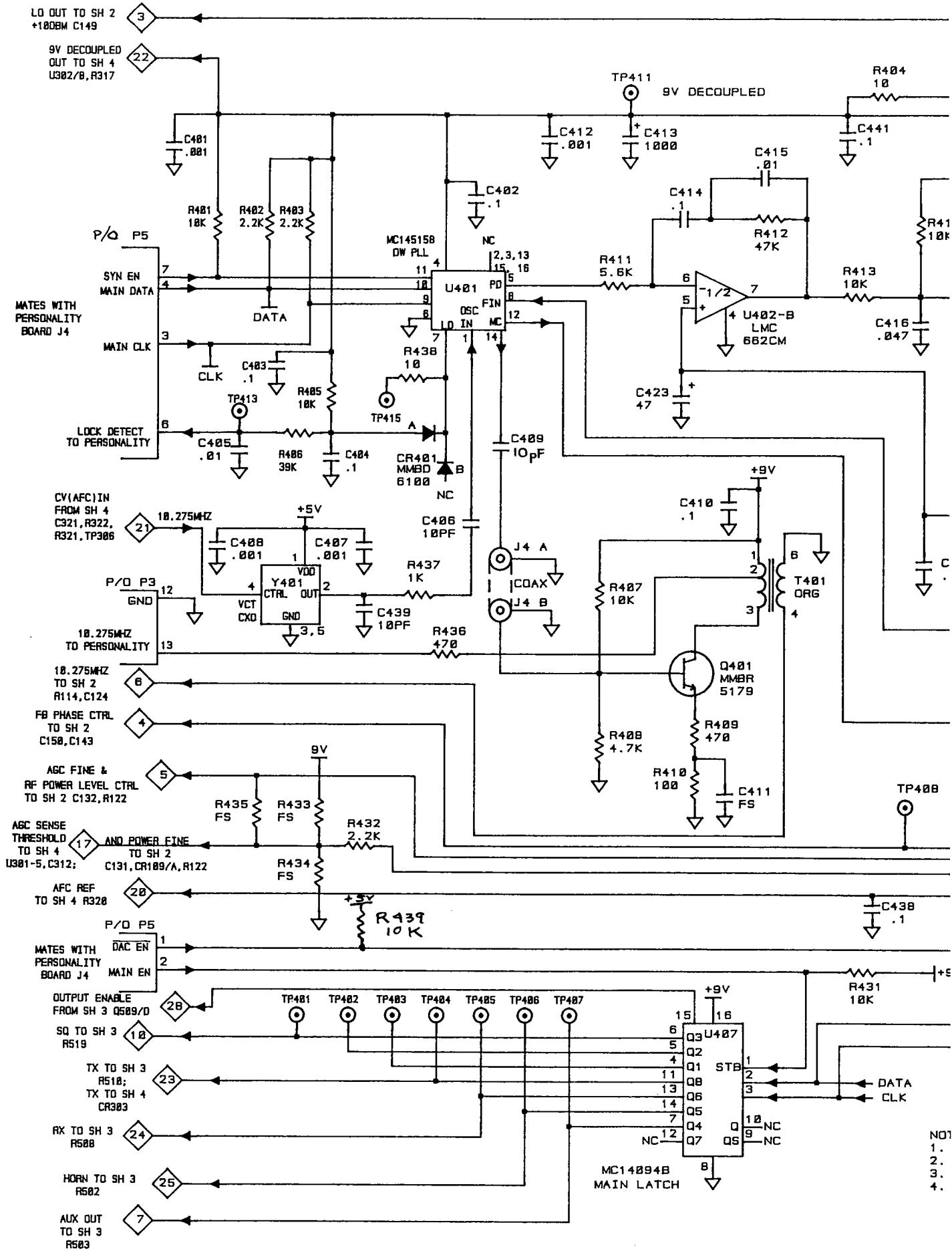
C442, CR401, L402, Q401, R439, ST401, TP415,  
T401, U407, Y401

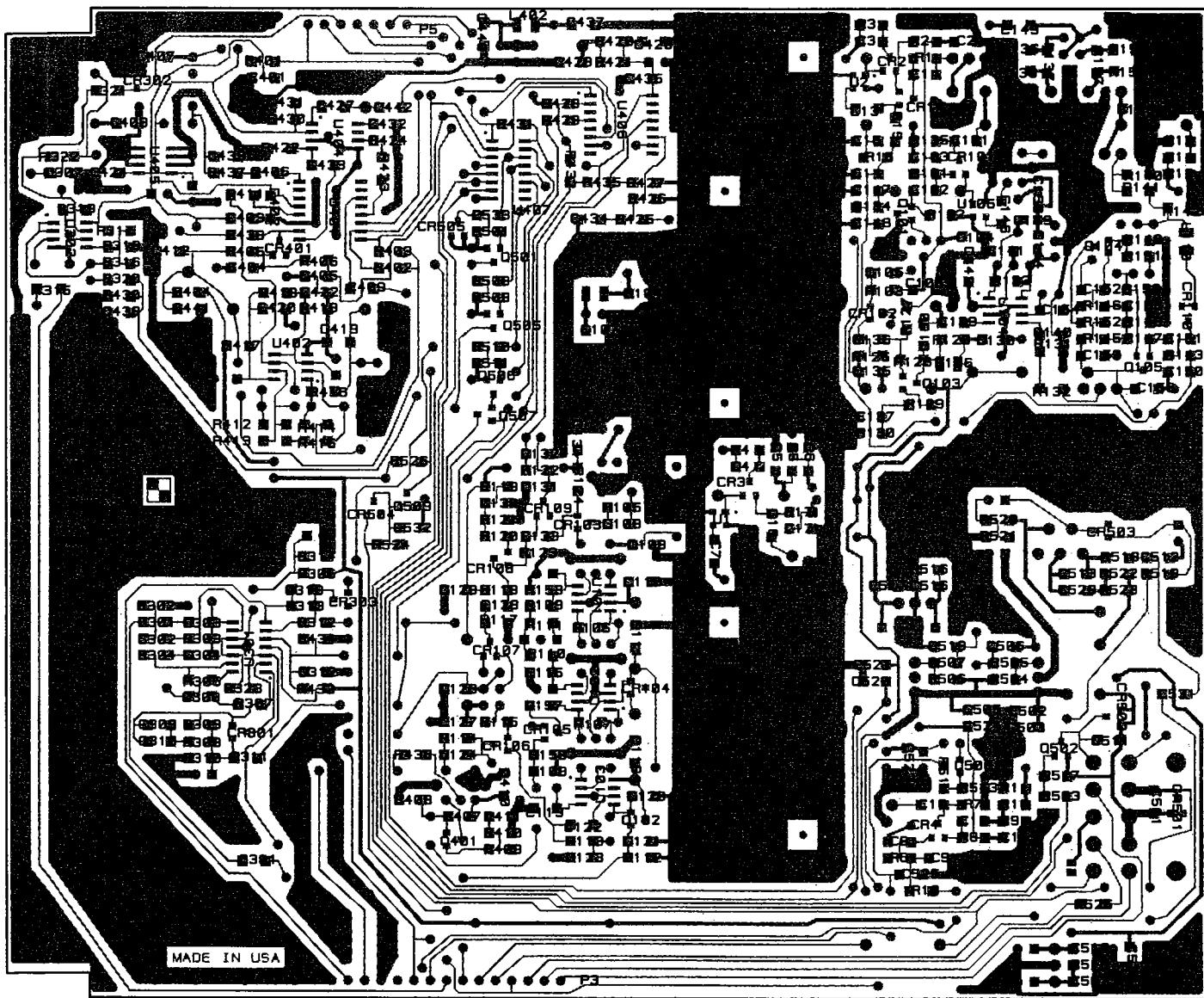
REFERENCE DESIGNATORS NOT USED:

UNLESS OTHERWISE SPECIFIED  
RESISTORS ARE IN OHMS, 1/4 W, 5%  
CAPACITORS ARE IN MICROFARADS  
IDEAS ARE MMBD7000  
INDUCTORS ARE IN MICROHENRYS

ECN 5847 11-4-94

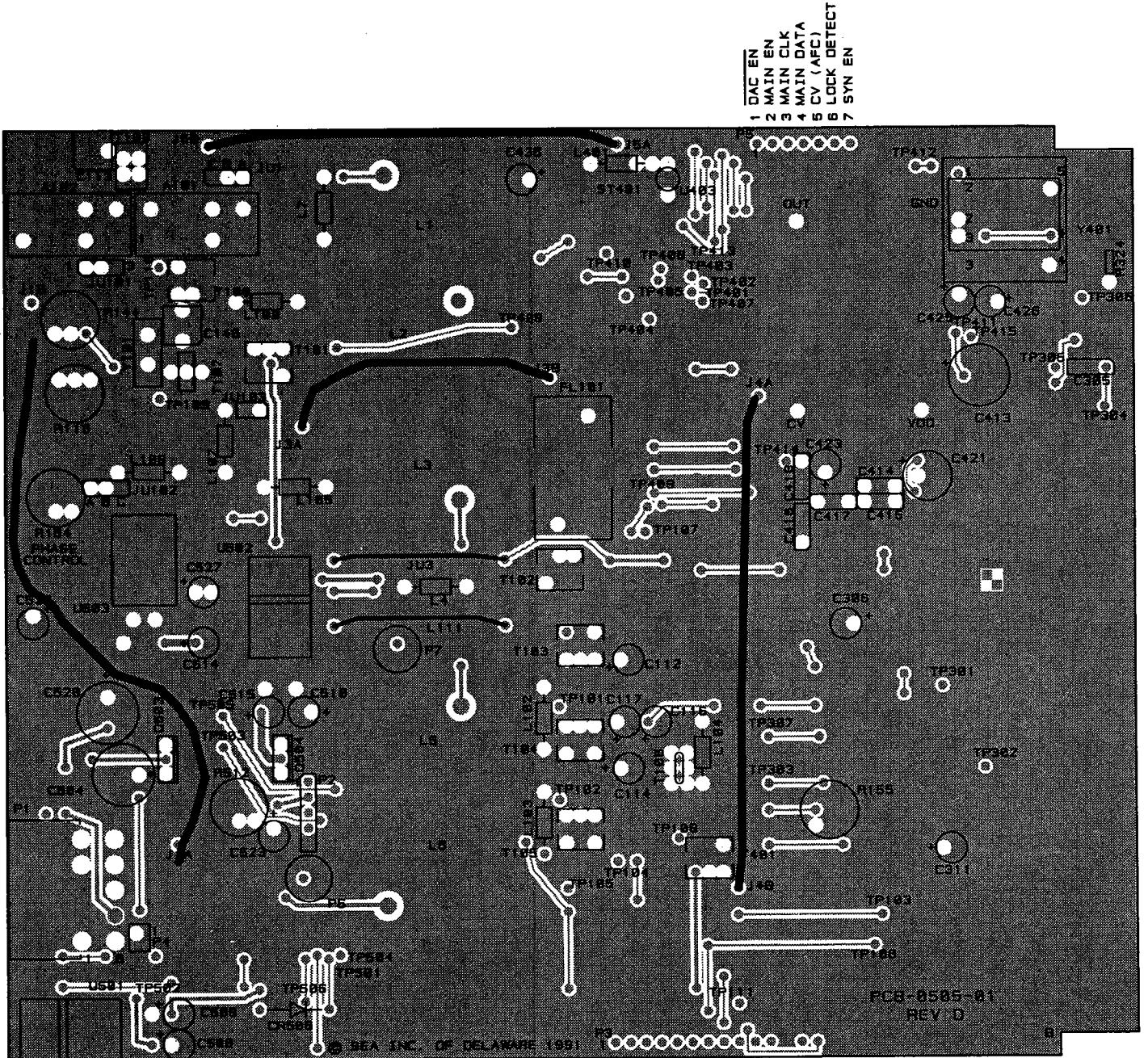
Figure 13.5  
ESP504/520  
Mainboard Schematic  
ASY-0505-01  
SYN, DAC, Ser to Par  
Sheet 5 of 5



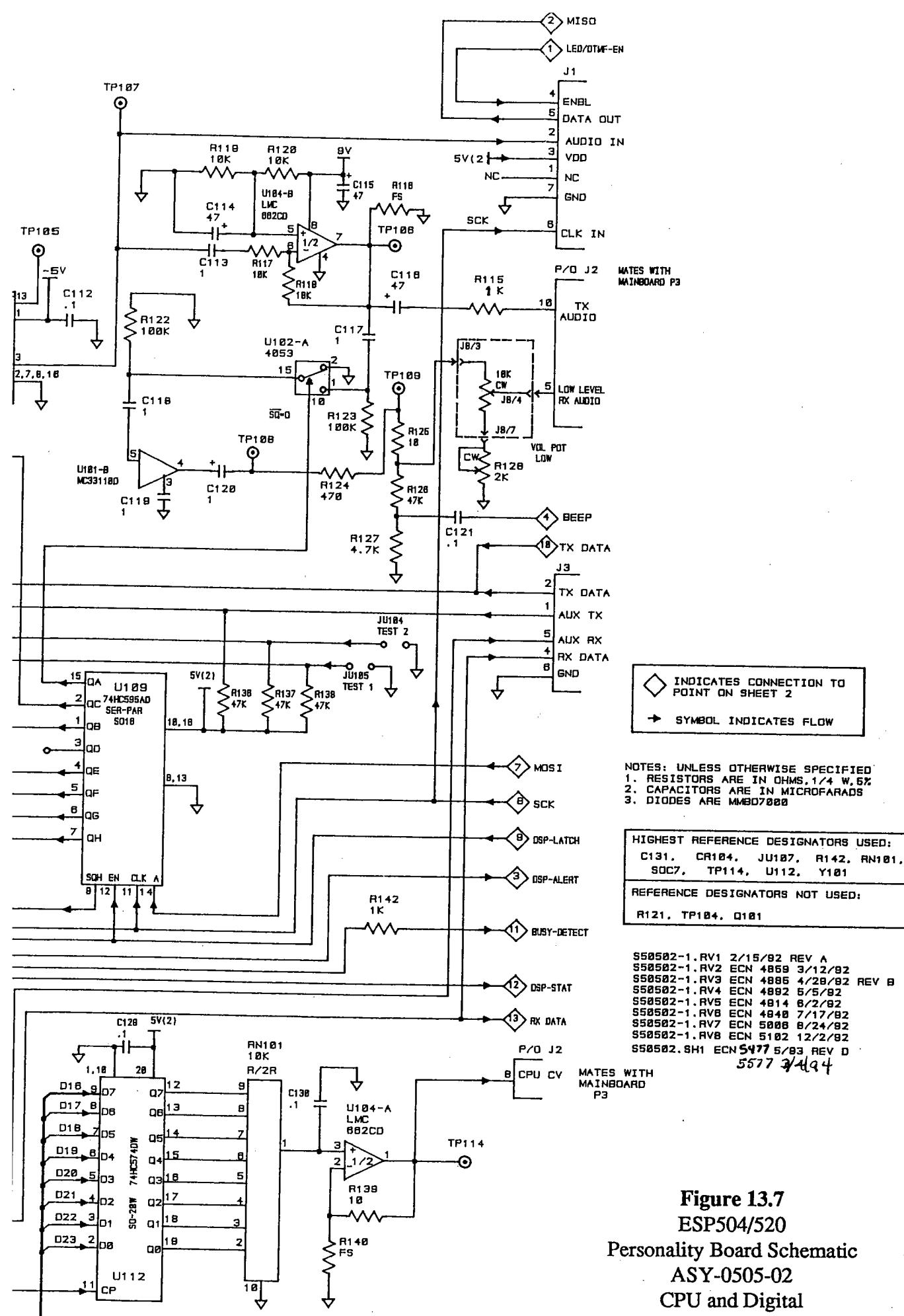


CIRCUIT SIDE

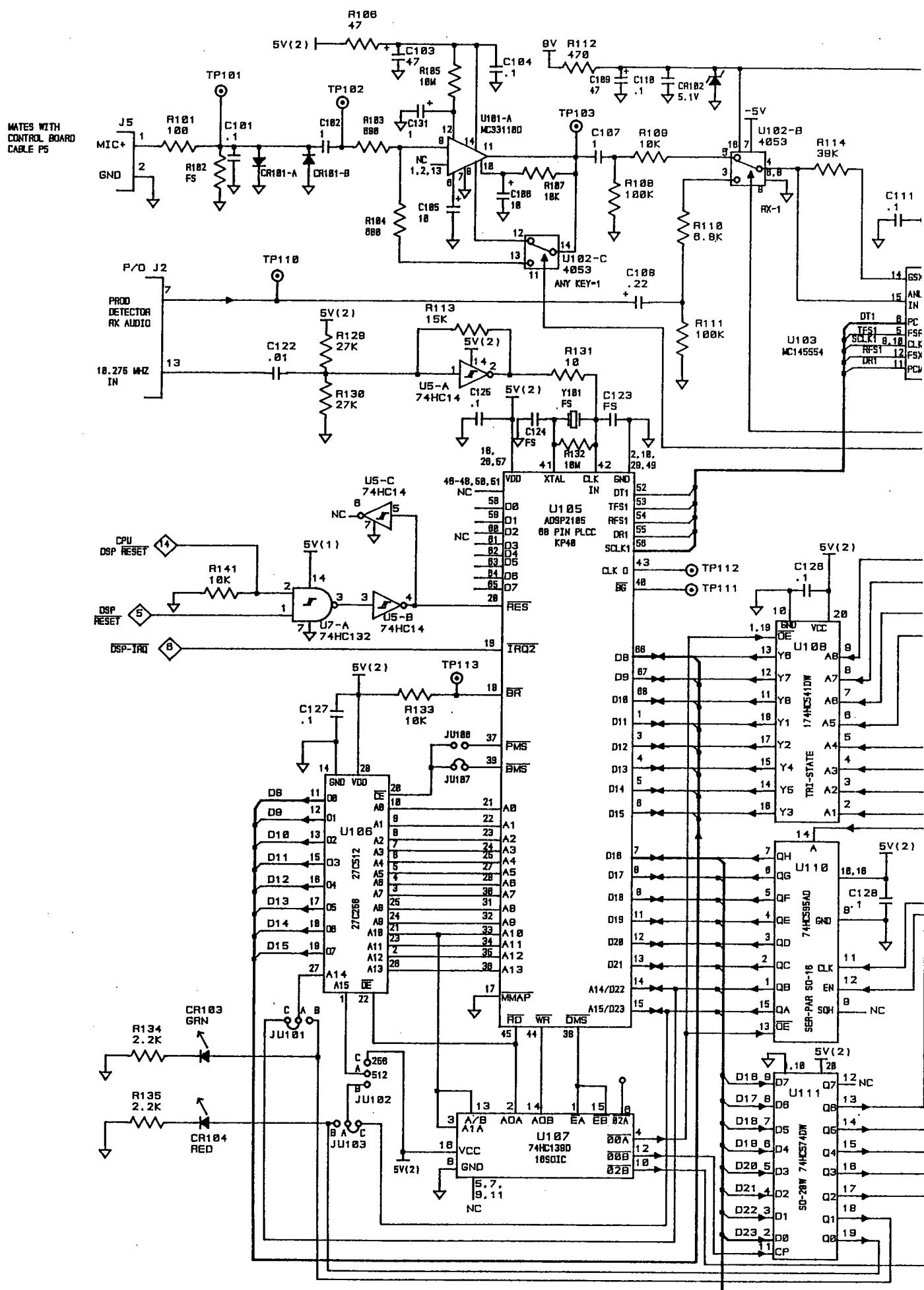
**Figure 13.6**  
**ESP504/520**  
**Mainboard**  
**Circuit Board Detail**  
**ASY-0505-01**

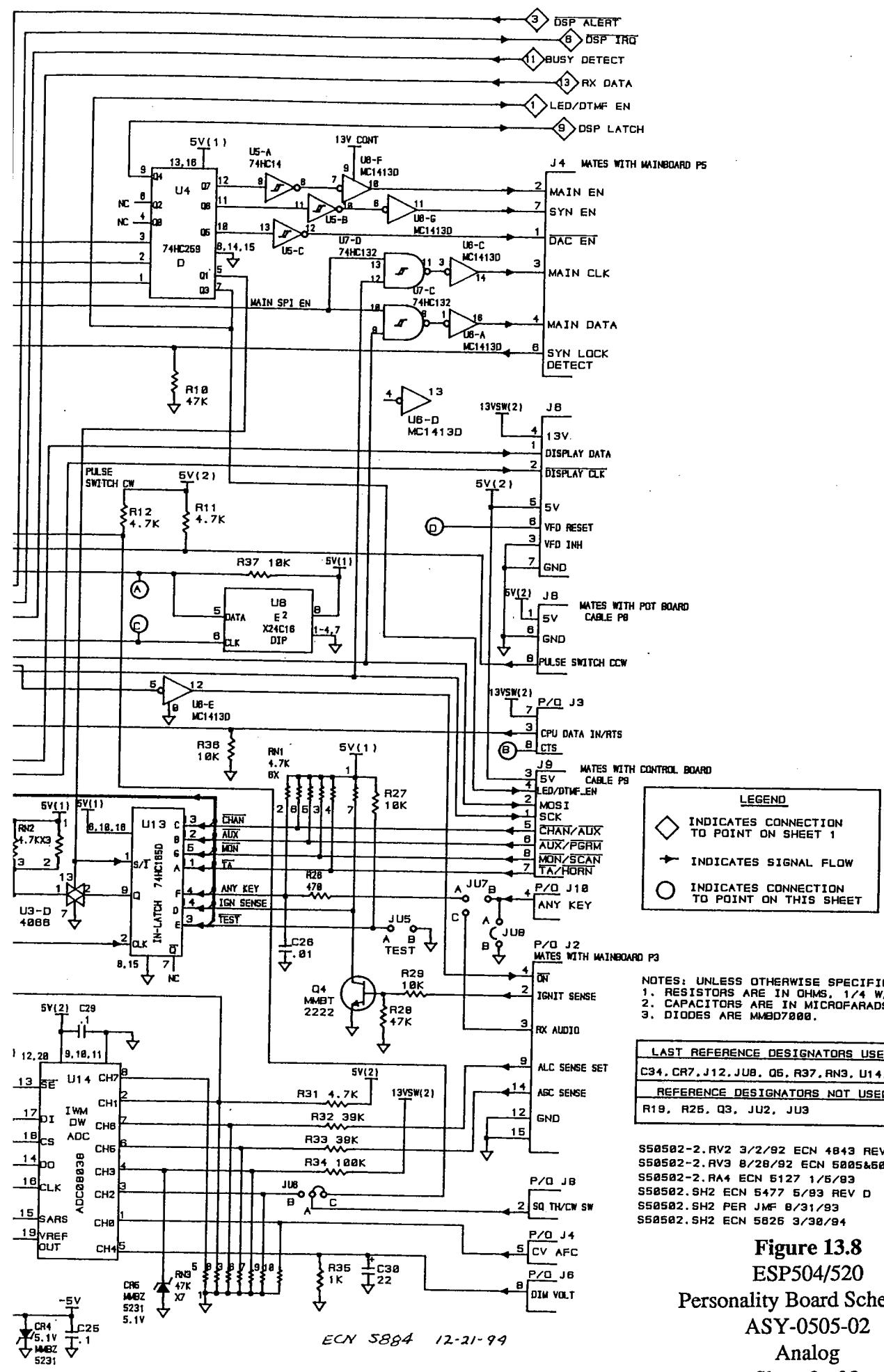


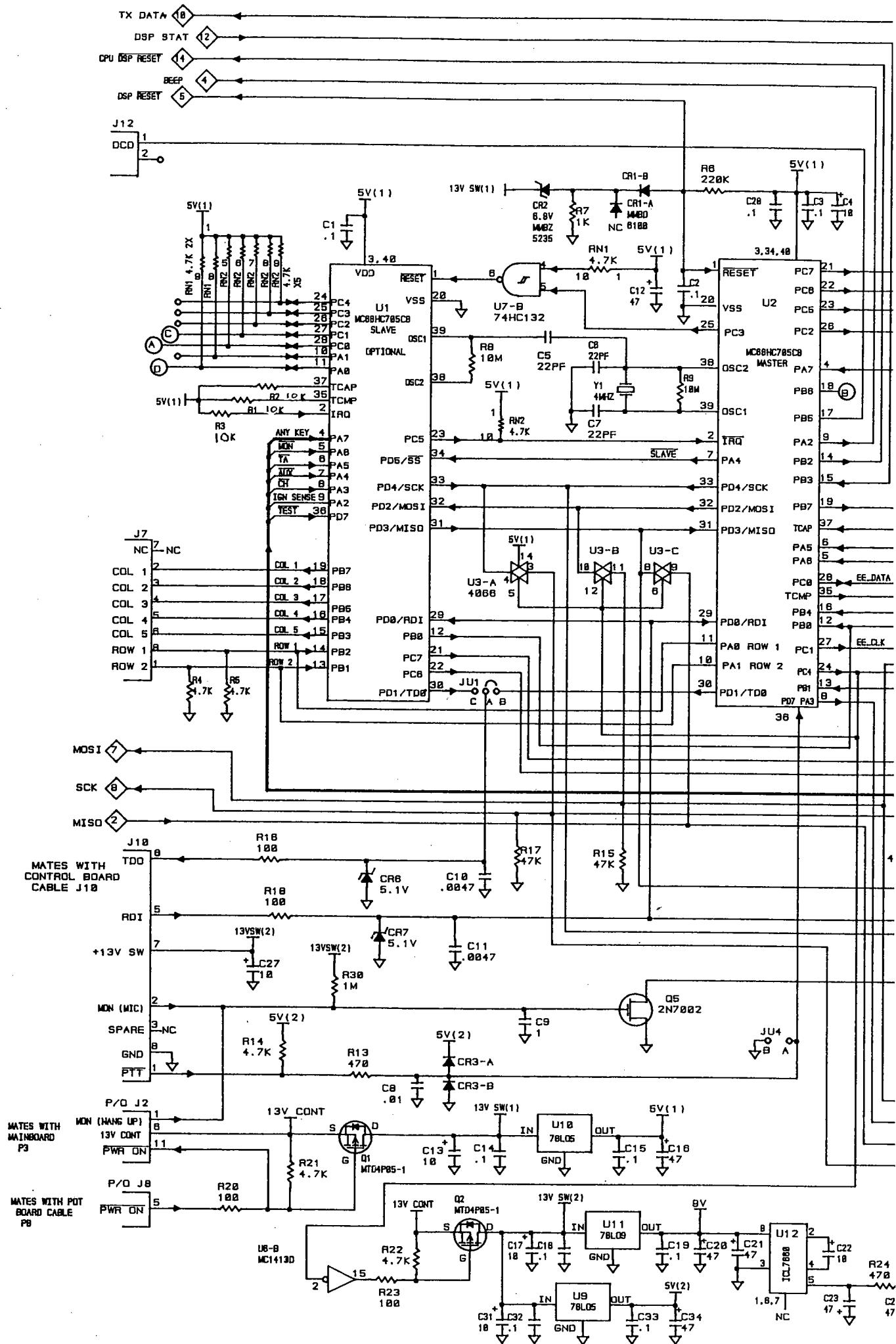
P1			
SPARE 1	5	10	AUX OUT
HORN OUT	4	9	MON (HUB)
GND	3	8	INT SPKR
SPKR-	2	7	SPKR +
IGNIT SENSE	1	6	SPARE 2



**Figure 13.7**  
**ESP504/520**  
**Personality Board Schematic**  
**ASY-0505-02**  
**CPU and Digital**  
**Sheet 1 of 2**







J6

1 DISPLAY DATA  
2 DISPLAY CLK  
3 RESET (VFD)  
4 13V  
5 5V  
6 NC  
7 GND  
8 DIM VOLT

J7

1 ROW 2  
2 COL 1  
3 COL 2  
4 COL 3  
5 COL 4  
6 COL 5  
7 NC  
8 ROW 1

J8

1 5V  
2 SQ TH/CW SW  
3 NC  
4 NC  
5 PWR ON  
6 GND  
7 NC  
8 PULSE SWITCH CCW

J9

1 SCK  
2 MOSI  
3 5V  
4 LED/DTMF EN  
5 CHAN/AUX  
6 AUX/PRGM  
7 TA HORN  
8 MON/SCAN

J10

1 PTT  
2 MON (MIC)  
3 NC  
4 ANY KEY  
5 RDI  
6 TDO  
7 +13V SW  
8 GND

Figure 13.9

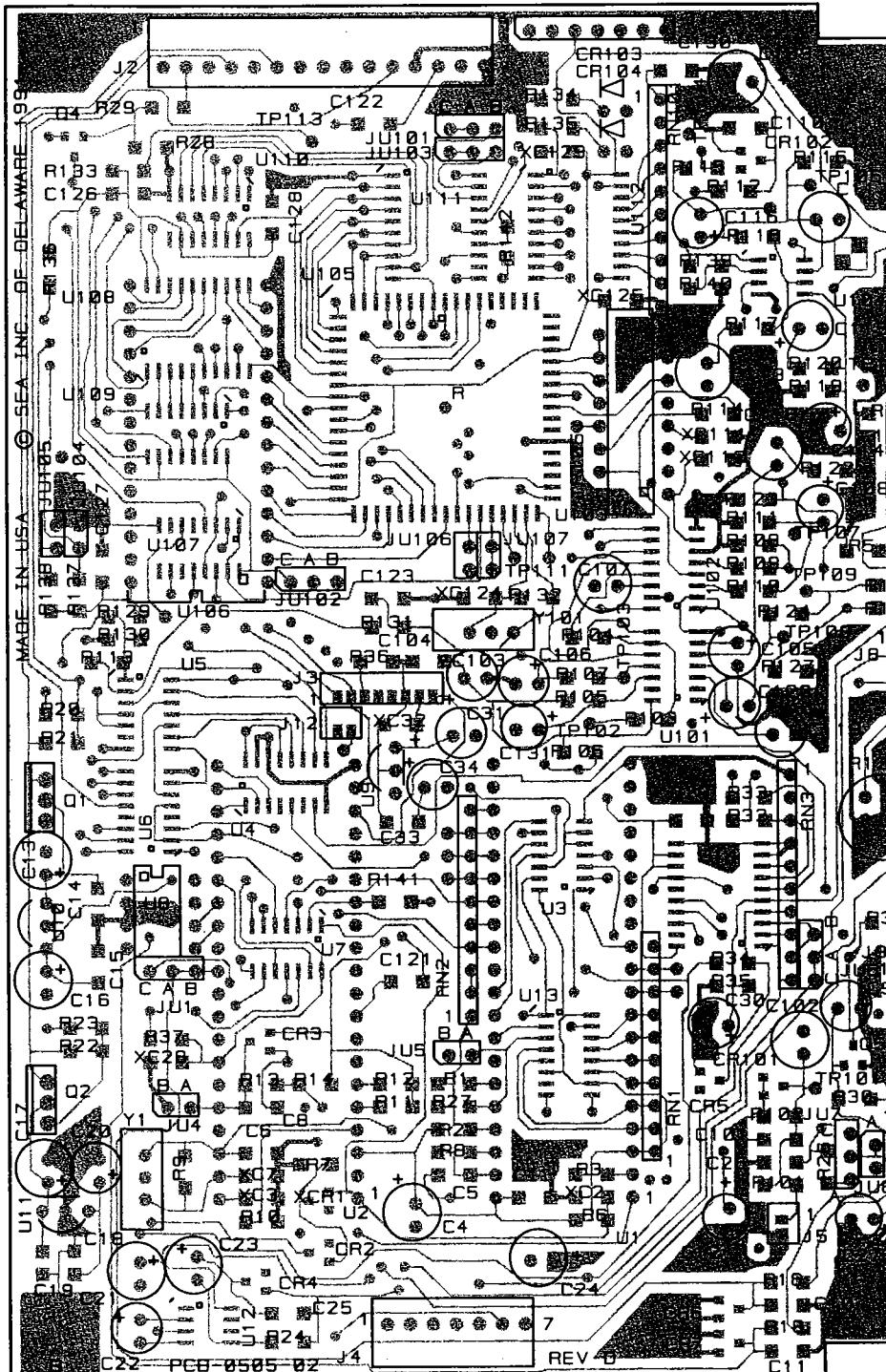
ESP504/520

Personality Board

Circuit Board Detail

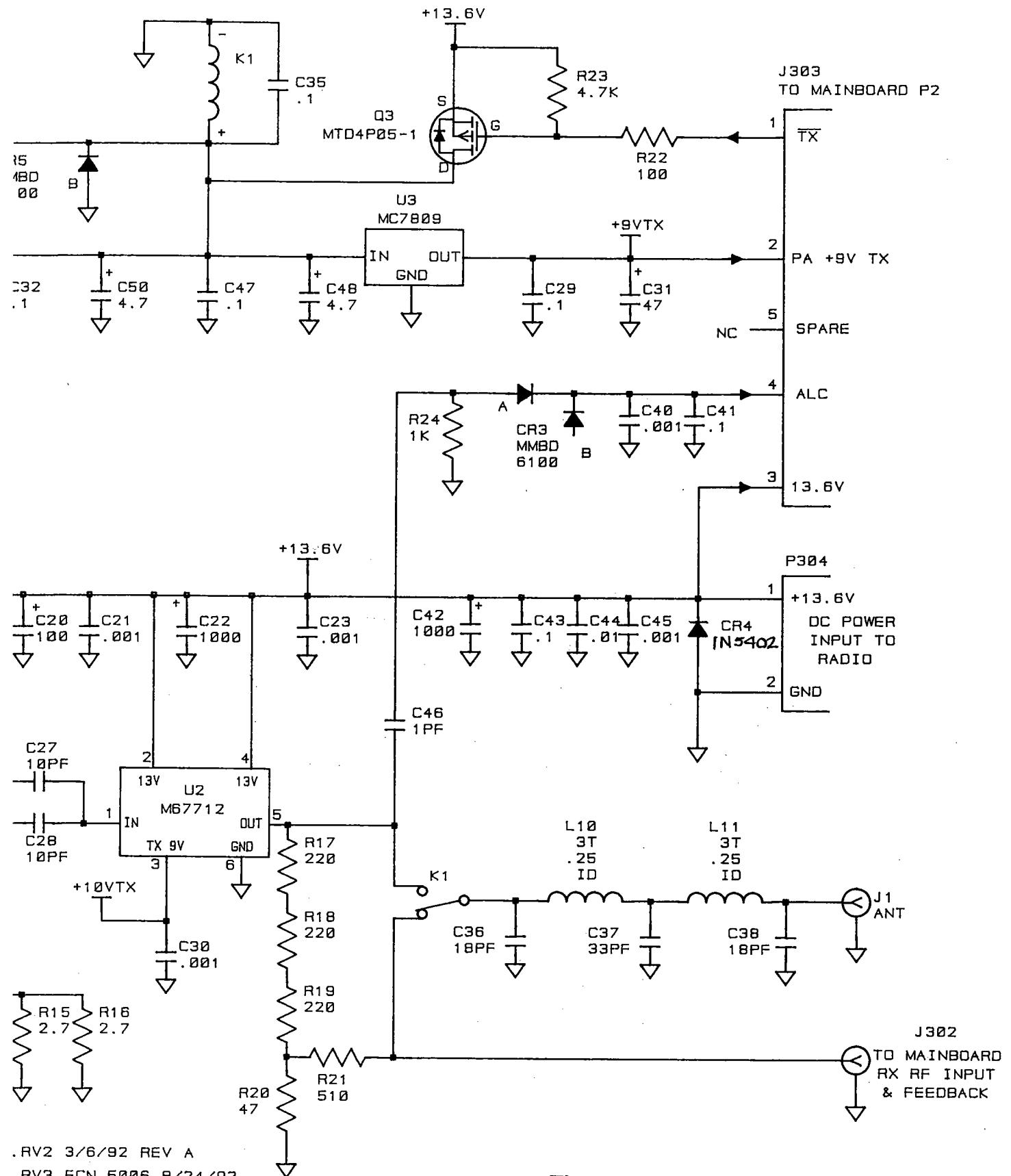
ASY-0505-02

J3	AUX TX	1	
	TX DATA	2	
	CPU DATA IN	3	
	RX DATA	4	
	AUX RX	5	
	GND	6	



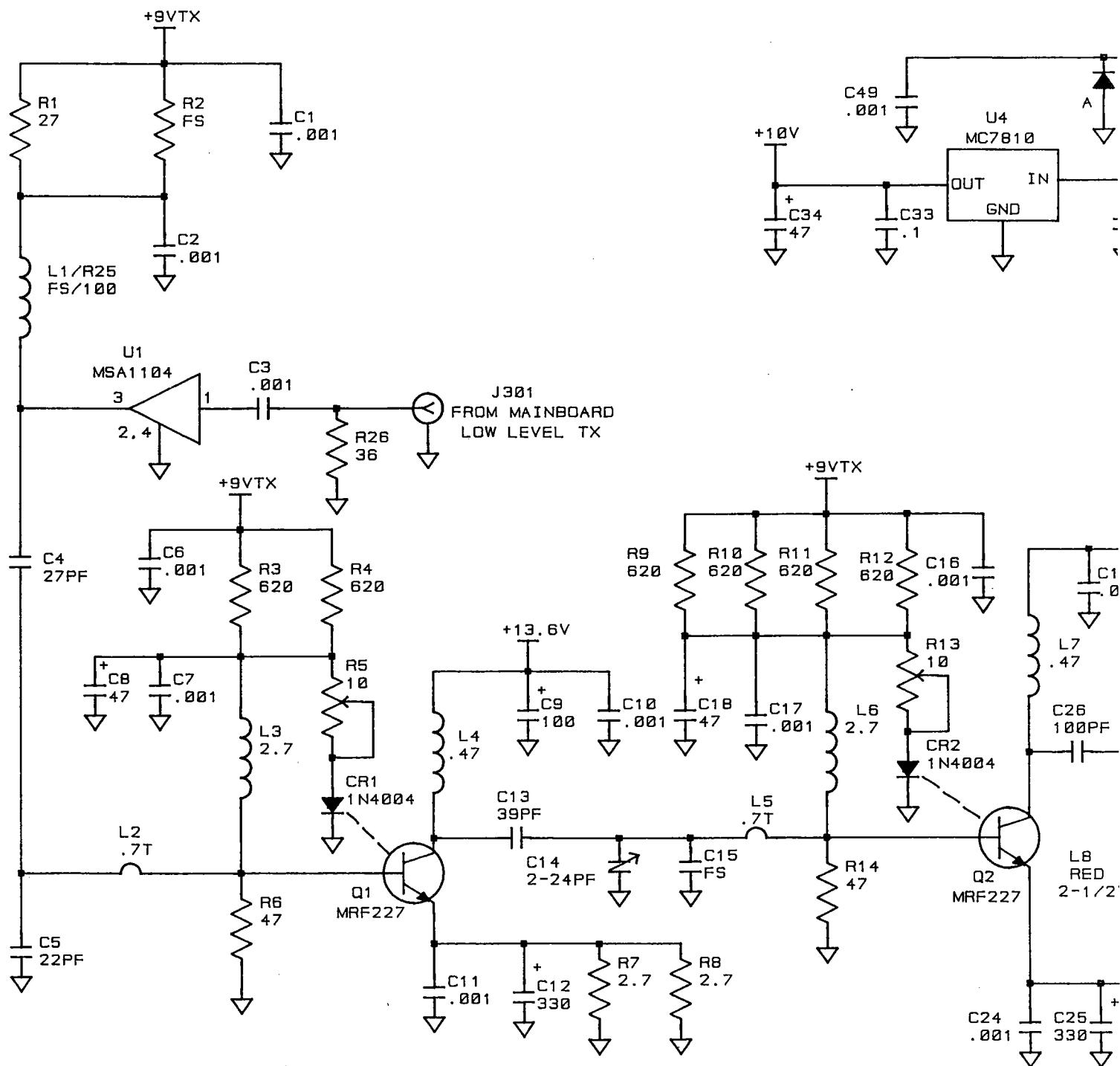
SILKSCREEN

<u>DAC</u>	<u>EN</u>	1	
MAIN	EN	2	
MAIN	CLK	3	
MAIN	DATA	4	
CV	AFC	5	
SYN	LOCK	DET	6
SYN	EN	7	



**Figure 13.10**  
**ESP504/520**  
**RF Power Amplifier Schematic**  
**ASY-0505-03**

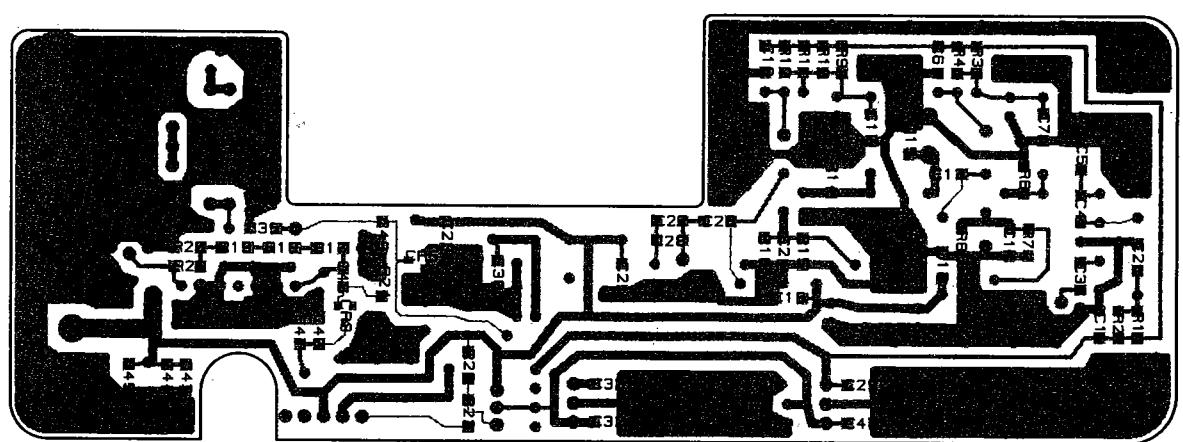
.RV2 3/6/92 REV A  
.RV3 ECN 5006 8/24/92  
.CSD ECN 5706 5/11/94  
.CSD ECN 5977 4/14/95  
1995 5-5-95



NOTES: UNLESS OTHERWISE SPECIFIED  
1. RESISTORS ARE IN OHMS, 1/4 w, 5%.  
2. CAPACITORS ARE IN MICROFARADS.  
3. DIODES ARE MMBD7000.  
4. R26 36ohm IS FACTORY SELECT FOR  
HIGH RF GAIN.

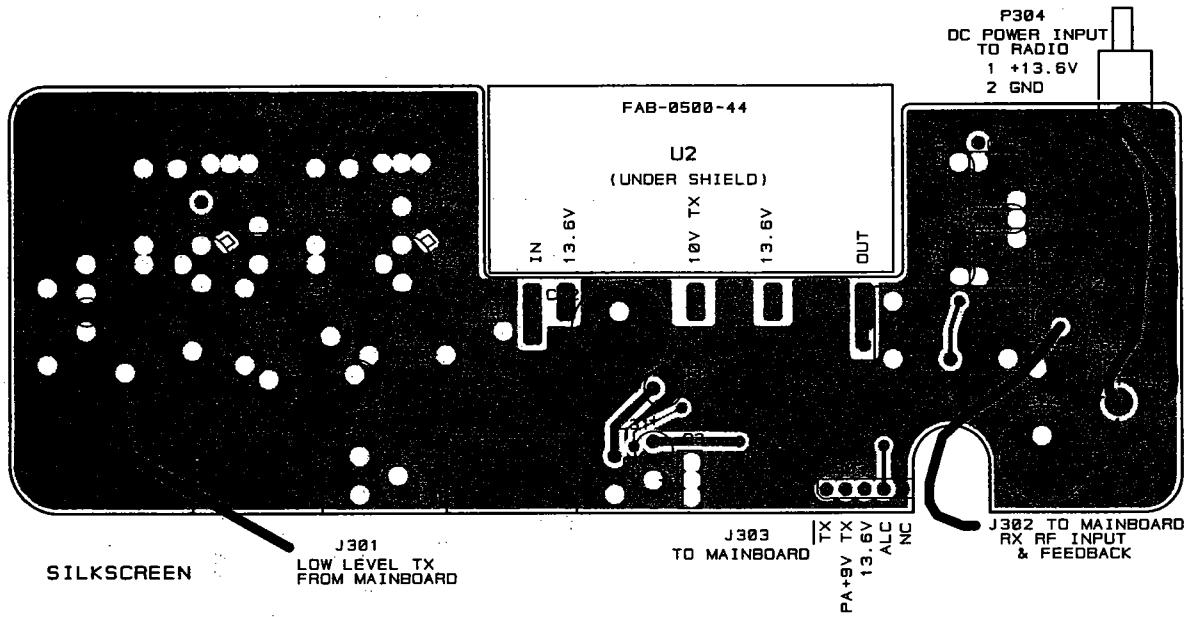
LAST REFERENCE DESIGNATORS USED:  
C50 CR5 HAQ2 HEQ2 J303 L11 P304 Q3 R26 U4  
REFERENCE DESIGNATORS NOT USED:  
C39

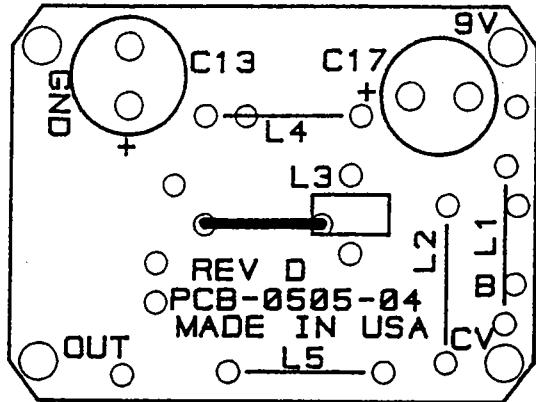
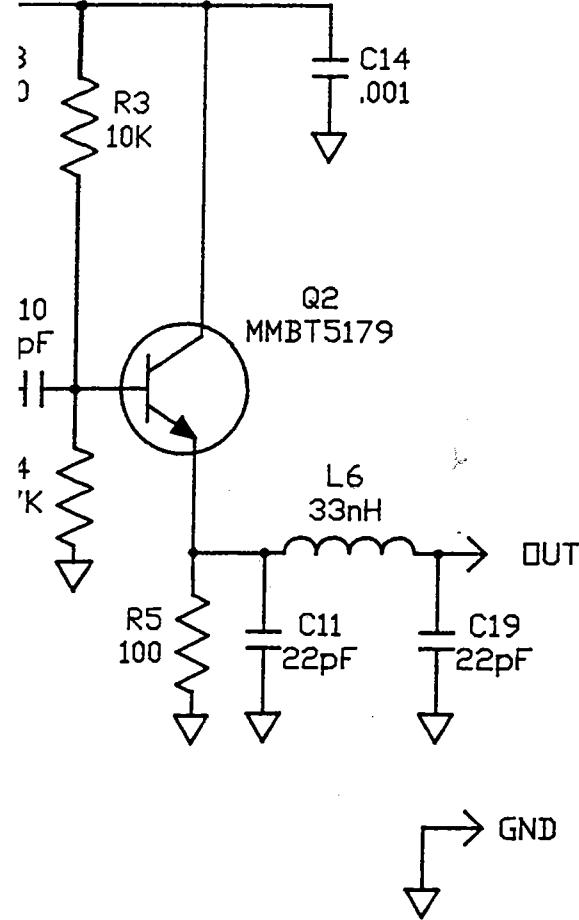
S50E  
S50E  
S50E  
S50E  
ECN



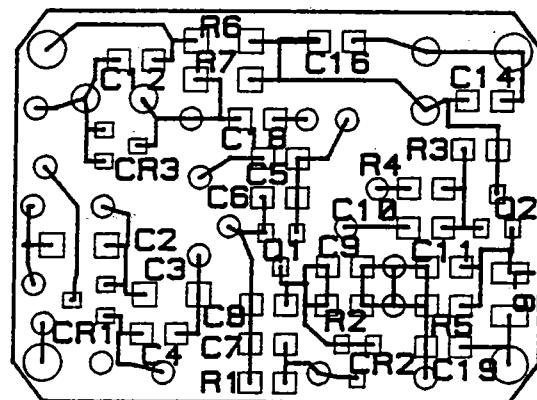
SOLDER SIDE

**Figure 13.11**  
**ESP504/520**  
**RF Power Amplifier**  
**Circuit Board Detail**  
**ASY-0505-03**



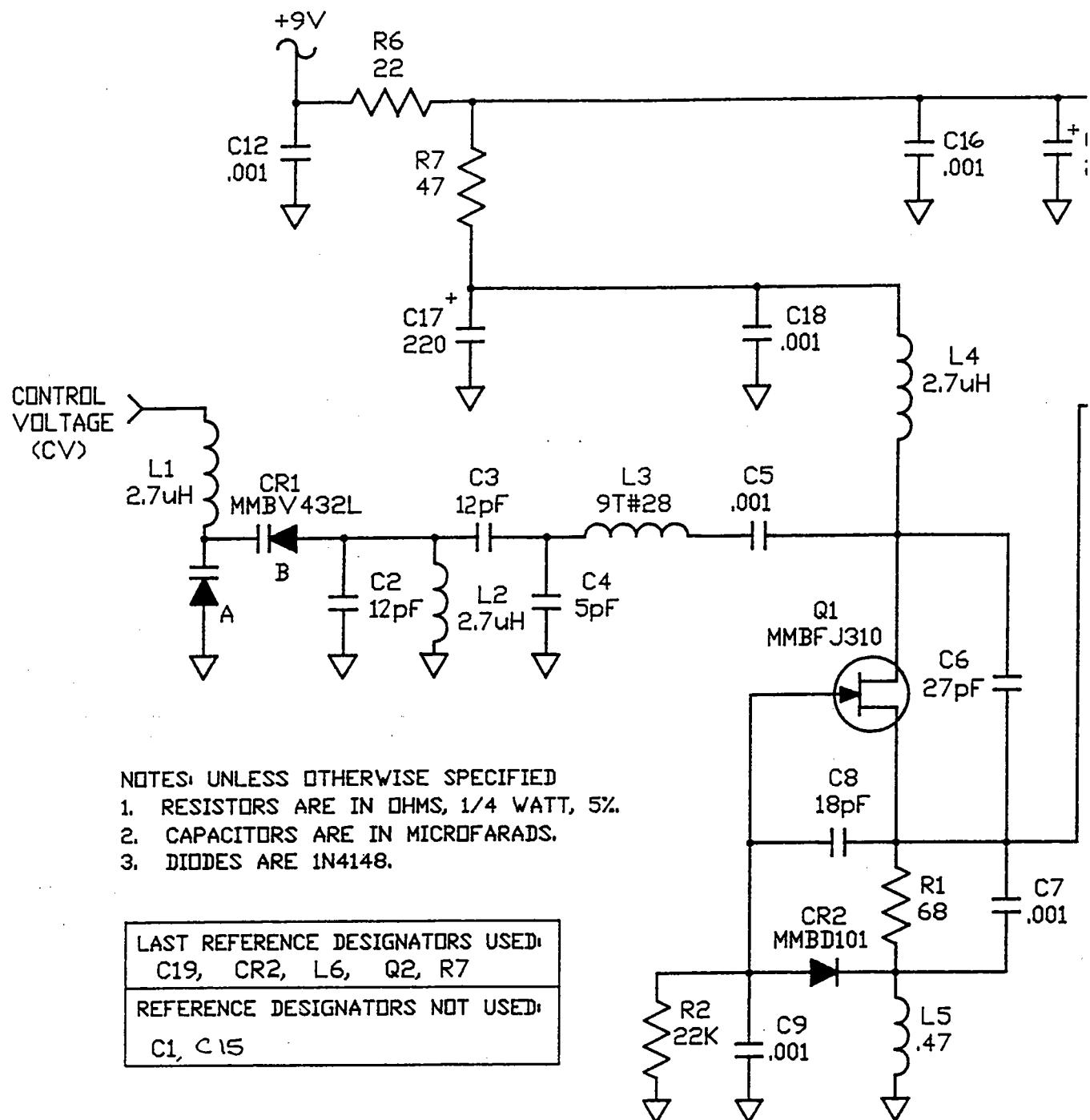


**COMPONENT SIDE**



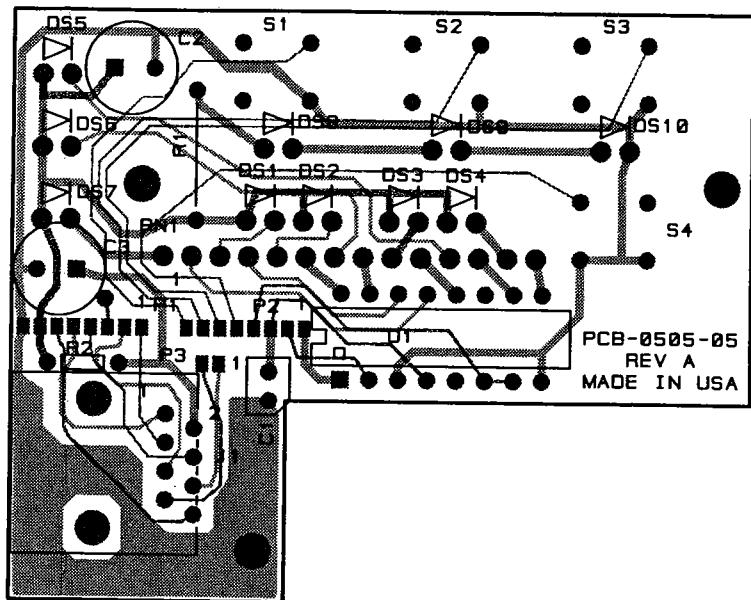
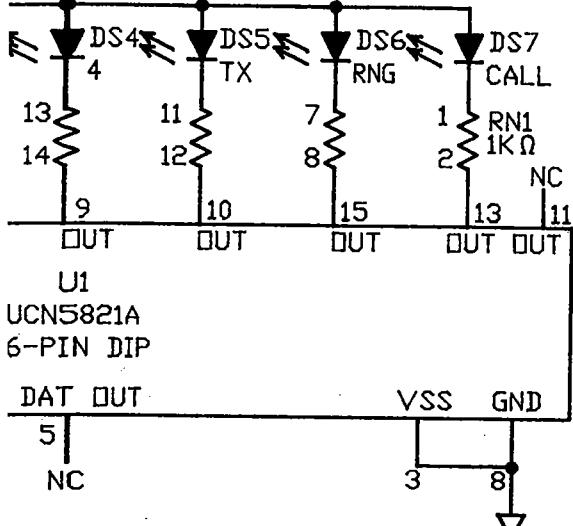
CIRCUIT SIDE

**Figure 13.12**  
**ESP504/520**  
**VCO Schematic and**  
**VCO Circuit Board Detail**  
**ASY-0505-04**



S50504.DWG 4/1/92 REV A  
 S50504.DWG ECN 5006 8/24/92  
 S50504.DWG ECN 5237 4/6/93  
 SP50504.DWG ECN 5532 2/1/94 REV B  
 ECN 5784 7/28/94 REV D

ANTIC



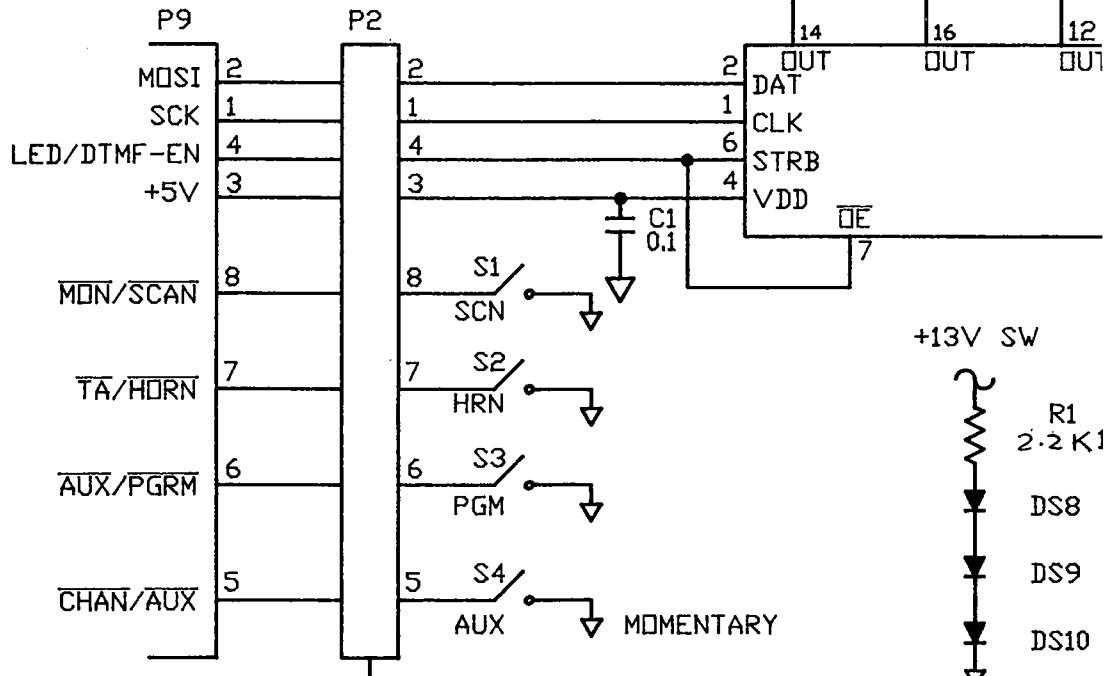
**Figure 13.13**  
ESP504/520

**Control Board Schematic and  
Control Board Circuit Board Detail  
ASY-0505-05**

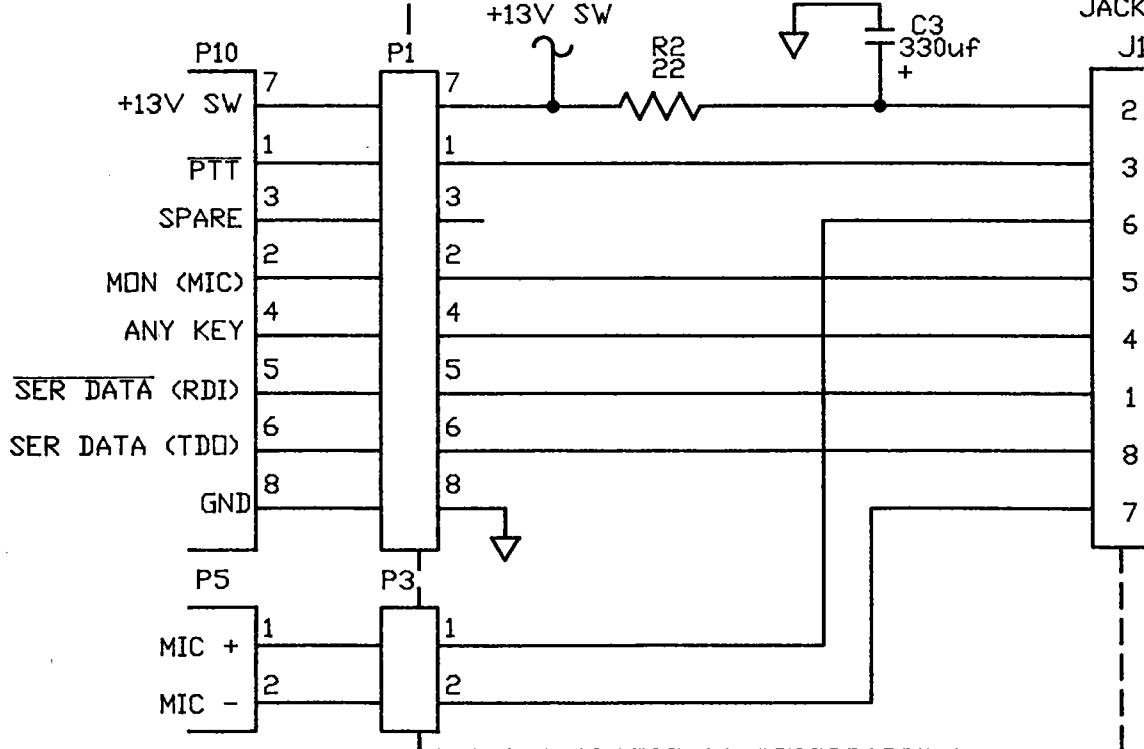
CONTROL BOARD SCHE  
ASY-0505-05

S50505-6.DWG REV P1 1/17/92  
S50505-6.DWG REV P2 7/9/92  
S50505-6.DWG REV A 7/30/92  
ECN 6380 9/15/93

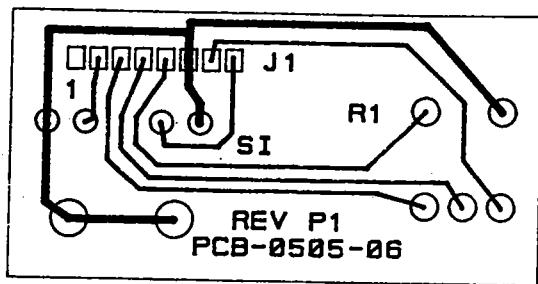
TO PERSONALITY BOARD J9



TO PERSONALITY BOARD J10



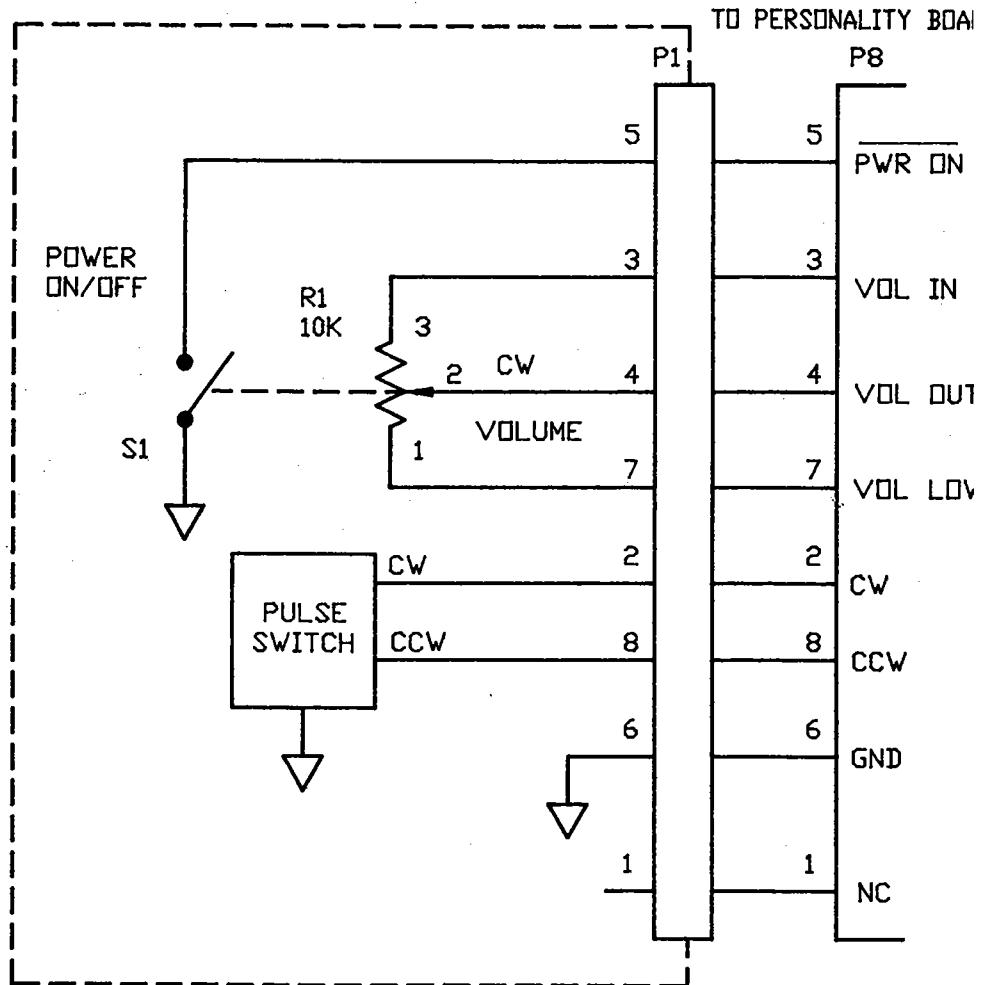
J8



SOLDER SIDE

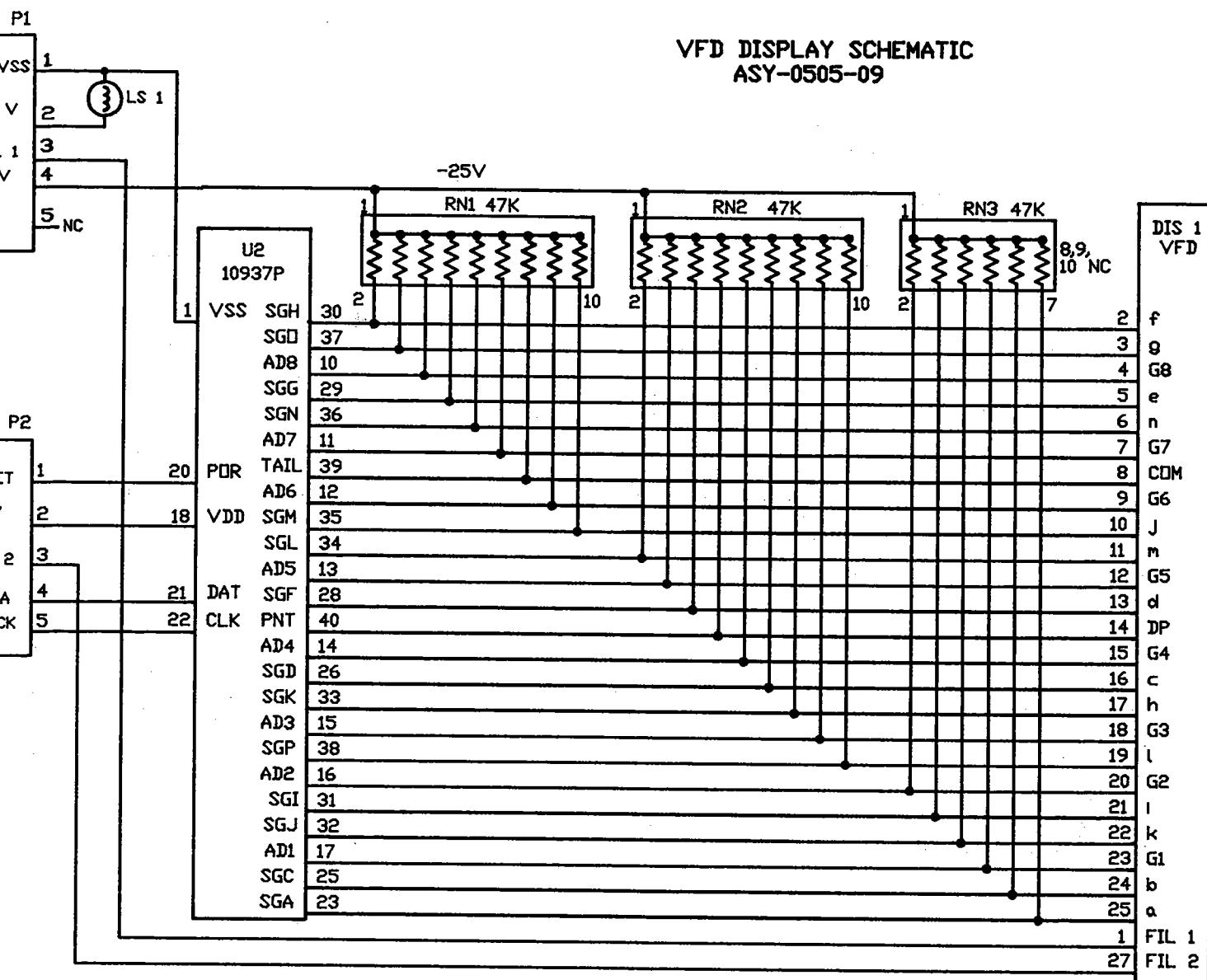
**Figure 13.14**  
**ESP504/520**  
**Pot Board Schematic and**  
**Pot Board Circuit Board Detail**  
**ASY-0505-06**

POT BOARD SCHEMATIC  
ASY-0505-06



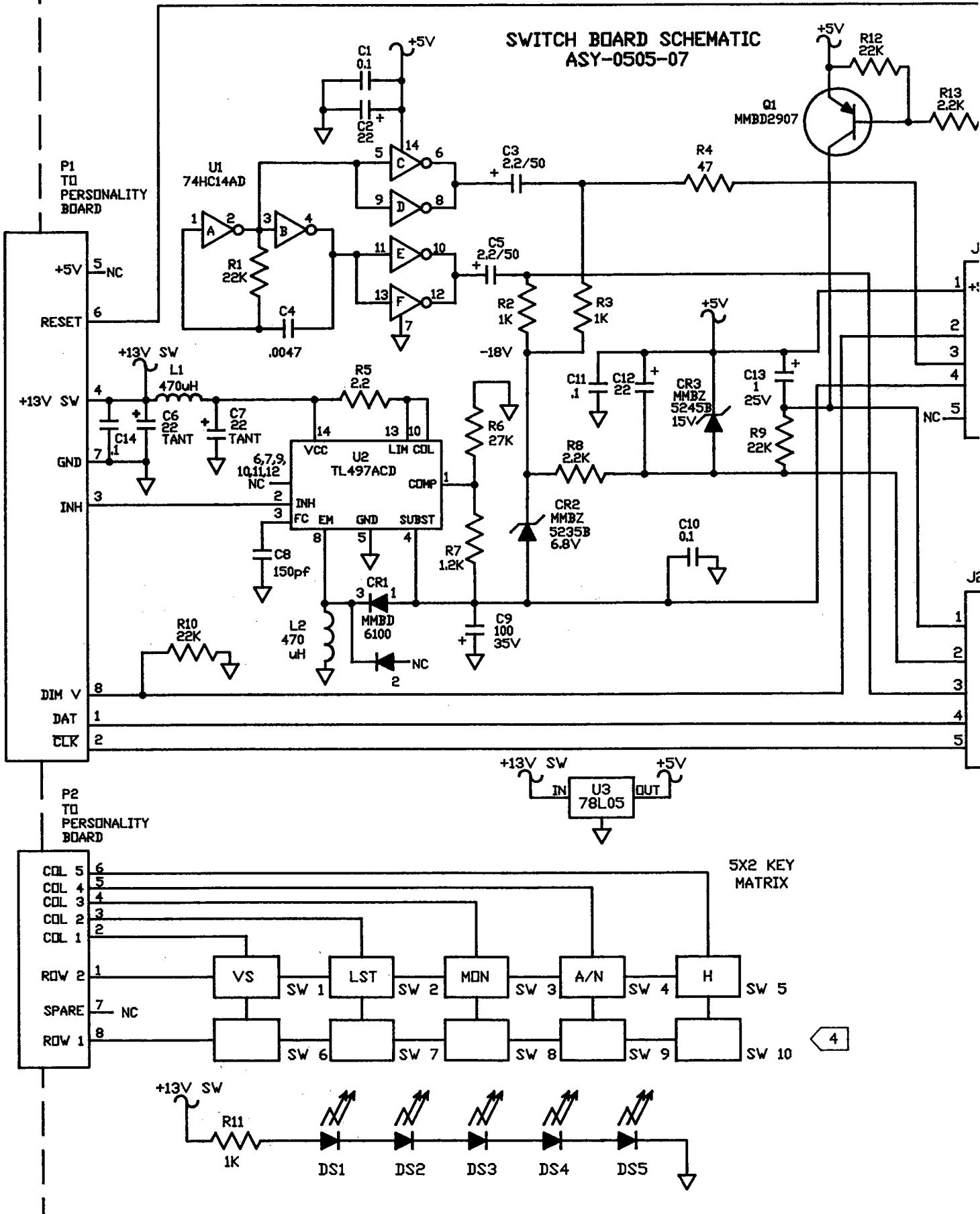
NOTES: UNLESS OTHERWISE SPECIFIED  
 1. RESISTORS ARE IN OHMS, 1/8 WATT, 5%.  
 2. ALL CAPACITORS ARE IN MICROFARADS.  
 3. S1-S10 SPST N.O. MOMENTARY.  
 4. SW6-SW10 NOT INSTALLED ON ASY-0505-07.

FILE# S50507.DWG  
 1/20/92 REV P1  
 REVISED 4/21/93 REV A  
 REVISED 6/29/93 REV B  
 REVISED 8/31/93



HIGHEST REFERENCE DESIGNATORS USED:  
 C14, CR3, L2, Q1, R13, SW10, U3

**Figure 13.15**  
**ESP520 ONLY**  
**Switch Board and**  
**VFD Schematics**  
**ASY-0505-07 / ASY-0505-09**

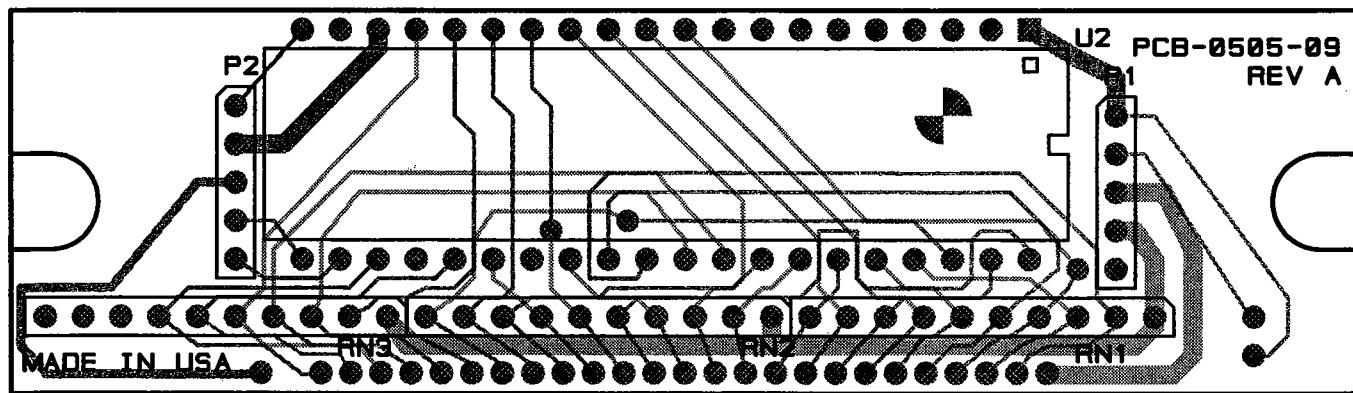


P2

RESET	1
-10V	2
FIL2	3
DATA	4
CLOCK	5

P1

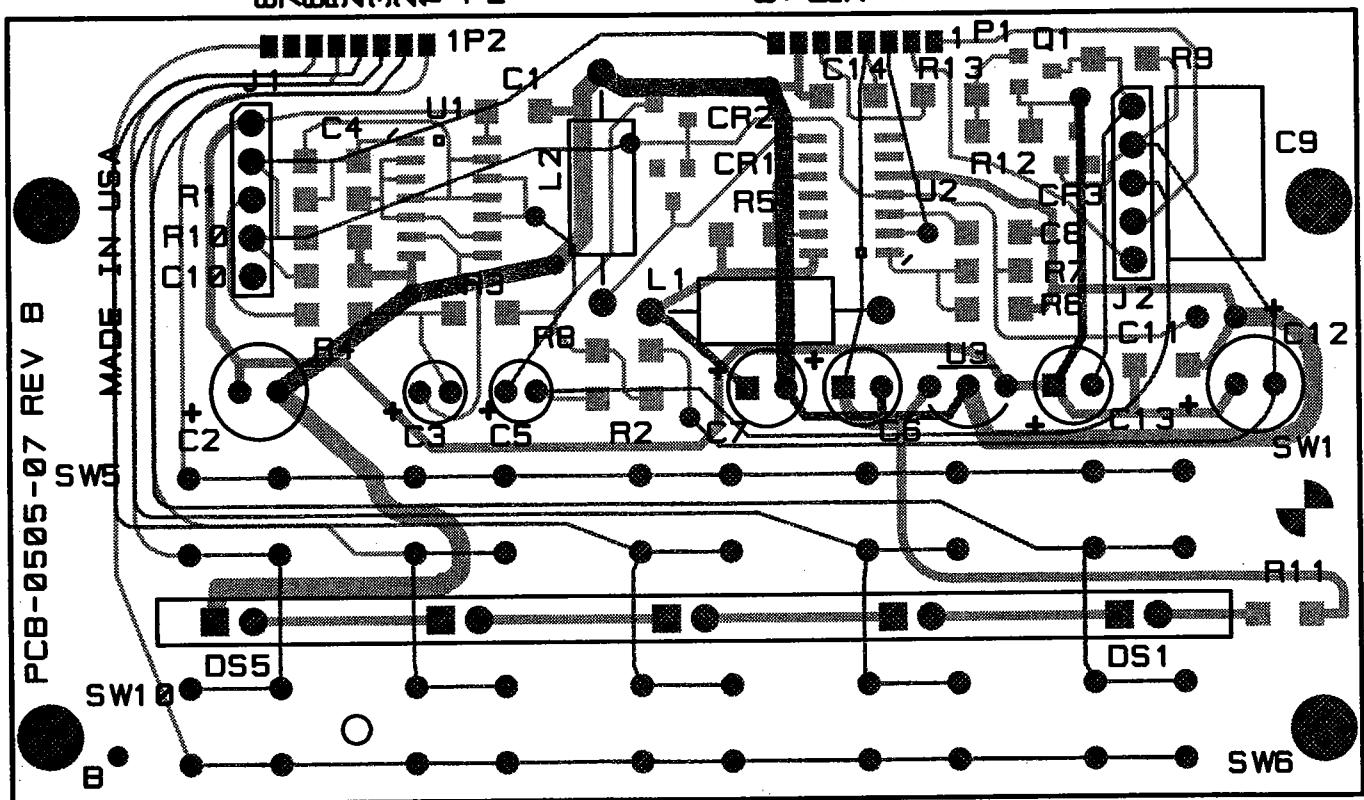
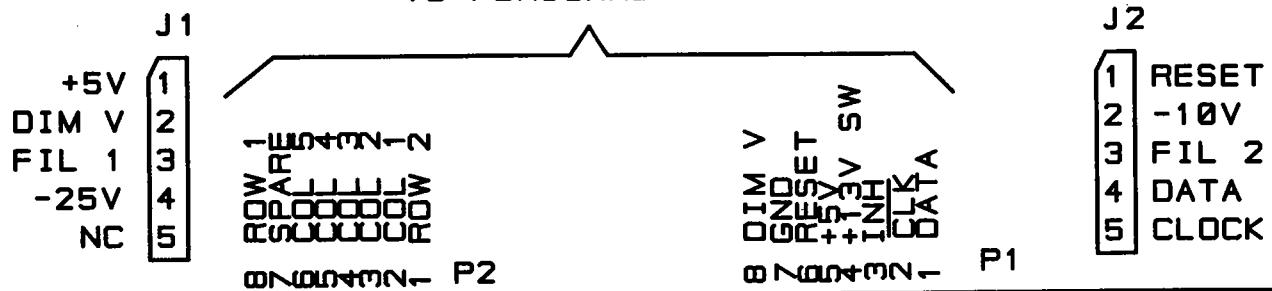
+5V	VSS	1
DIM	V	2
FIL	1	3
-25V		4
NC		5



COMPONENTS ID

Figure 13.16  
ESP520 ONLY  
Switch Board and  
VFD Circuit Board Detail  
ASY-0505-07 / ASY-0505-09

TO PERSONALITY BOARD



EXP.BILL - SINGLE LEVEL BILL-OF-MATERIAL LISTING EFFECTIVE 10/18/94

LEVEL	PART	DESCRIPTION	QTY/ASSY	UM	ITEM DESIGNATORS
0.....	<u>504</u>	<u>4 MODE 220MHz DASH MOUNT</u>		EA	
1.....	ASY-0500-15	COVER W/FELT	2	EA	
1.....	FAB-0500-14	BRACKET, TRUNION	1	EA	
1.....	KIT-0504-99	HARDWARE KIT	1	EA	
1.....	ASY-0500-23	ASSY, MICROPHONE PALM	1	EA	
1.....	ASY-0500-26	CABLE, ACCESSORY	1	EA	
1.....	ASY-0505-11	ASSY, SPEAKER BEZEL	1	EA	
1.....	ASY-0505-14	RADIO, BASIC	1	EA	
1.....	BOX-0500-01	OUTER CONTAINER, ESP500	1	EA	
1.....	FOM-0500-02	2# CUT FOAM	1	EA	
1.....	FOM-0500-03	1# FLAT FOAM	2	EA	
1.....	LBL-0009-003	FCC LABEL, ESP500	1	EA	
1.....	OPR-504	ESP504 OPERATING MANUAL	1	EA	
1.....	OPS-0504-U2	SOFTWARE REV	1	EA	U2
1.....	OPS-0504-U6	SOFTWARE REV	1	EA	U6
1.....	W0504000.1F0	ESP504 FINAL ASSY INSTR.	0	EA	
1.....	W0504000.1S0	ESP504 BOXING INSTR.	0	EA	

EXP.BILL - SINGLE LEVEL BILL-OF-MATERIAL LISTING EFFECTIVE 10/18/94

LEVEL	PART	DESCRIPTION	QTY/ASSY	UM
0.....	<u>ASY-0505-14</u>	<u>RADIO, BASIC</u>		EA
1.....	ASY-0500-10	CHASSIS	1	EA
1.....	ASY-0505-01	MAINBOARD, ESP/DSP	1	EA
1.....	ASY-0505-02	PERSONALITY, ESP/DSP	1	EA
1.....	CAB-0501-001	MINI COAX CABLE, 50 MM	1	EA
1.....	CAB-0501-002	MINI COAX CABLE, 127 MM	1	EA
1.....	FAB-0500-08	SHIELD, FLAT	1	EA
1.....	FAB-0500-30	SPRING CLIP	2	EA
1.....	W0505014.000	ASY-0505-14 RADIO ASSY.	0	EA

## EXP.BILL - SINGLE LEVEL BILL-OF-MATERIAL LISTING EFFECTIVE 10/18/94

LEVEL	PART	DESCRIPTION	QTY/ASSY	UM
0.....	<u>520</u>	<u>20 MODE 220MHz DASH MOUNT</u>		EA
1.....	ASY-0500-15	COVER W/FELT	2	EA
1.....	CON-0034-002	CONNECTOR, RECEPTACLE	1	EA
1.....	FAB-0500-14	BRACKET, TRUNION	1	EA
1.....	KIT-0504-99	HARDWARE KIT	1	EA
1.....	ASY-0500-23	ASSY, MICROPHONE PALM	1	EA
1.....	ASY-0520-12	ASSY, DISPLAY BEZEL	1	EA
1.....	ASY-0520-14	RADIO, BASIC 520	1	EA
1.....	BOX-0500-01	OUTER CONTAINER, ESP500	1	EA
1.....	FOM-0500-02	2# CUT FOAM	1	EA
1.....	FOM-0500-03	1# FLAT FOAM	2	EA
1.....	LBL-0009-005	FCC LABEL, ESP520	1	EA
1.....	OPR-520	ESP520 OPERATING MANUAL	1	EA
1.....	OPS-0504-U6	SOFTWARE REV	1	EA
1.....	OPS-0520-U1	ESP520 OP SYSTEM SLAVE	1	EA
1.....	OPS-0520-U2	ESP520 OP SYSTEM MASTER	1	EA
1.....	SPE-0500-23	EXTERNAL SPEAKER, 4" 40HM 15	1	EA
1.....	W0520000.1F0	520 FINAL ASSY. INSTR	0	EA
1.....	W0520000.1S0	ESP520 BOXING INSTR.	0	EA

EXP.BILL - SINGLE LEVEL BILL-OF-MATERIAL LISTING EFFECTIVE 10/18/94

LEVEL	PART	DESCRIPTION	QTY/ASSY	LM
0.....	<u>ASY-0520-14</u>	<u>RADIO, BASIC 520</u>		EA
1.....	ASY-0500-10	CHASSIS	1	EA
1.....	ASY-0505-01	MAINBOARD, ESP/DSP	1	EA
1.....	ASY-0520-02	PERSONALITY 520 ESP/DSP	1	EA
1.....	CAB-0501-001	MINI COAX CABLE, 50 MM	1	EA
1.....	CAB-0501-002	MINI COAX CABLE, 127 MM	1	EA
1.....	FAB-0500-08	SHIELD, FLAT	1	EA
1.....	FAB-0500-30	SPRING CLIP	2	EA
1.....	W0520014.000	ASY-0520-14 INSTR	0	EA

## EXP.BILL - SINGLE LEVEL BILL-OF-MATERIAL LISTING EFFECTIVE 10/18/94

LEVEL	PART	DESCRIPTION	QTY/ASSY	UM
0.....	<u>ASY-0505-01</u>	<u>MAINBOARD, ESP/DSP</u>		EA
1.....	ASY-0010-07	7 TURN TRANSFORMER	1	EA
1.....	ASY-0175-T8	WIDE BAND TRANSFORMER	1	EA
1.....	ASY-0500-20	ASSY VCO SHIELD	1	EA
1.....	ASY-0500-31	660MHz 1/4 WAVE STUB	1	EA
1.....	ASY-0500-J1	90o PHASE SHIFTER 17"	1	EA
1.....	ASY-0500-J3	2.25" COAX	1	EA
1.....	ASY-0500-J4	3.45" COAX	1	EA
1.....	ASY-0500-J5	3" COAX	1	EA
1.....	ASY-0505-04	VCO, DSP	1	EA
1.....	CAP-0027-103	CAPACITOR FILM CK05 .01	1	EA
1.....	CAP-0027-104	CAPACITOR FILM CK05 .1	2	EA
1.....	CAP-0027-224	CAPACITOR FILM CK05 .22	1	EA
1.....	CAP-0027-472	CAPACITOR FILM CK05 .0047	1	EA
1.....	CAP-0027-473	CAPACITOR FILM CK05 .047	1	EA
1.....	CAP-0037-002	CAP.ELECT 2.2uf RAD	2	EA
1.....	CAP-0037-004	CAP.ELECT 47UF RAD	8	EA
1.....	CAP-0037-006	CAP.ELECT 10UF RAD	4	EA
1.....	CAP-0039-107	CAP, ELEC 100uF 35V	1	EA
1.....	CAP-0039-108	CAP, ELEC 1000uF 16V	3	EA
1.....	CAP-0039-337	CAP ELEC 330uF 16V	1	EA
1.....	CAP-0074-001	CAP 1uf NONPOLARIZED ELECT	1	EA
1.....	CAP-0076-002	TRIMMER 3-10PF SEALED	2	EA
1.....	CON-0001-010	JACK, MINI RF 90Deg	2	EA
1.....	CON-0026-001	JUMPER, POST HEADER	2	EA
1.....	CON-0034-001	CONNECTOR, RT ANG HEADER	1	EA
1.....	CON-0036-007	POST HEADER	1	EA
1.....	CON-0036-015	POST HEADER	1	EA
1.....	CON-0052-005	POST HEADER 5-CKT, .420 HT	1	EA

## EXP.BILL - SINGLE LEVEL BILL-OF-MATERIAL LISTING EFFECTIVE 10/18/94

LEVEL	PART	DESCRIPTION	QTY/ASSY	UM
0.....	ASY-0505-01	MAINBOARD, ESP/DSP		EA
1.....	CON-0053-002	HEADER, 2CKT	1	EA
1.....	CON-0240-030	POST HEADER 3 PIN	3	EA
1.....	CRY-0007-004	CRYSTAL, 10.2728 MHZ	1	EA
1.....	FAB-0500-42	SHIELD, L101	1	EA
1.....	FAB-0500-43	VCO GROUND STRAP	1	EA
1.....	FAB-0500-45	LO PASS SHIELD, .016" BRASS	1	EA
1.....	FAB-0500-61	FELT STRIP, .75"	1	EA
1.....	FAB-0500-64	FELT STRIP .6 X 1.9"	1	EA
1.....	FAB-0500-65	FELT STRIP .5 X .65"	1	EA
1.....	FER-0004-002	TOROID TYPE 43 BEAD	2	EA
1.....	FIL-0007-008	TEN POLE I-F, 10.275 MHZ	1	EA
1.....	HAR-0025-002	FINGER STOCK COPPER	0.2	IN
1.....	HAR-0103-001	O-RING .029x.040 BUNA-N 50D	4	EA
1.....	IND-0002-221	HELIX, 221 MHz CLEAR	4	EA
1.....	IND-0002-222	HELIX 2, 221 MHz BLUE	1	EA
1.....	IND-0021-020	INDUCTOR, 27uh CRAMER	1	EA
1.....	IND-0022-002	INDUCTOR, 2.7 uH	2	EA
1.....	IND-0022-270	27 UH MINI INDUCTOR	7	EA
1.....	JUM-0002-110	JUMPER, 1.10" #24 TEFLON	1	EA
1.....	MIX-0002-001	DBL BAL MIXER	1	EA
1.....	MIX-0002-004	MIXER DBL BAL UP CONVERSION	1	EA
1.....	OSC-0010-275	VCTCXO, 10.275023 MHz	1	EA
1.....	RES-0001-101	RESISTOR 100 1/4W	1	EA
1.....	RES-0001-103	RESISTOR 10K 1/4W	1	EA
1.....	RES-0010-182	RESISTOR, 1.8K OHM	1	EA
1.....	RES-0027-105	TRIMMER, 1 MEG POT	1	EA
1.....	RES-0027-201	TRIMMER, 200 OHM POT	2	EA
1.....	RES-0027-202	RESISTOR, TRIMPOT 2K	1	EA

REFERENCE DESIGNATORS FOR ASY-0505-01 MAINBOARD, ESP/DSP

EFFECTIVE 10-18-94

REF DES	PART NUM	DESCRIPTION
A101	MIX-0002-004	MIXER DBL BAL UP CONVERSION
A102	MIX-0002-001	DBL BAL MIXER
C112	CAP-0037-002	CAP.ELECT 2.2uf RAD
C113	CAP-0076-002	TRIMMER 3-10PF SEALED
C114	CAP-0037-002	CAP.ELECT 2.2uf RAD
C117	CAP-0037-004	CAP.ELECT 47UF RAD
C145	CAP-0076-002	TRIMMER 3-10PF SEALED
C305	CAP-0027-224	CAPACITOR FILM CK05 .22
C306	CAP-0037-004	CAP.ELECT 47UF RAD
C413	CAP-0039-108	CAP, ELEC 1000uF 16V
C414	CAP-0027-104	CAPACITOR FILM CK05 .1
C415	CAP-0027-103	CAPACITOR FILM CK05 .01
C416	CAP-0027-473	CAPACITOR FILM CK05 .047
C417	CAP-0027-472	CAPACITOR FILM CK05 .0047
C418	CAP-0027-104	CAPACITOR FILM CK05 .1
C421	CAP-0039-337	CAP ELEC 330uF 16V
C423	CAP-0037-004	CAP.ELECT 47UF RAD
C425	CAP-0037-004	CAP.ELECT 47UF RAD
C426	CAP-0037-004	CAP.ELECT 47UF RAD
C436	CAP-0037-004	CAP.ELECT 47UF RAD
C504	CAP-0039-108	CAP, ELEC 1000uF 16V
C508	CAP-0037-006	CAP.ELECT 10uF RAD
C509	CAP-0037-004	CAP.ELECT 47UF RAD
C514	CAP-0039-107	CAP, ELEC 100uF 35V
C515	CAP-0037-006	CAP.ELECT 10uF RAD
C518	CAP-0037-004	CAP.ELECT 47UF RAD
C523	CAP-0074-001	CAP 1uf NONPOLARIZED ELECT
C526	CAP-0037-006	CAP.ELECT 10uF RAD
C527	CAP-0037-006	CAP.ELECT 10uF RAD
C528	CAP-0039-108	CAP, ELEC 1000uF 16V
CR506	SEM-0087-001	1N4004 DIODE GP RECTIFIER, DO-14
FL101	FIL-0007-008	TEN POLE I-F, 10.275 MHZ
J1	ASY-0500-J1	90o PHASE SHIFTER 17"
J3	ASY-0500-J3	2.25" COAX
J4	ASY-0500-J4	3.45" COAX
J5	ASY-0500-J5	3" COAX
JU1	CON-0240-030	POST HEADER 3 PIN
JU101	CON-0240-030	POST HEADER 3 PIN
JU102	CON-0240-030	POST HEADER 3 PIN
JU3	JLM-0002-110	JUMPER, 1.10" #24 TEFLON
L1	IND-0002-221	HELIX, 221 MHz CLEAR
L102	IND-0022-270	27 UH MINI INDUCTOR
L103	IND-0022-270	27 UH MINI INDUCTOR
L104	IND-0022-270	27 UH MINI INDUCTOR
L105	IND-0022-270	27 UH MINI INDUCTOR
L107	IND-0022-270	27 UH MINI INDUCTOR
L108	IND-0022-270	27 UH MINI INDUCTOR
L109	IND-0022-270	27 UH MINI INDUCTOR
L111	IND-0021-020	INDUCTOR, 27uh CRAMER
L2	IND-0002-222	HELIX 2, 221 MHz BLUE
L3	IND-0002-221	HELIX, 221 MHz CLEAR

EXP.BILL - SINGLE LEVEL BILL-OF-MATERIAL LISTING EFFECTIVE 10/18/94

LEVEL	PART	DESCRIPTION	QTY/ASSY	UM
0.....	ASY-0505-01	MAINBOARD, ESP/DSP		EA
1.....	SEM-0027-003	MTD5P06E1 P-CHAN TMOSFET 4A,	2	EA
1.....	SEM-0087-001	1N4004 DIODE GP RECTIFIER, DO	1	EA
1.....	SEM-0109-008	7809 VOLTAGE REG, 9V T0-220	2	EA
1.....	SEM-0153-003	TDA2002H OR TDA2003H	1	EA
1.....	SEM-0165-007	MMIC, MSA-1104	1	EA
1.....	SMT-0505-01	MAIN BOARD, SMT	1	EA
1.....	TRA-0005-001	TRANSFORMER, BLK	4	EA
1.....	TRA-0006-001	TRANSFORMER, ORN	2	EA
1.....	TRA-0013-003	11MHZ-7MM TRANSFORMER SUB-MIN	1	EA
1.....	TRA-0016-002	RF TRANS, TRI-FILER .07-200 M	1	EA

REFERENCE DESIGNATORS FOR SMT-0505-01 MAIN BOARD, SMT

EFFECTIVE 10-18-94

REF DES	PART NUM	DESCRIPTION
C1	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C10	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C101	CAP-1206-103	SM.CAP .01uF @ 100V VIO A/A4
C102	CAP-1206-103	SM.CAP .01uF @ 100V VIO A/A4
C103	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C104	CAP-1206-103	SM.CAP .01uF @ 100V VIO A/A4
C105	CAP-1206-103	SM.CAP .01uF @ 100V VIO A/A4
C106	CAP-1206-103	SM.CAP .01uF @ 100V VIO A/A4
C107	CAP-1206-680	CAPACITOR, 'W1' SM 68pF
C108	CAP-1206-103	SM.CAP .01uF @ 100V VIO A/A4
C109	CAP-1206-103	SM.CAP .01uF @ 100V VIO A/A4
C11	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C110	CAP-1206-103	SM.CAP .01uF @ 100V VIO A/A4
C111	CAP-1206-103	SM.CAP .01uF @ 100V VIO A/A4
C115	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C118	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C119	CAP-1206-103	SM.CAP .01uF @ 100V VIO A/A4
C12	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C120	CAP-1206-103	SM.CAP .01uF @ 100V VIO A/A4
C121	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C122	CAP-1206-103	SM.CAP .01uF @ 100V VIO A/A4
C123	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C124	CAP-1206-103	SM.CAP .01uF @ 100V VIO A/A4
C126	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C127	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C128	CAP-1206-103	SM.CAP .01uF @ 100V VIO A/A4
C129	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C13	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C130	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C131	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C132	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C133	CAP-1206-103	SM.CAP .01uF @ 100V VIO A/A4
C134	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C135	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C136	CAP-1206-103	SM.CAP .01uF @ 100V VIO A/A4
C137	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C138	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C139	CAP-1206-103	SM.CAP .01uF @ 100V VIO A/A4
C14	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C140	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C141	CAP-1206-103	SM.CAP .01uF @ 100V VIO A/A4
C142	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C143	CAP-0805-039	CAPACITOR, 'Q0' SM 3.9pF
C144	CAP-0805-039	CAPACITOR, 'Q0' SM 3.9pF
C146	CAP-1206-103	SM.CAP .01uF @ 100V VIO A/A4
C147	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C148	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C149	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C15	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C150	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C151	CAP-1206-104	SM.CAP .1uF@50V RED A/A5

## REFERENCE DESIGNATORS FOR ASY-0505-01 MAINBOARD, ESP/DSP

EFFECTIVE 10-18-94

REF DES	PART NUM	DESCRIPTION
L4	IND-0022-002	INDUCTOR, 2.7 uH
L401	IND-0022-002	INDUCTOR, 2.7 uH
L5	IND-0002-221	HELIX, 221 MHZ CLEAR
L6	IND-0002-221	HELIX, 221 MHZ CLEAR
P1	CON-0034-001	CONNECTOR, RT ANG HEADER
P2	CON-0052-005	POST HEADER 5-CKT, .420 HT
P3	CON-0036-015	POST HEADER
P4	CON-0053-002	HEADER, 2CKT
P5	CON-0036-007	POST HEADER
P6	CON-0001-010	JACK, MINI RF 90Deg
P7	CON-0001-010	JACK, MINI RF 90Deg
PIN2	HAR-0103-001	O-RING .029x.040 BUNA-N 50D
PIN5	HAR-0103-001	O-RING .029x.040 BUNA-N 50D
PIN6	HAR-0103-001	O-RING .029x.040 BUNA-N 50D
PIN8	HAR-0103-001	O-RING .029x.040 BUNA-N 50D
Q503	SEM-0027-003	MTD5P06E1 P-CHAN TMOSFET 4A, 369-03
Q504	SEM-0027-003	MTD5P06E1 P-CHAN TMOSFET 4A, 369-03
R116	RES-0027-201	TRIMMER, 200 OHM POT
R144	RES-0027-202	RESISTOR, TRIMPOT 2K
R155	RES-0027-201	TRIMMER, 200 OHM POT
R19	RES-0001-101	RESISTOR 100 1/4W
R439	RES-0001-103	RESISTOR 10K 1/4W
R512	RES-0027-105	TRIMMER, 1 MEG POT
ST401	ASY-0500-31	660MHz 1/4 WAVE STUB
T101	TRA-0006-001	TRANSFORMER, ORN
T102	TRA-0005-001	TRANSFORMER, BLK
T103	TRA-0005-001	TRANSFORMER, BLK
T104	TRA-0005-001	TRANSFORMER, BLK
T105	TRA-0005-001	TRANSFORMER, BLK
T106	TRA-0016-002	RF TRANS, TRI-FILER .07-200 MHZ
T107	ASY-0010-07	7 TURN TRANSFORMER
T108	TRA-0013-003	11MHZ-7MM TRANSFORMER SUB-MIN
T109	ASY-0175-T8	WIDE BAND TRANSFORMER
T401	TRA-0006-001	TRANSFORMER, ORN
U403	SEM-0165-007	MMIC, MSA-1104
U501	SEM-0109-008	7809 VOLTAGE REG, 9V TO-220
U502	SEM-0109-008	7809 VOLTAGE REG, 9V TO-220
U503	SEM-0153-003	TDA2002H OR TDA2003H
Y101	CRY-0007-004	CRYSTAL, 10.2728 MHz
Y401	OSC-0010-275	VCTCXO, 10.275023 MHz

## REFERENCE DESIGNATORS FOR SMT-0505-01 MAIN BOARD, SMT

EFFECTIVE 10-18-94

REF DES	PART NUM	DESCRIPTION
C152	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C153	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C154	CAP-1206-103	SM.CAP .01uF @ 100V VIO A/A4
C155	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C156	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C157	CAP-1206-103	SM.CAP .01uF @ 100V VIO A/A4
C158	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C159	CAP-0805-039	CAPACITOR, 'Q0' SM 3.9pF
C16	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C160	CAP-1206-103	SM.CAP .01uF @ 100V VIO A/A4
C17	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C2	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C3	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C301	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C302	CAP-1206-223	SM CHIP CAP .022 MF
C303	CAP-1206-223	SM CHIP CAP .022 MF
C304	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C307	CAP-1206-103	SM.CAP .01uF @ 100V VIO A/A4
C308	CAP-1206-103	SM.CAP .01uF @ 100V VIO A/A4
C309	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C310	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C312	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C313	CAP-1206-223	SM CHIP CAP .022 MF
C4	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C401	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C402	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C403	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C404	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C405	CAP-1206-103	SM.CAP .01uF @ 100V VIO A/A4
C406	CAP-1206-100	CAPACITOR, 'A1' SM 10pF
C407	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C408	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C409	CAP-1206-103	SM.CAP .01uF @ 100V VIO A/A4
C410	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C412	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C419	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C420	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C422	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C424	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C427	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C428	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C429	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C430	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C431	CAP-1206-103	SM.CAP .01uF @ 100V VIO A/A4
C432	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C433	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C434	CAP-1206-103	SM.CAP .01uF @ 100V VIO A/A4
C435	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C437	CAP-1206-150	CAPACITOR, 'E1' 15pF
C438	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C439	CAP-1206-100	CAPACITOR, 'A1' SM 10pF

## REFERENCE DESIGNATORS FOR SMT-0505-01 MAIN BOARD, SMT

EFFECTIVE 10-18-94

REF DES	PART NUM	DESCRIPTION
C440	CAP-1206-150	CAPACITOR, 'E1' 15pF
C441	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C442	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C5	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C501	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C502	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C503	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C505	CAP-1206-103	SM.CAP .01uF @ 100V VIO A/A4
C506	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C507	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C510	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C511	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C512	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C513	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C516	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C517	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C519	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C520	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C521	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C522	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C524	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C525	CAP-1206-103	SM.CAP .01uF @ 100V VIO A/A4
C529	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C530	CAP-1206-103	SM.CAP .01uF @ 100V VIO A/A4
C531	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C532	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C533	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C6	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C7	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C8	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C9	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
CR1	SEM-1003-001	BAV74 DL SW, CC3, SOT23, "JAX"
CR101	SEM-1003-001	BAV74 DL SW, CC3, SOT23, "JAX"
CR102	SEM-1003-001	BAV74 DL SW, CC3, SOT23, "JAX"
CR103	SEM-1003-001	BAV74 DL SW, CC3, SOT23, "JAX"
CR104	SEM-1003-004	MMBD7000L DL SW, A1, SOT-23, "5C"
CR105	SEM-1005-001	PMBD352T DL HC, A1, SOT-23, "5G"
CR106	SEM-1003-001	BAV74 DL SW, CC3, SOT23, "JAX"
CR107	SEM-1005-001	PMBD352T DL HC, A1, SOT-23, "5G"
CR108	SEM-1003-003	BAR16-1 DL PIN, CA3, SOT-23, "L9"
CR109	SEM-1003-003	BAR16-1 DL PIN, CA3, SOT-23, "L9"
CR110	SEM-1006-001	MMBV109L VVD, HA, A1, SOT-23, "4A"
CR2	SEM-1003-001	BAV74 DL SW, CC3, SOT23, "JAX"
CR3	SEM-1003-001	BAV74 DL SW, CC3, SOT23, "JAX"
CR301	SEM-1005-001	PMBD352T DL HC, A1; SOT-23, "5G"
CR302	SEM-1008-051	MMBZ5231B, 5.1ZD, A1, SOT-23, "8F"
CR303	SEM-1003-001	BAV74 DL SW, CC3, SOT23, "JAX"
CR4	SEM-1003-002	BAR15-1 DL PIN, CA3, SOT-23, "L8"
CR401	SEM-1003-001	BAV74 DL SW, CC3, SOT23, "JAX"
CR501	SEM-1003-001	BAV74 DL SW, CC3, SOT23, "JAX"
CR502	SEM-1003-001	BAV74 DL SW, CC3, SOT23, "JAX"

REFERENCE DESIGNATORS FOR SMT-0505-01 MAIN BOARD, SMT

EFFECTIVE 10-18-94

REF DES	PART NUM	DESCRIPTION
CR503	SEM-1003-001	BAV74 DL SW, CC3, SOT23, "JAX"
CR504	SEM-1003-001	BAV74 DL SW, CC3, SOT23, "JAX"
CR505	SEM-1003-001	BAV74 DL SW, CC3, SOT23, "JAX"
L101	IND-1210-335	INDUCTOR 3.3uH SMD
L106	IND-1210-106	INDUCTOR 10 uH SMD
L110	IND-1210-106	INDUCTOR 10 uH SMD
L402	IND-1210-333	INDUCTOR 33nH SMD
PCB1	PCB-0505-01	DSP MAINBOARD
Q101	SEM-1055-001	J310, RF N-CH JFET, "6T", SOT-23
Q102	SEM-1041-001	2222, NPN GP TRANS, "1B/1P", SOT-23
Q103	SEM-1045-001	5179, NPN RF TRANS, "7H", SOT-23
Q104	SEM-1045-001	5179, NPN RF TRANS, "7H", SOT-23
Q105	SEM-1045-001	5179, NPN RF TRANS, "7H", SOT-23
Q401	SEM-1045-001	5179, NPN RF TRANS, "7H", SOT-23
Q501	SEM-1051-001	2N7002, N-CH MOSFET, "702", SOT-23
Q502	SEM-1041-001	2222, NPN GP TRANS, "1B/1P", SOT-23
Q505	SEM-1041-001	2222, NPN GP TRANS, "1B/1P", SOT-23
Q506	SEM-1041-001	2222, NPN GP TRANS, "1B/1P", SOT-23
Q507	SEM-1051-001	2N7002, N-CH MOSFET, "702", SOT-23
Q508	SEM-1051-001	2N7002, N-CH MOSFET, "702", SOT-23
Q509	SEM-1051-001	2N7002, N-CH MOSFET, "702", SOT-23
R1	RES-1206-102	RESISTOR, 1K, SMD
R10	RES-1206-680	SM RES 68 OHM 1/4W 5%
R101	RES-1206-102	RESISTOR, 1K, SMD
R102	RES-1206-271	RESISTOR, 270 OHM
R103	RES-1206-241	RESISTOR, 240 OHM
R104	RES-1206-241	RESISTOR, 240 OHM
R105	RES-1206-102	RESISTOR, 1K, SMD
R106	RES-1206-332	RESISTOR, 3.3K
R107	RES-1206-332	RESISTOR, 3.3K
R108	RES-1206-104	RESISTOR, 100K
R109	RES-1206-222	RESISTOR, 2.2K
R11	RES-1206-101	RESISTOR, 100 OHM
R110	RES-1206-332	RESISTOR, 3.3K
R111	RES-1206-220	SMD RESISTOR, 22 OHM
R112	RES-1206-102	RESISTOR, 1K, SMD
R113	RES-1206-102	RESISTOR, 1K, SMD
R114	RES-1206-102	RESISTOR, 1K, SMD
R117	RES-1206-101	RESISTOR, 100 OHM
R118	RES-1206-202	RESISTOR, 2K
R119	RES-1206-162	RESISTOR, 1.6K
R12	RES-1206-101	RESISTOR, 100 OHM
R120	RES-1206-430	RESISTOR, 43 OHM
R121	RES-1206-182	RESISTOR, 1.8K
R122	RES-1206-471	RESISTOR, 470 OHM
R123	RES-1206-202	RESISTOR, 2K
R124	RES-1206-102	RESISTOR, 1K, SMD
R125	RES-1206-241	RESISTOR, 240 OHM
R126	RES-1206-182	RESISTOR, 1.8K
R127	RES-1206-681	SM RES 680 1/4W 5%
R128	RES-1206-471	RESISTOR, 470 OHM

## REFERENCE DESIGNATORS FOR SMT-0505-01 MAIN BOARD, SMT

EFFECTIVE 10-18-94

REF DES	PART NUM	DESCRIPTION
R129	RES-1206-360	SM RES 36 1/4W 5%
R13	RES-1206-101	RESISTOR, 100 OHM
R130	RES-1206-101	RESISTOR, 100 OHM
R131	RES-1206-222	RESISTOR, 2.2K
R132	RES-1206-102	RESISTOR, 1K, SMD
R134	RES-1206-221	RESISTOR, 220 OHM
R135	RES-1206-102	RESISTOR, 1K, SMD
R136	RES-1206-151	SM RES 150 1/4W 5%
R137	RES-1206-360	SM RES 36 1/4W 5%
R138	RES-1206-151	SM RES 150 1/4W 5%
R14	RES-1206-680	SM RES 68 OHM 1/4W 5%
R140	RES-1206-301	SM RES 300 1/4W 5%
R141	RES-1206-180	SM RES 18 1/4W 5%
R142	RES-1206-301	SM RES 300 1/4W 5%
R143	RES-1206-103	RESISTOR, 10K
R145	RES-1206-102	RESISTOR, 1K, SMD
R146	RES-1206-221	RESISTOR, 220 OHM
R147	RES-1206-221	RESISTOR, 220 OHM
R148	RES-1206-102	RESISTOR, 1K, SMD
R149	RES-1206-332	RESISTOR, 3.3K
R15	RES-1206-102	RESISTOR, 1K, SMD
R150	RES-1206-332	RESISTOR, 3.3K
R151	RES-1206-220	SMD RESISTOR, 22 OHM
R152	RES-1206-222	RESISTOR, 2.2K
R153	RES-1206-473	RESISTOR, 47K
R156	RES-1206-151	SM RES 150 1/4W 5%
R157	RES-1206-360	SM RES 36 1/4W 5%
R158	RES-1206-151	SM RES 150 1/4W 5%
R16	RES-1206-220	SMD RESISTOR, 22 OHM
R17	RES-1206-471	RESISTOR, 470 OHM
R18	RES-1206-560	SM RES 56 1/4W 5%
R2	RES-1206-471	RESISTOR, 470 OHM
R3	RES-1206-102	RESISTOR, 1K, SMD
R301	RES-1206-272	RESISTOR, 2.7K
R302	RES-1206-101	RESISTOR, 100 OHM
R303	RES-1206-393	RESISTOR, 39K
R304	RES-1206-153	SM RES 15K 1/4W 5%
R305	RES-1206-154	RESISTOR, 150K
R306	RES-1206-103	RESISTOR, 10K
R307	RES-1206-473	RESISTOR, 47K
R308	RES-1206-473	RESISTOR, 47K
R309	RES-1206-105	RESISTOR, 1Meg
R310	RES-1206-472	RESISTOR, 4.7K
R311	RES-1206-181	SM RES 180 1/4W 5%
R312	RES-1206-104	RESISTOR, 100K
R313	RES-1206-106	RESISTOR, 10 Meg
R314	RES-1206-103	RESISTOR, 10K
R315	RES-1206-102	RESISTOR, 1K, SMD
R316	RES-1206-472	RESISTOR, 4.7K
R317	RES-1206-103	RESISTOR, 10K
R318	RES-1206-103	RESISTOR, 10K

## REFERENCE DESIGNATORS FOR SMT-0505-01 MAIN BOARD, SMT

EFFECTIVE 10-18-94

REF DES	PART NUM	DESCRIPTION
R319	RES-1206-473	RESISTOR, 47K
R320	RES-1206-473	RESISTOR, 47K
R321	RES-1206-472	RESISTOR, 4.7K
R322	RES-1206-681	SM RES 680 1/4W 5%
R323	RES-1206-104	RESISTOR, 100K
R4	RES-1206-102	RESISTOR, 1K, SMD
R401	RES-1206-103	RESISTOR, 10K
R402	RES-1206-222	RESISTOR, 2.2K
R403	RES-1206-222	RESISTOR, 2.2K
R404	RES-1206-100	RESISTOR, 10 OHM
R405	RES-1206-103	RESISTOR, 10K
R406	RES-1206-393	RESISTOR, 39K
R407	RES-1206-103	RESISTOR, 10K
R408	RES-1206-472	RESISTOR, 4.7K
R409	RES-1206-471	RESISTOR, 470 OHM
R410	RES-1206-101	RESISTOR, 100 OHM
R411	RES-1206-562	RESISTOR, 5.6K
R412	RES-1206-473	RESISTOR, 47K
R413	RES-1206-103	RESISTOR, 10K
R414	RES-1206-103	RESISTOR, 10K
R415	RES-1206-103	RESISTOR, 10K
R416	RES-1206-332	RESISTOR, 3.3K
R417	RES-1206-430	RESISTOR, 43 OHM
R418	RES-1206-103	RESISTOR, 10K
R419	RES-1206-103	RESISTOR, 10K
R420	RES-1206-101	RESISTOR, 100 OHM
R421	RES-1206-101	RESISTOR, 100 OHM
R422	RES-1206-202	RESISTOR, 2K
R423	RES-1206-102	RESISTOR, 1K, SMD
R424	RES-1206-102	RESISTOR, 1K, SMD
R425	RES-1206-102	RESISTOR, 1K, SMD
R426	RES-1206-102	RESISTOR, 1K, SMD
R427	RES-1206-102	RESISTOR, 1K, SMD
R428	RES-1206-102	RESISTOR, 1K, SMD
R429	RES-1206-471	RESISTOR, 470 OHM
R430	RES-1206-103	RESISTOR, 10K
R431	RES-1206-103	RESISTOR, 10K
R432	RES-1206-222	RESISTOR, 2.2K
R436	RES-1206-471	RESISTOR, 470 OHM
R437	RES-1206-102	RESISTOR, 1K, SMD
R438	RES-1206-100	RESISTOR, 10 OHM
R5	RES-1206-221	RESISTOR, 220 OHM
R501	RES-1206-106	RESISTOR, 10 Meg
R503	RES-1206-472	RESISTOR, 4.7K
R504	RES-1206-472	RESISTOR, 4.7K
R505	RES-1206-101	RESISTOR, 100 OHM
R506	RES-1206-472	RESISTOR, 4.7K
R507	RES-1206-101	RESISTOR, 100 OHM
R508	RES-1206-472	RESISTOR, 4.7K
R509	RES-1206-472	RESISTOR, 4.7K
R510	RES-1206-472	RESISTOR, 4.7K

## REFERENCE DESIGNATORS FOR SMT-0505-01 MAIN BOARD, SMT

EFFECTIVE 10-18-94

REF DES	PART NUM	DESCRIPTION
R511	RES-1206-472	RESISTOR, 4.7K
R513	RES-1206-271	RESISTOR, 270 OHM
R514	RES-1206-471	RESISTOR, 470 OHM
R515	RES-1206-103	RESISTOR, 10K
R516	RES-1206-103	RESISTOR, 10K
R517	RES-1206-473	RESISTOR, 47K
R518	RES-1206-103	RESISTOR, 10K
R519	RES-1206-103	RESISTOR, 10K
R520	RES-1206-471	RESISTOR, 470 OHM
R521	RES-1206-220	SMD RESISTOR, 22 OHM
R522	RES-1206-027	RESISTOR, 2.7OHM
R523	RES-1206-027	RESISTOR, 2.7OHM
R524	RES-1206-105	RESISTOR, 1Meg
R525	RES-1206-222	RESISTOR, 2.2K
R526	RES-1206-103	RESISTOR, 10K
R6	RES-1206-471	RESISTOR, 470 OHM
R7	RES-1206-471	RESISTOR, 470 OHM
R8	RES-1206-471	RESISTOR, 470 OHM
R9	RES-1206-101	RESISTOR, 100 OHM
U1	SEM-1022-006	VAM-6, MMICRF AMP, "A06", SOT-143
U101	SEM-1023-001	MC1350, IF AMP WITH AGC, SO-8
U102	SEM-1023-001	MC1350, IF AMP WITH AGC, SO-8
U103	SEM-1027-001	NE602, BALANCED ACTIVE MIXER, SO-8
U104	SEM-1023-001	MC1350, IF AMP WITH AGC, SO-8
U105	SEM-1022-006	VAM-6, MMICRF AMP, "A06", SOT-143
U2	SEM-1022-007	VAM-3, MMIC RF AMP, "A03", SOT-143
U301	SEM-1022-001	MC3403, QUAD OPAMP, SO-14
U302	SEM-1022-002	LMC662, DUAL OPAMP, SO-8
U401	SEM-1020-001	MC145158, SERIAL PLL SYNTH, SOL-16
U402	SEM-1022-002	LMC662, DUAL OPAMP, SO-8
U404	SEM-1019-001	MB504, 32/33-64/65 PRESCALER, SOL-8
U405	SEM-1024-001	78L05, 5 LIN REG, 100 MA, SO-8
U406	SEM-1029-001	MC144111, QUAD 6-BIT DAC, SOL-14
U407	SEM-1014-094	MC14094BD, 8 BIT SHFT REG, SO-16

REFERENCE DESIGNATORS FOR ASY-0505-02 PERSONALITY, ESP/DSP

EFFECTIVE 10-18-94

REF DES	PART NUM	DESCRIPTION
AC102	CON-0026-001	JUMPER, POST HEADER
C102	CAP-0074-001	CAP 1uf NONPOLARIZED ELECT
C103	CAP-0037-004	CAP.ELECT 47UF RAD
C105	CAP-0037-006	CAP.ELECT 10UF RAD
C106	CAP-0037-006	CAP.ELECT 10UF RAD
C107	CAP-0074-001	CAP 1uf NONPOLARIZED ELECT
C108	CAP-0030-008	CAP, TANT .22 50V
C109	CAP-0037-004	CAP.ELECT 47UF RAD
C113	CAP-0074-001	CAP 1uf NONPOLARIZED ELECT
C114	CAP-0037-004	CAP.ELECT 47UF RAD
C115	CAP-0037-004	CAP.ELECT 47UF RAD
C116	CAP-0037-004	CAP.ELECT 47UF RAD
C117	CAP-0074-001	CAP 1uf NONPOLARIZED ELECT
C118	CAP-0074-001	CAP 1uf NONPOLARIZED ELECT
C119	CAP-0074-001	CAP 1uf NONPOLARIZED ELECT
C12	CAP-0037-004	CAP.ELECT 47UF RAD
C120	CAP-0074-001	CAP 1uf NONPOLARIZED ELECT
C13	CAP-0037-006	CAP.ELECT 10UF RAD
C131	CAP-0031-008	CAP TANT 1uf 16-25V
C16	CAP-0037-004	CAP.ELECT 47UF RAD
C17	CAP-0037-006	CAP.ELECT 10UF RAD
C20	CAP-0037-004	CAP.ELECT 47UF RAD
C21	CAP-0037-004	CAP.ELECT 47UF RAD
C22	CAP-0037-006	CAP.ELECT 10UF RAD
C23	CAP-0037-004	CAP.ELECT 47UF RAD
C24	CAP-0037-004	CAP.ELECT 47UF RAD
C27	CAP-0037-006	CAP.ELECT 10UF RAD
C30	CAP-0037-005	CAP.ELECT 22UF RAD
C31	CAP-0037-006	CAP.ELECT 10UF RAD
C34	CAP-0037-004	CAP.ELECT 47UF RAD
C4	CAP-0037-006	CAP.ELECT 10UF RAD
C9	CAP-0074-001	CAP 1uf NONPOLARIZED ELECT
CR103	SEM-0085-001	LED, GREEN, T1
CR104	SEM-0084-001	LED, RED, T1
J10	CON-0053-008	HEADER, 8CKT
J2	CON-0035-015	SOCKET, BOTTOM ENTRY 15 CKT
J4	CON-0035-007	SOCKET, BOTTOM ENTRY 7 CKT
J5	CON-0053-002	HEADER, 2CKT
J8	CON-0053-008	HEADER, 8CKT
J9	CON-0053-008	HEADER, 8CKT
JU1	CON-0240-030	POST HEADER 3 PIN
JU102	CON-0240-030	POST HEADER 3 PIN
JU104	CON-0240-020	POST HEADER 2 PIN
JU105	CON-0240-020	POST HEADER 2 PIN
JU4	CON-0240-020	POST HEADER 2 PIN
JU5	CON-0240-020	POST HEADER 2 PIN
JU7	CON-0240-030	POST HEADER 3 PIN
JU8	CON-0240-020	POST HEADER 2 PIN
Q1	SEM-0027-003	MTD5P06E1 P-CHAN TMOSFET 4A, 369-03
Q2	SEM-0027-003	MTD5P06E1 P-CHAN TMOSFET 4A, 369-03
R128	RES-0027-202	RESISTOR, TRIMPOT 2K

REFERENCE DESIGNATORS FOR ASY-0505-02 PERSONALITY, ESP/DSP

EFFECTIVE 10-18-94

REF DES	PART NUM	DESCRIPTION
RN1	RES-0028-472	RNET, 10-SIP, 4.7K PULLUP
RN101	RES-0040-103	R/2R RES NET 10K 10 PIN SIP
RN2	RES-0028-472	RNET, 10-SIP, 4.7K PULLUP
RN3	RES-0028-473	RESISTOR NETWORK 47K 10 PIN
SOC-7	SOC-0002-008	IC SOCKET, 8 PIN DIP
U10	SEM-0170-015	LM78L05AWC
U103	SEM-0158-007	MC145554 DOM CODEC-FILTER
U11	SEM-0109-007	78L09 VOLTAGE REG, 9V 100mA
U2A	SOC-0009-020	SIP-20 MILLED SOCKET
U2B	SOC-0009-020	SIP-20 MILLED SOCKET
U6A	SOC-0009-014	SOCKET, 14 PIN
U6B	SOC-0009-014	SOCKET, 14 PIN
U8	SEM-0187-002	16K-BIT SERIAL E2 PROM
U9	SEM-0170-015	LM78L05AWC
Y1	CRY-0024-001	CRYSTAL 4.0000 MHZ

REFERENCE DESIGNATORS FOR SMT-0505-02 PERSONALITY, SMT

EFFECTIVE 10-18-94

REF DES	PART NUM	DESCRIPTION
C1	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C10	CAP-1206-472	CAPACITOR, 'S3' .0047uF
C101	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C104	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C11	CAP-1206-472	CAPACITOR, 'S3' .0047uF
C110	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C111	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C112	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C121	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C122	CAP-1206-103	SM.CAP .01uF @ 100V V10 A/A4
C125	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C126	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C127	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C128	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C129	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C130	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C14	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C15	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C18	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C19	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C2	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C25	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C26	CAP-1206-103	SM.CAP .01uF @ 100V V10 A/A4
C28	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C29	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C3	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C32	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C33	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C6	CAP-1206-220	CAPACITOR, 'J1' SM 22pF
C7	CAP-1206-220	CAPACITOR, 'J1' SM 22pF
C8	CAP-1206-103	SM.CAP .01uF @ 100V V10 A/A4
CR1	SEM-1003-001	BAV74 DL SW, CC3, SOT23, "JAX"
CR101	SEM-1003-004	MMBD7000L DL SW, A1, SOT-23, "5C"
CR102	SEM-1008-051	MMBZ5231B, 5.1ZD, A1, SOT-23, "8F"
CR2	SEM-1008-068	MMBZ5235B, 6.8ZD, A1, SOT-23, "8K"
CR3	SEM-1003-004	MMBD7000L DL SW, A1, SOT-23, "5C"
CR4	SEM-1008-051	MMBZ5231B, 5.1ZD, A1, SOT-23, "8F"
CR5	SEM-1008-051	MMBZ5231B, 5.1ZD, A1, SOT-23, "8F"
CR6	SEM-1008-051	MMBZ5231B, 5.1ZD, A1, SOT-23, "8F"
CR7	SEM-1008-051	MMBZ5231B, 5.1ZD, A1, SOT-23, "8F"
Q4	SEM-1041-001	2222, NPN GP TRANS, "1B/1P", SOT-23
Q5	SEM-1051-001	2N7002, N-CH MOSFET, "702", SOT-23
R1	RES-1206-103	RESISTOR, 10K
R10	RES-1206-473	RESISTOR, 47K
R101	RES-1206-101	RESISTOR, 100 OHM
R103	RES-1206-681	SM RES 680 1/4W 5%
R104	RES-1206-681	SM RES 680 1/4W 5%
R105	RES-1206-106	RESISTOR, 10 Meg
R106	RES-1206-470	RESISTOR, 47 OHM
R107	RES-1206-103	RESISTOR, 10K
R108	RES-1206-104	RESISTOR, 100K

## REFERENCE DESIGNATORS FOR SMT-0505-02 PERSONALITY, SMT

EFFECTIVE 10-18-94

REF DES	PART NUM	DESCRIPTION
R109	RES-1206-103	RESISTOR, 10K
R11	RES-1206-472	RESISTOR, 4.7K
R110	RES-1206-682	RESISTOR, 6.8K
R111	RES-1206-104	RESISTOR, 100K
R112	RES-1206-471	RESISTOR, 470 OHM
R113	RES-1206-153	SM RES 15K 1/4W 5%
R114	RES-1206-393	RESISTOR, 39K
R115	RES-1206-102	RESISTOR, 1K, SMD
R117	RES-1206-103	RESISTOR, 10K
R118	RES-1206-183	SM RES 18K 14/W 5%
R119	RES-1206-103	RESISTOR, 10K
R12	RES-1206-472	RESISTOR, 4.7K
R120	RES-1206-103	RESISTOR, 10K
R122	RES-1206-104	RESISTOR, 100K
R123	RES-1206-104	RESISTOR, 100K
R124	RES-1206-471	RESISTOR, 470 OHM
R125	RES-1206-100	RESISTOR, 10 OHM
R126	RES-1206-473	RESISTOR, 47K
R127	RES-1206-472	RESISTOR, 4.7K
R129	RES-1206-273	RESISTOR, 27K
R13	RES-1206-471	RESISTOR, 470 OHM
R130	RES-1206-273	RESISTOR, 27K
R131	RES-1206-100	RESISTOR, 10 OHM
R132	RES-1206-106	RESISTOR, 10 Meg
R133	RES-1206-103	RESISTOR, 10K
R134	RES-1206-222	RESISTOR, 2.2K
R135	RES-1206-222	RESISTOR, 2.2K
R136	RES-1206-473	RESISTOR, 47K
R137	RES-1206-473	RESISTOR, 47K
R138	RES-1206-473	RESISTOR, 47K
R139	RES-1206-100	RESISTOR, 10 OHM
R14	RES-1206-472	RESISTOR, 4.7K
R141	RES-1206-103	RESISTOR, 10K
R142	RES-1206-102	RESISTOR, 1K, SMD
R16	RES-1206-101	RESISTOR, 100 OHM
R18	RES-1206-101	RESISTOR, 100 OHM
R2	RES-1206-103	RESISTOR, 10K
R20	RES-1206-101	RESISTOR, 100 OHM
R21	RES-1206-472	RESISTOR, 4.7K
R22	RES-1206-472	RESISTOR, 4.7K
R23	RES-1206-101	RESISTOR, 100 OHM
R24	RES-1206-471	RESISTOR, 470 OHM
R26	RES-1206-471	RESISTOR, 470 OHM
R27	RES-1206-103	RESISTOR, 10K
R28	RES-1206-473	RESISTOR, 47K
R29	RES-1206-103	RESISTOR, 10K
R3	RES-1206-103	RESISTOR, 10K
R30	RES-1206-105	RESISTOR, 1Meg
R31	RES-1206-472	RESISTOR, 4.7K
R32	RES-1206-393	RESISTOR, 39K
R33	RES-1206-393	RESISTOR, 39K

## REFERENCE DESIGNATORS FOR SMT-0505-02 PERSONALITY, SMT

EFFECTIVE 10-18-94

REF DES	PART NUM	DESCRIPTION
R34	RES-1206-104	RESISTOR, 100K
R35	RES-1206-102	RESISTOR, 1K, SMD
R36	RES-1206-103	RESISTOR, 10K
R37	RES-1206-103	RESISTOR, 10K
R4	RES-1206-472	RESISTOR, 4.7K
R5	RES-1206-472	RESISTOR, 4.7K
R6	RES-1206-224	RESISTOR, 220K
R7	RES-1206-102	RESISTOR, 1K, SMD
R9	RES-1206-106	RESISTOR, 10 Meg
U101	SEM-1027-004	MC33110, 5V COMPANDOR, SO-14
U102	SEM-1014-053	MC14053BD, 3X 2 CHNL SW, SO-16
U104	SEM-1022-012	TLC272CD, DUAL CMOS OPAMP, SO-8
U105	SEM-1026-001	ADS2105 DSP MICROCOMPUTER, PLCC-68
U107	SEM-1015-139	74HC139, DUAL 1-OF-4 DECODER, SO-16
U108	SEM-1015-541	74HC541 OCTAL 3-STATE BUFFER, SOL-20
U109	SEM-1015-595	74HC595 8-BIT SHIFT REG SO-16
U110	SEM-1015-595	74HC595 8-BIT SHIFT REG SO-16
U111	SEM-1015-574	74HC574 OCTAL 3-STATE D F/F, SOL-20
U112	SEM-1015-574	74HC574 OCTAL 3-STATE D F/F, SOL-20
U12	SEM-1024-011	TC7660, VOLATAGE INVERTER, SO-8
U13	SEM-1015-165	74HC165, 8-BIT PAR TO SER, SO-16
U14	SEM-1029-004	ADC08038, 8-CHAN 8-BIT ADC, SOL-20
U3	SEM-1015-066	74HC4066 QUAD ANALOG SWITCH SO-14
U4	SEM-1015-259	74HC259, 1-OF-8 DECODER, SO-16
U5	SEM-1015-014	MC74HC14AD, HEX SCHMITT INV, SO-14
U6	SEM-1017-001	ULN2003 NPN DARL DRVR ARRAY SO-16
U7	SEM-1015-132	74HC132, QUAD SCHMITT NAND, SO-14

REFERENCE DESIGNATORS FOR ASY-0505-04 VCO, DSP

EFFECTIVE 10-18-94

REF DES	PART NUM	DESCRIPTION
C13	CAP-0037-014	220 UF 10V RAD ELECTROLYTIC
C17	CAP-0037-014	220 UF 10V RAD ELECTROLYTIC
C19	CAP-1206-220	CAPACITOR, 'J1' SM 22pF
L1	IND-0022-002	INDUCTOR, 2.7 uH
L2	IND-0022-002	INDUCTOR, 2.7 uH
L3	ASY-0505-L1	TOROID .25" 8T #26
L4	IND-0022-002	INDUCTOR, 2.7 uH
L5	IND-0022-004	INDUCTOR, 0.47 uH

REFERENCE DESIGNATORS FOR SMT-0505-04 VCO BOARD, DSP SMT

EFFECTIVE 10-18-94

REF DES	PART NUM	DESCRIPTION
C10	CAP-0805-020	CAPACITOR, 'H0' SM 2pF
C11	CAP-0805-220	SMD CAP, 22pF 100V "J1"
C12	CAP-0805-102	SMD CAP, .001uF 50V "A3"
C14	CAP-0805-102	SMD CAP, .001uF 50V "A3"
C16	CAP-0805-102	SMD CAP, .001uF 50V "A3"
C18	CAP-0805-102	SMD CAP, .001uF 50V "A3"
C19	CAP-0805-220	SMD CAP, 22pF 100V "J1"
C2	CAP-1206-120	CAPACITOR, 'C1' SM 12pF
C3	CAP-1206-120	CAPACITOR, 'C1' SM 12pF
C4	CAP-0805-051	CAPACITOR, 'T0' 5.1pF
C5	CAP-0805-102	SMD CAP, .001uF 50V "A3"
C6	CAP-0805-270	SMD CAP, 27pF 100V "L1"
C7	CAP-0805-102	SMD CAP, .001uF 50V "A3"
C8	CAP-0805-180	SMD CAP, 18pF 100V "G1"
C9	CAP-0805-102	SMD CAP, .001uF 50V "A3"
CR1	SEM-1007-001	MMBV432L, DLVVD, CC3, SOT-23, "4B"
CR2	SEM-1004-001	MMBD101L HC, A1, SOT-23, "4M"
L6	IND-1210-333	INDUCTOR 33nH SMD
Q1	SEM-1055-001	J310, RF N-CH JFET, "6T", SOT-23
Q2	SEM-1045-001	5179, NPN RF TRANS, "7H", SOT-23
R1	RES-0805-680	SMD RES, 68, 1/10W 5%
R2	RES-0805-223	SMD RES, 22K, 1/10W 5%
R3	RES-0805-103	SMD RES, 10K, 1/10W 5%
R4	RES-0805-472	SMD RES, 4.7K, 1/10W 5%
R5	RES-0805-101	SMD RES, 100, 1/10W 5%
R6	RES-1206-220	SMD RESISTOR, 22 OHM
R7	RES-1206-470	RESISTOR, 47 OHM

## EXP.BILL - SINGLE LEVEL BILL-OF-MATERIAL LISTING EFFECTIVE 05/12/94

LEVEL	PART	DESCRIPTION	QTY/ASSY	UM	ITEM DESIGNATORS
0.....	<u>ASY-0500-10</u>	CHASSIS		EA	
1.....	ASY-0505-03	POWER AMP, DSP	1	EA	
1.....	CON-0007-004	MINI-UHF BULKHEAD FEMALE	1	EA	J1
1.....	FAB-0500-01	CHASSIS	1	EA	
1.....	FAB-0500-16	SPRING, HELICAL	1	EA	
1.....	FAB-0500-41	PA GND BRACKET	1	EA	GND1
1.....	FAB-0500-44	RF POWER AMP SHIELD	1	EA	
1.....	OEM-0500-001	220MHZ RF POWER MODULE	1	EA	
1.....	TUN-0001-375	TUNING SCREW, 3/8 SS HEX	2	EA	4,5
1.....	TUN-0001-437	TUNING SCREW, 7/16 SS HEX	3	EA	1,2,3
1.....	W0500010.000	ASY-0500-10 P.A.	0	EA	

REFERENCE DESIGNATORS FOR ASY-0505-03 POWER AMP, DSP

EFFECTIVE 10-18-94

REF DES	PART NUM	DESCRIPTION
C12	CAP-0037-012	CAP, ELECT. 330uF RAD
C14	CAP-0076-001	4-24PF TRIMMER SEALED
C18	CAP-0037-004	CAP.ELECT 47uF RAD
C20	CAP-0039-107	CAP, ELEC 100uF 35V
C22	CAP-0039-108	CAP, ELEC 1000uF 16V
C25	CAP-0037-012	CAP, ELECT. 330uF RAD
C31	CAP-0037-004	CAP.ELECT 47uF RAD
C34	CAP-0037-004	CAP.ELECT 47uF RAD
C36	CAP-0022-180	CAP DISC 18PF NPO 5% 500V .25LS
C38	CAP-0022-180	CAP DISC 18PF NPO 5% 500V .25LS
C42	CAP-0039-108	CAP, ELEC 1000uF 16V
C48	CAP-0037-003	CAP.ELECT 4.7uF RAD
C50	CAP-0037-003	CAP.ELECT 4.7uF RAD
C8	CAP-0037-004	CAP.ELECT 47uF RAD
C9	CAP-0039-107	CAP, ELEC 100uF 35V
CR1	SEM-0087-001	1N4004 DIODE GP RECTIFIER, DO-14
CR2	SEM-0087-001	1N4004 DIODE GP RECTIFIER, DO-14
CR4	SEM-0192-015	SA15A 15V OVERVOLTAGE SUPPRESSOR
HAQ1	HAR-0023-005	INSULATOR, TO-5 PACKAGE
HAQ2	HAR-0023-005	INSULATOR, TO-5 PACKAGE
HEQ2	HEA-0006-002	HEATSINK, TO-5
J301	CON-0001-010	JACK, MINI RF 90Deg
J302	CON-0001-010	JACK, MINI RF 90Deg
J303	CON-0051-005	PCB SOCKET, 5-CKT
K1	REL-0010-003	RELAY, RF MINI
L10	ASY-0500-L10	INDUCTOR, 3T, .25ID
L11	ASY-0500-L10	INDUCTOR, 3T, .25ID
L2	IND-0007-001	FLEXSTIP INDUCTOR
L3	IND-0022-002	INDUCTOR, 2.7 uH
L4	IND-0022-004	INDUCTOR, 0.47 uH
L5	IND-0007-001	FLEXSTIP INDUCTOR
L6	IND-0022-002	INDUCTOR, 2.7 uH
L7	IND-0022-004	INDUCTOR, 0.47 uH
L8	IND-0005-025	INDUCTOR, 2.5 Turns
P304	CON-0038-001	PLUG, 2 WAY
Q1	SEM-0067-006	MRF227 NPN PWR 3W 13V, TO-39
Q2	SEM-0067-006	MRF227 NPN PWR 3W 13V, TO-39
Q3	SEM-0027-003	MTD5P06E1 P-CHAN TMOSFET 4A, 369-03
R13	RES-0027-100	10 OHM TRIM POT
R24	RES-0001-101	RESISTOR 100 1/4W
R5	RES-0027-100	10 OHM TRIM POT
U1	SEM-0165-007	MMIC, MSA-1104
U3	SEM-0109-008	7809 VOLTAGE REG, 9V T0-220
U4	SEM-0109-002	LM2940T-10 VOLTAGE REG, 10V

REFERENCE DESIGNATORS FOR SMT-0505-03 POWER AMP

EFFECTIVE 10-18-94

REF DES	PART NUM	DESCRIPTION
C1	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C10	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C11	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C13	CAP-1206-390	CAPACITOR 39pF SM
C16	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C17	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C19	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C2	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C21	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C23	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C24	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C26	CAP-1206-101	CAPACITOR, 100pF SM 'A2'
C27	CAP-1206-100	CAPACITOR, 'A1' SM 10pF
C28	CAP-1206-100	CAPACITOR, 'A1' SM 10pF
C29	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C3	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C30	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C32	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C33	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C35	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C4	CAP-1206-270	CAPACITOR, 'L1' SM 27pF
C40	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C41	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C43	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C44	CAP-1206-103	SM.CAP .01uF @ 100V VIO A/A4
C45	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C46	CAP-0805-010	CERAMIC CHIP, 1.0PF COG
C47	CAP-1206-104	SM.CAP .1uF@50V RED A/A5
C49	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C5	CAP-1206-220	CAPACITOR, 'J1' SM 22pF
C6	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
C7	CAP-1206-102	SM.CAP .001uF@100V BLU A/A3
CR3	SEM-1003-001	BAV74 DL SW, CC3, SOT23, "JAX"
CR5	SEM-1003-001	BAV74 DL SW, CC3, SOT23, "JAX"
PCB1	PCB-0505-03	POWER AMP, DSP
R1	RES-1206-027	RESISTOR, 2.7OHM
R10	RES-1206-621	RESISTOR, 620 OHM
R11	RES-1206-621	RESISTOR, 620 OHM
R12	RES-1206-621	RESISTOR, 620 OHM
R14	RES-1206-470	RESISTOR, 47 OHM
R15	RES-1206-027	RESISTOR, 2.7OHM
R16	RES-1206-027	RESISTOR, 2.7OHM
R17	RES-1206-221	RESISTOR, 220 OHM
R18	RES-1206-221	RESISTOR, 220 OHM
R19	RES-1206-221	RESISTOR, 220 OHM
R20	RES-1206-470	RESISTOR, 47 OHM
R21	RES-1206-511	RESISTOR 510 OHM
R22	RES-1206-101	RESISTOR, 100 OHM
R23	RES-1206-472	RESISTOR, 4.7K
R24	RES-1206-102	RESISTOR, 1K, SMD
R3	RES-1206-621	RESISTOR, 620 OHM

REFERENCE DESIGNATORS FOR SMT-0505-03 POWER AMP

EFFECTIVE 10-18-94

REF DES	PART NUM	DESCRIPTION
R4	RES-1206-621	RESISTOR, 620 OHM
R6	RES-1206-470	RESISTOR, 47 OHM
R7	RES-1206-027	RESISTOR, 2.7OHM
R8	RES-1206-027	RESISTOR, 2.7OHM
R9	RES-1206-621	RESISTOR, 620 OHM

## EXP.BILL - SINGLE LEVEL BILL-OF-MATERIAL LISTING EFFECTIVE 05/12/94

LEVEL	PART	DESCRIPTION	QTY/ASSY	UM	ITEM DESIGNATORS
0.....	<u>ASY-0505-11</u>	<u>ASSY, SPEAKER BEZEL</u>		EA	
1.....	ASY-0505-05	CONTROL BOARD, DSP	1	EA	
1.....	ASY-0505-06	POT BOARD, DSP	1	EA	
1.....	CAB-0500-001	JST CABLE, INTERNAL SPEAKER	1	EA	SP+/-
1.....	FAB-0500-02	BEZEL, SPEAKER	1	EA	
1.....	FAB-0500-05	KNOB, CONTROL	2	EA	
1.....	FAB-0500-06	ESCUTCHEON, SPEAKER	1	EA	
1.....	FAB-0500-50	SUPPORT BRACKET	4	EA	
1.....	FAB-0500-63	FELT STRIP, 2"	2	EA	
1.....	FAB-0500-66	FELT STRIP .400 X .200	4	EA	
1.....	HAR-0043-007	NYLON WASHER, .031 THK.	3	EA	
1.....	SPE-0002-002	SPEAKER, 4 OHM, 5W	1	EA	SP1
1.....	W0505011.000	ASY-0505-11 BEZEL ASSY.	0	EA	

REFERENCE DESIGNATORS FOR ASY-0505-05 CONTROL BOARD, DSP

EFFECTIVE 05-12-94

REF DES	PART NUM	DESCRIPTION
C1	CAP-0013-001	CAPACITOR MONO .1uf
C2	CAP-0039-337	CAP ELEC 330UF 16V
C3	CAP-0039-337	CAP ELEC 330UF 16V
DE7	SEM-0085-004	LED, GREEN, 2.5X7MM
DS1	SEM-0084-007	LED, RED, 5MM SQ
DS10	SEM-0085-005	LED, GREEN, 2.5X5MM
DS2	SEM-0084-007	LED, RED, 5MM SQ
DS3	SEM-0084-007	LED, RED, 5MM SQ
DS4	SEM-0084-007	LED, RED, 5MM SQ
DS5	SEM-0084-004	LED, RED, 2.5X7MM
DS6	SEM-0086-004	LED, YELLOW, 2.5X7MM
DS8	SEM-0085-005	LED, GREEN, 2.5X5MM
DS9	SEM-0085-005	LED, GREEN, 2.5X5MM
J1	CON-0050-001	CONNECTOR, JACK MODULAR
P1	CAB-0500-003	JST, 8-CKT, 64 MM
P2	CAB-0500-003	JST, 8-CKT, 64 MM
P3	CAB-0500-007	JST, 2-CKT, 80 MM
R1	RES-0001-222	RESISTOR 2.2K 1/4W
R2	RES-0010-220	RESISTOR, 22 OHM
RN1	RES-0041-102	RES NET 1K 14 PIN ISO
SW1-3	SWI-0033-103	SWITCH, PUSH-PUSH 3-STA
SW4	SWI-0033-001	SWITCH, MOMENTARY 1-STA
U1	SEM-0151-002	5821 CMOS SERIAL INP LATCHED DRV

REFERENCE DESIGNATORS FOR ASY-0505-06 POT BOARD, DSP

EFFECTIVE 05-12-94

REF DES	PART NUM	DESCRIPTION
P1	CAB-0500-002	JST, 8-CKT, 83 MM
R1/S1	RES-0022-003	RESISTOR, 10K POT W/SW

REFERENCE DESIGNATORS FOR ASY-0505-07 ASSY, SWITCH BOARD

EFFECTIVE 10-18-94

REF DES	PART NUM	DESCRIPTION
C12	CAP-0039-226	CAP, ELECT. 22uF 35V
C13	CAP-0031-008	CAP TANT 1uf 16-25V
C2	CAP-0039-226	CAP, ELECT. 22uF 35V
C3	CAP-0039-225	CAP, ELECT 2.2uF 50V
C5	CAP-0039-225	CAP, ELECT 2.2uF 50V
C6	CAP-0031-007	CAPACITOR TANT 22uf 16V
C7	CAP-0031-007	CAPACITOR TANT 22uf 16V
C9	CAP-0039-107	CAP, ELEC 100uF 35V
DS1	SEM-0085-005	LED, GREEN, 2.5X5mm
DS2	SEM-0085-005	LED, GREEN, 2.5X5mm
DS3	SEM-0085-005	LED, GREEN, 2.5X5mm
DS4	SEM-0085-005	LED, GREEN, 2.5X5mm
DS5	SEM-0085-005	LED, GREEN, 2.5X5mm
J1	CON-0243-105	SOCKET
J2	CON-0243-105	SOCKET
L1	IND-0020-014	INDUCTOR, 470uh CRAMER
L2	IND-0020-014	INDUCTOR, 470uh CRAMER
P1	CAB-0500-004	JST, 8-CKT, 38 MM
P2	CAB-0500-004	JST, 8-CKT, 38 MM
S1	FAB-0500-04H	VS KEYCAP
S1-5	SWI-0033-005	SWITCH, MOMENTARY, 5-STA
S2	FAB-0500-04L	LST KEYCAP
S3	FAB-0500-04F	MON KEYCAP
S4	FAB-0500-04E	A/N KEYCAP
S5	FAB-0500-04D	H KEYCAP
U3	SEM-0170-015	LM78L05AWC

SEA INC.  
SINGLE LEVEL BILL OF MATERIAL

PARENT: SMT-0505-07

DESC: SWITCH BOARD, SMT

UM: EA      MB: M      REV:  
EFFECTIVITY DATE: 092195      EFFECTIVE REV:

PT USE	SEQN COMPONENT	DESCRIPTION	M C Q   REV B T T IN OUT	QUANTITY	UM	EFFECTIVITY IN   OUT	SCRAP LTOS   PCNT
000	000 CAP-1206-104	SM.CAP .1UF@50V RED A/A5 C1,C10,C11,C14	B N I	4	EA	011595	0   0.0
000	000 CAP-1206-151	CAPACITOR, 'E2' 150PF C8	B N I	1	EA	011595	0   0.0
000	000 CAP-1206-472	CAPACITOR, 'S3' .0047UF C4	B N I	1	EA	011595	0   0.0
000	000 PCB-0505-07	PCB, SWITCH BOARD	B N I	1	EA	011595	0   0.0
000	000 RES-1206-022	RESISTOR, 2.2 OHM R5	B N I	1	EA	011595	0   0.0
000	000 RES-1206-102	RESISTOR, 1K, SMD R2,R3,R11	B N I	3	EA	011595	0   0.0
000	000 RES-1206-122	RESISTOR, 1.2K R7	B N I	1	EA	011595	0   0.0
000	000 RES-1206-222	RESISTOR, 2.2K R8,R13	B N I	2	EA	011595	0   0.0
000	000 RES-1206-223	SM RES 22K 1/4 W 5% R1,R9,R10,R12	B N I	4	EA	011595	0   0.0
000	000 RES-1206-273	RESISTOR, 27K R6	B N I	1	EA	011595	0   0.0
000	000 RES-1206-470	RESISTOR, 47 OHM R4	B N I	1	EA	011595	0   0.0
000	000 SEM-1003-001	BAV74 DL SW, CC3, SOT23, CR1	B N I	1	EA	011595	0   0.0
000	000 SEM-1008-068	MMBZ5235B, 6.8ZD, A1, SOT CR2	B N I	1	EA	011595	0   0.0
000	000 SEM-1008-150	MMBZ5245B, 15ZD, A1, SOT- CR3	B N I	1	EA	011595	0   0.0

SEA INC.  
SINGLE LEVEL BILL OF MATERIAL

PARENT: SMT-0505-07

DESC: SWITCH BOARD, SMT

UM: EA MB: M REV:  
EFFECTIVITY DATE: 092195 EFFECTIVE REV:

PT USE	SEQN COMPONENT	DESCRIPTION	M C Q B T T IN OUT	REV QUANTITY UM	EFFECTIVITY IN OUT LTOS	SCRAP PCNT
000	000 SEM-1015-014	MC74HC14AD, HEX SCHMITT I U1	B N I	1 EA	011595	0 0.0
000	000 SEM-1024-010	TL497, SWITCHING REGULATO U2	B N I	1 EA	011595	0 0.0
000	000 SEM-1042-001	2907, PNP GP TRANS, 2B/2 SOT-23 Q1	B N I	1 EA	011595	0 0.0

\* \* \* \* \* \* \* \* \* \* \* \* \* \* \* \* \* END OF REPORT \* \* \* \* \* \* \* \* \* \* \* \* \* \* \*

REFERENCE DESIGNATORS FOR ASY-0505-09 ASSY, VFD DISPLAY BOARD

EFFECTIVE 10-18-94

REF DES	PART NUM	DESCRIPTION
DIS1	DIS-0002-001	VF DIS, 8 DIGIT ALPHA
LS1	SEM-0100-001	NSL-5112 PHOTOCELL, MINI
P1	CON-0243-005	HEADER
P2	CON-0243-005	HEADER
RN1	RES-0028-473	RESISTOR NETWORK 47K 10 PIN
RN2	RES-0028-473	RESISTOR NETWORK 47K 10 PIN
RN3	RES-0028-473	RESISTOR NETWORK 47K 10 PIN
U1	SEM-0170-022	10937 (RED)

REFERENCE DESIGNATORS FOR ASY-0520-02 PERSONALITY 520 ESP/DSP

EFFECTIVE 10-18-94

REF DES	PART NUM	DESCRIPTION
AC102	CON-0026-001	JUMPER, POST HEADER
C102	CAP-0074-001	CAP 1uf NONPOLARIZED ELECT
C103	CAP-0037-004	CAP.ELECT 47UF RAD
C105	CAP-0037-006	CAP.ELECT 10UF RAD
C106	CAP-0037-006	CAP.ELECT 10UF RAD
C107	CAP-0074-001	CAP 1uf NONPOLARIZED ELECT
C108	CAP-0030-008	CAP, TANT .22 50V
C109	CAP-0037-004	CAP.ELECT 47UF RAD
C113	CAP-0074-001	CAP 1uf NONPOLARIZED ELECT
C114	CAP-0037-004	CAP.ELECT 47UF RAD
C115	CAP-0037-004	CAP.ELECT 47UF RAD
C116	CAP-0037-004	CAP.ELECT 47UF RAD
C117	CAP-0074-001	CAP 1uf NONPOLARIZED ELECT
C118	CAP-0074-001	CAP 1uf NONPOLARIZED ELECT
C119	CAP-0074-001	CAP 1uf NONPOLARIZED ELECT
C12	CAP-0037-004	CAP.ELECT 47UF RAD
C120	CAP-0074-001	CAP 1uf NONPOLARIZED ELECT
C13	CAP-0037-006	CAP.ELECT 10UF RAD
C131	CAP-0031-008	CAP TANT 1uf 16-25V
C16	CAP-0037-004	CAP.ELECT 47UF RAD
C17	CAP-0037-006	CAP.ELECT 10UF RAD
C20	CAP-0037-004	CAP.ELECT 47UF RAD
C21	CAP-0037-004	CAP.ELECT 47UF RAD
C22	CAP-0037-006	CAP.ELECT 10UF RAD
C23	CAP-0037-004	CAP.ELECT 47UF RAD
C24	CAP-0037-004	CAP.ELECT 47UF RAD
C27	CAP-0037-006	CAP.ELECT 10UF RAD
C30	CAP-0037-005	CAP.ELECT 22UF RAD
C31	CAP-0037-006	CAP.ELECT 10UF RAD
C34	CAP-0037-004	CAP.ELECT 47UF RAD
C4	CAP-0037-006	CAP.ELECT 10UF RAD
C9	CAP-0074-001	CAP 1uf NONPOLARIZED ELECT
CR103	SEM-0085-001	LED, GREEN, T1
CR104	SEM-0084-001	LED, RED, T1
J10	CON-0053-008	HEADER, 8CKT
J2	CON-0035-015	SOCKET, BOTTOM ENTRY 15 CKT
J4	CON-0035-007	SOCKET, BOTTOM ENTRY 7 CKT
J5	CON-0053-002	HEADER, 2CKT
J6	CON-0053-008	HEADER, 8CKT
J7	CON-0053-008	HEADER, 8CKT
J8	CON-0053-008	HEADER, 8CKT
J9	CON-0053-008	HEADER, 8CKT
JU1	CON-0240-030	POST HEADER 3 PIN
JU102	CON-0240-030	POST HEADER 3 PIN
JU104	CON-0240-020	POST HEADER 2 PIN
JU105	CON-0240-020	POST HEADER 2 PIN
JU4	CON-0240-020	POST HEADER 2 PIN
JU5	CON-0240-020	POST HEADER 2 PIN
JU7	CON-0240-030	POST HEADER 3 PIN
JU8	CON-0240-020	POST HEADER 2 PIN

## REFERENCE DESIGNATORS FOR ASY-0520-02 PERSONALITY 520 ESP/DSP

EFFECTIVE 10-18-94

REF DES	PART NUM	DESCRIPTION
Q1	SEM-0027-003	MTD5P06E1 P-CHAN TMOSFET 4A, 369-03
Q2	SEM-0027-003	MTD5P06E1 P-CHAN TMOSFET 4A, 369-03
R128	RES-0027-202	RESISTOR, TRIMPOT 2K
RN1	RES-0028-472	RNET, 10-SIP, 4.7K PULLUP
RN101	RES-0040-103	R/2R RES NET 10K 10 PIN SIP
RN2	RES-0028-472	RNET, 10-SIP, 4.7K PULLUP
RN3	RES-0028-473	RESISTOR NETWORK 47K 10 PIN
SOC -U8	SOC-0002-008	IC SOCKET, 8 PIN DIP
U1	OPS-0520-U1	ESP520 OP SYSTEM SLAVE
U10	SEM-0170-015	LM78L05AWC
U103	SEM-0158-007	MC145554 DCM CODEC-FILTER
U11	SEM-0109-007	78L09 VOLTAGE REG, 9V 100mA
U1A	SOC-0009-020	SIP-20 MILLED SOCKET
U1B	SOC-0009-020	SIP-20 MILLED SOCKET
U2	OPS-0520-U2	ESP520 OP SYSTEM MASTER
U2A	SOC-0009-020	SIP-20 MILLED SOCKET
U2B	SOC-0009-020	SIP-20 MILLED SOCKET
U6A	SOC-0009-014	SOCKET, 14 PIN
U6B	SOC-0009-014	SOCKET, 14 PIN
U8	SEM-0187-002	16K-BIT SERIAL E2 PROM
U9	SEM-0170-015	LM78L05AWC
Y1	CRY-0024-001	CRYSTAL 4.0000 MHZ

EXP.BILL - SINGLE LEVEL BILL-OF-MATERIAL LISTING EFFECTIVE 10/18/94

LEVEL	PART	DESCRIPTION	QTY/ASSY	UM
0.....	<u>ASY-0520-12</u>	<u>ASSY, DISPLAY BEZEL</u>		EA
1.....	ASY-0505-05	CONTROL BOARD, DSP	1	EA
1.....	ASY-0505-06	POT BOARD, DSP	1	EA
1.....	ASY-0505-07	ASSY, SWITCH BOARD	1	EA
1.....	FAB-0500-03	BEZEL, DISPLAY	1	EA
1.....	FAB-0500-05	KNOB, CONTROL	2	EA
1.....	FAB-0500-07	ESCUTCHEON, DISPLAY	1	EA
1.....	FAB-0500-12	PLUG, HOLE	5	EA
1.....	HAR-0043-007	NYLON WASHER, .031 THK.	7	EA
1.....	W0520012.000	ASY-0520-12 BEZEL	0	EA

EXP.BILL - SINGLE LEVEL BILL-OF-MATERIAL LISTING EFFECTIVE 05/12/94

LEVEL	PART	DESCRIPTION	QTY/ASSY	UM
0.....	<u>KIT-0500-30</u>	<u>MIC HANGER KIT</u>		EA
1.....	MIC-0003-003	HANGER BRACKET	1	EA
1.....	TER-0014-005	#6 RING LUG, INSULATED CRIMP	1	EA
1.....	W0500030.000	ASY-0500-30 HANGER KIT	0	EA

## **15. FACTORY LIMITED WARRANTY**

SEA Inc. warrants to the original purchaser that each SEA land mobile radio product, or SEA branded accessory is free of defects in material and workmanship for a period of one year from the date of delivery, except as noted below\*. SEA Inc. will provide through its authorized service agent, supplier, or directly, the parts and labor to repair such products found defective.

The purchaser is responsible for any cost of travel or transportation connected with warranty repair. The purchaser is also responsible for all costs of investigating or correcting a failure caused by the purchaser's misuse, abuse, or neglect, by unauthorized alteration or repair, by accidents or other factors beyond the control of SEA Inc. No warranty is made as to availability of the radio repeater system provided by the carrier or repeater operator or the system's coverage, grade of service or operation.

SEA reserves the right to make changes in design and/or improvements to its products, at any time, without any obligation to include these changes in previously manufactured products. Correction of defects by repair or replacement shall constitute fulfillment of all warranty obligations on the part of SEA. Corrective actions may include replacement of defective modules with factory rebuilt modules which are warranted for the remainder of the product's warranty period. Peripheral equipment purchased from other manufacturers or vendors which are incorporated into radio systems carry the original equipment manufacturer's warranty.

This is the sole and exclusive express warranty offered by SEA for any claim of damages arising from any defect in the SEA product. Implied warranties, including any warranty of merchantability or fitness for a particular purpose, are limited to the duration of this written warranty, and are excluded to the extent permitted by law. SEA shall have no liability for consequential damages or personal injury or for loss, damage or expense directly or indirectly arising from the use of its products. Some states do not allow limitations on how long an implied warranty lasts, or exclusion of incidental or consequential damages, so the above limitations may not apply to you.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

- \*     90 days - Portable radio batteries
- No warranty on expendable parts, such as fuses and lamps.

## **504/520 Instruction Manual Supplement for ESP520D**

### **INTRODUCTION**

The ESP520D narrowband mobile data transceiver provides all the features and benefits of the voice-only ESP520 plus data dispatch capability. The ESP520D interfaces directly to several popular mobile mobile data terminals (MDTs) to provide reliable two-way data communications between dispatcher and fleet. The purpose of this supplement to the ESP 504/520 Instruction Manual (MAN-0504-01) is to aid in the installation, operation, and maintenance of the ESP520D radio.

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### **CAUTION**

The ESP520D radio is designed to connect to specific mobile data terminals. Please contact SEA before connecting an unfamiliar terminal to the ESP520D. Failure to do so may cause damage to the ESP520D or the MDT.

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### **SPECIFICATIONS**

The specifications below apply only to the data communications features of the ESP520D. Other specifications for the ESP520D are tabulated in the ESP504/520 Instruction Manual.

#### **ESP520D Modem**

User data rate	1200 bps
User data modulation format	Dual 600 bps BPSK
User data carriers	950 and 2950 Hz

#### **MDT Interface**

MDT cable	Shielded 2' long 10 conductor
MDT connector	Female DB-25
MDT supply voltage	13.6 V
PTT input from MDT	Active low
Clear to send (CTS) to MDT	Active low
Squelch to MDT	Low = audio squelched
Rx output impedance	75 ohm
Tx input impedance	10k ohm

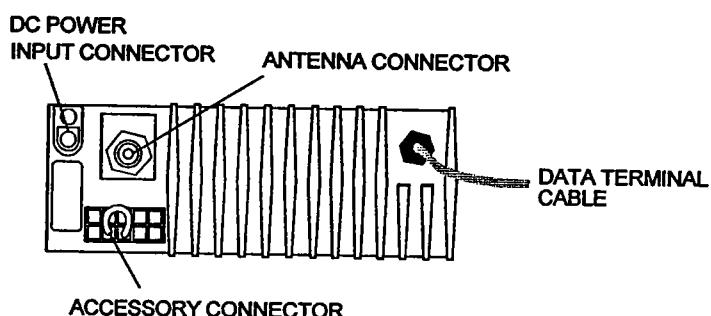
## **MDT Modem**

MDT data rate	1200 bps
MDT modulation formats	1200/1800 Hz MSK or 1200/2200 Hz FSK
Required tone amplitude to radio	Approximately 0.1 V P-P
Tone amplitude out to MDT	2 V P-P

## INSTALLATION

### **MDT Connection Requirements**

The MDT or Base Station Controller connects to the ESP520D via a pigtail cable protruding from the rear of the radio as shown below:



The MDT connector is a Female DB-25 type. Its pinout is as follows:

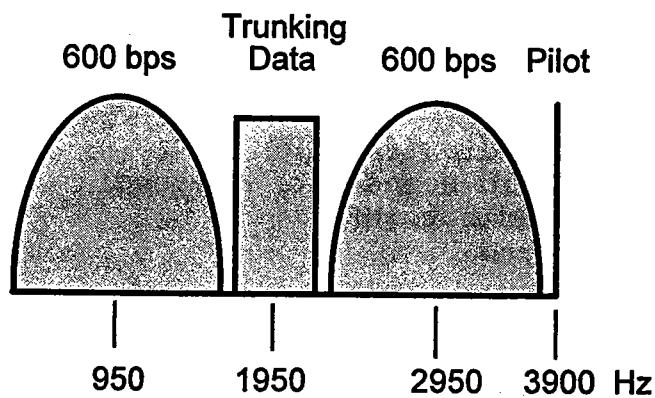
<u>Pin</u>	<u>Color</u>	<u>Function</u>
1	Yellow	Power ground
5	Brown	PTT (active low)
6	White	CTS (active low)
10	Purple	Receive audio to MDT
11	Green	Audio ground
12	Red	Transmit audio from MDT
13	Black	+13 V DC
20	Orange	Squelch (high = squelch open)
Shell	Bare	Shield

## ELECTRICAL DESCRIPTION

### **Transmitter**

The ESP520D transmitter data communications processing is accomplished in a modified version of the ESP520 DSP. When transmitting data, the ESP520D DSP demodulates the frequency

shift keyed (FSK) data from the MDT and recovers the original 1200 bps data stream. The DSP demodulates both 1200/1800 Hz MSK or 1200/2200 Hz FSK modulations, depending on the signalling format of the MDT (programmed into the radio's EEPROM). The demodulated 1200 bps data stream is first scrambled using a seven tap linear feedback shift register. Then alternating bits of the scrambled data stream are differentially encoded and re-modulated onto low and high user data carriers at 950 and 2950 Hz, respectively. Each user data carrier is modulated at 600 symbols/sec using binary phase shift keying (BPSK). The 600 bps data streams are composed of differentially encoded alternating bits of the scrambled 1200 bps data. The low and high user data channels are summed with the trunking data and pilot tone prior to transmission. Preemphasis and deemphasis are not used during data transmission. The audio spectrum output by the DSP looks as follows:



### **Receiver**

The ESP520D receive data communications processing is also accomplished in the DSP. The input to the DSP is a noisy and distorted version of the transmit spectrum above, sampled at 9600 samples/sec with 12 bits of dynamic range. The two BPSK user data channels are mixed to baseband and two 600 bps data streams are differentially detected. The 600 bps data streams are alternately shifted into a seven tap descrambler which outputs the originally transmitted 1200 bps data stream. If the MDT uses 1200/1800 Hz MSK signalling, then a 1500 Hz carrier is frequency modulated with a deviation of 300 Hz (modulation index 0.5) by this data stream. If the MDT uses 1200/2200 FSK signalling, the

carrier is 1700 Hz and the deviation is 500 Hz (modulation index 0.83). The MDT modulation type is programmed into the radio's EEPROM. The FSK audio signal is output to the MDT at about 2 V peak-to-peak amplitude (this does not depend on the transmitting MDTs output level). This signal matches the FSK signal output by the transmitting MDT.

The ESP520D radio does not include the AFC sweep function which was added to the ESP520 to increase the receiver's capture range. This function was deleted because the 1200 bps modem cannot tolerate the residual frequency error induced by the AFC sweep function.

### **Interface Circuit**

The primary function of the interface circuit located on the MDT Interface Board, ASY-520D-11, is to connect the conductors in the pigtail cable to the Personality Board. The ten conductors from the pigtail cable solder to the interface board at holes E1-E10 (there are matching strain relief holes). E1-E10 are defined as follows:

E1	N/C
E2	Transmit audio from MDT
E3	Cable shield connection (ground)
E4	Receive audio to MDT
E5	Power ground
E6	+13.6 V DC
E7	Squelch
E8	CTS
E9	Audio ground
E10	PTT from MDT

The transmit and receive data connections between the ESP520D and the MDT are gated on only when necessary to prevent noise from being injected during voice operations. The circuit which accomplishes this, located on the Interface Board, operates as follows:

1. CTS high --> transmit audio from MDT not connected to radio
2. CTS low --> transmit audio from MDT connected to radio
3. Squelch high (open) --> receive audio to from radio not connected to MDT
4. Squelch low --> receive audio from radio connected to MDT

Jumper JU1 on the Interface Board is intended to be cut if the MDT (or base station controller) is powered by a source external to the radio such as a 110 V AC transformer.

### **Personality Board**

The ESP520D Personality Board is a standard ESP520 version with the following hardware changes:

1. Install J3 (CON-0053-008) and J12 (CON-0053-002) headers
2. Jumper U102A/1 to J12/2
3. Jumper U102B/5 to J3/1
4. Cut land leaving J3/1
5. Cut land leaving U111/16
6. Jumper J3/5 to C101 ground side
7. Remove R36
8. Jumper R36 (non ground side) to RN2/9
9. Move JU102 to AB;

and the following software changes:

10. Replace U1 with OPS-520D-U1
11. Replace U2 with OPS-520D-U2
12. Replace U106 with OPS-520D-U6

The changes above co-locate all the MDT interface points to the J3 and J12 headers on the Personality Board. The pinouts of J3 and J12 (after the ESP520D modifications) are:

J3/1	Transmit audio from MDT to radio
J3/2	N/C (can't use)
J3/3	PTT signal from MDT to radio
J3/4	N/C (can't use)
J3/5	Audio ground
J3/6	DC ground
J3/7	+13.6 V DC
J3/8	CTS
J12/1	Squelch
J12/2	Receive audio from radio to MDT

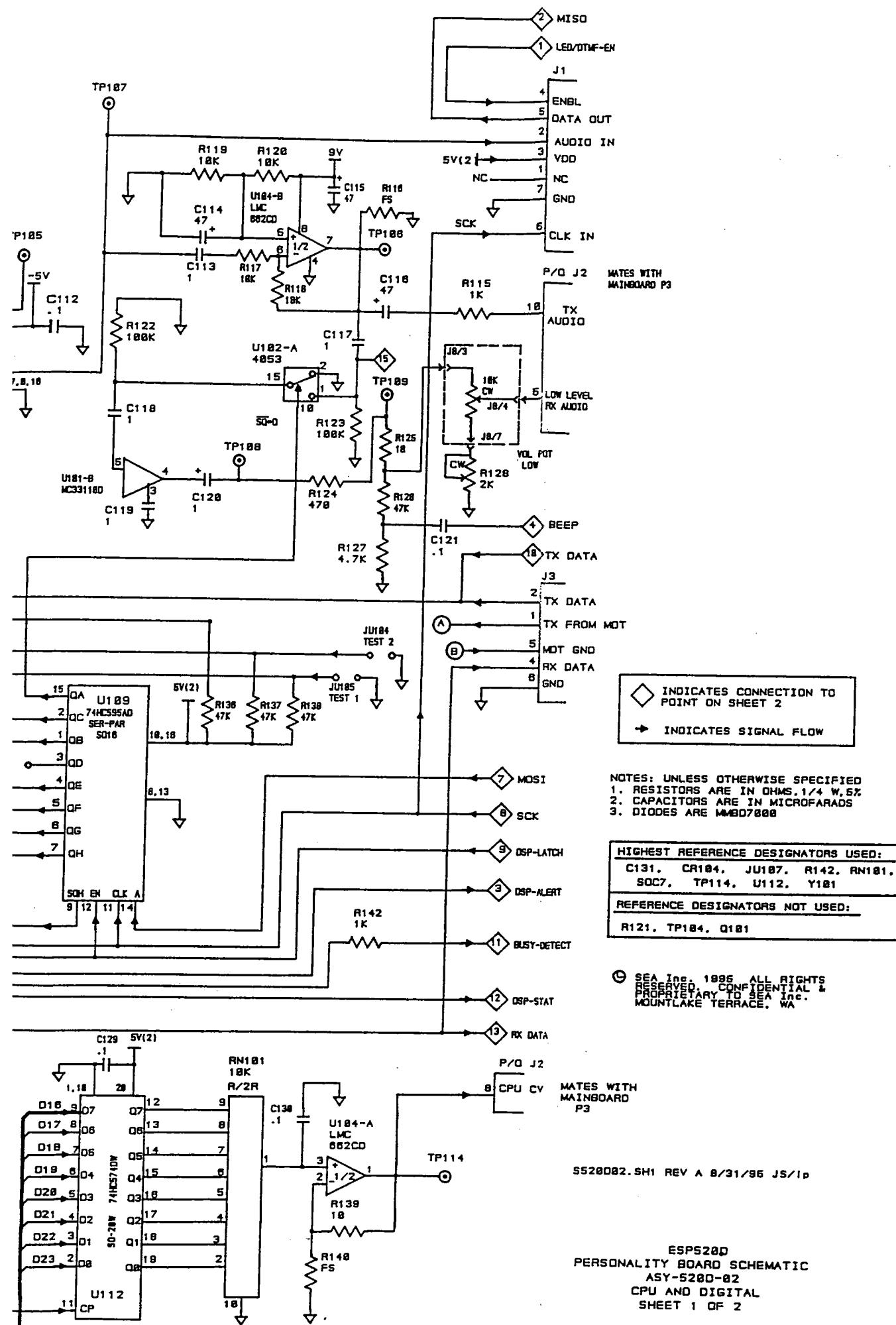
### **Schematics**

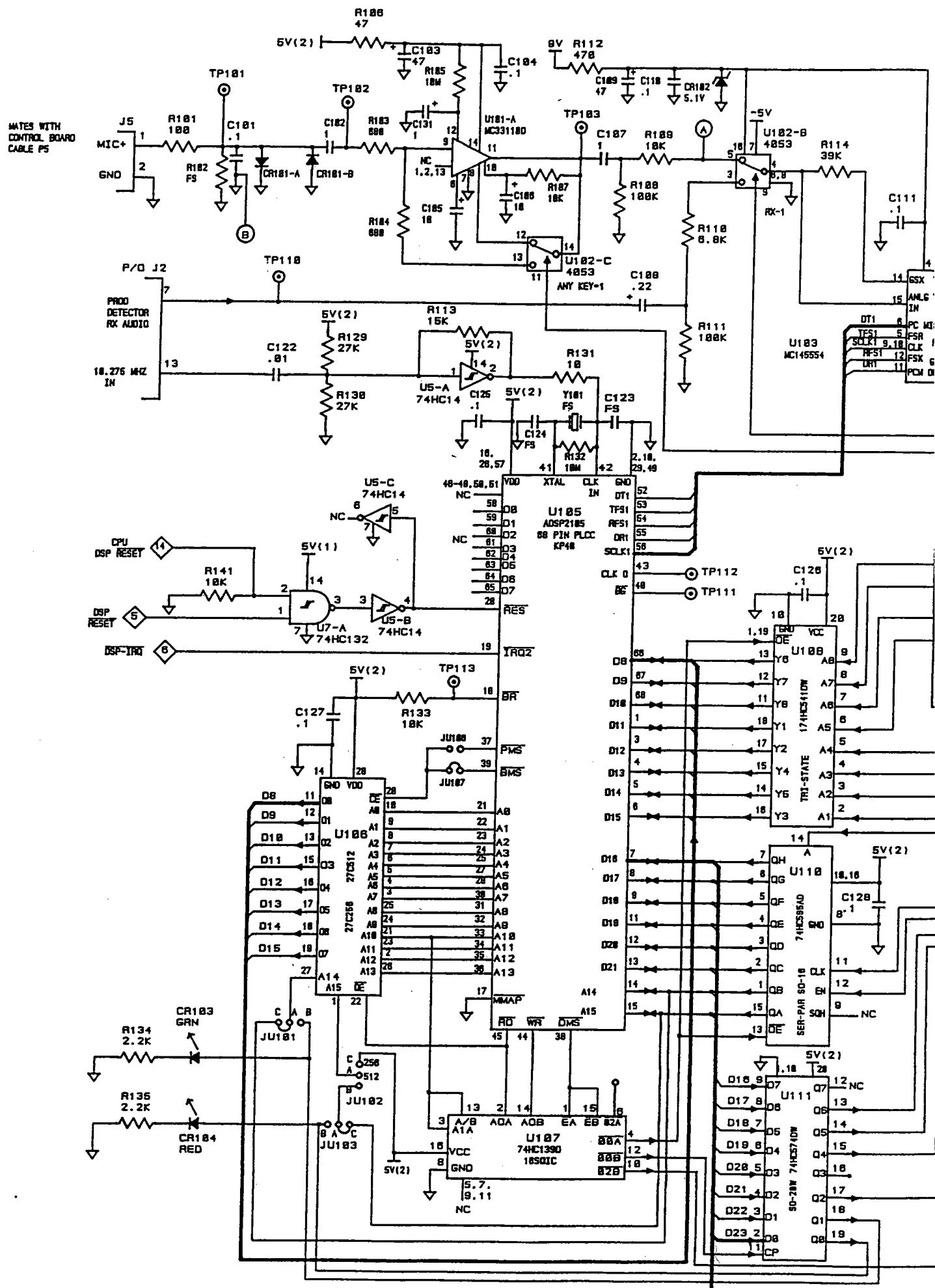
Attached

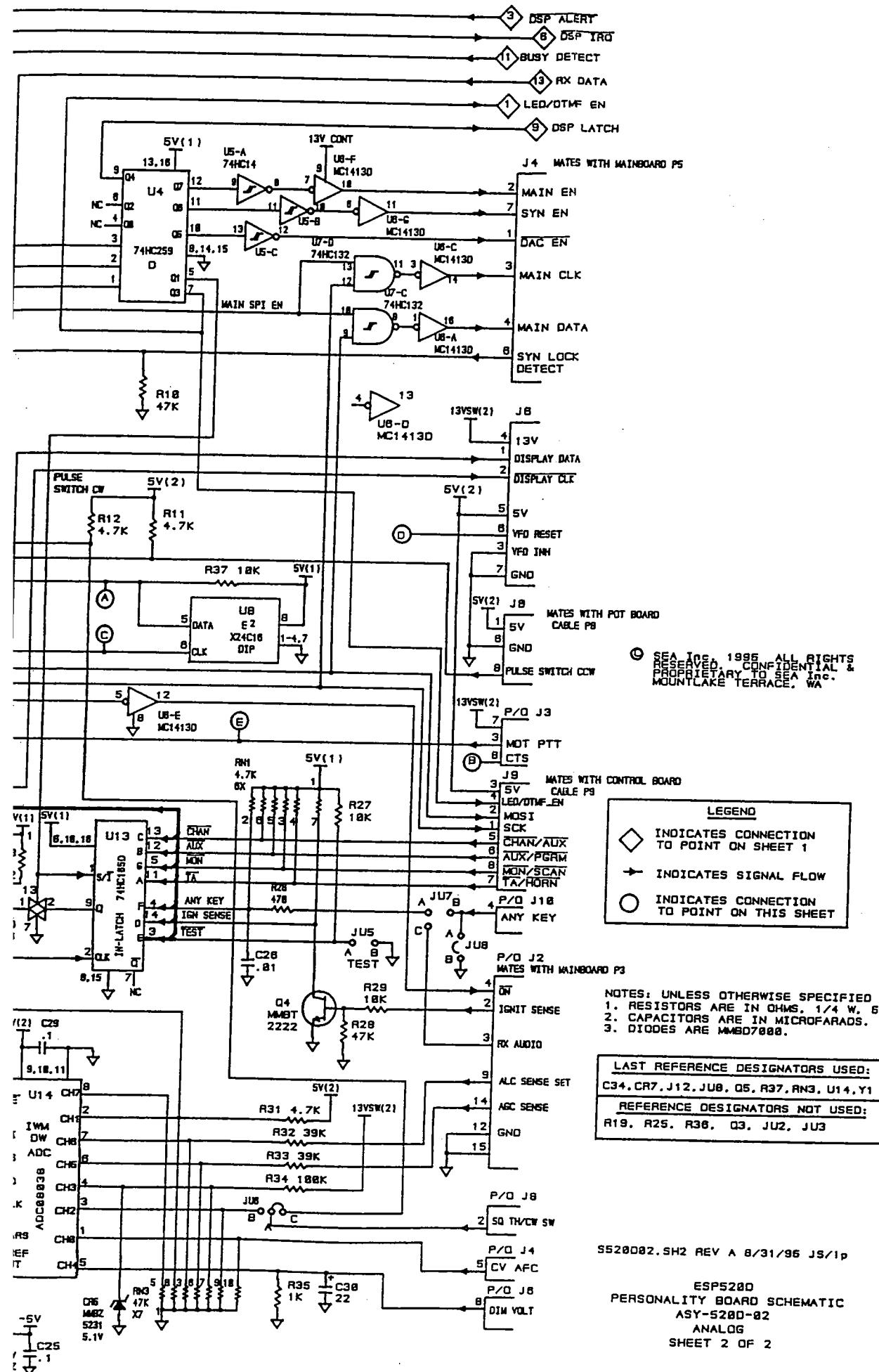
### **Bills of Material**

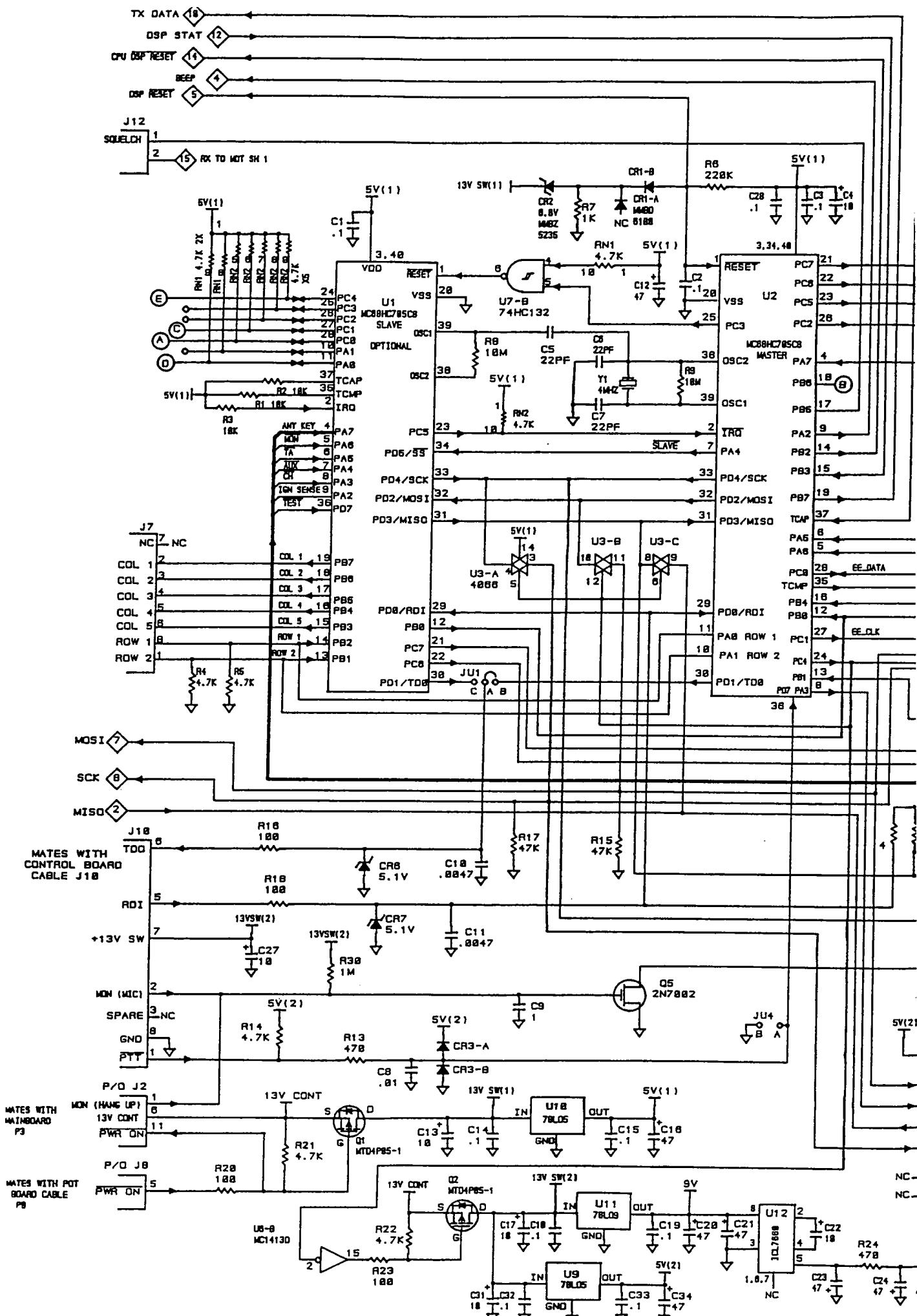
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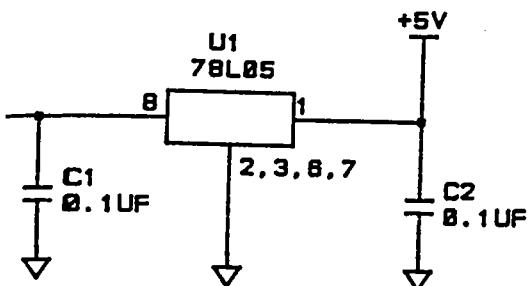






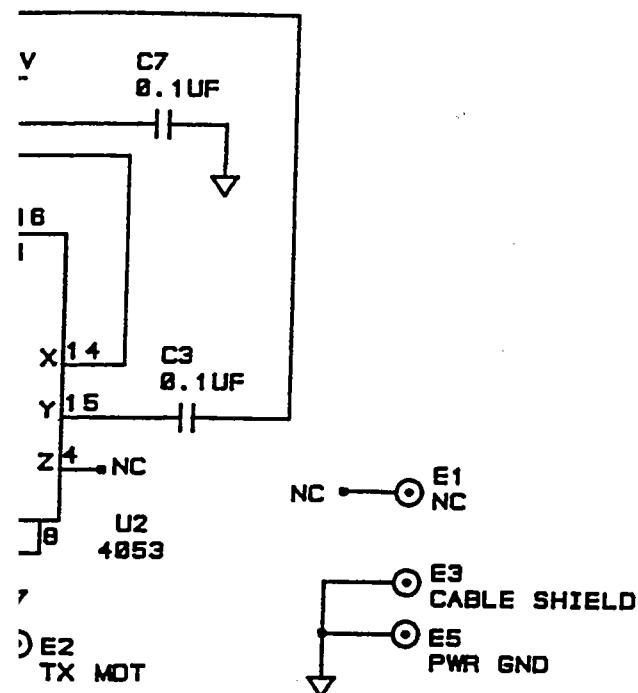






S50510.SH1 REV P1 7/10/95 KJW  
S520D11.CSD 9/1/95 JBS/lmp

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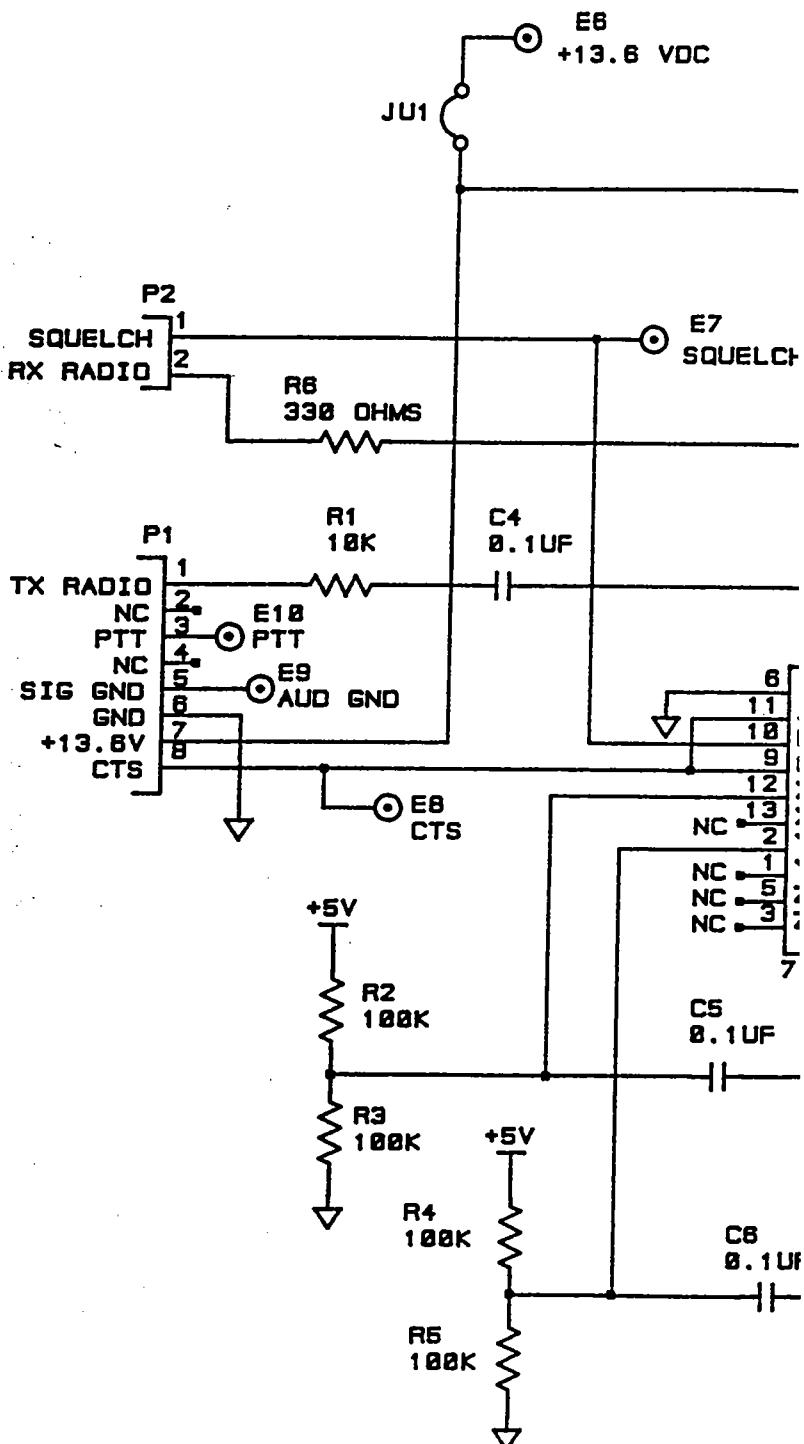
NOTES: UNLESS OTHERWISE SPECIFIED  
1. RESISTORS ARE IN OHMS, 1/4W, 5%.  
2. CAPACITORS ARE IN MF/D/WVDC.

LAST DESIGNATORS USED:

C7, E10, JU1, P2, R6, U2

ESP520D  
DATA TERMINAL INTERFACE SCHEMATIC  
ASY-520D-11

E4 RX MOT



11:30:43

FUNCTION: BILI

SEA INC.  
SINGLE LEVEL BILL

OPTION: A IN EFF: 100995 OUT EFF: 123179

PAGE: 1  
10/09/1995PARENT: 520DDESC: 520, DATA VERSION

RV:	UM: EA	RUN LT:	4	FIXED LT:	0
PLNR:	PLN	LT:	N	PLN POL:	M

PT USE SEQN COMPONENT  
STARTING:

PT	USE	SEQN	COMPONENT	DESCRIPTION	C	Q	M	L
					T	QUANTITY	T	U
000	000	ASY-0500-15		COVER W/FELT	P	2	I	EA M N
000	000	ASY-0500-23		ASSY, MICROPHONE PALM	N	1	I	EA M N
000	000	ASY-0520-12		ASSY, DISPLAY BEZEL	N	1	I	EA M N
000	000	LBL-0009-005		FCC LABEL, ESP520	X	1	I	EA B N
000	000	W0520000.1F0		520 FINAL ASSY. INSTR	X	0	I	EA M N
000	000	W0520000.1S0		ESP520 BOXING INSTR.	X	0	I	EA M N
000	000	ASY-520D-14		RADIO, BASIC 520D	P	1	I	EA M N
BOXNG	000	BOX-0500-01		OUTER CONTAINER, ESP500	N	1	I	EA B N
BOXNG	000	FAB-0500-14		BRACKET, TRUNION	N	1	I	EA B N
BOXNG	000	FOM-0500-02		2# CUT FOAM	N	1	I	EA B N
BOXNG	000	FOM-0500-03		1# FLAT FOAM	N	2	I	EA B N
BOXNG	000	KIT-0504-99		HARDWARE KIT	N	1	I	EA M N
BOXNG	000	OPR-520		ESP520 OPERATING MANUAL	N	1	I	EA B N
BOXNG	000	SPE-0500-23		EXTERNAL SPEAKER, 4IN. 40HM	N	1	I	EA B N
BOXNG	000	INSERT-26		OPR-520 INSERT FOR ESP520D	N	1	I	EA B N
LAB	000	LAB [R] ASSY		LABOR, ASSEMBLY	R	8.15	I	HR M N
LAB	000	LAB [R] INSP		LABOR, INSPECTION	R	2	I	HR M N
LAB	000	LAB [R] TEST		LABOR, TEST	R	.4	I	HR M N
LAB	001	LAB [R] TEST		LABOR, TEST	R	.3	I	HR M N
POST	000	OPS-520D-U6		520D DSP CODE	N	1	I	EA M N
POST	000	OPS-520D-U1		520D OP SYSTEM SLAVE	N	1	I	EA M N
POST	000	OPS-520D-U2		520D OP SYSTEM MASTER	N	1	I	EA M N
REF	000	HAR-040P-250		4-40 X 1/4 PH PH PATCH LOCK	X	4	I	EA B N
REF	000	HAR-041F-250		4-40X1/4 FH 100	X	4	I	EA B N

\*\*\* END OF REPORT \*\*\*

11:33:59

FUNCTION: BILI

SEA INC.  
SINGLE LEVEL BILL

OPTION: A IN EFF: 100995 OUT EFF: 123179

PAGE: 1  
10/09/1995PARENT: ASY-520D-14DESC: RADIO, BASIC 520DRV: UM: EA RUN LT: 5 FIXED LT: 0  
PLNR: BEC LT: N PLN POL: N DRWG:PT USE SEQN COMPONENT  
STARTING:

PT USE	SEQN	COMPONENT	DESCRIPTION	C T	Q T	M UM	L B	T	
000	000	ASY-0505-01	MAINBOARD, ESP/DSP	N	1	I	EA	M	N
000	000	CAB-0501-002	MINI COAX CABLE, 127 MM	N	1	I	EA	B	N
000	000	FAB-0500-08	SHIELD, FLAT	N	1	I	EA	B	N
000	000	FAB-0500-30	SPRING CLIP	N	2	I	EA	B	N
000	000	W0520014.000	ASY-0520-14 INSTR	X	0	I	EA	M	N
000	000	ASY-520D-11	DATA TERMINAL INTERFACE	N	1	I	EA	M	N
000	000	ASY-520D-02	PERSONALITY BOARD, 520D	N	1	I	EA	M	N
000	000	ASY-520D-10	CHASSIS ASSEMBLY, 520D	N	1	I	EA	M	N
000	000	HAR-0021-003	NYLON STUFFING GLAND	N	1	I	EA	M	N
000	000	HAR-0071-012	4-40X3/4 SS STANDOFF	N	1	I	EA	B	N
000	000	CAB-0501-001	MINI COAX CABLE, 70 MM	N	2	I	EA	B	N
000	000	ASY-520D-C01	ASSY, CABLE 520D	N	1	I	EA	B	N
REF	000	HAR-040P-187	4-40 X 3/16 PH PH PATCH LOCK	X	1	I	EA	M	N
REF	000	HAR-040P-250	4-40 X 1/4 PH PH PATCH LOCK	X	4	I	EA	B	N
REF	000	HAR-040P-375	4-40 X 3/8 PH PH PATCH LOCK	X	21	I	EA	B	N
					1	I	EA	B	N

\*\*\* END OF REPORT \*\*\*

13:21:13

FUNCTION: BILI

SEA INC.  
SINGLE LEVEL BILL  
OPTION: A IN EFF: 100995 OUT EFF: 123179

PAGE: 1  
10/09/1995

PARENT: ASY-520D-10DESC: CHASSIS ASSEMBLY, 520D

RV:	UM: EA	RUN LT:	2	FIXED LT:	0
PLNR: BEC	LT: N	PLN POL:	N	DRWG:	

PT USE SEQN COMPONENT  
STARTING:

PT	USE	SEQN	COMPONENT	DESCRIPTION	C	Q	M	L
					T	QUANTITY	T	UM B T
000	000	ASY-0505-03	POWER AMP		N	1	I	EA M N
000	000	CON-0007-004	MINI-UHF BULKHEAD FEMALE		N	1	I	EA B N
000	000	FAB-0500-16	SPRING, HELICAL		N	1	I	EA B N
000	000	FAB-0500-41	PA GND BRACKET		N	1	I	EA B N
000	000	FAB-0500-44	RF POWER AMP SHIELD		N	1	I	EA B N
000	000	OEM-0500-001	220MHZ RF POWER MODULE		N	1	I	EA B N
000	000	TUN-0001-375	TUNING SCREW, 3/8 SS HEX		X	1	I	EA B N
000	000	TUN-0001-437	TUNING SCREW, 7/16 SS HEX		X	2	I	EA B N
000	000	W0500010.000	ASY-0500-10 P.A.		X	3	I	EA B N
000	000	FAB-520D-01	520D MOBILE CHASSIS, FINISHED		X	0	I	EA M N
LAB	000	LAB [R] TEST	LABOR, TEST		R	1	I	EA S N
REF	000	HAR-040P-250	4-40 X 1/4 PH PH PATCH LOCK		X	.2	I	HR M N
REF	000	HAR-040P-375	4-40 X 3/8 PH PH PATCH LOCK		X	6	I	EA B N
REF	000	TUN-0001-375	TUNING SCREW, 3/8 SS HEX		X	2	I	EA B N
REF	000	TUN-0001-437	TUNING SCREW, 7/16 SS HEX		X	2	I	EA B N
					X	3	I	EA B N

\*\*\* END OF REPORT \*\*\*

13:18:45

FUNCTION: BILI

SEA INC.

SINGLE LEVEL BILL

OPTION: A IN EFF: 100995 OUT EFF: 123179

PAGE: 1  
10/09/1995

PARENT: ASY-520D-11

DESC: DATA TERMINAL INTERFACE

RV: UM: EA RUN LT: 5 FIXED LT: 0  
PLNR: BEC LT: N PLN POL: N DRWG:

PT USE SEQN COMPONENT  
STARTING:

PT	USE	SEQN	COMPONENT	DESCRIPTION	C	Q	M	L			
					T	QUANTITY	T	UM	B	T	
000	000	CAB-0500-002	JST, 8-CKT, 83 MM		N		1	I	EA	B	N
000	000	CAB-0500-007	JST, 2-CKT, 80 MM		N		1	I	EA	B	N
000	000	SMT-520D-11	520D INTERFACE BOARD		N		1	I	EA	M	N

\*\*\* END OF REPORT \*\*\*

13:18:59

FUNCTION: BILI

SEA INC.  
SINGLE LEVEL BILL  
OPTION: A IN EFF: 100995 OUT EFF: 123179

PAGE: 1  
10/09/1995

<u>PARENT:</u> SMT-520D-11	<u>DESC:</u> 520D INTERFACE BOARD
RV: UM: EA	RUN LT: 5 FIXED LT: 0
PLNR: BEC LT: N	PLN POL: N DRWG:

PT USE SEQN COMPONENT  
STARTING:

PT	USE	SEQN	COMPONENT	DESCRIPTION	C T	Q T	M UM	L B T
000	000	SEM-1024-001	78L05, 5 LIN REG, 100 MA,		N	1	I	EA B N
000	000	CAP-1206-104	SM.CAP .1UF@50V RED A/A5		N	7	I	EA B N
000	000	RES-1206-103	RESISTOR, 10K		N	1	I	EA B N
000	000	RES-1206-104	RESISTOR, 100K		N	4	I	EA B N
000	000	RES-1206-331	RESISTOR, 330 OHM		N	1	I	EA B N
000	000	PCB-520D-11	DATA TERMINAL INTERFACE PCB		N	1	I	EA B N
000	000	SEM-1015-053	74HC4053 TRIPLE SPDT SWIT		N	1	I	EA B N

\*\*\* END OF REPORT \*\*\*

13:18:28

FUNCTION: BILI

SEA INC.  
SINGLE LEVEL BILL

OPTION: A IN EFF: 100995 OUT EFF: 123179

PAGE: 1  
10/09/1995

PARENT: ASY-520D-C01

DESC: ASSY, CABLE 520D.

RV: UM: EA RUN LT: 5 FIXED LT: 0  
PLNR: BEC LT: N PLN POL: N DRWG:

PT USE SEQN COMPONENT  
STARTING:

PT	USE	SEQN	COMPONENT	DESCRIPTION	C	Q	M	L			
					T	QUANTITY	T	UM	B	T	
000	000	CON-0020-006	CONNECTOR HOOD, 25 POS D-		N		1	I	EA	B	N
000	000	CON-0020-014	CONTACT FEMALE D-SUB		N		9	I	EA	B	N
000	000	WIR-0032-017	10 CONDUCTOR SHIELDED CABLE		N		2.5	I	FT	B	N
000	000	CON-0020-016	CONN DB-25 FEMALE		N		1	I	EA	B	N

\*\*\* END OF REPORT \*\*\*