



## **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 Manual revision sheets may accompany this manual upon delivery to the customer which are intended to replace outdated or revised sheets in this manual.

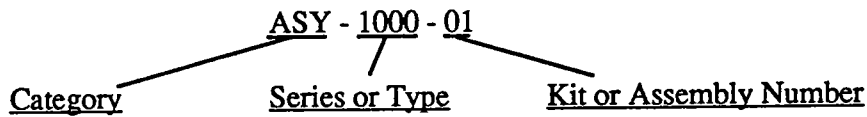
### **2.2 NOMENCLATURE**

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

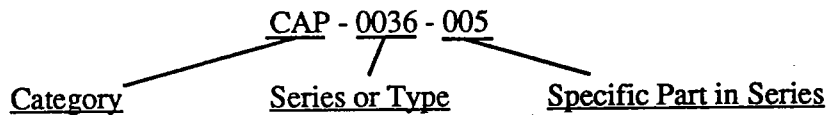
#### **2.2.1 Model Numbers**

|          |                                                                                                  |
|----------|--------------------------------------------------------------------------------------------------|
| ESP504   | 4-Mode trunked/conventional 220-222 MHz<br>dash-mount transceiver equipped with palm microphone  |
| ESP504-1 | ESP504 less palm microphone                                                                      |
| ESP520   | 20-Mode trunked/conventional 220-222 MHz<br>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

---

|                                    |                                                    |            |         |
|------------------------------------|----------------------------------------------------|------------|---------|
| 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<br>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<br>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<br>with pilot tone above band |
| Pilot Carrier                      | 3900 Hz *                                                                |
| Data Carrier                       | 1950 Hz *                                                                |

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

\* When referenced to the suppressed carrier.

### **RECEIVER**

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

### **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 Companded 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

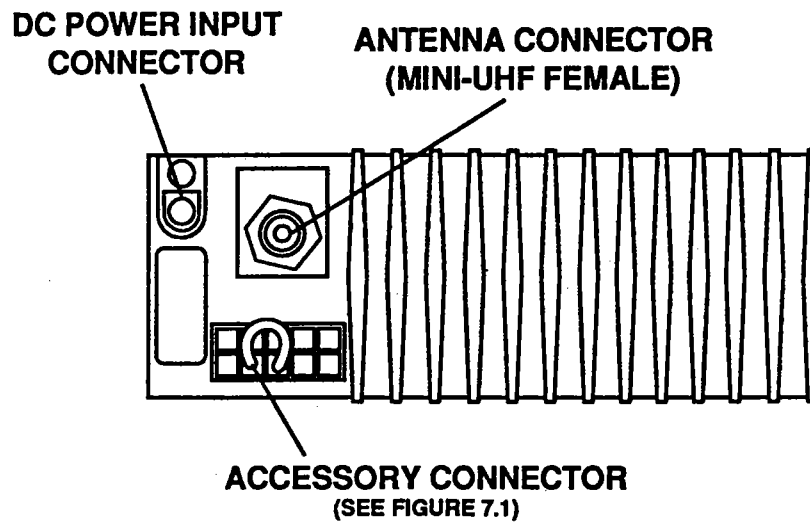
**Table 6.1 Recommended Mini-UHF Plugs for RG-58 cable**

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.

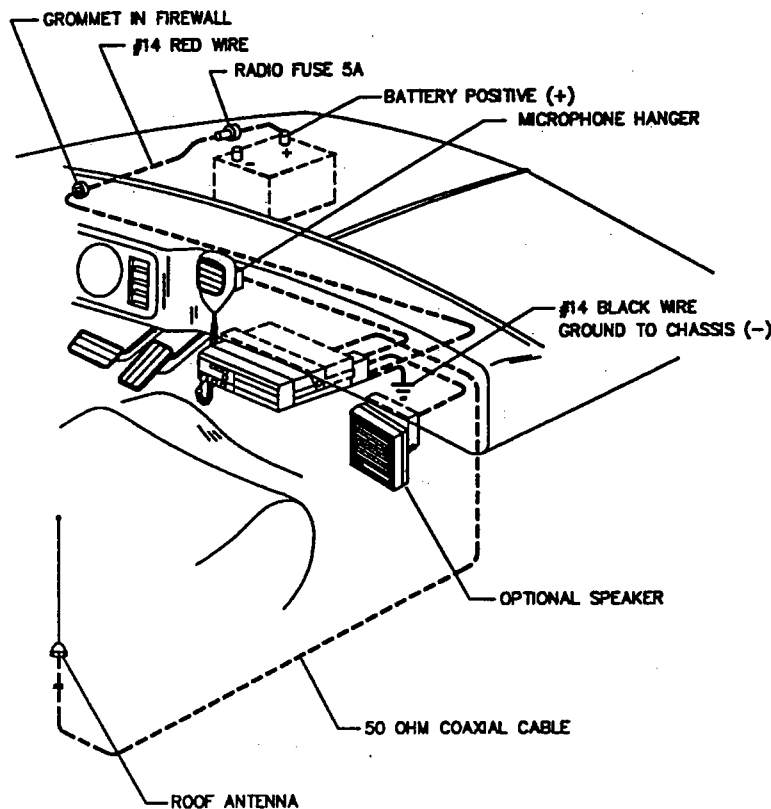
The installer will need to be able to connect a thru-line wattmeter between the transceiver and antenna being installed to check for power out and VSWR. The following adapters, or their equivalents, will be found useful during installation:

|                             |                    |
|-----------------------------|--------------------|
| 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**

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).

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.

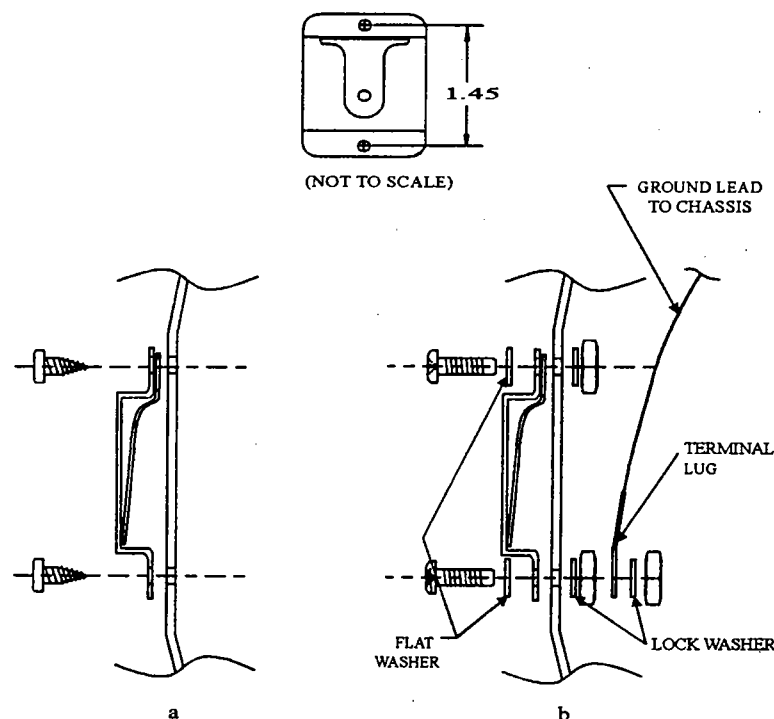


Figure 6.3 Microphone Hanger Installation

### 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.

---

#### 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

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#### NOTE

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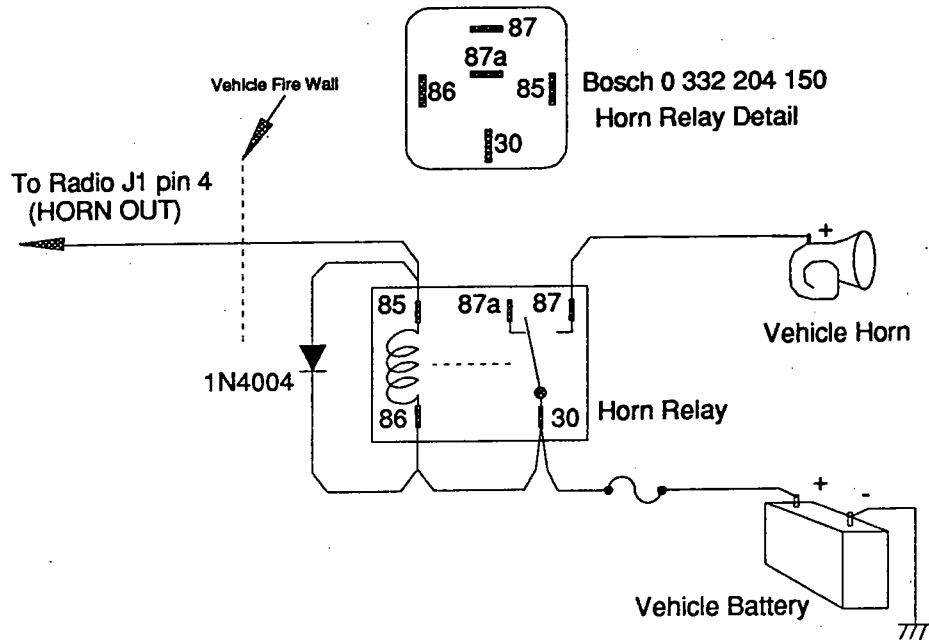
DO NOT hookup the radio Horn Relay line directly to the horn relay installed in the vehicle for honking the horn from the steering wheel horn button.

---

<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 microphone 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.

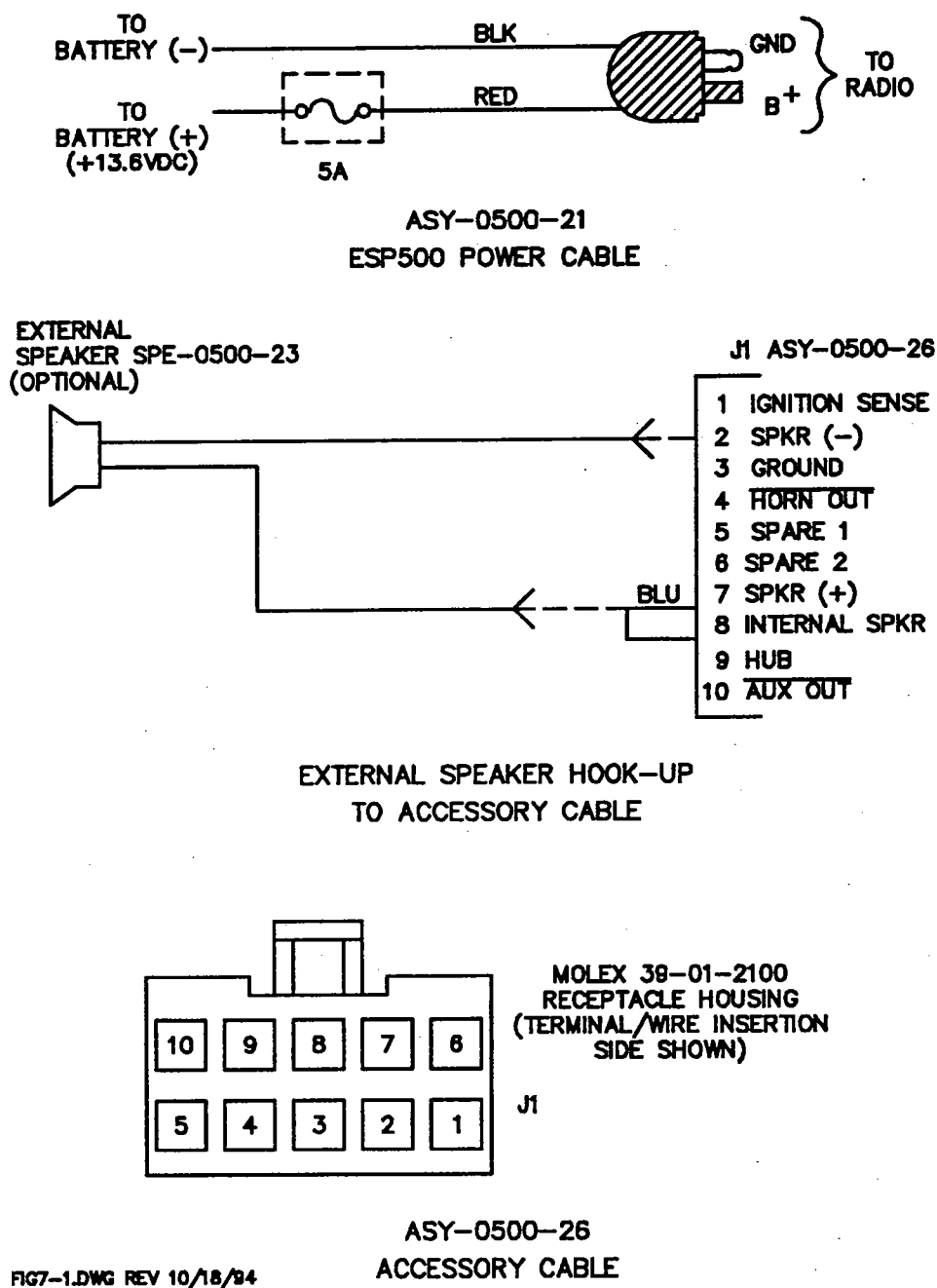
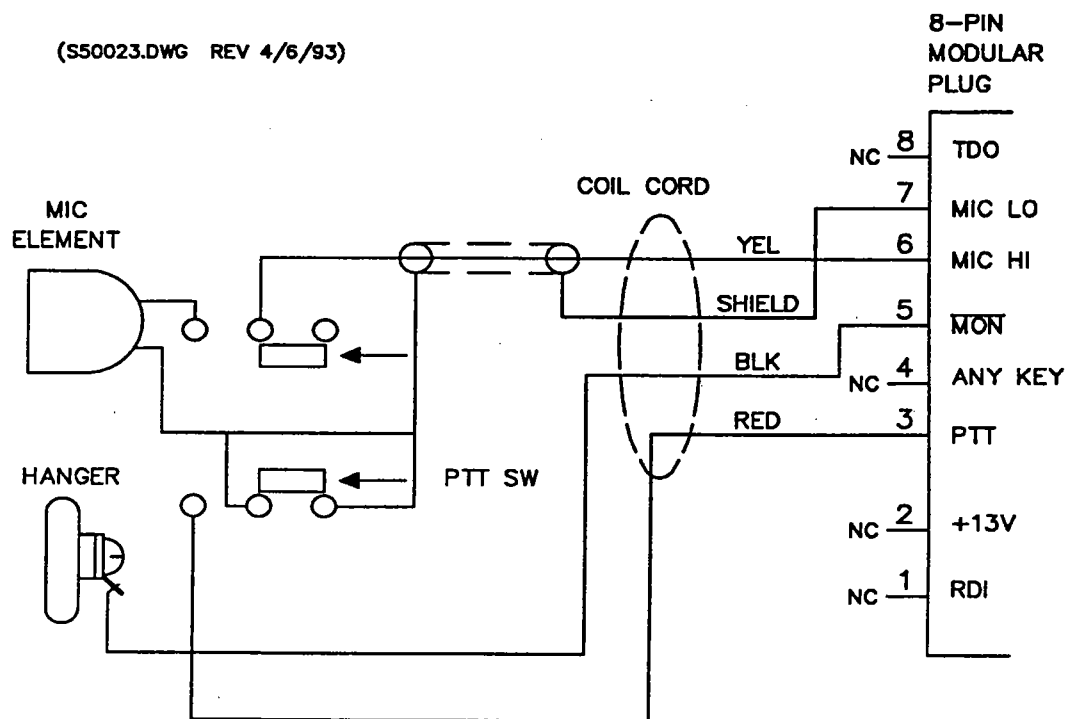


Figure 7.1 Power Cable, Accessory Cable, External Speaker

(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

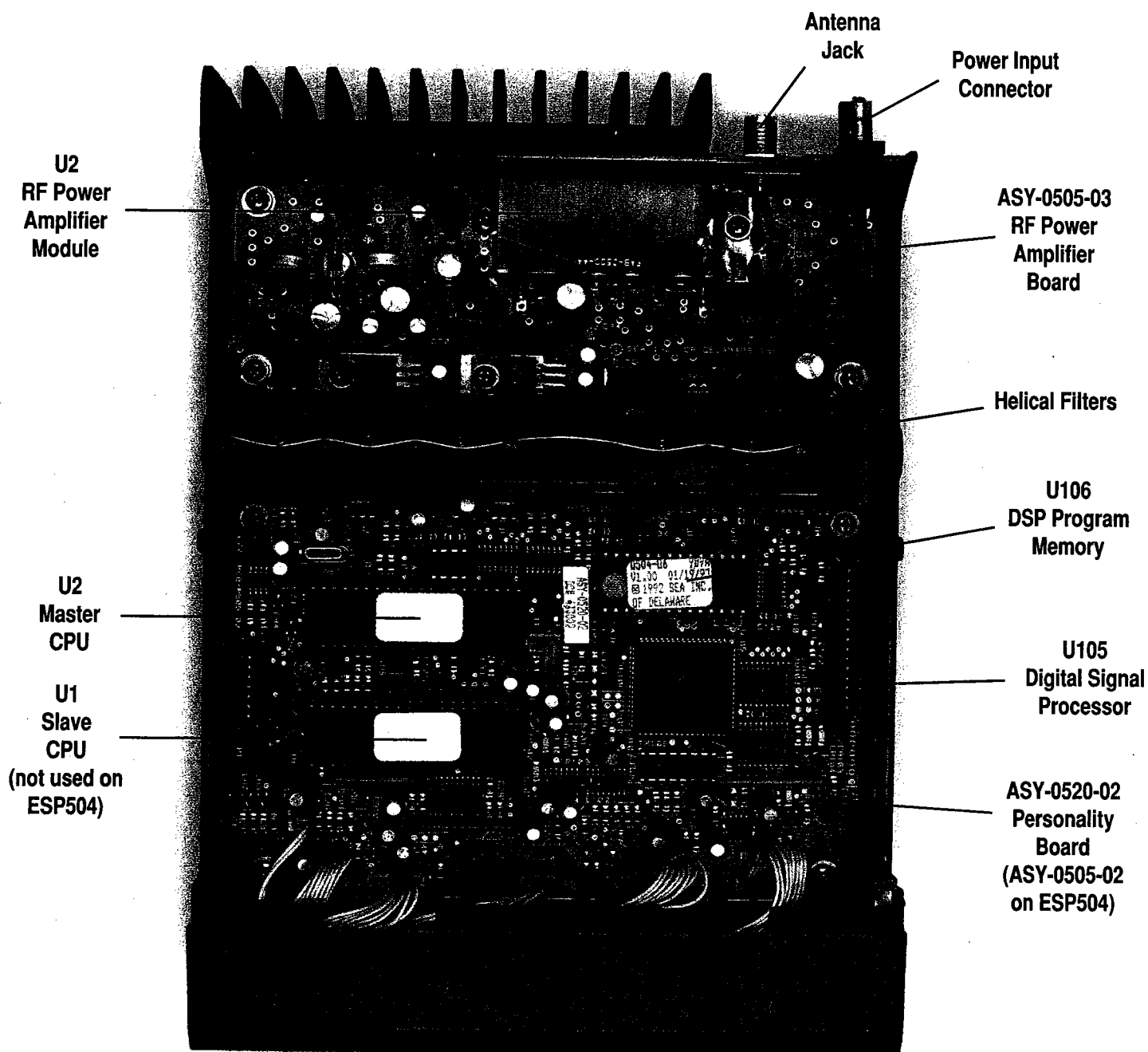
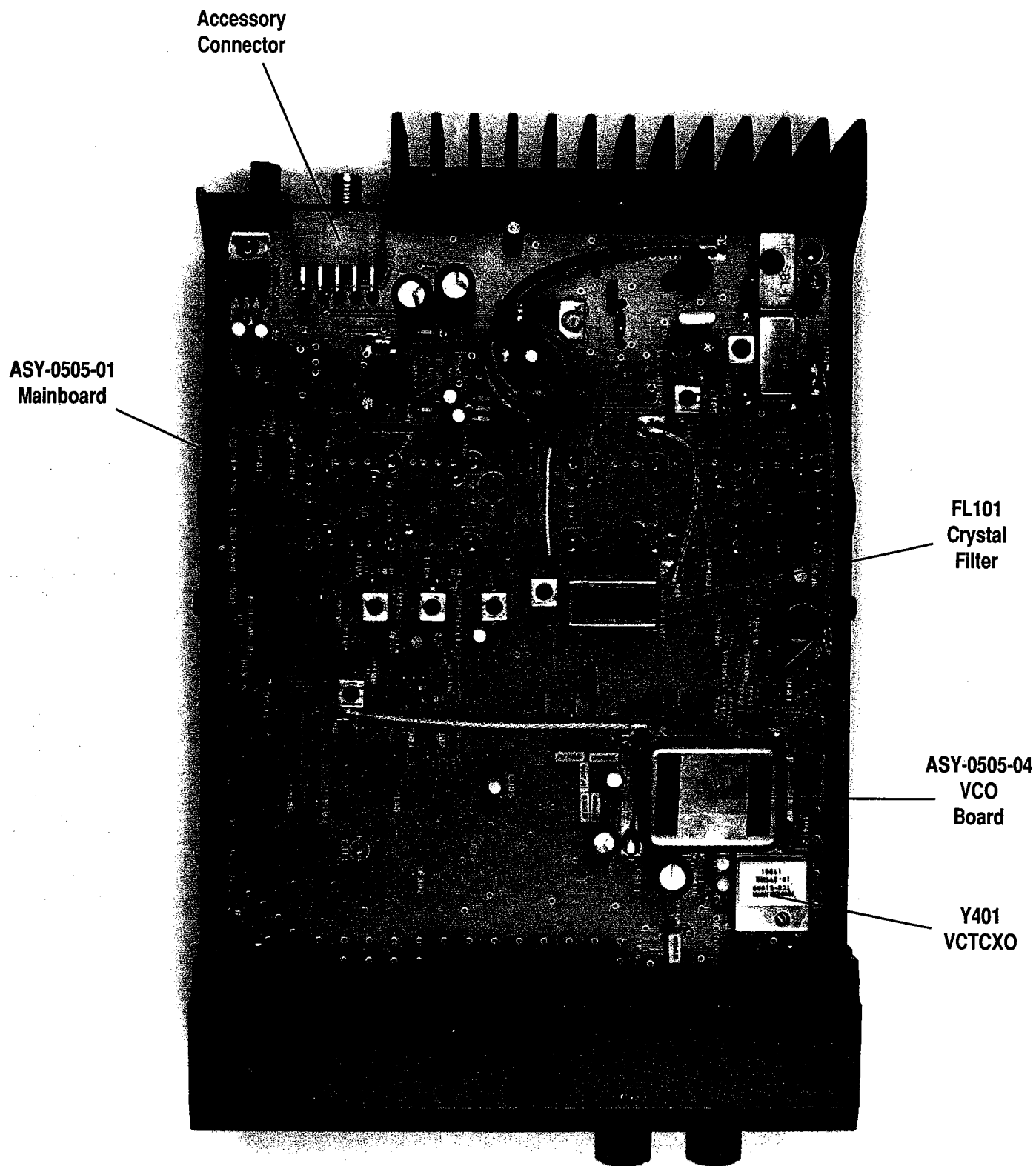
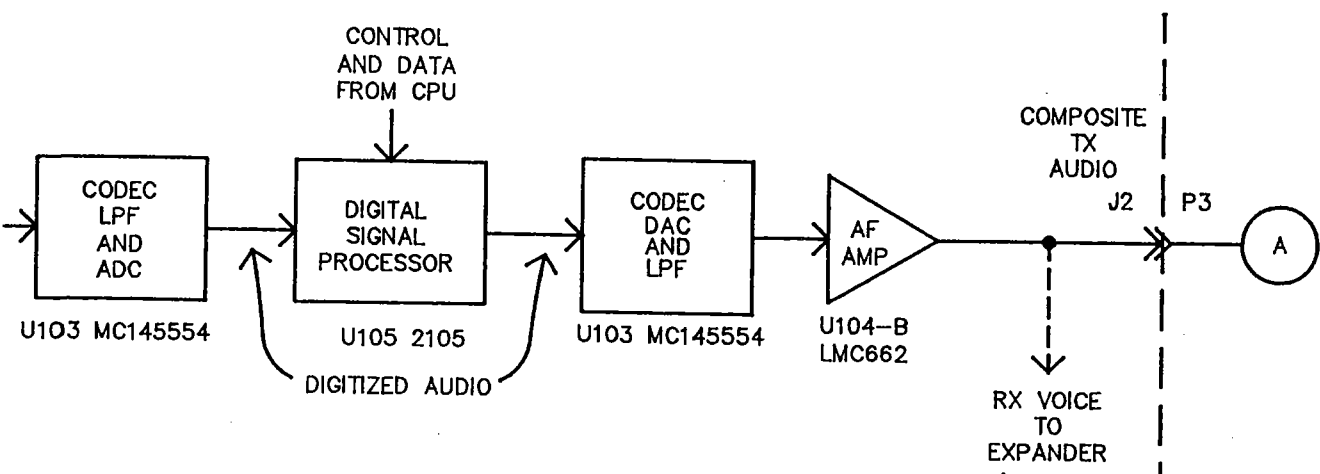


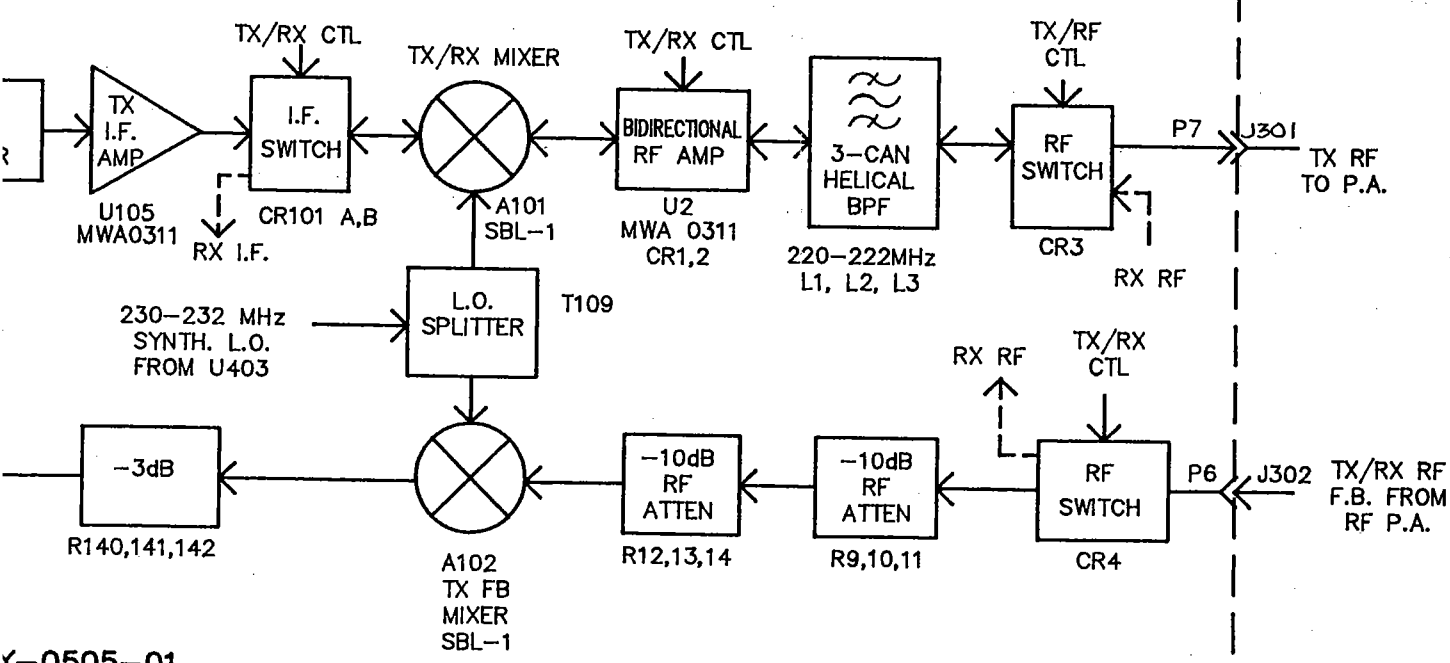
Figure 9.1 Top View of ESP504/ESP520 with Covers Removed



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

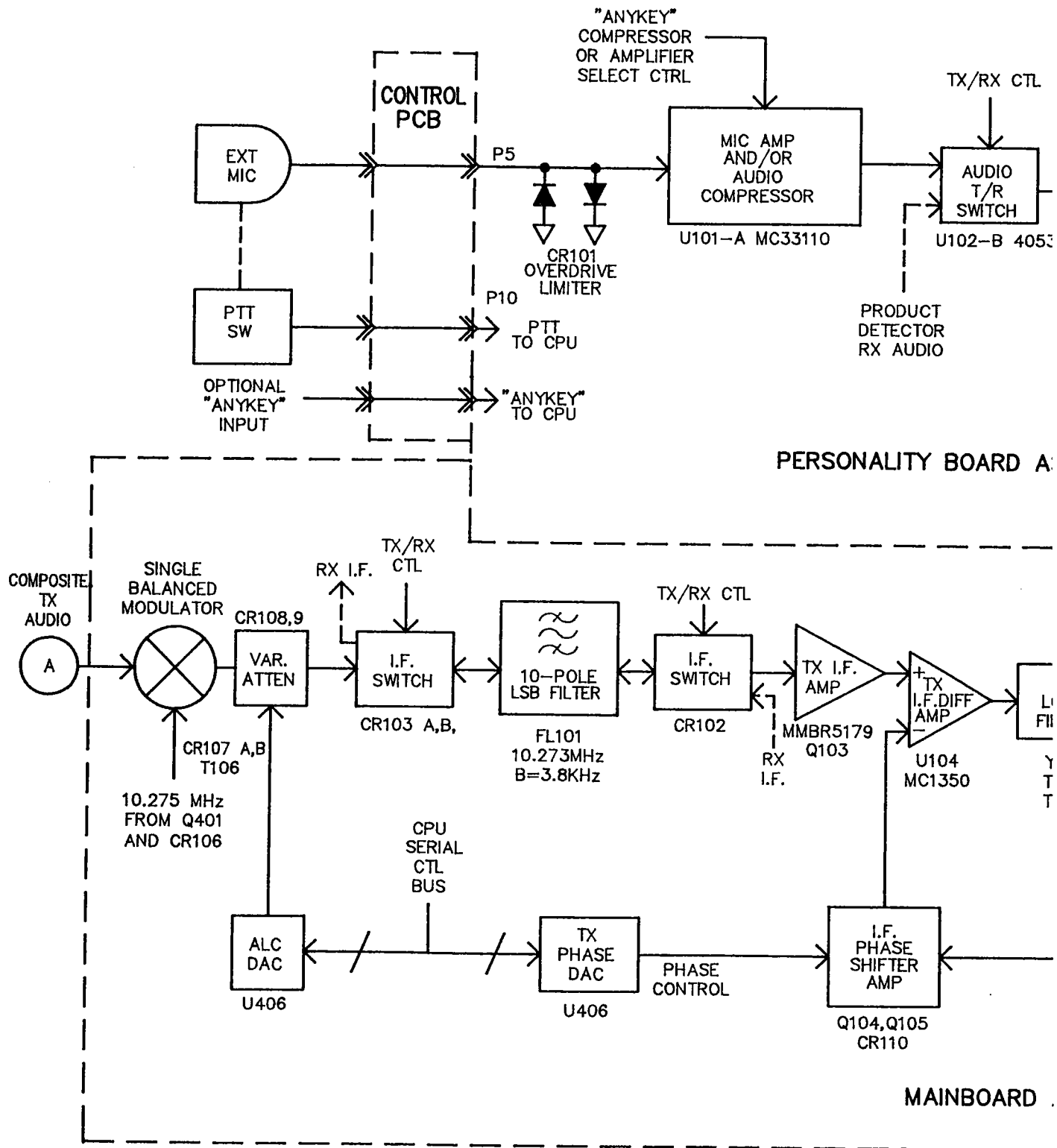


-0505-02

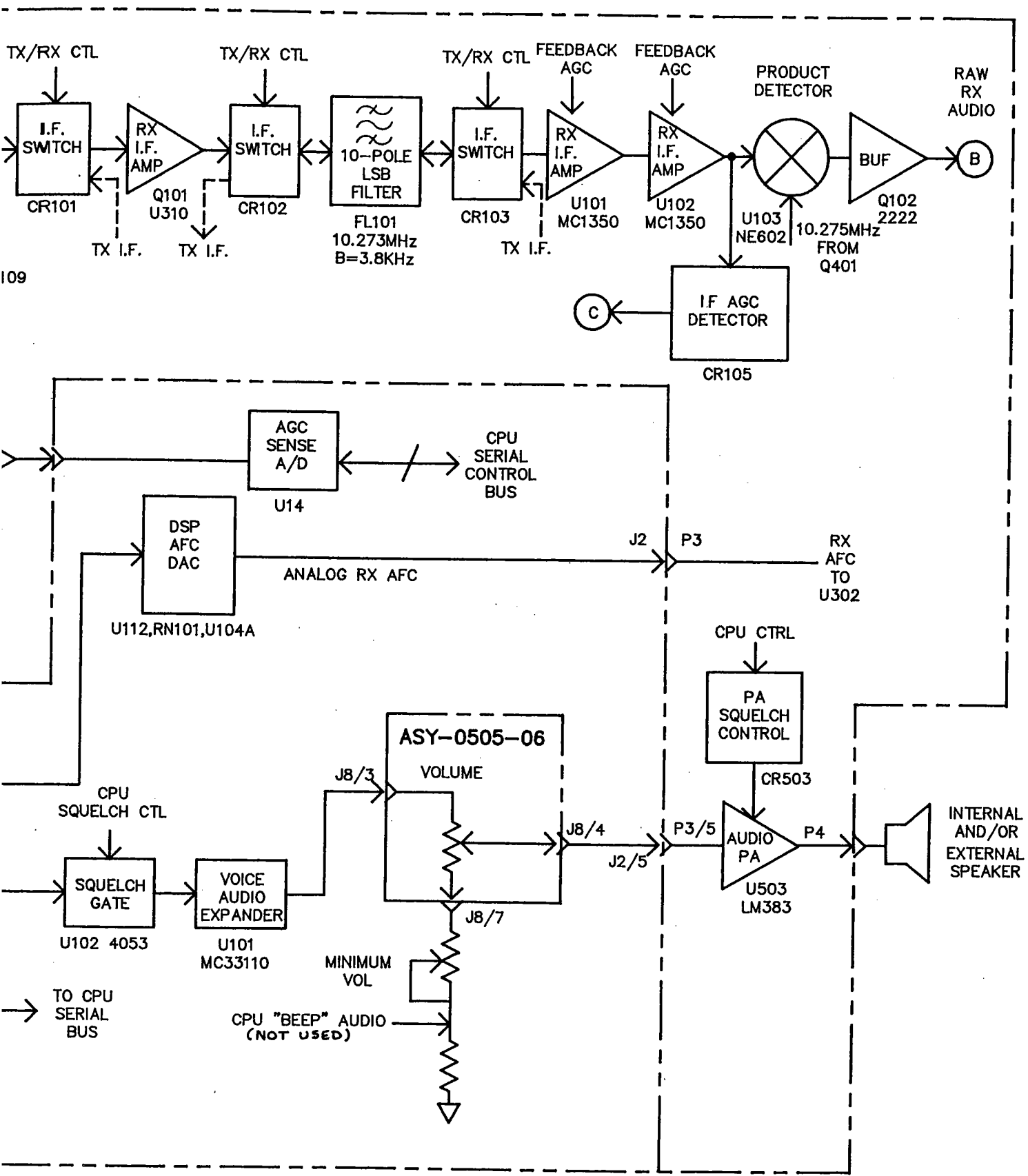


Y-0505-01

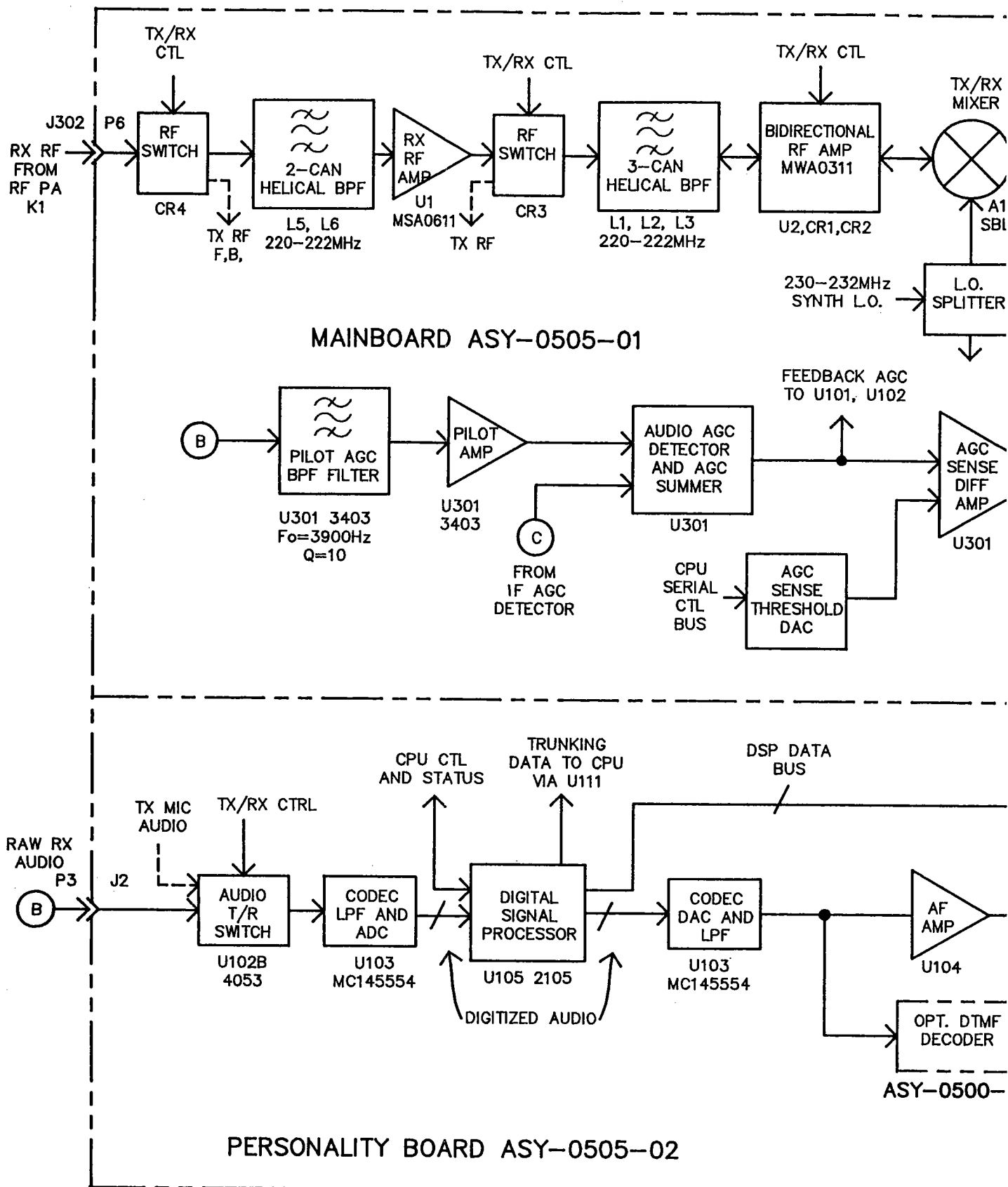
Figure 10.1  
Low Level Transmit Block Diagram  
ESP500 Series



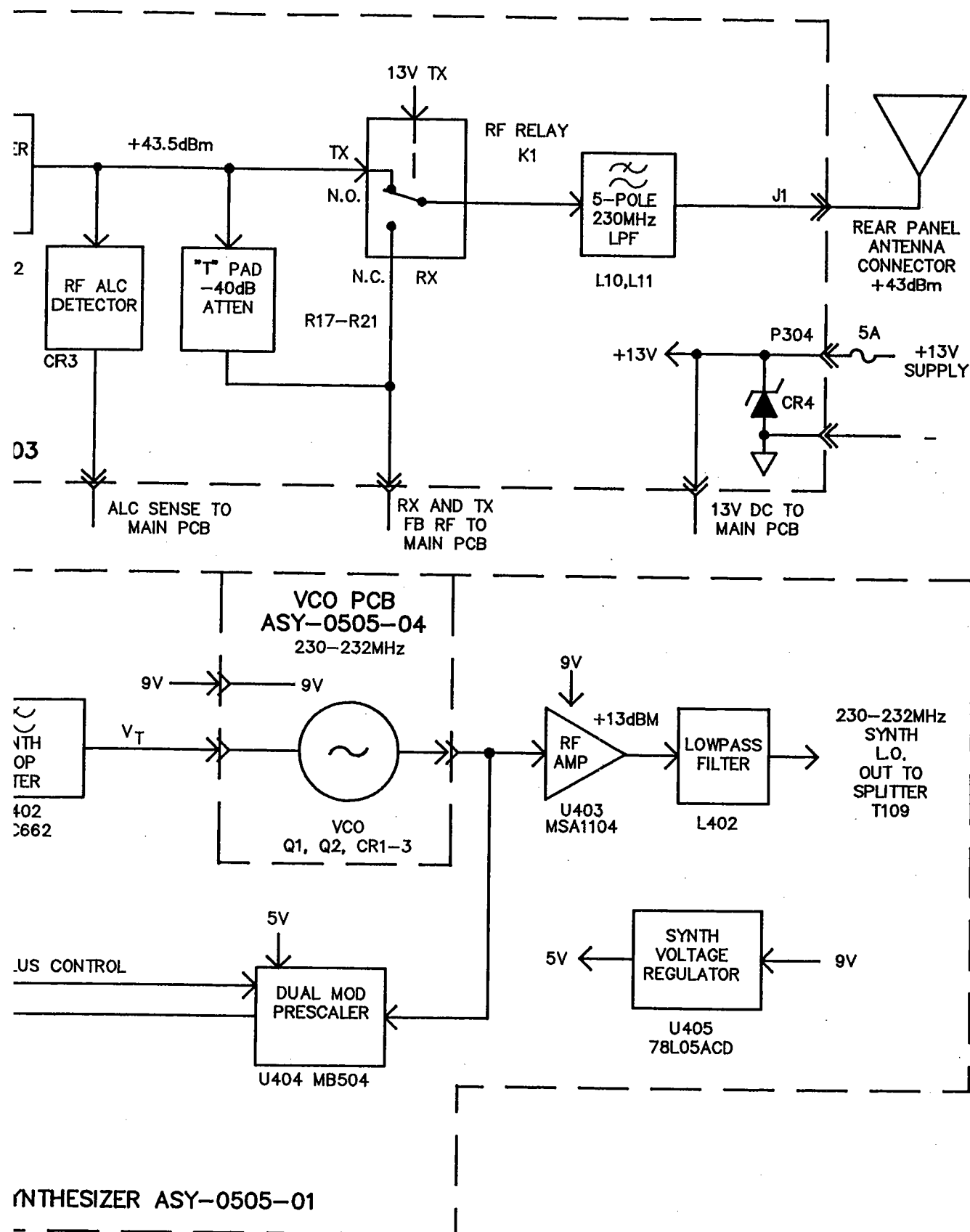
NOTE: DASHED LINES REPRESENT RECEIVE PATHS -----



**Figure 10.2**  
Receiver Block Diagram  
ESP500 Series

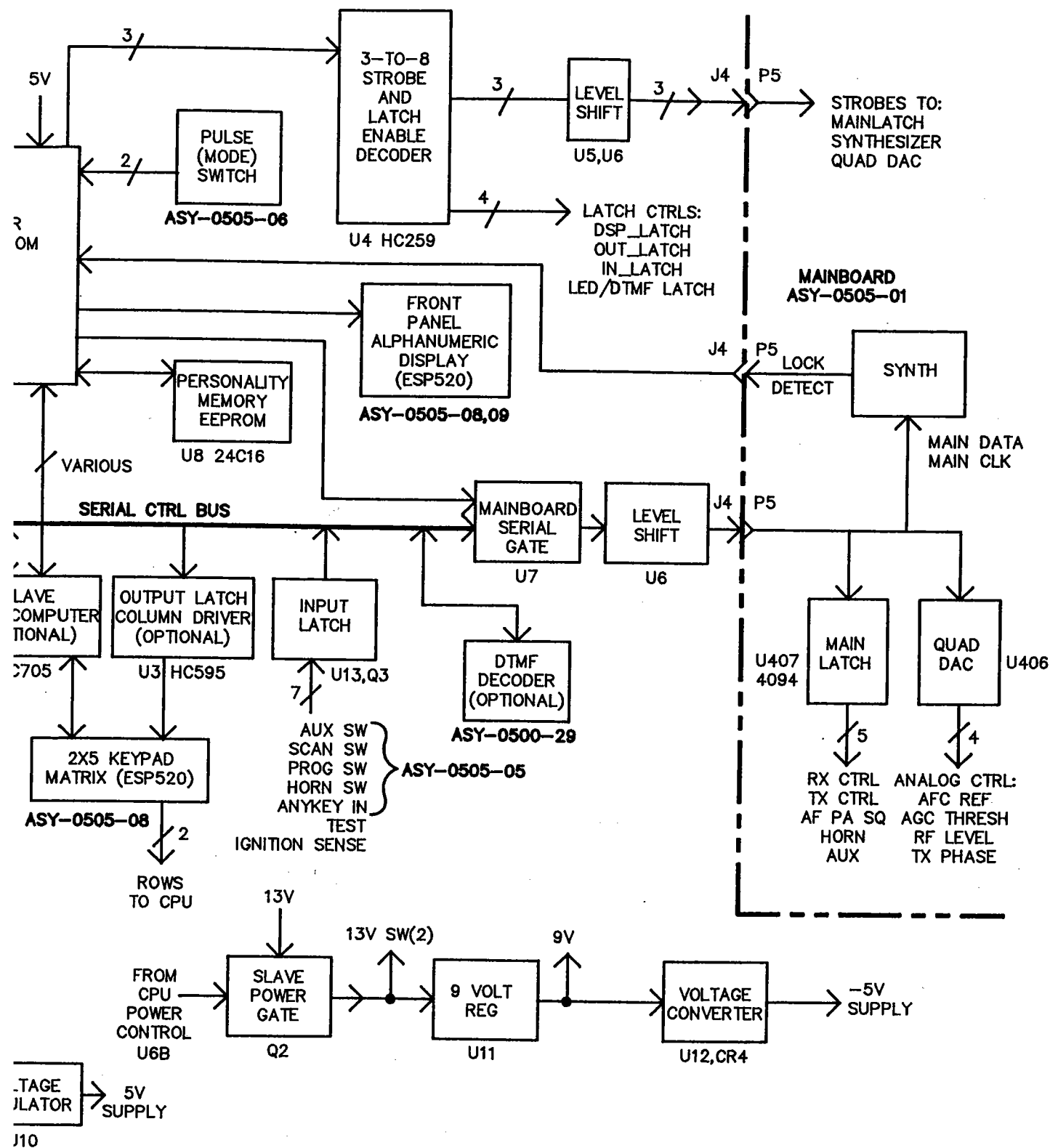


NOTE: DASHED LINES REPRESENT TRANSMIT SIGNAL PATHS -----

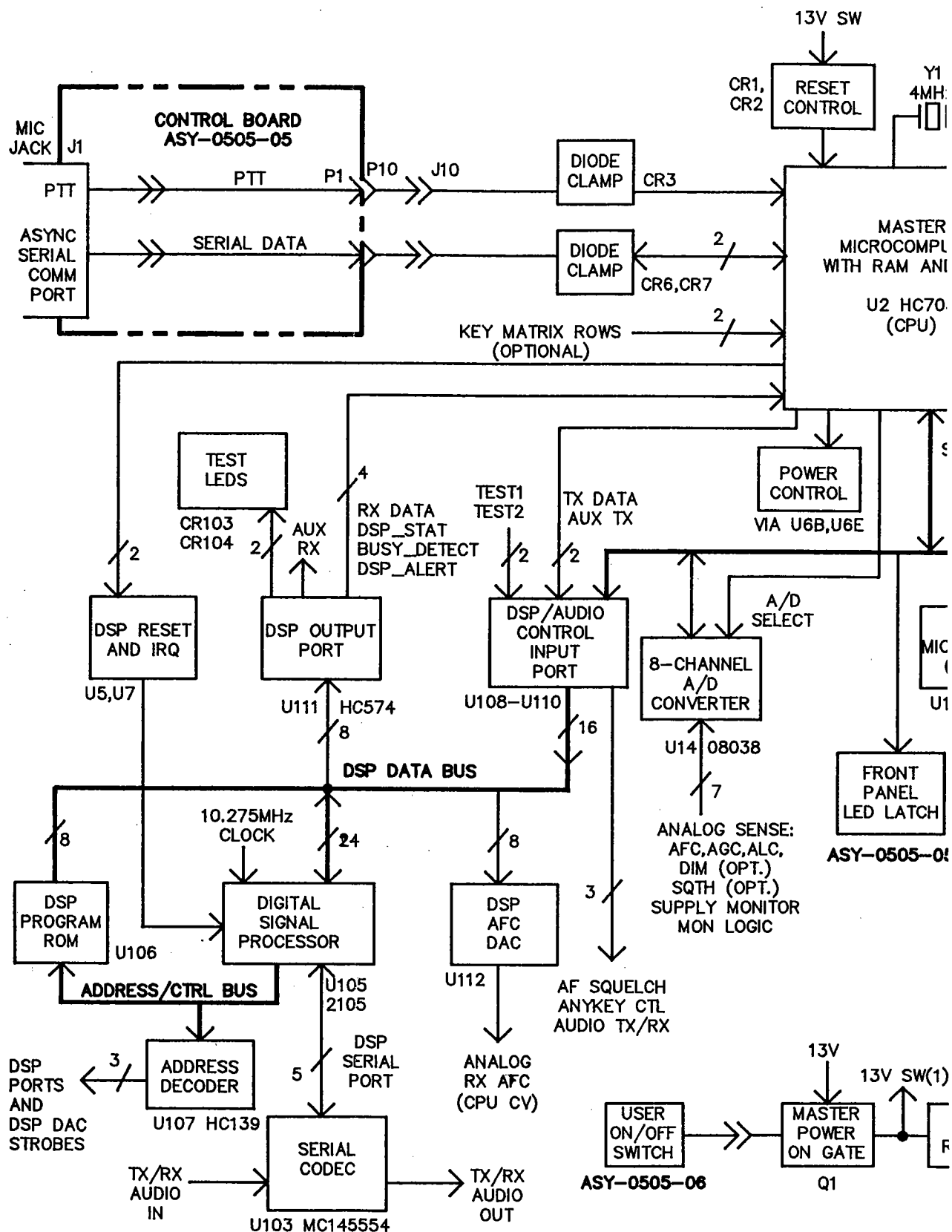


**Figure 10.3**  
RF Power Amplifier and  
RF L.O. Synthesizer  
Block Diagrams  
ESP 500 Series





**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.

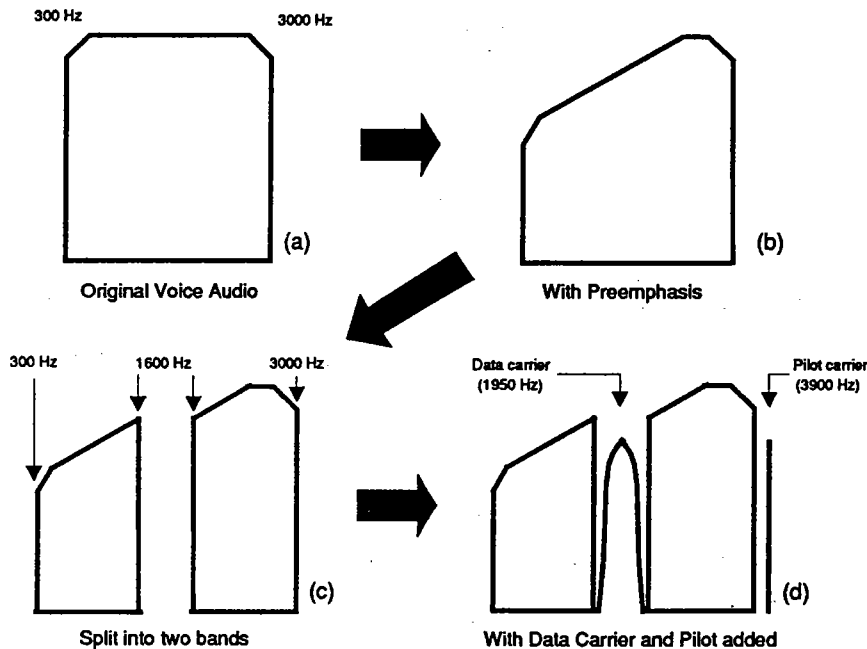
- > 3900 Hz Pilot carrier generation and insertion

- > 1950 Hz Data carrier generation and insertion

> Frequency modulation of the data carrier with signaling data

> Second stage of 2:1 Compression

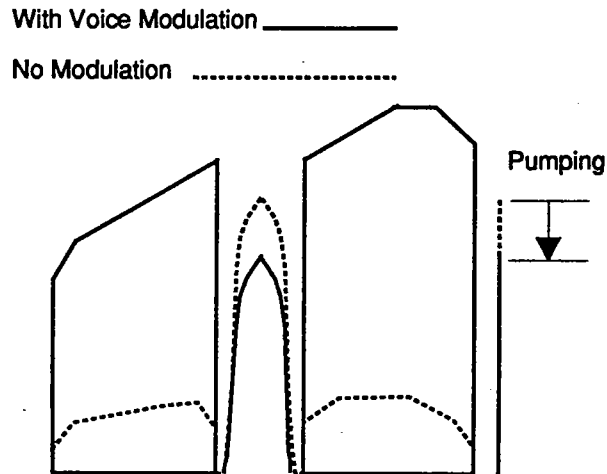
The data carrier is frequency modulated with signaling data for trunking system or conventional repeater control. The ESP504 is designed to operate on a trunked system using the DTL control and signaling protocol. Refer to the SEA 220-222 MHz System Guide (MAN-0500-01) for details on how this system 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  $\pm 1.5$  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.

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#### CAUTION

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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.

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#### 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.

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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.

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- 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.

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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.

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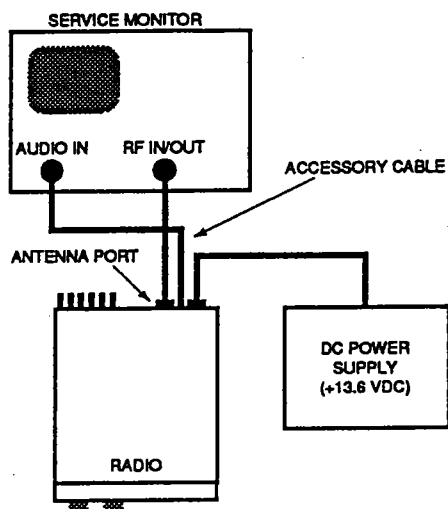


Figure 12.1 Receiver Test Set Up

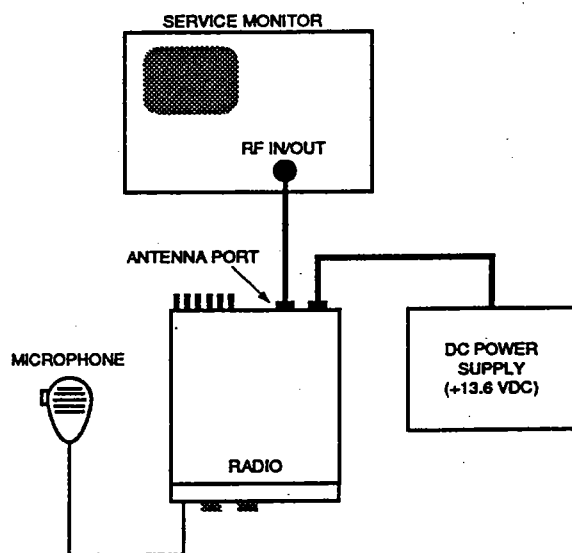


Figure 12.2 Transmitter Test Set Up

### 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. Unsquench 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

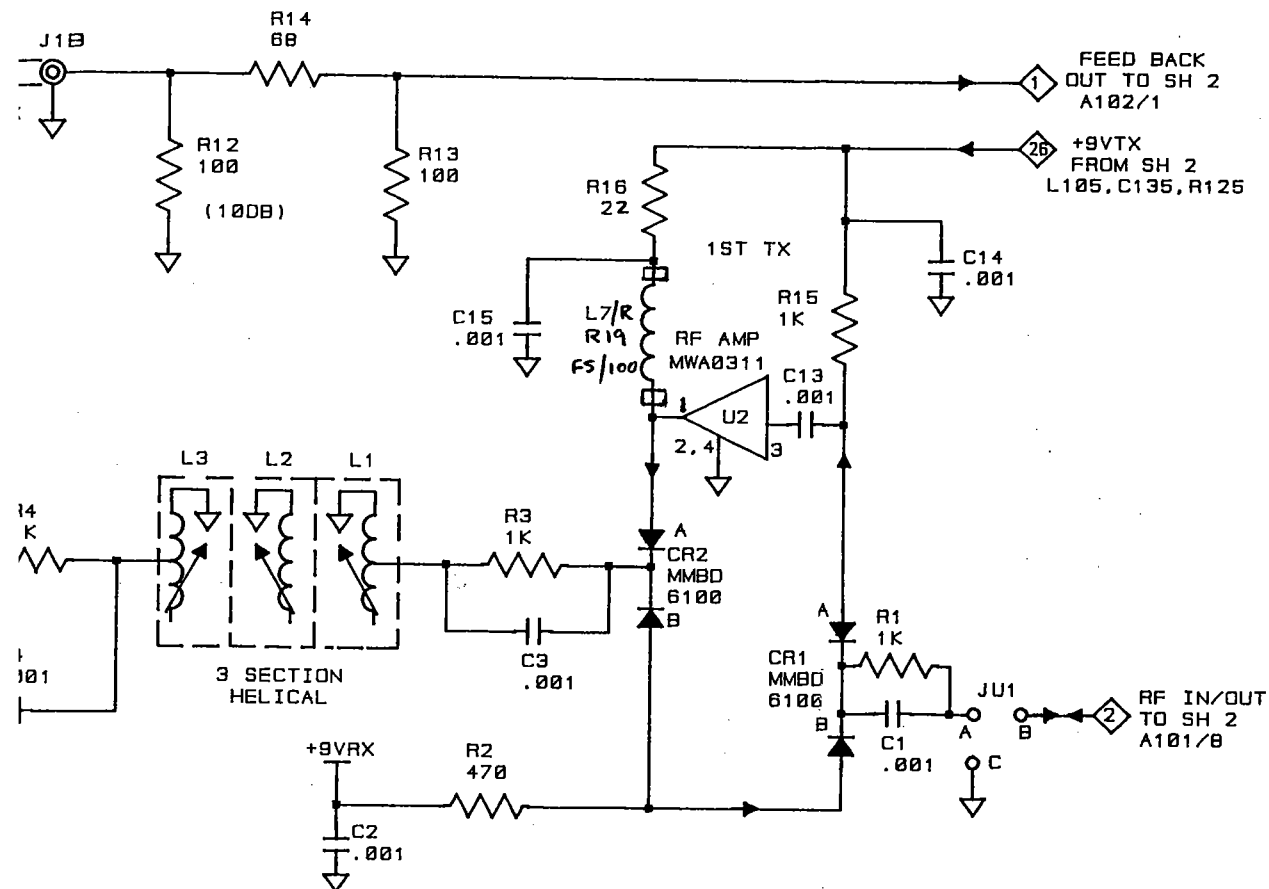
- a. Set the mobile to 1 kHz test tone by pressing the "PGM" key in.  
Note: The mobile will now transmit a calibrated 1 kHz test tone when the mic's PTT is pressed.
- b. Set the mobile to talk around by pressing and releasing the "AUX" key. On the ESP504 the channel LED will blink. On the ESP520 the 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.

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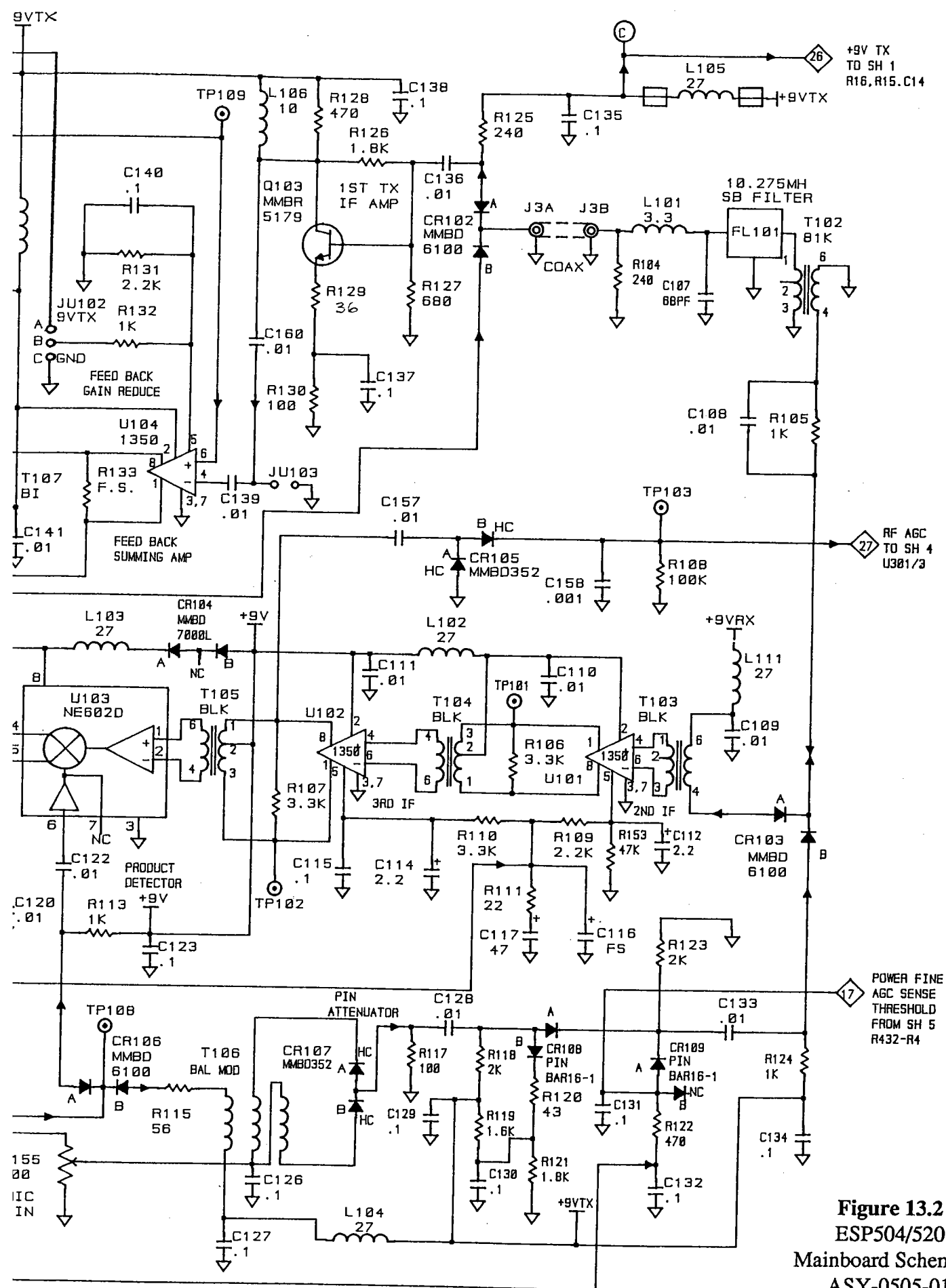
#### NOTE

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.

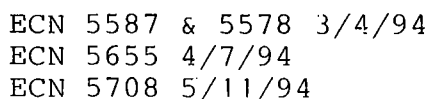
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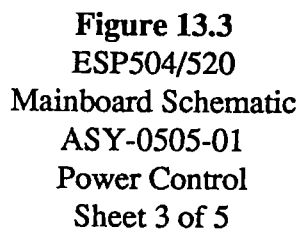




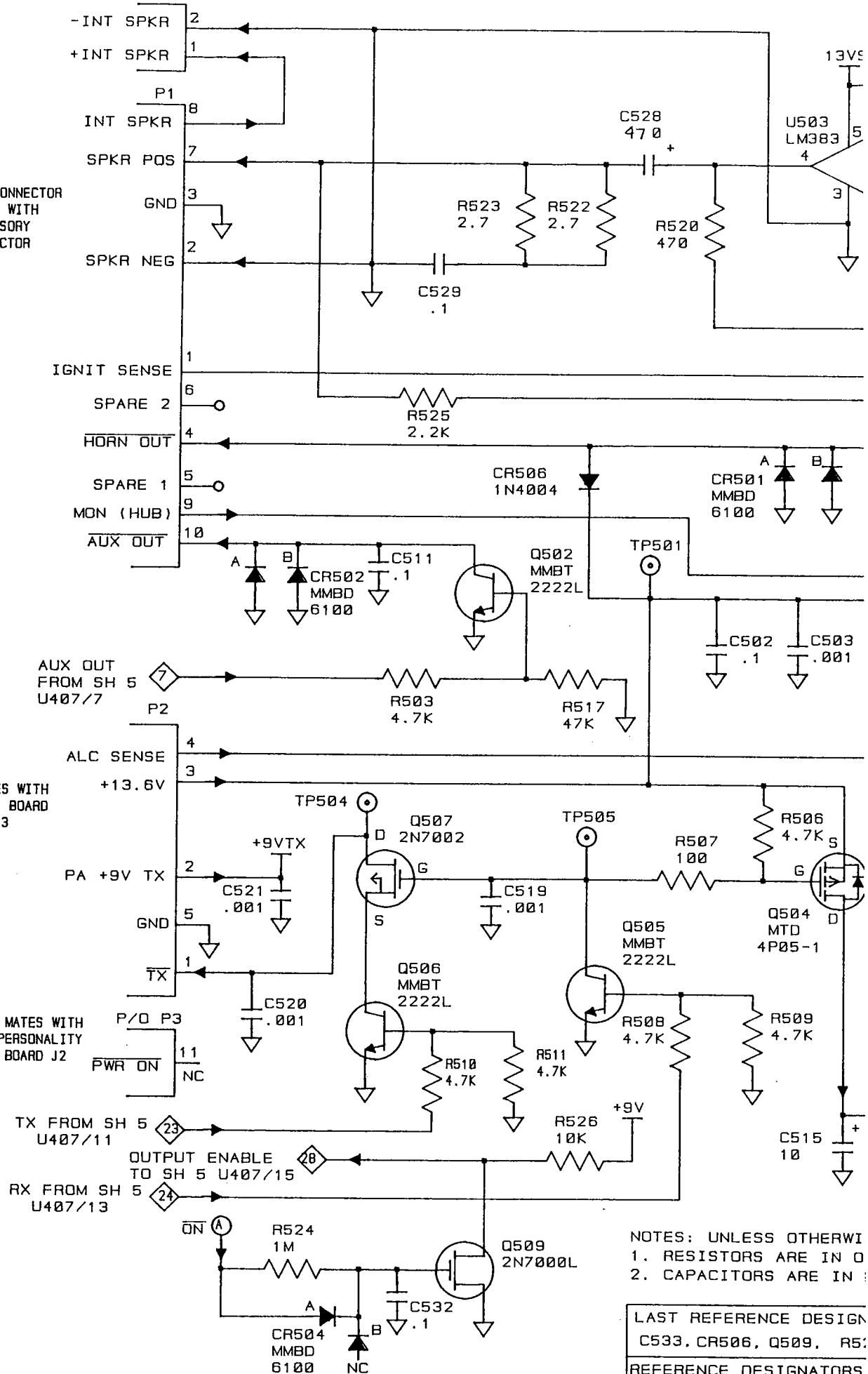


**Figure 13.2**  
**ESP504/520**  
**Mainboard Schematic**  
**ASY-0505-01**  
**I.F.**  
**Sheet 2 of 5**



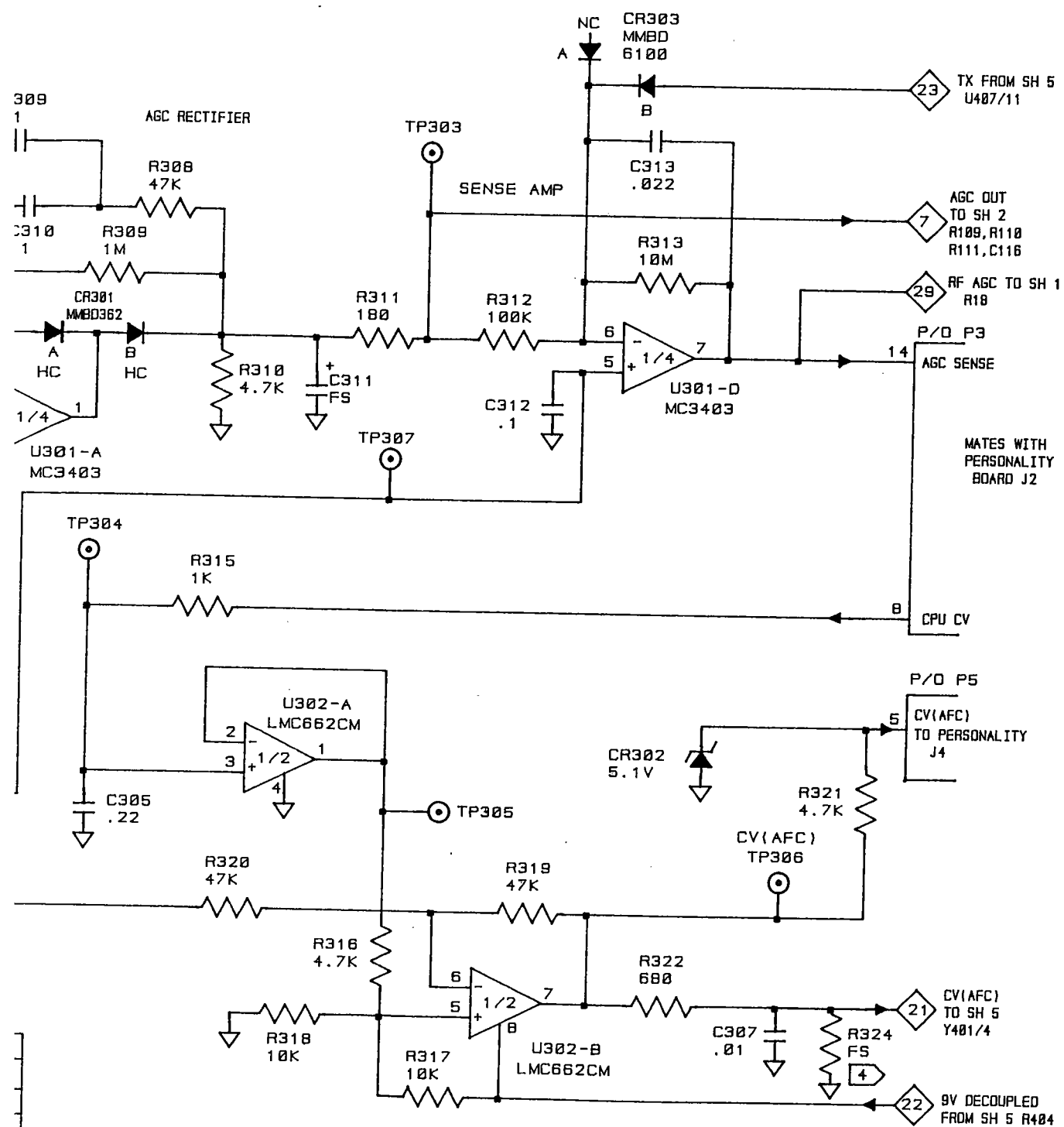


REAR CONNECTOR  
MATES WITH  
ACCESSORY  
CONNECTOR



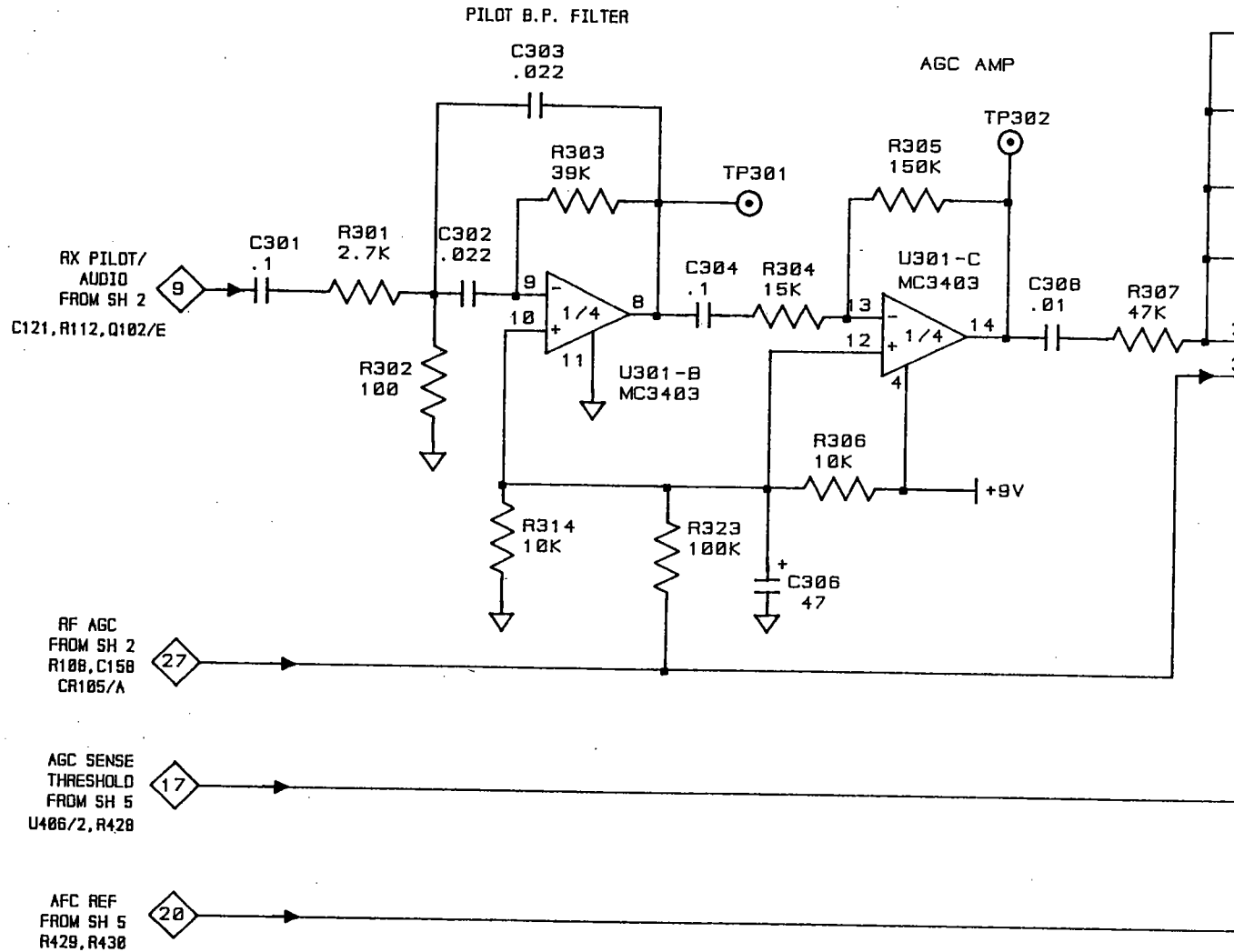
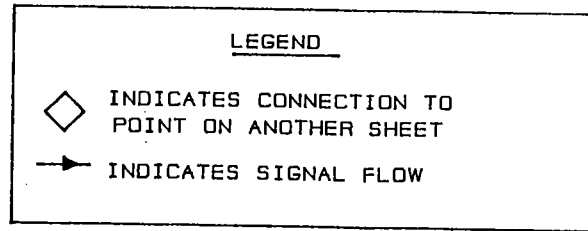
NOTES: UNLESS OTHERWISE SPECIFIED  
1. RESISTORS ARE IN OHMS  
2. CAPACITORS ARE IN FARADS

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



550501-4. RV4 ECN 5098 12/2/92  
 550501.SH4 ECN 5174 2/3/93  
 550501.SH4 ECN 55377&5378 9/8/93 REV C  
 550501.SH4 ECN 5402 9/29/93  
 550501.SH4 ECN 5618 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

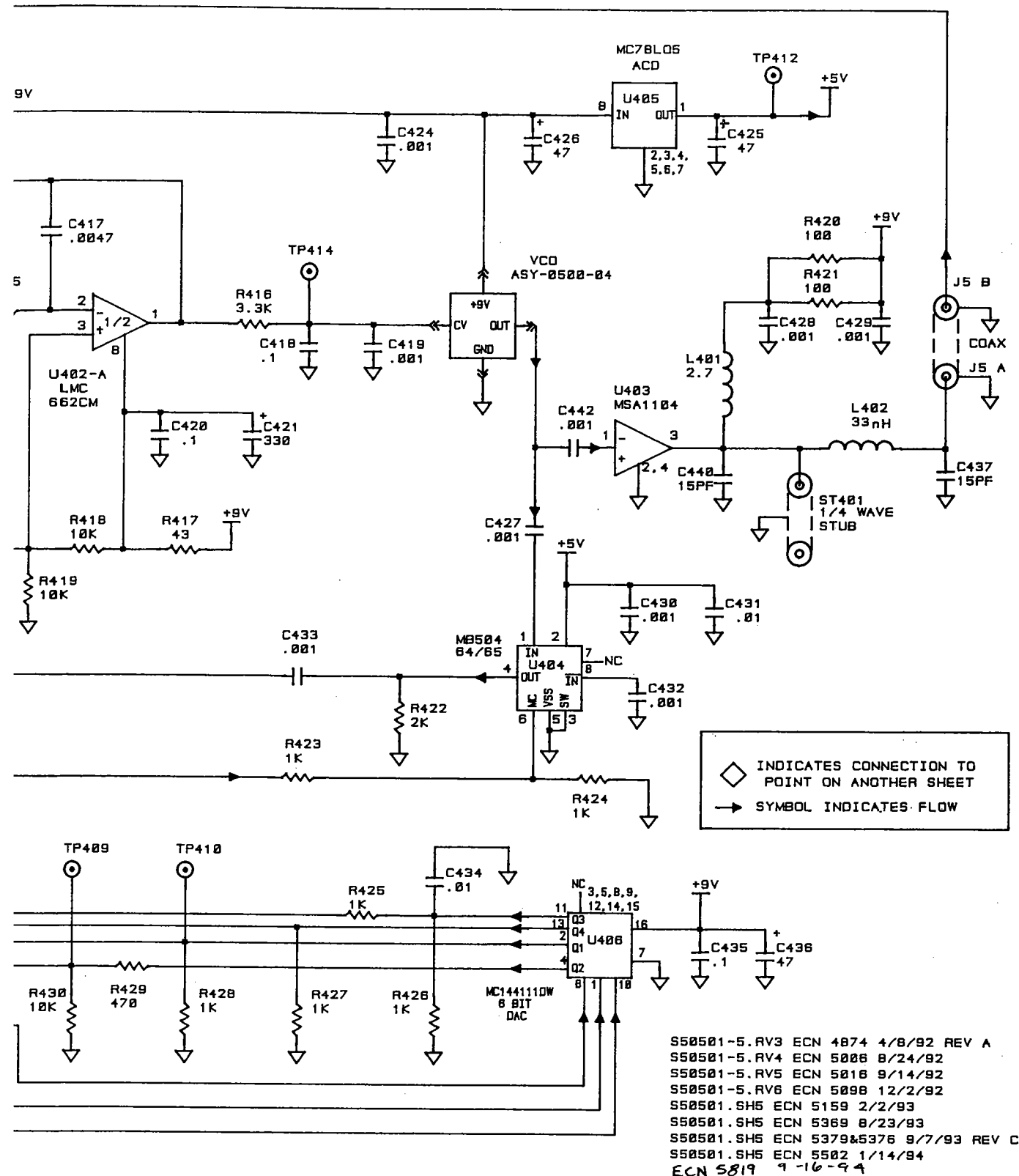
1. RESISTORS ARE IN OHMS, 1/4W, 5%.

2. CAPACITORS ARE IN MICROFARADS.

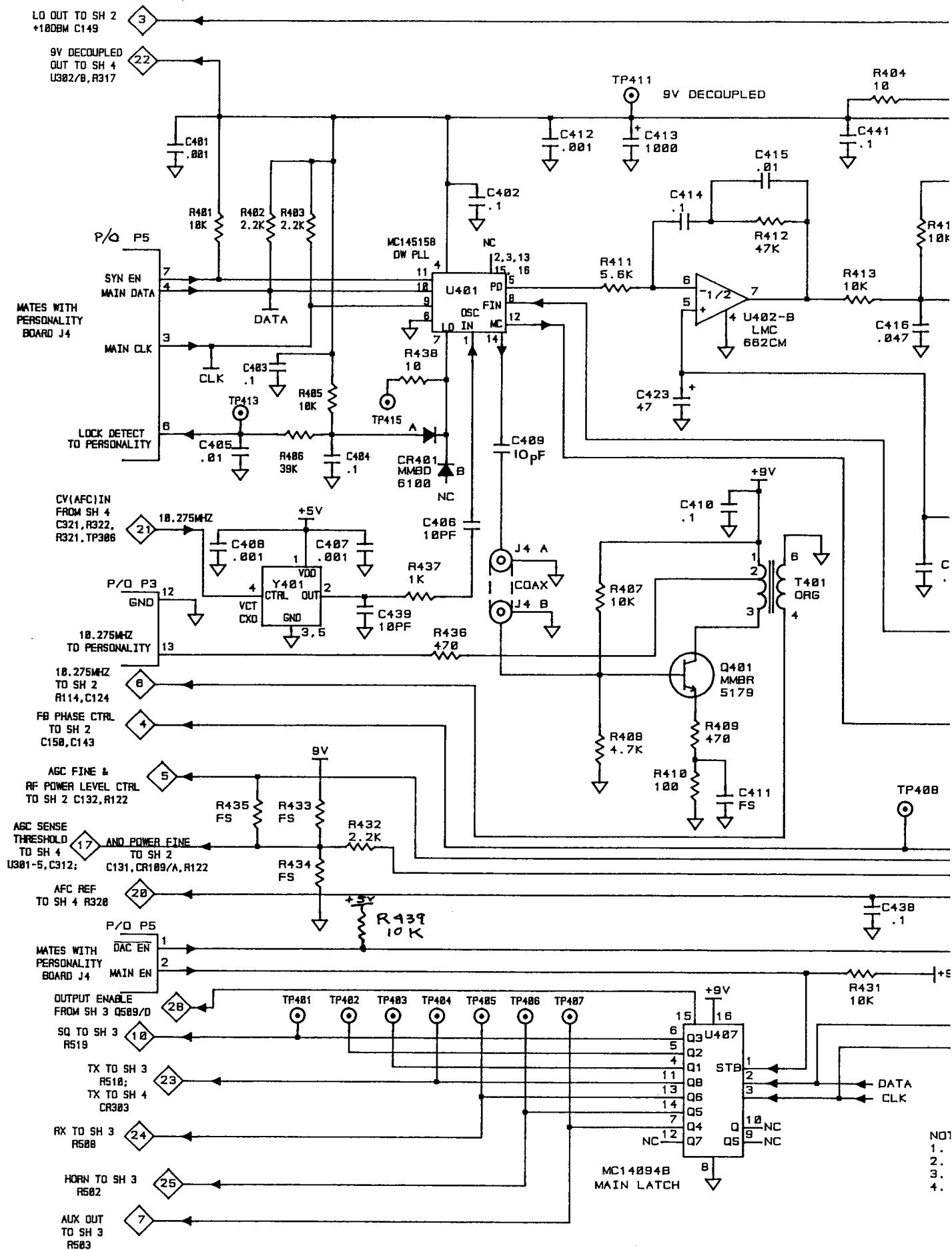
3. DIODES ARE MMBD7000.

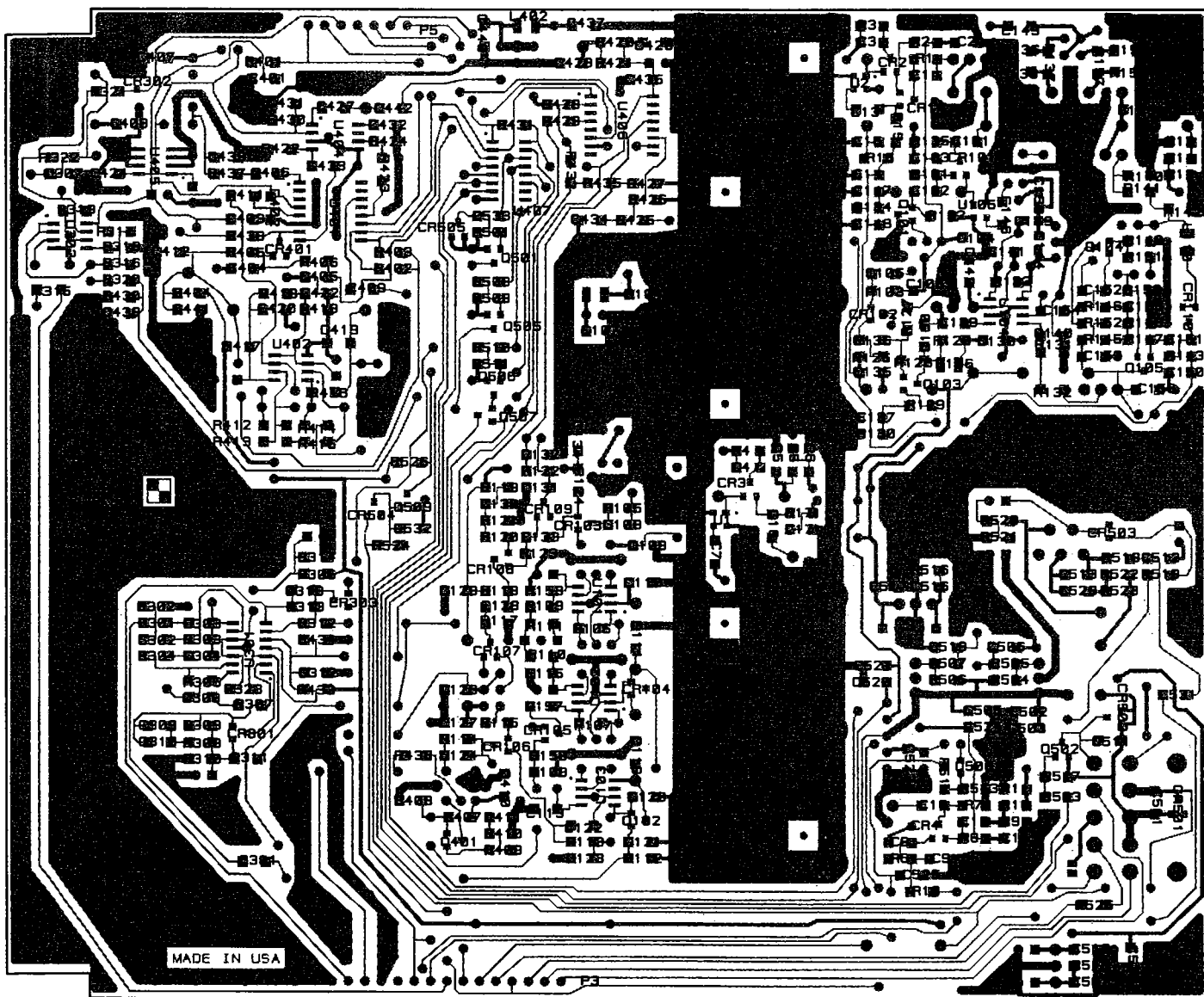
4. R324 IS MATCHED WITH Y401'S TUNING RATE.

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



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

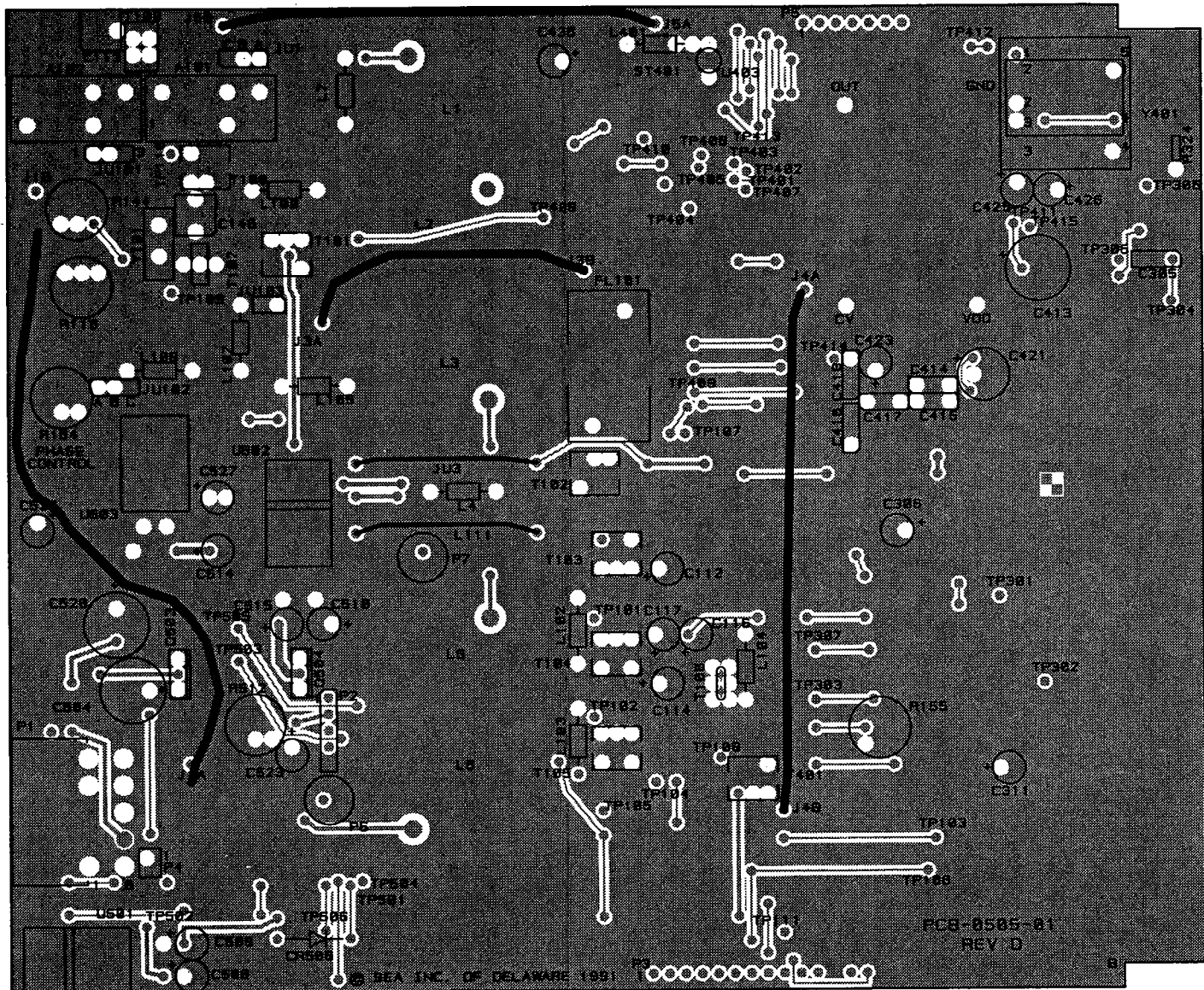




CIRCUIT SIDE

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

- 1 DAC EN
- 2 MAIN EN
- 3 MAIN CLK
- 4 MAIN DATA
- 5 CV (AFC)
- 6 LOCK DETECT
- 7 SYN EN



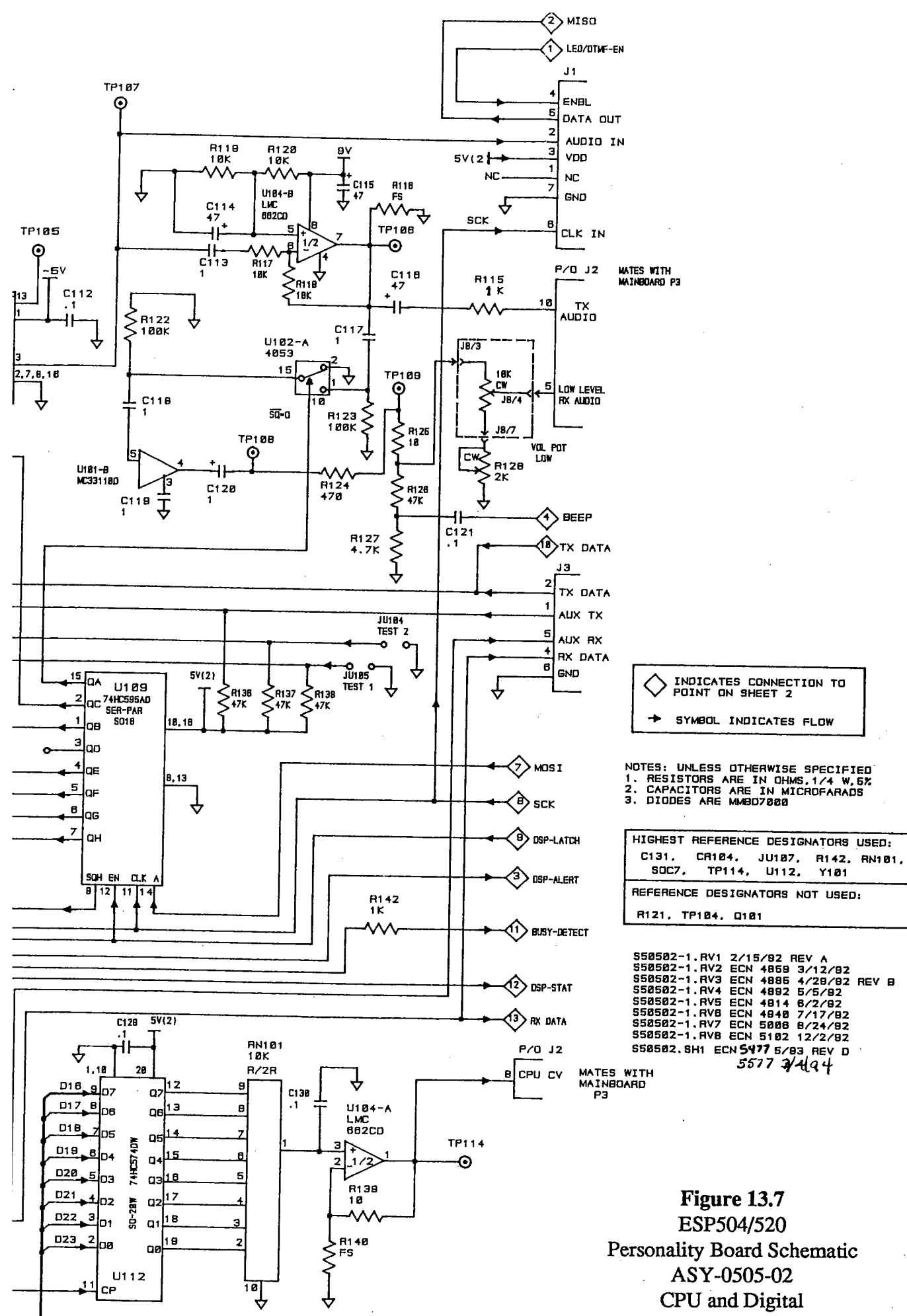
PCB-0505-01  
REV D

SEA INC. OF DELAWARE 1991

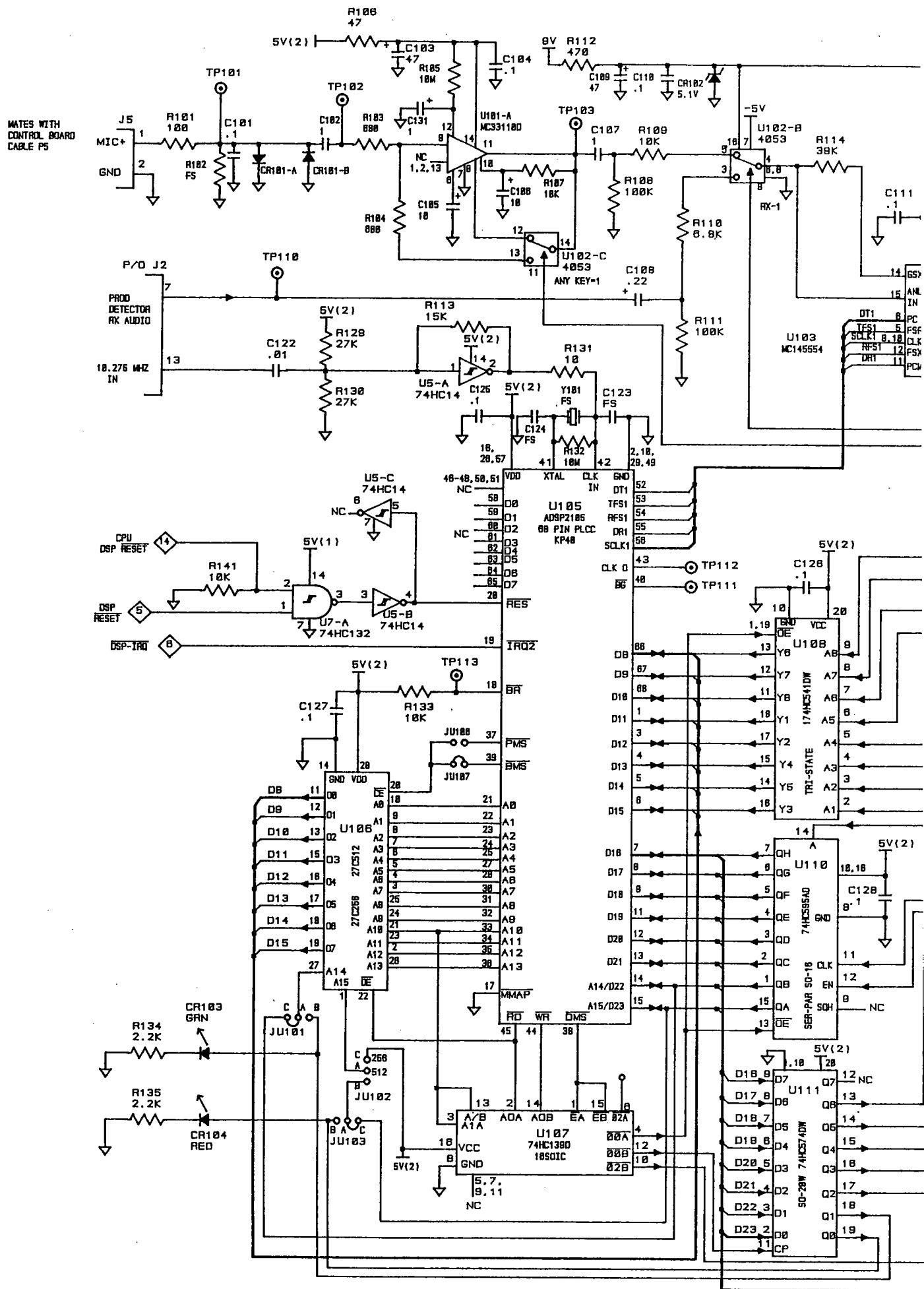
| P1          |    |
|-------------|----|
| SPARE 1     | 5  |
| HORN OUT    | 4  |
| GND         | 3  |
| SPKR-       | 2  |
| IGNIT SENSE | 1  |
|             | 10 |
|             | 9  |
|             | 8  |
|             | 7  |
|             | 6  |

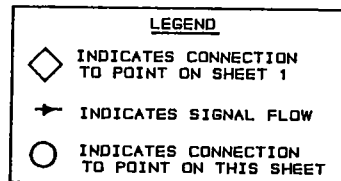
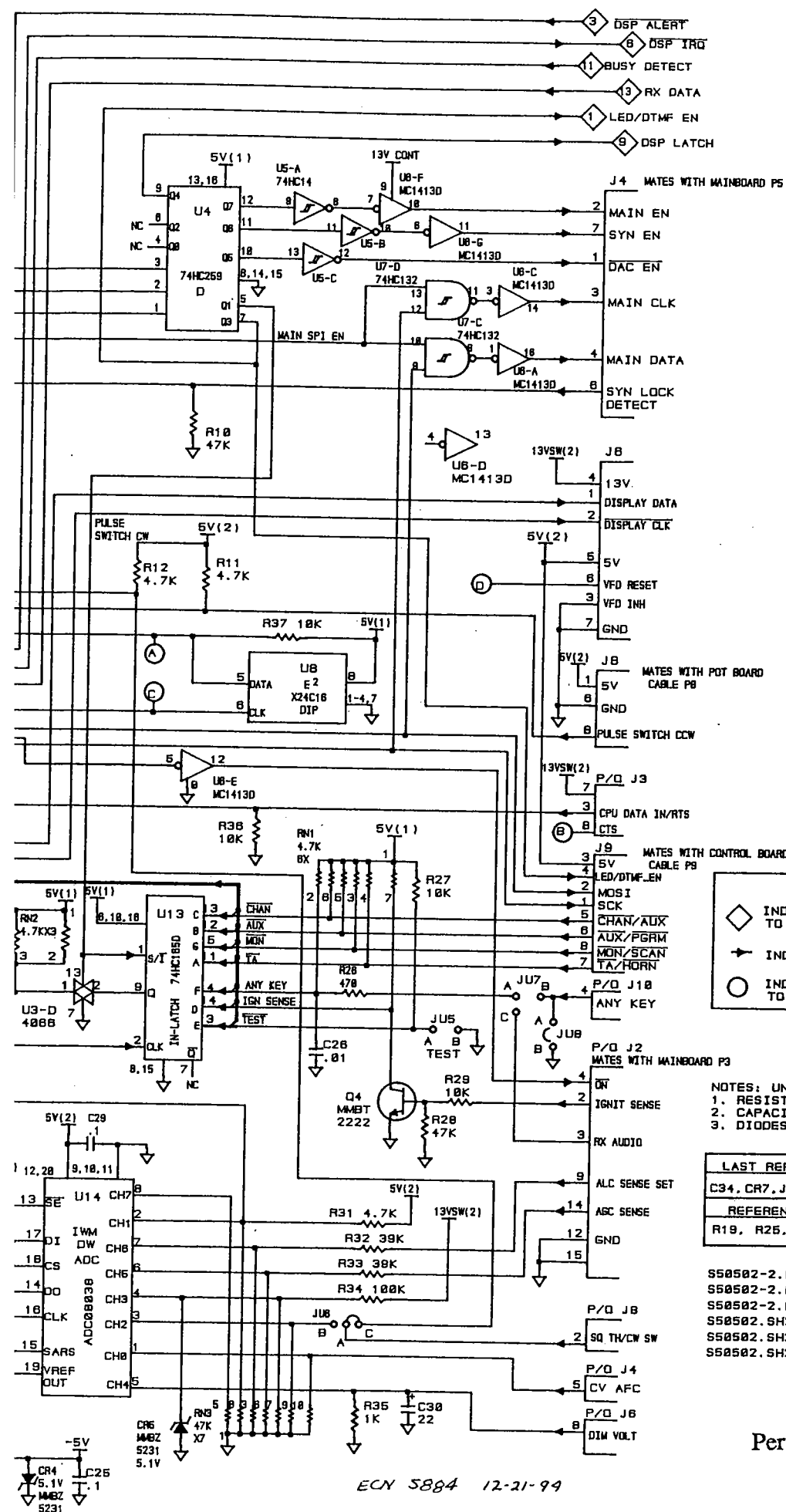
| P2        |   |
|-----------|---|
| TX        | 1 |
| PA +9V TX | 2 |
| +13.6V    | 3 |
| ALC SENSE | 4 |
| GND       | 5 |

- MON 1
- IGNIT SENSE 2
- RX AUDIO 3
- ON 4
- L.L. RX AF 5
- 13V CONT 6
- P.D. RX AUDIO 7
- AFC 8
- ALC SENSE SET 9
- TX AUDIO 10
- PWR ON 11
- GND 12
- 10.275 MHZ 13
- AGC SENSE 14
- GND 15



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





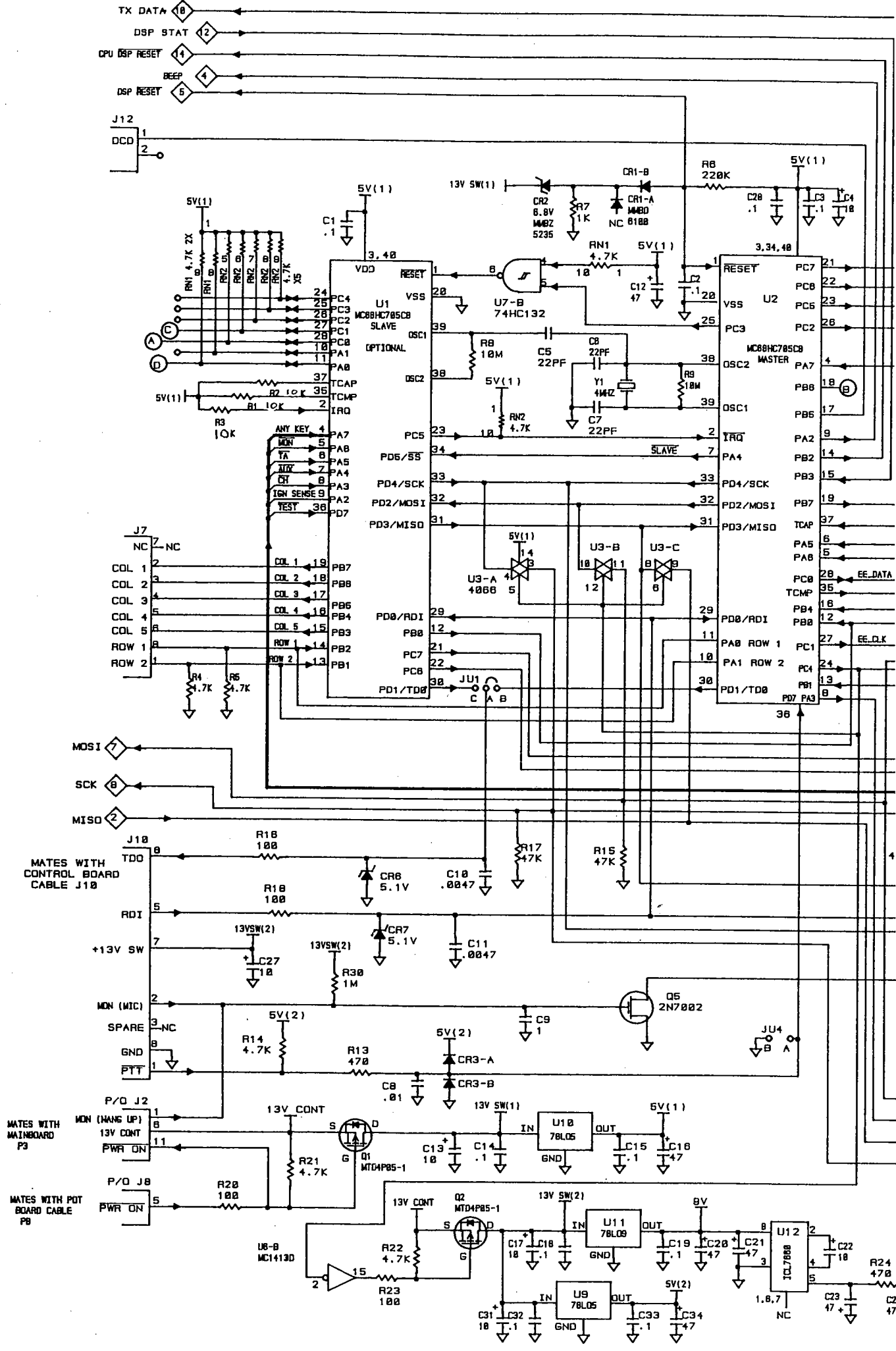
NOTES: UNLESS OTHERWISE SPECIFIED  
 1. RESISTORS ARE IN OHMS, 1/4 W, 5%.  
 2. CAPACITORS ARE IN MICROFARADS.  
 3. DIODES ARE MMBD7000.

| LAST REFERENCE DESIGNATORS USED:          |  |
|-------------------------------------------|--|
| C34, CR7, J12, JUB, Q6, R37, RN3, U14, Y1 |  |
| REFERENCE DESIGNATORS NOT USED:           |  |
| R19, R25, Q3, JU2, JU3                    |  |

S50502-2.RV2 3/2/92 ECN 4843 REV A  
 S50502-2.RV3 8/28/92 ECN 5005&5006  
 S50502-2.RA4 ECN 5127 1/5/93  
 S50502.SH2 ECN 5477 5/93 REV D  
 S50502.SH2 PER JMF 8/31/93  
 S50502.SH2 ECN 5825 3/30/94

**Figure 13.8**  
**ESP504/520**  
**Personality Board Schematic**  
**ASY-0505-02**  
**Analog**  
**Sheet 2 of 2**

ECN 5884 12-21-94



#### 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

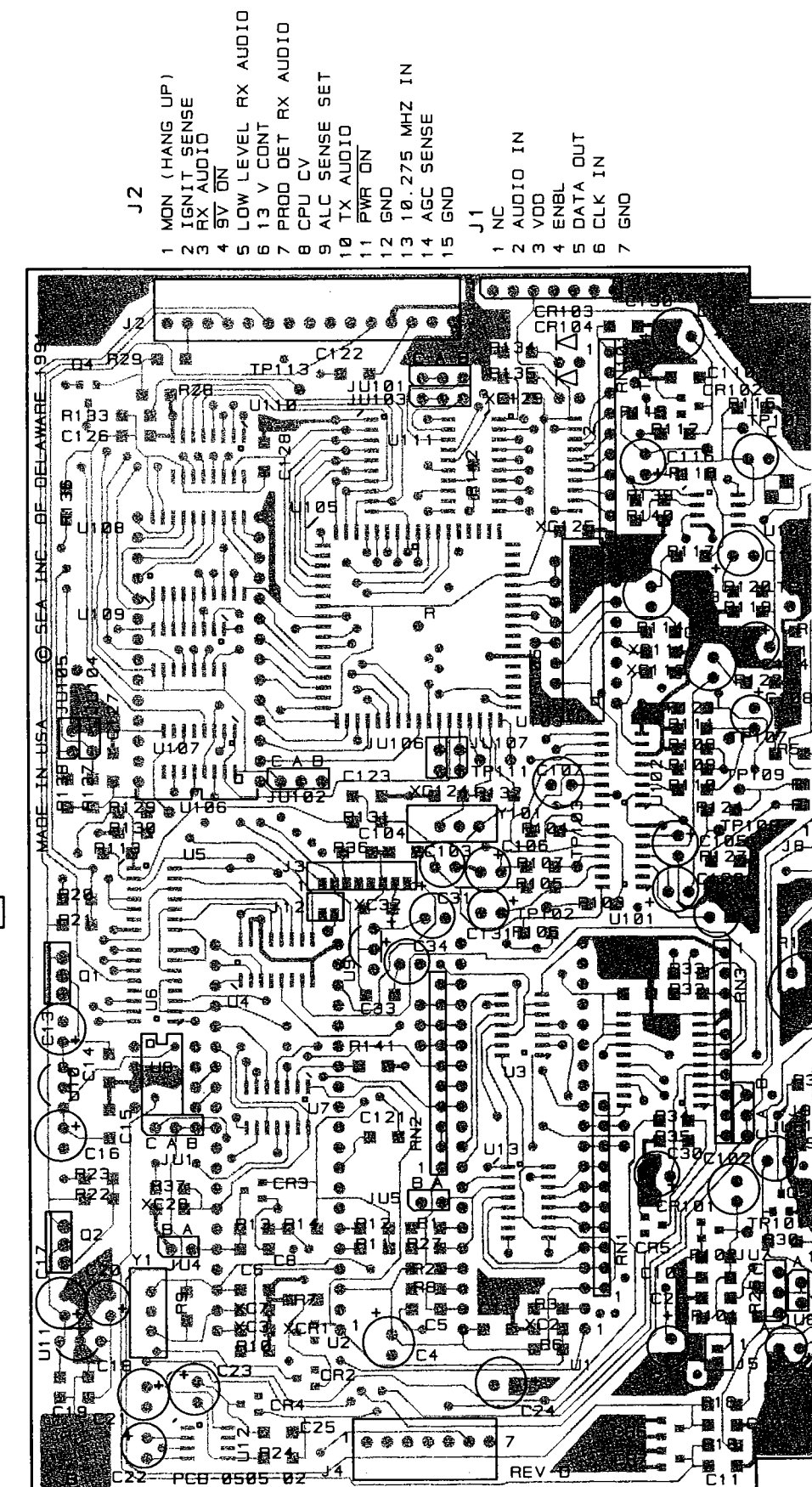
- 1 SCK
- 2 MOSI
- 3 5V
- 4 LED/DTMF EN
- 5 CHAN/AUX
- 6 AUX/PRGM
- 7 TA HORN
- 8 MON/SCAN

#### 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

- J4
- |              |   |
|--------------|---|
| DAC EN       | 1 |
| MAIN EN      | 2 |
| MAIN CLK     | 3 |
| MAIN DATA    | 4 |
| CV AFC       | 5 |
| SYN LOCK DET | 6 |
| SYN EN       | 7 |

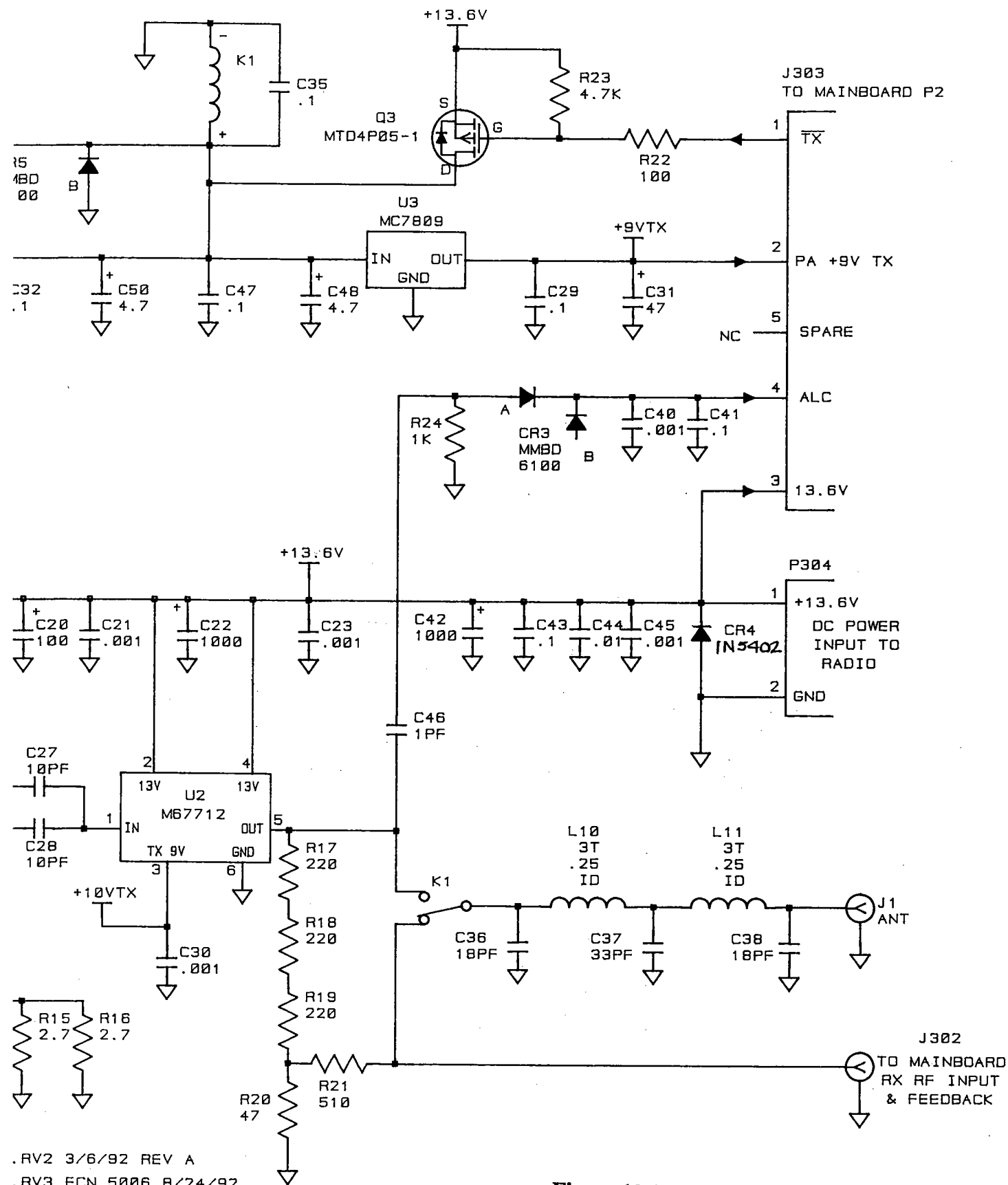
- J5
- |   |
|---|
| 1 |
| 2 |

J2

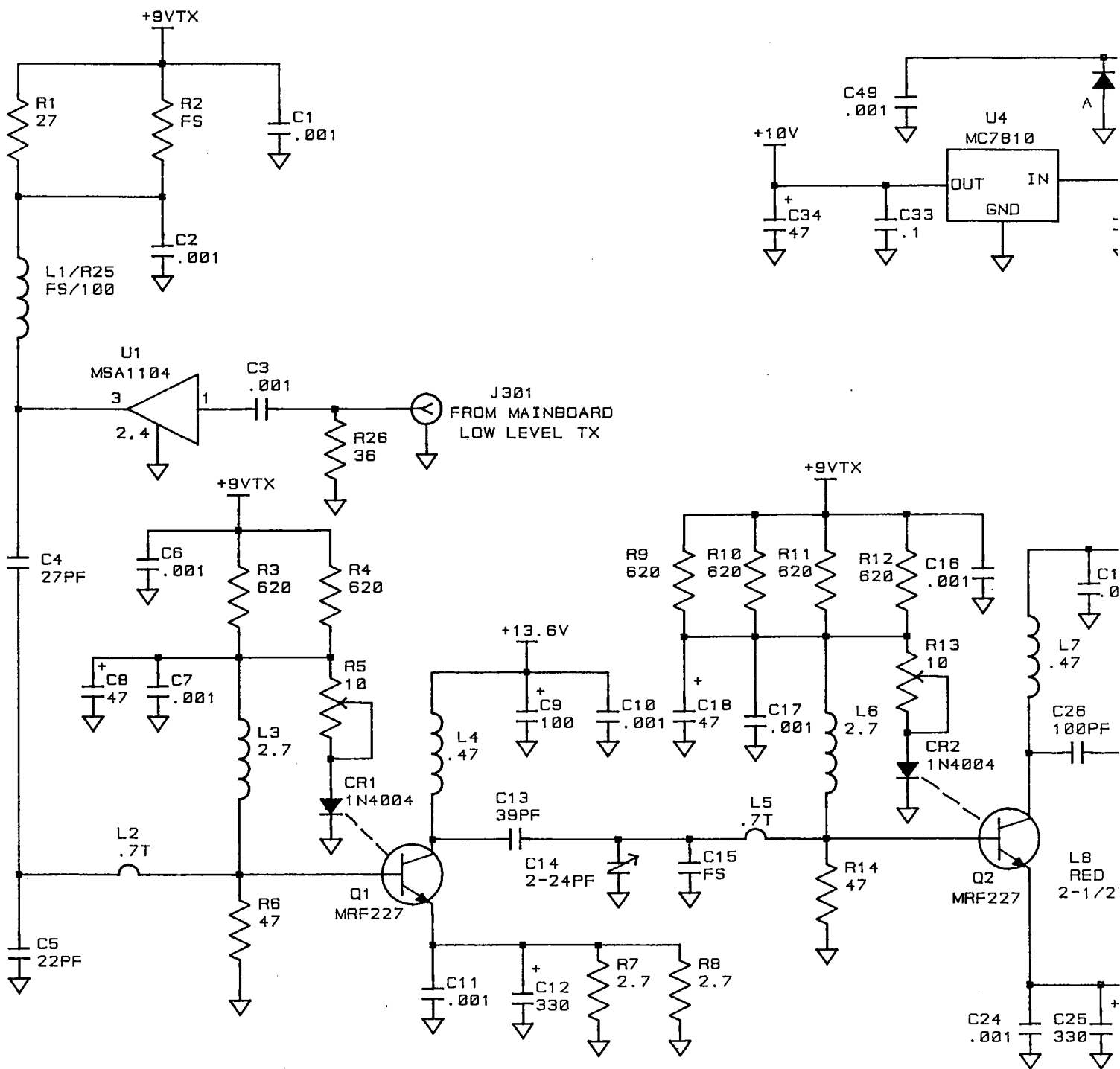
- |    |                    |
|----|--------------------|
| 1  | MON (HANG UP)      |
| 2  | IGNIT SENSE        |
| 3  | RX AUDIO           |
| 4  | SV ON              |
| 5  | LOW LEVEL RX AUDIO |
| 6  | 13 V CONT          |
| 7  | PROD DET RX AUDIO  |
| 8  | CPU CV             |
| 9  | ALC SENSE SET      |
| 10 | TX AUDIO           |
| 11 | PWR ON             |
| 12 | GND                |
| 13 | 10.275 MHZ IN      |
| 14 | AGC SENSE          |
| 15 | GND                |

J1

- |   |          |
|---|----------|
| 1 | NC       |
| 2 | AUDIO IN |
| 3 | VDD      |
| 4 | ENBL     |
| 5 | DATA OUT |
| 6 | CLK IN   |
| 7 | GND      |



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



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.

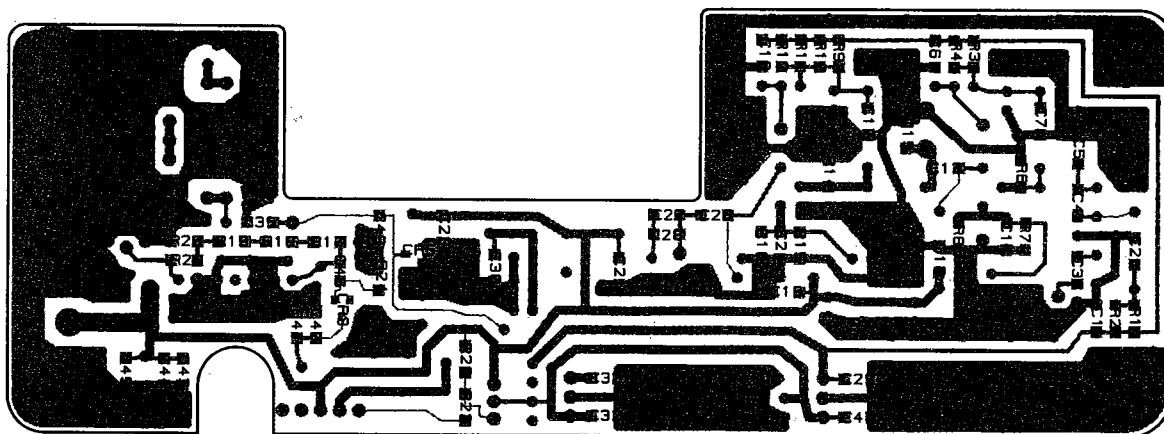
LAST REFERENCE DESIGNATORS USED:

C50 CR5 HAQ2 HEQ2 J303 L11 P304 Q3 R26 U4

REFERENCE DESIGNATORS NOT USED:

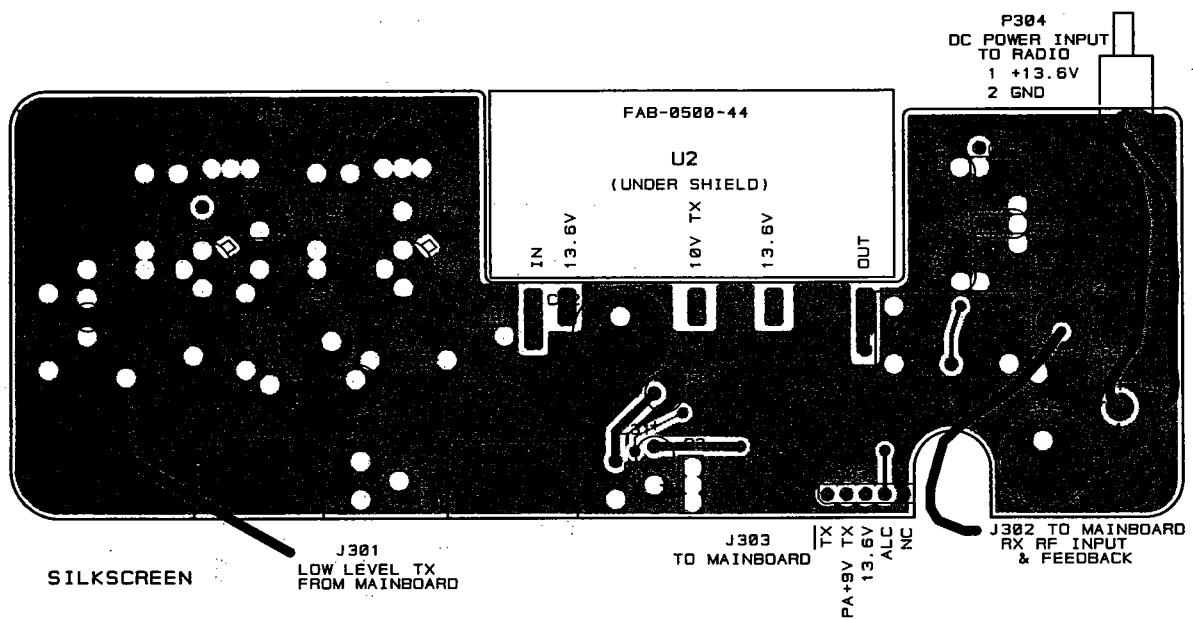
C39

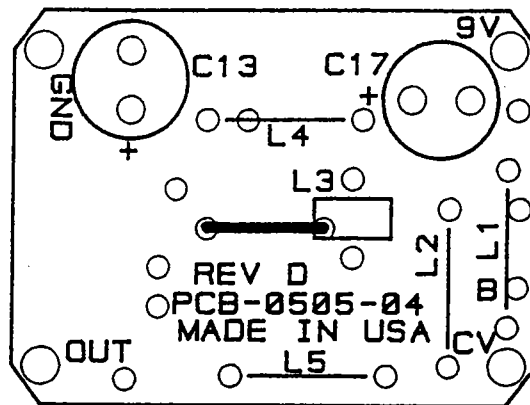
S505  
 S505  
 S505  
 S505  
 ECM



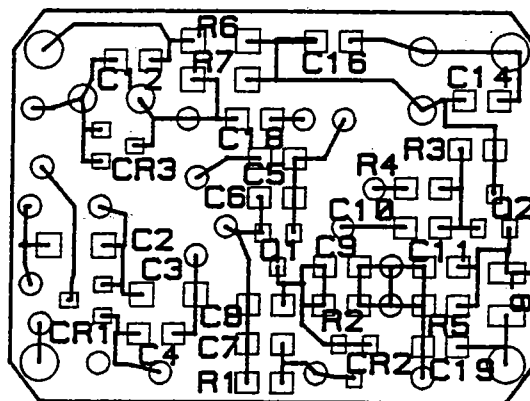
SOLDER SIDE

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



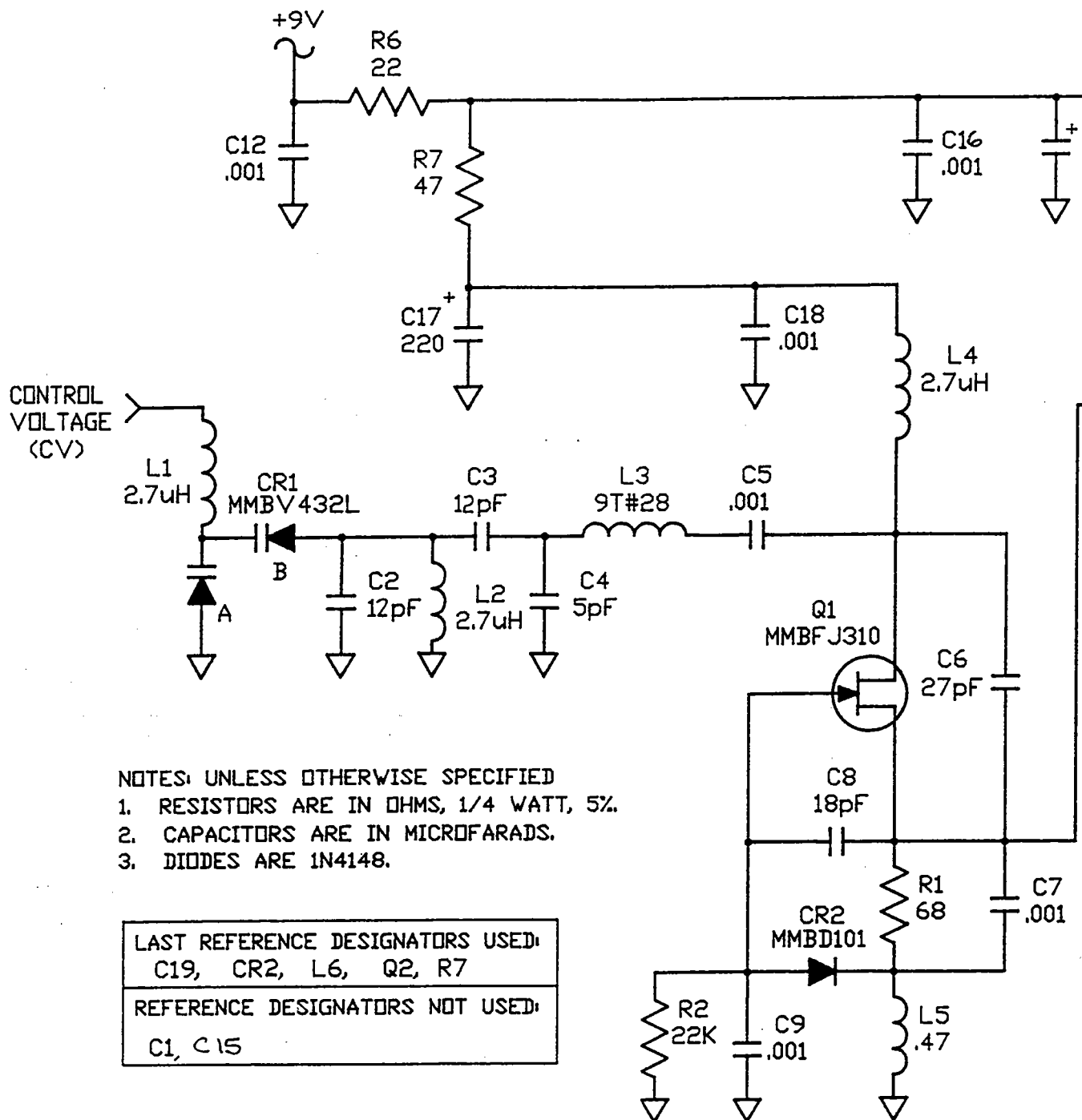


COMPONENT SIDE



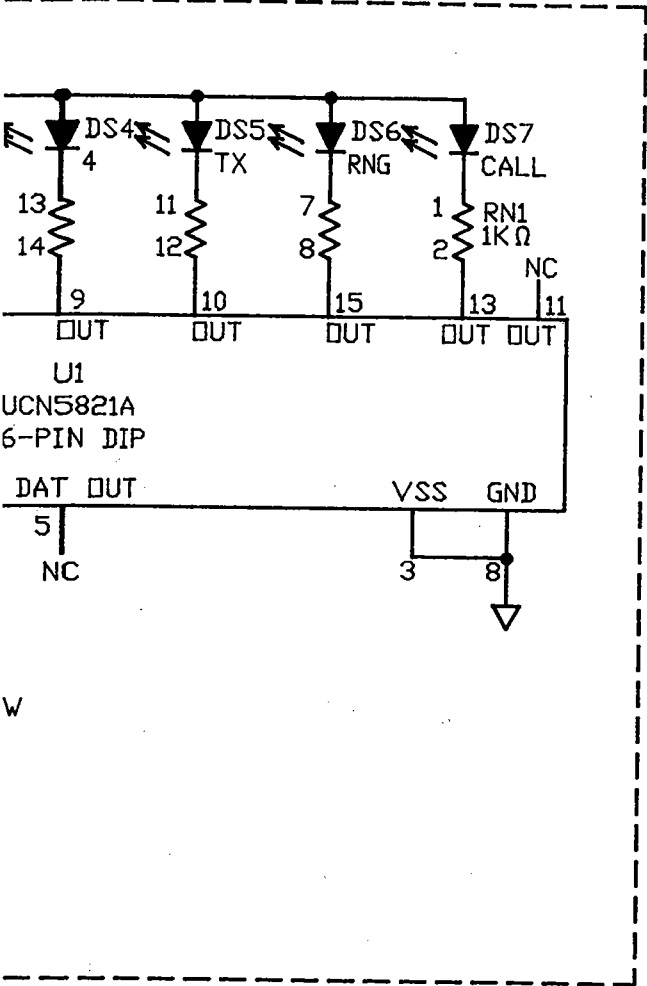
CIRCUIT SIDE

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



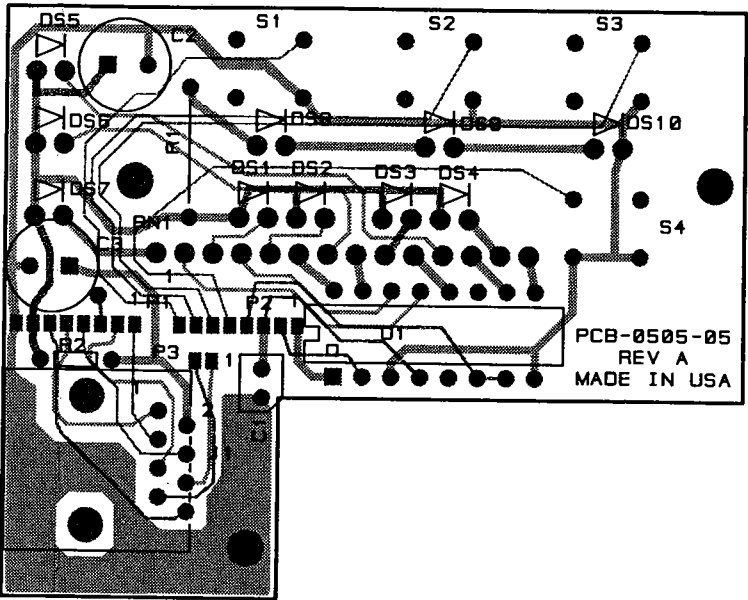
S50504.DWG 4/1/92 REV A  
 S50504.DWG ECN 5006 8/24/92  
 S50504.DWG ECN 5237 4/6/93  
 SP50504.DWG ECN 5532 2/1/94 REV B  
 ECN 5784 7/28/94 REV D

ATIC



W

R



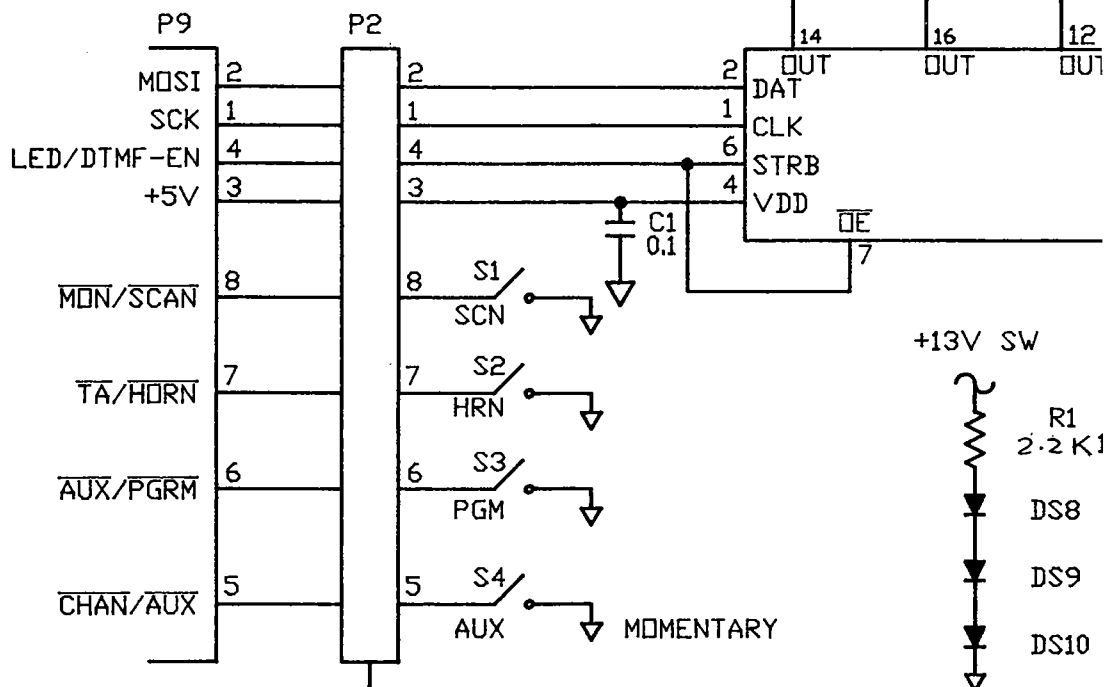
SILKSCREEN

Figure 13.13  
ESP504/520  
Control Board Schematic and  
Control Board Circuit Board Detail  
ASY-0505-05

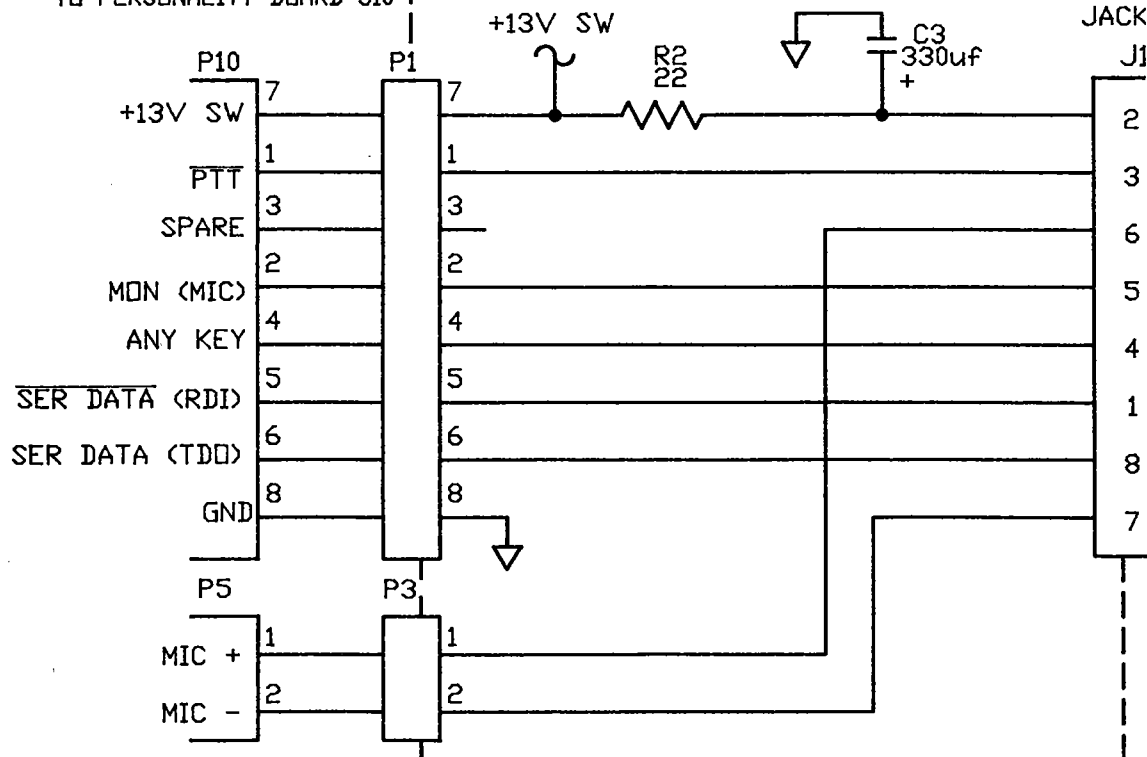
# CONTROL BOARD SCHE ASY-0505-05

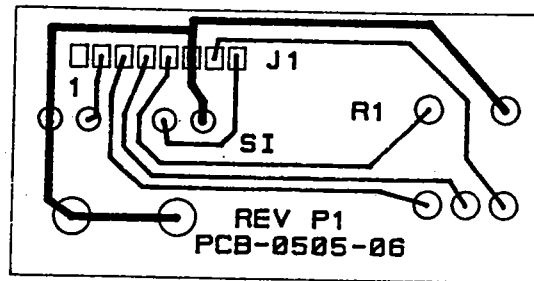
7120  
S50505-6.DWG REV P1 1/17/92  
S50505-6.DWG REV P2 7/9/92  
S50505-6.DWG REV A 7/30/92  
ECN 6380 9/15/93

TO PERSONALITY BOARD J9



TO PERSONALITY BOARD J10

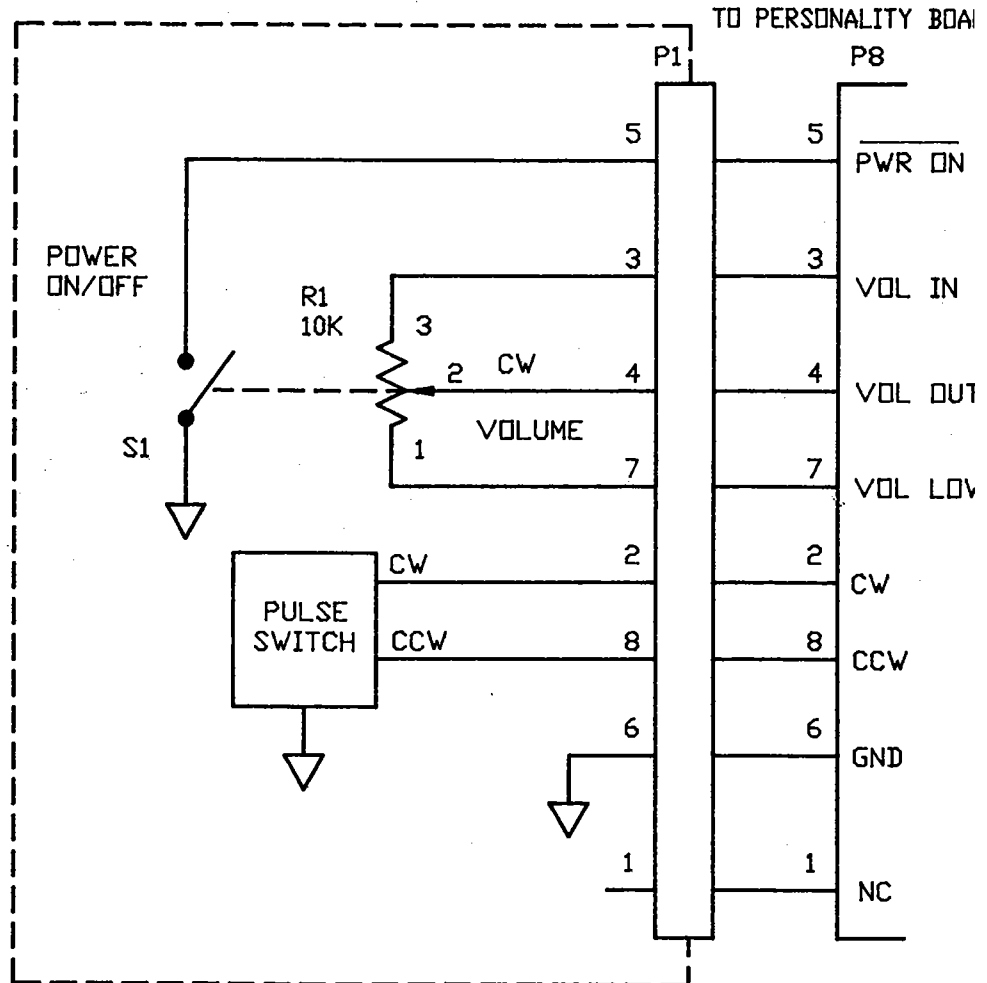




SOLDER SIDE

**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.

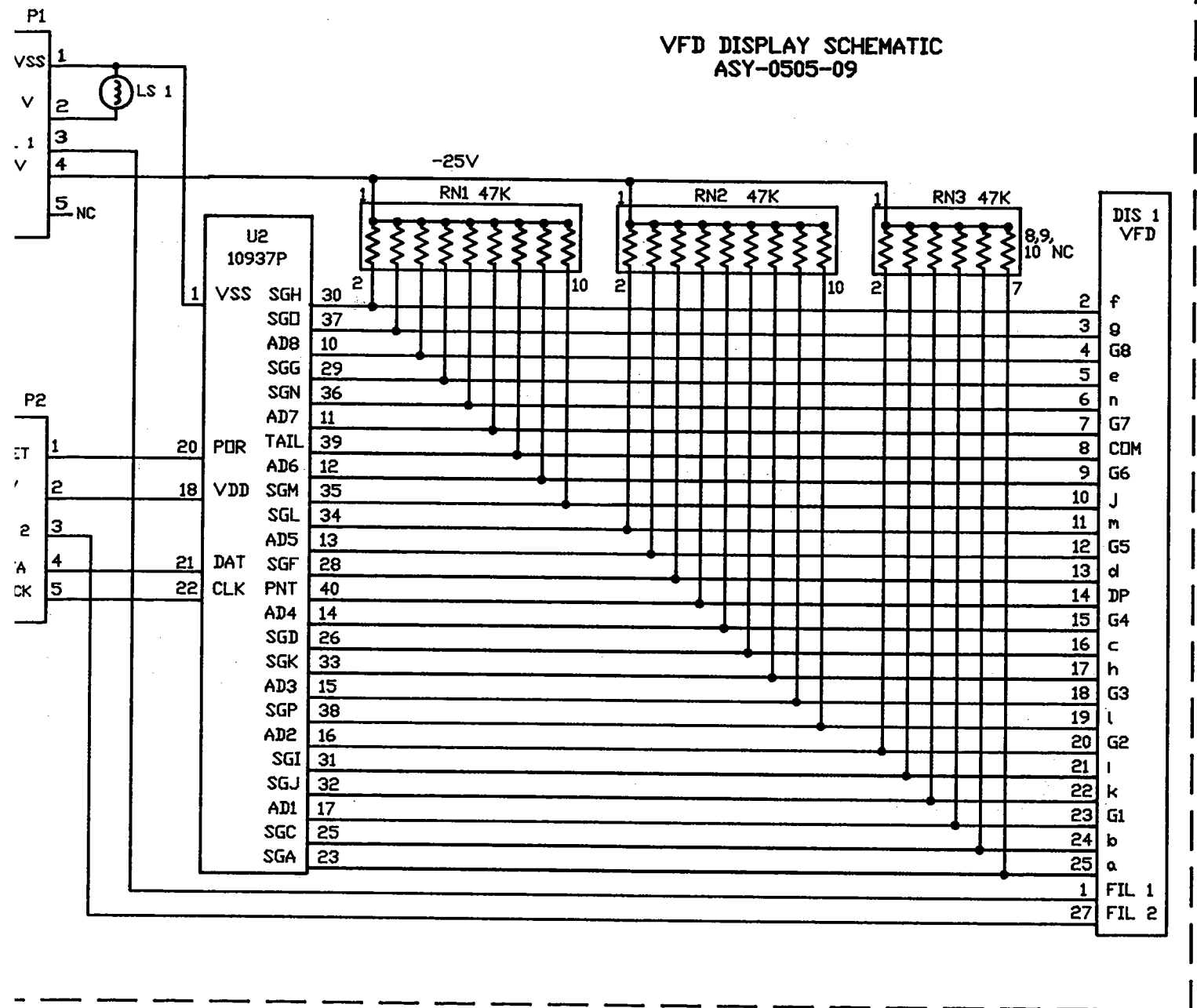
FILE# S50507.DWG

1/20/92 REV P1

REVISED 4/21/93 REV A

REVISED 6/29/93 REV B

REVISED 8/31/93

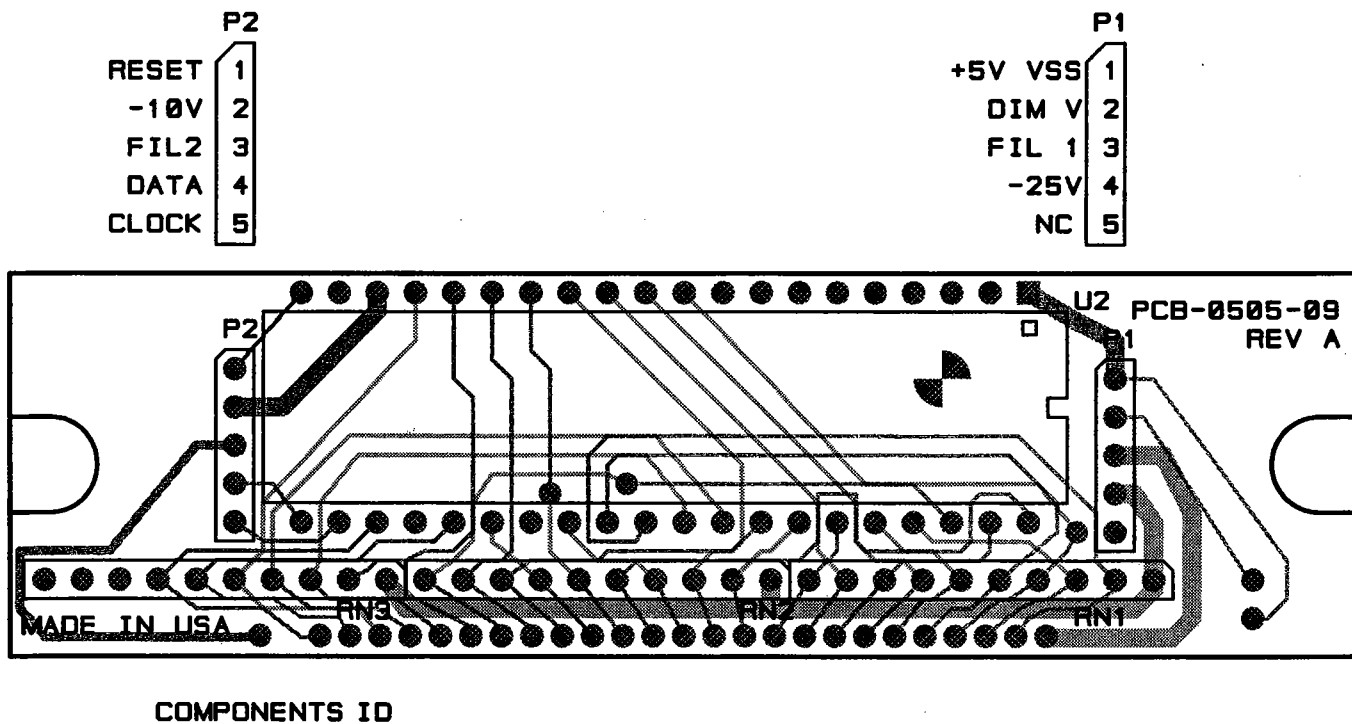


HIGHEST REFERENCE DESIGNATORS USED:

C14, CR3, L2, Q1, R13, SW10, U3

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





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

TO PERSONALITY BOARD

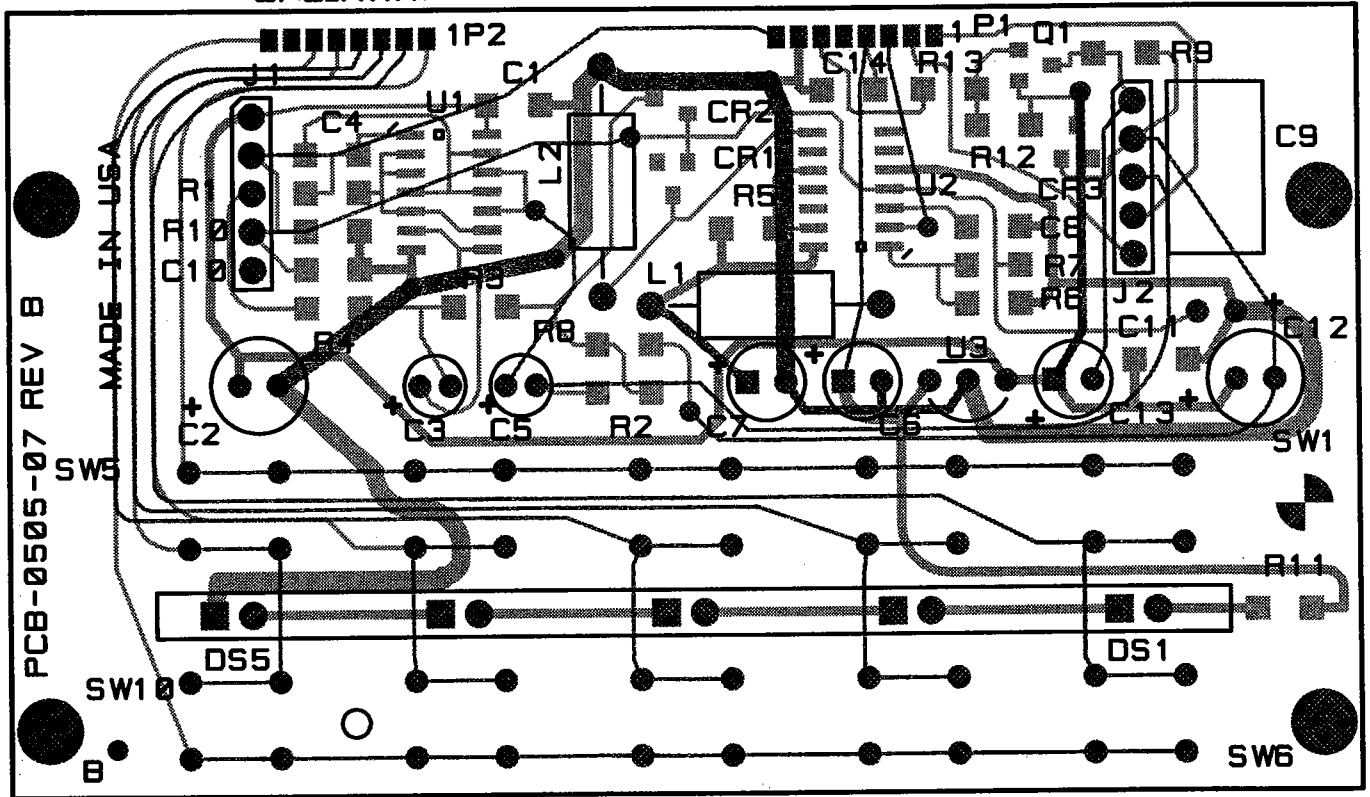
J1  
 1 +5V  
 2 DIM V  
 3 FIL 1  
 4 -25V  
 5 NC

1W047N-2  
 W A R L L L L L W  
 O P L L L L L L O W  
 R S U U U U U R

0N0047N- P2

SW  
 V  
 DIM V  
 GND  
 RESET  
 +5V  
 +13V  
 INH  
 CLK  
 DATA

J2  
 1 RESET  
 2 -10V  
 3 FIL 2  
 4 DATA  
 5 CLOCK



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 | UM |
|--------|--------------------|-------------------------|----------|----|
| 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 NONPOLORIZED 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 NONPOLORIZED 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     | JUM-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 CRAWER            |
| 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 T0-220         |
| U502    | SEM-0109-008 | 7809 VOLTAGE REG, 9V T0-220         |
| 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

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| 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 | MMD7000L 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, CC3, 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 NONPOLORIZED 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 NONPOLORIZED ELECT          |
| C108    | CAP-0030-008 | CAP, TANT .22 50V                   |
| C109    | CAP-0037-004 | CAP.ELECT 47UF RAD                  |
| C113    | CAP-0074-001 | CAP 1uf NONPOLORIZED 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 NONPOLORIZED ELECT          |
| C118    | CAP-0074-001 | CAP 1uf NONPOLORIZED ELECT          |
| C119    | CAP-0074-001 | CAP 1uf NONPOLORIZED ELECT          |
| C12     | CAP-0037-004 | CAP.ELECT 47UF RAD                  |
| C120    | CAP-0074-001 | CAP 1uf NONPOLORIZED 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 NONPOLORIZED 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 DCM 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 VIO 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 VIO 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 VIO A/A4        |
| CR1     | SEM-1003-001 | BAV74 DL SW, CC3, SOT23, "JAX"      |
| CR101   | SEM-1003-004 | MMD7000L 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 | MMD7000L 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 1/4W 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 DECODR, 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 DRV R 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, OC3, 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> | <u>CHASSIS</u>            |          | 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, T0-5 PACKAGE             |
| HAQ2    | HAR-0023-005 | INSULATOR, T0-5 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 TO-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 | LTOS | PCNT | SCRAP |
|-----|-----|--------------|--------------------------------------------|-------------|-----------|--------------|----------|----|-------------|-----|-----|------|------|-------|
| 000 | 000 | CAP-1206-104 | SM.CAP .1UF050V RED A/A5<br>C1,C10,C11,C14 | B N I       | 4         | EA           | 011595   |    | 0           | 0.0 |     |      |      |       |
| 000 | 000 | CAP-1206-151 | CAPACITOR, 'E2' 150PF<br>C8                | B N I       | 1         | EA           | 011595   |    | 0           | 0.0 |     |      |      |       |
| 000 | 000 | CAP-1206-472 | CAPACITOR, 'S3' .0047UF<br>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<br>R5                    | B N I       | 1         | EA           | 011595   |    | 0           | 0.0 |     |      |      |       |
| 000 | 000 | RES-1206-102 | RESISTOR, 1K, SMD<br>R2,R3,R11             | B N I       | 3         | EA           | 011595   |    | 0           | 0.0 |     |      |      |       |
| 000 | 000 | RES-1206-122 | RESISTOR, 1.2K<br>R7                       | B N I       | 1         | EA           | 011595   |    | 0           | 0.0 |     |      |      |       |
| 000 | 000 | RES-1206-222 | RESISTOR, 2.2K<br>R8,R13                   | B N I       | 2         | EA           | 011595   |    | 0           | 0.0 |     |      |      |       |
| 000 | 000 | RES-1206-223 | SM RES 22K 1/4 W 5%<br>R1,R9,R10,R12       | B N I       | 4         | EA           | 011595   |    | 0           | 0.0 |     |      |      |       |
| 000 | 000 | RES-1206-273 | RESISTOR, 27K<br>R6                        | B N I       | 1         | EA           | 011595   |    | 0           | 0.0 |     |      |      |       |
| 000 | 000 | RES-1206-470 | RESISTOR, 47 OHM<br>R4                     | B N I       | 1         | EA           | 011595   |    | 0           | 0.0 |     |      |      |       |
| 000 | 000 | SEM-1003-001 | BAV74 DL SW, CC3, SOT23,<br>CR1            | B N I       | 1         | EA           | 011595   |    | 0           | 0.0 |     |      |      |       |
| 000 | 000 | SEM-1008-068 | MMBZ5235B, 6.8ZD, A1, SOT<br>CR2           | B N I       | 1         | EA           | 011595   |    | 0           | 0.0 |     |      |      |       |
| 000 | 000 | SEM-1008-150 | MMBZ5245B, 15ZD, A1, SOT-<br>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 REV | B T T IN OUT | QUANTITY UM | EFFECTIVITY | IN | OUT | LTOS | PCNT | SCRAP |
|----|-----|------------------|---------------------------------------|-----------|--------------|-------------|-------------|----|-----|------|------|-------|
|    | 000 | 000 SEM-1015-014 | MC74HC14AD, HEX SCHMITT I<br>U1       | B N I     |              | 1 EA        | 011595      |    |     | 0    | 0.0  |       |
|    | 000 | 000 SEM-1024-010 | TL497, SWITCHING REGULATO<br>U2       | B N I     |              | 1 EA        | 011595      |    |     | 0    | 0.0  |       |
|    | 000 | 000 SEM-1042-001 | 2907, PNP GP TRANS, 2B/2 SOT-23<br>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 PHOTOCCELL, 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 NONPOLORIZED 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 NONPOLORIZED ELECT  |
| C108    | CAP-0030-008 | CAP, TANT .22 50V           |
| C109    | CAP-0037-004 | CAP.ELECT 47UF RAD          |
| C113    | CAP-0074-001 | CAP 1uf NONPOLORIZED 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 NONPOLORIZED ELECT  |
| C118    | CAP-0074-001 | CAP 1uf NONPOLORIZED ELECT  |
| C119    | CAP-0074-001 | CAP 1uf NONPOLORIZED ELECT  |
| C12     | CAP-0037-004 | CAP.ELECT 47UF RAD          |
| C120    | CAP-0074-001 | CAP 1uf NONPOLORIZED 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 NONPOLORIZED 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 merchant ability 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 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.

---

### **C A U T I O N**

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.

---

### **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                       |

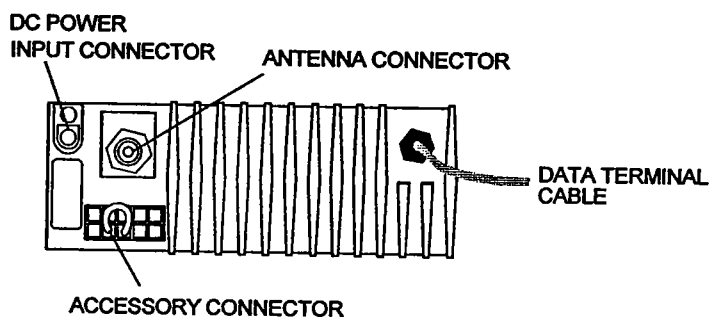
## **MDT Modem**

|                                  |                                         |
|----------------------------------|-----------------------------------------|
| MDT data rate                    | 1200 bps                                |
| MDT modulation formats           | 1200/1800 Hz MSK or<br>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:

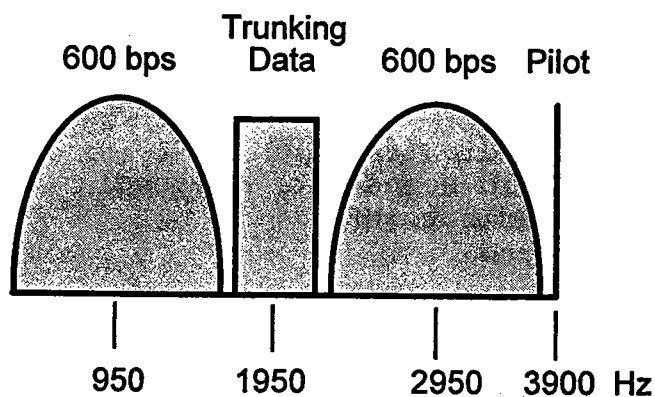
| <u>Pin</u> | <u>Color</u> | <u>Function</u>               |
|------------|--------------|-------------------------------|
| 1          | Yellow       | Power ground                  |
| 5          | Brown        | PTT (active low)              |
| 6          | White        | CTS (active low)              |
| 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  |

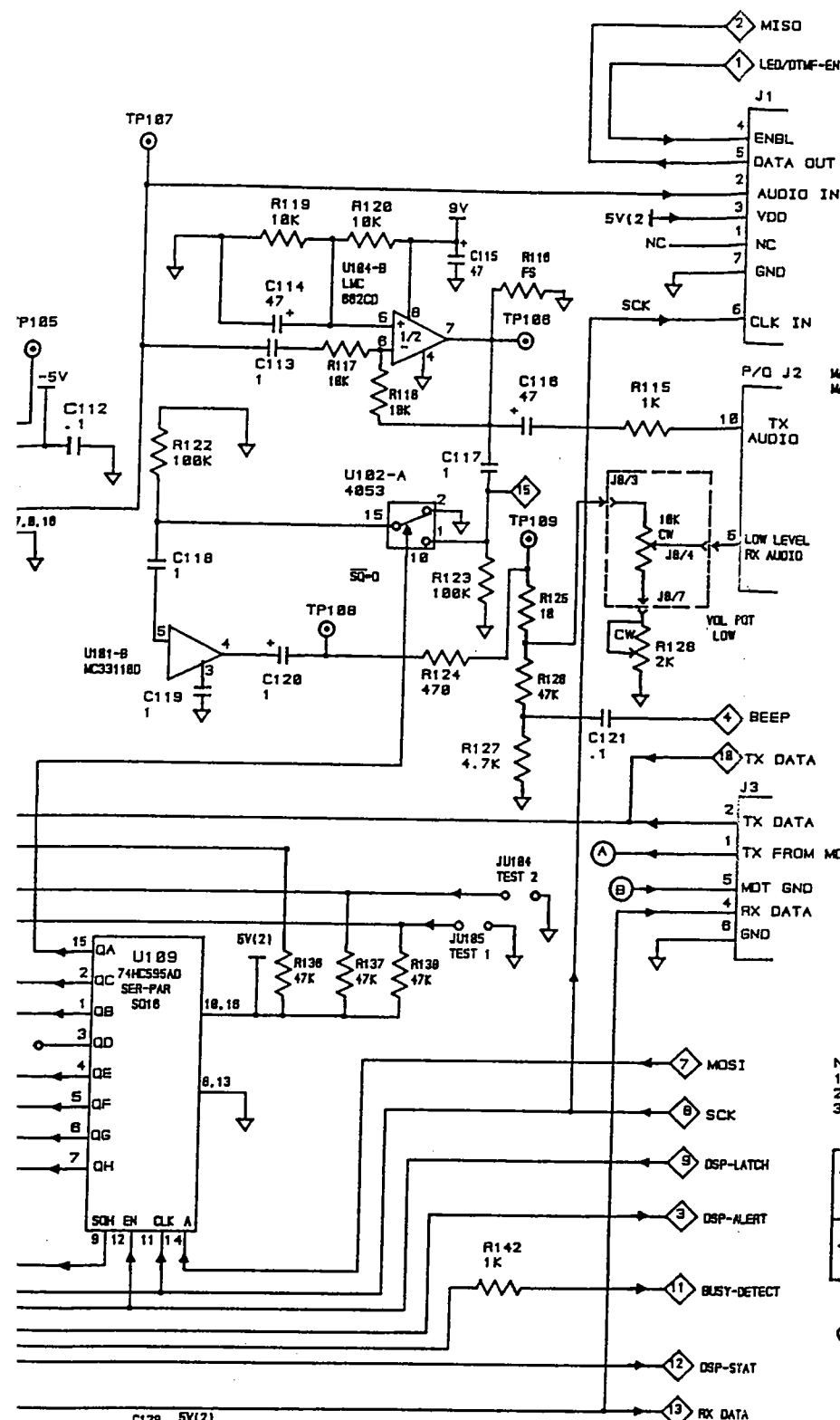
### **Schematics**

Attached

### **Bills of Material**

Attached





MATES WITH  
MAINBOARD P3

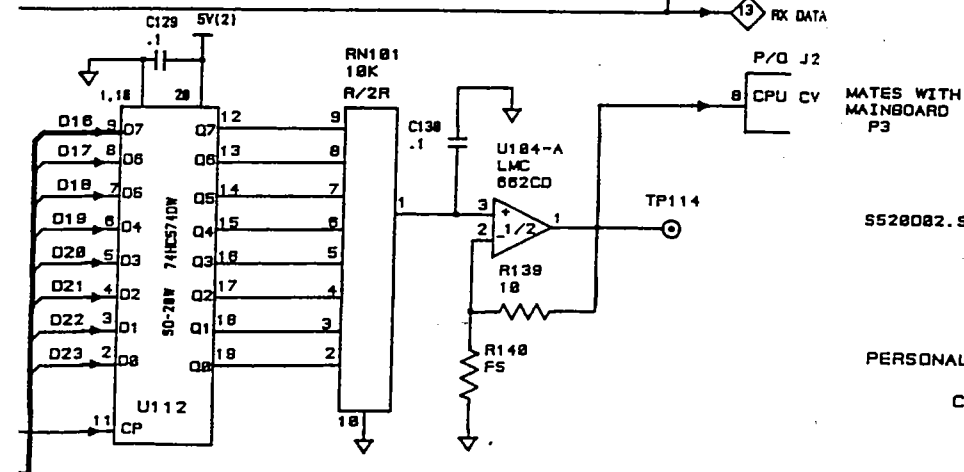
◇ INDICATES CONNECTION TO  
POINT ON SHEET 2  
→ INDICATES SIGNAL FLOW

NOTES: UNLESS OTHERWISE SPECIFIED  
1. RESISTORS ARE IN OHMS, 1/4 W. 5%  
2. CAPACITORS ARE IN MICROFARADS  
3. DIODES ARE MMBD7808

HIGHEST REFERENCE DESIGNATORS USED:  
C131, CR184, JU187, R142, RN181,  
SOC7, TP114, U112, Y181

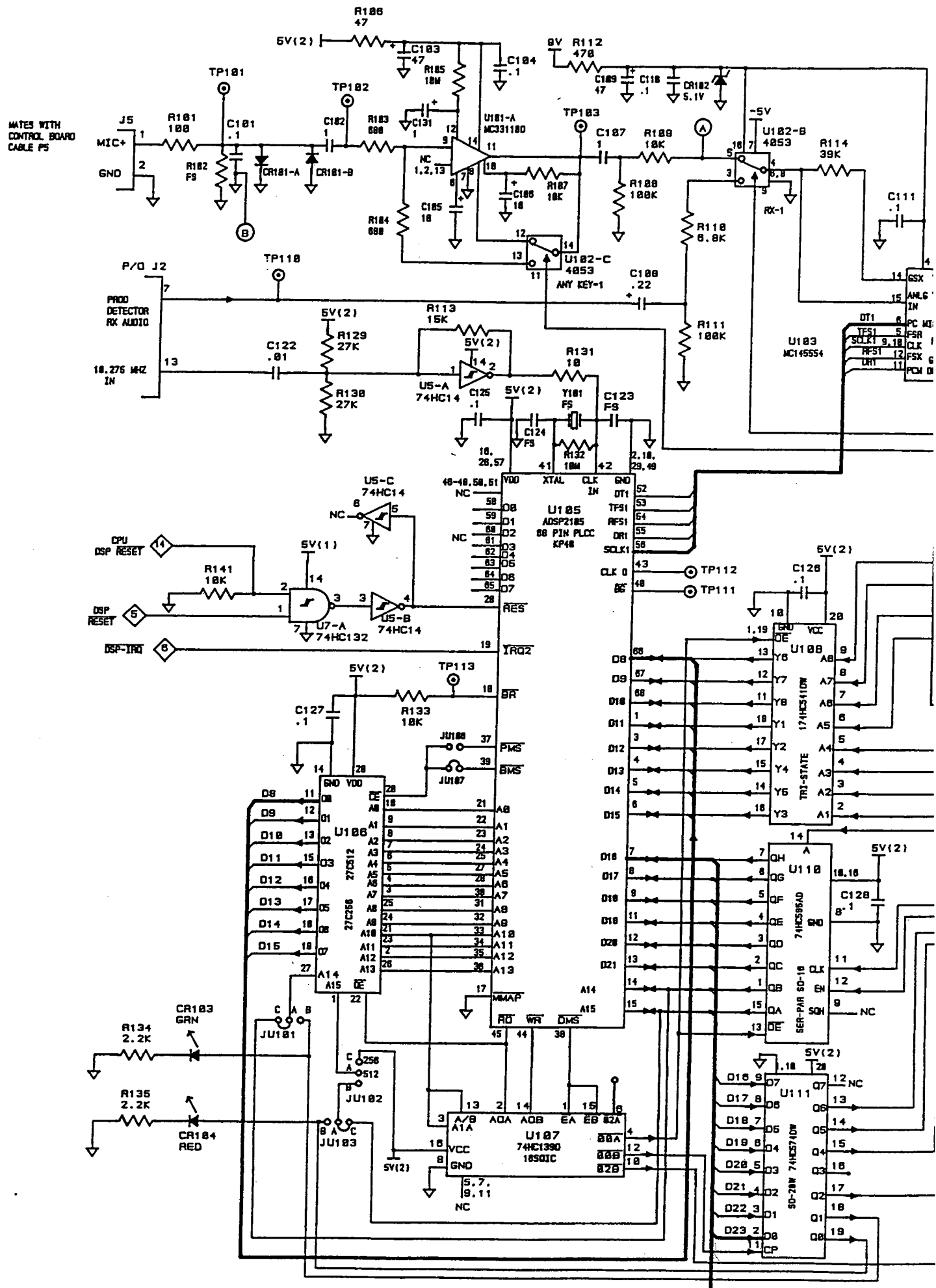
REFERENCE DESIGNATORS NOT USED:  
R121, TP184, Q181

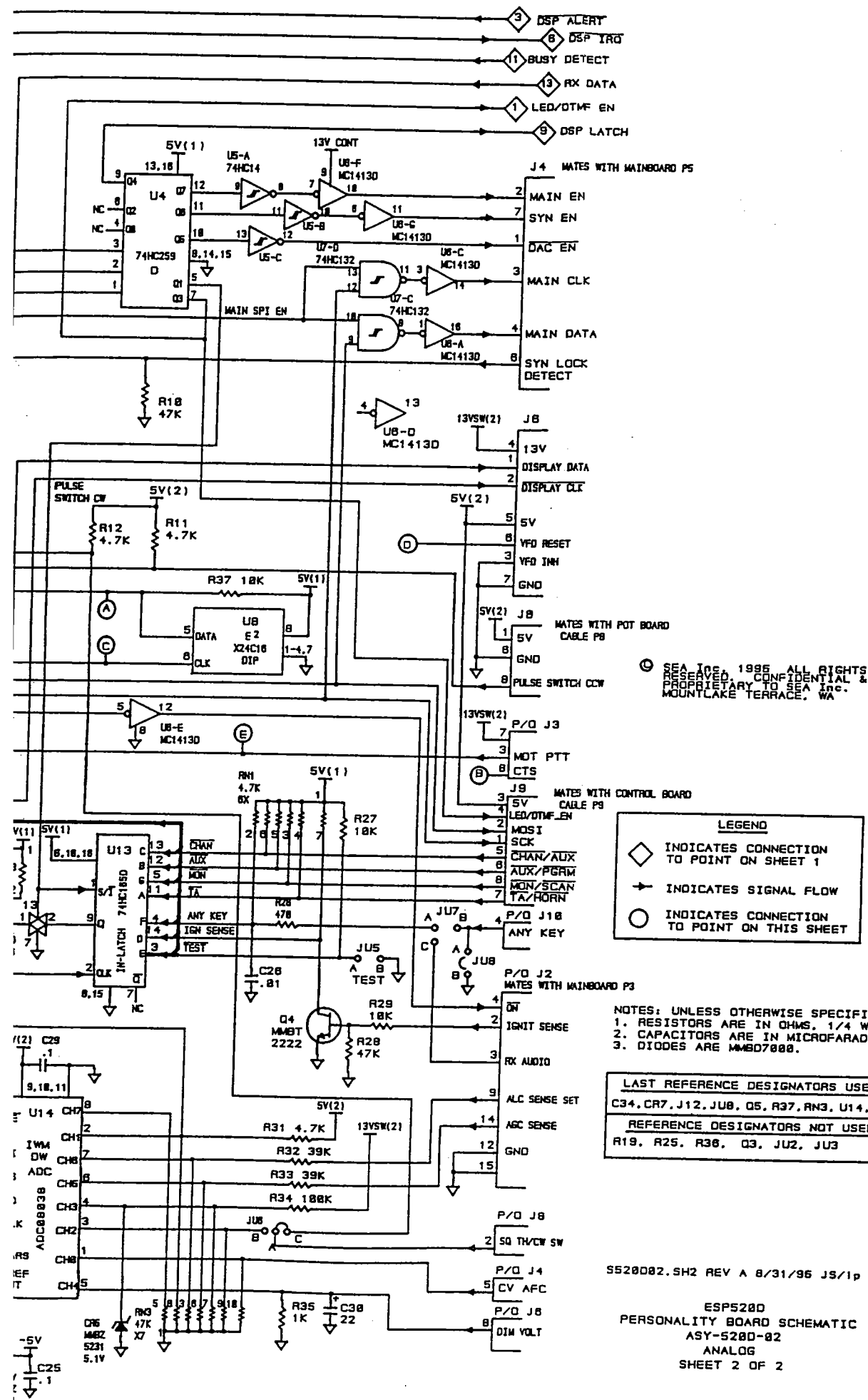
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MOUNTLAKE TERRACE, WA

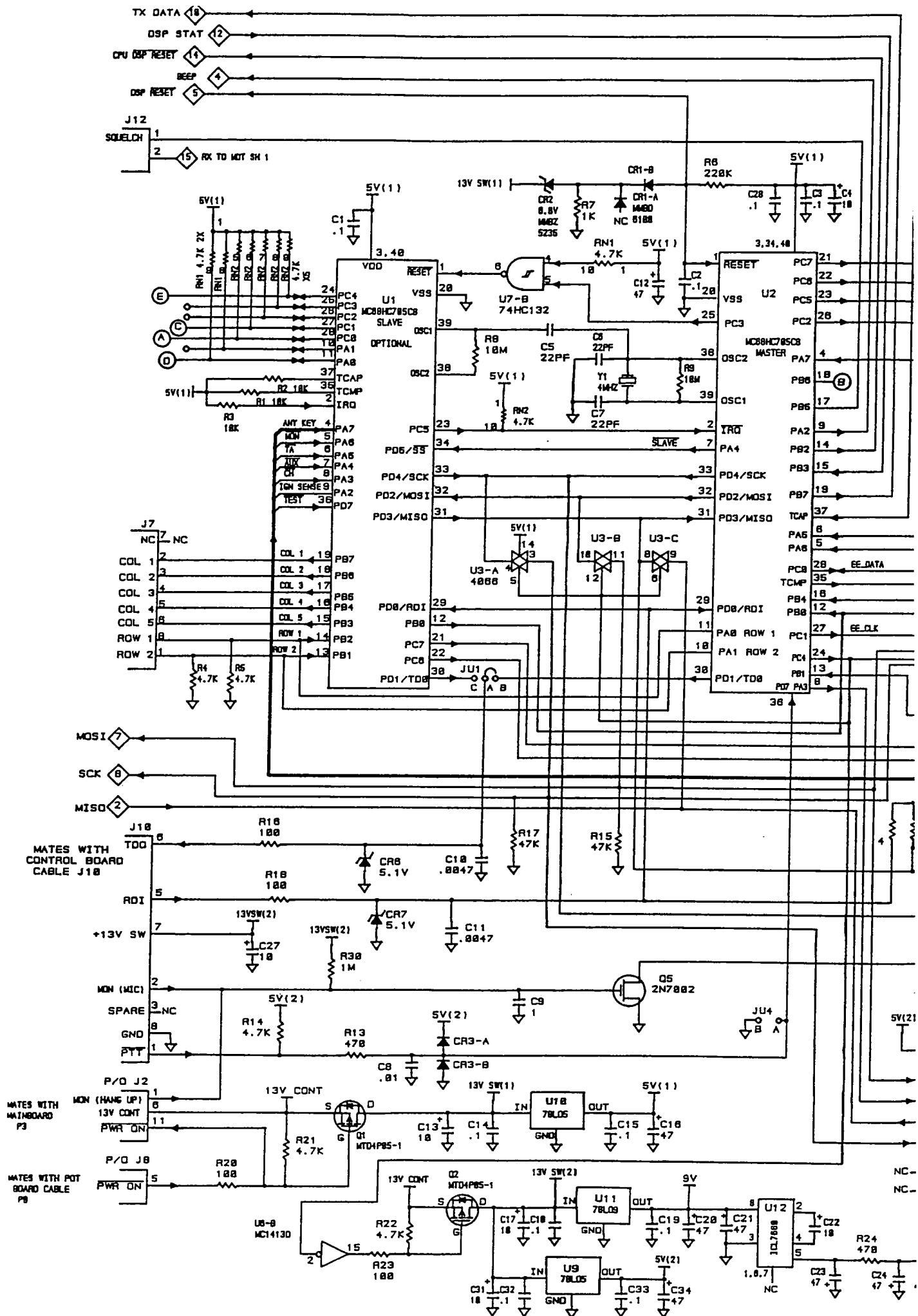


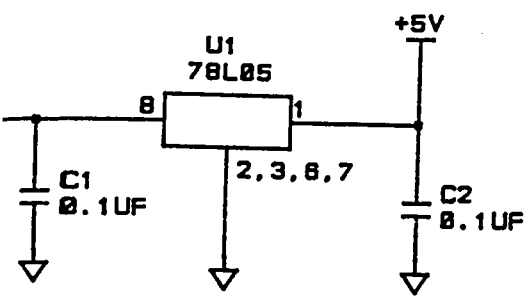
SS28082.SHI REV A 8/31/95 JS/lp

ESP520D  
PERSONALITY BOARD SCHEMATIC  
ASY-528D-02  
CPU AND DIGITAL  
SHEET 1 OF 2



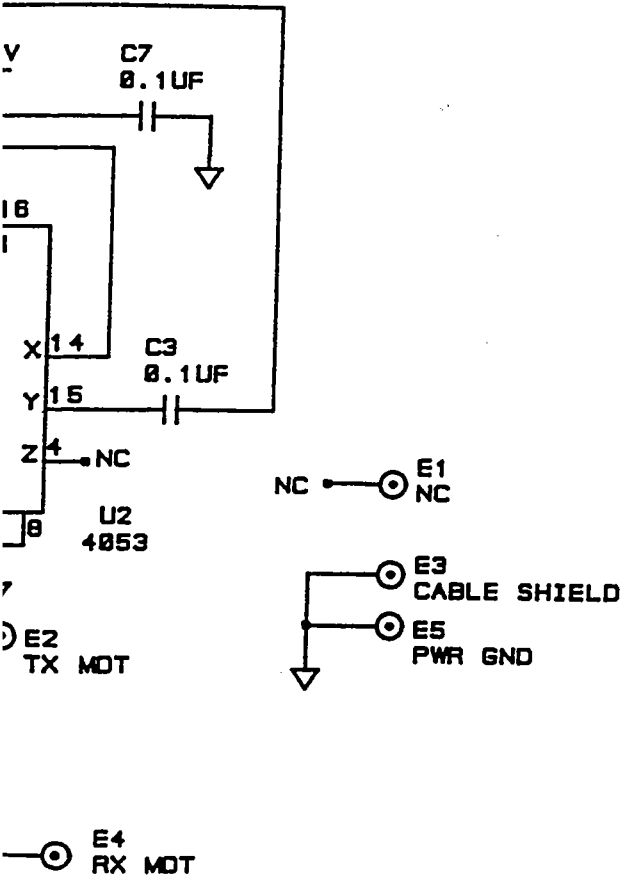






S50510.SH1 REV P1 7/10/95 KJW  
 S520D11.CSD 9/1/95 JBS/lmp

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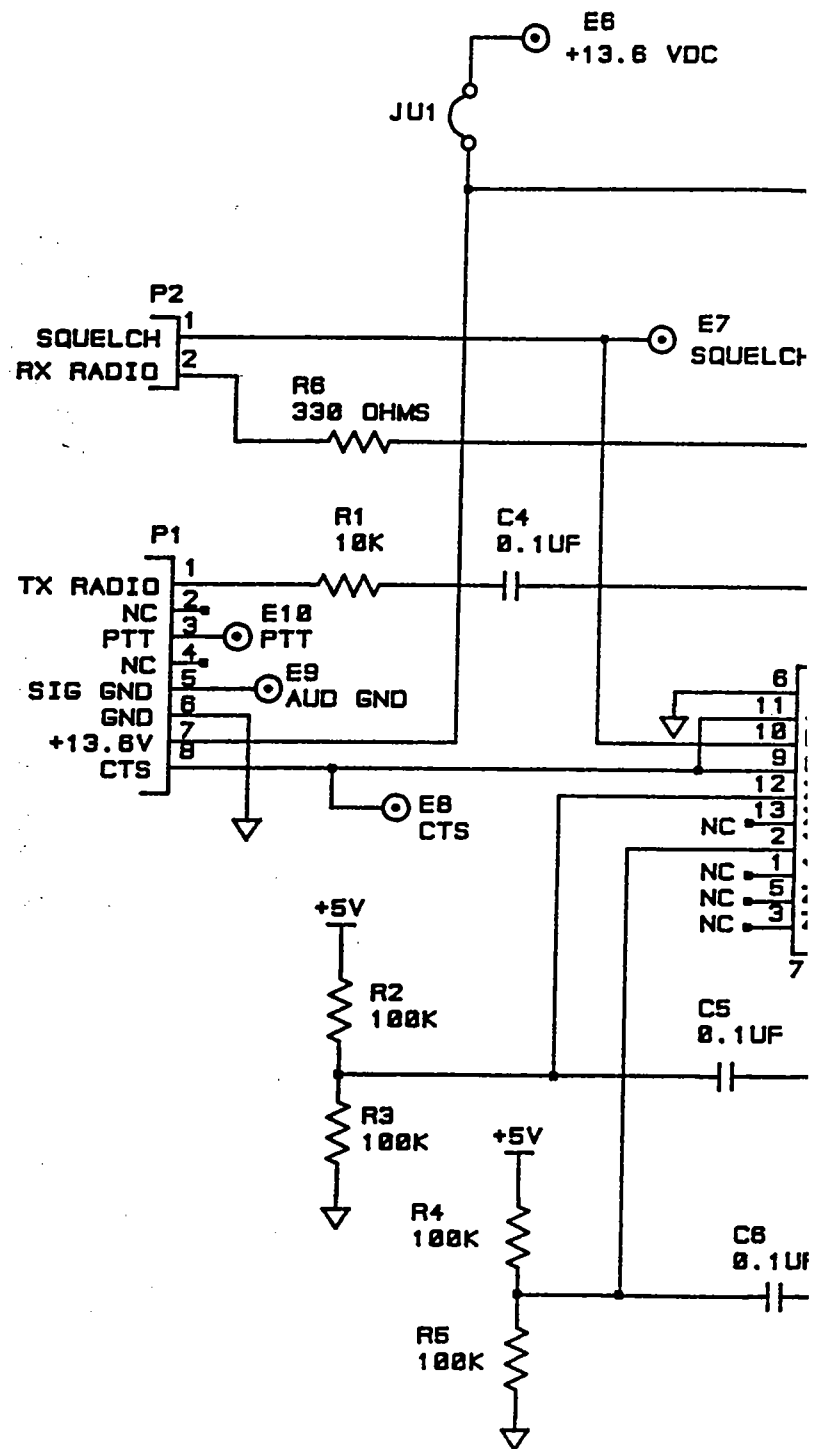


- NOTES: UNLESS OTHERWISE SPECIFIED
1. RESISTORS ARE IN OHMS, 1/4W, 5%.
  2. CAPACITORS ARE IN MFD/WVDC.

LAST DESIGNATORS USED:

C7, E10, JU1, P2, R6, U2

ESP520D  
 DATA TERMINAL INTERFACE SCHEMATIC  
 ASY-520D-11



11:30:43  
FUNCTION: BILI

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

PAGE: 1  
10/09/1995

PARENT: 520D DESC: 520, DATA VERSION  
RV: UM: EA RUN LT: 4 FIXED LT: 0  
PLNR: PLN LT: N PLN POL: M DRWG:

PT USE SEQN COMPONENT  
STARTING:

| PT<br>USE | SEQN | COMPONENT    | DESCRIPTION                 | C<br>T | QUANTITY | Q<br>T | UM | M<br>B | L<br>T |
|-----------|------|--------------|-----------------------------|--------|----------|--------|----|--------|--------|
| 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

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OPTION: A IN EFF: 100995 OUT EFF: 123179

PARENT: ASY-520D-14

DESC: RADIO, BASIC 520D

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

PT USE SEQN COMPONENT  
 STARTING:

| PT<br>USE | SEQN | COMPONENT    | DESCRIPTION                  | C<br>T | QUANTITY | Q<br>T | M<br>UM | L<br>B | L<br>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      | B      | N      |
| 000       | 000  | HAR-0071-012 | 4-40X3/4 SS STANDOFF         | N      | 2        | I      | EA      | B      | N      |
| 000       | 000  | CAB-0501-001 | MINI COAX CABLE, 70 MM       | N      | 1        | I      | EA      | B      | N      |
| 000       | 000  | ASY-520D-C01 | ASSY, CABLE 520D             | N      | 1        | I      | EA      | M      | N      |
| REF       | 000  | HAR-040P-187 | 4-40 X 3/16 PH PH PATCH LOCK | X      | 4        | I      | EA      | B      | N      |
| REF       | 000  | HAR-040P-250 | 4-40 X 1/4 PH PH PATCH LOCK  | X      | 21       | I      | EA      | B      | N      |
| REF       | 000  | HAR-040P-375 | 4-40 X 3/8 PH PH PATCH LOCK  | X      | 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

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PARENT: ASY-520D-10 DESC: 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<br>USE | SEQN | COMPONENT    | DESCRIPTION                   | C<br>T QUANTITY | Q<br>T | UM | M<br>B | L<br>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               | 2      | I  | EA     | B N    |
| 000       | 000  | TUN-0001-437 | TUNING SCREW, 7/16 SS HEX     | X               | 3      | I  | EA     | B N    |
| 000       | 000  | W0500010.000 | ASY-0500-10 P.A.              | X               | 0      | I  | EA     | M N    |
| 000       | 000  | FAB-520D-01  | 520D MOBILE CHASSIS, FINISHED | N               | 1      | I  | EA     | S N    |
| LAB       | 000  | LAB[R]TEST   | LABOR, TEST                   | R               | .2     | I  | HR     | M N    |
| REF       | 000  | HAR-040P-250 | 4-40 X 1/4 PH PH PATCH LOCK   | X               | 6      | I  | EA     | B N    |
| REF       | 000  | HAR-040P-375 | 4-40 X 3/8 PH PH PATCH LOCK   | X               | 2      | 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               | 3      | I  | EA     | B N    |

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

13:18:45

FUNCTION: BILI

SEA INC.

SINGLE LEVEL BILL

PAGE: 1  
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OPTION: A IN EFF: 100995 OUT EFF: 123179

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<br>USE | SEQN | COMPONENT    | DESCRIPTION          | C<br>T QUANTITY | Q<br>T | M<br>UM | L<br>B | L<br>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  
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PARENT: SMT-520D-11 DESC: 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<br>USE | SEQN | COMPONENT    | DESCRIPTION                 | C<br>T QUANTITY | Q<br>T | U | M  | B | L<br>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  
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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<br>USE | SEQN | COMPONENT    | DESCRIPTION                 | C<br>T QUANTITY | Q<br>T | M<br>UM | L<br>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 \*\*\*