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Non-Profit Research and Development Corporation

DSP-93

DSP-93 Assembly Manual

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INTRODUCTION

The DSP-93 is designed to provide radio amateurs the capabilities of Digital Signal Processing in a stand-alone low-cost design. Not just limited to one mode, the DSP-93 can support data, audio, and video modes with the proper software.

The DSP-93 Kit is the original design of Bob Stricklin, N5BRG. Co-Project Managers: Greg Jones, WD5IVD and Bob Stricklin, N5BRG. TAPR Joint DSP Project Officers: Greg Jones, WD5IVD (TAPR) and Robert Diersing, N5AHD (AMSAT). The Alpha-test group consisted of: Bob Stricklin, N5BRG, Frank Perkins, WB5IPM, Lon Cecil, WB5PKJ, Tom McDermott, N5EG, Robert Diersing, N5AHD, John Conner, WD0FHG, Jon Bloom, KE3Z, N5AHD, UoSAT/Doug Loughmiller, KO5I/ G0SYX, Greg Jones WD5IVD, and Bill Reed, WD0ETZ. The Beta-test group consisted of the alpha-test group plus: Ron Parsons, W5RKN, Mark Hammond, KC4EBR, Roy Welch, W0SL, Michael Zingman, N4IRR, Jack Davis, WA4EJR, Paul Beckmann, WA0RSE, Bill Beech, N7JP, Gould Smith, WA4SXM, Greg Ratcliff, NZ8R, Brian Straup, NQ9Q, Doug Howard, KG5OA, Scott Zehr, K9GKC, Jim Tittsler, 7J1AJH/AI8A, Stan Salek, KD6CVL, Marcel Losekoot, G1NBR, and Robert Greenfield, VE3DSC.

The first board (DSP Engine) contains the TMS320C25 DSP, 32K by 16 bits each of program and data memory (expandable to 64K by 16 each), the clock circuitry and some programmable array logic (PALS) for system I/O. All the DSP lines are connected to the backplane bus. The clock speed is 40 MHz. Board two (Radio Interface Board) contains two eight pin mini-DIN connectors for the radio interface. The Texas Instruments TLC32044 Analog I/O chip samples and updates at a rate of up to 45K operations per second and it includes aliasing filters. The chip communicates with the DSP using a 5 MHz serial interface. This AI/O chip is fast enough for most of the current amateur modes.

This manual provides sufficient information for the advanced experimenter to build and operate the DSP-93 kit. This kit includes all parts and components necessary to fully populate the PC board and mating connectors.

NOTE: Builders of the kit estimate the time to build this kit between 10-20 hours, with additional time required to get the unit properly interfaced to whatever radios you plan on using.

Please check the shipment for any possible errata sheet(s) and/or additions/corrections to instructions provided in this manual.

Read this manual completely prior to assembly.

Access to an ohmmeter may aid in identifying some resistor values.

NOTE: Requests for assistance in building this kit are only being handled via the Internet using the DSP-93 mail group. If you do not have access to the Internet, you will need to locate someone who does, or find someone to help you locally with your kit.

When you are ready to subscribe, send e-mail to 'listserv@tapr.org' with the following command in the message text:

```
subscribe dsp-93 First_Name Last_Name
```

For more information on TAPR, send the following commands to 'listserv@tapr.org':

```
        help
        index -all
        get tapr taprinfo.txt
```

PARTS LIST
This parts list is organized by part type. Please verify that all parts are present, checking the space provided. You may wish to take this opportunity to sort the parts into a compartmented container, such as an egg carton or muffin tin. Be sure to check the BOTTOM of the bags!

Capacitors, Ceramic, Monolithic

( ) 32	Cap 0.1 uF (104)	C100-C115, C118-C120, C123, C215, C217, C218, C219, C220, C221, C223, C225, C227, C228, C234, C238
( ) 3	Cap 0.22 uF (224)	C208, C209, C210
( ) 1	Cap 0.47 uF (474)	C211
( ) 2	Cap 22 pF (22 or 22J)	C207, C212
( ) 1	Cap 47 pF (47)	C213
( ) 1	Cap 1.0 uF (105)	C214
( ) 1	Cap 0.047 uF (473)	C237

Capacitors, Electrolytic, Radial Lead

( ) 6	Cap 1000 uF 16V	C116, C117, C224, C226, C229, C232
( ) 1	Cap 100 uF 16V	C236
( ) 6	Cap 10 uF 25V	C202-C206, C233
( ) 2	Cap 4.7 uF 50V	C216, C222

Crystal and Oscillator

( ) 1	XTAL-4.9152 MHz	X201
	Crystal 4.9152 MHz	
( ) 1	MXO-55GA-2C	X101
	40 MHz Clock Oscillator	

Diodes

( ) 3	1N5817 or HSCH1001	D201, D202, D205
	HP Diode or BAT 42 diode	
	or 1N5802,03, 04, 05, or 06 diode	
( ) 4	1N4002 or 1N4003	D100,D203,D204,D206

Resistors, SIP

( ) 1	4310R-101-104	R106
	Res 100K 1/4 W 5% SIP Resistor	
( ) 1	4308R-101-473	R217
	Res 47K 1/4 W 5% SIP Resistor	

Resistor, Variable

( ) 2   1K POT   R213, R214
          Bourns 3299W-1-102

( ) 2   25K POT   R215, R216
          Bourns 3299W-1-253

( ) 1   10K POT   R234
          Audio Chassis Mount w/switch

Connectors

Note - Strip headers may be supplied as a multi-pin strip that must be cut up.

( ) 1   CA-S4VSC-31B **(below)**   JP100
          1X4 Modular PCB Interconnect

( ) 1   CA-D20VSC-63B or 31B **(below)**   JP103
          2X10 Modular PCB Interconnect

( ) 2   CA-D50VSC-63B or 31B **(below)**JP101,JP102
          2X25 Modular PCB Interconnect

( ) 1   CA-S4VSC-83B **(below)**   JP205
          1X4 Modular PCB Interconnect

( ) 1   CA-D20VSC-83B **(below)**   JP203
          2X10 Modular PCB Interconnect

( ) 2   CA-D50VSC-83B **(below)**   JP201,JP202
          2X25 Modular PCB Interconnect

( ) 2   6 pin male header   P204, P202

( ) 3   3 pin male header   J100, JP204, JP206

( ) 9   2 pin male header   J103(1), J103(2), J101,
                                JP207, JP208, JP209,
                                JP210, JP211, JP212

( ) 1   HDR-20M (TNC I/O)   TNC
          Header 20-pin Male, Dual Row

( ) 2   8 Mini DIN   IO201, IO202
          8 Pin Mini-DIN Female PCB

( ) 1   DB9S PCB Conn.   P201
       Connector DB9S PC Mt. Right Angle

Resistors (1/4 w, 5%)

( ) 2   Res .22   R107, R210
        (red-red-silver-gold)

( ) 8   Res 120   R218, R219, R221,
       R222, R230, R231, R232, R233
        (brown-red-brown-gold)

( ) 1   Res 1M   R225
        (brown-black-green-gold)

( ) 1   Res 120K   R205
        (brown-red-yellow-gold)

( ) 1   Res 1.5K   R227
        (brown-green-red-gold)

( ) 2   Res 15K   R208, R203
        (brown-green-orange-gold)

( ) 1   Res 220   R105
        (red-red-brown-gold)

( ) 1   Res 20K   R211
        (red-black-orange-gold)

( ) 1   Res 240K   R204
        (red-yellow-yellow-gold)

( ) 2   Res 30K   R209, R207
        (orange-black-orange-gold)

( ) 3   Res 430   R101, R102, R103
        (yellow-orange-brown-gold)

( ) 2   Res 470   R220, R223
        (yellow-violet-brown-gold)

( ) 1   Res 470K   R201
        (yellow-violet-yellow-gold)

( ) 1   Res 51   R104
        (green-brown-black-gold)

( ) 1   Res 62K   R206
        (blue-red-orange-gold)

( ) 1   Res 10   R235
        (brown-black-black-gold)

( ) 2   Res 100K   R100, R228
        (brown-black-yellow-gold)

( ) 2   Res 10K   R226, R236
        (brown-black-orange-gold)

( ) 1   Res 1K   R229
        (brown-black-red-gold)

Integrated Circuits

ICs are inserted in anti-static foam. **Do not remove** them until they are called out in the construction steps that follow. ICs often contain many numbers, and the "core" number may have a prefix and/or a suffix. A 74HC14, for example, may be marked MC74HC14P or SN74HC14N.

( ) 4   71256S20TP   U104, U105, U108, U109
       32X8 Static RAM 20 nS

Note - *Static RAM chips to fill positions U106, U107, U110, and U111 are optional.*

( ) 2   MAX358CPA   U201, U203

( ) 1   MAX692ACPA   U116

( ) 1   145406   U211

( ) 2   GAL22V10A-15LNC   U112,U113

( ) 1   GAL16V8A-15LNC   U210

( ) 1   ST16550P (Startech Only!)   U212

( ) 1   78L05 VREG   VR203

( ) 1   LM386   U207

( ) 2   LM7805 TO220 VREG   VR100, VR201

( ) 1   LM7905 TO220 VREG   VR202

( ) 1   ULN2003A   U215

( ) 1   74ALS541   U213

( ) 3   74ALS573   U204, U206, U214

( ) 1   74S03   U115

( ) 1   74S112   U114

( ) 1   74S05   U205

( ) 1   74ALS245   U216

( ) 2   27C256-15 EPROM   U102,U103

( ) 2   TLC2272CP (8 pin dip)   U202, U209

( ) 1   TLC32044CN   U208

( ) 1   TMS320C25FNL (J-lead)   U101

I.C. Sockets

( ) 1	Socket 68 PLCC	Socket 68 pin PLCC
( ) 1	DIPS-406	DIP Socket 40-pin 0.6"
( ) 3	DIPS-286	DIP Socket 28-pin 0.6"
( ) 8	DIPS-283	DIP Socket 28-pin 0.3"
( ) 2	DIPS-243	DIP Socket 24 pin 0.3"
( ) 6	DIPS-203	DIP Socket 20-pin 0.3"
( ) 5	DIPS-163	DIP Socket 16-pin 0.3"
( ) 2	DIPS-143	DIP Socket 14-pin 0.3"
( ) 4	DIPS-083	DIP Socket 8-pin 0.3"

Miscellaneous

( ) 5	Red LED T1 3/4	L212, L213, L215, L216, L217
( ) 2	Yellow LED T1 3/4	L211, L214
( ) 1	Green LED T1 3/4	L218
( ) 2	Fuse Holders w/ 8AG 2A Fuse (a set) (Set contains two fuse holders and one fuse)	
( ) 2	Power Jack PCB Plug for AC P100, P203 10mm length, 5.5mm OD, 2.5mm ID RS274-1573A coxial power plug	
( ) 1	9 VAC 1.5 A Wall Transformer with Plug	
( ) 1	Pushbutton, Mom, N.O., Black SW1	
( ) 4	.8" by .250" Round Spacer PCB Spacers	
( ) 4	.25" by .250" Hex Spacer PCB Spacers	
( ) 22	4-40 Screws Mounting Screws	
( ) 2	4-40 Nuts Mounting Nuts	
( ) 4	#4 Lock Washer Mounting Lock Washers	
( ) 4	Rubber Feet for cabinet	
( ) 2	Heat Sink TO220 Heat Sink	
( ) 1	Small Knob Knob for R234	
( ) 1	Mini Jack 3.55mm stereo jack for Speaker	
( ) 1	DB25 to 20 pin IDC connector Pre-assembled DB25 connector to 20 Pin IDC	
( ) 1	Mounting hardware for DB25S	

( ) 1	10" length, 10-conductor ribbon cable
( ) 1	8-pin Mini-DIN Male-Male Cable for Radio Interfacing
( ) 1	BOARD ONE PCB DSP Engine Printed Circuit Board
( ) 1	BOARD TWO PCB Radio Interface Printed Circuit Board
( ) 1	CABINET (two plates, top, and bottom)
( ) 2	DISKS - Software Disks
( ) 2	DOCS Assembly Documentation Operations Documentation (What you are reading!)

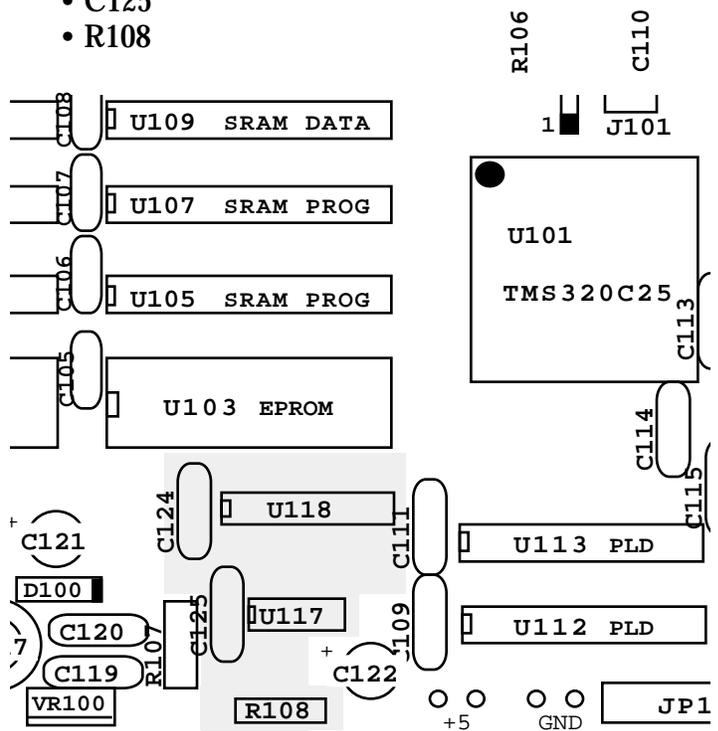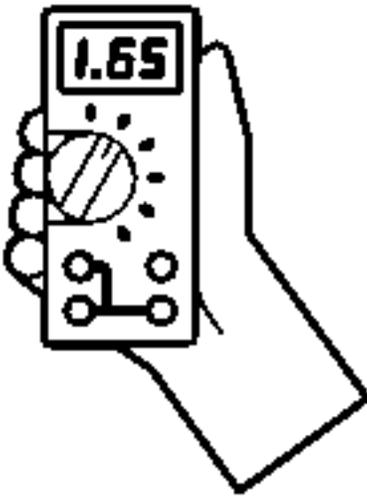## Components not Used in this Build

Several components on Board 1 will not be installed. These are planned for an option upgrade in 1995 to allow setup memory to be saved. The are of the option is shown below.

These components are:

- U118
- U117
- C124
- C125
- R108

WARNING !! - WARNING !!

**Be sure to read the following paragraphs carefully.
You must configure your DSP-93 properly or you may
cause your radio to go into a transmit mode after power up
or reset. If your radio is placed in transmit, it may burn
out a preamplifier or damage your radio. If you read and
understand the following information you will not have a
problem. These are <u>simple issues</u> which must be
considered when you allow external equipment to operate
your radio.**

The RADIO IO ports must be configured to a determined radio port control state at power up by
strapping certain lines on the DB25 "**Interface Port**" interfacing the TNC. The monitor code
checks the logical state of four lines after a power up or reset. The logical state of these lines will
establish the initial output condition of the lines which control your radio's push to talk line and the
external frequency shifter. It is suggested that you configure these lines with jumpers to +5 or
ground according to the requirements of your radio. Refer to your radio's manual for information
about how these signals will affect the radio's operation. In other words, do you ground your
radio's PTT input to key your radio or do you take it to plus five volts? After you have it wired,
test it with your equipment to be sure things are working as you expect. Remember, with
computers and so many things to connect properly it is easy to get something wrong and cause a
problem so **double check everything**.

The jumpers to configure the four radio control ports can be placed on a 20 pin header. This
header will then plug into the extra connector placed on the ribbon cable connecting the DB25
"Interface Port" and the 20 pin header on board two.

Refer to section "**IO Port Configuration Setup**" of this assembly manual or the Operations
Manual for more information.

It is also important to note that the DSP-93 (as well as most other radio modems) may cause
your transmitter to go into the transmit mode briefly when the DSP-93 is powered on and/or
powered off. This can occur even if the initializations lines referred to in the "Radio Port
Configuration Notice" are properly configured. **Take precautions so that your equipment
will not be damaged if this should occur.**

ШАRПIПG !!!

The long pins, on the Modular PCB interconnect sockets provided, are used to interconnect the two boards. Do not cut the pins on these sockets until you have completed the kit and thoroughly understand how it is assembled. It will be nearly impossible to replace these connectors if the wrong pins are cut. This kit production has different length connectors. BE SURE TO USE THE 83B (Longer Ones) on BOARD 2. Don't cut them until instructed!

Do not install any of the IC chips until all the board fabrication is completed. Sockets are provided for every IC. Do not use a socket for X101, the crystal oscillator module.

Figure 1 shows how the two board finally interconnect after assembly of the following instructions.

You need to be carefull when installing the interboard connectors and extra care is needed when handling the boards after they have been installed.

Figure 1:

Back

JP205   JP201

Board 2

JP202

JP203

LEDS

Front

DO NOT CUT BOARD 2
CONNECTOR PINS!
These PINS are used to connect to board 1 connectors.

Be sure to use the 83B connectors on Board 2. The 83B connectors are the **only ones** long enough to connect to Board 1 in this configuration.

See diagrams with connectors.

JP100   JP101

Board 1

JP102

JP103

BOARD 1 CONNECTOR PINS
WILL BE CUT LATER IN BUILD

Figure 2: Parts Placement Diagram

CONSTRUCTION
Board 1 (DSP Engine)

A parts placement diagram for both boards are shown in figure 2. Refer to these figures when looking for parts placement on the silkscreen.

The DSP-93 is built in two steps. Board 1 and Board 2. We will complete Board 1 and then move to Board 2. The PC board silkscreen legend shows the placement of all parts on the circuit board.

Pay particularly close attention to the resistor values - some may seem unclear as to color and value. Be very sure of value prior to installation. Use an ohmmeter if in doubt!

The PC board has four layers of metal with plated-through holes joining them. The center two layers are power and ground with almost 100% of the original copper still in place. The power and ground pads have some thermal inertia. These may require extra heating time while soldering. You should use a temperature-controlled soldering iron set at about 240C, fine 60/40 or 63/37 rosin core solder and painstaking care when making each and every joint. The reward will be a superior device of excellent reliability. The alternative will most likely be erratic operation. Keep the tip of your soldering iron bright and clean, wiping it frequently on a wet sponge. Make solder joints carefully, but swiftly. Each solder connection should take about five seconds maximum. Prolonged heat on a PC board pad or component can cause damage.

In addition to the soldering iron and solder, you will need small flush or semi-flush cutting pliers and small-tipped long nosed pliers. A magnifying glass may prove helpful to identify the values of the small components. A lead-bending jig will help maintain a neat appearance for the resistors and other axial-leaded parts.

If you exercise care, construction of this kit should take you just a few hours, depending on your experience. So, clear off your workbench, warm up your soldering iron, and enjoy!

IC SOCKETS

Check the PC Board and verify the exposed, tinned pads are clean and shiny. If they are not, scrub the board **lightly** with a household cleanser (such as "AJAX" or "COMET"), rinse with clean water, then dry with a clean soft towel.

( ) PC board is clean.

NOTE: The IC sockets are polarized, with the end nearest pin 1 marked with a notch, beveled corner or numeral 1 embossed in the body of the socket. When installing an IC socket, be sure all pins are through the PC board, then tack solder a diagonally opposite pair of pins. Double check that the socket is flush against the PC board surface and all pins are through, then solder the remaining pins. Finally, re-solder the original two tack-soldered pins.

Install the following IC sockets:

( ) U102   DIP Socket 28-pin 0.6"
( ) U104   DIP Socket 28-pin 0.3"
( ) U106   DIP Socket 28-pin 0.3"
( ) U108   DIP Socket 28-pin 0.3"
( ) U110   DIP Socket 28-pin 0.3"

( ) Check your solder joints.

( ) U103   DIP Socket 28-pin 0.6"
( ) U105   DIP Socket 28-pin 0.3"
( ) U107   DIP Socket 28-pin 0.3"
( ) U109   DIP Socket 28-pin 0.3"
( ) U111   DIP Socket 28-pin 0.3"

( ) Check your solder joints.

( ) U112   DIP Socket 24 pin 0.3"
( ) U113   DIP Socket 24 pin 0.3"
Note: You should install J100 (page 12) now.
( ) U114   DIP Socket 16-pin 0.3"
( ) U115   DIP Socket 14-pin 0.3"
( ) U116   DIP Socket 8-pin 0.3"

( ) Check your solder joints.

NOTE: Take extra care when placing the PLCC socket. The extra legs make it difficult to match the PCB in some cases. Mistakes with this socket are very hard to fix.

Be sure to orient the socket so the pin one mark or arrow points in the direction of the large white DOT. The dot is located near the corner of the socket which has a small flat. The DSP chip will only fit in the socket one way and the socket must be oriented properly.

( ) U101   Socket 68 pin PLCC

Solder connections should appear bright and shiny, with a concave fillet between the PC board pad and the socket pin. Gray, grainy-looking joints, round solder blobs or pads not completely and evenly covered with solder will result in an unreliable joint. These joints should be re-soldered, using a good grade of rosin-core flux to ensure the joint is clean and that the solder adheres.

Now, double check the solder connections that you have made. Look for solder that has wicked between two pins; this is a common problem. Also, make sure you soldered every pin.

( ) Solder joints OK.

RESISTORS

Discrete resistors have color-coded bands denoting their value. The color code will be given in each step to aid you in identifying the value. If you have any doubt about a resistor's value, we suggest that you measure it with an ohmmeter before you install it. We have tried to limit the number of different values, but it is better to be careful than to try and remove and reinstall a resistor on a plated-through-hole PC board!

When installing discrete resistors, bend the leads and then insert the resistor so that its body is flush with the PC board surface. Then bend the leads slightly to secure it in place. If you are using a lead-bending jig, most of the resistor leads are on 0.5" (12.7 mm) centers. After placing a number of resistors, you will be instructed to solder the leads

and clip the excess lead lengths. At that time a count of solder joints will be given as an aid to ensure you don't overlook a lead or two. Again, be sure of the component before you solder it on the board.

Install the following resistors (1/4 watt, 5%, values in ohms):

( ) R100   100K   (brown-black-yellow-gold)

( ) R101   430   (yellow-orange-brown-gold)

( ) R102   430   (yellow-orange-brown-gold)

( ) R103   430   (yellow-orange-brown-gold)

( ) R104   51   (green-brown-black-gold)

( ) R105   220   (red-red-brown-gold)

( ) R107   0.22   (red-red-silver-gold)

( ) Solder and clip fourteen (14) leads.

Carefully inspect the board for any poor solder joints, and correct any that you find.

( ) All solder connections look simply wonderful!

Resistor, SIP Network
The next part is a resistor SIP network. This is a polarized part. When installing the SIPs, tack solder the two end pins, verify the SIP's position against the PC board and make sure it is straight up and down, then solder the remaining pins. Finally, resolder the two end pins.

NOTE: The end of the part with the dot, stripe, or notch is pin 1 and goes into the square hole on the PC Board. This will result in Pin 1 being next to the PLCC socket.

( ) R106   4310R-101-104   (near U101)

CAPACITORS

The next components to be installed are capacitors. These come in monolithic radial-leaded devices that are non-polarized, and electrolytic radial-leaded devices that are polarized. You will first install the non-polarized parts.

NOTE: On Board One (Digital Board) the square pad of the capacitator pads is the + lead.

Capacitors, Ceramic, Monolithic
These parts should be mounted close to the top surface of the PC board. You will be instructed when to solder, so just install parts and secure by bending leads out about 30 degrees. You may need to straighten or bend some leads to make them fit the PC board hole spacings.

Install the following capacitors:

( ) C100   0.1 uF   (104)
( ) C101   0.1 uF   (104)
( ) C102   0.1 uF   (104)
( ) C103   0.1 uF   (104)
( ) C104   0.1 uF   (104)

( ) Solder and clip ten (10) leads.

( ) C105   0.1 uF   (104)
( ) C106   0.1 uF   (104)
( ) C107   0.1 uF   (104)
( ) C108   0.1 uF   (104)
( ) C112   0.1 uF   (104)

( ) Solder and clip ten (10) leads.

( ) C109   0.1 uF   (104)
( ) C111   0.1 uF   (104)
( ) C115   0.1 uF   (104)
( ) C114   0.1 uF   (104)
( ) C113   0.1 uF   (104)
( ) C110   0.1 uF   (104)

( ) Solder and clip twelve (12) leads.

( ) C118   0.1 uF   (104)
( ) C119   0.1 uF   (104)
( ) C120   0.1 uF   (104)
( ) C123   0.1 uF   (104)

( ) Solder and clip eight (8) leads.

Capacitors, Electrolytic
Now place the two electrolytic radial-leaded capacitors on the board and bend out the leads. Pay attention to the polarity orientation. The negative side is marked on the capacitor and the positive hole is marked on the PC. If you get this wrong the capacitors will pop open when power is applied and you may get some of the electrolyte in your eye. Make sure the capacitors are down against the PC all the way. We need all the clearance we can get above them for the analog board.

( ) C116   1000 uF   Electrolytic Capacitor
( ) C117   1000 uF   Electrolytic Capacitor

( ) Solder and clip four (4) leads.

NOTE: Capacitors C121 and C122 are optional and are only required if additional filtering is needed. **These parts are not included.** *It is suggested that 1000uF 16V radial caps be used for these if needed. Be carefull as to the height restriction between boards.*

REMAINING COMPONENTS

You will now be instructed to install the remaining parts on the PC board. Some of these parts are polarized, so continue to pay careful attention to the directions.

Diode

Diodes are polarity sensitive. Diodes are mounted flat near the surface of the board like the resistors previously installed. The cathode end of the diode is banded, and corresponds to the banded silkscreen legend on the PCB. Match the part number of the diode to the callout before soldering.

Install the following diode:

( ) D100   1N4003 or 1N4002   General Diode

Male Headers

The male headers will be installed next. The plastic body of this part should rest flush with the top surface of the PC board. The short end of the pins goes into the PC board, the long end sticks up.

NOTE: Do not solder the pin that you are holding with your finger! The pins quickly get very hot and you may injure yourself!

After you tack-solder the header in place, inspect it for mechanical placement and appearance. It should sit firmly against the surface of the PC board. If it necessary, re-heat the tacked joint(s) and re-position the part until you are satisfied with it. Then solder the remaining pins. Finally, re-solder the tack-soldered connection(s).

( ) J101   2 pin Male Header
( ) J103 (1)   2 pin Male Header
( ) J103 (2)   2 pin Male Header

( ) J100   3 pin Male Header

Modular Interconnect Headers

The next group of Modular PCB Interconnect headers will interface with headers on the analog board after assembly. You want to be sure you have these headers all nice and flat against the PC when you solder all the pins. Otherwise, it will be more difficult to match up the pins and the plug holes later. **See figure 1 at the first of this document to see how these interconnect headers are used.**

NOTE: The following connectors are the SHORTER ones (31B, 63B). Be sure you have the correct connectors for BOARD 1. Board 2 uses the longer ones.

NOTE - Leave the leads extending below the board at full length for now. **Do not clip yet!**

( ) JP100   31B - 1X4   Modular PCB Interconnect
( ) JP101   63B - 2X25 Modular PCB Interconnect
( ) JP102   63 B - 2X25 Modular PCB Interconnect
( ) JP103   63B - 2X10 Modular PCB Interconnect

( )   Inspect the solder connections and repair any that aren't perfect.

FUSE

Two fuse clips will need to be soldered in the board for the FUSE.

NOTE: Each clip has a set of guide projections on one side; these should be oriented away from each other on the circuit board. The fuse fits between these projections. If you solder the fuse holder backwards, you will not be able to insert the fuse.

Solder them one at a time but do your best to line them up. You may want to look for something about the size of the fuse to place in the clips. Do not use the fuse - you may melt the fuse wire.

( )   Fuse Holder Clips for PCB

( )   Fuse   8AG   2A FUSE

Power Jack

NOTE: P100 is used for initial power test of board 1, after that it is not used, unless the builder has problems attaining the proper supply voltages. This problem is rare and only exist in areas that use 50 cycles AC or maintain line voltages less than 110 VAC. P100 was provided as a connection point if the user is required to build his/her own external power supply.

Solder in a coaxial AC power jack at position P100. Take care to place the jack flat against the PC.

( ) P100 AC Jack   Black three pin jack

Jumpers

Jumpers are formed from the clipped leads of the installed resistors or capacitors. Form a lead into a loop of about 1/4" diameter (wrap one loop around a 1/4" diameter drill bit or similar item). The loop should stick up from the PC board. These are used as test points.

( ) +5   near U112
( ) GND   near U112
( ) GND   near U110

The DSP Board 1 is nearly complete. Every part (except C121, C122, J100, and J101, which are not used) should be installed except the integrated circuits, oscillator X101, and the voltage regulator. These will be installed shortly. At this point, you should take a break for at least five or ten minutes and relax.

( ) Break

Now that you are back, you need to perform a careful inspection of the PC board. Once again inspect each of the solder connections. We cannot over-emphasize the importance of these connections.

( ) All solder joints inspected and look great to me!

You also need to carefully inspect the top of the board in case some solder accidentally found its way through the holes and flowed to cause a short circuit somewhere. Or, perhaps a component got damaged while work was proceeding elsewhere on the board. It is better to find and fix all such problems now.

( ) This board is inspected and looks good.

Voltage Regulator

The voltage regulator is mounted vertically on the PCB and will have a heat sink attached. The orientation of the tab on the regulator is shown in the silk screening on the PCB.

( ) VR100   LM7805 TO220 VREG

NOTE: Be certain the tab is oriented properly. Later removal is difficult. The regulator tab faces towards the edge (outwards) of the PCB. See silk-screen.

( ) Pass a #4-40 screw through the regulator tab and the heat sink. The heat sink fins point away from the edge of the board.

( ) Place a #4 lockwasher on the end of the screw.

( ) Fasten a #4-40 nut on the screw and tighten snugly.

( ) Solder the three leads from the regulator to the PC board.

( ) Clip off the excess lead length.

Board 1 Temporary Power Jumper

Two holes near the lower left corner of the printed circuit board labeled "S2" are provided for an optional power switch. To power board one as a test, use a short piece of wire as a temporary jumper. You will remove this after testing, since S2 on board 2 will be used to connect to the permanent power switch.

Transformer Plug Size

Before plugging the supplied AC wall transformer into an energized outlet, check to see that the coaxial plug properly mates with the jack at J100. If it does not, cut off the plug at the end of the wire and install a proper size coaxial plug.

Board 1 Initial Check

( ) Check to make sure that the board to be powered is not shorting any of the connector pins. The board should be lying on a non-conductive surface.

Plug your wall transformer into the wall. Connect the small plug to the AC connector on the digital board. If the fuse blows you have a problem. If it does not and nothing smokes, use a voltmeter to check the voltages at a few points on the board. Check it between the +5 and GND loops you installed. If you get +5.0 ±0.1 volts you doing great! If not, remove the plug and start troubleshooting the board.

Reinspect your solder joints looking for shorts and opens. Look for missing components. **Do not install ICs until this problem is corrected.**

( ) 5 volts present between +5 and GND loops.

( ) Check to see if you have 5 volts between pins 14 and 28 of the 28 pin sockets.

( ) **Remove power and disconnect the voltmeter.**

Clock Oscillator

It is now time to install the 40 MHz crystal oscillator at position X101. Note that the silver oscillator package has four protruding leads, which line up with the four holes at the X101 position on the board. Be careful to orient the oscillator properly: The lead closest to the square corner on the oscillator case (and/or the black dot stamped on top of the oscillator case) is installed through the hole with the square pad (near the round on the silkscreen). Refer to the positioning also shown on the parts placement diagram. Push the oscillator into the holes so it rests on the top surface of the board and solder the four wires. **Double check the positioning**. After soldering, clip four leads.

( )   X101   40 MHz Clock Oscillator

Integrated Circuits

Its now time to install the ICs. Observing static handling precautions (see comments at the front of the manual):

NOTE: Confirm the location of pin one on each part with a printed label, the labels are not necessarily in the same orientation as the chip. Also, if the label obscures the reference notch, double check the reference of the chip. The parts placement diagram shows placement in reference to the chip notch. You can burn out ICs but plugging them in the wrong orientation. Take extra care here, since several of the chips are very expensive.

( ) U102   27C256 EPROM   Labeled U102
( ) U103   27C256 EPROM   Labeled U103
( ) U112   GAL22V10A-10LNC Labeled U112
( ) U113   GAL22V10A-10LNC Labeled U113
( ) U114   74S112
( ) U116   MAX692ACPA
( ) U115   74S03   IC 74S03

Now install the static RAM chips. Be sure to put them in their designated sockets, as shown below. You will only be installing one half of the possible memory.

Be sure to put pin one in the proper location.

Figure of the Board with the SRAM shadowed!

( ) U104   71256S20TP 32X8 Static RAM 20 nS
( ) U105   71256S20TP 32X8 Static RAM 20 nS
( ) U108   71256S20TP 32X8 Static RAM 20 nS
( ) U109   71256S20TP 32X8 Static RAM 20 nS

Finally, install the DSP chip. Remove it from its foil shipping wrapper and orient it in the socket at U101 so that the beveled corner is nearest the large hashed dot silkscreened on the board. **Carefully** press it into the socket until it seats properly. Again, **CAREFULLY** press it in!

( ) U101   TMS320C25FNL Plastic J-Lead

( ) Verify that all the ICs are correctly oriented and that no leads are bent under the body of a chip or hanging over the side of a socket.

Jumper Settings

( )   Remove the S2 power jumper.

Board 1 is now completed. Set it aside until you complete construction of Board 2.

With Board 1 complete, now would be a great time to take another break. Builders have discovered that stopping an starting again the next day produces the best results. So, don't rush -- wait will tomorrow.

CONSTRUCTION

Board 2 (Radio/Computer Interface)

We will now complete Board 2. The PC board silkscreen legend shows the placement of all parts on the circuit board. Pay particularly close attention to the resistor values - some may seem unclear as to color and value. Be very sure of value prior to installation. Use an ohmmeter if in doubt! **A parts placement diagram for both boards are shown in figure 2.** Refer to these figures when looking for parts placement on the silkscreen.

IC SOCKETS

Check the PC Board and verify that the exposed, tinned pads are clean and shiny. If they are not, scrub the board **lightly** with a household cleanser (such as "AJAX" or "COMET"), rinse with clean water, then dry with a clean soft towel.

( ) PC board is clean.

NOTE: The IC sockets are polarized, with the end nearest pin 1 marked with a notch, beveled corner or numeral 1 embossed in the body of the socket. When installing an IC socket, be sure all pins are through the PC board, then tack solder a diagonally opposite pair of pins. Double check that the socket is flush against the PC board surface and that all pins are through, then solder the remaining pins. Finally, re-solder the original two tack-soldered pins.

Install the following IC sockets:

( ) U205   DIP Socket 14-pin 0.3"
( ) U211   DIP Socket 16-pin 0.3"
( ) U216   DIP Socket 20-pin 0.3"
( ) Check your solder joints.

( ) U202   DIP Socket 08-pin 0.3"
( ) U203   DIP Socket 16-pin 0.3"
( ) U204   DIP Socket 20-pin 0.3"
( ) U206   DIP Socket 20-pin 0.3"
( ) Check your solder joints.

( ) U209   DIP Socket 08-pin 0.3"
( ) U201   DIP Socket 16-pin 0.3"
( ) U212   DIP Socket 40-pin 0.6"
( ) Check your solder joints.

( ) U208   DIP Socket 28-pin 0.6"
( ) U207   DIP Socket 08-pin 0.3"
( ) U215   DIP Socket 16-pin 0.3"
( ) U210   DIP Socket 20-pin 0.3"
( ) U214   DIP Socket 20-pin 0.3"
( ) U213   DIP Socket 20-pin 0.3"
( ) Check your solder joints.

Solder connections should appear bright and shiny, with a concave fillet between the PC board pad and the socket pin. Gray, grainy-looking joints, round solder blobs or pads not completely and evenly covered with solder will result in an unreliable joint. These joints should be re-soldered, using a good grade of rosin-core flux to ensure the joint is clean and that the solder adheres.

Now, double check the solder connections you have made. Look for solder bridges between pins.

( ) Solder joints OK.

Take this opportunity to verify that there are no leftover IC sockets. If there are, make sure you have gotten all the sockets installed. There is a possibility that your kit was shipped with extra components by mistake.

RESISTORS

Discrete resistors have color-coded bands denoting their value. The color code will be given in each step to aid you in identifying the value. If you have any doubt about a resistor's value, we suggest you measure it with an ohmmeter before you install it. We have tried to limit the number of different values, but it is better to be careful than to try and remove and reinstall a resistor on a plated-through-hole PC board!

When installing discrete resistors, bend the leads and then insert the resistor so that its body is flush with the PC board surface. Then bend the leads slightly to secure it in place. After placing a number of resistors, you will be instructed to solder the leads and clip the excess lead lengths. At that time a count of solder joints will be given as an aid to ensure you don't overlook a lead or two. Again, be sure of the component before you solder it on the board.

Install the following resistors (1/4 watt, 5%, values in ohms):

( ) R229   1K   (brown-black-red-gold)
( ) R210   0.22   (red-red-silver-gold)
( ) R211   20K   (red-black-orange-gold)
( ) R204   240K   (red-yellow-yellow-gold)
( ) R201   470K   (yellow-violet-yellow-gold)

( ) Solder and clip ten (10) leads.

( ) R203   15K   (brown-green-orange-gold)
( ) R226   10K   (brown-black-orange-gold)
( ) R227   1.5K   (brown-green-red-gold)
( ) R228   100K   (brown-black-yellow-gold)
( ) R209   30K   (orange-black-orange-gold)

( ) Solder and clip ten (10) leads.

( ) R205   120K   (brown-red-yellow-gold)
( ) R206   62K   (blue-red-orange-gold)
( ) R207   30K   (orange-black-orange-gold)
( ) R208   15K   (brown-green-orange-gold)
( ) R225   1M   (brown-black-green-gold)

( ) Solder and clip ten (10) leads.

( ) R235   10   (brown-black-black-gold)
( ) R219   120   (brown-red-brown-gold)
( ) R218   120   (brown-red-brown-gold)
( ) R221   120   (brown-red-brown-gold)
( ) R222   120   (brown-red-brown-gold)

( ) Solder and clip ten (10) leads.

( ) R232   120   (brown-red-brown-gold)
( ) R231   120   (brown-red-brown-gold)
( ) R230   120   (brown-red-brown-gold)
( ) R233   120   (brown-red-brown-gold)
( ) R236   10K   (brown-black-orange-gold)
( ) R220   470   (yellow-violet-brown-gold)
( ) R223   470   (yellow-violet-brown-gold)

( ) Solder and clip twelve (12) leads.

Carefully inspect the board for any poor solder joints, and correct any that you find.

( ) All solder connections look simply wonderful!

Resistor, SIP Network

The next part is a resistor SIP network. This is a polarized part. The end of the part with the dot or stripe is pin 1 and goes into the marked silkscreened hole or square solder pad. In this case the pin one hole is closer to the center of the PC board.

When installing the SIP, tack solder the two end pins, and verify the SIP's position against the PC board. Make sure the SIP package is straight up and down on the board. Now solder the remaining pins. Finally, resolder the two end pins.

( ) R217   47K ohm (473)   install near U205

Resistor, Variable

The next parts are variable resistors. These resistors are not polarized, but the end of the part with the adjusting screw should match the silkscreen pattern on the PC board.

When installing the POTs, tack solder the center pin, verify the POT's position against the PC board, then solder the remaining pins. Finally, resolder the center pin.

( ) R213   1K POT   Pot Bourns 3299W-1-102

( ) R216   25K POT   Pot Bourns 3299W-1-253

( ) R214   1K POT   Pot Bourns 3299W-1-102

( ) R215   25K POT   Pot Bourns 3299W-1-253

( )   You should have only one remaining variable resistor, the chassis-mounted volume control. It will be installed later.

CAPACITORS

The next components to be installed are capacitors. These come in ceramic monolithic radial-leaded devices that are non-polarized, and electrolytic radial-leaded devices that are polarized. You will first install the ceramic, non-polarized parts.

NOTE: In most cases on Board Two the square pad of the capacitator pads is the + lead, except for C211 and C210, which are nonpolarized capacitors. So the orientation to these capacitors is not critical.

Capacitors, Ceramic, Monolithic

These parts should be mounted close to the top surface of the PC board. You will be instructed when to solder, so just install parts and secure by bending leads until then. You may need to straighten or bend some leads to make them fit the PC board hole spacings.

Install the following Capacitors:

( ) C215   0.1 uF   (104)

( ) C221   0.1 uF   (104)

( ) Solder and clip four (4) leads.

( ) C225   0.1 uF   (104)

( ) C217   0.1 uF   (104)

( ) C238   0.1 uF   (104)

( ) C219   0.1 uF   (104)

( ) C227   0.1 uF   (104)

( ) C223   0.1 uF   (104)

( ) Solder and clip twelve (12) leads.

( ) C207   22 pF   (22J)

( ) C214   1.0 uF   (105)

( ) C208   0.22 uF   (224)

( ) C209   0.22 uF   (224)

( ) Solder and clip eight (8) leads.

( ) C211   0.47 uF   (474)

( ) C210   0.22 uF   (224)

( ) C234   0.1 uF   (104)

( ) C237   0.047 uF   (473)

( ) Solder and clip eight (8) leads.

( ) C212   22 pF   (22J)

( ) C213   47 pF   (47)

( ) C218   0.1 uF   (104)

( ) C220   0.1 uF   (104)

( ) C228   0.1 uF   (104)

( ) Solder and clip ten (10) leads.

You should have no nonpolarized capacitors remaining to be installed.

( ) All ceramic capacitors have been used.

Polarized Capacitors

The next components you will install are the polarized capacitors. These may be aluminum electrolytic or tantalum type.

Electrolytic capacitors are cylindrical with radial leads (meaning both leads come out of one end). The negative lead is usually marked with a black band filled with minus signs. In addition, this lead is usually shorter than the positive one.

Tantalum capacitors, in addition to having incredibly small, hard to read print, mark the positive lead with little plus signs on one side of the part. Tantalums are usually a sort-of teardrop shape.

The PC board silkscreen has most of the components marked with a plus (+) sign near the positive lead. Additionally, the positive lead solder pad is square. **Refer to the parts placement diagram for placement.**

Be sure to get the positive lead in the square pad, no matter which type of part you are installing.

Install the following Polarized Capacitors:

( ) C224   1000 uF   Electrolytic Capacitor
( ) C226   1000 uF   Electrolytic Capacitor
( ) C232   1000 uF   Electrolytic Capacitor
( ) C229   1000 uF   Electrolytic Capacitor
( ) C236   100 uF   (107)

( )   Check placement, then solder and clip ten (10) leads.

( ) C216   4.7 uF   (475)
( ) C222   4.7 uF   (475)

( )   Check placement, then solder and clip four (4) leads.

( ) C203   10 uF   (106)
( ) C206   10 uF   (106)
( ) C202   10 uF   (106)
( ) C205   10 uF   (106)
( ) C204   10 uF   (106)
( ) C233   10 uF   (106)

( )   Check placement ,Solder and clip twelve (12) leads.

( )   All polarized capacitors look good well installed.

REMAINING COMPONENTS

You will now be instructed to install the remaining parts on the PC board. Some of these parts are polarized, so continue to pay careful attention to the directions.

Diodes

Diodes are polarity sensitive. Diodes are mounted flat near the surface of the board like the resistors previously installed. The cathode end of the diode is banded, and corresponds to the banded silkscreen legend on the PCB. The two diode types used are similar in appearance, so match the part number of the diode to the callout before soldering.

Install the following diodes:

( ) D203   1N4003 or 1N4002   General Diode
( ) D204   1N4003 or 1N4002   General Diode
( ) D205   1N5817   Fast Recovery Diode
( ) D206   1N4003 or 1N4002   General Diode
( ) D201   HSCH1001 or 1N5817
( ) D202   HSCH1001 or 1N5817

( ) Solder and clip twelve (12) leads.

( ) All diodes are correctly installed.

Male Headers

The male headers will next be installed. The plastic body of the part should rest flush with the top surface of the PC board. The short end of the pins goes into the PC board, the long end sticks up.

NOTE: Do not solder the pin which you are holding with your finger! The pins quickly get very hot and you may injure yourself!

NOTE: With the larger sockets, it is easier to insert starting on one side and then work with a small pliers in order to get the other legs into the holes. Be careful not to bend the leads. Take your time and they will fit in. If you get frustrated, take a break and then have another try.

After you tack-solder the header in place, inspect it for mechanical placement and appearance. It should sit firmly against the surface of the PC board and rise perpendicularly from it. If it doesn't, re-heat the tacked joint(s) and re-position the part until you are satisfied with it. Then solder the remaining pins. Finally, re-solder the tack-soldered connection(s).

The first header is marked on the board as TNC and is located between U213 and U214 on the PC board (however, the U213 and U214 sockets already installed cover the U213 and U214 silkscreen markings). So, **refer to the parts placement guide!**

NOTE: The TNC header **is not** a modular interboard connector, but a standard 20 pin (2x10) male header used for TNC-2 headers.
Make sure you don't use one of the interboard connectors here !!!!

( ) TNC   2X10HDR-20M
                Header 20-pin Male, Dual Row

Next, install the single row strip headers in a similar fashion. **Note**: Strip headers may be supplied as a multi-pin strip that must be cut up.

( )   JP207   2 Pin Male Header (near U212)

( )   JP208   2 Pin Male Header

( )   JP209   2 Pin Male Header

( )   JP210   2 Pin Male Header

( )   JP211   2 Pin Male Header

( )   JP212   2 Pin Male Header (near IO202)

( )   JP204   3 Pin Male Header

( )   JP206   3 Pin Male Header

( )   P202   6 Pin Male Header

( )   P204   6 Pin Male Header

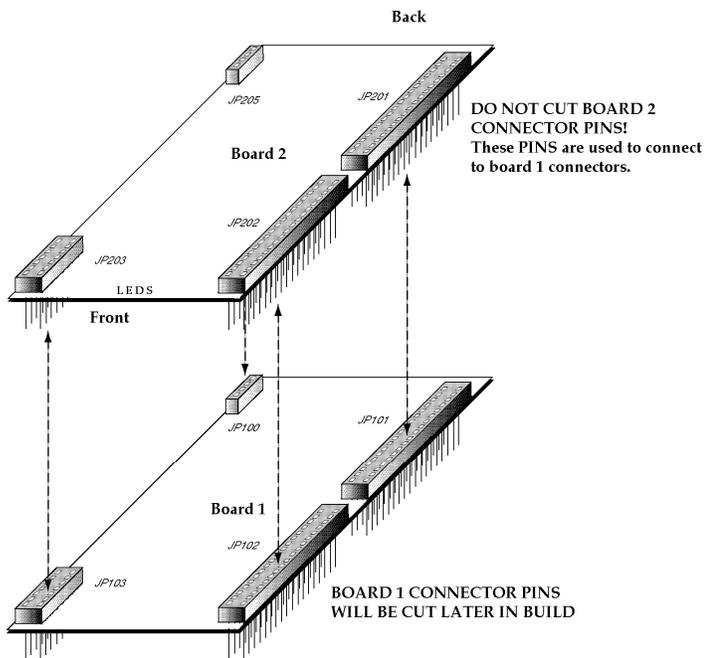( )   Inspect the solder connections and repair any that aren't perfect.

Modular Interconnect Headers

The next group of Modular PCB Interconnect headers will interface with headers on Board 1 after assembly. You want to be sure you have these headers nice and flat against the PC before you solder all the pins. Otherwise it will be more difficult to match up the pins and the plug holes later.

To make sure everything lines up, you may want to put the pins through the PC board, then stack the boards and plug each connector into the mating Board 1 connector. While it is plugged in, you can tack solder the corner pins and a few other pins. Then unplug Board 1 and solder the remaining pins. Be sure not to get any solder in the connector to pin mating area. Only solder the pad and pin egress area.

NOTE: Use the LONGER connectors as shown in the included page. The 83B connectors are long enough to allow the two boards to be interconnected.

Figure 1 shows a view of these connectors.

( ) JP201   83B - 2X25 Modular PCB Interconnect

( ) JP202   83B - 2X25 Modular PCB Interconnect

( ) JP203   83B - 2X10 Modular PCB Interconnect

( ) JP205   83B - 1X4 Modular PCB Interconnect

Crystal

NOTE: Some crystals will not have a long enough lead to be soldered into the PCB. If this is the case, soldered a 1" piece of lead (from a previous resistor or cap) in the hole provide for crystal mounting. Then form the wire flat down on the PCB so the crystal will rest near the PCB surface but on the wire. Next form the crystal leads so they will go into the proper holes. Now soldered the crystal leads. Next form the short wire up and over the back end of the crystal and then soldered it to the can trim off any excess wire. Be careful not to overheat the crystal, since overheating can ruin it.

The crystal should lay flat (on its side) against the surface of the PC board. Do not bend the leads sharply at the body of the crystal. Instead, form a large radius curve with the leads to act as a strain relief.

( ) X201   Crystal   4.9152 MHz

Other Items

Two fuse clips will need to be soldered in the board for the FUSE. Note that each clip has a set of guide projections on one side; these should be oriented away from each other on the circuit board. Solder them one at a time but do your best to line them up. You may want to look for something about the size of the fuse to place in the clips. Do not use the fuse - you may melt the fuse wire.

( )   Fuse Holder Clips   Fuse Holders For PCB
( )   Fuse   8AG 2A FUSE

Solder in a coaxial AC power jack at position P203. Take care to place the jack flat against the PC.

( ) P203AC Jack   Black three pin jack

Now install the right-angle DB9 connector at P201.

( )   P201   Connector DB9S PC Mount Right Angle. If you have solderable mounting tangs be sure to solder these tangs of the DB9 connector in the mounting holes. This will give the DB9 better mechanical support.

Next mount the two mini-DIN jack radio connectors. Press each firmly against the board and tack solder the mounting pins. After you have verified that the connector is straight, solder the terminal pins and then resolder the mounting pins.
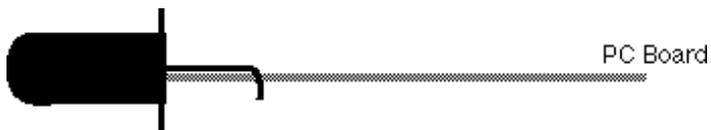
( ) IO201   RADIO 1 (8 pin mini-DIN)

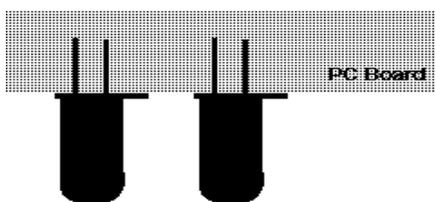( ) IO202   RADIO 2 (8 pin mini-DIN)

LED Displays
The LED displays will protrude through the front of the DSP-93 cabinet. Therefore, they must be mounted flush with the end edge of the board. Be sure to orient the flat on the package as shown on the silk pattern. See the following figures on how to mount them.

LED Assembly Drawings:
Edge View

Top View

NOTE: The LED flats are small and hard to see. It is good to double check this. The bend required for the LEDs to fit on the board is made about where the marking crimp's are on the leads.

Bend the leads of the LEDs so the leads will fit in the holes and the edge of the flange will be flush with the edge of the PC board. Then place the leads of the LEDs in the holes.

( ) L211   Yellow LED For Indicator Light

( ) L212   Red LED For Indicator Light

( ) L213   Red LED For Indicator Light

( ) L214   Yellow LED For Indicator Light

( ) L215   Red LED For Indicator Light

( ) L216   Red LED For Indicator Light

( ) L217   Red LED For Indicator Light

( ) L218   Green LED For Indicator Light

( ) Solder and clip sixteen (16) leads.

Voltage Regulator
The voltage regulators are mounted vertically on the PCB and the 5 volt digital regulator will have a heat sink attached. The orientation of the tab on each regulator is shown in the silk screening on the PCB.

NOTE: the +5 Volt digital regulator tab faces towards the edge of the PCB and the -5 Volt digital faces in toward the board. They are opposing each other to reduce the possibility of a short between the tabs.

( )   VR202   LM7905 TO220 VREG

( )   Solder the three leads from the regulator to the PC board, then clip off the excess lead length.

If a TO92-type (small plastic transistor) package is supplied for VR203, the flat side of the package should be turned to match the tab location shown on the silk screen pattern on the PC board.

( )   VR203   LM78L05 VREG

( )   Solder the three leads from the regulator to the PC board, then clip off the excess lead length.

Now install the heat sink on VR201:

( )   Pass a #4-40 screw through the regulator tab and the heat sink. The heat sink fins point away from the edge of the board.

( )   Place a #4 lock washer on the end of the screw.

( )   Fasten a #4-40 nut on the screw and tighten snugly.

( )   VR201   LM7805 TO220 VREG

( )   Solder the three leads from the regulator to the PC board, then clip off the excess lead length.

Jumpers
Jumpers are formed from the clipped leads of the installed resistors or capacitors. Form a lead into a loop of about 1/8" diameter (wrap one loop around a 1/8" diameter drill bit or similar item). The loop should stick up from the PC board. These are used as test points.

( )   +5   near JP201
( )   GND   near JP201
( )   +5   near JP203
( )   GND   near JP203

Power Switch

The power switch is part of the volume control that is a chassis mount pot that is mounted on the front of the enclosure. See the volume/power pot figure below. Two holes near the back left corner of the analog (Board 2) printed circuit board labeled "S2" are provided for the power switch. Two short lengths of wire (approximately 26 AWG) about 8-10 inches long will be needed to interface with the power switch, which is part of the volume pot. You may use part of the supplied 10-wire ribbon cable to obtain these wires.

Cut and strip the wires on each end. Solder one end of each wire in the two holes labeled "S2" near the back left corner of the board. Connect the other end of these wires to the "S" solder lugs on the volume/power pot as shown below.

NOTE: there is an S2 on both boards. Use the analog (board 2) for the connection. The S2 jumper on BOARD 1 should have already be removed. You only need to connect one set up in order to power both supplies. Later instructions assume that the switch is on board 2.

( ) Connect the wires from "S2" to the two terminals labeled "S" on the following figure. It does not matter which wire connects to which terminal.
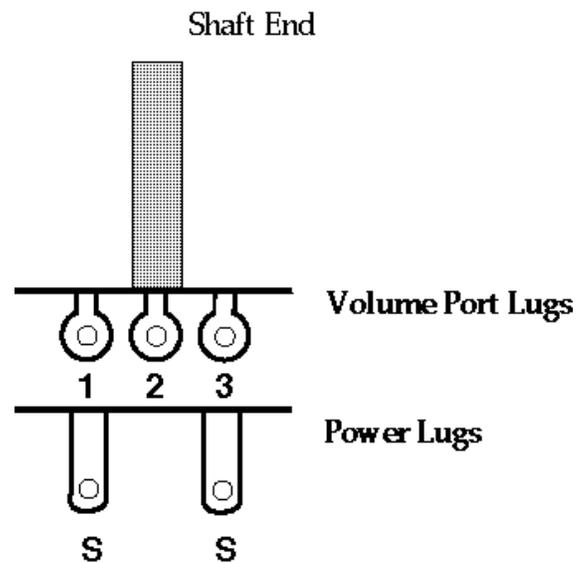
Volume Control

The volume control is a chassis mount pot that is mounted on the front of the enclosure. It will be connected with three six-inch conductors of the 10-conductor ribbon cable provided. Strip off a set of three conductors and strip the ends. Solder three leads on one end of the ribbon cable in the holes provided for R234.

( ) You may need to snap off or bend the anti-rotational tab of the pot when installing it, so that it fits flat aginst the front panel.

( ) Connect the center conductor of the three wire ribbon cable from R234 to terminal 2.

( ) Connect the wire from the square pad (towards the front of the PCB next to the dot) of R234 to terminal 1 (square pad)

( ) Connect the remaining wire to terminal 3.

Figure of Volume/Power Pot
View of the volume pot with the terminals on top.

Speaker Jack

This item is a 3.55mm mini stereo jack that will be mounted on the rear enclosure panel. It will be connected with two ten-inch conductors of the 10-conductor ribbon cable provided. Strip off a pair of conductors (two) and strip the insulation back on both ends.

( ) Solder two leads on one end of the ribbon cable in the holes labeled "SPK," located near the front left corner of Board 2.

( ) On the other end of the wires, connect the grounded wire to the shield terminal (ground) of the mini jack (see figure 2).

( ) Connect the other wire to the terminal that would make contact with the tip of a mating mini plug. If you wish, you can tie ring and tip together to provide output on both channels. **NOTE**: Wiring ring and tip together can cause problems with mono plugs.

Reset Button

Two short lengths of wire (approximately 26 AWG) about four inches long will be needed to interface with the reset button. You may use part of the supplied 10-wire ribbon cable to obtain these wires. Cut and strip the wire on each end. Solder one end of each wire in the two holes located next to the word RESET near the upper right corner of board one (1). Connect the other end of these wires to the back of the push button switch. This is your RESET button.

( ) SW1   Pushbutton, Mom, N.O.

The DSP-93 is nearly complete. Every part should be installed except the integrated circuits. These will be installed shortly. At this point, you should take a break for at least five or ten minutes and relax.

( ) Break taken, I'm ready to continue!

Now that you are back, you need to perform a careful inspection of the PC board. Once again inspect each of the solder connections, preferably with a magnifying glass. We cannot over-emphasize the importance of good connections.

( ) All solder joints inspected and look great to me!

You also need to inspect carefully the top of the board in case some solder accidentally found its way through the holes and flowed to cause a short circuit somewhere. Or, perhaps a component got damaged while work was proceeding elsewhere on the board. It is better to find and fix all such problems now.

( ) This board is inspected and looks good.

Board 2 Initial Check

( ) Check to make sure that the board to be powered is not shorting any of the connector pins. The board should be lying on a non-conductive surface.

Plug your wall transformer into the wall outlet. Connect the small plug to P203 on Board 2. If the fuse blows, you have a problem. Since you have wired the power switch in, you will have to use it to power the board. If it does not and nothing smokes, observe that just Power LED illuminates. Then use a voltmeter to check the voltages at a few points on the board. Check it at the +5 and GND loops you installed. If you get +5.0 ±0.1 volts then you doing great! If not, unplug the plug and start trouble shooting the board. Reinspect your solder joints looking for shorts and opens. Look for missing components. **Do not install ICs until this problem is corrected.**

( ) +5 volts present between +5 and GND loops.

Now check the -5 volt supply output by probing between one of the ground loops and the -5 volt pad near voltage regulator VR203. Voltage should be -5 volts ±0.1 volts.

( ) -5 volts present between -5 pad and GND loop.

Now check the analog +5 volts by checking the voltage between ground and the square pad of C233. Voltage should be +5 volts ± .1 volts.

( ) +5 volts present between square pad of C227 and nearby GND loop.

After you have these voltages checked out, check to see if you have 5 volts between pins 10 and 20 of U204 and between pins 10 and 20 of U206. Pin 10 is ground and pin 20 is +5V.

( ) +5 volts measured on U204 and U206 sockets.

( ) Remove power and disconnect the voltmeter.

Spacer Installation and Board Assembly

( ) Locate the four 1/4-inch long hex spacers with #4-40 threads protruding from one end.

( ) Locate the four .8" spacers that have threaded holes on each end.

( ) Place the threaded ends of each of the short spacers through the holes of Board 1, up from the bottom, then thread the longer spacers onto each of the studs on top of board one.
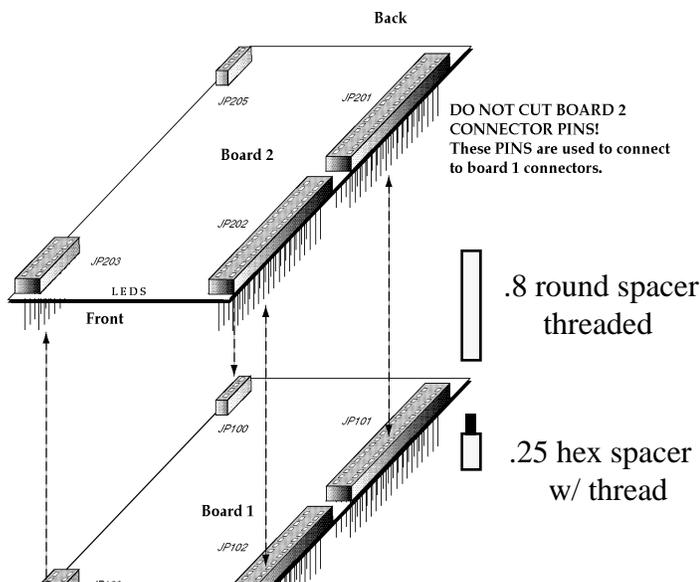
See figure below to see how the boards mate.

Carefully assemble the two boards, with Board 2 on top. Just place the pins in the holes of the mating socket. Keep adjusting the two boards until you feel all the pins are lined up. Then push a little harder until you feel the pins slip in place and the board will come to rest on the spacers.

( ) Place at least two screws in opposite corners of Board 2 into the spacers so the boards do not pop apart while under power.

( ) If there is a gap between the top board and the long spacer, a lock washer or washer might be needed to fill any small gap.

Make sure you do not set the stack down on any conductive material, such as clipped component leads.

Now the DSP-93 should operate and talk to your computer.
- **Don't put the boards in the case yet.**
- **Don't cut the bottom connector leads yet!**

DO NOT CUT BOARD 2 CONNECTOR PINS!
These PINS are used to connect to board 1 connectors.

.8 round spacer threaded

.25 hex spacer w/ thread

Integrated Circuits

The boards were assembled in order to reduce strain on the interconnected pins of the analog board when the following ICs are installed.

Its now time to install the ICs. Observing static handling precautions (see comments at the front of the manual):

NOTE: Confirm the location of pin one on each part with a printed label, the labels are not necessarily in the same orientation as the chip. Also, if the label obscures the reference notch, double check the reference of the chip. The parts placement diagram shows placement in reference to the chip notch. You can burn out ICs but plugging them in the wrong orientation. Take extra care here, since several of the chips are very expensive.

( ) 74S05N	U205
( ) 145406	U211
( ) TLC2272CP OPAMP (8-pin DIP)	U202
( ) MAX358CPA	U203
( ) 74ALS573	U204
( ) 74ALS573	U206
( ) ST16550P (Startech only!)	U212
( ) 74ALS245	U216
( ) TLC2272CP OPAMP (8-pin DIP)	U209
( ) MAX358CPA	U201
( ) TLC32044CN	U208
( ) GAL16V8A-15LNC Labeled U210	U210
( ) 74ALS573	U214
( ) LM386	U207
( ) ULN2003A	U215
( ) 74ALS541	U213

( ) Verify the ICs are correctly oriented and that no leads are bent under the body of a chip or hanging over the side of a socket.

DSP-93 Final Check

Serial Cable Hookup

PC Compatible: Use a straight through (1-1, 2-2, 3-3, etc.) cable between the DSP-93 and your computer. It is easy to get ribbon cable and press on 9-pin connectors from Radio Shack, but this is **NOT** the recommended final cable. This will work during test, but RF will cause problems if you continue to use it once you start operating. A shielded cable is best.

Macintosh: Use a Macintosh modem cable. **DO NOT** use a Macintosh printer which can have the same connectors. Purchase a 'MiniDIN-8 to DB-25 male' (hardware handshake type preferred) and connect the cable to an adapter DB-25 female/DB-9 male (Radio Shack 26-287).

Connect a cable between the DSP-93 and the serial port of your computer. Run some type of terminal program on the computer and set the data characteristics to: **19200 baud, no parity, 8 bits, 1 stop bit.**

Double check to make sure that the DSP-93 is not in contact with anything that might short it out.

Now apply power to the stack again using top (Board 2) AC jack.

Use the power switch to power the board. The two outside LEDs (LED218 followed quickly by LED211) should light up and nothing else. If they do not, try pressing and releasing the reset button. **On Reset, LED211 will flicker.**

If the lights work you should see an asterisk (*) on your computer. Type in a question mark (?) and the monitor commands will scroll up. If this happens then things are working fine.

If your DSP-93 **does not work** then power off. You need to debug the problem before going any further.

( ) Are you sure you have all the necessary wires in your serial cable. The computer (and cable) must assert (voltage) on the RTS line at the DSP-93 serial port.

( ) Check out the handshaking used by your terminal program. You should set it for **NO handshaking.**

( ) Look the boards over carefully checking for solder problems.

( ) Recheck the IC placement and orientation.

( ) Recheck power supply voltages.

( ) Check to see that the reset (Pin 7 of U116) is high and goes low when you push reset.

( ) If you have a logic probe or an oscilloscope then look at the clock on pin 8 of U115; it should be 20 MHz. With the logic probe it should just be clocking. Refer to the Hardware Debugging for additional help. Beyond this, you need to get help.

If your board shows the *, then so good so far!
( ) Remove power from the DSP-93.

( ) Install the two remaining screws to secure Board 2 to the spacers coming up from Board 1.

( ) **Now that you are sure you know how the two boards go together, you can cut the leads off the back side of the digital board, which is the bottom board. Be sure to cut only the Board 1 (bottom board) leads.**

( ) Trim the long leads off the back side of the connectors for Board 1.

Once again, test the operation of the DSP-93 using the procedure shown above. If the tests are once again successful, then you have completed building your DSP-93. Congratulations!

What is next is to run your unit through the test programs to ensure it is working correctly.

Radio Cable Hookup

The DSP-93 kit is supplied with a MiniDIN-8/MiniDIN-8 straight through cable. This cable can be cut in half and the appropriate connectors for your radio attached to the cut end. For the following operational testing, you can connect appropriate test equipment (DVM, scope, etc) to the outputs to see test results. After the operational testing, you will want to connect appropriate connector to interface to your radio.

Do not depend on the color codes of the wires - use an ohmmeter.

BOX ASSEMBLY

If your unit works for the following Tests (1, 2, 3, 4, and 6), then you are ready to install your unit inside the enclosure and then start getting it configured to your radios. **Be sure to run the operations TESTs before installing in the enclosure!**

The enclosure has 4 sections. A bottom, top, front panel, and rear panel.

( ) Locate the bottom. This is the piece with the folded ends and mounted nuts.

( ) Identify the orientation of the bottom (front and rear). The rear can be found by locating which end has the three holes in a row punched closer to that end. This is the rear. Also, the PCB mounting holes will be closer to the end on the rear than in the front.

NOTE: If you place the DSP-93 boards in backwards, the LEDs will protrude out from the front, instead of being flush mounted. Also, larger connectors will have a problem being used with the unit.

( ) Using four (4) 4-40 screws, attach the DSP-93 to the bottom of the enclosure using the .25 inch hex standoffs that should already be attached on the DSP-93.

( ) Run the volume/power pot and the reset switch with cables through the front opening.

( ) Locate the black anodized front panel and attach the volume/power and reset to the correct holes. You will want to take some care to not scratch the front panel.

( ) Using four (4) 4-40 screws, attach the front panel to the enclosure. Take care to arrange the LEDs while attaching so that they fit into the holes of the front panel.

( ) Locate the clear alodine rear panel for the enclosure.

( ) Run the DB25 cable and speaker cable with the attached speaker jack through the rear opening of the enclosure.

( ) Attach the DB25 and Speaker jack to the rear panel with its mounting hardware.

( ) Attach the back panel using four (4) 4-40 screws.

( ) Attach the other end of the DB25 cable, with the 20 pin female IDC connector to the TNC connector between U213 and U214 on Board Two.

( ) When attaching, be sure that pin 1 is located towards the outside of the board. The cable might need to be turned in order to do this, depending on the construction of the cable.

( ) Attach four (4) rubber feet.

Correction to Back Panel Silkscreen
The silkscreen indicates polarity for Power and Speaker. This is not correct. AC does not have polarity. The speaker jack is provided as a stereo jack and may not be wired as indicated, depending on how the builder builds the unit.

There are no other errors on the rear panel silkscreen.

Note on Front Panel Silkscreen
The first 200 front panels will have silkscreen on both sides. The company that produced these used the beta-test screen instead of the production art and redid the job. The offical side to use is the one that has AMSAT spelled out.

OPERATIONAL TESTING
If you have suggestions on how the operational testing section can be improved, please contact TAPR.

It is important to note that the DSP-93 (as well as most other radio modems) may cause your transmitter to go into transmit mode briefly when the DSP-93 is powered on and/or powered off. This can occur even if the initializations lines referred to in the "Radio Port Configuration Notice" are properly configured. Take precautions so that your equipment will not be damaged if this should occur.

One of the first tests of the DSP-93 is to talk to the monitor program. A full description of the monitor program and how the monitor works can be found in the file called `monitor.doc`.

There are three ways to communicate and load programs into the DSP-93 units. These include:

DOS: Use your favorite terminal emulator for the following tests. First, go to the directory that contains DSPLOAD and edit the file 'DSPLOAD.CFG' for your specific system. The file has remarks that should tell you what to edit.

Windows: Use the D93WE.EXE to perform the following tests. See the Install and Read Me files accompanying the program for instructions.

Macintosh: Use the DSP-93Control application to perform the following tests. See the ReadMe First and ReadMe files accompanying the program for instructions

Test 1: Monitor Test

At initial power up, POWER should illuminate from the +5 VDC power supply. After the initial CPU reset time out, the DSP-93 monitor blinks and then turns on LED 1 (the left-most LED) and waits for a program to be downloaded via the serial RS-232 port.

Using a terminal program (see above), press 'RETURN' or 'ENTER' to get the '*' monitor prompt. When you get the monitor prompt, press '?', which will bring a listing of the monitor version and the menu of commands as shown here. The Rev number should be the same as on the EPROM, with luck.

```
*?
DSP-93 TAPR/AMSAT REV ##.#
A-AR REGISTERS
D-DUMP MEMORY
F-FILL MEMORY
G-FLIP & RUN PROGRAM @ 1000h
J-JUMP TO XXXX & RUN
H-INTEL LOADER HIGH BITS
L-INTEL LOADER  LOW BITS
M-MODIFY WORD
P-PROGRAM
R-RESET
S-SHOW WORD
T-TEST
```

If you got this, then you are past the first hurdle of testing.

Test 2: Speed Test

At the monitor prompt enter 'g'

This tells the DSP-93 to run. We haven't loaded a program, but we can test to make sure that the unit switches between low (20Mhz) and high (40Mhz) speeds.

When you press 'g', LED 1 should go out and LED 2 should light. This indicates that the unit is running at 40Mhz.

Press 'r', and LED 2 should go out and LED 1 should light.

Test 3: Memory Test

At the monitor prompt press 't'.

This command tests the data memory for errors. It tests the memory by writing 0000, 5555, and FFFF into every location and reading it back. If no errors result the test will loop through all locations and then just give you a '*' prompt.

If an error occurs, the location of the error will be reported along with the value written and the value returned.

If an error occurs, use the chart below to determine which chip is suspect. Swap a pair of chips and see if the problem follows. If the problem follows the chip, the chip is probably suspect. If the problem stays at the same location, your soldering or board is suspect.

```
SRAM PROGRAM   U104   0000-7FFF   LSB
SRAM PROGRAM   U105   0000-7FFF   MSB
SRAM PROGRAM   U106   8000-FFFF   LSB
SRAM PROGRAM   U107   8000-FFFF   MSB

SRAM DATA      U108   0000-7FFF   LSB
SRAM DATA      U109   0000-7FFF   MSB
SRAM DATA      U110   8000-FFFF   LSB
SRAM DATA      U111   8000-FFFF   MSB
```

NOTE: If you are having continued memory problems, a more comprehensive memory test is available called MEMTEST. MEMTEST is described in the on-line help for D93WE. It is run from either the Windows or Mac interfaces, since error values come back to quickly for use with the DOS DSPLOAD. When run, it might print either continuous '1234567 <return>' when the test passes with no errors. If errors are found, it will print 12E:3, where E: specifies which test failed, in this example, test 3.

NOTE: The following programs can be run from the on board EPROM. This is done by resetting the DSP-93 and selecting 'p' from the menu. Then you tye a 1 through x selection or type a ? to review a list of the available programs.

Test 4: TESTLEDS

This is the first test that will load and run a program.

TESTLEDS can be downloaded to flash the LEDs in sequence, to assure general operation of the analog board and the digital interface to the CPU board.

DOS: From the DOS command prompt enter 'DSPLOAD TESTLEDS'

Windows: From D93WE, select the 'Download' menu item and locate and select the TESTLEDS.OBJ file. Click OK or double-click the file.

Macintosh: From DSP-93Control, choose Load Program (Mac) from the Actions menu and locate the TESTLEDS.OBJ file. Click OK.

After the short load delay (about 4 seconds, maximum), all LEDs except the power LED will go dark for about 2 seconds. Starting with LED 1 on the left, each LED will light for about 2 seconds in sequence, moving to LED 7, near the power LED. Any LED that remains dark may be broken, installed with reversed polarity, or have a broken limiting resistor near U215. If LEDs 2, 3, or 4 light at the same time (ignore the power LED), then carefully review solder joints near U213, U214, and U215 for bridges. Check U206 and U215 for errors in LED 5 or 6, and U204 and U215 for LED 7.

If U215 is removed from its socket, a test lead (with 100ohm series resistor soldered to the end) can be used to ground output pins 10 through 16 for manual tests. Use the digital ground connection near J203. Refer to the schematic to see what pins do what.
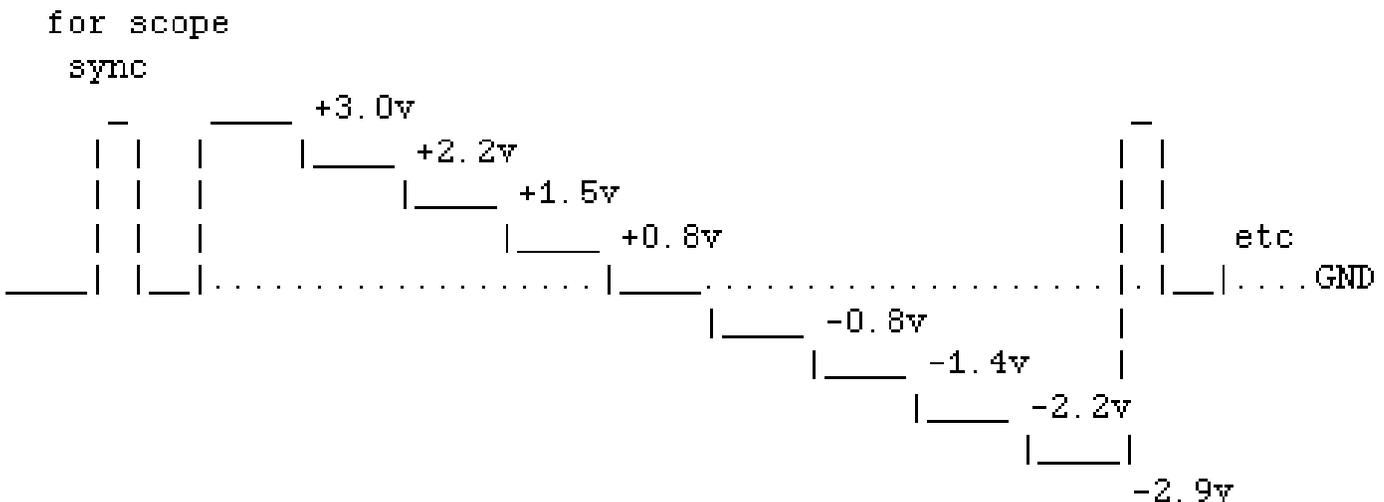
Test 5: TESTRAMP (Requires a Scope)

This program can be downloaded to provide a low frequency stair step test signal. The signal goes from +3 to -3 VDC, and uses selected digital voltage levels. For easy triggering, an oscilloscope can be connected to J203 pin 10 to monitor the output voltage level. After a brief flash sequence of the LEDs to show program load, the stair step ramp signal will begin. LED 1 thru 7 will be dark, when the waveform begins. If a speaker is connected, the output is at peak possible amplitude and will be a very loud clicking noise.

<u>CAUTION</u>: this signal is applied to Radio Port 1 & 2.

<u>WARNING</u>: Disconnect the radio interface or connect a dummy load before running this program. Port Control lines are reset to high state (+5 VDC), which may tune some radios (Yaesu FT736R, for example).

There is a short positive pulse at the front of the waveform, to trigger the scope. Use 1 volt per division vertical sensitivity and 10 milliseconds horizontal sweep, with positive edge (AC or DC) triggering. The stair step should descend from +3 volts to 2.2 volts, then 1.1, 0.5, -0.5, -1.1, -1.8, -2.3, and then -3.0 volts. After the -3.0 volt step, the waveform returns to 0.0 volts, until the next start pulse. The signal repeats until the CPU is reset.

Set your scope for 1 V/div, 10 msec. Here is an example of the wave form you will get while the LEDs cycle:

Press the RESET button.

DOS: From the DOS command prompt enter 'DSPLOAD TESTRAMP'

Windows: From D93WE, select the 'Download' menu item and locate and select the TESTRAMP.OBJ file. Click OK or double-click the file.

Macintosh: Using DSP-93Control, choose Load Program (Mac) from the Actions menu and locate the TESTRAMP.OBJ file. Click OK.

There may be significant droop to each step, due to the limited low frequency response of the D/A converter and amplifier system. Since this signal is generated in the AIO chip U208, none of the A/D and input multiplexer switches are involved. If the signal is unipolar (does not have a negative voltage step), check the wiring for the negative 5 VDC supply.

Each voltage step is directly loaded in the source code, and the user can easily change the levels to generate any arbitrary waveform, within the limits of the TAPR/AMSAT DSP-93 system. This code can be the basis of an RY generator, audio code generator, or packet flag simulator, for example.

```
   for scope
     sync
      _      ____  +3.0v                          _
     | |    |    |____  +2.2v                     | |
     | |    |        |____  +1.5v                 | |
     | |    |            |____  +0.8v             | |    etc
  ___| |__|.............|____.................|.|__|....GND
                          |____  -0.8v          |
                            |____  -1.4v        |
                              |____  -2.2v      |
                                |____|
                                     -2.9v
```

Test 6: TESTBUZZ
(Requires a speaker attached and/or a Scope)

This program can be downloaded to provide an audio test signal. The signal is similar to the TESTRAMP signal, except for a reduced start pulse and a 4 millisecond total period. This signal is representative of the typical communication signal needs and frequency responses, with energy bands from 250 Hz to well over 5 kHz.

CAUTION: this signal is applied to Radio Port 1 & 2.

WARNING: Disconnect the radio interface or connect a dummy load before running this program. Port Control lines are reset to high state (+5 VDC), which may tune some radios (Yaesu FT736R, for example).

Press the RESET button.

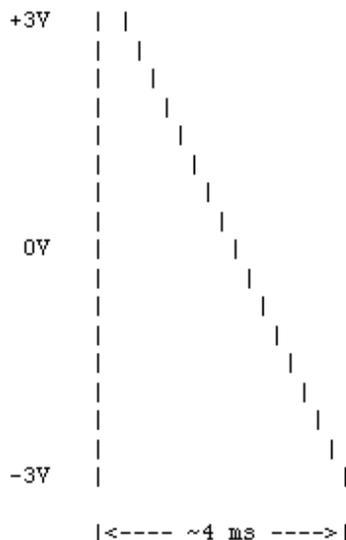**DOS**: From the DOS command prompt enter 'DSPLOAD TESTBUZZ'

Windows: From D93WE, select the 'Download' menu item and locate and select the TESTBUZZ.OBJ file. Click OK or double-click the file.

Macintosh: Using DSP-93Control, choose Load Program (Mac) from the Actions menu and locate the TESTBUZZ.OBJ file. Click OK.

After a brief sequence flash of the LEDs, LED 2 will remain lighted to indicate CPU active and remain this way until it is manually reset. The start pulse is reduced to 1/2 amplitude and appears as a step on the rise of the main waveform, but the other voltage information and troubleshooting information is listed in TESTRAMP.

You should now hear something on the speaker.

If you connect a scope to J203 pin 10 to monitor the output voltage level you should see:

```
+3V   | |
      |  |
      |   |
      |    |
      |     |
      |      |
      |       |
      |        |
 0V   |         |
      |          |
      |           |
      |            |
      |             |
      |              |
      |               |
-3V   |                |

      |<---- ~4 ms ---->|
```

Test 7: TESTGAIN (Requires a speaker attached and/or a Scope and Signal Generator)

This test uses an oscilloscope to measure the gain for each step of the Gain Multiplexer circuit U201. The test signal from an external generator or radio is connected to Radio Port 1 Pin 8 Receive. The monitor point is Pin 7 of U202. Peak signal is ±5 volts at this test point.

CAUTION: Control signals are applied to Radio Port 1 & 2.

WARNING: Disconnect the radio tuning cable wires or connect a dummy load before running this program. Port Control lines are reset to high state (+5 VDC), which may tune some radios.

Press the RESET button.

DOS: From the DOS command prompt enter 'DSPLOAD TESTGAIN'

Windows: From D93WE, select the 'Download' menu item and locate and select the TESTGAIN.OBJ file. Click OK or double-click the file.

Macintosh: Using DSP-93Control, choose Load Program (Mac) from the Actions menu and locate the TESTGAIN.OBJ file. Click OK. LED 4 lights to indicate complete download and operating program. LEDs 5, 6, and 7 are used to indicate the binary weight of the gain, determined by R201 and R203 thru R208. The gain with LED 5 lighted is approximately normal operating gain of 16X.

Note that the setting of R214 input level control will affect the measured absolute gain.

Program loops at each gain setting for 5 seconds, then steps to the next higher level. With LED 5, 6, and 7 lighted, the amplifier is in the comparator mode, and should be clipped at both peaks. Program runs until CPU is manually reset.

If you connect a scope to Pin 7 of U202 you should see the input signal at the gains of 1, 2, 4, 8, 16, 32, 64 and the final step is a comparator which will clip the incoming signal.

COMMENT: This program could be modified to activate the A/D converter and feed a copy of the signal to the speaker, to eliminate the need for internal probing. A version to use Port 1 Aux In (pin 3) would eliminate the input level pot variation. Suggested names TESTREC1 and TESTAUX1, respectively. If you program this, please let us know.

Test 8: TESTANIN

The Port 1 Auxillary Input (Pin 3 AUX) is connected to the gain selector and presented to Pin 7 of U202 for verification with an oscilloscope. The AUX input does not have gain control or DC blocking, so this program can be used during scope probing of U203 and U202.

CAUTION: Control signals are applied to Radio Port 1 & 2.

WARNING: Disconnect the radio interface or connect a dummy load before running this program. Port Control lines are reset to high state (+5 VDC), which may tune some radios.

This routine is a variation of TESTGAIN, modified for a single input and a single gain setting. This code is a general basis for any fixed test code you may need to hack for analog testing. This program could to be modified to activate the A/D converter and feed a copy of the signal to the speaker, to eliminate the need for internal probing and to act a signal monitor routine for cable tests.
Press the RESET button.

DOS: From the DOS command prompt enter 'DSPLOAD TESTANIN.OBJ'

Windows: From D93WE, select the 'Download' menu item and locate and select the TESTANIN.OBJ file. Click OK or double-click the file.

Macintosh: Using DSP-93Control, choose Load Program (Mac) from the Actions menu and locate the TESTANIN file. Click OK.

If you connect a scope to Pin 7 of U202 you should see the input signal as amplified by the op amp. This uses the AUX input which allows DC input.

COMMENT: This program could to be modified to activate the A/D converter and feed a copy of the signal to the speaker, to eliminate the need for internal probing. If you program this, please let us know.

Test 9: TESTPORT

This routine tests the Push to Talk (PTT) and Frequency Up (FU) and Frequency Down (FD) lines of Radio Ports 1 and 2. As assembled, the code sets the ports to match the common configuration, in which each control is active low (*) for all controls (PTT*/FD*/FU*) Each control line of each port is toggled active for approximately 5 seconds, with a corresponding front panel light. The code repeats until the CPU is manually reset.

CAUTION: Control signals are applied to Radio Port 1 & 2.

WARNING: Disconnect the radio interface or connect a dummy load before running this program. Port Control lines are changed, which may tune some radios or cause undesired keying of the transmitter.

	Radio Port 1	Radio Port 2
PTT	LED 7	LED 4
FU	LED 6	LED 3
FD/ICOM	LED 5	LED 2

Press the RESET button.

DOS: From the DOS command prompt enter 'DSPLOAD TESTPORT.OBJ'

Windows: From D93WE, select the 'Download' menu item and locate and select the TESTPORT file. Click OK or double-click the file.

Macintosh: Using DSP-93Control, choose Load Program (Mac) from the Actions menu and locate the TESTPORT.OBJ file. Click OK.

COMMENT: Comments are included in the code to show changes for radios that are active low for PTT, but active high for other lines (PTT*/FD/FU), such as the Yaesu 736R. See the files TESTPORY.OBJ and TESTPORY.ASM for use with the Yaesu 736R.

Hardware Debugging

Here are some of the things to check if you are having hardware problems.

Not to overlook the obvious, but a good AC/DC VOM is needed and should just about be all that is needed to get the unit up and running to the point that the user could use the DSP to test itself. With the VOM and schematics, you should be able to trace problems down.

#0 Use the loop connectors for GND and +5V on the boards for attachment of logic probes, voltmeters and scopes..

#1 Check voltages on the board. LED218 should be illuminated as it is a direct connection to the +5v power. LED211 is blinked and then illuminated after the processor initializes and talks to the serial port. If just these two are on, a great deal of the unit is working correctly. Check these from the source out. Since there is an AC source coming into the board a DMM/DVM (in AC mode) will give you the 9.x volts you expect. On a scope, you will get about ± 28 volts AC p-p, the RMS value of this is 9.8 VAC.

The +9v label on the board will actually give you somewhat more (around 12 V).

The +5v DC on the output side of the regulator should give you very close to +5v. Check both boards.

The 7400 family ICs generally have ground on the lower right pin as viewed from the top of the chip and Vcc (+5VDC) on the upper left pin. The analog chips may have both the + and - voltages on them. These are good places to check the voltages on the board.

#2 Check reset. (Pin 7 on U116) This line should rest in a high state (near +5v). Pressing the RESET button causes this pin to go low (near 0v). You should see the address and data lines go low while the RESET button is pressed

#3 Check clock. The 40 MHz oscillator gets divided by U114. Check at pin 5 for the 20 MHz signal and pin 9 for the 10 MHz. Even with 20 MHz scope you can easily see the clock signal. Make sure that it is giving you a full 5v swing (0v to 5v). When I had my oscillator in incorrectly, I got some oscillation, but only with a 0v - 1v swing. I mistakenly spent a great deal of time trying to find where the clock was going bad on

the boards thinking I had it plugged in correctly. Check for the clock on U114 pin 1.

#4 Check address and data bus. The two inter-board connectors (JP101/201 and JP102/202) give you easy access to nearly every signal on the board. This is an excellent place to sample these signals when you are tracking down a problem. Below are some diagrams I made. After RESET you should get a +5v swing on the data lines. I did on some lines and not on others, so check all the lines. If you have an address line or data line problem, separate the boards to isolate the problem. Place the scope on a bad data/address line - put a cap/resistor lead into the correct inter-board connector data/address line and attach your scope probe. Then with the power disconnected remove a chip that is on that particular bus, re-power and check the bad data/address line.

It can easily be a bad solder joint or a solder bridge between pins. Although rare, I have seen too much solder used on a IC socket pin that went through the plated through hole and bridged to an adjacent pin under the socket. Also double-check the IC socket pins that connect to ground or power. These connect to a lot of copper inside the PCB and it is easy to get a good looking, but a bad cold solder joint on these pins. If the DSP-93 is erratic when the boards are flexed, look for cold solder joints first.

#5 Check the serial port. Use a terminal program setup to 19200, COMx,N,8,1. Start off with hardware and software handshaking disabled.

Use a straight through modem cable. If you are going 9-pin to 9-pin it simply needs to connect 1-1, 2-2, 3-3,... .If you are going from a 9-pin to a 25-pin it needs to be wired this way:

```
9-pin   25-pin
  1        8      DCD
  2        3      RX  (receive data at terminal)
  3        2      TX  (transmit data from the terminal)
  4        20     DTR
  5        7      GND
  6        6      DSR
  7        4      RTS
  8        5      CTS
  9        22     RI  (This does not connect to the DSP-93)
```

DSP-93 Interboard Connectors
DSP-93 interboard pinouts

JP101/201

GND	49	50	GND
A9	47	48	A10
A8	45	46	A11
A7	43	44	A12
A6	41	42	A13
A5	39	40	A14
A4	37	38	+5
A3	35	36	+5
A2	33	34	+5
A1	31	32	D7
A0	29	30	D6
	27	28	D5
	25	26	D4
RLSD	23	24	D3
	21	22	D2
CTS	19	20	D1
	17	18	D0
	15	16	D8
	13	14	D9
	11	12	D10
RTS	9	10	D11
DTR	7	8	D12
	5	6	D13
S OUT	3	4	D14
S IN	1	2	D15

JP102/202

GND	49	50	GND
+5 ALG	47	48	+5 ALG
-5 ALG	45	46	-5 ALG
	43	44	
	41	42	INT2\
	39	40	
	37	38	
	35	36	FSR
	33	34	DR
	31	32	INT1\
	29	30	SYNC\
	27	28	
	25	26	
	23	24	HP/HC\
	21	22	IO\
HOLD\	19	20	READY
RS\	17	18	CLKR
CLKX	15	16	HSC\
CLKOUT1	13	14	IACK\
CLKOUT2	11	12	XF
HOLDA\	9	10	DX
FSX	7	8	X1
BR\	5	6	STRB\
PS\	3	4	R/W\
RESET	1	2	IS\

JP103/203

+5V	1	2	GND
+5V	3	4	GND
Q3	5	6	
Q4	7	8	
Q5	9	10	to pin 1,U209
Q6	11	12	
Q7	13	14	
Q8	15	16	to pin 7,U209
Q9	17	18	
Q10	19	20	

```
__Q10  19      20
|
to pin 1,U210
```

P204

1	L214, high is OFF
2	L213
3	L212
4	L211
5	speaker
6	ground

P202

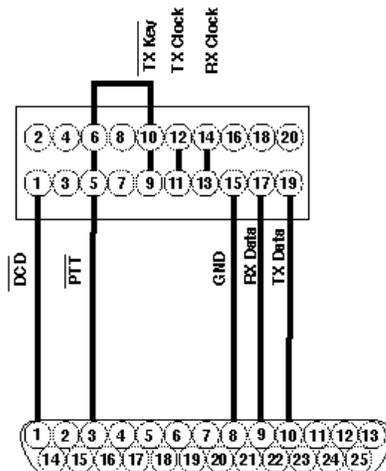|	
1	+9 to 12 VDC
2	-9 to 12 VDC
3	+ 5 digital
4	ground
5	+5 Analog
6	-5 Analog

TNC to DSP-93 Interface Signals

Signals shown are for the modem disconnect header on the TNC and the 20 pin (2x10) TNC connector on the DSP-93. Signals on the DSP-93 header were arranged to be similar to the TNC modem disconnect. Look at your TNC manual for more details on the signals to and from the TNC. The TAPR manual and the MFJ-1270 manual have detailed descriptions of these signals for the TNC. The signals on the DSP-93 are provided by U213 and U214. U213 is a 8 bit input buffer connected to D8 through D15. U214 is a 8 bit output latch connected also connected to D8 through D15. See the document MONITOR.DOC for more details on the address location and interfacing with this 8 bit I/O. All of the DSP-93 TNC signals are shown below. They are all listed here in case another code developer wants to use additional pins. The TNC is sensitive to these lines. If you connect one incorrectly everything stops.

TNC Modem Disconnect Header CONNECTOR		DSP-93 DB25	DSP-93 TNC		Interface ICs U213		Interface ICs U214	
PIN	SIGNAL	PIN	PIN	SIGNAL	SIG	IC_Pin	SIG	IC_Pin
1	DCDA SIO	1	1	DCD_I			Q1	19
2	DCD FROM TNC MODEM	14	2	DCD_O	A1	2		
3	DCD SIO	2	3	NC				
4	DCD INPUT	15	4	NC				
5	RTSA SIO	3	5	RTS_O	A2	3		
6	NO CONNECTION	16	6	KEY_I			Q2	18
7	DTRA SIO CONNECT LED	4	7	CONN_O	A4	5		
8	DTRB SIO STATUS LED	17	8	STAT_O	A3	4		
9	CTSA SIO	5	9	CTS_I			Q4	16
10	TRANSMITTER KEY INPUT	18	10	KEY_I			Q3	17
11	TXCLK IN TO STATE MACH	6	11	XCLK_I			Q5	15
12	TXCLK (16X) OUTPUT	19	12	XCLK_O				
13	RCLK SIO	7	13	RCLK_I			Q6	14
14	RCLK FROM TNC MODEM	20	14	RCLK_O	A5	6		
15	GROUND	8	15	GND				
16	NO CONNECTION	21	16	XCLK_O	A6	7		
17	RD TO TNC STATE MACHINE	9	17	RD_I			Q7	13
18	RD FROM THE TNC MODEM	22	18	RD_O	A7	8		
19	TX SIO DATA OUTPUT	10	19	TD_O	A8	9		
20	DATA TO TNC MODEM	23	20	TD_I			Q8	12

These are the minimum connections required for connecting the DSP-93 to an external TNC.

TNC Modem Disconnect Header CONNECTOR		DSP-93 DB25	DSP-93 TNC		Interface ICs U213		Interface ICs U214	
PIN	SIGNAL	PIN	PIN	SIGNAL	SIG	IC_Pin	SIG	IC_Pin
1	DCDA SIO	1	1	DCD_I			Q1	19
5	RTSA SIO	3	5	RTS_O	A2	3		
15	GROUND	8	15	GND				
17	RD TO TNC STATE MACHINE	9	17	RD_I			Q7	13
19	TX SIO DATA OUTPUT	10	19	TD_O	A8	9		

TNC-2 Modem Disconnect Header (20-pin Male)

Male DB-25 Cable to DSP-93 Interface

IO Port Configuration Setup

The RADIO IO ports can be configured to a determined state at power up by strapping certain lines (pin 2 is +5v and pin 8 is Gnd) on the DB25 interfacing the TNC. The monitor code checks the state of the following TNC/DIGITAL pins and configures the output with the same level (High or Low as defined by pin 2 and pin 8)
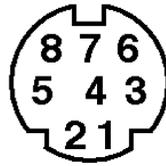
```
                                  DSP-93              Interface ICs
                             DB25   TNC           U213          U214
                             PIN    PIN   SIGNAL  SIG  IC_Pin   SIG  IC_Pin
Controls Freq UP/DOWN on IO201  20    14   RCLK_O  A5   6
Controls PTT      on     IO202  21    16   XCLK_O  A6   7
Controls PTT      on     IO201  22    18   RD_O    A7   8
Controls Freq UP/DOWN on IO202   4     7   CONN_O  A4   5
```

The IO pins will follow the state of the pins on the TNC connector at power up. The idea here is to strap the pins on the DB25 that plugs into the DSP-93 for the radio you are using. Then if you have more than one radio with different configurations you can set up different interface cables.

Radio Interface Mini-DINs

```
PIN        SIGNAL
 1         FREQ DN
 2         PTT
 3         AUX IN
 4         ICOM
 5         TD AUDIO
 6         GND
 7         FREQ UP
 8         RD AUDIO
```

8-pin Mini-DIN Socket
Female (on the DSP-93)

```
 8 7 6
5  4  3
  2 1
```

8-pin Mini-DIN Plug
Male (cable from Radio)

```
 6 7 8
3  4  5
  1 2
```