AMT3000

Low Power AM Broadcast Radio Transmitter Kit

Assembly and Operating Instructions

Instruction Manual Revision: R3
PCB 3000-05-1
December, 2004

SSTRAN
Dedicated to Quality Engineering

web: www.sstran.com
e-mail: info@sstran.com

TABLE OF CONTENTS

1 Getting Organized

This manual provides step-by-step assembly instructions to help you complete your kit with the least possible chance for error. Keeping your parts, tools and work area organized will further reduce the chance for error and keep you from getting frustrated looking for a part or tool.

Inventory and Organize Your Parts

Unpack your kit carefully and check each part against the parts list in section 2. Refer to section 17, "Component Identification", for help with identifying parts. During your inventory, put check mark in the box next to each part in the parts list.

Some parts, such as resistors and ceramic capacitors, are marked only with color codes or numeric codes. Other parts, such as transistors, voltage regulators and integrated circuits are marked with part numbers. A generic part number shown in the parts list may not correspond exactly with what you see on a component. However, the generic part will appear as part of a sometimes longer component part number. For example, a 74HC40103 (generic part number) integrated circuit may be marked as CD74HC40103E. The generic number is embedded in the actual part number along with varying prefixes and suffixes which may be ignored.

If there is a missing or damaged part, e-mail SSTRAN at sstran@sstran.com, and we will send you a replacement. Describe the part completely in your e-mail. Include Reference Designator, Value, Part Marking, and Description from the parts list . Also include your name, shipping address and date of original order.

Tools You Will Need

You will need a few inexpensive tools to assemble your kit:

- a low-wattage (15 - 25 watt) pencil-type soldering iron with a small diameter tip
- small gauge electronic solder, .032" (.81 mm) or smaller diameter flux-core for use in electronic assembly
- small long-nose pliers
- flush-cutting "nippy" wire cutters

- wire insulation stripping tool (a sharp knife is an acceptable substitute)
- solder removal tool
- small screwdriver with an approximately .1" (2.5mm) wide blade
- No. 1 Phillips screwdriver

If you don't have one or more of these tools you can purchase them at your local Radio Shack store or from a mail-order electronics supplier such as www.mouser.com or www.digikey.com. Here are some examples from the Radio Shack on-line catalog on the web at www.radioshack.com.

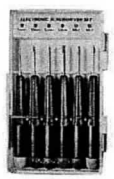
Radio Shack catalog #: 64-2051. "15-Watt with Grounded Tip. Good choice for integrated circuit work." (It is very important that your soldering iron have a small diameter tip like this one).

Radio Shack catalog #: 64-005: "Standard 60/40 formula rosin core solder. .032", 2.5 oz."

Radio Shack catalog #: 64-2033. "Long-Nose 4-3/4" Mini Pliers"

Radio Shack catalog #: 64-1833. "Flush-cutting nippy cutters fit tight places and lets you trim leads close to PC boards. Spring action."

Radio Shack catalog #: 64-2129. "Adjustable Wire Stripper/Cutter"



Catalog #: 64-1963. "6-Piece Precision Screwdriver Set"

Radio Shack catalog #: 64-2098. "Vacuum Desoldering Tool"

2 Parts List

Refer to section 1, "Component Identification", for help with parts identification. Refer to section 1, "Color Code Charts", for instructions on how to read resistor and RF choke color codes.

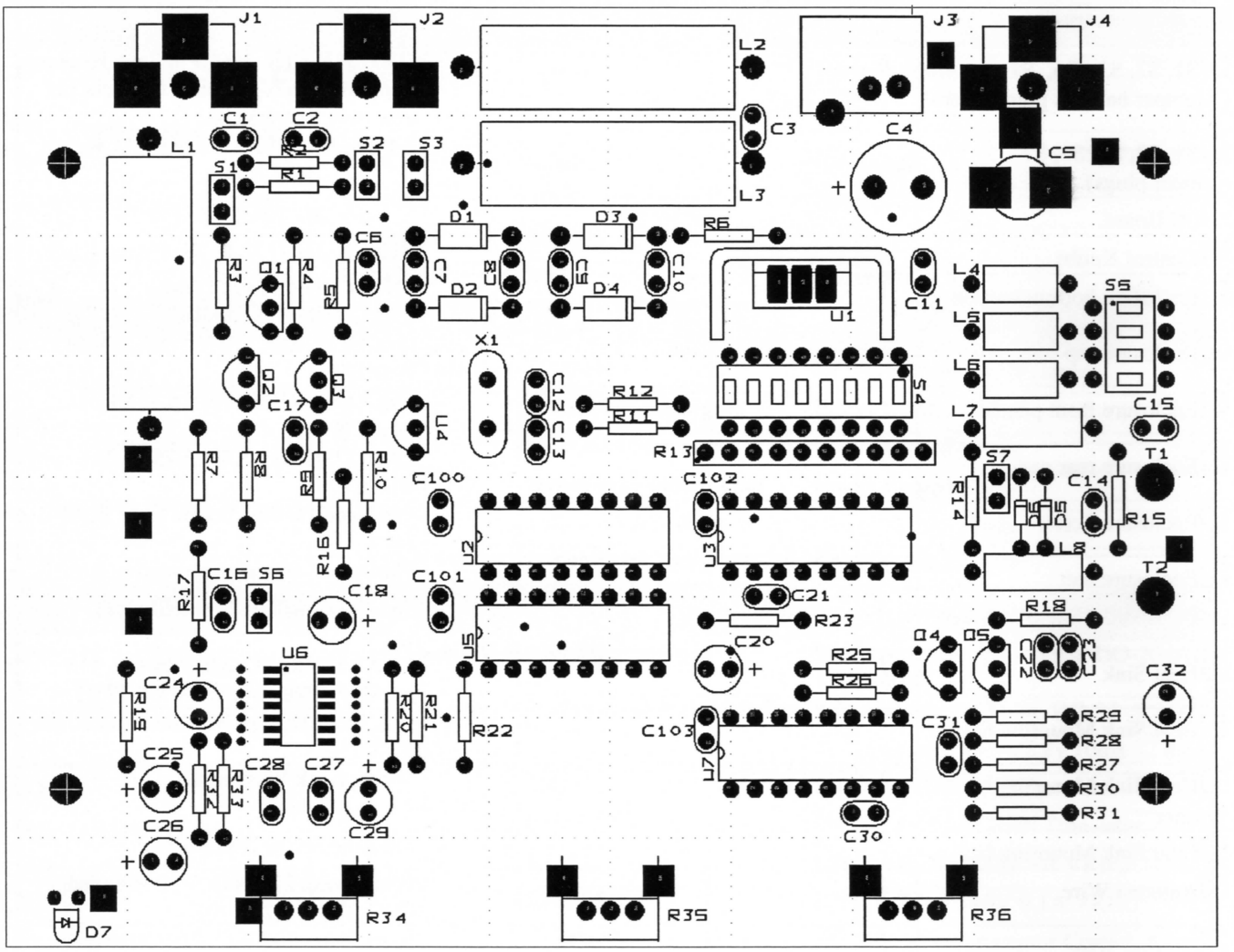
Reference Designator	Qty	Value	Part Marking	Description
Fixed Resistors and Resistor Network				
☐R8	1	22 ohms	red-red-black	1/4w carbon film resistor
☐R3	1	100 ohms	brown-black-brown	1/4w carbon film resistor
☐R25, R28, R29	3	220 ohms	red-red-brown	1/4w carbon film resistor
☐R7	1	510 ohms	green-brown-brown	1/4w carbon film resistor
☐R18	1	820 ohms	gray-red-brown	1/4w carbon film resistor
☐R12, R21, R31	3	1K ohms	brown-black-red	1/4w carbon film resistor
☐R17	1	1.5K ohms	brown-green-red	1/4w carbon film resistor
☐R27	1	1.8K ohms	brown-gray-red	1/4w carbon film resistor
☐R4	1	2.7k ohms	red-violet-red	1/4w carbon film resistor
☐R23, R30	2	4.7K ohms	yellow-violet-red	1/4w carbon film resistor
☐R10	1	6.8K ohms	blue-gray-red	1/4w carbon film resistor
☐R6	1	8.2K ohms	gray-red-red	1/4w carbon film resistor
☐R19, R22, R32	3	10K ohms	brown-black-orange	1/4w carbon film resistor
☐R16	1	15K ohms	brown-green-orange	1/4w carbon film resistor
☐R5	1	27K ohms	red-violet-orange	1/4w carbon film resistor
☐R33	1	30K ohms	orange-black-orange	1/4w carbon film resistor
☐R1, R2, R9	3	47k ohms	yellow-violet-orange	1/4w carbon film resistor
☐R26	1	100K ohms	brown-black-yellow	1/4w carbon film resistor
☐R14	1	220K ohms	red-red-yellow	1/4w carbon film resistor
☐R11, R15, R20	3	1M ohms	brown-black-green	1/4w carbon film resistor
☐R13	1	10K ohms	10A103GA	10K ohms x 9, 10 Pin Common Bus Resistor Network.
Jacks, Plug, Variable Resistors and Variable Trimmer Capacitor				
☐J1	1			RCA phono jack r/a pcb white
☐J2	1			RCA phono jack r/a pcb red
☐J3	1			Power jack pcb 2.1mm
☐J4	1			RCA phono jack r/a pcb yellow
☐P4	1			RCA phono plug w/yellow band
☐R34, R36	2	100K ohms	B100K	PC Mount Black Shaft Variable Resistor
☐R35	1	50K ohms	B50K	PC Mount Black Shaft Variable Resistor
☐C5	1	12-100pF	black paint dot	Black, 12-100pF, 7MM Trimmer Capacitor
Fixed Capacitors				
☐C12, C13	2	33pF	33	Ceramic
☐C30	1	180pF	181	Ceramic

Reference Designator	Qty	Value	Part Marking	Description
☐C15, C27	2	200pF	201	Ceramic
☐C23	1	820pF	821 For use with wire antenna. See step-by-step instructions.	Ceramic
	1	560pF	561 For use with external base-loaded vertical antenna. See step-by-step instructions.	Ceramic
☐C17, C21	2	1000pF	102	Ceramic
☐C14, C16	2	.01uF	.01 or 103	Ceramic Multi-Layer
☐C1, C2, C3, C6, C7, C8, C9, C10, C11, C22, C28, C31, C100, C101, C102, C103	16	.1uF	.1 or 104	Ceramic Multi-Layer
☐C18	1	4.7uF	4.7uF	Electrolytic
☐C20, C24, C25, C26, C29	5	10uF	10uF	Electrolytic
☐C32	1	100uF	100uF	Electrolytic
☐C4	1	470uF	470uF	Electrolytic
Coils and Chokes				
☐L1, L2, L3	3	1000 uH	1000 uH	RFI Suppression Coil (large)
☐L4	1	56 uH	green-blue-black-gold	Epoxy Coated Choke
☐L5	1	82 uH	gray-red-black-gold	Epoxy Coated Choke
☐L6	1	180 uH	brown-gray-brown-gold	Epoxy Coated Choke
☐L7	1	470 uH	yellow-violet-brown-silver	Epoxy Coated Choke
☐L8	1	1000 uH	brown-black-red-silver	Epoxy Coated Choke
Diodes, Transistors, Voltage Regulators and Quartz Crystal				
☐D1, D2, D3, D4	4	1.0A, 100V	1N4002	Silicon rectifier, 1N4002GP DO-204AL 1.0A 100V
☐D5, D6	2		Red with black end band	Silicon diode, 1N914A DO-35
☐D7	1			T-1 LED lamp green 2.2v 10ma 32 mcd
☐Q1	1		2N3906	2N3906 TO-92 PNP Transistor
☐Q2, Q3, Q4, Q5	4		PN2222A	PN2222A TO-92 NPN Transistor
☐U1	1		L7815	L7815 TO-220 +15V 1A VREG
☐U4	1		L78L05	L78L05 TO-92 +5V 0.1A VREG
☐X1	1		4.000000 (Used in models AMT3000 and AMT3000-SM)	HC-49U Microprocessor Crystal 4.0 MHZ 20pF
	1		3.6000 (Used in models AMT3000-9K and AMT3000-9KSM)	HC-49U Microprocessor Crystal 3.6 MHZ 20pF
Integrated Circuits, DIP Switches and 16-Pin IC Sockets				
☐U2	1		74HC4060	74HC4060 14-Stage Ripple Binary Counter, 16-pin DIP
☐U3, U5	2		74HC40103	74HC40103 8-bit synchronous binary down counter, 16-pin DIP

Reference Designator	Qty	Value	Part Marking	Description
☐U6	1		SSM2166S	SSM2166S Microphone Preamplifier with Variable Compression & Noise Gating, 14-pin SOIC surface mount
☐U7	1		74HC4046	74HC4046 Phase-Locked Loop, 16-pin DIP
☐IC sockets for U2, U3, U5, U7	4			DIP SOCKET, 16 PIN
☐S4	1			8 Pos DIP switch, extended actuator
☐S5	1			4 Pos DIP switch, extended actuator
Miscellaneous				
☐S1, S2, S3, S6, S7 (5 jumper headers plus 1 spare)	6			.230 8PIN STR .100" Pin Strip Headers. Supplied as a 6-pair strip to be cut per assembly instructions.
☐S1, S2, S3, S6, S7 (jumper plugs)	5			2-POS. JUMPER OPEN BLACK
☐PC Board	1		3000-02	5" x 3.9" printed circuit board
☐Control Knobs	3			BLACK .50"D X .61"H Plastic Knob
☐Enclosure bottom section	1			ENCLOSURE BOTTOM 6.08X4.26X.375, BONE
☐Enclosure top section	1			ENCLOSURE TOP 6.08X4.26X1.175, BONE
☐Enclosure front panel	1			ENCLOSURE FRONT 5.75X1.311, BLACK
☐Enclosure rear panel	1			ENCLOSURE REAR 5.75X1.311, BLACK
☐Enclosure Screws	2			Pan Head Phillips Screw Type B, #4 X 3/4"
☐Enclosure feet	4			Plastic self-adhesive protective feet.
☐PC Board Mounting Screws	4			Pan Head Phillips Screw Type B, #4 X 1/4"
☐Heat Sink	1			HEAT SINK, TO-220/126/127 low profile 0.750L x 0.750W x 0.375H
☐Heat Sink Mounting Screw	1			Pan Head Phillips Machine Screw, #6-32 X 1/4"
☐Heat Sink Mounting Lock Washer	1			Spring Lock Washer, #6
☐Heat Sink Mounting Nut	1			Machine Screw Nut, #6-32
☐Antenna Wire	1			White wire, 22AWG, 7/30 stranded, PVC, 118 in. (2.99 m)
☐Ground Wire	1			Black wire, 22AWG, 7/30 stranded, PVC, 6 ft. (183 cm)
☐AC Adapter	1		18VAC 500MA	18VAC 500MA 2.1MM F AC Adapter

3 Circuit Board Component Locations

The top of the circuit board is screen printed with component outlines and component reference designators to assist you with finding where to insert parts and which way to orient certain parts that must be inserted in a specific direction. The reference designator numbers begin at the top left corner of the board and increment from left to right across the board roughly along each row of components. The references then continue to increment at the left in the next row of components. The highest numbered references are at the bottom right corner. This is a guideline only, since the components are not always in well defined rows and board layout revisions may have led to some components to being moved.



4 Tips for Inserting and Soldering Components

Inserting Components

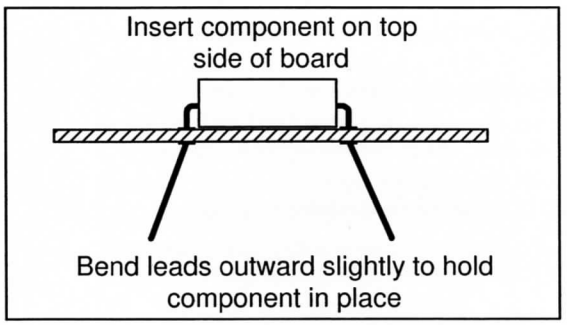
Except as noted later for transistors, all components should be mounted flush with the surface board.

All axial lead components such as resistors, chokes, and diodes require the leads to be bent at right angles. Bend the leads to match the hole spacing for each component. Leads can be bent by hand or with pliers.

All other components such as capacitors, switches, IC sockets, controls and jacks, have radial leads or pins that do not require bending other than to straighten or align leads to fit the hole spacing.

Never force a component into the board. If a component doesn't go in easily, remove it and re-bend the leads until they match the board hole pattern.

After inserting each component that has wire leads, bend the leads outward slightly at the bottom surface of the board to hold the component flush with the board while you apply solder.



Soldering

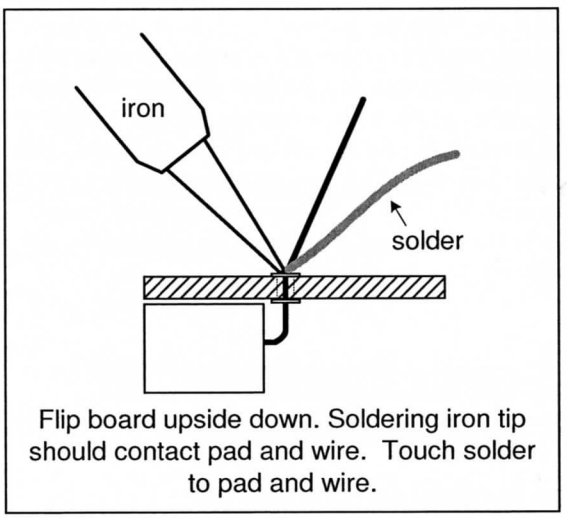
All soldering is done on the bottom side of the board. Assembly will go faster if you insert several components before you turn the board over for soldering.

Before soldering, be sure the iron is hot. This may take up to 5 minutes for some irons. Clean the soldering iron tip by wiping it on a damp cloth or sponge. Tin the tip by melting a small amount of solder over the surface of the tip. The tip should always be shiny before soldering. It will get dull with oxidation after a few minutes. When this happens, wipe and tin the tip again.

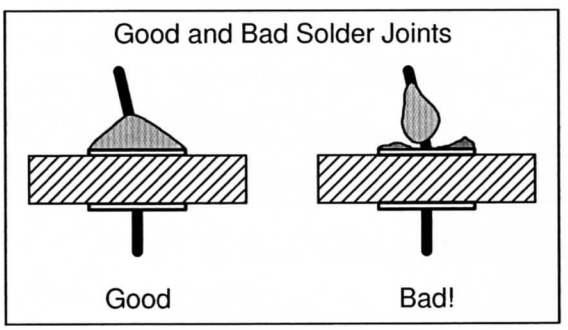
A component lead is soldered correctly when solder flows onto both the lead and the board pad, and forms a small, shiny mound over the pad. This creates a good electrical connection. A poor solder connection will cause failure of your kit to operate properly. All components used in this kit are highly reliable. If the kit doesn't work properly, the cause is very likely to be a bad solder connection.

To solder a connection place the soldering iron tip so that it contacts the board pad and the lead at the same time.

Feed the solder by touching the end of the solder to the soldering iron tip and pad simultaneously. Stop feeding solder when it looks like enough has melted to form a mound over the pad. Let the solder flow around the lead and into the hole before removing the soldering iron. If the solder doesn't melt and flow within 2 or 3 seconds, you probably need to re-clean and re-tin the tip. Never heat a connection for more than 5 seconds at a time or you could damage the component or the board.

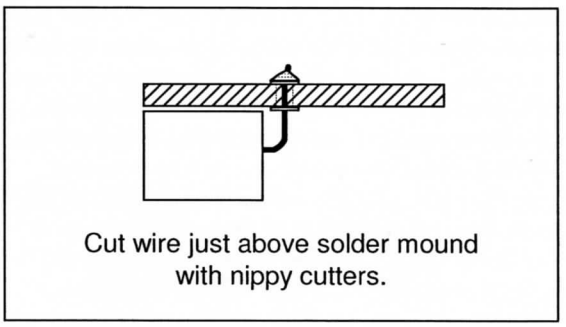


If a soldered connection doesn't look good, clean and tin the soldering iron tip again and reheat the connection while applying a little more solder if necessary.



If you accidentally apply too much solder or bridge two nearby pads on the board, use your solder removal tool to remove the excess solder. Then, re-apply solder if necessary until the connection looks good.

After soldering, cut any wire leads just above the solder mound using nipper wire cutters. Components that mount with lugs (controls and jacks) or pins (IC sockets and DIP switches) do not require the leads to be cut after soldering.



Temporary "Tack Soldering"

At several places in the assembly instructions we refer to the term "tack solder". This is a technique for holding a part in place before you apply solder properly. To tack solder a lead or pin to its board pad, clean and tin your iron and then apply addition solder to the tip until a small ball forms. Immediately touch the tip to the wire and pad to get some solder flow. This is only temporary. After you solder the other leads or pins on the component, go back and re-solder the tacked pads.

5 Step-by-Step Assembly Instructions

Fixed Resistors

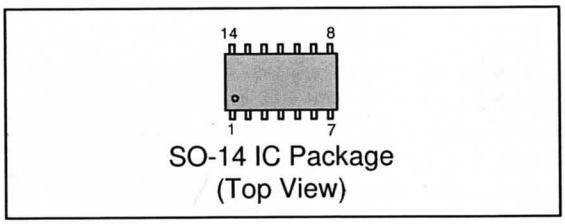
All resistors are 1/4 Watt. Only the first three color bands are shown below. You may ignore the fourth tolerance band color.

- ☐ **R8 22 ohms (red-red-black)**
- ☐ **R3 100 ohms (brown-black-brown)**
- ☐ **R25 220 ohms (red-red-brown)**
- ☐ **R28 220 ohms (red-red-brown)**
- ☐ **R29 220 ohms (red-red-brown)**
- ☐ **R7 510 ohms (green-brown-brown)**
- ☐ **R18 820 ohms (gray-red-brown)**

  Install R18 if you will be using the supplied wire antenna for in-home broadcasting and you want to use a frequency below 1000 kHz. If you will be operating exclusively above 1000 kHz, do not install R18. Also, do not install R18 if you will be using the external base-loaded vertical antenna described at: **http://www.sstran.com/pages/sstran_buildant.html.** Removal of R18 is one step in the transmitter modifications required for use with the vertical antenna. See the complete modification instructions at: **http://www.sstran.com/pages/sstran_amt3000mods.html**

- ☐ **R12 1K ohms (brown-black-red)**
- ☐ **R21 1K ohms (brown-black-red)**
- ☐ **R31 1K ohms (brown-black-red)**
- ☐ **R17 1.5K ohms (brown-green-red)**
- ☐ **R27 1.8K ohms (brown-gray-red)**
- ☐ **R4 2.7k ohms (red-violet-red)**
- ☐ **R23 4.7K ohms (yellow-violet-red)**
- ☐ **R30 4.7K ohms (yellow-violet-red)**
- ☐ **R10 6.8K ohms (blue-gray-red)**
- ☐ **R6 8.2K ohms (gray-red-red)**
- ☐ **R19 10K ohms (brown-black-orange)**
- ☐ **R22 10K ohms (brown-black-orange)**
- ☐ **R32 10K ohms (brown-black-orange)**
- ☐ **R16 15K ohms (brown-green-orange)**
- ☐ **R5 27K ohms (red-violet-orange)**
- ☐ **R33 30K ohms (orange-black-orange)**
- ☐ **R1 47k ohms (yellow-violet-orange)**
- ☐ **R2 47k ohms (yellow-violet-orange)**
- ☐ **R9 47k ohms (yellow-violet-orange)**
- ☐ **R26 100K ohms (brown-black-yellow)**
- ☐ **R14 220K ohms (red-red-yellow)**
- ☐ **R11 1M ohms (brown-black-green)**
- ☐ **R15 1M ohms (brown-black-green)**
- ☐ **R20 1M ohms (brown-black-green)**

Surface Mount IC



SO-14 IC Package
(Top View)

Important: ICs are static sensitive. Touch a grounded surface to discharge any static electricity from your body before handling the ICs. Avoid shuffling your feet or sliding around on a chair while handling the ICs. If you move around, touch a grounded surface again.

Soldering the surface mount IC (U6) requires some extra care. Just take a little more time on this one, it really isn't hard to do. If you have trouble seeing close up, you may want to use a magnifying eye loop or a pair of inexpensive high-magnification reading glasses available from drug or variety stores. Be sure your soldering iron tip is clean and tinned, then melt a small amount of solder (not a big glob!) on the tip in preparation for tack soldering.

1. Position the IC on the board, over the outline for U6, so the dot marking lead 1 on the IC is oriented over the dot on the board outline. Slide it around until you are satisfied that the IC leads are over the pads on the board. Hold in place with a finger.
2. Tack solder one corner lead by touching the iron to the lead and pad until you get some solder flow.
3. Recheck alignment of the remaining leads. Reposition the IC slightly if necessary to get alignment. Then tack solder the lead on the diagonally opposite corner from the one you just did. The IC is now firmly in place.
4. Solder the remaining leads normally. Because so little solder is required on each lead, it works well to apply a small amount of solder to the tip and then touch the tip to a lead and pad. Repeat this for each lead. *
5. Go back to your original corner leads and ensure they are soldered properly.

* If you accidentally bridge two adjacent leads with solder, don't panic! It's no big deal. Clean and tin your soldering iron tip and wipe off excess solder. Now touch the tip to the solder between the bridged leads and slide the tip outward to wipe the bridged solder away from the leads. If this doesn't work, use your vacuum de-soldering tool to suck away the solder bridge and then reflow the leads if necessary.

☐ **U6** SSM2166S Microphone Preamplifier, 14-pin SOIC surface mount.

Chokes

The epoxy coated chokes look similar to resistors and use the same color code as resistors. They have various diameters, but all are larger than the diameter of a resistor. If you are not sure whether a device is a resistor or a choke, measure its resistance with a meter. All chokes will measure less than 15 ohms. The DC resistance of a choke is a measurement of the resistance of the wire coil and has no relation to its inductance value. The measured DC resistance of a choke will not correspond to a resistor color code interpretation.

All four color bands are shown below. The fourth "tolerance" band color may be either silver or gold for any of the inductors L4 - L7. Be sure you read the color bands correctly. Sometimes gold can be confused with brown and silver can be confused with gray. Look carefully!

☐ **L4 56 uH (green-blue-black-gold)**

☐ **L5 82 uH (gray-red-black-gold)**

☐ **L6 180 uH (brown-gray-brown-gold)**

☐ **L7 470 uH (yellow-violet-brown-silver)**

☐ **L8 1000 uH (brown-black-red-silver)**

Rectifiers and Diodes

Important: Orient rectifiers and diodes so the band on one end of the component is over the line on one end of the board outline.

Bend leads 90 degrees at the component ends to match the board hole spacing before inserting.

☐ **D1 1N4002 silicon rectifier.**

☐ **D2 1N4002 silicon rectifier.**

☐ **D3 1N4002 silicon rectifier.**

☐ **D4 1N4002 silicon rectifier.**

☐ **D5 1N914A silicon diode**

☐ **D6 1N914A silicon diode**

Resistor Network

Important: orient the resistor network SIP package so the dot marking pin-1 on the package is aligned with the dot on the board outline.

☐ **R13 10K ohms x 9, 10-Pin SIP Common Bus Resistor Network (marked 10A103GA)**

IC Sockets

Important: Orient each socket such that the semicircular notch on one end of the socket is over the notch on one end of the board outline. If you mistakenly orient a socket the wrong way, it will still work. Don't bother trying to remove it. Just be careful later when inserting the IC to orient it according to the board outline and not the reversed socket.

Before inserting, visually check that all pins are straight. Don't force the socket into the board holes. If you feel resistance, straighten any pins that aren't aligned properly. Seat the socket against the board. While holding the socket in place with a finger, tack solder 2 diagonally opposite end pins on the bottom side of the board. Solder the remaining pins and properly solder the previously tack-soldered end pins.

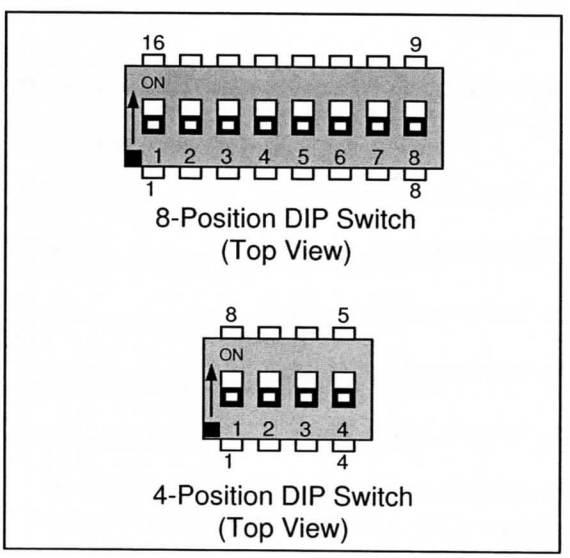
☐ **U2 16-pin DIP socket.**

☐ **U3 16-pin DIP socket.**

☐ **U5 16-pin DIP socket.**

☐ **U7 16-pin DIP socket.**

DIP Switches



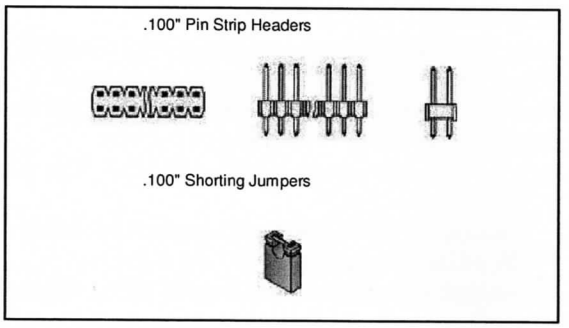
Important: Orient each switch package such that the pin-1corner is over the dot on the board outline.

Before inserting, visually check that all pins are straight. Don't force the switch into the board holes. If you feel resistance, straighten any pins that aren't aligned properly. Seat the switch against the board. While holding the switch in place with a finger, tack solder 2 diagonally opposite end pins on the bottom side of the board. Solder the remaining pins. Then properly solder the previously tack-soldered end pins.

☐ **S4 8 position DIP switch**

☐ **S5 4 position DIP switch**

Jumper Headers



The jumper headers are supplied as one strip containing six jumper header pairs. Five will be used. One spare is included in case you damage or lose one while separating them. You will need to cut this strip into individual single-pair pieces. Lay the strip on its side on a flat surface. Place the blade of a sharp utility knife in the first groove separating the jumper header pairs. Hold the knife so the blade will cut vertically downward. If the blade is angled to one side, you may damage the parts. When cutting the jumper header strip, one or both parts may fly. Use two fingers to restrain the strip on both sides of the utility knife. Apply downward pressure until the strip snaps at the groove. Repeat this procedure until you have separated all of the jumper pairs. Insert the short leads into the board. The long leads are the right length to receive the shorting plugs (installed later).

☐ **S1 Single-pair jumper header.**

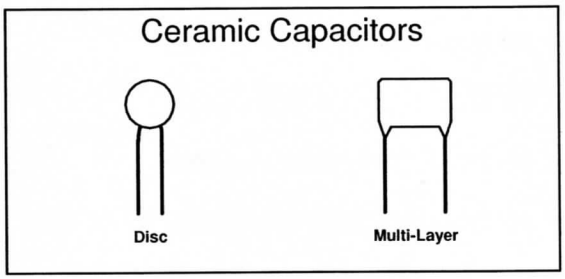
☐ **S2 Single-pair jumper header.**

☐ **S3 Single-pair jumper header.**

☐ **S6 Single-pair jumper header.**

☐ **S7 Single-pair jumper header.**

Ceramic Capacitors



The number shown in parenthesis is the value code marked on the device.

☐ **C12 33 pF (33) ceramic**

☐ **C13 33 pF (33) ceramic**

☐ **C30 180 pF (181) ceramic**

☐ **C15 200 pF (201) ceramic**

☐ **C27 200 pF (201) ceramic**

☐ **C23 820 pF (821) or 560pF (561) ceramic**

Both capacitors are supplied with your kit. Install the 820pF capacitor if you will be using the supplied wire antenna for in-home broadcasting. Install the 560pF capacitor if you will be using the external base-loaded vertical antenna described at: **http://www.sstran.com/pages/sstran_buildant.html.** Installation of the 560pF capacitor is one step in the transmitter modifications required for use with the vertical antenna. See the complete modification instructions at: **http://www.sstran.com/pages/sstran_amt3000mods.html**

☐ **C17 1000 pF (102) ceramic**

☐ **C21 1000 pF (102) ceramic**

☐ **C14 .01 uF (103 or .01) ceramic multi-layer**

☐ **C16 .01 uF (103 or .01) ceramic multi-layer**

☐ **C1 .1 uF (104 or .1) ceramic multi-layer**

☐ **C2 .1 uF (104 or .1) ceramic multi-layer**

☐ **C3 .1 uF (104 or .1) ceramic multi-layer**

☐ **C6 .1 uF (104 or .1) ceramic multi-layer**

☐ **C7 .1 uF (104 or .1) ceramic multi-layer**

☐ **C8 .1 uF (104 or .1) ceramic multi-layer**

☐ **C9 .1 uF (104 or .1) ceramic multi-layer**

☐ **C10 .1 uF (104 or .1) ceramic multi-layer**

☐ **C11 .1 uF (104 or .1) ceramic multi-layer**

☐ **C22 .1 uF (104 or .1) ceramic multi-layer**

☐ **C28 .1 uF (104 or .1) ceramic multi-layer**

☐ **C31 .1 uF (104 or .1) ceramic multi-layer**

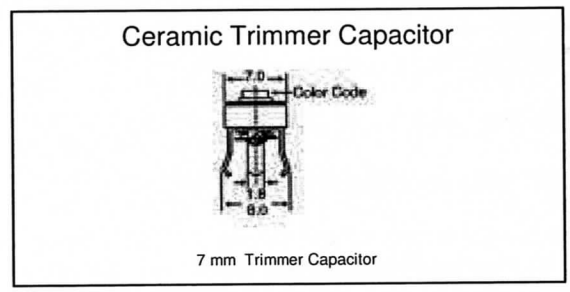
☐ **C100 .1 uF (104 or .1) ceramic multi-layer**

☐ **C101 .1 uF (104 or .1) ceramic multi-layer**

☐ **C102 .1 uF (104 or .1) ceramic multi-layer**

☐ **C103 .1 uF (104 or .1) ceramic multi-layer**

Ceramic Trimmer Capacitor



Match the shape of the trimmer capacitor to the board outline for C5. The trimmer will snap into the holes, holding it in place for soldering.

☐ **C5 12 - 100 pF 7 mm, ceramic trimmer capacitor**

Rear Panel Jacks

Important: All jacks must be seated squarely in place against the board before soldering to ensure proper alignment with the holes in the enclosure rear panel. The RCA jacks will snap into the board holes, holding them in place adequately for soldering. You may need to bend the three outer tabs slightly outward from the center to get proper snap-in action. The power jack (J3) does not snap in. You can press it against the board with a finger while tack soldering several pins to hold it in place. When soldering all jacks, flow plenty of solder until all holes are completely filled for mechanical stability.

☐ **J1 RCA phono jack with white insulator**

☐ **J2 RCA phono jack with red insulator**

☐ **J3 Power jack**

A note about antenna jack (J4): FCC rule 15.203, "Antenna Requirement", prohibits manufacturers from incorporating a readily available connector for the antenna. To comply with this rule, we must instruct you to permanently attach the antenna wire by soldering it to the circuit board. If you as the builder choose to install an antenna/ground jack on the board, the kit will then be considered to be modified by the user as regards FCC compliance and SSTRAN cannot be responsible. Instructions for attaching the antenna and ground wires appear later in this manual at the end of the step-by-step assembly instructions.

Variable Resistors

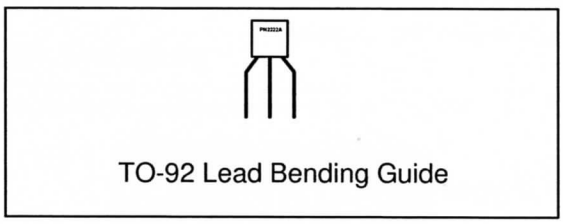
Important: like the jacks above, the variable resistors (R34, R35 and R36) must be seated squarely in place against the board before soldering so they will align properly with the holes in the enclosure front panel. They will snap into the board holes, holding them in place adequately for soldering. You may need to bend the side tabs slightly inward to get them to snap in properly.

☐ **R34 100K ohms (marked B100K)**

☐ **R35 50K ohms (marked B50K)**

☐ **R36 100K ohms (marked B100K)**

+5V Voltage Regulator and Transistors



Important: All transistors and the +5V voltage regulator have the same TO-92 package style. Because they all look alike, carefully check the part markings before insertion to get them all in the right places. Orient each component to match the board outline. Beginning at the body of the component, bend the two outer leads outward as shown in the illustration. After bending the outer leads, you should be able to insert the component until the bottom of the plastic body is about 1/8 in. or less from the board. Don't force it down. Remove and re-form the outer leads if necessary.

☐ **U4 L78L05 TO-92 +5V 0.1A VREG**

☐ **Q1 2N3906 TO-92 PNP transistor**

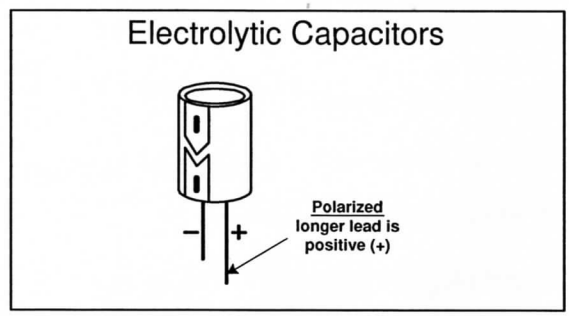
☐ **Q2 PN2222A TO-92 NPN transistor**

☐ **Q3 PN2222A TO-92 NPN transistor**

☐ **Q4 PN2222A TO-92 NPN transistor**

☐ **Q5 PN2222A TO-92 NPN transistor**

Electrolytic Capacitors



Important: Electrolytic capacitors are polarized and must be inserted in the proper direction. The shorter negative (-) lead is on the side with the vertical stripe. The longer positive (+) lead is opposite the stripe. You must insert the longer "+" lead into the hole marked with a "+" next to the board outline. During assembly think: "longer lead goes in "+" hole".

The number shown in parenthesis is the value marked on the device.

☐ **C18 4.7 uF (4.7uF) electrolytic**

☐ **C20 10 uF (10uF) electrolytic**

☐ **C24 10 uF (10uF) electrolytic**

☐ **C25 10 uF (10uF) electrolytic**

☐ **C26 10 uF (10uF) electrolytic**

☐ **C29 10 uF (10uF) electrolytic**

☐ **C32 100 uF (100uF) electrolytic**

☐ **C4 470 uF (470uF) electrolytic**

RFI Suppression Coils

These are the three large coils.

☐ **L1 1000 uH RFI Suppression Coil (marked 1000uH)**

☐ **L2 1000 uH RFI Suppression Coil (marked 1000uH)**

☐ **L3 1000 uH RFI Suppression Coil (marked 1000uH)**

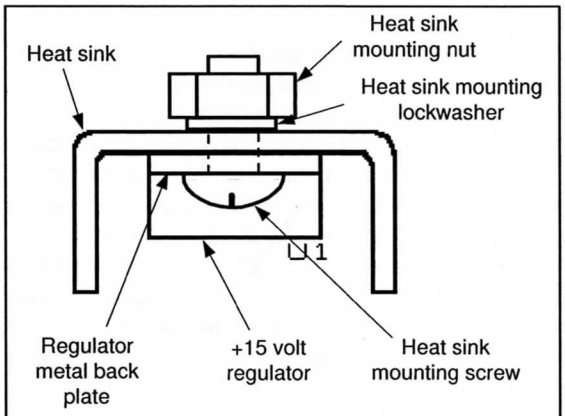
Quartz Crystal

☐ **X1 HC-49U Microprocessor Crystal (4.000) for models AMT3000 and AMT3000-SM**

OR

☐ **X1 HC-49U Microprocessor Crystal (3.600) for models AMT3000-9K and AMT3000-9KSM**

+15 Volt Regulator and Heat Sink



+15 Volt Regulator and Heat Sink Assembly (Top View)

☐ **U1 L7815 TO-220 +15V 1A VREG (L7815)**

First, innsert the +15 volt regulator at location U1, oriented such that the metal back plate on the regulator faces the rear edge of the board. Solder the regulator in place.

Now, following the illustration, mount the heat sink on the regulator. The heat sink must be oriented such that the mounting hole in the heat sink is toward the top. In this position, the bottom of the heat sink will be close to the board. Insert the mounting screw through the regulator and then through the heat sink. Install the lock washer and nut, and tighten until lock washer is compressed.

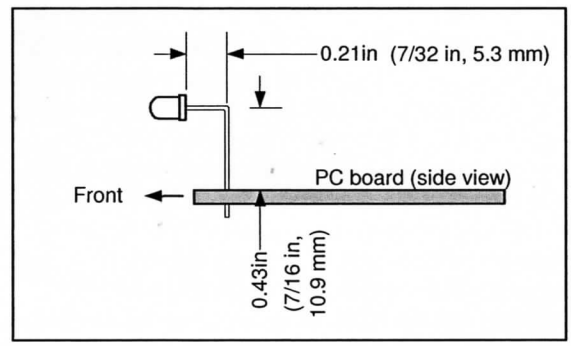
☐ **Heat Sink.**

☐ **Heat sink mounting screw (#6-32 X 1/4").**

☐ **Heat sink mounting lock washer (#6).**

☐ **Heat sink mounting nut (#6-32).**

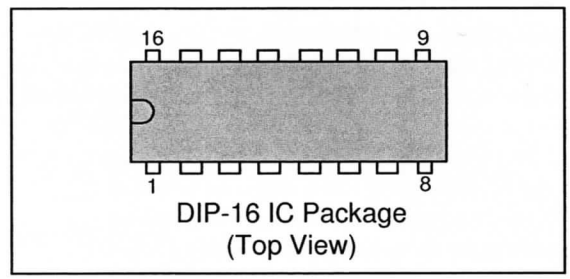
LED Power Indicator Lamp



To allow the LED lamp to properly engage the front panel hole, the leads must be bent as shown. The illustration above is printed actual size so you may use it as a template. Hold the LED horizontally with the shorter (cathode) lead facing you. Bend both leads downward at a right angle at a point .21" (7/32", 5.3 mm) from the LED body. Insert the leads into the board at location D7 with the longer lead on the "arrow" side and the shorter lead on the "line" side of the D7 "arrow/line" board outline. Slide the LED up or down in the holes until you measure .43" (7/16", 10.9 mm) from the top of the board to the bend in the leads. Tack solder one lead on the top side of the board. Re-check the height measurement and then solder the other lead and reflow solder to the tacked lead.

☐ **D7 Green LED lamp**

Insert 16-Pin ICs Into DIP Sockets



DIP-16 IC Package (Top View)

Important: ICs are static sensitive. Before handling ICs you should be sure to discharge any static electricity from your body by touching a grounded metal surface . Avoid shuffling your feet or sliding around on a chair while handling the ICs. Touch that grounded surface frequently while working with the ICs.

The ICs must be mounted in their sockets in one direction only or they may be damaged when power is applied.

The ICs are keyed with a notch in the top of one end or a dimple in the top corner of one end. Align the keyed end with the notched end of the socket (which will also be the notched end on the board component outline if the socket was installed properly).

Before inserting the ICs into their sockets you must first bend the leads on each side slightly inward to engage the socket pins properly. This can be done neatly by laying the IC on its side on a flat surface and pressing downward lightly on the IC body until the bottom leads start to bend slightly. This will keep all leads in a straight line. Do this to each side equally, Straighten any misaligned pins with your fingers or small pliers. Trial fit the IC into its socket. Re-bend any pins that are still out of alignment. When you are satisfied that all pins are aligned, press the IC as far as it will go down into the socket using firm, equal pressure on both ends. If it won't go, one or more pins may not be aligned. Remove the IC and re-bend any pins as necessary. You can remove an IC from its socket by alternately prying each end slightly with a small screwdriver until it is free.

☐ **U2 74HC4060 14-Stage Ripple Binary Counter, 16-pin DIP (74HC4060)**

☐ **U3 74HC40103 8-bit synchronous binary down counter, 16-pin DIP (74HC40103)**

☐ **U5 74HC40103 8-bit synchronous binary down counter, 16-pin DIP (74HC40103)**

☐ **U7 74HC4046 Phase-Locked Loop, 16-pin DIP (74HC4046)**

Jumper Plug Installation

Initially install the five jumper header plugs according to the following steps. You can change the options later, but this will get you going. A jumper plug may be installed in either the shorted or open position. A plug is in the shorted position when it is plugged onto both header pins. It is in the open position when only one terminal is plugged onto one pin of the header. This provides a convenient place to store the jumper plug for possible later use in the shorted position.

☐ **S1 Install in <u>shorted</u> position.**

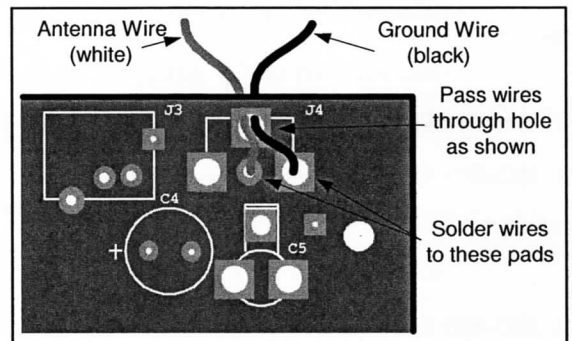
☐ **S2 Install in <u>shorted</u> position.**

☐ **S3 Install in <u>shorted</u> position.**

☐ **S6 Install in <u>open</u> position.**

☐ **S7 Install in <u>open</u> position.**

Antenna and Ground Wires



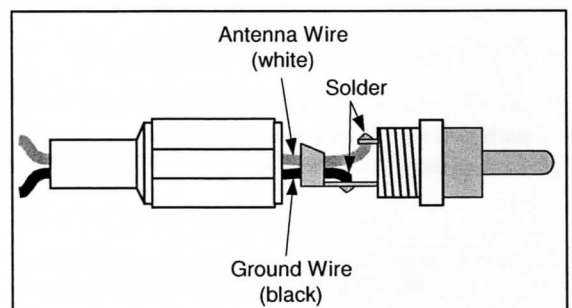
Antenna and ground wire connections on top side of board.

Using wire strippers or a sharp knife, remove about 1/8" (3.2mm) of insulation from one end of the white antenna wire and one end of the black ground wire, being careful not to nick or cut any of the wire strands.

If you previously elected to install J4 in the "Rear Panel Jacks" step, skip to the RCA plug assembly instructions below. Otherwise, pass the wires up from the bottom side of the board through the hole shown in the illustration This will provide strain relief. Then on the top side, insert the stripped ends of the wires into the holes shown in the illustration. Solder the stripped ends of the wires into the holes.

☐ **Antenna Wire White, 118 in.**

☐ **Ground Wire Black, 72 in.**



Antenna and ground wire connections to RCA phono plug

Separate the handle from the plug by unscrewing the handle. Pass both wires through the handle as shown. Solder the wires to the plug terminals as illustrated being careful to connect the white wire to the center pin

terminal and the black wire to the outer ring terminal. Screw the handle back on to the plug.

Congratulations! Your board is now fully assembled.

6 Final Checks

Your board is now fully assembled. Take a little time now to visually check your work. Here are some final inspection steps.

- Are all step-by-step assembly instructions checked in this manual?
- Are all electrolytic capacitors, diodes, transistors, voltage regulators and ICs installed in the proper direction?
- Visually inspect the board with a magnifying glass. Look at every pad on the bottom of the board systematically from one corner to the opposite diagonal corner. Look for: unsoldered or poorly soldered connections, wires not clipped properly, solder bridges between adjacent pads, and wires that may be bent over and touching a nearby pad.

7 Power On Check

Place the assembled circuit board on an insulated surface such as a wooden table top or a sheet of cardboard, plastic or heavy paper.

Plug the AC adapter cord into the power jack (J3).

For initial testing, just string the antenna and ground wires out away from the board. The ground wire doesn't need to be connected to ground for initial testing.

Connect an audio source such as a CD or cassette player to the audio input jacks, J1 and J2.

Plug the AC adapter into a 120 volt outlet. The green LED power indicator should light up.

Follow the procedures in section 8, "RF Tuning" and section 9, "Audio Adjustments" to verify the unit is operational.

8 RF Tuning

Setting the Frequency

Find a clear frequency on a nearby AM radio receiver between 530 kHz and 1700 kHz. Try to choose a clear frequency at the high end of the band. The antenna operates more efficiently at higher frequencies. Find your desired frequency in the chart in section 19, "Synthesizer Frequency Selection Chart", of this manual. Set the 8-position frequency selection DIP switch (S4) according to the chart. Use a small screwdriver to slide each of the eight switches to the specified on or off position.

Setting the RF Output Tuning Range

Set the tuning range that includes your desired frequency on the 4-position DIP switch (S5) according to the chart in section 20, "RF Output Tuning Range Selection", of this manual. Use a small screwdriver to slide each of the four switches to the specified on or off position.

Peaking the RF Output

Locate the meter test point holes labeled T1 and T2 on the right side of your circuit board. Insert the positive (red) probe from your meter into T1. Insert the negative (black) probe into T2. The meter mode and range switches should be initially set to measure voltages as high as about 15 VDC. The meter must be a 10 megohm/volt or higher analog or digital meter to give a good reading. Turn the GAIN, MODULATION and COMPRESSION controls fully counterclockwise. Use a small screwdriver to adjust the trimmer capacitor, C5, through its entire range (one full turn) until you observe a voltage peak. Usually you will see two voltage peaks as you rotate one full turn. Either peak may be chosen. Set the trimmer at the high point of the peak. Note this voltage reading. Next try setting the output tuning range switch, S5, to the next lower or higher range and re-tune the trimmer capacitor. Repeat until you find the S5 switch setting that give the highest voltage peak. If you are using a digital meter, peak by adjusting the trimmer slightly and waiting for a stable reading, Repeat until you are satisfied with the peak. Don't try to get a precise peak down to the last digit! A reading within one volt of peak is satisfactory.

9 Audio Adjustments

Front Panel Control Functions

Gain Control

The gain control varies the audio level feeding the SSM2166 preamplifier stage and serves to compensate for a wide range of possible audio input levels. Rotating the control clockwise increases the gain.

Modulation Control

The modulation control sets the limiting level of the compressor/limiter . Rotating the control clockwise increases the limiting level, which in turn, increases the

maximum amplitude of the audio to the modulation stage, increasing the modulation percentage.

Compression Control

The compression control varies the audio compression over a range between 1:1 (no compression) and 5:1 (maximum compression). Rotating the control clockwise increases compression.

Audio Adjustment Procedure

Initially set the three front panel controls as follows: *Gain* control fully clockwise, *Modulation* and *Compression* controls fully counterclockwise. Connect an audio source playing music that has a fairly constant volume range. Listen on a nearby radio. Follow these steps:

Rotate the *Modulation* control clockwise until the received signal begins to distort due to over-modulation. Back off from this point until the distortion goes away. This is approximately the 100% modulation point.
Rotate the *Gain* control counterclockwise until you reach a point where the volume just begins to decrease. At this point limiting will only occur on audio peaks.
The *Compression* control may be set in any position according to your preferences. A good way to observe the effect of the Compression control is to play a classical music CD with very quiet and very loud portions. As the Compression control is rotated clockwise you will notice that the volume of the quiet and loud portions begin to be the same.

Don't confuse over-modulation distortion with distortion that may be caused by your receiver being overloaded by the strong RF signal from the transmitter. If necessary, move the receiver farther away or reorient it to reduce the signal being picked up by it's antenna.

Your audio source level may not be high enough if you can't reach the distortion point in step 2 with both the Gain and Modulation controls in their maximum clockwise positions and the Compression control in the full counterclockwise position. You can compensate for lower level inputs by increasing the Compression. This will boost the audio signal, but you may get more compression than you desire, depending on your tastes.

10 Board Jumper Options

The four jumper headers labeled S1, S2, S3 and S6 on the circuit board provide grounding options and a treble boost option. Jumper header S7 should always remain open.

A Word About AC Building Wiring Interference Problems

RF isolation of the transmitter ground from the AC building wiring may be of benefit if you experience hum induced on the transmitted signal due to interaction of the transmitted RF field and the AC building wiring. The RFI suppression coils (L1, L2 and L3) may optionally be inserted in series with the ground paths to an AC powered audio source device (L1) and to the AC wiring through the AC wall adapter (L2 and L3). With all three coils enabled (not shorted by jumper plugs), you must connect the transmitter black ground wire to an earth ground or the transmitter will not function properly.

In general it is better to operate without RF ground isolation. Your transmitter range will generally be farther without RF ground isolation. Before you use the isolation options to reduce possible hum, thoroughly check your audio source connection for hum problems. Hum on the audio signal is usually caused by a break in the shield connection in the audio cable or in an audio connector.

Jumper Plug S1: Audio Source RF Isolation

Jumper S1 allows you to optionally connect the transmitter ground directly to the audio input cable ground (S1 jumper in shorted position) or to insert L1 in series with the ground side of the two audio jacks (S1 jumper in open position).

If you choose the isolation option (S1 jumper open) you may not experience much difference unless you also choose the open positions for S2 and S3. Otherwise there is still a ground path to the AC wiring through the AC adapter. Also with S1 in the open position you may need to connect the black transmitter ground wire to a good earth ground point. You will need to re-peak the trimmer capacitor, C5, each time to change the S1 option.

Jumper Plugs S2 and S3: AC Adapter RF Isolation

Jumpers S2 and S3 allow you to optionally isolate the transmitter from the RF ground path through the AC adapter transformer to the building wiring. With jumpers S2 and S3 removed, the RFI suppression coils, L2 and L3 are placed in series with the two wires from the AC adapter. You will need to re-peak the trimmer capacitor, C5, each time to change the S2 and S3 options.

Jumper Plug S6: Treble Boost

Installing jumper plug S6 in the shorted position will add about 8 dB of treble boost to the audio with the midpoint of the boost curve at 2 kHz. Installing S6 in the open position will result in a flat audio response.

Since treble boost is introduced after the SSM2166 compressor/limiter, you will probably need to readjust the modulation control counterclockwise somewhat to prevent over-modulation distortion at the higher audio frequencies.

Jumper Plug S7: Meter Resistor Bypass

This jumper header must always remain open for normal operation with the supplied wire antenna.

Jumper S7 allows shorting across resistor R14 in the meter driving circuit when you use the external base-loaded vertical antenna described at:
http://www.sstran.com/pages/sstran_buildant.html.
Shorting across resistor R14 is one step in the transmitter modifications required for use with the vertical antenna. See the complete modification instructions at:
http://www.sstran.com/pages/sstran_amt3000mods.html

11 Mounting the Board in the Enclosure

First locate all enclosure parts:

- Plastic enclosure bottom section (.375" high)
- Plastic enclosure top section (1.1" high)
- Black plastic front and rear panels
- Four #4 X 1/4" thread forming screws
- Two #4 X 3/4" thread forming screws
- Four self-adhesive enclosure feet.
- Three control knobs

Mount the printed circuit board and assemble the enclosure using the following steps:

1. Separate the four self-adhesive enclosure feet with scissors or a sharp knife. Peal off the backing paper and attach the feet to the bottom of the enclosure near the four corners.
2. Slide the front panel down into the slot on one of the wide sides of the bottom enclosure section (the enclosure is symmetrical with respect to front and rear, it doesn't matter which wide side you pick).
3. Lay the board down on the bottom enclosure section and slide it forward so that the control shafts protrude through the front panel holes.
4. Lift the rear of the board slightly and hold the black plastic rear panel over the jacks while sliding the rear panel down into the slot at the rear of the bottom enclosure section.
5. Reposition the board so the four mounting screw holes in the board align with the four plastic screw bosses on the bottom enclosure section. Check that the power indicator LED is engaged into the hole in the front panel. You may need to bend the LED leads slightly to properly position the LED in the front panel hole.
6. Secure the board to the bottom enclosure section with four #4 X 1/4" thread forming screws. Tighten the screws only to the point where there is no longer any movement of the board.
7. Mount the three control knobs on the front-panel control shafts. To mount a knob, loosen the set screw with a small-blade screwdriver, slide the knob onto the shaft as far as it will go without contacting the panel and then tighten the set screw lightly against the control shaft to hold the knob in place.

Leave the top enclosure section off for now to allow access for re-tuning after you move the transmitter to its final location.

12 Final Installation

The location of your transmitter will affect its range. Generally the higher the better, However, its range is adequate to cover a whole house no matter where it is located, even in a basement. Because it draws so little AC power, you may elect to place it out of the way on a shelf or in a closet and leave it powered on continuously. Once you set the tuning and audio controls properly, your transmitter will not require further adjustment. You may use extra long audio cables (up to 25 ft) to feed the transmitter if it is located remotely from the audio source. Cables longer than 25 ft. may attenuate higher audio frequencies due to the additional capacitance of the cables. If you use longer cables, you may be able to compensate for audio high frequency loss by enabling the transmitter treble boost option or by boosting the treble at the audio source.

FCC Antenna Rules

When installing your transmitter, keep in mind the FCC rule that governs antenna and ground lengths. Rule 15.219 states:
"The total length of the transmission line, antenna and ground lead (if used) shall not exceed 3 meters." Your transmitter does not have a transmission line, so you only need to be concerned with the total length of the white antenna wire and the black ground wire (if used). This total length is not to exceed 3 meters. You may need to cut the wires that are supplied in order to comply with this requirement.

Antenna Location

For best range the white antenna wire should be strung as vertically as possible and should be positioned away from grounded metal objects and electrical wiring. Secure the antenna wire as needed to keep it from moving around to prevent tuning variations.

Ground

A good, low impedance ground is required for best range. Just as a transmitter will not work without an antenna, it likewise will not work without a ground. A "ground" is simply any path from the transmitter circuit ground to earth ground that provides a low RF impedance. The AMT3000 has been designed to provide a low RF impedance path to ground through the AC adapter and your building wiring. Additionally, when you connect the transmitter via audio cables to an AC powered audio source, there is likely to be a low RF impedance through the audio cable outer shields and then through the building wiring connected to the audio source device. These "built in" ground paths will provide good performance in many cases, but variations in building wiring and transmitter location may require you to ground the transmitter directly to a separate earth ground. You should experiment by connecting the AMT3000 black ground wire to whatever ground sources are available at your transmitter location until you find the optimum arrangement. You can try connecting the ground wire to the center screw on a wall outlet, a copper water pipe, a copper heating pipe, or possibly a forced air heating register if your ductwork provides a continuous conductive path back to the furnace ground. Also one or more interconnected grounding rods driven into the earth will work well. Grounding rods are available at electrical supply stores. Also a very good ground can be established by burying bare copper wires so they fan out in a radial pattern from a center common point connected to the transmitter ground wire.

Refer back to section 10, "Board Jumper Options" for the optional ground isolation jumper settings. You can experiment with different jumper options and ground wire connections if you are not satisfied with the "default" shorted position of jumpers S1, S2 and S3.

Check Tuning

Whenever you change the antenna position or ground connection you will need to re-peak the RF output. Generally, all that is required is to readjust the trimmer capacitor, C5, but in some cases, you may need to set the 4-position DIP switch S5 to the next higher or lower tuning range to get the highest voltage peak on your meter.

Finish Assembling Enclosure

1. Orient the top enclosure section with respect to the bottom section so that the tabs and slots on the sides will engage properly (the top mates with the bottom only one way).
2. Slip the top enclosure section down over the front and rear panels so that the panels engage the slots in the front and rear of the top enclosure section.
3. Secure the top enclosure section to the bottom enclosure sections using two #4 X 3/4" thread forming screws inserted through the two holes on the bottom side of the enclosure. Tighten only to the point where there is no longer any play between the enclosure sections. These two screws may be removed at any time to access the circuit board for frequency changes or re-tuning if the location of the transmitter or antenna is changed.

13 Troubleshooting

If your transmitter does not work, the cause is most likely one of the following:

- Unsoldered or poorly soldered connections.
- Solder shorts across adjacent pads
- Components mounted in the wrong locations
- Polarized components mounted in the wrong orientation
- Misinterpretation or mistakes made when setting DIP switches.

Start troubleshooting by carefully inspecting all the solder connections. Look for unsoldered connections and solder bridges across adjacent pads. While inspecting, keep your soldering iron plugged in and ready. If you see any connection that looks the least bit suspect, re-solder it just to be sure.

Check the installation of all parts for proper location and orientation. Check the 16-pin ICs for any pins that may have been bent while plugging them into their sockets.

In the unlikely event of a component failure, you will need some knowledge of electronic troubleshooting methods and an understanding of how the transmitter operates. Refer to section 14, "Theory of Operation" and to section 0, "Circuit Diagram" to learn how the transmitter works.

Start by checking the voltages at the power pin of all IC's with a meter. Also check the voltages marked on the schematic around the transistors in the modulator and RF output stages.

You can home in on a problem by first determining whether it is in the RF or the Audio section of your transmitter. If you can receive the carrier at the frequency you have selected, but there is no audio, then the problem is in the audio sections. If you can't receive the carrier at all, then the problem is in the synthesizer of RF output stage.

Use of an oscilloscope to trace back to the failing area will make troubleshooting much easier.

If you are really stuck, or don't want to spend the time fixing it, refer to section 15, "Warranty, Return and Service Policy" for information on our repair service.

14 Theory of Operation

This section presents a description of the operation of the AMT3000. Referring to the circuit diagram in section 0 will aid in understanding the description.

The AMT3000 has five major functional sections: (1) Oscillator and Frequency Synthesizer, (2) RF Power Output, (3) Preamplifier and Compressor/Limiter (4), Modulator and (5) Power Supply.

Oscillator and Frequency Synthesizer Section

IC U2 serves as both a crystal oscillator and a frequency divider. The oscillator produces a 4 mHz signal whose frequency is determined by the 4.000 mHz Quartz Crystal (X1). The oscillator output is then divided by 16 to produce a 250 kHz square wave at U2 pin 7. IC U5 further divides the 250 kHz output of U2 by 25 to produce a constant 10 kHz reference signal at U5 pin 14.

ICs U7 and U3 work together as a programmable frequency multiplier. The 10 kHz reference signal is multiplied by the integer value selected by dip switch (S4) to produce the final AM band output frequency in 10 kHz increments. U7 is a phase locked loop (PLL), containing a phase comparator and a voltage controlled oscillator (VCO). The VCO is set to operate in the AM broadcast band range by capacitor C30 and resistor R23. The VCO output at U7 pin 4 feeds the U3 CP (clock) input, U3 pin 1. IC U3 counts down by one on every clock. When the counter reaches zero, it automatically parallel loads from the 8 input pins (P7-P0). Each input pin, P7-P0, is high (logic 1) or low (logic 0) when its switch is open or closed respectively. U3 output pin 14 pulses low for one clock while the count equals zero, producing a waveform that has a frequency equal to the VCO frequency divided by $n+1$ where n is the binary value of S4. The divided VCO frequency is connected back to the PLL phase comparator CMP IN input, U7 pin 3. The phase comparator PH CMP II output, U7 pin 13, produces high-level pulses when the divided VCO frequency is lower than the 10 kHz reference frequency, U7 pin 14 (SIGNAL IN), and produces low-level pulses when the divided VCO frequency is higher than 10 kHz. When the two frequencies are equal, the PH CMP II output of U7 goes to a high impedance state and the PLL is in the locked state.

Resistors R26 and R25 and capacitor C20 form a low-pass filter to smooth the pulses from the PH CMP II output pin resulting in a DC voltage which is connected to U7 input pin 9 (VCO IN) to control the VCO frequency. The average value of VCO IN will rise or fall, raising or lowering the VCO frequency, until the SIGNAL IN and CMP IN frequencies and phases are identical at which point the PLL becomes locked. This voltage is held by capacitor C20 while the PH CMP II output is in the high impedance state. Any drifting of the VCO frequency causes PH CMP II to pulse high or low as required until the frequency is corrected.

Complete descriptions of the 74HC-series ICs used in the AMT3000 are provided in datasheets available in downloadable PDF form from various manufacturer's websites. You can find the datasheet for a particular part by searching the web for "74HCxxxx datasheet".

RF Power Output Section

The design of the RF power output stage of the AMT3000 is an important contributor to its overall modulation quality. The output stage operates in class C mode, which simply means that the output transistor switches fully on and fully off at the RF carrier frequency rate. This results in higher efficiency than output stages that operate in the linear region. Modulation is applied to the output stage by varying the on-state emitter current to the output transistor at the input audio rate.

Output transistors Q4 and Q5 are connected to form a differential pair switching circuit. The VCO OUT signal from U7 pin 4 is applied to the base of Q4 through C31 and R27. Q4 is driven into saturation (on-state) when VCO OUT is high and to cutoff (off-state) when VCO OUT is low. Due to the biasing and common emitter connection of Q4 and Q5, when Q4 switches on, Q5 switches off, and vice versa. The current, determined by Q2, flows through either Q4 when VCO OUT is high or through Q5 when VCO OUT is low.

The transmitter RF output is taken from the collector of Q5, through DC blocking capacitor C22, to the pi-network tuning and antenna matching circuit. Because Q5 switches fully on and fully off at the RF rate, the Q5 collector current switches between zero and the instantaneous audio-rate current determined by modulation transistor Q2. The instantaneous modulation current determines the amplitude of the RF output signal, thus achieving amplitude modulation. For a 100% modulated carrier, Q5 collector current will vary at the audio rate from zero at full negative modulation to twice the un-modulated current at full positive modulation. RF choke L8 allows DC current to flow to Q5 but blocks the RF output from being shorted to the +15 volt supply. Resistor R18 across L8 limits the voltage swing across L8 to maintain a good modulated RF envelope for poorly tuned or very short antennas. It has little effect when a normal 2 - 3 meter long antenna is used and the output network is tuned properly.

The pi-network antenna matching circuit, consisting of C23, L4-L7 and tuning capacitor C5, is designed to transform the low impedance at the collector of Q5 to the high impedance of a short (3 meter) antenna. The resonant frequency is determined by the switch-selectable combined inductance of L4, L5, L6 and L7, and the total capacitance of C23 in series with the parallel combination of tuning capacitor C5 and the antenna capacitance. Switch S5 allows selectively shorting each of the four inductors, yielding 15 inductance values ranging from 56 uH minimum to 788 uH maximum. The variable tuning capacitor, C5, allows resonant peaking over a range of frequencies for each selected inductance value. The frequency range graph in section 20 shows the approximate tuning range for each setting of switch S5. The ranges are designed to overlap significantly to assure coverage of all frequencies. For any given frequency S4 should be set for the maximum inductance that still covers the desired frequency of operation. This minimizes the capacitance of C5 that is required for resonance resulting in more power being delivered to the antenna.

Preamplifier and Compressor/Limiter Section

IC U6 provides the functions of audio amplification and variable audio compression and limiting. Audio input signals connected to J1 and J2 are isolated from each other by R1 and R2 and summed across the GAIN control (R34). Even though the AMT3000 is monophonic, two inputs are provided for properly mixing stereo audio sources. A mono source may be connected to either J1 or J2. The GAIN control allows attenuating very high level input signals to prevent overloading the preamplifier input. The mixed audio signal is applied through C28 to U6 pin 7 (+ AUDIO IN). C27 is an RF bypass capacitor to prevent stray transmitter RF from being coupled into the high impedance U6 input. The gain of the U6 preamplifier stage is set at 12 dB by resistors R32 and R33. Capacitor C24 couples the preamplifier output to the Voltage Controlled Amplifier (VCA) input. The VCA is where the compression and limiting functions occur. Resistor R19 sets the VCA gain at 16 dB. The output of the VCA appears on U6 pin 13 (OUTPUT) and feeds the transmitter modulation stage. The COMPRESSION control, variable resistor R36, controls the audio compression ratio . R36 may be adjusted to set compression anywhere between a minimum 1:1 dB ratio (no compression) to a maximum 5:1 dB ratio. Audio compression reduces the dynamic range of the audio source, which in turn allows maintaining a higher average modulation level. The MODULATION control, variable resistor R35, controls the limiter function "rotation point". Any audio peaks above the selected rotation point are compressed at a very high 15:1 dB ratio, independently of the setting of the COMPRESSION control. This prevents the output of the VCA from significantly exceeding the rotation point amplitude. R35 is normally adjusted so the rotation point is just below the 100% modulation point. This prevents over-modulation distortion and allows a high average modulation level.

A complete description of the SSM2166 is provided in the datasheet available in downloadable PDF form at the Analog Devices website, which may be found by searching the web for "SSM2166 datasheet".

RFI suppression coil L1 connects between the outer ground terminals of J1 and J2 and the transmitter circuit ground. Jumper S1 allows L1 to be switched in or out of the ground path. With S1 in the open position L1 blocks RF from flowing through the audio cable shields back through the ground of the audio source device to the power lines. With jumpers S1, S2 and S3 (S2 and S3 are described below in the power supply section) all in the open position the transmitter circuit ground is completely RF isolated from paths to the power lines through the audio cables and the AC power adapter.

Modulator Section

The audio output signal from U6 pin 13 is coupled to the base of Q3 through C18, R17 and R16. Treble boost capacitor, C16, can be optionally connected in parallel with R16 by shorting jumper S6 to emphasize audio high frequencies. Emphasis occurs because the impedance of C16 is much lower than the resistance of R16 at higher audio frequencies. Lower frequencies are attenuated by R16, while higher frequencies are bypassed around R16 through C16.

Q3 and Q2 are configured as a Darlington amplifier which has high input impedance and high current gain. Since the SSM2166 (U6) is designed to drive a minimum load impedance of 5 K ohms, the bias resistors for Q3 and Q2 have been selected to present a load greater than 5 K ohms to U6 while at the same time keeping the values low enough to swamp out DC current gain variations in Q3 and Q2. This is important for keeping the input power to the RF output section as close to 100 mW as practicable. Transistor Q2 determines the current drawn by the RF output stage. With no audio input, Q2 is biased such that the input power to the RF output stage is 100 mW. The Q2 collector current varies linearly with an applied audio signal causing the RF output stage to be amplitude modulated. Transistor Q1 supplies a current of several milliamps to the collector of Q2 in parallel with the current flowing from the RF output transistors. 100% negative modulation occurs when Q2 collector current drops to the level of the current supplied by Q1. At this point, no current flows from the RF output transistors, but Q1 still supplies current to Q2. Without the small current supplied by Q1, Q2 would need to go to complete cutoff at negative modulation peaks causing some distortion near cutoff.

Power Supply Section

The power supply section consists of an RF filter section, a bridge rectifier, a +15 volt voltage regulator (U1) and a +5 volt voltage regulator (U4).

The wall transformer supplies 18 volt RMS AC power to the AMT3000 at the power jack (J3). Inductors L3 and L4 can optionally be included in the path or not by opening or shorting jumpers S2 and S3. With the jumpers in the open position L2 and L3 prevent transmitter RF from being coupled back to the AC power lines to help alleviate hum problems that are sometimes encountered due to interaction of the AC power lines with transmitter RF coupled to the power lines through the wall transformer. For most installations jumpers S2 and S3 can be kept in the shorted position to take advantage of the additional ground path provided by the AC lines.

The full wave bridge rectifier, consisting of diodes D1, D2, D3 and D4, converts the AC input to pulsating DC, which is then smoothed by filter capacitor C4. Each diode is bypassed with a .1 uF capacitor to assure a low RF impedance across the diode when the diode is in the non-conductive reverse-biased portion of the AC cycle. This prevents possible 120 Hz hum modulation that can be induced when the RF impedance to earth ground through the power lines varies with the on/off state of the diodes. Voltage regulator U1 supplies regulated +15 volts to the RF output and modulation stages. It also feeds voltage regulator U4, which provides regulated voltage at +5 volts for powering the ICs.

The 18 volt RMS input voltage level is conservatively high enough to assure that the ripple troughs of the smoothed DC at the input to the +15 volt regulator are well above the minimum value specified for the 7815 regulator to assure full regulation. This conservatively high DC regulator input voltage causes U1 to run too hot to touch without the small heat sink supplied. Since U1 does not get hot enough to exceed its maximum rating without the heat sink, the usual procedure of applying silicone heat sink compound is not necessary. Firmly bolting the heat sink to U1 is sufficient to dissipate enough heat to allow U1 to be touched without the danger of skin burns.

15 Warranty, Return and Service Policy

Warranty

SSTRAN guarantees that all AMT3000 kit parts listed in section 2, "Parts List", of this manual will be included in your kit and are not damaged at the time the kit is shipped. A part is damaged if it is physically broken, cracked or crushed. Parts with bent wire leads or pins that can be straightened and aligned are not considered to be damaged. If a part is missing from your kit or a part is damaged, we will replace it at no charge. If your kit has been severely damaged during shipment, it is your responsibility to report the damage to the shipper and arrange a settlement with the shipper. If minor shipping damage occurs, we will replace the damaged parts free of charge. If you damage a part during kit assembly, we will replace it for a reasonable charge. You may request a replacement part by sending an e-mail to support@sstran.com. Be sure to include your name, shipping address, the date when you ordered your kit, a description of the damage, and the complete description of the part as shown in the parts list. We will reply promptly with price and ordering instructions.

Returns

If for any reason you are not satisfied with your AMT3000 kit, you may return it for a full refund within 30 days provided that the returned kit has all parts in their original condition. We cannot accept returns of kits that have been partially or completely assembled.

Service

For a flat fee of $30.00 plus shipping, we will repair and test your assembled kit. You may send us your completed kit via pre-paid shipping . We will evaluate the condition of your assembled kit, replace defective parts, test it for proper operation and return it to you. If our evaluation indicates that the assembled kit is not repairable, we will return it to you and refund the $30.00 repair fee.

How to Contact SSTRAN

Send an e-mail to: support@sstran.com.

If you prefer to contact us by mail, send your request to:

Customer Service
SSTRAN
3053 Griffith Rd.
Norristown, PA 19403

16 About FCC Part 15 Regulations

For users in the United States it is important that you be aware of the FCC rules applying to the use of unlicensed low-power transmitters. You can access the rules at: http://www.fcc.gov/oet/info/rules/. If this link becomes outdated, you can find the information by searching the web for "fcc part 15 rules".

The FCC rules exist to prevent harmful interference to other electrical devices such as radio receivers, telephones

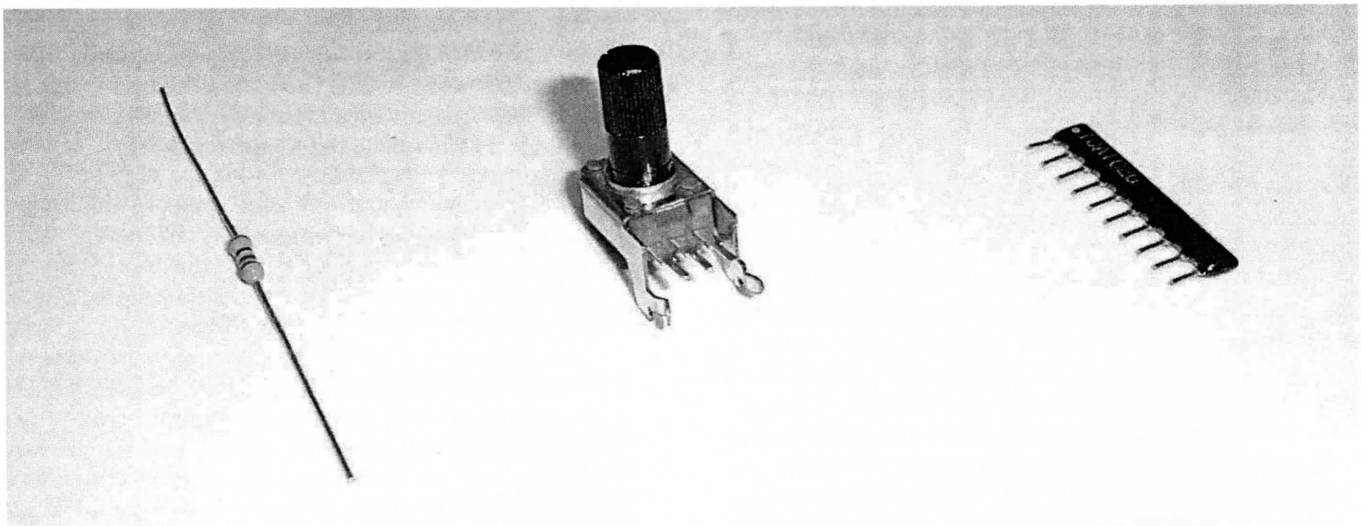
and sensitive electronic equipment. It is your responsibility to take precautions to ensure that your transmitter does not cause harmful interference. If you use your transmitter responsibly, you are not likely to experience any problems with the FCC. Always select the clearest frequency available in your area. This will reduce the likelihood that you will interfere with a licensed station that other people within your transmitter's range may be receiving. Do not broadcast offensive material that may result in complaints to the FCC. If the FCC does investigate a complaint, they will usually just request that you change your operation to remove the cause of the complaint. This may just involve switching to a different frequency or reducing your signal level by changing your antenna configuration. You must comply with FCC directives. FCC part 15.5 applies to this situation.

Most of the rules in part 15 do not apply to operation of low-power AM transmitters. Part 15 regulates the operation of all sorts of intentional and unintentional radiators. There are, however, some important paragraphs that you should read to gain an understanding of the applicable rules:

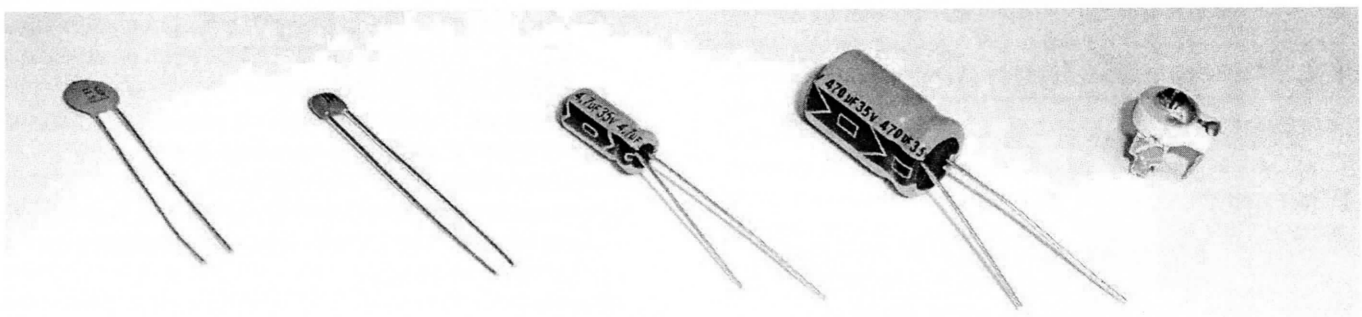
15.5 General conditions of operation.
15.35 Measurement detector functions and bandwidths.
15.203 Antenna requirement.
15.205 Restricted bands of operation.
15.209 Radiated emission limits; general requirements.
15.215 Additional provisions to the general radiated emission limitations.
15.219 Operation in the band 510-1705 kHz.

Rule 15.219 is particularly important for legal operation of the AMT3000. The AMT3000 input power to the final RF stage is designed to be 100 milliwatts. As long as you do not exceed the 3 meter limit for the total length of the antenna and ground lead wires, your transmitter will be compliant.

17 Component Identification



Fixed 1/4 Watt Resistor | Variable Resistor | Resistor SIP Pack

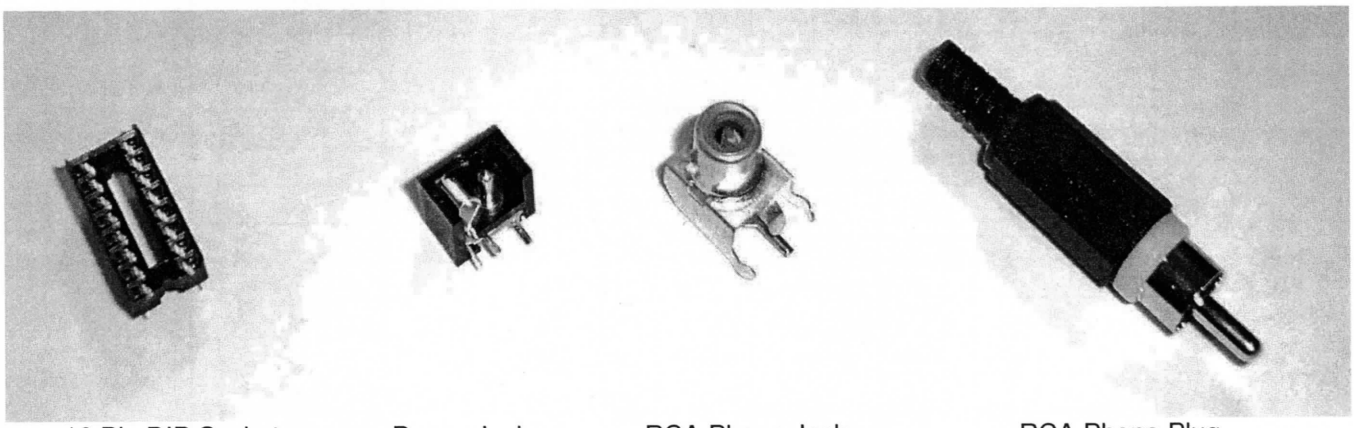


Ceramic Disc Capacitor | Multi-Layer Ceramic Capacitor | Small Electrolytic Capacitor | Large Electrolytic Capacitor | Ceramic Trimmer Capacitor

Epoxy Coated Choke

RFI Suppression Coil

Quartz Crystal

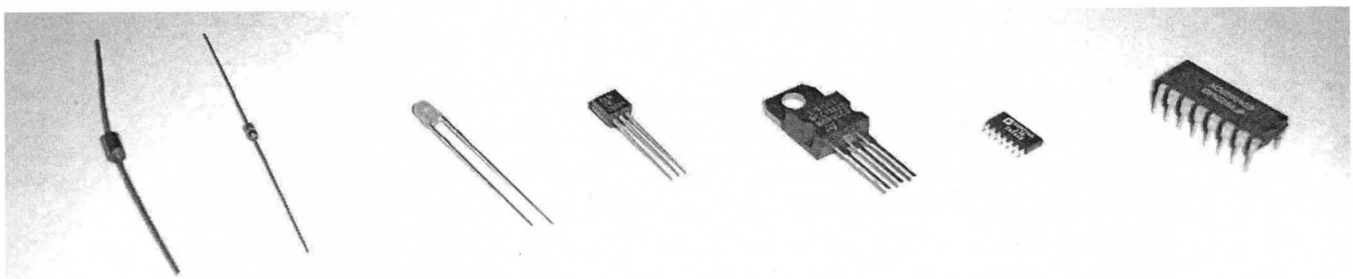


16 Pin DIP Socket

Power Jack

RCA Phono Jack

RCA Phono Plug



Silicon Rectifier

Silicon Diode

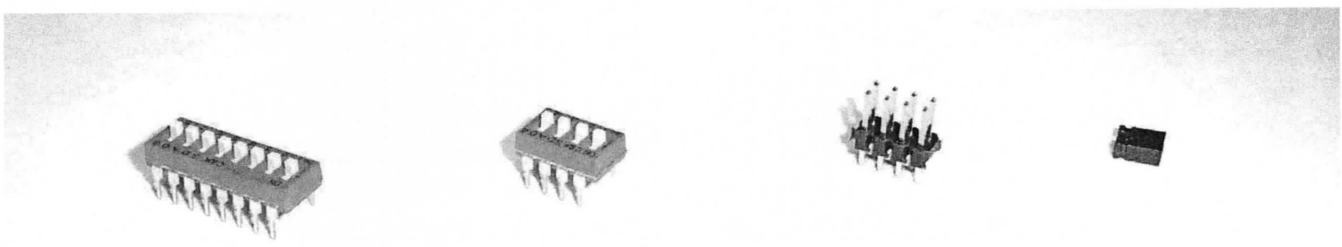
Green LED Lamp

TO-92 Transistor or Voltage Reg

TO-220 Voltage Reg

SSM2166 Surface Mount IC

16-Pin DIP IC



8-Position DIP Switch

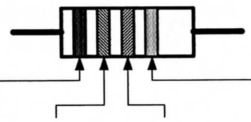
4-Position DIP Switch

Header Strip

Header Jumper

18 Color Code Charts

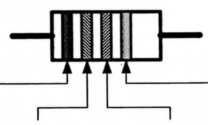
Resistor Color Code



COLOR	1st DIGIT	2nd DIGIT	MULTIPLIER	TOLERANCE
BLACK	0	0	1	
BROWN	1	1	10	
RED	2	2	100	
ORANGE	3	3	1,000	
YELLOW	4	4	10,000	
GREEN	5	5	100,000	
BLUE	6	6	1,000,000	
VIOLET	7	7	10,000,000	
GRAY	8	8	100,000,000	
WHITE	9	9	1,000,000,000	
GOLD			.1	+- 5 %
SILVER			.01	+- 10 %
(no band)				+- 20 %

Nominal Resistance (Ohms)

RF Choke Color Code



COLOR	1st DIGIT	2nd DIGIT	MULTIPLIER	TOLERANCE
BLACK	0	0	1	
BROWN	1	1	10	+- 1 %
RED	2	2	100	+- 2 %
ORANGE	3	3	1,000	
YELLOW	4	4		
GREEN	5	5		
BLUE	6	6		
VIOLET	7	7		
GRAY	8	8		
WHITE	9	9		+- 2.5 %
GOLD			.1	+- 5 %
SILVER			.01	+- 10 %
(no band)				+- 20 %

Nominal Inductance (uH)

19 Synthesizer Frequency Selection Chart

S4 Switch Settings For 10 kHz Channel-Spacing Models

Kit models AMT3000 and AMT3000-SM use a 4.000 mHz quartz crystal, which produces a 10 kHz PLL reference frequency. The resulting frequency spacing between successive S4 switch settings is 10 kHz. Use the following chart to find the S4 switch setting for your desired frequency in increments of 10 kHz.

Frequency	S4 Setting							
kHz	1	2	3	4	5	6	7	8
530	ON↑	ON↑	OFF↓	ON↑	OFF↓	OFF↓	ON↑	ON↑
540	OFF↓	ON↑	OFF↓	ON↑	OFF↓	OFF↓	ON↑	ON↑
550	ON↑	OFF↓	OFF↓	ON↑	OFF↓	OFF↓	ON↑	ON↑
560	OFF↓	OFF↓	OFF↓	ON↑	OFF↓	OFF↓	ON↑	ON↑
570	ON↑	ON↑	ON↑	OFF↓	OFF↓	OFF↓	ON↑	ON↑
580	OFF↓	ON↑	ON↑	OFF↓	OFF↓	OFF↓	ON↑	ON↑
590	ON↑	OFF↓	ON↑	OFF↓	OFF↓	OFF↓	ON↑	ON↑
600	OFF↓	OFF↓	ON↑	OFF↓	OFF↓	OFF↓	ON↑	ON↑
610	ON↑	ON↑	OFF↓	OFF↓	OFF↓	OFF↓	ON↑	ON↑
620	OFF↓	ON↑	OFF↓	OFF↓	OFF↓	OFF↓	ON↑	ON↑
630	ON↑	OFF↓	OFF↓	OFF↓	OFF↓	OFF↓	ON↑	ON↑
640	OFF↓	OFF↓	OFF↓	OFF↓	OFF↓	OFF↓	ON↑	ON↑
650	ON↑	ON↑	ON↑	ON↑	ON↑	ON↑	OFF↓	ON↑
660	OFF↓	ON↑	ON↑	ON↑	ON↑	ON↑	OFF↓	ON↑
670	ON↑	OFF↓	ON↑	ON↑	ON↑	ON↑	OFF↓	ON↑
680	OFF↓	OFF↓	ON↑	ON↑	ON↑	ON↑	OFF↓	ON↑
690	ON↑	ON↑	OFF↓	ON↑	ON↑	ON↑	OFF↓	ON↑
700	OFF↓	ON↑	OFF↓	ON↑	ON↑	ON↑	OFF↓	ON↑
710	ON↑	OFF↓	OFF↓	ON↑	ON↑	ON↑	OFF↓	ON↑
720	OFF↓	OFF↓	OFF↓	ON↑	ON↑	ON↑	OFF↓	ON↑
730	ON↑	ON↑	ON↑	OFF↓	ON↑	ON↑	OFF↓	ON↑
740	OFF↓	ON↑	ON↑	OFF↓	ON↑	ON↑	OFF↓	ON↑
750	ON↑	OFF↓	ON↑	OFF↓	ON↑	ON↑	OFF↓	ON↑
760	OFF↓	OFF↓	ON↑	OFF↓	ON↑	ON↑	OFF↓	ON↑
770	ON↑	ON↑	OFF↓	OFF↓	ON↑	ON↑	OFF↓	ON↑
780	OFF↓	ON↑	OFF↓	OFF↓	ON↑	ON↑	OFF↓	ON↑
790	ON↑	OFF↓	OFF↓	OFF↓	ON↑	ON↑	OFF↓	ON↑
800	OFF↓	OFF↓	OFF↓	OFF↓	ON↑	ON↑	OFF↓	ON↑
810	ON↑	ON↑	ON↑	ON↑	OFF↓	ON↑	OFF↓	ON↑
820	OFF↓	ON↑	ON↑	ON↑	OFF↓	ON↑	OFF↓	ON↑
830	ON↑	OFF↓	ON↑	ON↑	OFF↓	ON↑	OFF↓	ON↑
840	OFF↓	OFF↓	ON↑	ON↑	OFF↓	ON↑	OFF↓	ON↑
850	ON↑	ON↑	OFF↓	ON↑	OFF↓	ON↑	OFF↓	ON↑
860	OFF↓	ON↑	OFF↓	ON↑	OFF↓	ON↑	OFF↓	ON↑

Frequency	S4 Setting							
kHz	1	2	3	4	5	6	7	8
870	ON↑	OFF↓	OFF↓	ON↑	OFF↓	ON↑	OFF↓	ON↑
880	OFF↓	OFF↓	OFF↓	ON↑	OFF↓	ON↑	OFF↓	ON↑
890	ON↑	ON↑	ON↑	OFF↓	OFF↓	ON↑	OFF↓	ON↑
900	OFF↓	ON↑	ON↑	OFF↓	OFF↓	ON↑	OFF↓	ON↑
910	ON↑	OFF↓	ON↑	OFF↓	OFF↓	ON↑	OFF↓	ON↑
920	OFF↓	OFF↓	ON↑	OFF↓	OFF↓	ON↑	OFF↓	ON↑
930	ON↑	ON↑	OFF↓	OFF↓	OFF↓	ON↑	OFF↓	ON↑
940	OFF↓	ON↑	OFF↓	OFF↓	OFF↓	ON↑	OFF↓	ON↑
950	ON↑	OFF↓	OFF↓	OFF↓	OFF↓	ON↑	OFF↓	ON↑
960	OFF↓	OFF↓	OFF↓	OFF↓	OFF↓	ON↑	OFF↓	ON↑
970	ON↑	ON↑	ON↑	ON↑	ON↑	OFF↓	OFF↓	ON↑
980	OFF↓	ON↑	ON↑	ON↑	ON↑	OFF↓	OFF↓	ON↑
990	ON↑	OFF↓	ON↑	ON↑	ON↑	OFF↓	OFF↓	ON↑
1000	OFF↓	OFF↓	ON↑	ON↑	ON↑	OFF↓	OFF↓	ON↑
1010	ON↑	ON↑	OFF↓	ON↑	ON↑	OFF↓	OFF↓	ON↑
1020	OFF↓	ON↑	OFF↓	ON↑	ON↑	OFF↓	OFF↓	ON↑
1030	ON↑	OFF↓	OFF↓	ON↑	ON↑	OFF↓	OFF↓	ON↑
1040	OFF↓	OFF↓	OFF↓	ON↑	ON↑	OFF↓	OFF↓	ON↑
1050	ON↑	ON↑	ON↑	OFF↓	ON↑	OFF↓	OFF↓	ON↑
1060	OFF↓	ON↑	ON↑	OFF↓	ON↑	OFF↓	OFF↓	ON↑
1070	ON↑	OFF↓	ON↑	OFF↓	ON↑	OFF↓	OFF↓	ON↑
1080	OFF↓	OFF↓	ON↑	OFF↓	ON↑	OFF↓	OFF↓	ON↑
1090	ON↑	ON↑	OFF↓	OFF↓	ON↑	OFF↓	OFF↓	ON↑
1100	OFF↓	ON↑	OFF↓	OFF↓	ON↑	OFF↓	OFF↓	ON↑
1110	ON↑	OFF↓	OFF↓	OFF↓	ON↑	OFF↓	OFF↓	ON↑
1120	OFF↓	OFF↓	OFF↓	OFF↓	ON↑	OFF↓	OFF↓	ON↑
1130	ON↑	ON↑	ON↑	ON↑	OFF↓	OFF↓	OFF↓	ON↑
1140	OFF↓	ON↑	ON↑	ON↑	OFF↓	OFF↓	OFF↓	ON↑
1150	ON↑	OFF↓	ON↑	ON↑	OFF↓	OFF↓	OFF↓	ON↑
1160	OFF↓	OFF↓	ON↑	ON↑	OFF↓	OFF↓	OFF↓	ON↑
1170	ON↑	ON↑	OFF↓	ON↑	OFF↓	OFF↓	OFF↓	ON↑
1180	OFF↓	ON↑	OFF↓	ON↑	OFF↓	OFF↓	OFF↓	ON↑
1190	ON↑	OFF↓	OFF↓	ON↑	OFF↓	OFF↓	OFF↓	ON↑
1200	OFF↓	OFF↓	OFF↓	ON↑	OFF↓	OFF↓	OFF↓	ON↑
1210	ON↑	ON↑	ON↑	OFF↓	OFF↓	OFF↓	OFF↓	ON↑
1220	OFF↓	ON↑	ON↑	OFF↓	OFF↓	OFF↓	OFF↓	ON↑
1230	ON↑	OFF↓	ON↑	OFF↓	OFF↓	OFF↓	OFF↓	ON↑
1240	OFF↓	OFF↓	ON↑	OFF↓	OFF↓	OFF↓	OFF↓	ON↑
1250	ON↑	ON↑	OFF↓	OFF↓	OFF↓	OFF↓	OFF↓	ON↑
1260	OFF↓	ON↑	OFF↓	OFF↓	OFF↓	OFF↓	OFF↓	ON↑
1270	ON↑	OFF↓	OFF↓	OFF↓	OFF↓	OFF↓	OFF↓	ON↑
1280	OFF↓	OFF↓	OFF↓	OFF↓	OFF↓	OFF↓	OFF↓	ON↑
1290	ON↑	ON↑	ON↑	ON↑	ON↑	ON↑	ON↑	OFF↓
1300	OFF↓	ON↑	ON↑	ON↑	ON↑	ON↑	ON↑	OFF↓
1310	ON↑	OFF↓	ON↑	ON↑	ON↑	ON↑	ON↑	OFF↓

Frequency	S4 Setting							
kHz	1	2	3	4	5	6	7	8
1320	OFF↓	OFF↓	ON↑	ON↑	ON↑	ON↑	ON↑	OFF↓
1330	ON↑	ON↑	OFF↓	ON↑	ON↑	ON↑	ON↑	OFF↓
1340	OFF↓	ON↑	OFF↓	ON↑	ON↑	ON↑	ON↑	OFF↓
1350	ON↑	OFF↓	OFF↓	ON↑	ON↑	ON↑	ON↑	OFF↓
1360	OFF↓	OFF↓	OFF↓	ON↑	ON↑	ON↑	ON↑	OFF↓
1370	ON↑	ON↑	ON↑	OFF↓	ON↑	ON↑	ON↑	OFF↓
1380	OFF↓	ON↑	ON↑	OFF↓	ON↑	ON↑	ON↑	OFF↓
1390	ON↑	OFF↓	ON↑	OFF↓	ON↑	ON↑	ON↑	OFF↓
1400	OFF↓	OFF↓	ON↑	OFF↓	ON↑	ON↑	ON↑	OFF↓
1410	ON↑	ON↑	OFF↓	OFF↓	ON↑	ON↑	ON↑	OFF↓
1420	OFF↓	ON↑	OFF↓	OFF↓	ON↑	ON↑	ON↑	OFF↓
1430	ON↑	OFF↓	OFF↓	OFF↓	ON↑	ON↑	ON↑	OFF↓
1440	OFF↓	OFF↓	OFF↓	OFF↓	ON↑	ON↑	ON↑	OFF↓
1450	ON↑	ON↑	ON↑	ON↑	OFF↓	ON↑	ON↑	OFF↓
1460	OFF↓	ON↑	ON↑	ON↑	OFF↓	ON↑	ON↑	OFF↓
1470	ON↑	OFF↓	ON↑	ON↑	OFF↓	ON↑	ON↑	OFF↓
1480	OFF↓	OFF↓	ON↑	ON↑	OFF↓	ON↑	ON↑	OFF↓
1490	ON↑	ON↑	OFF↓	ON↑	OFF↓	ON↑	ON↑	OFF↓
1500	OFF↓	ON↑	OFF↓	ON↑	OFF↓	ON↑	ON↑	OFF↓
1510	ON↑	OFF↓	OFF↓	ON↑	OFF↓	ON↑	ON↑	OFF↓
1520	OFF↓	OFF↓	OFF↓	ON↑	OFF↓	ON↑	ON↑	OFF↓
1530	ON↑	ON↑	ON↑	OFF↓	OFF↓	ON↑	ON↑	OFF↓
1540	OFF↓	ON↑	ON↑	OFF↓	OFF↓	ON↑	ON↑	OFF↓
1550	ON↑	OFF↓	ON↑	OFF↓	OFF↓	ON↑	ON↑	OFF↓
1560	OFF↓	OFF↓	ON↑	OFF↓	OFF↓	ON↑	ON↑	OFF↓
1570	ON↑	ON↑	OFF↓	OFF↓	OFF↓	ON↑	ON↑	OFF↓
1580	OFF↓	ON↑	OFF↓	OFF↓	OFF↓	ON↑	ON↑	OFF↓
1590	ON↑	OFF↓	OFF↓	OFF↓	OFF↓	ON↑	ON↑	OFF↓
1600	OFF↓	OFF↓	OFF↓	OFF↓	OFF↓	ON↑	ON↑	OFF↓
1610	ON↑	ON↑	ON↑	ON↑	ON↑	OFF↓	ON↑	OFF↓
1620	OFF↓	ON↑	ON↑	ON↑	ON↑	OFF↓	ON↑	OFF↓
1630	ON↑	OFF↓	ON↑	ON↑	ON↑	OFF↓	ON↑	OFF↓
1640	OFF↓	OFF↓	ON↑	ON↑	ON↑	OFF↓	ON↑	OFF↓
1650	ON↑	ON↑	OFF↓	ON↑	ON↑	OFF↓	ON↑	OFF↓
1660	OFF↓	ON↑	OFF↓	ON↑	ON↑	OFF↓	ON↑	OFF↓
1670	ON↑	OFF↓	OFF↓	ON↑	ON↑	OFF↓	ON↑	OFF↓
1680	OFF↓	OFF↓	OFF↓	ON↑	ON↑	OFF↓	ON↑	OFF↓
1690	ON↑	ON↑	ON↑	OFF↓	ON↑	OFF↓	ON↑	OFF↓
1700	OFF↓	ON↑	ON↑	OFF↓	ON↑	OFF↓	ON↑	OFF↓

S4 Switch Settings For 9 kHz Channel-Spacing Models

Kit models AMT3000-9K and AMT3000-9KSM use a 3.600 mHz quartz crystal, which results in a 9 kHz PLL reference frequency. The resulting frequency spacing between successive S4 switch settings is 9 kHz. Use the following chart to find the S4 switch setting for your desired frequency in increments of 9 kHz.

Frequency kHz	S4 Setting 1	2	3	4	5	6	7	8
522	OFF ↓	ON ↑	ON ↑	OFF ↓	OFF ↓	OFF ↓	ON ↑	ON ↑
531	ON ↑	OFF ↓	ON ↑	OFF ↓	OFF ↓	OFF ↓	ON ↑	ON ↑
540	OFF ↓	OFF ↓	ON ↑	OFF ↓	OFF ↓	OFF ↓	ON ↑	ON ↑
549	ON ↑	ON ↑	OFF ↓	OFF ↓	OFF ↓	OFF ↓	ON ↑	ON ↑
558	OFF ↓	ON ↑	OFF ↓	OFF ↓	OFF ↓	OFF ↓	ON ↑	ON ↑
567	ON ↑	OFF ↓	OFF ↓	OFF ↓	OFF ↓	OFF ↓	ON ↑	ON ↑
576	OFF ↓	OFF ↓	OFF ↓	OFF ↓	OFF ↓	OFF ↓	ON ↑	ON ↑
585	ON ↑	ON ↑	ON ↑	ON ↑	ON ↑	ON ↑	OFF ↓	ON ↑
594	OFF ↓	ON ↑	ON ↑	ON ↑	ON ↑	ON ↑	OFF ↓	ON ↑
603	ON ↑	OFF ↓	ON ↑	ON ↑	ON ↑	ON ↑	OFF ↓	ON ↑
612	OFF ↓	OFF ↓	ON ↑	ON ↑	ON ↑	ON ↑	OFF ↓	ON ↑
621	ON ↑	ON ↑	OFF ↓	ON ↑	ON ↑	ON ↑	OFF ↓	ON ↑
630	OFF ↓	ON ↑	OFF ↓	ON ↑	ON ↑	ON ↑	OFF ↓	ON ↑
639	ON ↑	OFF ↓	OFF ↓	ON ↑	ON ↑	ON ↑	OFF ↓	ON ↑
648	OFF ↓	OFF ↓	OFF ↓	ON ↑	ON ↑	ON ↑	OFF ↓	ON ↑
657	ON ↑	ON ↑	ON ↑	OFF ↓	ON ↑	ON ↑	OFF ↓	ON ↑
666	OFF ↓	ON ↑	ON ↑	OFF ↓	ON ↑	ON ↑	OFF ↓	ON ↑
675	ON ↑	OFF ↓	ON ↑	OFF ↓	ON ↑	ON ↑	OFF ↓	ON ↑
684	OFF ↓	OFF ↓	ON ↑	OFF ↓	ON ↑	ON ↑	OFF ↓	ON ↑
693	ON ↑	ON ↑	OFF ↓	OFF ↓	ON ↑	ON ↑	OFF ↓	ON ↑
702	OFF ↓	ON ↑	OFF ↓	OFF ↓	ON ↑	ON ↑	OFF ↓	ON ↑
711	ON ↑	OFF ↓	OFF ↓	OFF ↓	ON ↑	ON ↑	OFF ↓	ON ↑
720	OFF ↓	OFF ↓	OFF ↓	OFF ↓	ON ↑	ON ↑	OFF ↓	ON ↑
729	ON ↑	ON ↑	ON ↑	ON ↑	OFF ↓	ON ↑	OFF ↓	ON ↑
738	OFF ↓	ON ↑	ON ↑	ON ↑	OFF ↓	ON ↑	OFF ↓	ON ↑
747	ON ↑	OFF ↓	ON ↑	ON ↑	OFF ↓	ON ↑	OFF ↓	ON ↑
756	OFF ↓	OFF ↓	ON ↑	ON ↑	OFF ↓	ON ↑	OFF ↓	ON ↑
765	ON ↑	ON ↑	OFF ↓	ON ↑	OFF ↓	ON ↑	OFF ↓	ON ↑
774	OFF ↓	ON ↑	OFF ↓	ON ↑	OFF ↓	ON ↑	OFF ↓	ON ↑
783	ON ↑	OFF ↓	OFF ↓	ON ↑	OFF ↓	ON ↑	OFF ↓	ON ↑
792	OFF ↓	OFF ↓	OFF ↓	ON ↑	OFF ↓	ON ↑	OFF ↓	ON ↑
801	ON ↑	ON ↑	ON ↑	OFF ↓	OFF ↓	ON ↑	OFF ↓	ON ↑
810	OFF ↓	ON ↑	ON ↑	OFF ↓	OFF ↓	ON ↑	OFF ↓	ON ↑
819	ON ↑	OFF ↓	ON ↑	OFF ↓	OFF ↓	ON ↑	OFF ↓	ON ↑
828	OFF ↓	OFF ↓	ON ↑	OFF ↓	OFF ↓	ON ↑	OFF ↓	ON ↑
837	ON ↑	ON ↑	OFF ↓	OFF ↓	OFF ↓	ON ↑	OFF ↓	ON ↑
846	OFF ↓	ON ↑	OFF ↓	OFF ↓	OFF ↓	ON ↑	OFF ↓	ON ↑
855	ON ↑	OFF ↓	OFF ↓	OFF ↓	OFF ↓	ON ↑	OFF ↓	ON ↑
864	OFF ↓	OFF ↓	OFF ↓	OFF ↓	OFF ↓	ON ↑	OFF ↓	ON ↑
873	ON ↑	ON ↑	ON ↑	ON ↑	ON ↑	OFF ↓	OFF ↓	ON ↑
882	OFF ↓	ON ↑	ON ↑	ON ↑	ON ↑	OFF ↓	OFF ↓	ON ↑
891	ON ↑	OFF ↓	ON ↑	ON ↑	ON ↑	OFF ↓	OFF ↓	ON ↑
900	OFF ↓	OFF ↓	ON ↑	ON ↑	ON ↑	OFF ↓	OFF ↓	ON ↑
909	ON ↑	ON ↑	OFF ↓	ON ↑	ON ↑	OFF ↓	OFF ↓	ON ↑
918	OFF ↓	ON ↑	OFF ↓	ON ↑	ON ↑	OFF ↓	OFF ↓	ON ↑
927	ON ↑	OFF ↓	OFF ↓	ON ↑	ON ↑	OFF ↓	OFF ↓	ON ↑

Frequency kHz	S4 Setting 1	2	3	4	5	6	7	8
936	OFF ↓	OFF ↓	OFF ↓	ON ↑	ON ↑	OFF ↓	OFF ↓	ON ↑
945	ON ↑	ON ↑	ON ↑	OFF ↓	ON ↑	OFF ↓	OFF ↓	ON ↑
954	OFF ↓	ON ↑	ON ↑	OFF ↓	ON ↑	OFF ↓	OFF ↓	ON ↑
963	ON ↑	OFF ↓	ON ↑	OFF ↓	ON ↑	OFF ↓	OFF ↓	ON ↑
972	OFF ↓	OFF ↓	ON ↑	OFF ↓	ON ↑	OFF ↓	OFF ↓	ON ↑
981	ON ↑	ON ↑	OFF ↓	OFF ↓	ON ↑	OFF ↓	OFF ↓	ON ↑
990	OFF ↓	ON ↑	OFF ↓	OFF ↓	ON ↑	OFF ↓	OFF ↓	ON ↑
999	ON ↑	OFF ↓	OFF ↓	OFF ↓	ON ↑	OFF ↓	OFF ↓	ON ↑
1008	OFF ↓	OFF ↓	OFF ↓	OFF ↓	ON ↑	OFF ↓	OFF ↓	ON ↑
1017	ON ↑	ON ↑	ON ↑	ON ↑	OFF ↓	OFF ↓	OFF ↓	ON ↑
1026	OFF ↓	ON ↑	ON ↑	ON ↑	OFF ↓	OFF ↓	OFF ↓	ON ↑
1035	ON ↑	OFF ↓	ON ↑	ON ↑	OFF ↓	OFF ↓	OFF ↓	ON ↑
1044	OFF ↓	OFF ↓	ON ↑	ON ↑	OFF ↓	OFF ↓	OFF ↓	ON ↑
1053	ON ↑	ON ↑	OFF ↓	ON ↑	OFF ↓	OFF ↓	OFF ↓	ON ↑
1062	OFF ↓	ON ↑	OFF ↓	ON ↑	OFF ↓	OFF ↓	OFF ↓	ON ↑
1071	ON ↑	OFF ↓	OFF ↓	ON ↑	OFF ↓	OFF ↓	OFF ↓	ON ↑
1080	OFF ↓	OFF ↓	OFF ↓	ON ↑	OFF ↓	OFF ↓	OFF ↓	ON ↑
1089	ON ↑	ON ↑	ON ↑	OFF ↓	OFF ↓	OFF ↓	OFF ↓	ON ↑
1098	OFF ↓	ON ↑	ON ↑	OFF ↓	OFF ↓	OFF ↓	OFF ↓	ON ↑
1107	ON ↑	OFF ↓	ON ↑	OFF ↓	OFF ↓	OFF ↓	OFF ↓	ON ↑
1116	OFF ↓	OFF ↓	ON ↑	OFF ↓	OFF ↓	OFF ↓	OFF ↓	ON ↑
1125	ON ↑	ON ↑	OFF ↓	OFF ↓	OFF ↓	OFF ↓	OFF ↓	ON ↑
1134	OFF ↓	ON ↑	OFF ↓	OFF ↓	OFF ↓	OFF ↓	OFF ↓	ON ↑
1143	ON ↑	OFF ↓	OFF ↓	OFF ↓	OFF ↓	OFF ↓	OFF ↓	ON ↑
1152	OFF ↓	OFF ↓	OFF ↓	OFF ↓	OFF ↓	OFF ↓	OFF ↓	ON ↑
1161	ON ↑	ON ↑	ON ↑	ON ↑	ON ↑	ON ↑	ON ↑	OFF ↓
1170	OFF ↓	ON ↑	ON ↑	ON ↑	ON ↑	ON ↑	ON ↑	OFF ↓
1179	ON ↑	OFF ↓	ON ↑	ON ↑	ON ↑	ON ↑	ON ↑	OFF ↓
1188	OFF ↓	OFF ↓	ON ↑	ON ↑	ON ↑	ON ↑	ON ↑	OFF ↓
1197	ON ↑	ON ↑	OFF ↓	ON ↑	ON ↑	ON ↑	ON ↑	OFF ↓
1206	OFF ↓	ON ↑	OFF ↓	ON ↑	ON ↑	ON ↑	ON ↑	OFF ↓
1215	ON ↑	OFF ↓	OFF ↓	ON ↑	ON ↑	ON ↑	ON ↑	OFF ↓
1224	OFF ↓	OFF ↓	OFF ↓	ON ↑	ON ↑	ON ↑	ON ↑	OFF ↓
1233	ON ↑	ON ↑	ON ↑	OFF ↓	ON ↑	ON ↑	ON ↑	OFF ↓
1242	OFF ↓	ON ↑	ON ↑	OFF ↓	ON ↑	ON ↑	ON ↑	OFF ↓
1251	ON ↑	OFF ↓	ON ↑	OFF ↓	ON ↑	ON ↑	ON ↑	OFF ↓
1260	OFF ↓	OFF ↓	ON ↑	OFF ↓	ON ↑	ON ↑	ON ↑	OFF ↓
1269	ON ↑	ON ↑	OFF ↓	OFF ↓	ON ↑	ON ↑	ON ↑	OFF ↓
1278	OFF ↓	ON ↑	OFF ↓	OFF ↓	ON ↑	ON ↑	ON ↑	OFF ↓
1287	ON ↑	OFF ↓	OFF ↓	OFF ↓	ON ↑	ON ↑	ON ↑	OFF ↓
1296	OFF ↓	OFF ↓	OFF ↓	OFF ↓	ON ↑	ON ↑	ON ↑	OFF ↓
1305	ON ↑	ON ↑	ON ↑	ON ↑	OFF ↓	ON ↑	ON ↑	OFF ↓
1314	OFF ↓	ON ↑	ON ↑	ON ↑	OFF ↓	ON ↑	ON ↑	OFF ↓
1323	ON ↑	OFF ↓	ON ↑	ON ↑	OFF ↓	ON ↑	ON ↑	OFF ↓
1332	OFF ↓	OFF ↓	ON ↑	ON ↑	OFF ↓	ON ↑	ON ↑	OFF ↓
1341	ON ↑	ON ↑	OFF ↓	ON ↑	OFF ↓	ON ↑	ON ↑	OFF ↓
1350	OFF ↓	ON ↑	OFF ↓	ON ↑	OFF ↓	ON ↑	ON ↑	OFF ↓
1359	ON ↑	OFF ↓	OFF ↓	ON ↑	OFF ↓	ON ↑	ON ↑	OFF ↓
1368	OFF ↓	OFF ↓	OFF ↓	ON ↑	OFF ↓	ON ↑	ON ↑	OFF ↓
1377	ON ↑	ON ↑	ON ↑	OFF ↓	OFF ↓	ON ↑	ON ↑	OFF ↓
1386	OFF ↓	ON ↑	ON ↑	OFF ↓	OFF ↓	ON ↑	ON ↑	OFF ↓
1395	ON ↑	OFF ↓	ON ↑	OFF ↓	OFF ↓	ON ↑	ON ↑	OFF ↓
1404	OFF ↓	OFF ↓	ON ↑	OFF ↓	OFF ↓	ON ↑	ON ↑	OFF ↓
1413	ON ↑	ON ↑	OFF ↓	OFF ↓	OFF ↓	ON ↑	ON ↑	OFF ↓

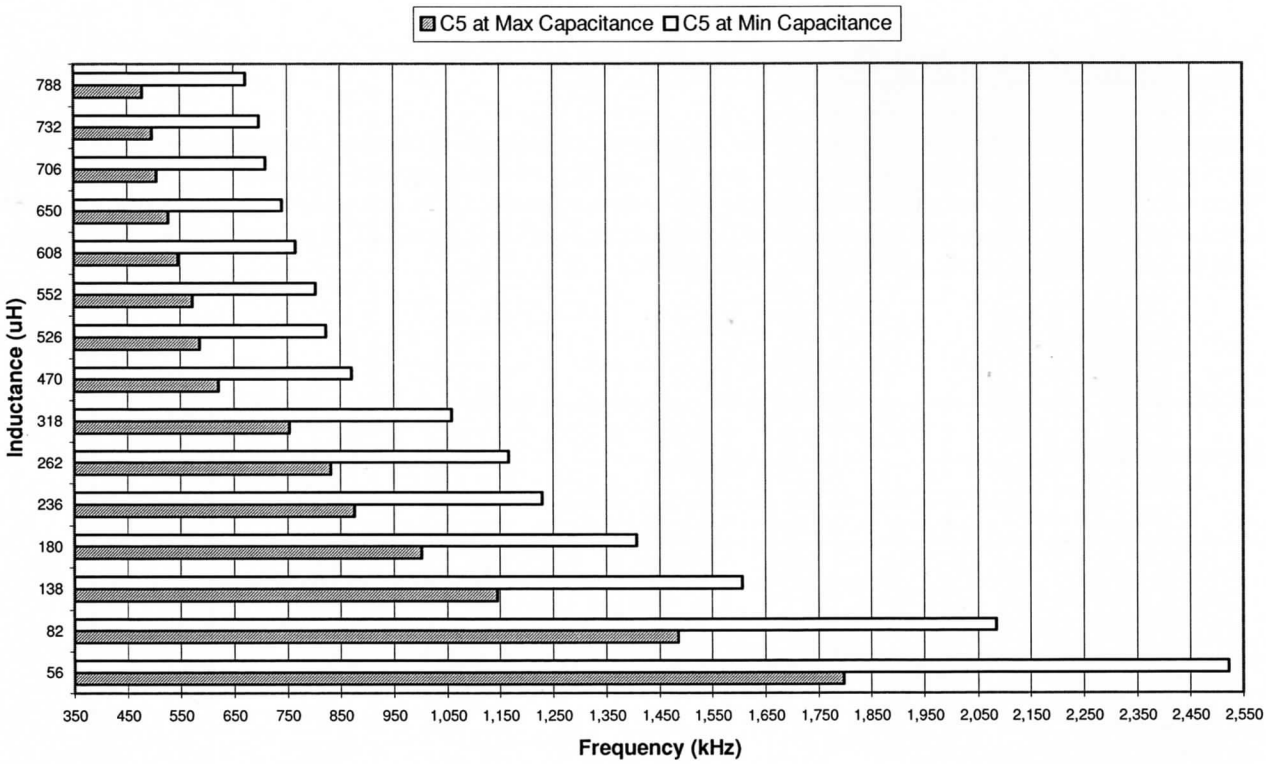
Frequency kHz	S4 Setting 1	2	3	4	5	6	7	8
1422	OFF ↓	ON ↑	OFF ↓	OFF ↓	OFF ↓	ON ↑	ON ↑	OFF ↓
1431	ON ↑	OFF ↓	OFF ↓	OFF ↓	OFF ↓	ON ↑	ON ↑	OFF ↓
1440	OFF ↓	OFF ↓	OFF ↓	OFF ↓	OFF ↓	ON ↑	ON ↑	OFF ↓
1449	ON ↑	ON ↑	ON ↑	ON ↑	ON ↑	OFF ↓	ON ↑	OFF ↓
1458	OFF ↓	ON ↑	ON ↑	ON ↑	ON ↑	OFF ↓	ON ↑	OFF ↓
1467	ON ↑	OFF ↓	ON ↑	ON ↑	ON ↑	OFF ↓	ON ↑	OFF ↓
1476	OFF ↓	OFF ↓	ON ↑	ON ↑	ON ↑	OFF ↓	ON ↑	OFF ↓
1485	ON ↑	ON ↑	OFF ↓	ON ↑	ON ↑	OFF ↓	ON ↑	OFF ↓
1494	OFF ↓	ON ↑	OFF ↓	ON ↑	ON ↑	OFF ↓	ON ↑	OFF ↓
1503	ON ↑	OFF ↓	OFF ↓	ON ↑	ON ↑	OFF ↓	ON ↑	OFF ↓
1512	OFF ↓	OFF ↓	OFF ↓	ON ↑	ON ↑	OFF ↓	ON ↑	OFF ↓
1521	ON ↑	ON ↑	ON ↑	OFF ↓	ON ↑	OFF ↓	ON ↑	OFF ↓
1530	OFF ↓	ON ↑	ON ↑	OFF ↓	ON ↑	OFF ↓	ON ↑	OFF ↓
1539	ON ↑	OFF ↓	ON ↑	OFF ↓	ON ↑	OFF ↓	ON ↑	OFF ↓
1548	OFF ↓	OFF ↓	ON ↑	OFF ↓	ON ↑	OFF ↓	ON ↑	OFF ↓
1557	ON ↑	ON ↑	OFF ↓	OFF ↓	ON ↑	OFF ↓	ON ↑	OFF ↓
1566	OFF ↓	ON ↑	OFF ↓	OFF ↓	ON ↑	OFF ↓	ON ↑	OFF ↓
1575	ON ↑	OFF ↓	OFF ↓	OFF ↓	ON ↑	OFF ↓	ON ↑	OFF ↓
1584	OFF ↓	OFF ↓	OFF ↓	OFF ↓	ON ↑	OFF ↓	ON ↑	OFF ↓
1593	ON ↑	ON ↑	ON ↑	ON ↑	OFF ↓	OFF ↓	ON ↑	OFF ↓
1602	OFF ↓	ON ↑	ON ↑	ON ↑	OFF ↓	OFF ↓	ON ↑	OFF ↓
1611	ON ↑	OFF ↓	ON ↑	ON ↑	OFF ↓	OFF ↓	ON ↑	OFF ↓
1620	OFF ↓	OFF ↓	ON ↑	ON ↑	OFF ↓	OFF ↓	ON ↑	OFF ↓
1629	ON ↑	ON ↑	OFF ↓	ON ↑	OFF ↓	OFF ↓	ON ↑	OFF ↓
1638	OFF ↓	ON ↑	OFF ↓	ON ↑	OFF ↓	OFF ↓	ON ↑	OFF ↓
1647	ON ↑	OFF ↓	OFF ↓	ON ↑	OFF ↓	OFF ↓	ON ↑	OFF ↓
1656	OFF ↓	OFF ↓	OFF ↓	ON ↑	OFF ↓	OFF ↓	ON ↑	OFF ↓
1665	ON ↑	ON ↑	ON ↑	OFF ↓	OFF ↓	OFF ↓	ON ↑	OFF ↓
1674	OFF ↓	ON ↑	ON ↑	OFF ↓	OFF ↓	OFF ↓	ON ↑	OFF ↓
1683	ON ↑	OFF ↓	ON ↑	OFF ↓	OFF ↓	OFF ↓	ON ↑	OFF ↓
1692	OFF ↓	OFF ↓	ON ↑	OFF ↓	OFF ↓	OFF ↓	ON ↑	OFF ↓
1701	ON ↑	ON ↑	OFF ↓	OFF ↓	OFF ↓	OFF ↓	ON ↑	OFF ↓
1710	OFF ↓	ON ↑	OFF ↓	OFF ↓	OFF ↓	OFF ↓	ON ↑	OFF ↓

20 RF Output Tuning Range Selection

The frequency range column gives approximate minimum and maximum resonant frequencies over the tuning range of trimmer capacitor (C5) for a typical antenna capacitance of 50 pF. If the desired frequency falls within more than one range, pick the lowest range (highest inductance) that includes the desired frequency. This will achieve resonance with the lowest C5 capacitance. A lower value of C5 capacitance will couple more power to the antenna. If you can't get a resonant peak with your chosen S5 setting, try the next higher or lower range setting.

Frequency Range (kHz)	S5 Setting				Inductance (uH)
	1	2	3	4	
1,797 - 2,523	OFF↓	ON↑	ON↑	ON↑	56
1,485 - 2,085	ON↑	OFF↓	ON↑	ON↑	82
1,145 - 1,607	OFF↓	OFF↓	ON↑	ON↑	138
1,003 - 1,407	ON↑	ON↑	OFF↓	ON↑	180
876 - 1,229	OFF↓	ON↑	OFF↓	ON↑	236
831 - 1,166	ON↑	OFF↓	OFF↓	ON↑	262
754 - 1,059	OFF↓	OFF↓	OFF↓	ON↑	318
620 - 871	ON↑	ON↑	ON↑	OFF↓	470
586 - 823	OFF↓	ON↑	ON↑	OFF↓	526
572 - 803	ON↑	OFF↓	ON↑	OFF↓	552
545 - 766	OFF↓	OFF↓	ON↑	OFF↓	608
528 - 740	ON↑	ON↑	OFF↓	OFF↓	650
506 - 710	OFF↓	ON↑	OFF↓	OFF↓	706
497 - 698	ON↑	OFF↓	OFF↓	OFF↓	732
479 - 672	OFF↓	OFF↓	OFF↓	OFF↓	788

S5 Frequency Range Switch Settings for 3 Meter Antenna

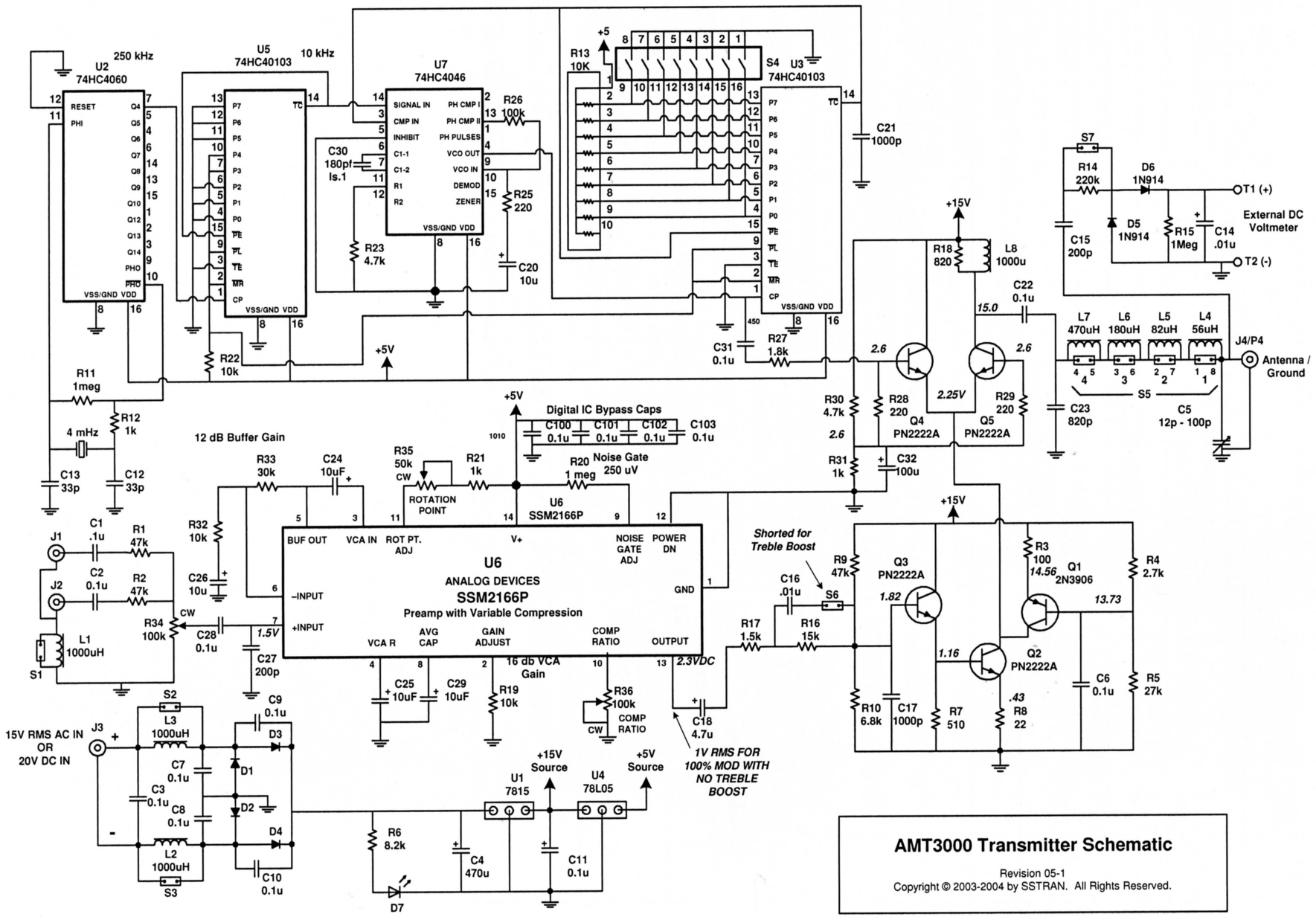


Frequency Range Graph for 3 Meter Antenna

21 Specifications

Frequency Coverage:	Models AMT3000 and AMT3000-SM: 530 to 1700 kHz in 10 kHz steps. Models AMT3000-9K and AMT3000-9KSM: 522 to 1710 kHz in 9 kHz steps.
Frequency Selection Method:	8-position DIP switch
Frequency Tolerance @ 25°C:	±.003%
Modulation Type:	Amplitude Modulation (AM)
Maximum Modulation Level:	100%
Power Input to Final RF Stage:	100 mW
Antenna:	118" wire (supplied with kit)
Antenna Matching:	Tunable pi-network. Matches high impedance antenna to low-impedance RF output stage.
Output Tuning:	4-position DIP switch selects inductance combination, adjustable ceramic trimmer capacitor peaks resonance.
RF Output Metering:	Test points on circuit board provide DC voltage to user-supplied 10 megohm/volt voltmeter. Measured voltage is maximum at resonance.
RF Grounding Options:	Jumper plug options for including/excluding RF isolation inductors in power supply and audio source ground paths.
Audio Response:	20 Hz to 20 kHz ±1 dB
Audio Treble Boost:	+8 dB, boost midpoint at 2 kHz. Jumper plug option.
Audio Distortion:	Less than 0.5% THD through audio stages.
Minimum Audio Input Level:	200 mV RMS for 100% modulation (input gain control at max).
Audio Compression:	Compression ratio adjustable from 1:1 to 5:1. Attack time less than 1 ms. Medium release time suitable for both voice and music.
Audio Limiting:	Adjustable threshold. 15:1 compression above threshold.
Front Panel Controls:	Audio input GAIN, MODULATION level, COMPRESSION ratio.
Rear Panel Jacks:	2 RCA audio in jacks, RCA antenna/ground jack, 2.1 mm power input jack.
Power Consumption:	120 VAC, 2 watts
Circuit Board:	5"W x 3.9"D x .062"H FR4, two layers, 1 oz. copper, top and bottom solder masks, top silkscreen.
Enclosure:	6.1"W x 4.2"D x 1.5"H ABS plastic. Drilled and labeled front and rear panels.

22 Circuit Diagram



Constructing a Base-Loaded Vertical Antenna

Drawing and Parts List

Solvent Welding PVC Joints

Soldering Copper Pipe Joints

Required AMT3000 Circuit Modifications

Safety and Legal Warnings

SSTRAN provides these antenna plans as a courtesy to our customers who want to experiment with a high performance antenna. Construction, installation, and use of this antenna is solely at your own risk. SSTRAN can not be held liable for any personal injury, property damage, or any other legal liabilities that you may incur at any time during the construction, installation, or use of this antenna.

PERSONAL SAFETY

1. As with any DIY project using hand tools, power tools and chemical products, there is always a risk of *personal injury*. Read and understand the safety notices that are included with all tools and chemical products that you use.
2. Installation of this antenna may present a risk of *electric shock injury* or *electrocution*. You must take all precautions to ensure that the antenna and any connecting wires will not come in contact with a live electric wire while maneuvering the antenna into position during installation. You must also ensure that no part of the antenna will contact a live electric wire in the event that the antenna becomes dislodged from its mounting position for any reason at any time.
3. As with any outdoor antenna, there is always the risk of lightning damage. For your safety, and to reduce the risk of damage to your home or property, ensure the transmitter is properly grounded.

LEGAL ISSUES

1. Check your local ordinances and covenants to ensure that your antenna installation complies with any rules that may be in effect that restrict the size, height, and location of outdoor antennas.
2. When constructed according to the plans, this antenna will comply with the generally accepted interpretation of FCC Part 15 section 15.219 governing antenna dimension restrictions . Be aware that the FCC can order you to cease operations if you cause interference to any commercially licensed station. You will reduce your likelihood of receiving an FCC order if you build the antenna as described, choose an unused frequency in your area, and operate your station in a civil manner.

Important Transmitter Information

The AMT3000 transmitter must be modified according to the instructions given in Required AMT3000 Circuit Modifications. These modifications are simple, but very important. This antenna will not perform properly without the transmitter modifications.

02/16/2005 Update

Thanks to more customer comments, steps 1, 8 and 9 under "Winding The Coil" were corrected.

03/07/2004 Update

Thanks to customer comments, the antenna plans have been refined to somewhat simplify construction. The new version will perform exactly the same as the original version. If you are currently constructing the original version or want to reference the original version you can access the plans here: original antenna plans

A well constructed tuned vertical antenna is a must for getting maximum range from your Part 15 AM transmitter. The FCC restricts the total length of the antenna, feed line, and ground lead to 3 meters (118 inches). This is very short at AM broadcast band frequencies. Because of this restriction, even the best Part 15

compliant antenna will not be very efficient compared to those big commercial broadcast station towers. Because the feed line length is included in the total length, the transmitter must be mounted at the base of the antenna in a weatherproof enclosure.

The antenna described here is designed to be rugged and stable in an outdoor environment. All materials are readily available from your local home improvement store (Home Depot, Lowes, Sears Hardware) and from electronics mail order suppliers (Mouser Electronics). You should be reasonably handy with hand tools and an electric drill. You also will need to do a couple of copper pipe "sweat" solder joints using a small propane torch and a few PVC solvent weld joints.

The antenna tuning range is restricted to 1500 kHz - 1700 kHz to make it simpler to construct.

For best results your antenna should be elevated by 20-25 feet, but you can still get good performance by mounting it on a pipe near ground level. Be sure to consider that you will need to access to the bottom portion of the antenna and the transmitter for tuning after installation.

Familiarize yourself with the antenna drawing and parts list: Drawing and Parts List and procure any parts that you need. If you have ever done any plumbing around the house, you may already have some of these parts.

If you don't have experience with solvent-welding PVC pipe fittings or soldering copper pipe fittings, click on the links to the left for some simple guidance.

Power and Audio Cables

The power and audio cables will need to be long enough to reach the transmitter at its final installation location.

You can extend the 18 VAC wall transformer output wire by fabricating an extension from readily available parts. Obtain one 2.1 mm power plug (female) and one 2.1 mm power socket (male) from RadioShack. Most any two conductor wire will work because the current draw is small. A length of lightly insulated lamp cord will work as long as the insulated wire will fit into the plastic handle of the 2.1 mm plug. Solder the plug and jack to the ends of the two conductor wire. Polarity is not important.

Obtain audio cables that will be just long enough to reach the transmitter in its final installation location. You can join shorter cables with female-to-female adapters. If the adapters will be outside, be sure to tape them well to seal out moisture. Long audio cables will attenuate higher audio frequencies. You can compensate by driving the audio from a low impedance source such as the 8 ohm speaker output terminals of a stereo amplifier. Make sure the Treble Boost jumper plug (S6) on the transmitter board is installed in the shorted position. You may also want to add treble boost to your audio source signal.

Fabricating The Loading Coil

This is the most time consuming step. The coil is made by wrapping #16 Nysol insulated wire in a tight spiral around a section of 3" white schedule 40 PVC pipe. However, tapping points must be formed at every other turn near one end of the

coil, making the winding process a little more complicated. Note that the outside diameter of the 3" PVC pipe is actually 3 1/2". The 3" nominal size refers to the inside diameter.

Do not use gray or black PVC pipe for the coil. Use only white schedule 40 PVC. Gray and black PVC may be formulated with carbon pigment, which can cause coil losses to be higher.

Preparing The PVC Pipe Before Winding The Coil

PVC pipe cutters are available, but are expensive. PVC can be easily cut with a hacksaw. A 24-tooth blade will make a nice cut. Use a miter box or other suitable method for guiding the blade to get a square cut. Or, you can mark the cut line with a pencil around the circumference, and make partial cuts incrementally around the circumference to avoid drifting off the line. Use sandpaper to remove outside burrs.

1. Begin by cutting an 11" section of 3" white PVC pipe (ref. 16).

2. Use medium-grit sandpaper to sand the entire outside surface until all lettering is removed and the surface is no longer shiny.

3. Mark the pipe 2 inches in from each end and wrap masking tape around the pipe at the marks so that the pipe is exposed between the marks. Coat the entire 7 inch long exposed area with exterior grade varnish to seal the pipe and keep it from absorbing moisture (PVC tends to absorb moisture over time which can lead to higher coil losses).

4. After the varnish dries, use a fine-tipped felt marker and a straight-edge to draw a single straight reference line from one end of the pipe to the other, parallel to the sides of the pipe.

5. On the reference line, mark and drill a 3/32" diameter hole 3" from one end. Now mark and drill a second 3/32" diameter hole 1/2" to either side of the first and at the same 3" distance from the end of the pipe. These two holes will secure the wire while you wind the coil.

Winding The Coil

You will now begin winding the coil, but first some important points. The coil must be wound tightly. There must be no space between turns. Be careful to avoid kinking the wire. Carefully straighten any kinks as you go along.

This is fairly stiff wire and will spring outward if you don't maintain constant tension on the wire while winding. Cut a bunch of 2" long strips of plastic electrical tape before you start. Keep them handy to put on the coil at various places as you wind to hold the wire in place. There will be a total of 87 turns in the coil. You should apply a strip of tape to the coil about every 5 turns or so to prevent the coil from springing out if you relieve the tension at any time. After winding is complete, you will be drilling two more holes to secure the wire at the far end. Once the wire is secured tightly through these holes, you can safely remove all the tape strips.

To avoid kinking the wire, it must be unrolled from the spool as you roll it onto the pipe. Place the spool of wire on a dowel or metal rod that is secured in a vise, or C clamp, in a vertical position. Devise a method for putting some drag on the spool

to keep the wire in tension as you wind. One way to do this is to clamp the dowel somewhat off-vertical so the spool tends to bind slightly against the top of the vise as you unwind the wire.

1. Unwind some wire from the end of the spool and insert the end about 12" into the hole that is on the reference line. Using pliers, form the wire protruding inside the pipe into a U shape and feed it back out through the second hole. Keep forming and pulling the wire out until the wire is snug against the inside of the pipe between the holes. Bend the length of the wire that now protrudes outside the pipe toward the closest end of the pipe to keep it out of the way while you wind the coil.

2. Electrically, it doesn't matter which direction you wind the coil. Choose a direction that is comfortable for you.

3. Wind 63 full turns of wire, tight and closely spaced around the PVC pipe. Secure this part of the coil well with tape before continuing to wind the rest of the coil.

Beginning at turn 63, you will be forming a tap point every other turn for the remainder of the winding process. A tap is formed by bending the wire with pliers to form a small "U" or hump in the wire. The hump should be about a quarter inch wide and about a quarter inch high. These measurements aren't critical. The objective is to form the wire out away from the pipe sufficiently to allow clearance for soldering a wire to the tap.

Before forming each tap, the wire needs to be tinned with solder for a total length of about 1" (1/2" on either side of the center of the tap). The wire has an insulating coating. If you purchased the recommended Nysol insulated wire, you may be able to solder directly to the wire with a high wattage iron without first stripping the insulated coating. Test this by attempting to apply solder to the end of the short piece of wire protruding from the pipe at the start of the winding. It helps to scrape away a small area of the coating down to bare copper to aid heat flow to the wire. Start heating at the bare copper and flow a blob of solder onto the wire. Move the iron and solder blob slowly along the wire until the Nysol coating begins to bubble and the solder adheres evenly to the wire. If you are not satisfied with the results, you will need to thoroughly scrape away the coating all around the wire with a sharp knife before applying solder.

Taps should be staggered about a half inch each side of the reference line to make it easier to make a connection without shorting to adjacent taps. Begin with the peak of the first tap hump positioned 1/2" before the reference line, then position the next tap hump peak 1/2" after the reference line, and so on.

4. Form the first tap at turn 63 (reference line minus 1/2").

5. Wind two full turns and form a tap that is staggered from the previous tap (reference line plus 1/2").

6. Repeat step 5 until you have a total of 12 taps staggered alternately before and after the reference line. The last tap should be at the 85 turn point.

7. After the last tap, continue to wind 2 more turns to the reference line.

8. Cut the wire with about 2" excess after the reference line. Secure the wire

well with tape while you drill two more holes. This wire will be connected to the antenna pipe clamp in a later step.

9. As you did at the beginning of the coil, drill two 3/32" holes at the end of the coil, one on the reference line and one 1/2" beyond the reference line. Insert the wire end into the hole on the reference line and back out the other hole. Cut the wire that now protrudes out to about 1/2". Then scrape and tin the end. This end wire is at turn 87 and will serve as the final "tap" point.

10. Now that the wire is secured at both ends of the coil, you can remove all the tape strips.

11. Coat the outside of the coil with a second coat of exterior grade varnish taking care not to get varnish on the wire ends or on the taps Coat just the coil, not the unvarnished ends of the plastic pipe.

12. After the second coat of varnish dries, remove the masking tape and cement the 3" PVC pipe caps (ref. 15) onto the ends of the coil pipe. See Solvent Welding PVC Joints for PVC pipe cementing instructions.

Antenna Construction Steps

First, some notes on cutting copper pipe. The best way to cut copper pipe is with a wheel-type tubing cutter. A cutter that can handle up to 3/4 in. pipe is inexpensive and worth purchasing at a home improvement store Copper pipe can also be cut with a fine-tooth hack saw. Be careful while cutting copper pipe with a hacksaw so as not to deform the circular shape of the pipe. Don't bear down too heavily while cutting, and lighten up while cutting the last little bit. Use a file to dress down any burrs.

1. Cut a 98" length of 1/2" copper pipe (ref. 2).

2. Solder the cap to one end (ref. 1). See: Soldering Copper Pipe Joints for instructions if you haven't soldered copper pipe before.

3. Cut a 10" length of 3/4" copper pipe (ref. 4).

4. Solder the 3/4" sweat to 3/4" male threaded copper adapter (ref. 6) to one end of the 3/4" pipe (ref. 4). Soldering the adapter in this step before cutting slots in the pipe in the next step will alleviate possible problems caused by pipe deformation while clamping for the cuts.

5. Lengthwise slots must be cut in the top end of the 3/4" copper pipe (ref. 4). Clamp the pipe in a vise or clamp it to a work surface with C clamps. Use some small scrap boards to distribute the clamping force to prevent deforming the pipe. Using a 24-tooth hacksaw, make two 3 in. long cuts in the form of a cross as illustrated.

6. Bend two of the opposing tabs created in step 5 inward a little more than the thickness of the pipe wall to allow the tabs to overlap each other when the hose clamps are tightened.

7. With a fine tipped felt pen, mark the non-capped end of the 1/2" antenna pipe at three points 3", 7", and 11" from the end. Extend the marks at each point all the way around the circumference of the pipe. Label each line: "top" (at

3"), "mid" at (7"), and "bottom" at (11"). This will help during the tuning procedure to indicate the limits of adjustment.

8. Loosely position the two hose clamps (ref. 3) over the 3/4" copper pipe (ref. 4). Temporarily insert the non-capped end of the 1/2" copper pipe (ref. 2) into the 3/4" copper pipe for a distance of at least 4" or more. Tighten the top hose clamp while watching for the tabs in the 3/4" pipe to begin overlapping each other. If the tabs jam together and don't overlap, try loosening the clamp and re-bending two opposing tabs a little farther inward (repeat of step 6). Once the overlap allows you to clamp the 1/2" pipe firmly, tighten the bottom clamp firmly. Now that the clamps have formed the tabs in the proper position, you may loosen the clamps and remove the 1/2" pipe to make it easier to finish assembling the antenna.

9. Cut a 10". length of 1 1/2 " PVC pipe (ref. 9).

10. Cement a 1 1/2" slip to 1 1/2" female threaded PVC adapter (ref. 14) on each end of the 10" PVC pipe (ref. 9).

11. Screw the 1 1/2" male threaded to 3/4" female threaded galvanized iron reducing bushing (ref. 7) into the PVC adapter at either end of the 10" PVC pipe. The threads are tapered so the fittings will get tight when they are threaded together about half way. Tighten firmly with a wrench or large channel-lock pliers.

12. Screw the threaded end of the adapter (ref. 6) previously installed on the 3/4" copper pipe (ref. 4) into the 3/4" threaded center hole in the reducing bushing (ref. 7). The threads are tapered so the fittings will get tight when they are threaded together about half way. Tighten firmly with a wrench or large channel-lock pliers.

13. Install the pipe grounding clamp (ref. 5) onto the upper portion of the 3/4" sweat to 3/4" male threaded copper adapter (ref. 6). This is called a "grounding clamp" in the electrical trade, but is actually being used here to make the RF connection to the copper antenna pipe.

14. Fasten the completed loading coil assembly to the 1 1/2" PVC pipe section (ref. 9) oriented with the tapped end of the coil down. Use two plastic wire ties (ref. 8) around the loading coil pipe and the 1 1/2" PVC pipe as illustrated. Position the tie wraps just inside the caps as illustrated. If your wire ties aren't long enough, you can daisy chain two or more to get the required length. Tighten the wire ties as much as you can with pliers. Apply a dab of PVC cement to both wire ties where they contact the 1 1/2" PVC pipe to prevent them from slipping.

15. Cut the 12" top coil end wire just long enough to comfortably reach the "ground clamp" (ref. 5) without straining. Scrape (if necessary) and tin the end of the wire. Insert the end of the wire into the ground clamp and tighten the wire clamping screw firmly.

Mounting The Weatherproof Box

Since the exact mounting position and dimensions are determined by the size and shape of your chosen weatherproof, the following steps are written in general terms.

Here are some important points to keep in mind.

- The transmitter should be mounted no higher than the bottom of the loading coil winding. This will minimize capacitive coupling between the coil and the transmitter board.
- The antenna and ground leads that run from the transmitter to the coil and the metal pipe mast, respectively, should be kept as short as possible for Part 15 compliance. Generally, this limits the choice of transmitter orientation inside the box to the vertical position with the transmitter rear panel facing up, as illustrated.
- The component side of the transmitter circuit board must be accessible for setting the frequency switches and adjusting the trimmer capacitor. Again, the transmitter orientation shown in the illustration is good for accessing the board.
- The weatherproof box should be no larger than necessary to reduce wind resistance and stress on the box mounting points. For a heavier box, you might consider using two U-shaped pipe mounts to attach the box more securely.

Now on with mounting the box:

1. Drill holes in the box for the two mounting screws (ref. 13). Exact position is not important, but they should be spaced far apart and should be on the vertical center line of the box.
2. Drill holes in the box large enough to pass the power and audio cable plugs into the box. These holes should be offset horizontally from the box center line enough to clear the mast pipe and must be positioned upward from the transmitter enclosure rear panel in its final position. See illustration. Note: if your audio source is already monophonic, you need only one audio cable plugged into either audio jack on the transmitter. If your source is stereo, you will need both left and right audio cables.
3. Drill a separate hole large enough to pass the antenna and ground wires out of the box.
4. Temporarily thread the top end of the antenna mast pipe (ref. 12) into the threaded PVC adapter (ref. 14) and tighten firmly.
5. Hold the box in its final position against the mast pipe and mark the locations on the pipe for the two mounting screws (ref. 13). Drill holes in the mast pipe at the marked locations. Use a drill sized to just clear the diameter of the screws at the valleys of their threads. Run the screws in and out of the holes a couple times to form the threads in the pipe sections.
6. With the same drill bit used in the previous step, drill a hole in the mast pipe for the self-threading ground screw (ref. 13) approximately as shown in the illustration. Run the screw in and out of the hole a couple times to form the threads in the pipe.
7. Attach the box to the mast pipe with two self-threading screws (ref. 13) through the mounting holes just prepared.

8. Attach the mating halves of the adhesive velcro strips (ref. 10) to the bottom of the transmitter enclosure and to the inside of the weatherproof box, respectively as illustrated. Remove the top cover from the transmitter for later access to the switches and trimmer capacitor for final tuning. You may elect to just leave the cover off in the final installation.

9. Route the antenna and ground wires from the transmitter rear panel out through the hole in the box that you previously drilled for them. Cut the black ground wire to the minimum length that will comfortably reach the ground screw on the mast pipe, allowing an extra 3/4" for the connection. Strip 3/4" of insulation from the wire. Lightly twist the conductor strands together, and tin the exposed wire with solder. Don't connect the ground wire to the mast pipe yet.

10. Cut the white antenna wire to the minimum length that will comfortably reach the uppermost tap on the coil (not the upper coil end wire), allowing an extra 1/4" for the connection. Strip 1/4" of insulation from the wire. Lightly twist the conductor strands together, and tin the exposed wire with solder. Don't connect the antenna wire to the coil yet. You will do that later after selecting the proper tap in the tuning procedure.

11. Remove the antenna assembly from the mast pipe by unscrewing at the antenna assembly/mast pipe fitting. Lay the antenna assembly aside while you install the mast pipe in its final location.

Installation

Installing The Mast Pipe

Install the mast pipe (ref. 12) securely in its final position making sure that the threaded end with the ground screw hole is at the top. How you mount the mast pipe is up to you. Some suggestions:

- If the mast pipe is fairly short, dig a hole about 3 ft deep and 1ft in diameter. Place the mast pipe in the hole. Mix a bag or two of concrete and pour around the pipe in the hole. Support the pipe vertically (check with a level) until the concrete sets.

- A longer mast pipe may be installed on the side of a building. You can use TV antenna mast wall mounts (RadioShack), or you can fabricate wood or metal wall standoff supports and use U shaped pipe mounts or U bolts. Wood supports can be fabricated from 2 x 4 wood stud stock. Metal supports can be fabricated from universal angle iron stock and bolts. The pipe should extend all the way to ground level to provide the necessary signal ground path and added support.

Grounding The Mast Pipe

Grounding is very important to the performance of your antenna. The mast pipe needs to be well grounded to minimize antenna ground loss. High resistance to ground will cause most of your signal to be dissipated in the ground resistance. Ground resistance drops when you are able to connect to a conductor that has a large area buried in moist ground.

A metal cold water pipe that has a good conductive path underground can

sometimes provide a very good ground, but presence of corrosion, gaskets, poorly conducting fittings or plastic pipe sections can severely affect the conduction path.

If your soil around the mast is relatively rock free, you will get good results with several 8-foot long electrical grounding rods driven vertically into the soil around the base of the mast. You will need to connect the tops of the rods to the mast with heavy copper wires (#14 or #12 are practical sizes). Use one or more grounding clamps above ground level at the base of the mast pipe to connect the ground wires. The ground rods are made of steel clad with an outer jacket of copper. They are available from home improvement stores and electrical supply dealers.

Burying a number of bare copper wires at least 6 ft. long (longer is better) in a radial pattern around the base of the mast is a popular solution, especially when your soil is too rocky for ground rods. Use as many wires as you can manage and make them as long as possible. Use un-insulated wire that is #14 gauge or heavier. Solid un-insulated wire is available in various size rolls from home improvement store and electrical supply dealers. You can rent a powered wire trencher from your local tool rental store. They cut a slot in the ground with a bladed wheel. You can lay a lot of wire in one day with a trencher. The wires need to be bonded together at the mast and connected to the mast. You can use one or more grounding clamps at the base of the mast pipe above ground level.

Mounting The Antenna And Transmitter To The Top of the Mast Pipe

1. Screw the antenna assembly onto the top of the mast pipe and tighten firmly.
2. Attach the black ground wire to the mast pipe by forming the wire around the ground screw and then tightening the screw firmly down on the wire to make good contact.
3. Slide the 1/2" antenna pipe (ref. 2) back into the slotted 3/4" pipe (ref. 4) for a distance of 7" so the line labeled "mid" is even with the top of the 3/4" pipe, and tighten the two hose clamps (ref. 3) sufficiently to keep the antenna pipe from slipping downward.

Tuning

Proper tuning of your antenna is critical to achieving maximum performance. The antenna has a very sharp resonance point. You must follow the tuning instructions carefully. Tuning must be done with the antenna installed in its permanent location.

1. Route the audio and power cables up to the transmitter, pass them through the holes in the transmitter box, and plug them into the transmitter jacks.
2. Apply power to the transmitter and connect the audio cables to an audio source.
3. Loosen the two hose clamps enough to be able to work the 1/2" pipe up and down for adjustments, but not so loose that it slides downward on its own. Start at the midpoint of adjustment range, which is the point where the 1/2" pipe is inserted into the top end of the 3/4" pipe for a length of 7". The range of adjustment is plus or minus 4" from the midpoint. Never raise the antenna to a point where less than 3' is inserted into the top of the 3/4" pipe, or it will

not be supported properly by the hose clamps.

4. Insert the probes from an analog or digital voltmeter into the two holes on the right side of the transmitter circuit board labeled T1 (positive) and T2 (negative). Set the meter to read DC volts, and set it to the lowest range that will allow reading up to about 15 volts DC. Your voltmeter should have an input impedance rating of at least 10 megohms. This is common for virtually all battery operated meters currently on the market.

5. Choose your desired operating frequency in the range between 1500 kHz and 1700 kHz. Pick a frequency that is unused in your area. Set the 8-position DIP switch, S4, to your chosen frequency according to the chart in the manual. Also, double check that all four switches on the 4-position DIP switch, S5, are set to the ON position. Set the trimmer capacitor, C5, to its minimum setting (rotate until the half moon shaped metal plate on the top faces the front side (control side) of the transmitter circuit board.

6. Set the front panel GAIN control to its minimum setting (fully counterclockwise) to ensure the transmitter is not being modulated during the tuning process.

7. Holding the short antenna wire lead coming from the transmitter antenna plug, touch it to the topmost loading coil tap (topmost tap, not the top end of the coil). Note the meter reading. Now touch the wire to each successive tap, moving downward along the taps (including the bottom coil end wire) until you find the tap that gives the highest meter reading. If you see the voltage peak and then start to drop lower as you move to successive taps, go back to the one that gives the highest reading. Temporarily clamp the wire in contact with this tap using an alligator clip or small paper clamp and move your hands and body away at least 2 feet. Note the meter reading and then move and clamp the wire to successive taps on either side of this tap until you find the one that gives the maximum meter reading with your hands and body away from the antenna at least 2 feet.

8. Fine tune the antenna by working the 1/2" pipe antenna up or down about a half inch at a time until you find the position that gives the highest meter reading with your hands and body at least a 2 feet away from the antenna.

9. If the voltage reading at the tuning peak is greater than 13 volts DC, increase the trimmer, C5, capacitance by rotating the trimmer clockwise until the voltage drops to 13 volts DC. Re-adjust the antenna length downward until the voltage peaks again. If the voltage peak is still higher than 13 volts DC. Repeat the process of increasing the trimmer capacitance and re-tuning the antenna until you get 13 volts DC at the tuning peak. You should only have to repeat this process a couple of times. This is an important step. Don't treat it lightly. If the voltage is not reduced to 13 volts DC, your RF output signal may be distorted resulting in audio distortion of the received signal. When the meter reads 13 volts DC, the antenna is perfectly matched to the transmitter: the power output will be maximum and the audio will be undistorted.

10. Solder the transmitter antenna lead to the selected tap. All other taps above and below your selected tap will remain unconnected. The portion of the coil between the selected tap and the top end wire now has the required inductance to tune to your selected frequency. The portion of the coil below

your selected tap is electrically open-circuited and does not contribute to the coil inductance.

11. Re-check that the voltage reading is still 13 volts. If it has changed higher or lower, repeat steps 8 and 9 to ensure the antenna is tuned properly after soldering the transmitter antenna wire, and then tighten the two hose clamps firmly.

12. Adjust the GAIN, MODULATION, and COMPRESSION controls to your preference according to the instructions in the manual. If you choose to use an external audio processor for level, compression and limiting control, set the GAIN and MODULATION controls to maximum (fully clockwise) and set the COMPRESSION control to minimum (fully counterclockwise). Your external audio processor must then be set for the proper audio level and limit level to achieve 100% modulation without over modulation.

Sealing The Box Against Moisture

Apply RTV silicone adhesive or 100% silicone caulk liberally around all wires where they enter the box to block any moisture from entering the box. .This is an important step. Any water that gets onto the circuit board will quickly damage the board. Attach the box cover.

◄ Back to SSTRAN Home

Solvent Welding PVC Pipe Joints

Building a Base-Loaded Vertical Antenna

Drawing and Parts List

Soldering Copper Pipe Fittings

PVC pipe is joined with two solvents. The first is a cleaner to remove wax, oil and dirt. and the second is the cement. A medium consistency cement is recommended.

1. Cut PVC pipe in a miter box with a hacksaw to get smooth, square cuts. A 24-tooth blade works best. Ordinary hand saws can be used, but their cuts are rougher.
2. Remove any burr around the outer edge with a knife, a file or sandpaper.
3. Brush the cleaner on the outside of the pipe and on the inside of the fitting.
4. Next brush the cement liberally on outside of pipe and lightly inside the fitting.
5. Without waiting, push the fitting and pipe together with no more than a quarter twist until the pipe bottoms.
6. A properly solvent-welded joint will show a bead of fused cement.

Soldering Copper Pipe Joints

Building a Base-Loaded Vertical Antenna

Drawing and Parts List

Solvent Welding a PVC Joint

You will need the following tools and supplies: a hacksaw or tubing cutter, plumbers sand cloth (emory cloth), flux paste, solid core plumbing solder and a propane torch . All of these items can be found at any home improvement or hardware store.

1. Use a tubing cutter or hacksaw to cut the copper pipe to the specified length. Even new copper pipe and fittings have a thin layer of oxidation that must be removed. Use emory cloth to clean each end of the pipe. You need to shine only about 1 inch at each end. Shine the inside of the fitting with emory cloth.

2. Use a small flux brush or your finger to apply a layer of flux paste to the areas of both the pipe and fitting you have cleaned.

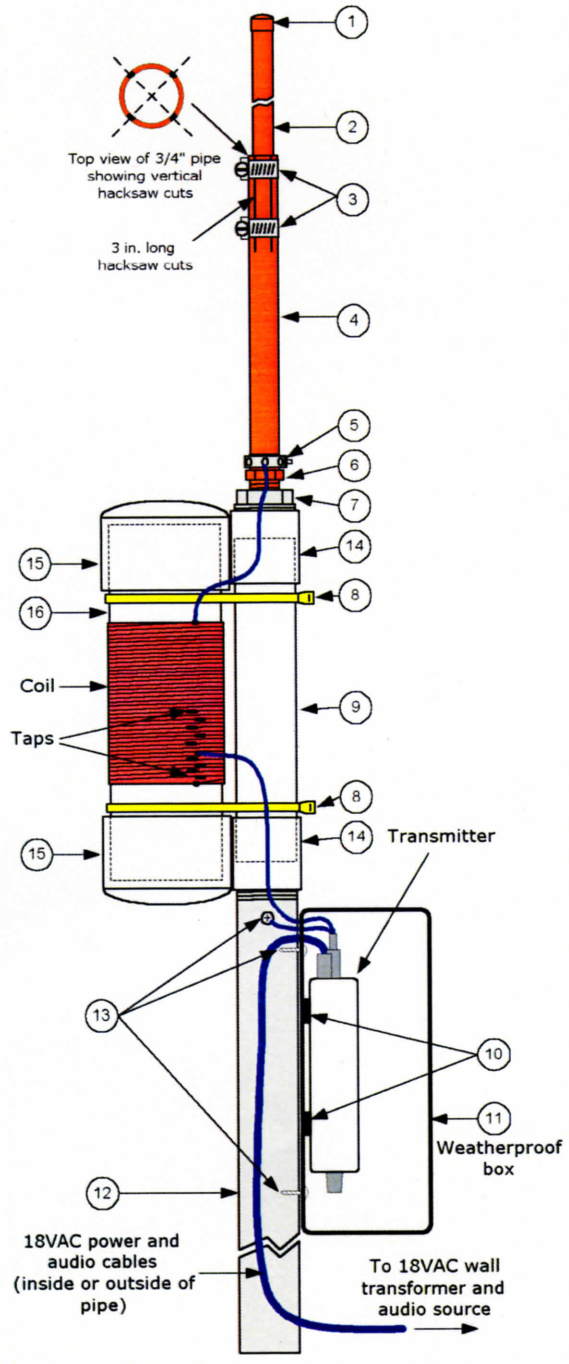
3. Join the pipe to the fitting. Light your torch. You should see a flame within a flame if your torch is adjusted correctly. The tip of the inner flame produces the hottest temperatures. Apply the torch to the pipe/fitting area so that the tip of the inner flame just touches the copper. The flux will immediately begin to boil.

4. Within about 10 - 20 seconds, the boiling flux will disappear. At this time, touch the solder to the intersection point of the pipe and fitting. Within 1 second, the solder should begin to melt. Immediately remove the torch. If the pipe and fitting are sufficiently hot, the solder will continue to melt and be drawn completely into the fitting. The pipe will usually retain enough heat to melt the solder for 10 to 15 seconds. However, you usually need to only apply solder for 3 - 5 seconds. You can wipe away any drips or blobs of solder with a swipe of a wet rag while the solder is still liquid.

Antenna Diagram And Parts List

(Revised 01/02/2005)

Back to "Building a Base-Loaded Vertical Antenna"



Dwg. Ref.	Qty	Description	Source
1	1.	1/2" copper pipe cap	Home improvement store (plumbing dept.)
2	98 in.	1/2".copper pipe (Type L)	Home improvement store (plumbing dept.)
3	2	3/4" hose clamps	Home improvement store (plumbing dept.)
4	10 in.	3/4" copper pipe (Type M)	Home improvement store (plumbing dept.)
5	1	Pipe grounding clamp to fit 3/4" pipe	Home improvement store (electrical dept.)
6	1	3/4" sweat to 3/4" male threaded copper adapter	Home improvement store (plumbing dept.)
7	1	1 1/2" male threaded to 3/4" female threaded galvanized iron reducing bushing	Home improvement store (plumbing dept.)
8	2	large plastic wire tie, also known as "tie wrap"	Home improvement store (electrical dept.)
9	10 in.	1 1/2" white schedule 40 PVC pipe	Home improvement store (plumbing dept.)
10	2	3" long adhesive-backed Velcro strips	Home improvement store (hardware dept.)
11	1	Waterproof box: plastic or metal outdoor electrical box. Minimum inside dimensions: 7" x 6.5" x 2"	home improvement store (electrical dept.) or electrical supply store
12	(see note 1)	1 1/2" rigid metal conduit	Home improvement store (electrical dept.)
13	3	#10 x 1" self-tapping stainless steel screw	Home improvement store (hardware dept.)
14	2	1 1/2" slip to 1 1/2" female threaded white schedule 40 PVC adapter	Home improvement store (plumbing dept.)
15	2	3" white schedule 40 PVC cap	Home improvement store (plumbing dept.)
16	11 in.	3" white schedule 40 PVC pipe	Home improvement store (plumbing dept.)
-	1	Small can PVC solvent cement, medium consistency	Home improvement store (plumbing dept.)
-	1	Small can PVC solvent cleaner	Home improvement store (plumbing dept.)
-	1	1 lb spool #16	powerwerx.com

			AWG gauge magnet wire	http://www.powerwerx.com/product.asp?ProdID=2101 or MarVac Electronics http://marvac.com/detail.aspx?ID=20123

Note 1. Be sure to use "rigid metal conduit", not the lighter grade conduit made for interior wiring. You can join several lengths with threaded couplers to get your desired height. If you need to cut an odd length, be sure the cut end is on the bottom of the mast and that a threaded end is on the top.

Modifying the AMT3000 for Driving the Base-Loaded Vertical Antenna

Building a Base-Loaded Vertical Antenna

Why Do You Need to Modify Your AMT3000?

The AMT3000 is designed for ease of tuning with a non-critical antenna setup for the casual user who wants to broadcast to radios within a house. The standard AMT3000 antenna output circuit is designed to match a high impedance, short wire antenna. The base-loaded vertical antenna presents a low impedance to the transmitter. The simple transmitter changes described here enable the AMT3000 to drive the low impedance antenna efficiently. The AMT3000 internal inductors are bypassed, and instead, the external base loading coil provides the required inductance. The antenna has a very high Q, which means that harmonic radiation will be highly attenuated (just as is true for the standard AMT3000). The transmitter modifications do not change the FCC-mandated 100 milliwatt RF input power specification.

If You Have Not Yet Assembled Your AMT3000

If you have not yet assembled your AMT3000 kit and want to use it with the base-loaded vertical antenna, follow these instructions.

1. Skip the assembly step which calls for installing resistor R18 (820 ohms). This component location will remain vacant with no component or wire connection between the two R18 holes.

2. At the assembly step which calls for installing capacitor C23 (820 pf), install instead, a 560 pf, 50VDC ceramic capacitor. You may order this capacitor by sending an e-mail request to mailto:orders@sstran.com.

3. At the assembly step which calls for installing resistor R14 (220k), install instead, a jumper wire between the two R14 holes. You can use a clipped lead from one of the other components for the wire.

4. Set all four switches to the ON position on the S5 DIP switch pack. These switches must always remain ON. They are not used as part of the tuning procedure for the base-loaded vertical antenna.

5. Follow the tuning instructions in Building a Base-Loaded Vertical Antenna in place of the tuning instructions in the manual.

If You Have an Assembled AMT3000

If you already have an assembled AMT3000 and want to modify it for driving the base-loaded vertical antenna follow these instruction.

1. Remove resistor R18 (820 ohms). You can clip the resistor out with wire cutters or unsolder it. This component location will remain vacant with no component or wire connection between the two R18 holes.

6. Unsolder capacitor C23 (820 pf) and insert in its place a 560 pf, 50VDC ceramic capacitor. You may order this capacitor by sending an e-mail request to mailto:orders@sstran.com.

2. Resistor R14 (220k) must be replaced with a jumper wire. You can do this in either of two ways: (1) keep R14 in place on the board and tack solder a short piece of wire across the resistor, or (2) remove resistor R14 and then insert a wire between the two R14 holes and solder. Either way will work. Choose whichever method you like best.

3. Set all four switches to the ON position on the S5 DIP switch pack. These switches must always remain ON. They are not used as part of the tuning procedure for the base-loaded vertical antenna.

4. Follow the tuning instructions in Building a Base-Loaded Vertical Antenna in place of the tuning instructions in the manual.