

Features

- 3.8MHz Amateur Phone Band Receiver
- 100 KHz Tuning Range
- Wideband Hi-Fi AM mode reception
- Single Sideband mode with on board BFO
- Uses single chip TRF TA7642 IC
- Low impedance 8 ohm speaker output
- Main tuning with separate Bandspread
- RF Gain and AF Gain controls
- 9-12 VDC operation
- Varactor Diode tuning
- NE602 1st Mixer
- 455 KHz IF with ceramic filter
- TDA7052 audio amplifier IC
- On board 6 volt regulator

Description

The AMR75 is an experimental AM phone band receiver which makes use of a TDA7642 TRF receiver IC along with a conventional NE602 first mixer stage. The design provides a wide bandwidth Hi-Fi output which is suitable for listening to the AM groups that are popular on 75 meters. The radio was designed as a nostalgic callback to vacuum tube receivers of the 1950s with main tuning, band spread, 455 KHz IF, BFO, and plenty of audio output. This radio is called experimental since the builder may want to tailor the radio's performance by adjusting component values. Also the builder needs to supply a suitable enclosure or open chassis platform.



Figure 1 – Assembled AMR75 Board

Theory of Operation

This discussion will refer to the block diagram on page 3 and the schematics on page 4. We will start at the antenna input with a two stage input bandpass filter consisting of two 10.7 MHz 42IF123 IF transformers that have been padded to resonate on the 75 meter band. An input impedance selector is provided to allow the radio to work with a tuned low impedance antenna, such as a dipole, or a high impedance antenna such a random length of wire. An NE602A is configured as a first mixer with an internal VFO oscillator. The oscillator is tuned with a varactor diode. The VFO frequency is determined by the DC voltage applied to the varactor which controls its capacitance. Two tuning controls are provided, a Main tuning control and a Bandsread tuning control. The Main tuning provides a coarse voltage adjustment to the varactor while the Bandsread allows a fine adjustment. The bandsread is useful in tuning SSB station when the BFO is enabled. The VFO operates at a frequency range of 4255 to 4405 KHz. When this is mixed with an incoming signal of 3800 KHz to 3950 kHz, the resulting mixing product is 455 KHz which is the radio's IF. This signal is passed through a 455 KHz ceramic filter which provides a 6 dB bandwidth at 4.5 KHz. This is coupled to a 455 KHz IF transformer which transforms the 2K ohm output impedance of the ceramic filter to the high impedance input of the TA7642 TRF receiver IC. The TA7642 is a complete AM radio on a single IC, providing gain stages, AGC, and an envelope detector. The IC is a three terminal device with input, ground, and output. The output bias voltage is fairly critical and is controlled by a dedicated bias regulator circuit that allows the voltage to be varied from 1.0V to 2.5V. The TA7642 is normally used as the main component in a tuned RF radio operating in the AM broadcast band. We are essentially using it as a fixed frequency radio at 455 KHz. The output of the TA7642 is baseband audio which is amplified by a TDA7052 audio output amplifier. This is a very capable amplifier which provides 1 watt of good sounding audio. To increase the capability of the receiver, a simple 455 KHz BFO oscillator is provided to allow SSB reception. A tiny amount of BFO energy is coupled into the signal path just after the 455 KHz ceramic filter. Note that this is old school SSB reception, both sidebands are presented and the user must tune in to the correct sideband to get proper reception. In addition, since this radio is designed for wide bandwidth reception, you may have a difficult time digging out SSB stations if the conditions are very crowded. But then this is primarily an AM phone receiver. It is possible to tune the receiver to the 80 meter CW band and use the BFO to copy CW, but that is an exercise left to the builder.

Block Diagram

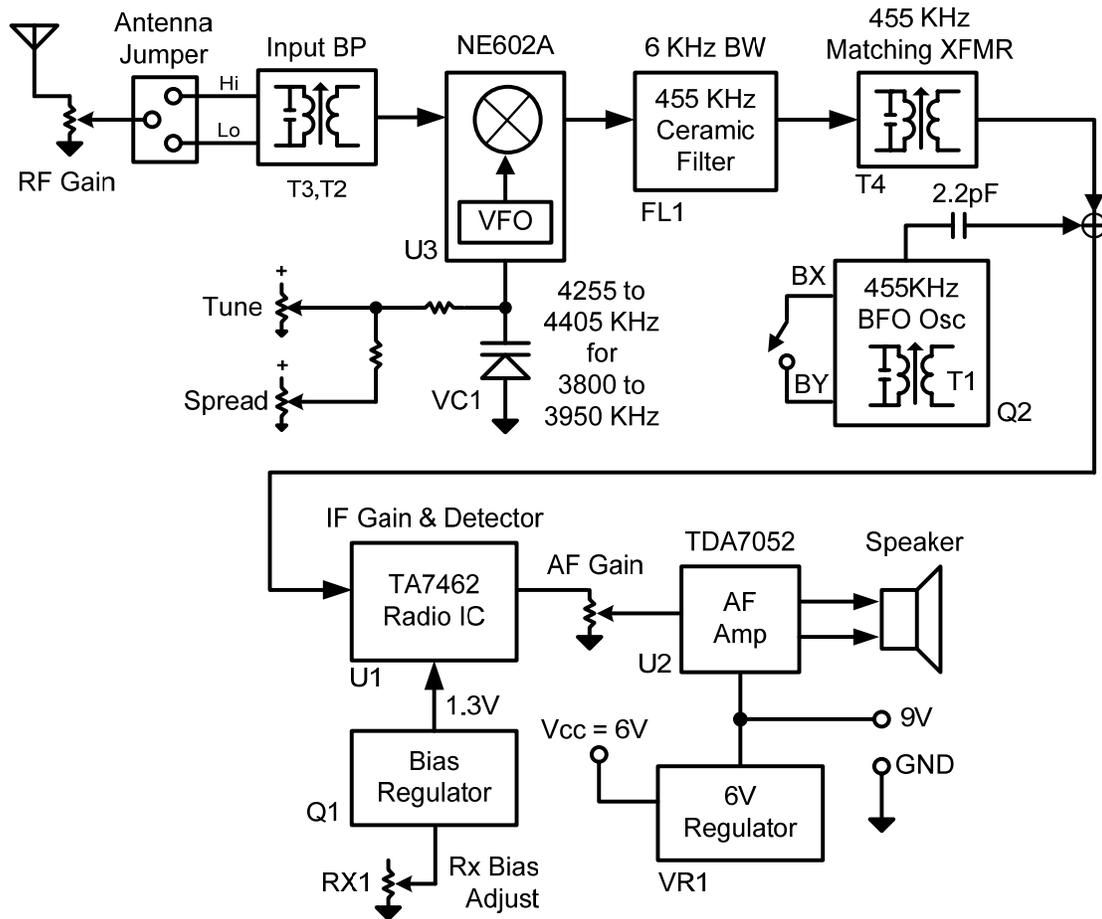
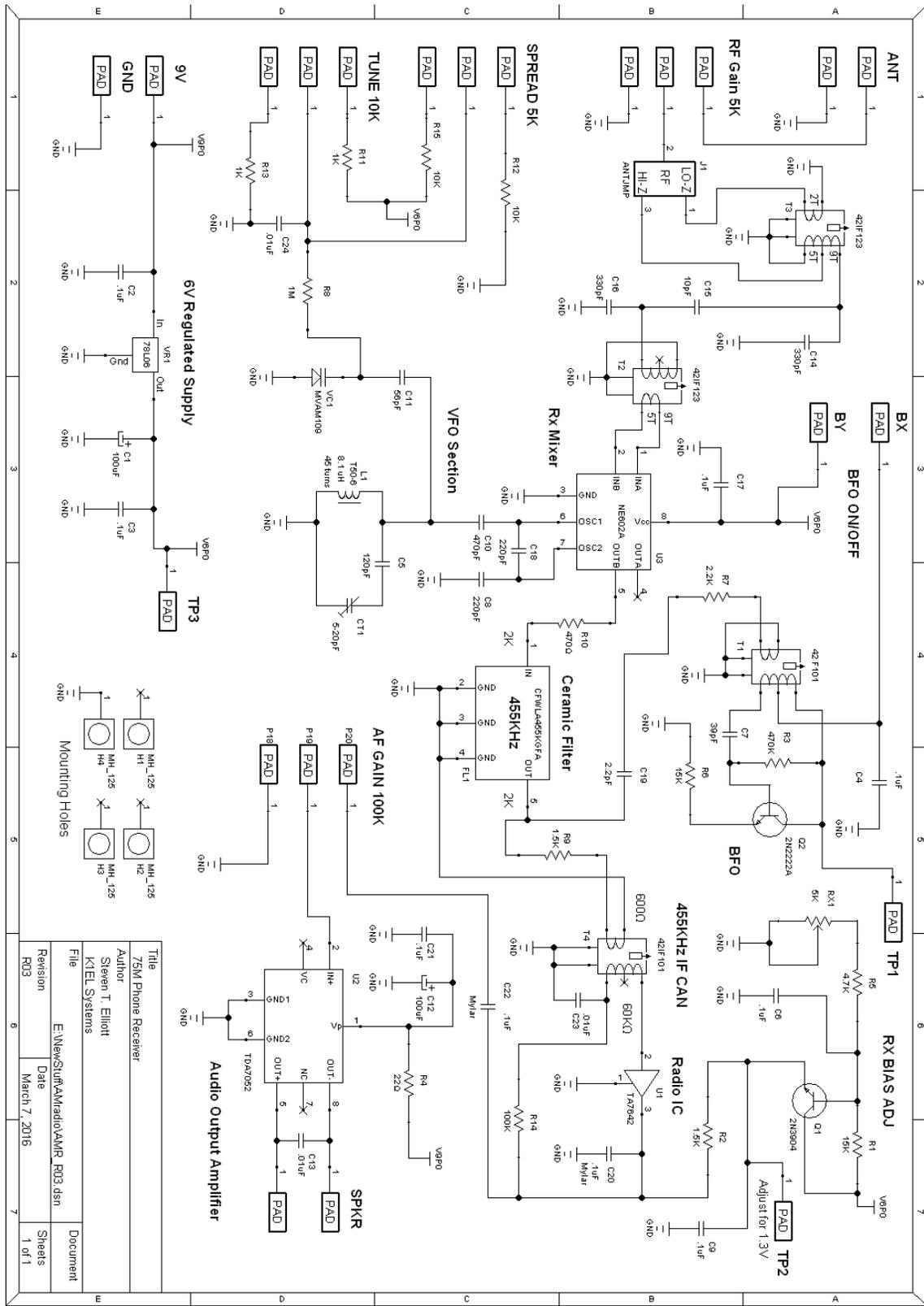


Figure 2 – Assembled AMR75 Block Diagram

AMR75 Schematics



AMR75 Kit Parts List

R14	1	100K	Brown Black Yellow
R12, R15	2	10K	Brown Black Orange
R2, R9	2	1.5K	Brown Green Red
R1, R6	2	15K	Brown Green Orange
R11, R13	2	1K	Brown Black Red
R8	1	1M	Brown Black Green
R5	1	4.7K	Yellow Violet Red
R7	1	2.2K	Red Red Red
R4	1	22 Ω	Red Red Black
R10	1	470 Ω	Yellow Violet Brown
R3	1	470K	Yellow Violet Yellow
RX1	1	5K	5K Ω Trimmer Potentiometer
C13, C23, C24	3	.01uF	Ceramic Disk Cap
C3, C4, C6, C9, C17, C2, C21	7	.1uF	Multilayer Cap (.1" spacing)
C20, C22	2	.1uF	Mylar Cap(.2" spacing)
C1, C12	2	100uF	Electrolytic Cap
C5	1	120pF	Ceramic Disk Cap
C19	1	2.2pF	Ceramic Disk Cap
C15	1	10pF	Ceramic Disk Cap
C10	1	470pF	Polystyrene Cap
C8, C18	2	220pF	Polystyrene Cap
C14, C16	2	330pF	Ceramic Disk Cap
C7, C11	1	56pF	NPO Ceramic Disk Cap
CT1	1	5-20pF	Green Trimmer Cap
T1, T4	2	42IF101	IF Transformer (BFO, IF)
T2, T3	2	42IF123	IF Transformer (BPF)
Q1	1	2N3904	NPN TO92
Q2	1	2N2222A	NPN Metal Case
VR1	1	78L06	6 volt regulator (TO92)
VC1	1	MVAM109	Varactor Diode TO92
L1	1	T50-6	Toroid, 45 turns #28
U1	1	TA7642	Single Chip Radio IC TO92
U2	1	TDA7052	BTL AF Amplifier DIP8
U3	1	NE602A	Mixer/VFO IC DIP8
FL1	1	CFWLA455KGFA	Ceramic Filter
REXT1, REXT2	2	5K	Potentiometer RF Gain, Spread
REXT3	1	10K	Pot AF Gain, Tune
REXT4	1	100K	Pot AF Gain with switch
SK1, SK2	2		DIP 8 sockets
Enameled Copper Wire	1	2.2 ft	
Insulated hook up wire	1	2.5 ft	

PCB Assembly

Install and test the 6 volt power supply

Install C2, VR1, C1 and C3. Observe polarity for C1, long lead goes in square hole.

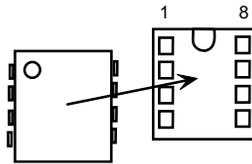
Attach power leads to the 9V and GND pads and attach them to a suitable power supply. 9V is optimal but any voltage from 8V to 12V will work. Make sure that the **plus** lead goes to the 9V pad. Turn on the power supply and you should see approx. 6V at TP3 then remove power.

Install Input Bandpass filter

Install and solder T2, T3, C14, C15 and C16

Install Mixer/VFO

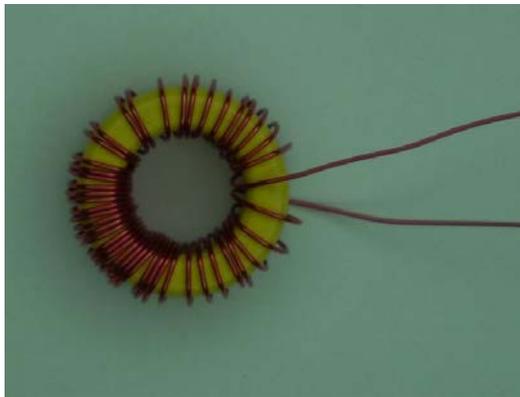
Install an 8 pin socket at U3. Next install C17, C18, C10, C8, C11, VC1, C5, then U3.



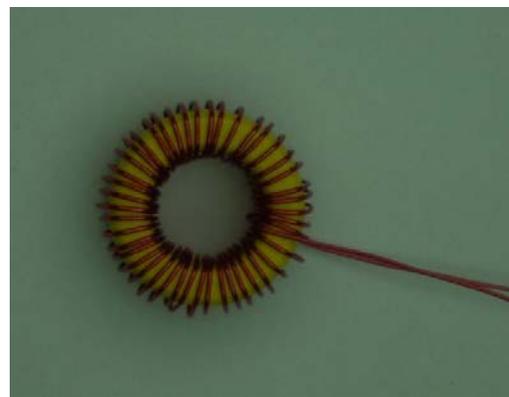
Install CT1 as shown in the pictures on page 10. Note that there is a squared side and a rounded side, orient CT1 so that the squared end is away from VC1.

Wind and install L1

Wind 42 turns of enameled copper wire on the yellow T50-6 core. The measured length is 2 feet 5 inches which includes an extra 1" at each end for leads. Count each pass through the core as one winding. When done verify the turns count while evenly spreading the turns around the core. Finished inductance should be approx. 8.1 uH. Coat the completed toroid with a thin layer of clear fingernail polish. After this dries, carefully remove the varnish from the toroid leads with fine sandpaper or the edge of a sharp knife and then tin the leads. To install L1 into the board, I first place a small dab of RTV glue on the PC board and then route the leads through pads so that the wound toroid sits on the glue. I let this set and then turn the board over and solder the leads.



After initial winding



After evenly spreading windings

Install Ceramic Filter and IF transformer

R10, FL1, R9 T4, and C23

Install RX Bias Regulator Circuit

RX1, R5, C6, R1, Q1, R2, and C9

NOTE: In the pictures, R5 is shown as 2.2K, we have changed this value to 4.7K.

Install the Single Chip Radio Circuit

U1, C20, R14, and C22

Adjust U1 Bias Voltage

Apply power and adjust RX1 so that there is 1.3V at TP2 then remove power

Install Audio Amplifier Circuit

Install an 8 pin socket at U2. Then install R4, C12, C21, C13 and U2 Observe polarity for C12, long lead goes in square hole.

Test AF amplifier

Attach a speaker to the SPKR and GND pads. Apply power to the board set the AF pot to half scale and touch the pot's middle pad; you should hear a loud 60 Hz hum in the speaker.

Install BFO Circuit

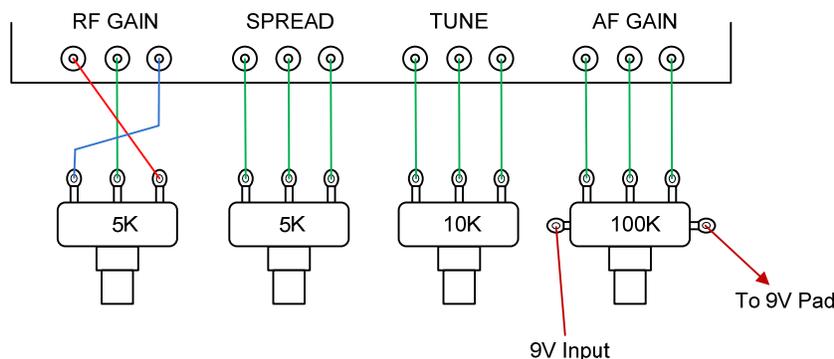
Q2, T1, C4, R3, C7, R6, and C19

Antenna Impedance Jumper

If the receiver is to be used with a resonant antenna, such as a dipole cut for 3.8 MHz (recommended), install a jumper wire between LO and the center hole of the three position ANT-Z location. Otherwise, install jumper between HI and center hole for a random length non-resonant antenna.

Control Wiring

The length of wires used to connect the front panel controls will depend on how you build up the receiver. Enough wire is included in the kit to cover a wide range of options. Cut six wires for the central two controls (TUNE and SPREAD) then cut six more, longer wires for the RF and AF gain controls. The end control wires are slightly longer to result in a good looking wire harness. Attach a 5K potentiometer to the RF GAIN pads and a second 5K potentiometer to the SPREAD pads. Next, attach the 10K potentiometer to the TUNE pads and the 100K potentiometer to the AF GAIN pads. The 100K AF gain control has a built in on/off switch. This is wired in series with the input power lead and the pad marked 9V on the PC board.



VFO Calibration

This procedure requires a calibrated general coverage receiver. Set the main tuning knob and bandsread controls to midscale. Set your receiver to 4.305 MHz and connect a length of wire to the test receiver's antenna input. Route this wire so that it runs close to, but does not touch, the AMR75 board. Apply power up the AMR75 and adjust the CT1 trimmer so that you hear a zero beat on the receiver. Use a plastic screwdriver for best results. A small metal jeweler's screwdriver can work but note the screwdriver will influence the frequency and it might take several trials to get the frequency correct. The radio is now tuned close to the center of the 75 meter AM phone band (3850 KHz). You should get a range of at least 50 KHz to each end of the tuning range.

Alternate VFO Calibration Procedure

This procedure uses a signal generator to set the AMR75 VFO. Set the signal generator to 4305 KHZ and couple its output to the AMR75 antenna input through a 100 pF capacitor. Attach a speaker to the AM75. We will follow the same procedure outlined above with the exception that we will be listening for a signal from the AMR75 as we adjust CT1. Make sure you have turned the RF gain control fully clockwise and the AF gain to mid-position.

IF Adjustment and Input BPF Calibration

Connect the speaker to the AMR75 and then connect an antenna to the AMR75 antenna input. Set the RF gain control fully clockwise and set the AF gain mid-position. Set the bandspread control to midscale. Turn the main tuning pot fully counterclockwise and return about 20% clockwise. Adjust T2 and then T4 for a peak in band noise,. Now turn the main tuning pot fully clockwise and return about 20% counterclockwise. Peak T3 for maximum noise.

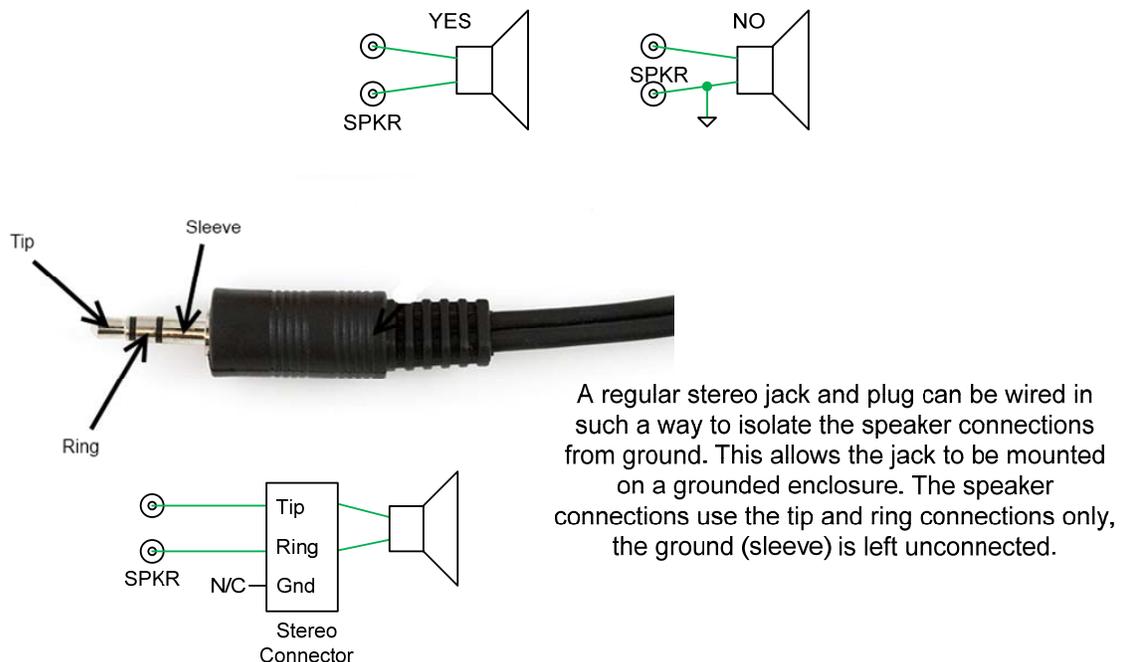
BFO Calibration

Attach an on/off switch (not supplied) to the BX and BY pads and set it to the off position. The best way to adjust the BFO is to tune to the center of a carrier in AM mode. You don't have to be exactly on center but get as close as you can. Now turn on the BFO switch and carefully adjust T1 for a zero beat note. Once you get to zero beat turn the adjustment clockwise so that you get about a 2 KHz beat note. As mentioned this is not a critical adjustment, as long as you are reasonably close it will work fine.

If there are any SSB stations on the band try tuning one in to get the feel for how it works. Since this is not a single signal receiver, you will be able to tune in both sidebands of an SSB phone transmission. Only one will be intelligible, the lower sideband. Since receiver bandwidth is fairly wide, about 5 KHz, you may hear other stations that are higher or lower in frequency bleed through.

Speaker Connection – IMPORTANT !

Neither of the TDA7052 audio amplifiers outputs should be connected to ground. A speaker or headphones are connected between the two outputs. This can be a problem if you decide to put the radio into a metal enclosure that is connected to power supply ground. You must choose a speaker connection that is isolated from ground unlike most 1/8" or 1/4" connectors.

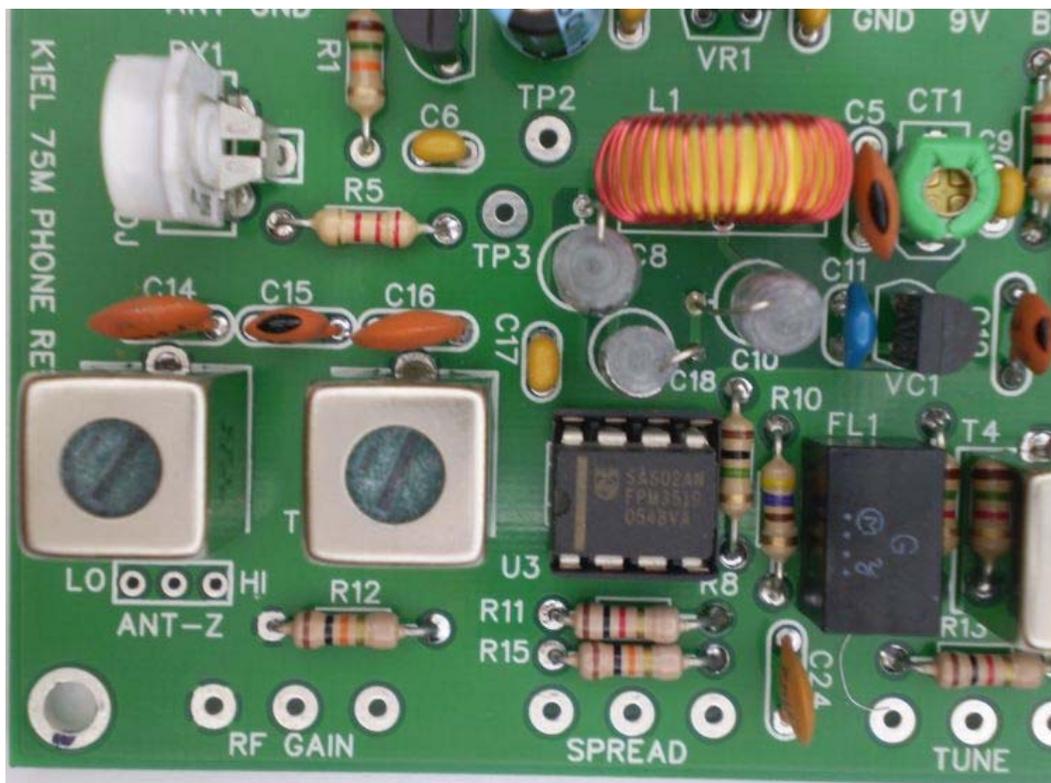
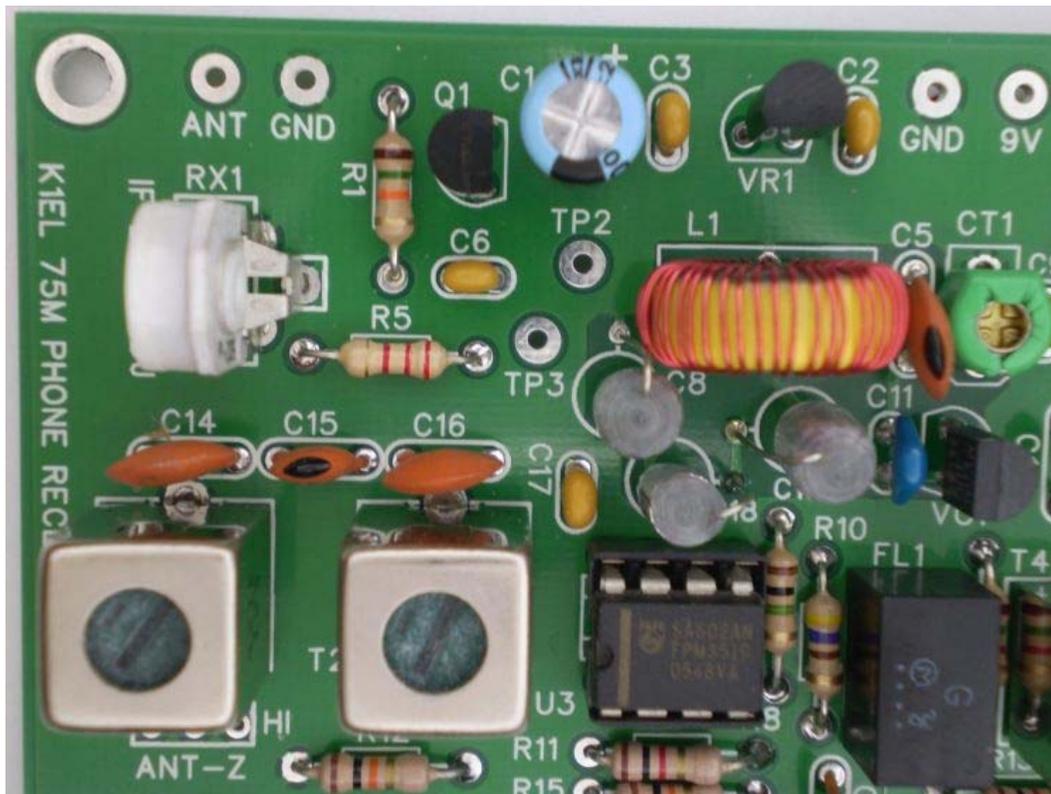


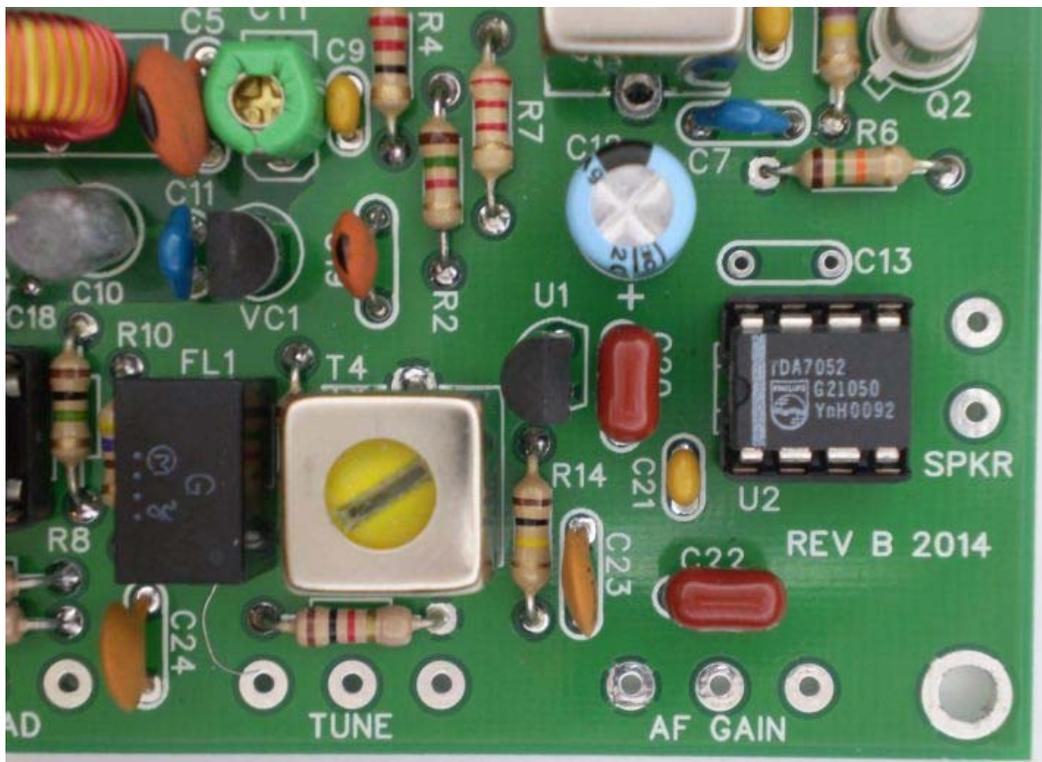
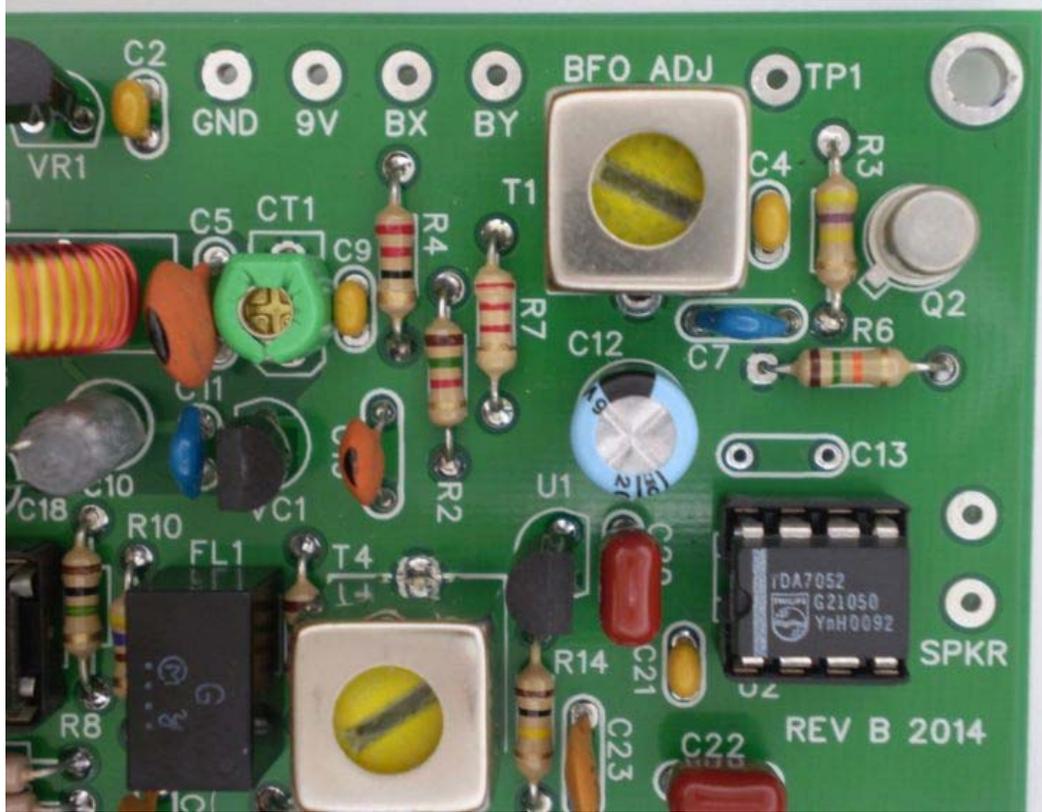
General Operational Notes

This receiver has a surplus of gain. This will become apparent when band conditions are good. You will find that you rarely have to turn the RF gain control all the way up, particularly for SSB stations. If you are finding that signals are distorted, try backing off on the RF gain control. If you only want to use AM mode, don't bother with a BFO switch, the BFO circuit is disabled when the switch is disconnected.

When tuning around the band, generally set the bandspread control set to mid position, this provides a good range of fine tuning when you find a station. Larger knobs on the tuning and spread controls are a good idea with calibration marks on the front panel as a tuning aid. Remember to set the spread control to center when you are determining the calibration points. A center detent pot for the spread would be a nice option if you have one.

Close Up Photos of an Assembled AMR75 PC Board





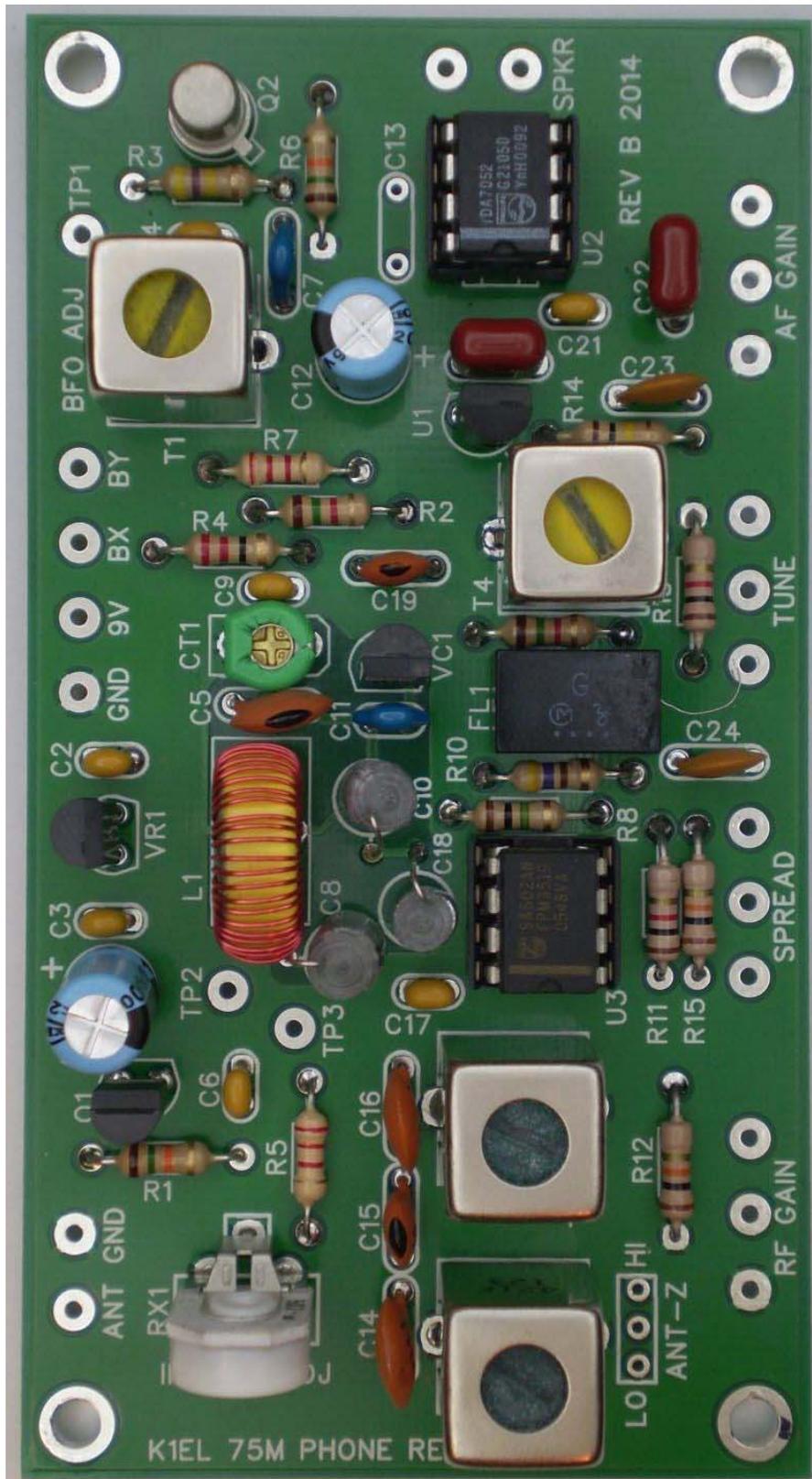


Figure 3 – Assembled AMR75 Board Close Up

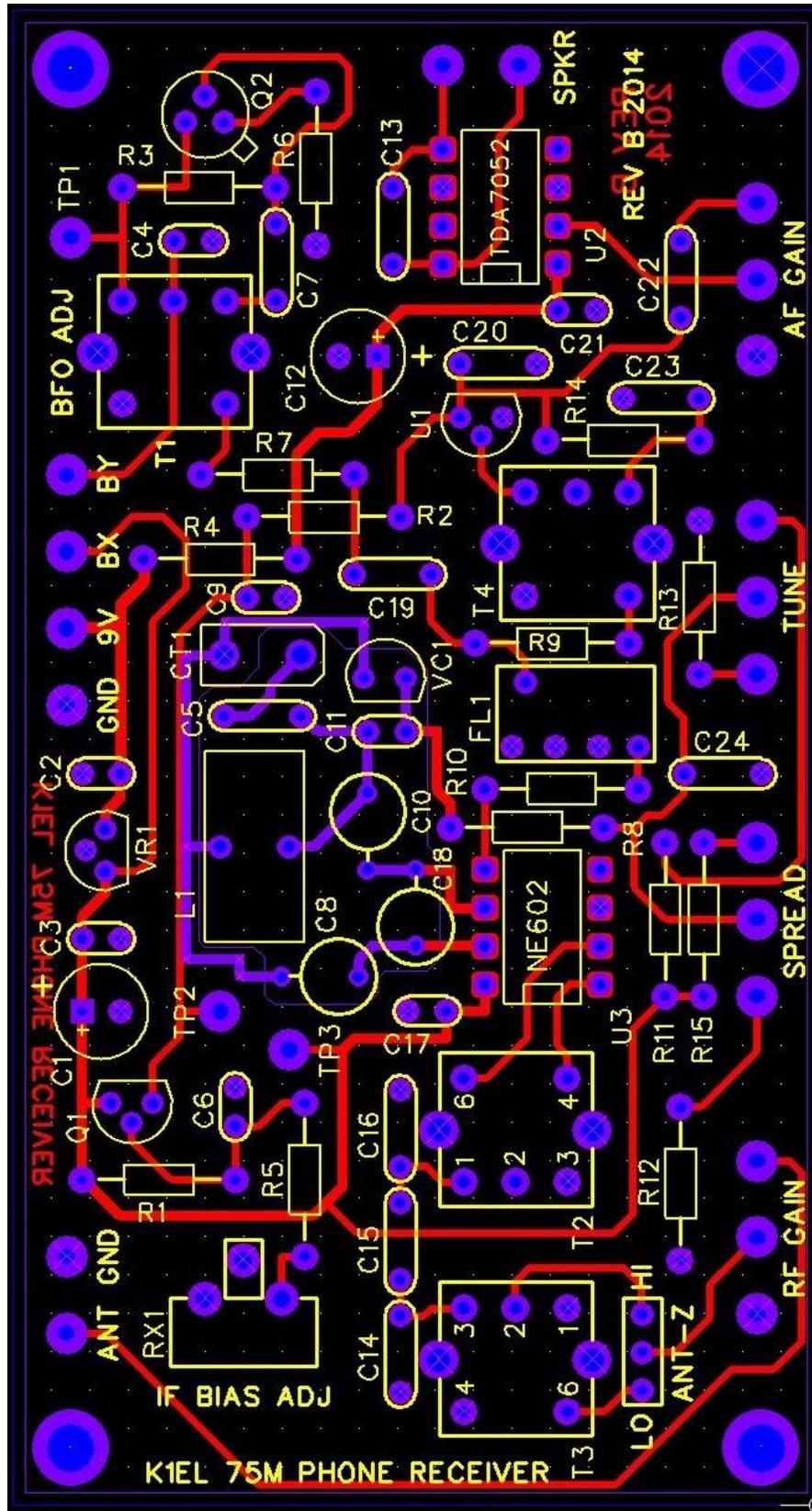


Figure 4 – Printed Circuit Board Image

Contact Information

The AMR75 Kit is fully guaranteed; if you are not satisfied please return the kit for a full refund.

Questions will be handled by e-mail via: k1el.kitsinfo@gmail.com

Watch the Hamcrafters Website for latest updates and new product offerings: <http://www.hamcrafters.com>

Revision History

3-16-2015	AMR75 Rev A.1 Original Release
11-11-2015	AMR75 Rev A.2 Updates and Corrections
3-7-2016	AMR75 Rev A.3 Updated PCB images, removed R120, R5 is now 4.7K

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Appendix A - Kit Construction Hints

1. Find a good workspace.

It is essential that you have a good place to work on your kit,

You will need room to spread out your parts and have access to tools. Good lighting and ventilation is essential. A magnifying glass or hood is highly recommended.

2. Have the proper tools.

At a bare minimum you will need:

Small side cutters, flush cutters are a plus.

Small needle nosed pliers

Small flat blade & Philips head screw drivers

A good quality, 40-60Watt, temperature controlled Soldering Iron. The price has come down on these, you can buy a Weller WLC100 40W adjustable soldering station for \$40 on Amazon.

3. Read the Instructions First.

Read through the assembly instructions completely and have everything on hand before you start. Carefully inventory the kit parts, make sure you have everything.

4. Follow the assembly instructions in order.

Although not always obvious, the order in which parts are installed is important and should be followed. Sometimes individual sections are completed and tested in order or there may be a mechanical clearance considerations.

5. Keep your Workplace Clean and Orderly.

Nothing spoils a kit building experience more than lost parts. Second to that are stray bits of dirt and metal that get on a printed circuit board assembly. Our PC boards are nicely plating and accept solder easily. There is no need to use solder flux or to clean the board with steel wool before starting.

6. Take your time.

There is no need to rush, enjoy the process and the difference will show in the end result. Moving too quickly or working when you are tired often leads to big mistakes which could be difficult if not impossible to fix.

Appendix B - Note About Safety

Burns to your skin can be very painful and can lead to serious injury.

Burns to your eyes can be catastrophic.

Toxic fumes can cause serious harm.

Flying objects such as wire ends etc. can cause painful and serious injuries.

When building your kit please remember that Soldering Irons and Solder are used at High Temperatures!

Soldering Irons can remain hot for many minutes after being turned off. Never touch the tip to see if it is hot. Place the tip on a wet pad to test for temperature.

Wear safety glasses to protect your eyes from flying objects.

Appendix C - Soldering Basics

1. Insert component leads into PCB holes and bend them back slightly to hold the part in place. You can either trim the lead now or wait till after the joint is soldered. I usually install several parts at one time and then solder and trim multiple leads in groups.
2. Place a hot and clean iron tip against both the lead and pad as in Fig. C1.

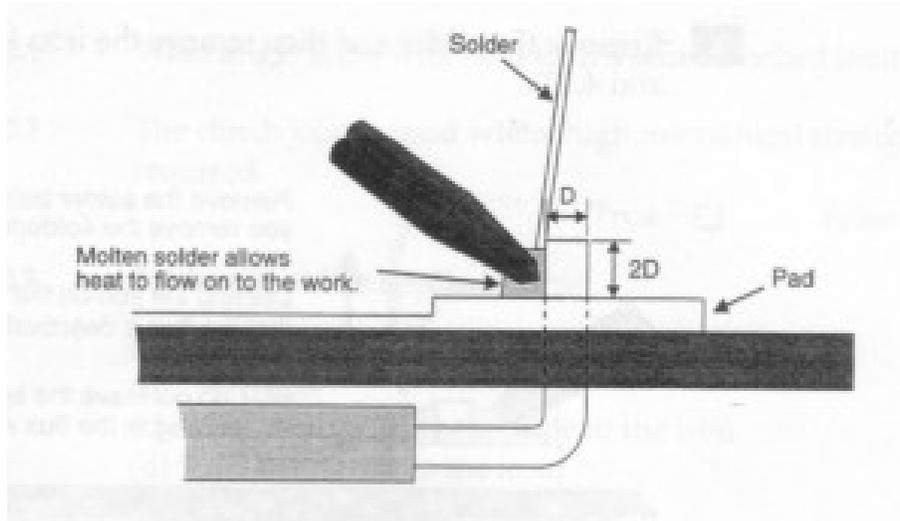


Fig. C1 - Form a heat bridge

3. Create a heat bridge between the lead, the PCB pad and the iron by placing a small amount of solder on the tip.
4. Apply solder around the outside edge of the pad as in Fig. C2. If the pad and lead are at the correct temperature, the solder will flow around the connection.

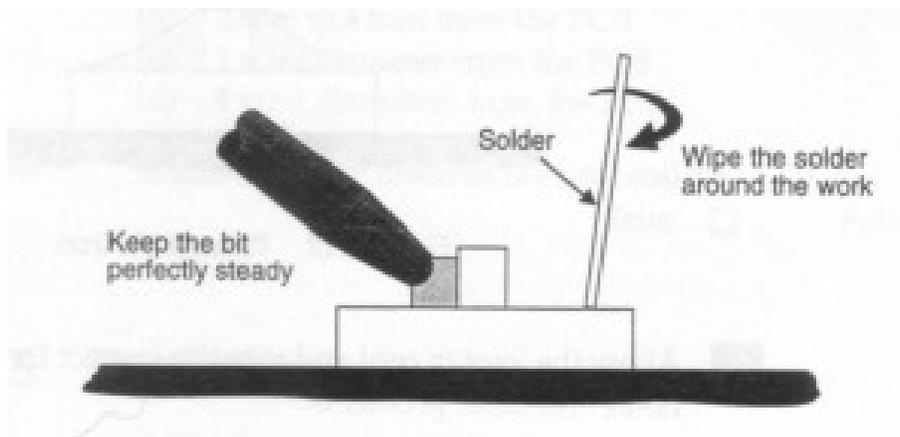


Fig. C2 - Spread solder around the work

5. Remove the solder and then remove the iron:

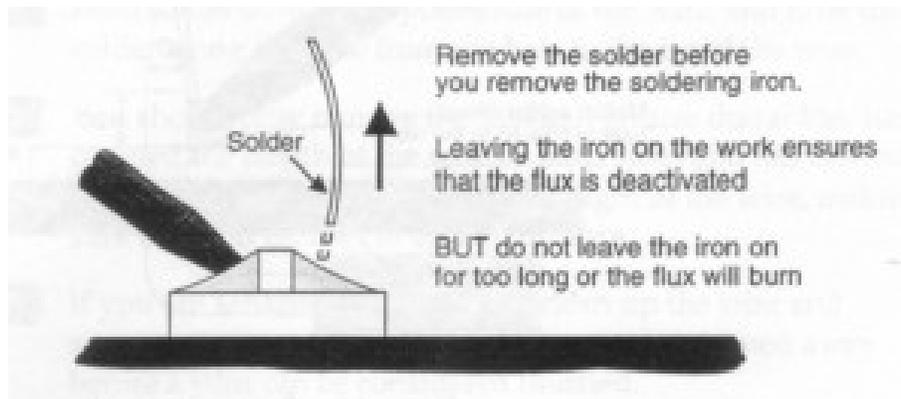


Fig C3 - Remove the solder

6. Allow the joint to cool and visually inspect for defects or other problems. You should have a solder joint with a bright shiny finish and a profile like that shown in Fig. C4.

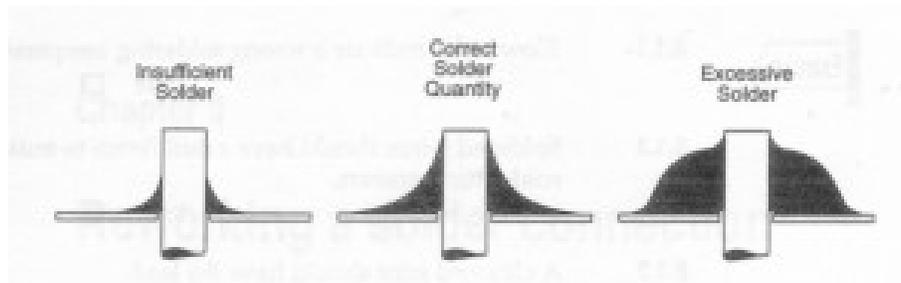


Fig. C4 - Solder quantity comparison