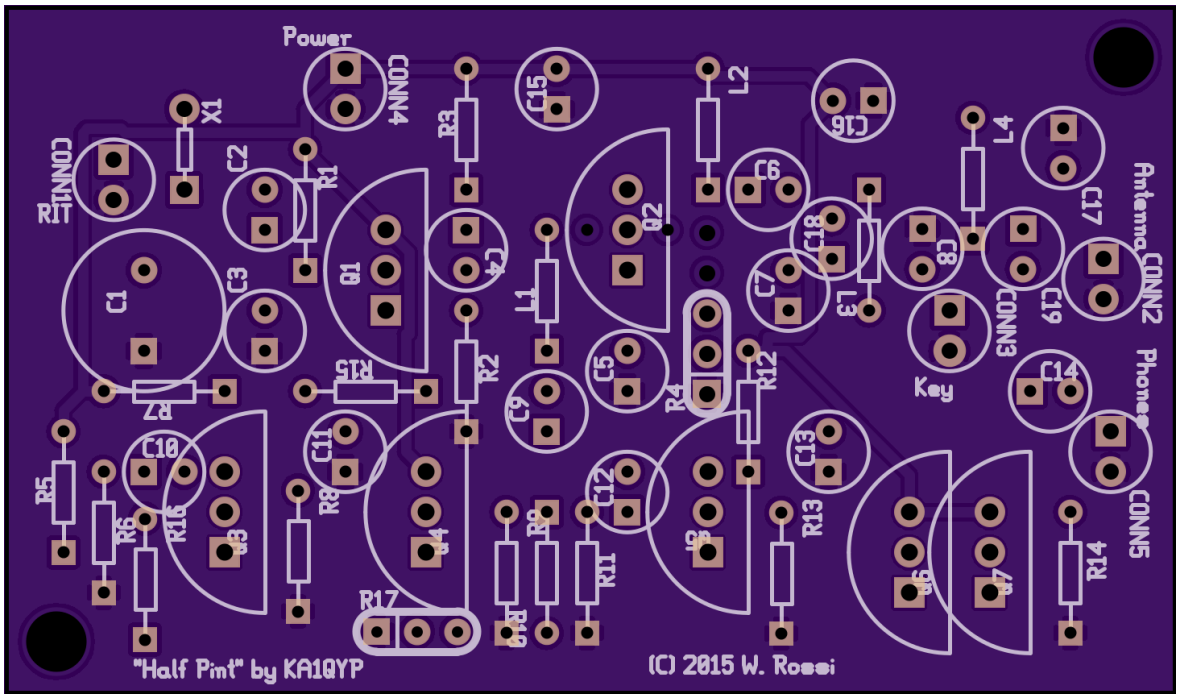
Half Pint Assembly Guide.
W. Rossi, KA1QYP
February 2016

Thank you for purchasing the “Half Pint” transceiver kit. This is a simple yet capable rig that I've had many hours of fun with, and I hope you will as well. This is intended to be an easy-to-build kit that facilitates learning and experimentation. The design uses only 7 discrete bipolar transistors, and there are no static sensitive parts to worry about. There will be a few suggested modifications at the end of this guide so that you can build the radio to suit your needs.

This document will guide you through the assembly process. First lets take a look at the circuit board; it will be helpful if you orient the board as shown in the drawing below.



In this orientation, the main components are laid out similarly to how they appear on the schematic. This will help you with locating the parts locations. In particular, note that all the transistors have the flat side of their plastic cases facing to the right, with their emitters facing downward and their colllectors upward.

Major assemblies are the local oscillator in the upper left, the power amplifier/mixer in the top center, and the low-pass filter in the upper right. The lower half of the board is the audio filter and amplifier. Signal flow is generally from left to right.

You may wish to install sockets for some components. In particular this is useful for C1, X1, R4, and Q2. Machine pin sockets are good for this, and also make good wire connectors for the connectors CONN1-CONN5. I found that the 24 gauge twisted pairs used in Category 5 ethernet cable make for good interconnects.

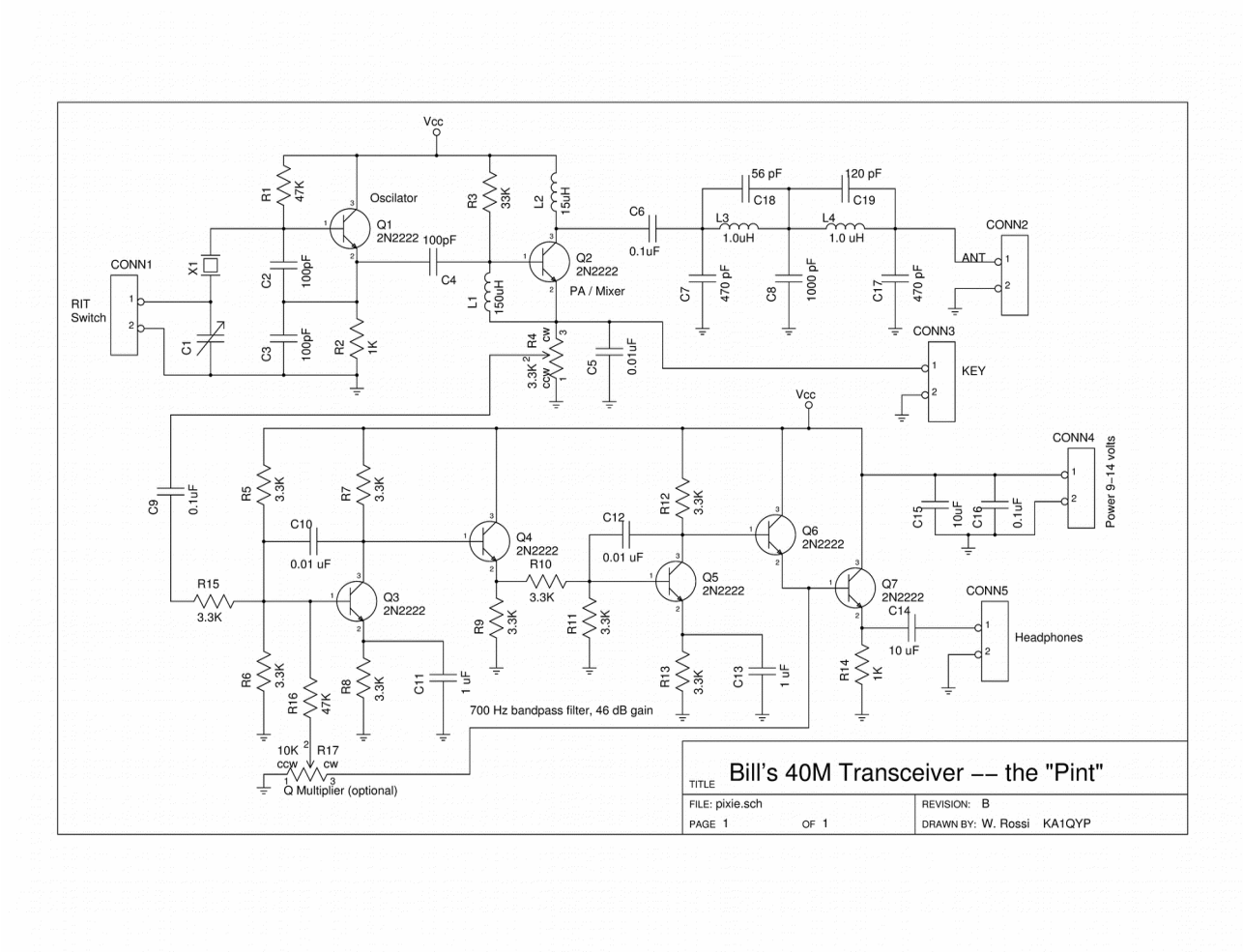
C1 controls the frequency of the local oscillator. A switch at CONN1 will short C1 to provide a transmit/receive offset. The simplest configuration here uses a fixed capacitor for C1 and a toggle switch at CONN1. A fixed capacitor is provided for such a configuration, but in order to get the most out of the receiver some tuning ability is needed. Please see the Appendix A of this guide for several solutions to this problem.

Parts list:

Reference Designator	Description	Notes
Printed Circuit Board		KA1QYP Rev B
Q1-Q7	PN2222A transistor	
C5, C10, C12	0.01 uF ceramic capacitor	103
C6, C9, C16	0.1 uF ceramic capacitor	104
C8	See band table	
C2, C3, C4	See band table	
C14, C15	10 uF electrolytic capacitor	
C19	See band table	
C11, C13	1 uF ceramic capactitor	105
C7, C17	See band table	
C18	See band table	
C1	68 pF ceramic capacitor	680 See discussion of C1
R17	10K potentiometer	Optional Q-Multiplier
R2, R14	1K resistor	brown-black, red
R3	33K resistor	orange-orange-orange
R1, R16	47K resistor	yellow-violet-orange
R4-R13, R15	3.3K resistor	orange-orange-red
L3, L4	See band table	
L2	See band table	
L1	150 uH inductor	brown-green-brown
X1	Crystal	

Ref	Band Table			
	80	40	30	20
C7, C17	560 pF (561)	470 pF (471)	330 pF (331)	220 pF (221)
C18	100 pF (101)	56 pF (560)	39 pF (390)	33 pF (330)
C19	220 pF (221)	120 pF (121)	82 pF (820)	68 pF (680)
C8	1200 pF (122)	1000 pF (102)	680 pF (681)	470 pF (471)
C2,C3	100 pF (101)	100 pF (101)	100 pF (101)	47 pF (470)
C4	100 pF (101)	100 pF (101)	100 pF (101)	220 pF (221)
L3, L4	2.2 uH (red,red,gld)	1 uH (brn,blk,gld)	0.68 uH (blu,gry,silver)	0.47 uH (yel,vio,silver)
L2	15 uH (brn, grn, blk)	15 uH (brn, grn, blk)	6.8 uH (blu, gry, gold)	4.7 uH (yel,vio,gold)

Schematic:



Although you can install the parts in any order, I find it useful to build up functional blocks that can be tested. I will present them in that order.

Local Oscillator:

Install Q1, X1, C2, C3, R1, R2. You will need to put something in for C1 at this point to test the local oscillator, even if its just a temporary jumper wire. Apply power to the board and you should be able to hear the oscillator running in a nearby receiver. Its normal for the oscillator to be running somewhat below the marked frequency.

Audio Amplifier / Filter:

Install Q3-Q7, R5-R16, C10-C14. On C14, note that the negative lead goes to the round pad on the right. If you temporarily short the right 2 holes for R17, and apply power, the audio stage will oscillate at its center frequency. This should be heard in any headphones attached to the output. Remove the short on the right 2 holes for R17 and the oscillation should stop. If this happens, your audio stage is working properly.

A potentiometer is provided for R17 which is optional. This potentiometer controls the level of positive feedback in the audio section. Increasing the feedback increases the gain and sharpens the filter. Too much feed back will result in ringing or oscillation however. This feedback level should be adjusted after final assembly to maximize gain without causing ringing. The impedance of the headphones will effect the level of feedback required somewhat, so be sure to align this with the headphones you intend to use.

Power amplifier/mixer:

Install C4-C6, R3, L1, L2 and Q2. A space is provided for a potentiometer at R4, to provide a gain control. This isn't really necessary, so install the fixed 3.3K resistor between pins 1 and 2, and put a jumper between pins 2 and 3. You may wish to install a socket for R4 in case you later want to install an alternate receiver mixer circuit. There are holes in the board to accept a plastic cased PN2222A for Q2, and additional holes to accommodate a metal can version.

If building for 20 meters you may wish to substitute an RF transistor such as the 2N3866 for Q2 in order to get more power output.

Low-pass filter:

Install L3, L4, C7, C8, C17-C19. These components comprise the low-pass filter. Once this is done, its possible to test the transmitter by placing a dummy load on the antenna connector. You should be able to key the transmitter and hear/see the increase in power in a nearby receiver. These parts will need to change if you're building this for a different band.

Bypass capacitors:

Installing C15 and C16 completes the circuit board assembly. Its is OK to swap the positions of C15 and C16 if it makes mechanical assembly easier. Be careful to get the polarity of the electrolytic capacitor for C15 correct: the negative lead should go to the square pad on the board.

Power supply notes:

Its recommended that the transceiver be powered by 9-24 volts DC. The receiver will operate at lower voltages but the transmitter output power will be minimal. Higher voltages will produce higher output power, but also consume more power during receive. Due to the high gain audio amplifier in this design, the power supply needs to be clean of audio frequency ripple. I recommend operating from battery for this reason. If attempting to run from a higher impedance battery, such as an alkaline 9 volt battery, you may need to install a larger capacitor at C15.

Specifications

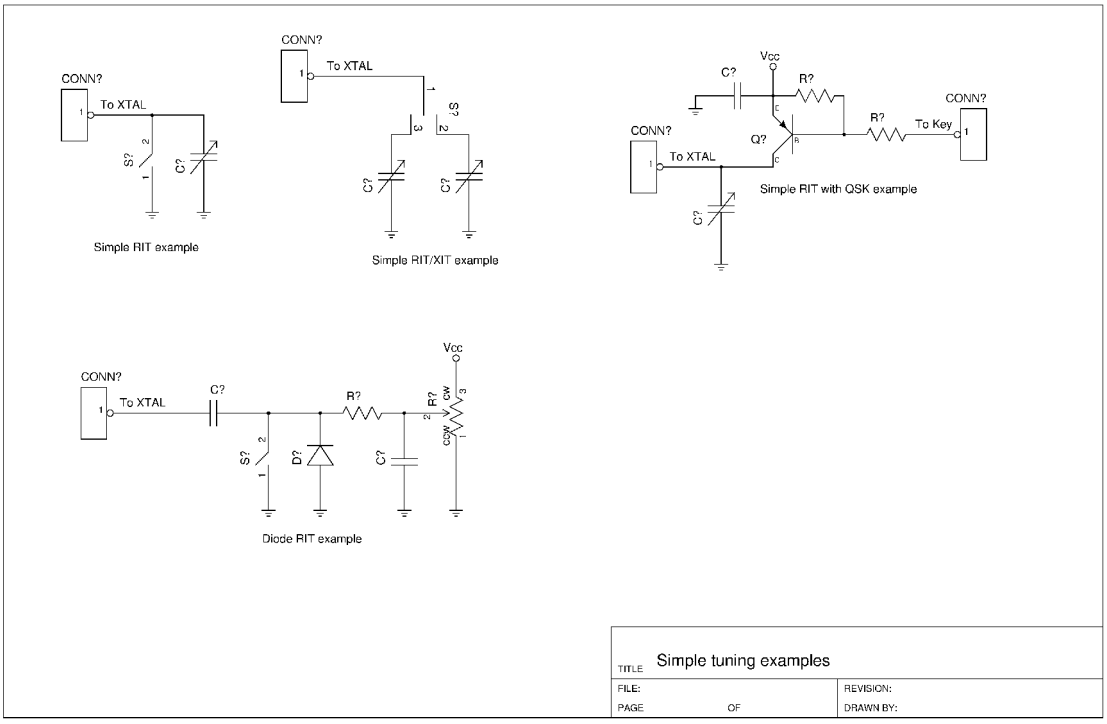
- Power supply: 9-20 volts DC
- Receive current: 35 mA @ 13.8 VDC
- Power output: up to 1 Watt on the 40 meter band with 16 VDC power supply
- Receiver sensitivity: approximately 10 uV @ 10 dB S/N
- Audio gain: 42 dB + 20dB from Q-Multiplier = 62 dB
- Receiver Selectivity: less than 500 Hz

Appendix A:

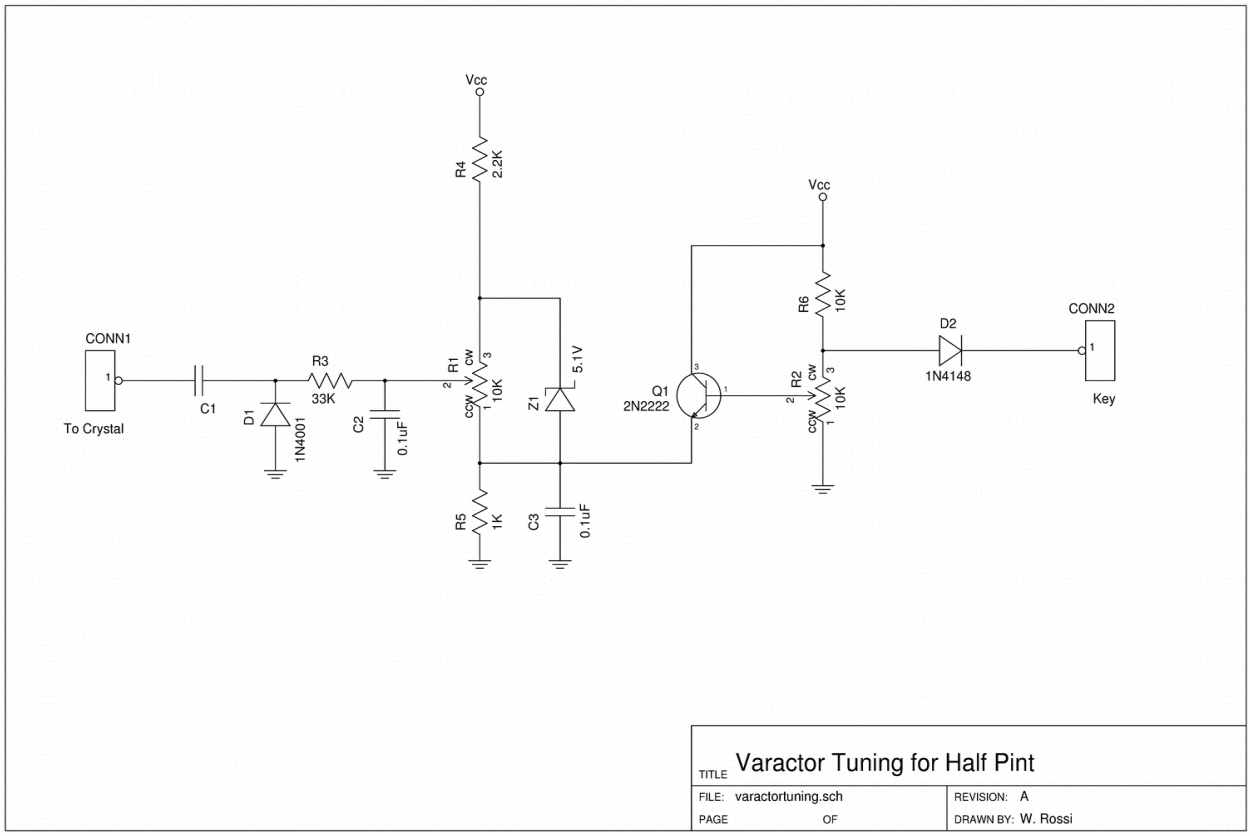
To get the most out of the transceiver you will need to provide a way to tune the receiver in order to get received signals centered in the audio passband. You will also need to be able to switch between transmit and receive frequencies, and you may want to be able to tune the transmit frequency. There are many ways to do this but there are trade offs between simplicity and ease of use.

The simplest solution is to use a variable capacitor at C1 an a toggle switch to short it out as a T/R switch. Another solution is to use 2 variable capacitors in place of C1 and a double throw toggle switch to select which capacitor is in use. You could even add a transistor to switch frequencies automatically when the key is down (QSK).

You may want to use a reverse-biased 1N4001 diode to provide the tuning capacitance if variable capacitors aren't available. The reverse bias voltage on the diode can then be varied with a potentiometer.



The following circuit uses diode tuning, and separate tuning and receiver offset controls. Transmit/receive switching is also done automatically (QSK). This is, of course, more complex but makes operating much easier. I may provide a kit for this in the future if there is demand.


Vcc
R4
2.2K
Vcc
R6
10K
D2
1N4148
CONN2
1
Key
CONN1
1
To Crystal
C1
R3
33K
D1
1N4001
C2
0.1uF
R1
cw
ccw
10K
Z1
5.1V
Q1
2N2222
R2
cw
ccw
10K
R5
1K
C3
0.1uF
TITLE
Varactor Tuning for Half Pint
FILE: varactortuning.sch
REVISION: A
PAGE OF
DRAWN BY: W. Rossi

Appendix B:

Having Q2 act as both the power amplifier and mixer is less than ideal. As a mixer it produces more inter-modulation product than desirable. Fortunately it is fairly easy to replace the mixer in the Half Pint with a better one. The circuit below is an example of a single-balanced diode mixer that can be added to the rig.