

CSRX01 - 20 Meter Receiver Circuit Sticker

1. General Description

A photo of a prototype CSRX01 Circuit Sticker receiver appears in Figure 1.

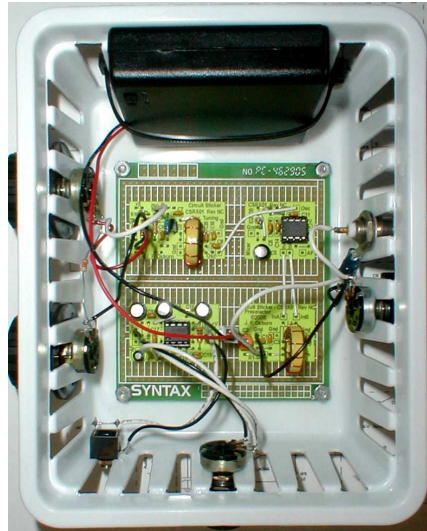


Figure 1 - CSRX01 Circuit Sticker Receiver Prototype

The CSRX01 Circuit Sticker receiver is a direct conversion receiver for the 20 meter Amateur Radio band. The circuit is based on the popular Neophyte/Sudden receiver design that uses an SA602 mixer IC and an LM386 audio amplifier IC. The VFO is varactor tuned and the receiver covers the entire 20 meter band plus a little more. The receiver is built on perforated board using Circuit Stickers to show component placement and interconnections.

2. Features

- ◇ Direct Conversion Receiver
- ◇ Covers entire 20 meter Amateur Radio band plus a little more
- ◇ Based on popular Neophyte/Sudden receiver design
- ◇ Varactor tuned VFO
- ◇ Circuit Sticker construction on perforated board
- ◇ Circuit Stickers reduce the chance of error compared to building on plain board
- ◇ Circuit Stickers cost less than printed circuit boards
- ◇ Circuit Stickers look better compare to plain board
- ◇ Circuit Stickers make it easier to do repairs compared to plain board

3. Applications

- ◇ Receiver for a QRP station
- ◇ Receiver to monitor the band
- ◇ Small portable receiver that you can take with you
- ◇ Receive W1AW code practice
- ◇ Something fun to build

4. Schematic

The schematic of the CSRX01 Circuit Sticker receiver appears in Figure 2. U1 is an SA602 mixer/oscillator. It converts signals received directly to audio. The preselector is tuned to peak the received signals. R1 is the RF gain control. Tuning of the oscillator is controlled by L3 and associated capacitors. D2 is the varactor. The DC voltage on D2 controls its capacitance at RF. R6 is the bandset control. It coarsely controls the DC voltage in D2 and thus the operating frequency. R3 is the bandspread control. It fine tunes the DC voltage on D2 and thus the operating frequency. D1 is a zener diode that provides a regulated DC voltage for the oscillator tuning. U2 is the audio amplifier. R8 is the audio gain control.

5. Parts List

The parts list for CSRX01 Circuit Sticker receiver appears in Table 1..

6. Layout

The CSRX01 receiver has 4 Circuit Stickers as shown in Figure 3. These stickers can be used on any perforated board with an appropriate pattern on the solder side. The basic perforated board pattern is shown in Figure 4. There are 3 holes per pad and traces for +V and ground. Circuit Stickers are stuck to the component side of the board opposite the pattern on the solder side. The rectangle in Figure 4 shows the typical alignment of the stickers with the pattern. Figure 5 shows the stickers installed on Radio Shack 276-168 perforated board and Figure 6 shows the stickers installed on Syntax 462905 perforated board.

The Radio Shack board is phenolic with bare copper pads and traces. The spacing between the rectangular pads is close. It's easy to lift a pad by applying too much heat. However the board can be used if care is taken. Use a low wattage soldering pencil. Inspect your work frequently for solder bridges and cold solder joints.

The Syntax board is glass-epoxy with tinned pads and traces. There's a solder mask and a silk screen legend. However it's still necessary to be careful when constructing the circuit. It is possible to lift a pad by applying too much heat. Use a low wattage soldering pencil. Inspect your work frequently for solder bridges and cold solder joints.

7. Assembly Instructions

- ◇ Read all instructions before beginning assembly.
- ◇ Observe all safety precautions during assembly.
- ◇ Inventory parts before beginning assembly.
- ◇ Carefully remove the release paper from the Oscillator Tuning Circuit Sticker and apply it to the perforated board properly aligned and orientated. Repeat for all the stickers. See Figure 4, Figure 5 and Figure 6.
- ◇ Using a sharp point make holes in the Circuit Stickers for the jumper and component leads.
- ◇ After soldering in each of the following jumpers and components trim the leads close to the board.
- ◇ The bare wire jumpers are indicated on the Circuit Stickers by straight lines. Use either recycled component leads or 22AWG solid wire to form the jumpers and solder them in place so that the jumpers are flat against the component side of the board. See Figure 7 as an example.
- ◇ Install and solder the insulated wire jumpers in place. The insulated wire jumpers are indicated on the stickers by curved lines. Use 22AWG solid wire to form the jumpers and solder them in place so that the jumpers are flat against the component side of the board. See Figure 7 as an example
- ◇ Solder the resistors in place. Some resistors are installed in a "hairpin" configuration. Bend one lead of the resistor back around so the a hairpin is formed. The body of the resistor is positioned over the circle on the Circuit Sticker indicating its position and the other lead goes in the other hole.

- ◇ Resistor R5 is not installed on the board but is soldered between the lugs of pots R3 and R6. Postpone installing R5 until you're wiring the chassis.
- ◇ Install and solder the capacitors in place. Observe correct polarity on the electrolytic capacitors. The long lead, the + lead, goes in the + hole.
- ◇ Capacitor C2 is the 50 pF trimmer in the preselector. Make sure the trimmer is installed aligned with the outline on the sticker. That connects the trimmer adjustment to ground allowing you to touch it without de-tuning the circuit. Push the trimmer into the board until it snaps into place then solder.
- ◇ Install and solder L2, the molded 100 uH choke.
- ◇ Install and solder D1, the zener diode. Observe correct polarity. The banded end of the diode aligns with the banded end of the outline on the sticker.
- ◇ D2 the varactor diode is in a TO-92 case and looks like a transistor except that it has 2 leads. Install it aligned with the outline on the sticker and solder.
- ◇ Install the 8 pin IC sockets for U1 and U2. Align the little notch in the end of the socket with the outline on the sticker. Tack solder 1 pin of the socket then make sure it's seated flat against the board. You might have to heat the pin while pushing the socket down with your finger. Once the socket is properly seated then solder all of the pins. Don't install the IC's at this time.
- ◇ Make the sticker interconnections using 22AWG solid wire. There are 4 interconnections to be made: InA on the preselector to InA on the mixer, InB on the preselector to InB on the mixer, Osc on oscillator tuning to Osc on the mixer, and AF on the mixer to AF on the audio amplifier. Route the interconnections as directly as you can but without interfering too much the components and off-board connections to be made. It's okay if the interconnections aren't completely flat against the board but don't over do it.
- ◇ Wind L1 and L3 on the toroids using the magnet wire. There are 10 turns on each toroid. Every time the wire passes through the middle of the toroid that counts as 1 turn. Wind the turns fairly tightly but spaced out evenly around the toroid.
- ◇ Trim the wire on L1 and L3 to form leads. Scrape the insulation off the leads with a knife. Tin the leads. Solder the toroids in place so that they are held tightly against the board in a vertical position.
- ◇ Inspect the board for solder bridges, cold solder joints and incorrectly installed components. Correct any problems before proceeding.
- ◇ Chassis wiring is summarized in Table 2 - Chassis Wiring. Use 22AWG stranded wire. Temporarily install the board, controls, battery holder and connectors in your enclosure. Determine wire lengths, cut, strip and tin wires. Uninstall the board, etc. from the enclosure then make the connections.
- ◇ The ring lug is used to make the ground connection to J1 - the BNC antenna connector. Crimp 22AWG black stranded wire on the lug and then solder the wire to the bottom lug of R1. Put the ring lug on the BNC connector when installing it in the enclosure.
- ◇ Again inspect your work for shorts, cold solder joints, incorrectly installed components, and incorrectly made connections. Reinstall the board, etc. in the enclosure.
- ◇ If you forgot to install R5 between the bottom lug of R6 and the top lug of R3 do so now.
- ◇ This completes assembly.

8. Test and Tune Up

- ◇ U1 and U2 are not installed.
- ◇ There are no batteries in the battery holder.
- ◇ Open the battery holder and with the switch off measure the resistance between the plus and minus terminals. It should be infinite.
- ◇ Turn the switch on and again measure the resistance. What you measure will depend on what you're measuring with. My DMM measure about 2 megaohms. The important things to note are that the resistance is no longer infinite, indicating that the circuit is connected, and that the resistance is not zero, indicating a short.
- ◇ Turn the switch off.
- ◇ Install 4 fresh AA alkaline batteries in the battery holder observing correct polarity.

- ◇ Turn the switch on and measure the voltage from U2 pin-6 to ground. It should be the battery voltage.
- ◇ Measure the voltage at U1 pin-8. Again it should be the battery voltage.
- ◇ Measure the voltage on the top lead of R4 or the banded end of D1. It should be about 5 volts.
- ◇ Turn the switch off.
- ◇ Install the LM386 at U2 observing correct orientation and being careful not to bend a pin.
- ◇ Connect headphones to J2.
- ◇ Turn the switch on. You should hear a thump as the receiver comes on and then a little bit of hiss.
- ◇ Touch the top lug of R8, the audio gain control. Depending on your environment you should hear some hum. You should be able to control the level of the hum with R8.
- ◇ Turn the switch off.
- ◇ One way to adjust C2, the trimmer capacitor in the preselector is to use an antenna analyzer that measures impedance. If that is not available the skip the following step.
- ◇ Connect the antenna analyzer to J1 and set it to measure impedance at 14.150 MHz (or a frequency of your choosing in the 20 meter band). Set R1 to it's maximum position. Adjust C2 until the impedance is maximum.
- ◇ Install the SA602 at U1 observing correct orientation and being careful not to bend a pin.
- ◇ An RF signal source is needed for the following step. If that's not available then on-the-air-tune-up or a second receiver is required. An antenna analyzer is sufficient for a signal source.
- ◇ Turn the switch on. You should hear a little bit of noise in the headphones.
- ◇ Turn on your signal source and bring it near the receiver. A direct connection to the receiver is not required.
- ◇ Set R6 and R3 to their minimum positions. Tune the signal source until you hear it in the receiver and note the frequency. It should be below the 20 meter band.
- ◇ Set R6 and R3 to their maximum positions. Again tune the signal source until you hear it and note the frequency. It should be above the 20 meter band.
- ◇ If necessary squeeze or spread the turns on L2 to get the receiver to tune across the band.
- ◇ Set the signal source to a specific frequency in the 20 meter band. Use R6 to tune in the frequency. R6 should provide coarse frequency control. Use R3 to fine tune the frequency.
- ◇ Tune up can also be done with a second receiver. Use it to tune in the oscillator in the Circuit Sticker receiver. Connect the second receiver to J1.
- ◇ If on-the-air-tune-up is done then known signals on the band are required. Make adjustments until the known signals are received as desired.
- ◇ Turn the switch off.
- ◇ This completes test and tune up.

9. Operation

Use a good antenna with the Circuit Sticker receiver. A good antenna can be fairly modest such as wire dipole 30 feet in the air or a quarter wave vertical with radials. Connect the antenna to J1 using 50 ohm coax.

The little audio amplifier might be able to drive a small speaker but it's best to use headphones with the Circuit Sticker receiver.

Use the bandset R6 control to tune stations in coarsely then use bandsread R3 control to fine tune them for maximum intelligence.

It's perhaps best to use maximum audio gain and use RF gain R1 control to set the desired signal level. Direct conversion receivers sometimes will AM detect shortwave broadcast stations. Turn down the R1 RF gain control until the AM detection stops.

SSB signals will tune in both inverted and right-side-up. To tune an inverted signal in tune R3 down through zero-beat until the signal becomes intelligible.

Table 1 - CSRX01 Circuit Sticker Receiver Parts List

Item	Quantity	Reference	Description	Marking/Color
1	1	BT1	6V Bat. & Switch	
2	1	C1	22pF	22J
3	1	C2	50pF trimmer	orange
4	1	C3	180pF	181
5	7	C4,C6,C7,C9,C17,C18,C19	0.1uF	104
6	2	C5,C15	10uF	10uF
7	1	C8	150pF	151
8	1	C10	82pF	82J
9	2	C14,C11	330pF	331
10	2	C12,C16	100uF	100uF
11	1	C13	1uF	1uF
12	1	C20	10pF	10J
13	1	D1	1N5231B	231B
14	1	D2	MV2109	MV2109
15	1	J1	BNC	
16	1	J2	PHONEJACK	
17	2	L3,L1	10 turns T68-6	yellow
18	1	L2	100uH	brn-blk-brn-gld blue body
19	1	R1	1k pot	B1K
20	2	R2,R4	100 ohms	brn-blk-brn-gld tan body
21	2	R3,R8	10k pot	3G4
22	2	R10,R5	22k	red-red-org-gld
23	1	R6	100k pot	3C
24	1	R7	100k	brn-blk-yel-gld
25	1	R9	12 ohms	brn-red-blk-gld
26	1	SW1	SW SPST in BT1	
27	1	U1	SA602	SA602AN
28	1	U2	LM386	LM386N-4
29	2		22AWG solid	
30	2		22AWG stranded white wire	
31	1.34		22AWG stranded black wire	
32	0.34		22AWG stranded red wire	
33	2	L1,L3	26AWG magnet	
34	1		perforated board	
35	2	U1,U2	8 pin DIP socket	
36	1	J1	3/8" ring lug	
37	4		Circuit Stickers	

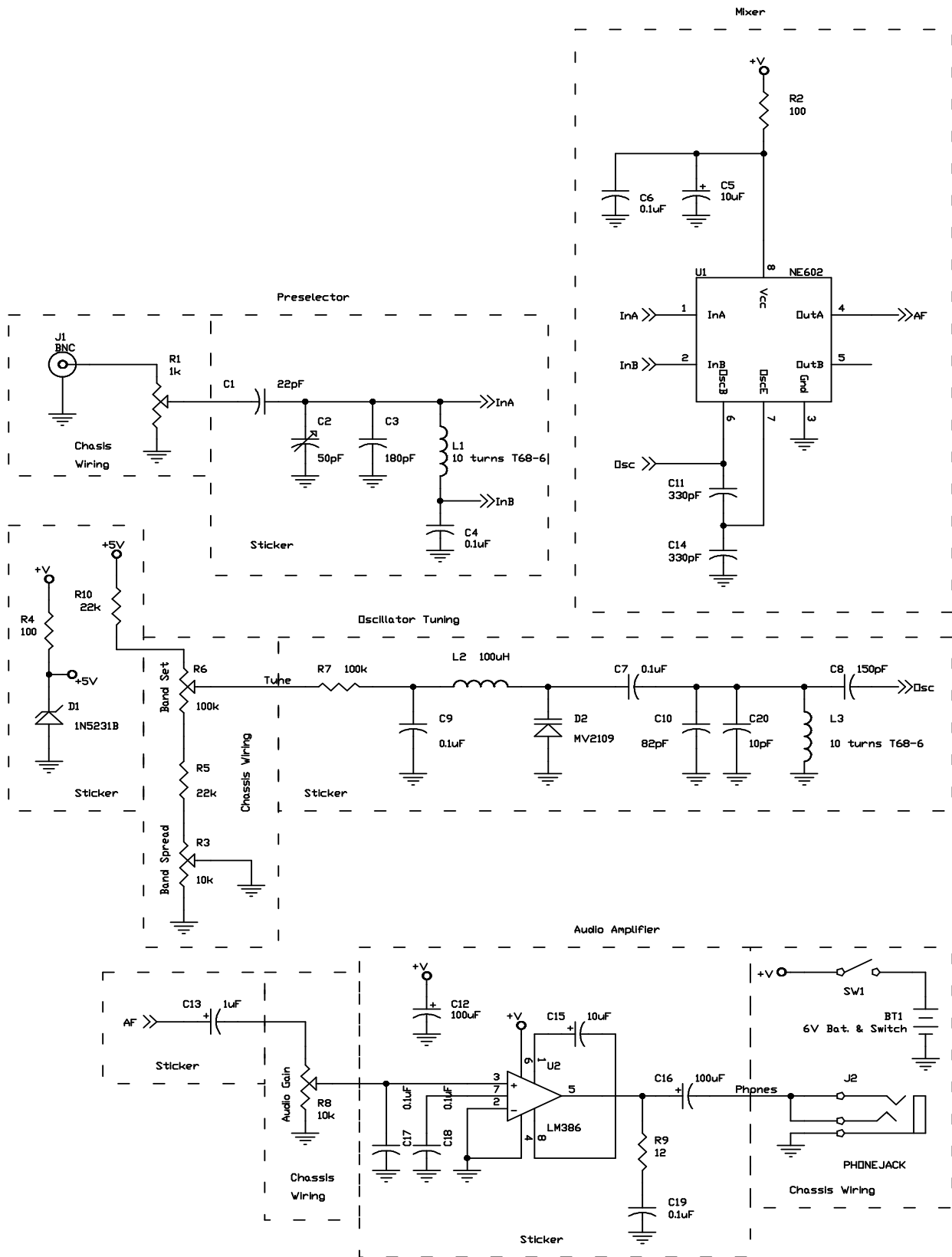


Figure 2 - CSRX01 Circuit Sticker Receiver Schematic

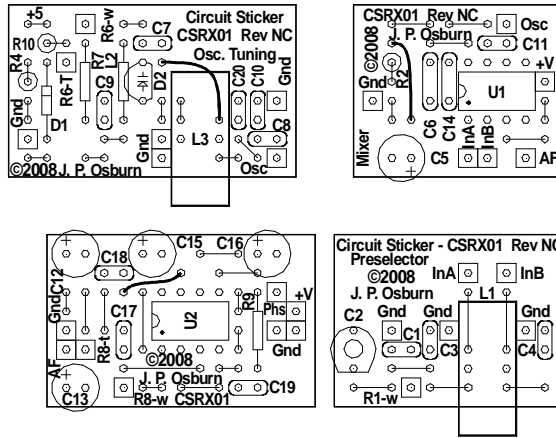


Figure 3 - CSRX01 Stickers

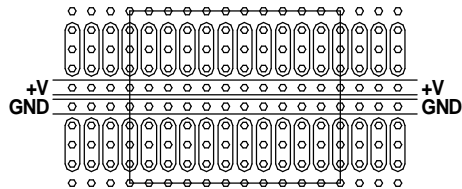


Figure 4 - Basic Perforated Board Pattern

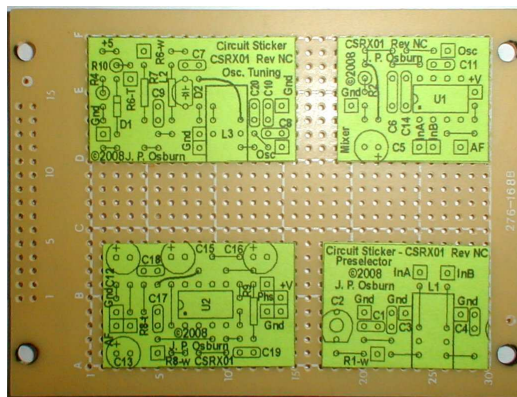


Figure 5 - CSRX01 Stickers on RS 276-168

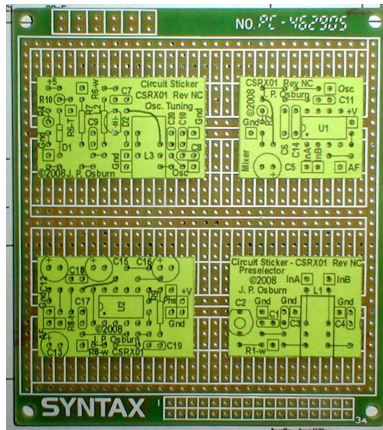


Figure 6 - CSRX01 Stickers on Syntax 462905



Figure 7 - Mixer Construction

Table 2 - Chassis Wiring

From	To	On Sticker	Wire Color
BNC center pin	Top lug R1		White
Ring lug on BNC	Bottom lug R1		Black
Wiper lug R1	R1-W	Preselector	White
Bottom lug R1	GND	Preselector	Black
Top lug R6	R6-T	Osc. Tuning	Red
Wiper lug R6	R6-W	Osc. Tuning	White
Bottom lug R6	R5-1		
Top lug R3	R5-2		
Wiper lug R3	GND	Osc. Tuning	Black
Bottom lug R3	Wiper lug R3		Black
Top lug R8	R8-T	Audio Amp.	White
Wiper lug R8	R8-W	Audio Amp.	White
Bottom lug R8	GND	Audio Amp.	Black
J2 tip lug	Phs	Audio Amp.	White
J2 ring lug	J2 tip lug		White
J2 sleeve lug	GND	Audio Amp.	Black
BT1 red lead	+V	Audio Amp.	
BT1 black lead	GND	Audio Amp.	