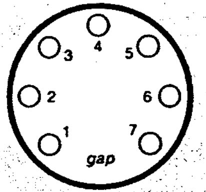
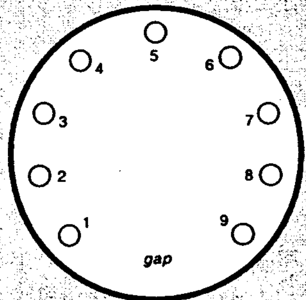
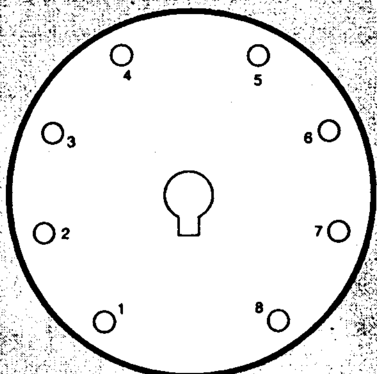
STANDARD PIN NUMBERING OF COMMON TUBE SOCKETS



7-PIN MINIATURE



9-PIN MINIATURE AND NOVAR



OCTAL

LOW COST SSB EXITER

Do you Know ?

R - Received as transmitted; are

RAC - Rectified alternating current

RCD - Received

REF - Refer to; refering to; reference

RFI - Radio Frequency interference

RPT - Repeat; I repeat

RX, RCVR - Receiver

SASE - Self-addressed stamped envelope

SED - Said

SEZ - Says

SIG - Signature; signal

SINE - Operator's personal initials or nick name

SKED - Schdule

SRI - Sorry

SVC - Service; prefix to service message

3

LOW COST SSB EXCITER.

Designed by Mani T . K

Construction of SSB projects are considered to be difficult due to the high cost of the filters and other components used . The complicated alignment procedure that to be followed for a perfect operation too makes it unaffordable .

Considering all these difficulties , I have designed and developed a low cost SSB circuit using easily available components and at the same time giving good result . The alignment procedures are so simple that even a beginner can afford it . The block diagram of the SSB exciter is given below .

THE CIRCUIT

Our SSB exciter mainly consists of six important parts . They are :

1. Mic
2. Mic Amp
3. Speech processor .
(Audio filter & Automatic level controller)
4. Mixer
5. Carrier oscillator
6. Ladder filter .

The block diagram of the exciter is given in Fig. 3.1 .Explanation for each sub system are also follows .

1. Mic amplifier.

The function of the mic preamplifier is to amplify the weak signals available at the output of the microphone. Mic preamplifier is always necessary if the microphone is of dynamic type . Any standard type of microphone can be used for SSB . In our design , we use a condenser mic that does not require a microphone amplifier .The output signal strength available at the output of the microphone depends upon the type of the microphone used .

A dynamic microphone provides good quality speech signals . It's output impedance is normally low and output also very weak and hence requires a mic amplifier .

A piezo electric mic also gives good quality speech with increased frequency response . The output impedance is high and required a pre amplifierwith high output impedance .

A condenser microphone is cheap alternative to the dynamic type or piezo electric mic . It provides sufficiently good output and need not use a microphone amplifier .

You can experiment with different types of microphones . Since the audio frequency response of each type and make of microphone varies , the experimenter is recomended to find a microphone suitable to your voice .Finally a word of advice .Mi

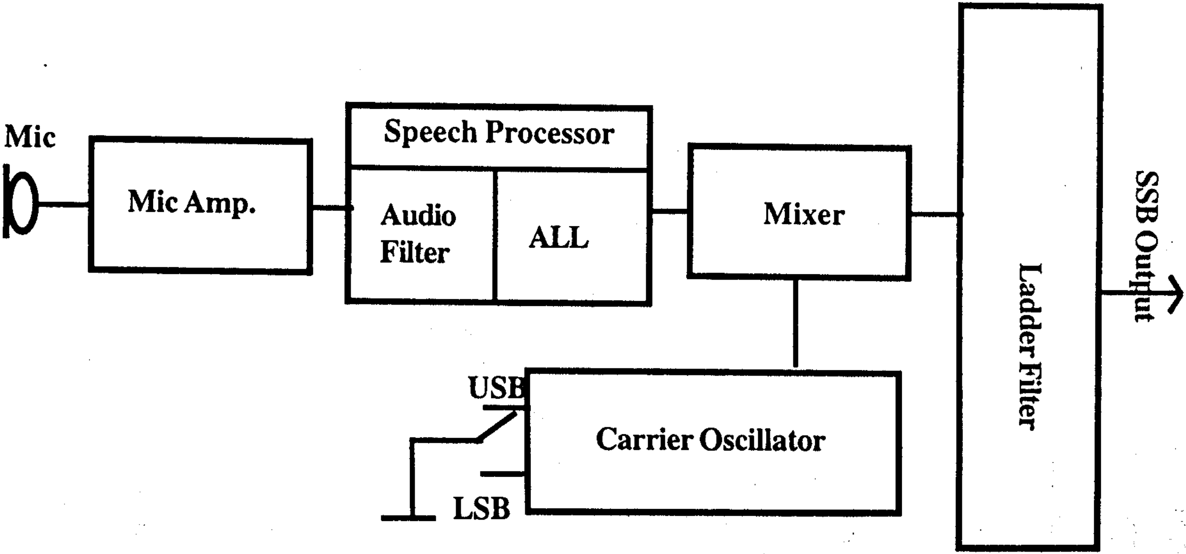


Fig. 3.1 BLOCK DIAGRUM OF SSB EXITER

crophone capsules available in telephone spare parts shops .These are very cheap when compared to a microphone with a cover . You can make your own cover for the microphone capsule purchased .Circuit diagram is given in fig. 3.2 .

2. Speech processing .

The output from the microphone varies with the loudness of the speech and the distance between the mic and the mouth . It is always necessary to maintain constant audio amplitude at the input of the mixer . Otherwise , if the audio is low , RF output from the exciter will be insufficient and if the audio level is too high , clipping and distortion can result in the SSB .

It is a good procedure to speak to the microphone at a medium volume and a steady voice keeping the microphone at a fixed distance from the mouth .

However to maintain the SSB output power at a constant level , The audio input to the mixer must be constant . An automatic level control is highly useful in this regard . So in our circuit , we a re using an automatic level controller to achieve the wanted effect .

3. Automatic level controller (ALC) .

The circuit of the automatic level controller is given in fig.3.4

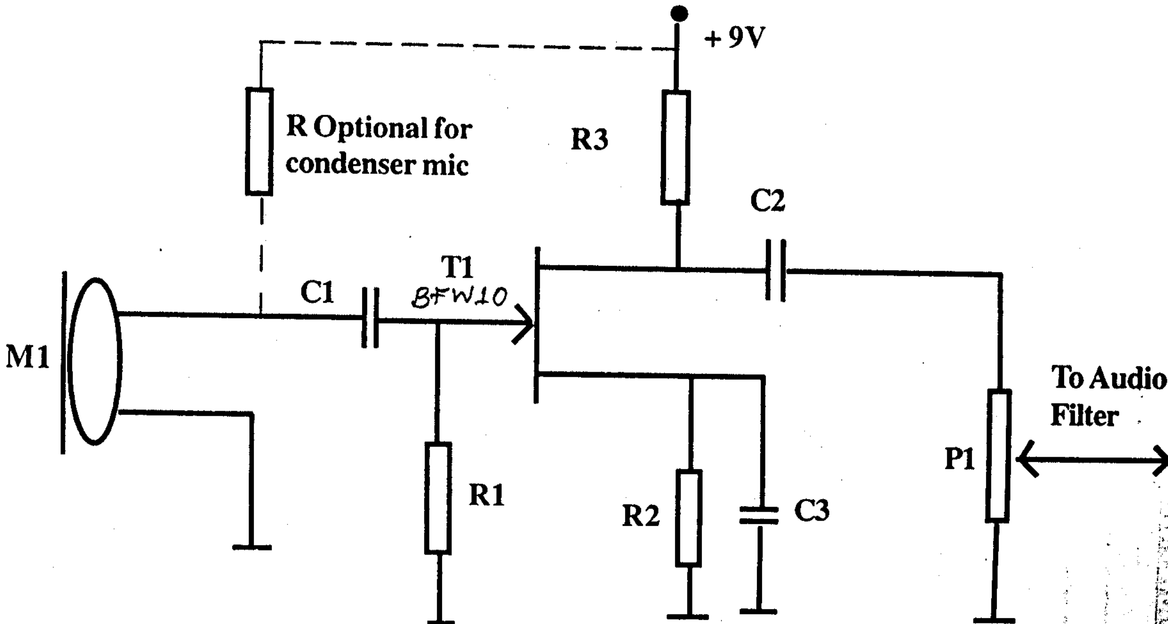


FIG.3.2 CIRCUIT DIAGRAM OF MIC PRE AMPLIFIER

COMPONENT DETAILS FOR AUDIO FILTER

Resistors		
No.	Item ID.	Description .
1.	R1	33K
2.	R2	220 K
3.	R3	13 K
4.	R4	10 K
5.	R5	10 K
6.	R6	10 K
7.	R7	10 K
8.	R8	10 K
9.	Rx	Test & select to get a volt age of 6 v at the pin 7 of IC1. Value is 200 K approx.
Capacitors		
1.	C1	1000 P
2.	C3	0.01
3.	C3	0.01
4.	C4	0.01
5.	C5	8200 P
6.	C6	470 P
7.	C7	0.01
8.	C8	100 MFD 16 V
9.	C9	2200 P
10.	C10	1000 P
11.	C11	270 P
12.	C12	160 P
13.	C13	8200 P
Other's		
1.	IC1 a&b	TL 082 Dip pakage .
2.	RFC 1	1 micro henry .

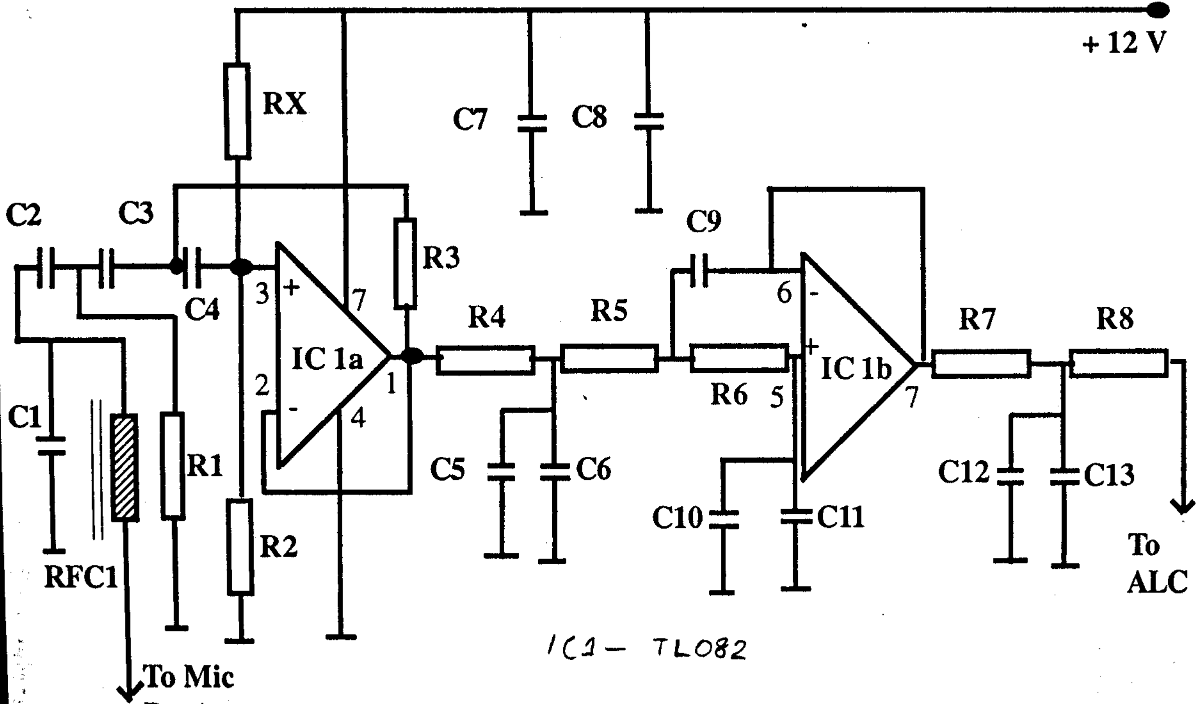


FIG. 3.3 CIRCUIT DIAGRAM OF AUDIO FILTER

It is also required to limit the band width of the audio signal It has been proved that, good quality intelligible speech is possible if we are limiting audio band width starting from 200 Hz to 3 kHz . By limiting the audio band width the following can be achieved .

1. Good absorption of the unwanted side band .
2. Reduction in the band width of the transmitter signal .

An audio filter is included in this design and the circuit for which is given in fig.3.3 .

The circuit uses FET input dual op-amp . IC1a is working as a low pass filter with a cut of frequency of 350 Hz and the IC1b is working as LPF with a 2.5 KHz cut off . The out put of the filter gives around to pass band 350 to 2500 Hz. If you want to limit the cost to minimum , the audio filter can be avoided .

4. Mixer .

The mixer circuit is not a conventional design . It uses CMOS logic chips to perform the mixing operation . The operation is similar to a diode balanced modulator . Here the diode is replaced with the CMOS analog switches . This switch is turned ON and OFF by the Xtal oscillator (carrier) oscillator . The switching control is derived from the crystal oscillator and the associated gate . switching if you are going for a transceiver .

5. Carrier oscillator .

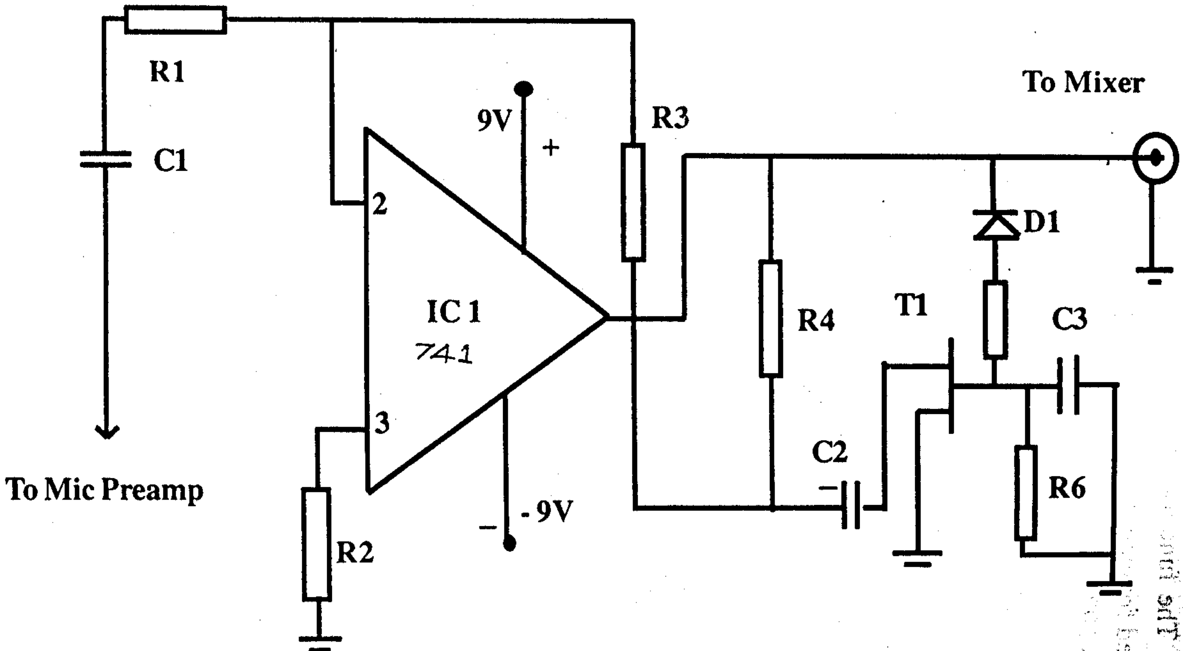


FIG. 3.4 CIRCUIT DIAGRAM OF ALC

The function of the carrier oscillators is to provide the needed frequency . It gives a frequency of 4.1945 MHz for USB and 4.1925 MHz for the LSB operation

The crystal oscillator is a colpitt design and frequency pulling is done to get the desired frequencies from a single crystal . This method generates two frequencies using a single crystal . It is found that these frequencies are sufficiently stable for the amateur radio purpose .

6. Ladder Filter

SSB filter used is a ladder filter consisting of 5 numbers of 4.194 MHz crystals . The crystals are experimentally selected to achieve better performance .See the method used for selecting the crystals explained in the apeendix .

The filter may give good performance even if you select the crystals in random . However it is recomanded to test to select the crystals . A circuit for testing the crystals is included in the appendix .

CONSTRUCTION

It is recomended to assemble and test each circuit independently A few words about the construction of the ladder filter . These guide lines includes the method to test the crystals and find out there equivalent series resistance . The test circuit for it is included in the appendix .

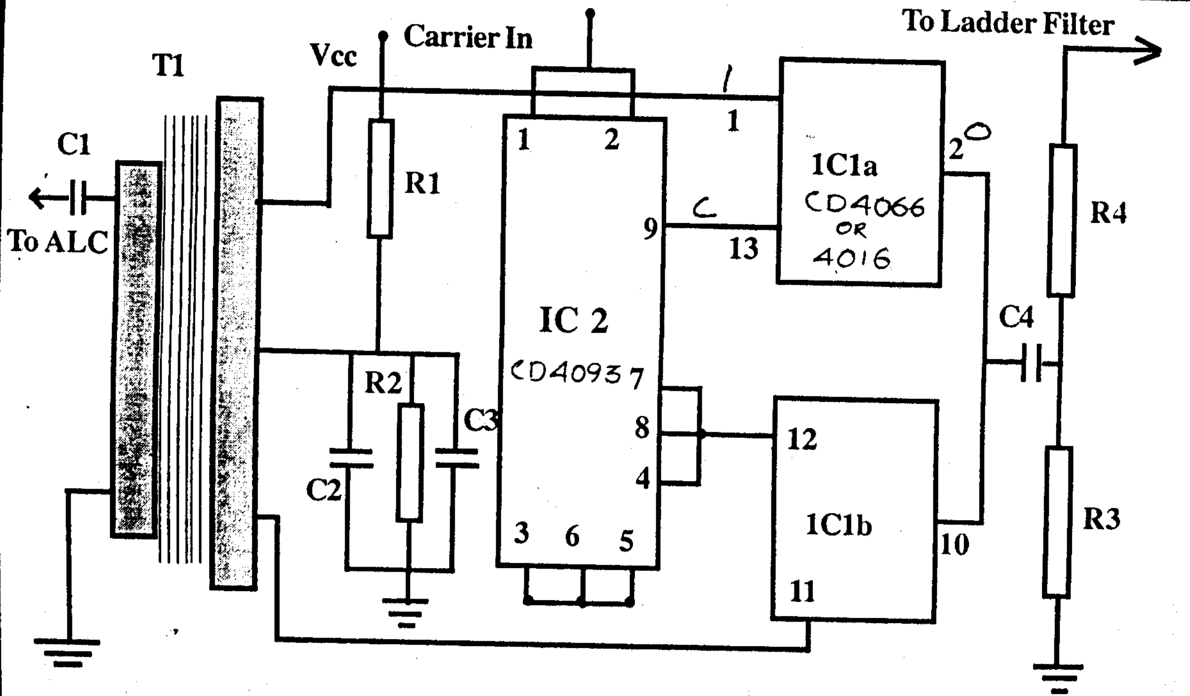


FIG . 3.5 CIRCUIT DIAGRAM OF MIXER

Selection of crystals.

The major attraction of a ladder crystal filter for SSB is that crystals that is used for computers, clocks TVs etc are suitable for the filter. These crystals are freely available and very cheap. However, the parameters of these crystals vary from sample to sample. Even though satisfactory performance is obtainable with random selection of crystals, it is recommended to test select the crystals to get optimum performance. For proper selection of the crystals, a few test equipments are required. The test equipments needed are frequency counter, variable frequency source, signal strength meter or a RF Probe. The author is willing to help those who are not having access to these facilities.

The crystals selected for single filter must lie their frequencies within the tolerance of +/- 50 HZ. (Actual frequency is not important.). The effective series resistance of every crystal must be very low. It is recommended not to use the crystal if its ESR is greater than 50 ohms. Lower the ESR, better will be the performance. If you purchase crystals in large quantities, you can group the crystals according to their frequency including tolerance and the ESR so that almost all can be usefull. For example, I have purchased 40 crystals of 4.194 MHZ and tested the crystals. I have noticed that only one crystal was having very low (6 ohms) ESR. Almost all crystals showed ESR within 15 to 25 ohms. I was able to group the crystals according to their frequency and ESR, and obtained 6 groups to construct 6 SSB filters. The remaining crystals were still usable as carrier oscillators.

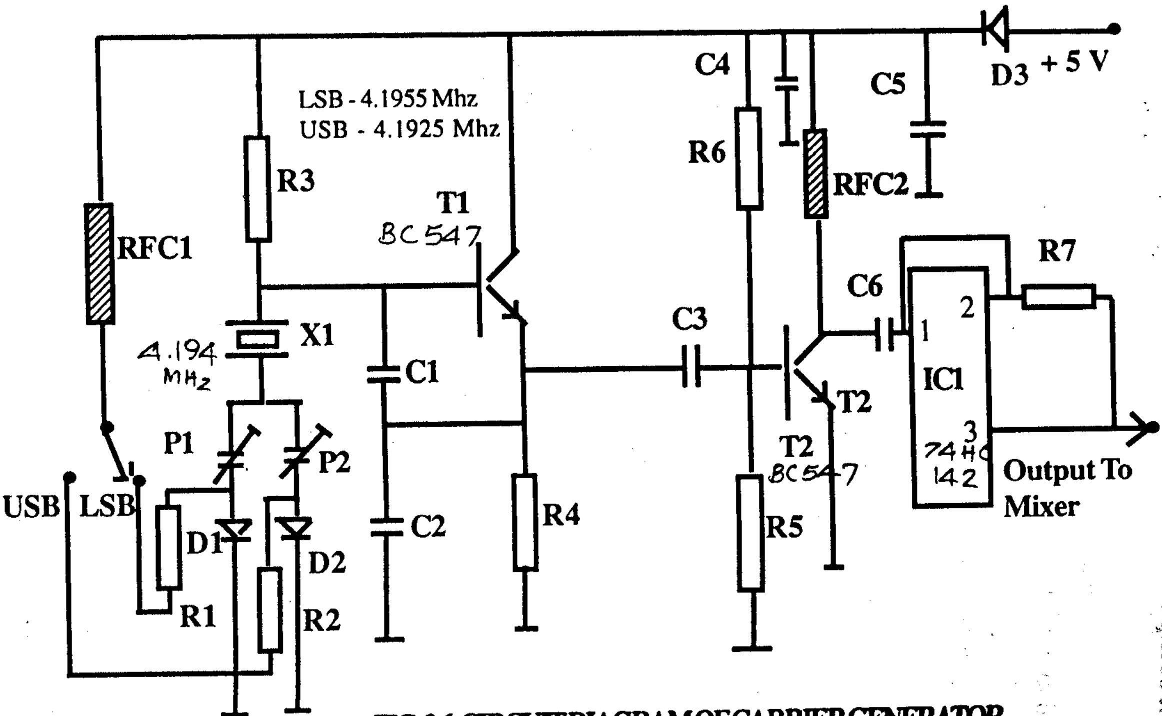


FIG.3.6 CIRCUIT DIAGRAM OF CARRIER GENERATOR.

Test setup and testing.

The test circuit is given in appendix. Test procedure is also explained there .

Final setup .

The circuit diagram for the SSB ladder filter is as shown in the figure. The crystals X1 to X5 must belong to the same group grouped by the earlier test. The construction is not critical. It is always advisable to assemble all crystals close to each other. It is a good practice to ground the casing of all crystals by soldering the cases by a piece of copper wire. Extreme care should be taken for soldering the case. High temperature can cause permanent damage to crystals. (It is recommended not to attempt to solder the casing if you are not familiar with that job.) PCB design is not shown, as it is not critical. A piece of fiberglass copper clad board can be etched for this purpose. The Two transformers T1 and T2 are used for impedance matching and response shaping. These can be wounded on standard 10-mm IFT core. The winding

After assembling each in separate PCB's , follow the steps .

1. Clean the PCB thoroughly using isopropyl alcohol or similar solvents .
2. Double check for any wrong connections , improper placement of components , and sol der bridges etc. . .

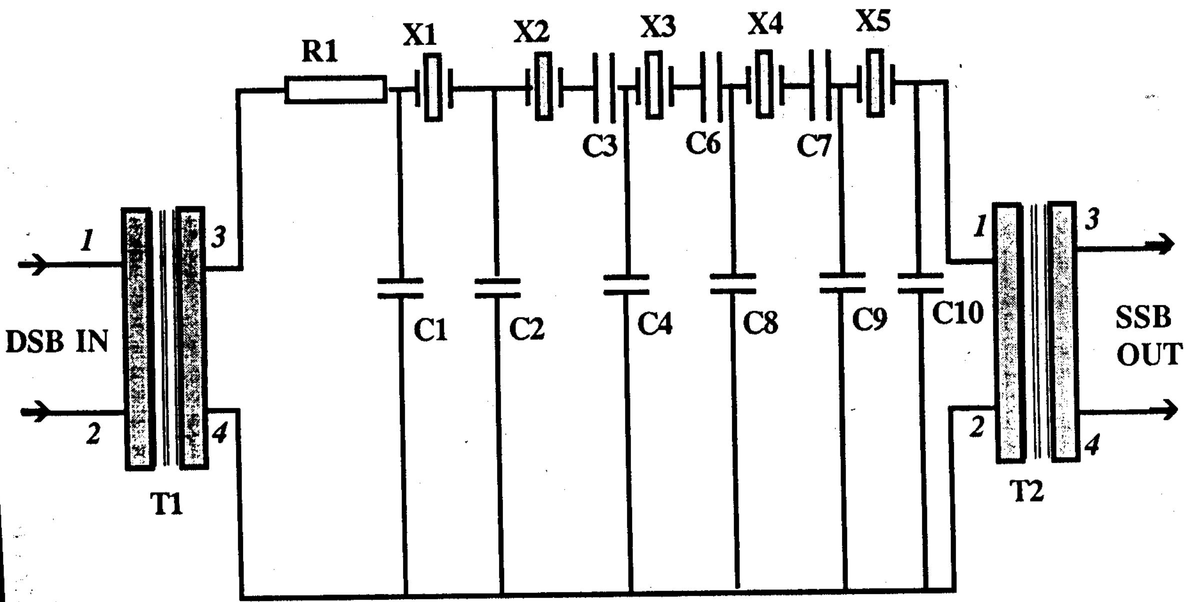


FIG.3.7 CIRCUIT DIAGRAM OF SSB LADDER FILTER

3 Connect the required power supply to the board and check for the DC condition .
4. If the DC condition widely differs from that given in the table , re-check connections , failure of components etc. .
5. Once satisfied , go to the alignment proce dure .

ALIGNMENT.

Speech processing

Only two alignments are needed for the speech processor . No special instruments is required for this . Initially keep the pre-sets in the middle position and with the help of the audio amplifier and speaker connected at the output , observe the quality of audio heard with loud speaker when taking through the mic . Remember to keep the mic away from the loud speaker to prevent the acoustic feed back .

Carrier oscillator .

Normally , there will not be any problem associated with the crystal oscillator . Adjusting the frequency in both modes by the respective trimmers . The output of the oscillator is level trans-lated by the NAND gates . If sufficient amplification amplitude is not there , the gates will not work .RF amplitude greater than 2.5 volts are needed for the gates to operate The output of the gates can be checked with an LED connected in series with a 2 K resistor

Observe the frequency using a frequency counter or a radio receiver tuned to the frequency .

Ladder Filter

Then comes the final part , the ladder filter .Testing of the filter can be done only after finishing the modulator, carrier osc and the microphone sections. After feeding the DSB signal to the filter, adjust T1 and T2 to obtain maximum signal strength at the output. Strictly speaking, the low band edges of the filter response must be slightly higher than the LSB carrier frequency and the upper edge must be slightly lower than the USB carrier frequency. If not, there is a chance of carrier leakage through filter. Adjusting of T1 and T2 slightly improves this condition. If severe carrier leak is noticed, the same can be cured only by varying the carrier oscillator frequency. Changing the values of (C7, C8 and C9) Nominal value being 330 PF can change bandwidth of the filter.

A better SSB results when, the carrier oscillator frequen-cies and the audio band pass filter selected accordingly. There is a scope for lot of experimentation to get optimum performance.

Integration

Connect all sub systems as shown in the block dia-gram . After powering up the device , talk through the mic .Ob-serve the SSB output by connecting an RF probe . If there is some deflection , tune all coils in the mic and filter circuit and keep them at maximum readings . It is recomented to say a long ‘aahh’to the misrophone while doing the tuning operations . There should not be any output while not talking into the mic . Check the output in both LSB and USB .

Note : If your crystals are having high ESR , see appendix

COMPONENT LIST FOR MIC PRE. AMP

No.	Item ID.	Description .
1.	R1	3.3 Meg 1/4 watt
2.	R2	2.2 k 1/4 watt
3.	R3	10 k 1/4 watt
4.	P1	10 k Variable
5.	C1	5 k pf
6.	C2	1 uf
7.	C3	47 uf
8.	T1	BFW 10
9.	M1	HI- Z Dynamic Mic

COMPONENT LIST FOR SPEECH PROCESSOR

1.	R1	10 k to 1 Meg. 1/4 watt
2.	R2	100 ohm 1/4 watt
3.	R3	10 k 1/4 watt
4.	R4	330 k 1/4 watt
5.	R5	100 k 1/4 watt
6.	R6	1 Meg. 1/4 watt
7.	IC1	741 op. amp
8.	D1	IN4001 or equalent
9.	C1	1 uf 16 V
10.	C2	1 uf 16 V
11.	C3	1 uf 16 V

COMPONENT LIST FOR MIXER

No.	Item ID.	Description
1.	R1	10 k 1/4 watt
2.	R2	10 k 1/4 watt
3.	R3	1 k 1/4 watt
4.	R4	1 k 1/4 watt
5.	C1	1 uf
6.	C2	0.1
7.	C3	10 MFD , 25 V
8.	C4	10 MFD , 25 V
9.	T1	Audio Driver Transformer
10.	IC1	CD 4066 or 4016
11.	IC2	CD 4093

COMPONENT LIST FOR CARRIER OSCILLATOR

1.	R1	1 k 1/4 watt
2.	R2	1 k 1/4 watt
3.	R3	330 k 1/4 watt
4.	R4	2.2 k 1/4 watt
5.	R5	68 k 1/4 watt
6.	R6	68 k 1/4 watt
7.	R7	100 k 1/4 watt
8.	D1	IN 4148
9.	D2	IN 4148
10.	D3	IN4148
11.	P1	22 PF.
12.	P2	22 PF
13.	X1	4.194 MHz

15.	C1 & C2	220 pf
16.	C3	100 pf
17.	C4	.1 uf
18.	C5	47 uf
19.	T1	BC 547
20.	T2	BC 547
21.	IC1	74HC132
22.	RFC1	150 turns of 36 swg on 1/2 watt resistor .
23.	RFC2	10 turns of 36 swg on ferrite beed

COMPONENT LIST FOR LADDER FILTER

1.	X1 - X5	4.194 MHz .All same type of crystals . For details see text .
2.	C1	5.9 pf
3.	C2	22 pf
4.	C3	330 pf
5.	C4	33 pf
6.	C6	330 pf
7.	C7	330 pf
8.	C8	33 pf
9.	C9	22 pf
10.	C10	5.9 pf
11.	T1	T1 and T2 are wound on standard 10 mm IFT core . T1 (1-2) 4 turns of 36 swg T1 (3-4) 16 turns of 36 swg
12.	T2	T2 (1-2) 16 turns of 36 swg . T2 (3-4) 4 turns of 36 swg .

BEAT FREQUENCY OSCILLATOR (BFO)