Hepping up the NE612 and LM386

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There are quite a few circuits around for the two chip DC receivers using the NE602 and LM386 ICs. I have made up a few of these sets and find that they generally lack a bit of guts and require a good antenna. Here are a few ideas that will boost the gain of these receivers without having to add RF or AF stages. I modified a two-chip receiver using these ideas. The mods were made switchable so that I could continuously check performance.

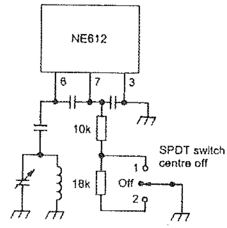


Fig 1: Oscillator switching

The oscillator output of the NE612 can be increased by connecting an emitter resistor from pin 7 to ground. If harmonics of the oscillator are used, it pays to have this resistor switchable to suit different bands, as in figure 1.

The RF gain of the NE612 can be boosted by about two times by increasing the normal bias of 1.4 volts on pins 1 and 2 to about 2.2 volts. I sometimes use a balanced input to the chip and figure 2 shows how this can be done in conjunction with an RF gain control. This control varies the bias from 0.5 volt (cut off) to 2.2 volts (max gain).

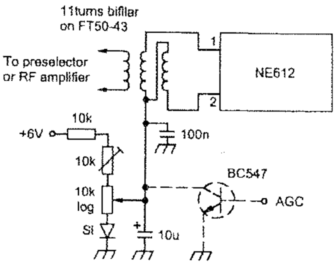


Fig 2: RF gain control

The RF gain control does away with the need for an audio gain control and possibly an RF attenuator. The normal standing current of the NE612 is 2.5mA but when using a gain control it varies from 1.5mA to about 4mA. Surprisingly the oscillator does not seem to be affected by these changes and even a self-excited oscillator does not change frequency. The balanced outputs of the 612 are bypassed for RF right at pins 4 and 5 and can be used to feed the + and – inputs of the LM386.

I installed a 3-position toggle switch to give audio filtering between the 612 and 386. This "selectivity" switch is labelled SSB/Wide/CW, and is shown in figure 3.

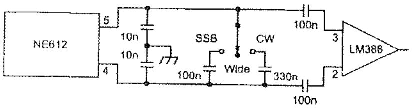


Fig 3: Selectivity switch

The gain of the LM386 is about 200 V/V with a 10uF capacitor between pins 1 and 8. This can be increased 2 or 3 times by feeding some of the audio output back into pin 7. This pin is sometimes bypassed for hum reduction. Figure 4 shows this "audio boost" circuit which uses a 3-position toggle switch labelled Boost/Off/Limit. The limit position of the switch uses a pair of silicon diodes to limit the amount of boost on strong signals. This is a primitive type of AGC and helps to keep strong signals from overloading the LM386 and distorting. As the hiss level of the LM386 seemed to increase with boosting, I installed a hiss filter, which is permanently connected.

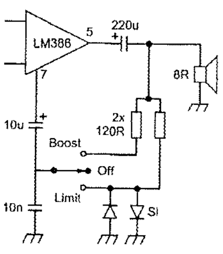
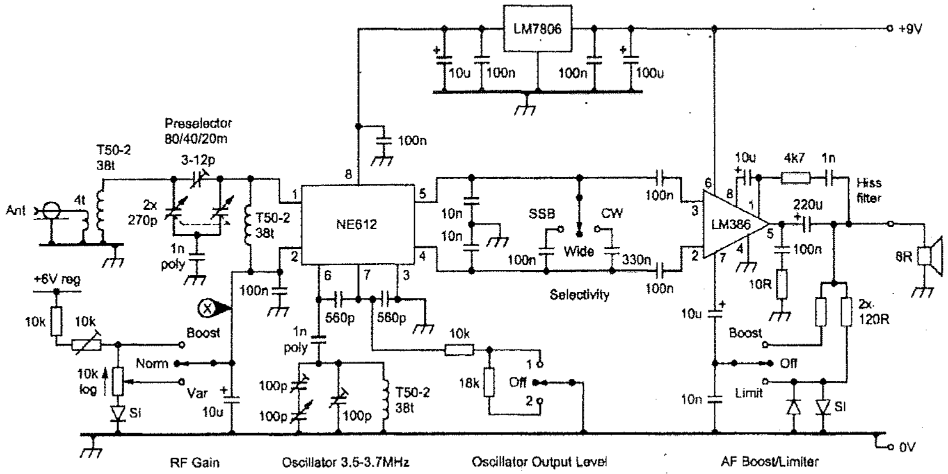


Fig 4: AF boost

The resultant receiver is shown in figure 5 and gives good results on 80 and 40. The VFO tunes 3.5 to 3.7MHz and the second harmonic is used to tune 40 metres. 20 metres is tuneable but conditions need to be good for speaker reception.
If you want 10MHz and 10.1 to 10.15MHz (30 metres), you can shunt the VFO with capacitors to tune, say 3.33 to 3.39MHz and use the third harmonic (9.99 – 10.17MHz). I have tried this and it works fine. The front end tunes 3.5 to 14.5MHz so there is no need for band switching there.



Voltage at X
Boost 2.2V
Normal 1.4V
Variable 0.5-2.2V

Two IC 80 to 20m DC Receiver

by Bill Currie VK2AWC

The set runs off 9 volts and uses 6 C cells, or a 9 volt "wall wart". An LM7806 regulator provides 6 volts for the NE612. You could of course add an RF stage, full AGC and an "S" meter, but then we are getting away from the KISS (Keep It Simple Stupid!) principle aren't we? You may be able to use some of these ideas in your receivers. You do not need to "switch" all functions like I did, but it is great fun for demonstrating "boost" circuits. These modifications described for the NE612 will also apply to the NE602 and the SA6xx versions. The modifications for the LM386 could also be applied to the LM380 with the appropriate circuit changes.

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The Heyphone

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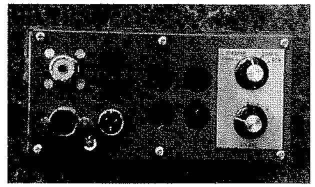
April 2001 saw the launch of a replacement radio for the cave rescue services; the first few delivered to British Cave Rescue Council (BCRC). Sixty-six radios have now been built with on-site testing slowed due to foot and mouth disease. In honour of the designer, or perhaps they couldn't think of another name, the radio was named the Heyphone by BCRC. There has been some coverage in the amateur press in recent times of the experimentation and construction which has been done by members of the Cave Radio and Electronics Group (CREG), a special interest group of the British Cave Research Association.



We have been asked at club lectures, "What has this got to do with amateur radio?" All the members turning up for experimental field meetings are radio amateurs, and while the caving frequency is not an amateur band, the circuitry below can easily be converted to 73kHz or 136kHz operation. Those wishing to read the full story should seek out the references given. The other radio magazines chose not to print the circuit details, but as Sprat readers are known to like circuit diagrams, here we go.

The transmitter/receiver uses SSB, the upper sideband being selected for compatibility with earlier cave radios.[4] Looking at the transmitter, most amateurs remark on the apparent simplicity – only one tuned circuit and a few op-amps. In band direct conversion is easy at 87kHz. A single op-amp U9a forms a mic amp. This is followed by a third order Butterworth low-pass filter U9b at about 2.6kHz to define the bandwidth. A 90deg audio phase shifter requires a low resistance drive in the ratio 3.5:1 and a very high resistance termination. The output of U9b drives the lower end of the network and U9c has the required gain of 3.5 to drive the upper part of the network. The strange values usually found in audio phasing networks are made from standard off-the-shelf values. U10b & U10d form the high resistance terminations.

U10a forms a signal inverter for U10b, and U10c does the same for U10d. There are two mixers or balanced modulators in a phasing method circuit U11a & U11b; sections U10a & U10b provide a p-p feed for U11a and U10c, and U10d drives U11b likewise. These electronic switches are fed with two digital switching signals from a crystal divider chain at 87kHz but with a phase difference of 90deg from U12, a 4060 with 5.568MHz crystal, and a 4013 which provides the 90deg bit. Carrier balance is done by varying the voltage on U10a & U10c non-inverting inputs.

Signal combining is a single transistor Q4, BC458 with a tuned circuit in its collector. A degree of series feedback is applied, as there is lots of signal available, this improving the waveform. With a two-tone generator into the mic socket and a 'scope at Q4 collector, a text book waveform is seen. The PA is a car radio audio power amp TDA2003. VR2 adjusts the drive to just flat-topping at strong voice level.

The Receiver

The aerial couples into the first tuned circuit through a capacitive tap. A well-known cascode circuit forms the RF stage with a gain of just over 40dB, with a second tuned circuit in the drain. There are two mixers, U2a and U2b, whose injection I & Q come from the transmitter crystal chain. The balanced amplifiers U3a and U3b are fed from U2a & U4a, and U4b driven from mixer U2b. Because the switches spend half their time off in each leg, sample and hold components R8 to 11, and C8 to 11, hold the voltage till refreshed again on the next half cycle. As any two switch elements are on at a time, a buffer with a modest 6dB gain is interspersed between RF stage and the mixers to provide low resistance feed and good isolation from L2.