73 Magazine Staff

Practical Af and Rf Speech Processing

—using modern ICs

The value of speech processing at either the af or rf levels for SSB transmitters has certainly been discussed and presented in many forms. However, some readily available and inexpensive ICs well suited to speech processing applications are still overlooked by many amateurs. These are the English line of Plessey ICs which are distributed also in the U.S.

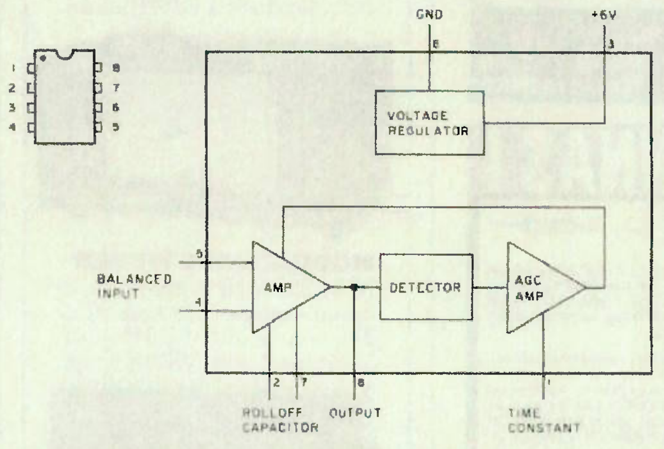

Fig. 1. Internal stages in the Plessey SL1626C af compressor.

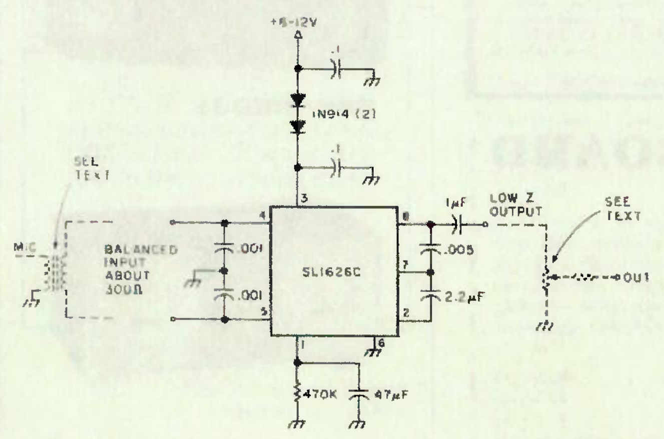

Fig. 2. Complete circuit of the af compressor with optional input transformer and output-level control. If the circuit is powered by a 9-volt transistor radio battery, the battery should be bypassed with a 100-uF, 15-volt capacitor.

Perhaps the most interesting IC yet developed for use in an af speech compressor is the Plessey SL1626C. A block diagram of the small, eight-pin IC is shown in Fig. 1. The input stage is a balanced one with a low-impedance input of about 300 Ohms. Part of the output (low impedance at about 50 Ohms) drives a detector stage which, in turn, drives an agc stage which regulates the gain of the input amplifier. A very wide control range of 60 dB can be achieved (100-uV to 100-mV input) over which the output will remain essentially constant. By the use of a small transistor-type matching transformer at the input, almost any low- or high-impedance microphone can be used with the IC. Supply voltages between 6 and 12 volts can be used with the unit, drawing about 14 mA at 6 V.

A few simple external components are all that are needed to implement a practical circuit. The low-frequency rolloff response of the compressor is set by a capacitor connected between pins 2 and 7. A 3-dB point at about 100 Hz is achieved by using a 2.2-uF capacitor, for example, although the value can be adjusted as desired for higher frequency rolloffs by reducing the size of the capacitor. The high-frequency rolloff response depends on the value of a capacitor connected between pins 7 and 8. A .005-uF capacitor provides a 3-dB point at 3 kHz, but one can vary this capacitor value also to achieve the best speech response with a given microphone.

The agc time constant is set by a parallel resistor/capacitor combination connected from pin 1 to ground. The attack time is set by the capacitor at 0.4 milliseconds/microfarad. The decay time constant is set by the time constant of the combined resistor/capacitor combination. The resistor and capacitor values can be varied to suit individual preferences, but the manufacturer recommends that the resistor value be between 500k and 1.5 megohms and that the capacitor be not less than 22 uF.

A practical circuit using the SL1626C is shown in Fig. 2. In addition to the resistor/capacitors mentioned previously, several other capacitors are used for rf bypassing. A balanced input is shown, although a single-ended input can be used at the sacrifice of some of the control range. In general, it is better to use a small input transformer of the transistor-interstage type. These transformers are inexpensive, and a 500/50k-Ohm type will suffice for most high-impedance microphones, while a 500/10k-Ohm type can be used with medium-impedance microphones.

There are no adjustments to make and the circuit will work very well in most applications with the component values shown. The one exception might be in a mobile application where the large dynamic range of the circuit might cause excessive background noise pickup during speech pauses. This problem can be cured by also placing a resistor between pins 7 and 8 to reduce the dynamic range. Resistor values of about 500 to 1,000 Ohms should be used, reducing the dynamic range to 35-40 dB. A 1k potentiometer may be connected on the output if it is desired to have a variable-output control. A series resistor may also be placed in the output line, if necessary, to reduce loading on the stage that the compressor works into. For instance, if the output of the compressor goes to a high-impedance microphone input on a transceiver, a series resistor of 50k to 100k may be necessary.

A parts layout for the SL1626 circuit is shown in Fig. 3. While there is nothing critical about the wiring of the circuit, a good, compact layout with good grounding will contribute greatly to avoiding any rf feedback problems from this high-gain circuit. Single- or double-sided PC board construction or use of the isolated-pad technique are particularly recommended. There are so few interconnections involved that isolated-pad construction is just as fast as etching a board, and this technique leaves almost all of the copper on the board for a good ground plane.

For those not familiar with the technique, it just involves the use of a special drill that simultaneously drills a hole in the PC board for a component lead while removing a small ring of copper around the hole for a small radius so that one can interconnect component leads without shorting to the remaining copper. The same effect can be achieved using regular drills—a small one for the component lead hole and a larger one to cut the copper away around the hole. A small modeling knife is handy in removing the copper so that there are wiring channels, where necessary, between component holes. I have used this technique for dozens of small projects with good success. It has all the electrical advantages of an etched board with almost the ease of construction associated with plain perforated board stock.

The af speech-compressor circuit just described is easy to implement and does provide some added audio "punch" with almost all transceivers. Probably, on the basis of the investment necessary in terms of money and constructional complexity, it provides the best return in terms of increasing a transceiver's effectiveness. However, numerous tests have shown that clipping at the rf level is still more effective. Completely outboard devices can be constructed to obtain the benefits of rf clipping where an SSB signal is generated, clipped, filtered, and then demodulated to provide an audio signal to a transceiver. The most economical way to provide the benefits of rf clipping, however, is to break the SSB generation chain in a transceiver, as shown in Fig. 4, and insert a few additional stages for clipping, amplification, and filtering. Some of the Plessey ICs make this particularly easy to do.

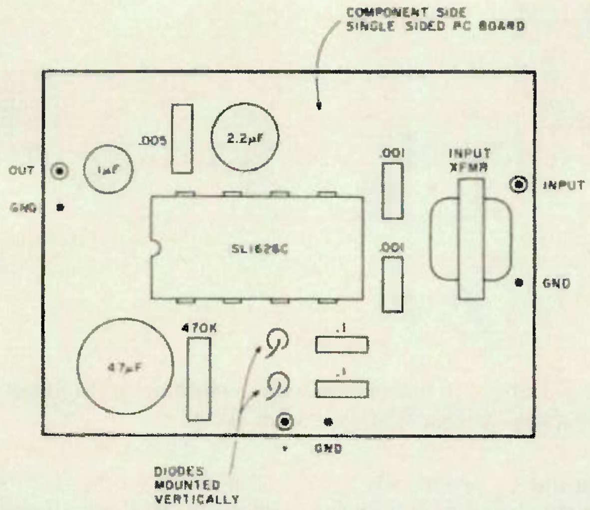

Fig. 3. A typical parts layout for the af compressor. The layout is exaggerated, of course, but any similar layout where the input/output is kept well separated will suffice.

The Plessey SL610C is an integrated rf amplifier having a modest voltage gain and a bandwidth up to 140 MHz. The supply voltage can be 6-9 volts, and the current drawn is about 15 mA. Internal HF decoupling is provided and the external circuitry needed is very simple. In fact, if agc is not applied to a stage using the SL610C, there is no need for any external circuitry other than an input/output coupling capacitor or a tuned circuit, if desired.

The Plessey SL613C is a broadband limiting amplifier consisting of a two-transistor amplifier stage, the output of which drives an emitter-follower output stage. Negative feedback is incorporated and careful design of the bias and feedback circuitry ensures that the amplifier limits or clips symmetrically. The limiting action starts with about a 120-mV input. The amplifier, like the SL610C, has internal HF decoupling so that the external circuitry needed is simplified. The circuit can operate on 6-9 volts and draws about 15 mA.

The two ICs just described can be used to form a simple but very effective rf signal processor (clipper) as shown in Fig. 5. This circuit, of course, is meant to be used in the scheme shown in Fig. 4. It can be

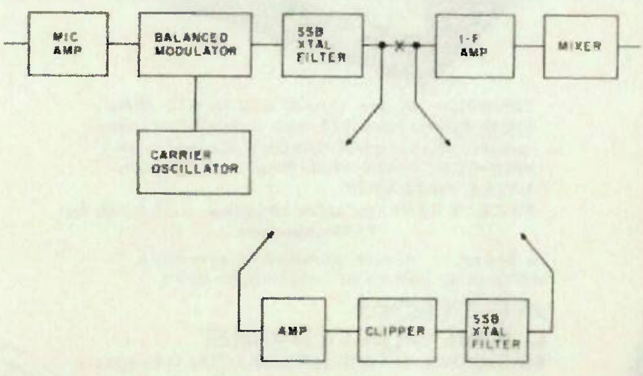

Fig. 4. Rf clipping can be added to most SSB transceivers by breaking the i-f chain after the SSB filter and adding the stages shown.

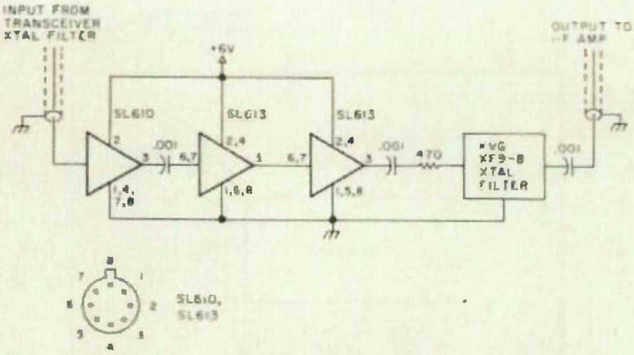

Fig. 5. Extremely simple but high-performance rf-clipper circuit shown with a 9-MHz crystal filter.

adapted to practically any transceiver i-f, although the circuit as shown uses a sideband filter for a typical 9-MHz i-f where the upper-sideband crystal frequency would be 8998.5 kHz, and the lower sideband crystal frequency would be 9001.5 kHz.

The KVG crystal filter shown is a West Germany product distributed by Spectrum International, Box 87, Topsfield MA 01983. It can be used with many 9-MHz i-f transceivers although, if possible, the best thing to do is to purchase a duplicate of the sideband filter used in any given transceiver.

The circuit, as can be seen, is extremely simple. The input signal is amplified by the SL610C stage and fed to two cascaded SL613Cs. The latter two stages clip the signal but, because of their inherent symmetrical clipping, preserve the zero-crossing points. The harmonics and higher-order intermodulation products are removed by the following crystal filter.

The mean-to-peak ratio of an unprocessed SSB signal can be increased by up to 12 dB. Although it is exactly this increase that makes rf speech processing so effective, you have to be sure that the output stage and power supply in a transceiver can take the extra average power dissipation. There is no way to be absolutely sure of this beforehand although, if the SSB and CW power-input ratings of a transceiver are drastically different (the CW input being lower), you should proceed with caution. This is not true of most newer transceivers, but mainly of some older types using sweep-tube finals.

The circuitry of Fig. 5 can be assembled on a small PC board. Again, the isolated-pad type of construction is recommended since there are so few interconnections and components involved. Short lengths of coaxial cable are used to connect the input/output into the transceiver circuitry, and a small DPDT relay can be incorporated to provide the ability to switch the clipper in or out of the transceiver circuitry. If you are wondering why there are no bypass capacitors, etc., remember that HF decoupling networks are *internal* to each IC.

The Plessey units are distributed nationwide; I have purchased units from Ancroma Corp., PO Box 2208, Culver City CA 90230. However, if you cannot locate a source of supply, write directly to Plessey, 1641 Kaiser Ave., Irvine CA 92714, for the name of the nearest distributor. ■