

## An LM386 Audio Amplifier Replacement?

Once again it's that time of year when the old is running down and the new is waiting to be born. With that fact in mind, the old standby LM386 audio amplifier chip that we all have grown to know and love is being threatened by a new breed of devices, one of which we will describe this month.

The new amplifier is the Analog Devices (patented) SSM2211, a simple-to-implement chip that is intended for use in toys, intercoms, hands-free telephones, personal computers, etc., and that will deliver one full watt (rms) of output at less than 2% THD into an 8 ohm load with no heat sink at all! The chip is designed to operate from Vcc levels of 2.7 to 5.5 volts and will even work down to 1.75 volts before quitting. A shutdown mode input is also provided to conserve power when not actually amplifying, such as in transceivers or other push-to-talk applications. In normal operation the device itself (not the load) draws 9.5 milliamperes, which drops to 1.0 milliamperes in shutdown mode.

Fig. 1 shows the internal operation of the chip, and fig. 2 shows a typical 1 watt amplifier using the SSM2211. Pins 4 and 3 are inverting terminals of internal op-amp A1, which is in turn connected to internal op-amp A2. The gain of op-amp A2 is set for -1, which results in an inverted replica of the signal at pin 5, the output of op-amp A1. This results in an overall gain of two times the ratio of the feedback resistors, and more important, no DC offsets between pin 5 and pin 6. Since the DC levels are the same, no coupling capacitor is needed between the chip and the speaker. As you can see from fig. 2, the amplifier does not require very much in the way of additional components. The only drawback is that in fig. 2 the speaker is floating. If a single-ended grounded speaker is desired, a simple rearrangement of the outputs and an additional capacitor are all that is needed. Fig. 3 shows this version.

The SSM2211 contains a shutdown, or "sleep," circuit that can be used to conserve power when not actually amplifying, such as in push-to-talk applications. Fig. 4 shows how to implement this circuit. As long as pin 1 is connected to ground, the amplifier will operate normally. Connecting this pin to Vcc will enable the shutdown mode. Circuitry can be devised to automatically disable the chip at the ap-

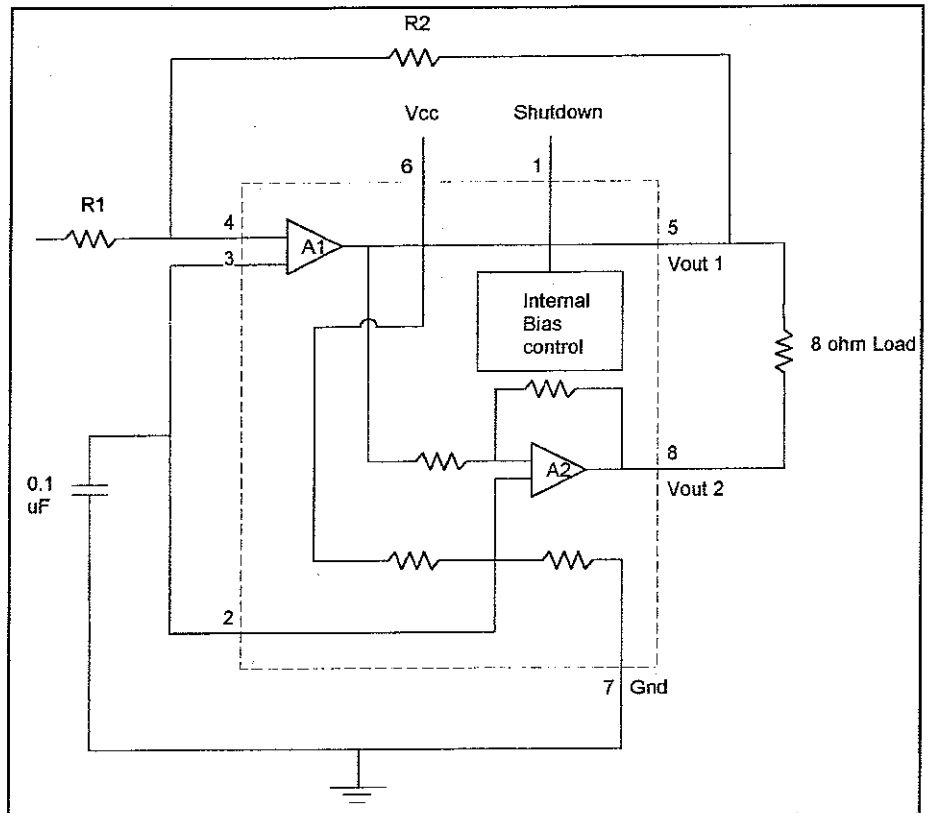


Fig. 1— Internal block diagram of the SSM2211 audio amplifier.

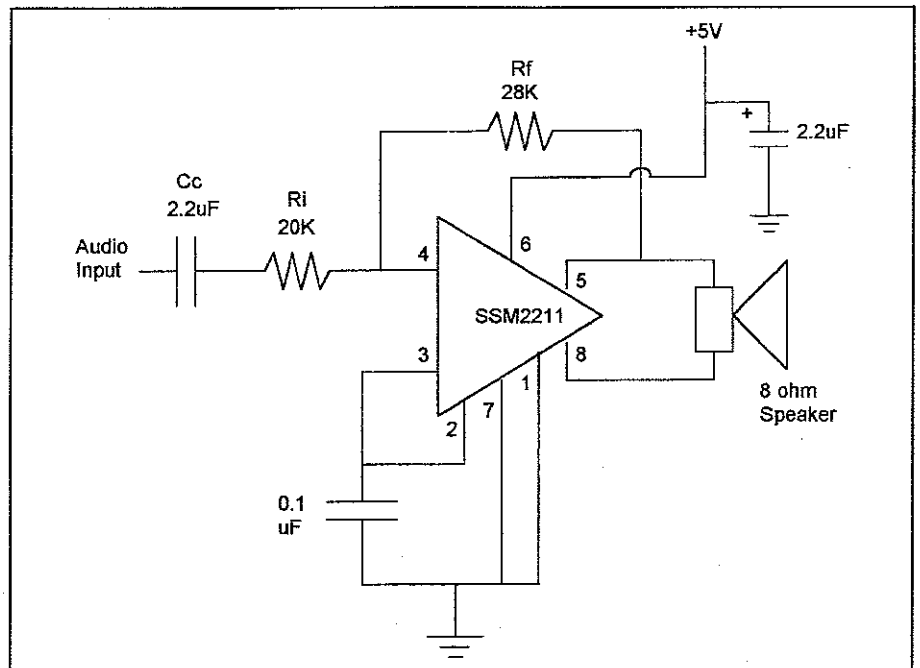
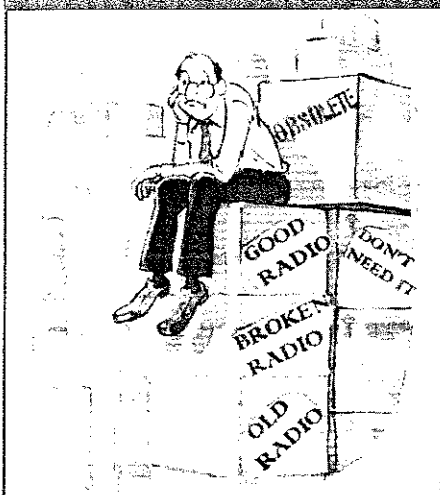


Fig. 2— Simple 1 watt audio amplifier using the SSM2211. Note that the overall gain is equal to  $2 \times R_f/R_i$  and the low frequency cutoff by  $C_c$ .

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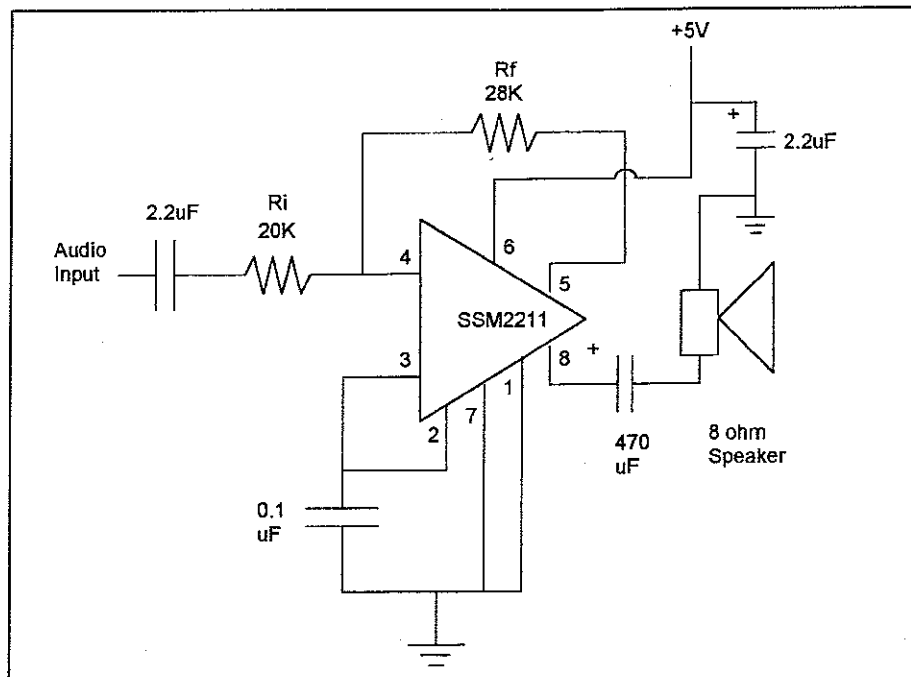


Fig. 3—Single-ended 1 watt audio amplifier using the SSM2211. Note that for this configuration the overall gain is equal to  $R_f/R_i$ .

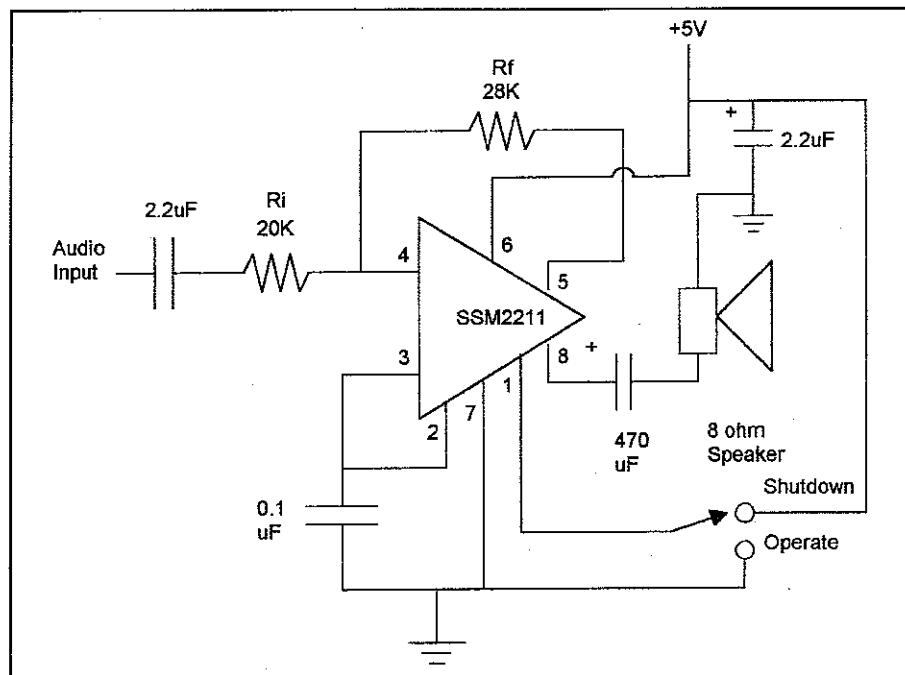


Fig. 4—Implementing the shutdown, or "sleep," mode.

appropriate time, thereby conserving the life of batteries in portable equipment. The data sheet for the chip shows one way to accomplish this.

The SSM2211 can deliver one watt of continuous audio output into 8 ohms at ambient temperatures that can range from  $-20$  to  $+85^{\circ}\text{C}$  due to a propriety process developed by Analog Devices. Distortion is 0.2% at full output as already mentioned, but drops to 0.1% at 350 milliwatts. The chip is available in an 8 pin DIP and also in an 8 lead SOIC. Power output is the

same for the tiny package as well, and cost is only \$0.73 in 100 piece quantities and a buck or so for a few. Hard to beat, huh?

Full details and an elaborate data sheet for the SSM2211 are available from Analog Devices on the Internet at <http://www.analog.com>, or from them at P.O. Box 9106, Norwood, MA 02062-9106.

At this time I would like to wish all of my readers a very happy and healthy holiday season. May all of your wishes come true in the next year.

73, Irwin, WA2NDM