SOLID STATE
Sound Recorders

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Dr Pei An introduces these novel 20 Sec Recorders

This article introduces a solid state sound recorder and playback module, QX-RD-20. The module allows 4 separate sound tracks to be recorded individually and played back. Each segment has 5 seconds recording length. It can also record just one 20-second sound track.

Sound is stored on its on-board non-volatile memory and is retained after the power supply is removed. The recorded sound can be played back at anytime. The recording cycle is in excess of 100,000 times. The data retention period is over 100 years.

Measuring 45mm x 25mm x 15mm in size, the device only requires a microphone, two pushbutton switches and an 8 Ohm speaker to form a complete 20 seconds sound recorder. The sampling rate is 6.4 kHz. The bandwidth of sound recording is 2.6kHz that is adequate for speech recording. It requires a power supply from 4.5 V to 6.5 V DC. In record and play modes, current consumption is typically 25mA. In idle mode, the current drops to 0.05mA. This makes the device favorable for battery-operated applications.

Pin-out of the Module

The device is shown in Figure 1. There are 13 soldering pads on the module. The pin pitch is 0.1 inch. Their functions are summarised in Table 1.

How to use the module

The basic connection of the module is shown in Figure 2. It consists of an LED, 3 pushbutton switches (named as RECORD, PLAYE and PLAYL), one speaker (8-16 Ohm), one 2-way switch, an electret microphone and a power supply (4.5-6V DC). It is very easy to operate. Let us first set B0 and B1 to logic 0. This causes the module to record/play only one segment. B0 and B1 can be set to other values to select other segments.

To record sound, press and hold the RECORD switch. The LED illuminates. Sound is recorded via the microphone or through the VANA input (Line-in input). When the RECORD switch is released or

when the total recording time is over 20 seconds, recording is terminated. Inside the chip, an end-of-message marker (EOM) is placed at the end of the sound track in the memory.

To playback the sound, press PLAYE switch once. The complete sound track (from the start of the track to the end-of-message marker) is played through the speaker. To stop replaying, press PLAYL

switch. During a message replay, the LED is off. When the replay is completed it flashes once. Pins B0 and B1 allow users to select 1 of 4 segments. The relation between B0 and B1 and the starting point of a segment is shown in Table 2.

During recording (RECORD switch is pressed), sound is stored in memory from the start point of a segment specified by B0 and B1. When the RECORD switch is released, an end-of-message marker (EOM) is placed in memory. The module allows in total 4 markers to be stored in memory. The marker plays an important role during replaying. After the PLAYE switch is toggled, sound stored in memory is played back from the start point to the next EOM marker.
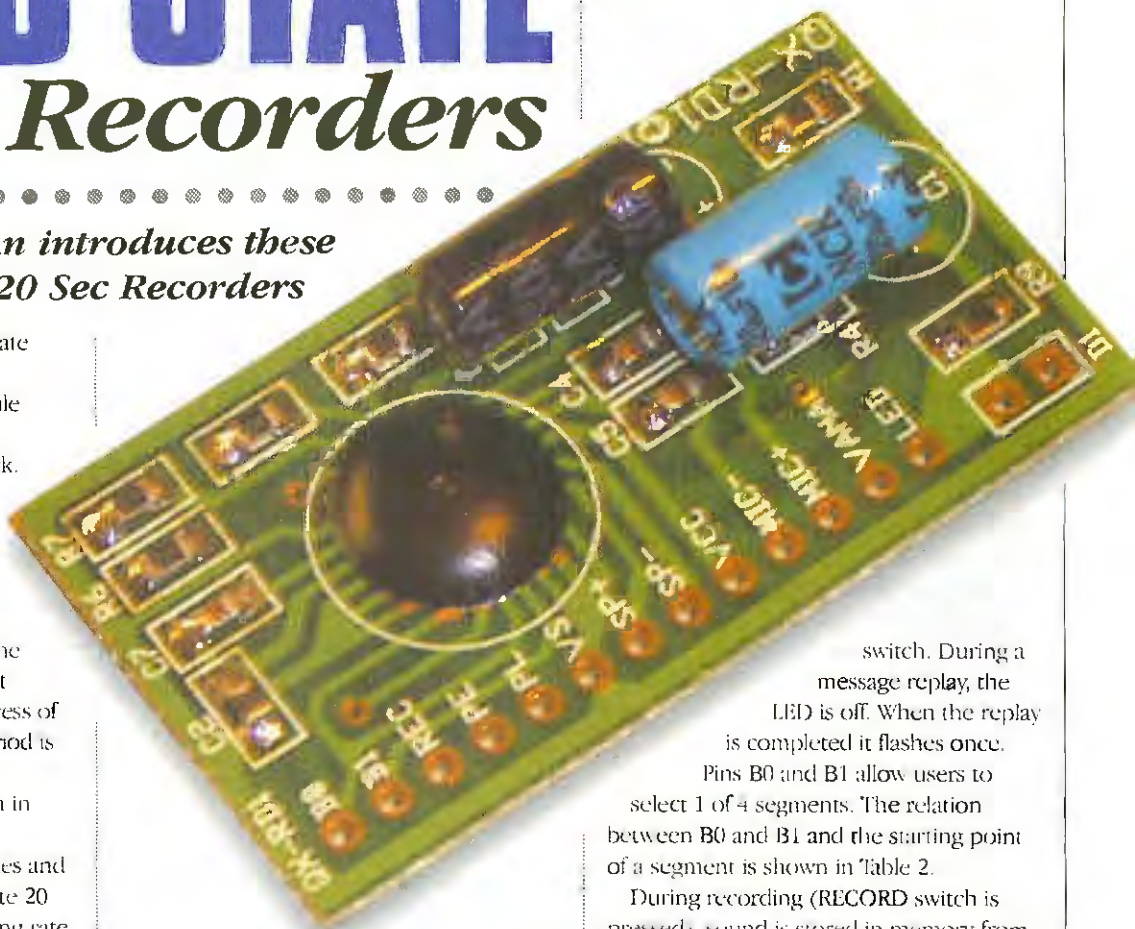
If the RECORD switch is held for more

Figure 1. QX series sound recording module. Overall size 45mm × 24mm × 5mm. Pin connector pitch: 0.1 inch. The above module is 20 second 4 segment version. You can use B0 and B1 to select the start of a segment.

1 2 3 4 5 6 7 8 9 10 11

than 5 seconds, the end-of-message marker will be placed in the next segment. When you replay the sound, the sound track covers two segments (time length will be longer than 5 seconds). As a result, you loose one segment. Hence in order to have 4 separated messages, the end-of message marker should appear in every segment. This means that the maximum recording time for each segment should be less than 5 seconds.

Application circuits: Basic circuit

Figure 2 gives the circuit diagram for basic operation. The circuit can be used for a simple message memo.

Circuit for continuous play of a sound track

It is often required that a sound track is played again and again. A circuit shown in Figure 3 can be used for such a purpose. In that circuit, the LED pin is connected to a 555 mono-stable and the output from the mono-stable is connected to the PLAYE pin. The LED pin is normally at logic high (LED is off). After a complete message is played, the pin generates a short low-going pulse. The LED flashes and the signal triggers the mono-stable. The output of the mono-stable goes high for a pre-set period of time then becomes low. At the high-to-low transition on the PLAYE pin, the sound track is played again. The delay period is determined by R and C values.

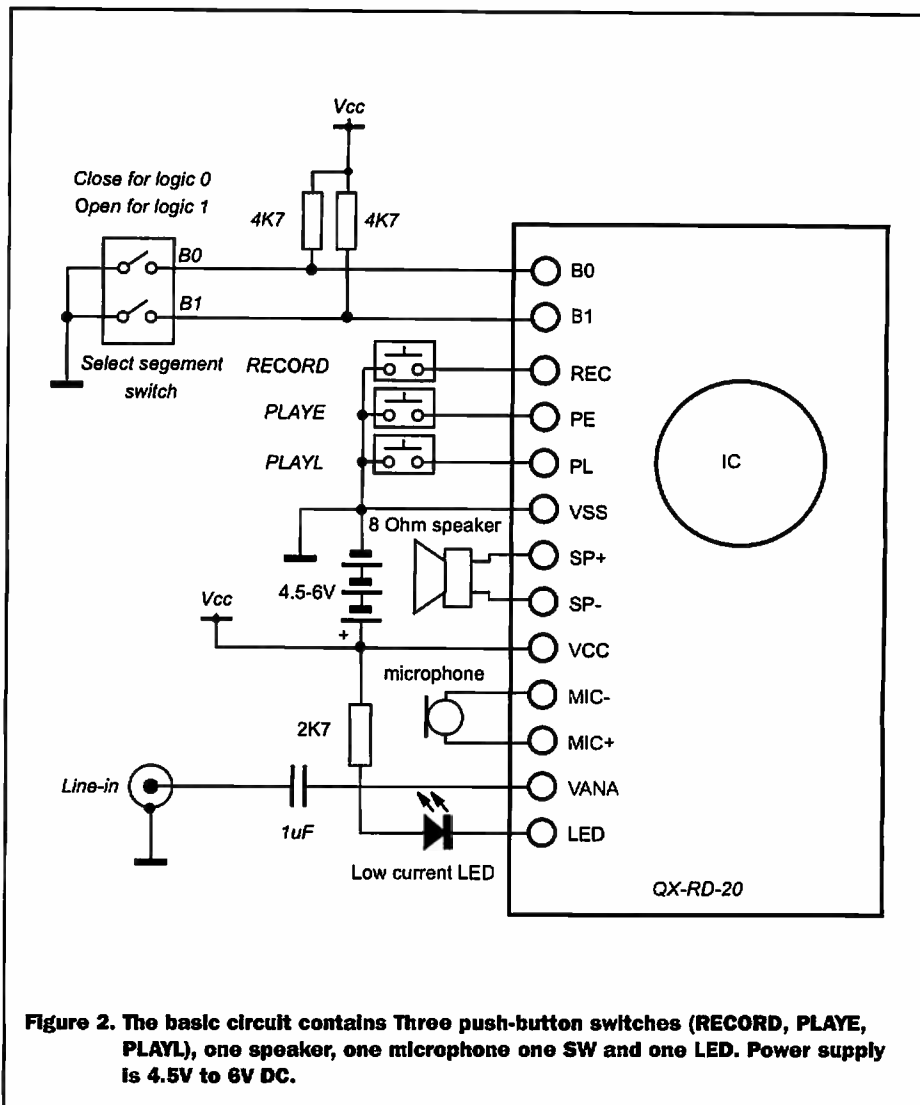To record message, just press RECORD

Figure 2. The basic circuit contains Three push-button switches (RECORD, PLAYE, PLAYL), one speaker, one microphone one SW and one LED. Power supply is 4.5V to 6V DC.

Pin	Functions
1	RECORD, Record (active at high-to-low transition)
2	PLAYE, Play (active at high-to-low transition)
3	PLAYL, Stop (active at high-to-low transition)
4	Ground
5	Connected to 16 Ohm Speaker. 12.5mW RMS output. Tests show that an 8 Ohm speaker is also acceptable
6	Connected to 16 Ohm Speaker. 12.5mW RMS output. Tests show that an 8 Ohm speaker is also acceptable
7	VCC (4.5 to 6.5 V DC) Active mode > 25mA, Idle mode: < 0.05mA
8	Electret Microphone -
9	Electret Microphone +
10	VANA: Audio line input (<50mVp-p). signal connected between VANA and Ground. A 0.1uF capacitor should be between VANA and input signal to filter out DC components. VANA recording has better sound quality than microphone recording.
11	Open collector output for an LED indicator. The LED illuminates during sound recording. It flashes once after a complete sound track is played.
B0 and B1	Selection pin for segments (each segment has 5 seconds length) B0=0 B1=0 1st segment B0=1 B1=0 2nd segment B0=0 B1=1 3rd segment B0=1 B1=1 4th segment

Table 1.

switch. In this circuit B0 and B1 are pulled to ground. So the message length can be up to 20 seconds.

Circuit for recording and playing 4 sound tracks

Figure 4 shows a circuit that allows one of four sound tracks to play by pressing one of four switches. The circuit is based on a standard CMOS logic IC, CD4532 keyboard encoder. It converts 8 parallel data (D0 to D7) into a binary data on Q0, Q1 and Q2 pins. D0 through to D7 are pulled down to ground via pull-down resistors (RL). While no switch is pressed, Q0, Q1 and Q2 output zero. Qgs pin is also at low. If a segment-select switch is pressed, the corresponding line (D0 to D3) becomes high. Q0 and Q1 output a binary data, which supply the address bits for B0 and B1. While the switch is pressed, Qgs pin also goes high. When the switch is released, Qgs pin goes low. At the transition from logic high to low, the module replays the sound stored in that particular segment.

In order to play 4 sound tracks, 4 separate sound tracks must be stored in each segment. This is done by holding the segment-select switch and pressing
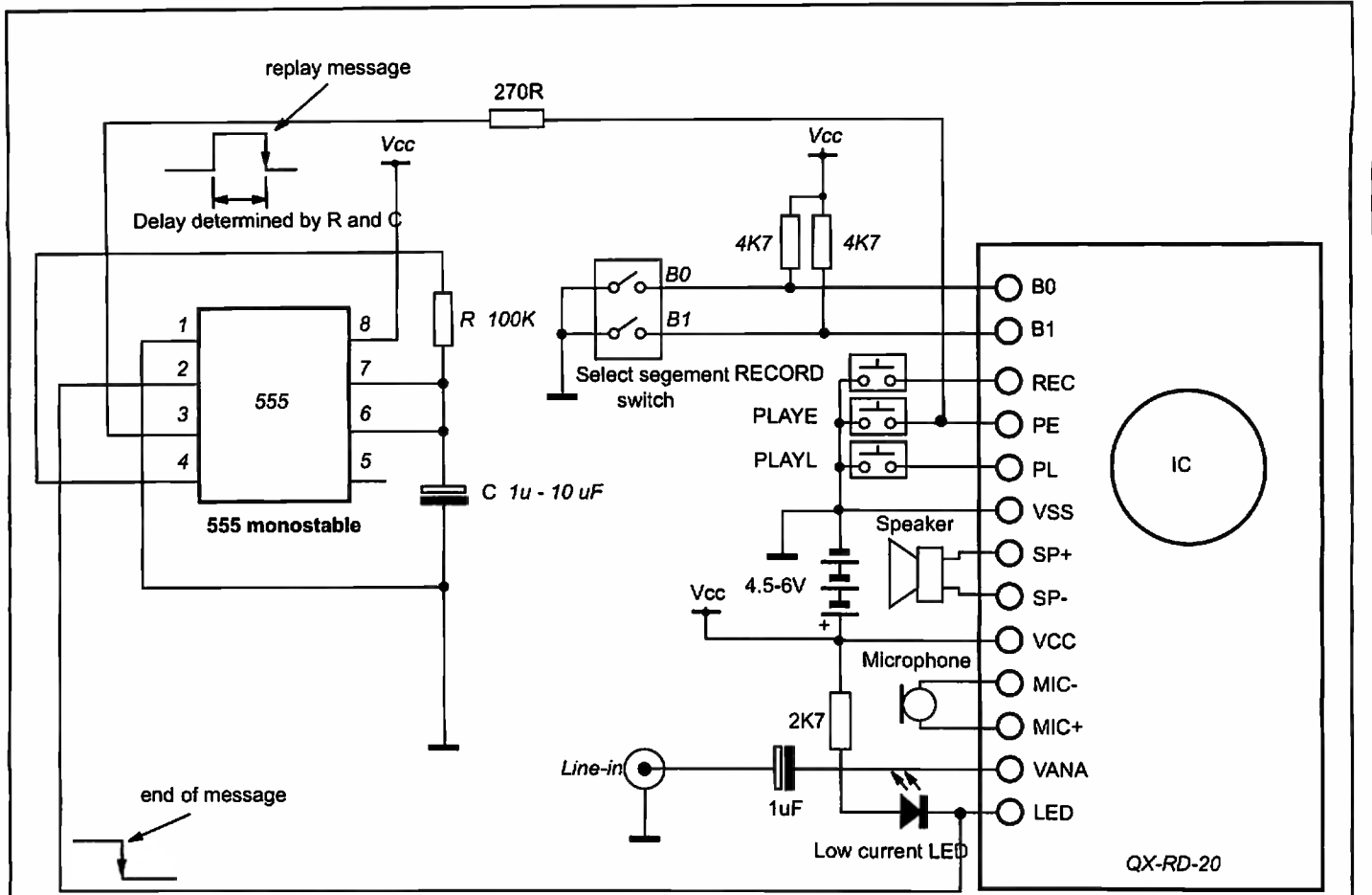
Figure 3. A 555 mono-stable circuit is used here to enable the module to play a sound track continuously.
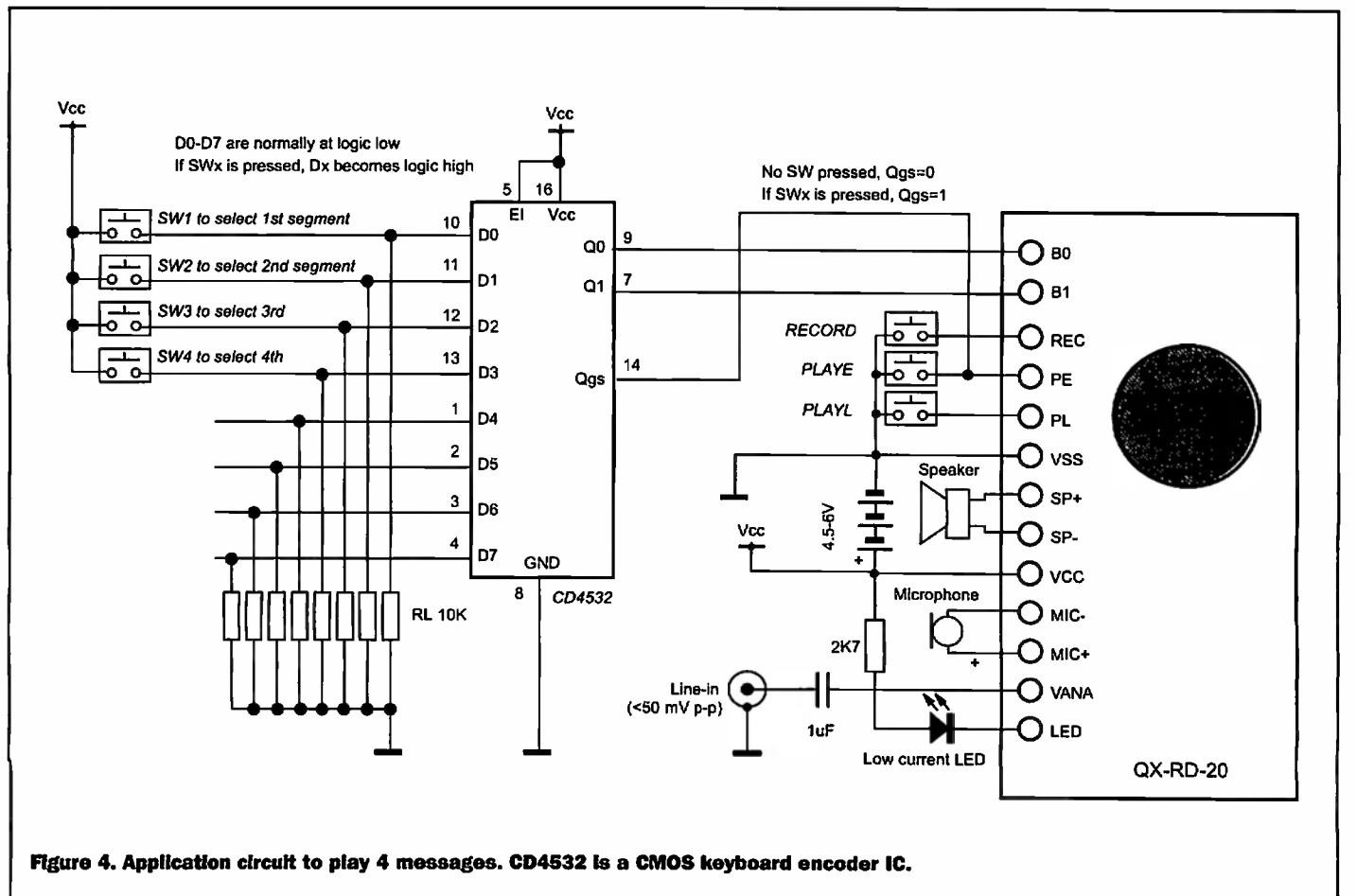

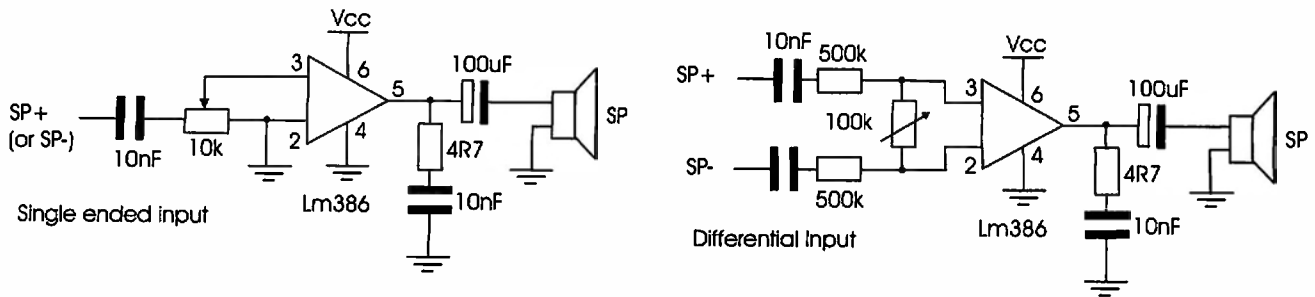**Figure 4. Application circuit to play 4 messages. CD4532 is a CMOS keyboard encoder IC.**

Figure 5. Using LM386 audio amplifier to boost audio output power. Two connection methods can be used: single-ended input and differential input.

Segments	B1 setting	B0 setting	Start point in memory
To select Segment 0	0	0	0 second (start of memory)
To select Segment 1	0	1	5 second (1/4 of memory)
To select Segment 2	1	0	10 second (2/4 of memory)
To select Segment 3	1	1	15 second (3/4 of memory)
NOTES: connected to VCC = Logic 1 connected to VSS = Logic 0			

Table 2.

under the control one pin. This feature is useful for some applications.

Technical Support

QX-RD-20 and QXLM-20 are both priced at £7.50 each (including VAT). Postage and packing is £3.50. QXLM-10 is £5.80. The Evaluation board (excluding sound modules itself) is £18.00. Please direct your enquiry to the author.
Telephone/fax: 44(0)1614779583.
E-mail address: <pan@intec-group.co.uk>

the RECORD switch at the same time. The record time for each segment must be less than 5 seconds.

Audio amplifiers

An 8 to 16 Ohm speaker can be connected to the module directly without using any amplifiers. To boost audio output, LM386 or other types of audio amplifier can be used. Circuits using an LM386 IC are shown in Figure 5. Figure 6 shows a circuit diagram using hybrid audio amplifiers (details of these amplifiers can be found at <www.intec-group.co.uk>).

Tips to obtain better sound quality

Use a good quality 8 Ohm speaker with a cavity such as speakers for computer sound systems. Do not use a bare speaker.

For better sound quality, speak to the microphone with a distance and speak clearly. Also keep the background noises as low as possible.

For best sound quality, use the Vana pin (Audio Line In). The audio signal is injected into the module between Vana and Ground. The voltage range is 100mV peak to peak.
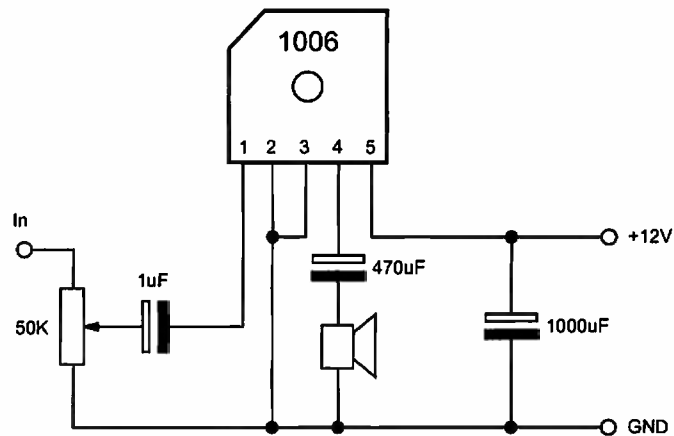
Other modules

There are two more sound recording modules with slightly different specifications. These are the QXLM-10 and QXLM-20. They are single section sound recorders. The former has a recording length of 10 seconds and the latter has 20seconds. For both modules, the recorded sound can be replayed once or continuous
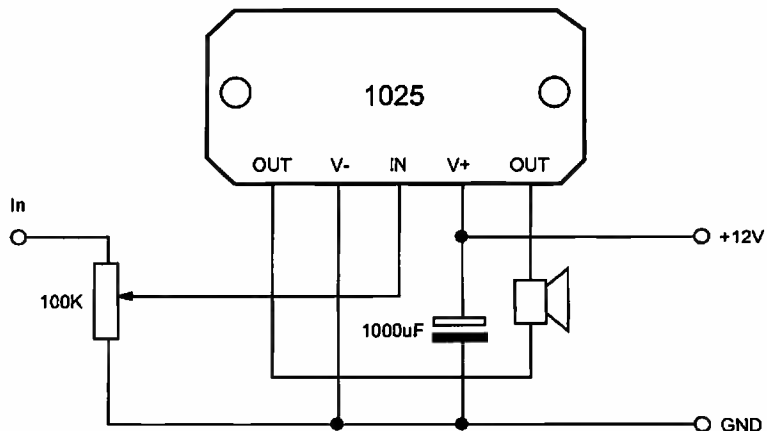

(a) 4 W audio amplification circuit

(b) 10 W audio amplification circuit

Figure 6. Two circuits (4W and 10W version) using hybrid audio amplifiers. In both circuits, the speaker is between 4 to 8 Ohm.