

# DOOR CHIME

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## No gimmicks, low cost "traditional" three-tone chime with decay

MANY designs have been published in the past for electronic door bells which generate a twin-tone chime, and some of them incorporate further circuitry in order to imitate more accurately the "ding dong" of a classical Friedland chime.

Other more elaborate microprocessor-based systems incorporate a custom chip which generates musical tunes, although there is always the danger that the integrated circuits utilised can become obsolete almost overnight, so that if the chip in a particular unit fails, there is no alternative but to scrap the unit altogether.

Electromechanical chimes themselves rely on the action of a solenoid-driven hammer striking a chime bar and then hitting another lower-frequency chime bar upon returning to its original position. The bars are suspended on rubber bushes to aid reverberation and clarity, and this results in a pleasant tone which decays over a period of several seconds.

## TONE GENERATION

It is possible to emulate this effect electronically and it is a simple matter to generate uncomplicated tones over a loud-speaker: the trick however is to modify this by modulating the tones to introduce the reverberation and decay characteristics of a Friedland. This can involve some fairly extensive circuitry.

The Door Chime to be described here utilises a single eight-pin integrated circuit which requires very little additional circuitry indeed to construct a complete chime. It incorporates an integral audio amplifier stage and will drive an eight ohm speaker directly.

The output is a little restricted—something to be expected in such a simple circuit as this—and is claimed to be about 160mW or so. This is obviously not quite as loud as a conventional chime but will prove quite adequate for use in smaller apartments; alternatively it could easily be employed in a larger household if the main Door Chime unit could be mounted within earshot of the occupants.

The Door Chime can actually generate a single, twin or treble chime, depending on which type of integrated circuit the user employs in his model. The author recommends the three-tone chime for its novelty value and pleasing effect.

If the twin or three-tone chime is constructed, the Door Chime will generate each tone successively, each tone overlapping the previous one which then decays away "naturally". After the last tone has died away, the Door Chime switches off automatically. The device operates from a 9V battery, and since the quiescent or "stand-by" current is tiny—less than 1µA—battery life should be exceptional.

Ease of construction is a keynote of this design, which has been kept deliberately simple, and the author recommends this project to beginners who will be able to assemble the Door Chime without any difficulty.

More experienced readers will also find this unit of value since it forms a quickly and economically assembled gift for a friend or relation.

triggering pulses of less than this duration are disregarded by the chip, and this provides some protection against false triggering caused by the switch wiring picking up interference from, for example, mains-borne glitches.

## FREQUENCY SELECTION

The basic frequency of the chimes, together with the overall period for which the chime sequence plays, is determined by an external RC network—the resistance comprises VR1 and R1, and C4 is the timing capacitor. Adjusting VR1 produces effects ranging from a high-pitch tinkle at one extreme, to an effect similar to a grandfather clock striking, at the other!

The three-chime effect itself consists of three tuned frequencies which are switched

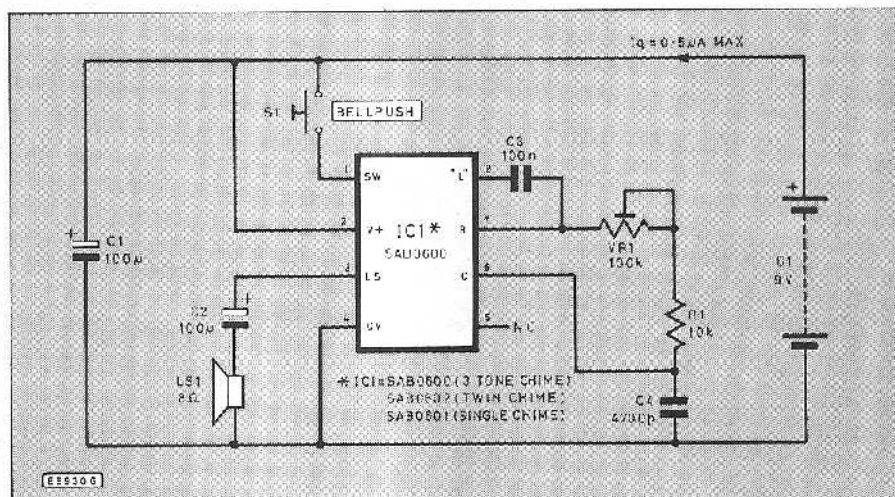


Fig. 1. Complete circuit diagram for the Door Chime. The i.c. used in this circuit is for the three-tone version.

## CIRCUIT DESCRIPTION

The circuit diagram is shown in Fig. 1. It will be seen that the Door Chime is of very simple design. IC1 does all the work and the user should select at the outset which chip he requires to produce the desired effect:

I.C. TYPE	EFFECT
SAB 0600	Three-tone Chime
SAB 0602	Twin-tone Chime
SAB 0601	Single Chime.

Any of the above chips can be employed in the circuit without any modification being necessary.

Switch S1 is the bell-push switch and this is a normally-open push to make switch which, when closed, will activate the chime sequence by connecting pin 1 to the positive rail. Pin 1 includes a 2mS time delay;

successively to a summing point. Three internal digital-to-analogue converters then generate the envelope decay waveforms which attenuate each chime individually so that each tone is heard to diminish in a manner similar to a traditional doorbell.

The single and twin-tone derivatives are all based on the three-tone chip, but with the relevant number of tones being suppressed from the end of the sequence.

The audio output is observed at pin three of IC1 and the chip will drive a speaker directly through a decoupling capacitor C2. When the last tone has decayed, the chip will automatically switch off. The quiescent current is typically less than 1µA. A PP3-type battery is used to power the circuit (B1) and should remain serviceable for at least one year. An alkaline type is preferred for its leakproof properties as well as the extended life that these batteries offer.

## TONE QUALITY

The tone quality itself, together with output volume, will depend not only on the power output of the chip, but also the following major factors:

1. The resonant frequency of the loudspeaker—the larger the speaker, the lower the resonant frequency. Maximum volume is achieved when the speaker is driven at its resonant frequency.
2. The operating frequencies of the chime circuit, as determined by VR1.
3. The resonant characteristics of the enclosure housing the loudspeaker.

A large speaker will improve the tone colour. A small 200mW speaker, for example, produces a "tinny" effect which is not particularly pleasant to listen to, nor is it particularly audible.

In practice, a compromise will have to be attained whereby volume is traded off to a certain extent for a more melodious tone, and this is achieved by setting VR1 to a fairly low resistance—generating higher frequency chimes—and reproducing the tones over a larger speaker than would theoretically be necessary to handle the power. The prototype utilised an eight ohm, one Watt loudspeaker and the resultant effect was quite acceptable.

Finally, C1 decouples the power supply rail and is essential to maintain stability when the i.c. is generating the chimes. Some pretty weird effects may be heard without it! C1 also smooths out to a certain extent any fluctuations on the power rails which will occur during operation once the battery starts to age.

## CONSTRUCTION

With such a simple circuit as this, the author considered it unnecessary to design a printed circuit board, and so in the interests

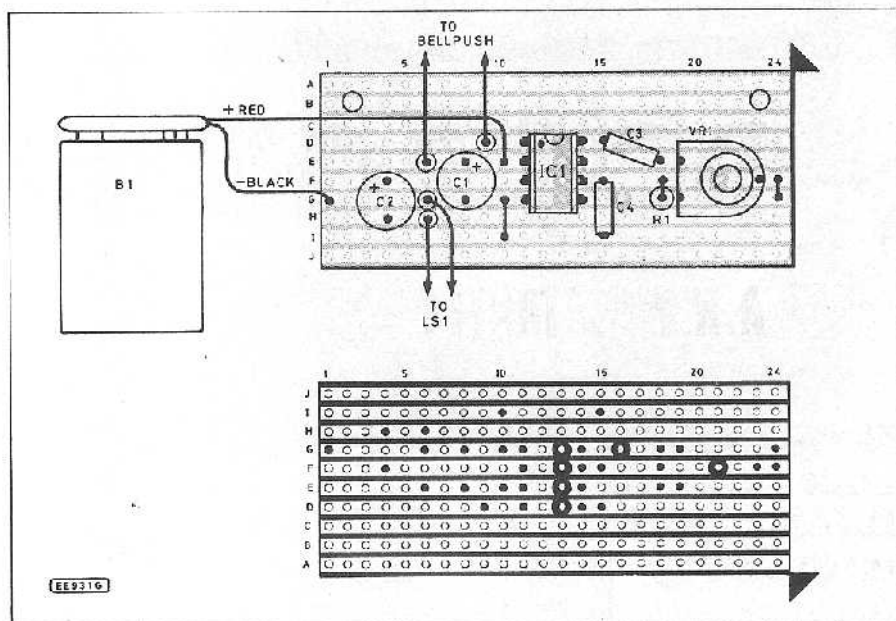


Fig. 2. Circuit board component layout, details of breaks to be made in the underside copper tracks and wiring details to the speaker LS1 and bellpush S1. An i.c. holder should be used to mount IC1 on the board.

of keeping construction simple, the circuit was assembled on a piece of 0.1 inch matrix stripboard size 24 holes x 10 strips—see Fig. 2.

Assembly of the components upon the stripboard is a straight-forward matter and should present no problems. An eight-pin d.i.l. socket is recommended to carry IC1. This will prevent any thermal damage being caused to the chip during the soldering process. It will also permit the constructor to change the chip at a later date for an alternative SAB type—so you can convert to a twin or single chime if desired.

Two holes are necessary in the stripboard at the positions indicated, to accommodate standard circuit-board mounting hardware, e.g. M3 or 6BA nuts, bolts and spacers.

## CASE

Since the completed Door Chime may well be displayed prominently in the home, it is desirable to house the circuit in a cabinet which is aesthetically pleasing. For the prototype an all-plastic Verobox type 65 40767F was employed. This measures 188 x 110 x 60 mm and is moulded in beige and

## COMPONENTS

### Resistor

R1 10k 0.25W carbon 5%

### Potentiometer

VR1 100k lin. min horizontal preset

### Capacitors

C1,2 100µ radial elect. 16V (2 off)  
C3 100n polyester layer  
C4 4700p polyester layer

### Semiconductors

IC1 SAB0600  
(three tone chime), or  
SAB0602  
(twin tone chime), or  
SAB0601  
(single tone chime)

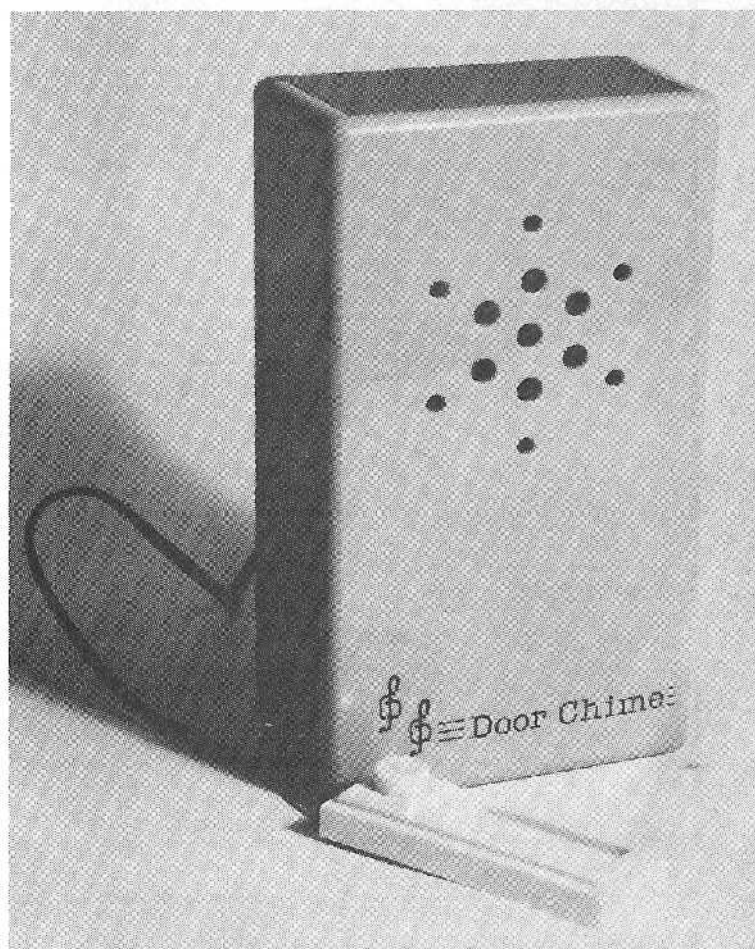
### Miscellaneous

B1 PP3 alkaline 9V, with battery clip  
S1 single pole push to make bell push  
LS1 8 ohm loudspeaker—see text  
Verobox 65-40767F size 188 x 110 x 60mm;  
0.1inch matrix stripboard, 24 holes x 10 strips; twin-core interconnecting wire to suit; wire; solder; 8 pin d.i.l. socket; circuit board mounting hardware, etc.

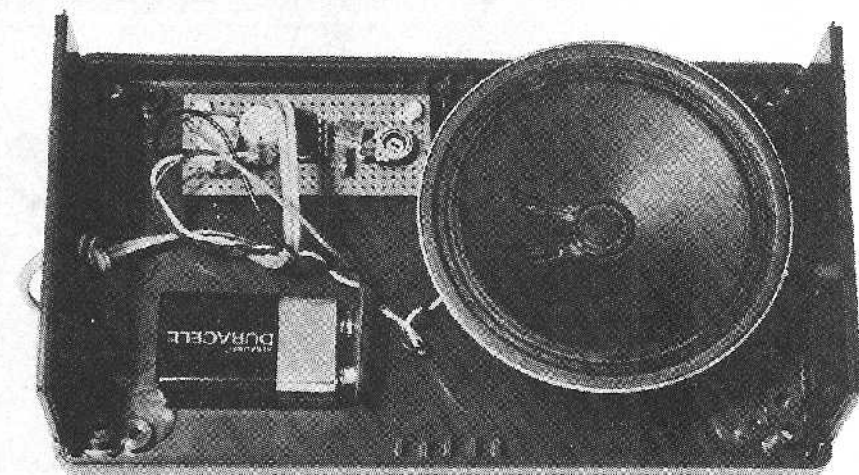
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brown plastic. It proves to be the most expensive component in the design, and you could of course use a different type if you wish, or perhaps make your own out of wood. Preferably acquire the loudspeaker first and then select a cabinet of appropriate dimensions to fit it.

The recommended case is prepared in the following manner. The base of the housing has knock-out keyhole slots which can be drilled out to permit the box to be positioned on the wall. Two further countersunk holes are required for the circuit board mounting hardware. Countersinking will prevent damage arising to wallpaper or paintwork.

On the prototype, the loudspeaker was merely glued down by applying a drop of cyanoacrylate adhesive gel ("Superglue Xtra") to the rear of the speaker and then

sticking into position on the base. It should never be dislodged, and apart from simplifying construction, also means that no unsightly loudspeaker mounting screws are visible anywhere.

An alternative means of affixing the speaker is to apply cement around the "gasket" or rim of the speaker and then sticking it to the lid of the case. However experience has shown that eventually the gasket—being made of cardboard—will separate into layers and the loudspeaker will simply fall off.

Obviously a loudspeaker grille is necessary in the removable lid to permit the chimes to be heard. The holes are best effected by careful use of a hand drill. Great care should be exercised when marking out the location of each hole prior to drilling. Afterwards, chamfer each hole to "soften"

the appearance by gently applying a countersinking bit: a couple of revolutions of the hand-held drill are all that are required.

The bell-push switch can be connected by a length of twin core "zip" wire and this passes through a hole in the base of the cabinet and is soldered to the stripboard inside. The wire was approximately five metres long on the prototype and the indications are that a much greater length could be used effectively (but see "Installation").

Finally a battery is clipped onto the battery connection clip and it can then be stuck down inside the case with a small piece of double-sided adhesive foam strip.

With assembly completed, the unit can be tested by operating the bell push to generate the chimes, and VRI can be adjusted to achieve the best effect. The cabinet can then be installed in the home.

## INSTALLATION NOTES

The main unit should naturally be installed in a location where it has most chance of being heard by the occupants of the house, though like most doorbells, the Door Chime may be drowned out by a loud T.V. or hi-fi.

When routing the twin-core wire it is desirable to keep the wires away from any mains cable or apparatus. In spite of the 2ms delay built into the trigger pin of IC1, it has been found that the Door Chime will upon occasion still sound if any adjacent mains equipment is switched on or off. This is especially true if the equipment incorporates a large mains transformer.

There should be no problem if the user steers clear of such equipment when installing the bell-push wiring. □

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4041	0.50	4518	0.38	74LS117	0.24	74LS174	0.90		
4042	0.45	4520	0.38	74LS118	0.24	74LS176	0.70		
4044	0.45	4522	0.60	74LS119	0.24	74LS191	0.31		
4045	1.00	4523	0.80	74LS120	0.24	74LS182	0.82		
4046	0.55	4524	0.38	74LS121	0.24	74LS183	0.82		
4047	0.55	4525	0.38	74LS122	0.24	74LS184	0.70		
4048	0.25	4529	1.35	74LS123	0.24	74LS185	0.70		
4050	0.20	4532	0.50	74LS124	0.24	74LS186	1.50		
4051	0.32	4538	3.49	74LS125	0.24	74LS187	1.00		
4532	0.32	4538	0.45	74LS127	0.30	74LS221	0.90		
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