An Electronic Bell

a novel decoration not just for Christmas time

Design by D. Petig

With Christmas not far away this project is guaranteed to add a sparkle to the festivities.

This novel design is of an electronic bell. The shape of the bell is outlined by a series of green LEDs while a moving light point on an arc of red LEDs represents the clapper. Each time the clapper hits the bell a delicate chime is generated.

Circuit description

The circuit diagram shown in **Figure 1** can be divided into two parts. The simplest part consists of 48 green LEDs forming the outline of the bell. The 150 Ω series resistors have been calculated assuming a forward conduction voltage drop of about 1.9 V for each LED so it is important here not to use high efficiency types.

The rest of the circuit is used to control the clapper display and chime generator. 16 red LEDs are used to simulate the bell clapper by a moving light point (again high efficiency types are unsuitable here). IC3a/b together with R1 and timing components R2 and C2 form an oscillator that controls the speed of the clapper. The output of this oscillator is used to clock a binary up/down counter IC4. This counter has four outputs and therefore counts up from 0 - 15 or down from 15 - 0 depending on the logic state of its up/down input. The outputs of this counter are connected to the inputs of the decoder IC2. This chip will set high only one of its 16 outputs corresponding to the binary code at its four inputs. Each of these 16 outputs is connected to an LED. The outputs representing each end of the binary count (pin 11 and pin 15 of IC2) are also used to toggle a flip-flop formed from IC3c/d. This has the effect of switching the counter to count down when it reaches its maximum count and to count up when it reaches its minimum count.

The overall effect is that the red light point swings continually backwards and forwards between D1 and D16.

The gong with eight legs

The two trigger signals from IC2 are also connected to an OR gate formed by diodes D65 and D66. The output of the OR gate is connected to the trigger input of IC1. This component is the SAE800 gong IC manufactured by Infineon. (**Figure 2**). This IC produces a single, dual or triple tone sound envelope from a single trigger signal and can directly drive a small loudspeaker or piezo sounder. The frequency of the tone is set by the values of C3 and R6 and the output volume by R7. The internal logic not only controls sequencing of the tones in the sound envelope but also the volume of each tone and its sustain time. Altogether each gong sound lasts for approximately 7 s. This chip has many interesting features and a copy of the datasheet is available for download from the Infineon website at: http://www.infineon.com.

In our application the IC is operated in its single tone mode, the intention here is to imitate the delicate chime of a glass hand bell and not the deep sonorous clang of Big Ben. The operating frequency is given as $f_0 = 0.03125/(R6/C3) = 4300$ Hz. This is relatively high and a piezo sounder is well suited to reproducing this frequency.

Circuit tuning

This circuit lends itself well to a bit of experimentation. The pitch and sustain of the bell ring can be adjusted by altering the value of capacitor C3. Increasing the capacitance will produce a lower note with a longer sustain.

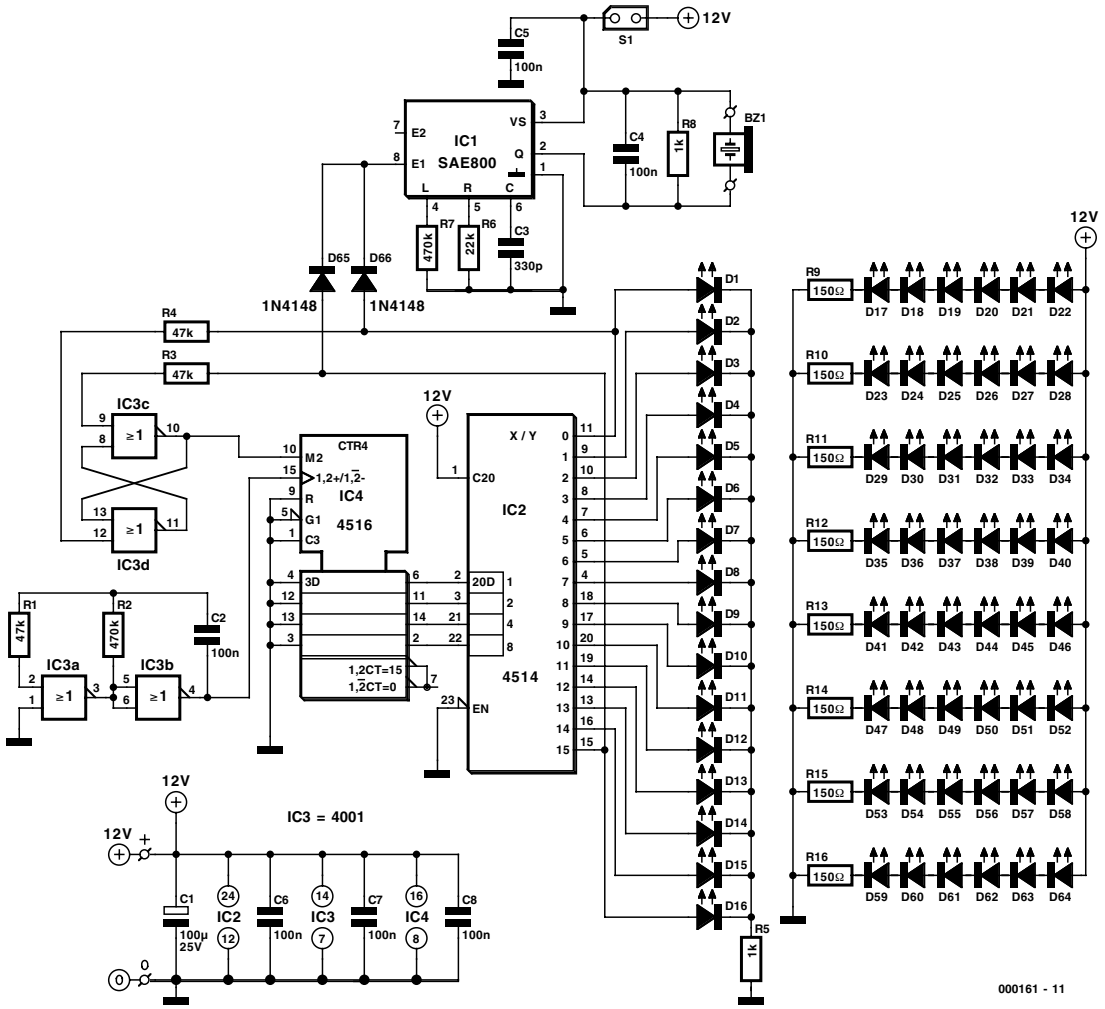


Figure 1. The electronic bell circuit.

The values of R2/C2 govern the speed of the clapper. Using a smaller value of capacitor C2 or reducing the resistance of R2 will speed up the oscillator and make the light point move faster. If you want the speed to be adjustable, R2 could be replaced by a fixed resistor of 47 kΩ in series with a 1 MΩ preset potentiometer. Increasing the speed too much however, will cause the sound of the chime to go out of step with the displayed clapper. In this case the gong IC will be receiving new trigger impulses before it has finished with the previous chime.

A stabilised 12 V mains unit can be used to power the circuit. Current consumption is in the order of 50 – 55 mA.

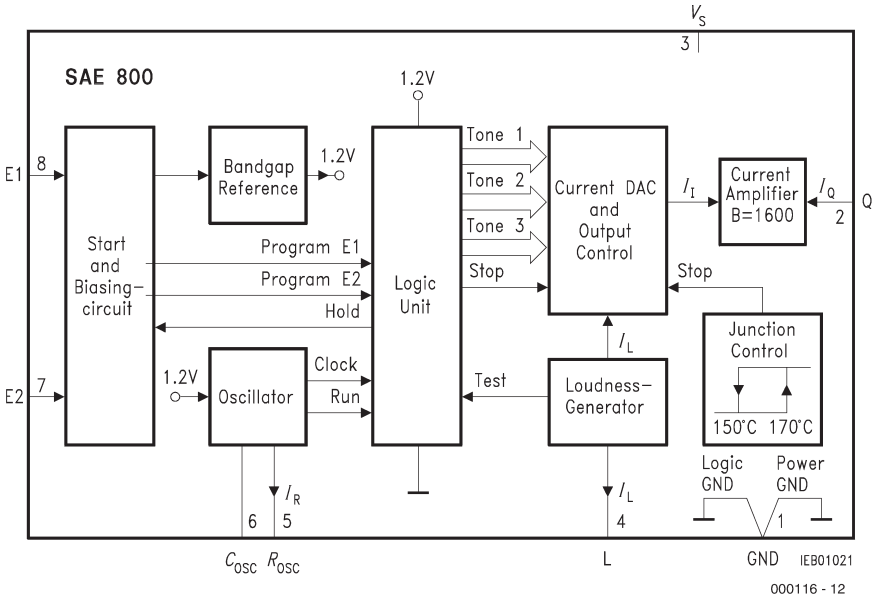


Figure 2. Block diagram of the SAE800 Gong IC.

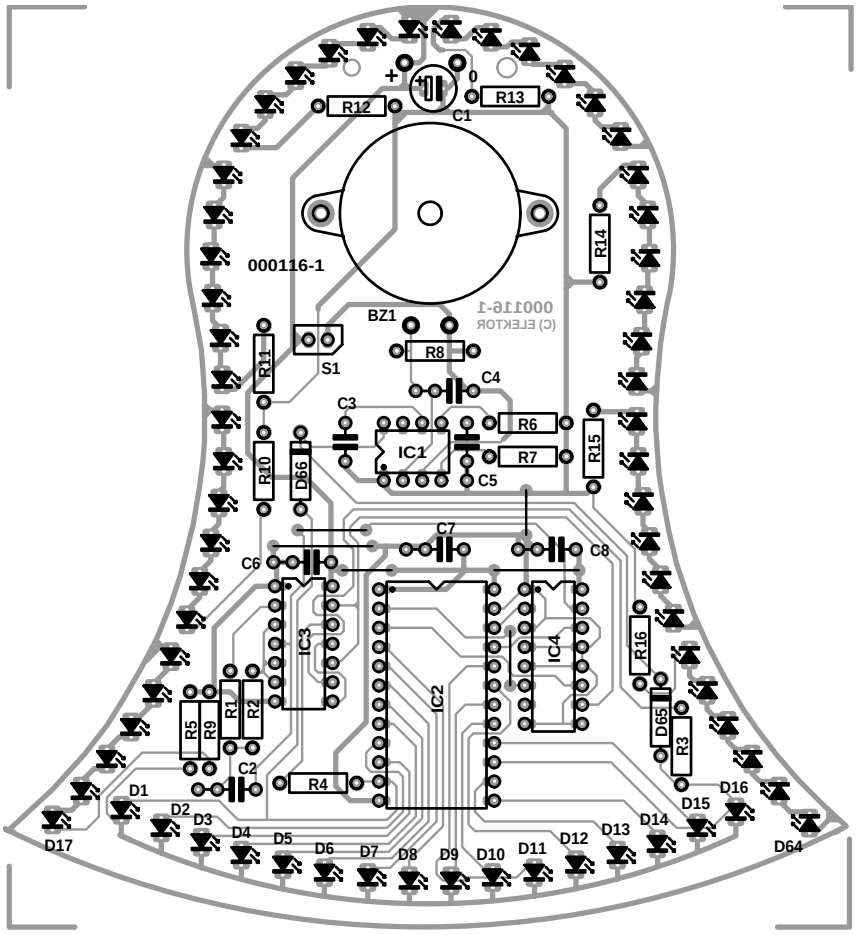
PARTS LIST

Resistors:
R1,R3,R4 = 47kΩ
R2,R7 = 470kΩ
R5,R8 = 1kΩ
R6 = 22kΩ
R9-R16 = 150Ω

Capacitors:
C1 = 100µF 25V radial
C2,C4-C8 = 100nF
C3 = 330pF

Semiconductors:
D1-D16 = red LED (no high-efficiency)
D17-D64 = green LED (no high-efficiency)
D65,D66 = 1N4148
IC1 = SAE800 Siemens/Infineon (Eurodis)
IC2 = 4514
IC3 = 4001
IC4 = 4516

Miscellaneous:
S1 = 2-pin header with jumper or switch
BZ1 = AC (Piezo) buzzer with connecting wires (dia. 24 mm).
PCB, order code 000116-1 (see Readers services page)



PCB assembly

Shown in **Figure 3** is the assembled PCB. Fitting the components should be quite straightforward and investing a little time and patience here will be well repaid in the finished product. All components with axial leads should be carefully bent to fit the position on the PCB (not forgetting the four wire jumpers) and then soldered into place. The best method of mounting the LEDs is to fit them into their positions on the PCB, flip the board so that it is track side up and on an even surface, then carefully solder only one lead of each LED. Now check that you really did mount them all the right way round! Also now you have the chance to slightly re-position them, if necessary, to ensure they are exactly in line with the outlines. Next solder the second leg of each of the LEDs and fit the remaining components onto the PCB. The board should be given a final inspection before power is applied and the jumper across S1 is inserted to enable the Gong IC.

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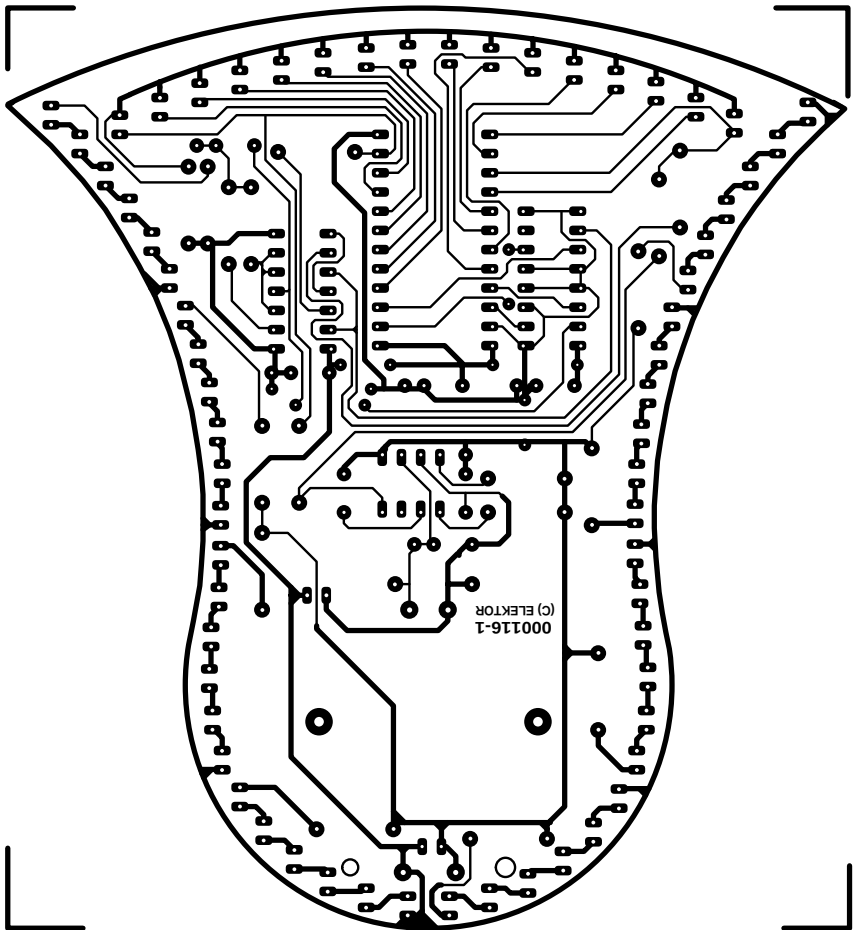

Figure 3. The electronic bell PCB is available ready-made through our Readers Services.