A special novelty project for the festive season!

Electronic Christmas Decoration

Your Christmas decorations this year can look quite different from your neighbour's with this flashing LED-illuminated Christmas tree picture. Set it up on your wall or mantlepiece as a Christmas conversation piece. It is easy to build and we have provided the artwork for you on the opposite page.

by NICK YULE*

It all came about one rainy October afternoon when one of our staff walked into the Technical Editor and asked, "Whaddawegunnado for Christmas?". In dazed soporific fashion, the Tech Ed, who had been quietly estivating** after lunch and otherwise trying to maintain a low profile, replied, "Whaddya mean whaddawegunnado?". Patiently, it was explained that we should have a special project to help celebrate Christmas.

Needless to say, it just had not crossed the Tech Ed's mind that Christmas would actually occur in December, the issue that he was working on at the time. But then in agile and creative fashion, he cast his mind forward to that festive season: "Christmas trees, presents under the Christmas tree, lights on the Christmas tree and so on". And so it came to pass that these visions were crystallised by a staff artist and are presented here for you to produce your own unique Christmas decoration.

While it is usual for the decorative lights on a conventional Christmas tree to flash on and off at a slow rate, the light-emitting diodes (LEDs) on our Christmas illustration can be arranged to flash in groups of three or four. The LEDs can be obtained in colours of red, green, orange and yellow and these can be intermingled in the four groups or each group can be made one particular colour.

A small printed circuit board carrying two ICs and four transistors drives the LEDs and it can be powered from batteries or a 9-volt DC plugpack. If neither of these are to hand, you can always use a donkey on a treadmill.

There are three parts to the circuit: an oscillator, a counter and an interface. IC1 is a quad two-input NAND gate which is wired as a conventional three-inverter oscillator (the fourth NAND gate is unused). Since both inputs of each NAND gate are tied together, each gate works as an inverter.

The time-constant of the oscillator is defined by the series-connected capacitors at pin 4 of IC1 and the 220kΩ resistor. The series connected capacitors will have an effective value of 2.35μF or half the nominal value of one capacitor.

The oscillator works as follows: Since each inverter has a change in polarity between input and output, the 2.35μF capacitor will be charged alternately in one direction and then the other, forcing all inverters to change state (from low to high or high to low) simultaneously. For example, when the output of IC1c is high and its input is low, the 2.35μF capacitor will charge towards the positive supply to the point where the input of IC1a is pulled high enough to force all the inverters to change state. The square wave output has a frequency of approximately 0.7Hz. Incidentally, the two capacitors are connected back-to-back to effectively produce a bipolar capacitor. If a single electrolytic capacitor was used here it would be reverse-polarised on every half-cycle of the oscillator.

IC2 is a decade counter with ten decoded outputs and a reset connection. We have wired it to count to four and then reset. So instead of counting to ten it counts to four continuously and is clocked forward by each positive transition of the oscillator ouput from IC1c. Each decoded output stays high for one clock cycle which means that each output, and thereby each set of LEDs, will stay on for about 1.4 seconds.

Each decoded output is buffered by a 10kΩ resistor and NPN transistor which drives a maximum of six LEDs via two series resistors. The transistors are the interface mentioned above.

Our prototype used a rough sketch and shows all the LEDs illuminated together.

A CHRISTMAS POEM

It's one thing to call for a project,
That suits the holiday season,
It's another to think up a circuit,
That has any appeal to reason.
But our artist came up with this drawing,
All vibrant in blacks, greens and reds,
So we added a few bits and pieces,
And a dozen or so blinking LEDs.
You can put it together dear reader,
In your holiday leave or your sickies,
So pick up the bits from a dealer,
Like Jaycar, Irving or Dickies.

Anong.

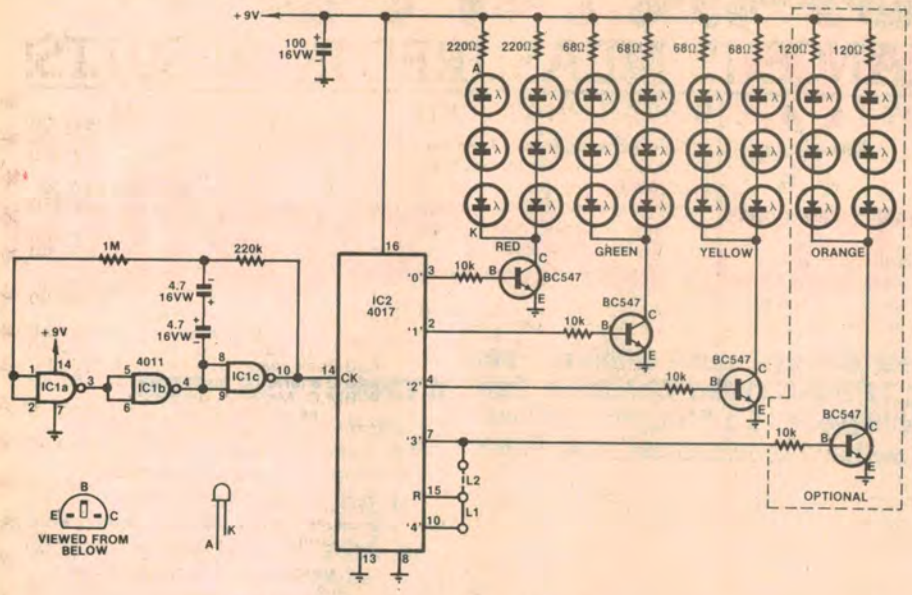
We estimate that the cost of parts for this project is approximately

$15

This does not include batteries or, alternatively, a DC plugpack.

**One of Santa's little helpers.*
***Estivating: Habit of some fish, frogs and insects; burying themselves in the mud during a long hot summer.*

Electronic Christmas Decoration



EA CHRISTMAS TREE LED FLASHER 2/MSI-

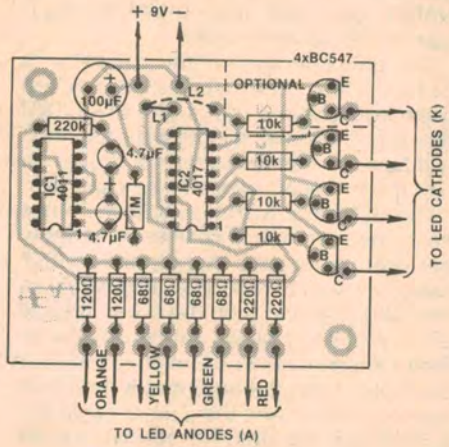
Note the different values of limiting resistors, depending on the LED colours.

PARTS LIST

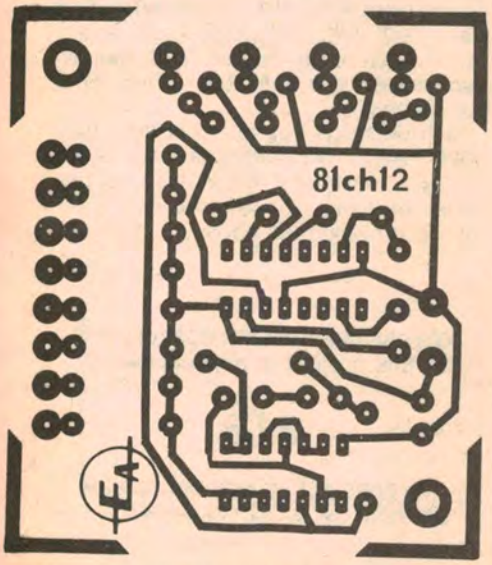
1 PC Board, 69 x 59mm, coded 81ch12
1 4017 CMOS decade counter
1 4011 CMOS quad two-input gate
4 BC547 NPN transistors
24 LEDs, 6 red, 6 orange, 6 yellow and 6 green
1 100µF/16VW PC electrolytic capacitor
2 4.7µF/16VW PC electrolytic capacitors

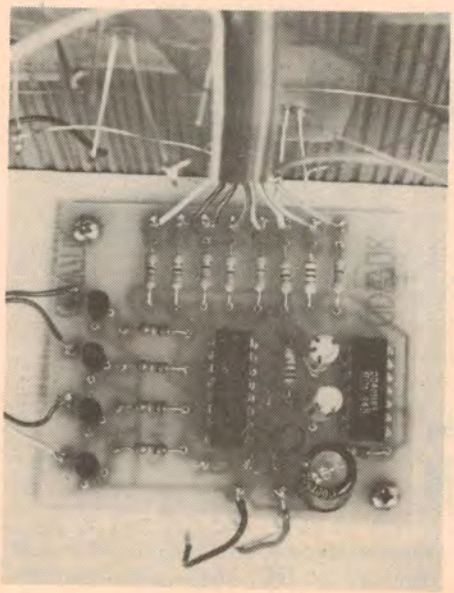
RESISTORS (¼W, 10% tolerance)
1 x 1MΩ, 1 x 220kΩ, 4 x 10kΩ, 2 x 220Ω, 2 x 120Ω, 4 x 68Ω.

MISCELLANEOUS
6 x 1.5V C-size cells, or 1 9V DC plugpack, rainbow cable, hookup wire, timber, PVA glue, solder.



Above is the component overlay for the PC board which is also depicted below.





The circuit can be powered by six 1.5V C-size cells connected in series to make 9 volts or, more economically, from a 9V DC plugpack.

CONSTRUCTION

All the circuit components apart from the LEDs are mounted on a small printed circuit board measuring 69 x 59mm and coded 81ch12. The board may be wired with three transistors and six current-limiting resistors to drive 18 LEDs or, as we wired it, with four transistors, and eight current-limiting resistors to drive 24 LEDs. If you wish to have the former option, install link two; if not, install link one.

Note that the current-limiting resistors vary in value depending on what colour LEDs you are using. If you wish to mix the colours in a particular string, the limiting resistor value should be 120Ω or selected so that the LED current through a particular string is less than 40mA.

PC pins should be installed on the board to simplify external connections. You will need 15. Install all the resistors first and then the three electrolytic capacitors and transistors. Watch the polarity of these components.

Now remove the CMOS ICs from their conductive foam and install them in the board. Use a soldering iron with its barrel connected with a flying lead to the negative supply input on the board and solder the positive and negative supply pins on the ICs first. These are pins 14 and 7 for IC1 and pins 16 and 8 for IC2. Now solder the remaining pins of the ICs.

THE BIG PICTURE

Cut out the glorious artwork on the page opposite page 53 and use PVA glue to affix it to a sheet of three-ply, hardboard or stiff cardboard which is itself fixed to a suitable piece of timber so that it will stand upright. Punch and drill holes in suitable locations for the 24 LEDs so that they are a push fit. Make sure your hands are clean during this task so that the artwork remains clean.

We fitted LEDs into Santa's eye sockets so that they flash on and off. We used green LEDs here because we thought they looked less gruesome then red. Of course, to be really whimsical, you could have the eyes flashing alternately.

Now install the PC board on the timber foot and wire the LEDs to it in whatever pattern you desire. Now apply power and the four sets of LEDs will flash in a slow sequence. If you wish to speed up the process, you should reduce the 4.7µF capacitors but note that both these capacitors should have the same nominal value.

The betting in the EA office at the moment is that commercial versions of this project will be available for Christmas in 1982. Why not build yours before the trendies latch onto it? And remember, you saw it first in "Electronics Australia". Merry Christmas!