ECT Education | eJournal for teachers of electronics and communication technology

Eco nightlight

Posted by Paul Gardiner on 01/11/11 • Categorized as Key stage 3

The nightlight is a popular project in schools and, depending on the circuit used, suitable for a very wide student age range. Even at key stage 2, students can learn much from a basic circuit comprising a battery, switch and LED. More sophisticated automatic PIC or RC timer controlled circuits offer the scope for programming or investigation of resistor and capacitor values and can form the basis for product design at 'A' level. Battery powered nightlight circuits however, have the downside that they contribute to the global mountain of discarded batteries. This includes the nightlight project I describe elsewhere in ECT Education.

One day, one of my year 8 students suggested that our night light project would be better if it could be solar charged instead of relying on batteries. Since the circuit was controlled by ambient light level, it seemed logical to her that it should also be re-charged by light. On the surface this seemed like a great idea but the problem is solar cells only produce 0.5V in strong light so 8 cells would be needed in series to generate an operating voltage of 4V (to drive white LEDs) for battery charging.

Download complete article Eco-nightlight (5)

Pages: 1 2 3 4 5 6

Tagged as: Joule thief, nightlight, solar cell, super capacitor, thyristor

40106 555 timer astable charge Joule thief LDR leakage monostable MOSFET nightlight potential difference solar cell super capacitor thyristor time constant time delay voltage voltmeter Zener diode ZVN4206

Our Twitter

Eco nightlight

Posted by Paul Gardiner on 01/11/11 • Categorized as Key stage 3

A single solar cell is available for around 70p (now 94p – gone up since this article was written!), a viable price for key stage 3 projects if only one is required but too expensive if 8 cells are needed. What we really need is a way of stepping up the voltage of a single solar cell (0.5V) to 4V to drive the LED. Such a circuit exists – it is a simple switched-mode power supply (see fig 1). This little gem of a circuit goes by the nickname of '*joule thief*'.

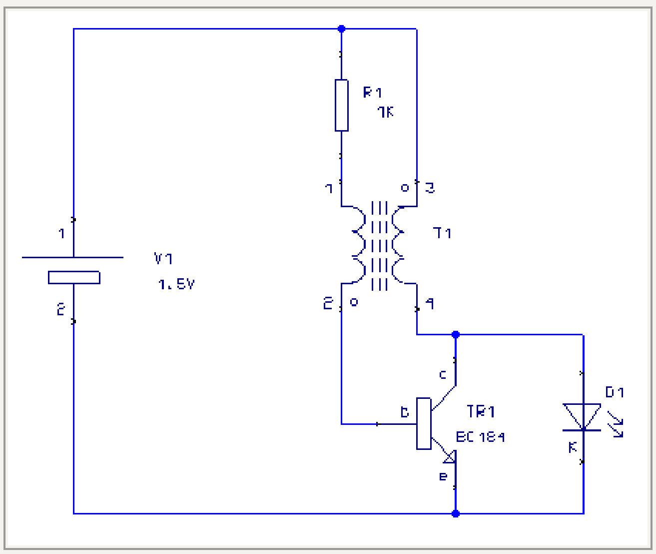


Fig 1 'Joule thief' circuit driving an LED (According to Wikipedia, this simple switched-mode power supply was first published by Z.Paparnik in the November issue of Everyday Practical Electronics in 1999.)

There are many versions of joule thief including the 'LED Boost' from www.mindsetsonline.co.uk

The 'joule thief' circuit shown in fig 1 is a valuable circuit as it stands because it can be powered by batteries that would otherwise be considered expended. Most battery powered consumer products fail to operate properly when their battery terminal voltage falls to about 2/3 of their voltage when new. When the terminal voltage of cell drops from 1.5V down to 1V it still contains up to half of its original chemical energy (depending on the rate at which it was discharged) which the 'joule thief' can 'steal'. An LED can be powered at full brightness from a 'flat' battery (cell) for many hours until the terminal voltage of the power supply falls to around 0.35V.

Download complete article Eco-nightlight (5)

Pages: 1 2 3 4 5 6

Tagged as: Joule thief, nightlight, solar cell, super capacitor, thyristor

You must be logged in to post a comment.

Profile

You must be logged in to post a comment.

40106 555 timer astable charge Joule thief LDR leakage monostable MOSFET nightlight potential difference solar cell super capacitor thyristor time constant time delay voltage voltmeter Zener diode ZVN4206

Our Twitter

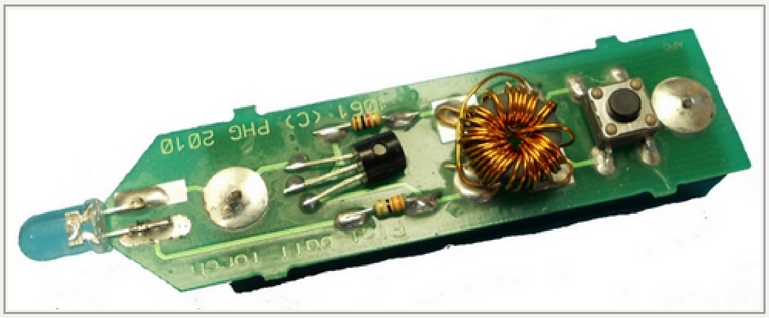
ECT Education

eJournal for teachers of electronics and communication technology

Eco nightlight

Posted by Paul Gardiner on 01/11/11 • Categorized as Key stage 3

Fig 2 shows an implementation of the 'joule thief' circuit using a transformer wound with 0.5mm diameter enamelled copper wire on an inexpensive ferrite core available from RS Components (stock no: 467-4239). (The coil ends have been terminated with 0R resistors to make them easier to plug into the breadboard). My year 10 students, who have just made a few of these, have dubbed it the 'Flat' battery torch.



'Flat battery' torch

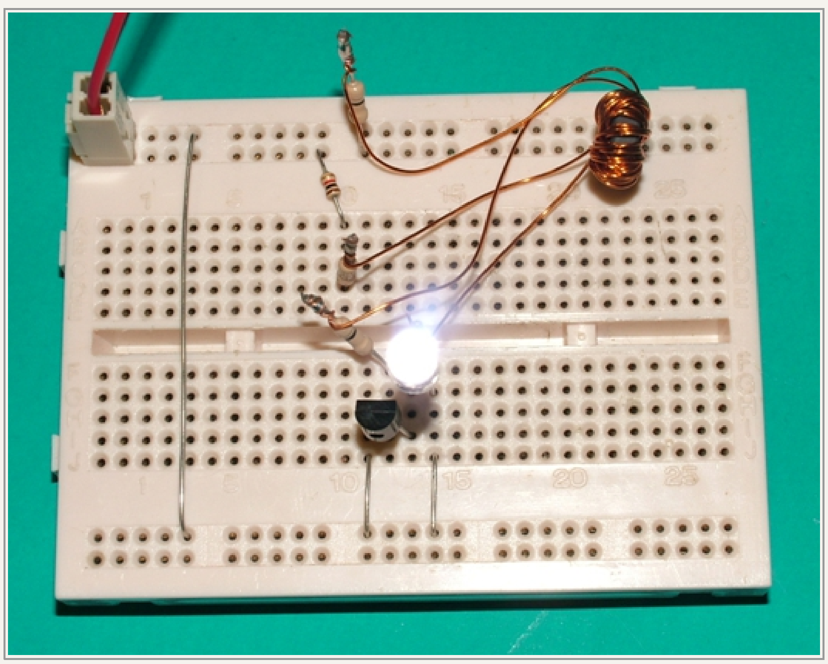


Fig 2 Implementation of the joule thief circuit

When connected to a single solar cell in bright light, the joule thief works perfectly!

Download complete article Eco-nightlight (5)

Pages: 1 2 3 4 5 6

Notices

To keep up to date with new content on this site you can:

- subscribe to the RSS feed (see bottom of the page),
- register an account to receive email updates.
- follow @ecteducation on twitter.

Login

Username

Password

Remember Me

Login →

- Register
- Lost Password

Pages

- About
  - Editors
  - eReaders
  - Licensing
  - What is ECT?
- Archive
- Contact
- Contribute
  - House rules
  - Submit article
- Links
  - Component Suppliers
  - Educational Resources
  - General
  - Software
- Q&A

Site Search

Key Words

Search

Tag Cloud

Tagged as: Joule thief, nightlight, solar cell, super capacitor, thyristor

You must be logged in to post a comment.

Profile

You must be logged in to post a comment.

40106 555 timer astable charge Joule thief LDR leakage monostable MOSFET nightlight potential difference solar cell super capacitor thyristor time constant time delay voltage voltmeter Zener diode ZVN4206

Our Twitter

ECT Education | *eJournal for teachers of electronics and communication technology*

Eco nightlight

Posted by Paul Gardiner on 01/11/11 • Categorized as Key stage 3

Having established that the sun's energy can be usefully harvested by a small single solar cell and converted to a useful voltage the next problem is how to store the energy. A similar, commonly available product, the solar powered garden light uses NiCad rechargeable batteries. I have three objections to using these; they are not environmentally friendly from the point of disposal, they have a lifetime limited by a fairly low number of charge/discharge cycles and they are too expensive for a key stage 3 project. Perhaps at last, this is a suitable application for the super capacitor. I know that the super capacitor has appeared in a number of situations in schools – mostly for powering motors – but we have yet to see it used on a wide scale as a component in student's projects. Fig 3 was used to explore its suitability as a storage device for the nightlight.

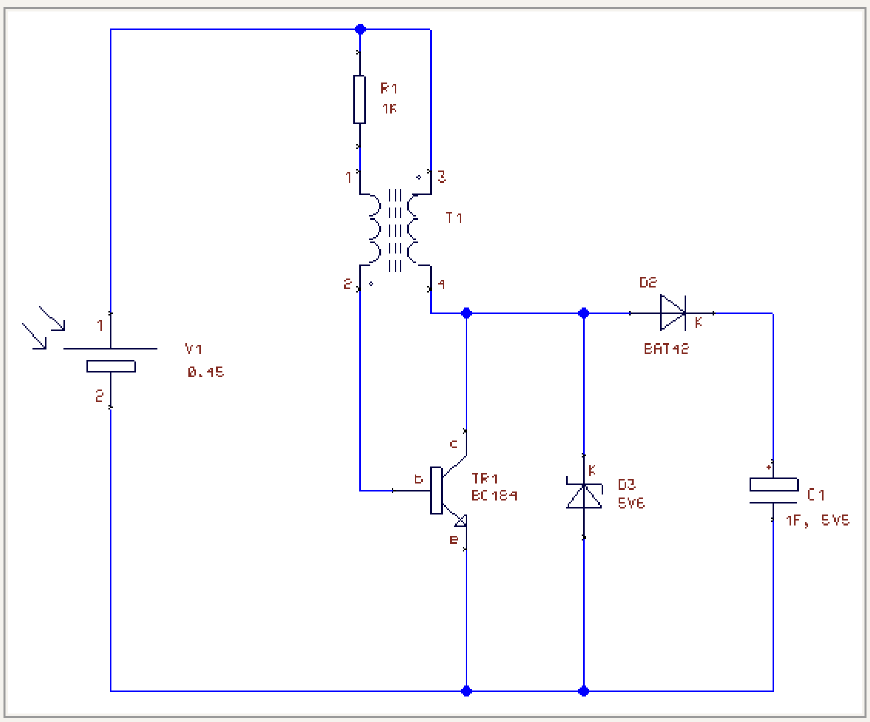


Fig 3 Super capacitor solar charger

Capacitor C1 is the super capacitor that stores the pulses of energy generated by the 'Joule Thief'. Zener diode D3 is included to prevent C1 from over charging to the point where the voltage at its terminals exceeds its maximum rated working voltage of 5.5V. D2 prevents the charge stored in C1 from discharging via TR1 during the off-portion of the joule thief switching cycle. A shottky barrier diode was used because it has a slightly lower forward voltage drop (typically 0.4V or less) than the more commonly used 1N4148 (V_f 0.6V). This allows C1 to reach a slightly higher fully charged voltage before D3 shunts surplus energy (see section on energy stored). C1 takes around 1 hour to fully charge on an overcast summer's day when it reaches a terminal voltage of 5.29V.

Download complete article Eco-nightlight (5)

Pages: 1 2 3 4 5 6

Tagged as: Joule thief, nightlight, solar cell, super capacitor, thyristor

Notices

To keep up to date with new content on this site you can:

- subscribe to the RSS feed (see bottom of the page),
- register an account to receive email updates.
- follow @ecteducation on twitter.

Login

Username

Password

Remember Me

Login →

- Register
- Lost Password

Pages

- About
  - Editors
  - eReaders
  - Licensing
  - What is ECT?
- Archive
- Contact
- Contribute
  - House rules
  - Submit article
- Links
  - Component Suppliers
  - Educational Resources
  - General
  - Software
- Q&A

Site Search

Key Words

Search

Tag Cloud

You must be logged in to post a comment.

Profile

You must be logged in to post a comment.

40106 555 timer astable charge Joule thief LDR leakage monostable MOSFET nightlight potential difference solar cell super capacitor thyristor time constant time delay voltage voltmeter Zener diode ZVN4206

Our Twitter

ECT Education | *eJournal for teachers of electronics and communication technology*

Eco nightlight

Posted by Paul Gardiner on 01/11/11 • Categorized as Key stage 3

To turn fig 3 into a fully functioning nightlight, all that is required is an LED, limiting resistor and on/off switch. See fig 4.

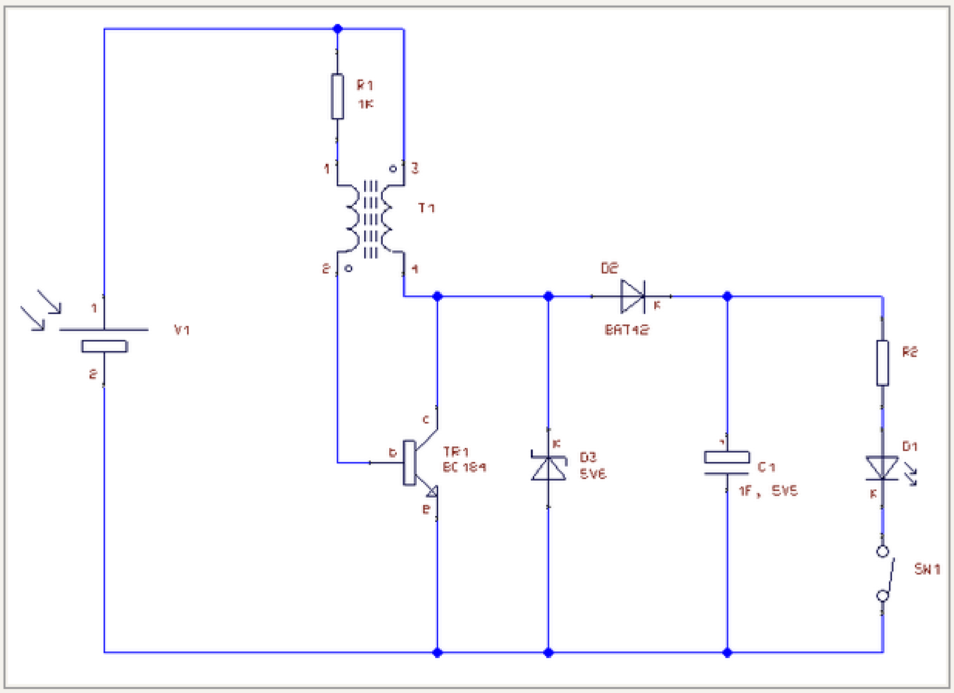


Fig 4 The basic solar powered nightlight

The nightlight is switched on by closing SW1. If C1 has been previously charged, then D1 will illuminate and remain lit until the terminal voltage across C1 drops to around 3V (for a white LED). Colour LEDs for example red, will remain lit for longer because they have a lower forward voltage drop. The problem with this circuit is that if SW1 remains closed during the day, then the capacitor charging current from the joule thief will bypass the capacitor and not be stored for use at night.

Download complete article Eco-nightlight (5)

Pages: 1 2 3 4 5 6

Tagged as: Joule thief, nightlight, solar cell, super capacitor, thyristor

40106 555 timer astable charge Joule thief LDR leakage monostable MOSFET nightlight potential difference solar cell super capacitor thyristor time constant time delay voltage voltmeter Zener diode ZVN4206

Our Twitter