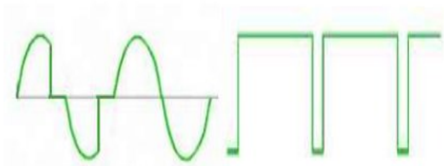
Current control LED dimmer. Many of you may be familiar with the concept of LED dimming.

Most dimmers are build with systems that cut part of the periods of the 230 volt mains voltage, the frequency will be around 50 Hz (EU or 60 Hz US). Modern LED dimmers use a similar strategy PWM, where the LED is dimmed with a smaller portion of an on /off signal. The frequency of the PWM can be different than the mains frequency, but is often around 100-200 Hz.



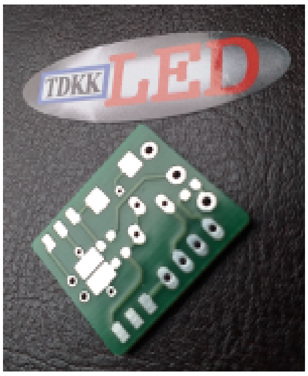
In a microscope, this relative low frequency will lead to a visible flickering, and stroboscopic movement of the sample, and impossible camera use....even health problems could arise. Measures to overcome these problems can be found in increasing the frequency, in the PWM dimmers that we make, we found a good point at 3000Hz. Higher is good, but not better. Invisible for the eye and the camera..... but still on /off. Some people are sensitive for even this high frequency.

A better way of regulating the LED is by current control, there are several ways to get there, especially in hobby situations. Chinese breakout boards are converted to be used as dimmer, we see adjustable power supplies, booster circuits or buck controllers that all can be (mis?) used to get the wanted result.

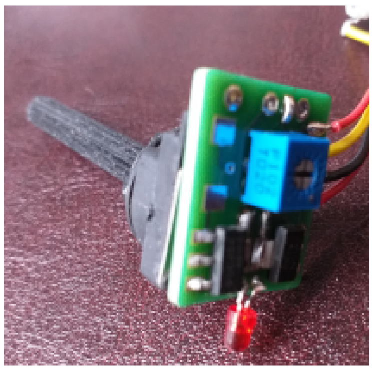
We have a few high end (costly) models, but had a need for a more universal (cheaper) current dimmer, to build in semi-professional to hobby microscopes (and for our Creative Microscopy programme. *Editor – see footnote*).

We have designed a special small dimmer that still has the current dimming system.
Most of our customers for which we rebuild the microscope, use 10 and 20 Watt halogen bulbs, an occasional 15 Watt incandescent bulb is seen.

In this dimmer we apply a, not much used, characteristic of a field effect transistor.
Modern day applications of these transistor components are fast switching, like in PWM or data systems.
There have been dimmers for halogen that made use of the voltage control option of this transistor, but we use the current control option.
Applying a voltage on the input of the transistor makes it let the current through, depending on the applied voltage, more or less current will flow through the transistor's main channel, and into the load (in this case the LED emitter).



We have made a regulating circuit around this transistor so that the dimmer can be powered from an USB (5 Volt) source, like a charger, a PC, a battery pack, solar etc.
The dimmer will go to almost or complete off at the lowest setting, and on the other end, go up to an adjustable highest setting, which is dependent on the LED characteristics, or the needed light output.

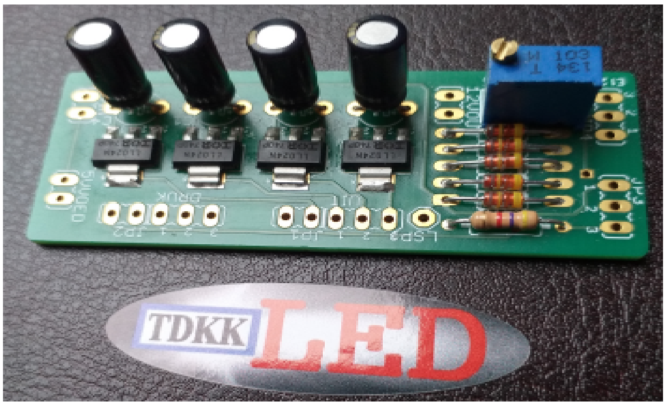


The design of the circuit permits us to make a few different variants of adjusting the light intensity.

First and most straightforward, with a regular potentiometer (rheostat), as mentioned, the low end of the knob rotation will be giving a light level near off, and the other end of the rotation will be

the (preadjusted) maximum power to the LED emitter. The PCB is so small that it will fit the rear of the potentiometer, for easy mounting in a minor location.
A regular 3,2 Volt, 1 Watt or 3 Watt LED may be used, and the current can be set to (f.i.) 200 or 300 mA.
This will already give a light level comparable with 20 – 30 Watt halogen (in a normally well adjusted microscope) so often we gain in light intensity, even on this low current.
Higher currents can be controlled by bypassing the transistor on the PCB and use a high power transistor with its own cooling.
Keep in mind that the LED emitter has also a need to be cooled enough.

The second way of regulating the light intensity with this dimmer has came from our previous dimmer design, where we had the need to regulate up to 4 LEDs, separate, it has 4 channels, each with a memory cell.



This 4 channel memory dimmer is used in our Creative Microscopes to regulate up to 4 LED lights or colors.

The same small single dimmer PCB gets now a set of 3 other SMD parts, that also include a memory element.
And to operate, a “joystick kind of switch”, with a springloaded center, off position and two non locking, on positions (up/down).
By pushing the lever in the up position you charge the memory element, relative slowly, the LED will shine brighter and brighter, up to the desired light level, leave the switch, the lever will return to the off / center position.
The memory will keep the light to this set level (for up to 12 hours), until you activate the switch again. (Or switch off the set to slowly empty the memory cell, which may take a day or two.)
Pushing the lever down will slowly lower the light to the new level or until full off.... this level is then kept in memory. Switching the microscope off, for lunch, and on afterwards will return to the last light level
The transistor does not get any other signals but the information from the memory cell, that is just one voltage, and is as steady as can be.

The only weak spot in the design is the power supply to the dimmer/LED, but that is external, and exchanging the USB source will normally be enough to solve any problem.

The third way of regulating this dimmer is to use two push buttons one for up one for down, like the joystick, also with the memory element, so the set light level is kept for further use.
Depending on the possibilities, and preferences of the user we can choose the best way of operating the dimmer.
By adding some Chinese accessories, we can use this current controlled dimmer even with higher LED voltages, such as for COB or strip LEDs, 12 to 24 volt, still powered from 5 volt USB.

Dimmer PCB's with parts or as complete dimmers can be ordered from the author (NL).

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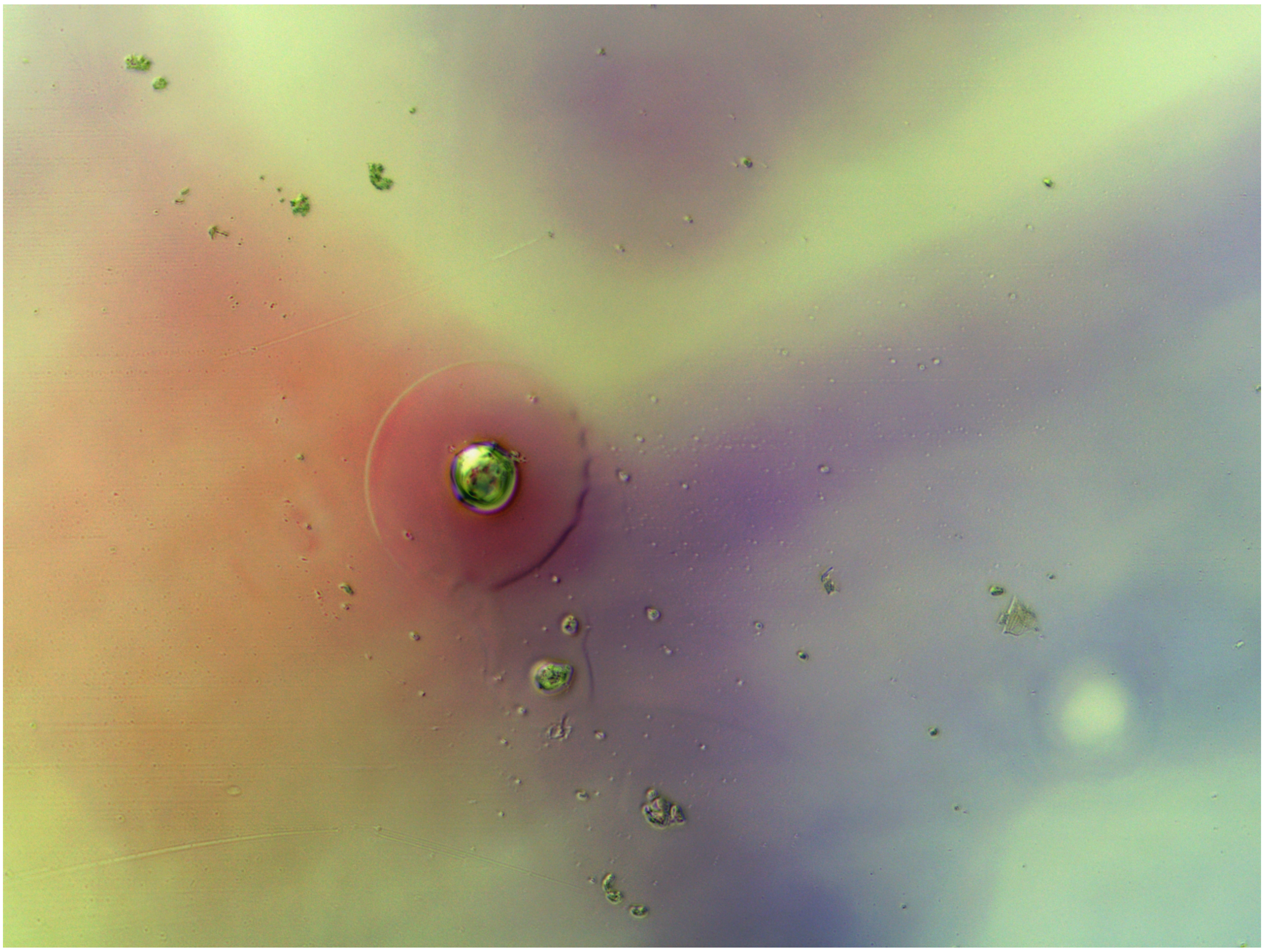
Footnote – Creative Microscopy programme. The author writes:

I do mention Creative Microscopy, that is a hobby project that even (post Coronavirus) involves group workshops etc, to not use the microscope for research, but rather for making "art" or at least beautiful images, preferably from nothing special.

To get to the best images, you need a good set of different light units, it has become a sport to use the smallest simplest microscope, and as much special lights one can think of (and can build)
No post processing, straight from the camera. An example below.



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