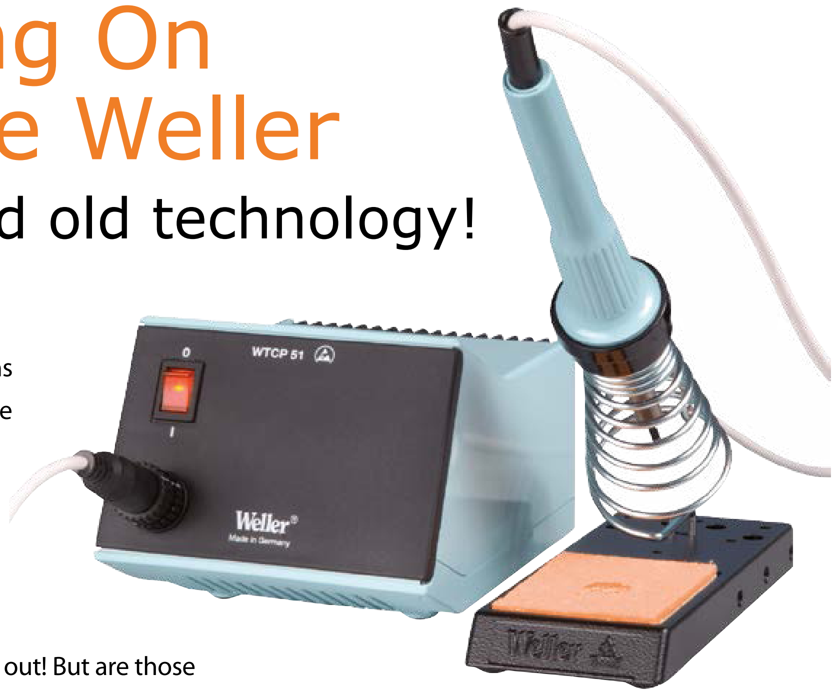
Soldering On With The Weller

Don’t discard old technology!

By **Ingo Burret**
(Germany)



Weller’s (Cooper Tools’) legendary Magnastat soldering stations have performed valuable service in labs and elsewhere over many years. Gradually, however, they get long in the tooth and develop one minor ailment or another. Old flames never die, they just burn out! But are those grounds for pensioning off faithful old servants?

Nowadays even the most basic soldering station contains elaborate control electronics. But in Weller’s revered turquoise-colored WTCP 51-LT, WTCP-S, WTCP 50, WTCP 51 [1] (and previous) soldering stations, the matter of temperature regulation was managed mechanically. In a number of countries Weller products are sold under the brand name Cooper Tools.

Figure 1 shows the internal construction of the soldering iron. Reading upwards, the tip (1) is linked mechanically to a metal cap (2), which forms the temperature sensor in this system. The cap is ferromagnetic and in its cold state attracts a permanent magnet (3). A push rod transfers the movement arising from this action to a contact bridge (4), which enables the heater current supply (5) to switch in.

The numeral on the ferromagnetic cap is a code for the regulated temperature (from 260°C to 480°C). As the iron heats up and the temperature rises towards the required value, the Magnastat loses its ferromagnetic characteristics abruptly, thanks to the Curie Effect [2]. It can then no longer retain the permanent magnet. The magnet drops off and operates the switch, cutting off the power supply to the heating element. When the tip cools, the temperature sensor attracts the permanent magnet once more and the whole sequence begins afresh.

This snap action of the Magnastat is very consistent and reliable, with no wear and tear caused by ageing or fatigue of the materials. In addition, the Curie Values of the soldering tips display very little variance. A further advantage of this arrangement is that changing the tip switches off the iron, meaning that the heating element does not burn out because the tip is missing.

Hot contacts

All the same, it frequently occurs that the magnetic switch seizes up. Then you have to knock or shake the iron in the hope of dislodging the switch. The soldering station itself is still OK otherwise and you probably have numerous soldering tips of different shapes and temperature values in the drawer. Over the years you must surely have become fond of the device, meaning you should not throw it out on account of such a minor flaw. Of course you can replace the magnetic switch (the replacement part comes as a single item with the push road and permanent magnet), but it’s expensive. And if you then establish that the heater winding is burnt out as well, it’s doubly annoying.

So how can you unburden the magnetic switch without undue effort? As the two-conductor wiring delivers 24 VAC to the heater (a third wire

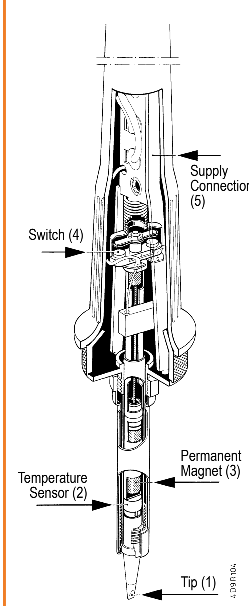


Figure 1.
Cutaway drawing of the Magnastat soldering iron (Weller illustration).

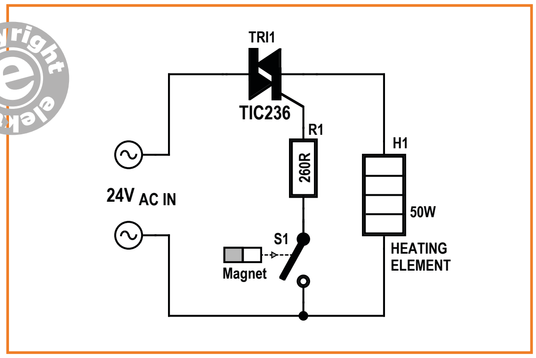


Figure 2.
A triac and a resistor ensure only meager current flow though the magnetic switch.

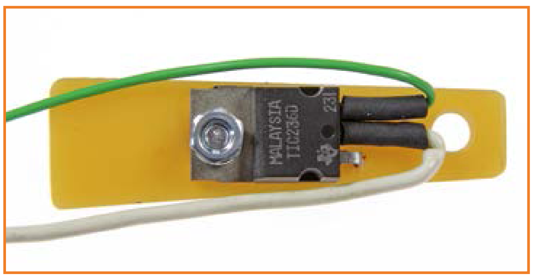


Figure 3.
The triac and resistor can easily be mounted inside the soldering iron handle on a small piece of PCB.

is provided for potential equalization)* a mosfet or bipolar transistor will not offer a simple solution. Relays would be too large to fit inside the soldering iron. The solution is a triac, which is conveniently small and wired almost like a transistor (Figure 2). The "electronics" comprise just a resistor for reducing the trigger current for the triac and hence the current through the switch to a tolerable value.

The triac fits nicely onto a wedge-shaped scrap** of PCB material fixed inside the handle of the soldering iron (Figure 3). So the magnetic switch soldiers on forever, even unto grim death...

(130008)

Web Links

[1] www.weller.de/products/product.php?pid=431 (set language to English)

[2] https://en.wikipedia.org/wiki/Curie_temperature

*** on more recent models only**
**** already contained in the earlier models**

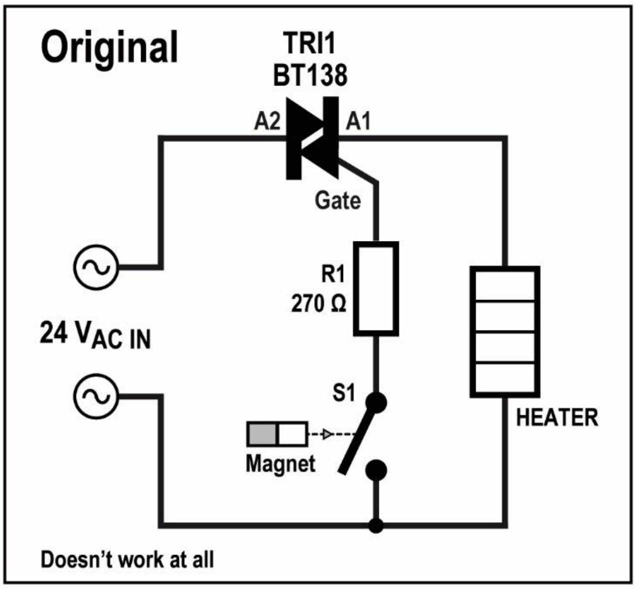
The Friendly Triac

(Correction/upgrade to 'Soldering On With The Weller' by *Ingo Burret*, published in Elektor issue 2014/7-8, p. 35)

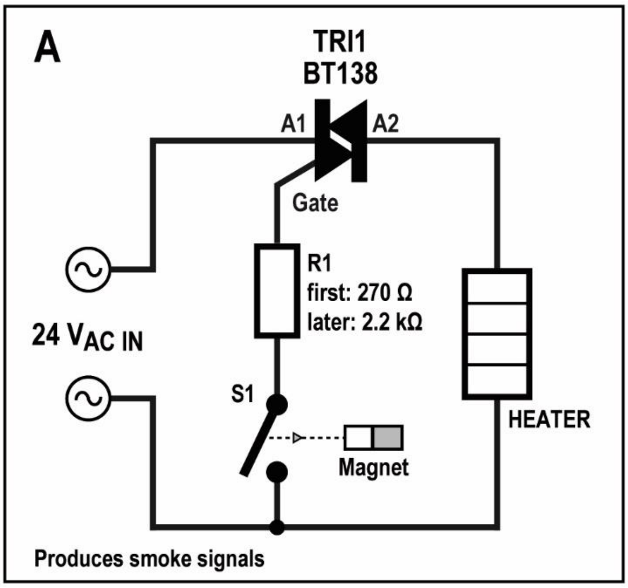
My Weller Magnastat soldering iron has been loyal to me for almost 50 years now. That's why the rescue circuit from Elektor magazine forced itself on me. I liked the idea of relieving the switch within the iron by delegating the heavy work to a triac ('triode for alternating current'). Very quickly I had a few more thoughts of my own about it. Needless to say, I mailed the following information to the Elektor editors several years ago, but obviously they decided to ignore my information, and I never got an answer from them. Therefor I'm happy to share my thoughts and experiences with you here. The attached article, btw, describes the functional principle of the Magnastat switch very well, there's no need to repeat it here. If Ingo Burret, the author of the original Elektor article, should read this by chance, I very much wonder how he feels about my thoughts.

The old Weller soldering stations are designed for the 220 V mains voltage that was common in Continental Europe at the time (I'm sure there were 110 V versions available as well), and their nominal output is 24 V. Plugged into our current mains voltage of 230 V, their output voltage rises to about 26 V under load – so the voltage drop at the triac (about 1.4 V) is not only acceptable, but even desired. The slightly higher voltage is no problem anyway, since the soldering iron regulates its temperature and power consumption itself. It simply heats up a little faster but consumes the same amount of power on average.

Triacs are among the electronic components I'm not very familiar with, so I asked the internet which one of the two terminals is called A1, which one A2. I found out that the terminal on the Gate side of the triac symbol is always A1 (also called T1 or MT1 – 'terminal' or 'main terminal' in data sheets). However, when powering up my first experimental setup according to the circuit diagram in the article ('Original'), nothing at all happened. This is unusual with circuit suggestions from Elektor magazine (and it usually is my fault), but it does happen from time to time.

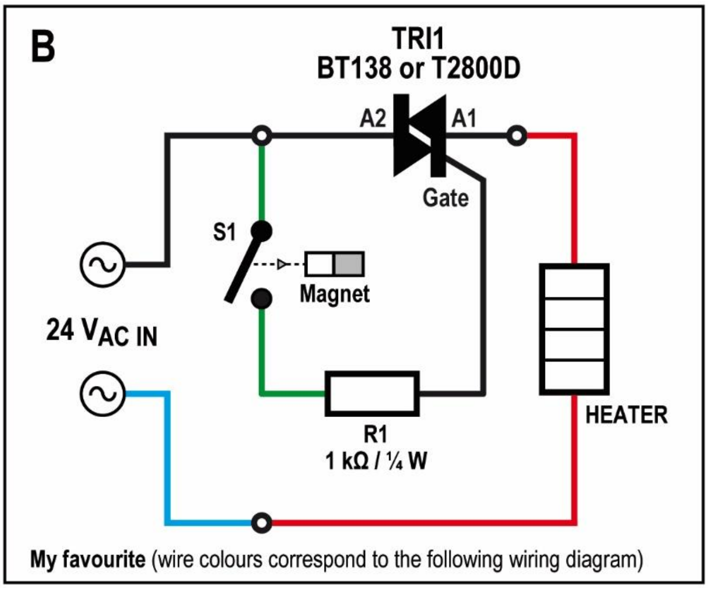


I soon realised that a triac's A1 and A2 terminals are not equivalent. After swapping them (diagram 'A') and trying again, the soldering iron heated up properly, but the gate series resistor R1 (270 Ω) quickly started to smoke – no wonder, there flows a current of about 100 mA through it, and it has to dissipate almost 3 W! So I tried to reduce the gate current. This indeed was possible when using 'sensitive gate' triacs (e.g. BT138) that I found in my junk box. R1 could be increased up to 2.2 kΩ without affecting the function.



Nevertheless, R1 continued to get so warm that after a few minutes even the handle of the soldering iron heated up noticeably; this still was nothing to write home about.

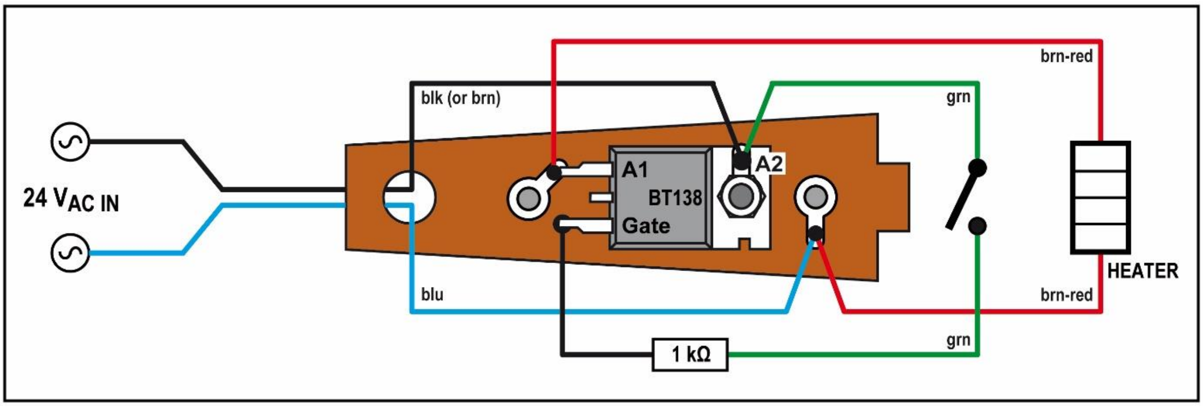
Now, for components with three terminals, several connection combinations are possible. I played around a bit, because what else do you have a breadboard for? The circuit according to diagram 'B' was the clear favourite.



After thinking about it for a while, it became clear why the gate series resistor no longer got hot: As soon as the triac is turned on, the gate current drops, since the voltage across R1 is reduced to the triac's forward voltage (approx. 1.4 V). Which means that the triac conveniently reduces its own gate current to a minimum. And for energy-conscious readers, it should be noted that the residual, low gate current flows via the heater of the iron, contributing to the heating power, thus generating no loss.

A value of 1 kΩ for R1 seems to be a good compromise to me – this way, triacs with lower gate sensitivity (such as the T2800D) can also be used in the circuit. For very low sensitivity triacs, R1 may be reduced to the original 270 Ω (¼ W) without heating up noticeably during operation.

In the old Magnastat irons, a small connecting piece made from PCB material is already included. Three solder lugs are riveted to this piece; a further hole at its narrow end is used to feed through the connecting cable. This connecting piece will be re-used. The middle rivet is carefully drilled out with a 4 mm drill and removed; its solder lug can be re-used. It is fixed, together with the triac, in the hole of the connecting piece that is now free, using a short M3 screw and nut. The centre terminal A2 of the triac is internally connected to its mounting tab, so A2 can be cut off close to the case; the solder lug on the mounting tab now serves as an alternate A2 terminal.



The 10 nF capacitor connected in parallel to the Magnastat switch is no longer necessary after the conversion and can be removed.

For installation in the old Weller soldering irons with the insulating base mentioned above, it is important to observe the following instructions:

NEVER stress the thin wires to the heater by pulling them, they break easily. If that happens, the heater immediately is beyond any repair (which I had to learn the hard way, unfortunately...).

- In order to determine the correct distance between the insulating base, the magnetic switch and the heater, first screw the soldering tip with the sleeve to the heater. Then push the magnetic switch into the heater as far as it will go. For the position of the spring refer to the drawing in the original article.
- Connect all the cables. The cable from the heater to terminal A1 of the triac needs to be extended with some flexible stranded wire; take care to have it properly insulated, e.g. with a piece of heat shrink tube.
- Install the whole assembly into the handle.