MEASUREMENTS ON AUTOMOTIVE FLASHER RELAYS AKA BLINKERS

Background

Quote from Eng-Tips forum:

StephenVB (Industrial) 5 Nov 10 15:39

I'm curious about how a (not so) simple electro-mechanical turn signal auto blinker works.
The simple and incorrect answer, given by the how does it work sites, is a heater on a bi-metallic strip. This doesn't explain the blinker properties.
The blinker is in series with the load. A simple bi-metalic strip would have a shorter on time with more load (more current) and once open it would cool at a fixed rate so the off time would not depend on the load.
This would also delay the turn signal lamps while the bi-metal strip first heated up.

In fact the turn lamps are initially on and have shorter on and off times with less current (a single bulb instead of two). Does anyone know how this actually works?

Thanks
Stephen Van Buskirk

In the discussion that followed, there seemed to be several contradicting opinions:

1. Who cares?
2. The lamps are on from the start
3. There is a delay when turning direction lights on
4. Blink frequency doesn't depend on number of lamps connected
5. Blink frequency depends on number of lamps connected

The discussion didn't lead to any consensus – instead, more and more differing views were aired and GKE finally decided to spend a rainy day on finding out what the truth is.

Tests

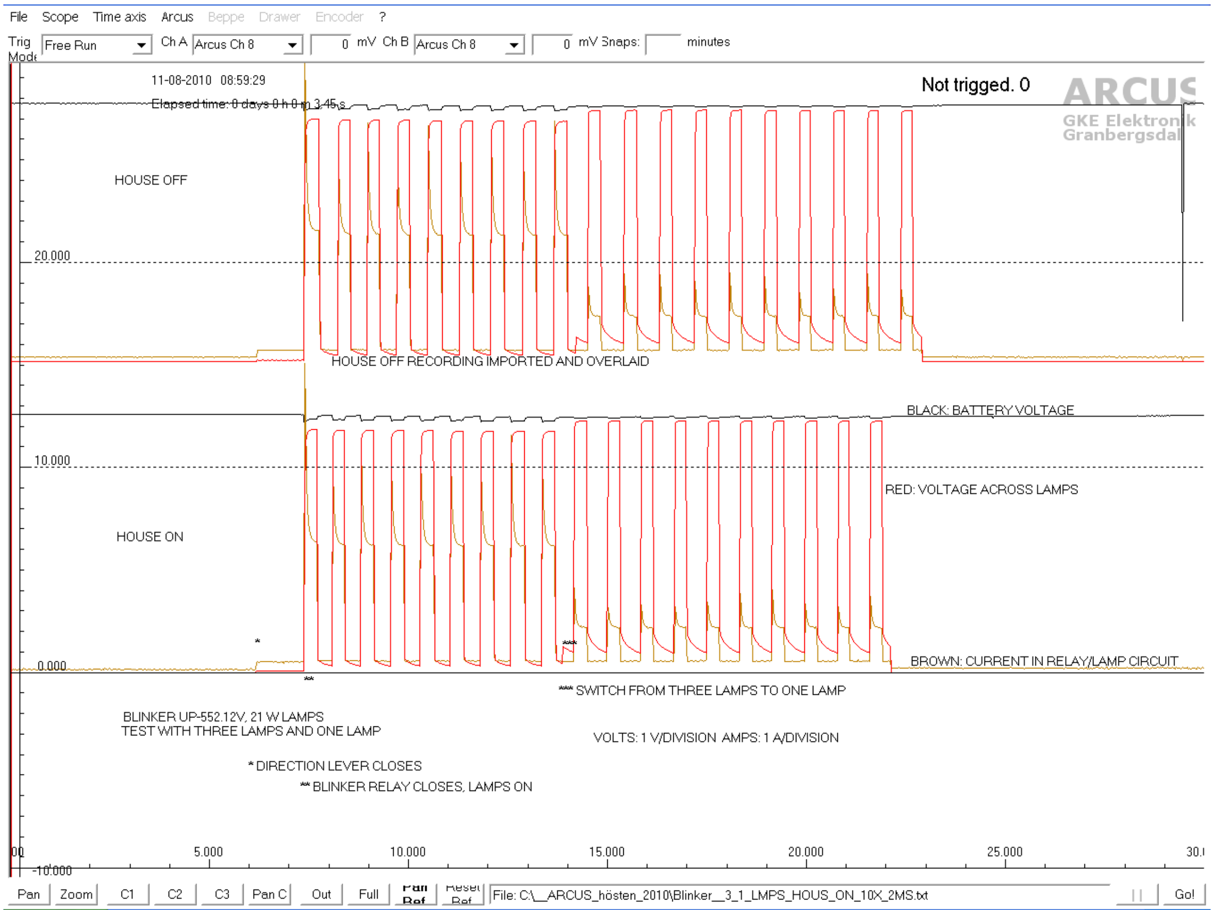
A standard flasher and lamps were supplied by a trailer shop[1] and a test set-up with a 12 V lead accumulator, a set of 21 W lamps with switches for on/off and one or three lamps load was built. Voltages and current were recorded using three channels of an ARCUS recorder.

Results

An overview is shown in picture 1. The bottom traces show battery voltage (black trace), lamp voltage (red trace) and lamp current (brown trace) for around ten cycles with three lamps and ten cycles with one lamp. The switch-over from three to one lamp is marked with three asterisks (***).

[1] Thanks to Kenneth at Solberga Släp och Däck, www.slapodack.se

The top traces show the influence of the relay housing. Removing it exposes the internal for weak air streams present in the building and slows the action down somewhat. These traces have been imported, overlaid and positioned using the 'Pan Ref' function.



Picture 1. Overview.

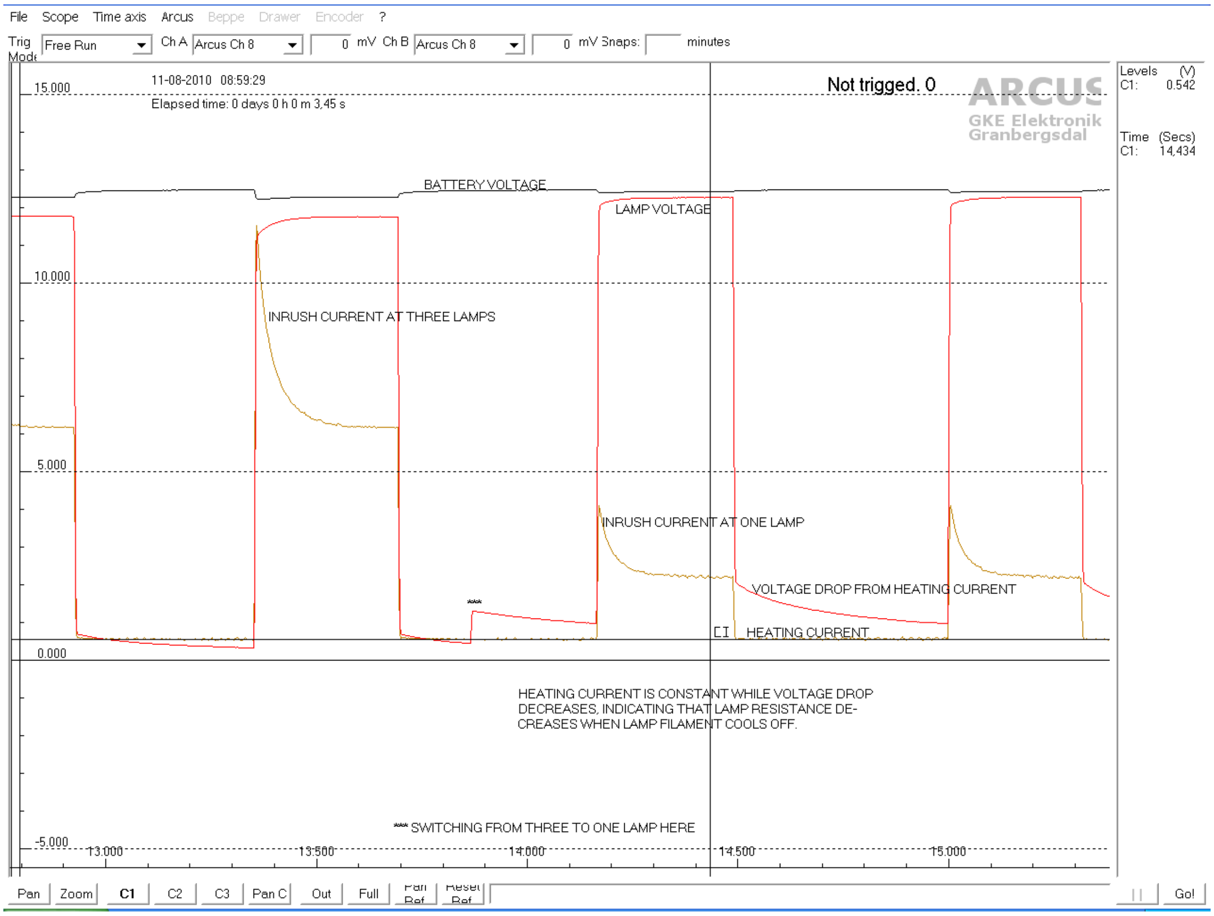
The overview shows that opinions 2 and 5 in the discussion mentioned above are misconceptions. At least for the blinker relay under test[2]. It also shows that the housing has an influence on blink frequency. That is expected since air streams cool the heated element that switches the relay on.

Switching from three lamps (63 W) to one lamp (21 W) doesn't influence the blinking frequency much. The frequency is 1.3 Hz with three lamps and 1.2 Hz with one lamp in circuit. Duty cycle is 46 % with three lamps and 38 % with one lamp, which is plausible because heating is somewhat reduced with one lamp in circuit so that time needed to heat the wire up to the switch-on temperature is longer and switch stays open for a longer time. At the same time, the ON period is somewhat shorter because additional heating from voltage drop across the relay is reduced when current is 2.2 A

[2] We are now looking for an older relay that may (or may not) show other characteristics.

instead of 6.2 A[3]. So the sum of ON and OFF period stays relatively constant when lamps are switched from three to one. This is contrary to common belief and makes us think that there has been a change in technology sometimes during the last decades. This remains unanswered until we have found an older type blinker relay and made the corresponding measurements.

Details



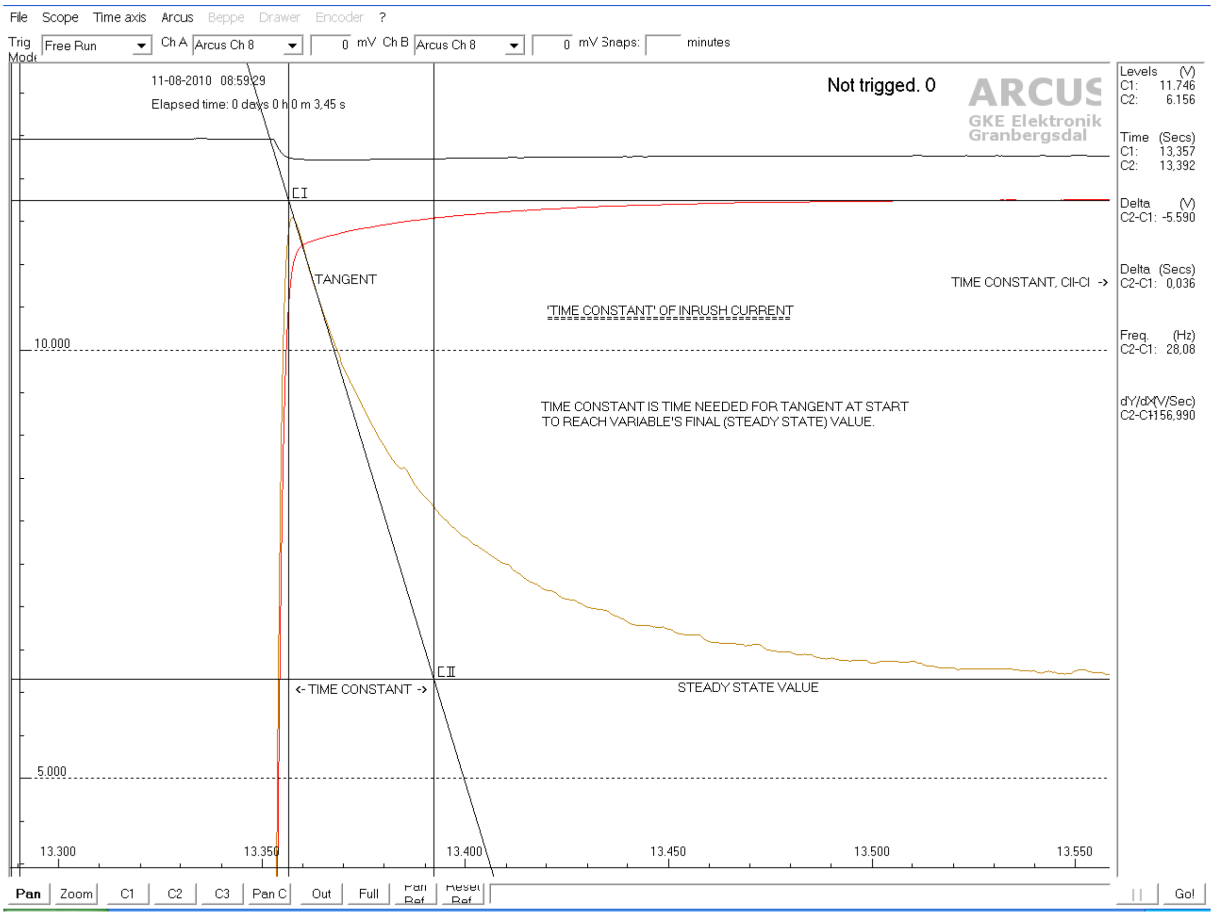
Picture 2. Currents and voltage drops.

Lots of details here!

Inrush current is what first meets the eye. It is around twice the lamp's nominal current and does sometimes eat relay contacts if they are not designed to handle inrush. Blink relays are built to handle the inrush.

The time constant of the lamp is quite long. A measurement is shown in picture 3.

[3] One would expect a clean 1:3 relation (6.6 A instead of 6.2 A), but bear in mind that there is also external wiring and internal voltage drop in the battery that reduces current when three lamps are in circuit.



Picture 3. Time constant of inrush current is 36 milliseconds.

The 36 milliseconds are typical for lower wattage low volt incandescent lamps. For the headlamps, a much longer time constant can be expected. Picture 3 illustrates a unique possibility in the ARCUS software; the ease with which CI and CII can be used to set a tangent to a curve and then read off pertinent data in the result panel to the right. In this case inrush peak value (CI: 11.7 A), the steady state value (CII: 6.2 A), the 'peak part' of the peak (CII-CI: 5.6 A) and the time constant (CII-CI: 0.036 seconds).

The **heating current** during the OFF periods is quite constant. That is shown in picture 2 where CI has been set at exactly the heating current level and the fact that the brown trace is more or less hiding behind the cursor says that it doesn't change much. It is somewhat confusing that the heating current is constant. One would expect a slight variation because the lamp filament resistance changes quite a lot so that battery voltage minus voltage drop across lamps (black trace minus red trace) increases, which *should* create an increasing current – but it doesn't. A good explanation is still to be found, but one explanation *could* be that the heating wire's resistance increases as the heating process proceeds AND that the resistance change in the heating wire's resistance exactly matches the decrease in the filament's resistance. A refined measurement will show if that is the case. More to come…