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DIY Dead Man's Switch (No Microcontrollers)

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A "dead man's switch" (abbreviated here as DMS) is a very useful device for applications where the effect of forgetting to turn something off ranges from a mild annoyance to costly or dangerous consequences. We first learned about the DMS from a locomotive engineer, who explained vividly that an engineer is supposed to press a button every minute to keep the locomotive going, otherwise the machine stops. Less "dramatic" applications include turning off lights or other equipment after a period of time.

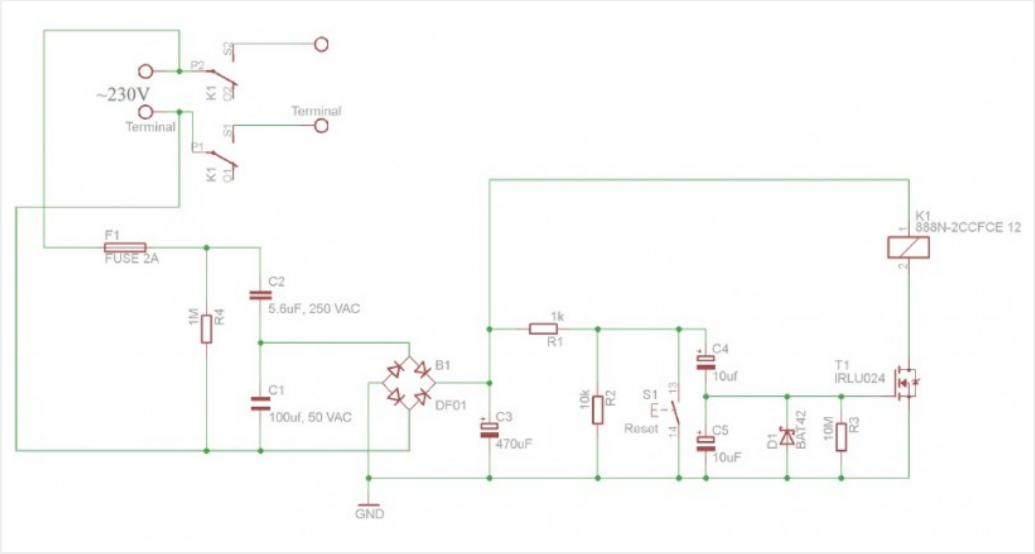
The ideal DMS provides several minutes of "on" time, requires no programming, external controls, additional power supplies and no modifications of the existing equipment. In effect, no changes should occur in the standard operating procedures of using the equipment. To reset the timer from "off" back to "on," it is desirable to either use a button or just cycle the power.

Ironically, a multitude of electronic timers available online or at home improvement retail stores are highly over-engineered. These timers either require programming of specific date-times to be "ON" or have very long pre-sets, require changes in equipment wiring, etc.

DMS OPERATION

This article presents a DMS design that has been tested and currently in use in two different systems. One is controlling a UV source and another is controlling a hydrogen gas line valve. If someone forgets to turn off the UV source, the repairs are costly. When it comes to forgetting to turn off hydrogen, a violent explosion may happen!

The DMS works as follows. First, there are no microcontrollers—just plain physics. Capacitors C1 (bipolar, electrolytic) and C2 make a voltage divider (see **Figure 1**). Note this timer was originally designed for the European voltage; however, it is very simple to recalculate the capacitor divider for the US voltage.



— Figure 1: This is the timer schematic. The Reset button S1 is optional.

The voltage is rectified by a bridge and smoothed by C3. The voltage on C3 is approximately 13 V. When the timer is powered on, both capacitors C4 and C5 are quickly charged each to a half of the supply voltage. FET is turned on and relay is engaged. At the same time, the charge begins a slowly redistribution between the capacitors, with C5 discharging via R3 and C4 further charging. Note that diode D1 is not conducting. When C5 is discharged enough, FET is turned off. This causes the relay to disengage. The timer will continue to be in this state as long as the power is provided, because C4 is effectively blocking any current flow. If the power is removed, D1 opens up to discharge C4 via R2. Remember: C5 is already discharged. Thus, the timer is reset to its initial condition. In addition, a manual reset switch S1 is added in case if it is more convenient to reset the timer by pushing a button rather than briefly disconnecting the mains power.

“ON” TIME

With the indicated components, the “on” time is for approximately 6 minutes. Changing C4 and C5 adjusts the “on” time. Our hydrogen valve control system uses capacitances of 30 µF each, resulting in approximately 25 minutes of “on” time. Note that the capacitances of C4 and C5 must be the same.

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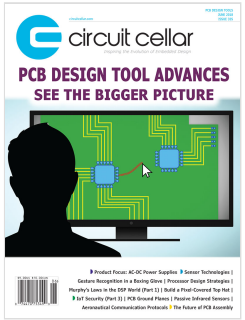

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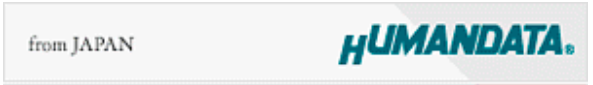
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