IDEA OF THE MONTH

Low cost appliance timer

Steve Garland

I originally designed this timer for controlling irrigation systems, particularly systems where frequent short duration applications are required. It proved very cheap, easy to make and reliable. Subsequently it has proven equally valuable for longer period timing applications, turning lights on and off each day, turning open field irrigation systems on and off twice a week and so on. In short, this timer will lends itself to any application where cheap reliable control is required.

The basis of the timer is Exars' 2240 programmable timer/counter. This is actually a 555 with its output wired to a binary counter. Eight outputs are available and they change state in the normal binary fashion on every pulse from the 555. The timing period of the 555 is set by an RC network on pin 13 of the XR 2240.

The counter is arranged in a 'wire'or' configuration through the DIL switch. When the counter outputs match the switch outputs the output pin of the 2204, pin 10, goes high and counting is inhibited until the next trigger pulse.

The timer uses two of these counters, one to measure interval and the other duration. To initiate circuit action, SW3, the start button, is depressed. This puts a negative going pulse onto pin 11 if IC2. The rising edge of this triggers the IC. Pin 10 goes low and switches off Q2. This drives the collector up almost to the supply rail, turning on Q3, and thus the relay. It also acts as a positive going voltage on pin 11 of IC1, and so triggers it. The circuit operation of IC1 is now identical to IC2. The positive going voltage on pin 11 initiates the count sequence, pin 10 goes low, turning off Q1 and turning LED2 on. Incidentally this also puts a low voltage back onto pin 11 of IC2, thus effectively resetting its trigger circuits.

The result of this is that both counters are counting at the same time. However, they are not counting at the same rate. IC2 (the duration timer) reaches its turn off count long before the interval timer (IC1). When his happens pin 10 of IC2 goes high and so turns the relay off.

The circuit will now wait for IC1 to finish counting. This defines the 'interval' When it is finished pin 10 rises rapidly, becoming a rapid positive going voltage for pin 11 of IC2, and it thus has exactly the same effect as the original start pulse. The whole sequence repeats itself again.

The duration of the two timers is set by a combination of the timing period defined by the RC network on pin 13 and the setting of the DIL switches. T=RC subject to the limitation that R should be between 1k and 1M and C between 7n and 1000µ. Pin 1 will, in fact, change states at this rate, pin 2 at twice the duration and so on. With eight outputs it is possible to derive accurate timing intervals 255 times longer than RC. This gives an approximate timing limit of about 70 hours.

Construction is quite straightforward, paying attention to polarity of diodes and capacitors. Make sure that the choice of filter capacitor is rated above the rectified voltage, i.e: >12 V for 240 V switching circuit and >32 V for 24 V switching circuit. The manual override switch must be a DPDT with adequate current capability and standard size (not mini) to enable sufficient separation between leads when soldered. Be sure to connect the output leads to the poles, with both mains leads at one throw and both relay leads at the other. This setup provides isolation between the two streams, but it is still necessary to pair the active and neutral leads on each pole to reduce the risk of short circuit and to comply with the standard wiring convention.

The choice of relay, manual override switch, fuse and wire gauge is decided by the output requirement. Usually 5 A at 240 V is adequate for your

IDEAS FOR EXPERIMENTERS

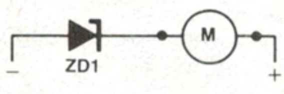
Range extension

Barry Bown of **Lalor Victoria** sent us this idea.

A problem with multimeters is that the 5, 10, and 50 volt range selection do not allow very accurate determination of voltages that lie just outside the range, like 12 volts.

He uses a 10 volt zener to convert the five volt range into a 10-15 volt range. In a similar way, almost any range can be obtained with the correct selection of zener values and meter range.

Meter Range	Zener Voltage	Extended Range
5 V	10 V	10-15 V
10 V	10 V	10-20 V
5 V	5 V	5-20 V
5 V	15 V	15-20 V



Low voltage alarm

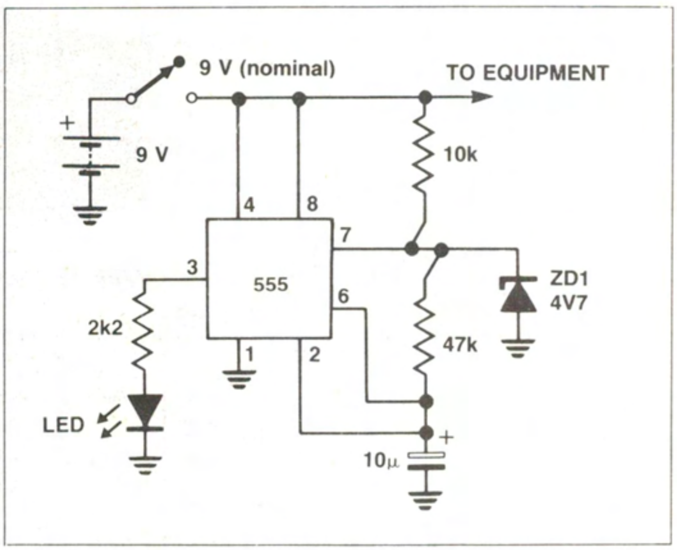
J. Chubb of **Kingsford NSW** sent us his useful little circuit. It will light a LED when the supply voltage is above a certain level, and flash it when the batteries need replacing.

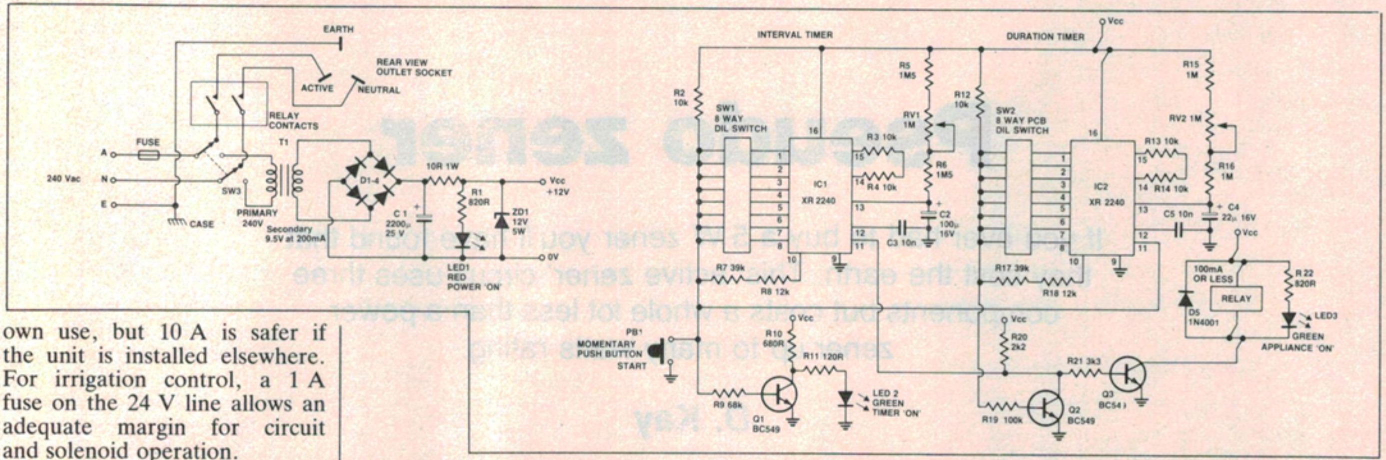
The values shown are for 9 V operation. Flashing starts at about 7V5 and the lamp won't light at all below 2 V.

The circuit consists of a 555 timer connected in the bistable mode and driving a LED. The trick is to connect a zener diode between pin 7 and ground. In normal operation pin 7 oscillates between one-third and two-thirds of the supply rail voltage Vcc. If 2/3 Vcc is greater than the zener voltage then the function of the 555 will be inhibited.

Thus to customise the circuit for your own requirements, decide on the minimum voltage that will operate the equipment correctly, and multiply by 2/3. This is the zener voltage. R may also need to be changed to suit the particular LED you use.

As originally constructed the indicator drew 7 mA at 9 V, falling to 5 mA at 7 V. If these values are likely to cause problems try the CMOS version of the 555, the 7555.





own use, but 10 A is safer if the unit is installed elsewhere. For irrigation control, a 1 A fuse on the 24 V line allows an adequate margin for circuit and solenoid operation.

I generally use a 185x70x160 mm metal cabinet (such as sold by Dick Smith) for housing the unit as it provides a good amount of room inside for isolating the mains and transformer and can be directly earthed. For external applications, the timer can be housed in a rigid PVC juntion box, with supply and output run through conduit, transformer and PCB fastened with nylon bolts and all holes sealed with silicone.

Once construction is completed, confirm the 12 V supply. Then turn on switch 1 of each DIL switch, grab a stopwatch or watch with seconds clearly displayed and power on. The red LED only should be on. If one of the timers has accidentally fired (either green LED is on) turn the power off and on again. When ready, depress the 'start' button and start timing immediately that you release it. Timing extends until the moment that the 'appliance on' LED cuts out. Adjust RV2 and repeat until the required duration is obtained.

Repeat the above for the interval period, adjusting via RV1 and timing from when you release the start button until the 'appliance on' LED lights for the second time. Having completed this, bundle up your timer and you are ready to roll.

If the timer is being dedicated to one purpose with constant interval and duration periods, you can streamline the project (and the cost) by hard-wiring the timer output connections, deleting the manual override, mounting the fuse in a PCB holder and connecting the appliance leads directly to the relay, bringing the all-up cost of components down below $30 for 240 V at 5 A.