Building and Operating: Battery Saver kit
from Jackson Harbor Press

Introduction:

The kit is intended to prevent a dead battery when hooked up to yout favorite 9V powered project. A press of the button turns on the device for a preset amount of time and then shuts off the power. The button (or an external open-collector/open drain signal) can be used to retrigger the delay at any time during the "countdown". With a keyer such as the NORCAL keyer, this retrigger could come from the output transistor. This allows the user to keep the device in use "alive" while it is actively doing something (and thus activating the retrigger) but then allows the device to automatically shut off when the time period is complete.

The Battery Saver kit was inspired by a Hint and Kink in the November 2001 issue of QST magazine, page 60. This kit differs from the idea by Lyle Kohler in several ways. A "purpose built" monostable multivibrator (one-shot) IC, the CD4538, is used to time the ON duration instead of the hysteresis gate used in the original. The CD4538 features predictable delay times with outputs that switch cleanly (don't linger in the linear region). A P-channel MOSFET is used instead of the PNP pass transistor of the original to reduce the on-state drive current and also to minimize the on-state voltage drop across the pass element. The two parts just mentioned are surface mount devices which will allow the beginner to try surface mount with hopfully few problems as these parts are relatively large.

Although the kit is intended to be used with a 9V battery, it will function just fine over a wide range of voltages from 3 to 14 volts. The delay time may change depending on the supply voltage.

General notes on building the Battery Saver kit

The integrated circuit (U1) and the transistor (Q1) are MOS devices. This means that they should be handled as little as possible to prevent static damage. The builder should use a grounding strap and anti-static mat if available or at the very least, work on a grounded metal surface and be sure to touch ground prior to touching these devices.

One decision the builder should make before starting construction of the Battery Saver kit is how the project will be mounted in the case. The Battery Saver will work well either as a separate unit or built in to an existing project. A candy tin will make a good case for a Batter Saver kit housed in a separate enclosure.

The pads and traces are small and delicate - a small tipped, low power (25 watts or less) soldering iron should be used.

The use of good quality desoldering braid or solder wick is suggested for cleaning up any short circuits between the IC leads. The cheap stuff isn't worth the trouble. I use the no-clean SODER WICK from Chemtronics, available from Digi-key.

Building the Battery Saver

Step 1) Get the parts together: All of the board mounted components have been supplied but you will still have to provide off-board items to fully implement the kit. These items include:

Input power connector (a 9V battery "snap")
Output power connector (another 9V battery "snap" ?)
Momentary switch, normally open
metal case, an Altoids or other candy tin will work fine
mounting hardware, 4-40 sized

Step 2) Identify and orient the components: Most of the components should be fairly easy to identify and place - see the parts list and the parts placement diagram for descriptions. The electrolytic cap is clearly marked for polarity - be sure to orient the negative stripe correctly per the parts placement diagram.

step 3) Place and solder the components on the main circuit board: Use the parts placement diagram for information on the placement and orientation of the parts. Clip the leads of the through hold parts after soldering.

a) Q1, the MOSFET transistor. Place Q1 as shown on the parts placement diagram. When the leads are centered on the traces, use something like a screwdriver or a toothpick to hold Q1 in place. Next, use a soldering iron to tack down one of the leads. Usually there is enough solder on both the board and part to allow this, if not, add a little extra solder to the tip of the iron and try again. Double check the lead alignment of the other two pins, it's easier to move the part (if needed) with only one lead soldered. If the other leads are OK, then solder them down to the board. Use the solder wick to clean up any excess solder.

b) U1, the SO packaged IC. Handle U1 in a similar fashion to Q1, put it down on the board per the diagram. Adjust the leads until they all are aligned correctly, then hold the part down while tack soldering one corner pin. Double check the alignment of

the other pins and if they are OK, solder the rest of the pins down to the board. Don't worry if there are solder bridges, just use the solder wick to clean them up after you have soldered all the leads.

c) R1, select appropriate value for the time delay you want, medium (10 megohm, about 17 minutes) or long (22 megohm, about 37 minutes) and then place it below U1 as shown on the diagram. Use the outer two holes, the middle hole is a via bringing a signal from the bottom of the board to the top.

d) R2, 10k ohms (brown black orange gold), placed below R1.

e) C2, .1 uF, (light blue, marked 104), placed to the left of U1

f) C1, 100 uF, place on right side of board with negative stripe towards the right (if the leads are left long C1 can be bent at a right angle to lower the profile of the Battery Saver slightly.

g) Connect the 9V battery snap (or other power input connector to the ground and +Vin holes on the left side of the board.

h) Connect the momentary switch to the two holes at the top right of the board

Step 4) Check the board: Before proceeding, take the time to check the bottom of the board for solder bridges. Use the parts placement and bottom view diagrams as a guide to visually check for these shorts. It may help to clean the flux from the board and then use a strong light in conjunction with a magnifying glass to see these problems. Also, double check the orientation of the critical components such as the 100 uf electrolytic cap and U1.. After you are convinced that the board is OK, connect the board to a 9V battery using a VOM to measure the current used, current should be less than 2 mA, if it's larger, power down and re-check the board for shorts and polarity problems. If the current is relatively low, power down, disconnect the meter, connect the output (+Vout) to the output connector or directly to the circuit being powered, along with a matching ground connection - both holes on the right side of the board. If a 9V snap connector is used on the output, be sure to reverse the polarity, the black lead to the positive switched output and the red lead to ground.

Operation:

Pressing and releasing the ON switch will turn on the output voltage for a period of time specified by the voltage, temperature, timing capacitor and resistor values. For the 10 megohm resistor and a 100 uF capacitor operated at 7.5 volts, I see about 17 minutes of time. Pressing the ON switch again during the delay will retrigger the delay, so for the above RC pair, another 17 minutes of delay will be added after the switch is released. This can be done automatically using an active low retrigger signal from an open collector/drain output, such as the keyed output of a keyer like the Norcal keyer. Be sure to use a separate transistor to drive the battery saver, don't try to share an open drain/collector output with another item such as a transmitter.

Circuit description:

The circuit consists of a 4538 monostable multivibrator driving a p-channel MOSFET. When the ON switch is pressed, it starts a "low going" single pulse of width (in seconds) approximately equal to the value of R in meg ohms times the value of C in microfarads. For the 10 megohm/100 uF RC pair this is 10 x 100 = 1000 seconds or about 16 minutes and 40 seconds. When the pulse time is over the gate of the MOSFET is driven high, turning it off.

Modification ideas:

1) an OFF switch: if you'd like to be able to turn off the power before the normal time duration, a momentary switch can be used to end the timing period prematurely by charging C1 quickly. Use an SPST switch connected in series with a 1k resistor (to limit current). Solder the other end of the switch to +Vin. Solder the other end of the 1k resistor to the via hole on the bottom of the board, below R1, the timing resistor. Now, if this switch is pressed for a second or so, the MOSFET will be turned OFF.

2) If you'd like to add the OFF switch but don't want to drill more holes, here is another idea. Use a DPDT momentary switch, center off, the other two positions momentary. One pole of the switch can be connected in place of SW1 (the ON switch). The other pole can be connected in place of the OFF switch mentioned in mod idea 1 above. This will allow the user to turn on the power with a momentary press in one direction and turn OFF the power with a momentary (1 second) press in the other direction using only one switch and thus one hole in the enclosure.

3) Use a different cap in place of C1, the 100 uF timing cap. A lower profile cap (smaller) will make the circuit easier to fit in a smaller space. Use a higher quality cap, tantalum caps have smaller size and lower leakage along with longer life and possibly better temperature characteristics but cost a lot more. Using a different value than 100 uF to change the timing, smaller values will equal shorter times.

Please feel free to email with any questions, comments, suggestion or problems with this kit. My email address is:

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Thanks for choosing the Battery Saver kit and
Best Regards,

Chuck Olson, WB9KZY

List of parts included with the Battery Saver kit

Ref	designation	Description
C1	100 uf	100 uF electrolytic capacitor, may be replaced with a different value for a different delay time
C2	.1M or 104	.1 uf multilayer ceramic .1" lead space cap
Q1	IRFR9120	p channel, TO-252AA surface mount MOSFET
R1	10 megohms	brown, black, blue, gold 1/4 watt resistor, may be replaced with a different value for a different delay
	AND	
	22 megohms	red, red, blue, gold 1/4 watt resistor, may be replaced with a different value for a different delay time
R2	10 k ohms	brown black orange-gold 1/8 watt resistor
U1	4538B	16 pin SO, dual monostable multivibrator (one-shot) CMOS IC
		circuit board

Items you may need to provide to complete the Battery Saver kit

	Metal case (an Altoids tin is fine)
	4-40 sized mounting hardware
	output power jack (9V snap or ?)
	input power jack (9V battery snap connector OR other power connector)
SW1	SPST momentary switch (optional)
	solder, wire, good quality desoldering braid