Word Generator

This version of the Four Letter Word Generator, while inspired by Ray Weisling's original version, is a complete redesign from first principles. It is based around the Atmel ATmega168 microcontroller, a modern RISC processor from the AVR family, and takes full advantage of the chip's features to reduce the component count.

The PCB is laid out to be similar to the Weisling board (though slightly slimmer), with tubes and most mounting holes in the same positions, and some of the operational modes have been emulated. Words are selected from a list of over 3,200 real words taken from a dictionary, and include proper names, abbreviations, acronyms (eg FDNY), some common alternate spellings (eg SHOW and SHEW) and a few foreign words that are generally understood by English speakers such as FRAU. There are no random or rule-generated "words".

DIP switches

There is a bank of 8 DIP switches at the rear of the board. Looking at the back, they are numbered 1 to 8 from left to right. These are "piano key" style switches. Down is off, up is on.

Switches 1 and 2 control the display mode, as follows.

Sw1	Sw2	
Off	Off	Normal display mode
On	Off	Segment Hangman display mode
Off	On	Letter Hangman display mode
On	On	Transitions display mode

- In normal mode, words change immediately from one to another.
- In segment hangman mode, display segments light one at a time in random order until a word is completely formed.
- In letter hangman mode, letters light one at a time in random order until a word is completely formed.
- In transitions mode, the display changes from one word to another with various animated transition styles, chosen at random.

Switch 3 controls the display time. With switch 3 off, the time between word changes is about three seconds. With switch 3 on, the time is about six seconds.

Switch 4 controls the time display. If switch 4 is off, the time is never displayed. If switch 4 is on, the time is displayed for one word period (3 or 6 seconds) on the minute. The time is always displayed in normal mode – no hangman, no transitions. Note that the clock must have been set since the last reset – if the time is not set, it will not display regardless of the position of switch 4.

Switch 5 causes the time display to be underlined when turned on, using the otherwise unused cursor segments at the bottom of the tubes. This makes it easier to notice that it's the time and not a word.

Switches 6 and 7 control the vulgarity level. The device has a complete vocabulary including the FCC's seven words and George Carlin's extensions to the list. It also knows some words that, while not actually offensive, are best avoided in polite company. These switches control the frequency with which such words appear.

Sw6	Sw7	
Off	Off	Swears like a gentleman
On	Off	Swears like an engineer
Off	On	Swears like a trooper
On	On	Swears like a nun

- A gentleman swears when it is appropriate

- An engineer swears sometimes
- A trooper swears frequently
- A nun never swears and is always polite

The category “swears like a rap artist” was considered, but this would have resulted in a very limited vocabulary.

Switch 8 controls the tube-saver. When Switch 8 is on, the high voltage supply is turned off to blank the display after 20 minutes if no activity is detected by a motion sensing device. It will turn back on immediately if the motion sensor detects somebody within viewing range, or if switch 8 is turned off. The board is designed for a PIR sensor. If no sensor is installed, switch 8 can be used as a display on-off switch to blank the tubes (after 20 minutes delay) while still leaving the unit powered up for time keeping.

Setting the Clock

Looking at the rear of the unit, there are two push button switches to the right of the DIP switch. The one furthest to the right is Button 1, the other is Button 2 (the push button to the extreme left of the board is a reset switch). The clock is crystal controlled and very accurate.

To enter clock set mode, press and hold Button 1 for three seconds.

The display will show either “12” or “24”. This is the clock mode – 12 or 24 hour. To toggle between them, press Button 2. When the desired mode is showing, press Button 1 again.

The display will show “HRnn” where “nn” is the current hour, eg “HR03” for 3 o’clock. This would be 3am in 24 hour mode, and either 3am or 3pm in 12 hour mode. Press button 2 until the correct hour shows on the display, then press Button 1 again.

The display will show “MNnn” where “nn” is the current minute, eg “MN16” for 16 minutes past the hour. Press button 2 until the correct minute shows on the display, then press button 1 again. Set mode is now finished and the display returns to normal.

The device always keeps time internally in 24 hour mode. It makes no difference in 12 hour mode whether “HR03” is 3am or 3pm but changing to 24 hour mode will show which it is.

The clock is maintained by a “supercap”, a very high value capacitor, which keeps it going through trucks hitting power lines, rolling blackouts or just unplugging it to move it to another room. The supercap charges up when the unit is powered and takes over when power is lost, and can keep the clock going (with the tubes dark) for at least 12 hours and generally 24 hours or more. Unlike a normal NiCd battery or lithium cell, it never wears out and never needs to be replaced. It can be disconnected by removing the small black jumper marked “BAT”. This is provided for test purposes and should never normally be disconnected.

Reset Switch

Generally when a piece of equipment containing software starts acting weird, it’s because the program crashed. Generally you can turn the power off and on again to reset it. You can’t do that with the four letter word generator because of the supercap – it takes a day to turn off. So the Reset switch was provided just in case. I don’t anticipate you will ever need it, except for test mode (see below). You will need to set the clock after resetting.

Pressing the Reset switch while the power is off will cause a full reset when the power comes back on.

Mounting the Board

There are eight, 1/8 inch holes provided for mounting the board to a base or case. At least six of these (the four end holes and the two near the center) should be used or the board may sag in the middle. The mounting holes between the end pairs of tubes are optional. I fit standoffs to the

board here for support, but I don't screw them to the base. Standoffs should be long enough to keep the tube pins and any projecting glass tubes clear of the base – 3/8 inch minimum.

Inserting the tubes

Make sure the pins are straight and clean. Line up the two pins that are far apart with the front of the socket ring and carefully work the whole pin circle down into the sockets. Don't force it. When properly seated, the pins will be about level with the open bottoms of the socket contacts. Be careful of the glass tube sticking out of the base. This is often a little longer than the pins, so don't put the PCB down on a hard surface to insert the tubes or you may end up breaking it. Either hold the PCB in your hand for this operation, or have it mounted on stand-offs.

Test Mode

To enter test mode, with the unit turned on hold down Buttons 1 and 2 and press Reset. The unit enters a special mode for testing tubes, lighting one segment at a time on all tubes. Press either button 1 or 2 to step to the next segment. It's necessary to hold the button down until the segment actually changes, which may take a second. Every segment should light in turn, and only one segment should light at a time. Press Reset again to leave test mode.

Tubes that have been stored a long time are often reluctant to strike at first. In this case, warm them up by running for a few minutes in "normal" mode to circulate the gas and accelerator.

Safety

The tube operating voltage is 180 volts. This will probably not kill you, but you will remember it if you touch it, and if you happen to be handling the board at the time you might drop it. The high voltage generator is at the left rear corner of the board and that area is the most hazardous to touch. The high voltage runs everywhere, so handle the board only by its edges when it's running and keep it away from metal objects like screwdrivers that may cause shorts.

Power Supply

The board needs 12-18V DC at about a third of an amp. Almost any 12V DC "wall-wart" power supply will run it. The power connector is a coaxial type, **center pin positive**. Connecting the power supply backwards (center pin negative) or using an AC supply will short it out and may damage the board. If the display flickers or dims out when many segments are lit, the voltage is too low or the power supply is inadequate.

There are many different sizes of coaxial plug. This one is the most common size, a P-5, which has a 5.5mm diameter barrel with a 2.1mm diameter pin.

Tube Saver Connector

This is a 3-pin connector at the right rear of the board, behind tube 4, marked "PIR". Pin 1 is to the rear of the board and has a square pad. It is provided to extend the tube life by turning them off when nobody is around to look at them. The connections are as follows:

Pin 1 +5V
Pin 2 Sense input
Pin 3 0V

Pin 2 is pulled down to 0V, the "off" state, by a 47k resistor. If DIP switch 8 is turned on with nothing connected, this will blank the tubes after 20 minutes. To unblank, sense input pin 2 should be momentarily connected to 5V (pin 1). This is designed for a PIR motion sensor from the Panasonic AMN-1 family. Other controls are possible, such as a light dependent resistor or a simple switch between pins 1 and 2. A light dependent resistor will shut the tubes off at night when the room lights are out. It needs a "light" resistance of less than 20k and a "dark" resistance of 200k or more to work. This is an average specification and most cadmium sulfide cells should meet it, though I have not tested many of them.