A Simple Repeater Fan Controller

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Unlike many repeater systems, our local club repeater has always been located within a member's home, many times in a basement or in this case, my home office area. The latter created a desire to lower the noise level generated by the repeater, specifically, the power amplifier cooling fans.

Regardless of the size of a repeater, continuous duty requires a cool power amplifier. In any other location where noise was not a factor, simply running the fan 24/7 is the easy answer. This was not an acceptable option for me. Thinking more about it, one might ask why run the fans during the quiet times anyway, regardless of location?

I first tried controlling the fan using just a thermostat on the power amplifier heat sink. While it did cut down on fan run time, it did not completely meet my requirements. With a thermostat alone, the fan did not activate until the power amplifier was already hot. Once hot, it takes quite some time before it cools down again.

I wanted a way to have the fan activate as soon as the power amplifier was in use. The idea being to start cooling it off before it had a chance to get really hot. However, even the best airflow will not keep a power amplifier from getting warm under typical repeater duty cycles, so I also wanted a way to ensure that the fans ran for at least some time after the last QSO, to dissipate any residual heat buildup after the last key down.

To do this I needed a circuit that would activate the fans while the system was in use, and then provide a few minutes hang time for the post QSO cool down period. The following circuit is the result. The timing circuit is based on every experimenter's little buddy, the 555. Two are used in this design, but a single 556 (dual 555) could also be used. As I am somewhat of an isolation freak, the circuit also makes use of two 4N25 optical isolators. In addition to electrical isolation, they provide a somewhat universal I/O capability.

The basic fan timer is configured as a monostable (one shot), triggered by a low on pin two. This works great for running the fan once a signal was received. However, in the event of a long QSO holding the input low, the monostable will not reset, and the fan shuts off until after the next de-key.

Personally, I subscribe to the three-minute rule limit for any single user; and my fan timer is configured to run for approximately six minutes. So, if I were to get a long-winded user on the repeater who talks for five minutes, the transmitter times out after three minutes, and I get about three minutes of post TX fan time.

The problem with the above situation is that because the fan timer monostable has not timed out, when the next user keys the repeater, no reset of the monostable has taken place. If the other user then talks for three minutes, the fan will shut down after the first minute, leaving the power amplifier without any fan for the remaining two minutes. This would not be a good situation. I needed a way to ensure the monostable would be re-triggered should it timeout mid conversation.

The solution was to trigger the monostable timer with an astable. The astable needed to be fast enough to supply a trigger continuously during a QSO, but slow enough to ensure the monostable was reset. For the astable, I chose values for R1, R2, and C to provide a 5-10 Hz pulse as close to a 50% duty cycle as possible. The duty cycle is not critical; it's just one of "those things" with me, I like symmetry whenever possible.

The formula for the 555-astable timing is:

Frequency = 1.44 / ((R1 + R2 + R2) * C)

Values for R are in Ohms and C in Farads, so be sure and use the correct values. In the case of my circuit, R1 = 1000, R2 = 10,000 and C = 0.00010 (10 uF). This calculates to a frequency of 6.85714 Hz (close enough). If you are not great with math, there are literally hundreds of websites that have on-line calculators for the 555.

The formula for the 555-monostable timing is:

Time Out Delay (seconds) = 1.1 * R * C

In the monostable, I used R = 500K and C = 0.00060 (60 uF). This calculates to 330 seconds, or 5 minutes, 30 seconds.

Note 1: I've read the time calculations for the 555 astable and monostable are only accurate with tantalum capacitors and if one stays within certain component ranges. I have not tested this statement, but have noticed that there is some variation from calculated values using electrolytic capacitors and/or resistor values greater than 1 megohm. Generally speaking, timing-wise, nothing is that critical in this circuit.

Looking at the schematic, the 555 on the left is the astable generating 6.8 Hz pulses out of pin 3. These pulses are gated to the monostable 555 on the right via the transistor output of the first 4N25 optical isolator. When 4N25 gate is activated, the 6.8 Hz pulse, effectively resets and re-triggers the monostable, driving its output (pin 3) high, turning on the photo-diode of the second 4N25 optical isolator, enabling its transistor output.

The second 4N25 optical isolator output is used to drive a 2N2222 transistor. The 2N2222 was chosen as it is rated up to 1 Amp current, which is sufficient to drive almost any 12V relay, or in the case of my system, a single cooling fan, which draws 500 milliamps at 12VDC.

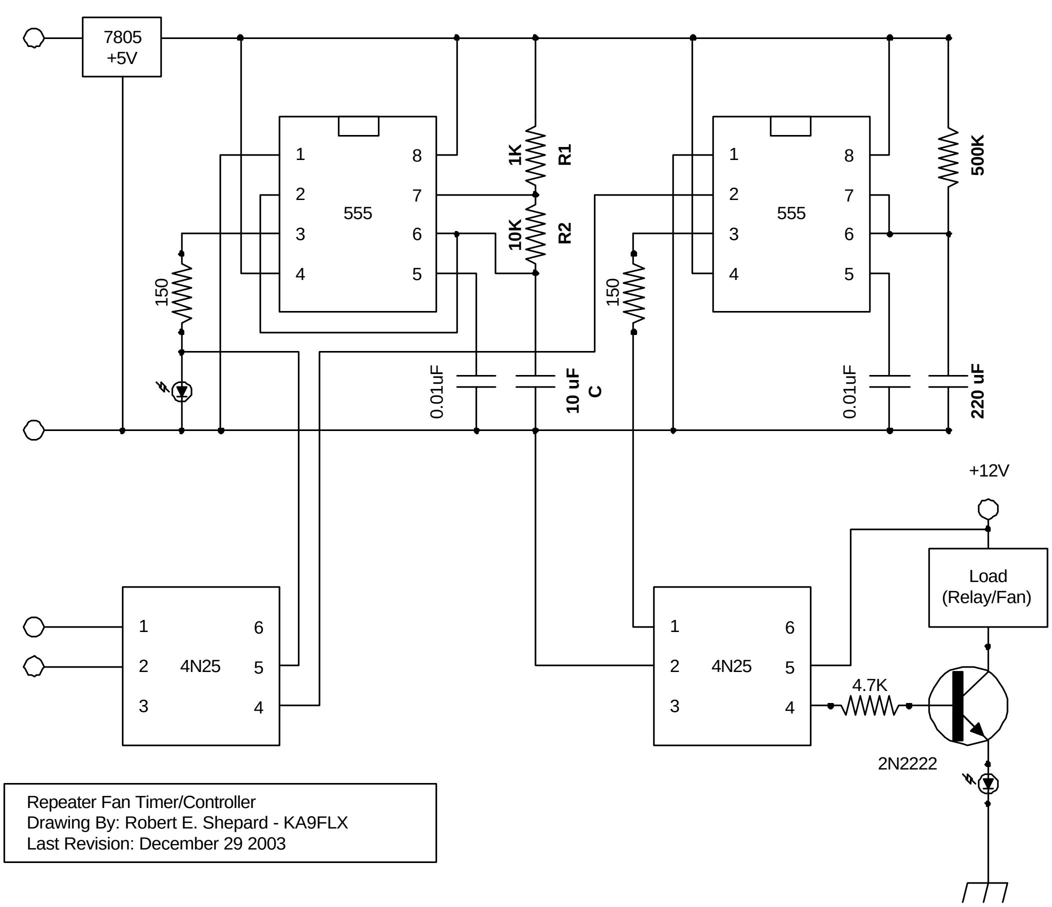
Both LEDs depicted in the schematic are optional. I leave them in because they are an easy, visual, indication of circuit operation.

As stated, a relay could be used if your particular fans require something other than 12-16 volts DC. Additionally, the 2N2222 could be substituted with something rated for higher current, such as a TIP-120. This was the primary reason for using the 4N25 optical isolator in the output stage it provides flexibility.

Similarly, the use of a 4N25 on the input was for the same reasons. Since the 4N25's input is really nothing more than an LED, it allows a multitude of possible interfaces, active high, active low, and voltages ranging from 1.5 to 120. This should more than meet the requirements for most repeaters.

In my particular system, the fan controller circuit is triggered by PL detect. That way the fan only runs during actual QSOs. It could be triggered by PTT, but I did not feel it necessary to have the fan running for 6 minutes just because the otherwise idle system sent the CWID. The input could be driven by an AND/OR circuit as well. For example, if I felt the power amplifier was not cool enough after a QSO, I could OR together the PL detect and a thermostat. The possibilities are almost as many as can be imagined.

I have no doubt that there was probably an easier or even better way to do this. However, it was quick, cheap, and met all the requirements for what I wanted to do. The circuit has been in use for over four years without a single problem.



Note 2: The schematic above shows a 220 uF timing cap in the monostable, which was used in a different system where a longer run time was desired (approximately 9 minutes)