psychedelic lights

A favourite gimmick in discotheques is to use flashing lights, which are usually synchronised to the music. An interesting addition is the psychedelic lamp driver, which livens things up a bit by flashing one or more lamps in a continuously changing rhythm.

The electrical wiring in, say, a dance hall is usually such that operating the light switch turns on the room lighting to full brightness. This situation remains unchanged until the switch is operated a second time.

The consensus of opinion is that something ought to be done about this rather dreary state of affairs. The first idea that comes to mind is to arrange for the room lighting (or some additional 'spots') to switch on and off by itself, without requiring a human operator. However a simple regular on-off rhythm quickly becomes rather boring, so we looked for ways and means to vary the flashing rate.

One of the several ways of doing this is to modulate the flashing rate – determined by a multivibrator – according to a sine wave function. Another possibility is to modulate the rate with a sawtooth function. Instead of a rhythmic deviation about some central frequency the flash rate now rises steadily from some starting value and then, when the sawtooth reaches its peak, suddenly drops back to the starting value. It would of course be possible, by inverting the modulating signal, to provide a steady slow-down instead of acceleration. It turns out that the non-inverted sawtooth provides an attractive effect, so that this is what was chosen.

The circuit

The basis of this circuit is formed by a simple uni-junction oscillator and a voltage-controlled astable multivibrator. The sawtooth waveform produced by the circuit around UJT T_1 is not particularly linear – but it doesn't need to be in this application.

What happens is that capacitor C_1 is charged via R_3 until the voltage is reached at which T_1's emitter fires. The ensuing breakdown enables C_1 to discharge rapidly through T_1's junction and the current-limiter R_2. The voltage across C_1 therefore approximates a sawtooth wave. The linearity could be improved (for possible other applications) by replacing R_3 with a current-source. The charging current is then held at a constant level, without the inverted-exponential decay.

The periodic time of the voltage across C_1 is about 7 seconds. The sawtooth waveform voltage is applied, via emitter follower T_2, to the base resistors of the astable multivibrator formed by T_3 and T_4. As the applied voltage level increases, the multivibrator's repetition frequency will rise, vice versa.
The multivibrator output is taken from the collector of T_4 and applied via resistor R_9 to the base of T_5. This transistor therefore switches between cutoff and saturation, to produce a better waveform than that at the collector of T_4 (which is 'spoilt' by C_3's charging current flowing through R_8 when T_4 is cutoff).
Modulation of the astable multivibrator is only possible in this arrangement when its running frequency is several times the repetition frequency of the sawtooth. With the values given the sawtooth varies the flash frequency in the range 2 to 6 Hz. The sharply-switched current through T_5 is used to control a triac, which switches the tree lights on and off. The triac is therefore DC-driven. This has the major advantage that the triac turns on close to the zero-crossings of the mains waveform, so that no interference-causing switching peak arises. The triac specified here requires about 50mA triggering current so that the collector resistor for T_5, R_{11}, is selected at 220 ohms.

Since the triac can switch up to 6 Amps it is possible to flash several lamps at the same time, to a maximum of about a kilowatt, allowing for the fact that the resistance of the lamp-filaments when cold will be lower than their rated (i.e. hot) value.
If several lamps are used, it is actually a better solution to provide each with its own flasher – each unit having a different sawtooth frequency. This frequency can be altered by changing the value of R_3. A lower value increases the frequency, since the heavier current into C_1 will charge this up faster.

The circuit is supplied via D_1, R_{10} and D_3 directly from the raw AC mains. Observe the skull-and-crossbones symbol on the drawing – and make sure of the insulation!