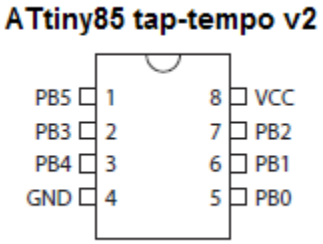
ATtiny85 tap-tempo LFO, version 2

By Harald Sabro, 14.12.2013. Document version 1.

Introduction

This is a small tap-tempo Low Frequency Oscillator (LFO) micro controller intended primarily for use in guitar effects and similar. You get five different waveforms, five different tempo multiplier settings, and the tempo can be set either manually by switch or automatically via a synchronization signal.

The chip



Pin 1 (PB5): Synchronization signal input.

Pin 2 (PB3): Waveform selection input.

Pin 3 (PB4): Tempo multiplier selection input.

Pin 4 (GND): Ground.

Pin 5 (PB0): LFO signal output.

Pin 6 (PB1): Synchronization signal output / LED indication.

Pin 7 (PB2): Tap-tempo switch input.

Pin 8 (VCC): +5V DC.

Features

Tap-tempo input

Use a momentary on stomp switch (e.g. those “soft-touch” stomp switches). First tap initiates the tempo count, and the second tap sets the tempo. Any tempo between 0.05 sec (20Hz) and 10 sec (0.1Hz). If a second tap never occurs, or happens after 10 sec. has passed, the first tap is discarded.

LFO signal output

This is your Low Frequency Oscillation output and the main reason for using this chip to begin with. The frequency depends on the tap-tempo and the multiplier setting, and the shape of the signal depends on the waveform setting. The signal is actually generated by means of Pulse Width Modulation (PWM) and thus will contain a good deal of high frequency noise that typically should be filtered out. Driving a LED/LDR combination should be enough filtering. Alternately use some form of low-pass filter.

Synchronization signal / LED indication output

This signal will alternate high/low at the same frequency as the base tap-tempo (no multiplier), i.e. if driving a LED it will be lit for an entire unit of tempo. This signal can also be used as input to a second chip, synchronizing the second chip's base tempo to the driving ones'. See "Synchronization signal input" for more.

Waveform selection input

This is a continuous voltage sampling input where the static voltage seen at any time defines what waveform is being drawn on the LFO output. There being five options, assuming the chip receives +5V:

0V - +1V: Sine wave
+1V - +2V: Ramp-up wave
+2V - +3V: Ramp-down wave
+3V - +4V: Triangle wave
+4V - +5V: Square wave

See the example diagrams for some suggestions.

Tempo multiplier selection input

Same as the waveform selection input, this is a continuous voltage sampling input, and this input also have five options:

0V - +1V: 4x tempo – The LFO output signal oscillates four times as fast as the tap-tempo input.
+1V - +2V: 2x tempo – The LFO output signal oscillates twice as fast as the tap-tempo input.
+2V - +3V: Base tempo – The LFO output signal frequency matches the tap-tempo input.
+3V - +4V: ½ tempo – The LFO output signal oscillates twice as slow as the tap-tempo input.
+4V - +5V: ¼ tempo – The LFO output signal oscillates four times as slow as the tap-tempo input.

See the example diagrams for some suggestions.

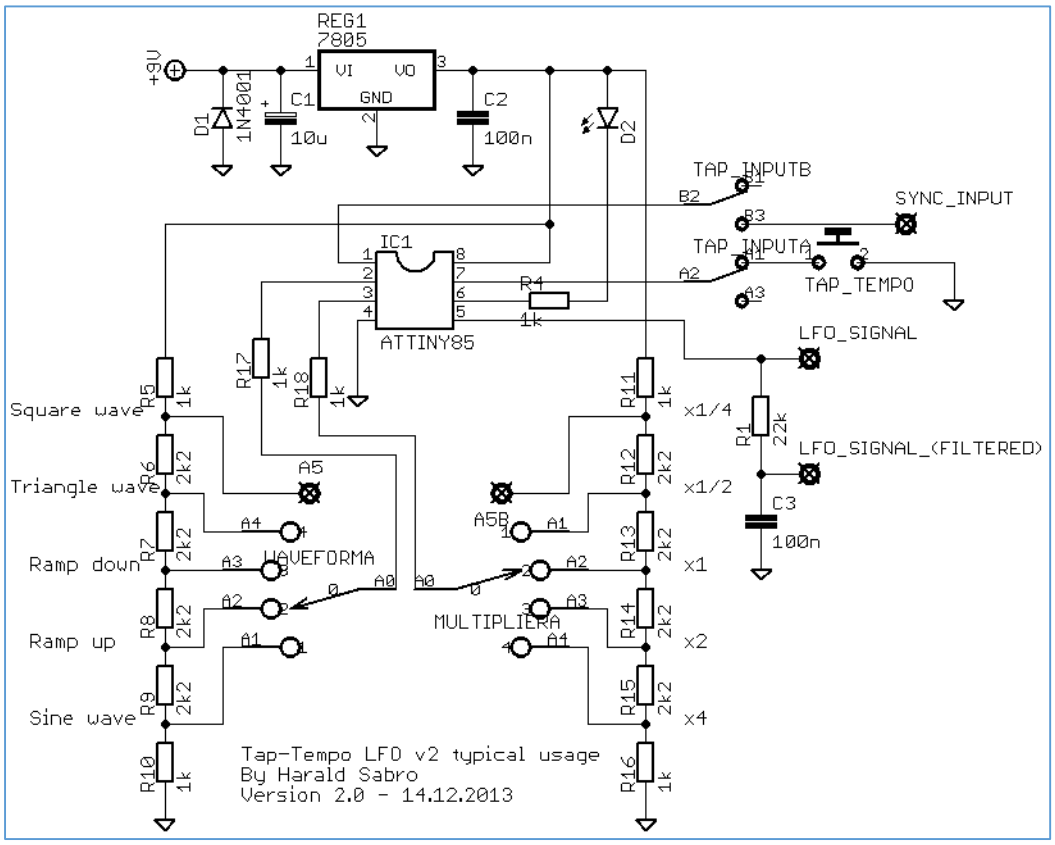
Synchronization signal input

Unlike the first version, this version of the tap-tempo LFO chip also supports being controlled by an external tap-tempo source as an alternative to the standard switch input. The assumption is that this same chip is going to be used, since I did no attempt at following a standardized clock synchronization scheme, but just went with what would work for this chip (read: this does not necessarily "talk" correctly with other clock sync implementations).

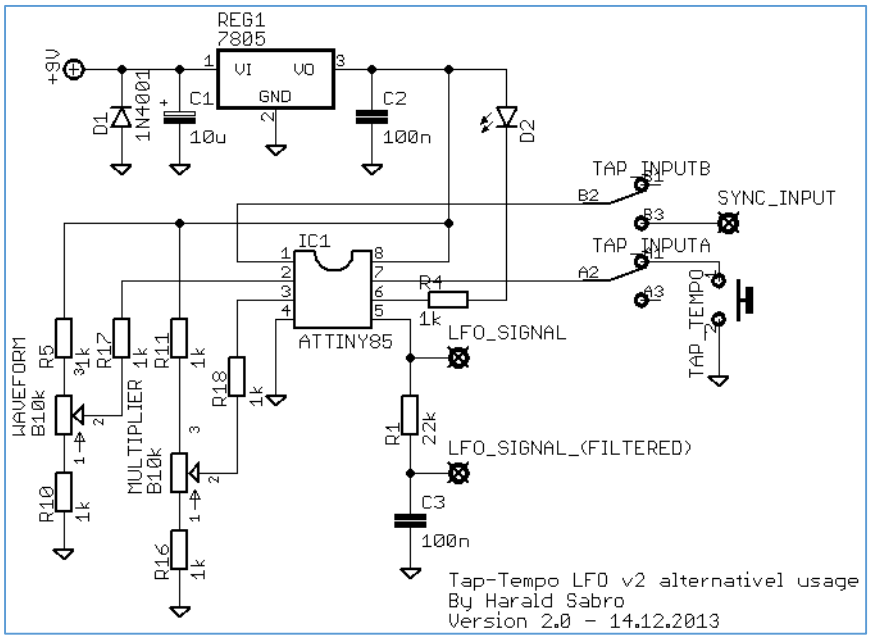
If receiving a synchronization clock signal, the chip will keep its own base tempo synced to this external source, and using the "local" tap-tempo switch will be unnecessary. Note that this sync signal only removes the need for a tap-tempo switch. The multiplier and waveform settings will still be entirely localized to the current chip, and is not part of the sync.

In a nutshell the idea is to use a central tap-tempo circuit, *one* stomp switch easily accessible on the pedal board, setting a synchronized base tempo on all the relevant effects at the same time (each of which use the same LFO chip).

Example application



Example 1: Using SP5T rotary switches to select waveform and multiplier.



Example 2: Using potentiometers to select waveform and multiplier.

Notice that either the synchronization input or tap switch input can be used to establish a tempo, but the chip assumes only one input method will be used at any one time. If both inputs are used simultaneously the results are unpredictable (the sync signal will most likely take precedence as this signal is continuously sampled).

Specifications

Microcontroller: Atmel ATtiny85

Fuse bit settings:

- SUT_CKSEL = INTRCOSC_8MHZ_6CK_14CK_64MS (default)
- CKDIV8 = false (not default)
- RSTDISBL = false (not default)

Clock speed: 8MHz

Clock: Internal oscillator

LFO PWM output frequency: 31.25kHz

Tap switch input sampling frequency: 1kHz

Waveform/multiplier input sampling frequency: 15.625kHz

Minimum/maximum tempo (no multiplier): 10 sec. (0.1Hz) / 0.05 sec. (20Hz)

Minimum/maximum tempo (with multiplier): 40 sec. (0.025Hz) / 0.0125 sec. (80Hz)