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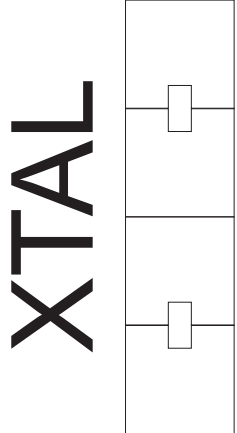
DC5V IN

32KHZ TESTer

CD4060

D2 D1 D3 D0

X -

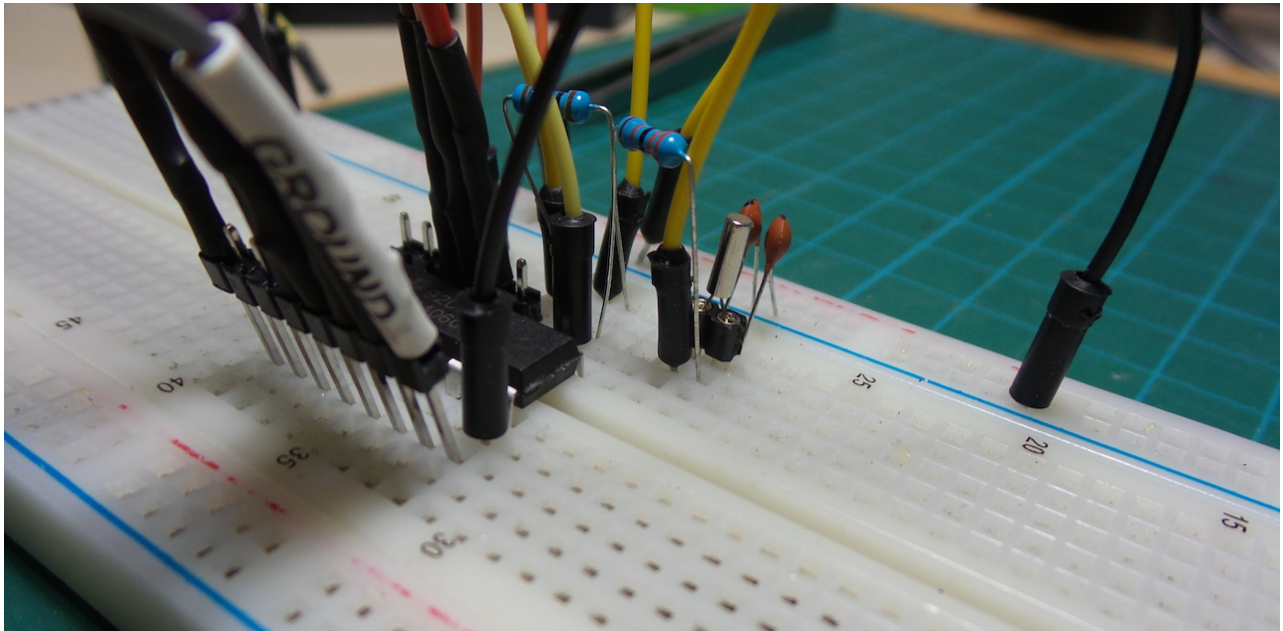


Counter OUT

Project Notes

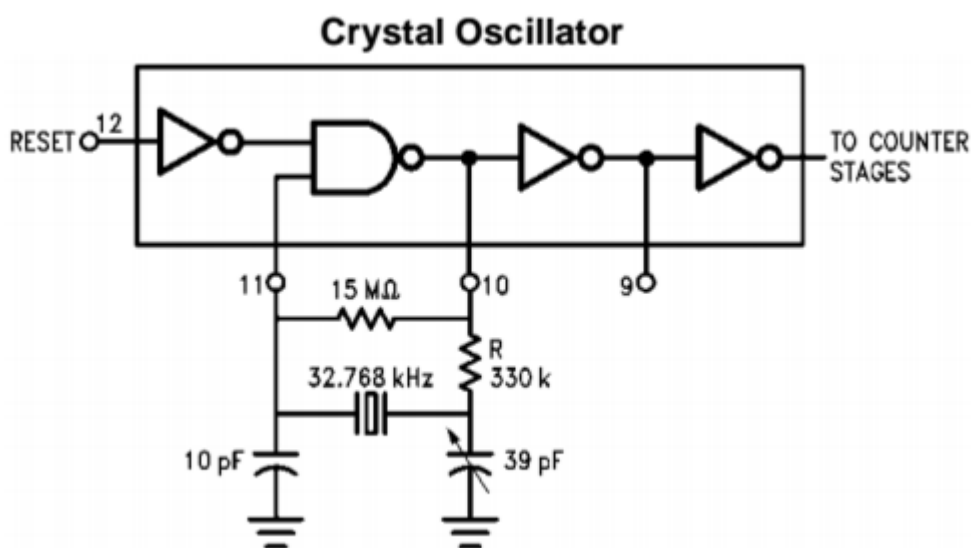
#294 CD4060 Crystal Oscillator

Exploring the behaviour of the CD4060 ripple counter driven by a crystal oscillator.



Notes

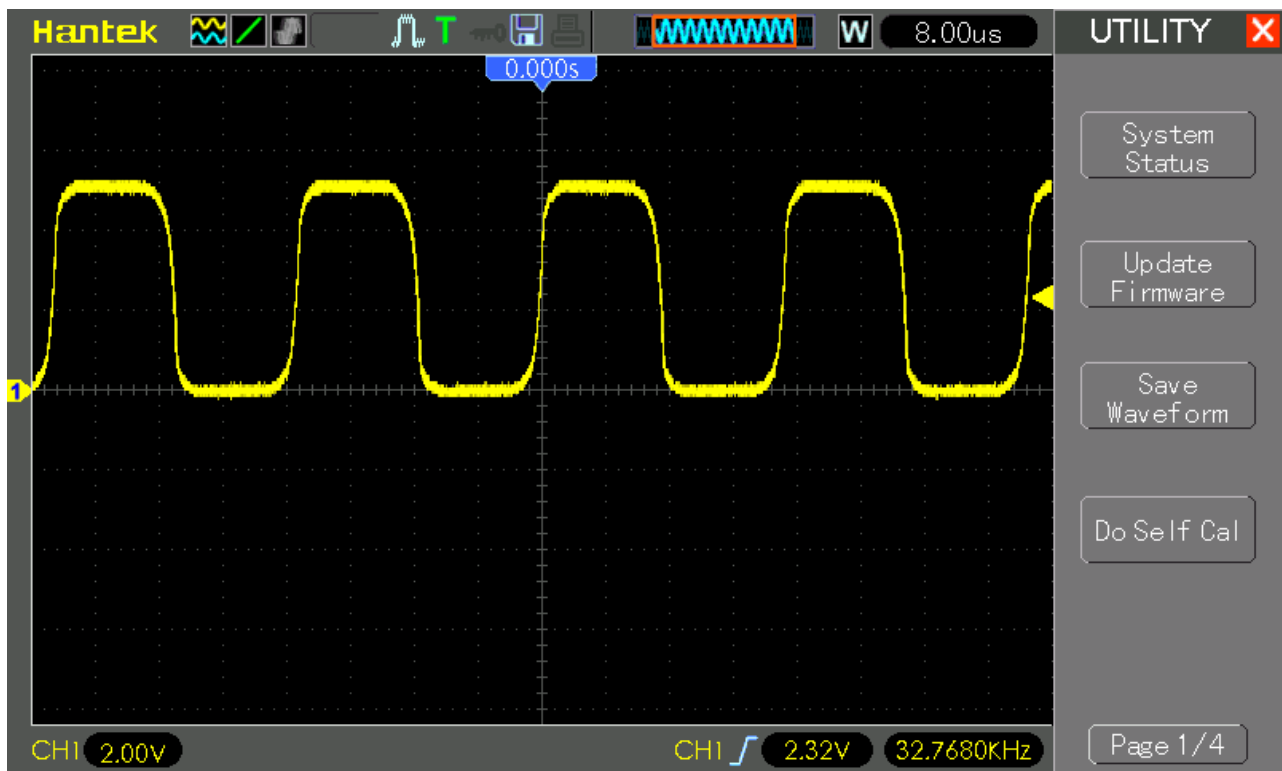
The CD4060 datasheet describes a crystal oscillator configuration for self-driving the ripple counter. The use of a crystal provides very precise (but fixed) frequency control.



See the LEAP#293 CD4060/RCOscillator (../RCOscillator) project a similar circuit that is RC controlled, thus allows variable frequency control.

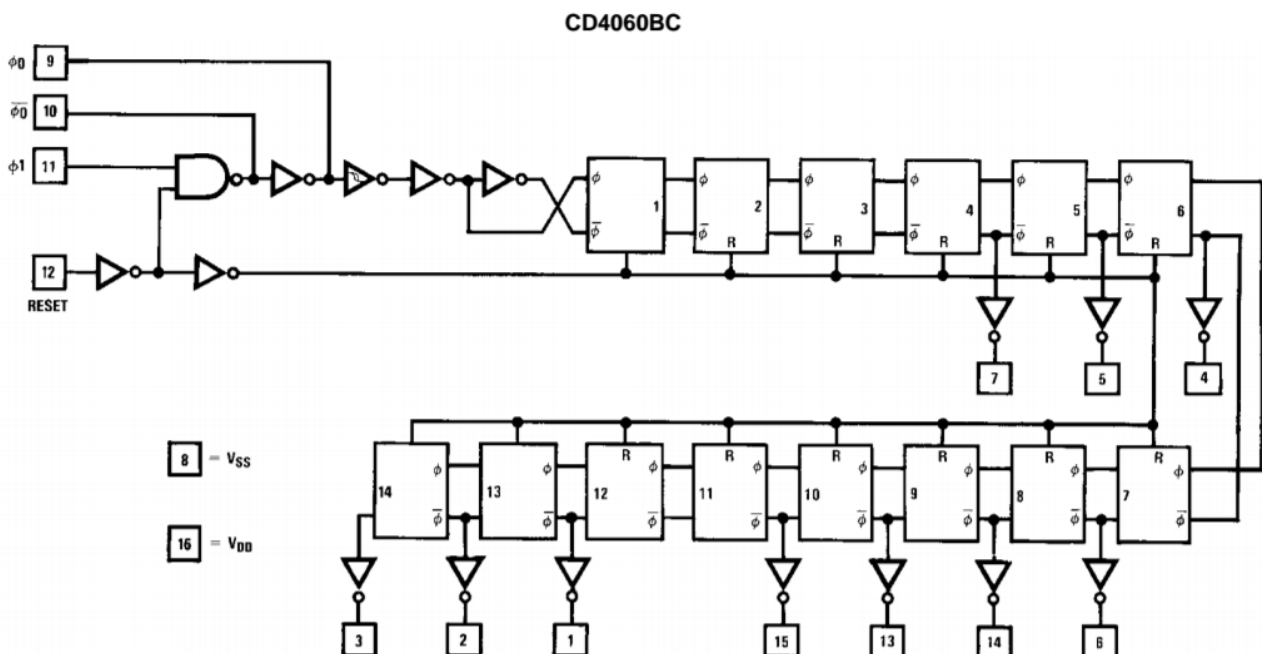
In this test I'm using a 32.768kHz crystal. The resulting oscillation looks like this (tapped

at the net marked CH2 in the schematic):



Ripple Counter

The CD4060 is a 14 stage ripple counter constructed of RS flip-flop units - see the functional diagram from the datasheet:



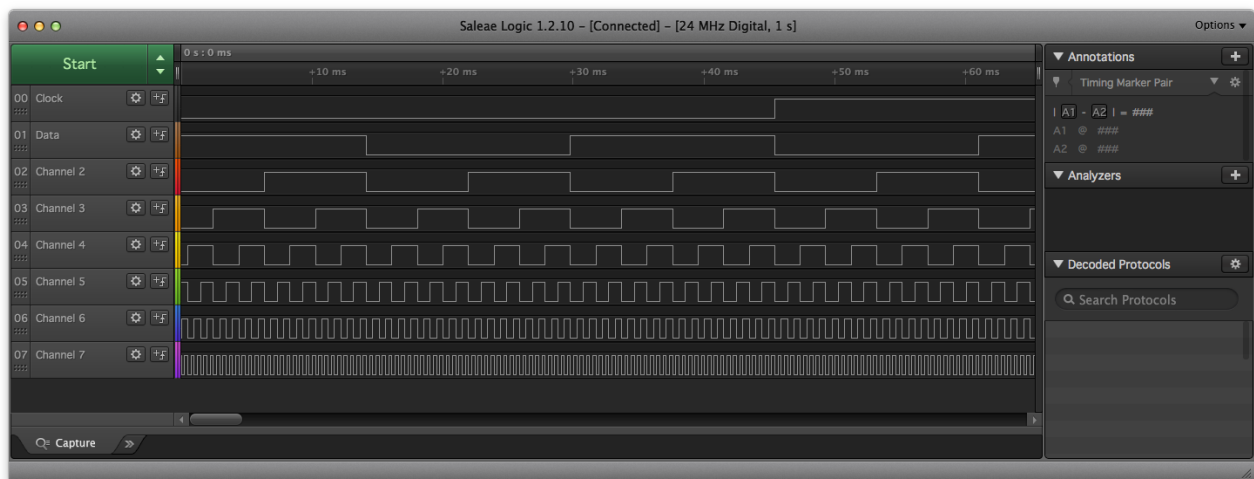
The input signal passes 4 stages before the first output is tapped (Q4). Thus the first (Q4) output signal divides the input frequency by a factor of 2^4

Stage 11 (Q11) of the ripple counter is also not exposed on a pin.

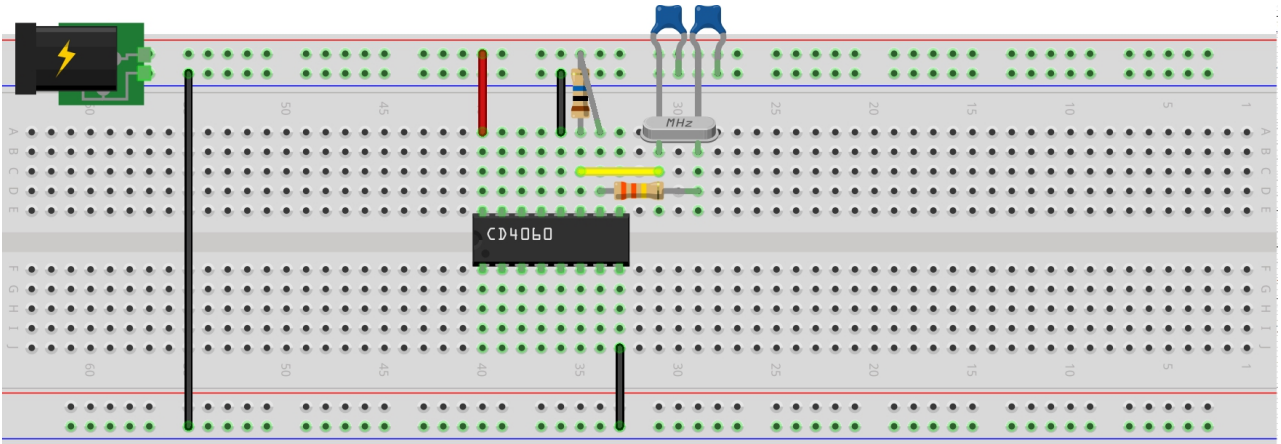
The lack of Q0-3 and Q11 is I think just pin economics so it all fits it in a DIP16 package.

The performance is summarised in the following table and the logic analyzer (LA) capture. While 32.768kHz may sound like an odd crystal frequency, the table below gives away its purpose: the ripple counter divides this frequency into lots of familiar powers of 2! Also note how under crystal control, the actual frequency (as measured with an oscilloscope) is exactly equal to the theoretical frequency.

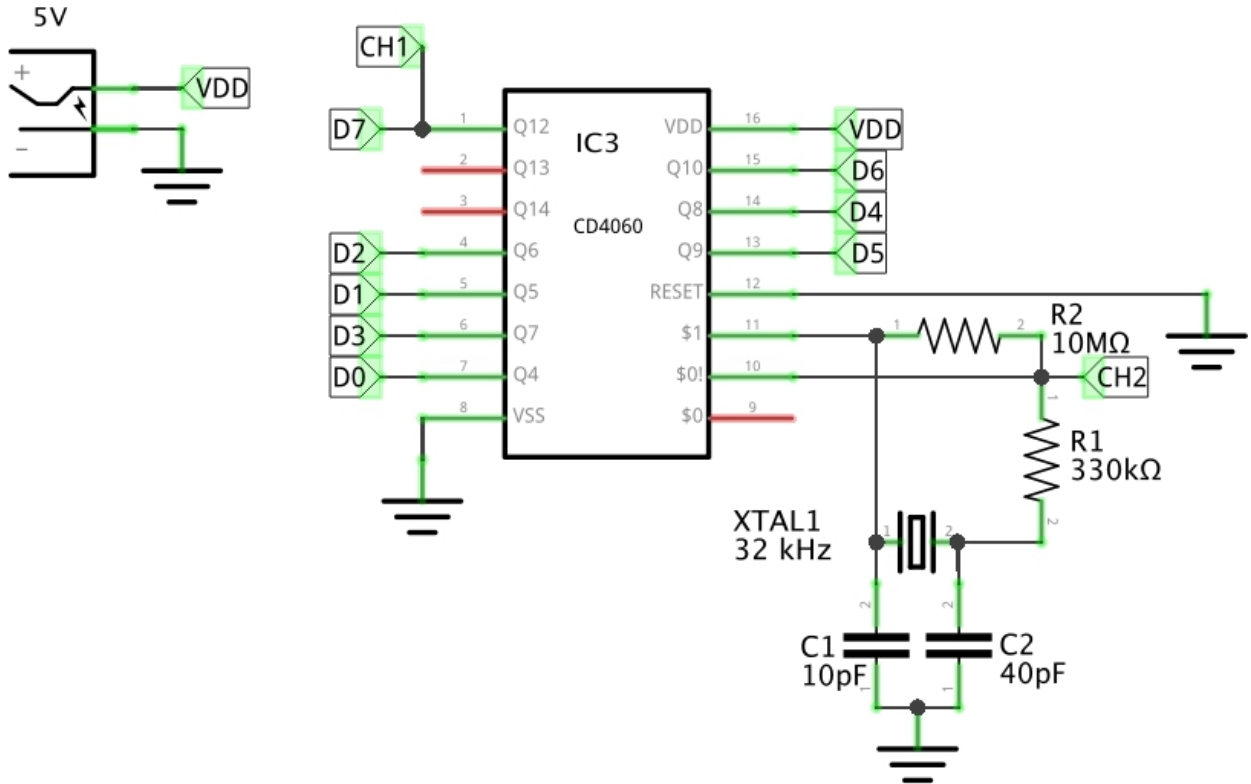
Signal	LA	Frequency (theory)	Frequency (actual)	Note
CH2		32768Hz	32768Hz	f-input
Q4	07	2048Hz	2048Hz	f-input/2 ⁴
Q5	06	1024Hz	1024Hz	f-input/2 ⁵
Q6	05	512Hz	512Hz	f-input/2 ⁶
Q7	04	256Hz	256Hz	f-input/2 ⁷
Q8	03	128Hz	128Hz	f-input/2 ⁸
Q9	02	64Hz	64Hz	f-input/2 ⁹
Q10	01	32Hz	32Hz	f-input/2 ¹⁰
Q12	00	8Hz	8Hz	f-input/2 ¹²
Q13		4Hz	4Hz	f-input/2 ¹³
Q14		2Hz	2Hz	f-input/2 ¹⁴



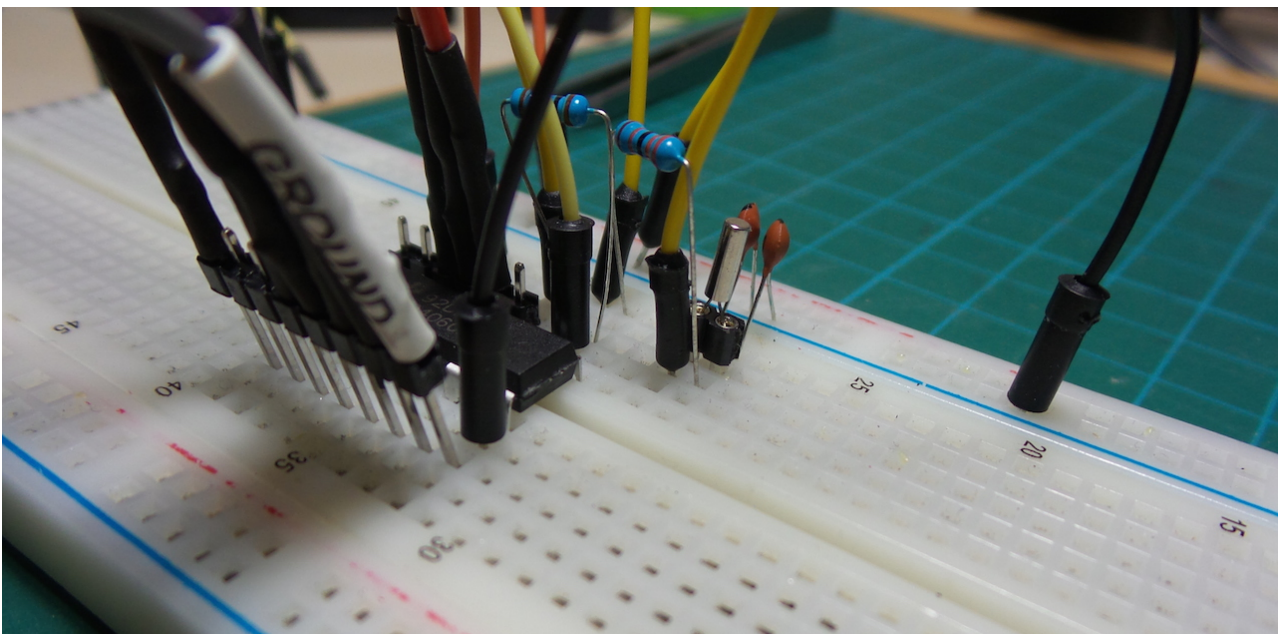
Construction



fritzing



fritzing




Credits and References

- CD4060 datasheet (<https://www.futurlec.com/4000Series/CD4060.shtml>)
- Flip-flops (http://en.wikipedia.org/wiki/Flip-flop_%28electronics%29) - wikipedia
- LEAP#293 CD4060/RCOscillator (./RCOscillator) - similar circuit but RC controlled
- ..as mentioned on my blog (<https://blog.tardate.com/2017/05/leap294-cd4060-crystal-oscillator.html>)

About LEAP#294

Oscillators CMOS/TTL

 Project Source on GitHub (<https://github.com/tardate/LittleArduinoProjects/blob/master/Electronics101/CD4060/CrystalOscillator/>)

 Project Gallery (</gallery.html>)

 Return to the LEAP Catalog (<https://leap.tardate.com>)

This page is a web-friendly rendering of my project notes shared in the LEAP GitHub repository.

LEAP is just my personal collection of projects, usually involving an Arduino or other microprocessor in one way or another. Some are full-blown projects, while many are trivial breadboard experiments, intended to learn and explore something interesting (IMHO!).

The projects are usually inspired by things found wild on the net, or ideas from the sources such as:

- Boldport Club (<https://www.boldport.club/>)
- Elektor magazine (<https://www.elektormagazine.com/>)
- Nuts&Volts magazine (<https://www.nutsvolts.com/>)
- Silicon Chip magazine (<https://www.siliconchip.com.au/>)
- Electrical Engineering StackExchange (<https://electronics.stackexchange.com/>)
- Arduino StackExchange (<https://arduino.stackexchange.com/>)
- Arduino Playground (<https://playground.arduino.cc/>)
- books from my electronics bookshelf (<https://www.goodreads.com/review/list/17475014-paul?shelf=electronics>)
- the many great electronics YouTube channels e.g.
 - Afrotechmods (<https://www.youtube.com/channel/UCosnWgi3eorc1kIEQ8plgJQ>)
 - Ben Eater (<https://www.youtube.com/channel/UCS0N5baNIQWJCUrhCEo8WIA>)
 - GreatScott! (<https://www.youtube.com/channel/UC6mIxFTvXkWQVEHPsEdfzQ>)
 - Julian Ilett (<https://www.youtube.com/channel/UCmHvGf00GDuPYG9DZqQKd9A>)
 - Scullcom Hobby Electronics (<https://www.youtube.com/channel/UCDqryeq1kMDSEQwltWqASrA>)
 - w2aew (https://www.youtube.com/channel/UCiqd3GLTluk2s_IBt7p_LjA)
- and my favourite podcasts e.g.
 - Embedded.fm (<https://embedded.fm/>)
 - Ham Radio Workbench (<https://www.hamradioworkbench.com/>)
 - MacroFab Engineering Podcast (<https://macrofab.com/blog/podcast/>)
 - The Amp Hour (<https://theamphour.com/>)
 - Unnamed Reverse Engineering Podcast (<https://unnamedre.com/>)

Feel free to borrow liberally, and if you spot any issues do let me know. See the individual projects for credits where due. There are even now a few projects contributed by others - send your own over in a pull request if you would also like to add to this collection.

LittleArduinoProjects
(<https://leap.tardate.com/>)

LittleCodingKata
(<https://codingkata.tardate.com/>)

 ([HTTPS://GITHUB.COM](https://github.com/TARDATE)
/TARDATE)

 ([HTTPS://STACKOVERFLOW.COM](https://stackoverflow.com/users/6329)
/USERS/6329)

 (/CATALOG/ATOM.XML)

 ([@TARDATE](https://ruby.social))

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