Electric Druid Noise Generator

Introduction

This very simple digital noise source provides pure white noise over the full audio spectrum. With the additional filtering shown, it can also produce pink noise and red noise.

Digital noise sources have a bad reputation, mainly due to the infamous MM5837 chips that appeared in the Sequential Prophet 5. This chip allegedly makes a noise like a broken recording of a steam train. It uses a 17-bit LFSR at a rate which is somewhere between 24KHz and 56KHz. The datasheet doesn't commit itself to offering a 'typical' rate between these extremes. Assuming the best case from an audio point of view (56KHz rate), the output of the chip repeats every 2.3 seconds! This is hardly random!

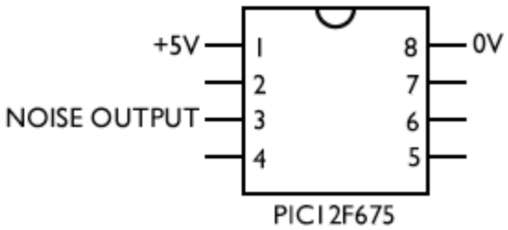
However, there is no technical reason why a digital noise source should sound bad if the sample rate is high enough and the shift register is long enough.

The Electric Druid Noise Generator uses a dual linear feedback shift register (LFSR) algorithm to generate pseudo-random bits at an output rate of around 100KHz. There is a 21-bit LFSR (with taps at 21 and 19) coupled with a 31-bit LFSR (with taps at 31 and 28). This gives an effective LFSR length of 52 bits.

The output bits from the two generators are alternated. Since the generators have different lengths, the resulting bit pattern will not repeat until the two generators both restart at the same time. This will not happen for 2^{52} samples, which is over 1400 years!

The high output rate ensures that the noise is pure white throughout the audio spectrum. Subsequent filtering can provide other colours of noise.

Pinout Diagram



Problems programming the chip?

The code uses the 12F675's internal oscillator and also disables the MCLR pin so that no resistor is required to tie it to +5V. Unfortunately, some programmers are unable to handle this combination. I know that Microchip ICD2 clones and the JDM programmer both suffer from this. The Microchip PICKit1 flash starter kit is able to program the chip without any problems, as is the Warp13 programmer.

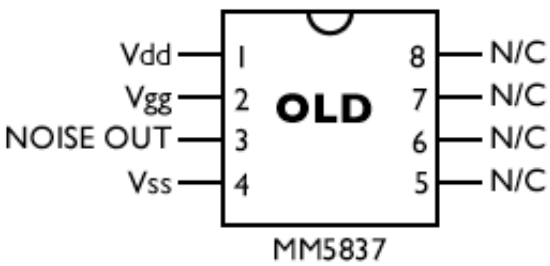
If you really can't find any other solution, you can reenable MCLR by changing the configuration options in the code (change MCLRE_OFF to MCLRE_ON in the __CONFIG line). When the code is recompiled and programmed, the problem will have disappeared. This change will require MCLR to be set high, so tie pin 4 of the chip to +5V with a 10K resistor.

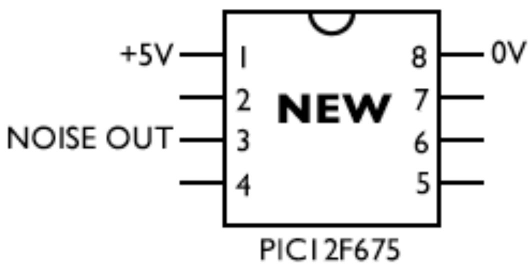
Application Notes

Replacing a MM5837 for improved sound

Although this chip isn't a pin-for-pin replacement for the MM5837, it is pretty close, and the difference is easily worth the minor modifications.

The MM5837 pinout is below. The chip is based on MOS technology, and can handle a wide range of supply voltages to Vdd, Vss, and Vgg. The PIC replacement needs a simple +5V supply and will be destroyed by 15V supplies. Depending on the original circuit this will require more or less changes. **Supplies to pin 1 and 4 (and 2 if present) must be removed before installing the PIC**.





Replacement noise generator for Sequential Prophet 5

Whilst both Rev 2 and Rev 3 Prophets use the MN5837, there are differences. The Rev 2 uses a single chip, splitting the output to provide the pink noise for the wheel mod source and white audio noise for the voices. The Rev 3 uses separate chips for each job.

The datasheet suggests that a typical connection for the MM5837 is Vdd to -15V and Vss at 0V, whilst Vgg is optional. All revs of the Sequential Prophet 5 use the chip this way, with no Vgg. Thus the traces to pin 1 and pin 4 must be cut. Pin 1 must then be linked to a convenient +5V supply. The trace that used to go to pin 4 (ground) should be connected to pin 8.

Rev 3 Prophet 5

The white noise source is U427, which sends its output via C458 (100nF) and R4131 (200K) to U430, a CA3280 VCA. The noise level can be adjusted if necessary by altering the value of R4131. Reduce the value to 150K or 100K to boost it.

The pink noise source is U375. It sends its output via R395, 47K. This resistor feeds an op-amp inverting amplifier at pin 6 of U374, a LM346. The noise modulation level can be adjusted if necessary by altering this resistor. Reducing the value to 33K, 20K or even 15K will boost the level.

Rev 2 Prophet 5

The noise source is U365 or U356 (can't read schematic clearly). The output is via C332 (100nF) to U364, a SSM2020 VCA for the white audio noise source. Additionally, the output is connected by R354 (100K) to U367, an LM348 op-amp, used as a filter to make pink noise that is used as the wheel modulation noise source. I've been told that no adjustments to noise levels is required on the Rev 2 Prophet.

Replacement noise generator for early Korg MonoPoly

The early MonoPolys also use the MM5837. It was replaced with an analogue noise source in later models. The early Monopoly runs the MM5837 with Vdd=0V, Vgg=-15V, and Vss=+15V.

To replace the MM5837, the traces to pins 1, 2, and 4 must all be cut. The trace from pin 1 (ground) can be connected to pin 8. Pin 1 must be supplied with +5V from elsewhere in the synth.

Again, the output level might need adjusting. This involves reducing the value of resistor R148 (4K7) on KLM354, the oscillator board.

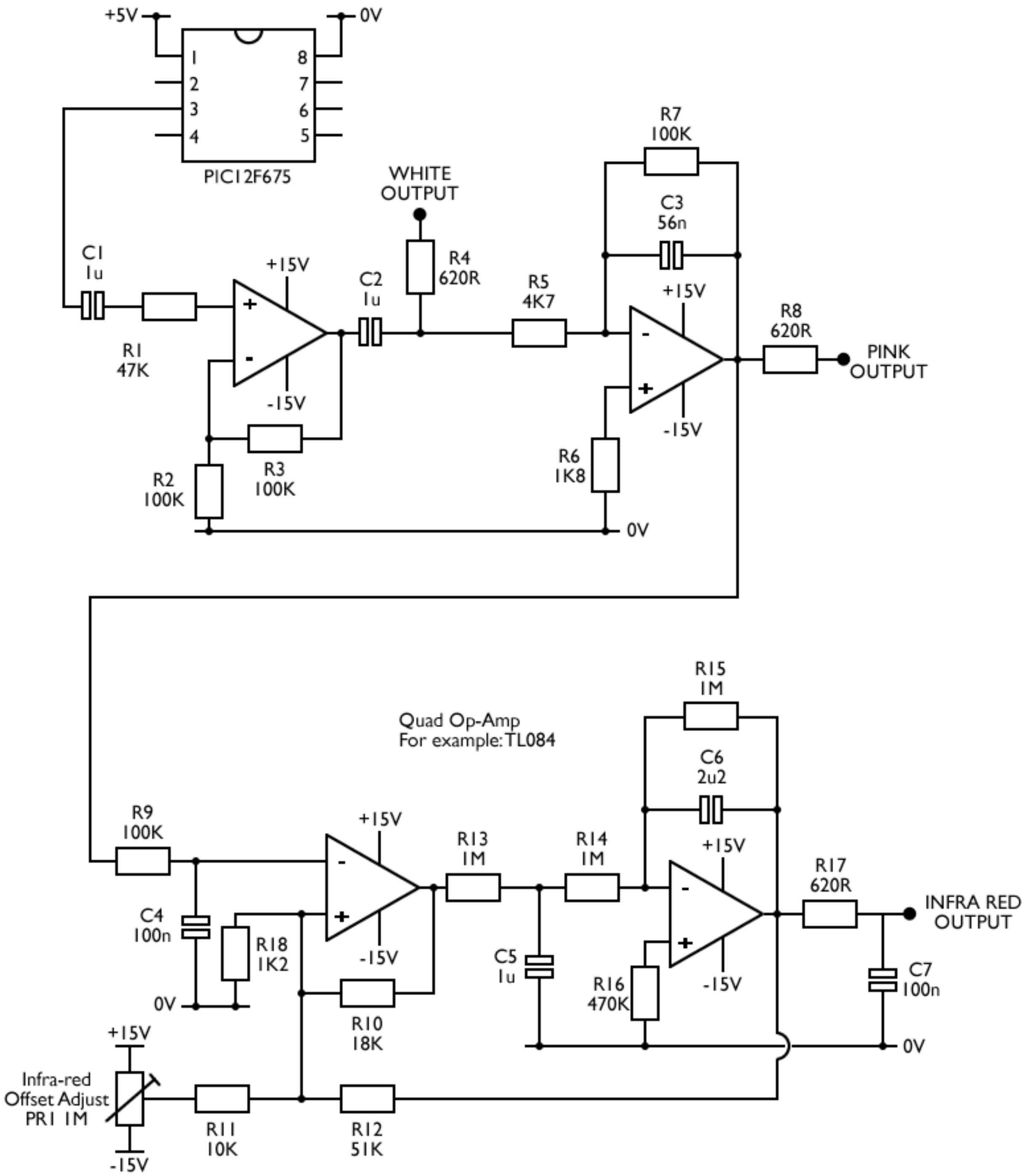
Replacement noise generator for Oberheim OB-X

The Oberheim OX-X uses the MM5837 with Vdd=0V, Vgg=0V, and Vss=+15V. To replace the MM5837, the traces to pins 1, 2, and 4 must all be cut. The trace from pin 1 or 2 (ground) can be connected to pin 8. Pin 1 must be supplied with +5V from elsewhere in the synth.

The output is fed via a 100nF capacitor to a 100K resistor connected to pin 6 of a 1458 op-amp. This 100K resistor might need its value adjusting. Try 47K for starters.

The output also goes via a 47K resistor to one input of a 4051 analogue switch IC. This 47K resistor might need altering too.

Circuit diagram for white, pink, and infra-red noise



This circuit is based on the famous Polyfusion modular synthesizer Random Signal Generator, module 2002.

If all that is required is a simple white noise output, or just white noise and pink noise, the subsequent op-amp stages can be ignored.