



# RETRO NIXIE CLOCK

*Limited Edition*

**NIXII-1**

Fred M. Niell, III

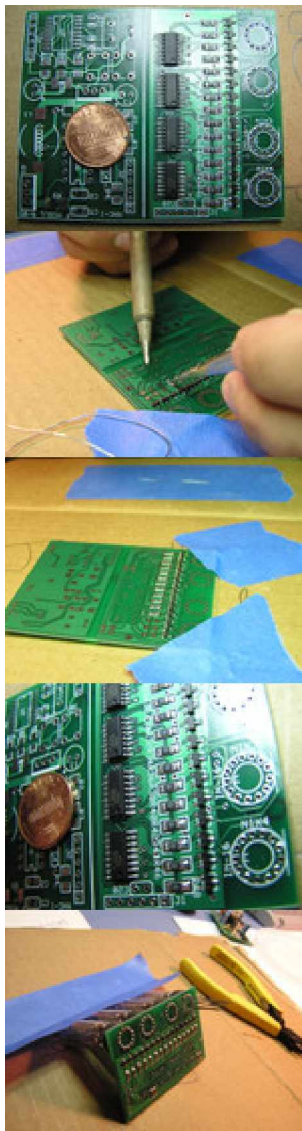
10/4/2005

[fred.niell@gmail.com](mailto:fred.niell@gmail.com)

[www.niell.org](http://www.niell.org)

v1.4

**Retro Nixie Clock:** functional art, bringing electronics from the peak of the Cold War era to the modern consumer.



## 1. INTRODUCTION

This clock is a typical desk-type clock one might find on a bookshelf in an office. However, this clock is quite unique in that it uses genuine vacuum-tube technology to display the time. The use of vacuum tubes in modern electronic appliances is in some sense a way to connect with the past. This clock mixes a little bit of history with modern electronics to create a design ethos combining both the ultra modern 1960s with current retro trends.

## 2. ARTISTIC STATEMENT

The model name, NIXII (pronounced nik'sē'ē), hints at the provenance of the vacuum tubes used, but moreover, tries to pay tribute to the history invoked by this clock's design. With this clock, I wanted to capture an element of a bygone era, the nixie tube, in a modern piece of electronics equipment suitable for display.

The nixie tube is itself an anachronistic cast-off in the timeline of modern electronics development. As the dawn of digital electronics loomed, the days of the vacuum tube were numbered. True, the first computers were powered by vacuum tubes, but as soon as the transistor was commercially accepted, the vacuum tube's role as the switching element in digital electronics was clearly diminishing. And yet, the Burroughs Corporation produced the nixie tube well into the 1970s. This apparent disconnect points to an interesting loophole in the ceaseless march of progress of the electronics industry.



Display technology significantly lagged the early development of the transistor. Tremendous energy was being spent to develop the new transistor, so the then-mature vacuum tube technology lost some of its development steam. In this slack water created by the relatively primitive display technology, a market niche opened for vacuum tubes to dominate the technology. The computers of the day did not have suitable means to display their coded, binary output on a simple, legible numerical output in real time. Computers could easily display output on a teletypewriter terminal, but real-time displays were difficult for the then-new computers in the late 1950s. To fill this need, the Burroughs Corporation developed the nixie tube (Numerical Indicator, eXperImental typE). The digital display tube quickly made its way into test equipment, timing displays, scientific experiments, and anywhere else digital data needed to be displayed.

Seeing this development in the West, the USSR set about to manufacture its own nixie-like tubes that performed the same function. The ИH-series of glowing discharge display tubes was created to mimic the various size and shape nixie tubes of the West. By the 1970s however, LED and semiconductor technology in the US had advanced to the point that the nixie tubes had become obsolete. In fact, US tube manufacturers stopped making them altogether by the mid-70s. However the silicon chip industry in the USSR, and by extension LEDs, was not as advanced as the West. As such, the vacuum tube display technology stayed current well into the 80s in the USSR. Now the cold war has ended, the entire world has moved on from nixie tube technology. Nixie tubes are today most commonly seen in old print ads and dated sci-fi movies. Occasionally, dinosaur laboratory equipment will surface with the tubes as the display element. As we move ever faster toward the digital future, technologies are left behind every day. On an ever shorter time scale, electronics of yesterday are today obsolete and anachronistic. This clock stands to remind the user of the pace of technology, and the rather sad fate of technologies left behind, no longer en vogue.

Nixie tubes are now available through collector and surplus outlets only. The US-made tubes are available still, but they hold a less poignant place in the history of

the demise of vacuum tube technology than their USSR cousins. As such, Russian-made vacuum tubes were specially selected for this clock. According to their original manufacturer, these tubes are rated for tens of thousands of hours of continuous use in extreme vibration and altitude environments. The exotic materials used in the tubes, construction, Molybdenum, Tungsten, Mercury, steatite ceramics, etc., stand testament to the immense work put into their development and manufacture. The manufacture date of 1971 points to a time when the tube industry had reached its pinnacle in both reliability and technological advancement. Truly, these tubes represent one facet of the peak of the USSR's intellectual and scientific output, fueled by the Cold War's escalations. Thus, it is important to reflect on the place these tubes occupy in their new home. As military surplus from the former soviet state of Ukraine, they stand as a tribute to the enormity of the Cold War's impact on technological development on both sides of the iron curtain.

The electronics driving the nixie tubes are state-of-the-art by current standards. Surface-mount components, the peak of current discrete electronics miniaturization, were chosen expressly to further underline the generation gap between the clock itself and its nixie display tubes. The contrast is heightened through this difference, allowing the clock to pay tribute to its digital past.

### **3. USAGE**

Your NIXII-1 clock is intended to be used and displayed as you would any other stationary clock. It is a non-alarm digital clock. It displays time in a 12-hour format, HH:MM. The glass door on the front of the clock opens for closer inspection of the vacuum tubes. Recently-trained electrical engineers may have never seen a vacuum tube in real life, much less a vacuum tube in operation. As such, the tubes inside will garner a fair amount of interest from technically-inclined people. However, be warned that hazardous voltages exist in the clock. While not lethal, the clock can deliver an unpleasant shock. Keep fingers away from the bottom of the circuit board to which the tubes are soldered.

The clock should be placed in a low-traffic area, as the internal tubes (while rated for extreme abuse) are still

delicate. Consider the clock a piece of functional art, and treat it as such. Occasional dusting of the wooden box with a gentle wood cleaner such as Pledge is appropriate, as well as periodic cleaning of the glass door with a surface cleaner.

For reference, the horizontal board holding the tubes is the display board. It decodes the time signals from the microprocessor and displays them on the vacuum tubes. The circuit board mounted on the back wall of the clock box is the microprocessor and high voltage power supply board. Nixie tubes require 175V to operate, so the power supply steps the 9V input up to the 175V required. The microprocessor uses a quartz time base and divides the oscillations of the quartz crystal down to the appropriate units; hours, minutes, etc. The 9V powering the clock comes from a black plug-in transformer, attached to the clock's box. The transformer is a standard black plug-in type unit, 120V 60Hz, and is attached to the clock by a 6 foot cord.

Time is set by pushing the "H(our)" and "M(inute)" buttons on the back of the clock. When first plugged in, your clock will display 08:08, and the time inside the clock's circuitry will be 08:08:58. Three seconds later, the time will display 08:09. This was done to aid in synchronization of your clock to another time base.

Nixie tubes, unlike other vacuum tubes, do not have a filament. This has two major impacts on the operational characteristics of the clock. Nixie tubes produce very little heat, and as such, do not require the kind of ventilation that other vacuum tubes need to function. Also, the tubes' operational lifetimes are greatly extended past that of regular vacuum tubes.

#### 4. **WARRANTY**

Your clock is warranted against defects such as malfunctioning tubes or circuitry for one year of continuous, normal use from the date of shipment. Breakage of the tubes due to misuse or abuse of the clock is not covered. Normal use as outlined in 3) is recommended. Following the recommendations should give the user many years of trouble-free use. After some time, the tubes will begin to lose brightness. This is

normal ageing for these tubes. When the tubes are no longer legible from darkening of the glass, the tubes must be replaced. The tubes can be replaced by the manufacturer for a fee.

## 5. TECHNICAL DETAILS

This clock is microprocessor controlled, using the PIC16F84A chip. This microcontroller has over 1k of memory, and runs at 3.6MHz. This makes it a little less powerful than the venerable Apple IIe, but on a single chip. It is no surprise that given Moore's law, integration of electronics technology has progressed to this scale. The quartz oscillator used is a low-drift type, giving accurate time for years to come. High voltage is supplied by a high efficiency switching power supply. Data are latched in TTL chips. Cathodes of the vacuum tubes are switched by miniature FFMTA42 high voltage transistors. The nixie tubes are type IH-16 tubes. Power comes from a Diamond Multimedia 9V wall transformer.

The enclosure is a deeply stained wood box measuring 4 5/8" x 4 5/8" x 2 7/8". The handsome box has a door on the front with a glass insert that allows inspection of the unique Russian nixie tubes and the circuit boards driving them. The door has quality latch hardware and black hinges. Each clock has an individually signed label on the back with serial number and brief operating instructions.

[\[Back\]](#)