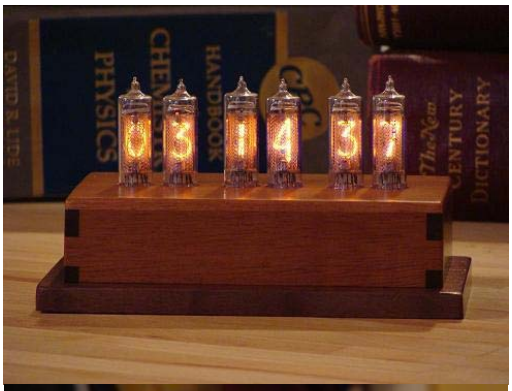
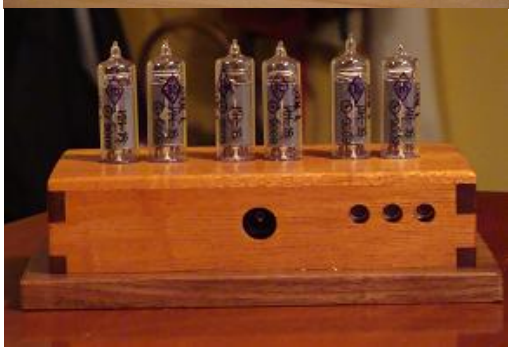
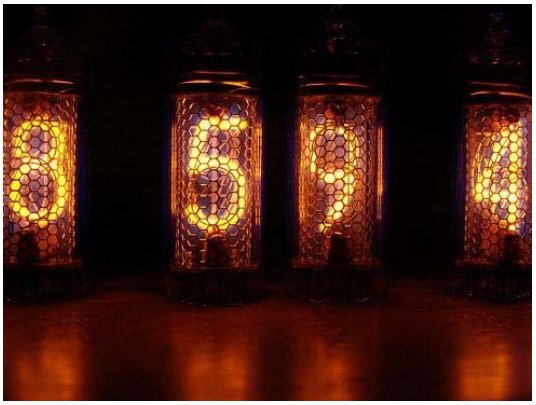
Retro Nixie Tube Clock V2: Индикатор-6

Fred Niell 6/2009 http://www.niell.org





Above is the back view of the clock. The center hole is the access for the power jack. To the right are three button holes. The buttons can be accessed simply with a ballpoint pen or a pencil. Left to right, the first button is the "C" button, setting the digit cycling. The default is no cycling at all. The second button is the "M"(inute) button, setting the minutes. The last is the "H"(our) button, which sets the hours.



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. A simple, sleek design for the wood case was chosen to reflect the minimalist design cues of the late 1950s to the mid 1970s.

2. ARTISTIC STATEMENT

The model name, Индикатор-6 (pronounced 'indicator-6'), hints at the provenance of the vacuum tubes used, but moreover, pays tribute to the history invoked by this clock's design. With this clock, I wanted to display an intriguing element of a bygone era, the nixie tube, in a minimalist, hand-crafted wooden display case evocative of mid-century designs.

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.

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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 line printer or 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. The nixie tube even starred in the Olympic games of the 1960s, as an overlay for timing markers on most winter and summer events.

Seeing this development in the West, the USSR set about to manufacture its own nixie-like tubes that performed the same function. The ИН-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 developed in 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, and 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. Just look at the cassette tape or the rotary phone. 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 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. The clock itself is small; only 5.75” x 3.5” x 3.25”. Miniaturization on this scale would have been beyond any conceivable technology of the 1950s. The sleek design and the prominent vacuum tubes highlight the strangeness of the device - it could never have existed 50 years ago, but is made of and takes its outward design from professional equipment of the mid 1950s. Such

a clock would have been an extreme extravagance in the 1950s for personal users, and an ultra-high precision timepiece fit for a laboratory in its day.

3. **USAGE**

Your Индикатор-6 clock is intended to be used and displayed as you would any other stationary clock. It is a 6-digit digital clock. It displays time in a 12-hour format, HH:MM:SS (or 24-hour by special request). The vacuum tubes are prominently on display through the top of the clock enclosure. 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. The tubes will glow orange during the day, and orange with a slight blue halo during the night. It is quite striking when viewed in the dark.

The clock should be placed in a low-traffic area, as the tubes (while rated for extreme abuse) are still delicate. Consider the clock a piece of functional art, and treat it as such. The wood is lacquered, and should only need light, occasional dusting. Occasional dusting of the wooden box with a gentle wood cleaner, as well as periodic cleaning of the glass tubes with a surface cleaner.

For reference, inside the box is a circuit board containing a microprocessor and a temperature-compensated clock chip. The clock chip decodes the time signals, and the microprocessor displays them on the vacuum tubes. The circuit board is mounted to the inside top surface of the clock box. These nixie tubes require 185V to operate, so the power supply steps the 12V input up to the 185V required. The clock chip uses a quartz time base and divides the oscillations of the quartz crystal down to the appropriate units; hours, minutes, seconds, etc. The 12V powering the clock comes from a black plug-in transformer, which is mated to the 5mm jack on the back of the clock's box. The transformer is a standard black plug-in type unit, center-positive, 5mm plug, 120V 60Hz, 12VDC 300mA ouput, and is attached to the clock by a 6 foot cord. The clock is specially designed to be compatible with AC output wall transformers as well.

Time is set by pushing the “H(our)” and “M(inute)” buttons on the back of the clock as shown to the left. When first plugged in, your clock will display 08:13:10.

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.

The Индикатор-6 includes a unique feature to extend the life of the nixie tubes even further than typical. This clock includes a third button on the back labeled “C” for (C)ycle. The nixie tubes can exhibit age-related darkening of certain numerals if they are in the “on” state too long. This is due to some rather subtle chemical plasma interactions inside the tube. However, this aging effect can be mitigated by simply making sure that all of the digits in a tube are illuminated occasionally. Typically it is sufficient to illuminate each digit for a fraction of a second once per 12 hours or so. The third button on the clock selects how often the digits should cycle. Pressing the “C” button will briefly illuminate a marker at the bottom left of the digit corresponding to how often the user wants the digits to cycle.

For example, if the time on the clock is 12:34:59, and the user wants the digits to cycle every 12 hours, the user should press the "C" button until the 10s-hours digit marker below the "1" illuminates. If the user wants the digits to cycle every 60 seconds, the user should press the "C" button until the minutes digit "4" marker is illuminated. The menu defaults to no cycling. The menu options are as follows: no cycling, every minute cycling, every 10 minutes cycling, every hour cycling, and every 12 hour cycling, then repeats. The digits cycle in a visually appealing manner, as shown in the video at http://www.niell.org. The manufacturer typically keeps his clock set to the cycle-every-minute setting.

The Индикатор-6 also includes an ultracapacitor memory backup to keep time even in the event of a power outage. Typical tests show that the clock will keep correct time for up to 12 hours (possibly more) when unplugged or otherwise unpowered.

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 above 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 may be replaced by the manufacturer for a fee subject to availability.

5. **TECHNICAL DETAILS**

This clock is microprocessor controlled, using the PIC16LF87 chip. This microcontroller has over 4k of memory and runs at 1MHz. This makes it a little more 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 temperature-compensated type, giving accurate time for years to come. High voltage is supplied by a high efficiency switching power supply. Data are latched in specialized HV-CMOS chips which also drive the cathodes of the vacuum tubes. The nixie tubes are type ИН-16 tubes.

The enclosure is a gorgeous 5.75" x 3.5" x 3.25" custom-made box with dovetail corners, and contrasting woods to show the high level of craftsmanship. The sides and bottom of the box are made of sustainably-harvested black walnut and the remaining sides of deep grain mahogany. This handsome, handmade box has several coats of quality lacquer and should maintain its lustrous finish for quite some time. The woodworking was completed by Virginia craftsmen at Goose Creek Woodworks. Each clock has an individually signed label on the bottom with serial number and brief operating instructions.