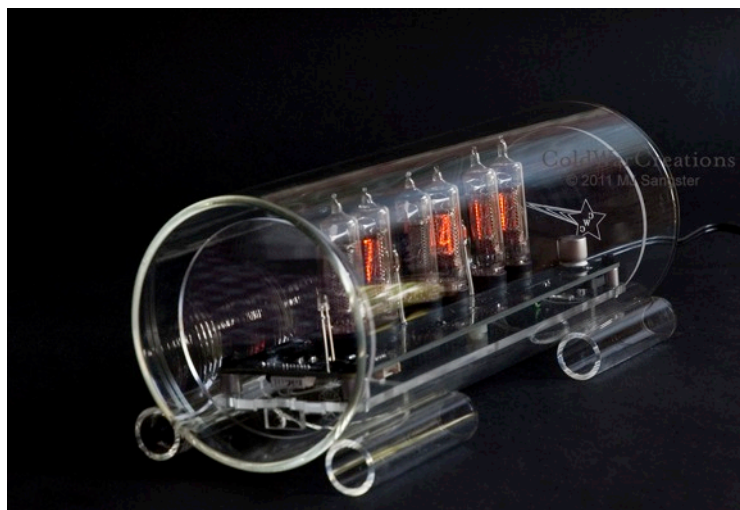

Glass Nixie Tube Clock #3 Mini



User's manual

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1 Glass Clock Design #3 Mini

Congratulations on your purchase of this unique timepiece! This clock uses Cold War era Nixie display tubes. The old is mixed with the new, using a RISC processor based single chip computer – which has more processing power than the old computers that originally used these Nixie tubes.

The case is all optically clear Simax glass from the Czech Republic, and uses clear acrylic support pieces to complement the glass vacuum tube construction of the Nixies.

“Стекло часы Дизайн номер 3”, or “Glass Clock Design #3” is the third design for my Nixie tube based clock. It uses a microprocessor that multiplexes 3 tubes by 2 (meaning 2 tubes are on at a time, with 3 sets of 2). SMD (surface mount) construction is used throughout. A high efficiency high voltage power supply is used to generate the 180v required for the Soviet Nixie tubes.

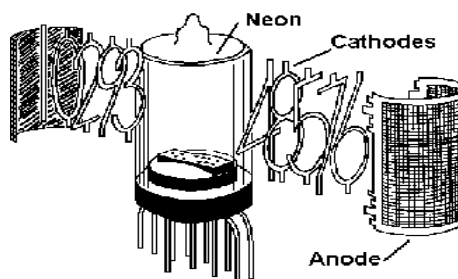
This is the Mini version of the Glass Clock #3. It is a more compact design with smaller tubes that will fit in smaller areas. It's an excellent size for offices and bedrooms.

2 Introduction to Nixie Tubes

Nixie tubes (gas indicator tubes) were invented during the Cold War in the early 50's by a small vacuum tube manufacturer called Haydu Brothers Laboratories. These tubes were sold by the Burroughs Corporation, who came up with the trade name "Nixie". This name refers to "NIX I", an abbreviation that stood for, "Numeric Indicator eXperimental No. 1", which was a label for one of the drawings for the tube. This was shortened to "NIXIE" and the name stuck.

Early computers and test instruments didn't have any means to display digits easily until the Nixie tube appeared. Nixies found their way into numerical computer displays, volt/ohm meters, frequency counters, radiation counters and even calculators. By the mid 1970's, they were obsolete (replaced by LED's and LCD displays) and were discontinued.

A Nixie tube display, which should really be called a gas indicator tube, works like a neon bulb. A neon bulb works by a high voltage ionizing neon gas, causing the gas to glow with an orange color. The Nixie tube takes this a step further, by shaping the cathodes like a numeral (0 – 9). When the cathode is energized, the numeral glows orange. There are individual cathodes for each digit, 0 – 9. Some tubes have decimal points, and others may contain special characters, such as "F" or "Hz".



Nixie tubes require high voltage with special drivers for each digit, provided by a special high voltage converter on the circuit board. There are many failure modes for Nixie tubes: Breakage of the glass tube, loss of seal between the metal pins and the glass, and cathode poisoning. Cathode poisoning is when unused or seldom-used digits acquire a coating of material “sputtered” off of the active digits. This coating insulates the metal, making it difficult for the digit to glow.

The tubes used in this clock are Russian (Soviet) military tubes. The Soviets, seeing the Western Nixie, came up with their own versions with similar sizes and shapes. Unlike the U.S. Tubes, they were manufactured well into the 1980's. Since the collapse of the Soviet Union, these tubes became available on the surplus market, possibly from old warehouses of obsolete electronic equipment. This clock contains the IN-16 series of tubes. Unlike some Soviet tubes, the '5' digit is a unique '5', and not the '2' digit upside down and reversed.

3 Clock Features

The glass clock has many features. They are listed below:

- Unique look of individually formed digits with a neon orange glow.
- Optically pure Simax brand glass (from the Czech Republic) tubes for the outer case and feet.
- Laser cut clear acrylic used for the case's internal support pieces.
- Time can be displayed in either 12 or 24-hour format.
- Date can optionally be displayed in either “mm dd yy” or “dd mm yy” format.
- Temperature can optionally be displayed in either Degrees F, or Degrees C.
- Power loss time backup (up to 1 hour), will not lose the time if power fails, and no battery to replace.
- Nixie tube anti-cathode protection software, helps prevent tube failure.
- Programmable display Off period – blanks display, while still keeping time.
- Temperature compensated Quartz Crystal controlled time base for accuracy.
- Automatic Leap Year correction.
- Auto display brightness settings.
- Options for special effects: cross fading digits and sliding digits.

4 Unpacking and setting up the Clock

Carefully unpack the clock from the box. The box contains a wall plug-in power supply, the user manual and the clock itself.

The power supply plugs into the wall outlet. The other end plugs into the clock's power input jack.

When powered up for the first time, the clock will go through the self-test checkout. This checkout will set all the digits to '9', and each digit (starting with the leftmost digit) will count down from '9' to '0'. When this is complete the display will read "00 00 00". Then each digit will go blank one at a time starting with the leftmost digit. This completes the self-test.

The clock has two control buttons. On the back left is a black function button, and on the back right is a red mode button.

At this point, the clock should show "0:00" with the leftmost digits (hours) blinking. It is now in the time/date set mode. There is no need to press the right mode button to enter the time set mode. Go to the next section, "Setting the clock". Note: Due to the time save function of the clock, if it was disconnected from power less than an hour ago, it will not enter the time set mode – it will show the current time.

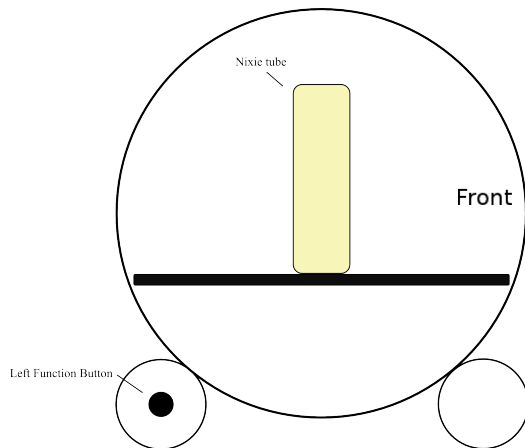


Illustration 1: Side View, Left

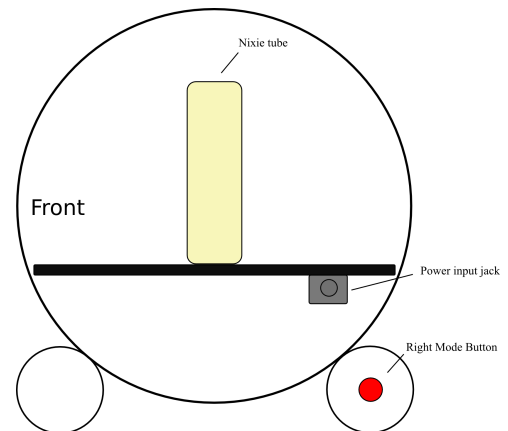


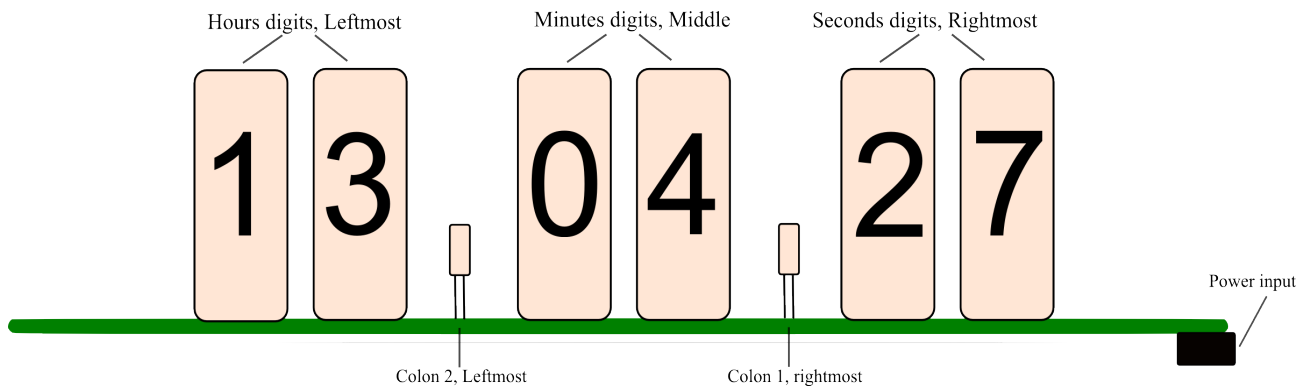
Illustration 2: Side View, Right

5 Setting the Clock

This section describes how to set the clock. This includes setting the time and date, plus all the display options. Setting the Nixie clock features is accomplished by using the red mode button (right side) and the black function button (left side).

Clock diagram

Illustration 3: Side view



Setting the time and date

When setting the time/date, the time is entered first followed by the date. Set the time by pressing the red mode button on the right side momentarily (Note: when powered up the clock will already be in set time mode, no need to push the mode button). When pressed, the hour's digits will flash on and off once a second "00:00". Note: If the mode button is held too long, the display will blank, indicating that the clock is in the "set on/off time" mode. Press and hold the red mode button until the display goes blank if this happens and try again.

Set time mode

When the clock is in the set time mode, the current time will be displayed with the hours (2 leftmost digits)

Note: If the clock loses time (first setup, or without power for an extended period of time) the time displayed will be all zeroes: 0:00.

To skip setting the time and go directly to setting the date, momentarily press the red mode button to skip the time set functions.

To cancel setting the time value at any point, press and hold the red mode button until the display goes blank. This will cancel setting the time/date. When the mode button is released, the clock will go back to the normal display. The old time value will be used.

5.1.1 Setting the time - hours

When the hours (leftmost) digits are blinking, the hour value can be changed.

The black function button on the left side will change the hour value when pressed. Holding the function button on will quickly cycle through the hours (0-23). Note: When setting the hours, 24 hour mode is used, regardless of the hour format setting (12/24 hour display mode). This means '00' is 12 AM (midnight), and '13' is 1 PM (afternoon). The hour format setting will be used when displaying the time normally.

Once the hours are set to the proper value, press the red mode button (right side) momentarily. The clock will then go to the minutes set mode.

5.1.2 Setting the time – minutes

When the minutes (middle) digits are blinking, the minutes value can be changed.

The black function button (left side) will change the minute value when pressed. Holding the function button on will quickly cycle through the minutes (0-59).

After the minutes are set correctly, momentarily press the red mode button (right side). At this point, all the digits (Hours:Minutes:Seconds) will flash once a second. Pressing the mode button again will update the time to the new settings. Note: The seconds value will be reset to '00' when the time is set.

Now that the time is set, the clock will go to the set date mode.

Set date mode

When the clock is in the set date mode, the current date will be displayed with the days (2 leftmost digits) blinking. The colons will both be off.

The clock will automatically compensate for leap year.

If not in the date set mode, see the “Setting the time and date” section. Before the date can be set, the time must be set. Note: If only the date needs to be set, enter time set mode, and momentarily press the red mode button to go through the hours, minutes until the date mode appears. The time will not change.

To cancel setting the date value at any point, press and hold the red mode button until the display goes blank. This will cancel setting the date. When the mode button is released, the clock will go back to the normal display. The old date value will be used.

5.1.3 Setting the date – month

At this point, the month number (2 leftmost digits) will be blinking. Use the function button to change the month value ('01' = January, '12' = December, etc).

Once the month value is set to the proper value, press the red mode button momentarily. The clock will then go to the day set mode.

Note: If using the alternate date format (dd mm yy), the day will be shown, followed by the month value).

5.1.4 Setting the date – day

At this point, the day number (2 middle digits) will be blinking. Use the black function button (left side) to change the day value (01 – 31).

5.1.5 Setting the date - year

At this point, the year number (2 rightmost digits) will be blinking. Use the function button to change the year value ('10' = 2010, '99' = 2099, etc).

Once the year value is set to the proper value, press the red mode button (right side) momentarily. At this point the date is set and the clock will go back to the normal display mode.

Changing clock options

There are several clock and display options available that can be changed by the user. When changed, these options will be saved to permanent memory. They will be saved even if the power is off for an extended period of time.

Enter the options mode by pressing and holding the black function button (left side) until the display goes blank. After releasing the function button, the 2 leftmost digits will flash with '12' or '24' value, (starts with option 1). Each option is displayed one after another (by pressing the red mode button), starting with option 1 and ending with option 6.

Table of clock options

Option 1	12/24 hour mode
Option 2	Date format option: mm-dd-yy or dd-mm-yy
Option 3	Display option, time/date/temperature, digit special effects
Option 4	Temperature units, F or C
Option 5	Brightness level, auto or fixed brightness
Option 6	Anti-cathode poisoning mode start time

5.1.6 Option 1 – 12/24 hour mode

Display: “12 □□ □□”

This option selects the hour style displayed:

- 12 hour style is 1:00 → 12:00 AM/PM (default).
- 24 hour style is 0:00 → 23:00.

A blinking '12' or '24' will be displayed in the 2 leftmost digits, indicating the hour style. To change the style, press the black function button (left side). Press the red mode button (right side) when the desired hour style is displayed. Then the next option will be displayed.

To cancel the option mode, press and hold the red mode button until the display goes blank. Release the mode button and the clock will go back to normal operation, aborting setting option 1.

5.1.7 Option 2 – Date format display option

Display: “□□ 01 □□”

This option selects the date format displayed. There are 2 different date display formats available:

- ‘01’ = display date format: mm dd yy (default).
- ‘02’ = display date format: dd mm yy.

A blinking '01' → '02' will be displayed in the 2 middle digits, indicating the selected date display format. To change the format, press the black function button (left side). Press the red mode button (right side) when the desired display format is shown. Then the next option will be displayed.

To cancel the option mode, press and hold the red mode button until the display goes blank. Release the mode button and the clock will go back to normal operation. Option 1 will still be saved, but option 2 will not be saved.

5.1.8 Option 3 – Display options, Special effects

Display: “□□ □□ 13”

There are 3 different display styles available; the following code numbers are used:

- '00' = display time only. No special effects.
- '01' = display time and date. No special effects.
- '02' = display time and temperature. No special effects.
- '03' = display time, date and temperature. No special effects.
- '10' = display time only with digit crossfade.
- '11' = display time and date with digit crossfade.
- '12' = display time and temperature with digit crossfade.
- '13' = display time, date and temperature with digit crossfade (default).
- '21' = display time and date with digit slide across and crossfade.
- '22' = display time and temperature with digit slide across and crossfade.
- '23' = display time, date and temperature with digit slide across and crossfade.

Time is displayed HH:MM:SS (HH = hours, MM = minutes, SS = seconds) with blinking colons between the digits.

Date is displayed MM:DD:YY (MM = Month, DD = day, YY = year), or DD:MM:YY.

Temperature is displayed TT (TT = temperature, Deg C or Deg F, see option 4).

The time will display for 15 seconds, followed by the date

The Crossfade style option is when a digit changes value (seconds counting up, etc) the old digit fades out while at the same time the new digit fades in. This is a user preference, and other than changing the look of the digits as they change, has no other effect.

The Slide Across style option is when a switching to a different display value (time/date/temperature). The old digits “slide” off the display on the right side and the new digits slide in from the left side. This is a user preference, and other than changing the look of the digits as they change, has no other effect.

A blinking '00' → '03', '10' → '13', '21' → '23' will be displayed in the 2 rightmost digits, indicating the selected display style. To change the style, press the black function button (left side). Press the red mode button (right side) when the desired display style is shown. The next option will be displayed.

To cancel the option mode, press and hold the red mode button until the display goes blank. Release the mode button and the clock will go back to normal operation. Option 1 & 2 will still be saved, but option 3 will not be saved.

5.1.9 Option 4 – Temperature units, F or C

Display: “01:□□ □□”

This option selects the temperature units displayed:

- '00' format is Degrees Celsius.
- '01' format is Degrees Fahrenheit (default).

A blinking '00' or '01' will be displayed in the 2 leftmost digits, with the colon on. To change the temperature display format, press the black function button (left side). Press the red mode button (right side) when the desired hour format is displayed. The next option will be displayed.

To cancel the option mode, press and hold the red mode button until the display goes blank. Release the mode button and the clock will go back to normal operation. Option 1, 2 & 3 will still be saved, but option 4 will not be saved.

5.1.10 Option 5 – Brightness level

Display: “□□:00 □□”

This option selects the brightness level for the display.

There are 5 brightness levels to select. '01' → '04' select a fixed brightness level as follows:

- '01' = dim, no colons
- '02' = low-medium
- '03' = medium
- '04' = brightest level
- '00' = Auto brightness level (default). When this level is selected, a light sensor on the clock will automatically set the display brightness level, depending on the ambient light level.

Note: When the clock is in the dim level, either manually selected or selected by the auto level, the blinking colons will not be displayed on the time display.

A blinking '00' → '04' will be displayed in the 2 middle digits, with the colon on. To change the brightness level, press the black function button (left side). Press the red mode button (right side) when the desired brightness level is displayed. The next option will be displayed.

To cancel the option mode, press and hold the red mode button until the display goes blank. Release the mode button and the clock will go back to normal operation. Option 1 - 4 will still be saved, but option 5 will not be saved.

5.1.11 Option 6 – Anti-cathode poisoning function

Display: “□□:□□ 02”

This option selects the anti-cathode poisoning function. This option will enable/disable anti-cathode poisoning function for the display.

- '00' = disable anti-cathode poisoning function.
- '01' → '23' = selects which hour anti-cathode poisoning starts.
- '02' is the default value (2 am).

Anti-cathode poisoning mode helps prevent a condition in Nixie tubes where the cathodes (the individual digits) that aren't used often will be 'poisoned'. This is where deposits build up on the digits. When these deposits are thick enough, parts of the digit will not light up. This mode will cycle all the tubes through all the digits at full brightness 4 times, exercising the digits, preventing cathode poisoning.

A blinking '00' → '23' will be displayed in the 2 rightmost digits, with the colon on. To change the enable time, press the black function button (left side). Holding the function button on will quickly cycle through the hours (0-23). Press the red mode button when the desired anti-cathode poisoning enable time is displayed. The next option will be displayed.

To cancel the option function, press and hold the red mode button until the display goes blank. Release the mode button and the clock will go back to normal operation. Option 1 - 5 will still be saved, but option 6 will not be saved.

Setting the display ON/OFF times

The clock display can be programmed to turn off and on at a specified time. Turning the digits off at night can extend the life of the tubes, or it may be desired to have the clock dark at night. The OFF time setting is the hours: minute when the display will turn off. The ON time setting is the hours: minute when the display will turn back on. Note: When the display is off, and either the red mode button or the black function button is momentarily pressed, the display will go back on. It will stay on until the next OFF time is reached.

Note: Default setting is display OFF at 23:00, and display ON at 6:00.

5.1.12 Entering the OFF/ON set time enable

Enter the OFF/ON set time enable by pressing and holding the red mode button until the display goes blank. Then release the mode button (the hour digits will start to flash right away, keep holding the button until the display goes blank). The clock will now be in the Set OFF/ON times mode, which is indicated by the current OFF time (initially zero hours, zero minutes), and the leftmost colon on. Seconds digits will be blank.

5.1.13 **Setting the OFF time**

The OFF time setting is indicated by the leftmost colon on.

Setting the display OFF time is accomplished by using both the mode button and the function button.

The hours digits will be flashing on and off once a second. The black function button will change the hour value. Holding the function button on will quickly cycle through the hours (0-23). Note: When setting the hours, 24 hour mode is used, regardless of the hour format setting (12/24 hour display mode). This means '00' is 12 AM (midnight), and '13' is 1 PM (afternoon).

Once the hours are set correctly, press the red mode button to change to the minute value. When the mode button is momentarily pressed, the minutes digits will flash on and off once a second. The black function button will change the minute value. Holding the function button on will quickly cycle through the minutes (0-59).

After the minutes are set correctly, momentarily press the red mode button. At this point, all the digits (Hours:Minutes:Seconds) will flash once a second. Pressing the mode button again will update the OFF time to the new settings.

To cancel setting the OFF time value at any point, press and hold the red mode button until the display goes blank. This will cancel setting the OFF time. When the mode button is released, the clock will go back to the normal display.

After the OFF time is set, the ON time is set next.

5.1.14 Setting the ON time

The ON time setting is indicated by the rightmost colon on.

Setting the display ON time is accomplished by using both the mode button and the function button.

The hours digits will be flashing on and off once a second. The black function button (left side) will change the hour value. Holding the function button on will quickly cycle through the hours (0-23). Note: When setting the hours, 24 hour mode is used, regardless of the hour format setting (12/24 hour display mode). This means '00' is 12 AM (midnight), and '13' is 1 PM (afternoon).

Once the hours are set correctly, press the red mode button (right side) to change to the minute value. When the mode button is momentarily pressed, the minutes digits will flash on and off once a second. The black function button will change the minute value. Holding the function button on will quickly cycle through the minutes (0-59).

After the minutes are set correctly, momentarily press the red mode button. At this point, all the digits (Hours:Minutes:Seconds) will flash once a second. Pressing the mode button again will update the ON time to the new settings.

To cancel setting the ON time value at any point, press and hold the red mode button until the display goes blank. This will cancel setting the ON time. When the mode button is released, the clock will go back to the normal display.

After the ON time is set, the clock will go back to normal time display.

5.1.15 Disabling OFF/ON time

The display OFF function can be disabled by setting both the OFF and ON time to the same value, such as 00:00. This will disable the OFF mode.

5.1.16 New Year's Eve display

During New Year's Eve, the clock has a special display to mark to New Year.

At 11:50 PM New Year's Eve, the clock display will turn on if it is disabled (it will stay on if it is not).

At 11:59 PM to 12:00 AM, the display will blink, indicating the end of the current year.

At 12:01 AM the display will stop blinking.

At 12:05 AM the display will return to normal. If it was programmed to be off at this time, the display will go off.

To cancel the blinking digits, press either the mode or function button, and the New Year's display will be cancelled.

6 Trouble Shooting the Clock

This section is a guide to basic trouble shooting of potential problems for this clock.

6.1.1 Display is blank

- 1) Obvious cause – power cord not plugged in, no power at outlet. I had to ask....
- 2) Clock is in Display Off mode (see section 5.1.12). Pressing either the mode or the function button will enable the display (for one day, the next day the display will turn off again at the programmed time). Set a new OFF time, or disable completely (see section 5.1.13).
- 3) CPU locked up, remove power for 10 seconds, reapply power. Clock should go through display self-test (see section 4). Enter correct time and date.
- 4) Clock failed, contact ColdWarCreations for repair work (info@coldwarcreations.com).

6.1.2 Time not working

- 1) Display blank, see section 6.1.1.
- 2) Display or part of display digits blinking. Clock not in normal time display mode. Note: Time will blink during New Year's Eve, see section 5.1.16). Press and hold mode button (right side) until the display goes blank, release button. Clock will now be in normal mode. It may be necessary to set the time/date to the correct value, see section 5.1.1.
- 3) Display shows '00 00 00' or '11 11 11' ... '99 99 99'. Clock is in Anti-cathode poisoning mode (see section 5.1.11). Press either the mode or function button to cancel this mode. The clock will return to normal mode (for one day, the next day the clock will start the anti-cathode poisoning mode at the programmed time).

6.1.3 Date is not displayed properly

- 1) Clock must be in Display Options 01, 03, 11, 13, 21, or 23 to display the date (see section 5.1.8).
- 2) If the format is wrong (mm-dd-yy or dd-mm-yy), check date format option (see section 5.1.7).

6.1.4 Temperature display not working

- 1) Clock must be in Display Options 02, 03, 12, 13, 22, or 23 to display the temperature (see section 5.1.8).
- 2) If the format is wrong (Fahrenheit or Celsius), check temperature display format option (see section 5.1.9).

6.1.5 Colon(s) not working

- 1) The display may be dimmed to minimum. Colons are off at this setting (see section 5.1.10).
- 2) Display or part of display digits blinking. Clock not in normal time display mode, colons will display differently. Press and hold mode button (right side) until the display goes blank, release button. Clock will now be in normal mode. It may be necessary to set the time to the correct value, see section 5.1.1.
- 3) Display shows '00 00 00' or '11 11 11' ... '99 99 99'. Clock is in Anti-cathode poisoning mode (see section 5.1.11). Press either the mode or function button to cancel this mode. The clock will return to normal mode (for one day, the next day the clock will start the anti-cathode poisoning mode at the programmed time).

6.1.6 Tube(s) not working

- 1) Display blank, see section 6.1.1.
- 2) Tube(s) delay coming on when clock cold or in dark room. This is normal for Nixie tubes – they need external energy to turn on. When it is dark they may not come on right away. Once they warmup, they should be ok.
- 3) Parts of the digit do not show up. The tubes have Cathode Poisoning. Make sure the Anti-Cathode poisoning function is enabled. If it does not clear after a week or two, the clock will need servicing (new tubes). Contact ColdWarCreations (info@coldwarcreations.com).
- 4) A Nixie tube(s) does not light up; the clock will need servicing (new tubes). Contact ColdWarCreations (info@coldwarcreations.com).

7 Maintenance and Care

Cleaning

Use a non-abrasive cleaner on the outer glass case. Do not get any water inside the clock!

Note: Make sure to unplug the clock before cleaning. While operating high voltage is present.

Use

The Nixie clock may be used indoors 50 Deg F. to 120 DegF. Higher or lower temperatures will shorten the life of the tubes.

Never use outdoors!

8 Warranty

Limited Warranty

- ⤴ What is covered
The case, circuit board and switches from any manufacturing defects. The Nixie tubes are covered for incomplete digits and/or blank digits. Neon colons are covered for failed colons.
- ⤴ What is not covered
Breakage due to misuse, neglect, water damage or outdoor use. Damage due to incorrect voltage converters is not covered. Minor flickering of neon colons is not covered.
- ⤴ Period of coverage
One (1) year from date of purchase for the case, circuit board and switches.
- ⤴ What We Will Do to Correct Problems
We will repair or replace (at our discretion) free of charge. Shipping is not included.
- ⤴ How You (the customer) Can Get Service
Email: info@coldwarcreations.com for a conformation number for returns or any questions on this warranty.

Date of purchase _____

Serial Number _____

Inspected

9 Specifications

- ⤴ Simax brand glass case material
- ⤴ Laser cut acrylic internal pieces
- ⤴ 8 bit AVR Mega168 RISC processor
- ⤴ Temperature compensated 32 kHz time keeping crystal
- ⤴ 115 VAC wall transformer supplying 12 VDC 200 MA maximum current. Also a 9 VDC 300 mA supply may be used.
- ⤴ 6 IN-16 Soviet Nixie Tubes, 180v anode voltage, running at 2.7 mA peak, 0.93 mA average. Multiplexed 2x6.

- ⤴ Dimensions: 8.4” L x 3.58” H x 3.4” W, 1.2 lbs

- ⤴ Dimensions: 214mm L x 91mm H x 86mm W, 0.544 kg