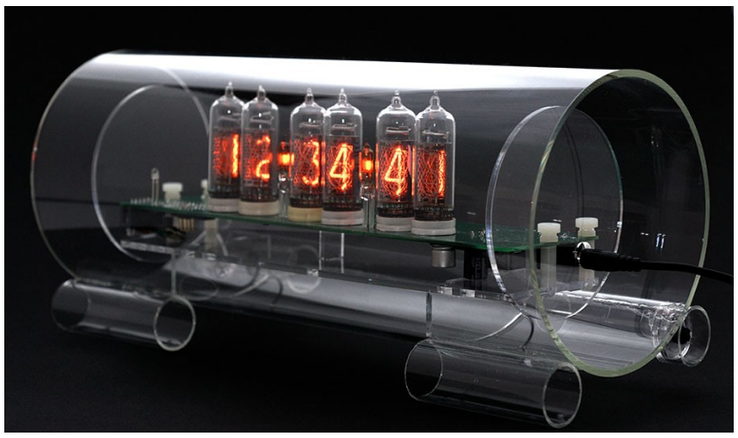
Glass Nixie Tube Clock #3



User's manual

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1 Glass Clock Design #3

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 and 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.

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”.

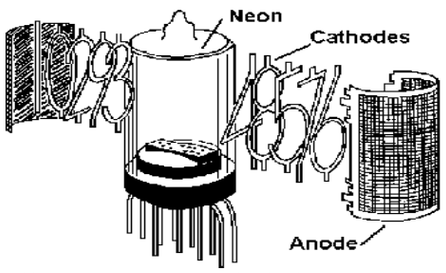


Illustration 1: Exploded view of a Nixie tube

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-14 series of tubes. One interesting feature is the '5' digit. It is actually the '2' digit upside down and reversed, making for a very unique looking '5'.

3 Clock Features

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

- Unique look of individually formed digits.
- Optically pure Simax brand glass tubes for the case.
- 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, 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 timebase for accuracy.
- Automatic Leap Year correction.
- Auto display brightness settings.
- Option for cross fading digits.

4 Unpacking and setting up the Clock

Carefully unpack the clock from the box. The box should contain a wall plug-in power supply, two clear acrylic end plates and the clock itself.

The power supply plugs into the wall outlet. The other end plugs into the clocks 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 to buttons. On the left is a black function button, and on the right is a red mode button.

At this point, the clock should show “0 00 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.

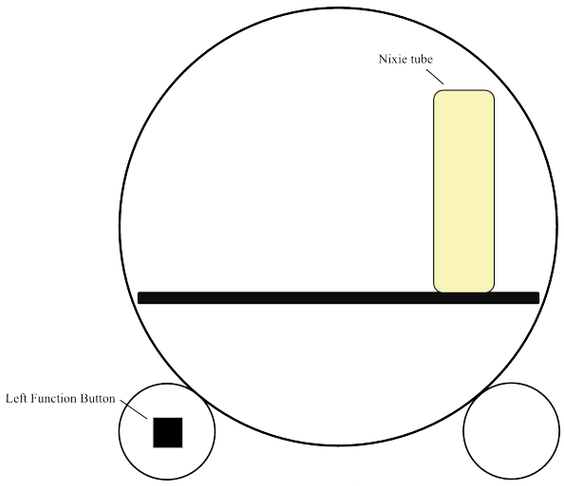


Illustration 2: Side View, Left

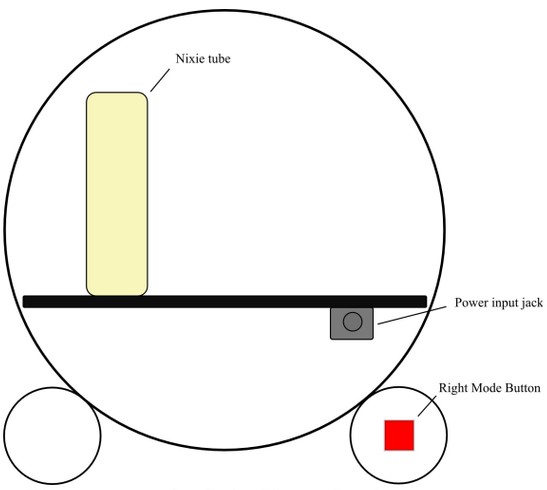


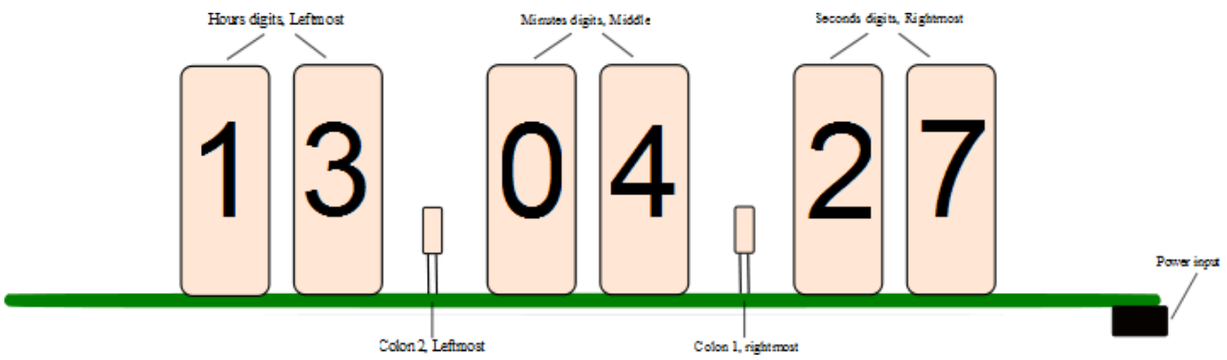
Illustration 3: Side View, Right

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 and the black function button.

5.1 Clock diagram

Illustration 4: Side view



5.2 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 hours digits will flash on and off once a second.

5.3 Set time mode

When the clock is in the set time mode, the current time will be displayed with the hours (2 leftmost digits) blinking. The colons will both be on steady (no blinking) and the seconds will be off.

If the colons are blinking, the clock is still in the normal display mode, and the red mode button on the right side should be momentarily pressed to enter the set time mode.

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 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.

5.3.1 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).

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.

5.3.2 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 hours 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.

5.4 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.

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 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.

5.4.1 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).

5.4.2 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).

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

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

5.4.3 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.

5.5 Setting the Alarm Time

Set the alarm time by pressing the black function button on the left side momentarily. When pressed, the right most colon will be flashing, and the hours digits will flash on and off once a second.

5.5.1 Enabling the Alarm

The alarm function is enabled by putting the Alarm Enable Switch (SW3) in the ON position.

When this switch is OFF, the alarm time will be ignored. Also, if an alarm is present, turning the switch OFF will cancel the alarm.

When the time equals the alarm time, the alarm output will go on for 30 seconds, unless canceled by the Alarm Enable Switch.

5.5.2 Set Alarm time mode

When the clock is in the set time mode, the current alarm time will be displayed with the hours (2 leftmost digits) blinking and the right most colon will be flashing.

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

5.5.3 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).

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.

5.5.4 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 hours 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 alarm time to the new settings.

5.6 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 cross fade
Option 4	Temperature units, F or C
Option 5	Brightness level, auto or fixed brightness
Option 6	Anti-cathode poisoning mode start time

5.6.1 Option 1 – 12/24 hour mode

This option selects the hour style displayed. 12 hour style is 1:00 → 12:00 AM/PM. 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.

5.6.2 Option 2 – Date format display option

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.

5.6.3 Option 3 – Display option, time/date/temperature, crossfade

There are 3 different display styles available:

'01' = display time and date.
'02' = display time and temperature.
'03' = display time, date and temperature.
'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.

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 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.

A blinking '01' → '03', '11' → '13' 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.

5.6.4 Option 4 – Temperature units, F or C

This option selects the temperature units displayed. '01' format is Degrees Centigrade. '02' format is Degrees Fahrenheit.

A blinking '01' or '02' 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.

5.6.5 Option 5 – Brightness level

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. When this level is selected, a light sensor on the clock will automatically set the display brightness 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 - 3 will still be saved, but option 5 will not be saved.

5.6.6 Option 6 – Anti-cathode poisoning function

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.

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 - 4 will still be saved, but option 6 will not be saved.

5.7 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 pressed, the display will go back on. It will stay on until the next OFF time is reached.

5.7.1 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 clock will now be in the set OFF/ON times. This is indicated by the current OFF time (initially zero hours, zero minutes), and the leftmost colon will be on. Seconds digits will be blank.

5.7.2 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.

5.7.3 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.

5.7.4 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.

6 Maintenance and Care

6.1 Cleaning

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

The sides of the clock may be removed, but only with the clock unplugged! If the inside of the case needs to be dusted, be very careful of the tubes, they are delicate!

The round acrylic side shields (mounted on both sides of the printed circuit card) can be removed. Remove the clear tape from the tabs, and gently pull the side shields straight out. To install, push the side shields back on the tabs.

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

6.2 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!

7 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. The Nixie tubes and neon colons are covered for 6 months from date of purchase.

- 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

8 Specifications

- Simax brand glass case material
- Laser cut acrylic internal pieces
- 8 bit AVR Mega88 RISC processor
- Temperature compensated 32 kHz time keeping crystal
- 115 VAC wall transformer supplying 12 VDC 200 MA maximum current
- 6 IN-14 Soviet Nixie Tubes, 180v anode voltage

- Dimensions: 12” L x 5.5” H x 5.25” W, 2. lbs