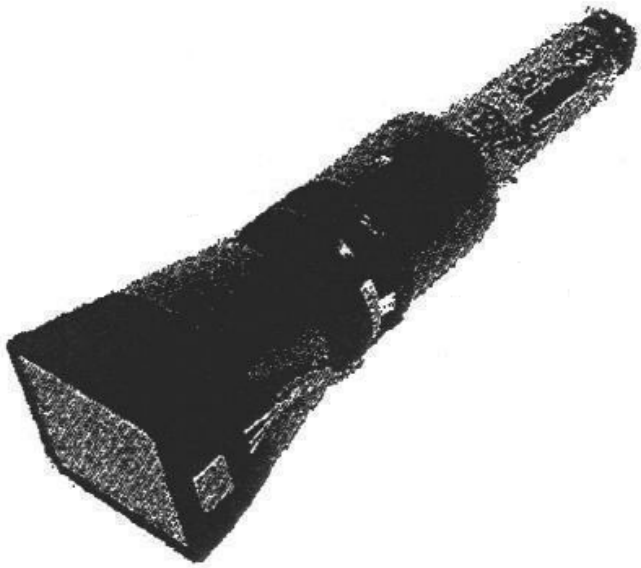
BHD Direct Viewing Storage Tube

E2668B1



Toshiba E2668B1 is a 6-inch diagonal rectangular flat-face electrostatic convergence/electrostatic deflection, two constant potential BHD-type, direct-viewing storage tube.

The newly developed BHD (Black matrix, Hybrid mesh, Dot screen) technology makes this tube a high performance, direct-viewing storage tube that can be used not only for usual waveform storage but also for character storage.

This tube can also be used as a normal oscilloscope tube.

General Specifications

Electrical Specifications:

	writing part	reading part
Heater (indirectly heated)		
Voltage (1)	6,3 V ac or dc +/- 10%	6,5 V dc +/- 10%
Current	0.6 A	0.6 A
Convergence method	Electrostatic	--
Deflection method	Electrostatic	--
Capacitance between electrodes		
G1 to all other electrodes	6.5 pF	13 pF
Cathode to all other electrodes	5.5 pF	27 pF
Backplate to all other electrodes	--	1 pF
Between X-axis deflection plates	4.0 pF	--
Between Y-axis deflection plates	1.5 pF	--
Deflector plate X+ to all other electrodes	7.0 pF	--
Deflector plate X- to all other electrodes	7.0 pF	--
Deflector plate Y+ to all other electrodes	4.0 pF	--
Deflector plate Y- to all other electrodes	4.0 pF	--

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Optical Specifications

Fluorescence	B1 (P1)
Phosphorescence	Yellowish green
Persistence	Normal (medium)
Faceplate	Rectangular clear flat

Mechanical specifications

Total length	427 +/- 7 mm
Maximum diameter	max. 153 mm
Neck diameter	51 +/- 2 mm
Available scanned area	
Diagonal	min. 128 mm
Width	min. 100 mm
Height	min. 80 mm
Side pins	Special pins
Side pins arrangement	See external dimension diagram
Base	Special 14-pin base

Base arrangement :

- Deflection electrodes X+ and X- are closer to the scanned area and Y+ and Y- are closer to the base side.
- The angle between the plane through the tube axis and pin 4, and the horizontal axis of graticule is 0 +/- 30°.
- The angle between the plane through the tube axis and collimator electrode terminal, and the horizontal axis of graticule is 0 +/- 10°.
- A positive voltage on X+ deflection electrode deflects the beam approximately towards pi n 11.
- A positive voltage on Y+ deflection electrode deflects the beam approximately towards pi n 14.

Deflection axis angle (2)	90° +/- 1.5°
Bright line tilt (3)	+/- 5°
Mounting orientation	any
Weight	ca. 1500 g

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Absolute Maximum Ratings

	writing part	reading part
Backplate voltage	--	400 V *
Hybrid voltage	--	400 V *
Collimator voltage	--	400 V *
	writing part	reading part
2nd anode voltage	max. 4500 V	--
	min. 2900 V	--
G2 voltage	max. 4500 V	300 V *
	min. 2900 V	--
Deflection shield voltage	max. 4500 V	--
	min. 2900 V	--
First anode voltage	1500 V	--
G1 voltage :		
Negative bias voltage	200 V	400 V
Positive bias voltage	0 V	0 V
Peak positive voltage	0 V	0 V
Peak voltage between heater and cathode	+/- 180 V	--
Peak voltage between deflection electrodes and 2nd anode	550 V	--
Voltage between backplate and hybrid electrode	--	400 V
Voltage between hybrid electrode and collimator	--	400 V
Voltage between collimator and 2nd anode	--	400 V

Voltages marked with ***** are referenced to the reading gun cathode. Other voltages are referenced to the writing gun cathode.

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Equipment Design Data

In case of design with G2 to writing gun cathode voltage E_{WC2} (4) between 3000 V to 4000 V:

Shield voltage between deflection electrodes (5)(6)	E_{WC2} x (95 ... 105)% V
2nd anode voltage	E_{WC2} x (95 ... 105)% V
1st anode voltage	E_{WC2} x (16.1 ... 23.8)% V
1st anode current	-30 µA ... +20 µA
Spot cut-off voltage	max. E_{WC2} x (-22.5)% V
Deflection factor :	
X-axis	E_{WC2} x (5.8 ... 6.8) x 10^{-3} V/cm
Y-axis	E_{WC2} x (4.3 ... 5.5) x 10^{-3} V/cm

Usage Example

Writing gun **

G2 voltage (4)(5)	3000 V	4000 V
2nd anode voltage	2800 V ... 3200 V	3850 V ... 4150 V
Voltage on shield between deflection		
electrodes	2850 V ...3150 V	3800 V ... 4200 V
Spot cut-off voltage	-35 V ... -70 V	-50 V ... -90 V
1st anode voltage	500 V ... 750 V	700 V ... 950 V
Deflection factor :		
X-axis	17 V/cm ... 21 V/cm	22 V/cm ... 27 V/cm
Y-axis	13 V/cm ... 17 V/cm	17 V/cm ... 22 V/cm
Available scan area :		
X-axis direction	min. 100 mm	
Y-axis direction	min. 80 mm	
Raster distortion (7)	max. 1.5 %	
Linearity	max. 5 %	
Spot Position (8)	max. 14 mm	

** voltages are referenced to the writing gun cathode.

Reading gun ***

G2 voltage (5)(9)	200 V
G1 voltage (10)	0 V ... -50 V
Spot cut-off voltage (10)	-200 V ... -320 V
G2 current	max. 20 mA
Cathode current	max. 30 mA
Collimator electrode :	
Voltage	150 V ... 250 V
Current	-3 mA ... +5 mA
Hybrid electrode :	
Voltage, any mode	300 V
Current	max. 20 mA

Backplate (10) :

Voltages :	
Writing mode	70 V ... 190 V
Reading mode	70 V ... 190 V
Erasing mode :	
Positive erasing mode	300 V
Negative erasing mode	0 V
Current, max.	-5 mA ... +20 mA

******* voltages are referenced to the reading gun cathode.

Characteristic Example

Bright line thickness (12):	
for a G2 voltage of 3000 V	ca. 0.5 mm
for a G2 voltage of 4000 V	ca. 0.4 mm
Accumulated optical output (13)(14)	min 8.0 fL
Reading time	--

(see supplement to usage example)

Writing speed	min. 250 m/s
Erasing time	max. 0.5 s

Maximum Figures

G1 resistor	1.5 MΩ
Deflection electrode resistor (14)	1 MΩ

Notes :

(1) The heater voltage of the reading gun is 6.5 V dc. One side of the reading gun heater is internally connected to the cathode and should be connected to the positive of the heater voltage.

(2) The trace drawn by X+ and X- deflection electrodes is within 90° +/- 1.5° to the one drawn by the Y+ and Y- electrodes.

(3) The trace drawn by X+ and X- electrodes is within +/- 5º to the horizontal axis of the face.

(4) For bright and sharp trace apply 3000 V or more to G2.

(5) G2 of the writing gun has an independent terminal WG2 and it is not connected to any electrode internally. G2 of the reading gun is internally connected to the shield between the deflection electrodes and has a separate Isd,VA external pin.

(6) Set the deflection electrode shield voltage so that the geometry distortion becomes minimum.

(7) The raster distortion shall fall within the boundaries of the 81.2 x 101.5 mm² and 78.8 x 98.5 mm² rectangles.

(8) The undeflected spot is within a 14 mm-square in the center of the screen. The position changes depending on external magnetic field.

(9) Set the average voltage between deflection electrodes or the reading gun's cathode voltage so that the voltage between G2 and the reading gun cathode is kept as specified.

(10) Set the reading gun's G1 voltage, collimator voltage, hybrid voltage and backplate voltage all relative to the reading gun cathode voltage as above (9).

(11) Always keep the hybrid electrode voltage as the highest voltage in the tube even when the power is turned on or off. If this condition is not fulfilled, the screen fluorescence degrades.

(12) The width of the bright line is measured with a 20x-power microscope at the center of the faceplate when the beam current is 10 μA, the vertical deflection frequency is 4500 Hz synchronized with horizontal deflection frequency of 60 Hz and the scanned area is 80 x 100 mm².

(13) This brightness is measured at the center of the scanned area when the operation voltage is the backplate voltage. This brightness is the initial value and the optical storage output decreases gradually

after long use due to the impact of ions and the reading electrons. So, if you often use the oscilloscope as a normal scope, set the reading gun heater voltage to the stand-by voltage (E_{VF} = 4.2 Vdc) and cut the reading beam off.

(14) For deflection electrodes facing each other, use the same deflection electrode resistance value.

Supplement to Usage Example

1. Adjustments before use

(1) Correct tilt with the attached correction coil.
(2) Focus adjustment.
Display a spot in the center of the faceplate and adjust the writing gun's anode voltage (P2 terminal) and focus voltage so that you get the best spot.
(3) Geometry distortion adjustment.
Adjust the shield voltage between the deflection plates so that the geometry distortion becomes minimum.
(4) Setting the collimator voltage.
After setting the backplate voltage to about 300 V (full area storage) with the beam flowing, set (the collimator voltage to) the voltage specified in the datasheet. At this point, all the scanned area is illuminated. After that, adjust the collimator voltage so that the brightness becomes even everywhere in the available scanned area.
Incomplete collimator adjustment may result in problems such as low brightness, lack of available storage area or incomplete erase.
(5) Setting the reading gun's G1 voltage.
When you adjust the collimator voltage, adjust G1 voltage also so that the storage brightness becomes optimum. About -15 V, normally.
(6) Setting the backplate operating voltage.
Writing is ready if you set the backplate voltage from 0 V to the operating voltage F_{STB}(OL) within the spot cut-off time (0.5 s or less). The optimum voltage may be a little higher or lower than the specified voltage. So, check it and set (properly).
If the backplate voltage is set higher than the specified voltage, the brightness and writing speed will increase, but the contrast will decrease.
If the backplate voltage is set lower than the specified voltage, the contrast will increase but brightness and writing speed will decrease.

2. How to store and erase

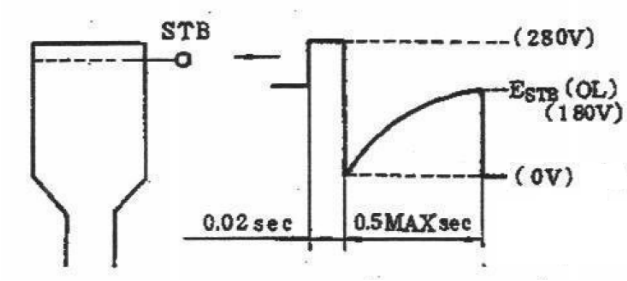
(1) Storing.
After adjusting each voltage, the writing will be done if you activate the writing gun and scan with appropriated frequency and amount of writing beam.
(2) Writing speed and width of writing bright line.
Writing speed and width of writing bright line are related to the amount of recording beam. Less beam gives a narrower bright line.
(3) Reading time and storage.
The reading time is semipermanent in principle, but avoid unnecessarily long time reading as much as possible.

If you observe the screen for long time, the writing speed of what you observe may become lower, so be careful when you hold the stored image.

(4) How to increase the writing time.
The best way to increase the writing time is to apply appropriated pulses to the backplate or reading gun's cathode.

(5) Erasing.
Erasing of the stored image is done by applying a negative pulse with quick falling and slow rising time to the backplate, or by applying a positive pulse to the reading gun's cathode.
For a perfect erasing, apply a positive pulse first before applying a negative pulse with a shape of an inverted triangle to make all the storage area in the storage status.

A typical erase pulse is shown below :



Voltages are measured relative to the reading gun's cathode voltage.

3. Operation as a normal oscilloscope

(1) To use as a normal oscilloscope set the backplate voltage to the same voltage as the reading gun's cathode voltage.

(2) In addition, to prolong the life of the fluorescent screen, we recommend you to set the reading gun's heater to stand-by (E_{VF} = 4.2 V +/- 5 %) and to set the reading beam to cut-off. However, please note that switching the reading beam on and off may change the X and Y axis sensitivity by several %.

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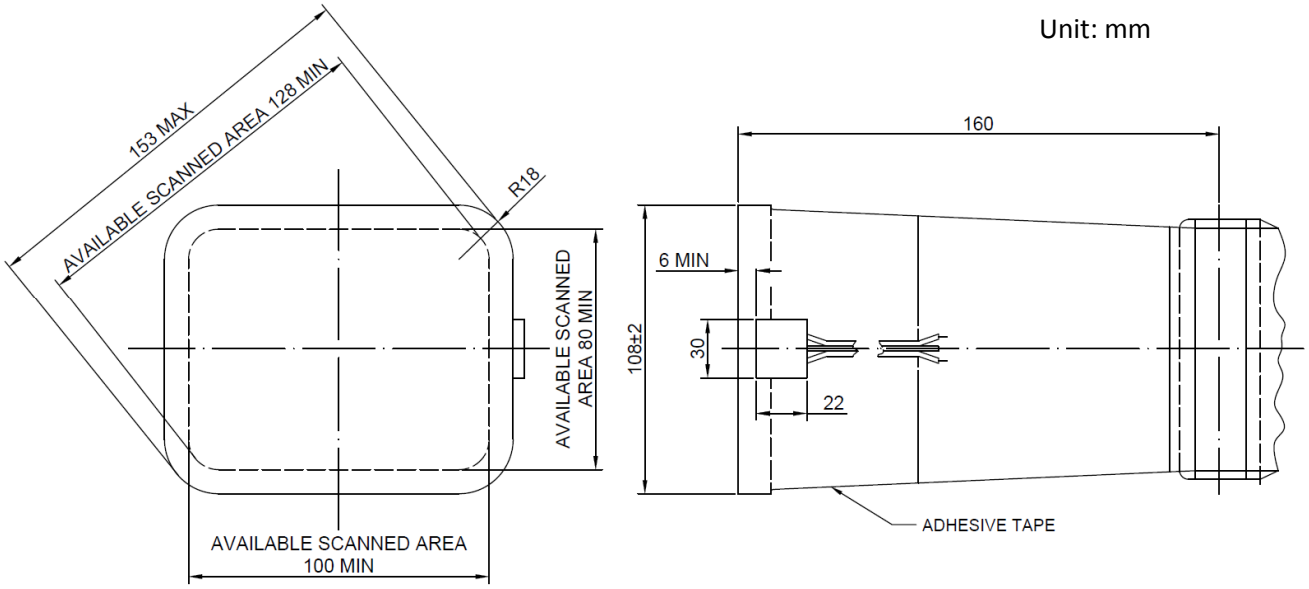
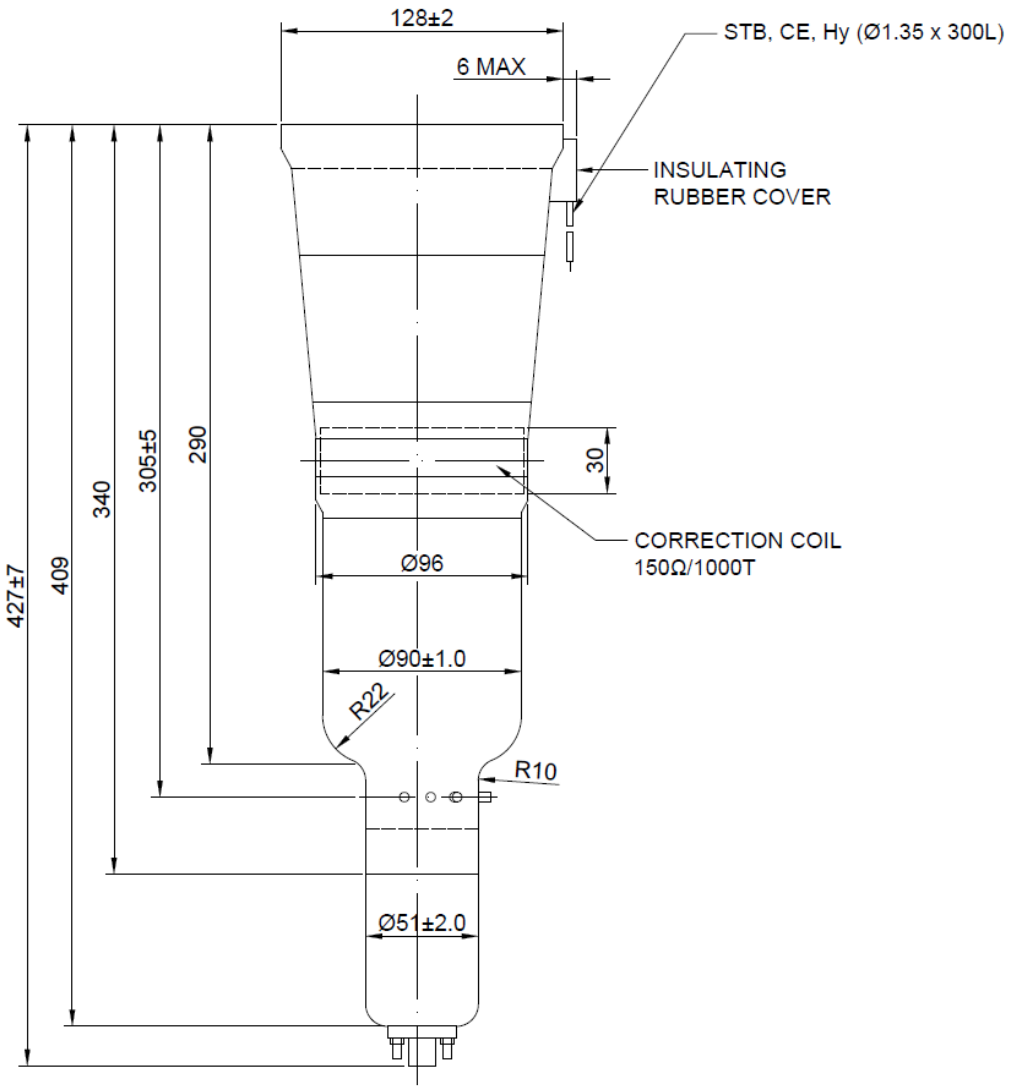
Outline Dimensional Drawings

Unit: mm





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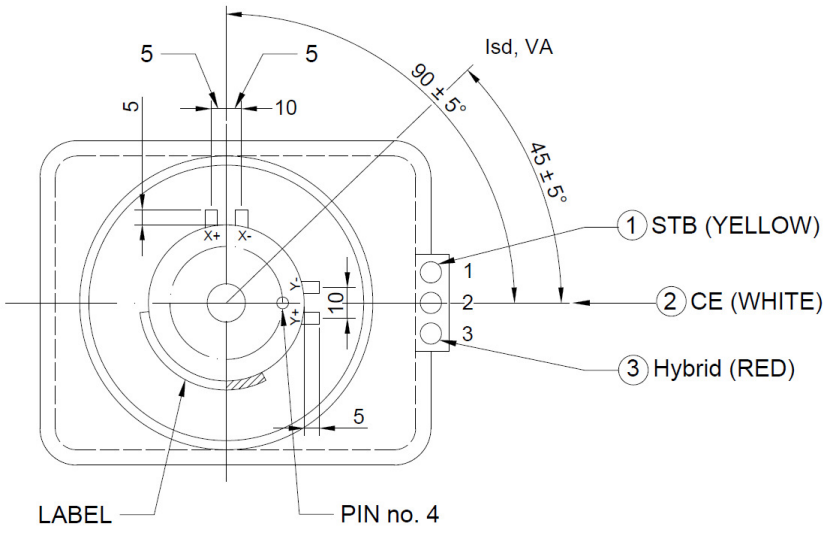
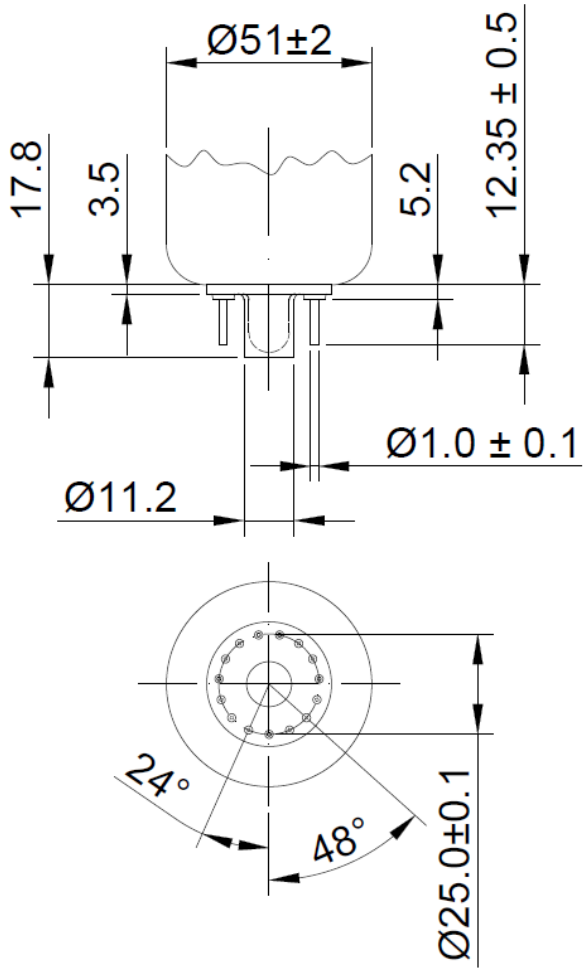

5
5
5
10
Isd, VA
90 ± 5°
45 ± 5°
X+
X-
Y-
Y+
10
5
1
2
3
1 STB (YELLOW)
2 CE (WHITE)
3 Hybrid (RED)
LABEL
PIN no. 4


Ø51±2
17.8
3.5
5.2
12.35 ± 0.5
Ø1.0 ± 0.1
Ø11.2
24°
48°
Ø25.0±0.1

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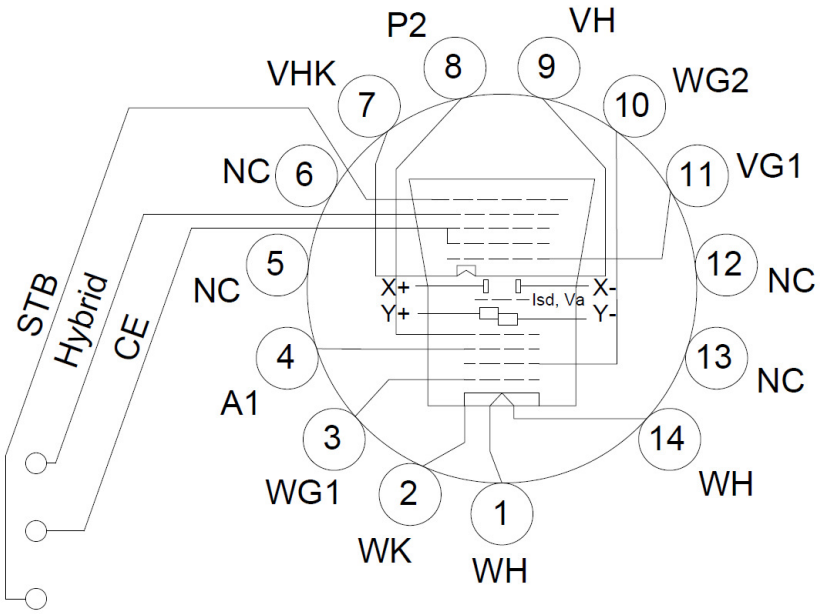
Base diagram



Electrode placement diagram