

## TELTRON TUBES

### THREE CLASSICAL ELECTRON PHYSICS EXPERIMENTS FOR YOUR LAB:

- e/m experiment
- Hertz experiment
- electron diffraction experiment

Tel-Atomic Classical Electron Physics System includes all the apparatus necessary for performing these experiments.

The System is a modular design which permits the experiments to be performed with the same basic setup; only the tubes need to be changed. Apparatus included in the complete System includes the following:

TEL 501 Universal Stand  
TEL 502 Helmholtz Coils  
TEL 525 Deflection e/m Tube  
TEL 533 Hertz Critical Potentials Tube  
TEL 555 Electron Diffraction Tube

**CATALOG TEL TS560**  
**CLASSICAL ELECTRON PHYSICS SYSTEM** **\$1,907.00**

#### ALSO NEEDED:

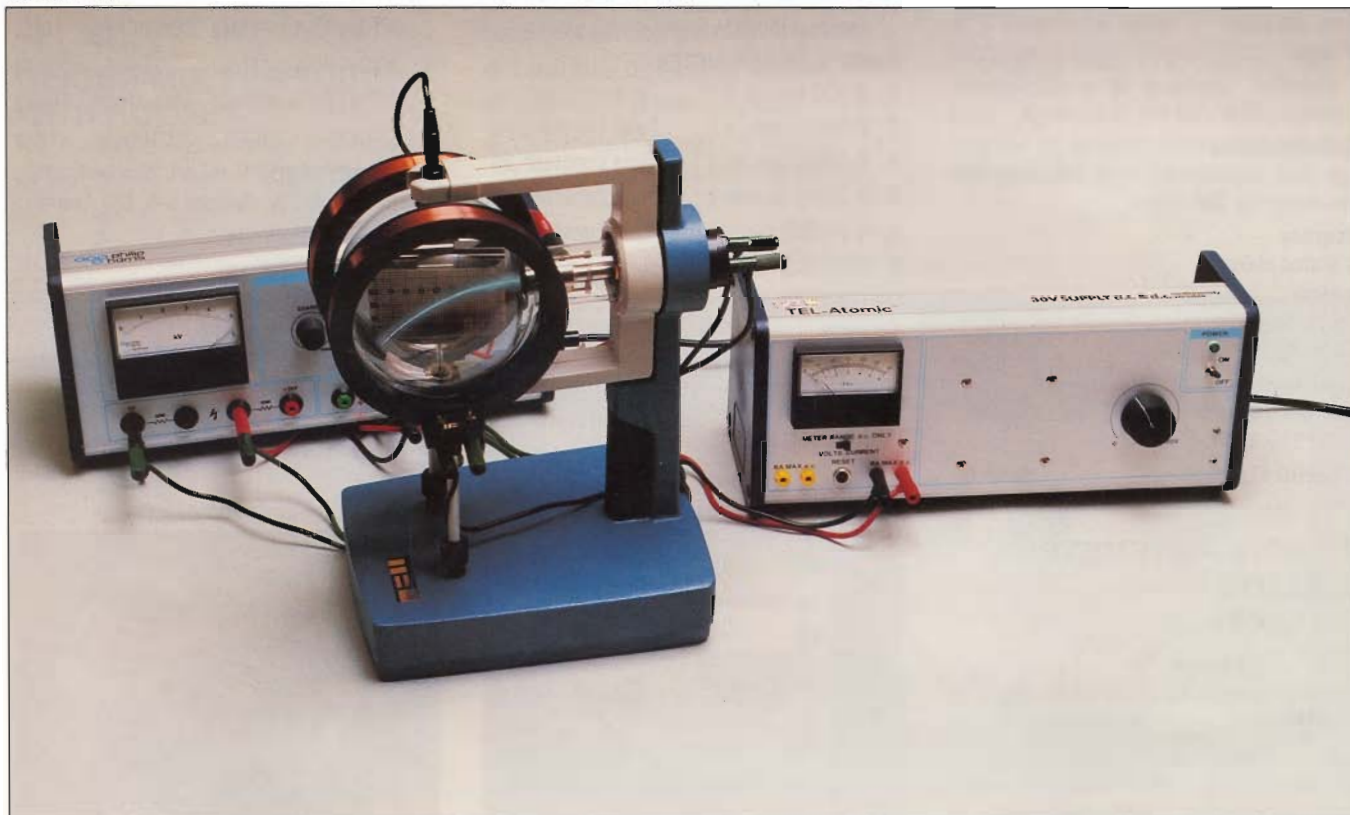
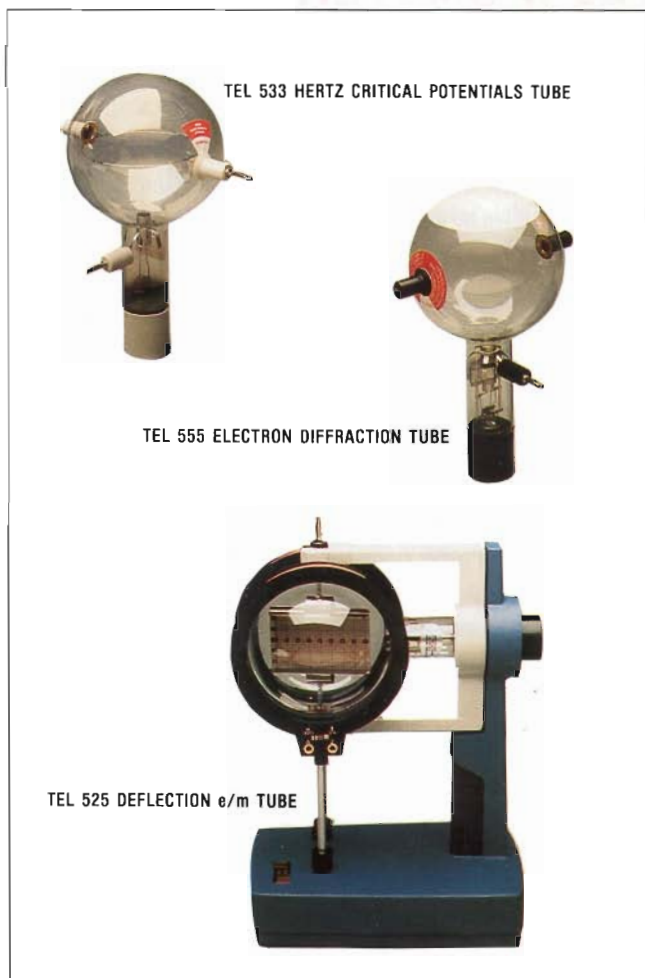
Power supplies for use with the Classical Electron Physics Systems are described on page 23.

### TEL 500 BANANA CORD SET

Banana cord set provides all the connectors required for use with Teltron tubes. Each set includes six couplers, four sockets, four plugs and thirteen banana cords.

**CATALOG TEL 500** **\$238.00**

TEL 525 DEFLECTION e/m TUBE WITH TEL 501 UNIVERSAL STAND AND TEL 502 HELMHOLTZ COILS TEL 813E KV POWER UNIT IN FRONT AND TEL 800E L.V. POWER UNIT ON RIGHT



# TELTRON TUBES

## TELTRON TUBES ARE:

- Perfect for the laboratory
- Excellent for an introduction to atomic physics
- Large enough to use for demonstration
- Modular
- In compliance with DHEW radiation safety standards

## SYSTEMATIC STUDY OF THE ELECTRON

With Teltron tubes properties of the free electron and the electron within the atom can be studied. A logical progression of experiments can be performed with these tubes from thermionic emission of electrons from a hot filament to dual properties of the electron. Experimental instructions are included with each tube.

## AN INTRODUCTION TO ATOMIC PHYSICS

Knowledge of the electron is fundamental to an understanding of atomic structure. Teltron tubes and their accessories allow the teacher to provide students with a clear grasp of the nature of the electron, leading to a proper understanding of positive ions, radioactivity and x-rays.

## DEMONSTRATIONS

Teltron tubes are designed for use in the laboratory; however, the large size of the tubes and the stand used to hold the tubes make them excellent for classroom demonstrations. Intensity of the electron beam is such that lights in the classroom need only to be dimmed to see it clearly.

## THE COMPLETE ASSEMBLY

The photograph below illustrates a typical assembly in which a tube is mounted in the Universal Stand. The experimental zone sphere is contained within the Helmholtz Coils to obtain magnetic deflection of a cathode ray beam.

## TEL 501 UNIVERSAL STAND

Designed to accommodate the whole range of Teltron tubes and accessories, the Universal Stand provides easy access to all plug and socket connections and gives a clear view of the experimental zone. The vertical stanchion is die-cast, integral with the plinth, in aluminum and finished in Teltron blue. The jaws, clamped in the stanchion cavity are made of heat-resistant plastic and provide good electrical insulation. Any tube can be mounted in the stand by placing the neck within the stanchion cavity and springing the side caps of the experimental zone sphere into the jaw clamps. Tubes can be rotated through 360° about an axis which is 25 cms above the table top. The stand is mounted on 3 rubber feet. It has overall dimensions of 34 cms high, 18 cms wide, 30 cms long and weighs 2 kg.

**CATALOG TEL 501 \$245.00**

## TEL 502 HELMHOLTZ COILS

Magnetizing coils are supplied in pairs. When mounted on the Universal Stand they automatically provide an helmholtz configuration, where the coil radius is equal to the coil separation. Each coil has 320 turns of 22 swg enamelled copper wire wound on a plastic former of 13.6 cm mean diameter. The terminations are 4 mm sockets and "start" and "finish" is indicated.

Power Supply  
Continuous Operation-30 oersted (12 volts DC, 1.0A).

Short-Term Operation-45 oersted (18 volts DC, 1.5A).

Recommended Accessories

TEL 800E L.V. Power Unit

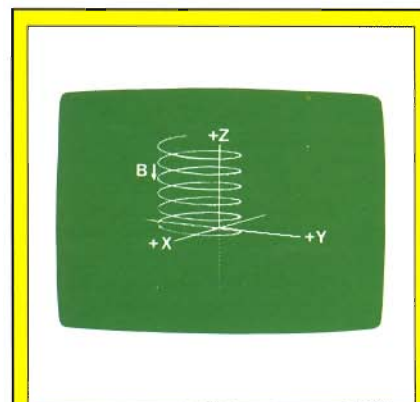
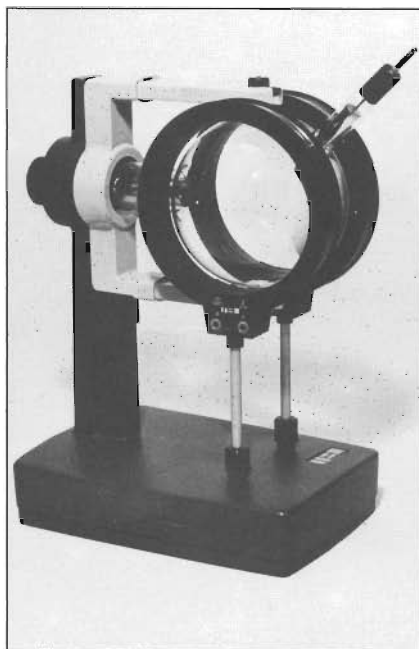
**CATALOG TEL 502 \$245.00**

## TEL 525 DEFLECTION e/m TUBE

- electron deflection by magnetic and electric fields
- determination of e/m by balanced deflections
- more accurate determination by magnetic deflection alone
- the electron mirror, trochoidal spirals
- velocity distribution and magnetic focusing
- beam divergence with an alternating magnetic field

The diode electron gun, a tungsten wire "hair-pin" filament and a cylindrical collimating anode, projects a narrow ribbon of electrons into the evacuated experimental zone. The metal plates support the phosphorcoated mica sheet to intercept the ribbon of electrons at 15° with respect to the axis of the beam. Printed on the opposite side of the mica is a

## TEL 501 UNIVERSAL STAND ACCOMMODATES ALL TELTRON TUBES



## SOFTWARE

### Motion of a Charged Particle in Electric and Magnetic Fields

The concepts of magnetic and electric fields are difficult to teach in an introductory physics course. Describing how charged particles move in a combined electric and magnetic field is even more formidable because trajectories are laborious to calculate and difficult to draw.

With this software the motion of a charged particle in a combined electric and magnetic field can be simulated. The strength of either field and its orientation can be changed and the resulting trajectory of the particle represented on a three dimensional graph which can be viewed from any angle.

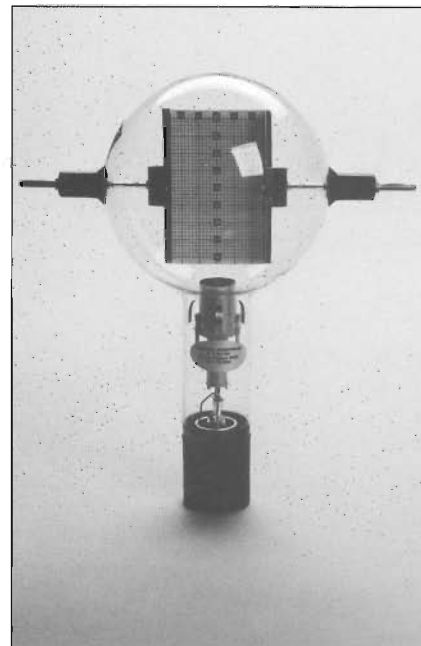
Recommended Accessories

TEL 525 Deflection e/m Tube

**CATALOG TEL CPA35 (Apple) \$56.00**

**CATALOG TEL CPI35 (IBM) \$56.00**

## TEL 525 DEFLECTION e/m TUBE



# TELTRON TUBES

centimeter graticule whose center line zero lies along the axis of the undeflected electron beam. This configuration makes visible the path of the electrons as the beam traverses the experimental zone. Deflection of the beam is caused by the electric field between the internal parallel plates or by a magnetic field applied externally by means of the Helmholtz Coils, **TEL 502**. Deflections are clearly detected and displacements relative to the undeflected beam can be easily recorded. The filament terminations are 4 mm sockets and connections are made by 4 mm plugs and sockets.

Power supply  
Anode Voltage, 1500-5000V DC  
Maximum Filament Voltage, 7.5V.  
Typical Anode Current, 1 mA.  
Recommended Accessories  
TEL 813E K.V. Power Unit  
TEL 502 Helmholtz Coils

**CATALOG TEL 525 \$476.00**

## TEL 533 HERTZ CRITICAL POTENTIALS TUBE

- electrical detection of excitation potentials Hertz
- no oven required
- measurement by oscilloscope 3 energy levels plus ionization
- measurement by spot galvanometer, 3 to 4 energy levels plus ionization
- measurement by potentiometric recorder, up to 6 energy levels
- evidence of meta-stable states

Experiments with the Gas-Filled Planar Triode reveal that energy exchanges take place through non-elastic collisions, but the resolution is not sufficient to show the existence of individual energy levels; electrons with a narrow energy spread are necessary. The

Critical Potentials Tube has the inside surface of the glass bulb coated with a transparent conducting layer connected to the anode of a diode gun to create a field-free collision region. A hot cathode emits electrons in a narrow cone determined by the exit aperture in the anode. The collector is a wire ring positioned so it cannot receive electrons directly from the cathode. The tube contains helium at low pressure. The collector ring is made positive by a few volts with respect to the anode. The collector attracts electrons which have been scattered by collision processes out of the main beam and, in contrast to the classical Franck/Hertz experiments, the collector current exhibits peaks by collecting, rather than repelling, the low energy electrons when their population is at a maximum.

The filament cathode is terminated at two 4mm sockets in the grey plastic end cap and the anode and collector ring are each connected to 4mm plugs mounted on grey plastic side caps.

Power supply  
Maximum Anode Voltage, 50V DC  
Anode Current at 30V, 2mA.  
Collector Voltage, 1 to 2V DC.  
Filament Voltage, 5 to 7V.

Recommended Accessories  
TEL 801E H.V. Power Unit  
**CATALOG TEL 533 \$428.00**

## TEL 555 ELECTRON DIFFRACTION TUBE

- study of the de Broglie hypothesis
- an optical analog of electron diffraction (see **TEL 555 A**)
- detection by ring patterns, Planck's constant
- variation of "wavelength" with anode voltage

- verification of the de Broglie hypothesis
- establishment of the dual nature of the electron
- calculation of spacing of diffracting planes
- reassessment of supposed carbon atom crystal arrangement

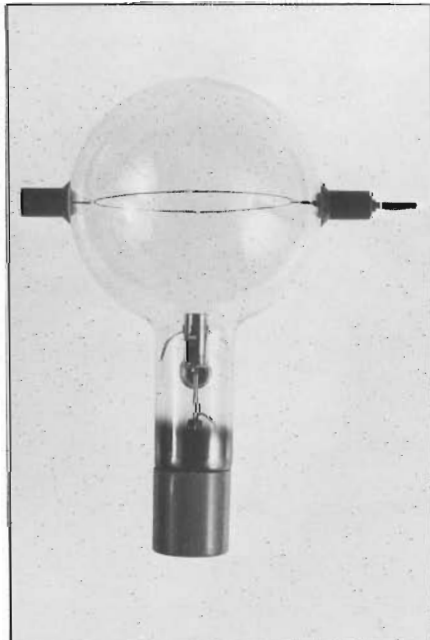
The electron gun uses an indirectly-heated oxide-coated cathode and projects a converging narrow beam of electrons through a thin layer of graphitized carbon which is supported on a fine mesh grid over the exit aperture of the gun assembly. Electrons diffracted during transmission through the carbon traverse the evacuated experimental zone to impinge on the luminescent screen in ring patterns, the center of the rings being the spot caused by the undiffracted electrons. The brightest rings are caused by diffraction at the planes in the carbon atoms separated by 1.23 and 2.13 angstroms, d11 and d10 respectively. The filament heater assembly is terminated at two 4mm sockets in the end cap and the anode assembly is connected to a 4mm plug mounted on a side cap.

Power supply  
Anode Voltage, 1500-5000 V DC  
Filament Voltage, 6.3V  
Anode Current, 0.2-0.4 mA.  
Recommended Accessories  
TEL 813E K.V. Power Unit  
**CATALOG TEL 555 \$513.00**

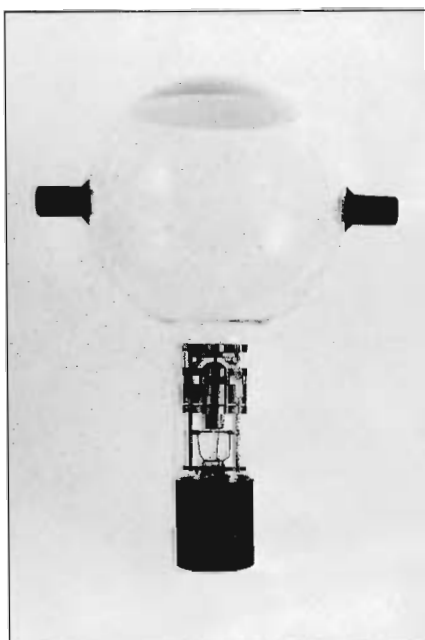
## 534 FINE BEAM TUBE (GAS-FILLED)

- narrow visible electron beams
- mean free path studies and unstable beams
- velocity focusing and gas multiplication
- primary and higher orders of ionization
- loss of energy in a spiral path
- measurement of "assumed circular path" e/m

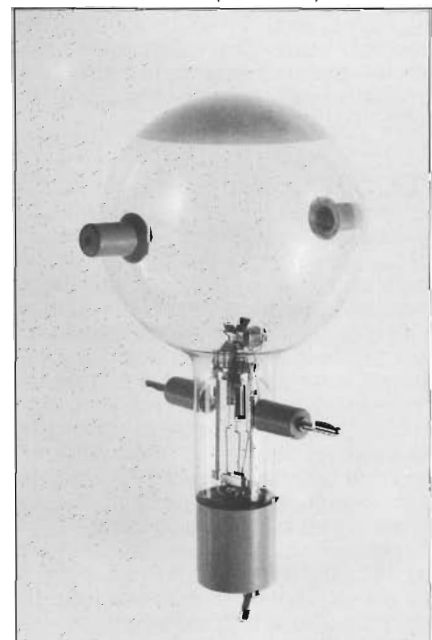
TEL 533 HERTZ CRITICAL POTENTIALS TUBE



TEL 555 ELECTRON DIFFRACTION TUBE



TEL 534 FINE BEAM TUBE (GAS-FILLED)



# TELTRON TUBES

- secondary emission and phosphor screen "blanking"
- introduction to plasma technology

The electrons emitted by the indirectly heated oxide coated cathodes are projected from the two identical guns in the form of a narrow pencil beam. These beams can be accurately traced within the helium gas as a green glow due to the emission of energy during the collision processes experienced by the electrons. The angle of projection from the guns can be modified by applying a potential across miniature deflecting plates located just beyond the emission apertures. The filament heaters are terminated at a two-way switch. Two 4 mm sockets in the grey plastic end cap; the anodes and deflecting plates are connected to two 4 mm plugs mounted on grey plastic side caps.

#### Power supply

Anode Voltage, 0-300 V DC  
Anode Current, 10-20mA.  
Heater Voltage, 6.3 V, 0.3 A.  
Deflector Voltage, 0-25 V DC  
Recommended Accessories  
TEL 801E H.V. Power Unit  
TEL 502 Helmholtz Coils

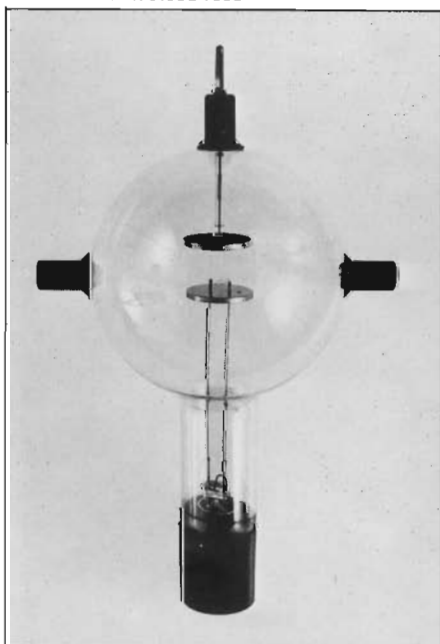
**CATALOG TEL 534**

**\$508.00**

## TEL 520 PLANAR DIODE

- phenomena of thermionic effect in vacuum
- the Edison effect and space charge
- for fixed temperature, charge flow depends on electrode potential difference
- "saturation" current depends on filament temperature
- evidence of unilateral flow of charge
- determination of  $e/m$  by magnetron method (use **TEL 502**)
- application of diode as rectifier
- characteristic curve  $I_a/V_a$ , Three Halves Power Law
- filament temperature studies, Richardson-Dushman and Stefan

TEL 520 PLANAR DIODE TUBE



The Planar Diode consists of a pure tungsten wire filament and a circular plate within an evacuated, clear glass bulb, the inside of which has been made electrically conducting to eliminate external electrostatic field effects. The filament terminations are 4 mm sockets and the anode plate is connected to a 4 mm plug mounted on the plastic top cap. The planar form of construction corresponds with the conventional diode symbol. The performance of the large geometry configuration has been improved by attaching to one of the filament leads a circular backing disk to provide a more uniform electric field between the cathode and anode electrodes.

#### Power supply

Optimum plate voltage, 500V.  
Maximum filament voltage, 7.5V.  
Typical plate current, 0.35mA.  
Recommended Accessories  
TEL 801E H.V. Power Unit

**CATALOG TEL 520**

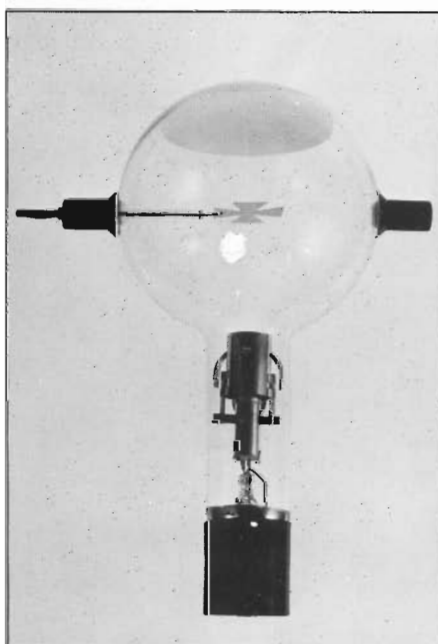
**\$235.00**

## TEL 523 MALTESE CROSS

- linear propagation of cathode rays
- deflection by a magnetic field, a particle-nature effect
- electrostatic charging, image distortion, a particle-nature effect
- introduction to electron optics, inversion magnification, reduction, aberration, a wave-nature effect (use one coil of **TEL 502**)
- comparison of cathodic stream and electromagnetic radiation
- postulation of the de Broglie theory of duality

The diode gun, a tungsten wire "hair-pin" filament and a cylindrical anode, projects a wide beam of cathode rays into the evacuated experimental zone. A beam of light from the hot filament is also projected into the experimental zone. Comparisons can be made of

TEL 523 MALTESE CROSS TUBE



the respective shadows cast on the luminescent screen by the interception of both beams by the Maltese Cross. The filament is connected to two 4 mm sockets in the end cap. The cylindrical anode and the Maltese Cross are each connected to 4 mm plugs mounted on plastic side caps.

#### Power supply

Anode voltage, 2000-5000V DC  
Maximum filament voltage, 7.5V.  
Anode current at 4000V, 1.8mA  
Recommended Accessories  
TEL 813E K.V. Power Unit.

**CATALOG TEL 523**

**\$314.00**

## TEL 521 PLANAR TRIODE

- establishment of direction of charge flow
- concept of a cathode ray gun (diode electron gun)
- application as an amplifier
- application as an oscillator (use **TEL 502** Coils)
- anode and mutual characteristic curves

The Planar Triode is essentially the Planar Diode with a parallel wire grid interposed between the cathode and anode electrodes; the grid is connected to a 4 mm plug mounted on one of the plastic side caps. As with the diode the form of construction corresponds with the conventional triode symbol. Performance of the large geometry configuration has been improved by attaching to one of the filament leads a circular backing disk to provide a more uniform electric field between the cathode and anode electrodes.

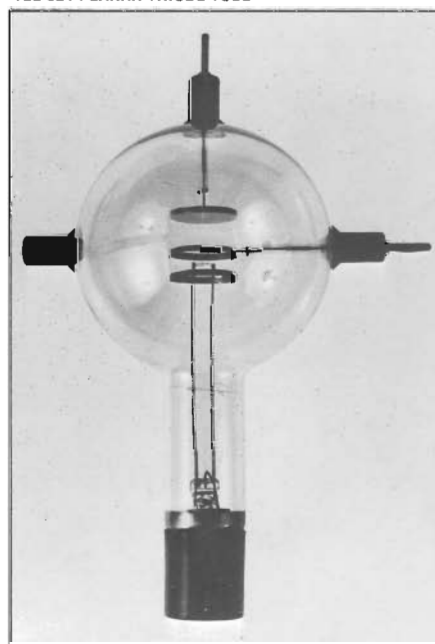
#### Power supply

Optimum plate voltage, 500V.  
maximum filament voltage, 7.5V.  
Typical plate current, 0.35mA.  
Recommended Accessories  
TEL 801E H.V. Power Unit

**CATALOG TEL 521**

**\$270.00**

TEL 521 PLANAR TRIODE TUBE



# TELTRON TUBES

## TEL 522 LUMINESCENT

- establishment of the cathode ray gun (diode electron gun)
- excitation of luminescence by ultraviolet light.
- excitation without ionization, no charge emitted
- persistence and infra-red quenching
- the metastable state of excitation
- different colors, analysis spectroscopy
- introduction of concept of excitation potentials

The luminescent Tube comprises a simple diode electron gun in a cylindrical neck and three mica flags coated with different phosphors mounted on a metal support and located in the center of an evacuated spherical glass bulb.

The diode gun, a tungsten wire "hair-pin" filament and a cylindrical anode, projects a wide beam of cathode rays into the experimental zone. This beam is intercepted by the phosphor screens. Filament connection is by two 4 mm sockets. Anode and phosphor flags are connected to 4 mm plugs mounted on plastic side caps.

### Power supply

Anode voltage, 2000-5000V, DC

Maximum filament voltage, 7.5V.

Anode current at 4000V, 1.8mA.

Recommended Accessories

TEL 813E K.V. Power Unit

**CATALOG TEL 522**

**\$273.00**

**NEED TECHNICAL  
INFORMATION?  
CALL 1-800-622-2866**

## TEL 524 PERRIN TUBE

- evidence of the particular nature of cathode rays
- establishment of negative sign of charge
- introduction of the "electron" as an atomic particle
- electron deflection sensitivity studies
- the concept of a "time-base"
- operation of a cathode ray oscilloscope
- simple Lissajous' figures

The diode gun, a tungsten wire "hair-pin" filament and a cylindrical collimating anode, projects a narrow beam of cathode rays into the evacuated experimental zone. This beam traverses the sphere to impinge on the luminescent screen in a spot about 4 mm in diameter. The narrow beam may be deflected in a vertical plane to enter the Faraday cage by using Helmholtz Coils, **TEL 502**. This assembly is illustrated on a previous page of this catalog. A further and horizontal deflection can be obtained using Secondary Coil, **TEL 507** thereby constructing a simple cathode ray oscilloscope. The filament is connected to two 4 mm sockets in the end cap and the cylindrical anode. The Faraday cage is connected to a 4 mm plug mounted on the plastic side caps.

### Power supply

Anode Voltage, 1500-5000 V DC

Maximum filament voltage, 7.5V.

Anode current at 4000V, 1.8mA.

Beam current at 4000V, 4 A

Recommended Accessories

TEL 813E K.V. Power Unit

TEL 502 Helmholtz Coils

TEL 507 Secondary Coil.

**CATALOG TEL 524**

**\$314.00**

## TEL 532 GAS-FILLED PLANAR TRIODE

- the  $I_a/V_a$  Diode Characteristic, no saturation
- occurrence of gaseous glow at a discrete potential
- the thermionic effect in gas, no rectifier effect
- the cold cathode discharge, positive ions
- collision processes, energy absorption and emission
- ultra-violet excitation
- spectroscopy studies, lines dependent on potential difference
- introduction of excitation potentials
- anode and mutual characteristics, the thyatron
- the principles of a relaxation oscillator

Identical in construction to the Planar Triode, this tube has grey plastic caps instead of black, to indicate the presence of helium gas within the sealed tube. The gaseous glow can be made sufficiently intense to analyze the spectral lines using a spectroscopy. The filament/cathode is terminated at two 4 mm sockets in the grey plastic end cap and the grid and anode electrodes are each connected to 4 mm plugs mounted on grey plastic side caps.

Due to current requirements, the **TEL-801 H.T. Power Unit** \$679.00 is recommended. Specifications: 0-50V 10mA .01% ripple 0-500V 50mA 0.1%.

### Power Supply

Maximum Anode Voltage, 400V DC

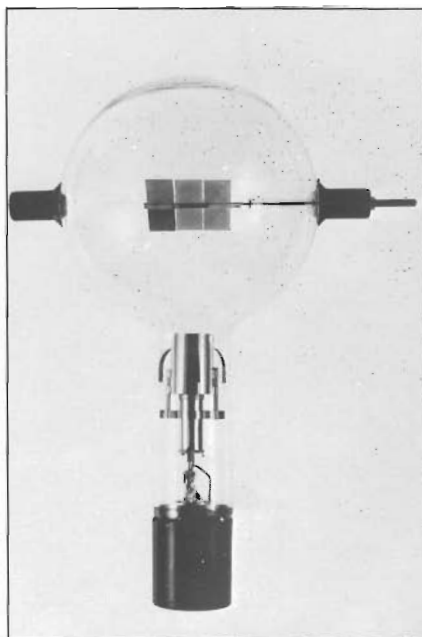
Anode Current at 300V, 10 mA.

Maximum Filament Voltage, 7.5V.

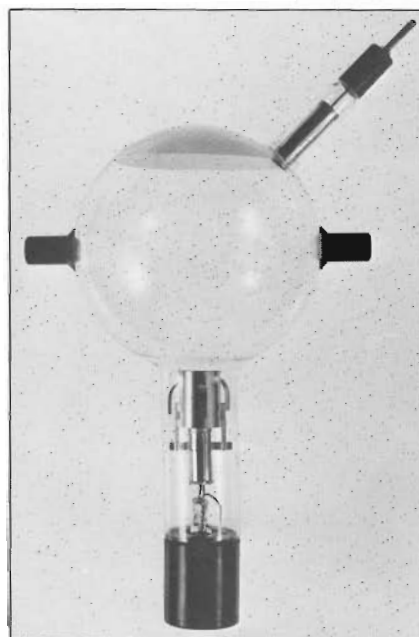
**CATALOG TEL 532**

**\$345.00**

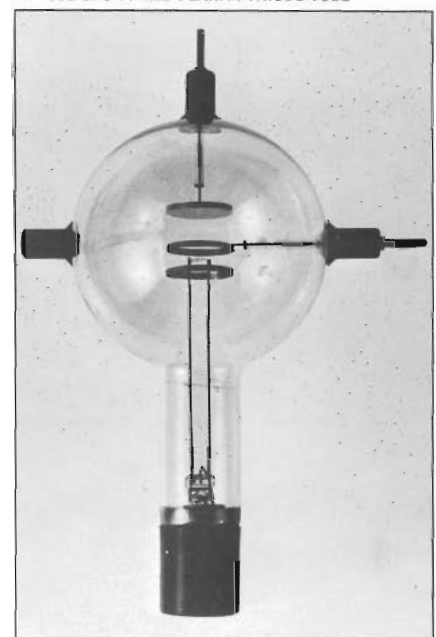
TEL 522 LUMINESCENT TUBE



TEL 524 PERRIN TUBE



TEL 532 GAS-FILLED PLANAR TRIODE TUBE



# TUBE ACCESSORIES AND POWER UNITS

## TEL 504 THERMIONIC EFFECT

This kit consists of 6 replaceable nichrome wire chips which can be mounted in the Universal Stand. When current is passed through the wire, the effect on both a positively and negatively charged electroscope can be studied. This introduces the first experiment performed with the Planar Diode, **TEL 520**.

Power supply  
6.3 volts, 0.3 amps

Accessories  
TEL 800E L.V. Power Unit

Accessories required—Gold-leaf or similar electroscope.

**CATALOG TEL 504 \$48.00**

## TEL 507 SECONDARY COIL

For use with the Perrin Tube **TEL 524**. The Secondary Coil will provide a field at right angles to the Helmholtz Coils.

**MAXIMUM CURRENT**—2 amps. Use **TEL 800E L.V. Power Unit**

**CATALOG TEL 507 \$175.00**

## TEL 555A OPTICAL ANALOG KIT

An aluminum disk mounted on a hollow shaft which houses a 20 mm mesh grid can be rotated. If a light beam passes through this grid, a cross pattern is observed. If the disk is

rapidly rotated a random nature is simulated and the pattern will change to concentric rings.

**CATALOG TEL 555A \$156.00**

## TEL 800E L.V. POWER UNIT

The LV power unit is designed as a general purpose power supply for the student laboratory. The output varies from 0-30 volts AC and DC with a maximum current of 6 amps. Ripple is less than 1%. This unit is well suited for operation of the Helmholtz Coils, **TEL 502** and the Secondary Coil, **TEL 507**.

### SPECIFICATIONS

Output: 0-30VDC and 0-30VAC at 6 Amps, ripple better than 1%. Both AC and DC outputs can be used simultaneously but maximum total load is 6 amps. The output is protected with resettable thermal trip. Metering: AC and DC voltage or amps; selectable. Operating voltage: 110, 117, 50-60 Hz. Dimensions: 380 x 165 x 140 mm. (A 230-240VAC version is available.)

**CATALOG TEL 800E \$626.00**

## TEL 801E H.V. POWER UNIT

Use this power supply for mid to high voltage experiments that require a low current. Both the 50VDC and the 500VDC outputs can be varied independently. Output current electrically limited. Particularly suitable for electron tubes **520, 521, 533, 534**. Separate filament

supplies provide outputs of 1, 2, 3, 6, 7VAC 3 amps.

### SPECIFICATIONS

Output: 0-50VDC 10mA ripple .01%; 0-500VDC 20mA, ripple 0.05%. Metering: Rotary switch, selectable for volts or amps. Operating voltage: 110, 117, 50-60Hz. Dimensions: 380 x 165 x 140 mm. (A 230-240VAC version is available.)

**CATALOG TEL 801E \$562.00**

## TEL 813E K.V. POWER UNIT

This power supply is designed for use with experiments requiring a very high voltage with extremely low current such as, electrostatics experiments. It also works with electron tubes, **522, 523, 524, 525, and 555**. Ripple is less than 0.1%. Two filament supplies provide outputs of 6VAC 4A and 12VAC 3A.

### SPECIFICATIONS

Output: 10-5000VDC 3mA; ripple less than 0.1%. Metering: 0-5000VDC. Operating voltage: 110, 117, 230-240, 50-60 Hz. Dimensions: 380 x 165 x 140 mm. (A 230-240VAC version is available.)

**CATALOG TEL 813E \$624.00**

**NEED TECHNICAL  
INFORMATION?  
CALL 1-800-622-2866**

SHOWN FROM LEFT TO RIGHT TEL 813E, TEL 801E AND TEL 800E

