

# MODEL 401 OSCILLOSCOPE

## PERFORMANCE SPECIFICATIONS

### Y-AXIS AMPLIFIER

Deflection Sensitivity — 15 millivolts p-p per cm.

Frequency Response — D.C. to 10 Mc (3-db point)

Transient Response — Rise time (10%-90%) 0.035  $\mu$  sec

Signal Delay — 0.25  $\mu$  sec

Deflection — 3" visible deflection. Due to deflection plate cut-off the maximum visible deflection is approximately 3". The output amplifier is capable of developing sufficient voltage to provide 5" of linear deflection, any portion of which may be observed by adjustment of the vertical positioning control

Input Impedance

Direct — 1 megohm, 30  $\mu$ mf  
Probe — 10 megohm, 10  $\mu$ mf

Attenuator — 1x, 10x, 100x, 1000x

Input Termination — Direct, 52, 72, or 93 ohms for A.C. or D.C. input

Maximum Signal Input — 600 volts peak

### X-AXIS

External Sweep:

Deflection Sensitivity — 3 volts peak to peak per cm.

Band width — 10 cycles to 500 kc.

Triggered and delayed sweeps or recurrent sweeps with built-in trigger generator are included

Time range — 0.01 sec/cm to 0.1  $\mu$  sec/cm calibration accurate to within  $\pm 5$  per cent

Repetition rate of recurrent sweep triggers — 100 c.p.s. to 10000 c.p.s.

External Trigger Requirements — 0.5 volt to 100 volts peak to peak, either polarity

### DELAYED SWEEP

Delayed Range — 5-5000  $\mu$  sec in three ranges

Dial Scale — 500 divisions for ten turns. Lowest range calibration is 0.1  $\mu$  sec per division

### CALIBRATING VOLTAGE

60 cycle square wave

Four ranges — 0.1, 1.0, 10 and 100 volts full scale

### Z-AXIS INPUT

15 peak volts will blank the beam at normal intensity settings

### TRIGGER OUTPUT

+ or — trigger or + delayed trigger

### CATHODE RAY TUBE

Type 5YP-1, other screens optional

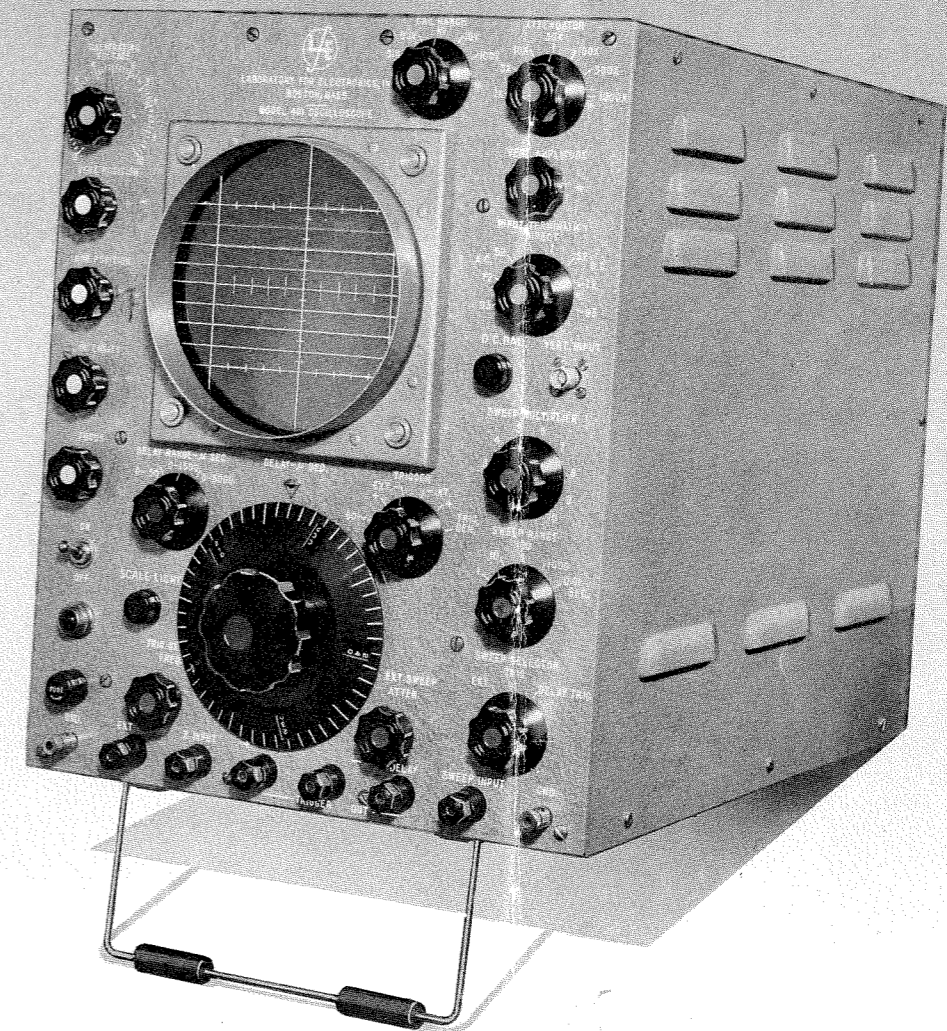
### POWER SUPPLY

105-125 v., or 210-250 v., 50-60 cycles, 400 watts

Size 12½" Wide, 15" High, 19" Deep

Weight — 55 lbs.

# MODEL 401 OSCILLOSCOPE



**A new high gain, wide band, versatile general purpose instrument**

M. P. ODELL COMPANY  
MANUFACTURERS' REPRESENTATIVES  
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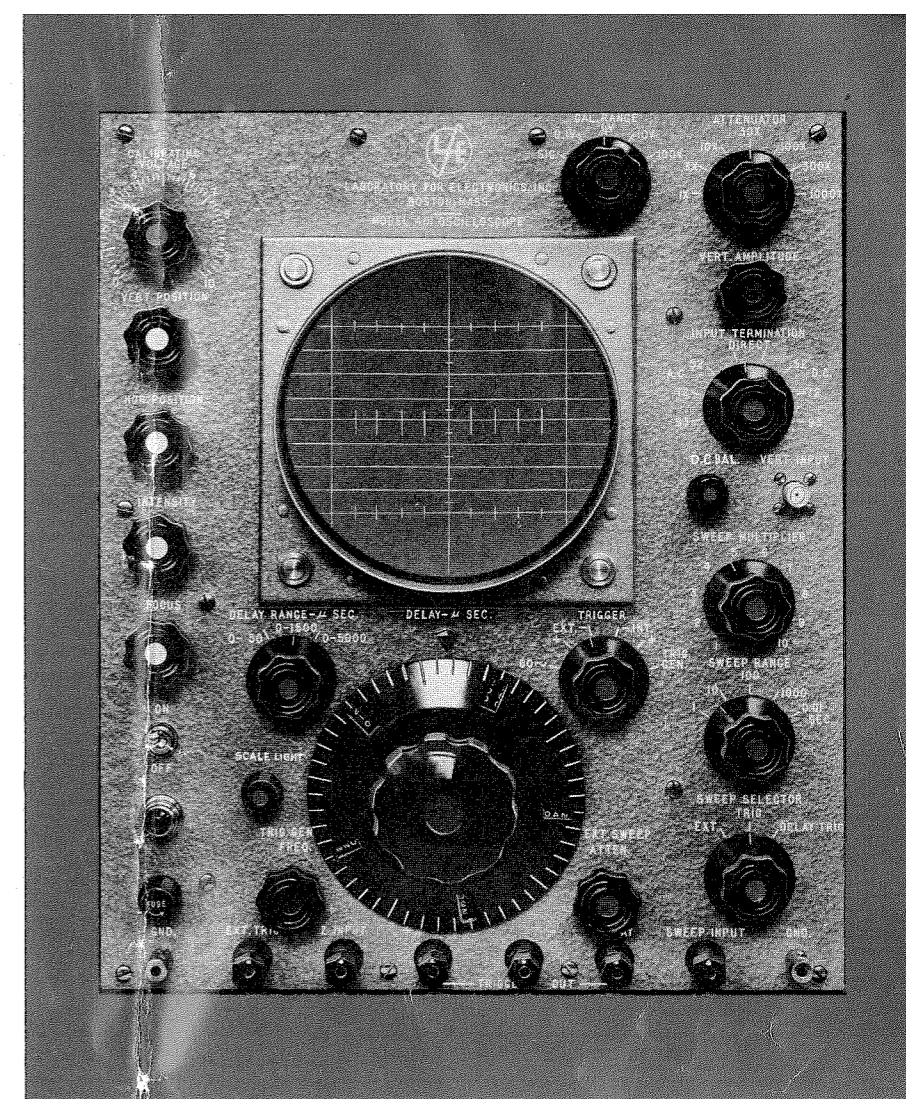
**LABORATORY FOR ELECTRONICS, INC.**  
43 LEON STREET  
BOSTON, MASS.

Advances in electronics have placed greater demands on the time, frequency, and amplitude measuring capabilities of laboratory oscilloscopes. LABORATORY FOR ELECTRONICS, INC., recognizing the ever increasing requirements of the rapidly expanding electronics industry, and using specifications set forth by electronics engineers, has developed the MODEL 401 oscilloscope to provide the features and conveniences required by the industry in a medium price, general purpose laboratory instrument.

**LABORATORY FOR ELECTRONICS, INC.**  
**43 LEON STREET • BOSTON, MASS.**

## MODEL 401 OSCILLOSCOPE

- A high gain, wide band, versatile, general purpose instrument capable of quantitative measurements of high and low speed electrical phenomena.
- Perfectly suited for the precise examination of pulse waveforms and transient phenomena, as well as customary oscilloscope applications.



### features:

#### ELECTRICAL

High sensitivity  
 Wide band response — D.C. to 10 Mc  
 Excellent transient response  
 Triggered linear sweeps  
 Recurrent sweeps with built-in trigger generator  
 Continuously adjustable precision sweep delay  
 Internal and external triggering  
 Signal delay — 0.25  $\mu$  sec  
 Signal input line terminations  
 Accurate 60 cycle square wave calibrating voltage

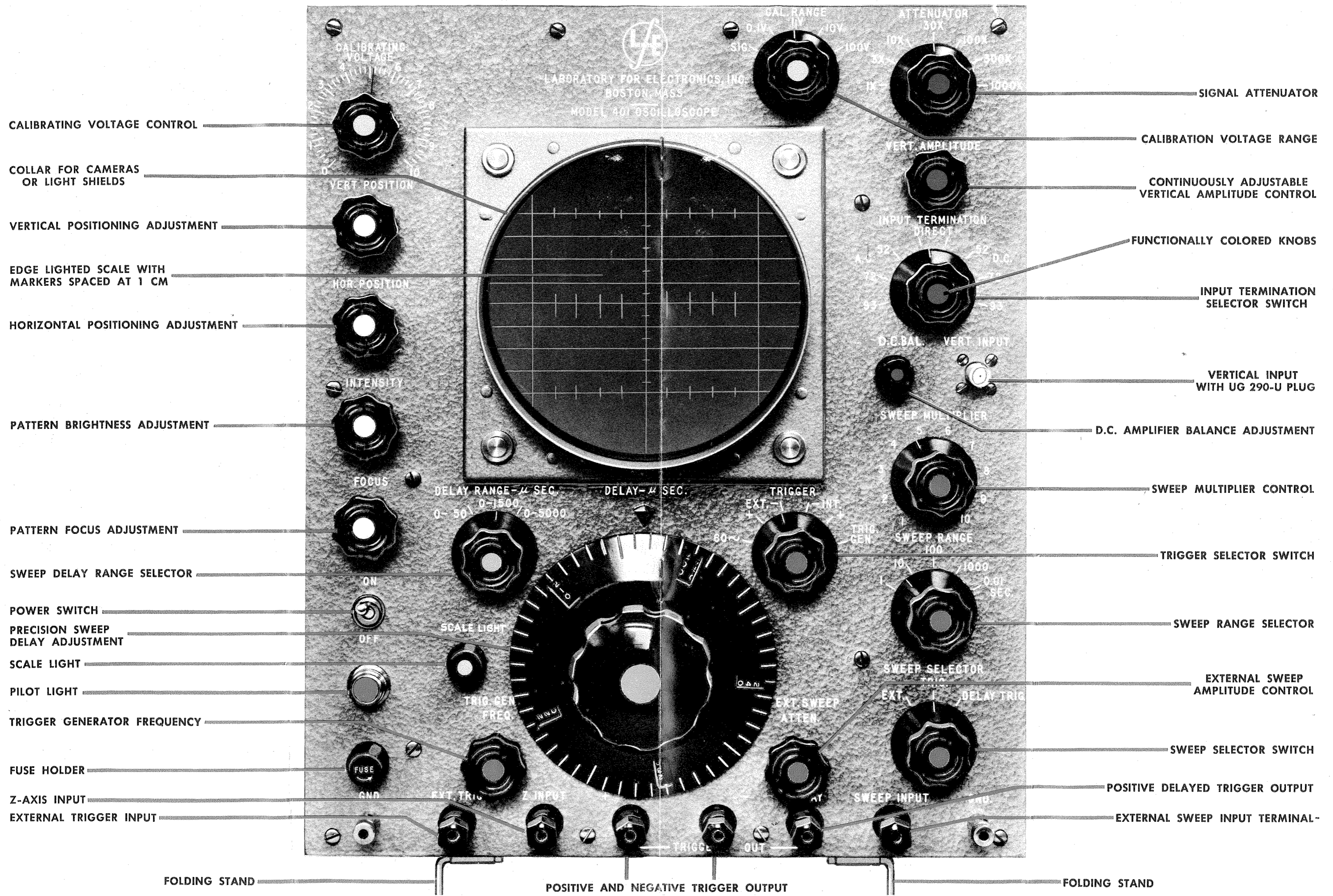
#### GENERAL

Functionally grouped and colored control knobs  
 Folding Stand  
 Sensitive, high definition cathode ray tube  
 Low capacity probe  
 Adjustable scale lighting  
 Accessibility of all components  
 Facilities for mounting oscilloscope cameras

#### MECHANICAL

Rugged construction  
 Steel chassis mounted for easy access to all components  
 Adequate ventilation enhanced by chassis assembly  
 Dimensions — 12½" wide x 15" high x 19" deep  
 Weight — 55 lbs.





CALIBRATING VOLTAGE CONTROL

COLLAR FOR CAMERAS OR LIGHT SHIELDS

VERTICAL POSITIONING ADJUSTMENT

EDGE LIGHTED SCALE WITH MARKERS SPACED AT 1 CM

HORIZONTAL POSITIONING ADJUSTMENT

PATTERN BRIGHTNESS ADJUSTMENT

PATTERN FOCUS ADJUSTMENT

SWEEP DELAY RANGE SELECTOR

POWER SWITCH

PRECISION SWEEP DELAY ADJUSTMENT

SCALE LIGHT

PILOT LIGHT

TRIGGER GENERATOR FREQUENCY

FUSE HOLDER

Z-AXIS INPUT

EXTERNAL TRIGGER INPUT

FOLDING STAND

POSITIVE AND NEGATIVE TRIGGER OUTPUT

FOLDING STAND

SIGNAL ATTENUATOR

CALIBRATION VOLTAGE RANGE

CONTINUOUSLY ADJUSTABLE VERTICAL AMPLITUDE CONTROL

FUNCTIONALLY COLORED KNOBS

INPUT TERMINATION SELECTOR SWITCH

VERTICAL INPUT WITH UG 290-U PLUG

D.C. AMPLIFIER BALANCE ADJUSTMENT

SWEEP MULTIPLIER CONTROL

TRIGGER SELECTOR SWITCH

SWEEP RANGE SELECTOR

EXTERNAL SWEEP AMPLITUDE CONTROL

SWEEP SELECTOR SWITCH

POSITIVE DELAYED TRIGGER OUTPUT

EXTERNAL SWEEP INPUT TERMINAL



# PERFORMANCE FEATURES

The advanced design features of the Model 401 oscilloscope make possible precise quantitative studies of pulse waveforms, transients, and the conventional signals developed by the most modern electronic circuits and equipments. A description of the most important and interesting features included in the design is presented below.

## **SENSITIVITY and FREQUENCY RESPONSE of VERTICAL DEFLECTION CHANNEL.**

A high-gain, two-channel amplifier is provided to make possible amplification of signals ranging from D.C. to 10 mc. The response is only 3 db down at 10 mc. and falls off slowly to 25 mc. Deflection sensitivity of the system is 15 milli-volts per cm. of deflection. Stability has been achieved by voltage stabilization and heater voltage regulation in the D.C. amplifier.

## **PULSE RESPONSE**

Degradation of pulse response has been reduced to a minimum by careful design. The vertical deflection amplifier has a step-function response rise time of 0.035 microseconds from 10 to 90 per cent of peak response. Overshoot has been kept to less than 2 per cent.

## **DEFLECTION**

Use of a 5YP — cathode ray tube with high deflection sensitivity has made possible high sensitivity and wide band response. However, due to the deflection cut-off characteristics of the tube, the useful vertical scan is limited to 3 inches. The vertical amplifier will develop the equivalent of 5 inches of undistorted deflection, any part of which may be observed by proper adjustment of the vertical positioning control, if it is desired to develop such a swing.

## **SWEEP SYSTEM**

A wide range of driven and recurrent sweeps is provided in the Model 401. The sweep time range may be varied from 0.01 seconds per cm. to 0.1 microseconds per cm. The recurrent sweeps are controlled by a built-in trigger generator which provides a range of triggers

with repetition rates varying from 500 c.p.s. to 5000 c.p.s. for triggering external circuits and sweeps.

## **TRIGGER OUTPUTS**

Three triggers are available for external use, plus and minus triggers, and a plus delayed trigger whose delay range can be adjusted by the delay sweep dial to give an accurate indication of time intervals. In the Trigger Generator position of the Trigger Selector the internally generated triggers associated with the recurrent sweeps are available as above.

## **DELAYED TRIGGERED SWEEP**

In many instances it is desirable to adjust the time relationship between the triggering pulse and the sweep. A continuously adjustable precision delay system has been incorporated in the Model 401 to accomplish this function. Delays ranging from 5 microseconds to 5000 microseconds are available. A high degree of precision has been achieved with the 10 turn control employed. Thus, this accuracy may be obtained in the measurement of time intervals, eliminating the need for time markers.

## **SIGNAL DELAY**

A 0.25 microsecond delay line is included in the vertical deflection amplifier to delay the signal sufficiently to compensate for the inherent delay of the sweep circuits, thereby permitting observation of the leading edge of even the triggering pulse.

## **VOLTAGE CALIBRATION**

The amplitude of the applied signal can be measured by comparison with a 60 cycle square wave which can be varied in amplitude from 100 millivolts to 100 volts full scale.

## **INPUT TERMINATION**

LFE Model 401 provides a convenient means for terminating transmission lines with impedance of 52, 72, or 93 ohms; a position is also provided with no terminating resistance. Any of these terminations may be used for A.C. or D.C. coupling to the amplifier.

## **COLORED CONTROL KNOBS ARE FUNCTIONALLY GROUPED**

Reputable scientific studies have proved that greater facility in the handling of controls is achieved when functionally colored and grouped knobs are used. LFE Model 401 is one of the first electronic commercial instruments to apply this principle. All controls for each channel have distinctive identifying colors. Thus, at a glance, an operator can locate the controls of the vertical deflection channel which are colored blue, those of the sweep delay system which are green, etc.

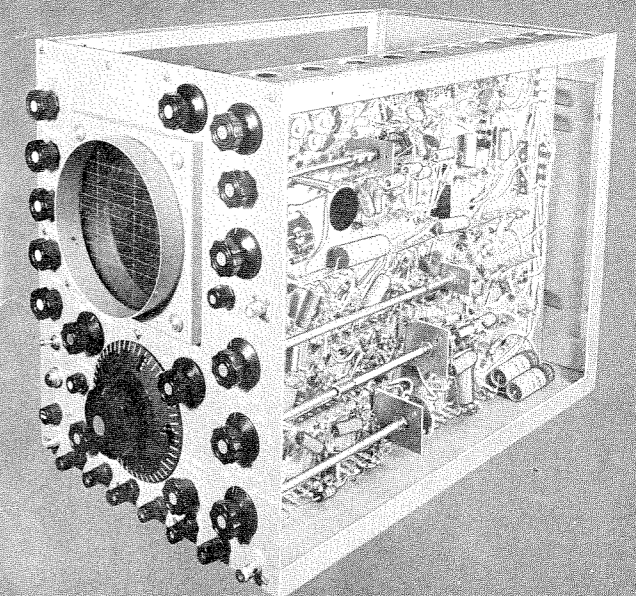
## **FOLDING STAND AFFORDS BETTER VIEWING ANGLE**

A folding stand under the front of the oscilloscope makes it possible to raise the front of the unit and change the viewing angle. In most laboratories oscilloscopes are placed on a work bench which makes it necessary for the operator to sit down or bend over to properly view the screen. The Model 401 includes a folding stand which, when opened, raises the front of the oscilloscope sufficiently to enable the average operator to view the screen without bending over.

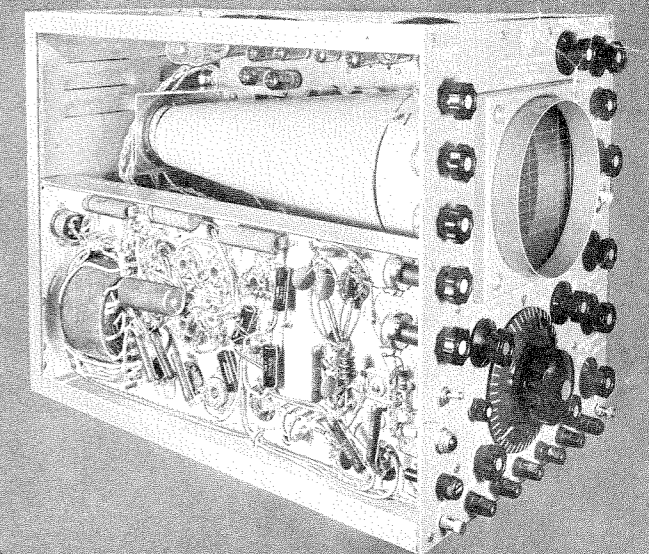
## **EASILY ACCESSIBLE COMPONENTS FACILITATE SERVICING**

Considerable effort has been made to simplify the mechanical assembly of the Model 401 to facilitate servicing and increase the effectiveness of normal ventilation.

Two chassis, a power supply chassis and a signal chassis, are mounted vertically in an aluminum frame in such a manner that all components except tubes and a few controls are readily accessible from the sides of the instrument. This makes circuit checks and component replacement easy. Tubes and a few controls can readily be replaced from the top, rear, or bottom of the assembly. All tubes are mounted horizontally facing inward, thus providing a space from top to bottom of the assembly through which air can flow. An adequate number of louvers on the covers helps to create a good movement of air through the cabinet.



SIGNAL CHASSIS



POWER SUPPLY CHASSIS