

# TELEVISION MEASURING EQUIPMENT

## CATHODE-RAY OSCILLOGRAPH

The "Video" frequencies employed in television circuits, extending from about 30 to 4,000,000 cycles, have necessitated the development of special laboratory equipment and technique in order to obtain the requisite accuracy for measurement and investigation of these circuits. RCA, during its long experience in the television field, has developed a number of high-quality instruments especially designed for the exacting requirements of television.

Among those described in this section is a square-wave generator designed to produce waves over a wide range of frequencies with extremely steep sides and a flat top. Such waves are very useful for rapidly checking the transient characteristics of video amplifiers with an accurate cathode-ray oscillograph. By supplying square waves to the input of the circuit under test, any distortion observable in the output wave may readily be interpreted with respect to frequency response and phase shift. The special cathode-ray oscillograph described in this section has been designed not only for this purpose, but also for studies and adjustments of amplitudes and wave shapes of the synchronizing impulses, blanking impulses, and picture signal.

Two television sweep oscillators are available, one covering the video frequencies and the other the intermediate and ultra-high frequencies. These units have been designed for use with the oscillograph to eliminate laborious point-by-point measurement of frequency-response characteristics and to enable rapid circuit alignment.

The synchronizing generator described herein is a very complete equipment which may be used in the establishment of small test systems as well as with larger transmitters operating on regular schedules.

### 9" SPECIAL CATHODE-RAY OSCILLOGRAPH Type 305-A

**Applications:** The Type 305-A Cathode-Ray Oscillograph may be used in all general applications, and possesses advantages over other types of oscillographs because of its extremely wide frequency range. It is highly valuable for modulation measurements on transmitters or for study of impulses or transients, showing wave shape of combined noise and desired signal. The 305-A is applicable to any class of work where low- or high-frequency voltages of small amplitude must be studied. Also, since the horizontal and vertical amplifiers are identical and admit use of a wide range of input voltages, the instrument is ideally suited for measurement of phase delay in amplifiers and networks.

Because of its excellent frequency-response characteristics, this oscillograph may be used as a peak-reading voltmeter over an input range of 0.05 to 400 volts. A 60-cycle calibration source is provided by a metered circuit in the equipment, measurements being made by the substitution method. Thus the voltage at any portion of the wave may readily be determined.

**Description:** The deflection amplifiers of this de luxe cathode-ray oscillograph have been exceptionally well designed. Their response is essentially flat from 30 cycles to 10 megacycles; and, using square-wave input, distortion is under 5% at 30 cycles.

An integral saw-tooth oscillator provides linear timing, and may be synchronized with the signal in the vertical amplifier or with an external frequency. The synchronizing

signal may be applied in either polarity, as desired. A phase-changing network permits synchronization of the timing-axis oscillator with the power-supply frequency. A blanking amplifier varies the grid bias of the cathode-ray tube from an external signal for introducing time or frequency calibration.

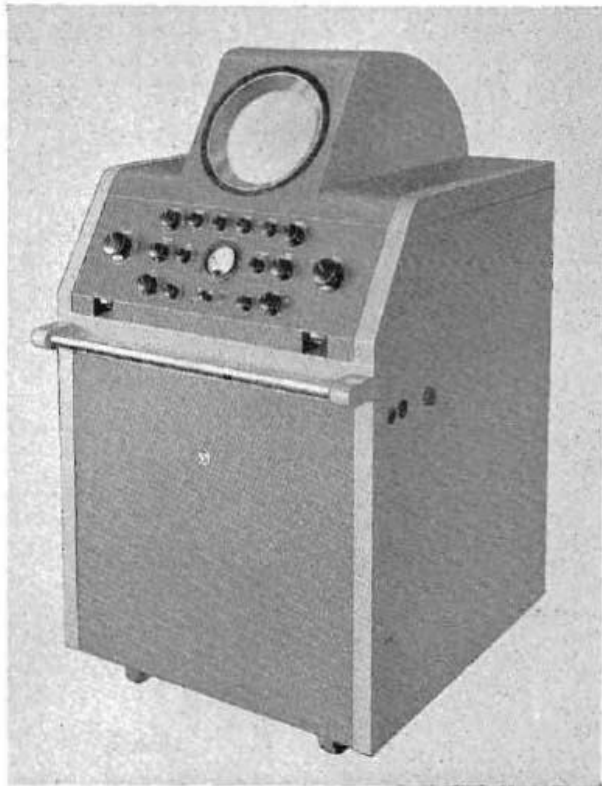
The cathode-ray tube, the RCA-914, is the largest commercially available, and provides a large, brilliant trace suitable for either visual or photographic observation. The Type 305-A is equipped with large casters to facilitate movement about the laboratory.

**Features:** Wide-range, high-gain amplifiers; gain control in a-c circuit, stabilizing spot on screen during adjustment; phase-changing network for synchronizing saw-tooth oscillator with power-supply frequency; blanking amplifier for time or frequency determination; internal source of calibration voltage which may be applied to either deflection amplifier, allowing use of oscillograph as a peak-reading voltmeter; regulated plate supply for all tubes, except output stage and cathode-ray tube, assuring independence from line-voltage variation.

#### Specifications:

Cathode-ray tube	RCA-914, 9" screen, electrostatic deflection
Amplifier response	30 cycles to 10 megacycles
Timing-axis range	30 to 30,000 cycles
Power supply	110-120 volts, 50-60 cycles
Power consumption	800 watts
Dimensions	height 50 $\frac{1}{4}$ ", width 29", depth 34"

List Price and more detailed information may be had on request.



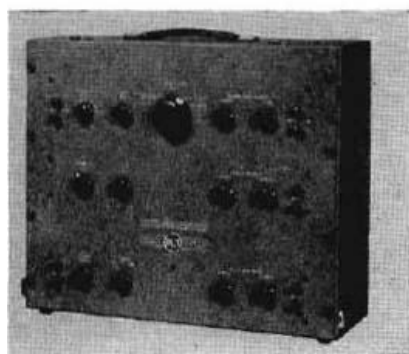
# TELEVISION MEASURING EQUIPMENT

## FREQUENCY-RESPONSE AND PHASE-INDICATING UNITS

### SQUARE-WAVE GENERATOR Type 350-A

**Applications:** This instrument generates square-wave signals for rapidly checking the transient characteristics of television video amplifiers, in conjunction with a suitable cathode-ray oscillograph.

**Description:** The Type 350-A Square-Wave Generator offers a choice of five square-wave output frequency ranges, as shown under "Specifications," permitting separation of the low- and high-frequency transient effects.



In addition to square waves, two sinusoidal voltages are also available (range 5). The 100-kc sine wave may be used for horizontal deflection of the oscillograph beam or for synchronizing the timing axis. The 10-mc signal may be applied to the grid of the cathode-ray tube to modulate the spot intensity, thus introducing marker dots on the pattern at time intervals of 0.1 microsecond.

**Features:** Wide range of square-wave output frequencies providing great flexibility of operation; two sine-wave outputs which may be used for synchronizing the oscillograph sweep and marking time intervals on the oscillograph pattern; regulated power supply assuring optimum performance irrespective of line-voltage fluctuations.

#### Specifications:

##### Outputs:

Range	Frequency	Wave Form	Voltage (Peak-to-Peak)	Source
1	3-50 cy.*	Square	0-20 v	Int. Osc.
2	50-60 cy.	Square	0-20 v	Power Supply
3	60 cy.-100 kc	Square	{ 0-20 v below 13 kc } { 0-3 v above 13 kc }	External
4	13 kc	Square	0-20 v	Int. Osc.
5	{ 100 kc 100 kc 10 mc }	Square	0-3 v	Int. Osc.
		Sine	0-50 v	
		Sine	0-50 v	

\*In seven steps providing approx. frequencies of 3, 5, 8, 12, 30 and 50 cycles.

##### Rise time:

100-kc square wave (Range 5) will rise from maximum negative to maximum positive potential in approximately 0.12 microsecond. At other frequencies, the square waves will rise in less than 0.01 period if output-voltage limits are not exceeded.

Power supply..... 105-125 volts, 50-60 cycles  
 Power consumption..... 120 watts  
 Radiotrons... 6 RCA-6C6, 1 RCA-6F7, 3 RCA-6J7-G, 2 RCA-6K7-G,  
 2 RCA-991, 1 RCA-2A3, 1 RCA-874, 1 RCA-80, 1 RCA-57;  
 total 18  
 Dimensions..... height 19 $\frac{3}{4}$ " , width 20 $\frac{1}{2}$ " , depth 9 $\frac{1}{4}$ "  
 Weight..... 44 lbs.  
 List Price (complete with tubes).....

### VIDEO SWEEP OSCILLATOR Type 351-A

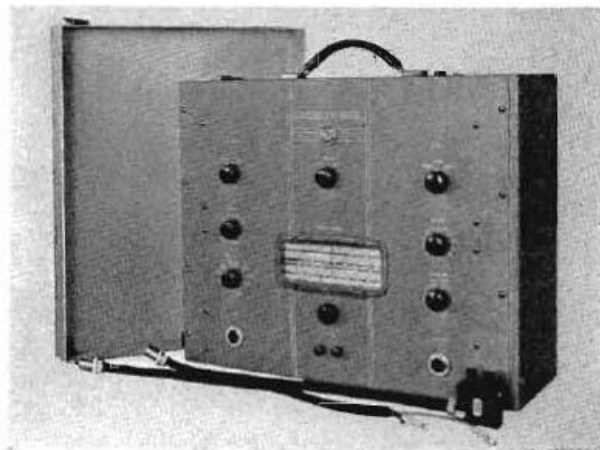
**Applications:** This instrument enables reproduction of the response characteristic of television video and other wide-range amplifiers on the screen of the Type 305-A Oscillograph, for visual investigation and rapid adjustment. It is suitable for use on television transmitters, and is sufficiently portable for field test work on television receivers. When a rectifier, such as the Type 353-A described on page 17, is employed, the Type 304-A Oscillograph may be used instead of the 305-A.

**Description:** The circuit of the Type 351-A Video Sweep Oscillator comprises a beat-frequency oscillator, equipped with a frequency modulator for sweeping the output frequency from maximum to minimum at a definite rate; and a marker oscillator which superimposes an interference pattern on the response curve at any desired position for locating values of frequency in the response curve.

**Features:** Two ranges of video output, giving unusual flexibility in adjustment of amplifier circuits; marker oscillator which provides direct frequency calibration on easy-reading, straight-line dial, permitting rapid location of any specific point in response curve; virtual freedom from distortion, insuring a high degree of accuracy; electronically regulated power supply, rendering the instrument independent of line-voltage variations.

#### Specifications:

Frequency Range:  
 Video— { Band 1 (linear)..... 100-5000 kc  
           { Band 2 (non-linear)..... 2000-7000 kc  
 Marker—Overall (8 bands)..... 100-25,000 kc  
 Output voltage, maximum:  
 Video..... approx. 0.2 volt  
 Marker..... approx. 0.1 volt  
 Output impedance:  
 Video..... 120 ohms  
 Marker..... 2000 ohms  
 Power supply..... 105-125 volts, 60 cycles  
 Power consumption..... 50 watts  
 Radiotrons... 1 RCA-6K8, 1 RCA-6J7, 1 RCA-6C5, 1 RCA-1851,  
 2 RCA-874, 1 RCA-574; total 7  
 Dimensions..... height 19 $\frac{3}{4}$ " , width 20 $\frac{1}{2}$ " , depth 9 $\frac{1}{4}$ "  
 Weight..... 38 lbs.  
 List Price (complete with tubes).....



# TELEVISION MEASURING EQUIPMENT

## SYNCHRONIZING AND SWEEP APPARATUS

### R-F AND I-F SWEEP OSCILLATOR Type 352-A

**Applications:** The Type 352-A permits rapid oscillographic alignment of television circuits, studies of the sound and picture channels, and general studies of all types of transmission circuits within its frequency range. It can also be employed as a general-purpose frequency meter.

**Description:** This unit contains two r-f oscillators, one covering the range of 40 to 90 megacycles for r-f alignment and the other heterodyning with the former to provide a range of 8 to 13 megacycles for i-f alignment.

A marker oscillator permits superimposition of an interference pattern on the response curve at any point for frequency-measuring purposes.

**Features:** Marker oscillator calibration referred to 2-mc internal crystal insuring absolute accuracy; two sweep ranges enabling separate study of sound- and picture-channel i-f circuits; output voltage adjustable over wide range.

#### Specifications:

Frequency range (center of sweep)	
R-F.....	40-90 mc
I-F.....	8-13 mc
Sweep range	
R-F.....	.8 mc (accurate at channel points)
I-F.....	.8 or 1 mc
Output voltage.....	R-F, 0.1 volt (max.); I-F, 0.3 volt (max.)
Output impedance	
R-F.....	100 ohms (balanced)
I-F.....	75 ohms (unbalanced)
Marker oscillator:	
Frequency range.....	R-F, 37-105 mc; I-F, 4.2-16.8 mc
Modulation frequency (from audio oscillator).....	400 cycles
Crystal oscillator frequency (fundamental).....	2 mc
Power supply.....	105-125 volts, 60 cycles
Radiotrons.....	1 RCA-955, 1 RCA-954, 1 RCA-1851, 3 RCA-6C5 1 RCA-6J7, 1 RCA-5W4; total 8
Dimensions.....	height 19 $\frac{3}{4}$ " , width 20 $\frac{1}{2}$ " , depth 9 $\frac{1}{4}$ "
Weight.....	44 lbs.
List Price (less tubes).....	

### SWEEP RECTIFIER 353-A

A linear diode rectifier for checking response characteristics of wide-range amplifiers in conjunction with a sweep oscillator and cathode-ray oscillograph. This instrument, equally useful for single- or double-image operation, eliminates the need for a wide-range oscillograph for sweep-circuit applications.



#### Specifications:

Frequency range.....	100 kc to 150 mc
Voltage range.....	0.1-100 volts
Input circuit.....	25,000 ohms, 8 mmfd
Output circuit.....	250,000 ohms, 1,000 mmfd
Power supply.....	110-120 volts, 50-60 cycles
Power consumption.....	2 watts
Radiotrons.....	1 RCA-955
Dimensions.....	height 2 $\frac{1}{2}$ " , width 2 $\frac{3}{8}$ " , length 6 $\frac{7}{16}$ "
Weight.....	1 lb., 2 oz.
List Price (less tube).....	

The Type 301-A U-H-F Field-Intensity Meter is a wide-range instrument covering all channels assigned to television broadcasting. Description on page 100.

### SYNCHRONIZING GENERATOR Type 560-A

**Applications:** This generator affords complete synchronizing signals for operation of television transmitters and receivers. It may be used on any RMA Std. 441-line system with a frame frequency of 30 and a field frequency of 60 (interlaced).

**Description:** Five different types of pulses are generated by a system of oscillators to accomplish Iconoscope driving and blanking, and Kinescope blanking and synchronizing. The blanking pulses effect return-line elimination, the driving pulses actuate the deflection and other circuits, and the synchronizing pulses insure proper synchronization of television receivers. Circuits are also included to insure proper locking with the power-supply frequency.

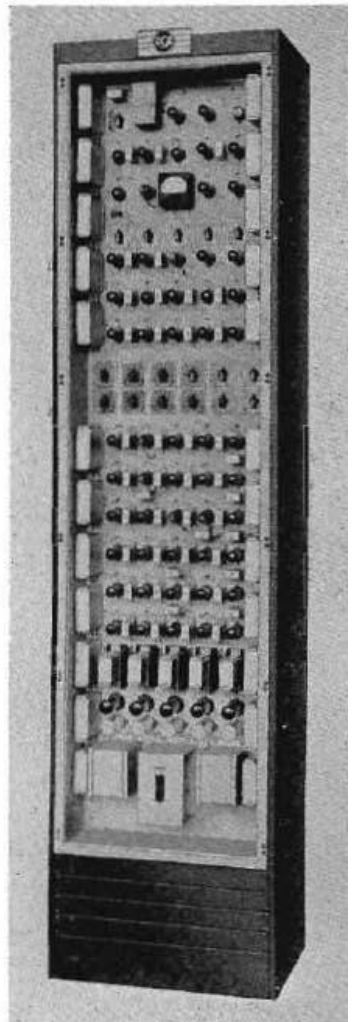
The Type 561-A auxiliary rack recommended for operation of this generator contains two regulated plate-supply units of the 580-A Type\*, mounted in a cabinet rack.

**Features:** Special timing circuits maintaining extreme accuracy between leading edges of all pulses; improved locking circuit which synchronizes generator with 60-cycle power supply; conservative tube rating for long life.

#### Specifications of 560-A:

Power supply (Type 560-A):	110-120 volts, 60 cycles, 250 watts
(Obtained through 561-A Rack)	
Power supply (Type 561-A):	110-120 volts, 60 cycles, 850 watts
Power consumption	(complete equipment) 1100 watts
Radiotrons:	
Type 560-A:.....	15 RCA-6F6, 6 RCA-6H6, 1 RCA-6K7, 5 RCA-6L6, 5 RCA-6L7, 30 RCA-6N7; total 62
Type 561-A:.....	4 RCA-VR-150, 4 RCA-5U4-G, 10 RCA-6Y6-G, 2 RCA-1852; total 20
Dimensions (both racks).....	height 82 $\frac{7}{8}$ " , width 20 $\frac{5}{8}$ " , depth 14 $\frac{3}{8}$ "
List Price 560-A and 561-A (both units, less tubes).....	

\*Type 580-A Plate Supply furnishes a potential of 300 volts d.c. for loads up to 400 ma. Description on page 94.



### TELEVISION TEST CHARTS

These charts permit precise measurements of resolution in all or any portion of the screen, and independent determination of horizontal and vertical resolution, upper-frequency cutoff, and quality of half-tone transmission. Also available on 35-mm. motion-picture film.

