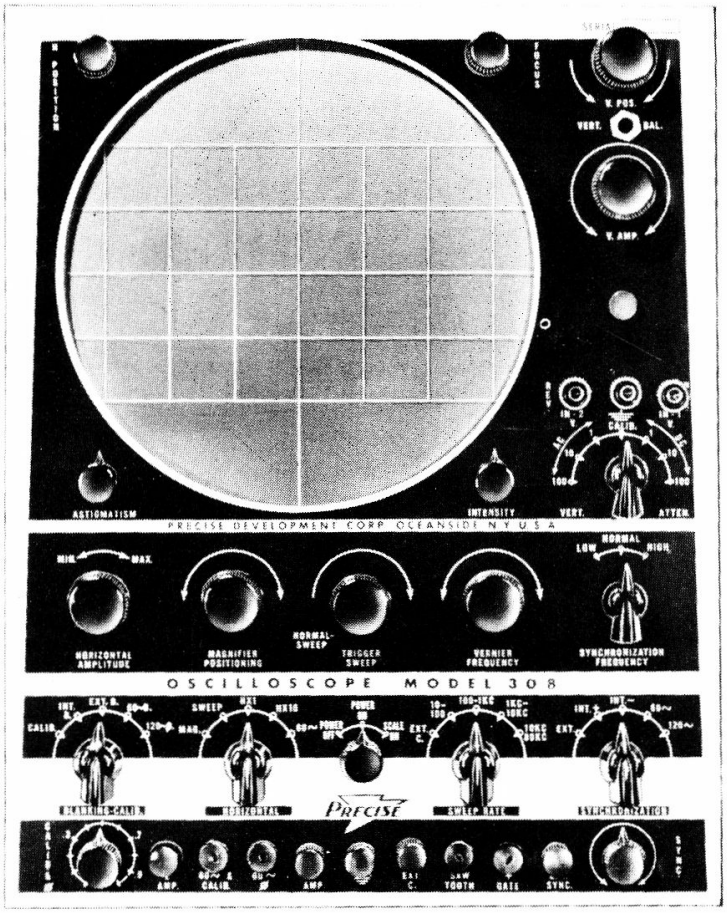
INSTRUCTIONS

MODEL 308

WIDE BAND OSCILLOSCOPE



PRECISE

PRECISE DEVELOPMENT CORP.
Oceanside, L. I., N. Y.

SPECIFICATIONS (Electrical)

1 - Vertical

a) Sensitivity - 10 millivolts per inch approx. (3.94 mv/cm), push-pull inputs.
b) Bandwidth - 0 (DC) through 5 megacycles (3db).
c) Inputs - Input #1, normal phase. Input #2, reverse phase (180 degrees). Inputs #1 & #2 for push-pull. Two different signals may be electronically mixed. Choice of AC or DC input. Constant R in, of approximately 500K ohms.
d) Attenuation - Frequency compensated stepping attenuator. Cathode inverse feedback vernier attenuator.
e) Jacks - Provided with 3 each 5 way type binding post.
f) Output - The entire vertical is push-pull from input through output. Pentode type tubes used.
g) Positioning - Bridge type which does not disturb tube characteristics.

2 - Horizontal

a) Sensitivity - 150 millivolts per inch (59 mv/cm) single ended input.
b) Attenuation - Frequency compensated stepping attenuator for coarse adjust and absorption type for high frequency vernier adjust.
c) Amplifier - AC only. Also has internal 60 cycle position.

3 - Blanking -

a) Internal - Sweep blanking through blanking amplifier.
b) External - " " " " "
c) 60 Cycle - Through blanking amplifier.
d) 120 Cycle - " " "

4 - Synchronization

a) Selector Switch - External.
Internal plus.
Internal minus.
Internal 60 Cycle.
Internal 120 Cycle.
b) Vernier Control - Varies amount of synchronization from source selected by selector switch.
c) Synchronization Frequency - LOW, NORMAL, HIGH. Selects the range of synchronization frequencies to be used.

5 - Sweep Rate (Normal)

a) Multivibrator - Hard vacuum tubes.
b) 5 Position Coarse Frequency Switch - 1-10 cycles (External capacitor circuit).
10-100 cycles (Internal).
100-1000 cycles (Internal).
1K-10K (Internal).
10K-80K (Internal).
c) Dual potentiometer vernier control.

6 - Sweep Rate (Triggered)

a) As listed in normal sweep rate above.
b) Triggered sweep potentiometer.

7 - Magnifier

a) Shaper - Electronically shapes sawtooth thereby magnifying signal width by factor of 10 or equivalent of 85 inches of sweep width.

b) Positioner - Magnifier positioning potentiometer allows selection of the portion of the signal to be magnified.

8 - Calibrator

a) Internal - Square wave calibrator, plus vernier calibration potentiometer, allows measurement of vertical gain settings.

9 - Scale

a) Graticule - Illuminated "edge lit" scale may be turned off or on. Appears as red lines against green filter in front of tube, calibrated in inches or centimeters.

10- Outputs

a) Plus Gate - Sharp triggered pulse for synchronizing other devices.
b) Sawtooth - As external generator.
c) 60 Cycle ϕ - For internal and external phasing.
d) 60 Cycle - Unphased. Test signal.
e) Calibration - Internal and external.

11- Phasing

a) Control - Internal 60 cycle phasing potentiometer.
b) Output - 60 cycle phasing output terminal.

12- Astigmatism

a) Control - Allows for much finer focusing over entire face of tube.

13- Tube

a) 8CP1 - P1 phosphor, medium persistency, green screen is normally supplied, other types available on special order.

14- Deflection Plates

a) Horizontal - Horizontal deflection plates, with positioning, are readily accessible at rear of cabinet.

15- Z Modulation

a) Intensity - Intensity modulation through a modulation amplifier jack is available at front panel.

16- Power Supply

a) Low Voltage - Power supply is of the full wave 60 cycle type with multiple filtering in both horizontal and vertical amplifiers. Over designed to take many additional circuits.

b) High Voltage- Two rectifiers for high voltage with multiple filtering provide a high positive voltage & a high negative voltage. The former is used for accelerating anode button.

c) Voltage Regulation - Various sections of the power supply are voltage regulated by means of two VR tubes.

CIRCUIT DESCRIPTION

Basically an oscilloscope is an indicating device with a cathode ray tube in place of a mechanical meter. The main reason for using the CRT as the meter is the essentially zero inertia of an electron beam - viz. its very low mass. This means that high frequency signals may be observed without a time lag or a "smoothing out" action due to mechanical inertia. In essence the major limiting factor of the CRT is the electron transit time which may be considered negligible below 100 megacycles. The object then is to magnify, shape and phase signals so that they will operate the CRT.
With this thought in mind, the development of the Block Diagram follows:

1) WIDE BAND VERTICAL AMPLIFIER (Single ended input). - The signal to be observed is applied to VERTICAL INPUT #1. It is attenuated through the frequency compensated VERTICAL STEPPING ATTENUATOR to the desired level. The AC-DC selector either blocks or permits the DC component to be amplified. VERTICAL AMPLIFIER #1 is the first stage of vertical amplification. The VERTICAL ATTENUATOR is a degenerative type of cathode attenuator and is virtually free from frequency distortion effects. The DC BALANCE establishes the cathode bias on the amplifiers #3 & #4, thereby compensating for different tubes and changes in operating conditions.
AMPLIFIERS #3 & #4 again amplify the signal. The VERTICAL POSITIONING is a specially designed bridge type circuit which has the great advantage that it does not disturb the tube static conditions thereby maintaining constant gain and operating conditions. The signal is then transferred to the VERTICAL DEFLECTION PLATES of the CRT.
When VERTICAL INPUT #2 is not used, it should be shorted to ground at the front 5 way binding posts. The signal from VERTICAL AMPLIFIER #1 is cathode coupled to VERTICAL AMPLIFIER #2 which converts to push-pull operation through the entire VERTICAL AMPLIFIER although a single-ended input was used.

2) WIDE BAND VERTICAL AMPLIFIER (Push-pull input). - INPUT #1 & INPUT #2 are both used for push-pull operation. The signals are electronically mixed in the vertical amplifiers. Note: A stepping attenuator for AMPLIFIER #2 is available at additional cost.

3) SWEEP RATE. - The Multivibrator SWEEP RATE OSCILLATOR develops the sawtooth signal. It is controlled by the Sweep

Rate selector switch for the sweep range and by the Sweep Rate dual potentiometer for the VERNIER frequency adjust.
One of the various forms of Synchronization (Internal +, Internal-, Internal 60 & 120 or External Synchronization) is selected by the SYNCHRONIZATION SELECTOR. The SYNCHRONIZATION CONTROL acts as the synchronization attenuator. This accounts for the synchronization of the SWEEP RATE OSCILLATOR.
The SYNCHRONIZATION FREQUENCY switch selects the range of frequencies desired for synchronization.
The sawtooth signal is then fed to the HORIZONTAL SELECTOR. The PHASE INVERTER changes the signal to push-pull. The HORIZONTAL OUTPUT AMPLIFIERS amplify it. It is attenuated at the HORIZONTAL ATTENUATORS and centered by the HORIZONTAL POSITIONING.
When the HORIZONTAL SELECTOR is switched to the Magnifier position, the sawtooth signal is first shaped and then amplified by the MAGNIFIER. The Magnifier Positioning Control varies the shaping thereby positioning the signal.
The Trigger control changes the Multivibrator from a recurrent to a driven (one shot) sweep which requires a trigger pulse before it will operate. The sawtooth signal is available from the cathode follower portion of the PHASE INVERTER.
Blanking is achieved by feeding a sharp pulse from the SWEEP RATE OSCILLATOR to the Z AMPLIFIER which shapes and amplifies the signal. It is then applied to the grid of the CRT which blanks the return trace. The Z AMPLIFIERS may also be driven by 60 cycle, 120 cycle or External Modulation.

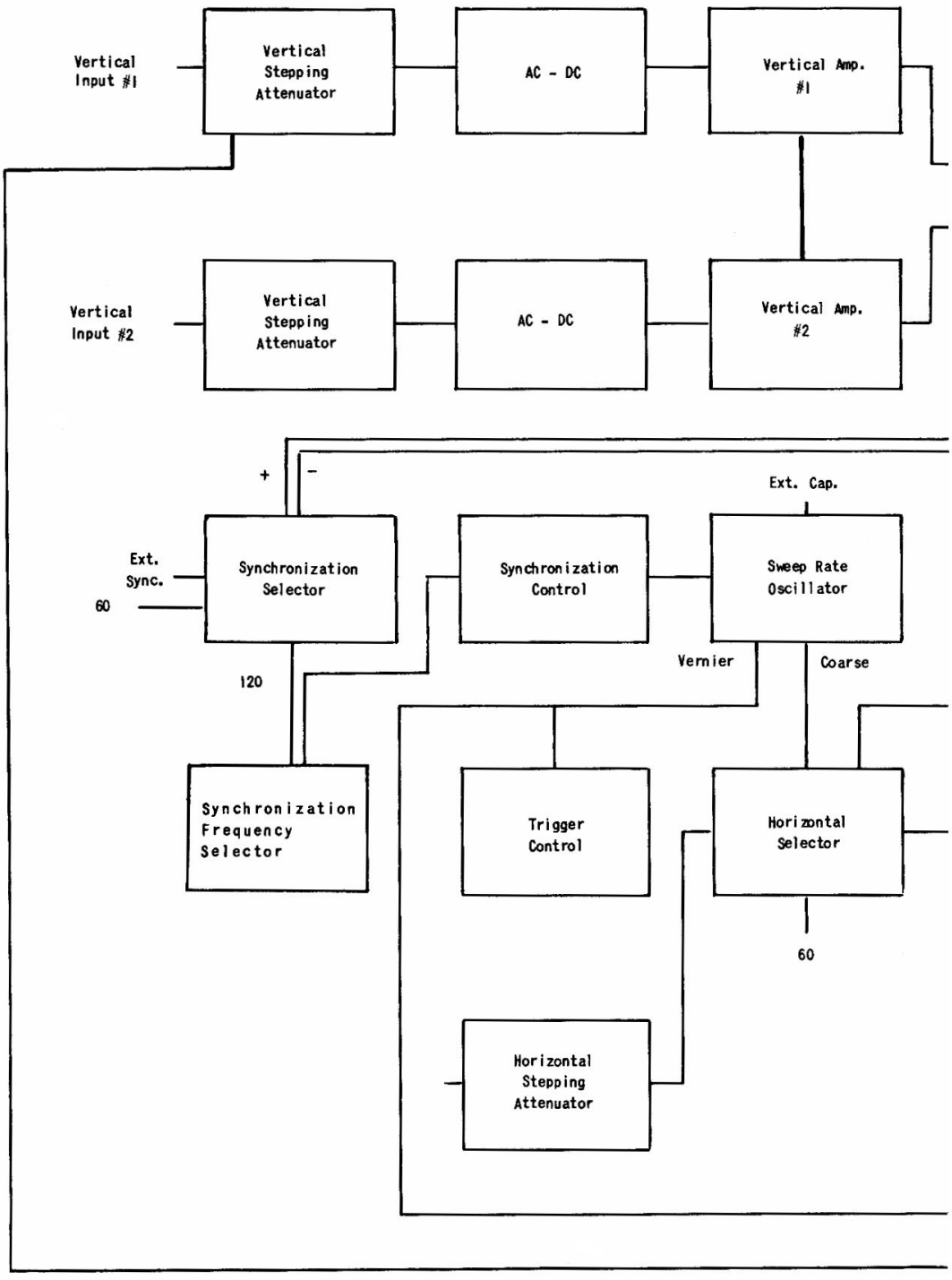
4) HORIZONTAL AMPLIFIER. - When a signal is connected to the Frequency compensated HORIZONTAL STEPPING ATTENUATOR, the HORIZONTAL SELECTOR transfers it to the PHASE INVERTER, which in turn feeds the HORIZONTAL AMPLIFIERS and ultimately the HORIZONTAL DEFLECTION PLATES.
In the 60 cycle position of the HORIZONTAL SELECTOR an internal 60 cycle signal is fed into the HORIZONTAL AMPLIFIERS.

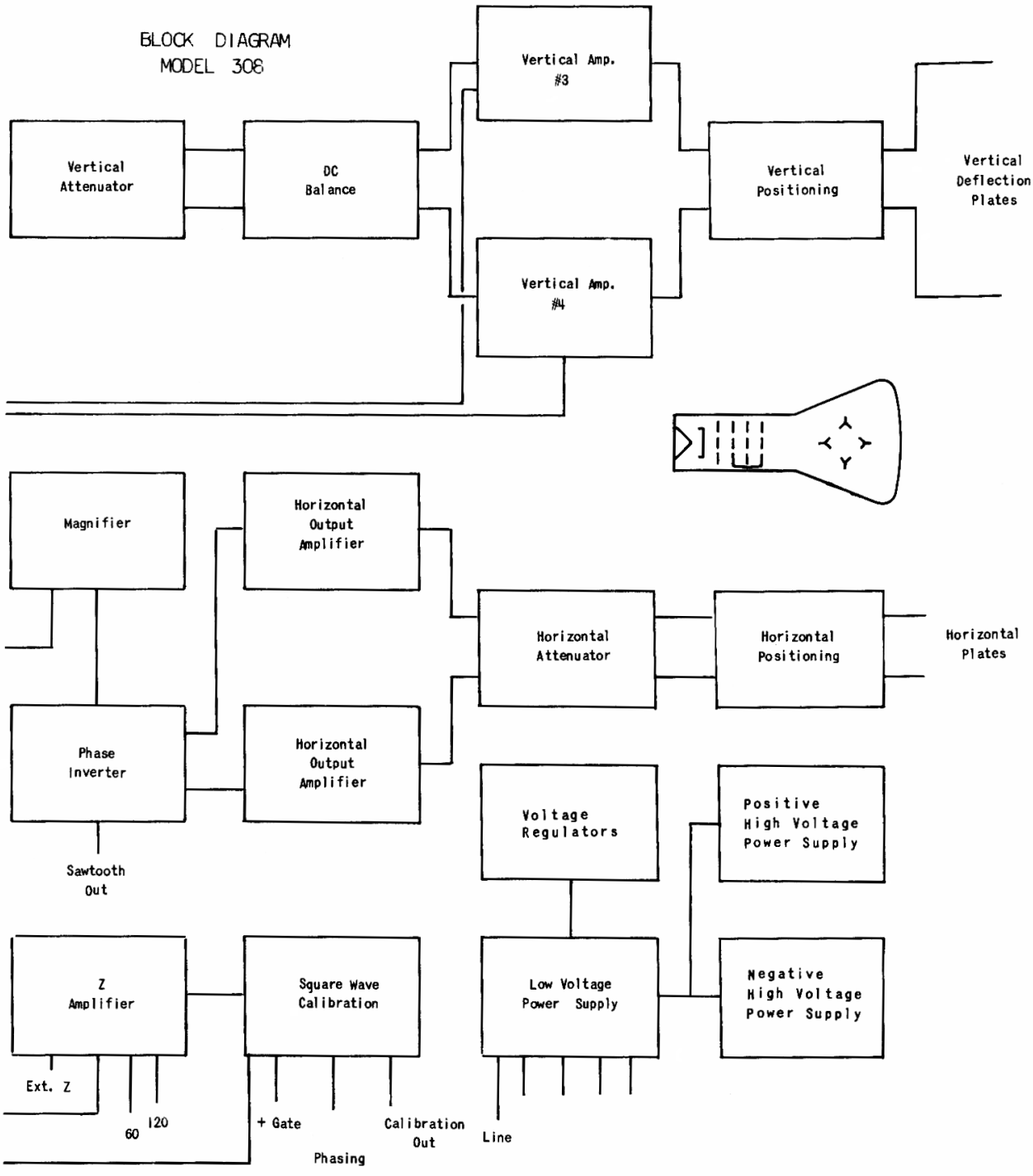
5) SQUARE WAVE CALIBRATION. - The SQUARE WAVE CALIBRATOR shapes a sine wave which is then connected to the vertical input #1 when the latter is in the CALIB position. The same signal is also available at the Calibration Output Jack.

6) LOW VOLTAGE POWER SUPPLY. - A full wave rectifier that supplies both the six different horizontal and vertical B+ voltages and the 60 and 120 cycle signals. The transformer and components are over-designed to withstand a much greater load for many new circuits that can be added.

7) HIGH VOLTAGE POWER SUPPLY. - A half wave, 60 cycle multi -filtered negative and positive supply for the CRT.

BLOCK DIAGRAM




BLOCK DIAGRAM
MODEL 308
Vertical Amp. #3
Vertical Attenuator
DC Balance
Vertical Positioning
Vertical Deflection Plates
Vertical Amp. #4
Y
Magnifier
Horizontal Output Amplifier
Horizontal Attenuator
Horizontal Positioning
Horizontal Plates
Phase Inverter
Horizontal Output Amplifier
Voltage Regulators
Positive High Voltage Power Supply
Sawtooth Out
Z Amplifier
Square Wave Calibration
Low Voltage Power Supply
Negative High Voltage Power Supply
Ext. Z
60
120
+ Gate
Calibration Out
Phasing
Line

CONTROLS AND JACKS

The controls of your Model 308 have been placed with ease of operation as the keynote. The grouping is very simple: The grouping directly to the right of the CRT comprises the entire vertical section.
All the controls directly under the CRT are for the horizontal section except for the "POWER & SCALE" switch.
Around the CRT are the three CRT voltage controls: "ASTIGMATISM" "FOCUS" & "INTENSITY".
The extreme upper right hand and upper left hand controls are "VERTICAL POSITIONING" and "HORIZONTAL POSITIONING" respectively.

1) VERTICAL SECTION (Y AXIS)

a) V. POS. (VERTICAL POSITIONING) Positions the electron beam up and down. The action of this control has been purposely limited to reduce the possibility of overdrive.

b) VERT. BAL. (VERTICAL BALANCE) Establishes the DC balance at the grids of the output amplifiers. A more detailed description of the operation of this control is given under the section marked "OPERATION".

c) V. AMP. (VERTICAL AMPLIFIER GAIN) Varies the amount of vertical gain of the amplifiers by a degenerative feedback method. To prevent overdrive of the input vertical amplifiers, this control does not attenuate the signal to zero.

d) VERT. ATTEN. (VERTICAL STEPPING ATTENUATOR) Has a triple function. The left hand divisions marked AC block the DC component of the signal to be observed. The right hand side marked DC permits both the AC and DC components of the signal to be observed. Maximum gain is at 100, minimum is at 1. The center position marked CALIB. (CALIBRATION) is for Vertical calibration and will be discussed in the BLANKING-CALIB. section.

e) JACK IN-1 N
V O
R (INPUT #1, VERTICAL, NORMAL PHASE) This 5 way Binding Post is most commonly used as the Vertical Input. It will show signals in their normal phase.

f) JACK IN-2 R
V E
V (INPUT #2, VERTICAL, REVERSE PHASE) This 5 way Binding Post reverses the phase of the input signal. It should be shorted at all times to the ground terminal when it is not in use. It may be used for push-pull or mixing applications with Input #1. If the accessory attenuator #2 pad has not been purchased, IN #2 is automatically in the maximum position (X100).

g) ⏚

(GROUND) Ground terminal for vertical section. The 3 Vertical Input terminals are spaced 3/4 inches apart for standard Banana plug adapters.

2) CRT, VOLTAGE CONTROLS

a) INTENSITY Controls the brightness of the trace. Should always be in a minimum useable position for the finest and most exact trace. Internal bias prevents the grid from going positive.

b) FOCUS Operates in conjunction with Intensity control to focus beam at finest trace.

c) ASTIGMATISM Allows the beam to stay in focus over the entire face of the tube rather than being in focus at one point and out of focus at another. A more detailed description is given under "OPERATION".

3) HORIZONTAL SECTION (X AXIS)

a) H POSITIONING (HORIZONTAL POSITIONING) Positions the electron beam from left to right along the X axis. The action of this control has been purposely limited to reduce the possibility of overdrive.

b) HORIZONTAL AMPLITUDE (HORIZONTAL GAIN CONTROL) Varies the amount of horizontal gain. The action of this control has been limited to reduce the possibility of overdrive distortion. Max gain is in the clockwise position. Minimum gain is in the counter-clockwise position.

c) MAGNIFIER POSITIONING Selects the portion of the sawtooth signal to be shaped and magnified. Only operates in the MAG. (Magnifier Position) of the HORIZONTAL selector switch.

d) TRIGGER SWEEP (RECURRENT & DRIVEN SWEEP) Control should normally be in extreme counter-clockwise position for normal sweep. When rotated beyond this point, trace will only appear when a trigger signal is present. NOTE: DO NOT ALLOW A SPOT TO REMAIN ON THE SCREEN FOR ANY EXTENDED PERIOD OF TIME. This could cause a hole to be burned through the phosphor.

e) VERNIER FREQUENCY (FINE FREQUENCY) Varies the sawtooth sweep through the range selected by the SWEEP RANGE switch. Dual potentiometer maintains amplitude balance between upper and lower sweep frequencies.

f) POWER & SCALE POSITION #1 - Power is off; POSITION #2- Power is on and graticule (screen) is not illuminated; POSITION #3 - Power is on and the graticule is illuminated.

g) BLANKING-CALIB. (BLANKING-CALIBRATION) POSITION #1 - CALIB. turns on the square wave calibration voltage which is applied to the VERT. ATTEN. switch when the latter is in its CALIB position. Also sends calibration voltage to 60 ~ & CALIB. Jack.
POSITION #2 (INT. B) Internally blanks out return trace of sweep voltage through internal Blanking Amplifier.
POSITION #3 (EXT. B) Turns internal Blanking off and connects Blanking Amplifier to Z AMP. (INTENSITY MODULATION INPUT) Jack. When a signal is connected to the Z AMP. Jack it will blank or intensity modulate the horizontal trace.
POSITION #4 (60 ~ B) Internally blanks the horizontal trace at a 60 cycle rate.
POSITION #5 (120 ~ B) Internally blanks the horizontal trace at a 120 cycle rate.

h) HORIZONTAL (HORIZONTAL FUNCTION SELECTOR) POSITION #1 (MAG) Electronically magnifies and shapes the horizontal sawtooth signal by a factor of approximately 10, thereby effectively increasing the sweep width to approximately 85 inches. This position is used in conjunction with the MAGNIFIER POSITIONING control.
POSITION #2 (SWEEP) A normal sawtooth sweep is fed to the horizontal deflection plates.
POSITION #3 (HX1) Turns off sweep oscillator and amplifies a signal fed into the H AMP. (HORIZONTAL AMPLIFIER) Jack. Has approximately 1/10 the gain of the HX10 position. The stepping attenuator section of this switch is frequency compensated.
POSITION #4 (HX10) Operates as Position #3 above except with 10 times the gain.
POSITION #5 (60 CYCLE) 60 cycle sine wave is connected to the horizontal deflection plates through the horizontal amplifiers.

i) SWEEP RATE (COARSE SWEEP FREQUENCY) Selects the sweep frequency range for the sawtooth oscillator. Used in conjunction with Vernier Frequency control directly above it. In Position #1 the sweep range may be extended down to 1 cycle by using an external capacitor circuit connected to EXT. C Jack and ground.

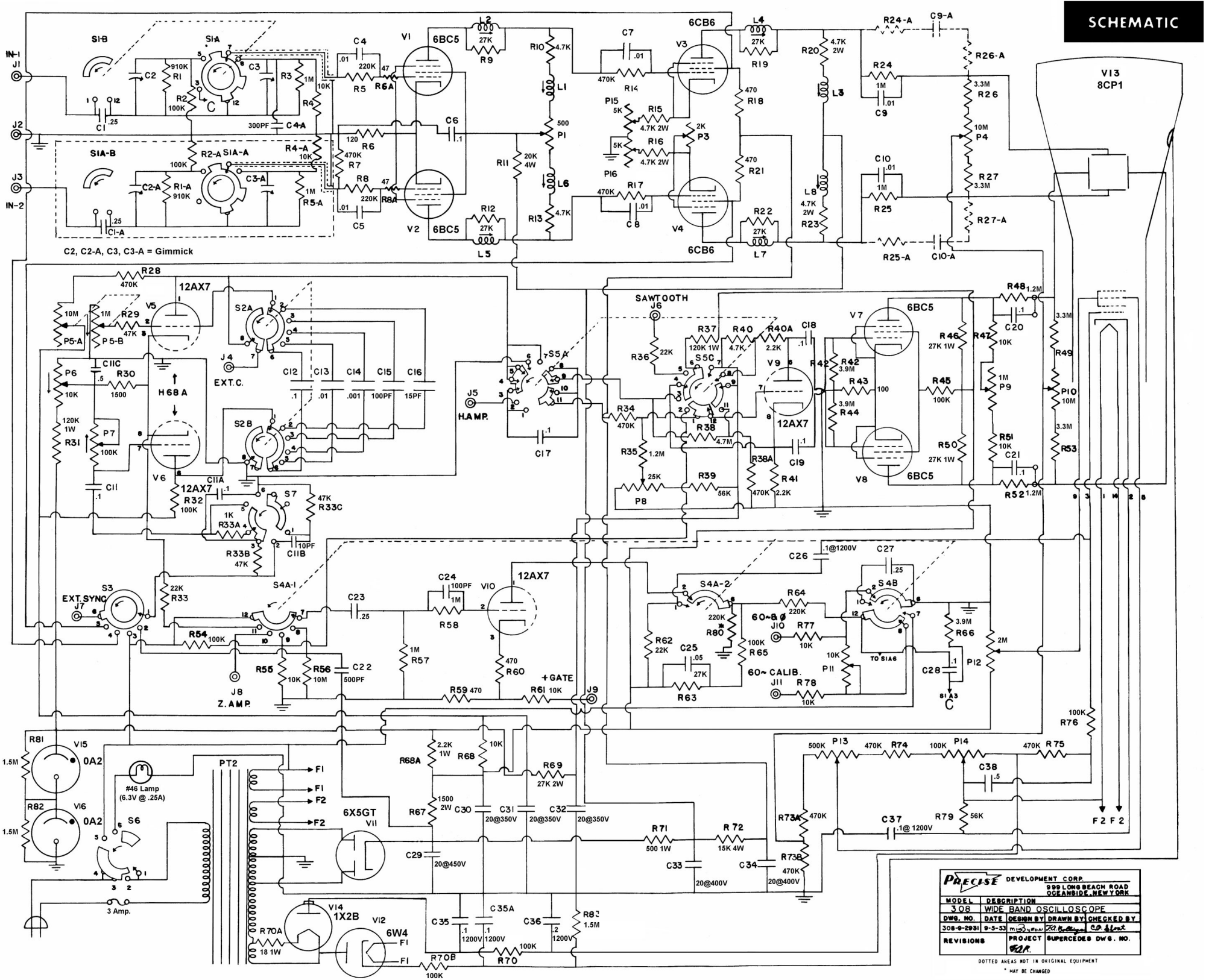
j) SYNCHRONIZATION-POSITION #1 (EXT.) Synchronizes the sweep rate oscillator by an external signal fed into the EXT SYNC Jack.
POSITION #2 (INT. +) Synchronizes the sweep rate oscillator by an internal positive pulse from the vertical amplifier.
POSITION #3 (INT. -) As above except that synchronization is accomplished by a negative pulse.
POSITION #4 (60 ~) Synchronizes the sweep rate oscillator at a 60 cycle rate.
POSITION #5 (120 ~) Synchronizes the sweep rate oscillator at a 120 cycle rate.

k) CALIB. & ϕ (CALIBRATION & PHASING) The CALIB. & ϕ potentiometer varies the height and therefore voltage output of the square wave calibrator in Position #1 of the Blanking-Calib. switch. This is connected both to the Vertical Attenuator and to the 60 ~ & Calib. Jack. In all other positions of the Blanking-Calib. switch, the CALIB.& ϕ pot phases the signal available at the 60 ~ ϕ Jack.

l) SYNC. (SYNCHRONIZATION POTENTIOMETER) Varies the amount of synchronization voltage to the sweep rate oscillator.

m) SYNCHRONIZATION FREQUENCY Selects the synchronization frequency to be fed into the sweep oscillator.
POSITION #1 (LOW) Bypasses all high frequencies to ground and only allows the low frequency signals to synch. the horizontal oscillator.
POSITION #2 (NORMAL) Allows all synch signals to synchronize the sweep oscillator.
POSITION #3 (HIGH) Only permits the high frequency signals to synch the horizontal oscillator.

SCHEMATIC


C2, C2-A, C3, C3-A = Gimmick
V13 8CP1
SAWTOOTH
EXT.C.
H.AMP.
EXT.SYNC
Z.AMP.
+GATE
60~CALIB.
#46 Lamp (6.3V @ .25A)
3 Amp.
PT2
F1
F2
TO SIA6
SIA3
PRECISE DEVELOPMENT CORP.
900 LONG BEACH ROAD
OCEANSIDE, NEW YORK
MODEL 308
DESCRIPTION WIDE BAND OSCILLOSCOPE
DWG. NO.
DATE 9-3-53
DESIGN BY
DRAWN BY
CHECKED BY
REVISIONS
PROJECT
SUPERCEDES DWG. NO.
DOTTED AREAS NOT IN ORIGINAL EQUIPMENT
* MAY BE CHANGED

4) BINDING POSTS & JACKS

a) VERTICAL These are covered in section 1(e,f,g).

b) -Z AMP. (INTENSITY MODULATION) See section 3(g).

c) 60 ~ & CALIB. (60 CYCLE & CALIBRATION) Normally supplies a 60 cycle test signal except in Position #1 of BLANKING-CALIB. switch. In Position #1 a square wave calibration signal is available. See section 3(k).

d) 60 ~ ϕ (60 CYCLE PHASED) In all positions of the BLANKING-CALIB. switch, other than Position #1, a 60 cycle phased signal is available at this Jack. In Position #1 no signal is available.

e) H AMP. (HORIZONTAL AMPLIFIER) Horizontal Amplifier input Jack. See section 3(h), Position #3.

f) EXT. C. (EXTERNAL CAPACITOR) An external capacity circuit may be connected from this jack to ground for extending the sweep range to as low as 1 cycle. See section 3(i).

g) SAWTOOTH (SAWTOOTH OUTPUT) A sawtooth signal, at the same frequency as the sweep oscillator, is available at this jack in the SWEEP position of HORIZONTAL SELECTOR.

h) + GATE (GATED OUTPUT) This jack delivers the same signals through a cathode follower as set on the BLANKING-CALIB. switch. In Position #2, a sharp pulse (+ gate) at the same frequency as the sweep rate oscillator is available.

i) EXT. SYNC. Used for connecting in an external synchronizing signal to the sweep rate oscillator. See section 3(J).

5) DIRECT DEFLECTION PLATES

a) HORIZONTAL The horizontal deflection plates are available at the rear of the cabinet by unscrewing the large guard plate. Note: Normally, the 2 upper screws, left side of Barrier Strip, should be shorted together. The same applies to the two bottom screws. For externally using the H deflection plates, remove the short across the two top and the two bottom screws. Connect signal, to be observed, to the two center screws. In order to maintain centering, a voltage of a few hundred volts is present at all times. Use blocking condensers if desired. High voltage (over 1000 volts) is on the tube socket. USE CAUTION. Make certain the instrument is turned off and the high voltage is discharged before connecting to H plates. The H AMPLITUDE control should be in its maximum counter-clockwise direction, and if necessary, the H. AMP. Jack should be shorted to ground to prevent stray pick-up. The HORIZONTAL selector switch should be in the HX1 position.

b) VERTICAL DEFLECTION PLATES These plates should not be used unless absolutely necessary, since it is possible to disturb the peaking of the circuit.

OPERATION

1 - GENERAL

Although the circuit of the MODEL 308 OSCILLOSCOPE is complete and by necessity somewhat complex, the operation has been made as simple as possible by the inclusion of a special panel design.

As was already mentioned in the section on CONTROLS & JACKS, the Vertical Controls are situated to the right of the CRT. The Horizontal are below the CRT and the Tube Voltage Controls are around the CRT. The Positioning are in the upper right and upper left sides of the panel. The Power On Switch is in the Horizontal Section.

For general oscilloscope applications, all switch controls should be in their 2nd position. All potentiometer controls should be in their center position except for TRIGGER SWEEP which should be in its extreme counter-clockwise direction.

After a few minutes warm-up period, a trace should appear on the screen.

2 - POWER ON

Rotate POWER & SCALE switch to its 2nd or 3rd position. In Position #3 the graticule (lines on the screen)are illuminated. Allow a 30 second warm-up.

3 - INTENSITY

Rotate until trace appears on screen. Always use as low intensity as possible. If no trace appears, change the setting on the FOCUS control.

4 - FOCUS

Rotate until trace is clear and sharp (least fuzzy). If too bright, the intensity control setting may be reduced.

5 - ASTIGMATISM

Rotate until trace is at finest focus. If necessary, readjust FOCUS. Final adjustment of this control is made with a signal present.

6 - POSITIONING

Horizontal positioning is controlled by the top left hand control. Vertical positioning by the top right hand control. Rotate each until the beam is properly centered: equally spaced horizontally and vertically.

7 - VERTICAL

a) VERTICAL SIGNAL (Single Ended) Connect a lead to IN-1 of the Vertical Jacks. The other end goes to the signal to be observed. IN-2 should be shorted at all times to the ground (⏚) Jack unless push-pull is used. Connect a lead from the ground Jack to the ground side of the device being tested. If no instrument is available for an external signal, connect a lead from the 60 ~ and CALIB. Jack to IN-1 for these tests. This will automatically feed 60 ~ to the Vertical.

b) Rotate the VERT. ATTEN. switch to a position on the AC side where in height a signal of about 1 to 2 inches is seen. This control should be kept to the lowest possible setting. #1 is desirable. The DC side is only used for very low frequencies or when it is desirable to see the DC component such as restoration circuits, etc.

c) The V. AMP. control may be used to further adjust the height of the vertical signal. Note: Always keep the height of the signal to under 5 inches, if possible, in order to reduce any possibility of overdrive.

d) VERT. BAL. Will be adjusted later on.

8 - HORIZONTAL

a) NORMAL SWEEP

(1) All switches in the horizontal section should be in their 2nd position; all pots, at center except TRIGGER SWEEP which should be in its maximum counter-clockwise position (NORMAL SWEEP).

(2) Rotate the SWEEP RATE selector and the VERNIER FREQUENCY control until 1 or 2 patterns appear on the screen.

(3) Reduce the SYNCHRONIZATION potentiometer to zero (Bottom Right). The signal should start to "walk" across the screen. If it does not, it means the VERNIER FREQUENCY potentiometer is exactly locked in frequency. The synchronization should be just enough to stop the signal. Too much synchronization can cause sweep distortion and should not be used. The HORIZONTAL AMPLITUDE potentiometer controls the horizontal gain or width. With the pattern locked in the same position, rotate the SYNCHRONIZATION switch to INT. -. Note how the signal is now locked 180 degrees apart. Rotate the SYNCHRONIZATION switch to

60 ~ and note that the sweep is locked at a 60 ~ rate. (Most important for AC line applications). If a signal which is not a multiple of 60 cycles is on the Vertical, the signal will walk. Rotate to 120 ~ and note that synchronization is at 120 cycle rate. Rotate the switch to EXT. and the sweep will now be locked in by a signal fed into the EXT. SYNC. Jack.

(4) With the SYNCHRONIZATION back at INT. +, rotate the BLANKING-CALIB. control from INT. B to EXT. B. Note how the return trace disappears in the INT. B. position and appears in the EXT. B. position. In the EXT. B. position, a signal fed into the Z AMP. terminal will intensity modulate the sweep. Never feed a signal into the Z jack of greater amplitude than a volt or 2 as this could cause injury to the CRT. Rotating the switch to 60 ~ B or 120 ~ B will blank or modulate the trace at a 60 cycle and a 120 cycle rate respectively.

(5) With the BLANKING-CALIB. back to INT. B., rotate the HORIZONTAL selector switch to MAG. (Magnifier). Observe the tremendous amplifications of the signal(up to 10 times). Adjusting the MAGNIFIER POSITIONING control now allows the portion of the signal desired to be viewed.

(6) Rotating the HORIZONTAL selector switch to the HX1 position turns off the sweep and connects the horizontal amplifiers to the H. AMP. jack. If a signal is now fed into this jack it will appear as the horizontal trace. Moving the switch to HX10 increases the gain through the internal frequency compensated stepping attenuator by a factor of 10. The 60 ~ position of the same switch feeds a 60 cycle sine wave to the horizontal amplifiers.

(7) The Binding Posts on the instrument are for input signals; the Pin Jacks are output signals for synchronizing other devices.

b) TRIGGERED SWEEP (DRIVEN)

(1) A driven or one-shot or triggered sweep is a very important asset to an instrument where transient signals(ones which are not exactly repetitive) are to be observed. A sweep does not appear unless a signal is present.

(2) NOTE: Never allow a spot to remain stationary on the screen as this could burn a hole through the phosphor.

(3) Reduce the setting of the SYNC. potentiometer to minimum (maximum counter-clockwise). Rotate the TRIGGER SWEEP pot until the horizontal trace just disappears to a spot. Increase the synchronization until the same pattern is again properly on the screen. (In this position it is desirable to use as much sync. as possible. Too little sync. will cause distortion. This is opposite to NORMAL SWEEP which should use the least possible amount of synchronization). Momentarily remove the signal from the Vertical input. The trace should drop back to a spot in the center of the screen. If the horizontal trace remains, advance TRIGGER control until it falls back to a spot. Replacing the vertical signal will again develop the trace. Note that the trace is only present when a vertical signal is applied. The horizontal motion of the spot back to center, when vertical is removed, is a time delay bias. The triggered sweep operates in both the MAG. & SWEEP positions of the HORIZONTAL selector.

9 - ASTIGMATISM

a) This control need only be set periodically. Set TRIGGER SWEEP back to normal.

b) With no vertical signal present, adjust the FOCUS for the finest horizontal line.

c) Feed a signal to the Vertical and adjust the ASTIGMATISM.

d) Repeat b) & c) until no further adjustment is necessary.

10 - D.C. BALANCE

a) This control is also one which does not need more than occasional adjustment.

b) Turn the V. AMP. control to min with no signal on the vertical. Adjust the V. POS. until the beam is properly centered.

c) Turn the V. AMP. to maximum clockwise (Full Gain) and rotate the VERT. BAL. until the beam is in the same place as in step b).

d) Repeat steps b) & c) until the beam does not change position by V. AMP. control.

11 - CALIBRATION

a) Observe height of signal on screen and note setting on VERT. ATTEN.

b) Set VERT. ATTEN to CALIB.

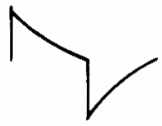
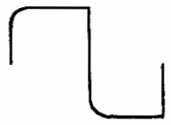
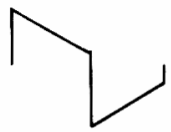
c) Set BLANKING-CALIB. control to CALIB.

d) Adjust CALIB. & ϕ potentiometer so that height of calibration signal (peak to peak) is the same as that observed in step a).

Calibration may be ascertained by noting the reading on the CALIB & ϕ potentiometer and multiplying it by: 1 for the 100 position of the VERT ATTEN; 10 for the 10 position; 100 for the 1 position.

CHECKING TRANSIENT LINE VOLTAGE VARIATIONS

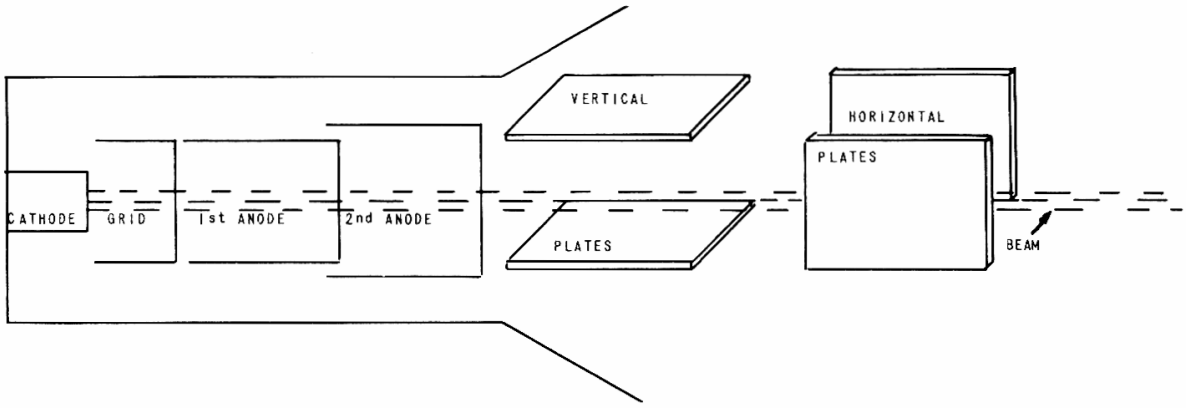
The AC power line transient voltage variations may readily be seen and measured by switching to the CALIB position on the VERT ATTEN switch and then switching the BLANKING CALIB switch to any position other than the CALIB position. To measure the voltage variation, switch the latter to the CALIB position and adjust the CALIB potentiometer for the same variation. The potentiometer is then read directly in rms volts.

INPUT SIGNAL	OBSERVED AT:	TYPE OF DISTORTION:	WAVEFORM	POSSIBLE CAUSE
SINE WAVE	GRID	GRID OVERDRIVE GRID CLIPPING		LEAKY COUPLING CONDENSER
SINE WAVE	PLATE	PLATE OVERDRIVE PLATE CLIPPING		SHORT IN PLATE LOAD
SINE WAVE	PLATE	GRID & PLATE CLIPPING		INPUT SIGNAL TOO STRONG
SQUARE WAVE	OUTPUT	DIFFERENTIATION LOSS OF LOWS		OPEN COUPLING CONDENSER
SQUARE WAVE	OUTPUT	ROUND-OFF LOSS OF HIGHS		EXTRA CAPACITY ADDED TO GROUND. DEFECTIVE PEAKING COILS.
SQUARE WAVE	OUTPUT	TILT LOW FREQUENCY PHASE SHIFT		OPEN LOW FREQUENCY COMPENSATION CAPACITOR. COUPLING CONDENSERS. BYPASSES.
SQUARE WAVE	OUTPUT	OVERSHOOT OVER PEAKING		OPEN DAMPING RESISTORS.
VIDEO SIGNAL	OUTPUT	CLIPPING		LEAKY COUPLING CONDENSER.
VIDEO SIGNAL	OUTPUT	ROUND-OFF LOSS OF HIGHS		DEFECTIVE PEAKING COILS. EXTRA CAPACITY ADDED TO GROUND.
VIDEO SIGNAL	OUTPUT	OVERPEAKING		OPEN DAMPING RESISTORS

DEVELOPMENT OF WAVEFORMS

1) The operation of the Cathode Ray tube.

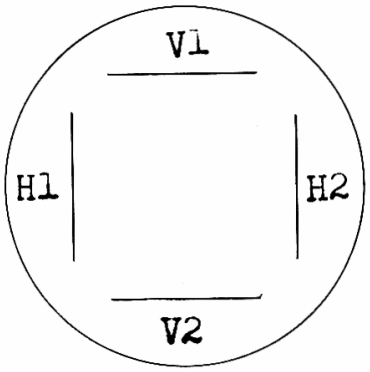
a) The CRT consists of the various components shown below.



b) Electrons are emitted by the cathode; accelerated by the first and second anodes into the space between the vertical and horizontal deflection plates to the face of the tube. There they impinge on the phosphor and, due to an energy exchange, give off visible light which is seen on the front surface. The grid varies the number of electrons going through the tube, thereby adjusting the intensity of the beam (brightness).

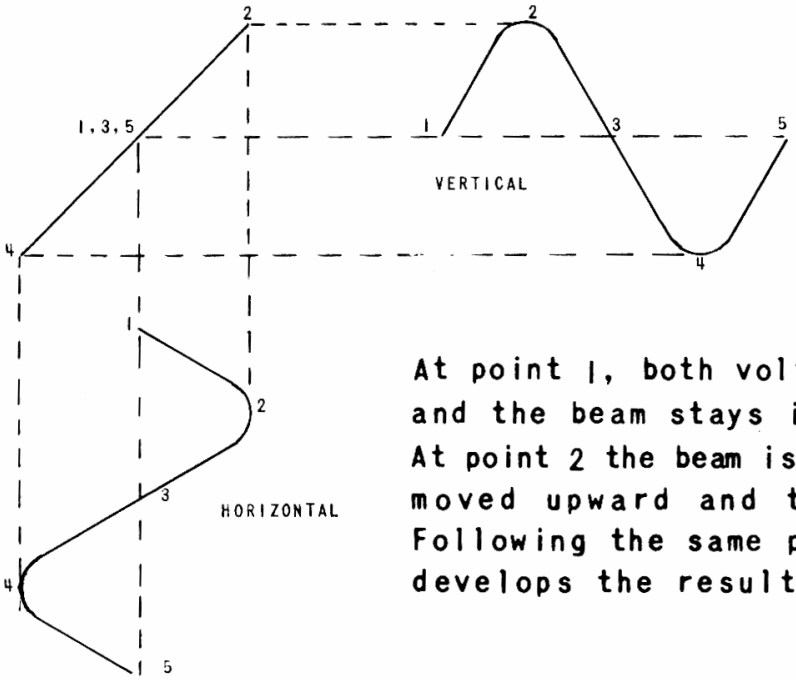
c) If a voltage is applied to the vertical plates, the beam is moved in the direction of the more positive voltage. If the top plate were made more positive than the lower plate, the beam would be deflected upward. The converse is also true. The same applies to the horizontal plates except the motion is now in a lateral (left to right) direction.

d) Looking into the face of the tube (if no phosphor were present) the plates would appear as shown below.



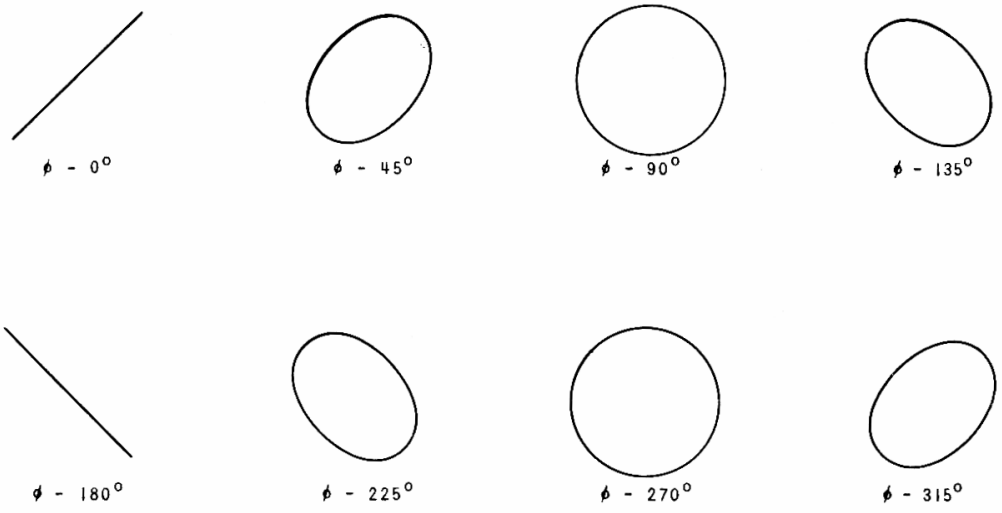
e) If an AC sine wave were now applied to the vertical plates, the beam would move up and down at the same rate as the sine wave. The resultant signal would appear as a vertical line (this, of course assumes no signal on the horizontal plates).

f) Applying a sine wave signal, of the same frequency and phase, to the horizontal and vertical plates simultaneously would present a resultant signal as shown.



At point 1, both voltages are at 0 and the beam stays in the center. At point 2 the beam is simultaneously moved upward and to the right. Following the same principle thru develops the resultant waveform.

g) If the phase of the signals varied, patterns such as shown below would appear.

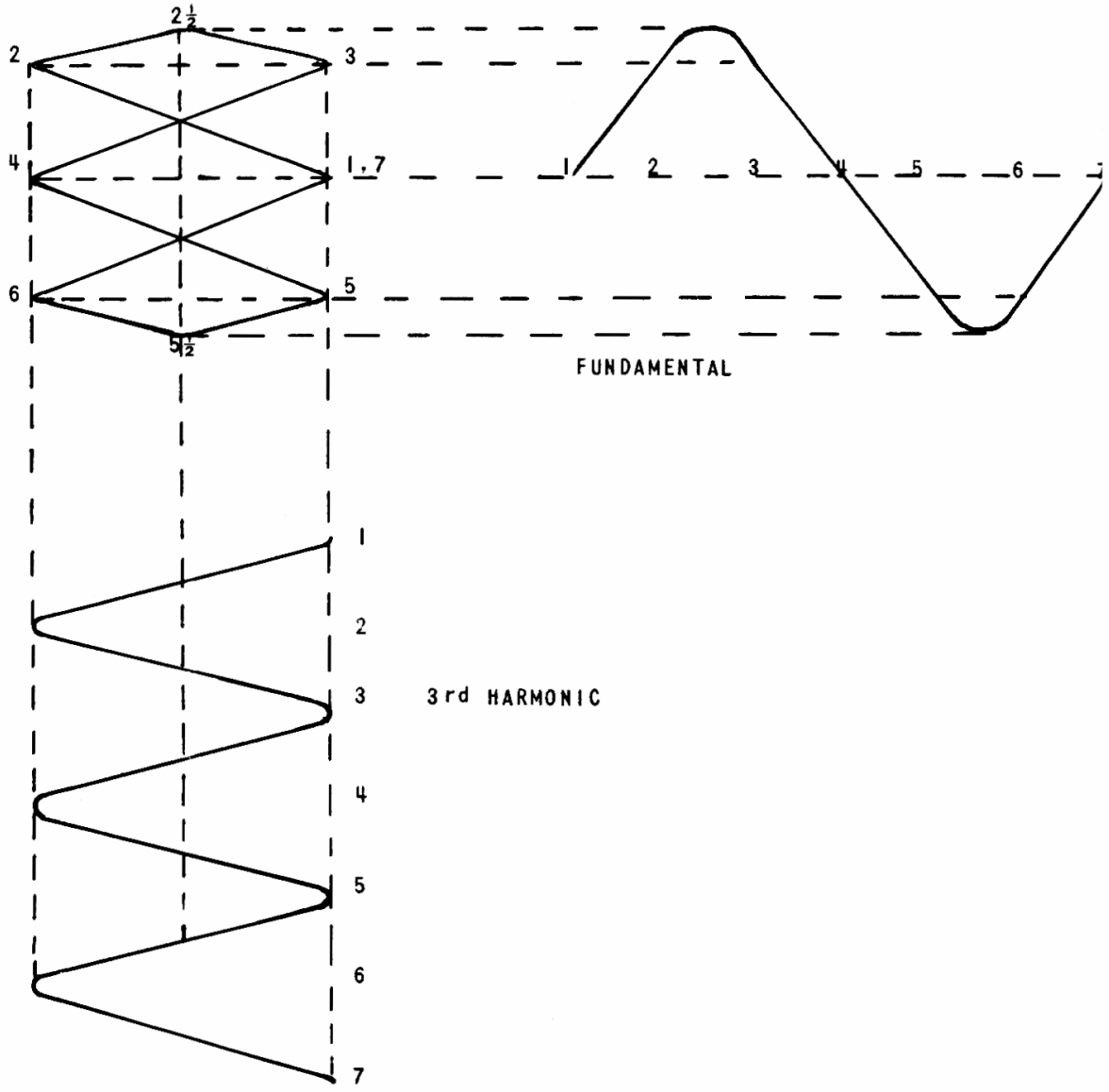


h) The phase angle, in degrees, may be determined by the formula:

$$\text{Sine } \theta = \frac{\text{Height at center}}{\text{Maximum height}}$$

It is very important to maintain the horizontal and vertical gains exactly the same. The direction of the pattern will aid in determining the approximate number of degrees.

i) If different frequencies are placed on the vertical and horizontal, the frequency of one may be used to determine the other, assuming one is known. As an example:-Assume a 60 cycle signal is fed to the vertical and 180 cycles to the horizontal. The resultant would be:

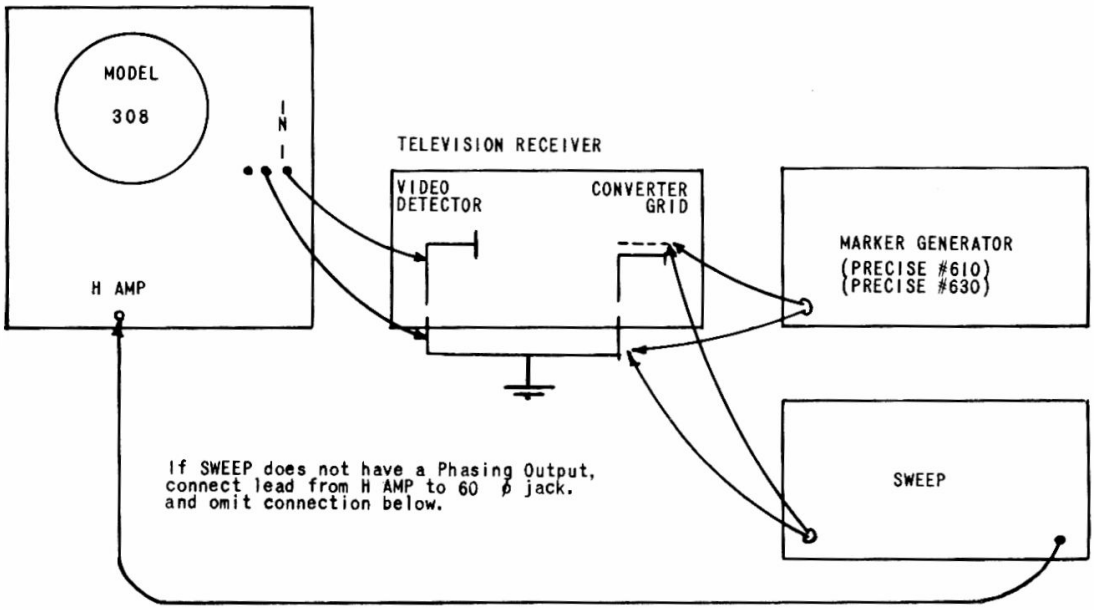


j) The ratio of two signals may be determined by counting the number of loops vertically along any one line(usually at the edge) and dividing it by the number of loops along a horizontal line.

TV APPLICATIONS

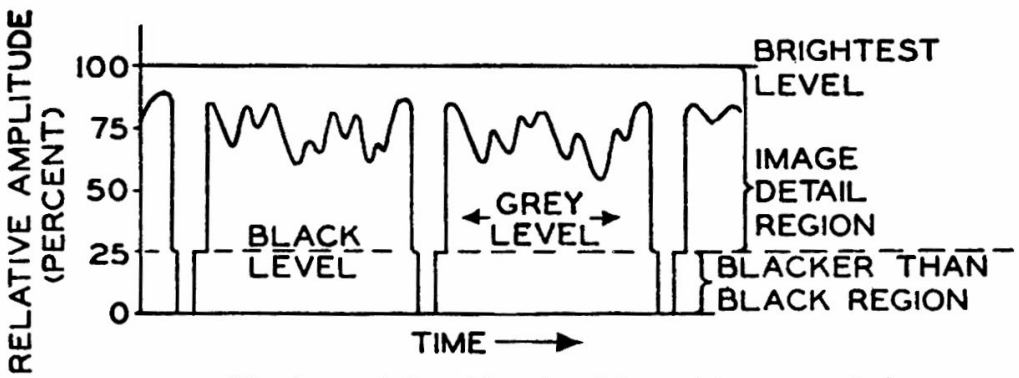
1) Developing the TV video IF response curve.

This is perhaps one of the most simple and yet useful patterns that can be readily obtained. It demonstrates at a glance the actual characteristics of the IF section. It is particularly important since it will show overpeaking, improper operation and tuning of a stage.

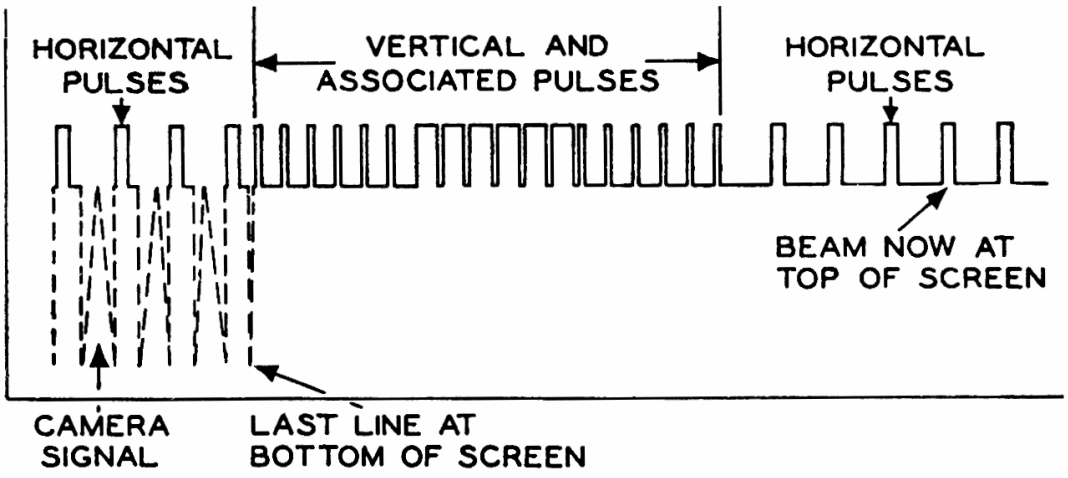


a) Set all the vertical controls for a signal of normal height.
b) BLANKING-CALIB switch is set to 60~B or 120~B to eliminate the return trace. If phasing is necessary, set to EXT.B. and feed a phased signal from the H AMP to Z Amp jacks.
c) The HORIZONTAL control is set to HX1 or HX10 and the HORIZONTAL AMPLITUDE is varied for the desired width. Other controls are not used.

2) The most important signal in television circuits is the video pattern itself. All the circuits in the receiver are designed to faithfully reproduce the pattern.



The form of the video signal in positive transmission.



The form of the vertical synchronizing pulses.

The Model 308 with its exceptionally broad band amplifiers, magnifier, synchronization and blanking features enables the actual pulses to be seen with a minimum of distortion.

a) Connect a lead from IN-| Binding Post of the Vertical section to a grid or plate circuit in the video amplifier of a television receiver. Another lead should be connected to ground.

b) Set the HORIZONTAL selector switch to SWEEP.

"	" BLANKING-CALIB	"	" INT.B.
"	" SWEEP RATE	"	" IKC-IOKC
"	" SYNCHRONIZATION	"	" INT. +
"	" SYNCH FREQ.	"	" HIGH

c) Adjust the SYNCHRONIZATION potentiometer & VERNIER FREQUENCY controls for | or 2 patterns.

d) For a closer examination of the pulses, switch the HORIZONTAL to the MAG. position and adjust the MAGNIFIER POSITIONING for the desired portion of the signal.