

## .type OSG18

DS918a)  
DS918b) har rimlock  
rör - der er  
kun lavet een stic  
erstatte af a indstik  
ny type fremkomme

*Pectulus* side 6 line 17 of 819-20

✓ - 7 - 17-19

- 9 -

12

er rettet  
i stensl



### Type OSG18 CATHODE-RAY OSCILLOGRAPH

The type OSG18 Cathode-Ray Oscilloscope is designed as an all-round Oscilloscope. Owing to its high sensitivity and wide frequency range it is very suitable for both scientific work, ordinary development and routine work in electrical and mechanical laboratories.

The Oscilloscope incorporates a cathode-ray tube having a screen diameter of 16 cm, a high-voltage eliminator for the cathode-ray tube, device for intensity modulation, anode voltage eliminator, sweep generator with device for synchronization and release of single sweep, X amplifier for horizontal deflection of the light spot, and Y amplifier with calibrating device for vertical deflection.

A glass plate with a graticule is mounted in front of the screen of the cathode-ray tube. The glass plate can be removed when the shade is carefully removed. A knob for fine adjustment of the Y amplifier is located to the lower left of the cathode-ray tube. Below that is a knob for coarse adjustment (voltage divider) and for setting to special calibrating voltages. Immediately below the screen are knobs for fine and coarse adjustment of the sweep generator and to the right of those is a knob for adjusting the amplification of the X amplifier and the synchronization of the sweep generator.

In the center of the front panel is a switch - the X switch - by means of which the sweep generator can be made to operate with single sweep or periodical sweep or by means of which the X amplifier can be connected to the X plates. To the right of the X switch is a knob for adjustment of the sweep length. To the left in the lower row are two knobs for displacement of the beam in horizontal and vertical directions (X and Y position). The two other knobs to the right are marked "Intensity" and "Focus" and are for adjusting the brilliance and focus of the beam. Below the "X switch" is the power switch which is also used for adjusting the operating voltage of the cathode-ray tube to 1400 volts or 2000 volts. When the right-hand side panel of the instrument is removed the voltage selector is accessible. The latter can be set to the voltages 110, 127, 150, 200, 220, and 240 volts, 50 cycles a-c. Input terminals for the Y and X amplifiers are located on the left-hand and the right-hand



side panel of the instrument. On the right-hand side panel there are also jacks that are employed for release of single sweep. On the top panel of the instrument are binding posts for magnetic deflection of the beam by means of current coils. Above on the back panel of the Oscillograph is a jack marked "Intensity" which through a condenser is connected to the grid of the cathode-ray tube. The jacks  $X_1$  and  $X_2$  are directly connected to the deflecting plates for horizontal deflection of the cathode-ray.  $X_1$  and  $X_2$  are connected to  $X_1'$  and  $X_2'$  respectively through condensers of 9  $\mu$ f when the sweep switch is in the positions "A" and through condensers of 1  $\mu$ f when it is in the position "B".

The jack  $Sy_i$  is connected to the jack  $Sy_e$  through a resistor of 1 megohm, and the voltage at  $Sy_e$  is employed for synchronizing the sweep generator. A negative voltage pulse occurs at the jack "Cut-off" when the beam is moved back to its starting position, and if the "Cut-off" jack is connected to the jack "Intensity" immediately above, the fly-back trace disappears from the screen.

The output voltages of the sweep generator and the X amplifier are at the jacks  $S_1$  and  $S_2$ , and the output voltages of the Y amplifier are at the jacks  $O_1$  and  $O_2$ .

The two jacks marked "G" are connected to the chassis of the Oscillograph.

#### THE CATHODE-RAY TUBE

The cathode-ray tube is of the high-vacuum type (Philips type DN16-2, DG16-2, or DB16-2), and is designed for electrostatic deflection in both vertical (Y) and horizontal (X) direction.

The Y deflecting plates are connected to the jacks  $Y_1$  and  $Y_2$ . Through resistors of 2 megohms they are connected to the two arms of the dual potentiometer "Y Position". When the image is placed symmetrically around the horizontal axis on the screen the d-c voltage at the jacks is zero referred to the chassis, whereas it becomes positive at one of the jacks and negative at the other when the knob "Y Position" is rotated. If the voltage to be tested is applied directly to the jacks the Y displacement knob does not operate if the resistance of the



voltage source is small in proportion to the leak resistors of 2 megohms. The jacks  $Y_1$  and  $Y_2$  are sensitive to d-c voltages. The sensitivity to d-c voltage is about 0.38 mm per volt with the power switch in position "1400V" and about 0.27 mm per volt in position "2000V". The corresponding sensitivities at a-c voltage is 2 2 times as high. Consequently it is about 1.1 mm per volt in position "1400V" and about 0.75 mm per volt in position "2000V". The capacitance referred to chassis is about 20 picofarads on each of the jacks. The voltages applied to the jacks  $Y_1$  and  $Y_2$  must be symmetrical referred to chassis so as to avoid defocusing. The jacks  $Y_1'$  and  $Y_2'$  are connected to  $Y_1$  and  $Y_2$  respectively through blocking condensers of 1  $\mu$ f, and they are employed when the a-c voltage to be tested is superimposed on a d-c voltage, or when it is desirable to displace the image even if a generator with a small ohmic resistance is connected. The lower frequency limit is 0.08 cycles when the jacks  $Y_1'$  and  $Y_2'$  are employed. At this frequency the voltage across the deflecting plates is 0.7 times the input voltage. The upper frequency limit is at about 30 megacycles.

The X deflecting plates are connected to the jacks  $X_1$  and  $X_2$ . Analogous with that applying to the Y plates the X plates are supplied with d-c voltages with reverse signs (also through resistors of 2 megohms) when the knob "X Position" is operated. The deflection voltages must - like those for the Y plates - be symmetrical to avoid trapezium distortion and defocusing. The sensitivity to d-c voltage is about 0.28 mm per volt with the power switch set to "1400V", and 0.20 mm per volt with the power switch in position "2000V". The corresponding sensitivities for a-c voltage is about 0.80 mm per volt and about 0.57 mm per volt respectively.

$X_1'$  and  $X_2'$  are connected to  $X_1$  and  $X_2$  respectively through condensers of either 1  $\mu$ f or 9  $\mu$ f, according as the coarse adjustment for sweep frequency is in the position "B" or "A". With 1  $\mu$ f as a coupling condenser (positions "B") the capacitance at each of the jacks is about 40 picofarads to chassis and with 9  $\mu$ f (positions "A") the capacitance is about 240 picofarads. The limit frequency is 0.08 cycle with 1  $\mu$ f as for the Y plates and 0.009 cycle with 9  $\mu$ f. The upper frequency limit is not sharp



as it depends on the distortion permissible. The distortion results from the changing of voltage across the deflecting plates while the electrons are between the plates, because of their final speed. At 30 megacycles the said distortion will generally be negligible.

#### Operating Voltages of the Cathode-Ray Tube. Time Marking

The anode voltage and the d-c voltages necessary for adjusting the intensity and focus of the light spot and for the placing of the image on the screen is fed from a high-voltage eliminator that can be set to supply either 1400 volts or 2000 volts d-c. The selector on the front panel switches between the two voltages. Through the jack "Intensity" on the back panel of the Oscillograph the voltage that governs the intensity can be altered by an a-c voltage or pulse that modulates the intensity and which can be employed for timing the image. In order to avoid blurring, a-c voltages with edged waveform should be employed for the timing, or preferably short negative pulses, because the focus of the cathode-ray beam is dependent on the brilliance owing to the design of the tube.

The input impedance across the jack "Intensity" is about 2000 picofarads. The maximum peak voltage permissible is about 30 volts.

#### The Anode Voltage Eliminator

The anode voltage eliminator supplies all the voltages necessary for the amplifiers and the sweep generator. Like the high-voltage eliminator it is operated from the power line (50 cycles a-c). The total consumption of the Oscillograph from the power line is about 85 VA.

#### Sweep Generator and Synchronizing Device

The sweep generator supplies a serrated voltage for guiding the light spot in horizontal direction and in most cases it is employed when a movement proportional to the time is required (e.g. when examining a-c voltage curves). When the jacks on the back panel of the instrument marked "Sweep Generator  $S_1$  &  $S_2$ " are connected to the jacks  $X'_1$  and  $X'_2$  the sweep generator is coupled to the X deflecting plates through condensers of 1  $\mu$ f or 9  $\mu$ f. The light spot moves from the left to the right and then



flies back to its starting position to repeat the movement, if the switch in the center of the front panel is in position "Periodical Sweep". The speed and the amplitude of the movement are adjusted by means of the knobs "Sweep Fine" and "Sweep Coarse" and "Sweep Range". However, if the switch is in position "Single Sweep" the light spot remains stationary on the screen until the two jacks marked "Make" on the right-hand side panel of the instrument are connected to each other. One of the jacks is connected to the chassis while the other is directly connected to the anode of a tube, and therefore it carries about 150 volts d-c referred to chassis. The anode resistance of the tube is so dimensioned that it can carry the current - about 10 mA - flowing when the two jacks are connected. Release of single sweep (the starting of the light spot from the left towards the right) can also be obtained by breaking the connection that a short-circuit strap generally maintains between the jacks "Break". The current that is broken is of about 5 milliamps, and after breaking there is a voltage of about 430 volts between the jacks. The jacks "Break" must be connected at all uses of the Oscillograph except when single sweep is to be released by breaking the connection between them.

To utilize the whole screen when operating with single sweep, the light spot is directed to the extreme left of the screen by means of the knob "X Position". The sweep frequency is controlled in the same way as at periodical sweep. The coarse adjustment is made in steps of 1:3 and has 10 positions. By means of the coarse adjustment the sweep frequency required should always be set to the lowest figure possible in order to have the sweep movement as linear as possible.

The sweep frequencies stated on the switch "Sweep Coarse" approximately state the sweep frequencies which are obtainable by means of the "Sweep Fine" knob at about 100 mm sweep length.

The sweep generator can be made to operate at any value between about  $1/4$  and 60.000 sweeps per second.

The sweep generator can be synchronized with an a-c voltage fed to one of the jacks  $Sy_1$  or  $Sy_e$ . The synchronizing voltage is controlled by means of the knob "Synchronization X Amplifier". At internal synchronization the jack  $Y_2$  has to be connected



to the jack  $Sy_1$ . The sweep generator is then synchronized with the a-c voltage supplied to the Y plates, either directly or through the amplifier. At external synchronization a voltage is employed differing from that at the Y plates. If the voltage is less than 10 volts the jack  $Sy_e$  is employed, otherwise the jack  $Sy_1$ .

#### The X Amplifier

The X amplifier is a two-stage amplifier with symmetrical output and a wide frequency range. Typical curves of the phase shift at maximum and half amplification are found on a sheet appended to the operating instructions together with curves of the frequency response. The curves apply when the input terminal XA is employed. As will be seen the variation in amplification is less than 1 db from 0.03 cycle to 5000 cycles when the "Sweep Coarse" switch is in one of the positions A. When it is set to one of the positions B the amplification varies less than 1 db from 0.3 cycle to 50 kilocycles. XA' is connected to XA through a condenser of 0.5  $\mu$ f. The terminals G are connected to chassis. If the terminal XA' is employed the amplification has decreased by 1 db at about 7 cycles. The XA' is insensitive to d-c voltages.

The input impedance across terminal XA is about 0.1 megohm in parallel with about 30 picofarads.

The amplification can be controlled between zero and maximum by the knob "Synchronization X Amplifier". On the range from zero to about 0.75 times maximum amplification the input capacitance is 20 picofarads and then increases to 40 picofarads at maximum amplification. The highest permissible input voltage is 350 volts. The sensitivity at maximum amplification is about 40 mm per volt r-m-s a-c voltage at 1400 volts anode voltage on the cathode-ray tube. At 2000 volts anode voltage the maximum sensitivity is about 28 mm per volt r-m-s.

The X amplifier is connected and the sweep generator is disconnected when the X switch is set to the position "X Amplifier". The output jacks of the X amplifier are the same as those at the sweep generator. When the X amplifier is connected the impedance at the jack  $S_1$  is about 45 kilohms in parallel with about 45 picofarads, and at the jack  $S_2$  it is about 5 kilohms in parallel with about 30 picofarads.



With a view to frequency response and phase shift the switch "Sweep Coarse" should always be set to one of the positions A when operating with very low frequencies, and to one of the positions B when operating with higher frequencies, e.g. audio frequencies.

### The Y Amplifier

The Y amplifier is a two-stage amplifier with symmetrical output. The special features of the amplifiers is its good frequency response, high sensitivity, and high input impedance.

The amplification varies less than 0.5 db on the frequency range 0.5 cycle to about 30 kilocycles. At 50 kilocycles the amplification has decreased between 0 and 1 db depending on the position of the amplifier control. In the position "Max. Ampl.", however, the amplification has decreased by about 2 db at 50 kilocycles. The input terminal YA is connected to the terminal G through a condenser of 1 pf. The terminal G is connected to chassis. If the YA terminal is employed the amplification has decreased by 1 db at about 0.5 cycle. ✕

Typical curves of phase shift and frequency response for various positions of the amplifier control are shown on the chart appended to the instructions. The amplifier control consists of a coarse adjustment and a fine adjustment. The coarse adjustment is made as a voltage divider that divides the input voltage in the ratios 1:1, 1:3, 1:10, etc. The fine control has a range of about 1:5. When the coarse adjustment is in position "Max. Ampl." the fine control is out of action. ✕

In the positions 10, 20, and 50 mV a calibrating voltage of 10, 20, or 50 mV a-c is fed to the amplifier input from the power line. By means of the fine adjustment and one of these calibrating voltages the amplification can be set so that a division on the graticule in front of the cathode-ray tube corresponds to for example 5 millivolts. If an a-c voltage fed to the input terminals of the Y amplifier gives a height of image of for example 12 divisions when the voltage divider is at 1:1000 the magnitude of the a-c voltage can be found as  $5 \times 1000 \times 12$  mV = 60 volts. The calibrating voltages are only correct when the line voltage is nominal.



The input impedance of the Y amplifier is about 1 megohm in parallel with 25 picofarads. With the voltage divider in positions "1:3", "1:1", and "Max. Ampl." the parallel capacity, however, is about 40 picofarads. Maximum input voltage permissible is 350 volts.

The sensitivity in position "Max. Ampl." is about 10 mm per millivolt at 1400 volts anode voltage and about 7 mm per millivolt at 2000 volts. With the voltage divider in position "1:1" the maximum sensitivity is about 5 mm per millivolt and 3.5 mm per millivolt at 1400 volts and 2000 volts anode voltage respectively.

The output jacks of the Y amplifier are  $O_1$  and  $O_2$ . The impedance on each of the jacks is about 75 kilohms in parallel with 15 picofarads.

#### Frequency Curves

The appended chart shows the frequency response and the phase shift of both amplifiers. At the highest frequencies the curves are somewhat dependent on the amplifier control.

It should be observed that the non-sinusoidal voltage curves will be distorted if the fundamental or harmonics of considerable magnitude lies outside the straight part of the phase shift curves. It appears from the curves that the straight part of the phase shift curves are essentially shorter than the straight part of the frequency response.

#### Magnetic Deflection

2 coils for magnetic deflection are mounted on the cathode-ray tube proper. The connection to the two coils is established through the four binding posts on the top of the Oscilloscope. The coils are connected in series when terminal 2 is connected to 3, and in parallel when terminal 1 is connected to 2, and 3 to 4. When coupling in parallel the sensitivity is about 19 mm per amp r-m-s at 2000 volts anode voltage, and about 22 mm r-m-s a-c at 1400 volts (about 6.7 and 8 mm per amp respectively at d-c). Coupled in series the sensitivity is about 39 and about 45 mm per amps r-m-s a-c respectively (4 and 16 mm per amp d-c respectively).



## OPERATING INSTRUCTIONS

### Connection. Control of "Intensity" and "Focus"

The Oscillograph is connected to a-c the power line (50 cycles) after having made sure that the voltage selector is set at the correct voltage. The instrument is switched on by the combined switch and selector on the front panel below. In position "1400V" the anode voltage of the cathode-ray tube is 1400 volts while it is 2000 volts in the last position. The intensity obtained at 1400 volts anode voltage is generally sufficient for most measurements so that it is only necessary to employ 2000 volts when the image is going to be photographed, or when the intensity, for some reason or other, has to be as great as possible. The intensity is adjusted to a suitable value by means of the knob "Intensity", and adjustment to sharp focus by means of the knob "Focus". The light spot can be moved to any place on the screen by means of the knobs "X Position" and "Y Position". However, the luminous spot should only remain stationary on the screen for a short while so as to avoid damaging the screen. Therefore an a-c voltage should always be at one of the deflecting plate pairs, e.g. the sweep voltage.

### Plotting voltage curves with time base

The sweep generator is connected to the X deflecting plates by connecting the jack  $S_1$  to the jack  $X'_1$  and the jack  $S_2$  to the jack  $X'_2$  by means of the short-circuit straps supplied with the Oscillograph. The Y amplifier is connected to the Y deflecting plates by connecting the jacks  $O_1$  and  $O_2$  to  $Y'_1$  and  $Y'_2$  respectively. The synchronizing terminal  $Sy_1$  of the sweep generator is connected to the jack  $Y_2$ . The voltage to be examined is applied between the terminal YA and the chassis. If the a-c voltage is superimposed on a d-c voltage the terminal YA' should be employed. (X) The amplification is adjusted by the knobs "Attenuation Ratio" and "Fine Control" to such a value that an image of suitable height is produced on the screen. The adjustments for the sweep generator (sweep frequency and sweep length) are made by experiments. When the synchronizing potentiometer is turned suitably on, various stationary images can be obtained corresponding to the sweep frequency being  $1/2$  or  $1/3$  of the frequency of the voltage under test.



As the pulse for synchronization is fed from one of the Y deflecting plates the position of the synchronizing potentiometer becomes dependent on the height of image. If it is desirable to synchronize the sweep generator with the external voltage source, the strap connecting the jack  $Y_2$  to the jack  $Sy_1$  is removed and the voltage is applied between  $Sy_e$  and chassis. The voltage must be at least 0.5 volt and must not exceed 200 volts. If the voltage exceeds 10 volts the jack  $Sy_1$  may often be employed to advantage as the impedance at this jack is about 1 megohm while it is about 0.1 megohm at the jack  $Sy_e$ . If sufficient voltage is available the direct input jacks  $Y_1$  and  $Y_2$  or  $Y_1'$  and  $Y_2'$  can be employed.  $Y_1$  and  $Y_2$  are direct coupled to the Y plates and consequently they are sensitive to d-c voltages in the voltage under test, while the jacks  $Y_1'$  and  $Y_2'$  are connected to the corresponding jacks through condensers of 1  $\mu f$ .

Normally symmetrical input should be employed on the direct jacks as this provides for the best focusing. If a symmetrical voltage is not available the jack  $Y_1'$  should be connected to chassis and the voltage fed to  $Y_2'$ , as in that case the voltage can readily be carried on to the jack  $Sy_1$  by means of the short-circuit strap (if the sweep generator is to be synchronized with the voltage under test). If the jacks  $Y_1$  or  $Y_2$  are connected to chassis the possibility of Y displacement will be reduced.

#### Employing the X Amplifier

The X amplifier is amongst others used for measuring modulation percentage, for frequency comparisons and for amplifier examinations. The amplifier is connected by setting the switch in the middle of the front panel to position "X Amplifier".

Modulation percentage measurements may be made by applying the modulated h-f oscillation to the Y plates and the modulating voltage to the X amplifier. The Oscilloscope will then produce a trapezium on which the modulation percentage can be measured directly. The measurement will be most accurate when the modulating frequency is so chosen that phase shift in the amplifier is avoided, as otherwise the inclined sides of the trapezium take the shape of ellipses.



Frequency comparisons may be made by producing Lissajous figures. When two a-c voltage having frequencies in simple ratios to each other are fed to the two deflecting plate pairs these figures occur by means of which the ratio between the frequencies in question can be determined.

Of amplifier examinations may be mentioned direct plotting of the characteristic of an amplifier. The amplifier is fed from a suitable generator - e.g. a type H012 Radiometer Beat Frequency Oscillator - which is also connected to the X deflecting plates of the Oscillograph, either directly or through the X amplifier. The Oscillograph will then produce an inclined more or less curved line representing the characteristic of the amplifier. In order to make sure that irregularities, if any, are not due to the amplifiers of the Oscillograph, voltage may be applied to both amplifiers of the Oscillograph direct from the same Beat Frequency Oscillator. It will then be observed that as the frequency varies the inclined line will change to an ellipse owing to the varied phase shift of the two amplifiers of the Oscillograph. At about 800 cycles the phase shift is zero in both amplifiers.

#### Intensity Modulation. Time Marking

The time marking device may in certain cases be employed as a third co-ordinate when more complicated examinations are to be made. If an a-c voltage, preferably with sharp negative points, is applied to the jack "Intensity" the image will become dotted. A peak voltage of about 10 volts is required to extinguish the beam. The maximum voltage permissible is about 30 volts.

If the jack "Intensity" is connected to the jack located below and marked "Cut-off" the cathode-ray is extinguished during the fly-back if the sweep frequency lies on the range from about 10 sweeps per second to about 500 sweeps per second.

#### T u b e s

The Oscillograph is supplied complete with the following tubes:

Cathode-ray tube	1	Philips type DG16/2
High-voltage eliminator	1	" " 1875
Anode-voltage eliminator	1	" " EZ4
Y amplifier	4	" " EF6
X amplifier and sweep generator	2	" " EF6
	2	" " EL3



All tubes except the 4 type EF6 (marked 1, 2, 3, and 4 in the instrument) can be replaced by tubes of the same type right away.

If the axis of the cathode-ray tube is not horizontal the base is loosened and the tube is turned into position. As the length of the tubes differs a little the housing on which the base is mounted is movable.

#### Protection against connection to d-c

The Oscillograph has a 1-amp fuse for the power transformer and consumes about 0.4 amp at 220 volts.

#### Replacement of tubes

All tubes except the 4 type EF6 tubes (No. 1 to 4) in the Y amplifiers can be replaced by tubes of the same type right away.

When replacing tube 1 or 2 a re-adjustment should be made by means of the slotted shaft of the foremost of the two potentiometers that become accessible when the left-hand side panel is removed. The potentiometer is adjusted at the slowest sweep frequency and maximum amplification so that the light spot produces a straight line on the screen.

When replacing tube 3 or 4 an adjustment should be made on the rear potentiometer. During the adjustment the Y fine control is set to 0 and the voltage selector to "1:1". The potentiometer is then set so that the light spot does not move in vertical direction when the voltage selector is turned from position "1:1" to position "Max. Ampl.". <sup>divider</sup>  
<sup>divider</sup>



# Specifications

Cathode-ray tube:	diameter of screen 16 cm Color: green, afterglowing
Sweep generator:	1/4 - 70.000 cycles Device for synchronizing and single sweep
X amplifier:	Frequency range: 0.03 cycle to 50 kilocycles Input impedance: 0.1 megohm in parallel with 30 picofarads
Y amplifier:	Frequency range: 0.5 cycle to 50 kilocycles Input impedance: 1 megohm in parallel with 30 picofarads
Sensitivity:	X amplifier: 40 mm per volt r-m-s X plates direct: 0.8 mm per volt r-m-s Y amplifier: 10 mm per millivolt r-m-s Y plates direct: 1.1 mm per volt r-m-s
Calibrating voltages:	10, 20, and 50 millivolts
Current coils:	maximum 2.5 and 5 amps sensitivity: 19 and 22 mm per amp r-m-s
Power supply:	110, 127, 150, 200, 220, and 240 volts a-c Consumption: 85 VA
Overall dimensions:	Height: 46 cm Widht: 30 cm Depth: 62 cm
Weight:	25 kilos

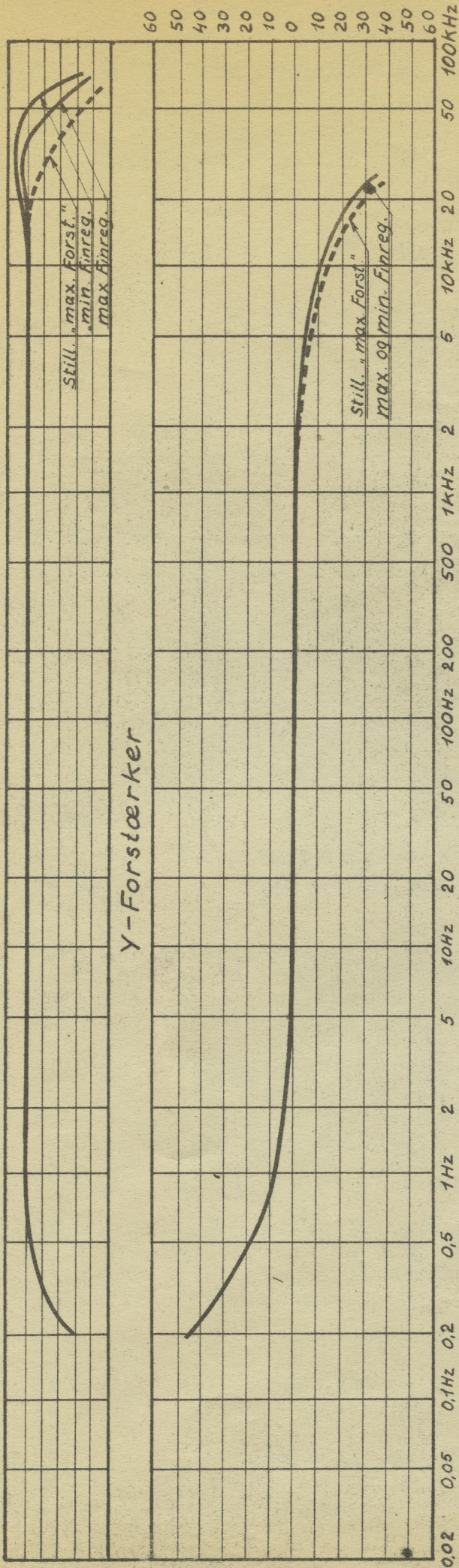


# Frekvenskurver for Oscillograf, Type OSG 18a.

°

db

+ 1  
0  
- 1  
- 2  
- 3  
- 4  
- 5



+ 1  
0  
- 1  
- 2  
- 3  
- 4  
- 5

