NATIONAL UNION
TYPE 2203
MONOTRON

THREE INCH ELECTROSTATIC DEFLECTION TYPE
PICTURE SIGNAL GENERATOR TUBE

National Union Monotron type 2203 is a special cathode ray tube designed primarily for the production of a single television pattern, useful in testing circuits designed to resolve television signals. The Monotron finds a use in all fields where an experimental television signal is desired which can be obtained at will, especially in locations where modern television transmission is not available. This field includes experimental laboratories, schools, colleges, radio clubs, radio experimenters, radio amateurs, and all others, such as radio set manufacturers, radio broadcasting stations, and trade schools, where the principles employed in modern television are under development and study. With the advent of modern television a Monotron signal generator will be found indispensable in servicing television receivers.

The type 2203 Monotron is basically a three inch cathode ray tube in which the customary fluorescent screen on the end of the bulb has been replaced with an aluminum plate on which is printed a special test pattern useful in testing television equipment.

The electrodes in the 2203 provide a focused beam of electrons which impinge upon the signal plate and produce secondary electrons at the point of contact which are collected by the Aquadag coating. This coating is connected to the second anode inside the tube and is normally at ground potential. The amount of secondary emission depends upon the material upon which the beam is incident, the maximum being given off when the electron beam strikes the clear aluminum and the minimum when the beam strikes the ink of the printed pattern—half tones are produced by varying densities of ink.

The position of the spot is controlled by two sets of electrostatic deflection plates as in a normal cathode ray tube (2003). When the Monotron is used for television signal generation, voltages of saw tooth wave form are applied to the vertical and horizontal deflection plates, causing the spot to scan the signal plate, which in turn will give off secondary electrons in proportion to the density of the ink upon which the spot falls.

The picture detail provided by the 2203 is adequate for testing the response of a television receiver up to three hundred lines per picture. The pattern design has been chosen so that the distance out along the wedges which is clearly reproduced will be an indication of the extent of detail which can be resolved.

The spot size in the Monotron is small enough to resolve all the information on the signal plate and if all the detail present is resolved, full three hundred line detail will result.

A three hundred line picture at sixty pictures per second requires approximately the same band width as a four hundred and forty-one line interlaced sixty fields per second to produce thirty complete pictures per second.

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TENTATIVE CHARACTERISTICS AND RATINGS

Heater Voltage—AC or DC	2.5 Volts
Heater Current	2.1 Amperes
Overall Length	12"
Maximum Diameter	3-1/16"
Bulb Dimensions (See figure 3)	
Cap (Signal plate)	Small Metal
Base (See figure 3)	Medium 7 pin
Direct Interelectrode Capacities	
Grid to all other electrodes	12 uuf Maximum
High Voltage Anode No. 2	1000 Volts Max.
Focusing Electrode Anode No. 1	(Adjust for sharpest focus) 400 Volts Max.
Grid Voltage for Cut-Off	—20 Volts Approx.
Signal Plate Voltage	—150 Volts Max.
Signal Plate Input Power	5 MW/Sq. Cm. Max.
Signal Output	0.1 Volts

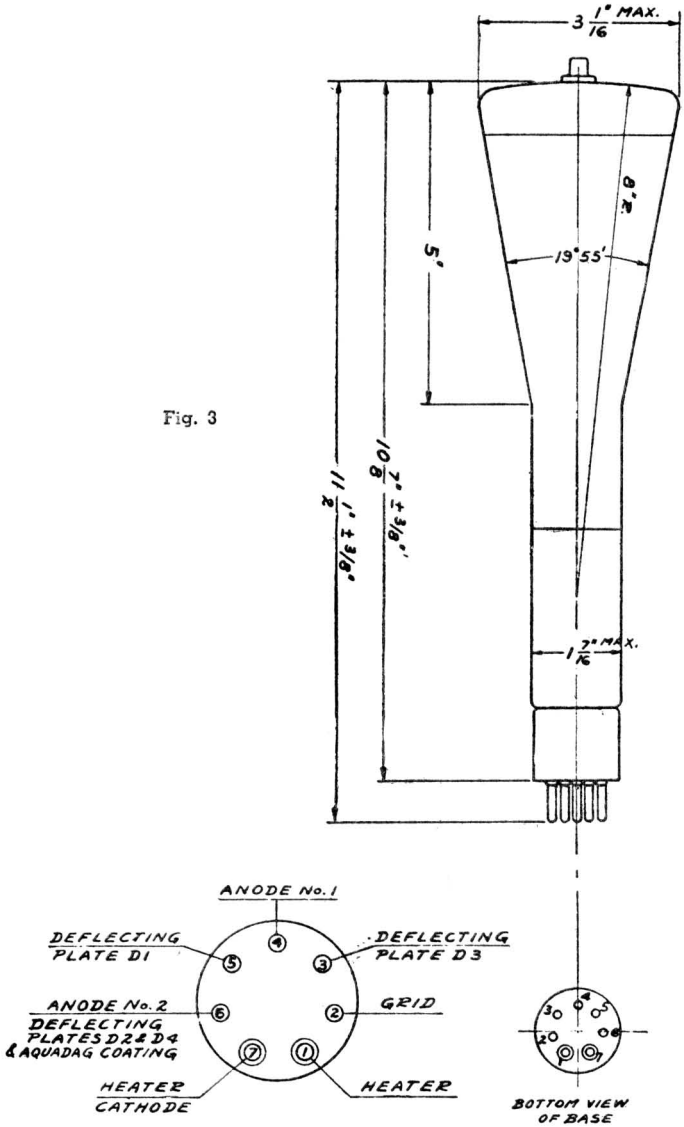
Deflection Sensitivity	800V	1000V.
D_1 & D_2	.34	.27mm/v
D_3 & D_4	.37	.30mm/v

Picture Detail	300 lines

TYPICAL OPERATION

Heater Voltage	2.5 Volts
Anode No. 2 Voltage	900 Volts
Anode No. 1 Voltage	285 Volts
Grid Voltage—Adjust to give desired output	
Signal Plate Voltage	—70

Fig. 3



TOP VIEW OF SOCKET CONNECTIONS

The 2203 is based so that the plane through the tube axis and pin No. 6 does not deviate more than 10° from the plane midway between D_1 and D_2 (top set of deflecting plates). Deflecting plate D_2 is located on the same side of the tube as the heater pins No. 1 and No. 7. D_2 is tied within tube to D_4 which is on same side of tube as pin No. 6. D_3 and D_4 (bottom set of deflecting plates) are positioned so that the plane of the deflection produced by them is at right angles to the plane of the deflection produced by D_1 and D_2.

The handling of National Union 2203 in transportation and storage requires considerable care because the tube may be broken or damaged if subjected to sudden jars or excessive strain. When the 2203 is transported, the tube should be protected from moisture and in no case should the tube be placed on or slid across a hard surface. Such practice may result in scratches at the signal plate end of the bulb, which might lead ultimately to cracks and subsequent destruction of the tube. The bulb should never be subjected to extreme or rapid temperature changes. When a 2203 is removed from its associated apparatus, it is recommended that the bulb be stored in its original carton.

The base pins of the 2203 fit the standard medium 7 contact socket which can be installed for the operation of the tube in any position. The socket should be made of good insulating material, preferably one of the better ceramics. The heater is designed to operate at 2½ volts. The transformer winding supplying the heater power should be designated to operate the heater at the rated voltage under average line voltage conditions. This transformer should be insulated to stand the full high voltage or a total of 1000 volts. Although the filter requirements are simple, a one microfarad paper condenser either side of a 1000 henry choke is desirable in order to avoid ripple appearing in the picture output.

The National Union Monotron Type 2203 is designed for the production of a single standard Television picture. A typical circuit for the development of this picture is shown in Fig. 1. Electrode voltages are obtained from a bleeder circuit connected across the high voltage supply. A bleeder current of 2 to 3 milliamperes is usually satisfactory. A variable DC voltage for the control electrode, Anode No. 1, is obtained from a potentiometer in the bleeder circuit. The voltage to bias the grid is obtained from a second portion of the same bleeder, across a second potentiometer. It is important to note that the input power to the signal plate should not exceed 5 milliwatts per square centimeter. A signal plate input power in excess of this rating may cause serious loss of secondary emission, or partial destruction of the picture design material. The spot should always be kept in motion over a large area of the signal plate by adequate sweep voltages to the deflecting plates.

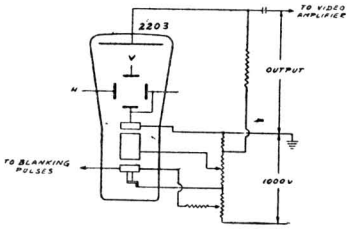


FIG. 1

When it is desirable to scan a small area of the signal plate, the grid should be biased in the direction of cut off and the gain of the video amplifier increased. This will result in a finer trace which will be necessary when scanning a smaller portion of the pattern than is normally scanned and avoid the possibility of destruction or damage to the signal plate.

Typical vertical and horizontal deflecting circuits are shown in Fig. 2. Multivibrators are employed as with this type of saw toothed oscillator, it is possible to obtain a sharp pulse of the proper polarity which can be mixed with the video signal and applied in the receiver under test as a blanking and synchronizing pulse. The operation of this type of multivibrator is as follows:

Some irregularity at the grid of one of the tubes, say Tube No. 1, will be amplified by both tubes and fed back to Tube No. 1 in a very enlarged form. If this irregularity were in the positive direction the plate current of Tube No. 1 would climb very rapidly. The current through R-9 causes the cathode to become so positive that the tube

cuts off, sending a positive pulse around to Tube No. 2, which amplified appears as a very negative voltage on the grid of Tube No. 1, insuring cut off. With Tube No. 1 cut off, the charge in C-5 will discharge through R-9 until the cathode falls so negative that plate current again flows. With this rise in plate current a negative pulse will pass around and be amplified as well as reversed in phase by Tube No. 2 to aid the rise until cut off once more occurs. This cycle repeats at a definite rate. A small synchronizing impulse through C-19 can set the exact point where cut off is reached and the frequency of the output will be a multiple of the synchronizing impulse. The choke L-1 in series with the cathode register R-9 causes the discharge of the condenser C-5 to be linear rather than exponential, as it keeps the discharge current of the condenser constant.

The frequency of oscillation is a function of the R-C ratio in the cathode circuit of Tube No. 1.

The second multivibrator unit (Tubes No. 1′ and 2′) has different values of R and C (R-10 and C-6) to give the other necessary sweep frequency. During the charge portion of the cycle, the plate voltage of Tube No. 1 will fall very sharply, creating a negative pulse which can be employed as a blanking and synchronizing pulse. The output of the plate circuit of Tube No. 1 and 1′ respectively are combined in a double diode plate circuit so that the resulting compound signal consists of the low frequency and high frequency blanking and synchronizing pulses ready for application to the Monotron grid. This pulse will insure no picture signal generation during the return trace of the electron beam.

A portion of this same complex signal is injected into the final stage of the video amplifier through a pulse shaping network consisting of a 6F8G used as a 2 stage resistance coupled amplifier. This second diode is employed to prevent video signals from going to ground via the sweep circuits. In order to obtain a picture signal from the Monotron, the signal plate must be biased approximately 70 volts negative with respect to ground through a series resistor of approximately 20,000 ohms. The signal is taken off through a ½ microfarad condenser to the grid of the video amplifier first stage. A potentiometer is employed to insure against overloading the grid of the first video amplifier.

A type 1851 high transconductance pentode and a type 6V6G are used in a two stage video amplifier of conventional design. At the output terminal in the plate circuit of the second video stage appears a complete complex television signal with its line and frame blanking and synchronizing pulses. In order to view the picture, a standard National Union Type 2003 Cathode Ray Videotron tube may be used. It has its deflecting plate circuits wired in parallel with those of the Monotron. It may obtain its high voltage from the same power supply as the Monotron, but should employ separate focusing and grid bias potentiometers. The complex signal can be applied to the grid of this tube and will result in a reproduction of the picture from the Monotron signal plate appearing on the screen of the viewing tube.

The type 2203 Monotron has been primarily designed, however, as a source of locally generated and controlled television signals for the development, study, and servicing of television receivers. The signal appearing in the output circuit of the Monotron amplifier should be applied just after the second detector of a television receiver for the purpose of testing this receiver as regards proper synchronization, proper linearity of sweep, and overall video amplifier response. The setting of the gain control in the video amplifier in the Monotron signal generator is determined by the gain required so that the resulting signal will not overload the video amplifier in the receiver under test.

REFERENCES:

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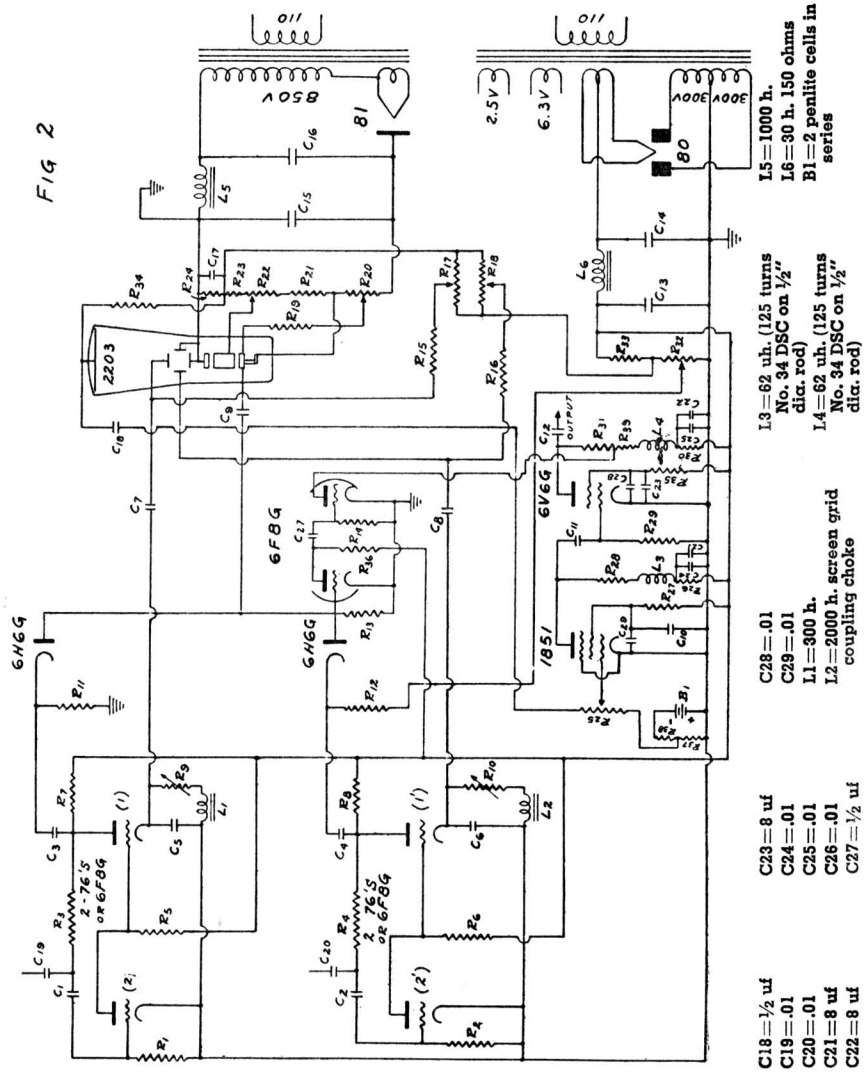
FIG 2



R1 =1 meg.	R15=2 meg.	R29=2 meg.	C4 =½ uf
R2 =1 meg.	R16=2 meg.	R30= 5,000 ohms	C5 =.007
R3 =6000 ohms	R17=2 meg. pot.	R31= 1,200 ohms	C6 =¼ uf
R4 =6000 ohms	R18=2 meg. pot.	R32= 50,000 ohms pot.	C7 =.01
R5 =100,000 ohms	R19=1 meg.	R33=100,000 ohms	C8 =½ uf
R6 =100,000 ohms	R20= 50,000 ohms pot.	R34= 10,000 ohms	C9 =½ uf 1000 volt
R7 =1,500 ohms	R21=150,000 ohms	R35= 40,000 ohms	C10=8 uf
R8 =1,500 ohms	R22=100,000 ohms pot.	R36=300,000 ohms	C11=¼ uf
R9 =50,000 ohms pot.	R23=½ meg.	R37=200,000 ohms	C12=½ uf 1000 volt
R10=100,000 ohms pot.	R24=70,000 ohms	R38=100,000 ohms	C13=8 uf
R11= 50,000 ohms	R25=1 meg. pot	R39= 800 ohms	C14=8 uf
R12= 10,000 ohms	R26= 5,000 ohms	C1 =.002	C15=1 uf 1000 volt
R13= 25,000 ohms	R27=60,000 ohms	C2 =.002	C16=1 uf 1000 volt
R14=½ meg.	R28= 2,000 ohms	C3 =.01	C17=1 uf

C18=½ uf	C23=8 uf	C28=.01
C19=.01	C24=.01	C29=.01
C20=.01	C25=.01	
C21=8 uf	C26=.01	
C22=8 uf	C27=½ uf	

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