Conversion Unit For Projecting 3- by 4-Foot Television Pictures

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This article describes an auxiliary type of television equipment, known as the Norelco Protelgram projection system, which presents the viewer with a 3- by 4-foot television picture. The system can be used with any standard 10-, 12½-, or 16-inch table-model television receiver.

PRIOR TO THE advent of common television usage, pictures in the home became popular by the use of home-movie projectors. By a process of evolution the 3- by 4-foot home-movie picture size became an accepted one. These facts would indicate a preference for picture sizes of this order, at least for some types of picture presentations.

When home use of television became a reality, circumstances caused small pictures to be presented to the public. They were accepted then, but a steady trend to larger pictures is now apparent. Some television receivers have been manufactured which produce a 3- by 4-foot projected picture using a standard home-movie viewing screen. These receivers, as well as home movies, are limited to operation in extremely low ambient light. This limitation does not seem to be well accepted by the public. The problem of presenting a 3- by 4-foot television picture is therefore difficult to solve. One solution is presented here.

It is obvious that any such picture presentation in the home should be in the auxiliary type of equipment and should complement the normal television picture. The Norelco Protelgram projection system offers considerable advantages in solving this problem. The compactness and deflection sensitivity of this system make the design of the unit described here possible.

The Protelgram unit selected for this design utilizes a 90-inch "throw distance" to produce a 3- by 4-foot picture.

Figure 1. Front view of the complete Duo-Vue conversion unit with television receiver attached

It includes a pulse-type well-regulated 25-kv anode power supply and *3NP4* projection cathode-ray tube with associated yoke and focus coils.

The requirements of a television receiver to operate a Protelgram system are stated as compared to a *10BP4* receiver in Table I. In addition, the Protelgram system requires 1.2 amperes at 6.3 alternating volts and 50 milliamperes at 350 direct volts as power for the 25-kv supply.

Table I. Receiver Requirements*

	10BP4	Protelgram
Video output	60 volts, peak to peak	180 volts, peak to peak
Horizontal deflection current	470 milliamperes, peak to peak	400 milliamperes, peak to peak
Focus current	115 milliamperes	121 milliamperes
Ion-Trap	109 milliamperes	Not required
Automatic biasing	Not required	Required
Flyback high-voltage	Required	Not required

* Values are approximate and vary for certain conditions. Tabulated values show requirements with standard components.

It can be seen then that an auxiliary unit can be designed to adapt and convert a standard 10-inch television receiver to a projection set using this system. Also, it is apparent that by proper use of such an auxiliary unit together with a switching arrangement, it is possible to switch from the direct-view picture to the projected picture. The basic requirements for a unit to convert standard television receivers to projection pictures of 3- by 4-foot size by switching are therefore available to the design engineer.

In order to design a commercially feasible conversion system, the following design requirements are indicated:

1. Cabinet should be small and easily movable from place to place in the user's home. Its general layout should be as simple as possible.

2. Electrical requirements should be such that by simple connections to a standard 10-inch, 12½-inch, or 16-inch table-model television receiver, the unit would perform the following functions:

(*a*). Amplify and recompensate the video output for the Protelgram Projection System used.

(*b*). Supply 350 direct volts at 50 milliamperes.

(*c*). Supply 6.3 alternating volts at 1.2 amperes.

(*d*). Supply a range of focus current from 90 to 150 milliamperes.

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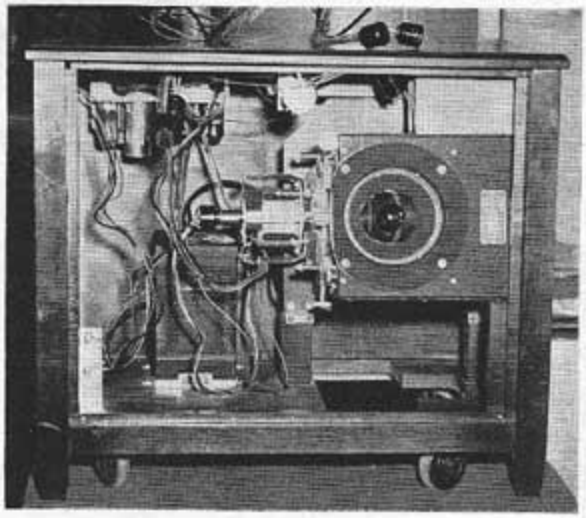

Figure 2. Rear view of the complete Duo-Vue conversion unit

(*e*). Incorporate an automatic biasing circuit to cut off the *3NP4* tube if receiver deflection circuits should fail.

(*f*). Arrange a switching and deflection control circuit for selection of the picture desired.

GENERAL DESIGN

THE DESIGN is accomplished satisfactorily in the Norelco Duo-Vue product. An auxiliary chassis, a function switch, and a complete projection system are housed in a cabinet which is styled to be utilized as a table-model television-receiver support. Figure 1 shows the completed conversion unit with television receiver attached. The unit is mounted on concealed casters so that it may be rolled away from the wall when the 3- by 4-foot picture projects from the rear of the cabinet. Figure 2 shows the rear cover removed from the cabinet and the placement of parts within the cabinet. The Duo-Vue is placed against the wall during normal small-picture viewing and is rolled away from the wall to project its large picture on a movie screen or other suitable viewing area 90 inches distant. Optical focusing is obtained by rolling the unit toward or away from the viewing screen. This adjustment is not critical. Optimum focus is obtained within a range of several inches. The unit is designed to be attached to the television receiver by cables incorporating disconnect plugs and sockets.

ELECTRICAL DESIGN

A BLOCK diagram of the system is shown in Figure 4. The chassis (Figure 3) is of compact design, measuring $7^1/_2$ by $5^1/_2$ by $2^1/_4$ inches. The schematic (Figure 5) shows the circuit used in the complete Duo-Vue unit. Loctal tubes are utilized because of their obvious advantage in inverted position use.

Video Amplifier. One stage of video amplification is used to obtain adequate video drive and also to compensate for added cable and switch capacity in the system. Shunt, series, and cathode-regeneration peaking are utilized to obtain excellent video response. A slight rise in the response curve in the 4-megacycle region actually improves the apparent resolution in the 3- by 4-foot picture over the original direct-view picture in many cases. The gain of the *7C5* video amplifier is in the order of 2.8 to 1 and is selected so that adequate video will be applied to the *3NP4* tube from practically any television receiver. The signal is injected into the *3NP4* cathode because of the phase reversal obtained in the video amplifier. The *3NP4* cathode-heater potential is maintained within limits by use of a separate transformer heater winding connected to the plate side of the video-amplifier load resistor. Capacity loading is eliminated by using a 1-megohm resistor for isolation.

Low-Voltage Power Supplies. The power requirements for the amplifier, focus current, Protelgram high-voltage unit, and biasing circuits are supplied by a transformer and a *7Z4* fullwave rectifier, together with a completely isolated half-wave selenium rectifier. The *7Z4* supplies 350 direct volts at 70 milliamperes. This current is split up between the high-voltage unit and the internal chassis requirements. The video amplifier utilizes approximately 30 milliamperes and the high-voltage unit approximately 40 milliamperes. Normal capacity input-choke type filtering is used in this supply.

The half-wave selenium rectifier supplies a maximum of 150 milliamperes of focus current. This rectified voltage is also used as a bias voltage when the direct-view tube is switched off during projection performance, as will be noted later. Resistance-capacitance filtering is used in this supply and is sufficient to reduce effectively the focus-current ripple.

Automatic Biasing Circuit. A *7B6* dual diode-triode is utilized in this circuit. As can be seen by examining Figure 5, each diode of this tube is furnished with pulses derived from the deflection circuits, both vertical and horizontal. Rectified negative voltages from each diode are added and supplied to the control grid. Positive

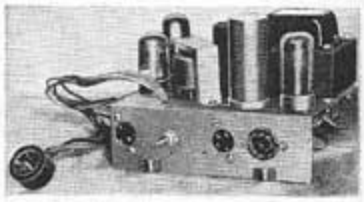

Figure 3. Duo-Vue conversion unit chassis

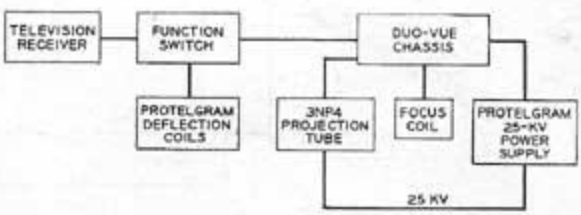

Figure 4. Block diagram of the Norelco Protelgram projection system

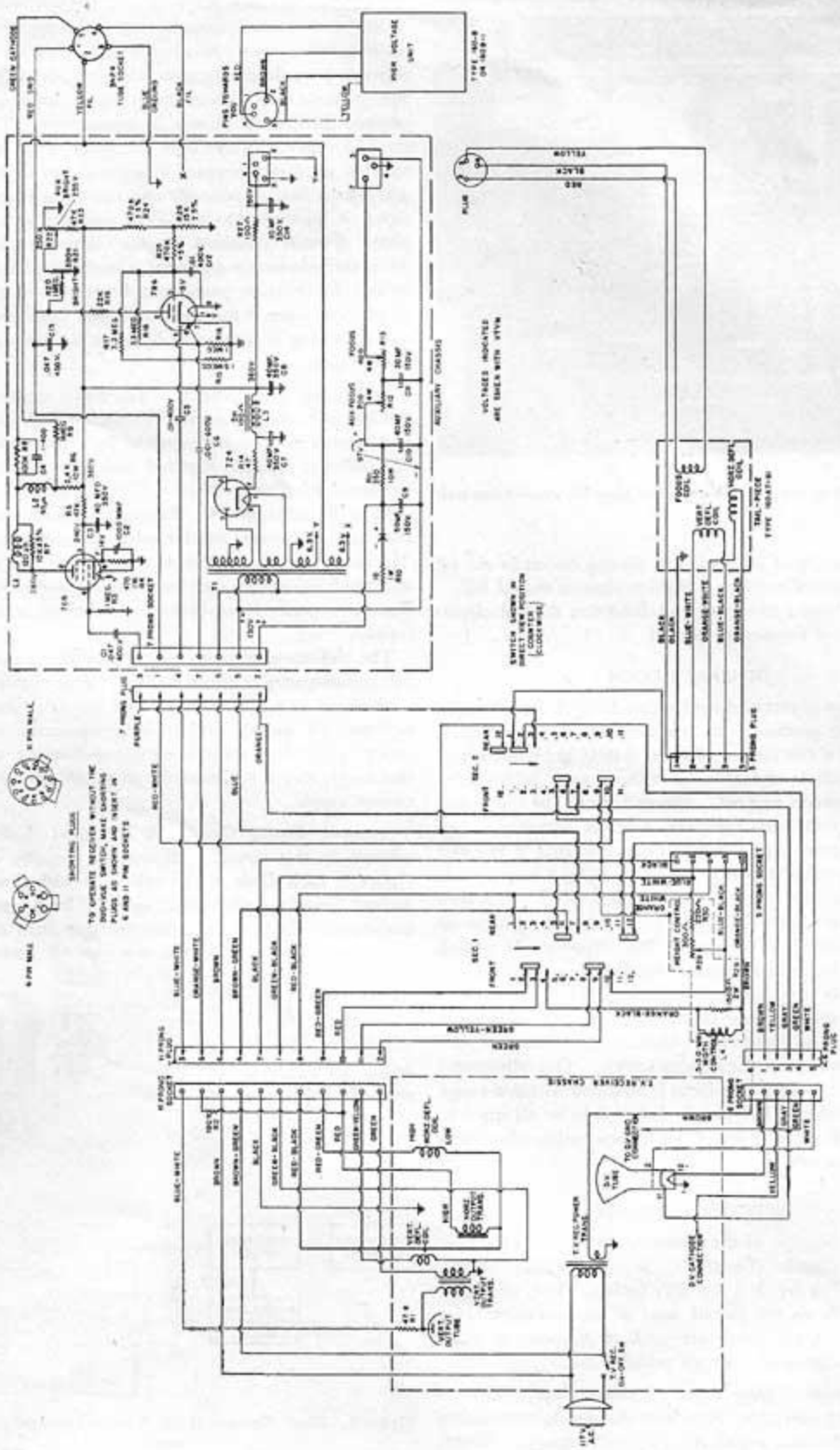

Figure 5. Schematic of Duo-Vue conversion unit

"bucking" voltage is then applied at the control grid until the resulting grid voltage during normal set operation is approximately minus nine volts. The plate current of the triode section is effectively cut off when operating in this condition. The plate of the triode section is connected to the *3NP4* grid through a 22,000-ohm resistor. The triode plate voltage and the *3NP4* grid voltage are derived through a high-impedance circuit (one megohm). A failure of either the horizontal or vertical sweeps will allow the triode grid to approach zero bias. The triode section will conduct and the *3NP4* grid voltage will be reduced to a point near zero. This effectively increases the *3NP4* bias beyond cutoff, thus reducing the possibility of sweep burns.

Function Switch. A 2-section range switch is used. It switches video, deflection coils, alternating current, picture-tube bias, and direct-view cathode-ray tube grid, cathode, and heater. In the case of video, it merely connects the video output of the set to the direct-view tube or the input of the Duo-Vue amplifier. The switch is physically positioned at the center and extreme rear of the unit, which places it immediately under the direct-view tube socket in most receiver designs. This position is selected to reduce lead capacity. In "direct-view" position the direct-view tube is connected normally. In "projection" position, the direct-view heater, cathode, and grid are opened, and bias voltage from the selenium rectifier is applied to the grid and cathode to cut off residual spot emission. When switching from "projection" to "direct-view," the *3NP4* tube is biased beyond cutoff by simply grounding its grid. The deflection energy is transferred from the direct-view to the Protelgram deflection coils by short-circuiting-type switches. This insures ample load on the receiver output transformers at all points of the switching sequence. The function switch assembly is designed to be the central connector for all units. Two cables are installed in the television receiver and fitted with connectors which, in turn, are mated to the switch assembly. The Duo-Vue chassis and projection deflection yoke are plug connected to the switch.

The unit contains front panel brightness and focus knobs and auxiliary brightness and focus controls. This method of design is selected to make the front-panel controls of the vernier type and simple to operate. Height and width controls for the projected picture are incorporated as service controls. These controls are of the attenuator type. This is made possible by the excellent deflection sensitivity of the Protelgram system. More than adequate sweep is obtained from any 10-, $12\frac{1}{2}$, or 16-inch picture-tube set. The height control is a simple resistive shunt across the vertical deflection coils. The width control consists of a permeability tuned coil in series with the horizontal deflection coils. The inductance is damped by a resistor to prevent ringing.

Sockets are provided on the Duo-Vue chassis for easy connection of the focus coil and high-voltage unit.

The Duo-Vue unit has been operated with television receivers of many makes and prices. It has successfully produced a fine quality 3- by 4-foot picture, and has apparently not reduced the picture quality of the television receiver. The highlight brightness of the 3- by 4-foot picture measures approximately three to four foot lamberts. The resolution of the picture has been measured at 425 lines and has always shown itself, in tests, to be as good or better than the direct-view picture of the receiver.

A Duo-Vue is simple to operate and after proper installation, adds little more adjusting than the original receiver required.

It is believed that this instrument will do much to interest the small picture television-set owner in real large-screen television since it can be purchased and installed at low cost.

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