SERIES 2510 COMMUNICATIONS DISPLAY TERMINAL (CDT) WITH CDDC801 OR CDDC803 MODULE ELECTRONIC ADJUSTMENTS

CONTENTS PAGE

CONTENTS PAGE

1. GENERAL

1.01 This section provides an electronic adjustment procedure for the Series 2510 Communications Display Terminal (CDT). Issues 1 through 3 of this section were limited printing editions and did not receive general system-wide availability nor distribution. Since this issue is a general revision and represents the first standard printing available for Bell System distribution, marginal arrows normally used to indicate changed or new information items have been omitted. Field change notice (TCN) information, wherever applicable, has been incorporated into this section up to the time of this printing.

1.02 Early factory production 2510 CDT Sets were equipped with the TP322912 function generator assembly and early design deflection yoke (Figure 8). These sets are capable of operation with the "italics" (slanted character) feature. Thereafter, factory built sets were equipped with the late design CRT deflection yoke (Figure 10), which is interchangeable with the early design deflection yoke with exception that italics operation is not provided.

Prepared for American Telephone and Telegraph Company by Teletype Corporation

1.03 Present factory built 2510 CDT Sets are equipped with the late design deflection yoke and the TP322612 (MC612) function generator. Italics (slanted characters) or Video Highlight is not provided when the MC612 function generator is used in the 2510 CDT.

1.04 In some instances the craftsman may encounter either the MC612 or MC912 function generator, or an early or a late design CRT deflection yoke within the CDT requiring adjusting. Using this adjustment procedure and illustrations contained herein, the craftsman should by simple observation be able to determine the type of function generator and deflection yoke used in the CDT, and adjust the set using the appropriate adjustment procedure.

1.05 Electronic assembly adjustments are factory set at the time of manufacture and require no additional adjusting at the time of CDT Set installation. Adjusting may only be necessary when troubleshooting analysis, component part, or electronic assembly part replacement requires readjusting or checking of the adjustment in the affected circuit.

1.06 In some instances an adjustment may have interrelated parts; the sequence that should be followed in checking the requirements and making the adjustments are indicated by (1) first step, (2) second step, and (3) etc. Before making any adjustment, read the adjustment procedure thoroughly. All adjustments in this section are listed in a logical order of sequence for adjusting operation of the set, except where noted otherwise.

CAUTION 1: ALWAYS EXERCISE EXTREME CARE WHEN MAKING ADJUSTMENTS IN THE CRT AREA. DO NOT ALLOW THE CRT TO BE SCRATCHED OR PHYSICALLY BUMPED. APPROVED SAFETY GLASSES WITH SIDE SHIELDS OR GOGGLES SHOULD BE WORN WHILE MAKING ALL ADJUSTMENTS WHEN POWER IS ON OR OFF.

CAUTION 2: EXERCISE EXTREME CARE WHEN CHECKING TEST POINTS AND MAKING ADJUSTMENTS ON THE FUNCTION GENERATOR CIRCUIT CARD. VOLTAGE POTENTIAL DIFFERENCES EXIST BETWEEN COMPONENT CASES AND THE CIRCUIT CARD. DO NOT ACCIDENTALLY SHORT A COMPONENT CASE TO ADJACENT COMPONENT CASES OR TO THE BOARD. DO NOT SHORT TEST POINTS TO THE CARD CIRCUIT LAND AREAS. REMOVE PERSONAL OBJECTS FROM SHIRT POCKETS WHICH MIGHT FALL ONTO THE SET PRINTED CIRCUITRY OR SCRATCH THE CRT.

1.07 Reminder: Circuit cards have Integrated Circuit (IC) packages and other components that are low voltage devices. Permanent damage can occur if these devices are subjected to voltages in excess of their rating. NEVER ATTEMPT TO REMOVE A CIRCUIT CARD WHEN POWER IS ON. After power is turned off wait approximately 20 or 25 seconds, then only if necessary, remove the card. This insures that power in the set circuitry has drained sufficiently. Oily skin and other body chemicals present on your fingers may also cause card contact terminals to be resistive after short periods of time — DO NOT TOUCH CARD CONTACT AREAS.

TEST EQUIPMENT AND TOOLS REQUIRED

1.08 Use only a nonmetallic screwdriver or equivalent for all screwdriver adjustments of potentiometers on the function generator circuit card and the low voltage power supplies. Teletype nonmetallic screwdriver TP335763 is available for ordering, although any shaft type nonmetallic screwdriver, 12 inches long with a shaft diameter of one-eighth inch maximum can be used.

1.09 For electronic adjustments, the following instruments and tools are recommended:

(1) DC Digital Voltmeter or equivalent (0.05% accuracy or better).

(2) Dual Trace Oscilloscope (such as Tektronix 422 - type or equivalent). Scope probes should be properly calibrated before monitoring waveform. Times ten (X10) attenuator probes are recommended for use in preference to times one (X1) probes due to their generally lower capacitance factor.

(3) Plastic 12-inch screwdriver (TP335763).

(4) A 12-inch ruler or flexible scale.

(5) AT-8350 B Plastic Goggles.

1.10 For additional instructions pertaining to use of the recommended test equipment, refer to the instruction manual supplied with the equipment. The instruction manual must be used until the user is completely familiar with all features of the test equipment.

2. ADJUSTMENTS

2.01 Remove the cabinet front panel by loosening the two 1/4-turn fasteners that secure the front panel in place (Figure 1).

2.02 Open the cover of the cabinet by depressing the left and right latch buttons inward (Figure 1). Lift the cover toward the rear of the cabinet. The cover will remain in the extreme rear position (open) by means of two counter balance arms.

2.03 Removing the front panel opens an interlock; and opening the cover also opens an interlock (Figure 1). To make the set operable, the interlocks must be manually extended to bypass position.

(1) Grasp the knurled plunger of the interlock, and rotate it while pulling slightly outward. This action will cause the plunger to release upward, bypass the interlock, and allow the set to be operated.

(2) To re-instate the interlock, just depress the plunger (twisting is not necessary).

(3) If it is necessary, at some time, to remove the rear panel, an interlock at the lower left of the frame can be bypassed in the same manner as above.

CAUTION: ONCE THE INTERLOCKS ARE POSITIONED FOR BYPASS THE SET IS OPERABLE WHEN POWER IS APPLIED BY ACTION OF THE POWER ON BUTTON.

2.04 If the CRT deflection yoke requires adjusting, remove the two tube cover locking screws (Figure 1). Lift the tube cover upward toward the rear of the set and proceed to the applicable adjustment sequence.

CDPS802 AND CDPS803 LOW VOLTAGE POWER SUPPLY DC VOLTAGE AND CURRENT LIMIT

2.05 Remove the CDPS803 power supply mounting screws and slide the power supply straight out the front of the cabinet. The cables are long enough to permit the power supply to be placed on the floor in front of the set. Make certain the cabling does not catch on the rearmost power transformers and restrict supply removal.

2.06 Remove the two holding screws from the screen cover on the supply and connect meter probes to TB terminal block, Figure 2. Do not attempt to make voltage adjustments on the power supply without accurate equipment, reference 1.09 (1).

2.07 Turn set power on. The set must be connected to a source voltage of 117 v ac ±12 volts.

Note: The set power supply is factory adjusted at the time of manufacture and requires no additional adjusting unless it is repaired or replaced. If a power supply voltage adjustment is changed, set analog display adjustments must be rechecked and adjusted to meet the specified requirement. All dc voltage adjustments must be made before any logic adjustments are attempted.

2.08 Positive 5 Volt dc (Figures 2 and 3)

(1) Place a dc voltmeter with the positive lead on TB-1, and the negative lead on TB-10 on the power supply terminal block.

(2) Adjust R2 on the TP322904 card for a +5 volts ±250 millivolts reading.

(3) Adjust R1 on the card until a drop in the voltage reading occurs.

(4) Back off R1 approximately 1/4-turn from the point where voltage drop occurred.

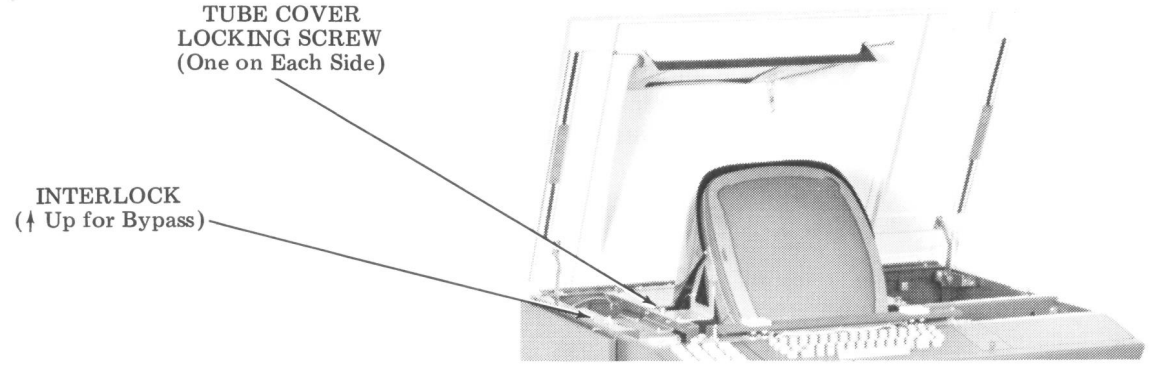
2.09 Positive 6 Volt dc (Figures 2 and 3)

(1) Place a dc voltmeter with the positive lead on TB-5 and the negative lead on TB-10 on the power supply terminal block.

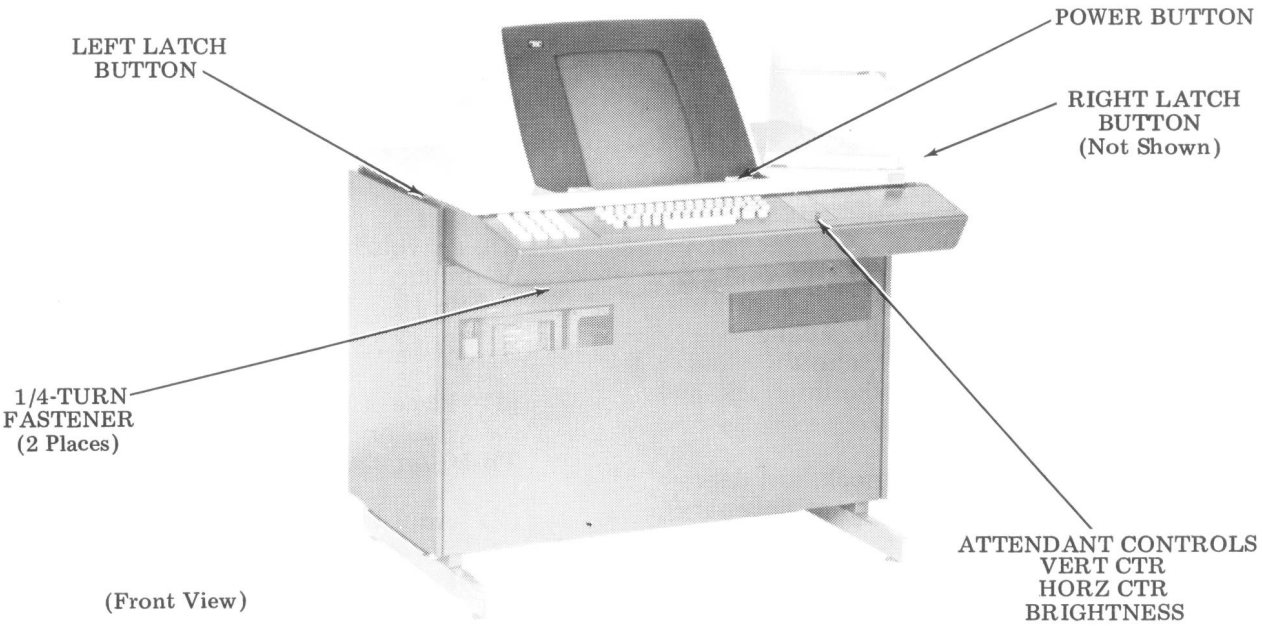
(2) Adjust R2 on the TP322905 card for a +6 volt ±300 millivolts reading.

(3) Adjust R1 on the card until a drop in the voltage reading occurs.

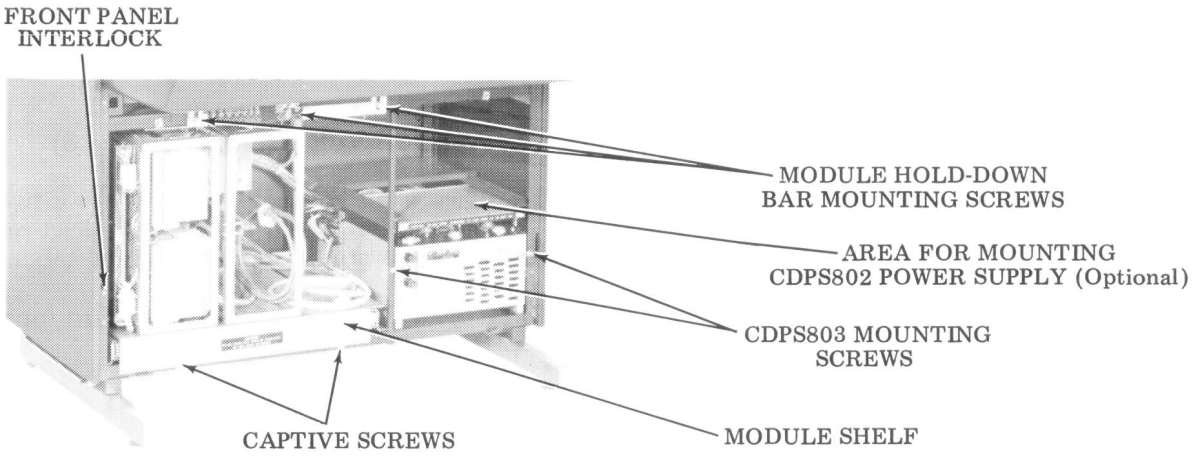
(4) Back off R1 approximately 1/4-turn from the point where voltage drop occured.



(Top Cover Raised)



(Front View)



(Front Panel Removed)

Figure 1 - CDT Set

2.10 Negative 11 Volt dc (Figures 2 and 3)

(1) Place a dc voltmeter with the negative lead on TB-9 and the positive lead on TB-10 on the power supply terminal block.

(2) Adjust R2 on the TP322907 card for a -11 volt ±550 millivolts reading.

(3) Adjust R1 on the card until a drop in the voltage reading occurs.

(4) Back off R1 approximately 1/4-turn from the point where voltage drop occurred.

2.11 Turn off set power and secure power supply cover screen. Remount the supply into the set; make certain the cables from the rear of the supply do not press against the screen grill of the cabinet ventillating fan. Cable interference may prevent fan operation.

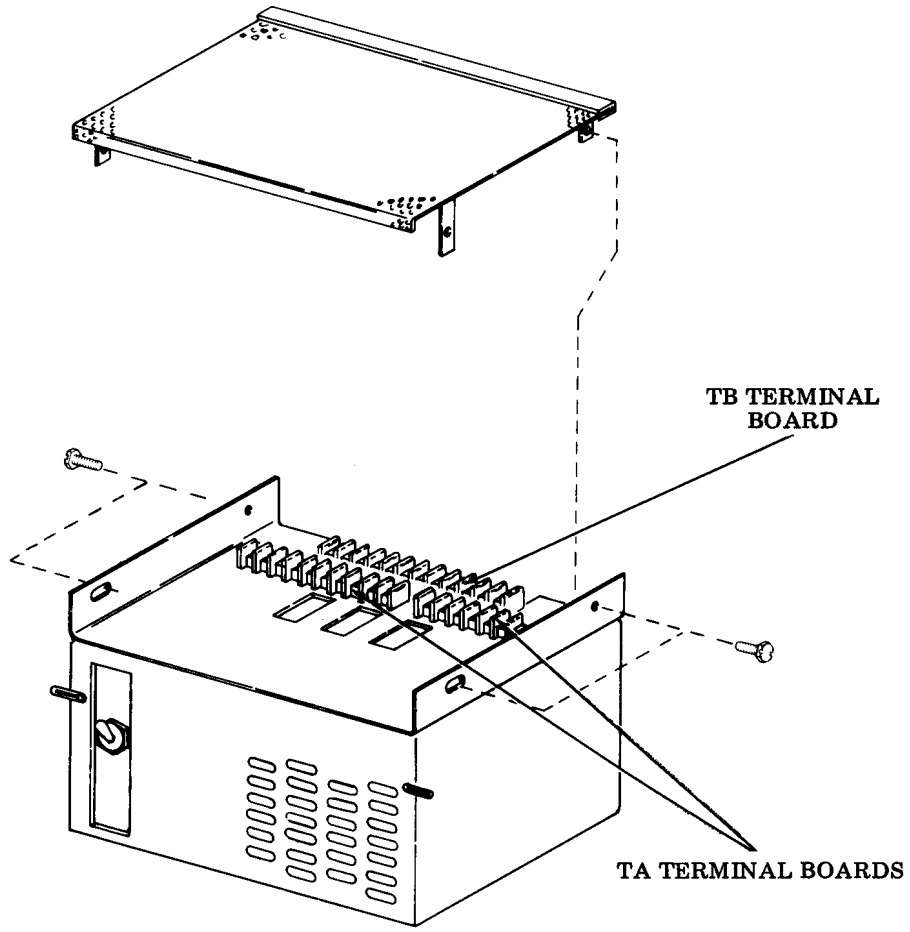
2.12 Remove the CDPS802 power supply mounting screws (present if set is equipped with CDBU module) and slide the supply straight out the front of the cabinet. The cables are long enough to permit the power supply to be placed on the floor in the front of the set. Remove the cover screen from the top of the supply, turn on ac power and adjust per 2.08, 2.09, 2.10, and 2.11.

TP322912 FUNCTION GENERATOR

2.13 Positive 15 Volt dc (Figure 4)

(1) Turn on set power and place a dc voltmeter or oscilloscope probe with the positive lead on TP (test point) 33 of the card, and the negative lead on TB3-28 of the card terminal block.

(2) Adjust R92 for a reading of +15 volts ±1.5 volts. An access hole is provided on the bottom side of the function generator board which will allow for inserting the plastic screwdriver into R92 adjusting slot.



Note: CDPS802 supply is present when CDT set is equipped with CDBU module (or CDIF module).

Figure 2 - CDPS802 and 803 Low Voltage Power Supplies

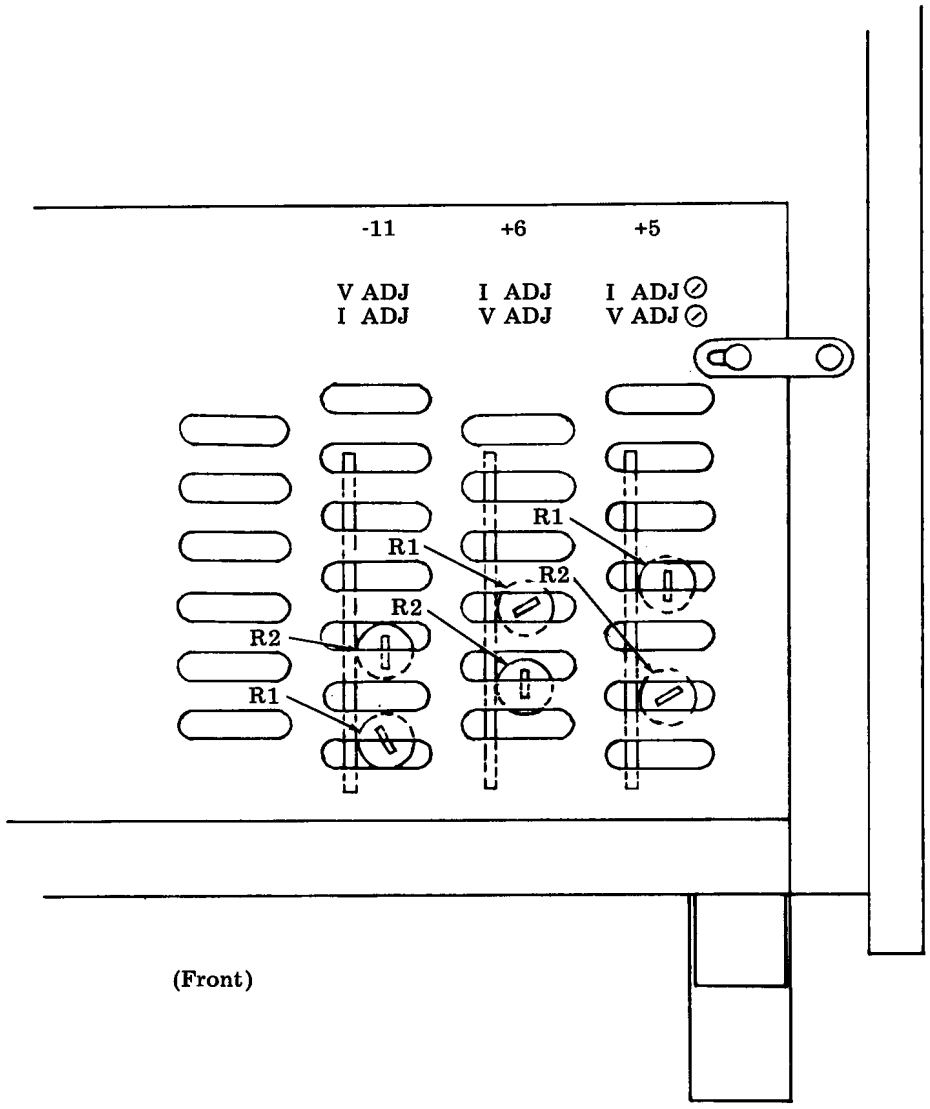


Figure 3 - Low Voltage Power Supply Adjustment Potentiometers

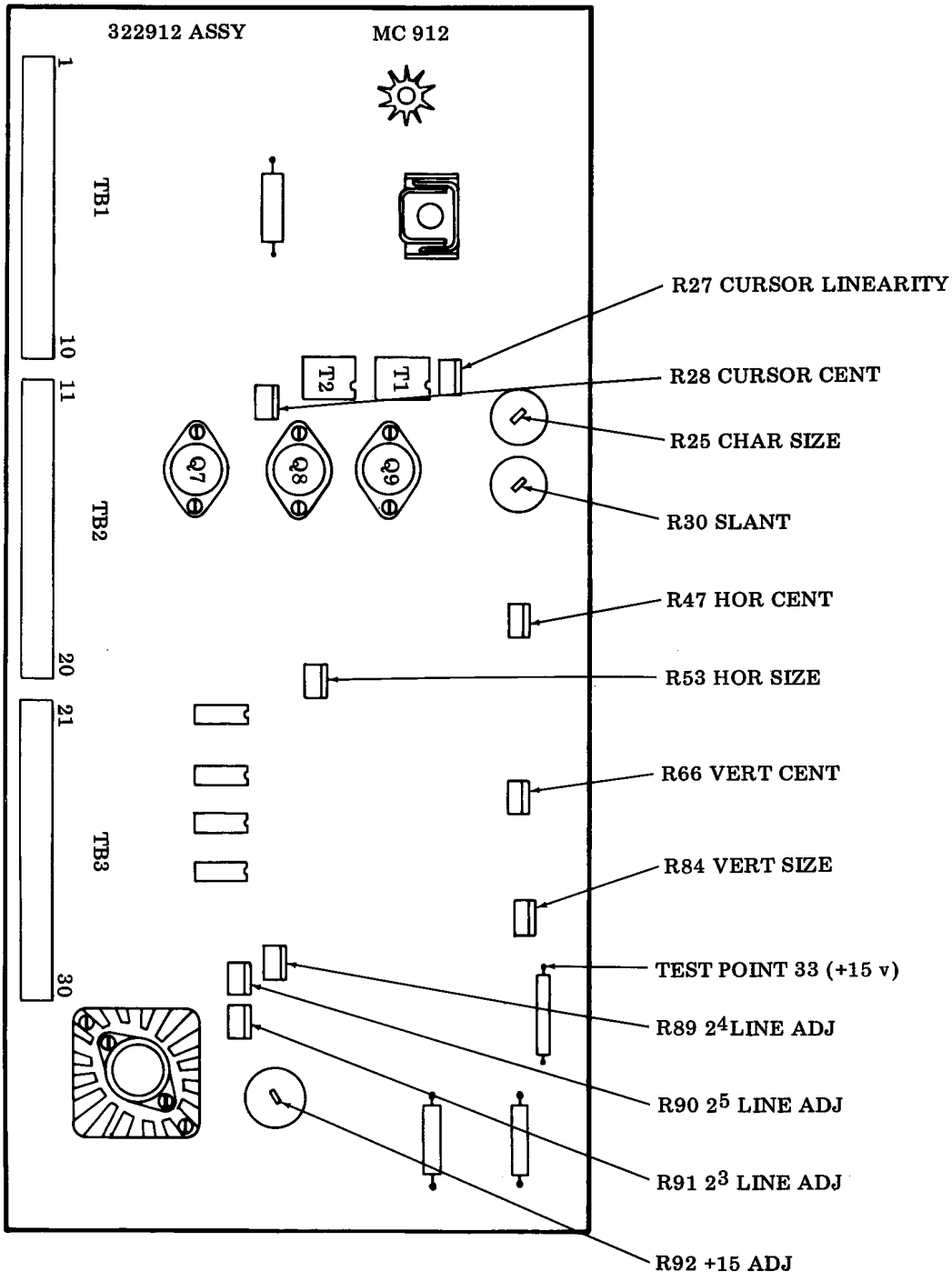


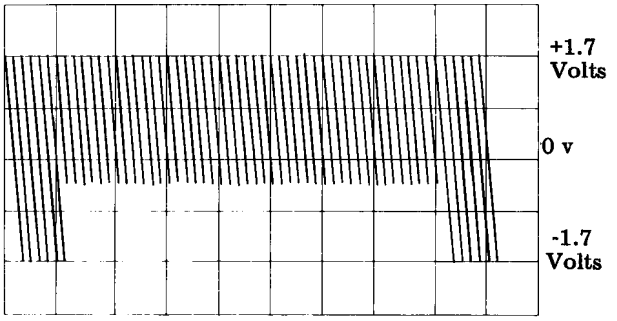
Figure 4 - TP322912 Function Generator

TP322912 FUNCTION GENERATOR (continued)

2.14 Horizontal Size and Centering (Figures 4 and 5)

(1) Connect oscilloscope probe to TB2 terminal 19 (probe ground on TB3 terminal 28).

(a) Horizontal . . . . . 2 ms/div
(b) Vertical . . . . . 0.1 volts/div (setting for X10 probe)
(c) Trigger . . . . . .Positive slope
(d) Input . . . . . DC couple



Note: Waveform shown here and in Figure 5, is typical for USO display format (set coded 2510AA). Waveform will vary accordingly with set display format.

(2) Adjust R53 (HOR SIZE control) for a signal of plus and minus 1.7 volts.

(3) Adjust R47 (HOR CTR control) for equal positive and negative excursion with respect to 0 volt reference.

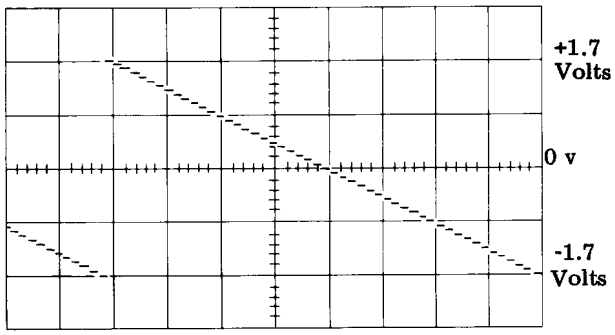
(4) Check the CRT face screen for proper display size: 8 inches across for vertically mounted CRT; 11 inches across for horizontally mounted CRT. Readjust R53 for proper page width.

(5) Check the HOR CTR control on the attendant control panel for horizontally centering the display on the CRT. If necessary readjust R47 until the attendant control is close to optimum setting.

2.15 Vertical Size and Centering (Figures 4 and 6)

(1) Connect oscilloscope probe to TB3 terminal 27 (probe ground on TB3 terminal 28).

(a) Horizontal . . . . . 2 ms/div
(b) Vertical . . . . . 0.1 volts/div (setting for X10 probe)
(c) Trigger . . . . . .Positive slope
(d) Input . . . . . DC couple



Note: Waveform shown here and in Figure 6, is typical for USO format (set coded 2510AA). Waveform characteristics will vary accordingly with set display format.

(2) Adjust R84 (VERT SIZE control) for a signal of plus and minus 1.7 volts.

(3) Adjust R66 (VERT CTR control) for equal positive and negative excursion with respect to 0 volt reference.

(4) Check the CRT face screen for proper display size: 11 inches high for a vertically mounted CRT; 8 inches high for a horizontally mounted CRT. Readjust R84 for proper page height.

(5) Check the VERT CTR control on the attendant control panel for vertically centering the display on the CRT. If necessary readjust R66 until the attendant control is close to optimum setting.

2.16 Character Size (Figure 4)

(1) The height of the displayed characters should be equal to twice the line spacing (0.150 inch for horizontally mounted CRT; 0.140 inch for vertically mounted CRT).

(2) Adjust R25 (CHAR SIZE control) for the proper character height. An access hole is on the underside of the function generator for adjusting R25.

TP322912 FUNCTION GENERATOR (continued)

2.17 Line Spacing (Figure 4)

(1) View the display screen on the CRT.

(2) Determine if the space between lines 7 and 8 is equal to the space between lines 6 and 7.

(3) If the space is not equal, adjust R91 (2^3 LINE) until it is.

(4) Determine if the space between lines 15 and 16 is equal to the space between lines 14 and 15.

(5) If the space is not equal, adjust R89 (2^4 LINE) until it is.

(6) Determine if the space between lines 31 and 32 is equal to the space between lines 30 and 31.

(7) If the space is not equal, adjust R90 (2^5 LINE) until it is.

2.18 Cursor Centering (Figure 4)

(1) Position the cursor to the center of the CRT display. Keyboard an upper case "I" onto the display. Reposition the cursor over the "I".

(2) Adjust R27 on the function generator so that cursor shows light on all sides of the "I".

(3) If necessary readjust R25 on the function generator for proper character height.

2.19 Slant Italics (Figure 4 and Reference 1.02)

(1) Depress keyboard ESCAPE key and release. Depress 3 key and release. Keyboard 1111 and observe characters are slanted approximately 12 degrees.

(2) If they are not, adjust R30 for proper slant.

(3) Adjust R28 on the function generator so that any irregularities in the "I" are removed.

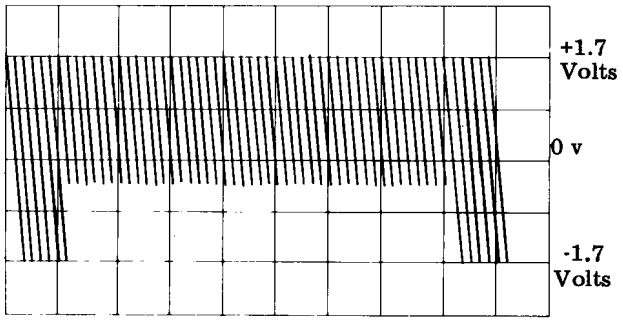
(4) Keyboard ESCAPE, then 4 to return characters following 4 to normal (not slanted).

TP322612 FUNCTION GENERATOR

2.20 Horizontal Size and Centering (Figures 1, 5, and 7)

(1) Connect oscilloscope probe to terminal TB19 (probe ground on terminal TB28).

(a) Horizontal . . . . . 2 ms/div
(b) Vertical . . . . . 0.1 volts/div (setting for X10 probe)
(c) Trigger . . . . . .Positive slope
(d) Input . . . . . DC couple



Note: Waveform shown here and in Figure 5, is typical for USO display format (set coded 2510AA). Waveform will vary accordingly with set display format.

(2) Adjust R25 (HOR SIZE control) for a signal of plus and minus 1.7 volts.

(3) Adjust R24 (HOR CTR control) for equal positive and negative excursion with respect to 0 volt reference.

(4) Check the CRT face screen for proper display size: 8 inches across for vertically mounted CRT; 11 inches across for horizontally mounted CRT. Readjust R25 for proper page width.

(5) Check the HOR CTR control on the attendant control panel for horizontally centering the display on the CRT. If necessary readjust R24 until the attendant control is close to optimum setting.

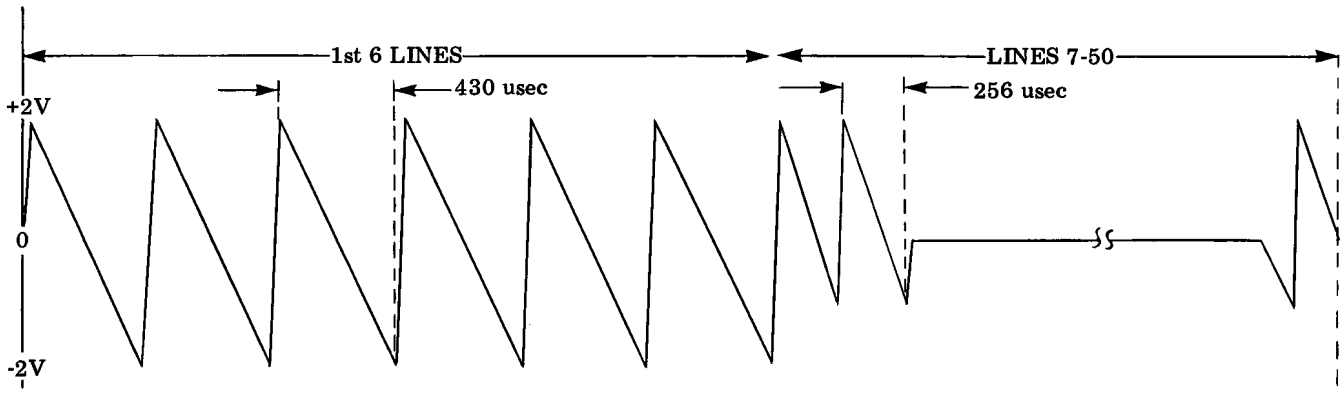


Figure 5 - Horizontal Size

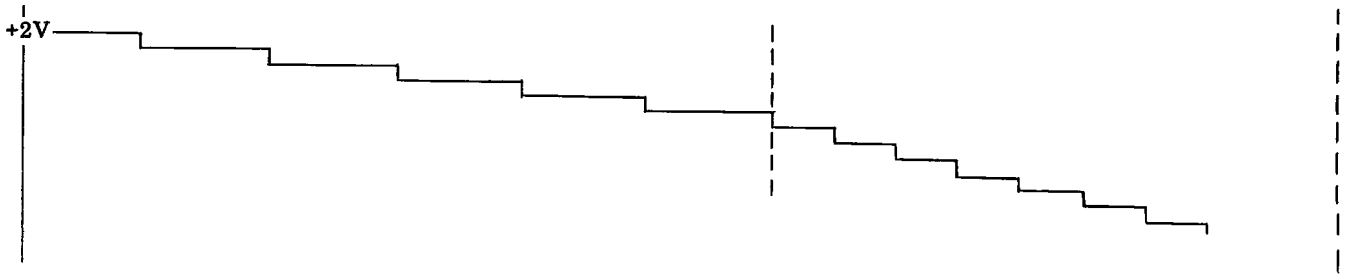


Figure 6 - Vertical Size

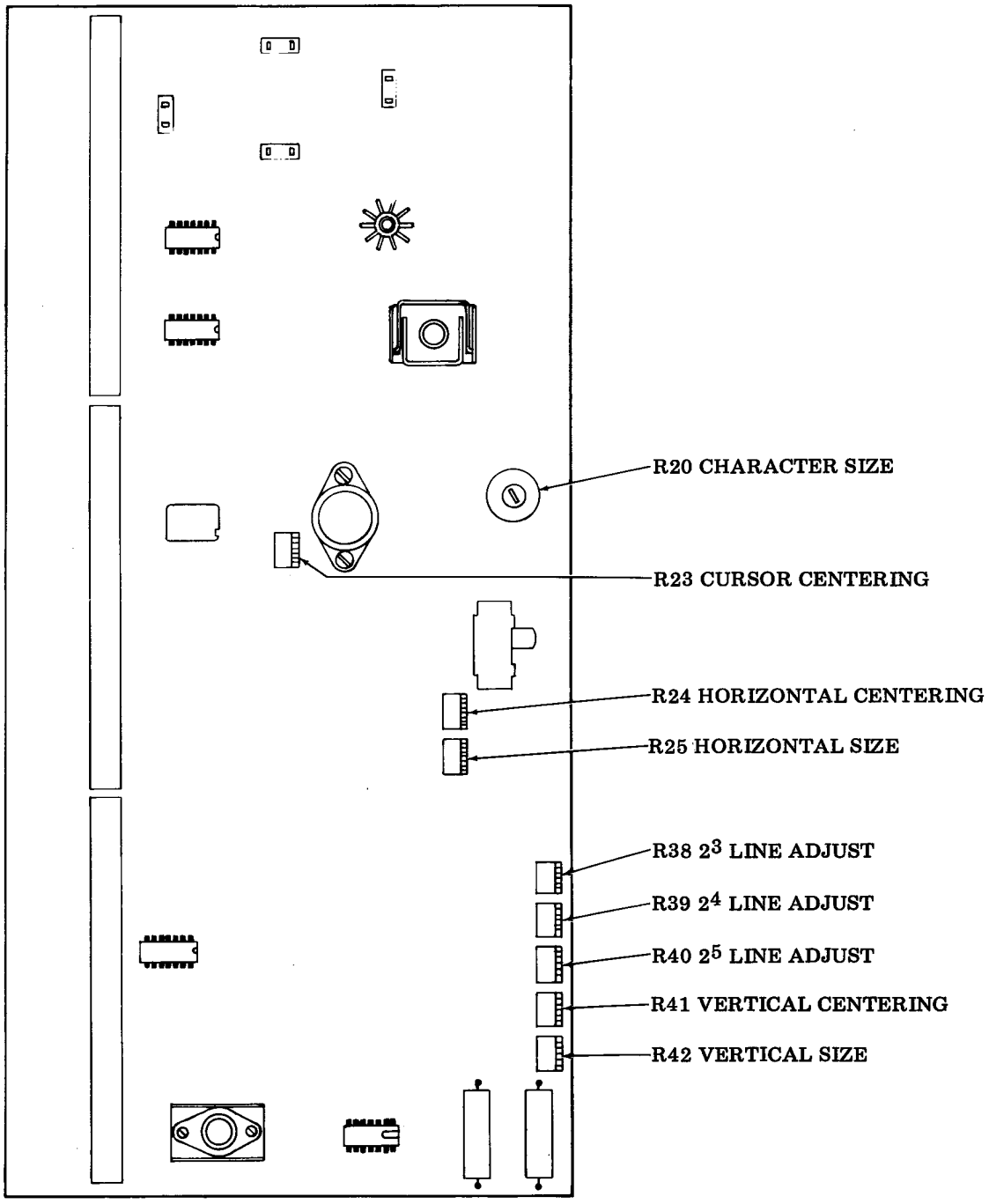


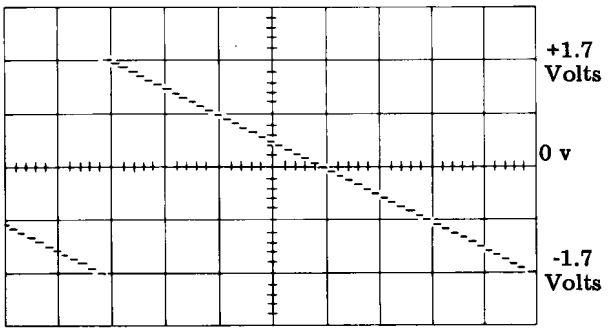
Figure 7 - TP322612 Function Generator

TP322612 FUNCTION GENERATOR (continued)

2.21 Vertical Size and Centering (Figures 1, 6, and 7)

(1) Connect oscilloscope probe to terminal TB27 (probe ground on terminal TB28).

(a) Horizontal . . . . . 2 ms/div
(b) Vertical . . . . . 0.1 volts/div (setting for X10 probe)
(c) Trigger . . . . . .Positive slope
(d) Input . . . . . DC couple



Note: Waveform shown here and in Figure 6, is typical for USO format (set coded 2510AA). Waveform characteristics will vary accordingly with set display format.

(2) Adjust R42 (VERT SIZE control) for a signal of plus and minus 1.7 volts.

(3) Adjust R41 (VERT CTR control) for equal positive and negative excursion with respect to 0 volt reference.

(4) Check the CRT face screen for proper display size: 11 inches high for a vertically mounted CRT; 8 inches high for a horizontally mounted CRT. Readjust R42 for proper page height.

(5) Check the VERT CTR control on the attendant control panel for vertically centering the display on the CRT. If necessary readjust R41 until the attendant control is close to optimum setting.

2.22 Character Size (Figure 7)

(1) The height of the displayed characters should be equal to twice the line spacing (0.150 inch for horizontally mounted CRT; 0.140 inch for vertically mounted CRT).

(2) Adjust R20 (CHAR SIZE control) for the proper character height. An access hole is on the underside of the function generator for adjusting R20.

2.23 Line Spacing (Figure 7)

(1) View the display screen on the CRT.

(2) Determine if the space between lines 7 and 8 is equal to the space between lines 6 and 7.

(3) If the space is not equal, adjust R38 (2^3 LINE) until it is.

(4) Determine if the space between lines 15 and 16 is equal to the space between lines 14 and 15.

(5) If the space is not equal, adjust R39 (2^4 LINE) until it is.

(6) Determine if the space between lines 31 and 32 is equal to the space between lines 30 and 31.

(7) If the space is not equal, adjust R40 (2^5 LINE) until it is.

2.24 Cursor Centering (Figure 7)

(1) Position the cursor to the center of the CRT display. Keyboard an upper case "I" onto the display. Reposition the cursor over the "I".

(2) Adjust R23 on the function generator so that cursor shows light on all sides of the "I".

(3) If necessary readjust R20 on the function generator for proper character height.

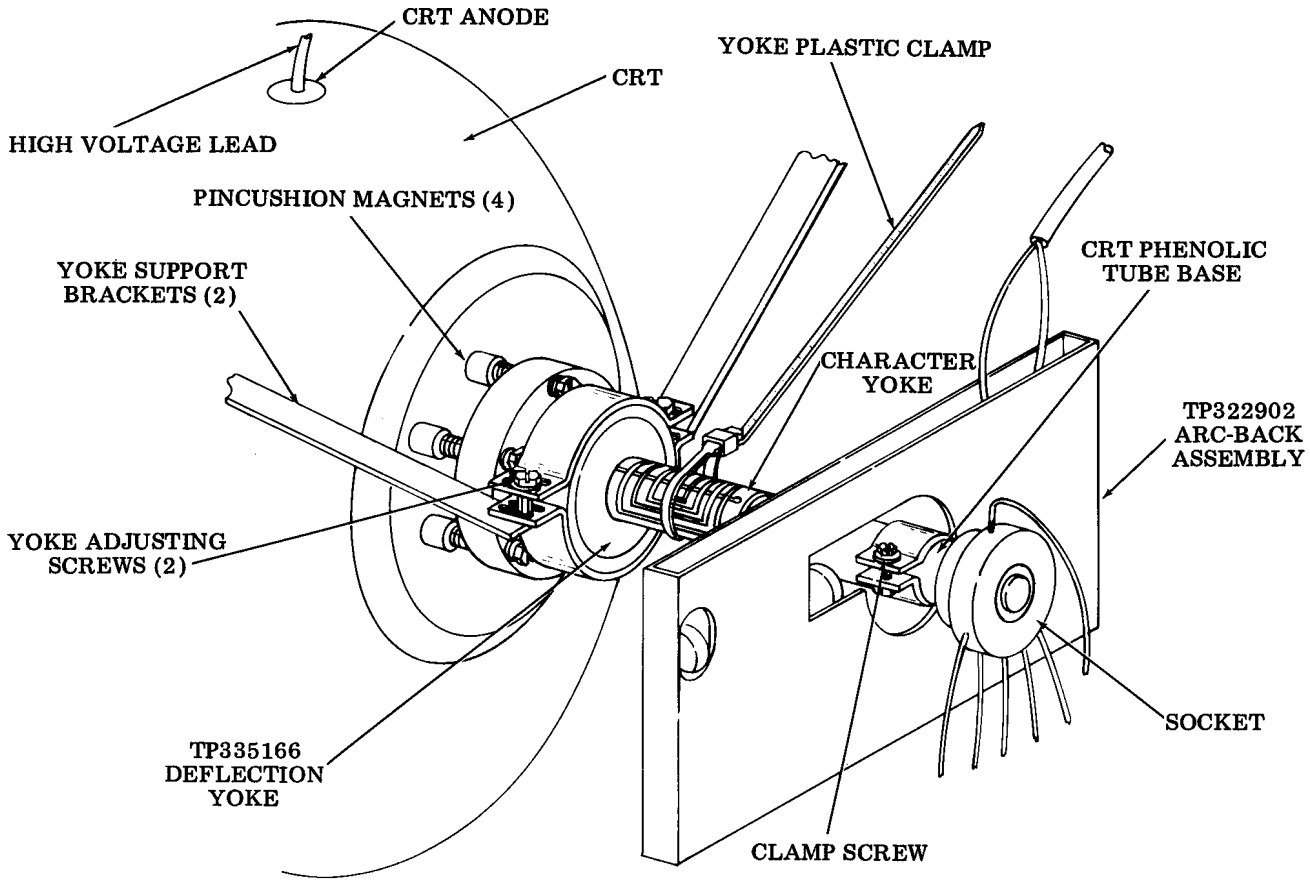


Figure 8 - CRT Deflection Yoke (Early Design)

CRT DEFLECTION YOKE (Early Design)

2.25 Main Yoke (Figure 8)

(1) Adjust the BRIGHTNESS control on the control panel for maximum brightness.

(2) Adjust the main BRIGHTNESS control on the CDPS801 high voltage supply until the horizontal sweep raster lines are displayed on the CRT.

(3) Loosen the yoke clamp screws on the yoke support brackets and rotate the yoke until the raster lines are horizontal. Secure the yoke clamp.

2.26 Character Yoke (Figure 8)

With the set not in italics mode, rotate the character yoke so that the vertical stroke of a displayed "T" character is perpendicular to the horizontal axis.

CAUTION: DO NOT APPLY EXCESSIVE FORCE WHEN REPOSITIONING YOKE.

2.27 Pincushion Magnets (Figures 8 and 9)

(1) Check the CRT screen display for pincushioning (rounded or peaked corners).

(2) If pincushioning exists, loosen the locknuts securing the pincushion magnets located on the yoke, and adjust the magnets until the corners of the page display are approximately square.

CRT DEFLECTION YOKE (Early Design) (continued)

CAUTION: DO NOT ALLOW MAGNETS TO TOUCH CRT. DO NOT ALLOW ANY SHARP POINTED OBJECTS TO COME INTO CONTACT WITH THE CRT.

CRT DEFLECTION YOKE (Late Design)

2.28 Main Yoke (Figure 10)

(1) Adjust the BRIGHTNESS control on the control panel for maximum brightness.

(2) Adjust the main BRIGHTNESS control on the CDPS801 high voltage supply until the horizontal sweep raster lines are displayed on the CRT.

(3) Loosen the yoke clamp screw on the CRT neck and rotate the yoke until the raster lines are horizontal. Secure the yoke clamp.

2.29 Character Yoke (Figure 10)

(1) Loosen the yoke clamp screw.

(2) Loosen the three character yoke adjustment screws.

(3) Holding the main yoke in place, rotate the character yoke until the characters on the display are straight.

(4) Retighten the character yoke adjustment screws and yoke clamp screw.

(5) Check the main yoke adjustment in 2.28 and refine if necessary.

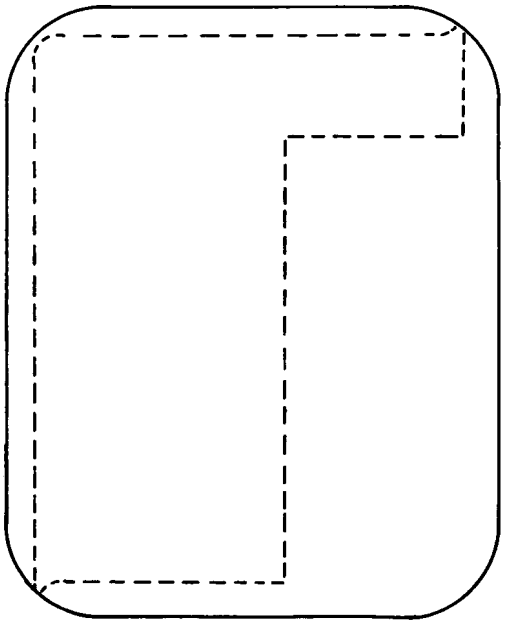


Figure 9 - Pincushion Effect

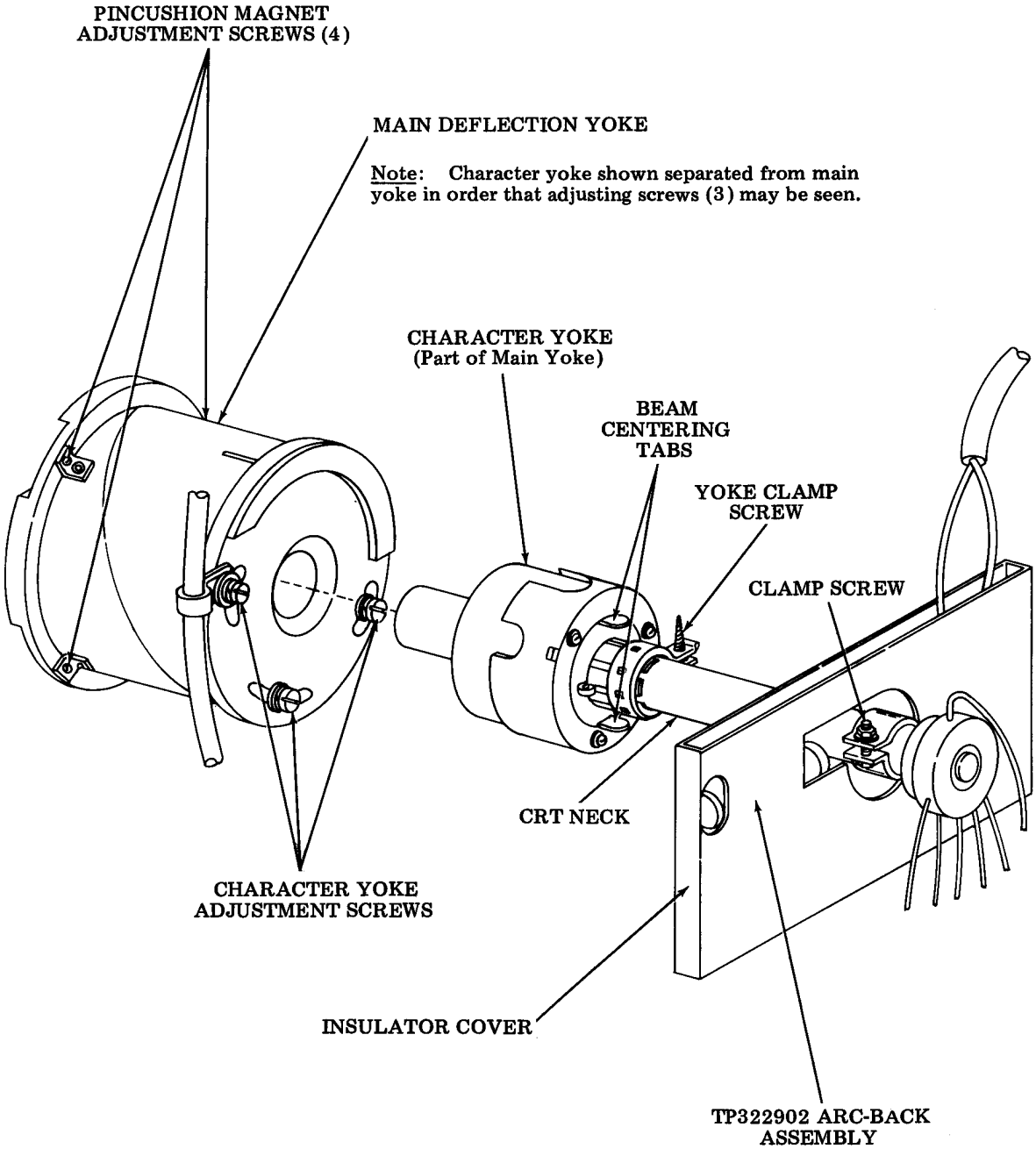
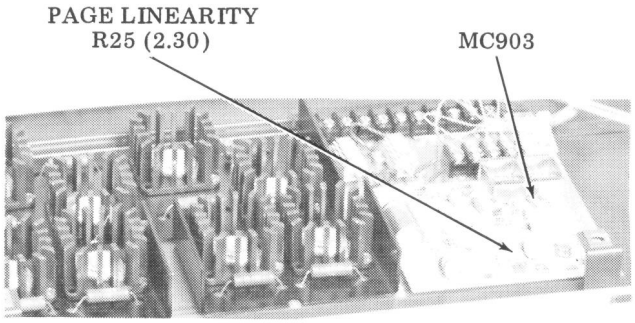


Figure 10 - CRT Deflection Yoke (Late Design)

TP322903 DEFLECTION PREAMPLIFIER

2.30 Page Linearity on MC903 Card

(1) While viewing the left margin on the CRT display, the page display line linearity (compare top line to bottom line) should be approximately equal.



(Front View - Module Shelf Extended)

Figure 11 - Deflection Amplifier

(2) If not, adjust R25 potentiometer on the TP322903 (MC903) circuit board for correct linearity (Figure 11).

CDPS801 HIGH VOLTAGE POWER SUPPLY

2.31 Main Brightness (Figures 1 and 12)

(1) Set the attendant BRIGHTNESS control on the control panel for maximum brightness.

(2) Adjust the BRIGHTNESS control on CDPS801 until the horizontal raster lines disappear from the display.

Note: CRT tube life may be greatly increased if the main brightness of the CRT is adjusted conservatively.

2.32 Focus (Figure 12)

(1) Keyboard a line of "T" and "$" onto the CRT display.

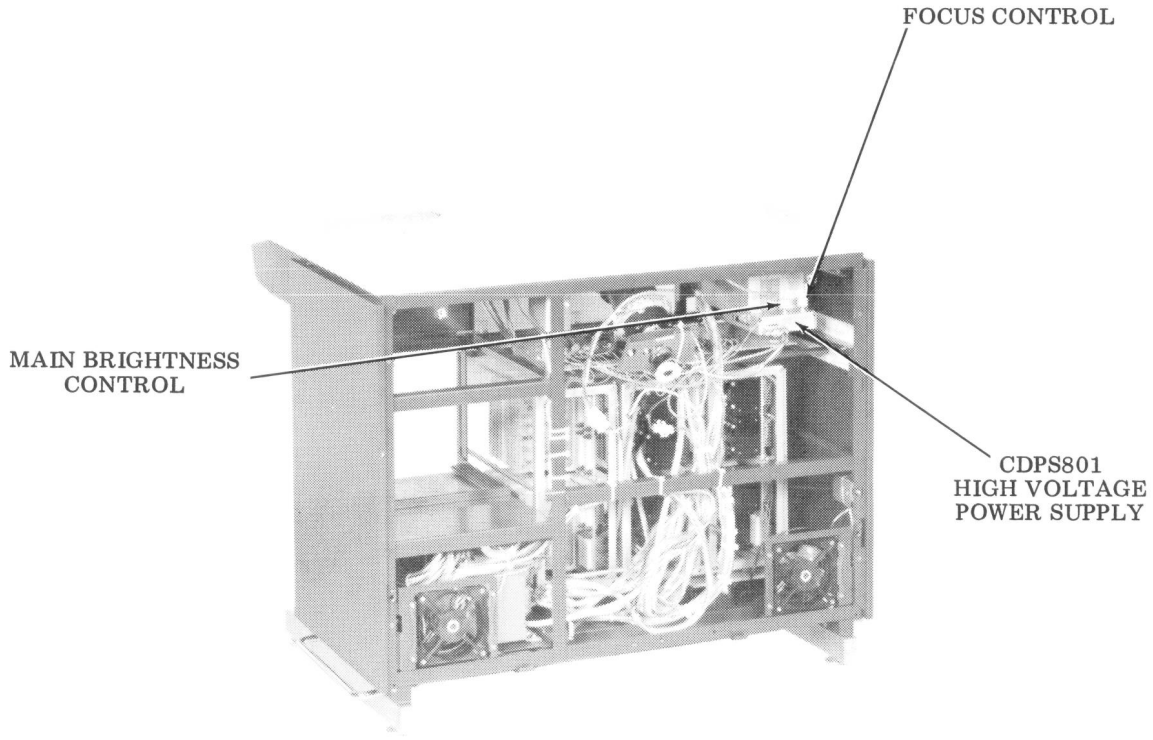


Figure 12 - High Voltage Power Supply

CDPS801 HIGH VOLTAGE POWER SUPPLY (continued)

(2) Set the BRIGHTNESS on the control panel for an intensity slightly more than the proper viewing level.

(3) View the "T" and "$"; adjust the FOCUS control on the CDPS801 power supply chassis for maximum sharpness.

CRT DEFLECTION YOKE (Late Design) (continued)

2.33 Beam Centering Tabs (Figure 10)

Note 1: Adjustment of the electron beam centering rings provided on the deflection yoke is not required for factory built CDT sets.

Note 2: The electron beam centering rings (tabs) are furnished on the deflection yoke to compensate for assembly variations in the manufacturer's assembly of the CRT electron gun, and the normal degeneration of elements used in the electron gun assembly during long term usage of the CDT. If the electron beam does not meet the manufacturing requirement of writing a small dot within a circle having a 0.500 inch radius concentric with the center of the CRT screen with CDT horizontal and vertical deflection off (disabled), the deflection yoke electron beam centering rings can be rotated into positions which would magnetically bias (bend) the electron beam into the forementioned center position on the CRT screen. Normally, in most instances, the tab portion of the beam centering rings after positioning will be located 180 degrees apart.

Note 3: Before the electron beam centering rings are positioned to center the CRT electron beam, the high voltage power supply FOCUS control should be previously adjusted for maximum sharpness on the video display screen (2.32).

Note 4: Uneven or poor video display intensity across horizontal or vertical raster with the CDT electronic logic properly adjusted could indicate that the CRT beam centering rings are incorrectly positioned. Do not attempt repositioning of the deflection yoke beam centering rings unless the procedure is clearly understood, the proper conditions can be implemented on the CDT to disable horizontal and vertical deflection, and the proper measuring tools are available.

2.34 Pincushion Magnets (Figure 9)

(1) Check the CRT screen display for pincushioning effect (rounded or peaked corners).

(2) If pincushioning exists, loosen the three holding screws on the pincushion ring of the major deflection yoke. Rotate the ring (only slight correction necessary) and adjust until the corners of the page display are approximately square.