MAINTENANCE AND ADJUSTMENTS

GENERAL MAINTENACE

Preventive Maintenance-Clean and recalibrate the Oscilloscope on a regular basis to keep the instrument looking nice working well.

Cleaning-Remove any dirt, dust, and grime whenever they become noticeable. You can remove dirt from the outside covers with a soft cloth moistened with a mild cleaning solution.

Recalibration-Recalibrate the Oscilloscope after 1000 hours of operation or twice a year if used daily.

ADJUSTMENT AND CALIBRATION

CAUTION:Be careful when calibrating your Oscilloscope; dangerous high voltage exists in several areas.

- You will need the following test equipment when calibrating your Oscilloscope.
- DC voltmeter(or DMM) for measuring ±2V to ±200V with ±0.25% accuracy.
- High-voltage DC meter or probe for measuring -2100V DC with ±0.5% accuracy.
- Precision calibrator(±0/25% accuracy) providing .1us to .5s timing signals.
- 50Ω, 1MHz, square wave/pulse source with rise time of 1ns or less.
- High-quality square wave signal source at 1KHz and 10KHz with precision amplitude of 50mV.
- peak-to-peak (±0.5% accuracy)and optional amplitudes of .1, 1, and 10V peak-to-peak.
- Sine wave source at 1KHZ and 10KHz.
- LOw-range capacitance meter for measurement of approximately 25pF, if a source that provides high-quality square wave amplitudes of .1, 1, and 10V peak-to-peak is not available.

1. With the line cord diconnected, remove the cabinet top and bottom.
2. Preset the front panel controls as described in steps 1 through 4 under"Preliminary Operation"on Page 15.
3. Allow the Oscilloscope at least a 20-minute warmup time before you start the calibration.

NOTES:

1. Use an insulated, low-capacitance adjustment tool for all of the following adjustments.
2. Measure each voltage with respect to a convenient ground(chassis)point.
3. Refer to Figure 17,18,19, and 22 for the location of the controls called out in the following steps.

POWER SUPPLY ADJUSTMENT

Refer to Figure-20 for the following steps.

1. +12V adjustment--Adjust VR914 for +12±0.05V at Q902 collector. Adjust this voltage very carefully, as it provides a reference for the other supplies.
   +12 VH check--Check pin(3) on connector p-60 for 11.4~12.6V.
2. -12V check--Check pin (5) on connector p-60 for -12±0.2V.
3. +5v check--Check pin 4 on connector p-60 for +5±0.25V.
4. +145V check--Check pin 7 on connector p-60 for +145±5v.

CAUTION:During the following measurement, use a high input impedance voltmeter and a probe that are rated for high-voltage measurements (-2100 VDC).Use extreme care.

5. -1975V check--Check the anode(unbanded)end of ZD804(at red wire) for -1975±10V

CRT CIRCUIT ADJUSTMENTS

Refer to Figure-19 for the following steps.

1. Minimum Intensity--Turn the front panel INTENSITY control to the 9 o'clock position. Then adjust VR819 so that the trace line is just dimly visible.
2. Maximum Intensity--Turn the front panel INTENSITY control fully clockwise Then adjust VR817 so that the thickness of the trace line is no more than 2/3 of one minor division of the vertical graduation at sharp focus.

3. Astigmatism--Set the VERT MODE switch to CH2, push the X-Y switch in, and use the ◆▶POSITION and CH2 controls to place the beam spot in the center of the CRT screen. Then adjust VR822 in combination with the front panel FOCUS control so that the shape of the the displayed beam spot becomes as sharp and nearly circular as possiable. Push the X-Y button to its normal (out) position and set the VERT MODE switch to CH1.
4. Trace Rotation--Adjust the front panel TRACE ROT control until the trace is parallel with the horizontal graticule lines.
5. Blanking--Set the TIME/DIV switch to .1ms,. and apply a 10KHz sine wave signal to the CH1 input connector. Adjust the TRIGLEVEL control for a stable waveform. Then adjust VR805 to make any"retrace"line(from right to left on the CRT screen)disappear. Then check each position of the TIME/DIV switch to make sure the retrace is not visible with a viewable sweep. Readjust VR805, if required.

VERTICAL AMPLIFIER ADJUSTMENTS

Refer to Figure-20 for the following steps

NOTES:(steps 1 to 8)for CH1 and then repeat for CH2.Adjustments specific to only one channel are indicated.

1. Step DC balance--Set the AC-GND-DC switch to GND. If the trace line shifts vertically when you switch between the most sensitive positions of the VOLTS/DIV switch, adjust VR123(CH1)or VR223(CH2) to obtain minimum shift.
2. X5 MAG DC balance--If the trace line shifts vertically when you pull the VAR switch for X5 magnification., adjust VR152(CH1) or VR252(CH2)for minimum shift between the out and in position of the VAR switch. After completing the adjustment, push the switch in.
3. Variable DC balance--If the trace line shifts when you turn the VAR control from the CAL'D position. adjust VR153(CH1)or VR253(CH2) for minimum shift. After cpmpleting the adjustment, leave the control at the CAL'D position.
4. ADD mode DC balance--Perform the following steps:
   A. Set the VERT MODE switch to CH1. Then, using the CH1 ◆ POSITION control, move the trace to the center of the screen.
   B. Set the VERT MODE switch to CH2. Then, using the CH2 ◆ POSITION control, move the trace to the center of the screen.
   C. Set the VERT MODE switch to ADD, and adjust VR394 to position the trace at the center of the screen. Then set the VERT MODE switch to CH1.
5. Sensitivity calibration--For this adjustment, you will need a square wave generator that producess a 1KHz signal with a 50mV peak-to-peak precision output amplitude. Perform the following steps:
   A. Set the TIME/DIV switch to 1ms.
   B. Set the generator for a 50mV p-p square wave output and connect it to the CH1 or CH2 input terminal, as required.
   C. Set the AC-GND-DC switch to DC.
   D. Be sure the VAR control on the VOLTS/DIV switch is set to the CAL'D position and set the VOLTS/DIV switch to 10mV.
   E. Adjust VR334(CH1) or VR311(CH2) for exactly 5 divisions of amplitude.
   F. Set the VOLTS/DIV switch to 5mV. Set the generator for a 50mV p-p sinewave. Set the AC-GND-DC switch to AC.
   G. Push the storage/analog switch, adjust VR9A(CH1) or VR9B(CH2) for an optimum sinewave (non distortion).
   H. Set the generator for a 20mV p-p square wave adjust VR67A(CH1), VR67B(CH2) for exactly 4 divisions of amplitude.
   I. If the DC level shifts vertically when you push/pull the storage/analog switch adjust VR60A(CH1), VR60B((CH2) to obtain minimum shift.

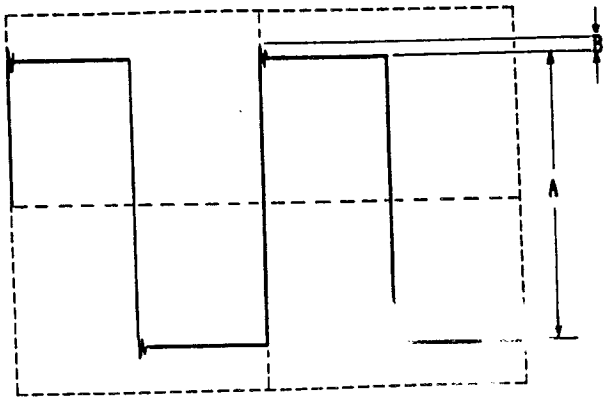

Figure 21

6. X5 gain calibration--Perform the following steps:
   A. Set square wave generator for a 5mV output and connect it to the CH1 or CH2 input terminal, as required.
   B. Be sure the VAR control is set to the CAL'D position and pull the knob out for X5 MAG.
   C. Adjust VR150(CH1)or VR250(CH2) for exactly 5 divisitions of amplitude.
   D. Push both VAR knobs in.
8. Vertical transient response--For this adjustment, you will need a high-quality 50Ω terminated, 1MHz, square wave or pulse signal with a rise time of 1.0ns or less. Perform the following steps:
   A. Set the VOLTS/DIV switch to 10mV and the TIME/DIV switch to .2us.
   B. Apply a square wave signal of 1 MHZ to the CH1 input connector through a terminated 50Ω cable with BNC connector and adjust the level for 5 divisions of amplitude.
   C. Adjust VR431,VC405,VC322, and VR151 until you obtain a waveform like the one shown in Figure 21. The following condition must be met:(B/A)X100%≦3%.
   Since there is some interaction between the control and capacitor settings, be patient and take your time as you reduce the B amplitude.
   D. Apply the 1MHz square wave signal to the CH2 input connector and adjust the level for 5 divisions of amplitude.
   E. Adjust VC303, and VR251 until you obtain a waveform as outlined in step C. Do not adjust VR431 and VC405 this time.

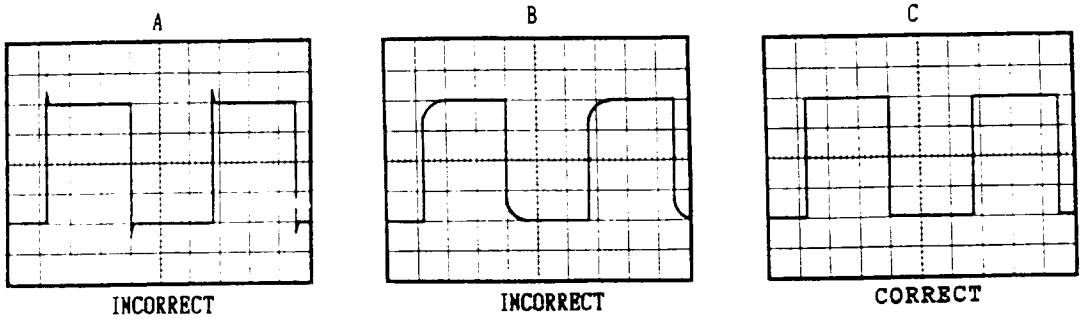

Figure 22

INPUT ATTENUATOR ADJUSTMENTS

NOTE:Refer to Figure 17 for the following steps (steps 1 and 2) for CH1 then repeat for CH2.

1. The purpose of the following adjustments is to obtain the proper amount of high-frequency compensation for all positions of the VOLTS/DIV switch. Figure 22 shows the conditions of too much compensation (A), too little compensation (B), and the correct amount of compensation (C).
   NOTE:You will need a square wave generator that delivers a high-quality 1KHz to 10KHz signal with a rise time of 1us less and without sag or overshoot.
   Perform the following step:
   Apply the signal to the appropriate CH1 or CH2 input connector. Set the VOLTS/DIV switch first to the .1 position and then to the 1 position, and display a waveform with an amplitude of 4 to 6 divisions over 2 to 5 cycles while you make the following adjustments to obtain a correct compensation waveform display:

RANGE	ADJUST CAPACITOR
.1V	VC103 (CH1) or VC203 (CH2)
1V	VC106 (CH1) or VC206 (CH2)

2. The purpose of the following adjustments is to set the input capacitance of CH1 and CH2 equal for all VOLTS/DIV switch positions. With equal input capacitances in all positions, a 10:1 probe needs to be adjusted only once for proper high-frequency compensation.Two methods of adjustments are provided. Method 1 requires the use of a 10:1 probe and a high-quality square wave signal at approximately .1, 1, and 10 volts peak-to-peak.Method 2 requires a low-range capacitance meter for measurement of approximately 25 pF .

Method 1

A. connect the 10:1 probe to the appropriate CH1 or CH2 input connector. Set the VOLTS/DIV switch to 20mV. Then adjust the trace position, TIME/DIV switch setting, and triggering for a display as shown in "C" of Figure 22.
B. Adjust the probe compensation capacitor for correct compensation, as shown in "C" of Figure 22.
C. Set the VOLTS/DIV switch to the following positions with 1V and then 10V square wave signals applied to the inputs. Then adjust the indicated trimmer capacitors for the ideal wave form appearance:

RANGE	ADJUST CAPACITOR
.2V	VC102 (CH1) or VC202 (CH2)
2V	*VC105 (CH1) or VC205 (CH2)

*Access to VC105 will require a flexible tool, or you may choose not to alter the factory setting of this capacitor.

Method2

A. Connect a low-range capacitance meter very directly to the appropriate CH1 or CH2 input connector. Set the VOLTS/DIV switch to 20mV, and measure the input capacitance. Then set the VOLTS/DIV switch to the following positions and adjust the indicated trimmer capacitors for the same capacitance value.

RANGE	ADJUST CAPACITOR
.2V	VC102 (CH1) or VC202 (CH2)
2V	*VC105 (CH1) or VC205 (CH2)

*Access to VC105 will require a flexible tool, or you may choose not to alter the factory setting of this capacitor.

TRIGGERING ADJUSTMENTS

NOTE:Perform the following steps only for CH1

1. CH1 trigger offset (X-axis DC level)--Refer to Figure 19 for the following steps
   A. Set the CH1 AC-GND-DC switch to AC and apply a 1KHz sine wave signal to the CH1 input.
   B. Set the VERT MODE switch to CH1 and set the SOURCE switch to CH1.
   C. Select an appropriate setting for the VOLTS/DIV switch and adjust the input signal amplitude for a deflection of 2 to 4 full division, vertically centered exactly on the center line of the screen.
   D. Set the TRIGLEVEL control to center position.
   E. Adjust VR588 to position the starting point (left edge of the trace) exactly at the center horizontal graticule line.
2. ALT adjustment--Refer to Figure 20 for the following steps:
   A. Set the CH1 and CH2 AC-GND-DC switches to AC.
   B. Set the VERT MODE switch to DUAL.
   C. Set the TRIG SOURCE switch to ALT.
   D. Simultaneously apply a 1KHz sine wave signal to the CH1 input connector and a 10KHz square wave signal to the CH2 input connector. Then adjust the amplitude of each waveform, externally or with the VOLTS/DIV switch, for a peak-to-peak display or one full division (1 cm) on the CRT screen.
   E. With the TRIGLEVEL control turned to center position adjust VR35A, VR35B until both displayed waveforms are stably triggered.

HORIZONTAL AMPLIFIER ADJUSTMENTS

1. Time base calibration--Refer to Figure 18 for the following steps. The purpose of the following adjustments is to calibrate the sweep time of the TIME/DIV switch using accurate time intervals of .1～.5us, 1～50us, .1ms～5ms, 10ms～.5s.
   Perform the following steps:
   A. turn the VAR sweep control fully clockwise to CAL'D.
   B. Apply a time maker signal of 50us to the CH1 input connector and set the TIME/DIV switch to 50us.
   C. Alternately adjust the ◀▶ POSITION and VR718 controls so that the displayed waveform aligns with each vertical graticule line, paying particular attention to the center 8 divisions, as shown in Figure 23.
   D. Change the time interval of the input signal to .1us and set the TIME/DIV switch to .1us.
   E. Adjust the ◀▶ POSITION control and VC708 so that the displayed waveform again aligns with the vertical graticule lines, as shown in Figure 23, with attention to the center 8 divisions.
   F. Apply a time marker signal of 5ms and change the TIME/DIV switch to 5ms.Alternately adjust the ◀▶ POSITION and VR717 so that the displayed waveform aligns with each vertical graticule line as shown in Figure 23.
   G. Apply a time marker signal of 50ms and change the TIME/DIV switch to 50ms. Alternately adjust the ◀▶ POSITION and VR716 so that the displayed waveform again aligns with vertical graticule line as shown in Figure 23.

H. Push the storage/analog switch and set the time marker signal of 20us,set the TIME/DIV switch to 20us.

I. Altermately adjust the ◀▶ POSITION and VR721 so that the displayed waveform aligns with each vertical graticule line as shown Figure 23.

J. Set time marker signal of 10us TIME/DIV switch to 10us adjust VR22 refer to Figure 22 so that the displayed waveform same as Figure 23.

NOTE:After you complete the above steps, you may wish to check the TIME/DIV accuracy for each range against those given in the "Specifications"section of this Manual.

2. X10 MAG calibration--Refer to Figure-19 for the follwing steps

A. Change the time interval of the input signal to .1 ms.

B. Set the TIME/DIV switch to 1 ms.

C. Pull out the PULL X10 MAG switch.

D. Adjust VR655 so the waveform aligns with the vertical graticule lines, as shown in Figure 23.

E. Push the PULL X10 MAG switch in.

CAL Signal Adjustments

Refer to Figure-21 for the following steps

1. Set the VOLTS/DIV switch for CH1 to .1V.
2. Set the VERT MODE switch to CH1.
3. Set the TIME/DIV switch to .1 ms.
4. Connect the CH1 input to the front panel CAL test point. Adjust the triggering for a stable display.
5. Adjust VR453 for exactly 5 divisions of Amplitude.
6. Alternately adjust the VR459 and VR464 until the waveform cycle is exactly 10 divisions per cycle.

X-Y Adjustments

Refer to Figure 20 for the following steps.

1. Set the VERT MODE switch to CH2.
2. Push the X-Y switch button in. Reduce the trace brightness, as required.
3. Adjust VR13C so that the beam spot is horizontally positioned at the center of the CRT screen.
4. X-axis gain--Perform the following steps:

A. Set the AC-GND-DC switch for CH1 and CH2 to AC.

B. Set the VOLTS/DIV switches for CH1 and CH2 to 50 mV.

C. Make sure the CH1 and Ch2 VAR controls are both turned fully clockwise to CAL'D.

D. Apply a .2 V p-p (approximately) sine wave signal to the CH1 and CH2 input connectors.

E. Adjust VR10C so that you obtain at race with a 45° slope, and 4 divitions for horizontally positioned as shown in Figure 24, which passes exactly through the vertical and horizontal graticule line intersections.

5. Pull the X-Y switch button out.

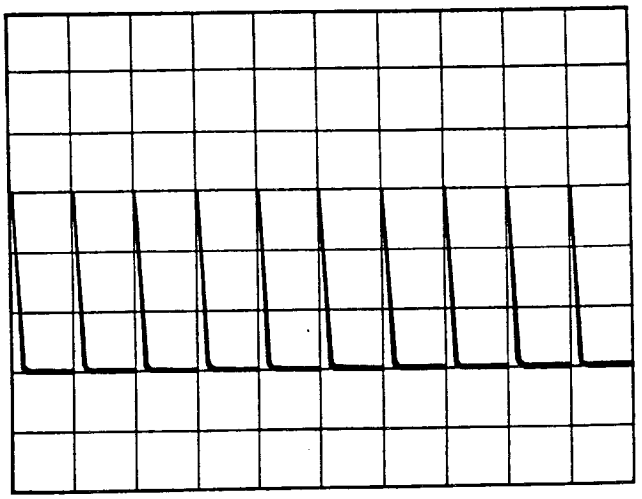

Figure 23

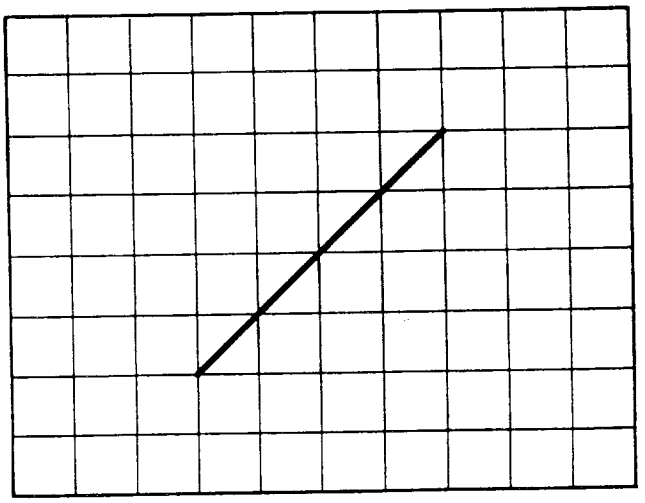

Figure24

NOTE: After the cabinet is reassembled and the Oscilloscope is on your workench, a "touch-up" of the front panel TRACE ROT control may be required to reast the trace parallel to the graticule.