# TEKTRONIX TYPE 180 TIME-MARK GENERATOR
Serial No. 101 thru 5,000

## SUGGESTED FIELD RECALIBRATION PROCEDURE

Normally it will not be necessary to make all of the adjustments given in these instructions at any one time. However, any adjustments you may make should be made in the sequence given below. This is especially important in the adjustment of the high-frequency-divider capacitors. Instability of the high-frequency dividers is generally caused by loss of regulation in the power supplies, or improper adjustment of the high-frequency-divider potentiometers.

Front-panel controls are indicated by UNDERLINED CAPITALS. Internal adjustments are indicated by PLAIN CAPITALS.

The following equipment is necessary for a full recalibration of the Type 180.

1. A dc voltmeter (at least 20,000 ohms per volt), calibrated for an accuracy within 1% at the following voltages: 135 volts, 140 volts and 225 volts.

2. An accurate rms-reading ac voltmeter, 0-150 volts.

3. A Variac, having a rating of at least 300 volt-amperes.

4. A Tektronix Type 541 or Type 545 oscilloscope with a Type 53/54K or Type 53/54L plug-in unit and a Type P410 probe.

5. A low-capacitance insulated alignment screwdriver.

A 530-Series oscilloscope may be substituted for the 540-Series oscilloscope (item 4 above) in cases where it is unnecessary to check the high-frequency sine-wave adjustments (Step 8) or trigger pulling (Step 9).

1. To check power-supply resistances to ground (power plug disconnected).-- In case of trouble in the power supplies, resistance measurements can be made at the 4-point ceramic terminal strip located on the left-hand vertical chassis directly behind the SIGNAL OUTPUT coaxial connector. Typical values of resistance are as follows:

| Supply | Ceramic strip terminal | Typical Resistance |
|---|---|---|
| +225-volt | Top Terminal | 5000 ohms |
| -135-volt | 2nd from top | 2900 ohms |
| +140-volt | 3rd from top | 12000 ohms |

2. To check power-supply voltages.-- Connect the Type 180 and the 0-150-volt ac voltmeter to the output of the Variac, set the power switch to POWER ON, and adjust the Variac for 117 volts output. Using the same terminal points as those used in measuring resistances in Step 1 above:

a. Set the -135 ADJ. control, located on the left side of the lower chassis next to V440, for a voltmeter reading of exactly -135 volts. Now adjust the Variac through the range of 105 to 125 volts and see that the output voltage of the -135-volt supply remains constant throughout this range.

b. Check the +140-volt supply for 140 volts ±2%. Check the regulation of the 140-volt supply by adjusting the Variac through the range of 105 to 125 volts.

c. Check the +225-volt supply for 225 volts ±2%. Check the regulation of the 225-volt supply by adjusting the Variac through the range of 105 to 125 volts.

3. <u>To check the ripple of power supplies</u>.-- Remove the crystal and the high-frequency-multiplier tubes, V202, V203 and V204. Using the test oscilloscope, observe the ripple at the output of each of the power supplies in the Type 180. Ripple observations should be made at the same points as those used for resistance and voltage measurements (Steps 1 and 2, above). Connect the probe ground-lead clip to the front-panel ground post on the Type 180. In the case of each power supply, use the Variac to adjust the applied line voltage to the Type 180 over the range from 105 to 125 volts, and check that at no Variac setting in this range does the ripple of any supply exceed 15 millivolts.

4. <u>To set high-frequency-divider potentiometer adjustments</u>.-- These are four controls located along the top of the right-hand vertical chassis, and can best be set with the oscilloscope, as it is necessary to check the free-run operating point of the dividers. Before you proceed with these adjustments, check the vertical calibration of the oscilloscope as follows:

Connect the Type P410 probe to the 53/54K <u>INPUT</u> and set the <u>VOLTS/CM</u> switch to <u>.5</u>, giving a vertical deflection factor of 5 volts per centimeter, and set the <u>AC-DC</u> switch to <u>DC</u>. Set <u>TIME/CM</u> to 100 <u>MICROSEC</u>., set <u>TRIGGERING MODE</u> to AC <u>AUTO</u> or <u>AUTOMATIC</u>, and set <u>TRIGGER SLOPE</u> to <u>+INT</u>. Now set the <u>SQUARE-WAVE CALIBRATOR</u> to <u>20 VOLTS</u>, plug the probe tip into the <u>CAL. OUT</u> connector, and turn the <u>STABILITY</u> control far enough to the right to obtain a stable square-wave pattern having 4 centimeters of vertical deflection. If necessary, slightly adjust the <u>GAIN ADJ</u>. on the front of the Type 53/54K for exactly 4 centimeters. The oscilloscope is now calibrated to indicate 1 volt per minor vertical division of the graticule (when the 10X attenuation of the probe is taken into account), with a total deflection of 20 volts for the full 4 centimeters. Remove the probe tip from the <u>CAL. OUT</u> connector.

a. With the **voltmeter**, measure the B3 (bias) voltage. This measurement can be made at the top of the 68,000-ohm resistor connected to pin 6 of V313 (6C4). Voltage at this point should be -20 to -25 volts.

b. Connect a jumper wire from the top of L207, located between V206 and the crystal socket, to ground.

c. Using the oscilloscope VERTICAL POSITION control, position the crt trace vertically to the top line of the graticule when the probe tip is disconnected from all signal sources.

d. Connect the probe tip to pin 2 of V302 and the probe ground lead to the nearest convenient chassis point in the Type 180, and turn the control labeled 5 MICROSEC. to the left until the 5-microsecond multivibrator starts to free-run. This condition will be indicated on the crt by a wide band instead of a narrow trace. Now turn the 5 MICROSEC. control slowly to the right until the multivibrator just stops free-running. The crt should display a single trace 5 to 7 minor divisions below the top graticule line, indicating -5 to -7 volts dc bias. If this voltage is more negative than -7 volts, replace V302 with another 12AT7. Now adjust the 5 MICROSEC. control for a final setting of -9 volts.

e. Move the probe tip to pin 2 of V306 and turn the control labeled 10 MICROSEC. to the left until the 10-microsecond multivibrator starts to free-run. This condition will be indicated on the crt by a wide band instead of a narrow trace. Now turn this control to the right until free-running just stops. Dc voltage indicated on the oscilloscope should be less negative than -8 volts. If more negative than this, replace V306 (12AT7). Adjust the 10 MICROSEC. control for a final reading of -10 volts.

f. Move the probe tip to pin 2 of V309 and turn the control labeled 50 MICROSEC. to the left until the 50-microsecond multivibrator starts to free-run. This condition will be indicated on the crt by a wide band instead of a narrow trace. Now turn this control to the right until free-running just stops. If the dc voltage indicated on the oscilloscope is more negative than -8 volts, replace V309 (12AT7). Adjust the 50 MICROSEC. control for a final setting of -10 volts.

g. Move the probe tip to pin 2 of V312 and check for the free-running point of the 100 MICROSEC. control. This condition will be indicated on the crt by a wide band instead of a narrow trace. If the corresponding meter reading is more negative than -16 volts, replace V312 (12AU7). Adjust the 100 MICROSEC. control for a final setting of -20 volts.

h. With the voltmeter, measure the voltage on the plates, pins 6, of V302, V306 and V309. If the voltage at any of these points exceeds +105 volts, replace the tube whose reading exceeds this value. If a tube is replaced, be sure to recheck the free-running point and final bias adjustment for that stage, as described above in this paragraph.

i. Remove the jumber wire from the top of L207 to ground.

5. To adjust L207.-- Set the oscilloscope TIME/CM control to 10 MICROSEC., VOLTS/CM to 1, TRIGGERING MODE to AC SLOW and STABILITY full right. Connect the probe tip to the top of L207, and the probe ground lead to the chassis. A dense, unstable display of pulses should appear. Adjust L207 with an insulated alignment screwdriver for maximum vertical deflection on the oscilloscope.

6. To adjust the high-frequency-divider capacitors.-- There are four ceramic capacitors located on the right-hand vertical chassis, between the two top rows of ceramic terminal strips, labeled C304, C320, C327 and C337. These capacitors determine the rate of division of the high-frequency-multivibrator stages. The high-frequency-division rates should NEVER be adjusted with the high-frequency-divider potentiometers. The proper method to use in adjusting these potentiometers was given in Step 4 above.

   a. Set up the equipment as follows:

| | | |
|---|---|---|
| Oscilloscope | TRIGGERING MODE | AC SLOW |
| | TRIGGER SLOPE | + EXT |
| | 5X MAGNIFIER | OFF |
| | TIME/CM | 1 MICROSEC. |
| | MULTIPLIER | 1 |
| | VOLTS/CM | .2 |
| Type 180 | SIGNAL SELECTOR | MARKERS |
| | TRIGGER RATE SELECTOR | 100 KC |
| | MICROSECOND MARKERS | 1-MICROSECOND MARKER switch in up position |

   (All other marker switches in down position)

   b. Connect the probe tip to the Type 180 SIGNAL OUTPUT connector and the probe ground lead to the Type 180 ground binding post. Connect a jumper from the Type 180 TRIGGER OUTPUT connector to the oscilloscope TRIGGER INPUT, and carefully adjust the oscilloscope STABILITY and TRIGGERING LEVEL controls for a stable display consisting of one-microsecond markers spaced at intervals of one centimeter.

   c. Make the adjustments listed in the following table, in the order shown.

| Oscilloscope TIME/CM | MULT. | Type 180 MICROSEC. MARKERS* | TRIGGER RATE SELECTOR | Adjust indicator capacitor for following: | |
|---|---|---|---|---|---|
| 1 μsec. | 1 | 1 & 5 | 100 kc | C304 | 1 marker per cm. Every 5th marker increased in amplitude. |
| 1 μsec. | 5 | 5 & 10 | 100 kc | C320 | 1 marker per cm. Every other marker increased in amplitude. Leave at point where short markers are slightly reduced in amplitude. |
| 10 μsec. | 1 | 10 & 50 | 10 kc | C327 | 1 marker per cm. Every 5th marker increased in amplitude. |
| 10 μsec. | 5 | 50 & 100 | 10 kc | C337 | 1 marker per cm. Every other marker increased in amplitude. |

*Set these toggle switches to up position.

7. To adjust intermediate- and low-frequency divider controls.-- The remaining dividers are located on the left-hand vertical chassis, and are adjusted by varying the resistance in the resistance-capacitance time-determining circuit. Each control should be set at the center of the range over which the division rate is correct, in accordance with the following table:

| Oscilloscope | | Type 180 | | |
|---|---|---|---|---|
| TIME/CM* | MULT. | MARKERS** | TRIGGER RATE SELECTOR | Adjust indicated control for following: |
| 100 µsec | 1 | 100 µsec & 500 µsec | 1 kc | 500 MICROSEC. - 1 marker per cm. Every 5th marker increased in amplitude. |
| 100 µsec | 5 | 500 µsec & 1 msec | 1 kc | 1 MILLISEC. - 1 marker per cm. Every other marker increased in amplitude. |
| 1 msec | 1 | 1 msec & 5 msec | 100 cycles | 5 MILLISEC. - 1 marker per cm. Every 5th marker increased in amplitude. |
| 1 msec | 5 | 5 msec & 10 msec | 100 cycles | 10 MILLISEC. - 1 marker per cm. Every other marker increased in amplitude. |
| 10 msec | 1 | 10 msec & 50 msec | 10 cycles | 50 MILLISEC. - 1 marker per cm. Every 5th marker increased in amplitude. |
| 10 msec | 5 | 50 msec & 100 msec | 10 cycles | 100 MILLISEC. - 1 marker per cm. Every other marker increased in amplitude. |
| 100 msec | 1 | 100 msec & 500 msec | 1 cycle | 500 MILLISEC. - 1 marker per cm. Every 5th marker increased in amplitude. |
| 100 msec | 5 | 500 msec & 1 sec | 1 cycle | 1 SEC. - 1 marker per cm. Every other marker increased in amplitude. |

*In the above table msec indicates milliseconds.
**Set the indicated switches to the up position.

8. To adjust the high-frequency-sine-wave capacitors.--

a. Set up equipment as follows:

| | | |
|---|---|---|
| Oscilloscope - - | TRIGGERING MODE - - - - | AC SLOW |
| | TRIGGER SLOPE - - - - - | +EXT. |
| | TIME/CM - - - - - - - - | .1 MICROSEC. |
| | MULTIPLIER - - - - - - - | 2 |
| | VOLTS/CM - - - - - - - - | .2 |
| | 5X MAGNIFIER - - - - - - | OFF |
| Type 180 - - - - | TRIGGER RATE SELECTOR - | 100 KC |
| | MARKERS - - - - - - - - - | All switches in down position. |

b. Connect the probe tip to the Type 180 SIGNAL OUTPUT connector and the probe ground lead to the ground binding post. Connect a jumper from the Type 180 TRIGGER OUTPUT connector to the oscilloscope TRIGGER INPUT connector.

c. With the settings shown on line (1) in the table below, carefully adjust the oscilloscope STABILITY and TRIGGERING LEVEL controls for a stable display. Then proceed with the adjustments in the order shown in the following table. Recheck the settings of each pair of capacitors in each of the steps, as there is a slight interaction between settings.

| | Oscilloscope | | | Type 180 | | |
|---|---|---|---|---|---|---|
| | TIME/CM | MULT. | 5X MAG. | SIGNAL SELECTOR | Adjust indicated capacitor for following: | |
| (1) | .1 μsec | 2 | OFF | 5 MC | C209<br>C216 | 1 cycle per cm at maximum amplitude.<br>Maximum amplitude |
| (2) | .1 μsec | 1 | OFF | 10 MC | C220<br>C225 | 1 cycle per cm at maximum amplitude.<br>Maximum amplitude |
| (3) | .1 μsec | 1 | ON | 50 MC | C228<br>C230 | 1 cycle per cm at maximum amplitude.<br>Maximum amplitude. |

9. To check trigger pulling.-- Trigger pulling is indicated by a multiple trace on the oscilloscope when examining the 50-mc output of the Type 180, triggered with the 100-kc trigger output from the Type 180. After completing Part c (3) of Step 8 above, check for trigger pulling by examining the pattern carefully for one or more light traces slightly displaced from the main trace. If multiple traces exist, they can be brought in step with the main trace by making very slight adjustments to L207, C304, C320, C327 and C337 in that order, going over the adjustments several times to reach exact final settings. CAUTION: Be sure that proper division rates of the high-frequency dividers are not disturbed by the above adjustments.