

ADJUSTMENT PROCEDURE

INTRODUCTION

Use this Adjustment Procedure to restore the FG 501A to original performance requirements. This Adjustment Procedure need not be performed unless the instrument fails to meet the Performance Requirements of the Electrical Characteristics listed in the Specification section, or if the Performance Check procedure cannot be completed satisfactorily. If the instrument has undergone repairs, the Adjustment Procedure is recommended.

Satisfactory completion of all adjustment steps in this procedure assures that the instrument will meet the performance requirements.

SERVICES AVAILABLE

Tektronix, Inc. provides complete instrument repair and adjustment at local Field Service Centers and at the Factory Service Center. Contact your local Tektronix Field Office or representative for further information.

RECALIBRATION INTERVAL

Recommended recalibration interval is 2000 hours of operation or six months, whichever occurs first.

TEST EQUIPMENT REQUIRED

The test equipment (or equivalent) listed in Table 4-1 is required for adjustment of the FG 501A. Specifications given for the test equipment are the minimum necessary for accurate adjustment. All test equipment is assumed to be correctly calibrated and operating within specifications.

If other test equipment is used, calibration setup may need to be altered to meet the requirements of the equipment used.

PREPARATION

Access to the internal adjustments is achieved most easily when the FG 501A is connected to the power module with a flexible extender (see equipment list). Removal of the left side cover provides access to all internal adjustments. Refer to the Adjustment Locations in the pullout pages at the rear of the manual.

Make adjustments at an ambient temperature between -20°C and $+25^{\circ}\text{C}$.


PRELIMINARY SETTINGS

Preset the FG 501A and test equipment controls as follows:

CAUTION

To prevent damage to equipment, be sure the power module and oscilloscope mainframe power is off before inserting or removing plug-in units.

Power Module

LINE SELECTOR	HI
FG 501A	
 (pushbutton)	in
FREE RUN (pushbutton)	in
0 dB (pushbutton)	in
FREQUENCY Hz dial	20
VAR SYMM	Mid-range & in
VAR \emptyset	Mid-range
MULTIPLIER	10^3
VAR (frequency)	cw
OFFSET	Mid-range & in
AMPL	cw

Digital Multimeter (DM 501)

RANGE/FUNCTION	20 DC VOLTS
INPUT	EXT

POWER SUPPLIES

1. Adjust the $+15\text{ V ADJ}$ (R1301), $\pm 0.1\%$
 - a. Insert the FG 501A and digital multimeter into the power module.
 - b. Connect the power module power cord to 117 Vac source and turn on the power module.
 - c. Connect the test leads to the digital multimeter HI and LO INPUTS.
 - d. Connect the digital multimeter LO test lead to the FG 501A chassis ground. Connect the HI test lead to the FG 501A test point, TP1323 located on the Main board.
 - e. ADJUST—potentiometer R1301 located on the Main board until the digital multimeter readout indicates between $+14.985$ and $+15.015$.

2. Adjust the -15 V ADJ (R1341), $\pm 0.1\%$

- a. Remove the digital multimeter HI test lead from TP1323 and connect to test point, TP1451 (also located on the Main board).
- b. ADJUST—potentiometer R1341 located on the Main board until the digital multimeter readout indicates between -14.985 and -15.015.

3. Check the +5 V Supply Accuracy, $\pm 0.5\%$

- a. Remove the digital multimeter HI test lead from TP1451 and connect to test point, TP1331 located on the Main board.
- b. The digital multimeter must indicate a readout between +4.975 and +5.025.

4. Check the +20 V Supply Accuracy, $\pm 0.5\%$

- a. Change the digital multimeter RANGE/FUNCTION switch to 200 DC VOLTS.
- b. Remove the digital multimeter HI test lead from TP1331 and connect to test point, TP1321 located on the Main board.
- c. The digital multimeter must indicate a readout between +19.90 and +20.10.

5. Check the -20 V Supply Accuracy, $\pm 0.5\%$

- a. Remove the digital multimeter HI test lead from TP1321 and connect to test point, TP1241 located on the Main board.
- b. The digital multimeter must indicate a readout between -19.90 and -20.10.
- c. Remove all connections.

DIAL ALIGNMENT

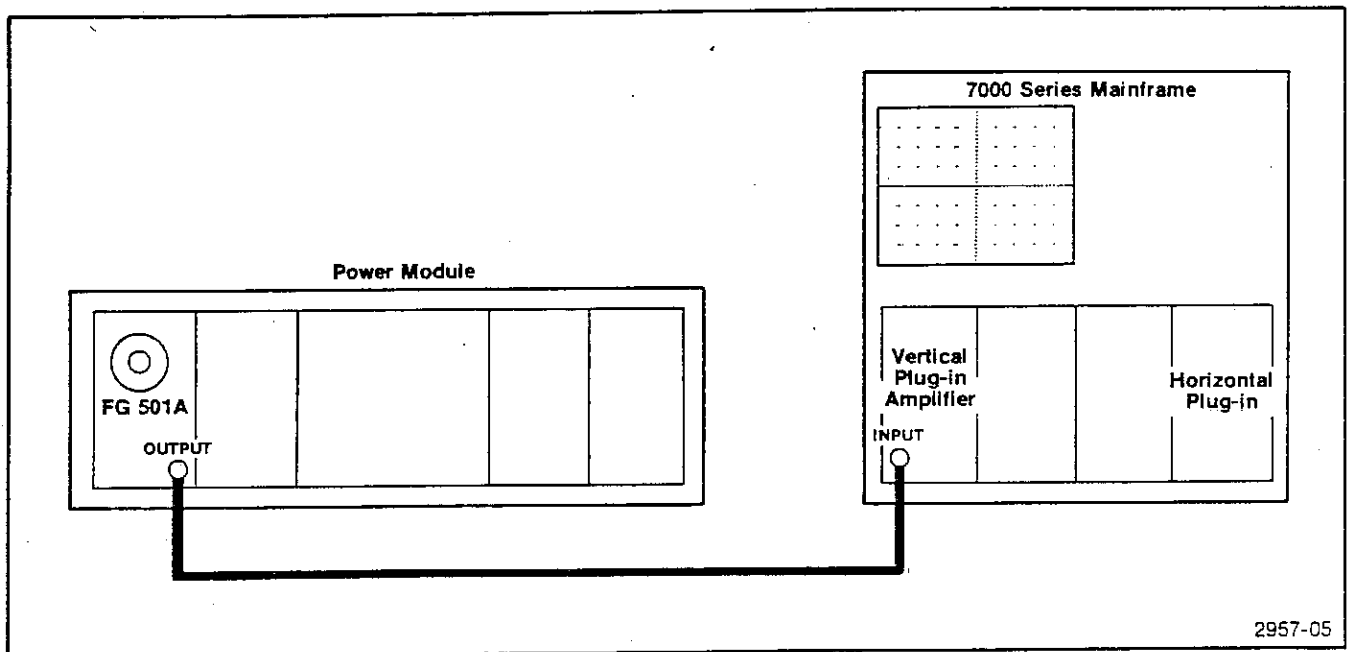
Refer to Fig. 4-1 test setup and preliminary control settings with the following exceptions.

7000 Series Oscilloscope

POWER	on
FOCUS	} as desired for a well-defined display
INTENSITY	
VERTICAL MODE	LEFT
HORIZONTAL MODE	B
B TRIGGER SOURCE	VERT MODE

Vertical Plug-in


VOLTS/DIV	5
VARIABLE	in
BANDWIDTH	FULL
POLARITY	+ (UP)
AC-GND-DC	DC
POSITION	centered display



2957-05

Fig. 4-1. Test setup for DIAL ALIGNMENT and OFFSET adjustment.

Horizontal Plug-in

DISPLAY MODE	TIME BASE
TIME/DIV	50 μ s
VARIABLE	in
LEVEL/SLOPE	
MODE	AUTO
COUPLING	AC
SOURCE	INT
MAGNIFIER	X1

Vertical Plug-in

VOLTS/DIV	2
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7. Adjust the OUTPUT OFFSET (R2201) and SINE OFFSET (R1104)

- a. The oscilloscope crt display is a triangle.
- b. ADJUST—potentiometer R2201 located on the Main board until the displayed waveform is centered on the vertical graticule line.
- c. Press the \surd (pushbutton) in.
- d. The oscilloscope crt display is a sinewave.
- e. ADJUST—potentiometer R1104 located on the Aux board until the displayed waveform is centered on the vertical graticule line.

6. Frequency Hz Dial Alignment

- a. Connect the coaxial cable from the FG 501A OUTPUT to the vertical plug-in INPUT.
- b. Adjust the horizontal plug-in LEVEL control for a stable squarewave display on the crt.
- c. Locate the coupler holding the FREQUENCY Hz potentiometer extension shaft and loosen the coupler set screw.
- d. ADJUST—the FREQUENCY Hz potentiometer counterclockwise until the displayed waveform just stops moving.
- e. While holding the potentiometer (coupler), adjust the FREQUENCY Hz dial to 20 (exact).
- f. Tighten the coupler set screw (snug only).
- g. Adjust the FREQUENCY Hz dial to 18. Then rotate dial slowly counterclockwise until the display crt waveform just stops moving.
- h. Check that the FREQUENCY Hz dial is on 20 (± 5 minor graticule division).
- i. Tighten the coupler set screw.

ADJUST SINE DISTORTION

8. Adjust the TRIANGLE AMPL ADJ (R1412), TRIANGLE OFFSET (R1511), and TOP DIAL SYMM CAL (R1421)

Refer to Fig. 4-2 check setup and preliminary control settings with the following exceptions.

FG 501A

AMPLITUDE	cw
Audio Analyzer	
INPUT LEVEL RANGE	20 V
FUNCTION	THD+N
PERCENT DISTORTION	AUTO
FILTERS	OUT
RESPONSE	AVE

a. Remove the vertical plug-in INPUT connection and re-connect to the audio analyzer using a bnc to banana plug adapter.

b. ADJUST—potentiometers R1412, R1511, and R1421 all located on the Main board for a minimum reading on the audio analyzer. Repeat these adjustments until no further improvement is noted.

ADJUST OFFSET

Refer to Fig. 4-1 test setup and preliminary control settings with the following exceptions.

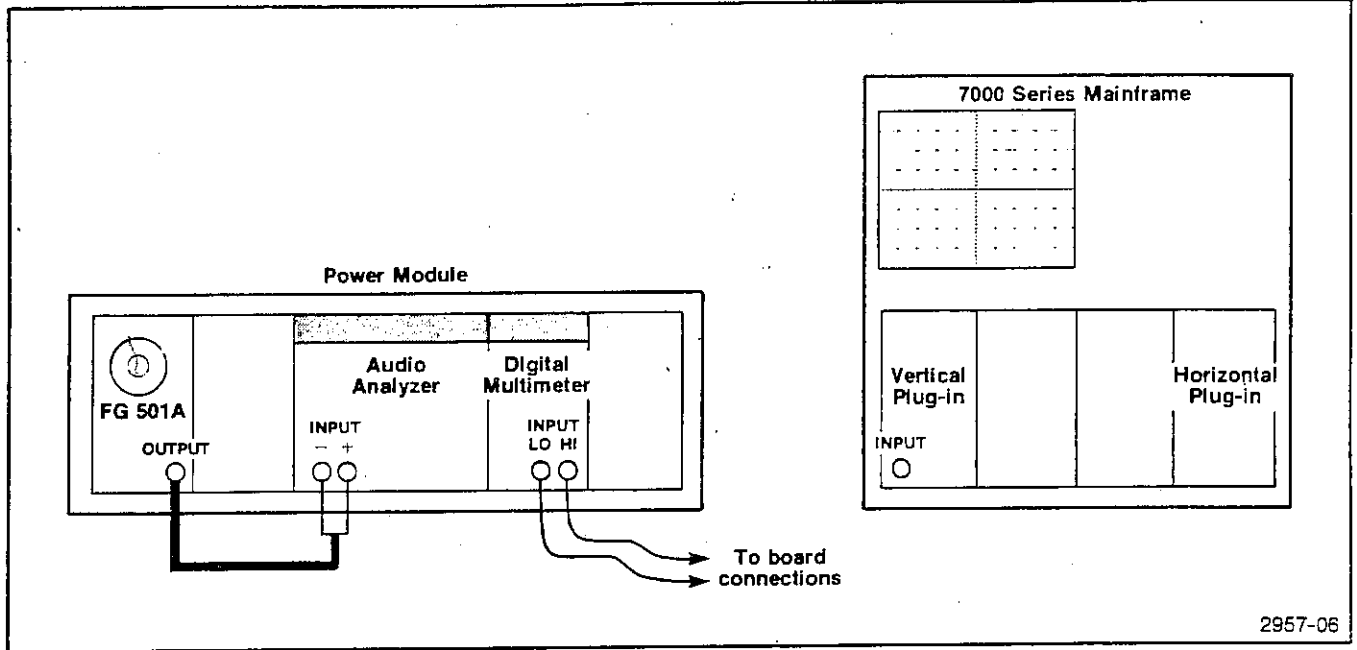
FG 501A

AMPLITUDE	ccw
\surd (pushbutton)	in
FREQUENCY Hz	20
MULTIPLIER	10 ²

9. Adjust the "C" MULT ADJ (R1951)

Refer to Fig. 4-2 test setup and preliminary control settings with the following exceptions.

** Look @ the SINE WAVE on the O'scope adjust R1412, R1511, R1421
4-10. For best visual representation - R1412 is the most effective of
the three and may require several turns to achieve a distortion-free
SINE WAVE - Then look @ the result with the distortion analyzer for
SPEC. compliance.*



2957-06

Fig. 4-2. Test setup for SINE DISTORTION adjustment.

Digital Multimeter

RANGE/FUNCTION	2 DC Volts
	FG 501A
MULTIPLIER	1

- a. Connect the digital multimeter LO INPUT test lead to pin 2 of IC, U1930 located on the Main board.
- b. Connect the HI INPUT test lead to pin 2 of IC, U1940 also located on the Main board.
- c. ADJUST—potentiometer R1951 located on the Main board for a .0000 digital multimeter readout.
- d. Remove digital multimeter test leads.

10. Adjust the BOTTOM DIAL SYMM CAL (R1441)

Refer to Fig. 4-2 test setup.

- a. Adjust the FG 501A FREQUENCY Hz dial to 1 and change the MULTIPLIER to 10^2 .
- b. ADJUST—potentiometer R1441 for a minimum reading on the audio analyzer.

OFFSET ADJUSTS

Refer to Fig. 4-3 test setup and preliminary control settings with the following exceptions:

FG 501A

~ (pushbutton)	in
MULTIPLIER	10^2
OUTPUT	ccw

Vertical Plug-in

VOLTS Polarity	+
+ INPUT Coupling	GND
- INPUT Coupling	GND
VOLTS/DIV	.1

11. Adjust OUTPUT OFFSET (R2201)

- a. Connect a coaxial cable with 50 Ω termination from the FG 501A OUTPUT to the vertical plug-in + INPUT.
- b. Adjust the vertical plug-in POSITION control until the trace lines up on the center horizontal graticule line.
- c. Change the vertical plug-in + INPUT coupling to DC.
- d. Adjust the vertical plug-in COMPARISON VOLTAGE control until the positive peak of the displayed waveform appears as graticule center.

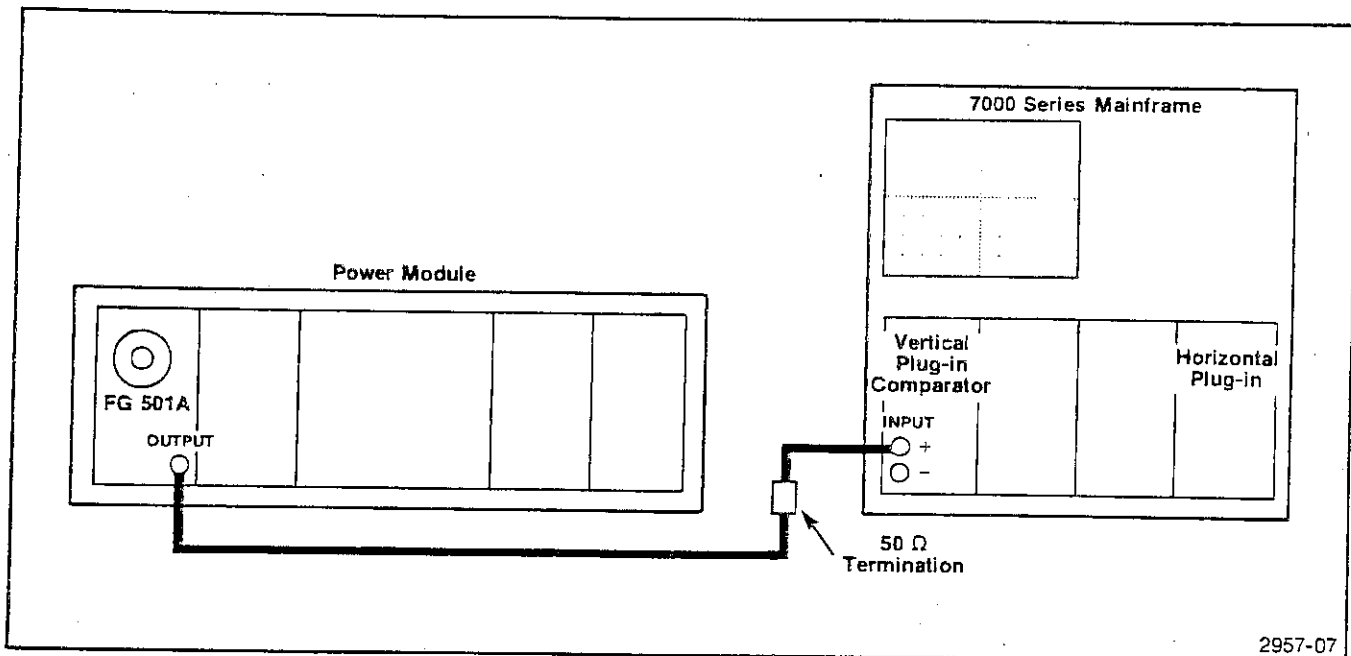


Fig. 4-3. Test setup for OFFSET and SINE/SQUARE AMPLITUDE adjustments.

e. Change the vertical plug-in VOLTS polarity to -.

f. Adjust the vertical plug-in COMPARISON VOLTAGE control until the negative peak of the displayed waveform moves half-way between its present position and the center horizontal graticule line.

g. ADJUST—potentiometer R2201 located on the Main board until the negative peak of the displayed waveform is on the center horizontal graticule line.

12. Adjust the SINE OFFSET (R1104)

a. Change the vertical plug-in VOLTS polarity to + and press the \sim pushbutton (in).

b. Adjust the vertical plug-in COMPARISON VOLTAGE control until the positive peak of the displayed waveform appears at graticule center.

c. Change the vertical plug-in VOLTS polarity to -.

d. Adjust the vertical plug-in COMPARISON VOLTAGE control until the negative peak of the displayed waveform moves half-way between its present position and the center horizontal graticule line.

e. ADJUST—potentiometer R1104 located on the Aux board until the negative peak of the displayed waveform is on the center horizontal graticule line.

SINE/SQUARE AMPLITUDE ADJUSTS

Refer to Fig. 4-3 test setup and the preliminary controls settings with the following exceptions:

	FG 501A
\sim (pushbutton)	in
AMPLITUDE	cw
	Vertical Plug-in
VOLTS/DIV	.2
+INPUT Coupling	GND
-INPUT Coupling	GND

13. Adjust the SINE AMPL (R1106)

a. Adjust the vertical plug-in POSITION control until the trace lines up on the center horizontal graticule line.

b. Change the vertical plug-in VOLTS polarity to -.

c. Change the vertical plug-in + INPUT coupling to DC and the - INPUT coupling to VC.

d. Adjust the vertical plug-in COMPARISON VOLTAGE control until the negative peak of the displayed waveform appears at graticule center.

e. Press the FG 501A \curvearrowright pushbutton (in).

f. ADJUST—potentiometer R1106 located on the Aux board until the negative peak of the displayed waveform is on the center horizontal graticule line.

14. Adjust the SQ WAVE AMPL (R1728)

a. Press the FG 501A \curvearrowright pushbutton (in).

b. Note the position of the negative level of the displayed squarewave.

c. Press the FG 501A \curvearrowleft pushbutton (in).

d. Change the vertical plug-in VOLTS polarity to +.

e. Adjust the vertical plug-in COMPARISON VOLTAGE control until the positive peak of the displayed waveform is on the center horizontal graticule line.

f. Press the FG 501A \curvearrowright pushbutton (in).

g. ADJUST—potentiometer R1728 located on the Main board until the positive level of the displayed squarewave is off of the center graticule line in the same direction and same amount as the negative level squarewave noted in step 29b.

SQUAREWAVE COMP/RISE AND FALLTIME ADJUSTS

Refer to Fig. 4-4 test setup and the preliminary control settings with the following exceptions.

FG 501A

FREQUENCY Hz	20
MULTIPLIER	10 ⁵
AMPLITUDE	ccw

Sampling Vertical Plug-in

mVOLTS/DIV	200
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Sampling Horizontal Plug-in

SWEEP RANGE	5 μ s
TIME/DIV	.1 μ s

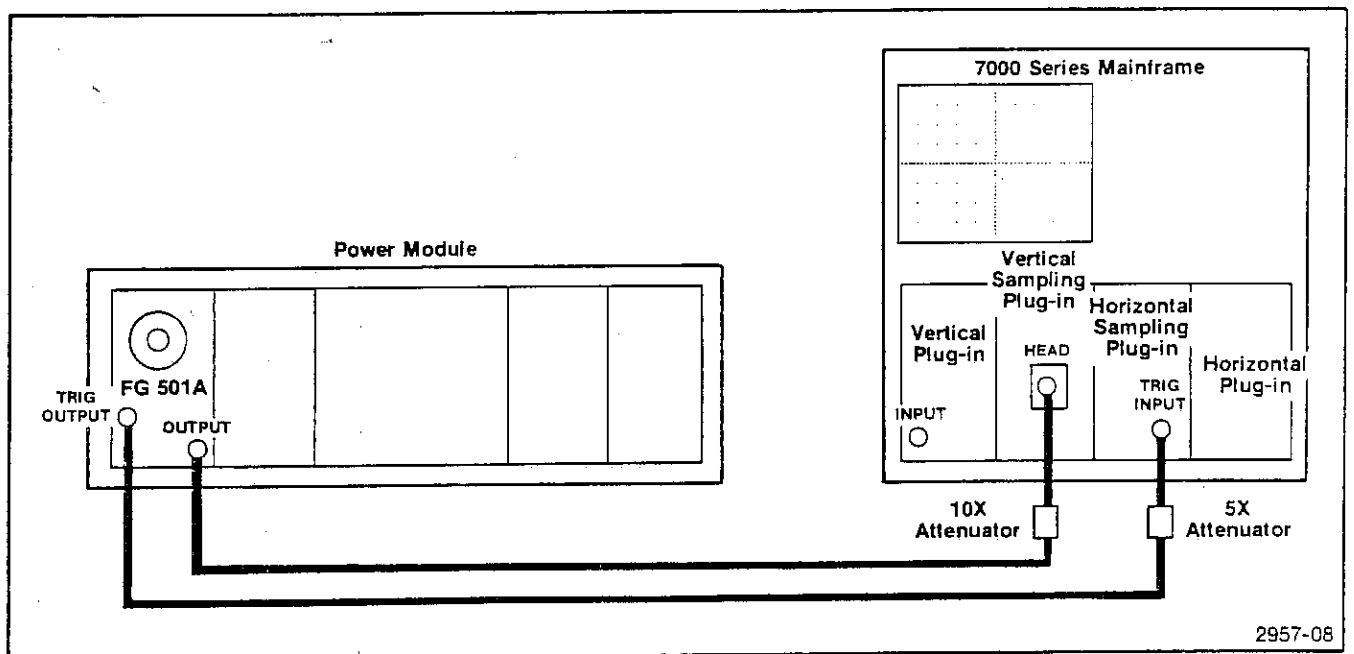


Fig. 4-4. Test setup for SQUAREWAVE COMP/RISE and FALL TIME adjustments.

Calibration—FG 501A
Adjustment Procedure

15. Adjust the SQ WV COMP (C2011)

a. Connect a coaxial cable with a 10X attenuator from the FG 501A OUTPUT to the vertical plug-in sampling head input.

b. Connect a coaxial cable with a 5X attenuator from the FG 501A TRIG OUTPUT to the sampling horizontal plug-in TRIG INPUT.

c. Set the sampling vertical plug-in VARIABLE out and adjust for a displayed waveform amplitude of five major graticule divisions.

d. Change the sampling vertical plug-in mVOLTS/DIV switch to 20.

e. ADJUST—variable capacitor C2011 located on the Main board for a peak-to-peak aberration of 1 major graticule division on the displayed waveform. This aberration will appear at both the top and bottom of the waveform.

DIAL CAL/LOOP DELAY

Refer to Fig. 4-5 test setup and preliminary control settings.

16. Adjust the DIAL CAL (R1321)

a. Connect a 50 Ω coaxial cable and terminator from the FG 501A output to the counter input.

b. ADJUST—potentiometer R1321 located on the main board for a counter display of 20.00.

17. Adjust LOOP DELAY (C1714)

a. Change the FG 501A MULTIPLIER to 10^5 and the digital counter FUNCTION to FREQUENCY/1 kHz.

b. ADJUST—variable capacitor C1714 located on Main board for a digital counter readout of 2.000.

c. Remove all cables and connections.

This completes the Adjustment Procedure for the FG 501A.

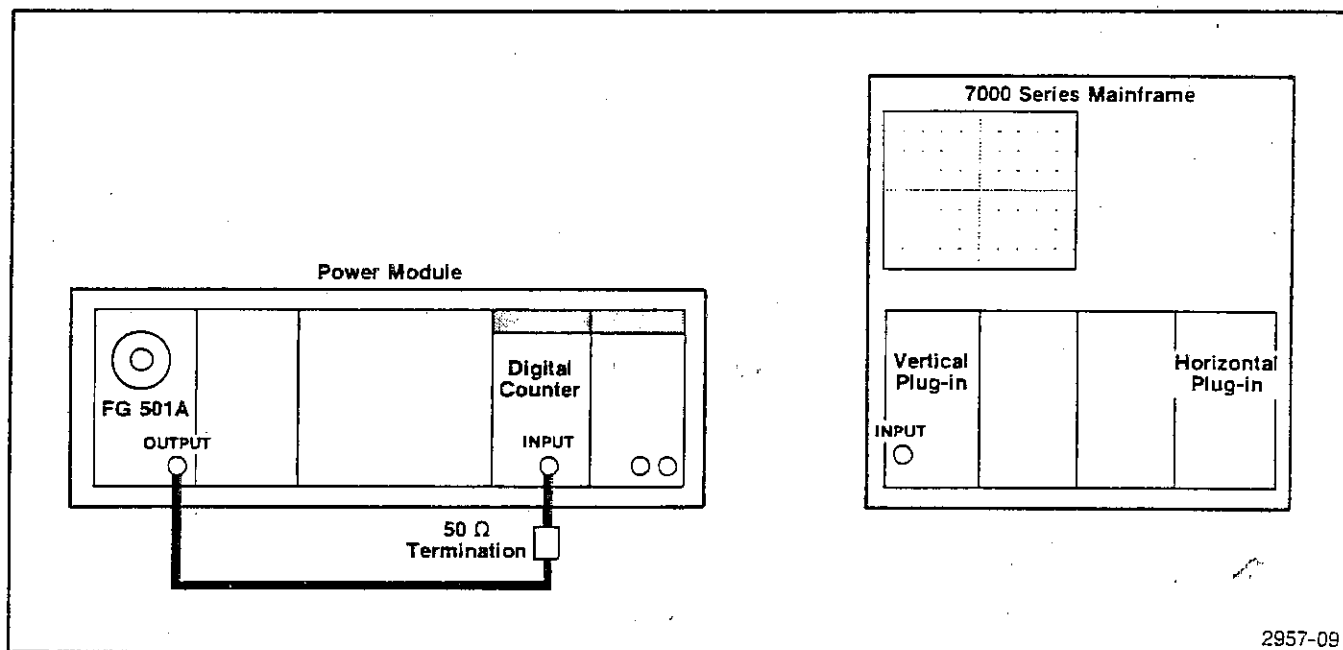


Fig. 4-5. Test setup for DIAL CAL and LOOP DELAY adjustments.