FACTORY CALIBRATION PROCEDURE

CONTENTS:

INTRODUCTION:

0

This is the guide for calibrating brand-new instruments, it therefore, calls out many procedures and adjustments that are rarely required for subsequent recalibration. *This procedure is company confidential.* In this procedure, all front panel control labels or Tektronix equipment names are in capital letters (VOLTS/DIV, etc.) internal adjustment labels are capitalized only (Gain Adj, etc.).

Tek form number:

0-158

October 1967

For all serial numbers.

Supercedes
July 1964

FACTORY TEST LIMITS:

We initially calibrate the instrument to Factory Test Limits. These limits are often more stringent than advertised performance requirements. This helps insure that the instrument will meet advertised requirements after shipment, allows for inaccuracies of test equipment used, and may allow for changes in environmental conditions.

QUALIFICATION:

Factory test limits are qualified by the conditions specified in the main body of the calibration procedure. The numbers and letters to the left of the limits correspond to the factory calibration procedure steps where the check or adjustment is made. Instruments may not meet factory test limits if calibration or check-out methods and test equipment differ substantially from those in this procedure.

ABBREVIATIONS:

Abbreviations in this procedure will be found listed in TEKTRONIX STANDARD A-100.

CHANGE INFORMATION:

This procedure has been prepared by Product Manufacturing Staff Engineering. For information on changes that have been made to this procedure, to make suggestions for changing this procedure, or to order additional copies: please contact PMSE, 47-261. (KM)

EQUIPMENT REQUIRED:

The following equipment is necessary to complete this procedure:

a. TEKTRONIX Instruments

*1	TYPE 546 OSCILLOSCOPE (Plug-in Scope)
1	TYPE 106 SQUARE-WAVE GENERATOR
*1	TYPE 191 CONSTANT AMPLITUDE SIGNAL GENERATOR

b. Test fixtures and accessories

1	47pF INPUT TIME-CONSTANT NORMALIZER (011-0068-00)
1	50Ω TERMINATION (011-0049-00)
2	42", 50Ω coaxial cables, BNC connectors (012-0057-00)
1	UHF male to BNC female adapter (103-0015-00) or BNC to Banana Plug patch cord (012-0091-00)
1	Plug-in extension (013-0055-00)
*1	STANDARD AMPLITUDE CALIBRATOR (SAC) (067-0502-00)
1	Grid Current Tester (067-0507-00)
1	AC Coupler (067-0083-00)
1	Attenuator shield (Dwg. #1802-B)
1	Compensating Network and Z Checker (Dwg. #1034-A)
1	Terminal board (329-0124-00) with 10kΩ (±1%) resistor
1	10X Attenuator checked to ±1%
1	.001μF capacitor, checked to ±0.1%
1	Extension Plug-in Inverter, (Dwg #1790-A)
1	Micro-shock hammer (Dwg # 1283-B)

c. Other equipment

1	Multimeter 20,000Ω/VDC

* This equipment must be traceable to NBS for instrument certification.

Substitute test equipment may be used. The Plant Staff Engineer must approve any substitutions. All equipment listed must perform within its manufacturer's specifications, unless otherwise stated.

It is assumed that all equipment is provided with BNC connectors; if equipment used has other than BNC connectors, adapters, not listed, may be needed.

QUALIFICATION

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PRELIMINARY

1. MECHANICAL INSPECTION

2. TYPE 0 UNIT PRESETS

3. RESISTANCE CHECKS

4. SET UP

DISPLAY AMPLIFIER

5. OUTPUT DC LEVEL +67.5V ±2.5V

6. DC BALANCE
   control must be centered ±90°

7. VERTICAL POSITION RANGE
   control must be centered ±90°

8. GRID CURRENT AND MICROPHONICS

a. Grid Current ≤2mm
b. Microphonics ≤2mm
   no ringing type

9. DC SHIFT ≤1mm

10. VERTICAL DISPLAY

11. GAIN

a. GAIN ADJ Range at least + and -10%

12. VOLTS/CM

* a. Accuracy within 2%
b. Variable VOLTS/CM range ≥2.5:1

13. ZERO CHECK

14. INPUT AND NEUTRALIZING CAPACITORS

b. Adjust for best square-wave response Max aberrations: 2%

15. VOLTS/CM COMPENSATIONS
    Max aberrations: 2%

16. HIGH FREQUENCY COMPENSATION
    Max aberrations: 2.5%

17. RISETIME ≤13.5ns
    ringing: ≤1%

18. FREQUENCY RESPONSE

* c. Check response within 3dB at 26MHz

OPERATIONAL AMPLIFIERS

19. OUTPUT DC LEVEL

b. OUTPUT DC LEVEL ADJ
   adjust to electrical center
c. DC Level Range
   adjust to 0 volts

* 20. OPEN LOOP GAIN 3000 ±500
   (Set at 3000)

21. OUTPUT CONNECTORS, VOLTAGE AND CURRENT

b. Check output voltage at least ±50V
c. Check output current $\geq$5mA

22. GRID CURRENT

c. Check Grid current, - grid $\leq$0.3nA
d. Check Grid current, + grid $\leq$0.15nA

23. NOISE

b. Check noise $\leq$0.5cm

24. Z_i - Z_f VALUES

b. Check Z_i and Z_f resistors must match within 2%
c. Check Z_i and Z_f capacitors must match within 2%

25. Z_i - Z_f EQUALIZATION

b. Select capacitors Less than 5% rolloff, hook, or overshoot
* c. Check unity gain bandwidth $\leq$3dB down at 750kHz

26. Z_i - Z_f .001μF AND 10pF VALUES

27. GAIN -- BANDWIDTH PRODUCT

* c. Check gain-bandwidth product $\geq$15MHz

28. COMPENSATED BANDWIDTH

a. Adjust compensation network
* b. Check bandwidth $\leq$3dB down at 10MHz

29. OUTPUT IMPEDANCE

30. B AMPLIFIER: REPEAT STEPS 20 THROUGH 29

31. CROSSTALK

* b. A to B amplifier $\geq$500:1
* c. B to A amplifier $\geq$500:1

* Indicates measurement characteristic; test equipment used must be traceable to the NBS for instrument certification.

1. MECHANICAL INSPECTION

a. Check Assembly

Check for unsoldered joints, rosin joints, lead dress and long leads. Check for loose hardware and protruding parts. Check controls for smooth mechanical operation, proper indexing, and knob spacing from front panel. Check for loose skirts on knobs. Correct any defects found.

b. Check Z_i and Z_f indexing

Check both A and B Z_i and Z_f switches for proper indexing by setting to 1MEG and seeing that wiper mates with correct contact on wafers.

2. TYPE 0 UNIT PRESETS

VERTICAL DISPLAY	+DC
VERTICAL POSITION	mid range
VOLTS/CM	.05
VARIABLE	CALIBRATED
DC BAL	mid range
GAIN ADJ	mid range

A and B Channels:

OUTPUT DC LEVEL ADJ	mid range
±GRID SEL	(-)
INTEGRATOR LF REJ	OFF
Z_i	.01 MEG
Z_f	EXT

Preset all internal adjustments to mid range.

2. (cont'd)

Leave controls and adjustments for any step as they were in the step preceding unless noted otherwise.

3. RESISTANCE CHECKS

Check interconnecting plug resistances to ground.

Use	Amphenol Pin#	Resistance (approximate)	Ohmmeter Range
output	1	500Ω	X1k
gnd	2	0Ω	X1k
output	3	500Ω	X1k
NC	4 to 8	----	---
+75V fil	15	100Ω	X1k
+100V	10	1.5kΩ	X1k
+225V	11	5kΩ	X1k
-150V	9	300kΩ to 1MΩ	X100k
+350V	12	400kΩ to 1MΩ	X100k
6.3VAC	13	∞	X100k
6.3VAC	14	∞	X100k
NC	16	----	---

Check for ∞ resistance between the front panel TIE POINT banana jacks and ground.

4. SET UP

a. Preset plug-in scope

Set plug-in scope TIME/CM to 1 mSEC, triggering to EXT, AUTO.

b. Connect TYPE 0 unit

Use plug-in extension to connect TYPE 0 Unit to plug-in scope. Turn plug-in scope power on. Allow to warm up for 10 minutes before proceeding.

5. DC OUTPUT LEVEL +67.5V ±2.5V

Adjust VERTICAL POSITION to center the display on the graticule. Use voltmeter to measure DC output levels at Amphenol pins 1 and 3 to gnd: +65 to +70 VDC.

6. DC BALANCE

control must be centered ±90°

Turn VARIABLE VOLTS/CM back and forth while adjusting DC BAL for no vertical trace shift. DC BAL pot must be within ±90° of midrange after adjustment.

7. VERTICAL POSITION RANGE

control must be centered ±90°

Set VERTICAL POSITION to midrange and adjust Vert Pos Range R6557 to place trace at electrical center. R6557 must be within ±90° of mid-range after adjustment.

Recheck oscilloscope for drift of electrical center periodically.

8. GRID CURRENT AND MICROPHONICS

a. Check Grid current ≤2mm

Set VOLTS/CM to .05 CALIBRATED, ground EXT INPUT, switch VERTICAL DISPLAY from +DC to +AC and check vertical trace shift (ignoring any shift while switching): ≤2mm.

Set VERTICAL DISPLAY to -DC and repeat, switching from -DC to -AC.

b. Check Microphonics ≤2mm; *no ringing type*

Set VERTICAL DISPLAY to +DC. Place micro-shock hammer on top center of oscilloscope. Raise and drop hammer to check microphonics: no ringing type. Remove EXT INPUT ground.

9. DC SHIFT ≤ 1 mm

Change VOLTS/CM to .5, apply enough DC voltage to EXT INPUT to deflect trace 3 to 4 cm (1.5V from ohmmeter) and note trace shift after initial deflection: ≤ 1 mm.

10. VERTICAL DISPLAY

a. Set up

TYPE O UNIT presets

VERTICAL DISPLAY	-DC
VOLTS/CM	.05
VARIABLE	CALIBRATED

b. Check -DC, +DC

Connect .1V~ from SAC to EXT INPUT and plug-in scope TRIGGER INPUT. Position display to place top of waveform on center graticule line. Change VERTICAL DISPLAY to +DC and note that waveform inverts.

c. Check -AC, +AC

Change VERTICAL DISPLAY to -AC and note that waveform is centered around graticule line. Change VERTICAL DISPLAY to +AC and note that waveform inverts and is still centered. Change TRIGGER SLOPE to -INT.

11. GAIN

a. Check GAIN ADJ range at least + and - 10%

Set VERTICAL DISPLAY to +DC and SAC to .2V. Turn GAIN ADJ full cw and check for ≥4.4cm deflection. Turn GAIN ADJ full ccw and check for ≤3.6cm deflection.

b. Set GAIN ADJ

Adjust GAIN ADJ for exactly 4cm deflection.

12. VOLTS/CM

a. Check VOLTS/CM accuracy Within 2%

VOLTS/CM	SAC	Deflection
.05	0.2V	4cm, ±0.8mm
.1	0.5V	5cm, ±1mm
.2	1V	5cm, ±1mm
.5	2V	4cm, ±0.8mm
1	5V	5cm, ±1mm
2	10V	5cm, ±1mm
5	20V	4cm, ±0.8mm
10	50V	5cm, ±1mm
20	100V	5cm, ±1mm

b. Check VARIABLE VOLTS/CM Range: ≥2.5:1

Turn VARIABLE ccw. Note deflection just before it reaches the detent; 2cm, max. Note any noise or open spots during rotation of VARIABLE. Return to CALIBRATED.

13. ZERO CHECK

Push ZERO CHECK and see that vertical signal disappears.

14. INPUT AND NEUTRALIZING CAPACITORS

a. Setup

TYPE 106 OUTPUT---50Ω cable---10X ATTENUATOR---50Ω TERMINATION--- 47pF INPUT TIME CONSTANT NORMALIZER-- EXT INPUT, TYPE 0 UNIT.

Set Type 0 UNIT VOLTS/CM to .05 and set TYPE 106 for 1 kHz signal. Install attenuator shield on TYPE 0 UNIT.

b. Adjust for best square wave response maximum aberrations: 1mm

Adjust input and neutralizing capacitors as directed below. Set TYPE 106 for 3.5cm deflection for each adjustment. Maximum aberrations: 1 mm peak.

VERTICAL DISPLAY	VARIABLE VOLTS/CM	Adjust	For
+DC	Min. gain	C6521	Best flat top
-DC	Min. gain	C6541	Best response on bottom
+DC	CALIBRATED	C6574	Best flat top
-DC	CALIBRATED	C6564	Best response on bottom

Set VERTICAL DISPLAY to +DC; readjust C6521 and C6574 as necessary for best flat top at both extremes of the VARIABLE VOLTS/CM control.

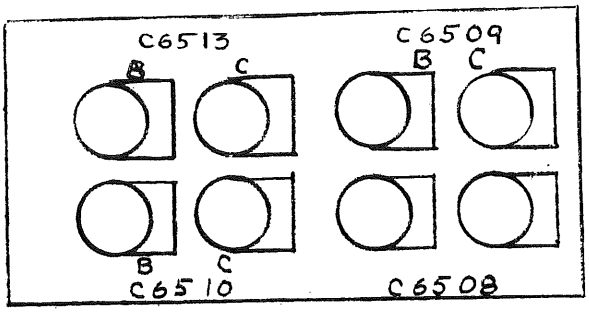
Set VERTICAL DISPLAY to -DC; readjust C6541 and C6564 as necessary for best square wave response on bottom at both extremes of the VARIABLE VOLTS/CM control.

15. VOLTS/CM COMPENSATION

maximum aberrations: 0.5mm peak

Set VARIABLE VOLTS/CM to CALIBRATED, VERTICAL DISPLAY to +DC and check or adjust VOLTS/CM compensations as directed below. Readjust the TYPE 106 signal amplitude for ≃ 3.5cm of signal each time the VOLTS/CM setting is changed. Remove the 10X ATTENUATOR when necessary.

	check or adjust	
VOLTS/CM	for optimum front corner	for optimum flat top
.05	check*	check*
.1	C6508C	C6508B
.2	C6509C	C6509B
.5	C6510C	C6510B
1	check*	check*
2	check*	check*
5	C6513C	C6513B
10	check*	check*
20	check*	check*



*The flat top of the waveform must be within 0.5mm of being level. If necessary, detune positions involved (within test limits) to bring the stacked positions within test limits.

Remove TYPE 106 signal.

16. HIGH FREQUENCY COMPENSATION

Max aberration: 2.5%

a. Set up

TYPE 106 FAST RISE + OUTPUT---50Ω cable---50Ω TERMINATION---EXT INPUT, TYPE 0 UNIT.

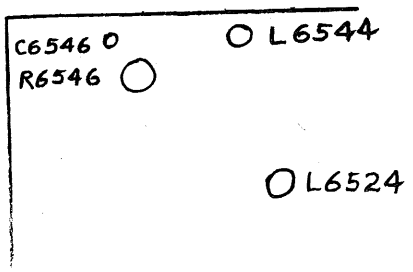
Remove plug-in extension and install TYPE 0 Unit in plug-in scope. Set VOLTS/CM to .05 and set TYPE 106 for 3cm of 500kHz. Set plug-in scope TIME/CM to 1μSEC, triggering to - INT.

b. Adjust R6546 and C6546

Adjust R6546 and C6546 for optimum response on top with VERTICAL DISPLAY set to +DC and optimum response on bottom with VERTICAL DISPLAY set to -DC.

c. Adjust L6524 and L6544

Increase the inductance of L6524 and L6544 equally in small increments, observing the appropriate front corners of the square wave while switching back and forth between +DC and -DC.



(17a.) Preset L6524 and L6544 so the cores are just below the top of the coil form. Preset R6546 and C6546 to midrange (silver area of C6546 over the arrow).

(17b.) R6546 affects the first 250 n seconds after the leading edge; C6546 affects the second 250 n seconds.

(17c.) The coils will affect about 1mm at the start of the square wave viewed at 0.2 μs/cm. Increase inductance for shortest risetime without excessive overshoot in +DC or -DC.

17. RISETIME

≤13.5nsec; ringing, ≤1%

Change plug-in scope TIME/CM to .1μSEC, 10X MAG on. Check risetime: ≤13.5ns (≤1.35cm). Check ringing: ≤1%.

Remove TYPE 106 signal.

18. FREQUENCY RESPONSE

a. Presets

Keep VERTICAL DISPLAY at +DC and VOLTS/CM at .05. Change plug-in scope TIME/CM to .2mSEC, 10X MAG OFF.

b. Connect TYPE 191

TYPE 191---50Ω cable---50Ω TERMINATION---EXT INPUT TYPE O Unit.

Set TYPE 191 for exactly 4cm of 50kHz signal.

c. Check response -3dB at 26MHz.

Change TYPE 191 to 26mHz and check deflection: ≥2.8cm. Remove TYPE 191.

OPERATIONAL AMPLIFIERS

Perform Steps 20 through 29 for A channel, then repeat for B channel. B channel circuit numbers are in parenthesis.

19. OUTPUT DC LEVEL ADJUSTMENTS

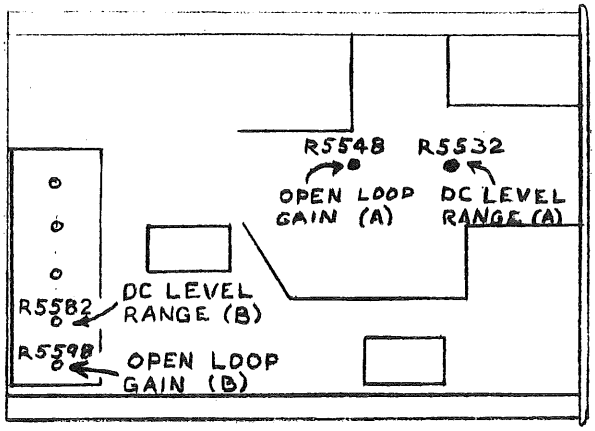
a. TYPE O unit presets

VERTICAL DISPLAY	+A (+B)
VOLTS/CM	.2
VARIABLE volts/cm	CALIBRATED
±GRID SEL	(-)
LF REJECT	OFF
Z_i and Z_f	1MEG

Recheck Preamp DC BAL (Step 7).

b. OUTPUT DC LEVEL ADJ R5522 (R5572) adjust to electrical center.

Rotate OUTPUT DC LEVEL ADJ through its full range and note amount of trace shift. Adjust DC LEVEL ADJ for center of trace shift (electrical center of DC LEVEL ADJ).



19. (cont'd)

c. DC Level Range R5532 (R5582)
Adjust to 0 volts

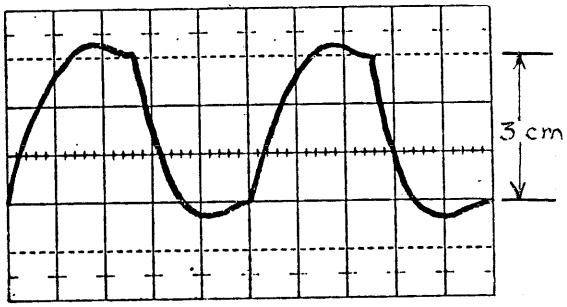
Push ZERO CHECK and use vertical POSITION to move trace to graticule center. Release ZERO CHECK, push OUTPUT DC LEVEL switch to ADJ and adjust DC Level Range R5532 (R5582) to center the trace on the graticule. Release switch.

20. OPEN LOOP GAIN

3000±5000
(adjust to 3000)

Change TIME/CM to .2mSEC, VOLTS/CM to 1, Z_i and Z_f to EXT. Apply 1mV of SAC signal to -GRID banana jack. Readjust R5532 (R5582) to obtain trace if necessary. Turn Open Loop Gain R5548 (R5598) cw for 3.5cm of display amplitude and check for no oscillation; then adjust for exactly 3.0cm of deflection.

Because open loop gain is quite high, set the unused channels Z_i and Z_f to settings other than EXT, otherwise stray signals may deflect the display offscreen.



21. VOLTAGE AND CURRENT AT OUTPUT CONNECTORS

a. Setup

Change setup to: SAC---50Ω cable--AC Coupler--EXT INPUT, TYPE 0 UNIT.

Change Z_i and Z_f to 1MEG, VERTICAL DISPLAY to +DC and VOLTS/CM to 20. Set SAC to 100V. Set VARIABLE VOLTS/CM for 4cm deflection.

21. (cont'd)

b. Check output voltage at least ±50V

Change AC Coupler and 100V SAC signal to A (B) INPUT and use a jumper to connect A (B) OUTPUT banana jack to EXT INPUT. Check for a display amplitude of 4cm or greater.

Remove the jumper.

c. Check output current $\geq$*5ma*

Connect a coax cable between A (B) OUTPUT coax connector and EXT INPUT. Connect a 10k ±1% resistor, mounted on a 329-0124-00 board, between the A (B) OUTPUT banana jack and GND. Check for display amplitude of 4cm or greater.

Remove resistor, jumper and SAC signal.

22. GRID CURRENT

a. TYPE O UNIT presets:

VERTICAL DISPLAY	+A (+B)
VOLTS/CM	.5
VARIABLE VOLTS/CM	CALIBRATED
±GRID SEL	+
LF REJECT	OFF
Z_i	EXT
Z_f	EXT

b. Connect Grid Current Tester

Change plug-in scope TIME/CM to 1 sec. Plug Grid Current Tester into the six amplifier banana jacks. Check that + GRID neon lights.

22. (cont'd)

c. Adjust grid current, -grid: ≤0.3nA

Push in on Tester's -grid button. Adjust Grid Current A R5535 (B R5585) for minimum vertical deflection (≤3cm for every 5cm horizontal deflection).

c. Calculating grid current of Operational Amplifier:

$$Q = CE,\ I_g = \frac{dQ}{dt} = \frac{dCE}{dt}$$

where Q = charge
C = capacity
E = voltage
I_g = grid current
t = time

is constant

$$\text{therefore } I_g = C\frac{de}{dt} \text{ so } I \simeq C\frac{\Delta e}{\Delta t}$$

Using Grid Current Tester, C = .001μF.

$$\text{Therefore } I_g = (.001 \times 10^{-6})\frac{\Delta E}{\Delta t} = \frac{\Delta E}{\Delta t}\ 10^{-9} \text{ amperes.}$$

d. Check grid current, +grid: ≤0.15nA

Push in on Tester's +grid button. Check for ≤1.5cm vertical deflection for every 5cm of horizontal deflection. Readjust Grid Current A R5535 (B R5585), if necessary. Recheck -grid current if readjustment is made and adjust R5535 (R5585) for best compromise.

Remove tester; set +GRID SEL switch to (-).

Repeat Step 19, Output DC Level Adj and Step 20, Open Loop Gain Adj.

23. NOISE and MICROPHONICS

a. TYPE 0 UNIT presets

VERTICAL DISPLAY	+A (B)
VOLTS/CM	.05
VARIABLE VOLTS/CM	CALIBRATED
±GRID SEL	-
LF REJECT	OFF
Z_i	.01 MEG
Z_f	1 MEG

If scope is set for 1 second/cm sweep rate and a deflection factor of 0.5 volts/cm, then 1cm of vertical movement in 5cm of horizontal sweep = 0.1nA; 3cm of vertical deflection = 0.3nA; 1.5cm = 0.15nA, etc.

b. Check Noise: ≤0.5cm

Set plug-in scope TIME/CM to .2mSEC. Ground A INPUT (B INPUT) and check noise: 0.5cm, max. Readjust OUTPUT DC LEVEL to bring trace on screen, if necessary.

b. If it is necessary to change the setting of the OUTPUT DC LEVEL, repeat Step 20 when Step 24 is completed.

23. (cont'd)

c. Check microphonics: ≤0.5cm

Change sweep rate to 0.5 mSEC/CM and check for ≤0.5cm microphonics by rapping lightly on the front panel of the TYPE 0. (Ignore the random noise observed in Step 24b).

24. Z_i AND Z_f MATCHING

a. Set up

TYPE 106 OUTPUT -- 50Ω cable -- 50Ω TERMINATION -- EXT INPUT, TYPE 0 UNIT.

Change VERTICAL DISPLAY to +DC and VOLTS/CM to .05. Set TYPE 106 for exactly 4cm of 1kHz.

b. Check Z_i and Z_f resistors: must match within 2%

Change TYPE 106 signal to A(B) INPUT and VERTICAL DISPLAY to A+ (B+) and LF REJECT to 1 CPS. Check Z_i and Z_f as follows:

Z_i	Z_f	deflection (±2%)
.01 MEG.	.01 MEG.	4cm
.1 MEG.	.1 MEG.	4cm
.2 MEG.	.2 MEG.	4cm
.5 MEG.	.5 MEG.	4cm
1 MEG.	1 MEG.	4cm
1 MEG.	.5 MEG.	2cm
.5 MEG.	.2 MEG.	1.6cm
.2 MEG.	.1 MEG.	2cm
.1 MEG.	.01 MEG.	0.4cm

The main purpose of Step 24 is to check for assembly errors. The tolerances of the components are tighter than the performance requirements and carry a high confidence level. If the display deflection varies by more than 2% from that given in the tables the most probable cause is a switch wiring error or a damaged component in the Z_i - Z_f network.

24. (cont'd)

c. Check Z_i and Z_f capacitors must match within 2%

Z_i	Z_f	Deflection
1 µf	1 µf	4cm
.1 µf	.1 µf	4cm
.01 µf	.01 µf	4cm
.001 µf	.001 µf	4cm
.001 µf	.01 µf	0.4cm
.01 µf	.1 µf	0.4cm
.1 µf	1 µf	0.4cm

25. Z_i - Z_f EQUALIZATION

a. Preliminary

Connect the plug-in extension between the oscilloscope and the TYPE 0 Unit. Set the following controls:

VERTICAL DISPLAY	A - (B-)
Z_i, Z_f	1 MEG
LF REJECT	OFF
Sweep Triggering	AUTO
Type 106 signal	4cm of 10kHz

Dress A (B) operational amplifier input, grid and output leads for best square-wave.

b. Select equalization capacitors ≤5% rolloff, hook, or overshoot

Compensate the stray capacitance of the resistors used for Z_i and Z_f. Do this by selecting and installing a capacitor in parallel with the resistors. Use either 0.68pF, 2pF, or no capacitor. Select them for less than 5% rolloff, hook or overshoot as follows:

Wire dress and placement and value of the equalization capacitors affect square-wave response (Step 25b) and bandwidth (Step 25c). It will probably be necessary to repeat all of Step 25 several times to obtain good square wave response and 750kHz unity gain bandwidth.

25b. (cont'd)

Z_i and Z_f R MEG.	Z_i capacitor increase pF to spike	Z_f capacitor increase pF to rolloff
1	C5509A(C4449A)	-- --
.5	C5509B(C5559B)	-- --
.2	C5509C(C5559C)	C551C(C5561C)
.1	C5509D(D5559D)	C551D(C5561D)
.01	(Check)	

c. Check Unity Gain Bandwidth <3dBdown at 750 kHz for all R(MEG) positions of Z_i and Z_f.

Connect the TYPE 191 to the plug-in's A (B) INPUT.

Set Z_i and Z_f to 1 MEG. Set TYPE 191 for 4cm of 50kHz signal. Change Type 191 to 750kHz and check for a display amplitude of $\geq$2.8cm.

Repeat the same procedure for each R MEG. position of Z_i and Z_f.

26. Z_i -Z_f 001µF AND 10PF VALUES

a. TYPE O UNIT presets

VERTICAL DISPLAY	A - (B-)
VOLTS/CM	.2
VARIABLE VOLTS/CM	CALIBRATED
± GRID SEL	-
LF REJECT	1 CPS
Z_i	EXT
Z_f	.001µf

Whenever Z_i is set to EXT, insert the special 0.001mF capacitor between the INPUT and -GRID banana jacks.

b. Connect TYPE 106

TYPE 106 OUTPUT -- 50Ω cable -- Special 10X Attenuator -- 50Ω TERMINATION -- EXT INPUT, TYPE O UNIT.

Set scope sweep rate to 20µs/cm. Set TYPE 106 for 4cm (peak to valley) of 10kHz.

All adjustments of the TYPE O and TYPE 106 should be measured peak-to-valley.

26. (cont'd)

c. Adjust .0001 μF and 1 pF positions of Z_i and Z_f switches as follows:

Z_i	Zf Spec. 10X Attenuator	Adjust for 4cm
EXT.*	.0001 Install	C5512F(C5562F)
.0001	.0001 Remove	C5512B(C5562B)
.0001	10pF Install	C5512G(C5562G)
10pF	10pF Remove	C5512C(C5562C)

*When Z_i is in EXT., the special 0.001 mF capacitor is inserted between the INPUT and -GRID banana jacks.

d. Check 1KC LF REJECT

Set Z_i and Z_f to .001 and change LF REJECT to 1KC. Check for approximately 4cm display amplitude.

27. GAIN -- BANDWIDTH PRODUCT ≥15mHz

a. TYPE 0 UNIT presets

VERTICAL DISPLAY	EXT DC+
VOLTS/CM	.5
VARIABLE VOLTS/CM	CALIBRATED
±GRID SEL	-
LF REJECT	1 CPS
Z_i	1μF
Z_f	10pF

b. Setup TYPE

Remove the plug-in extension, plug the TYPE 0 Unit directly into the plug-in compartment, and connect the TYPE 191 as follows:

TYPE 191 -- 50Ω cable -- 50Ω TERMINATION -- TYPE 0 UNIT EXT INPUT.

c. Check gain -- bandwidth product ≥15mHz

Set plug-in scope TIME/CM to .2mSEC and set TYPE 191 for 2cm of 50kHz. Change TYPE 191 to A (B) INPUT and change VERTICAL DISPLAY to A- (B-). Increase TYPE 191 frequency until you get 2cm deflection. This frequency should be 15mHz or greater.

28. COMPENSATED BANDWIDTH

a. Adjust Compensation Network

Change Z_i and Z_f to 1 MEG and LF REJECT to OFF. Install special Comp. Network and Z Checker into the Z_i and Z_f banana jacks. Apply 1 volt SAC signal to A (B) INPUT connector and adjust Comp Network compensation for best square-wave. Remove SAC signal.

b. Check bandwidth ≤3dB down at 10mHz

Connect TYPE 191 to A (B) INPUT and set for 4cm of 50kHz. Change TYPE 191 to 10mHz and check deflection: ≥2.8cm.

29. OUTPUT IMPEDANCE ≤35Ω

Change TYPE 191 frequency to 1mHz and set amplitude for 2 cm. Push button on Comp. Network and Z Checker to connect a 30Ω 1% resistor from output connector to ground and check deflection: ≥0.9cm. Remove TYPE 191 and Comp. Network and Z Checker.

30. B AMPLIFIER REPEAT

Repeat steps 20 through 29 for B channel. B channel circuit numbers are in parenthesis.

31. CROSSTALK ≥500:1

a. TYPE 0 UNIT presets

VERTICAL DISPLAY	B+
VOLTS/CM	.05
VARIABLE VOLTS/CM	CALIBRATED
A and B ±GRID SEL	-
A and B LF REJECT	OFF
A and B Z	1 MEG.
A and B Z_f^i	1 MEG.

b. Check crosstalk A to B amplifier ≥500:1 (4cm max)

Apply 100 volt SAC signal to A INPUT using the AC Coupler and check deflection: 4cm, max.

c. Check crosstalk B to A amplifier ≥500:1 (4cm max)

Change VERTICAL DISPLAY to A+ and SAC signal to B INPUT. Check deflection: 4cm, max.

Repeat Steps 20 (Output DC Level and Preamp DC Bal) and 21 (Open Loop Gain Adj.).

THE END