Errata

Title & Document Type: **1104A, 1106B and 1108A Trigger Countdown Operating Note**

Manual Part Number: **5955-2712**

Revision Date: **February 1977**

About this Manual

We've added this manual to the Agilent website in an effort to help you support your product. This manual provides the best information we could find. It may be incomplete or contain dated information, and the scan quality may not be ideal. If we find a better copy in the future, we will add it to the Agilent website.

HP References in this Manual

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, life sciences, and chemical analysis businesses are now part of Agilent Technologies. The HP XXXX referred to in this document is now the Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A. We have made no changes to this manual copy.

Support for Your Product

Agilent no longer sells or supports this product. You will find any other available product information on the Agilent Test & Measurement website:

www.agilent.com

Search for the model number of this product, and the resulting product page will guide you to any available information. Our service centers may be able to perform calibration if no repair parts are needed, but no other support from Agilent is available.

Agilent Technologies

HEWLETT PACKARD

TRIGGER COUNTDOWN

1104A Serials Prefixed: 994-
1106B and 1106B Opt 001 Serials Prefixed: 1217A
1108A Serials Prefixed: 723- or 732-

Models
1104A
1106B
1108A

OPERATING NOTE/FEBRUARY 1977

1. DESCRIPTION.

2. Model 1104A is used with either the Model 1106B or 1108A Tunnel Diode Mount (Figure 1) to form a Trigger Countdown to synchronize the time base of sampling oscilloscopes with displayed signals in the microwave region. Specifications are listed in Tables 1 and 2.

3. This note applies directly to the Model 1104A, 1106B, 1106B, Opt 001, and 1108A units with serial prefixes as listed in the title block. The serial prefix is the first group of digits in the serial number. Always refer to the complete serial number in any correspondence.

Table 1. Model 1104A/1106B Specifications

INPUT (1104A/1106B)
- FREQ RANGE: 1 GHz to 18 GHz.
- SENSITIVITY: Less than 20 ps jitter with 100 mV input up to 12.4 GHz; 200 mV up 18 GHz.
- MAX SAFE INPUT: 1V peak.
- INPUT IMPEDANCE: 50 ohms. Less than 10% reflection using a 40 ps TDR system. Precision type N input connector. Option 001 of Model 1106B changes input connector to APC-7.
- PULSE AT INPUT CONNECTOR: Approx. 250 mV step.

OUTPUT
- CENTER FREQ: Approx. 100 MHz.
- AMPLITUDE: Approx. 150 mV.

Table 2. Model 1104A/1108A Specifications

INPUT (1104A/1108A)
- FREQ RANGE: 1 GHz to 10 GHz.
- SENSITIVITY: Signals 50 mV pk-pk or larger required for less than 20 ps of jitter.
- MAX SAFE INPUT: 1V peak.
- INPUT CHARACTERISTICS: (1108A)
  - MECHANICAL: GR-874A connector.
  - ELECTRICAL: DC resistance, 50 ohms ±2%. Reflection from input less than 10% using 40 ps TDR system.

PULSE AT INPUT CONNECTOR: Approx. 250 mV.

OUTPUT
- CENTER FREQ: Approx. 100 MHz.
- AMPLITUDE: 150 mV nominal.

GENERAL
- POWER: 115 or 230 Vac ±10%, 50 to 1000 Hz, 1W.
- WEIGHT: 1104A; net, 2 lbs (0, 9 kg), shipping, 4 lbs (1, 8 kg). 1106B; net, 1 lb (0, 5 kg), shipping, 3 lbs (1, 4 kg). 1108A; net, 1 lb (0, 5 kg), shipping, 3 lb (1, 4 kg).

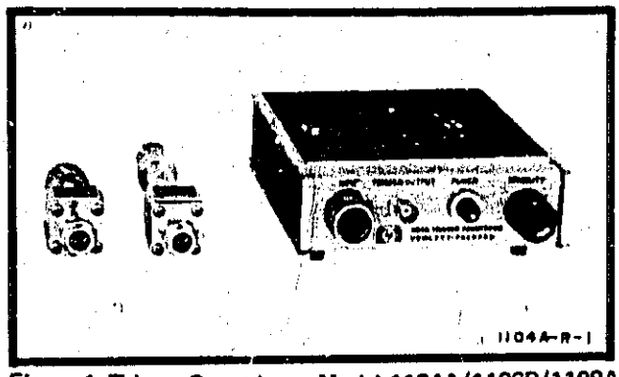

Figure 1. Trigger Countdown, Model 1104A/1106B/1108A

4. CLAIMS.

5. Upon receipt, inspect instrument for damage and do the performance checks. HP guarantees the performance of the instrument as stated in the specifications listed in Tables 1 and 2. If the condition of the instrument is unsatisfactory, notify the carrier and the nearest HP Sales/Service Office immediately. HP will arrange for repair or replacement without waiting for settlement of the claim with the carrier.

6. OPERATION.

7. Excessive current or mechanical shock will damage the T. D. Mount. If necessary to reduce input to a safe level, use a 50-ohm coaxial attenuator.

CAUTION

a. Before connecting the T. D. Mount, ensure that any voltage present will not cause peak current to exceed 20 mA (1V across 50 ohms). Discharge any static voltage from coaxial lines. Excessive peak current will instantly destroy the tunnel diode.

b. Avoid mechanical shock to the T. D. Mount. Make no attempt to open encasement. It is a delicate precision instrument.

c. Set the 115/230-volt switch on the Model 1104A for the line voltage to be used. The instrument may be damaged if this switch is set in the wrong position. Use a thin-bladed screwdriver, to change the setting.

Operating Note Part No. 5955-2712
Microfiche Part No. 5955-2713

For More Information, Call Your Local HP Sales/Service Office or, in U.S., East (201) 265-5000, Midwest (312) 677-0400, South (404) 436-6181, West (213) 877-1282. Or, Write: Hewlett-Packard, 1501 Page Mill Road, Palo Alto, California 94304. In Europe, Post Office Box 85, CH-1217 Meyrin 2, Geneva, Switzerland. In Japan, YHP, 1-59-1, Yoyogi, Shibuya-ku, Tokyo, 151.

PRINTED IN U.S.A.

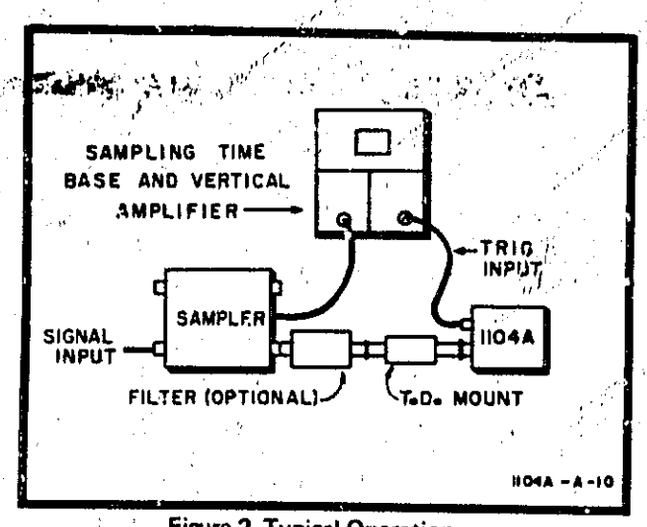

Figure 2. Typical Operation

8. A typical operating setup is illustrated in Figure 2. (Refer to paragraph 11 concerning optional filter.) With the sampling time base and vertical amplifier scan set to sweep and norm/auto set to auto, adjust Model 1104A STABILITY for most stable presentation. Refer to paragraph 9. Readjust time base trigger level for minimum signal jitter. Avoid the use of cables between the Model 1104A, the T. D. Mount and the sampler. The T. D. Mount input connector will mate directly with the sampler output connector. If a filter is desired, use proper adapter if required. Keep all connections secure since loose fitting connections can cause undesireable reflections, degrading the signal. Connect the Model 1104A TRIGGER OUTPUT to the time base trigger input.

9. The only front-panel adjustment on the Model 1104A, STABILITY, is a means of adjusting the frequency of the tunnel-diode waveform generator. A stable presentation will occur at several points throughout the range of this 10-turn control. These points occur whenever the tunnel-diode frequency is at a submultiple of the input signal. Try several different points to find the one offering the least jitter.

10. Jitter is defined as being 20 ps when 80% of the dots comprising the signal width appear within 20 ps on the fastest rising portion of a display. See Figure 3. Tables 1 and 2 give the sensitivity specification.

11. If the triggering signal is also the vertical signal (as in Figure 2) a small part of the tunnel-diode waveform will be coupled back to the vertical amplifier. This signal appears as a positive pulse approximately 250 millivolts in amplitude. See Figure 4. To reduce these pulses to spikes of a smaller amplitude, use a filter such as HP Model 1109B.

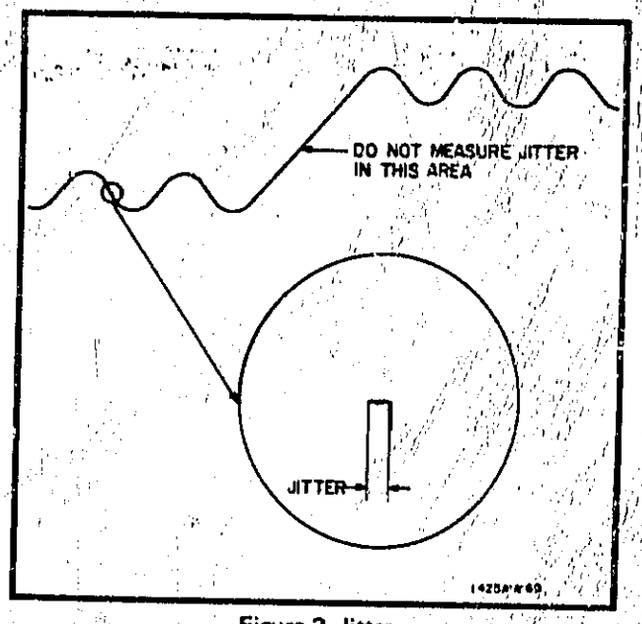

Figure 3. Jitter

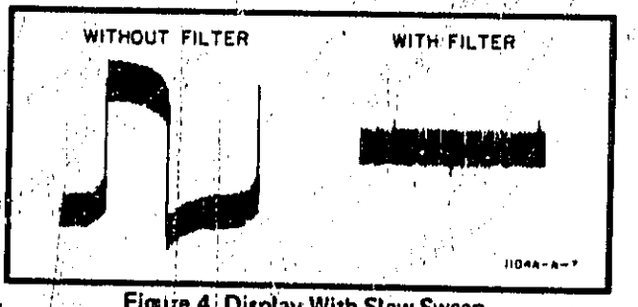

Figure 4. Display With Slow Sweep

12. PERFORMANCE CHECKS AND ADJUSTMENTS.

13. Test equipment recommended for the performance checks and adjustments is listed in Table 3. Similar instruments having the listed characteristics may be substituted. Ensure that test equipment is in calibration before use.

Table 3. Required Test Equipment

Recommended Instrument		Required Characteristics
Type	HP Model	
Sampling System Consisting of:		
Mainframe	180C/D	
Sampling Time Base and Vertical Amplifier	1811A	10 ps/div sweep pretrigger output
Sampler	1430C	20 ps risetime
Pulse Generator	1105A/ 1106B	20 ps risetime
DC VTVM	412A	100 mV to 15V
Signal Generator	612A	1 GHz, 100 mV
	620B	10 GHz, 100 mV
	628A	18 GHz, 200 mV

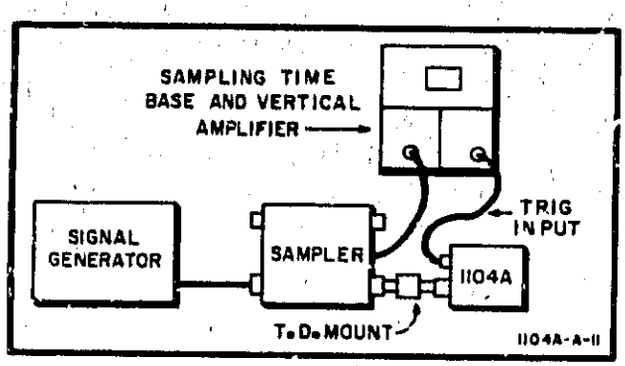

Figure 5. Sensitivity Check

14. SENSITIVITY CHECK.

15. This checks the sensitivity of the Trigger Countdown. Connect the equipment as shown in Figure 5.

16. a. Set appropriate signal generator for 100 mV at 1 GHz. Adjust STABILITY and time base trigger level for most stable display. Jitter should be less than 20 ps. Refer to Paragraph 10 .

b. Adjust appropriate signal generator for 200 mV at 18 GHz (1106B) or 100 mV at 10 GHz (1108A). Adjust STABILITY and time base trigger level for most stable display. Jitter should be less than 20 ps.

17. REFLECTION CHECK.

18. Connect the equipment as shown in Figure 6. The reflection from the T. D. Mount under test should be less than 10% using a 40 ps TDR system. The HP Sampling System listed in Table 3 forms a 40 ps TDR system as specified. Disconnect all equipment.

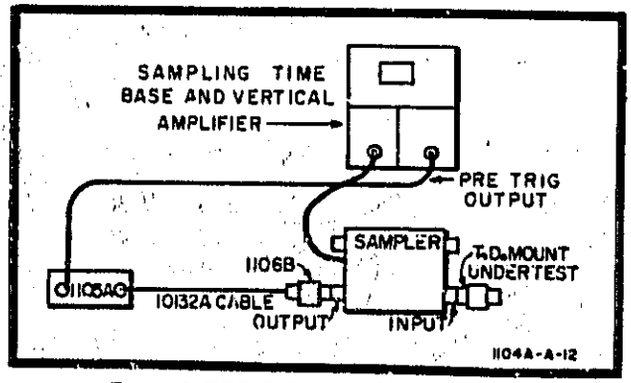

Figure 6. TDR Reflection Measurement

19. BIAS ADJUSTMENT.

20. Connect the DC VTVM to the input connector of the Model 1104A. Set the STABILITY control fully clockwise. Adjust the bias potentiometer R4 for a DC VTVM indication of 0.650 volt. Reset the STABILITY control fully counterclockwise. The DC VTVM should indicate less than 0.3 volt approximately.

21. FREQUENCY ADJUST.

22. This adjustment sets the free-run frequency of the Trigger Countdown to 100 MHz. Connect the equipment as shown in Figure 7. Adjust STABILITY throughout the range of oscillation, and set the control to the center of this range. Then adjust spacing of the turns of L5 so the frequency of oscillation is approximately 100 MHz or has a period of 10 ns. L5 consists of two inches of No. 22 wire which is formed into approximately two turns. After repair and replacement of L5/R8/C10 it may be necessary to relocate the connecting point of R8 and C11 on the coil L5 to adjust frequency to 100 MHz. This tap is typically located up one turn from the board connection.

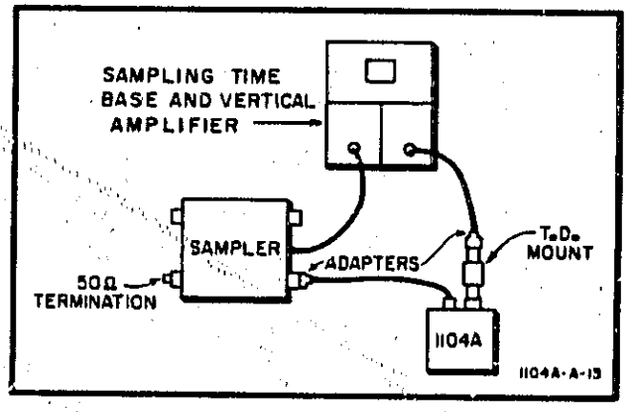

Figure 7. Frequency Adjustment

23. THEORY OF OPERATION.

24. The Model 1104A consists principally of a constant current bias supply for the tunnel diode. The output current is set by R3 and R4 (Figure 11) to a value which provides relaxation oscillation by the action of the tunnel diode and L5. The tunnel diode oscillates at a free-running frequency of approximately 100 MHz, depending on the current supplied by the bias supply and the inductance of L5. A typical tunnel diode characteristic curve is shown in Figure 8. A negative resistance region (in which current would decrease as voltage increases) exists between Ip and Iv. The bias output of the Model 1104A is adjustable between these two points; for instance, Ib.

25. When the power is applied, the current into the tunnel diode begins to rise toward Ib. When it reaches Ip, it encounters the negative resistance region where increasing voltage demands decreasing current. Since the Model 1104A supplies a constant current, and the current through L5 cannot increase instantly, T. D. voltage (E) jumps to Ea. Note as the current through L5 begins to increase, the current through the tunnel diode must decrease toward Ib (since total current is constant) and E begins to diminish toward Eb. When I reaches Iv, it again encounters the negative resistance region where decreasing voltage demands increasing current. Since total current is fixed and the current through L5 cannot decrease

instantly, E jumps to Ec and the cycle repeats. Figure 9 shows a typical waveform across the tunnel diode. The tunnel diode waveform is differentiated by C12 and coupled to the TRIGGER OUTPUT connector. The RLC network maintains 50-ohm impedance for all frequencies present in the circuit.

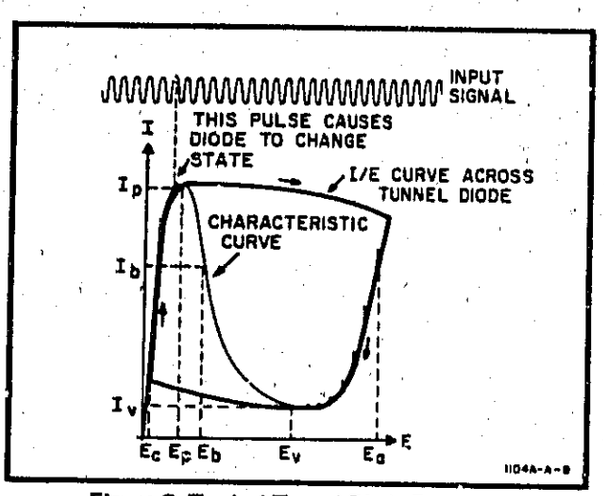

Figure 8. Typical Tunnel Diode Excursion

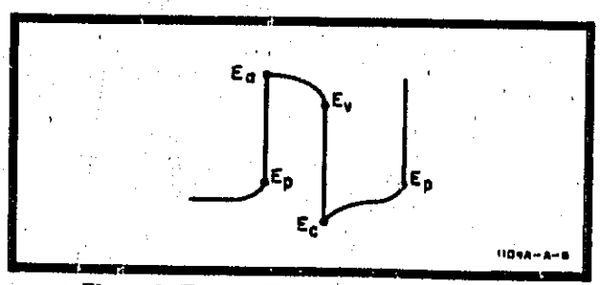

Figure 9. Typical Tunnel Diode Waveform

26. Application of a high-frequency input signal to the tunnel diode mount input connector causes the switching of the tunnel diode to synchronize with the input signal. Synchronism will occur when a specific cycle of the input signal causes the tunnel diode current to exceed the switching level. See Figure 8.

27. The major part of the circuitry of the Model 1104A is used to supply a variable regulated current of approximately 90 mA for biasing the tunnel diode. Transformer T1 and diodes CR1 and CR2 produce a rectified voltage which is filtered by C5. VR1 fixes the base voltage of the current regulator Q1. Emitter current of Q1 is controlled by the setting of R3 and R4 which adjusts the output current. C6 couples any ripple or transients to the base of Q1 to prevent variation in the output current. R7, CR3 and L4 serve to couple the current from the supply to the tunnel diode circuit while blocking transmission of the waveform back into the power supply. C9 and C10 provide final filtering of the rectified voltage. L3, C7 and C8 fix the base voltage of Q2 while filtering out any waveform transients from the tunnel diode. Once the output is set by R3, it remains fixed, and the current source supplies a constant current to VR1 to fix VR1 voltage drop.

28. Should the line voltage increase, the increasing current flow through R2/R3/R4 would be opposed by the reduced forward bias across the base to emitter junction of Q1. Thus, once set, the output current remains constant. Bias adjustment R4 centers the range of the STABILITY control for optimum operation of the tunnel diode. STABILITY control R3 sets the output current, and consequently, the tunnel diode oscillator frequency.

29. TROUBLESHOOTING.

30. The schematic (Figure 11) and the Theory of Operation are useful aids to troubleshooting. Figure 10 identifies each circuit component by reference designation. Tunnel Diode Mount components are not identified since field repairs are not recommended.

31. EXCESSIVE JITTER.

32. Excessive jitter may be caused by standing waves in the line. Ensure that all connections are tight. Jitter may also be caused by the input signal source being used since any FM in the input signal will be reflected as a degradation in the output of the Trigger Countdown. Excessive ripple in the Model 1104A power supply will also cause jitter. Check possible ripple in the power supply by connecting the INPUT connector of the Model 1104A directly to the vertical input of a sensitive oscilloscope capable of measuring 0.1 mV. During such check disconnect the T. D. Mount, connect a 2.7-ohm resistor across the INPUT connector and set STABILITY clockwise. Typical ripple is indicated on the schematic. Ensure good ground connections to reduce ground loop noise during measurements.

33. NO INPUT.

34. If there is no trigger output from the Trigger Countdown, check voltage using a VTVM with the T. D. Mount disconnected and a 2.7-ohm resistor connected across the Model 1104A INPUT connector. The schematic indicates typical dc voltages with the STABILITY control at full counterclockwise. Voltages in parenthesis are with the STABILITY control at full clockwise. Variations of 15% are normal. To check the T. D., use a Tektronix Type 575 Transistor Curve Tracer. Set Vertical to 10 mA/cm, Horizontal to .2 V/cm, Peak Volts Range to 0-20, Peak Volts to zero, Dissipation Limiting Resistor to zero and Polarity to +. Connect lead C to center conductor and lead E to T. D. Mount case. Slowly increase Peak Volts. The characteristic curve illustrated in Figure 8 should develop. The points on the curve should meet the following criteria: Ip $<$ 60 mA, Ep $<$ 400 mA, Ip-Iv $>$ 37 mA, Ea-Ep $>$ 400 mV.

CAUTION

Do not exceed 65 mA indicated on CRT.

35. OLDER INSTRUMENTS.

36. This operating note applies to the standard models having serial prefixes listed in the title block, page 1. Table 4 indicates changes required to adapt this operating note to an older instrument (lower serial prefix). Check Table 4 for the proper instrument serial prefix and make the changes indicated.

Table 4. Operating Note Changes

Serial Prefix	Make Changes
704—(1104A)	1, 2
806—(1104A)	2

CHANGE 1

Page 3, Paragraph 20,
Change to read: With the T. D. Mount connected, set Model 1104A STABILITY counterclockwise. Adjust bias potentiometer R4 for 0.16V at Modal 1104A INPUT connector. Set STABILITY clockwise; voltage should increase to greater than +0.4V.
Page 6, Table 5,
Delete R11.
Page 8, Figure 11,
Delete R11.

CHANGE 2

Page 6, Table 5,
J1: Change to HP Part No. 1251-0148; TQ 1; Connector: ac power.
S2: Change to HP Part No. 3101-0033; TQ 1; S: slide dpdt.
W1: Change to HP Part No. 8120-0078; TQ 1; W: power.
Change HP Part No. 01104-00205 to HP Part No. 01104-00203; TQ 1; Panel: rear.

37. REPLACEABLE PARTS.

38. Table 5 lists replaceable parts. The components of the T. D. Mount are not separately replaceable.

39. To order a replaceable part from HP, address the order to the nearest HP Sales/Service Office listed at the rear of this note. Include the model number, the serial number of the instrument and the HP Part No. of the replaceable part. If a part is not listed, in lieu of the part number provide a description of the part including function and location.

40. Upon request, information will be supplied to allow ordering of applicable parts from a manufacturer other than Hewlett-Packard. Contact the HP Sales/Service Office for details.

TUNNEL DIODE MOUNT

The tunnel-diode mount contains inductive, capacitive and resistive components integrated into a metal body. Due to extremely close assembly tolerances, repairs must be made at the factory. Return defective T. D. Mount to HP Sales/Service Office for repair.

Table 5. Replaceable Parts

Ref Desig	HP Part No.	TQ	Description
A1	01104-66501	1	A: board assy power supply
A2	01104-66502	1	A: board assy trigger
C1	0150-0014	2	C: fxd cer .005 µF 500 wVdc
C2	0150-0014		C: fxd cer .005 µF 500 wVdc
C3	0150-0121	4	C: fxd cer .1 µF -20 +80% 50 wVdc
C4	0150-0121		C: fxd cer .1 µF -20 +80% 50 wVdc
C5	0180-1988	1	C: fxd elect 2600 µF -10 +75% 15 wVdc

Table 5. Replaceable Parts (cont'd)

Ref Desig	HP Part No.	TQ	Description
C6	0180-0159	1	C: fxd Ta elect 220 μF 20% 10 wVdc
C7	0150-0121		C: fxd cer .1 μF -20 +80% 50 wVdc
C8	0180-0060	1	C: fxd elect 200 μF -10 +75% 3 wVdc
C9	0150-0121		C: fxd cer .1 μF -20 +80% 50 wVdc
C10	0180-0063	1	C: fxd elect 500 μF -10 +75% wVdc
C11	0150-0093	1	C: fxd cer .01 μF -20 +80% 100 wVdc
C12	0160-3448	1	C: fxd cer .001 μF 1000 wVdc
CR1	1901-0049	2	CR: Si
CR2	1901-0049		CR: Si
CR3	1901-0033	1	CR: Si
DS1	2140-0244	1	DS: neon lamp glow
J1	1251-2357	1	Connector: ac power
J2	215A-76A	1	Connector: switch
J3	1250-0782	1	Connector: RF
L1	9140-0096		Coil: molded choke 1 μH 10%
L2	9140-0096	1	Coil: molded choke 1 μH 10%
L3	9140-0037		Coil: rf 5 mH
L4	9140-0031	1	Coil: rf 75 μH
L5		1	Coil: var refer to Paragraph 22.
L6	9140-0142	1	Coil: molded choke 2.2 μH 10%
Q1	1853-0001	1	Q: Si pnp
Q2	1854-0071	1	Q: Si npn
R1	0757-0764	1	R: fxd metflm 33.2k ohms 1% 1/4W
R2	0757-0394	1	R: fxd metflm 51.1k ohms 1% 1/8W
R3	2100-2402	1	R: var 50 ohms 3% 2W
R4	2100-1423	1	R: var 50 ohms 5% 1W
R5	0698-3263	1	R: fxd metflm 500k ohms 1% 1/8W
R6	0757-0402	1	R: fxd metflm 110 ohms 1% 1/8W
R7	0698-3106	2	R: fxd carflm 5 ohms 1% 1/8W
R8	0698-3106		R: fxd carflm 5 ohms 1% 1/8W
R9	0757-0393	1	R: fxd metflm 50 ohms .1% 1/8W
R10	0757-0393	1	R: fxd metflm 47.5 ohms 1% 1/8W
R11	0757-0346	1	R: fxd metflm 10 ohms 1% 1/8W
S1	3101-0100	1	S: pushbutton with indicator
S2	3101-1234	1	S: slide dpdt
T1	9100-0312	1	T: power
VR1	1902-3066	1	VR: diode breakdown 4.02V 2%
W1	8120-1351		W: power (Option 900)
W1	8120-1369		W: power (Option 901)
W1	8120-1689		W: power (Option 902)
W1	8120-1378	1	W: power (Option 903)
W1	8120-0698		W: power (Option 904)
W1	8120-1625		W: power (Option 905)
W1	8120-2104		W: power (Option 906)
	0370-0025	1	Knob: black 5/8 inch diameter
	01104-00101	1	Deck
	01104-00201	1	Panel: front
	01104-00202	1	Panel: sub
	01104-00205	1	Panel: rear
	1205-0038	1	Heat dissipator: semiconductor
	1401-0047	1	Cap: plastic, for APC-7 connector
	1401-0049	1	Cap: plastic, for type N connector
	5000-0101	2	Panel: side
	5060-0727	1	Foot assy
	5060-0072	1	Cover assy: top
	5060-0073	1	Cover assy: bottom
	5060-0213	2	Frame: casting

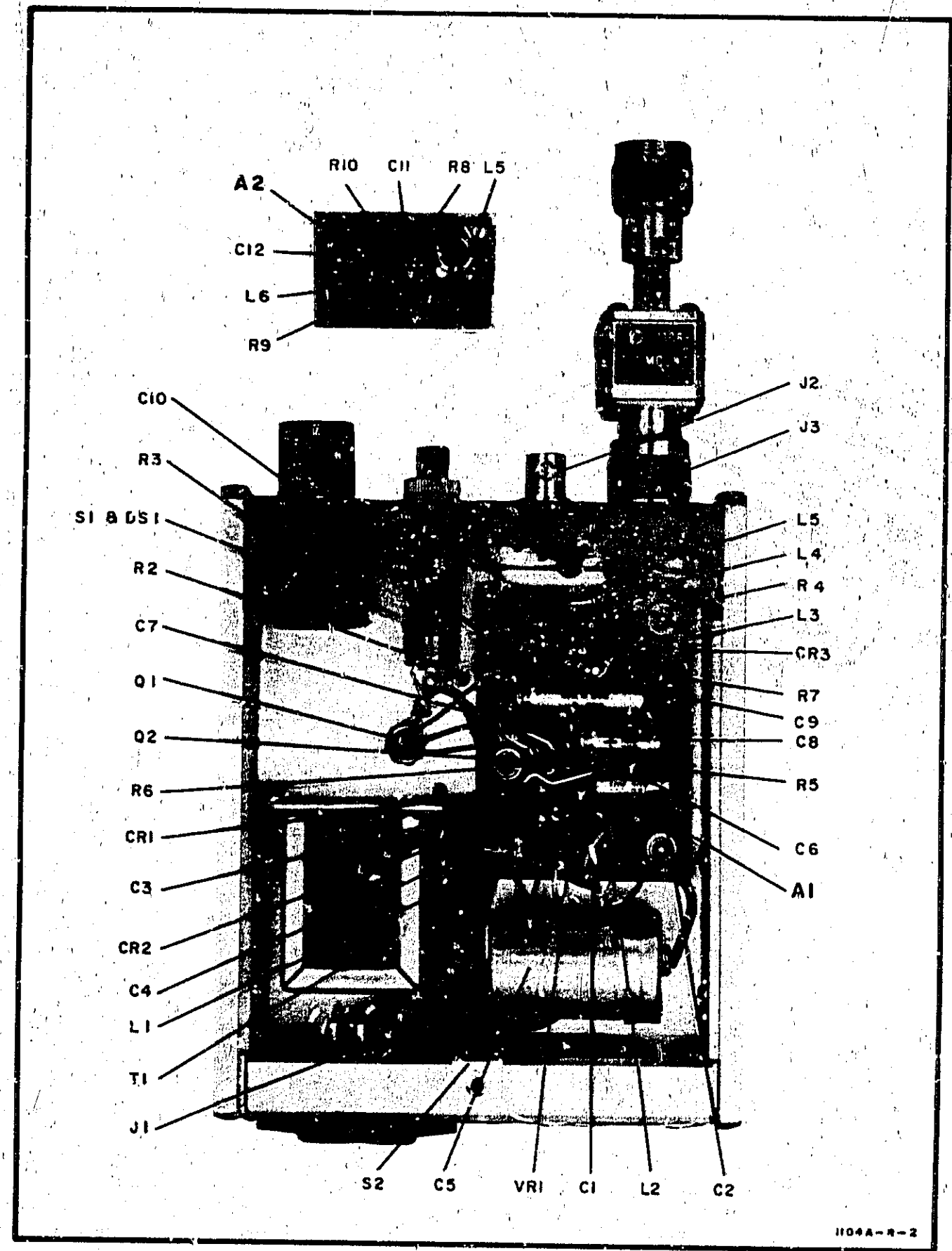

Figure 10. Component Identification, Model 1104A

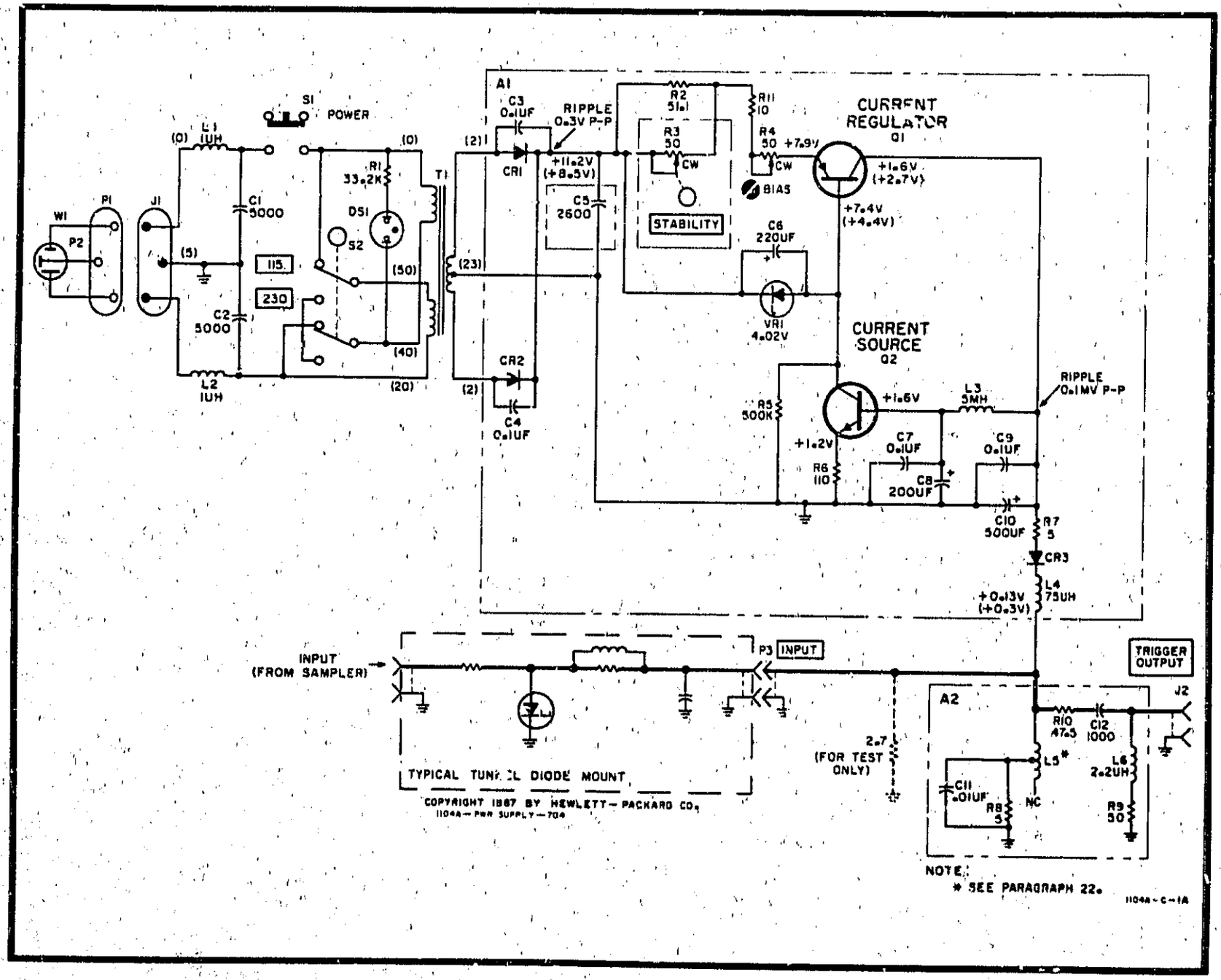

Figure 11. Schematic

END