INSTRUCTION MANUAL

Type 1157-B
Scaler
(500 MHz)

A

GENERAL RADIO

Contents

WARRANTY

We warrant that each new instrument manufactured and sold by us is free from defects in material and workmanship and that, properly used, it will perform in full accordance with applicable specifications for a period of two years after original shipment. Any instrument or component that is found within the two-year period not to meet these standards after examination by our factory, District Office, or authorized repair agency personnel will be repaired or, at our option, replaced without charge, except for tubes or batteries that have given normal service.

Type 1157-B
Scaler
(500 MHz)
A

West Concord, Massachusetts, U.S.A. 01781
Form 1157-0110-A
August, 1969
ID-B935

Condensed Operating Instructions

CAUTION

Be sure the line-voltage switch on the rear of the instrument is properly set for the available power.

a. Turn SENSITIVITY control to the left stop.

b. Connect power plug to a source of power at the correct voltage, using the power cord supplied.

c. Bring the signal of frequency to be measured to the INPUT connector. Max level: 7 V rms.

d. Connect the 10/100 OUT jack to a suitable counter, such as the GR 1192.

e. Set the MULTIPLY . . . BY switch to the desired ratio. The pilot light should glow.

f. Turn the SENSITIVITY control cw, as required, to obtain indication in the green sector of the INPUT LEVEL meter. The scaler is now in operation.

Specifications

INPUT

Frequency: 1 to 500 MHz.

Minimum Amplitude: 0.3 V pk-pk (0.1 V rms) on most sensitive setting of attenuator.

Maximum Signal: 7 V rms (1 W).

Impedance: AC-coupled, 50 Ω.

Attenuator (sensitivity control): Panel switch of x1, x2, x5 or x10 attenuation.

Meter: Green sector indicates adequate signal level for easy adjustment of sensitivity control.

Connector: GR874® locking connector; can be moved to rear panel.

OUTPUTS

Switched Output: DC-coupled positive pulse, >1 V behind 50 Ω. Repetition rate is input frequency divided by 10 or 100 depending on setting of panel switch. Duty ratio is 60% for 1/10 output, 40% for 1/100 output.

Sync Output: Positive pulse, >1 V behind 50 Ω. Repetition rate is input frequency divided by 100. Duty ratio, 60%.

Connectors: BNC; can be moved to rear panel.

GENERAL

Power Required: 100 to 125 or 200 to 250 V, 14 W.

Accessories Supplied: Power cord; patch cord to 1192 counter.

Mounting: Convertible-Bench cabinet.

Dimensions (width x height x depth): Bench, 8½ x 3⅞ x 14 in. (220 x 99 x 355 mm); rack, 19 x 3½ x 12¾ in. (485 x 89 x 325 mm).

Net Weight: Bench 7 lb (3.2 kg); rack 9.6 lb (4.1 kg).

Shipping Weight: Bench 9.3 lb (4.2 kg); rack 13 lb (5.9 kg).

Catalog Number	**1157-B Scaler** (500 MHz)
1157-9700	Bench Model
1157-9701	Rack Model

See *General Radio Experimenter*, July-August 1969.

Scaler/Counter Combination – GR 1192-Z.

Refer to 1192 Instruction Manual for information about the counter.

Introduction—Section 1

1.1 PURPOSE.

The General Radio 1157-B Scaler extends the upper-frequency limit of any frequency-measuring instrument by a factor of 100, to a maximum of 500 MHz, by direct-counting techniques.

The scaler can be combined with the GR 1191 or 1192 counters or with the GR 1159 Recipromatic Counter, to measure frequencies up to 500 MHz.

The 1157-B can be used with other frequency counters, oscilloscope synchronizing circuits, analog frequency meters, or in other applications requiring 100-to-1 or 10-to-1 frequency division.

1.2 DESCRIPTION.

The scaler is a completely self-contained direct-counting frequency divider that can divide input frequencies from 1 to 500 MHz by factors of 10 and 100.

The input circuitry consists of a GR874® locking input connector, a four-position attenuator, an input level meter, and a cascode input amplifier that provides better than 100-mV rms sensitivity and also isolates the input from noise generated by the switching circuits. The input level meter aids in proper setting of attenuator or signal-source level. The input amplifier is followed by a scale-of-two divider circuit, triggered by its own pulse generator. This circuit uses tunnel diodes to ensure proper high-frequency operation. Following the scale-of-two divider are a scale-of-five and a scale-of-ten divider, in cascade.

The main output — 10:1/100:1 OUT — comes from the appropriate divider, as determined by the MULTIPLY COUNTER READING BY switch. The final divider also provides the 100:1 SYNC OUT. Both output jacks are BNC.

Input and output connectors may be mounted separately on either front or rear panel. The location has no effect on operating characteristics of the instrument.

1.3 CONTROLS, INDICATORS, AND CONNECTORS.

Table 1-1 lists and describes the 1157-B Scaler controls, indicators, and connectors, illustrated by Figure 1-1.

1.4 ACCESSORIES SUPPLIED.

The scaler is supplied with a 6-in. patch cord, P/N 0776-2000 (to connect the 1192 Counter) and a 7-ft., 3-wire power cord, P/N 4200-9622. The rack-mounting version of the scaler includes also a rack adaptor set, P/N 0480-9722.

1.5 ACCESSORIES AVAILABLE.

General Radio instruments and accessories that are most frequently used with the scaler are listed in Tables 1-2, 1-3, and 2-2. Refer to the GR catalog for a complete listing of other appropriate accessories, such as attenuators, elbows, meters, etc. The rack adaptor set, GR cat no. 0480-9722 can be used for mounting the bench version, 1157-B, in a standard rack.

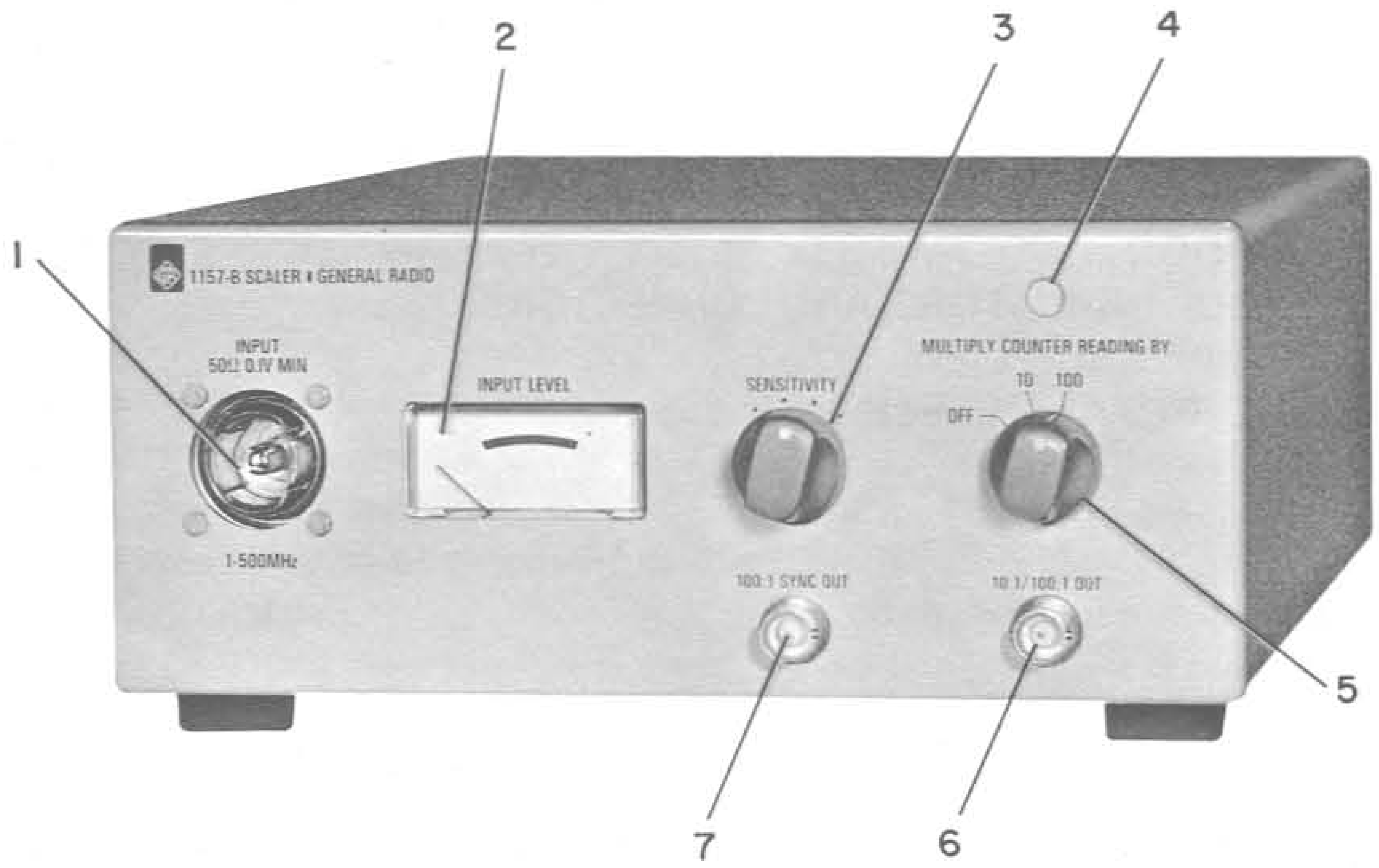


Figure 1-1. 1157-B Scaler, showing controls, indicators, and connectors. Front view, above; rear view, below.

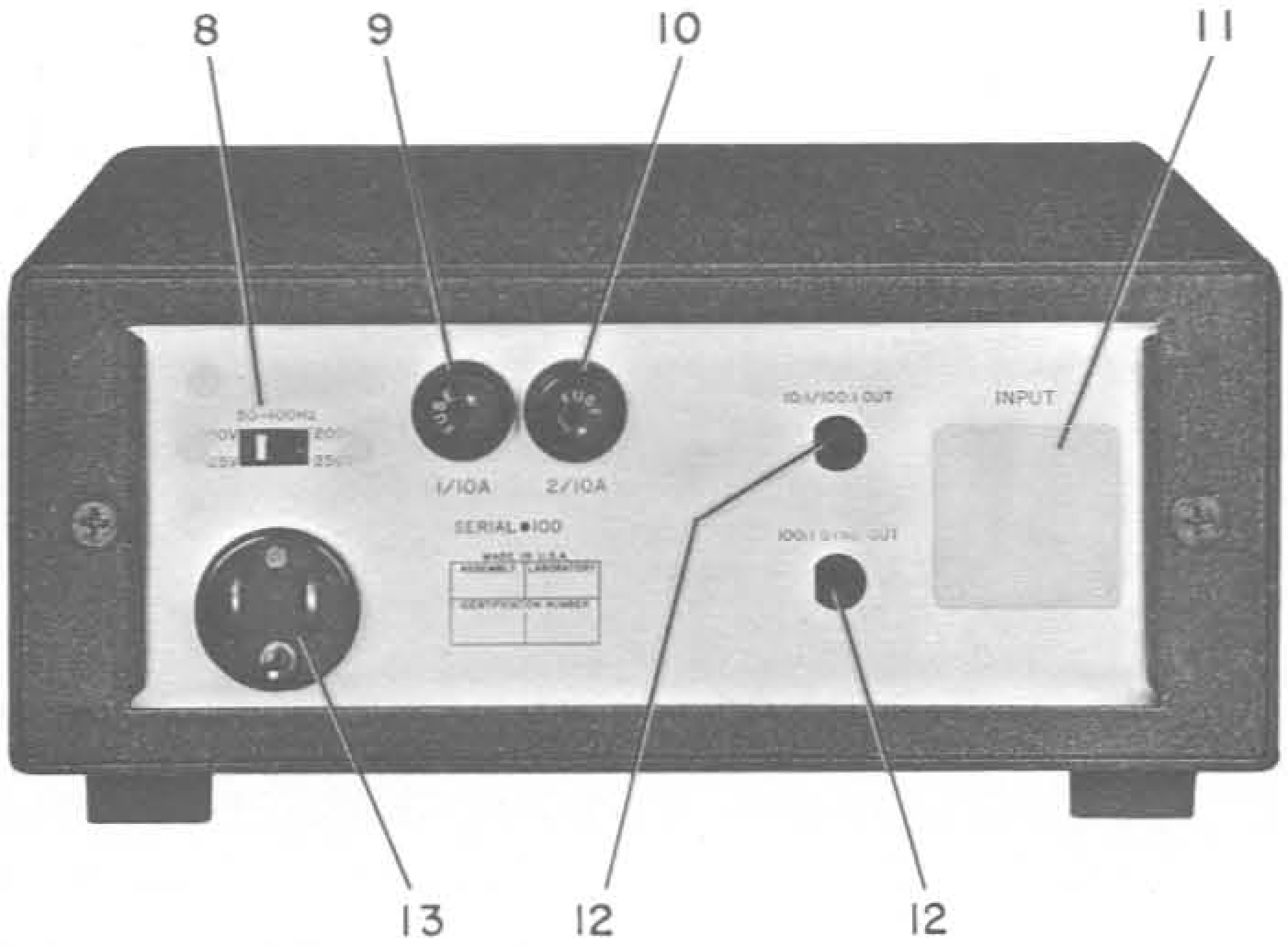


Table 1-1
CONTROLS, INDICATORS, AND CONNECTORS

Fig. 1-1 Item No.	Name	Description	Function
1	INPUT	GR874® locking coaxial connector.	Input port; can be moved to rear panel. Impedance: 50 Ω; frequency: 1-500 MHz; level: 0.1-7 V rms.
2	INPUT LEVEL	Meter.	Indicates acceptable combination of input level and SENSITIVITY-control setting, when pointer is in green sector.
3	SENSITIVITY	4-position rotary switch.	Attenuation of input signal; 0, 6, 14, and 20 dB (voltage ratios 1, 0.5, 0.2, 0.1). Max sensitivity cw.
4	Pilot light	Flush round lamp.	Indicates when line power on.
5	MULTIPLY COUNTER READING BY	3-position rotary switch.	Selects scale factor of main output frequency: 10 or 100. Turns line power OFF.
6	10:1/100:1 OUT	BNC coaxial jack.	Main output port; can be moved to rear panel. Impedance: 50 Ω; frequency: 0.01-50 MHz; source level: 1-V pk; waveform: + pulse from 0-V base line; duty ratios: 60% for 10:1, 40% for 100:1.
7	100:1 SYNC OUT	BNC coaxial jack.	Auxilliary output port; can be moved to rear panel. Characteristics like item 6 except frequency: 0.01-5 MHz; duty ratio: 60%.
8	Line-voltage switch "50-400 Hz"	2-position slide switch.	Accomodates power supply to line-voltage ranges: 100-125 or 200-250 V.
9	1/10 A FUSE	Fuse in extractor-post holder.	Protects against overload damage when line voltage 230 V.
10	2/10 A FUSE	Fuse in extractor-post holder.	Protects against overload damage when line voltage 115 V.
11	INPUT location	Mounting hole with cover plate.	Alternate location for Item 1.
12	OUT locations	Mounting holes.	Alternate locations for items 6 and 7.
13	Power plug	3-pin power plug.	Power-line connection, with ground.

Table 1-2
ACCESSORIES AVAILABLE

Tvpe and Name	Characteristic	Function
1159 Recipromatic Counter	Autoranging, fast, programmable, sensitivity: 20 mV; frequency: 0.6 Hz – 20 MHz.	Frequency measurement, 6-digit presentation.
1191 Counter	Programmable, sens: 20 mV; frequency: up to 35 MHz.	Frequency in 8 digits, period, interval, ratio.
1192 Counter	Manual only , sens: 20 mV. frequency: up to 32 MHz.	Frequency in 7 digits, period, interval, ratio.
1591 Variac® Automatic Voltage Regulator	Accuracy: ±0.2%, capacity: 1.0 kVA.	Line-voltage regulation without distortion.
874-F185L Low-Pass Filter	Frequency: 185 MHz.	Eliminate miscounts due to harmonics.
874-F500L Low-Pass Filter	Frequency: 500 MHz.	Eliminate miscounts due to harmonics.
874-TPDL Power Divider	Coax. tee, matched impedance.	Low-VSWR signal branching.
874-TL Tee	Coaxial.	Signal-path branching.

Table 1-3
GR874® LOCKING ADAPTORS TO OTHER SERIES

Mates	Type	Contains GR874 and . . .	Connects GR874 to . . .	Catalog Number
Type BNC	874-QBJL	BNC Jack	BNC Plug	0874-9701
Type C	874-QCJL	C Jack	C Plug	0874-9703
Type MICRODOT	874-QMDJL	Microdot Jack	Microdot Plug	0874-9721
Type N	874-QNJL	N Jack	N Plug	0874-9711
Type SC	874-QSCJL	SC Jack	SC Plug (Sandia)	0874-9713
Type TNC	874-QTNJL	TNC Jack	TNC Plug	0874-9717
GR900® Precision 14-mm Connector	874-Q900L	GR900	GR900	0874-9709
Type SMA Miniature	874-QMMJL	SMA Jack	SMA Plug	0874-9723
AMPHENOL APC-7	874-QAP7L	APC-7	APC-7 Precision 7-mm Connector	0874-9791

Installation—Section 2

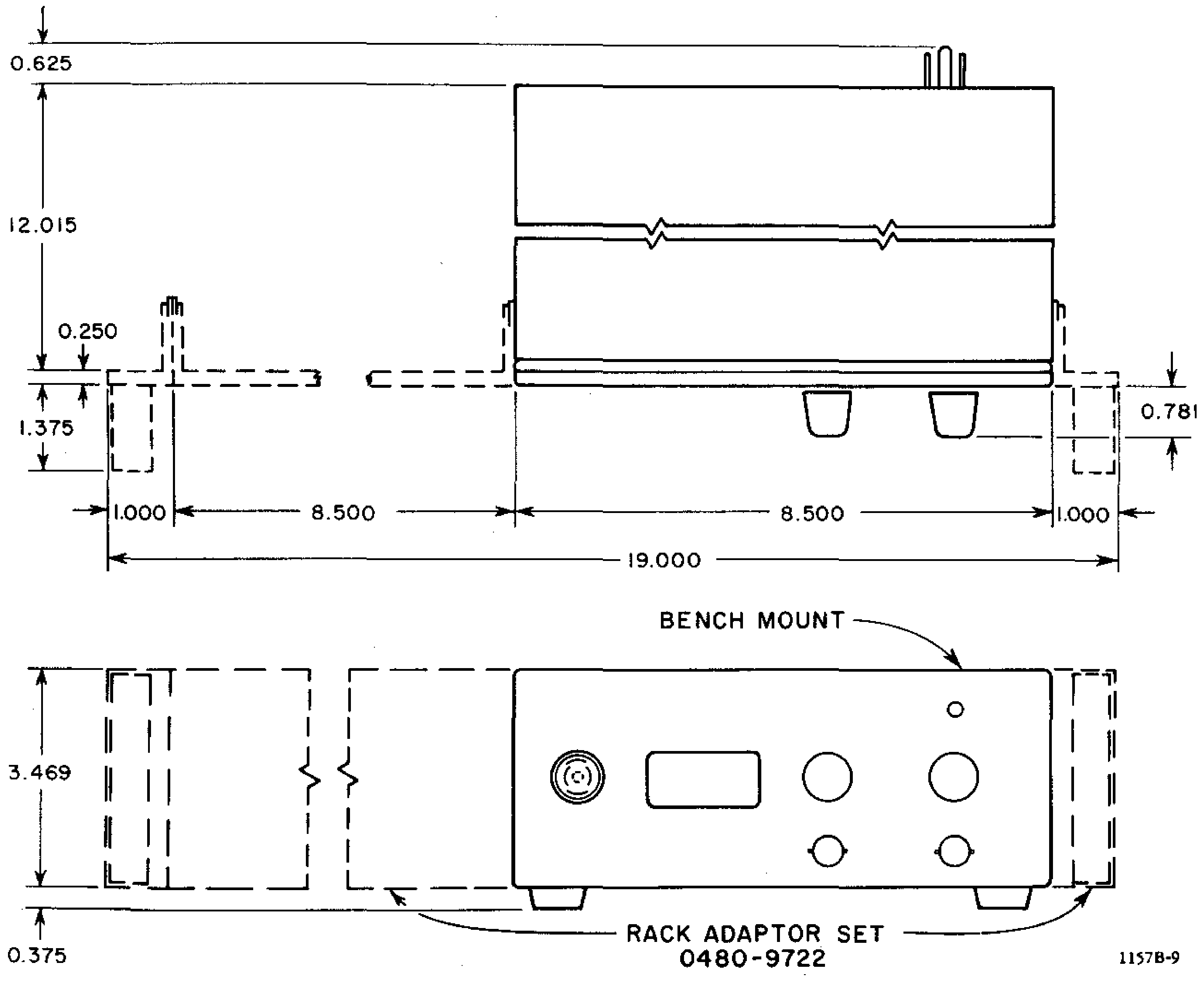


Figure 2-1. Dimensions of 1157-B Scaler.

2.1 GENERAL.

The 1157-B Scaler, having half a standard rack width, is a compact instrument on the bench and makes a convenient combination with the 1192 Counter, side-by-side, either bench or rack mounted. Only ac line power and an input signal are required. Available are frequency-scaled outputs and (on the counter) a digital frequency readout.

2.2 POWER.

Power requirements are 14 W at 100 to 125 V or 200 to 250 V, 50 to 400 Hz. A line-voltage switch (Figure 1-1, item 8) is provided on the rear panel of the instrument to convert from one line-voltage range to the other. Fuse A-F2, 0.1 A, is used for the 200- to 250-V range; fuse A-F1, 0.2 A, is used for the 100- to 125-V range (Figure 1-1, item numbers 9 and 10, respectively).

Make connection to the power line by means of three-wire power cord, supplied. Attach it to the power plug (Figure 1-1, item 13) on rear of instrument.

2.3 BENCH MODEL.

2.3.1 Dimensions.

The dimensions of the 1157-B in either available mounting configuration are shown in Figure 2-1. (Over-all height is reduced by 0.375 in. when feet are removed, as for rack installation.)

NOTE

Dimensions are given in inches, with all fractions expressed as decimals to 3 places. The number of digits is not intended to be significant nor to indicate tolerance.

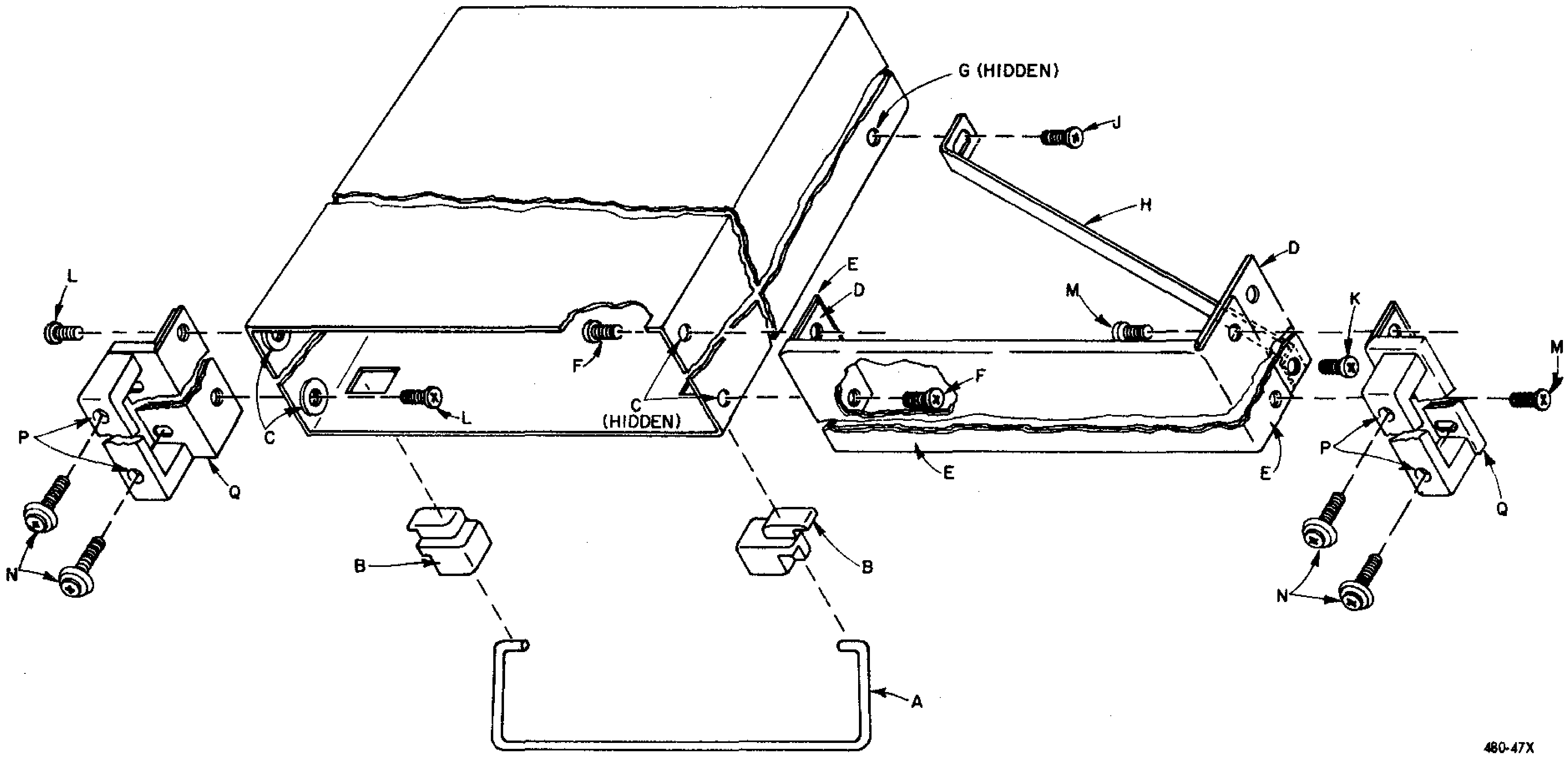


Figure 2-2. Method of mounting scaler in a relay rack.

2.3.2 Tilting.

The bench model can be tilted back, if desired for a better view of the panel, as follows: Pull the central part of the bail, which is pivoted at the front feet, down and forward. Let the bail support the front of the instrument. To return the bail to its storage position, push it back and up against bottom of cabinet.

2.4 RACK MOUNTING.

2.4.1 Single Instrument and Blank Panel (Figure 2-2).

The rack model of the 1157-B Scaler fits in any EIA standard RS-310 19-in. relay rack with universal hole spacing. This model, consists of the standard bench model and Rack Adaptor Set 0480-9722 (also available separately). Table 2-1 lists the parts included in that set. Conversion procedure is as follows:

a. Loosen the two captive 10/32 screws in the rear of the cabinet, near the sides, until instrument is free. Slide the instrument forward, out of its cabinet.

b. Remove the four feet from the cabinet. Simply push out the two rear feet. Spread the bail (A, Figure 2-2) slightly and the two front feet (B) will drop out, releasing the bail. Be sure to save all parts for possible reconversion of instrument to bench mounting.

c. Push out the plugs from the four bosses (C) on the cabinet sides, near the front. Use a hammer and a small punch inside the cabinet to push each plug outward. Do not damage threads in the threaded holes.

d. Press the subpanel (D) into the blank panel (E), to form a liner for the latter.

e. Attach the short flange of the blank panel near the front of the cabinet (on either side of cabinet, as desired) using two 5/16-in. screws(F). Note that the screws enter in opposite directions – one from inside the cabinet and one from the flange side, as shown.

f. Push out the plug in the lower rear boss(G) on the side toward the blank panel only, as in step c.

g. Attach one end of support bracket (H) to the lower rear boss. The bracket must be placed so that the screw passes through a clearance hole, into a tapped hole. Lock the bracket in position with a 5/16-in. screw (J).

h. Attach the other end of the support bracket to the lower, rear hole in the wide flange, as shown, using a 5/16-in. screw (K).

Table 2-1
RACK ADAPTOR SET, 0480-9722

Fig. 2-2 Item	No. Used	Name	GR Part No.
E	1	Blank panel	0480-8932
D	1	Sub panel	0480-8952
Q	2	Rack adaptor assembly	0480-4902
H	1	Support bracket	0480-8524
–	1	Hardware set includes:	0480-3080
F, J, K, L, M		8 Screws, Phillips head, 10-32, 5/16 in;	
N		4 Screws, Phillips head, 10-32, 9/16 in., with captive nylon cup washers.	

i. Attach one rack adaptor assembly (Q, including handle) to the side of cabinet opposite the blank panel, using two 5/16-in screws (L). Again, note that the screws enter in opposite directions, one from inside the cabinet and one from outside. Use the upper and lower holes in the assembly.

j. Attach the other rack adaptor assembly (Q, including handle) to the wide flange on liner (D) and the flange on blank panel (E). Use two 5/16-in. screws (M) through the two flange holes that are nearest the panel and through the upper and lower holes in the assembly. Again, the screws enter in opposite directions.

k. Install the instrument in its cabinet and lock it in place with two captive rear-panel screws that were loosened in step a.

l. Place a straight edge across instrument panel and blank panel. Loosen screw(J) through the slot in support bracket (H). Exert a slight pressure on blank panel (E) so that it forms a straight line with the instrument panel, and tighten screw (J), to lock the panels in this position.

m. Slide the entire assembly into the relay rack and lock it in place with four 9/16-in. screws (N, with captive nylon cup washers). Use two screws on each side and tighten them by inserting a screwdriver through holes (P) in the handles.

2.4.2 Reconversion to Portable Bench Mounting.

To reconvert the instrument for bench use, reverse the procedures of paragraph 2.4.1, first removing the entire assembly of instrument, cabinet, and blank panel from the rack.

a. Remove the instrument from its cabinet.

b. Remove support bracket (H) from the cabinet (Figure 2-2).

c. Remove the blank panel (E, with handle attached) from one side of cabinet.

d. Remove the rack adaptor set (handle) from the other side of cabinet.

e. Push the two rear (rubber) feet into the cabinet; slide bail (A) and two front feet (B) into place.

f. Install the instrument in its cabinet and lock it in place with the two captive screws through rear panel (Figure 1-1).

2.4.3 Rack-mounting Two Instruments.

Two instruments of the same panel size (such as two scalers or one scaler and one 1192 Counter) can be mounted side-by-side in a standard 19-in. relay rack. Use the procedure of paragraph 2.4.1, substituting the second instrument for the blank panel. Do not use the support bracket (H, Figure 2-2), but insert three screws through the bosses in the adjacent sides of the cabinets, two near the front (C) and one near the rear (G). The four feet and the bail must, of course, be removed from each cabinet. Use the four screws (N) with nylon washers to lock the instruments in the rack. The required hardware includes 2 of item Q, 3 of J, and 4 of N (Table 2-1).

2.5 OPTIONAL CONNECTOR LOCATIONS.

The INPUT connector is normally mounted on the front panel (Figure 1-1) but can be moved to the rear as follows:

a. Remove the scaler from its cabinet after loosening 2 captive screws at the rear, near left and right sides.

b. Remove four screws that secure the connector to the front panel.

c. Remove the corresponding cover plate from the rear panel.

d. Move the connector to the rear, reinsert its screws, and secure in place.

NOTE

> Mate another locking GR874 connector into this unit before tightening the screws, to ensure proper centering.

e. Install the cover plate in the vacant location on the front panel. Use the accompanying screws, lockwashers, and nuts.

The 10/100 OUT or SYNC OUT connector (or both) can also be moved to the rear as follows:

a. Remove the scaler from its cabinet, as before.

b. Unsolder the coaxial cable from connector and ground lug. Remove nut, lockwasher, and lug (inside); retain the spacer ring (outside).

c. Remount connector in the rear location having the appropriate label. Use all the hardware, in original sequence.

d. Resolder the cable to connector and ground lug, after appropriate changes in route through cable clamps.

2.6 INTERCONNECTIONS.

Use an appropriate patch cord (Table 2-2) to connect the signal to be measured to the INPUT connector. Connect the 10/100 OUT port of the scaler to the input port of a counter or other frequency-measuring instrument. The following choices of patch cords are appropriate for the corresponding counters: GR 0776-2000 for the 1192, 776-B for the 1159, and 776-C for the 1191 Counter.

2.7 ENVIRONMENT.

The scaler will operate reliably with ambient temperatures between 0° and 55°C (32° to 131° F).

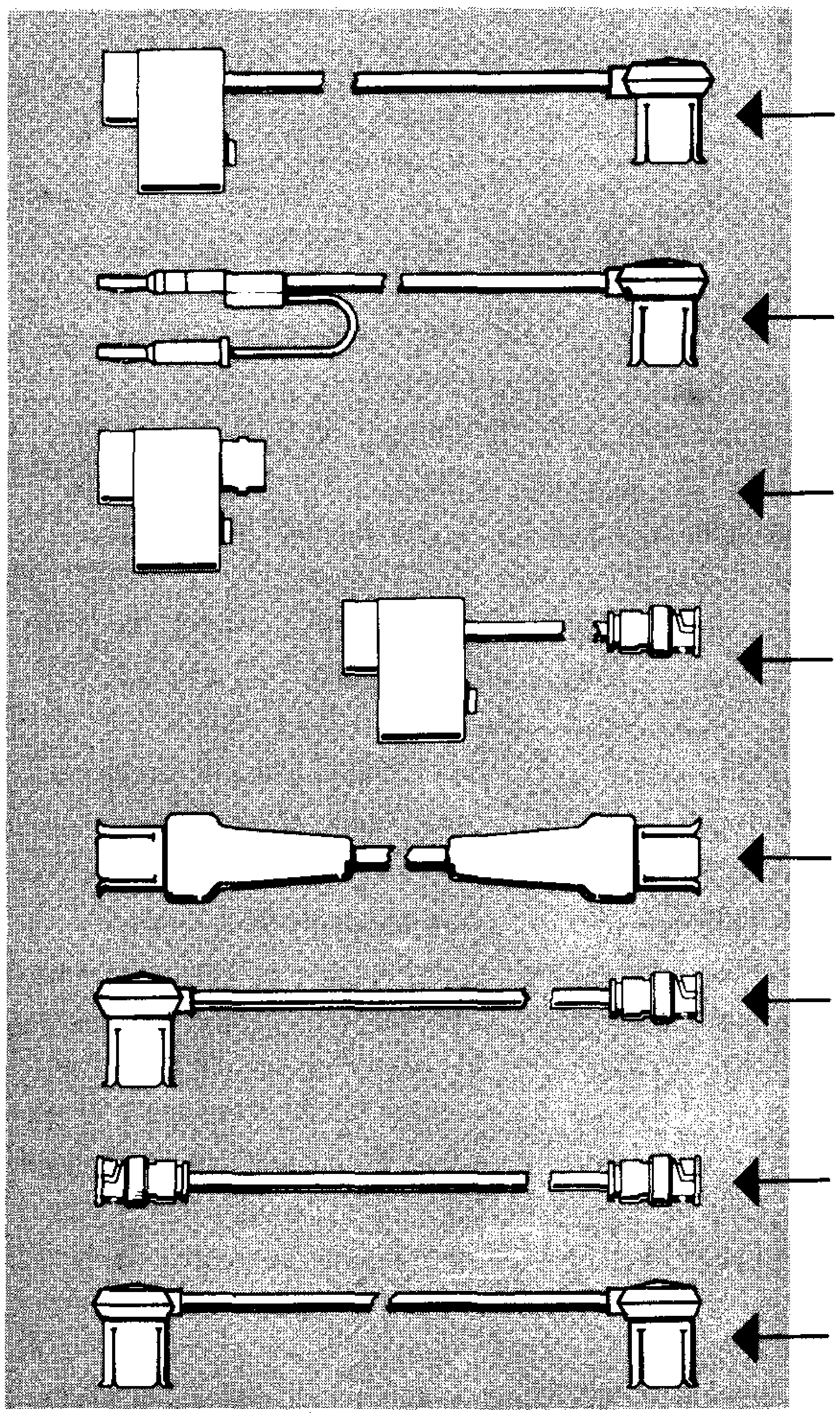
2.8 LINE-VOLTAGE REGULATION.

The accuracy of measurements accomplished with precision electronic test equipment operated from ac line sources can often be seriously degraded by fluctuations in primary input power. Line-voltage variations as much as ±5% are commonly encountered, even in laboratory environments. Although most modern electronic instruments incorporate some degree of regulation, possible power-source problems should be considered for every instrumentation setup. The use of line-voltage regulators between power lines and the test equipment is recommended as the only sure way to rule out the effects on measurement data of low line voltage, transients, and other power phenomena.

The General Radio Type 1591 Variac® Automatic Voltage Regulator is a compact and inexpensive equipment capable of holding ac line voltage within 0.2% accuracy for input ranges of ±13%. It will assure that the scaler, rated for 100-125 (or 200-250) V, can be operated reliably in spite of input transients in the range 85-140 (or 170-280) V. The 1-kVA capacity of the 1591 will handle a rack full of solid-state instrumentation with no distortion of the input waveform. This rugged electro-mechanical regulator comes in bench or rack-mount versions, each with sockets for standard 2- or 3-wire instrument power cords.

Further details can be found in your GR catalog or in the GR *Experimenter* for October, 1967.

Table 2-2
AVAILABLE INTERCONNECTION ACCESSORIES



874-R34	Coaxial patch cord, double plug to GR874, 36" long	0874-9692
874-R33	Coaxial patch cord, two plugs to GR874, 36" long	0874-9690
274-QBJ	Adaptor, shielded double plug to BNC jack	0274-9884
776-A	Patch cord, shielded double plug to BNC plug, 36" long	0776-9701
874-R22A	Coaxial patch cord GR874 to GR874, 36" long	0874-9682
776-B	Patch cord, GR874 (right-angle) to BNC plug, 36" long	0776-9702
776-C	Patch cord, BNC plug to BNC plug, 36" long	0776-9703
776-D	GR874 to GR874, both right-angle, 36" long	0776-9704

274-13XA

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Operation – Section 3

3.1 PRELIMINARY CHECKS.

Make the following checks before operating the scaler:

a. Check that the line-voltage switch (item 8, Figure 1-1) is positioned according to the available power-line voltage.

b. Connect the power plug (item 13, Figure 1-1) to a suitable power line, using the power cord supplied.

c. Turn the MULTIPLY . . . BY switch cw from OFF and check that the pilot light goes on (item 4).

3.2 GENERAL OPERATION.

Refer to paragraph 1.3 for a description of controls, indicators, and connectors. Proceed as follows:

a. Turn the MULTIPLY . . . BY switch to 100. The pilot light should glow.

b. Set the SENSITIVITY control ccw, to the least sensitive position.

c. Verify that the level of signal to be measured is less than 7 V rms into a 50-Ω load. Couple to the INPUT connector, using a patch cord selected from tables in paragraph 1.5.

d. Adjust the SENSITIVITY control as required to bring pointer into green segment of INPUT LEVEL meter. If two positions satisfy, use the one closer to a midscale reading.

e. Connect from the 10/100 OUT jack to a counter, scope, or other frequency-measuring instrument (as described in paragraph 2.6).

f. Multiply the indicated frequency by the scale factor, 100, to complete the measurement.

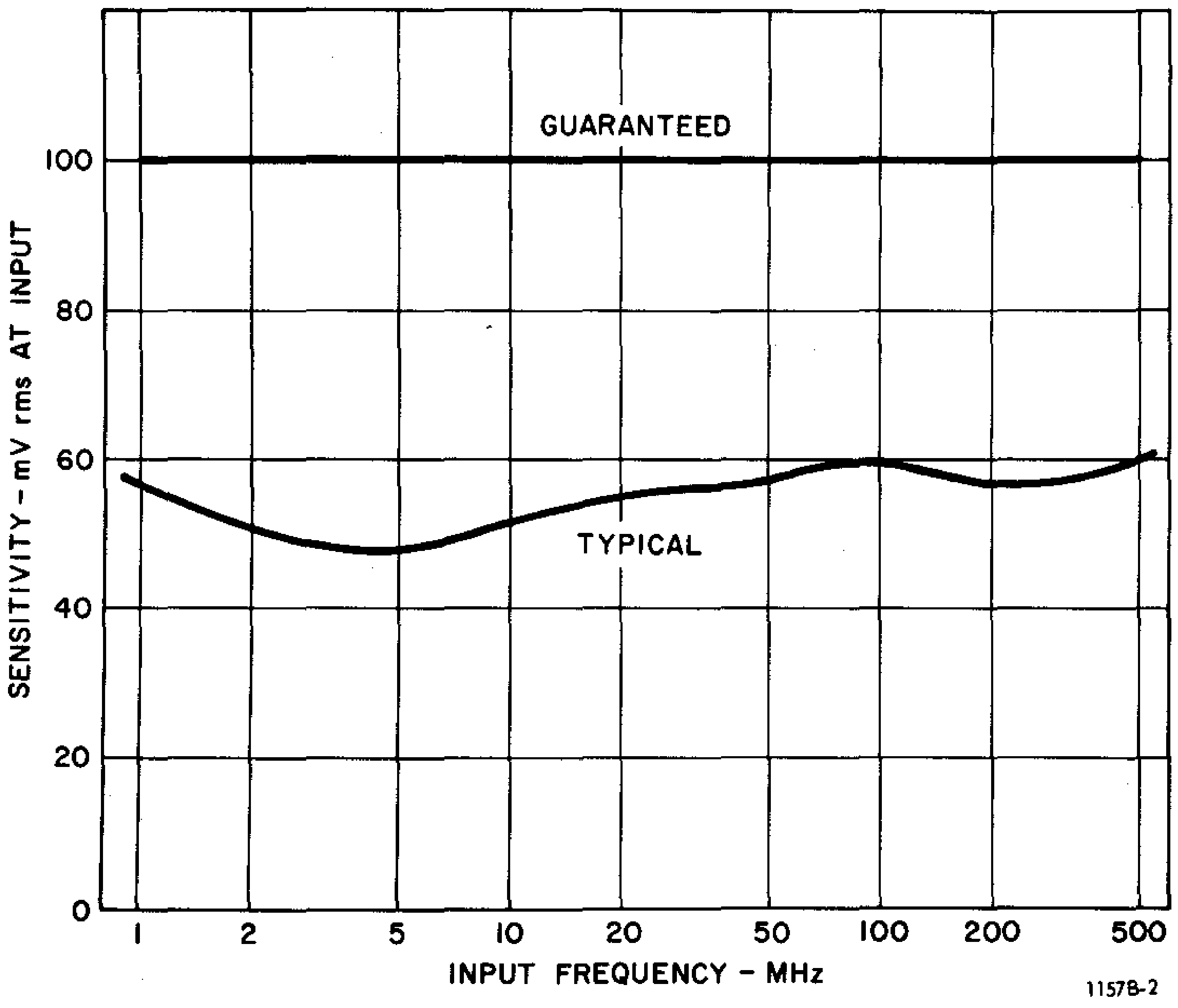

Figure 3-1. Typical scaler input sensitivity.

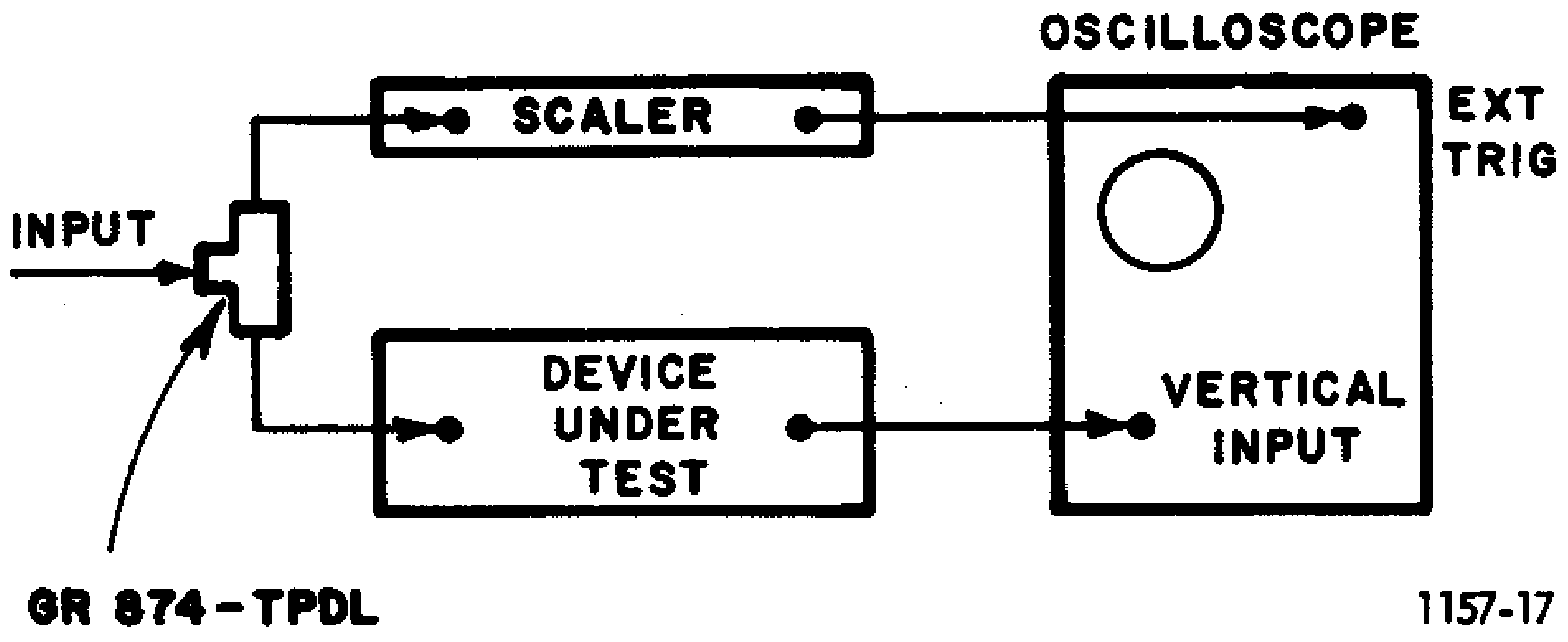

Figure 3-2. Use of scaler to trigger a scope.

g. If a scale factor of 10 is preferred, turn the MULTIPLY . . . BY switch to 10.

h. Obtain a coherent pulse-type signal at 1/100 the input-signal frequency from the SYNC OUT jack (for triggering a scope or controlling a gate independently of the main output circuit).

3.3 TERMINAL CHARACTERISTICS.

3.3.1 Input.

Frequency: 1-500 MHz.
Impedance: 50 Ω.
Attenuator: 1-2-5-10 sequence (voltage),
i.e., 0-6-14-20 dB.
Maximum safe level: 7 V rms.
Sensitivity: better than 0.1 V rms (0.3 V pk-pk); see Figure 3-1.
Coupling: ac (0.01 μF series capacitor).

3.3.2 Outputs.

Frequency: 0.01-50 MHz.
Impedance: 50 Ω.
Level: at least 1 V pk, source voltage.
Waveform: positive pulses.
Coupling: direct.

3.4 APPLICATIONS.

3.4.1 Counter Range Extension.

Extension of the upper frequency limit of any modern counter, by a factor of either 10 or 100 is limited only by the scaler input-terminal characteristics. The frequency readout must be interpreted; move the decimal point as shown explicitly by the MULTIPLY COUNTER READING BY switch.

Accuracy of measurement is unaffected by the scaler. Counter accuracy is usually specified as reference-oscillator stability ±1 count (at the counter input). That 1 count is 10 or 100 cycles of the signal at scaler INPUT. For increased resolution in any given measurement, increase the counter's gate time.

The upper frequency limit of other frequency-measuring instruments is similarly extended, instruments like analog frequency meters, discriminators, and scopes.

The recommended companion for this scaler is the compact, inexpensive, general purpose 1192 Counter.

3.4.2 Scope Trigger.

Use the scaler to process the trigger signal for an oscilloscope if its sweep circuitry is inadequate to do so directly. Often a signal within the bandwidth capability of the vertical amplifier is too fast for reliable triggering. When divided coherently by the scaler, that signal provides an ideal trigger.

Use the scaler-triggered time base to advantage (even at low frequencies) whenever the device under test involves delays that are large compared to a signal period. Such a time base may be particularly useful if the device is a digital processor such as a divider. The signal driving the scaler should be unchanged by the experiment, as suggested in the diagram of Figure 3-2.

3.4.3 Filtering.

If the signal to be measured has harmonic distortion or higher-frequency noise with it, use a low-pass filter at the INPUT port to improve reliability and significance of measurements. Two suitable filters, with cutoff frequencies of 500 and 185 MHz, respectively, are listed in paragraph 1.5.

Theory—Section 4

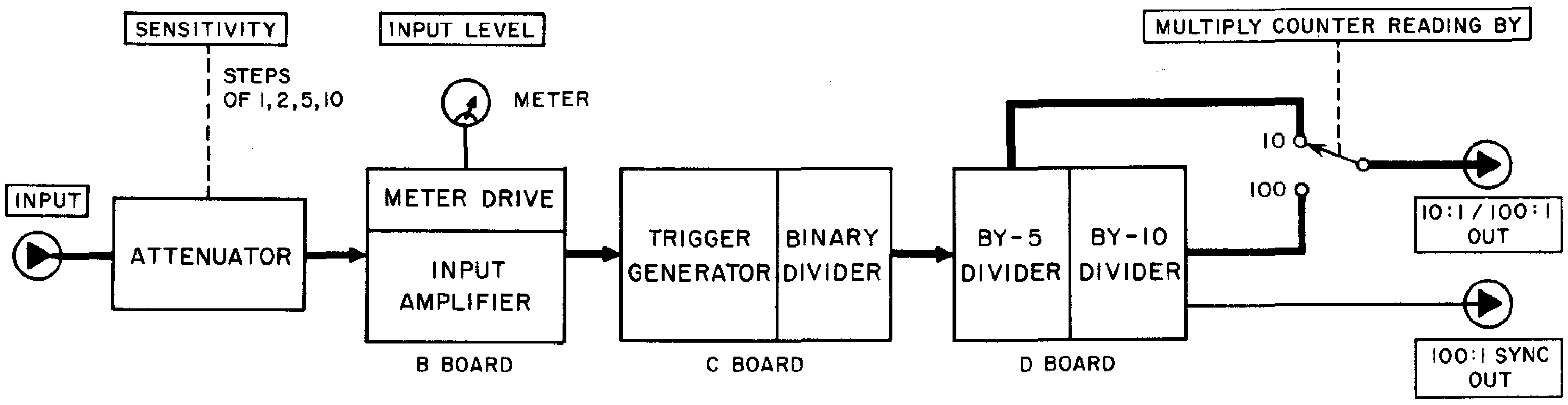

Figure 4-1. Block diagram of 1157-B Scaler.

1157B-8

4.1 GENERAL.*

Theory is discussed first by an explanation of the main functions, with reference to a block diagram. Then individual circuits are described, in greater detail. Circuits designated A, B, C, D, and V are the over-all assembly with panel wiring, 3 signal-processing boards, and the power-supply board, respectively.

NOTE

Each reference designator used in our schematic diagrams and circuit descriptions now includes an initial letter, before a hyphen, to identify the subassembly. The numeric portion of each designator is generally shorter than would be the case if a block of numbers were assigned to each subassembly. A new designation WT (wire-tie point) replaces the customary AT (anchor terminal). The letter before the hyphen may be omitted only if clearly understood, as within a subassembly schematic diagram.

Examples: B-R8 = B board, resistor 8; D-WT2 = D board, wire-tie point 2; CR6 on the V schematic is a shortened form of V-CR6 = V board, diode 6. The instrument may contain A-R1, B-R1, C-R1, and D-R1.

4.2 BLOCK FUNCTIONS (Figure 4-1).

The scaler accepts an essentially single-frequency input signal and provides an output suitable to drive a counter at 1/10 or 1/100 of the input frequency. Discussion of internal functions is related to the block diagram·

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*For scalers with ID no. B100, refer to Difference Data in rear of manual.

File Courtesy of GRWiki.org

4.2.1 Attenuator – A.

A switched resistive network provides 4 steps of input-signal attenuation to accomodate large signal levels, feeding an appropriate fraction to the sensitive, very broad-band input amplifier.

4.2.2 Meter Drive – B.

A stable metering circuit provides visual indication of signal level ahead of the input amplifier, to assist the operator in setting the attenuator properly.

4.2.3. Input Amplifier – B.

The input amplifier accepts signals in the ranges 1-500 MHz and 0.1-0.7 V. It provides gain, impedance transformation, and isolation ahead of the divider circuitry.

4.2.4 Pulse Generator – C.

Ahead of the first divider is a generator which produces one very sharp negative pulse per cycle of the input signal.

4.2.5 Binary Divider – C.

A very fast divider switches from one stable state to the other each time it receives a pulse. The resulting square wave, at ½ the input frequency, passes through a buffer amplifier on its way to subsequent dividers.

4.2.6 By-5 Divider – D.

A fast switching circuit divides further, to 1/10 the input frequency. One output channel goes through a buffer amplifier and selector switch to the 10/100 OUT jack. The other drives the subsequent divider.

4.2.7 By-10 Divider – D.

The final two steps of division, by 2 and 5, produce the output signal at 1/100 the input frequency. This signal passes through buffer channels to the 10/100 OUT jack (through the selector switch) and to the SYNC OUT jack.

4.3 CIRCUIT DESCRIPTION.

4.3.1 Over-all Assembly – A (Figure 6-3).

The attenuator is built around the SENSITIVITY switch A-S3. Each step selects a completely separate resistive pi network, the last one being the degenerate form, a single wire. Input impedance remains 50 Ω in all positions.

The other front-panel switch, MULTIPLY . . . BY, has two parts, A-S1 and A-S2. The latter selects either of the optional signals, 10:1 or 100:1, for the main output jack A-J3. In the OFF position it selects neither, and A-S1 opens the power line.

The ac power circuit includes a line voltage switch A-S4, which connects A-T1 dual primary windings in parallel or series for nominally 115 or 230-V lines. The appropriate fuse is automatically connected when A-S4 is in the correct position.

4.3.2 Input and Metering – B (Figure 6-6).

The input amplifier, 3 direct-coupled stages, incorporates high-frequency transistors and suitable compensation to obtain the necessary sensitive, broad-band performance. Gain is approximately 12 dB.

The meter-drive circuit uses an analog integrated-circuit amplifier B-IC1 to furnish meter A-M1 with 250 to 750 μA (the range of the green sector) for 100 to 700 mV of signal level at the input B-J1 (after the attenuator).

Diode B-CR1 serves as a peak detector. Diode B-CR2, carrying a small forward current, is used to subtract the initial forward voltage drop from the detector output, so that the transfer characteristic is nearly linear.

The gain of the meter-drive amplifier is switched by diode B-CR3. The diode is open, making gain higher, for signals 0-100 mV at B-J1. The diode conducts, making gain lower, for larger signals. The resistive network not only sets these gains to provide the correct meter currents (250 and 750 μA) for the accepted signal range, but also ensures that a safe overload current (1200 μA) follows from any large signal that saturates the amplifier.

4.3.3 Trigger – C (Figures 4-2, 6-7).

The trigger generator processes the incoming signal to supply a negative pulse to the binary divider. These circuits incorporate tunnel diodes, whose general characteristics are shown in Figure 4-2.

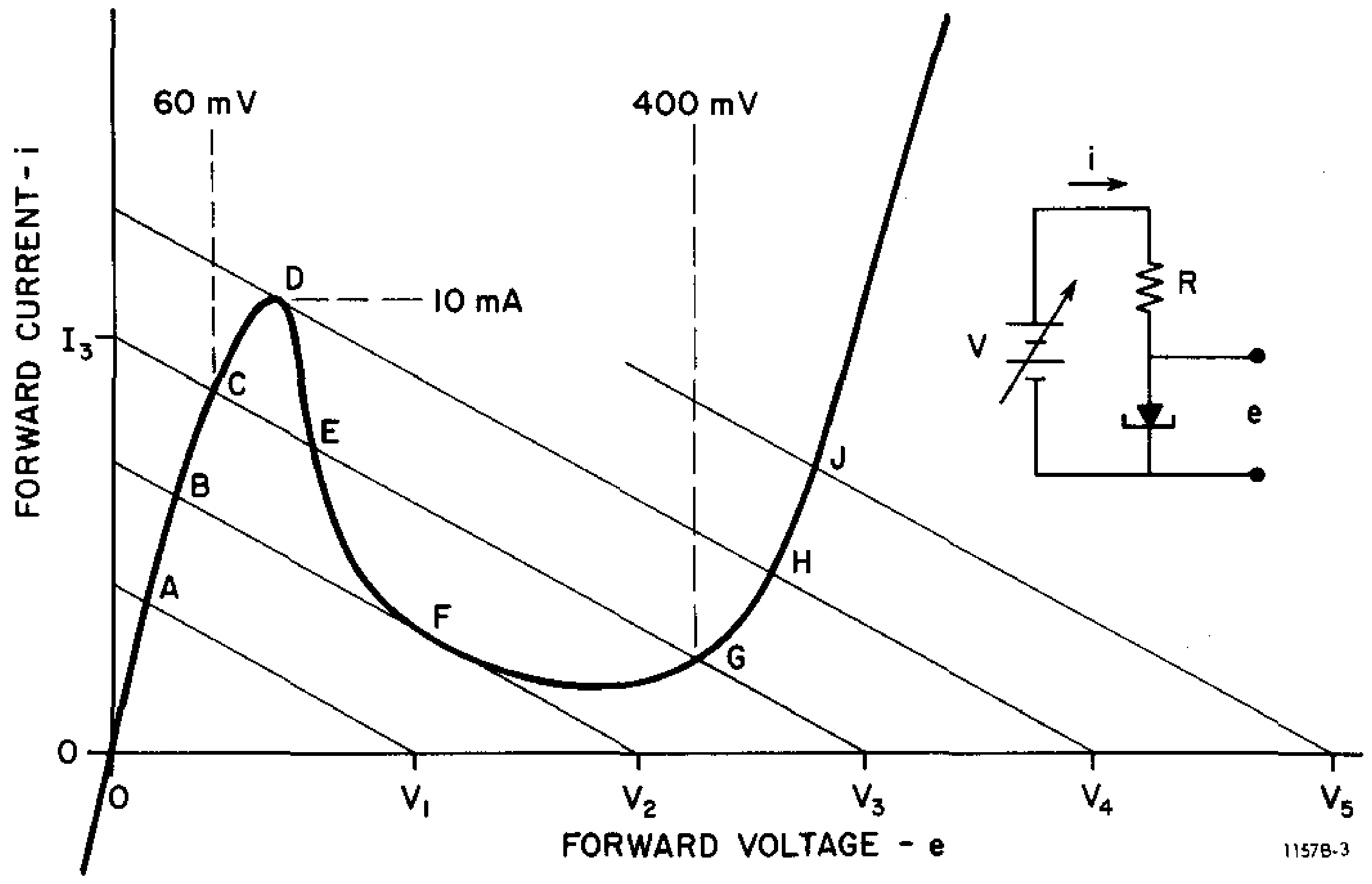

Figure 4-2. Tunnel-diode characteristics.

Load lines are drawn for a given resistance R= V_3/I_3. Notice that when V = V_3, there are 2 possible equilibrium conditions, C and G (E is unstable). If V increases, the sequence of stable conditions is A, B, C, D, H, J, with a very rapid transition from D to H. Conversely, the sequence is J, H, G, F, B, A, with a very rapid transition from F to B. These rapid transitions between high and low voltage states (and the exclusion of any intermediate state) make tunnel diodes useful for sharpening the rise-time of a pulse or making a fast flip-flop. The low dynamic impedance of the regions above and below the transition region make tunnel diodes useful also as limiters.

Tunnel diode C-CR1 is driven far enough to change state and reverse every cycle of the input signal. (There must not be enough noise or harmonic distortion to cause extraneous reversals.) With series resistor C-R1 to absorb the voltage peaks, the signal at C-Q1 base is therefore nearly square. The rise D-H (Figure 4-2) is particularly sharp; the fall is rounded at H-F before the sharp drop F-B.

Tunnel diode C-CR2 functions similarly, except that the waveform has been inverted by C-Q1. The sharp transition is further emphasized and so is the limiting action. Transistor C-Q2 amplifies and inverts again to produce a square wave with a very steep positive leading edge.

Pulse generator C-Q3 is turned on abruptly by this step, but conducts strongly for only a small fraction of a nanosecond thereafter, because the emitter bypass C-C11 is so small. Consequently the C-Q3 collector waveform is a short negative pulse, once each cycle of the main input signal.

4.3.4 Binary Divider – C (Figure 6-7).

The binary incorporates a bridge with tunnel diode pair C-CR3/C-CR4 on one side, a resistor pair opposite, and an inductor across the middle. Normally, the voltage across the bridge is about 0.5 V, enough to allow one diode to be in its high-voltage state and one low, but not both in the same state. The network also restricts the "high" diode to a lower current than its twin. (Suppose C-CR3 is in the high-voltage state; C-R24 is forced to a larger IR drop than C-R25; therefore current flows through C-L1, adding with C-CR3 current to give C-CR4 more current although its voltage is lower.)

The negative pulse applied to this bridge drops whichever diode was high into the low-voltage state. Then both tunnel diodes cycle momentarily below point B (Figure 4-2). After the pulse, whichever diode was low is the first to reach point D and switches to the high-voltage state, "taking turns." Memory is provided by inductor C-L1. (Continuing the above supposition, enough inductor current is still flowing during and shortly after the pulse to give C-CR4 more current than C-CR3.)

The signal out of this divider, then, is a square wave at half the frequency of the input signal. A 3-stage buffer amplifier (C-Q4, -Q5, and -Q6) follows the binary divider and drives the following stage.

4.3.5 By-5 Divider – D (Figures 4-3, 6-11).

A set of 3 integrated-circuit flip-flops is arranged with feedback to make a fast scale-of-5 divider. Each flip-flop has these properties, using positive logic:

a. In the 1 state, output Q is 1, $\overline{Q}$ is 0.

b. In the 0 state, output Q is 0,$\overline{Q}$ is 1.

c. Application of a + clock pulse at input C causes the flip-flop to assume the state of input D.

d. Application of a + pulse at input R resets the flip-flop to the 0 state.

The time sequence is shown in Figure 4-3. Start with a time when all 3 flip-flops are in the 0 state. The signal at D-J1 (having come through the binary divider) is used as the clock drive. (Abbrev. used: IC1, IC2 . . . for D-IC1, D-IC2 . . .)

1. First clock pulse sets IC1 to 1 because its input D is 1, obtained from $\overline{Q}$/IC3.

2. Second clock pulse sets IC2 to 1 because its input D is 1, obtained from Q/IC1.

3. Third clock pulse sets IC3 to 1 because its input D is 1, obtained from Q/IC2.

4. Fourth clock pulse sets IC1 to 0 because its input D is 0 ($\overline{Q}$/IC3 was made 0 by step 3).

5. Fifth clock pulse sets IC2 to 0 because its input D is 0, as a result of step 4.

6. A chain reaction sets IC3 to 0 because its input R becomes 1 with $\overline{Q}$/IC2, as a result of step 5. Notice that IC3 being reset before the next clock pulse makes the divider scale by 5 instead of 6.

7. Sixth clock pulse will act exactly like the first because all 3 flip-flops are in the 0 state. Therefore, the dividing cycle repeats with every 5 clock cycles, i.e., every 10 cycles of the input signal.

A difference amplifier, D-Q1/D-Q2, serves as a buffer for the ÷ 10 output, available at the 10/100 OUT jack when the MULTIPLY . . . BY selector is set to 10. The phase of this output is the same as that of $\overline{Q}$/IC3, and the duty ratio is likewise 60%.

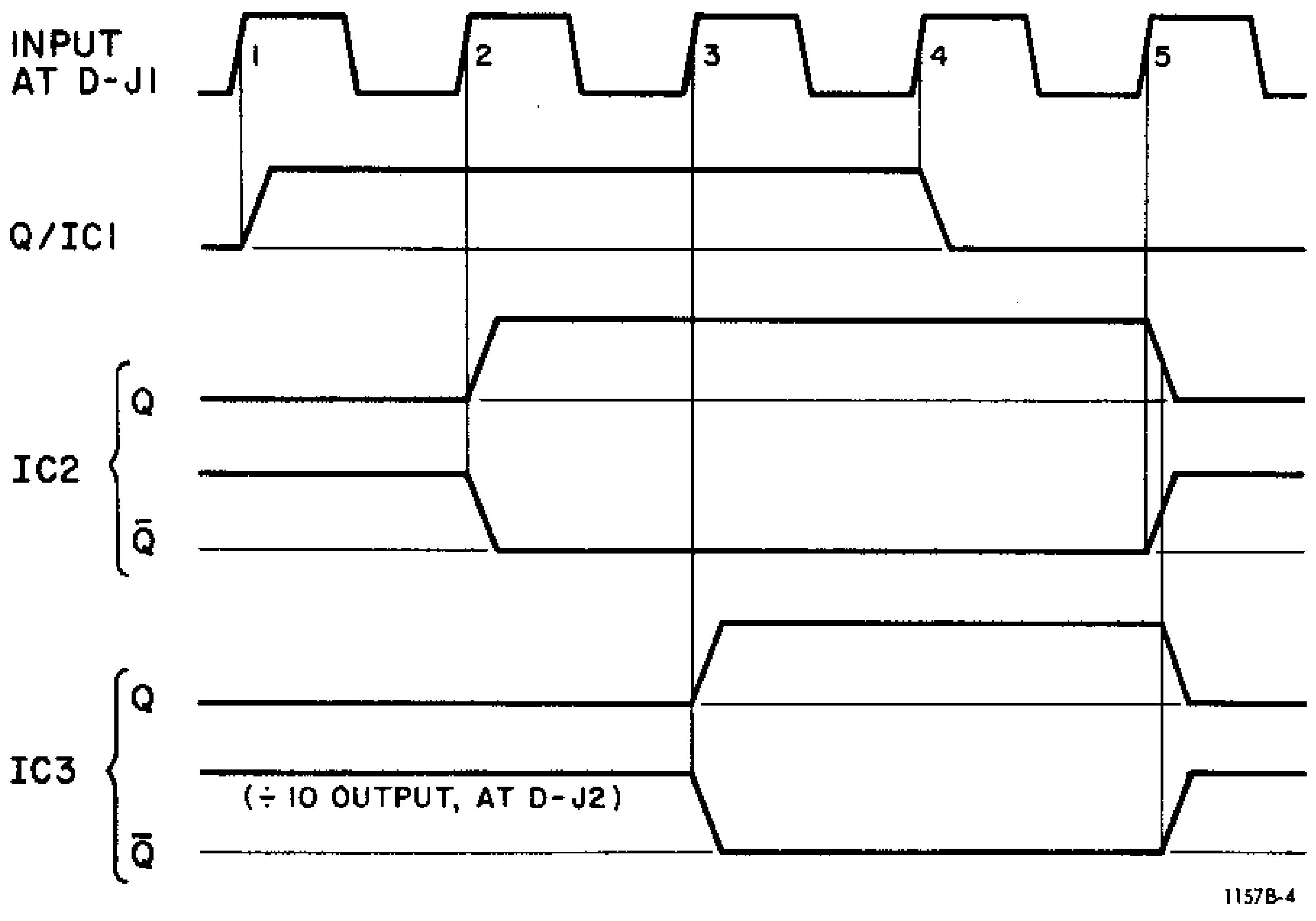

Figure 4-3. By-5 divider timing diagram.

4.3.6 By-10 Divider — D (Figures 4-4, 6-11).

An IC binary divider and another scale-of-5 circuit accomplish the decade division. A final buffer amplifier follows.

The binary IC4 has the property that each + pulse applied simultaneously to inputs J and K reverses the state of its internal flip-flop. Its output Q/IC4 is a square wave at half the frequency of the ÷10 output (at D-J2). Difference amplifier D-Q3/D-Q4 acts as a "clock" driver for the following divider. (See Figure 4-4, first 2 waveforms.)

Division by 5 takes place in D-IC5 and D-IC6 with logic very similar to that described in paragraph 4.3.5. D-IC5 contains flip-flops A and B, analagous to D-IC1 and D-IC2; D-IC6 is comparable to D-IC3. These flip-flops have the following properties, using positive logic:

a. In the 1 state, output Q is 1, $\overline{Q}$ is 0.

b. In the 0 state, output Q is 0, $\overline{Q}$ is 1.

c. Application of a — pulse at input C causes the flip-flop to assume the state of input J, provided that input K is always driven opposite to J. (If both J and K were 0, no change would occur; if both were 1 the flip-flop would switch state.)

d. Application of a — pulse at input R resets the flip-flop to the 0 state.

The timing sequence is shown in Figure 4-4. Start with a time when all 3 flip-flops are in the 0 state. The clock drive, from D-Q3 collector, is applied to all 3 flip-flops at their C terminals. (Abbrev. used: IC4, IC5 . . . for D-IC4, D-IC5 . . .)

1. Clock pulse C1 sets IC5A to 1 because its J/K inputs are 1/0, determined by IC6.

2. Clock pulse C2 sets IC5B to 1 because its J/K inputs are 1/0, determined by IC5A.

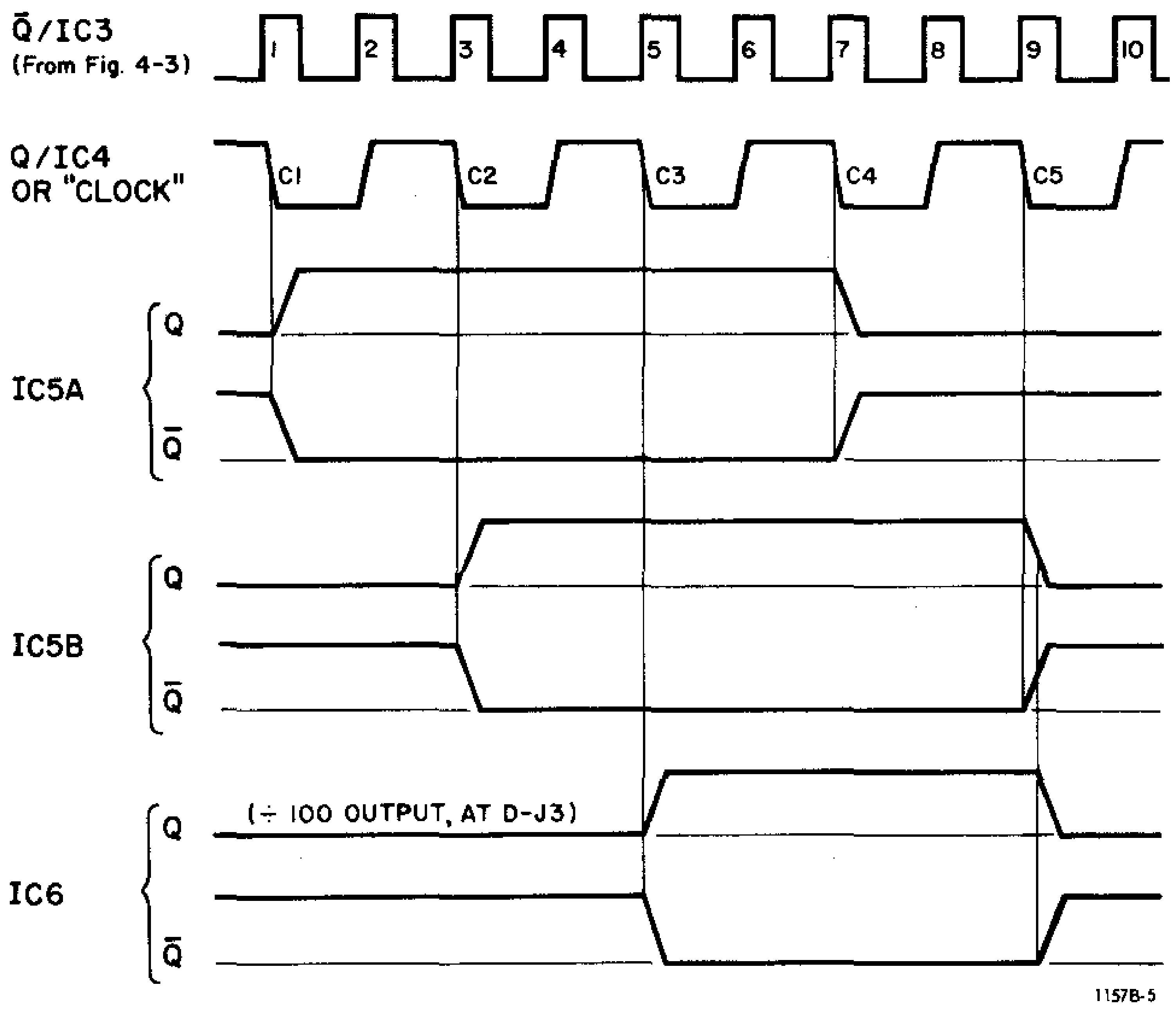

Figure 4-4. By-10 divider timing diagram.

3. Clock pulse C3 sets IC6 to 1 because its J/K inputs are 1/0, determined by IC5B.

4. Clock pulse C4 sets IC5A to 0 because its J/K inputs are 0/1, determined by IC6.

5. Clock pulse C5 sets IC5B to 0 because its J/K inputs are 0/1, determined by IC5A.

6. A chain reaction sets IC6 to 0 because its input R becomes 0 with Q/IC5B, as a result of step 5. Notice that IC6 being reset before the next clock pulse makes the divider scale by 5 instead of 6.

7. Clock pulse C6 will act exactly like C1 because all 3 flip-flops are in the 0 state. Therefore, the dividing cycle repeats with every 5 clock cycles, i.e., every 100 cycles of the signal at the INPUT connector.

A difference amplifier, D-Q5/D-Q6, serves as a buffer for the ÷100 outputs. D-J4 supplies the SYNC OUT signal, which has a 60% duty ratio. D-J3, with the complementary signal — 40%, is connected to the 10/100 OUT jack when the MULTIPLY . . . BY selector is set to 100.

4.3.7 Power Supply — V (Figure 6-10).

The +20-V section is nearly independent of the -20-V part, the former using rectifier diodes V-CR1 and -2, its own regulator, and current limiter. Filtering action by A-C1 is shared with -20-V supply. Cascode series regulator V-Q1/V-Q2 is driven by V-Q4 in the required sense to hold the output voltage constant at wire-tie point V-WT6. Normally, V-Q4 is turned mildly on with a base-emitter bias of 0.6 V, the tap on V-R5 "set 20-V" being that much above the potential across Zener-diode V-CR9, when the output terminal V-WT6 is +20 V above ground. V-Q3 is a current limiter that, if turned on by excessive IR drop in V-R3, will partially starve the base of V-Q2 and so protect the power supply from damage by a short circuit.

The -20-V section is dependent on the +20-V regulator for reference voltage. It uses rectifier diodes V-CR3 and -4, filter capacitor A-C1 (part of which is shared), a separate regulator, and limiter. Cascode series regulator V-Q7/V-Q8 is driven by V-Q5 in the proper sense to hold the output voltage at V-WT7 constant. Normally, V-Q5 is turned mildly on with an emitter-base bias of 0.6 V when V-WT7 voltage is -20 V. V-Q6 is a current limiter that, if turned on by excessive IR drop in V-R9, will partially starve the base of V-Q7.

The 5.25-V section also depends on the +20-V regulator for reference. Cascode series regulator V-Q9/V-Q10 is driven by V-Q12 so that the output voltage at V-WT12 stays constant. Normally, V-Q12 has a base-emitter bias of 0.6 V when V-WT12 voltage is +5.25 V. V-Q11 is a current limiter that, when turned on by excessive IR drop in V-R10, will partially starve the base of V-Q10.

Service and Maintenance—Section 5

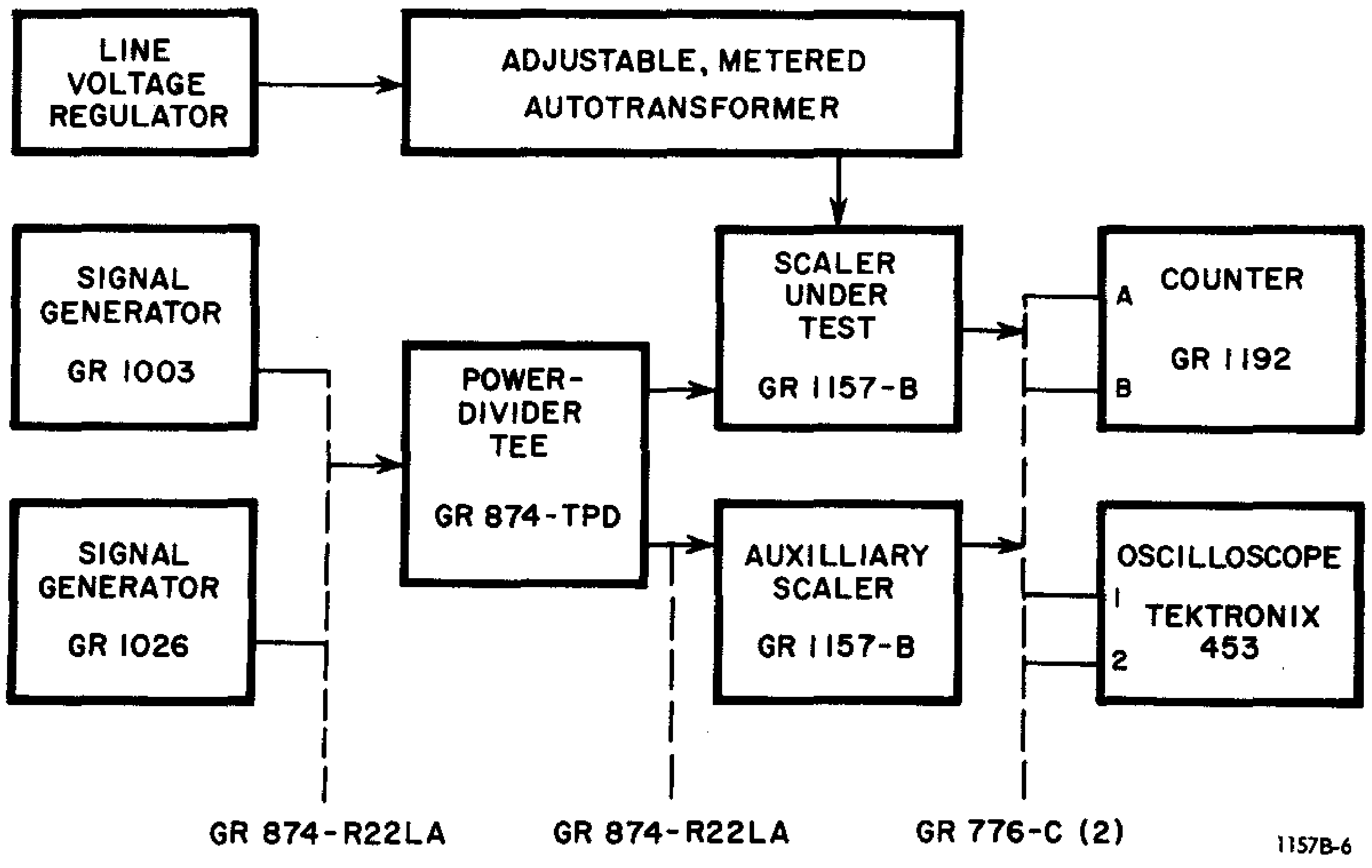

Figure 5-1. Generalized test setup.

5.1 GR FIELD SERVICE.

The two-year warranty attests the quality of materials and workmanship in our products. When difficulties do occur, our service engineers will assist in any way possible. If the difficulty cannot be eliminated by use of the following service instructions, please write or phone the nearest GR service facility (see back page), giving full information of the trouble and of steps taken to remedy it. Describe the instrument by type number (front panel), serial, and ID numbers (rear panel).

Before returning an instrument to General Radio for service, please ask our nearest office for a "Returned Material" number. Use of this number in correspondence and on a tag tied to the instrument will ensure proper handling and identification. For instruments not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay.

For return shipment, please use packaging that is adequate to protect the instrument from damage, i.e., equivalent to the original packaging. Advice may be obtained from any GR office.

5.2 MINIMUM PERFORMANCE STANDARDS.

5.2.1 General. Figure 5-1.

The significant aspects of performance are flawless scaling over the specified frequency range, input sensitivity, and output level.

The test setup is shown in Figure 5-1. Recommended test equipment is listed in Table 5-1. The requirements given are significant ones, but may not be a complete and

Table 5-1
TEST EQUIPMENT

Item	Requirements	Recommended Type*
Signal generators	Frequencies: 1-500 MHz; with ±0.5% accuracy; levels: 0.1 - 3 V into 50 Ω.	GR 1003 and GR 1026
Oscilloscope	Bandwidth: dc - 1 GHz; deflection factor: 2 - 200 mV/div; time base: 0.2 ns - 1 µs/div;	Tektronix 561 with 3S1 and 3T77A plug-in units.
Oscilloscope	Bandwidth: dc - 50 MHz; deflection factor: 5 mV - 10 V/div.	Tektronix 453 with P6008 probe.
Counter	Frequency range: up to 30 MHz; input impedance: 50Ω; digits: 6 or 7 preferred, 5 min.	GR 1192
Scaler	Same as scaler being tested.	GR 1157-B
Electronic multimeter and tee connector.	Voltage range: 0.01 - 30 V; accuracy: ± 2% dc, ± 10% at 500 MHz; ohmmeter accuracy: ± 5%; test voltage: 1.5 V.	GR 1806 with 1806-P1.
Line-voltage regulator	Stability: ±0.2%, capacity: 1 kVA; adjustment: 105-125 V.	GR 1591
Autotransformer, adjustable and metered.	Current rating: 5 A; meter accuracy, watts and volts: ± 3%.	GR W5MT3W Variac®
Adaptor	GR874 to Microdot plug.	GR874-QMDP
Patch cords (2)	GR874 each end.	GR874-R22A
Patch cords (2)	BNC plug each end.	GR 776-C
Patch cord	GR874 to BNC plug.	GR 776-B
Capacitor	Dc blocking, coaxial.	GR874-K
Power Divider	VSWR: <1.06, dc-0.5 GHz; insertion loss: 6 dB (+2, -0.5 dB) to each output.	GR874-TPD

* Equivalents may be substituted.

sufficient set of specifications for choosing substitutes for the recommended types.

5.2.2 Basic Operation and Sensitivity.

a. Set each signal generator to provide 0.2 V cw into a 50-Ω load, so that each in turn will drive the scalers at a 0.1-V level; or if only one scaler is available, omit the power-divider tee and set the signal generators to 0.1 V.

b. Connect the oscilloscope channels 1 and 2 from the outputs of the scaler under test. Set its MULTIPLY . . . BY switch to 10.

c. Set input frequency to 100 MHz.

d. Verify that the INPUT LEVEL meter points to the left end of its shaded zone, with clockwise setting of the SENSITIVITY switch.

e. Verify on the scope that the output level is at least 1 V pk-pk on each channel. (The scaler is driving a high impedance load.)

f. Verify on the scope that the output periods are 10 and 100 times the input period, i.e., 0.1 and 1 μs for a 100-MHz input.

g. Repeat steps e and f, for these input frequencies: 1, 10, (100 already done) and 500 MHz.

5.2.3 Scaling, Method 1.

NOTE

This method is satisfactory. However, the alternative, method 2, is much preferred if a second scaler is available. It may be part of a GR 1192-Z Counter (500 MHz).

a. Connect the 100:1 SYNC OUTPUT of the scaler to the counter. Set its gate and display times each to 1 s.

b. Verify that the counter reads 1% of the signal-generator frequency (500 MHz), within ±0.5%.

c. Change the frequency slowly (over several counts) to 450 MHz, keeping a watch for gross errors in counting.

d. Repeat step b at intervals of 50 MHz down to 50 MHz and also check at 1 MHz. During each transition except the last one, watch the counter, as in step c.

e. If a frequency is found where a gross error in counting occurs (step b is not verified) within the specified range of inputs for the 1157-B, the counter has failed.

f. Repeat steps a-e for these input levels (0.1 V already done): 0.316, and 1 V, i.e., for signal-generator OUTPUT RANGE steps of 10 dB.

5.2.4 Scaling, Method 2.

a. Connect the 100:1 SYNC OUTPUT of the scaler under test to channel A, that of the auxilliary scaler to channel B of the counter.

b. Set the counter controls to measure RATIO for 100,000 PERIODS, and to hold the DISPLAY for 10 ms, in the STORAGE mode. (With a 5-digit counter use 10,000 periods.)

c. Sweep the frequency 1-500 MHz in any convenient bands at a rate not exceeding one octave (or one band of the GR 1026) in 10 seconds. Any band of special interest may be explored at any lower sweep rate, down to zero.

d. Verify that the ratio is always 1.00000 ± .00002 (except when the count is interrupted by bandswitching). (Read 1.0000 ± .0002 on 5-digit counters.)

NOTE

There may be no decimal point displayed by a counter measuring ratio. Assume that the decimal point is in the 5th (4th) position from the right when measurement lasts 100,000 (10,000) periods.

e. Repeat steps c and d for these input levels (0.1 V already done): 0.316 and 1. V, i.e., for signal-generator OUTPUT RANGE steps of 10 dB.

5.3 DISASSEMBLY AND REASSEMBLY.

5.3.1 Cabinet.

Loosen the 2 captive screws in rear panel, one near each side, to release the instrument chassis. Slide instrument forward out of cabinet, whether rack or bench mounted. Reassemble by reversing this procedure.

5.3.2 Knobs.

CAUTION

Do not use a screwdriver or other tool to pry off the knob if it is tight. Do not lose the spring clip in the knob while it is off.

To remove the knob from a front-panel control, to replace a damaged knob or the associated control, proceed as follows:

a. Grasp the knob firmly with dry fingers, close to the panel, and pull the knob straight away.

b. Observe the position of the setscrew in the bushing when the control is fully ccw.

c. Release the setscrew with an Allen wrench; pull the bushing off the shaft.

NOTE

To separate bushing from knob, if for any reason they should be combined off of the shaft, drive a machine tap a turn or two into the bushing to provide sufficient grip for easy separation. To return the spring clip, if that falls out, install it in interior groove; push its curved flange into small slit in wall of knob.

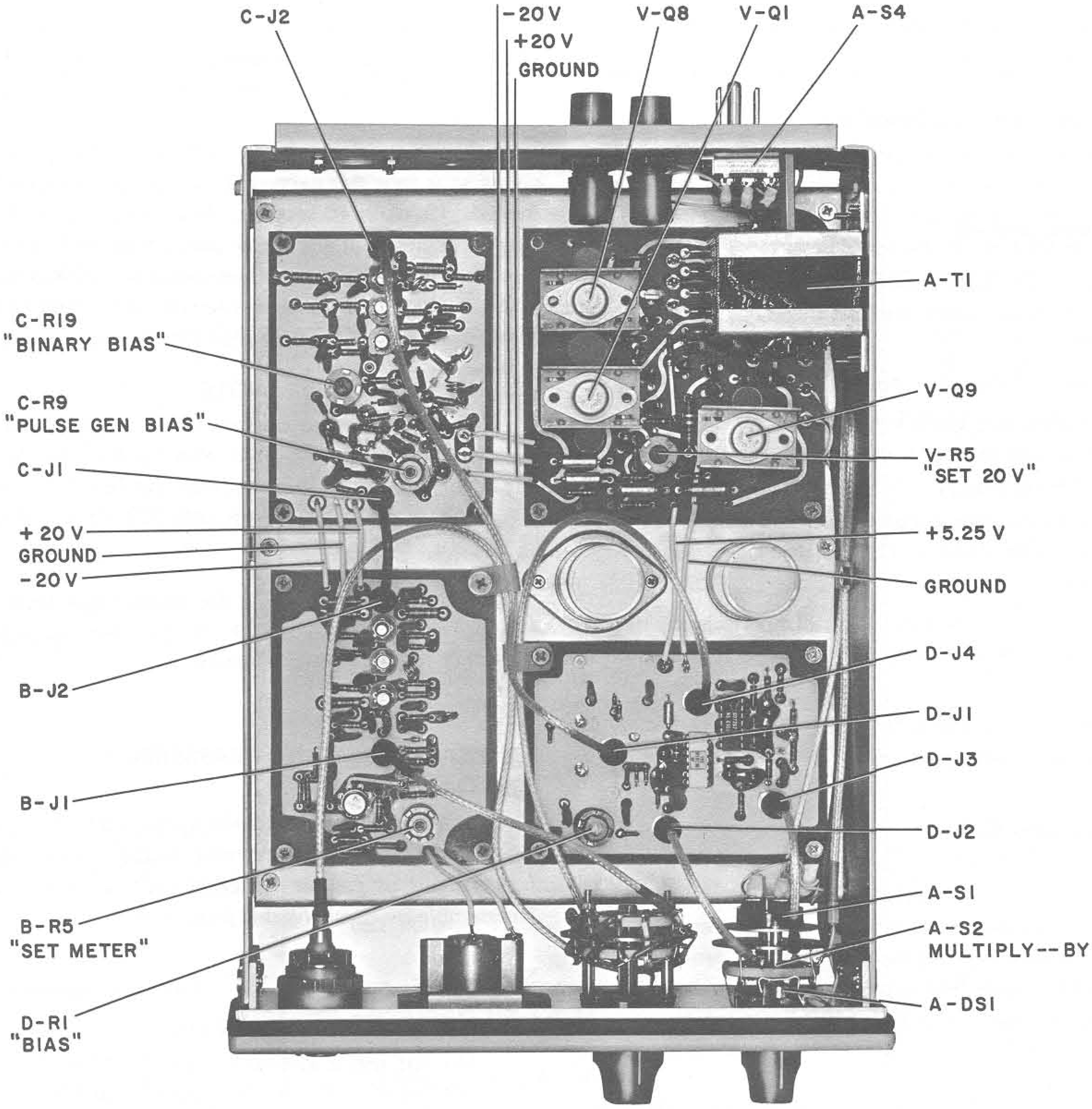

Figure 5-2. Interior top view.

Reassembly procedure follows:

d. Slip bushing on shaft and rotate to correct position as observed in disassembly.

e. Keep bushing away from panel by at least the thickness of a filing card. Pull it out farther if necessary to prevent tip of shaft from protruding.

f. Tighten the setscrew in the bushing.

g. Place knob on bushing with spring clip opposite the setscrew.

h. Push knob on until it bottoms, then pull it slightly, to check that spring clip engages groove in bushing. Knob should clear panel without touching.

5.3.3 Etched-Circuit Boards.

Removal of an etched board, for replacement or repair, is done as follows:

a. Disconnect each coaxial cable (if any) by unscrewing the outer shell of miniature connector and gently pulling up.

b. Disconnect each soldered wire by unsoldering. Do not overheat etched board. (If V-board is involved, use this checklist: 5 transformer leads, 2 braided-cable wires, 5 links to other boards, and 4 to nearby capacitors.)

c. Remove screws at corners of board and lift it out. (If V-board is involved, it may be necessary to temporarily unfasten power transformer — 5 screws — to gain access.)

The part number of each replacement board, complete with all parts and checked for performance, appears with the drawing of the board, near the corresponding schematic diagram in Section 6.

5.3.4 Individual Parts.

Specific instructions in paragraphs 5.7 explain which boards may be repaired. Removal of a faulty part requires care. The board is liable to be damaged by heating much above the melting point of solder or by pulling a part still attached, in any way, to the copper foil conductor. Use a suitable tool to suck molten solder away. Be sure holes are clear before inserting new parts.

5.4 ADJUSTMENTS.

The internal adjustments may each be made with a small screwdriver, at points shown in Figure 5-2.

5.4.1 Set Meter – B-R5.

If meter needs calibration, supply INPUT with a sinusoidal signal of 0.10 V rms, 100 MHz, and adjust B-R5 until pointer indicates left edge of green sector of INPUT LEVEL meter.

5.4.2 Pulse-Gen Bias – C-R9.

Adjust only with reference to instructions in paragraph 5.5.5. This sets the bias on tunnel diode C-CR2 for optimum drive into the pulse generator, and is most critical at highest frequencies.

5.4.3 Binary Bias – C-R19.

Adjust only with reference to instructions in paragraph 5.5.5. This sets the bias across the binary divider (tunnel-diode bridge) for optimum performance, insensitive to noise, at all input frequencies.

5.4.4 Bias – D-R1.

Adjust only with reference to instructions in paragraph 5.5.6. This sets the dc component of the "clock" pulse train applied to the scale-of-5 divider.

5.4.5 Set 20 V – V-R5.

Adjust only with reference to paragraph 5.5.1 This sets the +20-V regulator.

5.5 TROUBLE ANALYSIS.

Trouble analysis of the 1157-B Scaler is based on the functional block diagram of Figure 4-1. If the scaler falls short of the minimum performance standards given in paragraph 5.2, return the instrument to General Radio Company for service or proceed as follows to make whatever analysis and adjustment are feasible. If the fault can be localized to one etched board, time can be saved. A spare board may be substituted while the old one is returned to General Radio for repair. If adjustment is required upon such replacement, it is described in the following paragraphs.

5.5.1 Power Supply.

This procedure is to check the power supply for proper terminal voltages, to localize any fault, and to make pertinent adjustments. Complete this paragraph before making further trouble analysis.

a. Remove the cabinet.

b. Place controls in standard positions: SENSITIVITY, fully cw; MULTIPLY . . . BY, set at 100.

c. With the voltmeter ground terminal connected to WT2, verify the following dc voltages; refer to Figures 5-3 and 6-10:

at WT6, +20 V ± 1 V.
at WT7, -20 V ± 1 V.
at WT12, +5.25 V ± 0.25 V.

Adjust V-R5 if necessary to correct the +20-V terminal voltage.

d. Set the power-line voltage to 100 V rms. Repeat step c; record the measurements.

e. Reset the line to 125 V rms. Measure and record the dc voltages as in steps c and d. Reset the line to 115 V rms.

f. Verify that none of the 3 dc voltages varies more than 3% (total) between steps d and e. Otherwise, one or more of the regulators has failed.

Detailed trouble analysis will not be described. Data in Table 5-2 may be helpful. No-load transformer voltages are about 5% higher than the tabulated (operating) values. The voltage drops across series resistors V-R3, V-R9, and V-R10 will serve to measure corresponding currents, and thereby estimate the terminal currents of the power supply.

Table 5-2
POWER-SUPPLY PARAMETERS

Circuit	Terminals (V-)	Parameter	Tolerance
Transformer	WT1-WT2	20.8 V ac	±15%
	WT3-WT2	20.8 V ac	15
	WT8-WT9	8.4 V ac	15
+20-V	WT6	93 mA dc	10
-20-V	WT7	86 mA dc	10
+5.25-V	WT12	330 mA dc	10

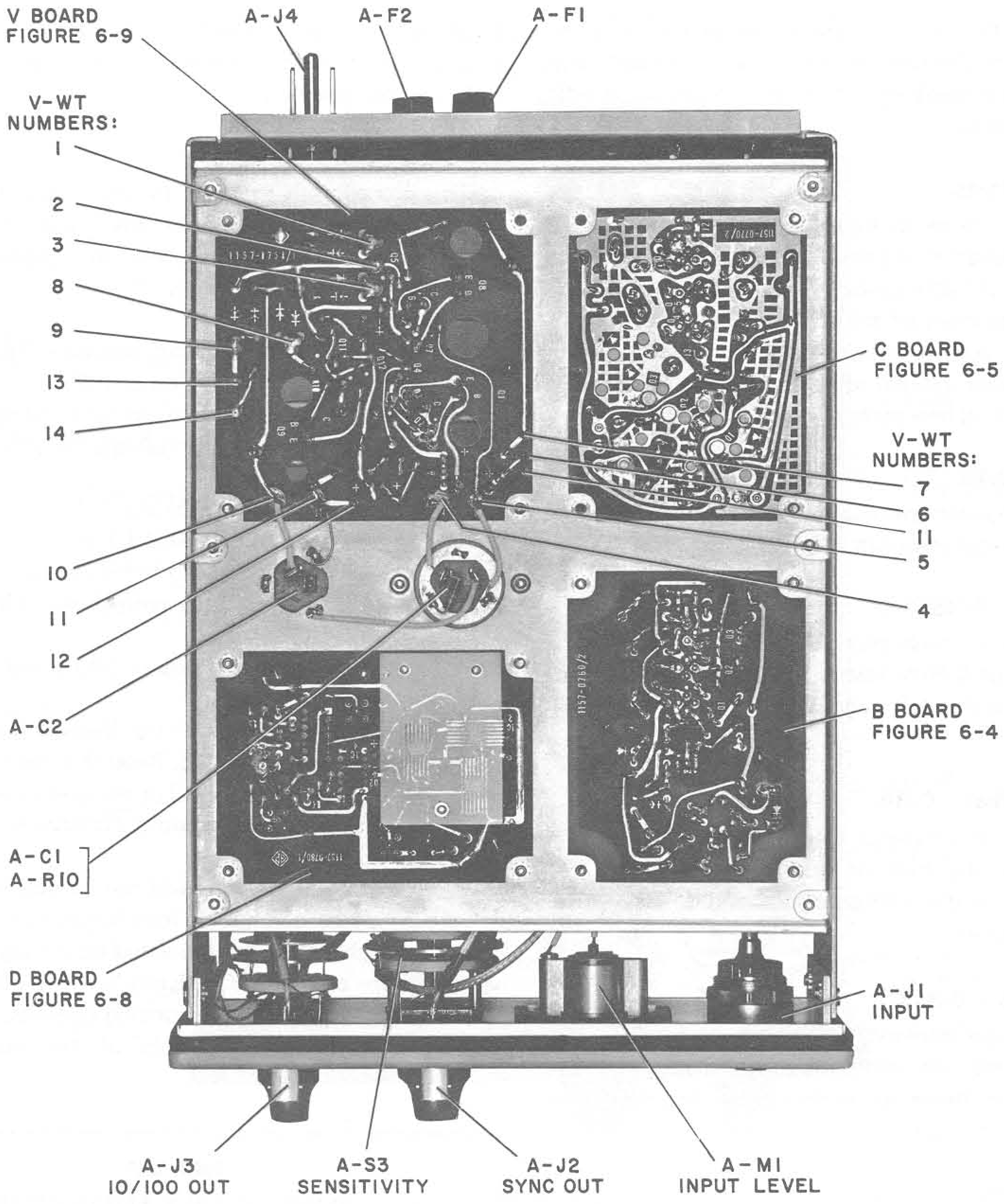

Figure 5-3. Interior bottom view.

Removal of the load from any power-supply circuit simply requires unsoldering of the corresponding wires.

If the power-supply board is replaced, repeat steps a through f.

5.5.2 Definition of Problem Input.

If possible determine the nature of the problem-input signal from the original complaint, such as a report of failure to pass paragraph 5.2.4 of the minimum performance standards. Unless the failure is catastrophic, it may depend on frequency and amplitude of the input signal. If such information is available, skip to step f; if unavailable, proceed as follows:

a. Use the appropriate signal generator (listed in Table 5-1). Set the modulation selector to CW, frequency to 500 MHz, and level to -7 dBm (100 mV at the scaler INPUT). Set the scaler controls clockwise (to standard settings).

b. Connect the counter to the SYNC OUT jack and determine whether it reads properly (5 MHz).

c. If there is no malfunction, tune to other frequencies until incorrect scaling is demonstrated. Investigate at least 1 frequency per octave, down to 1 MHz.

d. If necessary: raise the carrier level 4 dB, reset the SENSITIVITY control appropriately, and repeat step c.

e. Repeat step d until incorrect scaling is demonstrated. If necessary, cover the range 0.1-3 V in 7 steps of about 4 dB each.

f. Verify that the "problem-input" signal (one which results in faulty scaling) is within the specified ranges of frequency and level: 1-500 MHz, 0.1-7 V rms.

5.5.3 Input Circuitry. Figures 6-3, 6-6.

The following procedure checks the attenuator and meter and also establishes a test signal for later checks.

a. Provide the problem-input signal of paragraph 5.5.2 at the INPUT connector.

b. Turn the SENSITIVITY control until the meter reads in the green shaded area.

c. If this is impossible, make a detailed trouble analysis of the pertinent connectors, wiring, attenuator, and meter circuitry.

d. Check the meter, and adjust if necessary, as follows: Apply a 100-MHz, 100-mV signal as in paragraph 5.5.2, a. Adjust B-R5 to set pointer of INPUT LEVEL meter to left edge of green sector.

e. If the meter responds normally, proceed to the next paragraph.

5.5.4 Input Amplifier, B Board.

The following procedure applies to the input amplifier and completes the checkout from INPUT connector through the B board.

a. Disconnect the jumper cable from B-J2. Connect the output at B-J2 to the sampling scope. Use the adaptor and blocking capacitor listed in Table 5-1 (874-QMDP and 874-K).

b. Verify that the displayed waveform is satisfactory by comparison with Figure 5-4.

c. If the criteria of step b are met, replace the cable (step a) and proceed to the next paragraph.

d. If the criteria of step b are not met, return the B board to General Radio Company for repair or replacement.

e. If a replacement B-board is installed, check the meter adjustment, described in paragraph 5.5.3. Check the instrument by the method of paragraph 5.2.

5.5.5 First Divider, C Board. Figure 6-7.

The following procedure applies to the trigger generator and binary divider and completes the checkout from the INPUT connector through the C board.

a. Disconnect the jumper cable from C-J2. Connect the output from C-J2 to the sampling scope.

b. Verify that the displayed waveform is satisfactory by comparison with Figure 5-4 and the following comments. The period of the pulse should be exactly twice that of the INPUT signal. Examine the waveform carefully for irregularities such as skipping, pairing, or grouping of pulses. If these are found, check the observation, if possible, by changing the INPUT signal to one that the scaler handles properly. (The irregularity should disappear).

c. If the waveform of step b is satisfactory, replace jumper cable and proceed to next paragraph.

d. If the waveform of step b is unsatisfactory, the C-board is probably at fault. Return it to General Radio Company for repair or replacement.

e. After installing a replacement C-board, check its performance as in step b. *If necessary* make the following adjustments; use a 500-MHz, 100-mV signal as before, and set the SENSITIVITY control fully cw:

(1) Monitor dc voltage at C-J3 with electronic voltmeter; SYNC OUT signal with counter.

(2) Adjust C-R19 for 15.5 V dc at C-J3.

(3) Adjust C-R9 to center of a range of settings that give proper counter readout (5 MHz). If no such range can be found, try other settings of C-R19, such as 15, 16, 14, 17 V; adjust C-R9.

(4) Turn C-R19 over its range of settings that give proper counter readout, and note the corresponding voltage range measured at C-J3.

(5) Change the input signal from 500 MHz to 1 MHz, and repeat step (4).

(6) The ranges noted in steps (4) and (5) should overlap. Adjust C-R19 to the center of the overlapping voltage range.

(7) Return the frequency to 500 MHz and trim C-R9 if necessary as in step (3).

5.5.6 First Decade, C and D Boards. Figures 6-7, 6-11.

The following procedure applies to the by-5 divider and completes the checkout from the INPUT connector through the divide-by-ten circuitry and the 10/100 OUT connector.

a. Connect the counter to the 10/100 OUT connector and switch the MULTIPLY . . . BY control to 10.

NOTE

If the problem–input frequency is above 300 MHz, it will be necessary to use a second scaler, following the one being evaluated, to avoid exceeding the 30-MHz input-frequency limit of the 1192 Counter.

b. Verify that the counter reads 1/10 the input frequency (or 1/100 the input frequency if two scalers are cascaded).

c. Disconnect the counter and connect the main output of scaler to the sampling scope instead. Compare the displayed amplitude and waveform with Figure 5-4.

d. Verify that the output meets these specifications: rectangular waveshape, amplitude greater than +0.5 V pk., duty ratio more than 50%.

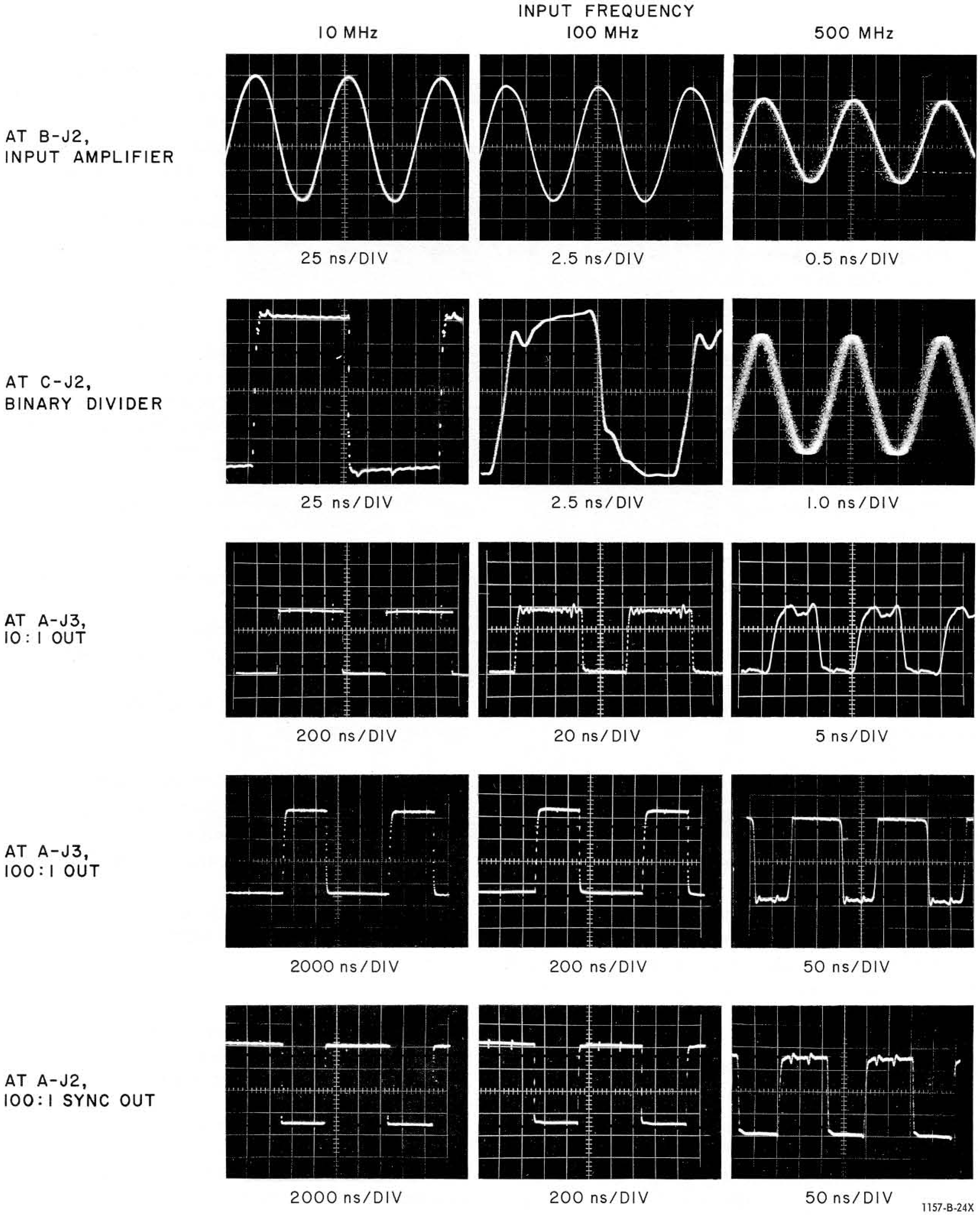

Figure 5-4. Typical waveforms at interior and panel-mounted connectors. All vertical scales are approximately 200 mV/div, and represent voltage across a 50-Ω load (the scope input impedance). These waveforms were photographed on a Tektronix 661 sampling oscilloscope with Type 4S1 (350 ps) and 5T1 plug-in units.

e. Check for loose connections by applying small forces to interconnecting cables in the instrument. Verify that no erratic changes occur in the scope display.

f. If loose connections are found, repair them and repeat steps a through d.

g. If the output is unsatisfactory (steps b and d), return the D-board to General Radio Company for repair or replacement.

h. If a replacement D-board is installed, check its performance as in paragraphs 5.5.6 and 5.5.7. Adjust D-R1 for the center of its range for proper output frequency when a 500-MHz signal is applied to the INPUT and the meter reads in the green sector.

i. Change the input signal from 500 MHz to 1 MHz and verify that the proper output frequency is obtained. If necessary reset D-R1 slightly, but within the range found in step h.

j. If the output is satisfactory, disconnect the scope and proceed to the next paragraph.

5.5.7 Final Decade, on D Board.

The following procedure applies to the final, divide-by-ten, portion of the D-board and completes the over-all checkout.

a. Connect the counter to the 10/100 OUT connector and switch the MULTIPLY . . . BY control to 100.

b. Verify that the counter reads 1/100 the input frequency.

c. Replace the counter with the sampling scope to look at the main output of scaler. Compare the displayed amplitude and waveform with Figure 5-4.

d. Verify that the output meets these specifications: rectangular waveshape, amplitude greater than +0.5 V pk., duty ratio less than 50%.

e. Check for loose connections by applying small forces to interconnecting cables in the instrument. Verify that no erratic changes occur in the scope display.

f. If loose connections are found, repair them and repeat steps a through d.

g. If the output is unsatisfactory (steps b and d), return the D-board to General Radio Company for repair or replacement.

h. If the output is satisfactory, no further service is required.

Parts Lists and Diagrams—Section 6

NOTE

Parts lists and etched-board drawings appear just before corresponding reference views or schematic diagrams.

INDEX page

NOTE

Each reference designator used in our schematic diagrams and circuit descriptions now includes an initial letter, before a hyphen, to identify the subassembly. The numeric portion of each designator is generally shorter than would be the case if a block of numbers were assigned to each subassembly. A new designation WT (wire-tie point) replaces the customary AT (anchor terminal). The letter before the hyphen may be omitted only if clearly understood, as within a subassembly schematic diagram.

Examples: B-R8 = B board, resistor 8; D-WT2 = D board, wire-tie point 2; CR6 on the V schematic is a shortened form of V-CR6 = V board, diode 6. The instrument may contain A-R1, B-R1, C-R1, and D-R1.

MECHANICAL PARTS LIST

Qnt.	*Ref. No.*	*Name*	*Description*	*GR Part Number*	*FMC*	*Mfg. Part No.*	**Stoc***FSN*
1	1	CABINET ASM.	Enclosure, including feet and bail.	4181-2528	24655	4181-2528	
1	2	METER	Meter, INPUT LEVEL, A-M1.	5730-1420	40931	20504010-017	
2	3	KNOB ASM.	Knob, SENSITIVITY; MULTIPLY--BY, including retainer 5220-5402.	5500-5221	24655	5500-5221	
1	4	GASKET	Cabinet gasket.	5331-3086	24655	5331-3086	
1	5	FOOT	Right-front rigid foot.	5250-2121	24655	5250-2121	
2	6	JACK	Jack, A-J2, SYNC OUT; A-J3, 10/100 OUT.	4230-2301	09408	UG-1094A/U	
1	7	CONNECTOR	Coaxial, A-J1, INPUT.	0874-4624	24655	0874-4624	
	8	FOOT	Left-front rigid foot.	5250-2120	24655	5250-2120	
	-	BAIL	Folding front leg.	5250-2123	24655	5250-2123	
1	9	SWITCH	Slide switch, A-S4, line voltage.	7910-0831	42190	4603	
2	10	FUSEHOLDER	Fuse-mounting device.	5650-0100	71400	HKP-H	5920-284-7144
1	11	COVER PLATE	Cover plate, INPUT.	0480-8190	24655	0480-8190	
2	12	FOOT	Rear resilient foot.	5260-2060	24655	5260-2060	
1	13	PLUG	Power plug, A-J4.	4240-0600	24655	4240-0600	5935-816-0254

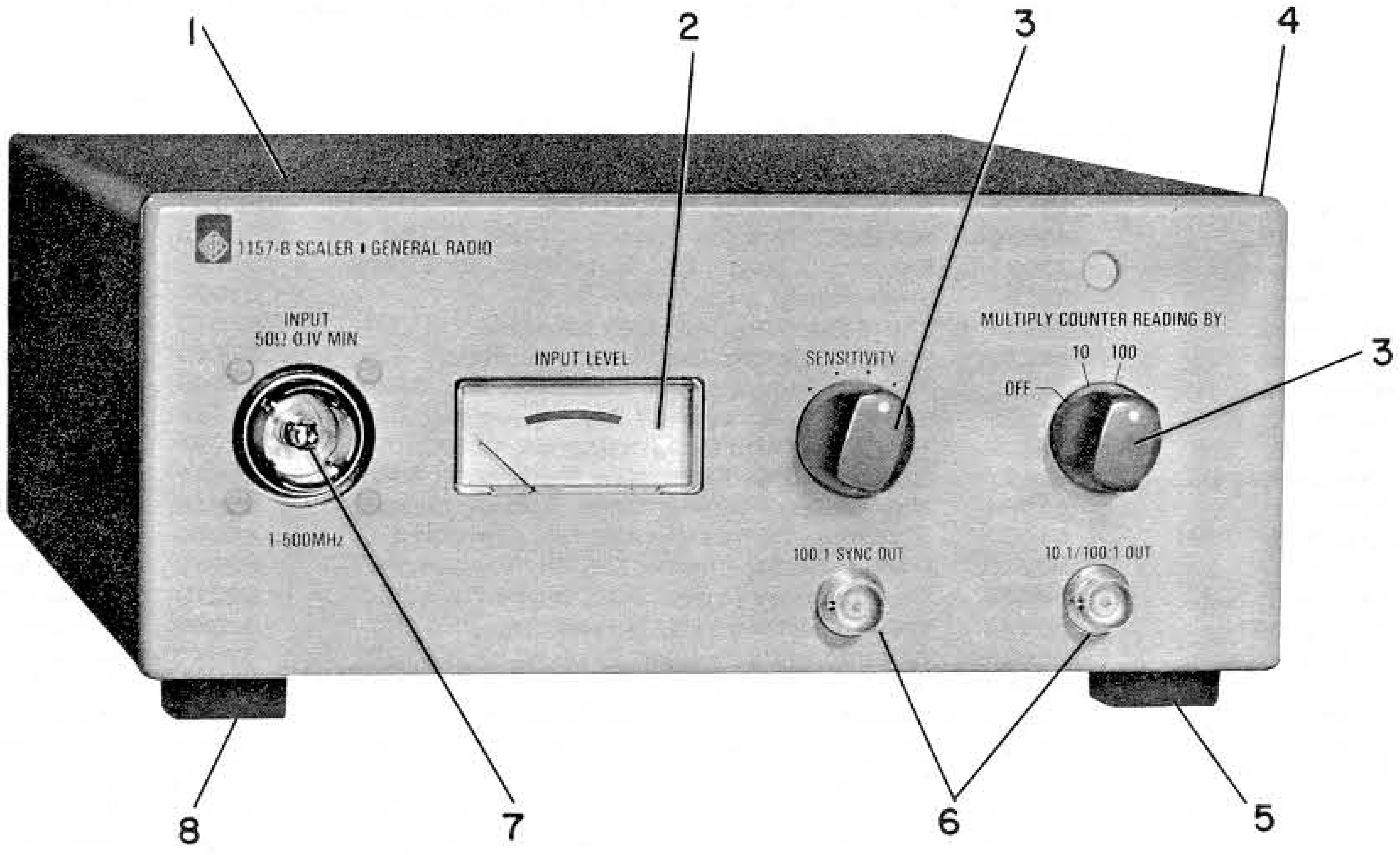

Figure 6-1. Front view, mechanical replaceable parts identified.

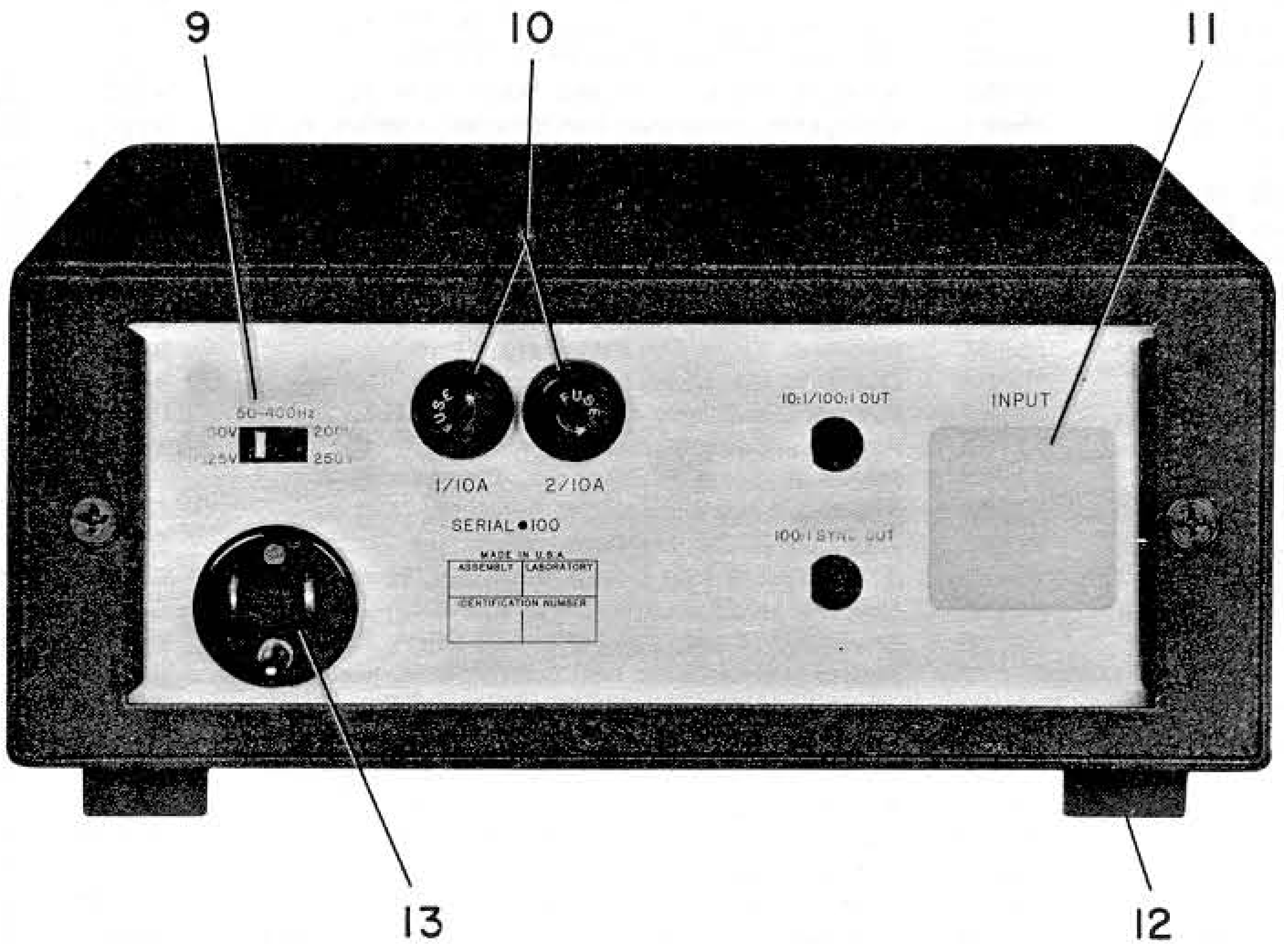

Figure 6-2. Rear view, mechanical replaceable parts identified.

FEDERAL MANUFACTURER'S CODE

From Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) as supplemented through August, 1968.

Code	Manufacturer
00192	Jones Mfg. Co, Chicago, Illinois
00194	Walsco Electronics Corp, L.A., Calif.
00434	Schweber Electronics, Westburg, L.I., N.Y.
00656	Aerovox Corp, New Bedford, Mass.
01009	Alden Products Co, Brockton, Mass.
01121	Allen-Bradley, Co, Milwaukee, Wisc.
01295	Texas Instruments, Inc, Dallas, Texas
02114	Ferroxcube Corp, Saugerties, N.Y. 12477
02606	Fenwal Lab Inc, Morton Grove, Ill.
02660	Amphenol Electron Corp, Broadview, Ill.
02768	Fastex, Des Plaines, Ill. 60016
03508	G.E. Semicon Prod, Syracuse, N.Y. 13201
03636	Grayburne, Yonkers, N.Y. 10701
03888	Pyrofilm Resistor Co, Cedar Knolls, N.J.
03911	Clairex Corp, New York, N.Y. 10001
04009	Arrow-Hart & Hegeman, Hartford, Conn. 06106
04713	Motorola, Phoenix, Ariz. 85008
05170	Engr'd Electronics, Santa Ana, Calif. 92702
05624	Barber-Colman Co, Rockford, Ill. 61101
05820	Wakefield Eng, Inc, Wakefield, Mass. 01880
07126	Digitron Co, Pasadena, Calif.
07127	Eagle Signal (E.W. Bliss Co), Baraboo, Wisc.
07261	Avnet Corp, Culver City, Calif. 90230
07263	Fairchild Camera, Mountain View, Calif.
07387	Birtcher Corp, No. Los Angeles, Calif.
07595	Amer Semicond, Arlington Hts, Ill. 60004
07828	Bodine Corp, Bridgeport, Conn. 06605
07829	Bodine Electric Co, Chicago, Ill. 60618
07910	Cont Device Corp, Hawthorne, Calif.
07983	State Labs Inc, N.Y., N.Y. 10003
07999	Borg Inst., Delavan, Wisc. 53115
08730	Vemaline Prod Co, Franklin Lakes, N.J.
09213	G.E. Semiconductor, Buffalo, N.Y.
09408	Star-Tronics Inc, Georgetown, Mass. 01830
09823	Burgess Battery Co, Freeport, Ill.
09922	Burndy Corp, Norwalk, Conn. 06852
11236	C.T.S. of Berne, Inc, Berne, Ind. 46711
11599	Chandler Evans Corp, W. Hartford, Conn.
12040	National Semiconductor, Danbury, Conn.
12498	Crystalonics, Cambridge, Mass. 02140
12672	RCA, Woodbridge, N.J.
12697	Clarostat Mfg Co, Inc, Dover, N.H. 03820
12954	Dickson Electronics, Scottsdale, Ariz.
13327	Solitron Devices, Tappan, N.Y. 10983
14433	ITT Semicondictors, W.Palm Beach, Fla.
14655	Cornell-Dubilier Electric Co, Newark, N.J.
14674	Corning Glass Works, Corning, N.Y.
14936	General Instrument Corp, Hicksville, N.Y.
15238	ITT, Semiconductor Div, Lawrence, Mass.
15605	Cutlet-Hammer Inc, Milwaukee, Wisc. 53233
16037	Spruce Pine Mica Co, Spruce Pine, N.C.
17771	Singer Co, Diehl Div, Somerville, N.J.
19396	Illinois Tool Works, Pakton Div, Chicago, Ill.
19644	LRC Electronics, Horseheads, N.Y.
19701	Electra Mfg Co, Independence, Kansas 67301
21335	Fafnir Bearing Co, New Briton, Conn.
22753	UID Electronics Corp, Hollywood, Fla.
23342	Avnet Electronics Corp, Franklin Park, Ill.
24446	G.E., Schenectady, N.Y. 12305
24454	G.E., Electronics Comp, Syracuse, N.Y.
24455	G.E. (Lamp Div), Nela Park, Cleveland, Ohio
24655	General Radio Co, W. Concord, Mass. 01781
26806	American Zettlet Inc, Costa Mesa, Calif.
28520	Hayman Mfg Co, Kenilworth, N.J.
28959	Hoffman Electronics Corp, El Monte, Calif.
30874	I.B.M, Armonk, New York
32001	Jensen Mfg. Co, Chicago, Ill. 60638
33173	G.E. Comp, Owensboro, Ky. 42301
35929	Constanta Co, Mont. 19, Que.
37942	P.R. Mallory & Co Inc, Indianapolis, Ind.
38443	Marlin-Rockwell Corp, Jamestown, N.Y.
40931	Honeywell Inc, Minneapolis, Minn. 55408
42190	Muter Co, Chicago, Ill. 60638
42498	National Co, Inc, Melrose, Mass. 02176
43991	Norma-Hoffman, Stanford, Conn. 06904
49671	RCA, New York, N.Y. 10020
49956	Raytheon Mfg Co, Waltham, Mass. 02154
53021	Sangamo Electric Co, Springfield, Ill. 62705
54294	Shallcross Mfg Co, Selma, N.C.
54715	Shure Brothers, Inc, Evanston, Ill.
56289	Sprague Electric Co, N. Adams, Mass.
59730	Thomas and Betts Co, Elizabeth, N.J. 07207
59875	TRW Inc, (Accessories Div), Cleveland, Ohio
60399	Torrington Mfg Co, Torrington, Conn.
61637	Union Carbide Corp, New York, N.Y. 10017
61864	United-Carr Fastener Corp, Boston, Mass.
63060	Victoreen Instrument Co, Inc, Cleveland, O.
63743	Ward Leonard Electric Co, Mt. Vernon, N.Y.
65083	Westinghouse (Lamp Div), Bloomfield, N.J.
65092	Weston Instruments, Newark, N.J.
70485	Atlantic-India Rubber, Chicago, Ill. 60607
70563	Amperite Co, Union City, N.J. 07087
70903	Belden Mfg Co, Chicago, Ill. 60644
71126	Bronson, Homer D, Co, Beacon Falls, Conn.
71294	Canfield, H.O. Co, Clifton Forge, Va. 24422
71400	Bussman (McGraw Edison), St. Louis, Mo.
71468	ITT Cannon Elec, L.A., Calif. 90031
71590	Centralab, Inc, Milwaukee, Wisc, 53212
71666	Continental Carbon Co, Inc, New York, N.Y.
71707	Coto Coil Co Inc, Providence, R.I.
71744	Chicago Miniature Lamp Works, Chicago, Ill.
71785	Cinch Mfg Co, Chicago, Ill. 60624
71823	Darnell Corp, Ltd, Downey, Calif. 90241
72136	Electro Motive Mfg Co, Wilmington, Conn.
72259	Nytronics Inc, Berkeley Heights, N.J. 07922
72619	Dialight Co, Brooklyn, N.Y. 11237
72699	General Instr Corp, Newark, N.J. 07104
72765	Drake Mfg Co, Chicago, Ill. 60656
72825	Hugh H. Eby Inc, Philadelphia, Penn. 19144
72962	Elastic Stop Nut Corp, Union, N.J. 07083
72982	Erie Technological Products Inc, Erie, Penn.
73138	Beckman Inc, Fullerton, Calif. 92634
73445	Amperex Electronics Co, Hicksville, N.Y.
73559	Carling Electric Co, W.Hartford, Conn.
73690	Elco Resistor Co, New York, N.Y.
73899	JFD Electronics Corp, Brooklyn, N.Y.
74193	Heinemann Electric Co, Trenton, N.J.
74861	Industrial Condenser Corp, Chicago, Iii.
74970	E.F. Johnson Co, Waseca, Minn. 56093
75042	IRC Inc, Philadelphia, Penn. 19108
75382	Kulka Electric Corp, Mt. Vernon, N.Y.
75491	Lafayette Industrial Electronics, Jamica, N.Y.
75608	Linden and Co, Providence, R.I.
75915	Littelfuse, Inc, Des Plaines, Ill. 60016
76005	Lord Mfg Co, Erie, Penn. 16512
76149	Mallory Electric Corp, Detroit, Mich. 48204
76487	James Millen Mfg Co, Malden, Mass. 02148
76545	Mueller Electric Co, Cleveland, Ohio 44114
76684	National Tube Co, Pittsburg, Penn.
76854	Oak Mfg Co, Crystal Lake, Ill.
77147	Patton MacGuyer Co, Providence, R.I.
77166	Pass-Seymour, Syracuse, N.Y.
77263	Pierce Roberts Rubber Co, Trenton, N.J.
77339	Positive Lockwasher Co, Newark, N.J.
77542	Ray-O-Vac Co, Madison, Wisc.
77630	TRW, Electronic Comp, Camden, N.J. 08103
77638	General Instruments Corp, Brooklyn, N.Y.
78189	Shakeproof (Ill. Tool Works), Elgin, Ill. 60120
78277	Sigma Instruments Inc, S.Braintree, Mass.
78488	Stackpole Carbon Co, St. Marys, Penn.
78553	Tinnerman Products, Inc, Cleveland, Ohio
79089	RCA, Rec Tube & Semicond, Harrison, N.J.
79725	Wiremold Co, Hartford, Conn. 06110
79963	Zierick Mfg Co, New Rochelle, N.Y.
80030	Prestole Fastener, Toledo, Ohio
80048	Vickers Inc, St. Louis, Mo.
80131	Electronic Industries Assoc, Washington, D.C.
80183	Sprague Products Co, No. Adams, Mass.
80211	Motorola Inc, Franklin Park, Ill. 60131
80258	Standard Oil Co, Lafeyette, Ind.
80294	Bourns Inc, Riverside, Calif. 92506
80431	Air Filter Corp, Milwaukee, Wisc. 53218
80583	Hammarlund Co, Inc, New York, N.Y.
80740	Beckman Instruments, Inc, Fullerton, Calif.
81030	International Insturment, Orange, Conn.
81073	Grayhill Inc, LaGrange, Ill. 60525
81143	Isolantite Mfg Corp, Stirling, N.J. 07980
81349	Military Specifications
81350	Joint Army-Navy Specifications
81751	Columbus Electronics Corp, Yonkers, N.Y.
81831	Filtron Co, Flushing, L.I., N.Y. 11354
81840	Ledex Inc, Dayton, Ohio 45402
81860	Barry-Wright Corp, Watertown, Mass.
82219	Sylvania Elec Prod, Emporium, Penn.
82273	Indiana Pattern & Model Works, LaPort, Ind.
82389	Switchcraft Inc, Chicago, Ill. 60630
82647	Metals & Controls Inc, Attleboro, Mass.
82807	Milwaukee Resistor Co, Milwaukee, Wisc.
83033	Meissner Mfg, (Maguire Ind) Mt. Carmel, Ill.
83058	Carr Fastener Co, Cambridge, Mass.
83186	Victory Engineering, Springfield, N.J. 07081
83361	Bearing Specialty Co, San Francisco, Calif.
83587	Solar Electric Corp, Warren, Penn.
83740	Union Carbide Corp, New York, N.Y. 10017
83781	National Electronics Inc, Geneva, Ill.
84411	TRW Capacitor Div, Ogallala, Nebr.
84835	Lehigh Metal Prods, Cambridge, Mass. 02140
84971	TA Mfg Corp, Los Angeles, Calif.
86577	Precision Metal Prods, Stoneham, Mass. 02180
86684	RCA (Elect. Comp & Dev), Harrison, N.J.
86687	REC Corp, New Rochelle, N.Y. 10801
86800	Cont Electronics Corp, Brooklyn, N.Y. 11222
88140	Cutler-Hammer Inc, Lincoln, Ill.
88219	Gould Nat. Batteries Inc, Trenton, N.J.
88419	Cornell-Dubilier, Fuquay-Varina, N.C.
88627	K & G Mfg Co, New York, N.Y.
89482	Holtzer-Cabot Corp, Boston, Mass.
89665	United Transformer Co, Chicago, Ill.
90201	Mallory Capacitor Co, Indianapolis, Ind.
90750	Westinghouse Electric Corp, Boston, Mass.
90952	Hardware Products Co, Reading, Penn. 19602
91032	Continental Wire Corp, York, Penn. 17405
91146	ITT (Cannon Electric Inc), Salem, Mass.
91293	Johanson Mfg Co, Boonton, N.J. 07005
91506	Augat Inc, Attleboro, Mass. 02703
91598	Chandler Co, Wethersfield, Conn. 06109
91637	Dale Electronics Inc, Columbus, Nebr.
91662	Elco Corp, Willow Grove, Penn.
91719	General Instruments, Inc, Dallas, Texas
91929	Honeywell Inc, Freeport, Ill.
92519	Electra Insul Corp, Woodside, L.I., N.Y.
92678	E.G.&G., Boston, Mass.
93332	Sylvania Elect Prods, Inc, Woburn, Mass.
93916	Cramer Products Co, New York, N.Y. 10013
94144	Raytheon Co, Components Div, Quincy, Mass.
94154	Tung Sol Electric Inc, Newark, N.J.
95076	Garde Mfg Co, Cumberland, R.I.
95121	Quality Components Inc, St. Mary's, Penn.
95146	Alco Electronics Mfg Co, Lawrence, Mass.
95238	Continental Connector Corp, Woodside, N.Y.
95275	Vitramon, Inc, Bridgeport, Conn.
95354	Methode Mfg Co, Chicago, Ill.
95412	General Electric Co, Schenectady, N.Y.
95794	Anaconda Amer Brass Co, Torrington, Conn.
96095	Hi-Q Div. of Aerovox Corp, Orlean, N.Y.
96214	Texas Instruments Inc, Dallas, Texas 75209
96256	Thordarson-Meissner, Mt. Carmel, Ill.
96341	Microwave Associates Inc, Burlington, Mass.
96791	Amphenol Corp, Jonesville, Wisc, 53545
96906	Military Standards
98291	Sealectro Corp, Mamaroneck, N.Y. 10544
98474	Compar Inc, Burlingame, Calif.
98821	North Hills Electronics Inc, Glen Cove, N.Y.
99180	Transitron Electronics Corp, Melrose, Mass.
99313	Varian, Palo Alto, Calif. 94303
99378	Atlee Corp, Winchester, Mass. 01890
99800	Delevan Electronics Corp, E. Aurora, N.Y.

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RESISTANCE IS IN OHMS, $K=10^3$, $M=10^6$
CAPACITANCE IS IN FARADS, $\mu=10^{-6}$, $p=10^{-12}$
VOLTAGES EXPLAINED IN INSTRUCTION BOOK SERVICE NOTES
▭=PANEL CONTROL ⬚=REAR CONTROL
⊘=SCREWDRIVER CONTROL WT=WIRE TIE TP=TEST POINT
COMPLETE REFERENCE DESIGNATION INCLUDES SUBASSEMBLY LETTER, C-R1, B-R1, ETC.

404F SWITCH NUMBERING
F — FRONT, REAR
04 — CONTACTS. FIRST CONTACT CW FROM STRUT SCREW ABOVE KEY IS .01.
4 — SECTION. SECTION NEAREST PANEL IS 1.
ROTORS SHOWN CCW

CONNECTIONS
→ OUTPUT LEAVES SUBASSEMBLY
▶ INPUT FROM DIFFERENT SUBASSEMBLY
▷ OUTPUT REMAINS ON SUBASSEMBLY
▷ INPUT FROM SAME SUBASSEMBLY

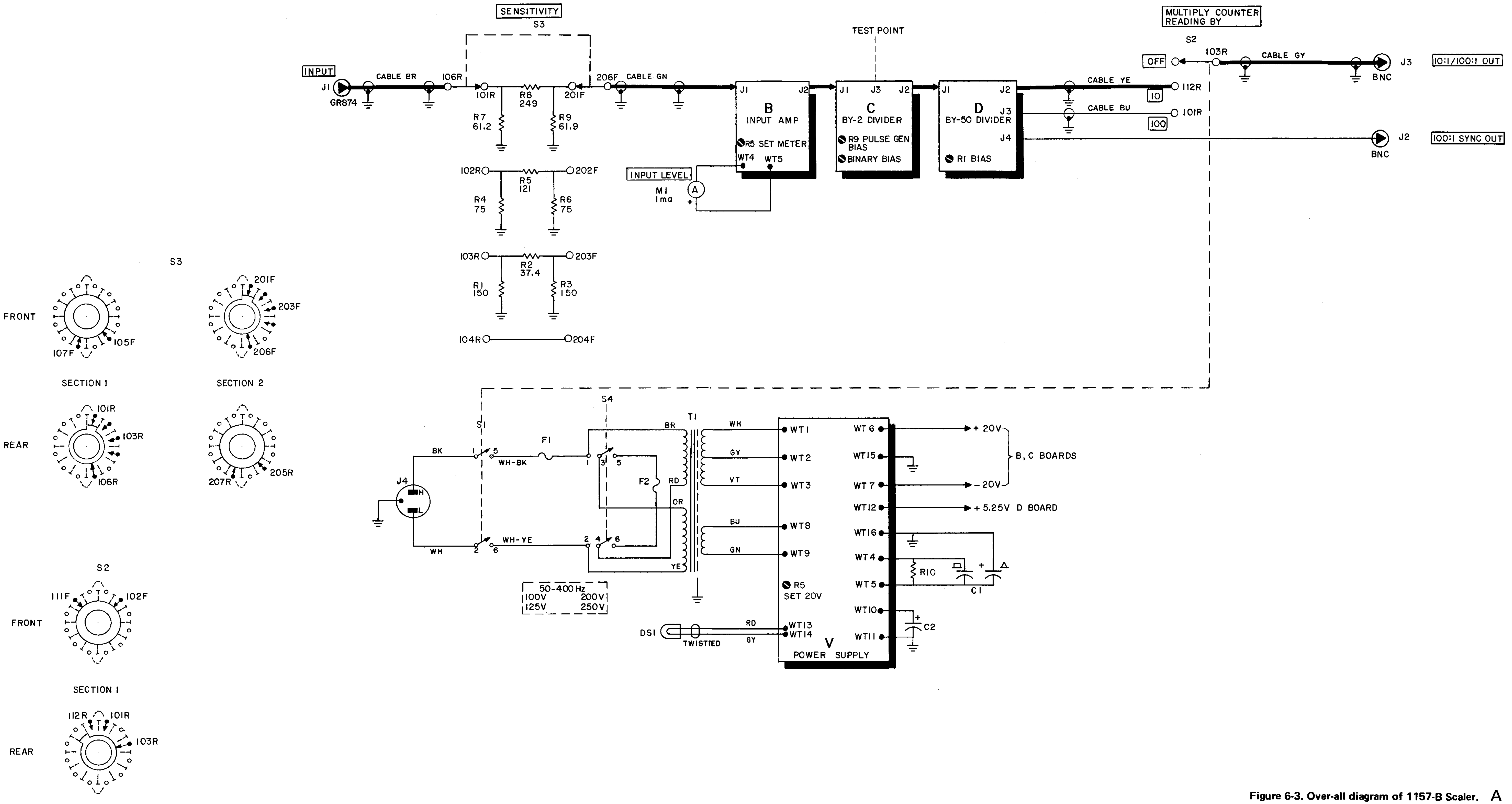

Figure 6-3. Over-all diagram of 1157-B Scaler. A

ELECTRICAL PARTS LIST

Ref. Desig.	*Description*	*GR Part No.*	*FMC*	*Mfg. Part No.*	*Fed. Stock No.*
CAPACITORS					
A-C1	Electrolytic, 300µF +100-10% 75 V	4450-5620	37942	20-222544990	5910-931-7040
A-C2	Electrolytic, 1600µF +100-10% 10 V	4450-5603	37942	20-22406990	5910-931-7042
FUSES					
A-F1	2/10A, Slo-blo	5330-0600	71400	MDL, .2 Amp.	
A-F2	1/10A, Slo-blo	5330-0400	71400	MDL, .1 Amp.	5920-356-2185
JACKS					
A-J1	INPUT	0874-4624	24655	0874-4624	
A-J2	100:1 SYNC OUT	4230-2301	09408	UG-1094A/U	
A-J3	10:1/100:1 OUT	4230-2301	09408	UG-1094A/U	
A-J4	Power plug	4240-0600	24655	4240-0600	5935-816-0254
METER					
A-M1	INPUT LEVEL	5730-1420	40931	20504010-017	
PILOT LAMP					
A-DS1	Incandescent	5600-0300	24454	#328	6240-155-7857
RESISTORS					
A-R1	Film 150Ω ±1% 1/8 W	6250-0150	75042	CEA, 150Ω ±1%	
A-R2	Film 37.4 KΩ ±1% 1/8 W	6250-9374	75042	CEA, 37.4 KΩ ±1%	
A-R3	Film 150Ω ±1% 1/8 W	6250-0150	75042	CEA, 150Ω ±1%	
A-R4	Film 75Ω ±1% 1/8 W	6250-0075	75042	CEA, 75Ω ±1%	
A-R5	Film 121Ω ±1% 1/8 W	6250-0121	75042	CEA, 121Ω ±1%	
A-R6	Film 75Ω ±1% 1/8 W	6250-0075	75042	CEA, 75Ω ±1%	
A-R7	Film 61.2Ω ±0.5% 1/2 W	6450-9612	75042	CEA, 61.2Ω ±0.5%	
A-R8	Film 249Ω ±1% 1/8 W	6250-0249	75042	CEA, 249Ω ±1%	
A-R9	Film 61.9Ω ±1% 1/2 W	6450-9619	75042	CEC, 61.9Ω ±1%	
A-R10	Comp. 20 KΩ ±5% 1/2 W	6100-3205	01121	RC20GF203J	5905-192-0649
SWITCHES					
A-S1	OFF	Part of A-S2	---	---	
A-S2	MULTIPLY -- BY	7890-5318	24655	7890-5318	
A-S3	SENSITIVITY	7890-5317	24655	7890-5317	
A-S4	Line Voltage	7910-0831	42190	4603	
TRANSFORMER					
A-T1	Power	0745-4640	24655	0745-4640	

Figure 6-3 →

ELECTRICAL PARTS LIST

Ref. Desig.	*Description*	*GR Part No.*	*FMC*	*Mfg. Part No.*	*Fed. Stock No.*
COMPLETE BOARD					
B	Input-Amplifier Board, Dipped	1157-4760	24655	1157-4760	
CAPACITORS					
B-C1	Ceramic, .01μF +80-20% 100 V	4401-3100	80131	CC61, .01μF +80-20%	5910-974-1141
B-C2	Ceramic .001μF +80-20% 500 V	4404-2109	72982	831, .001μF +80-20%	5910-938-9994
B-C3	Ceramic .01μF +80-20% 100 V	4401-3100	80131	CC61, .01μF +80-20%	5910-974-1141
B-C4	Ceramic 10pF ±10% 500 V	4404-0108	72982	831, 10pF ±10%	
B-C5	Ceramic .01μF +80-20% 100 V	4401-3100	80131	CC61, .01μF +80-20%	5910-974-1141
B-C6	Ceramic .01μF +80-20% 100 V	4401-3100	80131	CC61, .01μF +80-20%	5910-974-1141
B-C7	Ceramic 8.2pF (N30) ±5% 500 V	4411-9825	72982	0831003B1G00829J	
B-C8	Ceramic .01μF +80-20% 100 V	4401-3100	80131	CC61, .01μF +80-20%	5910-974-1141
B-C9	Ceramic .01μF +80-20% 100 V	4401-3100	80131	CC61, .01μF +80-20%	5910-974-1141
B-C10	Ceramic 7.5pF (30) ±5% 500 V	4411-9755	72982	831, 7.5pF (30)	
B-C11	Ceramic 15pF ±10% 500 V	4404-0158	72982	831, 15pF ±10%	
B-C12	Ceramic .01μF +80-20% 100 V	4401-3100	80131	CC61, .01μF +80-20%	5910-974-1141
B-C13	Ceramic .01μF +80-20% 100 V	4401-3100	80131	CC61, .01μF +80-20%	5910-974-1141
B-C14	Ceramic .01μF +80-20% 100 V	4401-3100	80131	CC61, .01μF +80-20%	5910-974-1141
B-C15	Ceramic .0022μF +80-20% 500 V	4404-2229	72982	831, .0022μF +80-20%	
B-C16	Ceramic .01μF +80-20% 100 V	4401-3100	80131	CC61, .01μF +80-20%	5910-974-1141
DIODES					
B-CR1	Type HD5000	6082-1021	73293	HD5000	
B-CR2	Type HD5000	6082-1021	73293	HD5000	
B-CR3	Type IN3604	6082-1011	24446	IN3604	5961-995-2199
INDUCTORS					
B-L1	Air-core	1157-8301	24655	1157-8301	
B-L2	Air-core	1157-8300	24655	1157-8300	
INTEGRATED CIRCUIT					
B-IC1	Linear	5432-1439	04713	MC1439G	
JACKS					
B-J1	Connector	4260-1800	15116	131-0141-0001	
B-J2	Connector	4260-1800	15116	131-0141-0001	
RESISTORS					
B-R1	Comp. 51Ω ±5% 1/4 W	6099-0515	75042	BTS, 51Ω ±5%	
B-R2	Comp. 330Ω ±10% 1/4 W	6099-1339	75042	BTS, 330Ω ±10%	
B-R3	Comp. 200 KΩ ±5% 1/4 W	6099-4205	75042	BTS, 200 KΩ ±5%	5905-681-8821
B-R4	Comp. 200 KΩ ±5% 1/4 W	6099-4205	75042	BTS, 200 KΩ ±5%	5905-681-8821
B-R5	Pot. Comp. 100 KΩ ±20%	6040-1000	01121	FWC, 100 KΩ 20%	5905-958-7949
B-R6	Comp. 10Ω ±5% 1/4 W	6099-0105	75042	BTS, 10Ω 5%	5905-809-8596
B-R7	Comp. 33Ω ±5% 1/4 W	6099-0335	75042	BTS, 33Ω 5%	
B-R8	Comp. 2.7 KΩ ±5% 1/4 W	6099-2275	75042	BTS, 2.7 KΩ 5%	
B-R9	Comp. 2 KΩ ±5% 1/4 W	6099-2205	75042	BTS, 2 KΩ 5%	5905-279-4629
B-R10	Comp. 82Ω ±5% 1/4 W	6099-0825	75042	BTS, 82Ω 5%	
B-R11	Comp. 33Ω ±5% 1/4 W	6099-0335	75042	BTS, 33Ω 5%	
B-R12	Comp. 3 KΩ ±5% 1/2 W	6100-2305	01121	RC20GF302J	5905-279-1751
B-R13	Comp. 1.1 KΩ ±5% 1/4 W	6099-2115	75042	BTS, 1.1 KΩ 5%	
B-R14	Comp. 82Ω ±5% 1/4 W	6099-0825	75042	BTS, 82Ω 5%	
B-R15	Comp. 10Ω ±5% 1/4 W	6099-0105	75042	BTS, 10Ω 5%	5905-809-8596
B-R16	Comp. 33Ω ±5% 1/4 W	6099-0335	75042	BTS, 33Ω 5%	
B-R17	Comp. 1 KΩ ±5% 1/2 W	6100-2105	01121	RC20GF102J	5905-195-6806
B-R18	Comp. 1 KΩ ±5% 1/2 W	6100-2105	01121	RC20GF102J	5905-195-6806
B-R19	Comp. 39Ω ±5% 1/4 W	6099-0395	75042	BTS, 39Ω 5%	
B-R20	Comp. 330Ω ±5% 1/2 W	6100-1335	01121	RC20GF331J	5905-192-3971
B-R21	Comp. 1.6 KΩ ±5% 1/4 W	6099-2165	75042	BTS, 1.6 KΩ 5%	
B-R22	Comp. 2 KΩ ±5% 1/4 W	6099-2205	75042	BTS, 2 KΩ 5%	5905-279-4629
B-R23	Comp. 15 KΩ ±5% 1/4 W	6099-3155	75042	BTS, 15 KΩ 5%	5905-681-8818
B-R24	Comp. 1.6 KΩ ±5% 1/4 W	6099-2165	75042	BTS, 1.6 KΩ 5%	
B-R25	Comp. 390Ω ±10% 1/4 W	6099-1399	75042	BTS, 390Ω 10%	
B-R26	Comp. 300Ω ±5% 1/4 W	6099-1305	75042	BTS, 300Ω 5%	5905-279-5481
B-R27	Comp. 6.8 KΩ ±5% 1/4 W	6099-2685	75042	BTS, 6.8 KΩ 5%	5905-686-9997
B-R28	Comp. 2 KΩ ±5% 1/4 W	6099-2205	75042	BTS, 2 KΩ 5%	5905-279-4629
SOCKETS					
B-S01	Transistor	7540-3450	91506	8069-1G2	
B-S02	Transistor	7540-3450	91506	8069-1G2	
B-S03	Transistor	7540-3450	91506	8069-1G2	
TRANSISTORS					
B-Q1	Type 2N2857	8210-1088	24454	2N2810-A	
B-Q2	Type 2N2857	8210-1088	24454	2N2810-A	
B-Q3	Type A485	8210-1194	73445	A485	

ELECTRICAL PARTS LIST

Ref. Desig.	*Description*	*GR Part No.*	*FMC*	*Mfg. Part No.*	*Fed. Stock No.*
COMPLETE BOARD					
C	Binary-Frequency-Divider board Asm, Cpt.	1157-4770	24655	1157-4770	
CAPACITORS					
C-C1	Ceramic 1000pF (GMV) 500 V	4400-2094	01121	SS5A	
C-C2	Ceramic .01µF +80-20% 100 V	4401-3100	80131	CC61, .01µF +80-20%	5910-974-5697
C-C3	Ceramic 10pF ±10% 500 V	4404-0108	72982	831, 10pF 10%	
C-C4	Ceramic 1000pF (GMV) 500 V	4400-2094	01121	SS5A	
C-C5	Ceramic .01µF +80-20% 100 V	4401-3100	80131	CC61, .01µF +80-20%	5910-974-5697
C-C6	Ceramic 1000pF (GMV) 500 V	4400-2094	01121	SS5A	
C-C7*	Ceramic 4.7pF (N30) ±5% 500 V	*4411-9475*	72982	831, 4.7pF (N30)*	
C-C8	Ceramic 1000pF (GMV) 500 V	4400-2094	01121	SS5A	
C-C9	Ceramic .01µF +80-20% 100 V	4401-3100	80131	CC61, .01µF +80-20%	5910-974-5697
C-C10	Ceramic .01µF +80-20% 100 V	4401-3100	80131	CC61, .01µF +80-20%	5910-974-5697
C-C11*	Ceramic 3.9pF ±5% 500 V	*4400-0600*	78488	GA, 3.9pF 5%*	
C-C12	Ceramic .01µF +80-20% 100 V	4401-3100	80131	CC61, .01µF +80-20%	5910-974-5697
C-C13	Ceramic .01µF +80-20% 100 V	4401-3100	80131	CC61, .01µF +80-20%	5910-974-5697
C-C14	Ceramic .01µF +80-20% 100 V	4401-3100	80131	CC61, .01µF +80-20%	5910-974-5697
C-C15	Ceramic 10pF ±10% 500 V	4404-0108	72982	831, 10pF 10%	
C-C16	Ceramic 0.1µF +80-20% 10 V	4431-4109	72982	5655, 0.1µF +80-20%	
C-C17	Ceramic .01µF +80-20% 100 V	4401-3100	80131	CC61, .01µF +80-20%	5910-974-5697
C-C18	Ceramic 20pF ±10% 500 V	4404-0208	72982	831, 20pF 10%	
C-C19	Ceramic 0.1µF +80-20% 10 V	4431-4109	72982	5655, 0.1µF +80-20%	
C-C20	Ceramic .01µF +80-20% 100 V	4401-3100	80131	CC61, .01µF +80-20%	5910-974-5697
C-C21	Ceramic .01µF +80-20% 100 V	4401-3100	80131	CC61, .01µF +80-20%	5910-974-5697
C-C22	Ceramic .01µF +80-20% 100 V	4401-3100	80131	CC61, .01µF +80-20%	5910-974-5697
C-C23	Ceramic 10pF ±10% 500 V	4404-0108	72892	831, 10pF 10%	
C-C24	Ceramic 0.1µF +80-20% 10 V	4431-4109	72982	5655, 0.1µF +80-20%	
C-C25	Ceramic .01µF +80-20% 100 V	4401-3100	80131	CC61, .01µF +80-20%	5910-974-5697
DIODES					
C-CR1*	Tunnel Diode	6085-1013*	70754	G05010C*	
C-CR2*	Tunnel Diode	6085-1012*	70754	G05005C*	
C-CR3/CR4*	Matched Tunnel Diodes	6085-1011*	24655	6085-1011*	
INDUCTORS					
C-L1	Air-core	1157-8300	24655	1157-8300	
C-L2	Air-core	1157-8301	24655	1157-8301	
JACKS					
C-J1	Connector,	4260-1800	15116	131-0141-0001	
C-J2	Connector	4260-1800	15116	131-0141-0001	
C-J3	Connector	4260-1291	70563	380598-1	
RESISTORS					
C-R1	Comp. 51Ω ±5% 1/4 W	6099-0515	75042	BTS, 51Ω 5%	
C-R2	Comp. 33Ω ±5% 1/4 W	6099-0335	75042	BTS, 33Ω 5%	
C-R3	Comp. 2.2 KΩ ±5% 1/4 W	6099-2225	75042	BTS, 2.2 KΩ 5%	5905-723-5251
C-R4	Comp. 3.9 KΩ ±5% 1/4 W	6099-2395	75042	BTS, 3.9 KΩ 5%	
C-R5	Comp. 33Ω ±5% 1/4 W	6099-0335	75042	BTS, 33Ω 5%	
C-R6	Comp. 2.7 KΩ ±5% 1/4 W	6099-2275	75042	BTS, 2.7 KΩ 5%	
C-R7	Comp. 110Ω ±5% 1/4 W	6099-1115	75042	BTS, 110Ω 5%	
C-R8	Comp. 3.6 KΩ ±5% 1/4 W	6099-2365	75042	BTS, 3.6 KΩ 5%	
C-R9	Pot. Comp. 5 KΩ ±20%	6040-0600	01121	FWC, 5 KΩ 20%	5905-034-5374
C-R10	Comp. 2.2 KΩ ±5% 1/4 W	6099-2225	75042	BTS, 2.2 KΩ 5%	5905-723-5251
C-R11	Comp. 150Ω ±5% 1/4 W	6099-1155	75042	BTS, 150Ω 5%	5905-683-2243
C-R12*	Comp. 33Ω ±5% 1/4 W	*6099-0335*	75042	BTS, 33Ω 5%*	
C-R13*	Comp. 33Ω ±5% 1/4 W	*6099-0335*	75042	BTS, 33Ω 5%*	
C-R14	Comp. 2.7 KΩ ±5% 1/4 W	6099-2275	75042	BTS, 2.7 KΩ 5%	
C-R15	Comp. 1 KΩ ±5% 1/4 W	6099-2105	75042	BTS, 1 KΩ 5%	5905-681-6462
C-R16	Comp. 3 KΩ ±5% 1/4 W	6099-2305	75042	BTS, 3 KΩ 5%	5905-682-4097
C-R17	Comp. 5.1 KΩ ±5% 1/4 W	6099-2515	75042	BTS, 5.1 KΩ 5%	5905-279-4623
C-R18	Comp. 33Ω ±5% 1/4 W	6099-0335	75042	BTS, 33Ω 5%	
C-R19	Pot. Comp. 500Ω ±20%	6040-0300	01121	FWC, 500Ω 20%	5905-072-7795
C-R21	Comp. 470Ω ±5% 1/4 W	6099-1475	75042	BTS, 470Ω 5%	5905-683-5242
C-R22	Comp. 510Ω ±5% 1/4 W	6099-1515	75042	BTS, 510Ω 5%	5905-801-8272
C-R23	Comp. 51Ω ±5% 1/4 W	6099-0515	75042	BTS, 51Ω 5%	
C-R24	Film 64.9Ω ±1% 1/8 W	6250-9649	75042	CEA, 64.9Ω 1%	
C-R25	Film 64.9Ω ±1% 1/8 W	6250-9649	75042	CEA, 64.9Ω 1%	
C-R26	Comp. 100Ω ±5% 1/4 W	6099-1105	75042	BTS, 100Ω 5%	
C-R27	Comp. 2.2 kΩ ±5% 1/4 W	6099-2225	75042	BTS, 2.2 KΩ 5%	5905-723-5251
C-R28	Comp. 100Ω ±5% 1/4 W	6099-1105	75042	BTS, 100Ω 5%	

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ELECTRICAL PARTS LIST (cont)

Ref. Desig.	*Description*	*GR Part No.*	*FMC*	*Mfg. Part No.*	*Fed. Stock No.*
RESISTORS (Cont)					
C-R29	Comp. 1 KΩ ±5% 1/4 W	6099-2105	75042	BTS, 1 KΩ 5%	5905-681-6462
C-R30	Comp. 10Ω ±5% 1/4 W	6099-0105	75042	BTS, 10Ω 5%	5905-809-8596
C-R31	Comp. 33Ω ±5% 1/4 W	6099-0335	75042	BTS, 33Ω 5%	
C-R32	Comp. 2.7 KΩ ±5% 1/4 W	6099-2275	75042	BTS, 2.7 KΩ 5%	
C-R33	Comp. 33Ω ±5% 1/4 W	6099-0335	75042	BTS, 33Ω 5%	
C-R34	Comp. 1.3 KΩ ±5% 1/4 W	6099-2135	75042	BTS, 1.3 KΩ 5%	5905-686-3119
C-R35	Comp. 33Ω ±5% 1/4 W	6099-0335	75042	BTS, 33Ω 5%	
C-R36	Comp. 3.3 KΩ ±5% 1/4 W	6099-2335	75042	BTS, 3.3 KΩ 5%	5905-681-9969
C-R37	Comp. 33Ω ±5% 1/4 W	6099-0335	75042	BTS, 33Ω 5%	
C-R38	Comp. 1 KΩ ±5% 1/2 W	6100-2105	01121	RC20GF102J	5905-195-6806
C-R39	Comp. 33Ω ±5% 1/4 W	6099-0335	75042	BTS, 33Ω 5%	
C-R40	Comp. 100Ω ±5% 1/4 W	6099-1105	75042	BTS, 100Ω 5%	
C-R41	Comp. 1.3 KΩ ±5% 1/2 W	6100-2135	01121	RC20GF132J	5905-279-1870
SOCKETS					
C-S04	Transistor	7540-3450	91506	8069-1G2	
C-S05	Transistor	7540-3450	91506	8069-1G2	
C-S06	Transistor	7540-3450	91506	8069-1G2	
TRANSISTORS					
C-Q1*	Type 2N2857*	8210-1088*	24454	2N2810-A*	
C-Q2*	Type 2N2857*	8210-1088*	24454	2N2810-A*	
C-Q3*	Type 2N2857*	8210-1088*	24454	2N2810-A*	
C-Q4	Type 2N2857	8210-1088	24454	2N2810-A	
C-Q5	Type 2N2857	8210-1088	24454	2N2810-A	
C-Q6	Type A485	8210-1194	73445	A485	

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ELECTRICAL PARTS LIST

Ref. Desig.	*Description*	*GR Part No.*	*FMC*	*Mfg. Part No.*	*Fed. Stock No.*
COMPLETE BOARD					
D-board Divide-By-5 & 10 Board, Cpt.		1157-4780	24655	1157-4780	
CAPACITORS					
D-C1	Ceramic .01μF +80-20% 100 V	4401-3100	80131	CC61, .01μF +80-20%	5910-974-5697
D-C2	Ceramic .01μF +80-20% 100 V	4401-3100	80131	CC61, .01μF +80-20%	5910-974-5697
D-C3	Ceramic .01μF +80-20% 100 V	4401-3100	80131	CC61, .01μF +80-20%	5910-974-5697
D-C4	Ceramic .01μF +80-20% 100 V	4401-3100	80131	CC61, .01μF +80-20%	5910-974-5697
D-C6	Electrolytic 4.7μF ±20% 10 V	4450-4700	56289	150D465X0015B2	5910-813-8160
INTEGRATED CIRCUIT					
D-IC1	Digital	5431-9611	04713	MC1013L	
D-IC2	Digital	5431-9611	04713	MC1013L	
D-IC3	Digital	5431-9611	04713	MC1013L	
D-IC4	Digital	5431-9610	04713	MC10131	
D-IC5	Digital	5431-9613	11293	SF123-P	
D-IC6	Digital	5431-8272	01295	SN74H72N	
JACKS					
D-J1	Connector	4260-1800	15116	131-0141-0001	
D-J2	Connector	4260-1800	15116	131-0141-0001	
D-J3	Connector	4260-1800	15116	131-0141-0001	
D-J4	Connector	4260-1800	15116	131-0141-0001	
RESISTORS					
D-R1	Pot. Comp. 100Ω ±20%	6040-0100	01121	FWC, 100Ω 20%	
D-R2	Comp. 100Ω ±5% 1/8 W	6098-1105	01121	BB, 100Ω 5%	
D-R3	Comp. 51Ω ±5% 1/8 W	6098-0515	01121	BB, 51Ω 5%	
D-R4	Comp. 470Ω ±5% 1/8 W	6098-1475	01121	BB, 470Ω 5%	
D-R5	Comp. 470Ω ±5% 1/8 W	6098-1475	01121	BB, 470Ω 5%	
D-R6	Comp. 470Ω ±5% 1/8 W	6098-1475	01121	BB, 470Ω 5%	
D-R7	Comp. 470Ω ±5% 1/8 W	6098-1475	01121	BB, 470Ω 5%	
D-R8	Comp. 470Ω ±5% 1/8 W	6098-1475	01121	BB, 470Ω 5%	
D-R9	Comp. 39Ω ±5% 1/8 W	6098-0395	01121	BB, 39Ω 5%	
D-R10	Comp. 51Ω ±5% 1/8 W	6098-0515	01121	BB, 51Ω 5%	
D-R11	Comp. 470Ω ±5% 1/8 W	6098-1475	01121	BB, 470Ω 5%	
D-R12	Comp. 33Ω ±5% 1/4 W	6099-0335	75042	BTS, 33Ω 5%	
D-R13	Comp. 100Ω ±5% 1/4 W	6099-1105	75042	BTS, 100Ω 5%	
D-R14	Comp. 300Ω ±5% 1/4 W	6099-1305	75042	BTS, 300Ω 5%	5905-279-5481
D-R15	Comp. 200Ω ±5% 1/4 W	6099-1205	75042	BTS, 200Ω 5%	5905-892-0107
D-R16	Comp. 51Ω ±5% 1/4 W	6099-0515	75042	BTS, 51Ω 5%	
D-R17	Comp. 39Ω ±5% 1/4 W	6099-0395	75042	BTS, 39Ω 5%	
D-R18	Comp. 51Ω ±5% 1/4 W	6099-0515	75042	BTS, 51Ω 5%	
D-R19	Comp. 200Ω ±5% 1/4 W	6099-1205	75042	BTS, 200Ω 5%	5905-892-0107
D-R20	Comp. 300Ω ±5% 1/4 W	6099-1305	75042	BTS, 300Ω 5%	5905-279-5481
TRANSISTORS					
D-Q1	Type 2N4258	8210-1136	93916	2N4258	
D-Q2	Type 2N4258	8210-1136	93916	2N4258	
D-Q3	Type 2N4258	8210-1136	93916	2N4258	
D-Q4	Type 2N4258	8210-1136	93916	2N4258	
D-Q5	Type 2N4258	8210-1136	93916	2N4258	
D-Q6	Type 2N4258	8210-1136	93916	2N4258	

ELECTRICAL PARTS LIST (cont)

Ref. Desig.	*Description*	*GR Part No.*	*FMC*	*Mfg. Part No.*	*Fed. Stock No.*
COMPLETE BOARD					
V	Power-Supply Board, Dipped	1157-4750	24655	1157-4750	
CAPACITORS					
V-C1	Electrolytic 6.8μF ±20% 35 V	4450-5000	56289	150D685X0035B2	5910-814-5869
V-C2	Electrolytic 15μF ±20% 20 V	4450-5200	56289	150D156X0020B2	5910-855-6335
V-C3	Electrolytic 15μF ±20% 20 V	4450-5200	56289	150D156X0020B2	5910-855-6335
V-C4	Electrolytic 47μF ±20% 6 V	4450-5500	56289	150D476X0006B2	5910-752-4185
DIODES					
V-CR1	Type 1N3253	6081-1001	79089	1N3253	5961-814-4251
V-CR2	Type 1N3253	6081-1001	79089	1N3253	5961-814-4251
V-CR3	Type 1N3253	6081-1001	79089	1N3253	5961-814-4251
V-CR4	Type 1N3253	6081-1001	79089	1N3253	5961-814-4251
V-CR5	Type 1N3253	6081-1001	79089	1N3253	5961-814-4251
V-CR6	Type 1N3253	6081-1001	79089	1N3253	5961-814-4251
V-CR7	Type 1N3253	6081-1001	79089	1N3253	5961-814-4251
V-VR9	Type 1N753A 6.2 V ±5%	6083-1006	07910	1N753A	5961-752-6121
RESISTORS					
V-R1	Comp. 10 KΩ ±10% 1/4 W	6099-3109	75042	BTS, 10 KΩ 10%	
V-R2	Comp. 10 KΩ ±10% 1/4 W	6099-3109	75042	BTS, 10 KΩ 10%	
V-R3	Comp. 2.7Ω ±5% 1/4 W	6099-9275	75042	BTS, 2.7Ω 5%	
V-R4	Comp. 13 KΩ ±5% 1/4 W	6099-3135	75042	BTS, 13 KΩ 5%	5905-702-4439
V-R5	Pot. Comp. 1 KΩ ±20%	6040-0400	01121	FWC, 1 KΩ 20%	
V-R6	Comp. 6.2 KΩ ±5% 1/4 W	6099-2625	75042	BTS, 6.2 KΩ 5%	5905-682-4100
V-R7	Film 3.83 KΩ ±1% 1/8 W	6250-1383	75042	CEA, 3.83 KΩ 1%	5905-827-3333
V-R8	Film 4.02 KΩ ±1% 1/8 W	6250-1402	75042	CEA, 4.04 KΩ 1%	5905-702-7231
V-R9	Comp. 4.7Ω ±5% 1/4 W	6099-9475	75042	BTS, 4.7Ω 5%	
V-R10	Wire-wound 1.5Ω ±10% 2 W	6760-9159	75042	BWH, 1.5Ω 10%	
V-R11	Comp. 15 KΩ ±10% 1/4 W	6099-3159	75042	BTS, 15 KΩ 10%	
V-R12	Film 1.78 KΩ ±1% 1/8 W	6250-1178	75042	CEA, 1.78 KΩ 1%	5905-824-3077
V-R13	Film 487Ω ±1% 1/8 W	6250-0487	75042	CEA, 487Ω 1%	
V-R14	Wire-wound 20Ω ±5% 2 W	6760-0205	75042	BWH, 20Ω 10%	
V-R15	Comp. 2.7 KΩ ±10% 1/4 W	6099-2279	75042	BTS, 2.7 KΩ 10%	
TRANSISTORS					
V-Q1	Type 40250V1	8210-1158	12672	40250-V1	
V-Q2	Type 2N3414	8210-1047	24446	2N3414	5961-989-2749
V-Q3	Type 2N3414	8210-1047	24446	2N3414	5961-989-2749
V-Q4	Type 2N3414	8210-1047	24446	2N3414	5961-989-2749
V-Q5	Type 2N3905	8210-1114	04713	2N3905	
V-Q6	Type 2N3414	8210-1047	24446	2N3414	5961-989-2749
V-Q7	Type 2N3414	8210-1047	24446	2N3414	5961-989-2749
V-Q8	Type 40250V1	8210-1158	12672	40250-V1	
V-Q9	Type 40250V1	8210-1158	12672	40250-V1	
V-Q10	Type 2N3414	8210-1047	24446	2N3414	5961-989-2749
V-Q11	Type 2N3414	8210-1047	24446	2N3414	5961-989-2749
V-Q12	Type 2N3414	8210-1047	24446	2N3414	5961-989-2749

NOTE

View shows component side of board. Circuit paths: solid=opposite side, shaded=this side.

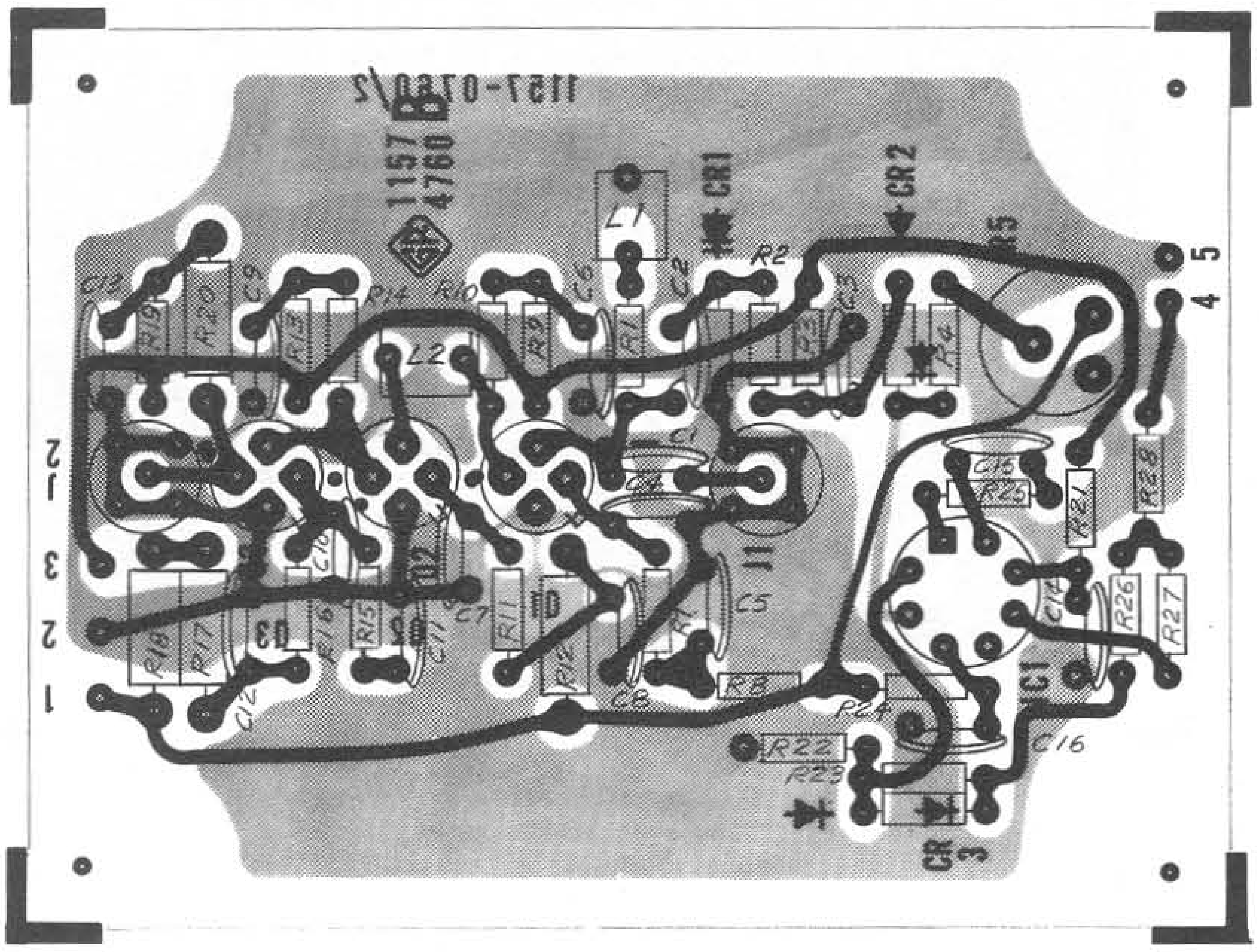


Figure 6-4. B-assembly etched-circuit board (P/N 1157-4760).

NOTE

View shows component side of board. Circuit paths: this side not shown, shaded=opposite side.

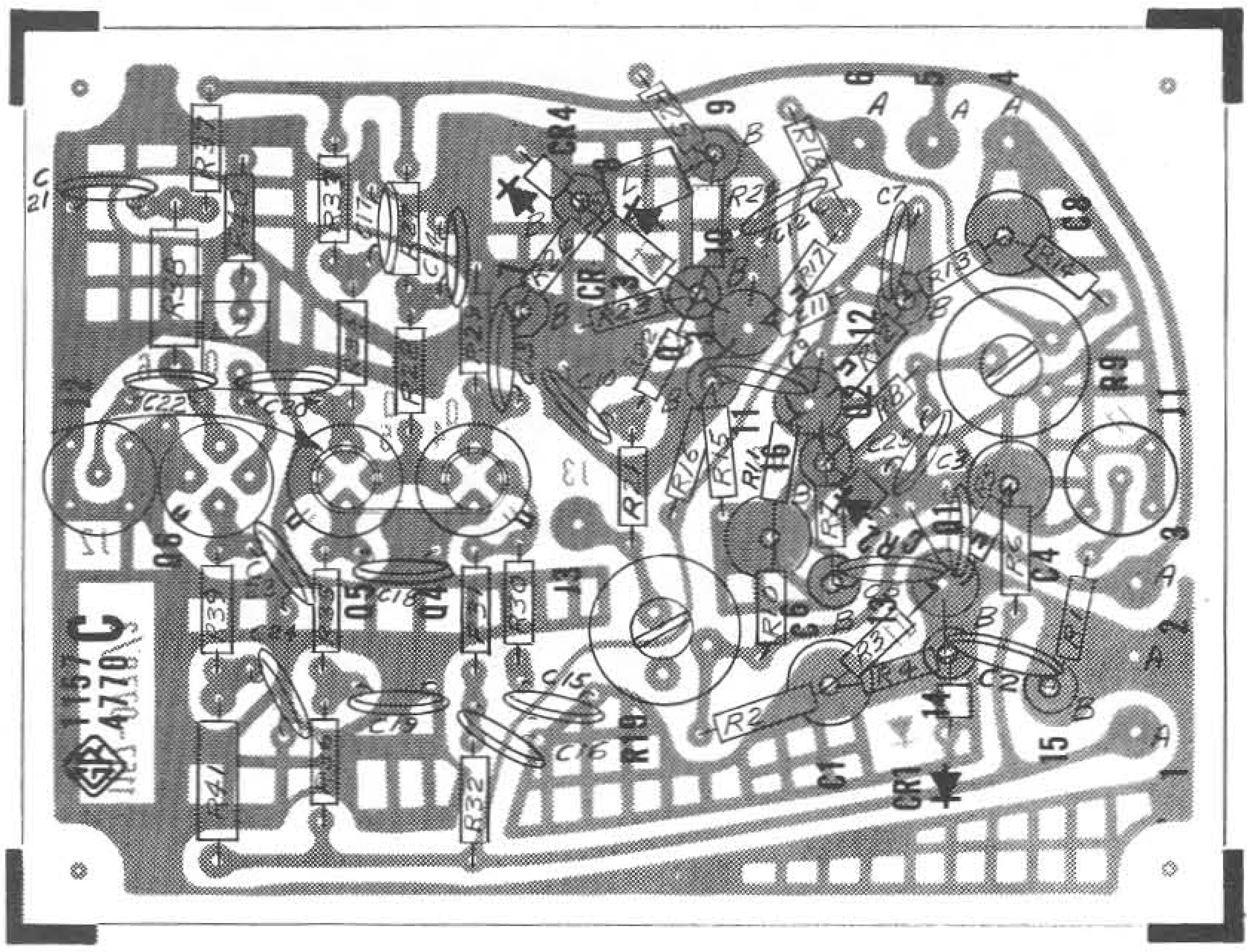


Figure 6-5. C-assembly etched-circuit board (P/N 1157-4770).

NOTE: The number etched on the foil is *not* the part number. The dot on the foil at the transistor socket indicates the collector lead.

Figure 6-7 →

RESISTANCE IS IN OHMS, K=10^3, M=10^6
CAPACITANCE IS IN FARADS, $\mu=10^{-6}$, $p=10^{-12}$
VOLTAGES EXPLAINED IN INSTRUCTION BOOK SERVICE NOTES
▭=PANEL CONTROL ⬚=REAR CONTROL
⊘=SCREWDRIVER CONTROL WT=WIRE TIE TP=TEST POINT
COMPLETE REFERENCE DESIGNATION INCLUDES SUBASSEMBLY LETTER, C-R1, B-R1, ETC.

404F SWITCH NUMBERING
F—FRONT, REAR
04—CONTACTS. FIRST CONTACT CW FROM STRUT SCREW ABOVE KEY IS .01.
4—SECTION. SECTION NEAREST PANEL IS 1.
ROTORS SHOWN CCW

CONNECTIONS
——▶ OUTPUT LEAVES SUBASSEMBLY
▶—— INPUT FROM DIFFERENT SUBASSEMBLY
——▷ OUTPUT REMAINS ON SUBASSEMBLY
▷—— INPUT FROM SAME SUBASSEMBLY

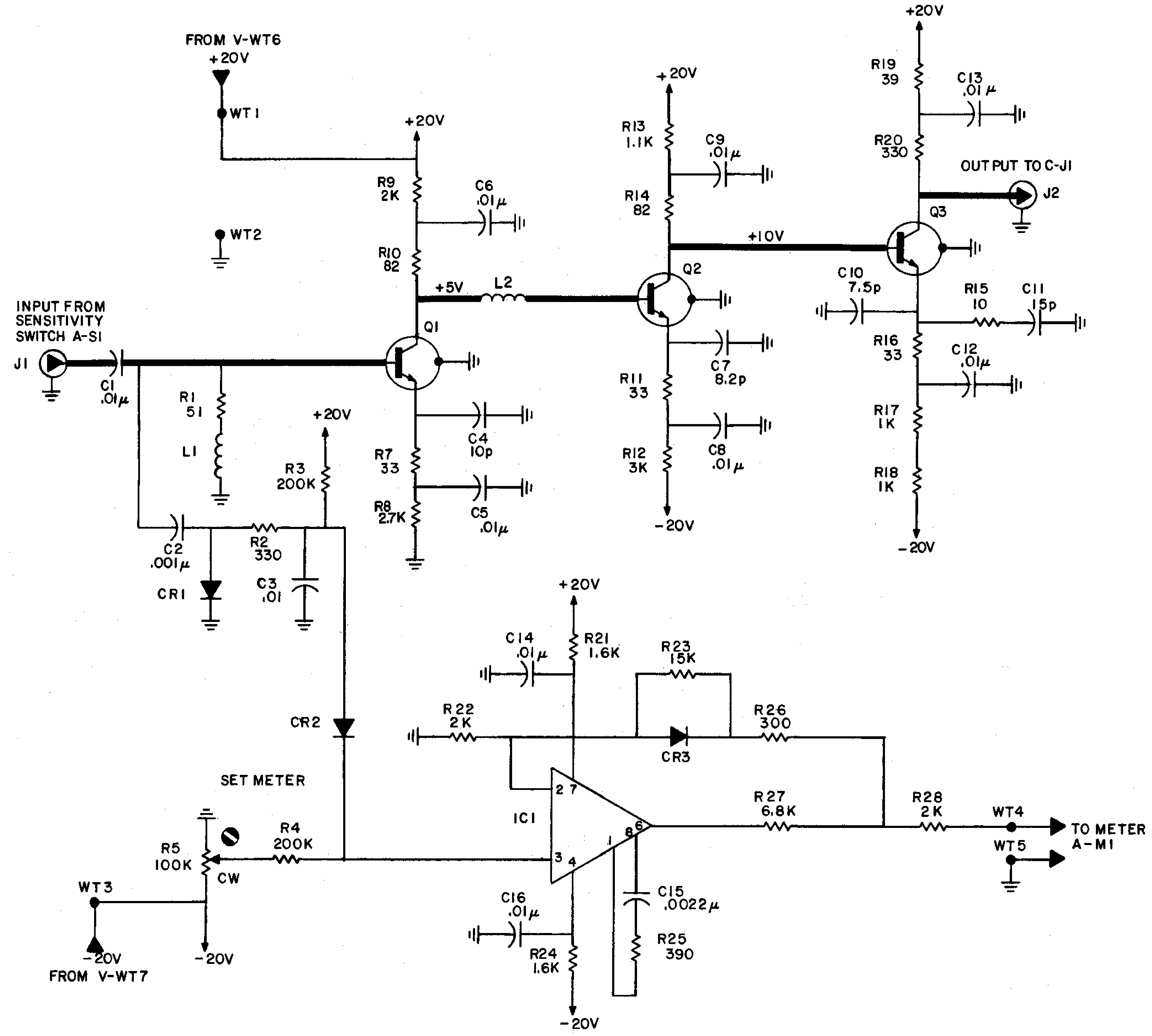
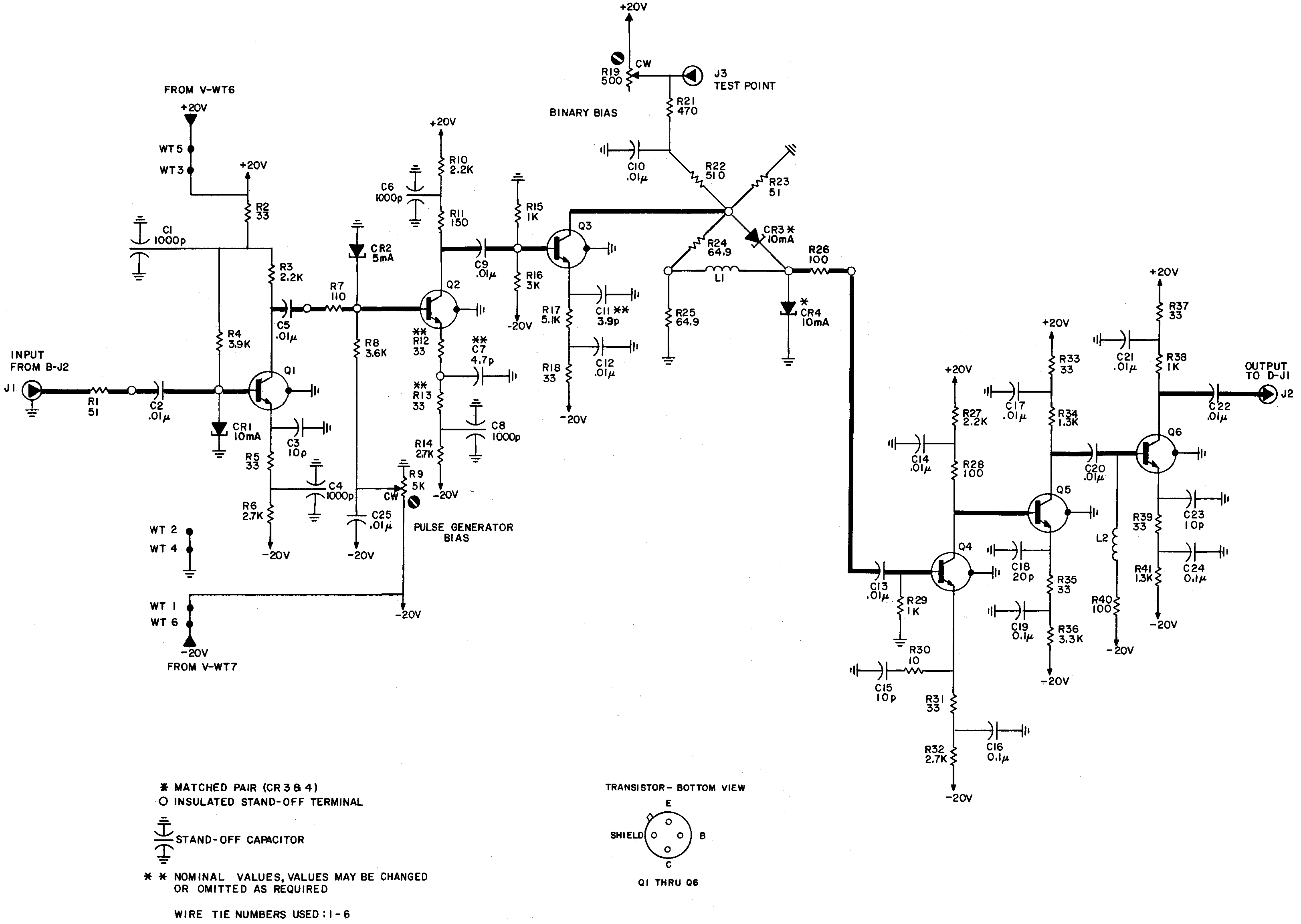


Figure 6-6. Input Amplifier/Meter Drive diagram. B



* MATCHED PAIR (CR 3 & 4)

○ INSULATED STAND-OFF TERMINAL

STAND-OFF CAPACITOR

** NOMINAL VALUES, VALUES MAY BE CHANGED OR OMITTED AS REQUIRED

WIRE TIE NUMBERS USED : 1 - 6

RESISTANCE IS IN OHMS, K=10^3, M=10^6
CAPACITANCE IS IN FARADS, μ=10^{-6}, p=10^{-12}
VOLTAGES EXPLAINED IN INSTRUCTION BOOK SERVICE NOTES
▭ =PANEL CONTROL ⬚ =REAR CONTROL
⊘ =SCREWDRIVER CONTROL WT=WIRE TIE TP=TEST POINT
COMPLETE REFERENCE DESIGNATION INCLUDES SUBASSEMBLY LETTER, C-R1, B-R1, ETC.

404F SWITCH NUMBERING
- F — FRONT, REAR
- 04 — CONTACTS. FIRST CONTACT CW FROM STRUT SCREW ABOVE KEY IS .01.
- 4 — SECTION. SECTION NEAREST PANEL IS 1.

ROTORS SHOWN CCW

CONNECTIONS
- ──► OUTPUT LEAVES SUBASSEMBLY
- ►── INPUT FROM DIFFERENT SUBASSEMBLY
- ──▷ OUTPUT REMAINS ON SUBASSEMBLY
- ▷── INPUT FROM SAME SUBASSEMBLY

Figure 6-7. Trigger Generator/Binary Divider diagram. C

NOTE

View shows component side of board. Circuit paths: shaded=this side, solid=opposite side. Component outlines: lined=this side, dashed=opposite side.

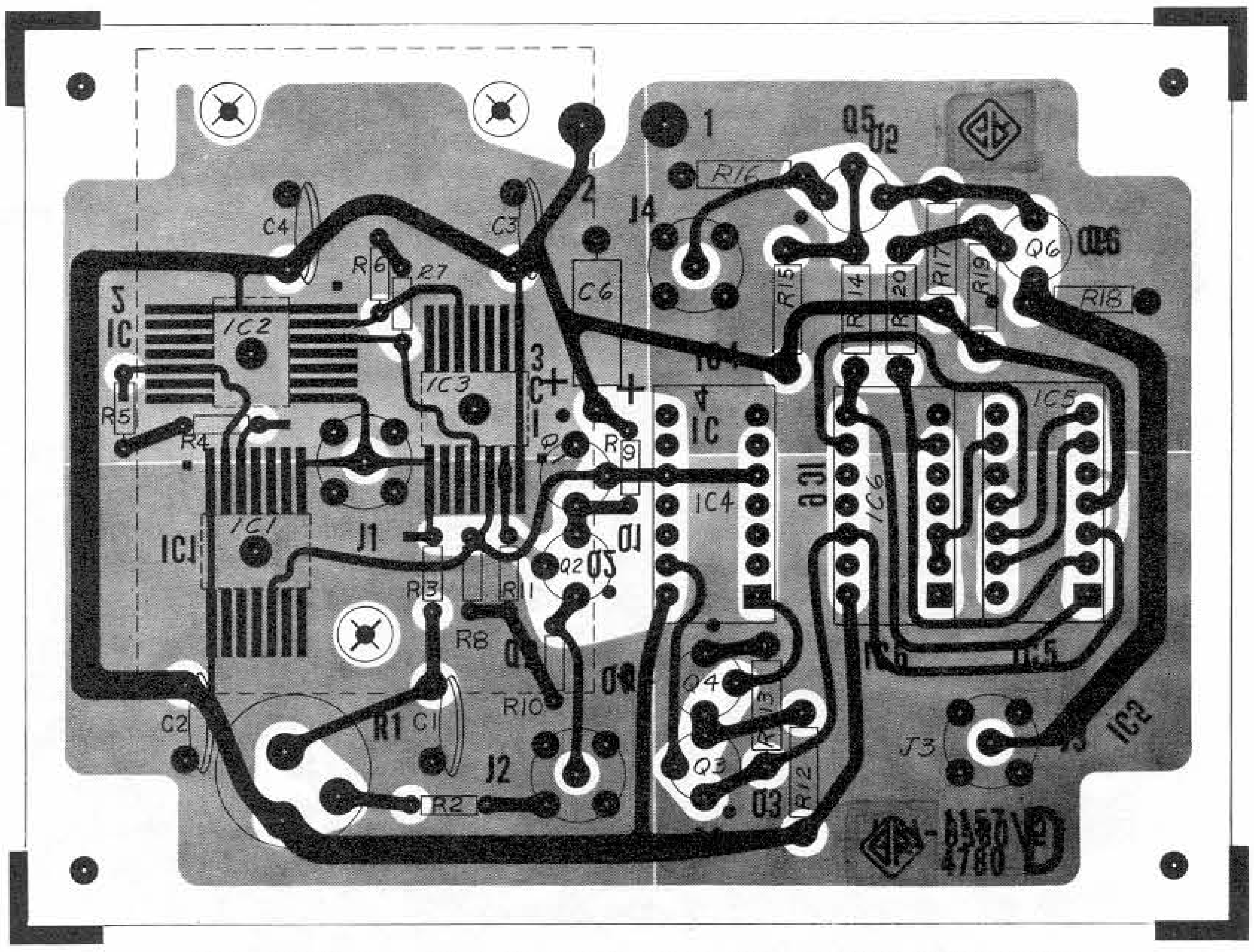


Figure 6-8. D-assembly etched-circuit board (P/N 1157-4780).

NOTE

View shows component side of board. Circuit paths: solid=this side, shaded=opposite side.

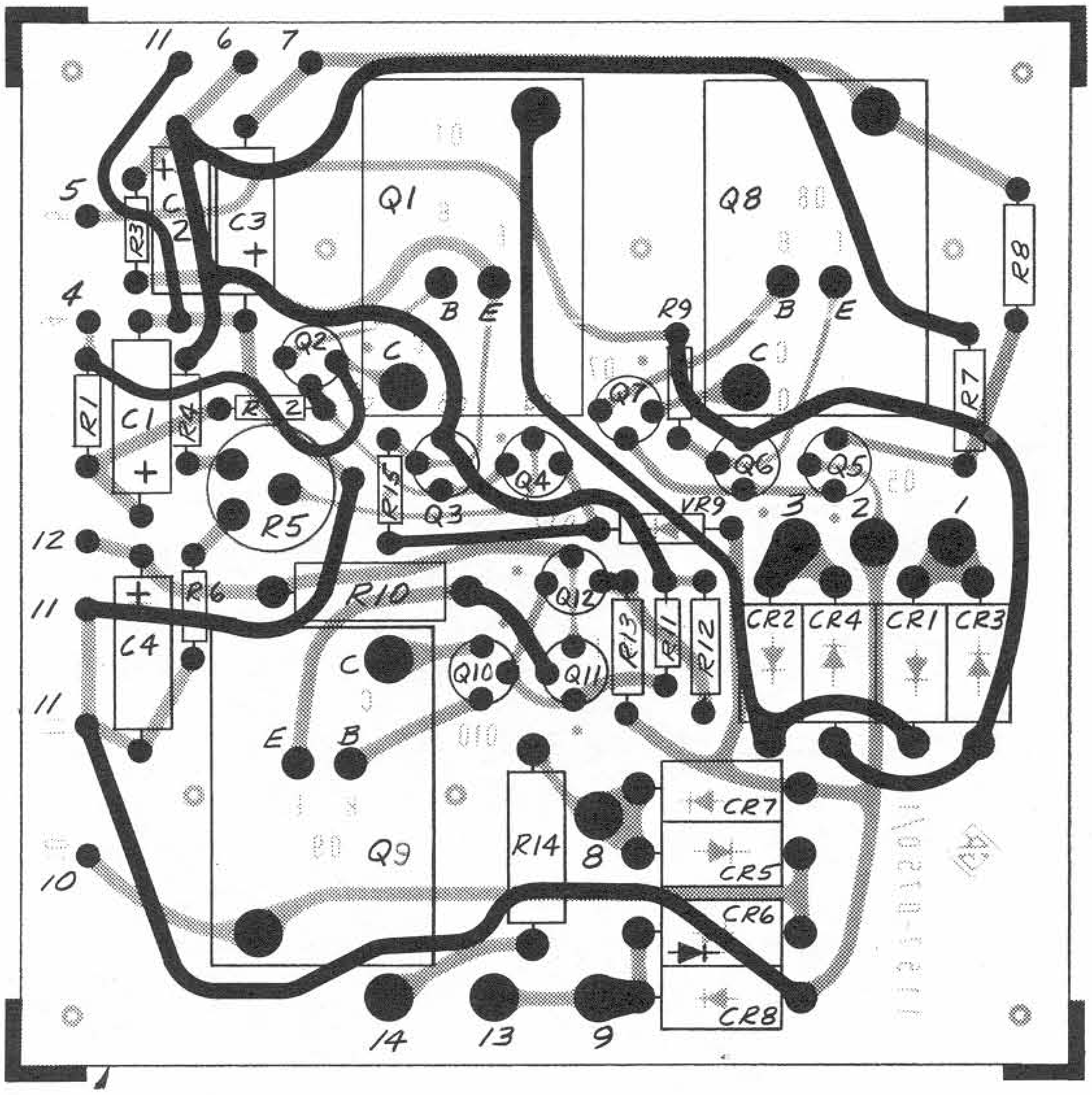


Figure 6-9. V-assembly etched-circuit board (P/N 1157-4750).

NOTE: **The number etched on the foil is** *not* **the part number. The dot on the foil at the transistor socket indicates the collector lead.**

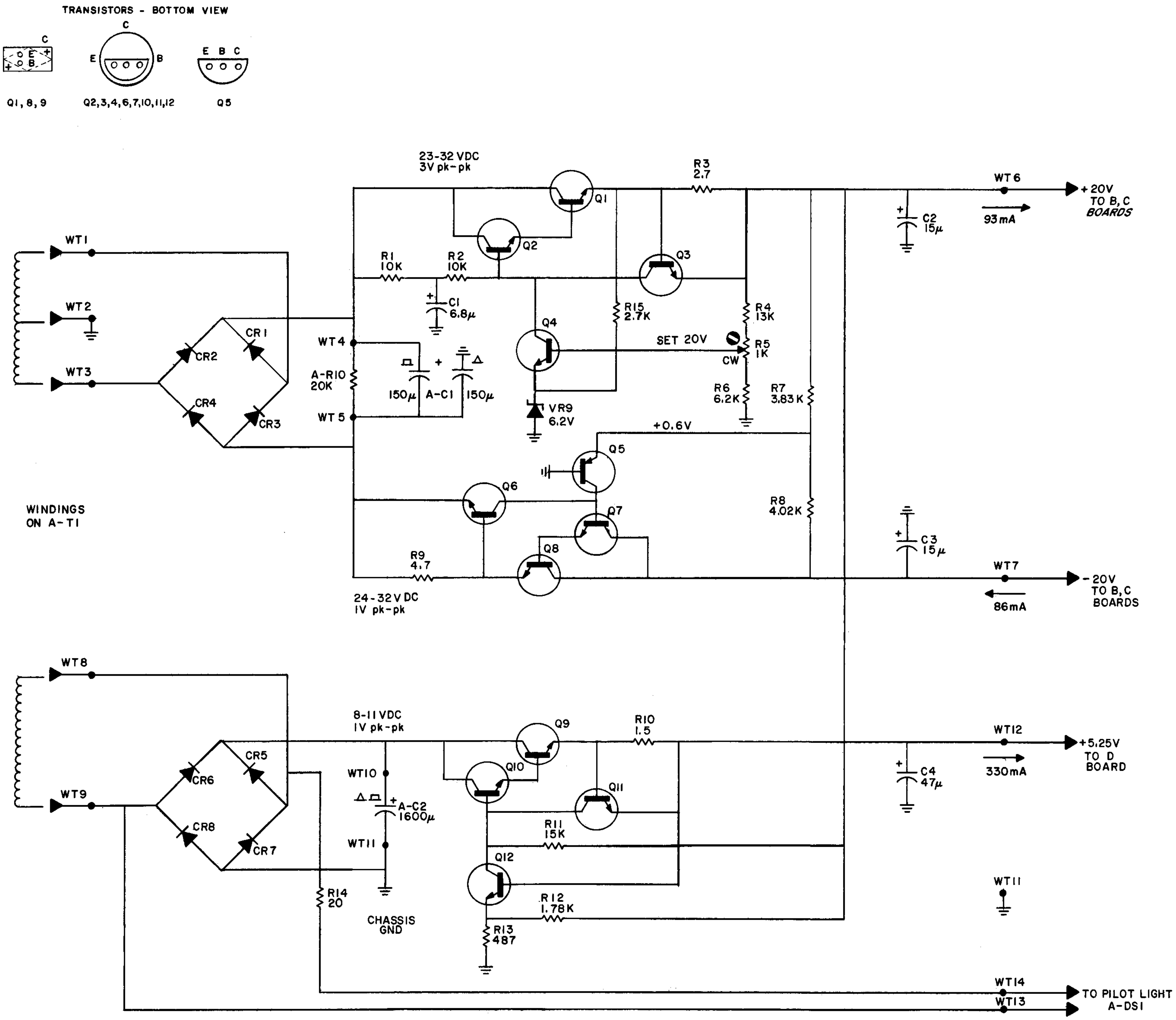


Figure 6-10. Power Supply diagram. V

RESISTANCE IS IN OHMS, K=10^3, M=10^6
CAPACITANCE IS IN FARADS, $\mu=10^{-6}$, $p=10^{-12}$
VOLTAGES EXPLAINED IN INSTRUCTION BOOK SERVICE NOTES
▭ =PANEL CONTROL ⬚ =REAR CONTROL
⊘=SCREWDRIVER CONTROL WT=WIRE TIE TP=TEST POINT
COMPLETE REFERENCE DESIGNATION INCLUDES SUBASSEMBLY LETTER, C-R1, B-R1, ETC.

404F SWITCH NUMBERING
FRONT, REAR
CONTACTS. FIRST CONTACT CW FROM STRUT SCREW ABOVE KEY IS .01.
SECTION. SECTION NEAREST PANEL IS 1.
ROTORS SHOWN CCW

CONNECTIONS
▶ OUTPUT LEAVES SUBASSEMBLY
▶ INPUT FROM DIFFERENT SUBASSEMBLY
▷ OUTPUT REMAINS ON SUBASSEMBLY
▷ INPUT FROM SAME SUBASSEMBLY

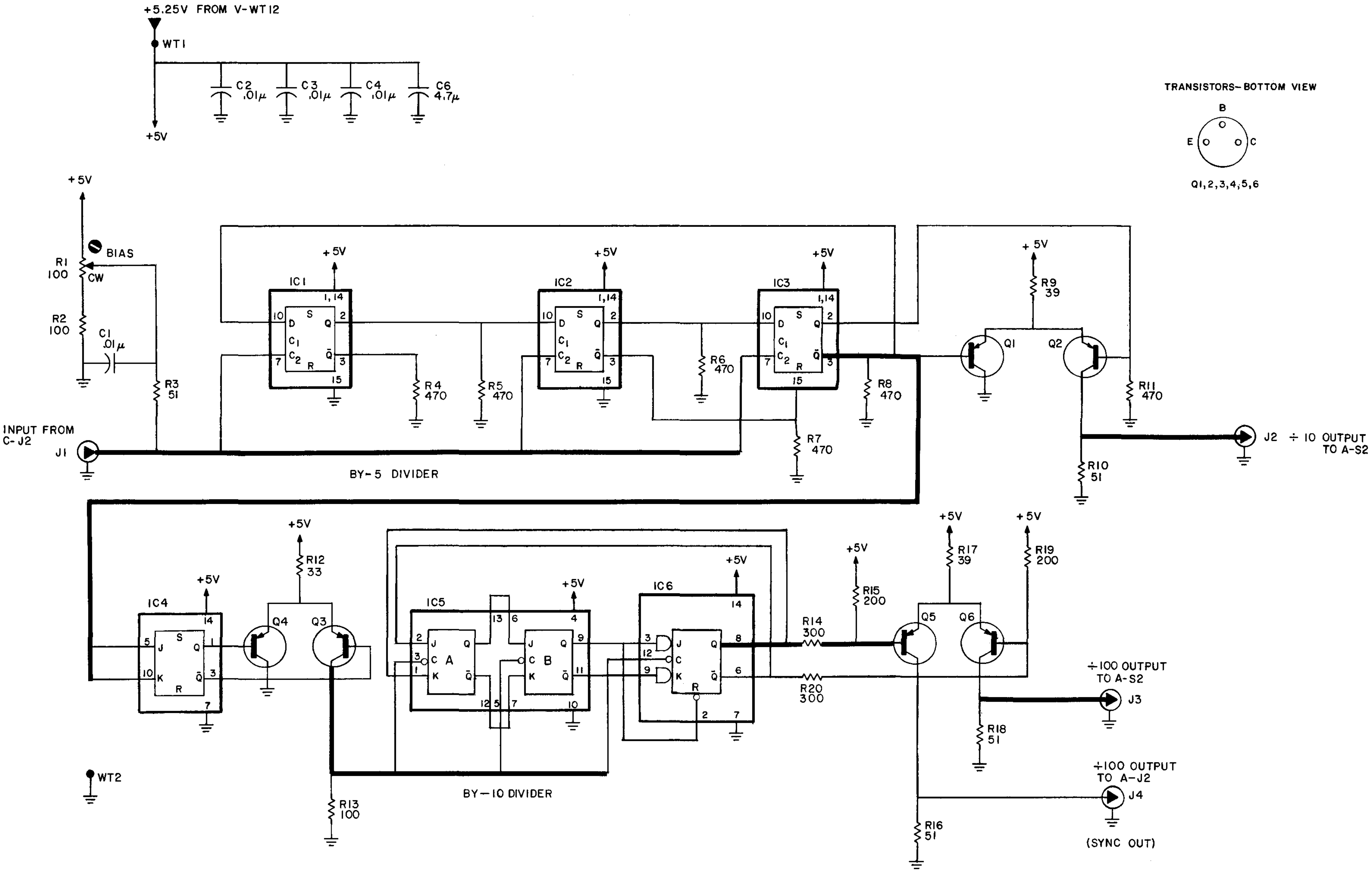


Figure 6-11. By-5 and By-10 Divider diagram. D

DIFFERENCE DATA
APPLICABLE TO EARLY PRODUCTION ONLY

For 1157-B Scaler Instruction Manual, Form 1157-0110 A, August 1969.

This difference data sheet adapts the manual to 1157-B Scalers having ID number B100. The following changes do not apply to scalers made more recently.

GENERAL.

Early production instruments of the lot No. ID-B100 have identical characteristics with later production, but differ in the circuitry for the last division by 5.

SPECIFIC CHANGES.

Please make the indicated changes on the pages below. Bold-face type characterizes short additions (easily penciled in the manual) or reference notes to lengthy additions.

page 4-4

Paragraph 4.3.6:

Delete the description starting with: Division by 5 takes place in D-IC5 and D-IC6 . . . to the end of Paragraph 4.3.6.

Add this note: **See difference data, page 6-10.**

4.3.6 By-10 Divider-D

(First 2 paragraphs unchanged.) New 3rd. and last paragraph of 4.3.6:

To complete the division by 10, the signal output from difference amplifier D-Q3/D-Q4 (from D-Q3 collector) drives the scale-of-5 divider IC5, at pin 1. The divided output from IC5, pin 8, is 1/100 the INPUT frequency, and has the 40% duty ratio characteristic of the main 100:1 OUTPUT. That signal emerges via difference amplifier D-Q5/D-Q6 and jack D-J3. The complementary signal from D-Q5 collector) is connected via D-J4 to the SYNC OUT jack.

page 4-4

Figure 4-4:

Delete the curves labeled IC5A, IC5B, and Q/IC6.

Relabel the Q/IC6 curve: **IC5 pin 8.**

page 6-8

Change the parts designated as follows:

Reference Desig.	Description	Part No.	FMC	Mfg. Part No.	Fed. Stock No.
D-IC5	**Digital Integrated circuit**	**5431-9609**	**42498**	**SD 7262**	
D-R19	**130 Ω 5% 1/4W**	**6099-1135**	**75042**	**BTS, 130Ω 5%**	**5905-807-6269**
D-R20	**330 Ω 5% 1/4W**	**6099-1335**	**75042**	**BTS, 330Ω 5%**	**5905-686-3369**

Delete:

D-IC6

page 6-9

Change Figure 6-11, the D-board schematic, as follows:

Connect R20 between Q6 base and ground (not to IC5). Substitute IC5 (new description) for both IC5 and IC6, with connections as follows: input from Q3 collector, pin l; output through R14 to Q5, pin 8; bias +5 V (bypassed to ground through C6), pin 5; ground points, pins 3, 6, and 10.

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