SERVICE MANUAL

DC VOLTAGE/CURRENT STANDARD Type 2554

1976.06.15—1st Edition

CONTENTS

1. OPERATING PRINCIPLE

1.1 Description

The Type 2554 DC Voltage/Current Standard generates any dc voltage and current from 0 to 120 V and 0 to 120 mA respectively at an accuracy of (±0.05% of setting) + (±0.01% of range). The battery incorporated makes the instrument usable where an ac source is not available. For operating method and applications of the instrument, refer to the instruction manual. This chapter concerns composition of the Type 2554, functions of each section and operating principle. Figs. 1-1 and 1-2 show operating controls on the front and rear panels.

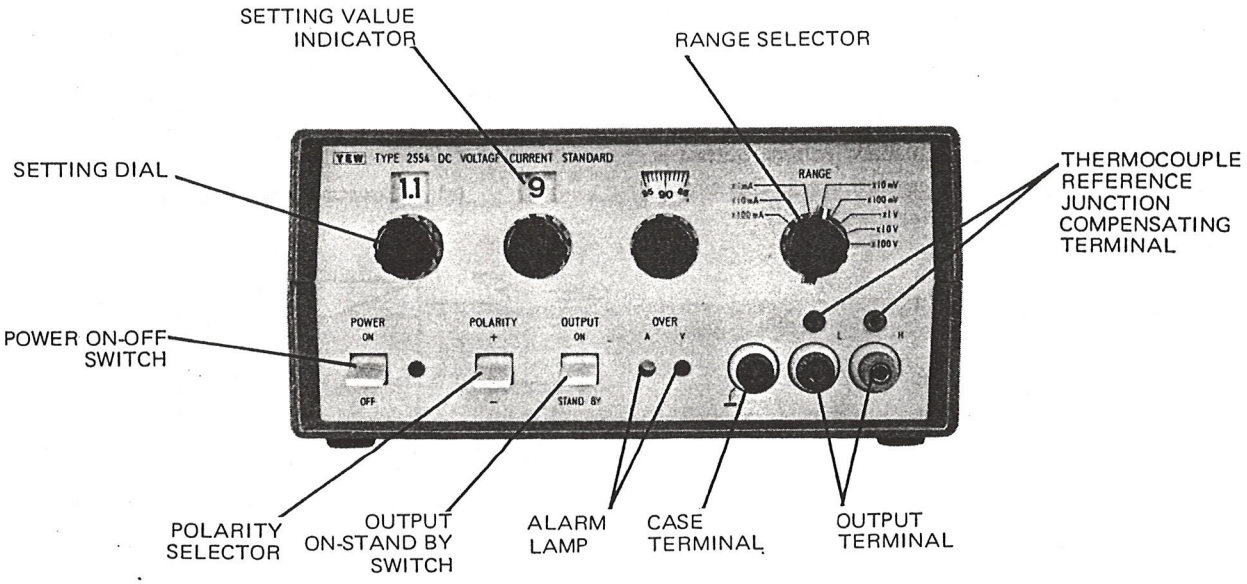


Fig. 1-1 Front Panel

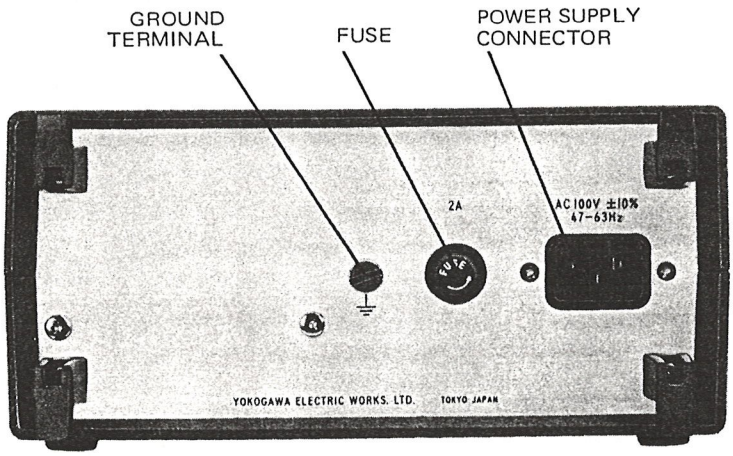


Fig. 1-2 Rear Panel

1.2 Operating Principle

Fig. 1-3 illustrates the basic operating principle. e_S in the figure is the basic voltage of the instrument stabilized by a temperature-compensated zener diode, e_S is arbitrarily divided by a voltage divider P to obtain E_S which constitutes an input for high-gain amplifier A. The output of this amplifier is detected by a voltage divider consisting of R1 and R2 for a constant voltage output, or shunt Rs for a constant current output, and fed back to the input side. The gain of this amplifier is so large that a voltage across its input terminal is negligible. Therefore, in case of the constant-voltage output in (a),

$$E_S = (1/n)E_O \qquad \therefore\ E_O = nE_S$$

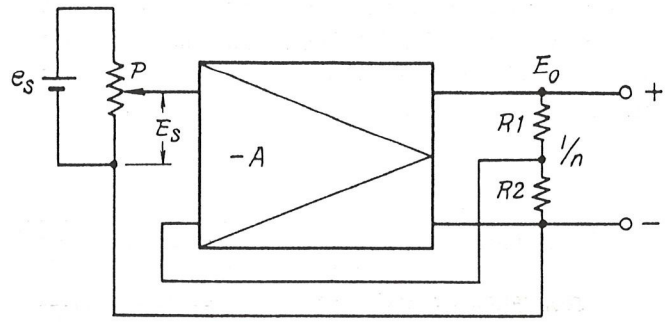
where: n (dividing ratio) = $\dfrac{R2}{R1 + R2}$

In case of the constant-current output in (b),

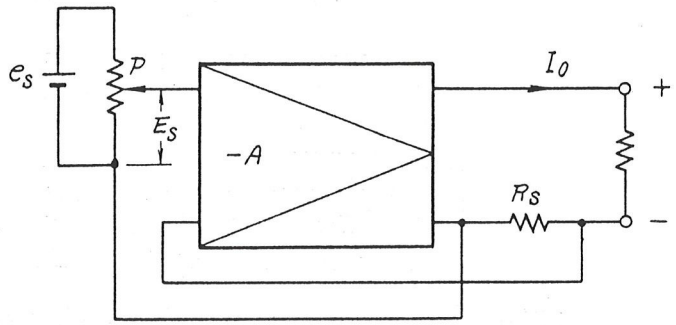
$$E_S = RsI_O \qquad \therefore\ I_O = E_S Rs$$

From this it is clear that the output is determined by E_S and Rs regardless of the amplifier gain or load resistance RL. In case of a mV output, a constant voltage output is taken out by voltage division as depicted in (c). This circuit composes a non-inverted negative-feedback amplifier.

(a) Constant-Voltage Output



(b) Constant-Current Output



(c) Constant-Millivolt Output

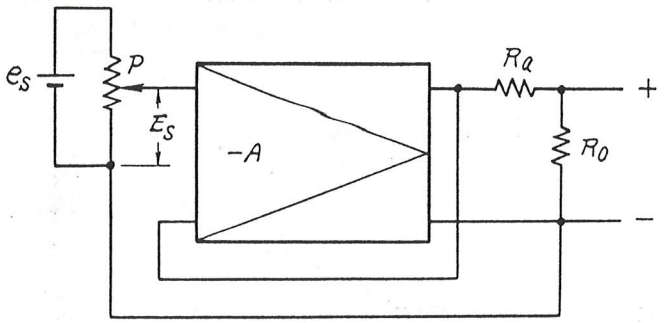


Fig. 1-3 Operating Principle

1.3 Circuit Composition

The circuit composition of the instrument is illustrated in a block diagram in Fig. 1-4. Fig. 1-5 illustrates the inside of the Type 2554 as viewed from the bottom, with the rear panel pulled down.

The electric circuitry of this instrument consists of the following assemblies.

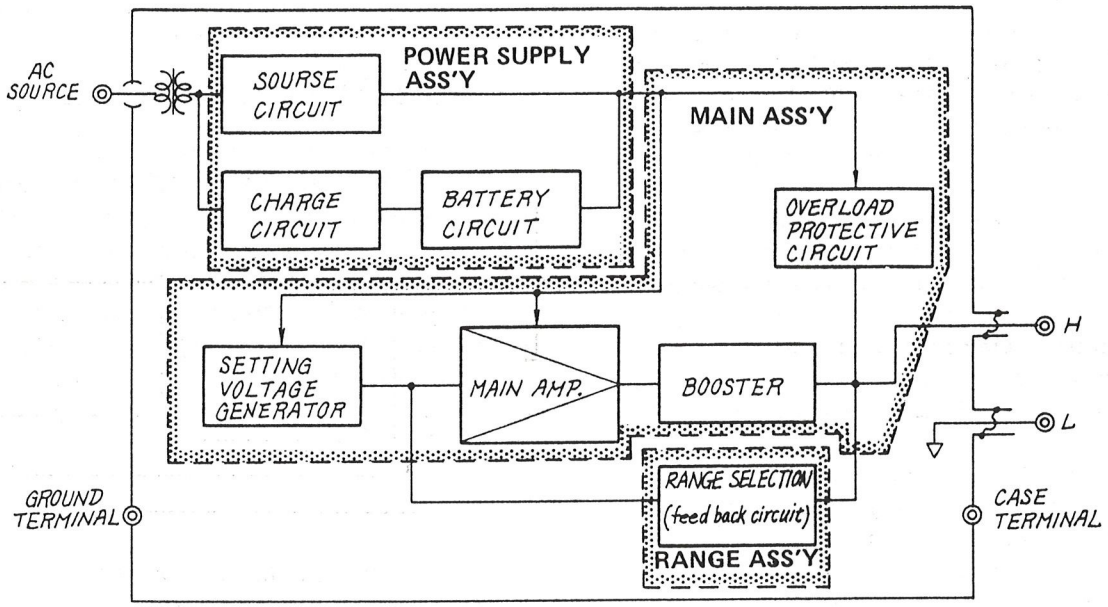


Fig. 1-4 Block Diagram

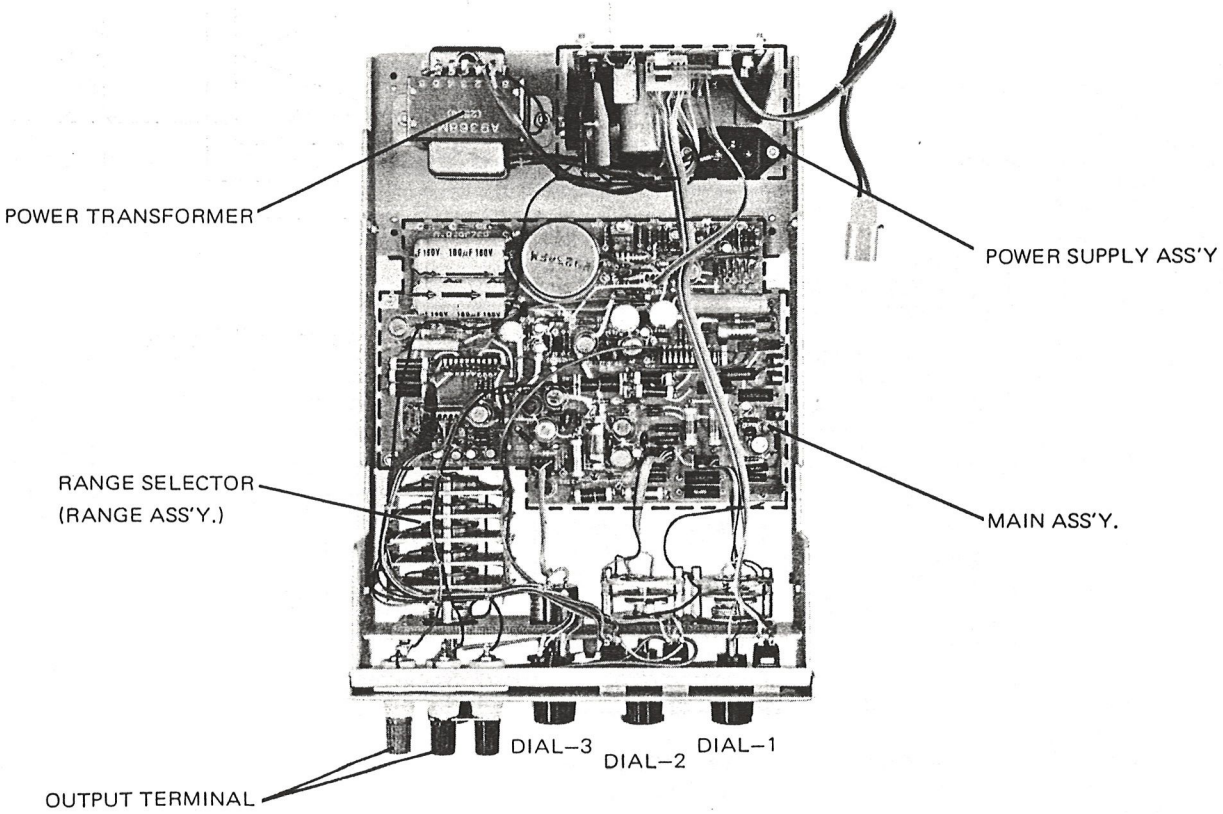


Fig. 1-5 Internal View

1.4 Functions and Operating Principle of Each Section

1.4.1 POWER SUPPLY ASS'Y (see Figs. 4-2a, b)

The instrument incorporates a battery (nickel-cadmium cells 1.2 V x 8 = 9.6 V). Thus operation is possible either by ac source or battery. In the block diagram of the POWER SUPPLY in Fig. 1-4,

a. Source circuit: Operates when using an ac source, and incorporates a rectifying diode and a voltage regulator. The circuit including U1 (power regulator EHD-RD-3093R) in Fig. 4-2a is the circuit in question.

b. Charge circuit: Presets a voltage for charging the battery (by R5 in U2 circuit) and charges the battery (by circuit comprising U3, Q1, Q2). The battery is charged just by connecting the power cord to the power line regardless of the position of the power on-off switch. Charge time is approximately 3 hours. A fully charged battery works for approximately three hours at a maximum load (100 mA range).

c. Battery control circuit: Comprises U4, Q3 and Q4. When using an ac source, a signal from the source circuit turns off Q4 to separate the battery power. When using the battery, on the other hand, Q4 is turned on. This circuit also has a function of separating the battery circuit as soon as the battery voltage begins to drop (from 8 V) from the viewpoint of the battery life. From the POWER SUPPLY ASS'Y, a single voltage of 8 V dc is supplied to terminals P+ and Po.

1.4.2 MAIN ASS'Y (see Figs, 4-3a, b)

Main part of electric circuits of the instrument excluding the above POWER SUPPLY ASS'Y, switches, connectors, power transformer and lamps is accommodated on this assembly. In the block diagram of Fig. 1-4, this assembly is divided into setting voltage generating circuit, main amplifier, voltage booster and overload protective circuit. In this instrument a 1-V range circuit is fundamental. So let's discuss the 1-V range circuit.

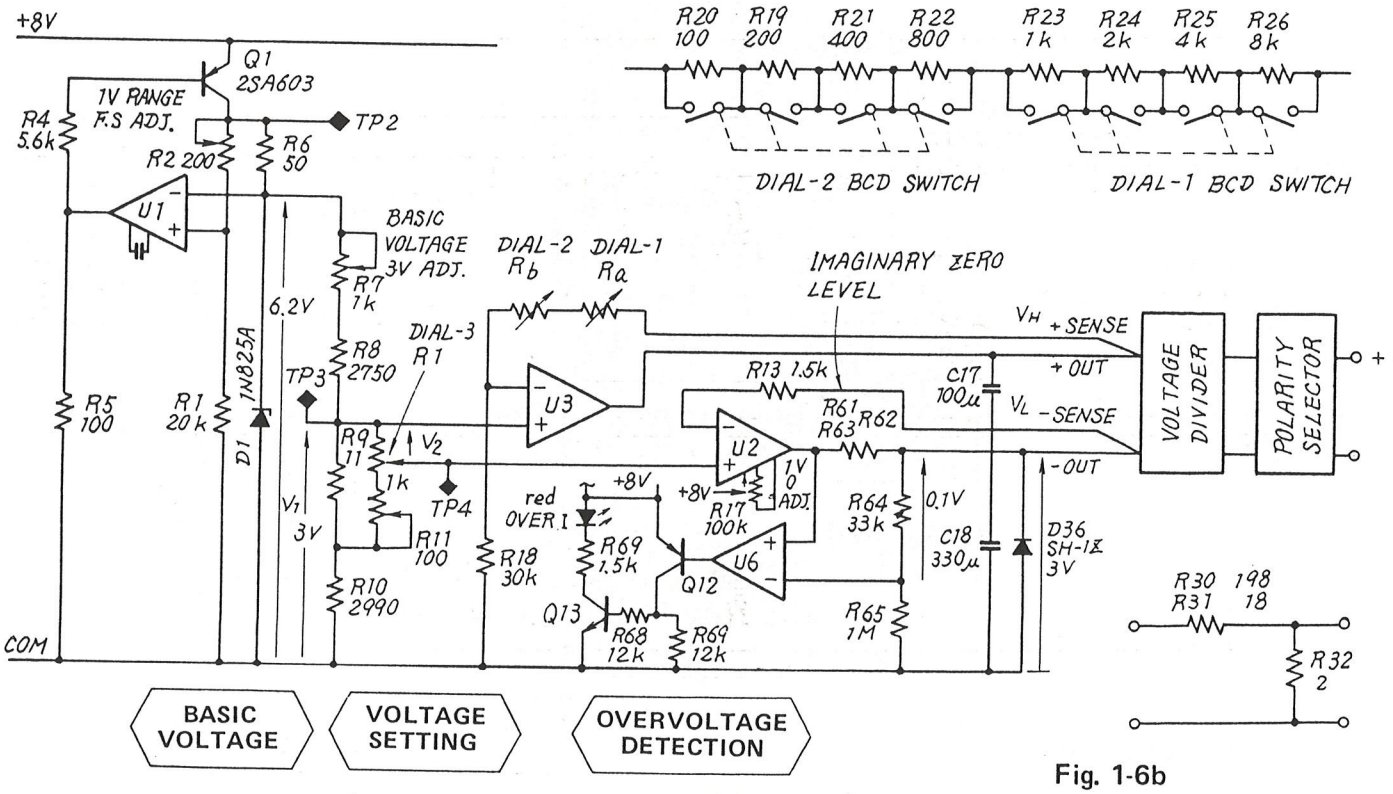


Fig. 1-6a 1-V Range Circuit

Fig. 1-6b
10-mV, 100-mV Divider

a. 1-V, 100-mV, 10-mV ranges

Fig. 1-6a corresponds to selection of the 1-V range. Since the instrument is operated by a single voltage of 8-V dc as stated before, V1 (3-V) in the figure is supposed to be zero. A circuit comprising U1, Q1 and D1 is for obtaining this basic voltage. A stable zener diode is employed for D1. A circuit comprising U3 and U2 is a setting voltage generating circuit. Voltages are set by Ra (DIAL-1), Rb (DIAL-2) and R1 (DIAL-3). For 10-mV or 100-mV range, the above output is divided into 1/100 or 1/10 by resistors as illustrated in Fig. 1-6b. For the 1-V range, the voltage divider is overridden. R61 to R63 are overcurrent detecting resistors. When an overcurrent has flowed, the circuit comprising U6, Q12 and Q13 illuminates an alarm lamp. Here U6 works as a comparator. Output voltage V_{OUT} at the 1-V range is calculated as follows.

$$V_{OUT} = V_H - V_L$$
$$= V_1 \times (1 + \frac{Ra + Rb}{R_{18}}) - (V_1 - V_2)$$
$$= \frac{Ra}{R_{18}} V_1 + \frac{Rb}{R_{18}} V_1 + V_2$$

(DIAL-1) (DIAL-2) (DIAL-3)

b. 10-V, 100-V ranges

Fig. 1-7a represents a circuit switched over to 10-V or 100-V range. A booster circuit is added onto the aforementioned 1-V range circuit, and a stable voltage is generated by incorporating the booster circuit into a feedback loop of amplifier U4. The feedback resistor of amplifier U4 is determined so that the gain will be 10 at the 10-V range, and 100 at the 100-V range. The dc-to-dc converter illustrated will be discussed later. Voltage V2 is obtained by rectifying a voltage boosted at the output side of the dc-to-dc converter. Finally output voltage, V3 of 0 to 120-V is obtained by feedback to *4, with Q4's emitter voltage V1 being influenced. The relationship between this V1, V2 and V3 is illustrated in Fig. 1-7b.

The circuit comprising Q10, Q11 and Q16 is a discharge circuit. When lowering the output voltage, Q10 and Q11 work, and discharge current I2 flows in the arrow direction as shown by a dotted line (provided V1 < 1.2 V). FET Q16 works when the power is off. The figure also illustrates an overvoltage detecting circuit. When this circuit works, Q15 illuminates the OVER V lamp, and Q14 actuates the oscillation stop circuit of the dc-to-dc converter, thereby stopping oscillation.

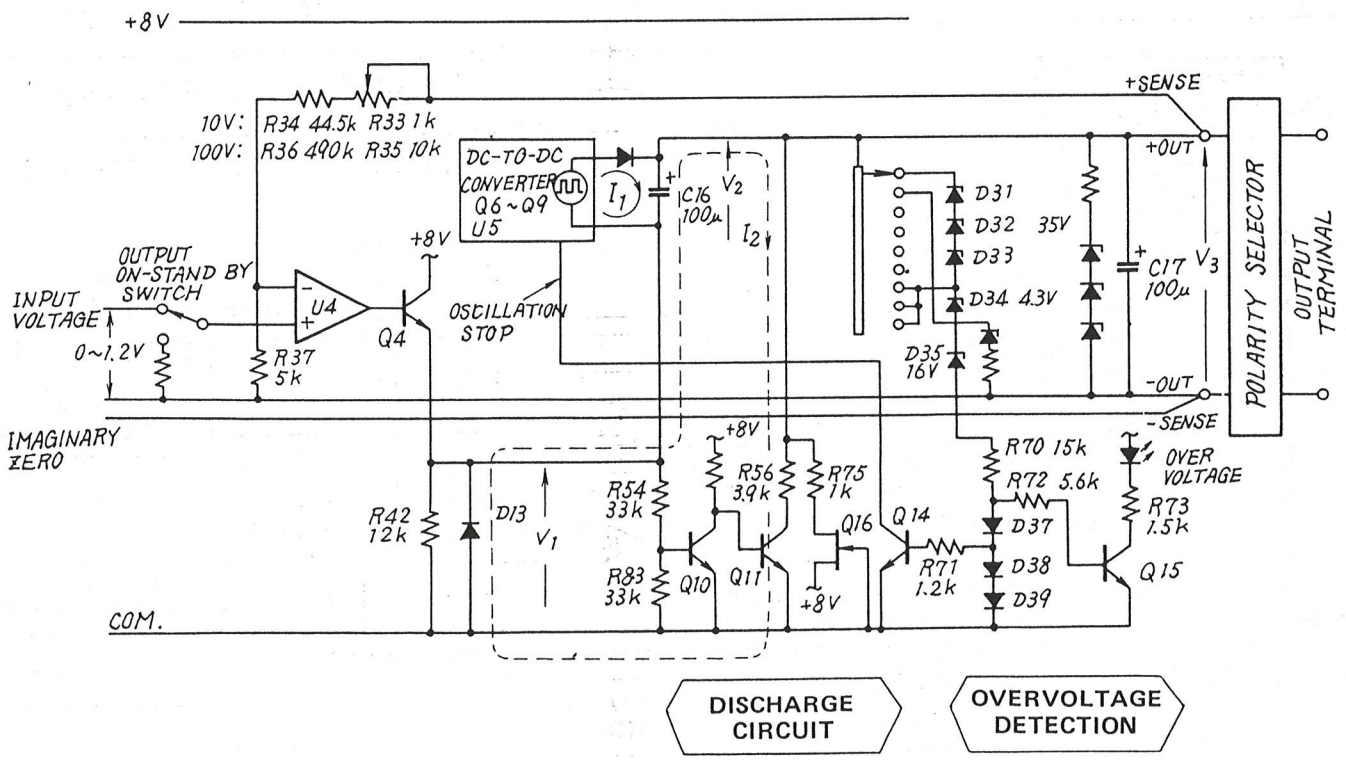


Fig. 1-7a 10-V, 100-V Range Circuit

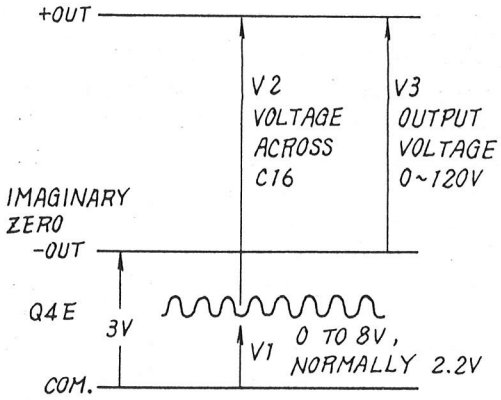


Fig. 1-7b
Relationship of Voltages V1, V2, V3

c. 1-mA, 10-mA, 100-mA ranges

Fig. 1-8 represents a circuit composed when selecting 1-mA, 10-mA or 100-mA range. In this circuit also, a discharge circuit, an overvoltage display circuit, etc. function as stated before, though they are not shown in the figure. Current I_L through a load flows in the arrow direction as indicated by a dotted line. The current that flows is determined by Vin = R58 x I_L or I_L = Vin/R58.

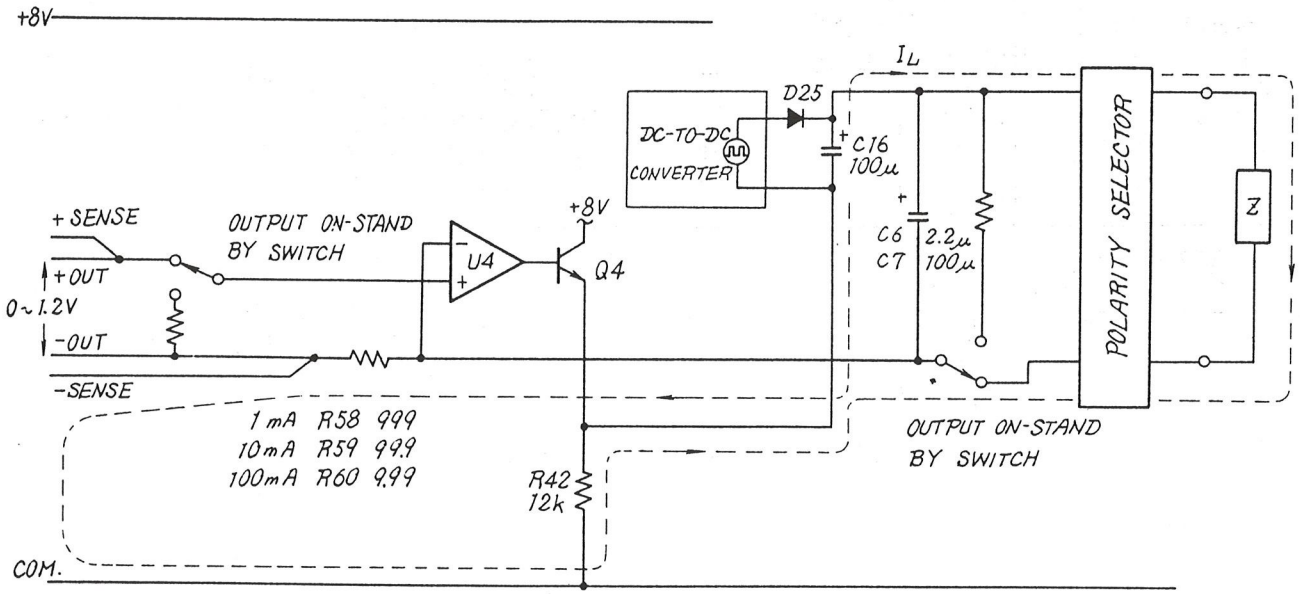


Fig. 1-8 1-mA, 10-mA, 100-mA Range Circuit

d. DC-to-DC converter

Because the output voltage is higher than 10 V at 10-V, 100-V, 1-mA, 10-mA and 100-mA ranges as stated above, the voltage is raised by a dc-to-dc converter. Its circuit is given in Fig. 1-9a.

Here a self-excited oscillator is turned on and off, and the voltage is raised and then rectified to obtain a dc voltage of 0 to 100 V. When Q9 is turned on, counter-electromotive force appears on the secondary of T1. By prolonging the turned-on period, the counter-electromotive force rises. By applying this principle, the secondary voltage is varied from 0 to 100 V. As is clear from the figure, the dc-to-dc converter consists of bootstrap circuit, comparator, oscillation stop circuit, self-excited oscillator (blocking oscillatory circuit) and amplifier/rectifier circuit. The circuit comprising Q5 and Q6 is a sawtooth wave generator where a sawtooth wave of excellent linearity is generated for bootstrap connection. The waveform in question at V1 is as illustrated in Fig. 1-9b.

As is apparent from the figure, the period during which Q9 is turned on depends upon the level of V2. The oscillation stop circuit stops oscillating when either Q8 or Q14 has turned on. Q14 turns on when the overvoltage detecting circuit has been actuated, or when the load resistance is large at a current range. Q8 turns on when V1 > V2 or when the voltage of the dc-to-dc converter has become higher than the output voltage.

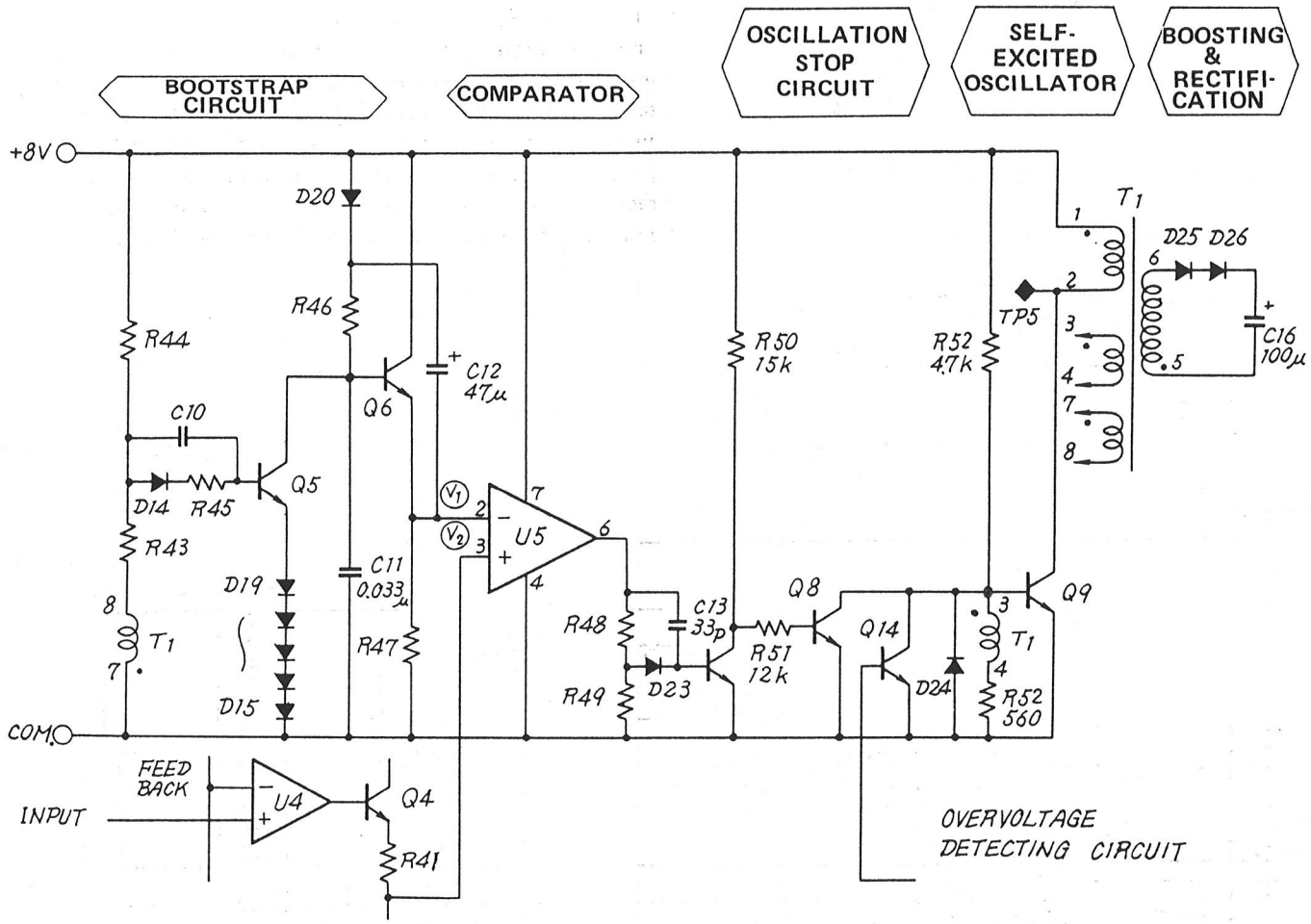


Fig. 1-9a DC-to-DC Converter

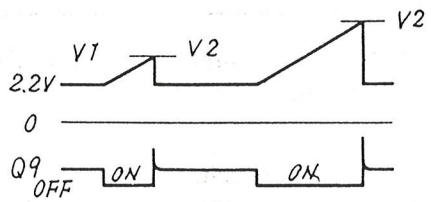


Fig. 1-9b Waveform at V1

1.4.3 RANGE ASS'Y

Consists of two flexible PWBs interconnecting range selector SW-1 mounted on the panel and the MAIN ASS'Y. Figs. 4-4a and 4-5a show their circuits, and Figs. 4-4b and 4-5b their structure. These two boards, large and small, are directly soldered on one side to terminals of switch SW-1 and on the other side to the connector of the MAIN ASS'Y. Wiring of the whole range selector is illustrated in Fig. 1-10. By operating this selector, any of the aforementioned ranges can be constituted.

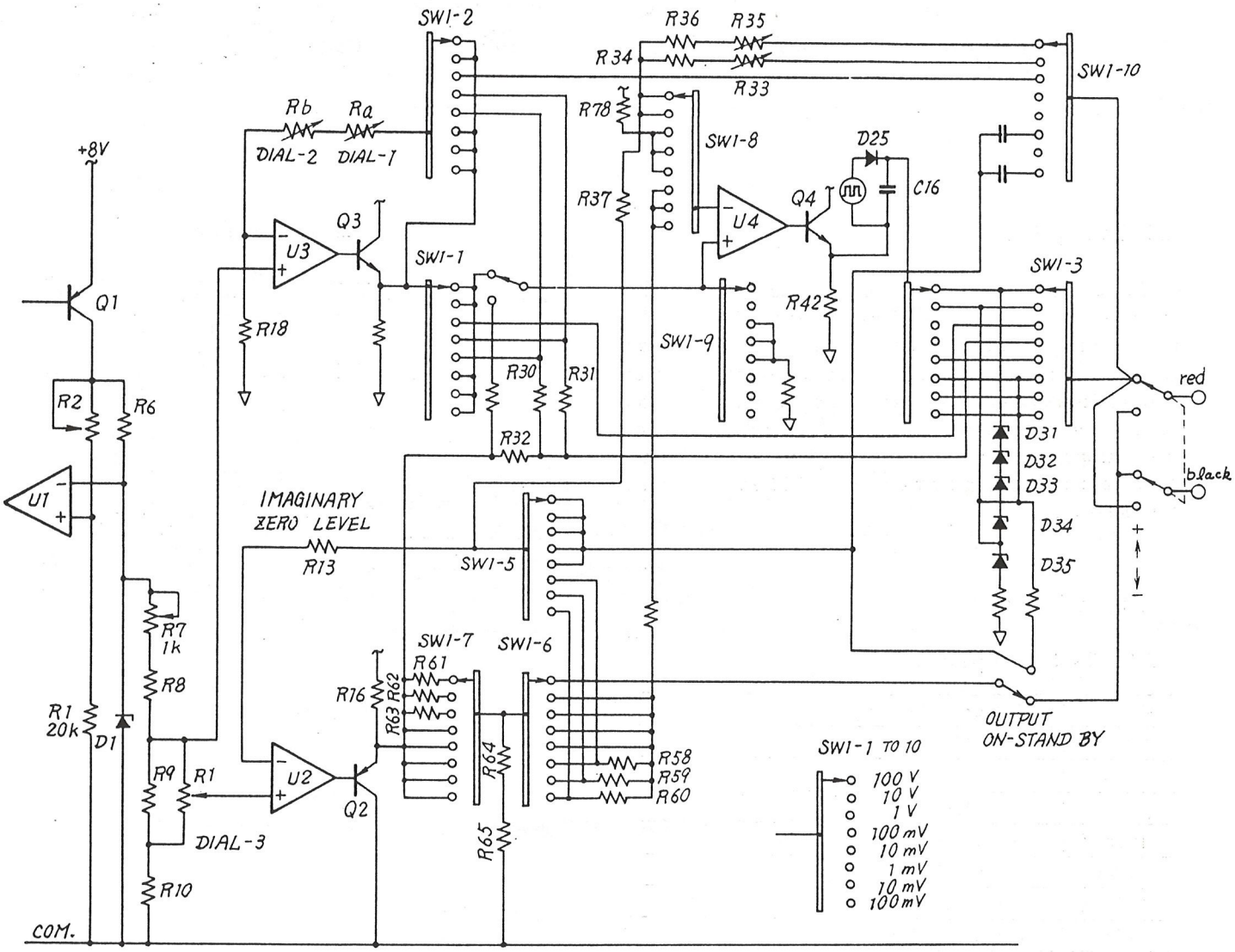


Fig. 1-10 Wiring of Range Selector

1.4.4 DIAL-1 ASS'Y and DIAL-2 ASS'Y

Figs. 4-6 and 4-7 show wiring diagrams. They are BCD switches for voltage setting. Refer to the upper section of the diagram in Fig. 1-6a. R19 and R20 are of small temperature coefficient.

1.4.5 PANEL ASS'Y

For wiring of switches, power transformer, fuse, LED and connector, refer to the overall wiring diagram in Fig. 4-1a. Fig. 4-1b shows connector engagement and conductors employed in the instrument. Because of many connectors used, it is necessary to take utmost care not to misconnect them. Misconnection might not only make the instrument inoperable but may damage it as well.

2. CALIBRATION, INSPECTION AND ADJUSTMENT

2.1 Description

This chapter concerns calibration, inspection and adjustment of the Type 2554. Firstly specifications of the instrument are listed. The instrument is originally adjusted strictly to all the specifications, but is subject to secular change. It is therefore necessary to carry out calibration periodically in order to maintain the original accuracy of the instrument. For calibration, measuring instruments having accuracy better than the Type 2554 and warranted are necessary.

2.2 Specifications

2.2.1 DC voltage/current ranges

Range	DC Voltage/Current	Min. Graduation
100V	0 ~ ±119.99V	10mV
10V	0 ~ ±11.999V	1mV
1V	0 ~ ±1.1999V	100μV
100mV	0 ~ ±119.99mV	10μV
10mV	0 ~ ±11.999mV	1μV
100mA	0 ~ ±119.99mA	10μA
10mA	0 ~ ±11.999mA	1μA
1mA	0 ~ ±1.1999mA	0.1μA

2.2.2 Accuracy

Range	Accuracy
100V	± (0.05% of setting) ± 10mV
10V	± (0.05% of setting) ± 1mV
1V	± (0.05% of setting) ± 100μV
100mV	± (0.1 % of setting) ± 10μV
10mV	± (0.1 % of setting) ± 2μV
100mA	± (0.05% of setting) ± 10μA
10mA	± (0.05% of setting) ± 1μA
1mA	± (0.05% of setting) ± 1.0μA

At
- Ambient temperature : 23 ± 2°C
- Relative humidity : 45 to 75%
- Rated source voltage range

2.2.3 Maximum output and internal resistance

Range	Maximum Output	Internal Resistance
100V	1mA	100 MΩ max.
10V	10mA	50 MΩ max.
1V	10mA	30 MΩ max.
100mV	*) 2kΩ	2 Ω max.
10mV	*) 2kΩ	2 Ω max.
100mA	**) 6V	Approx. 1 MΩ max.
10mA	15V	Approx. 1 MΩ max.
1mA	15V	Approx. 10 MΩ max.

*) Minimum load resistance corresponding to error of -0.1%.
**) 15 V at less than 50 mA

2.2.4 Temperature coefficient

50 ppm/°C at 5°C to 40°C
±(0.005% of Setting + 0.0005% of Range)/°C

2.2.5 Stability

At constant ambient temperature, source voltage and load resistance.

±(0.001% of Setting) ± (0.0005% of Range)/1 h
±(0.005% of Setting) ± (0.001% of Range)/1 d
±(0.015% of Setting) ± (0.003% of Range)/30 d

2.2.6 Output noise

Range	Output Noise (DC to 2 MHz)
100V	10 mVp-p max.
10V	1 mVp-p max.
1V	0.5 mVp-p max.
100mV	50 μVp-p max.
10mV	10 μVp-p max.
100mA	10 μAp-p max.
10mA	1 μAp-p max.
1mA	0.1 μAp-p max.

2.2.7 Line regulation

±(0.01% of setting) ± (0.005% of range)
at ac source ± 10%, dc source 9.6 V to 8 V

2.2.8 Settling time

To attain accuracy within ±(0.05% of setting) ± (0.01% of range)

Stepping up
1 s at 10-V, 1-mA, 10-mA ranges
1.5 s at 100-V, 100-mA ranges

Stepping down
1 s at 100-mA range
2 s at 10-V, 1-mA, 10-mA ranges
4.5 s at 100-V range

2.2.9 Warmup

5 minutes minimum after turning on power.

2.2.10 Charge and discharge time of battery

Charge ..... Approx. 3 h
Discharge ... Approx. 3 h at maximum load (100-mA range)

2.2.11 Overvoltage/overcurrent protection

Range	Alarm Actuation Level	Limiter Actuation Level
10 mV, 100 mV	Not actuated	Not actuated
1V	Approx. 20 mA	Approx. 100 mA
10V	Approx. 20 mA	Approx. 100 mA
100V	Approx. 2 mA	Approx. 100 mA
1mA	Approx. 16 V	Approx. 16 V
10mA	Approx. 16 V	Approx. 16 V
100 mA	Approx. 16 V	Approx. 16 V

2.2.12 Dielectric strength

1,500 V ac for 1 min between line and case
1,250 V ac for 1 min between output terminal and case

2.2.13 Insulation resistance

100 MΩ at 500 V dc between source and case.

2.2.14 Operating temperature range

5°C to 40°

2.2.15 Operating humidity range

20% to 80% relative humidity

2.2.16 Power source

100, 115, 200, 230 V ac whichever specified
9.6 V dc, Ni-Cd battery, rechargeable

2.2.17 Power consumption

Approx. 8 VA at maximum load
15 VA maximum when charging battery

2.2.18 External dimensions:

Approx. 100 x 210 x 230 mm

2.2.19 Weight:

Approx. 4 kgs

2.2.20 Others

Equipped with polarity selector, STAND BY switch, overvoltage/overcurrent protective circuit (self-return type)

2.2.21 Accessories

1 pc power cord, 2 pcs fuse (1 A), 1 copy instruction manual.

2.3 Calibration

2.3.1 Measuring instrument and tools employed

- YEW Type 2501 Precision Digital Meter or equivalent (1 mV to 100 V ± 0.01% or better)
- Screwdriver for adjustment
- Leads for measurement of low thermoelectromotive force

2.3.2 Preparation

Remove the upper half of the case by loosening four screws on the lower section of the case. Allow the instrument a warmup of at least five minutes. Then calibrate the instrument as follows referring to Fig. 4-3b.

2.3.3 Zero adjustment of 1-V range

Set the range selector to x 1 V, and all the setting dials to 0. Adjust R17 so that the voltage between output terminals H and L measured by the Type 2501 will be within ±30 μV.

2.3.4 Full-scale calibration of DIAL-3

Set the range selector to x 1 V, DIAL-1 and DIAL-2 to 0, and the DIAL-3 to 100. Adjust R11 so that the voltage between output terminals H and L measured by the Type 2501 will be 10.00 mV.

2.3.5 Full-scale calibration of 1-V range

Set the range selector to x 1 V, the DIAL-1 to 1.0, and the DIAL-2 and DIAL-3 to 0. Adjust R2 so that the output voltage will be 1.0000 V.

2.3.6 Zero adjustment of 10-V, 100-V and current ranges

Set the range selector to x 10 V, and all the setting dials to 0. See if the voltage between output terminals H and L is comprised within 0 V ± 0.3 mV. If not, adjust R40.

2.3.7 Full-scale calibration of 10-V range

Set the range selector to x 10 V, the DIAL-1 to 1.0, and the DIAL-2 and DIAL-3 to 0. Adjust R33 to obtain an output of 10.000 V.

2.3.8 Full-scale calibration of 100-V range

Set the range selector to x 100 V, the DIAL-1 to 1.0, and DIAL-2 and DIAL-3 to 0. Adjust R35 to obtain an output of 100.00 V.

Thus the instrument has been calibrated.

2.4 Inspection

2.4.1 Measuring instruments and tools employed

- Resistor 27 Ω, 3 W
- Stop watch *1
- Screwdriver for adjustment
- Leads for measurement (low thermoelectromotive force)

*1 ..... Used for inspection of settling time
*2 ..... Used for inspection of stability

Instrument Name		Type	Manufacturer	Remarks
Standard Resistor	10 kΩ	2792-08	YEW	
	1 kΩ	2792-07	YEW	
	100 Ω	2792-06	YEW	0 ~ 80 mA
	10 Ω	2792-05	YEW	50 mA ~ 100 mA
Digital Voltmeter		2501	YEW	
Transistorized Insulation Resistance Tester		3213	YEW	500 V/100 MΩ
Dielectric strength tester				
DC power supply		524	Metronix	Approx. 10 V, 1 A
Oscilloscope	Mainframe	561B	TEKTRONIX	Bandwidth more than 2 MHz
	Plugin		TEKTRONIX	
Multi-function meter		3450A	hp	Sample rate 1/60 s *1
Recorder		3047	YEW	*2

2.4.2 Applied Procedure and compatible standards

a. Insulation resistance:
The insulation resistance measured between the power supply and case by the Type 3213 should be higher than 100 MΩ at 500 V dc.

b. Dielectric strength:
Set the cutoff current of the dielectric strength tester to 1 mA. Apply 1,500 V ac for 1 minute between the line and case, and 1,250 V ac for 1 minute between the output terminal and case. The instrument should remain normal.

c. Accuracy:
Voltage ranges
At no load, the output voltage measured by the Type 2501 should be within the ranges given below. Note that values below are severer than the specifications.

Range	Accuracy
100 V	±(0.04% of setting) ± (0.01% of range)
10 V	±(0.04% of setting) ± (0.01% of range)
1 V	±(0.04% of setting) ± (0.01% of range)
100 mV	±(0.08% of setting) ± (0.01% of range)
10 mV	±(0.08% of setting) ± (0.01% of range)

Note: At 10-mV and 100-mV ranges, use leads whose ends are equipped with arrow-shaped tips which are soldered by low-temperature solder.

Current ranges
Connect a Type 2792 Standard Resistor across the output terminal, and measure the output voltage by the Type 2501. Confirm that the accuracy is within ± (0.04% of setting) ± (0.01% of range). Following Standard Resistors are employed for each range.

10 kΩ for 1-mA range
1 kΩ for 10-mA range
100 Ω for 100-mA range (up to 80 mA)
10 Ω for 100-mA range (50 to 100 mA)

d Output noise:
Set the dials to maximum output voltages and currents at each voltage and current range and observe the output voltages by the oscilloscope. Ripple and noise should be as follows.

Range	Output Noise (dc to 2 MHz)
100 V	10 mVp-p max.
10 V	1 mVp-p max.
1 V	0.5 mVp-p max.
100 mV	50 μVp-p max.
10 mV	10 μVp-p max.
100 mA	10 μAp-p max.
10 mA	1 μAp-p max.
1 mA	0.1 μAp-p max.

e. Temperature coefficient:
Obtain temperature coefficients by measuring output voltages at 0, 15, 30 and 45°C by the Type 2501 Digital Voltmeter. Temperature coefficients should be less than 40 ppm/°C over all ranges.

f. Stability:
At ambient temperature, set the Type 2554 to 1-V range. Measure and record output voltages 0 V and 1 V for one day by the Types 2501 and 3047. Readings should be ± (0.005% of setting) ± (0.001% of range).

g. Settling time:
Watch the output of the Type 2554 by the digital voltmeter (hp Model 3450A, sample rate 1/60 s) along with the stop watch.
Time required for obtaining accuracy of ± (0.05% of setting) ± (0.01% of range) should be as given below.

- Stepping up
  - 1 s at 10-V, 1-mA, 10-mA ranges
  - 1.5 s at 100-V, 100-mA ranges
- Stepping down
  - 1 s at 100-mA range
  - 2 s at 10-V, 1-mA, 10-mA ranges
  - 3.5 s at 100-V range

Note the settling time is 4.5 s for 10 V to 0 only.

h. Line regulation:
When changing the source voltage by ±10%, the line regulation should be ±(0.01% of setting) ± (0.005% of range). Note that for the battery power, measurement is made with the voltage changed from 10 V to 8 V.

i. Load regulation:
At voltage ranges, the load regulation should be as given below when changing the load from nil to rated value.

- < 0.007% at 100-V range
- < 0.007% at 10-V range
- < 0.03% at 1-V range
- < 0.1% at 100-mV range
- < 0.1% at 10-mV range

j. Battery charge:
Charge the battery for approximately three hours. Confirm at the 100-mA range that the battery is usable for about three hours under maximum load. The time is about five hours at other ranges.

k. Overvoltage/overcurrent protection
Confirm that the OVER A lamp illuminates when a load twice the rated current has been connected.
Confirm that when the output voltage is higher than approximately 16 V at a current range, the OVER-V lamp illuminates.

2.5 Adjustment

2.5.1 Description

The following adjustment of the Type 2554 is made if required such as when the Type 2554 doesn't satisfy the specifications or after repairing the instrument. The adjustment is mainly divided into the POWER SUPPLY ASS'Y and MAIN ASS'Y. For measuring instruments and tools necessary for adjustment, refer to the table below.

2.5.2 POWER SUPPLY ASS'Y: B9256FA

Note: The POWER SUPPLY ASS'Y is adjusted with the battery connector disengaged.

a. Output voltage check of U1 (EHD-RD3093R power supply regulator)
Connect the dummy load of 27 Ω 3 W between P+ and Po. Confirm that the output voltage of U1 (between pins 8 and Po) is 9 V ± 0.2 V.

b. Adjustment of battery charge voltage
Adjust rheostat R5 so that the voltage between test point TP1 and Po will be 11.6 V ± 0.1 V.

c. Adjustment of battery operating voltage
Disengage the ac power plug, and set the power on-off switch to ON. Connect the dummy load of 27 Ω, 3 W between P+ and Po. Using the dc power supply of approximately 10 V, 1 A instead of the battery, adjust rheostat R12 so that the voltage between Q4-E and COM will be 8 V ± 0.1 V.

2.5.3 MAIN ASS'Y: B9256FB

a. Zero setting of DIAL-3
Rotate the DIAL-3 counterclockwise so that the voltage at test point TP4 will be as near 3 V as possible. Align zero of the scale plate with the index.

b. Adjustment of basic voltage
Set the range to 1 V, and the DIAL-1 and DIAL-2 to 0. The DIAL-3 need not be set to 0. Adjust rheostat R7 so that the voltage between TP3 and COM will be 3 V ± 3 mV. Before this procedure, set R2 to approximately the middle.

Measuring instruments and tools employed.

Instrument Name		Type	Manufacturer	Remarks
Standard Resistor	10 kΩ	2792-08	YEW	
	1 kΩ	2792-07	YEW	
	100 Ω	2792-06	YEW	0 ~ 80 mA
	10 Ω	2792-05	YEW	50 mA ~ 100 mA
Digital Voltmeter		2501	YEW	
Dielectric strength tester				
DC power supply		524	Metronix	Approx. 10 V, 1 A
Transistorized Insulation Resistance Tester		3213	YEW	500 V/100 MΩ
Oscilloscope				Bandwidth more than 2 MHz

- Screwdriver for adjustment.
- Leads for measurement (low thermoelectromotive force)
- Dummy load (27 Ω, 3 W)

c. Zero adjustment of 1-V range
Set the range selector to x 1 V, and all the setting dials to 0. Adjust R17 so that the voltage between output terminals H and L measured by the Type 2501 will be within 0 ± 0.02 mV.

d. Full-scale calibration of DIAL-3
Set the range to x 1 V, the DIAL-1 and DIAL-2 to 0, and the DIAL-3 to 100. Adjust rheostat R11 so that the voltage between output terminals H and L will be 10 mV ± 0.03 mV.

e. Full-scale calibration of 1-V range
Set the range selector to x 1 V, the DIAL-1 to 1.0, and the DIAL-2 and DIAL-3 to 0. Adjust R2 so that the output voltage will be 1 V ± 0.2 mV.

f. Zero adjustment of 10-V, 100-V and current ranges
Set the range to x 10 V, and all the setting dials to 0. Adjust R40 so that the voltage between output terminals H and L will be 0 ± 0.2 mV. Then change the range to x 100 V, and confirm that the output voltage remains 0 ± 0.2 mV. Divide the error to the 10-V and 100-V ranges so that their error will be a minimum.

g. Full-scale calibration of 10-V range
Set the range to x 10 V, and the DIAL-1, DIAL-2 and DIAL-3 to 10, 0 and 00 respectively. Adjust R33 so that the voltage between output terminals H and L will be 10 V ± 2 mV.

h. Full-scale calibration of 100-V range
Set the range to x 100 V, and the DIAL-1, DIAL-2 and DIAL-3 to 10, 0 and 00 respectively. Adjust rheostat R35 so that the output voltage between output terminals H and L will be 100 V ± 20 mV.

3. TROUBLESHOOTING

3.1 Description

For troubleshooting, a good understanding of the circuitry is vital. Circuitry operation is traced successively by an oscilloscope starting from the power supply. This may seem a round about way, but it is the most dependable method of locating a trouble. If a complete assortment of good assemblies is available for replacement, it is advisable to change all the assemblies.

Good results won't be obtained by tampering with the troubled instrument without the necessary measuring instruments. The results may sometimes be even worse. Such an instrument won't be warranted by YEW.

This chapter comprises flow charts separately for the POWER SUPPLY ASS'Y and MAIN ASS'Y.

3.2 Measuring Instruments and Tools Employed

For measuring instruments and tools necessary for troubleshooting, refer to the relevant table in 2.5 Adjustment.

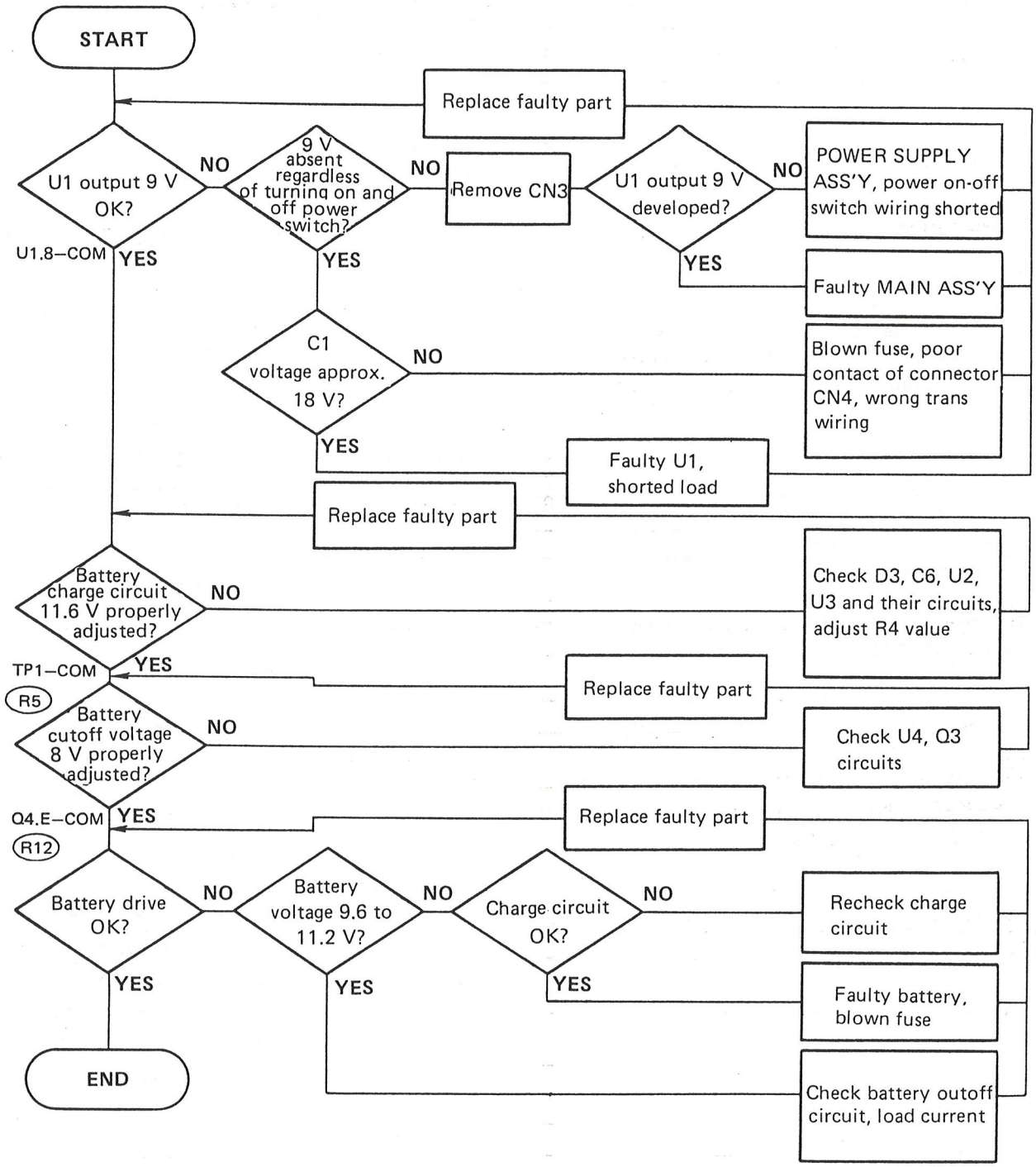


Fig. 3-1 Flow Chart (POWER SUPPLY ASS'Y)

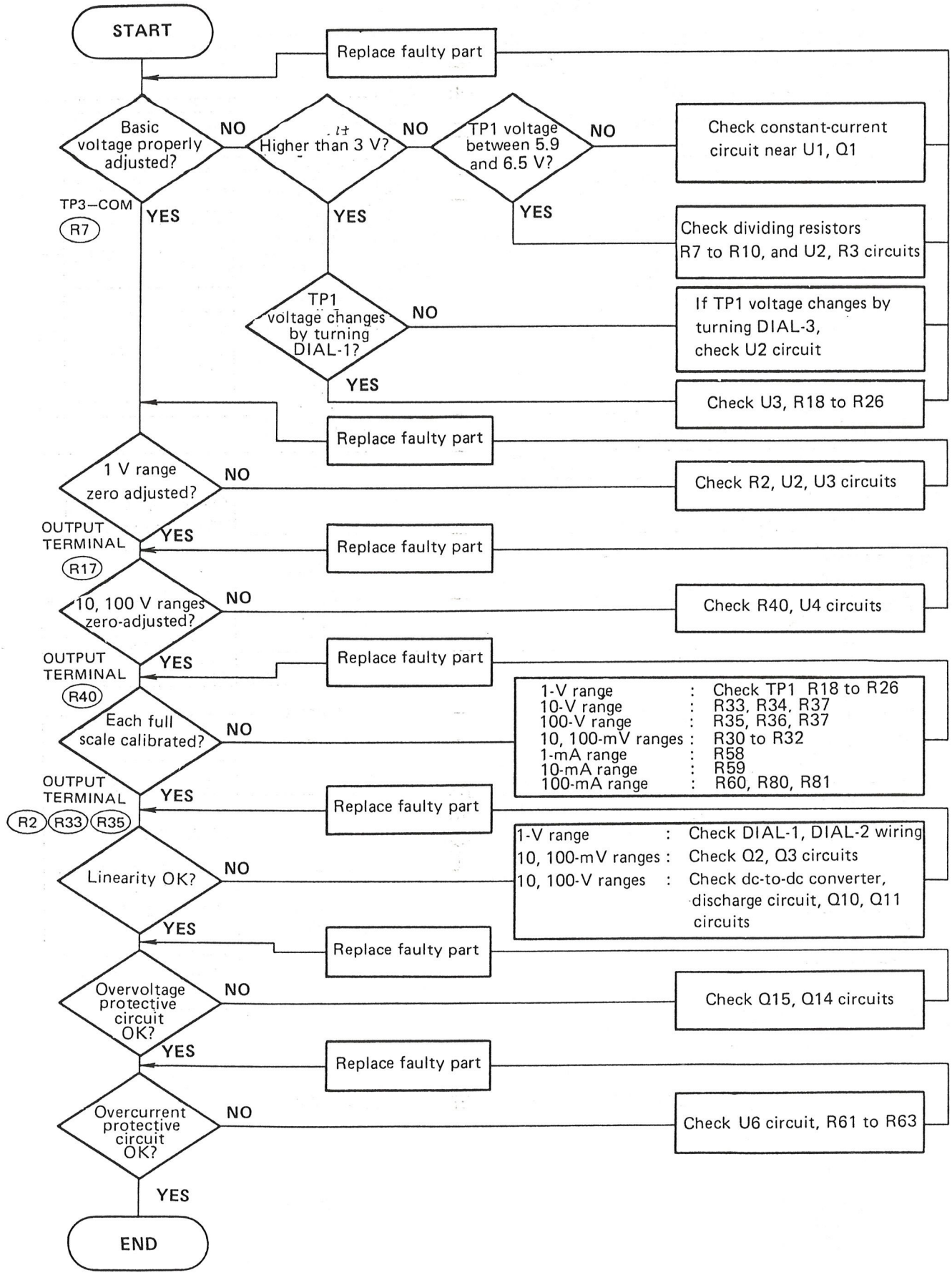
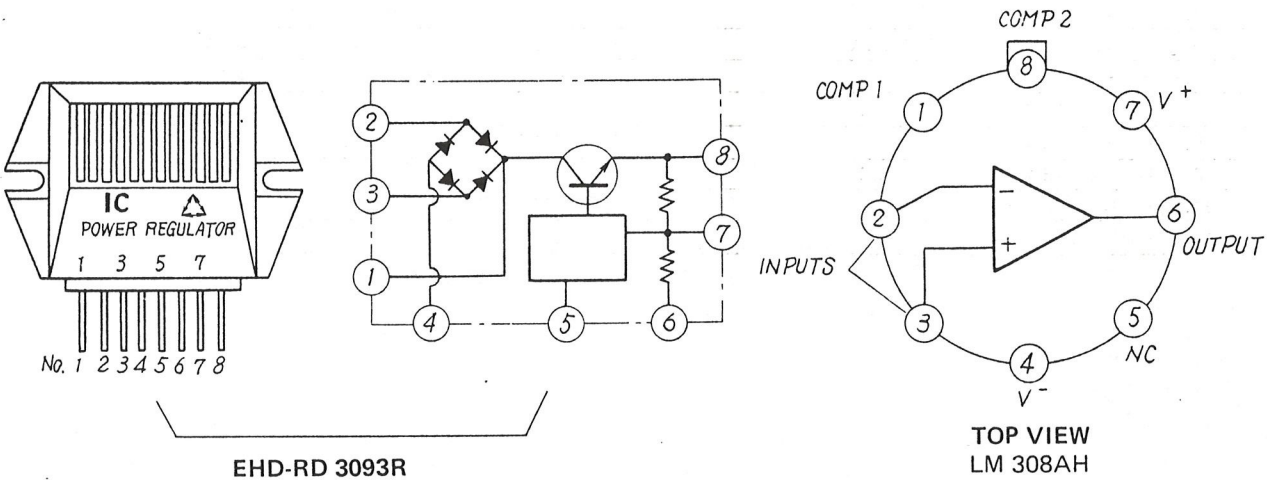


Fig. 3-2 Flow Chart (MAIN ASS'Y)

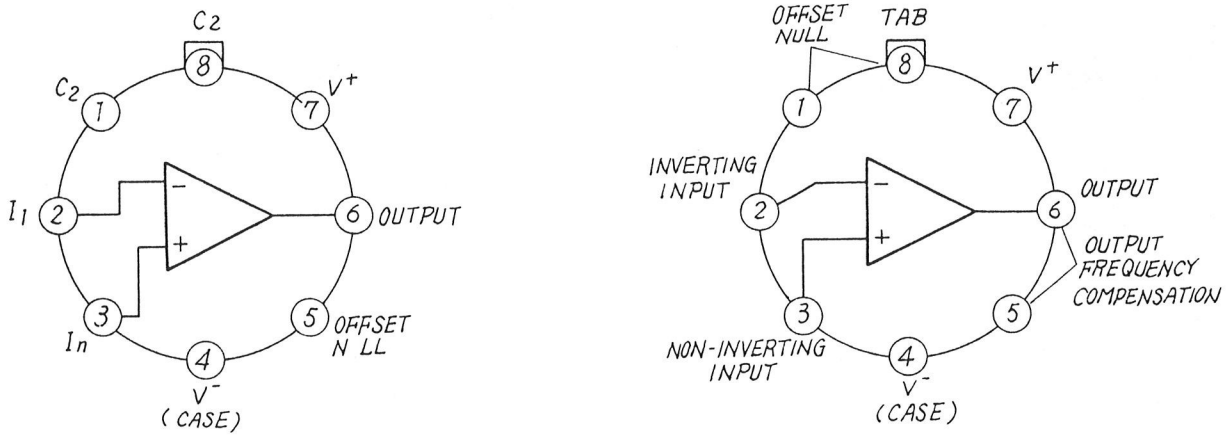
IC CONNECTION DIAGRAM

ASS'Y	ITEM	TYPE	MANUFACTURER	PART NO.	DESCRIPTION
Power Supply Ass'y	U1	EHD-RD 3093R	Matsushita	A9019LH	Power Regulator
	U2	μpc 157A	NEC	G9033LA	General purpose Operational Amplifier
	U3	μpc 157A(1)	NEC	G9034LA	General purpose Operational Amplifier
	U4	μpc 157A	NEC	G9033LA	General purpose Operational Amplifier
Main Ass'y	U1	μpc 157A(1)	NEC	G9034LA	General purpose Operational Amplifier
	U2	BC 725-S	RAYTHEON	A9049LA	Operational Amplifier
	U3	LM 308AH	NSC	A9022LA	Operational Amplifier
	U4	RC 725-S	RAYTHEON	A9049LA	Operational Amplifier
	U5	μpc 157A	NEC	G9033LA	General purpose Operational Amplifier
	U6	μpc 157A	NEC	G9033LA	General purpose Operational Amplifier



EHD-RD 3093R

TOP VIEW
LM 308AH



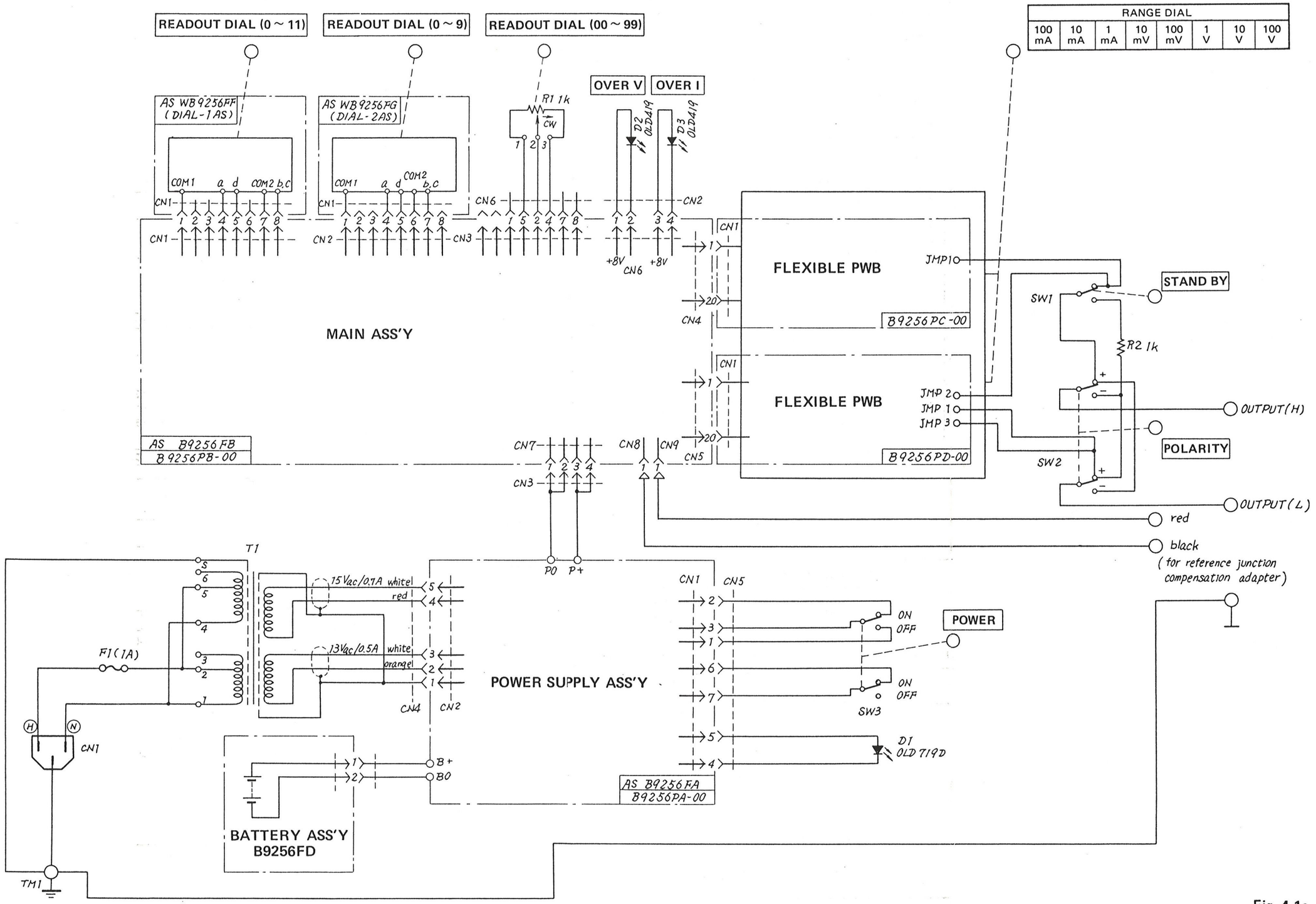
TOP VIEW
μpc 157A
μpc 157A (1)

TOP VIEW
RC 725-S

Fig. 3-3 IC Connection Diagram

4. CIRCUIT DIAGRAMS

Contents of Circuit Diagrams



('76. 01)

Fig. 4-1a
Type 2554 Overall Wiring Diagram

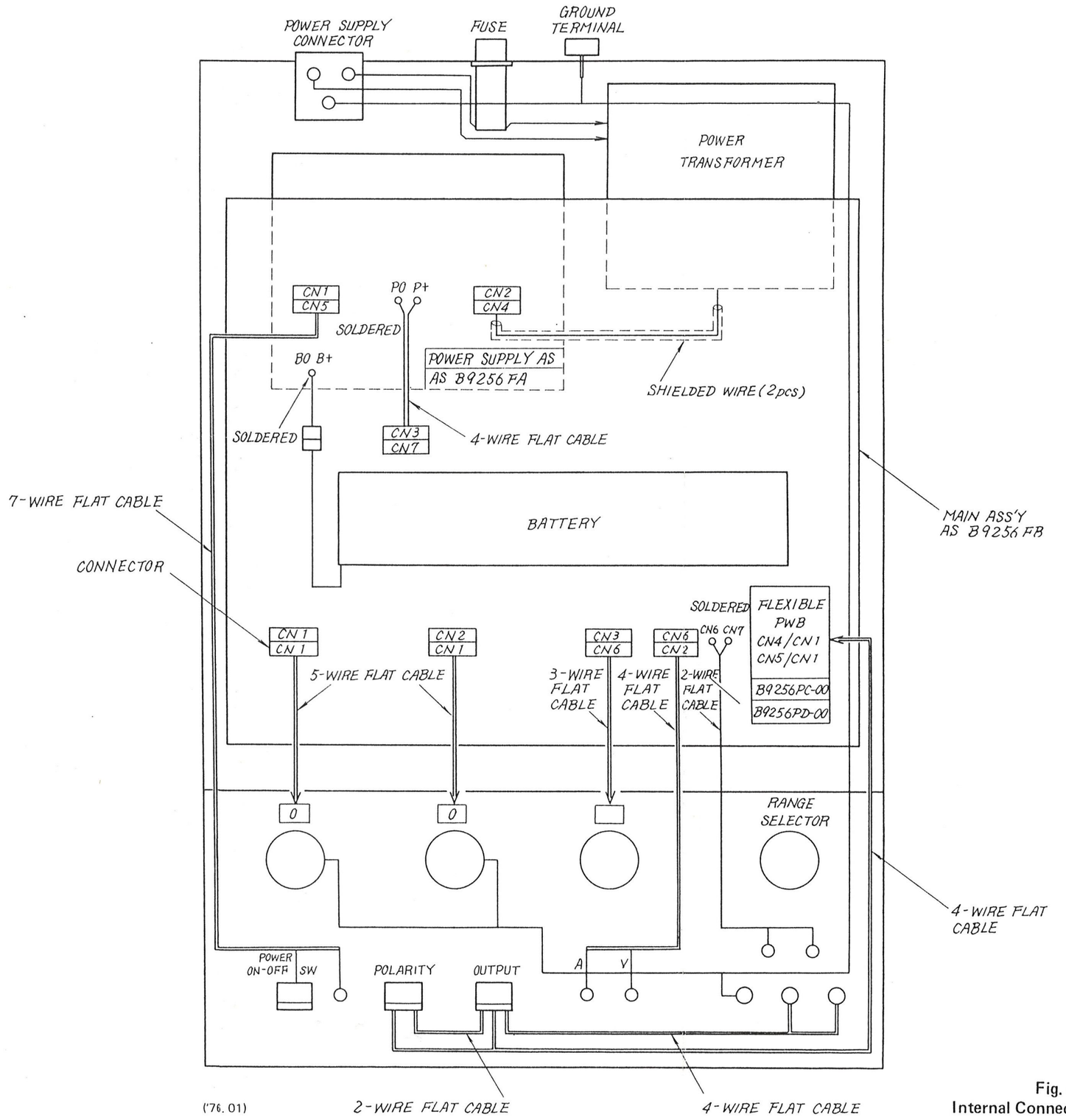
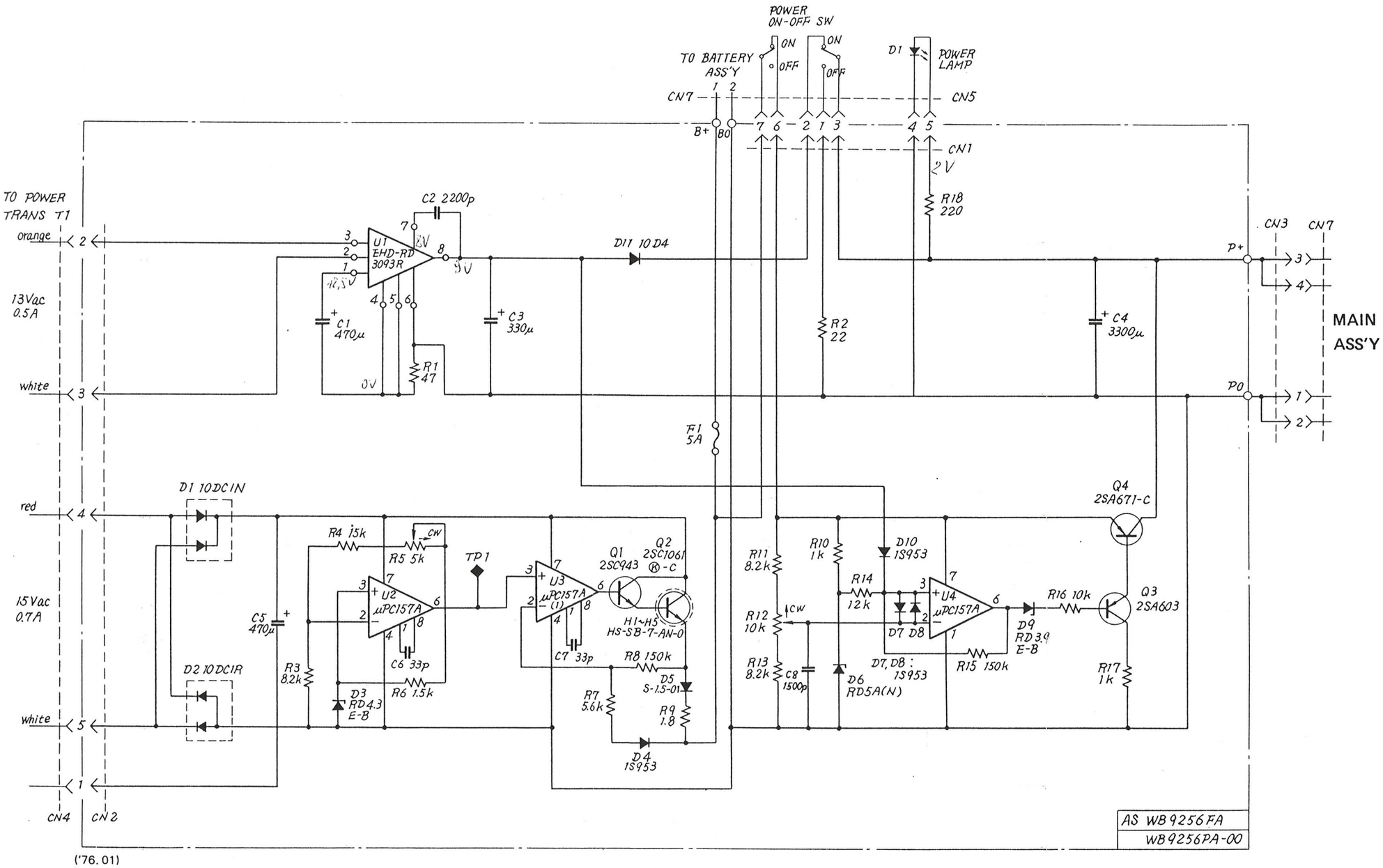
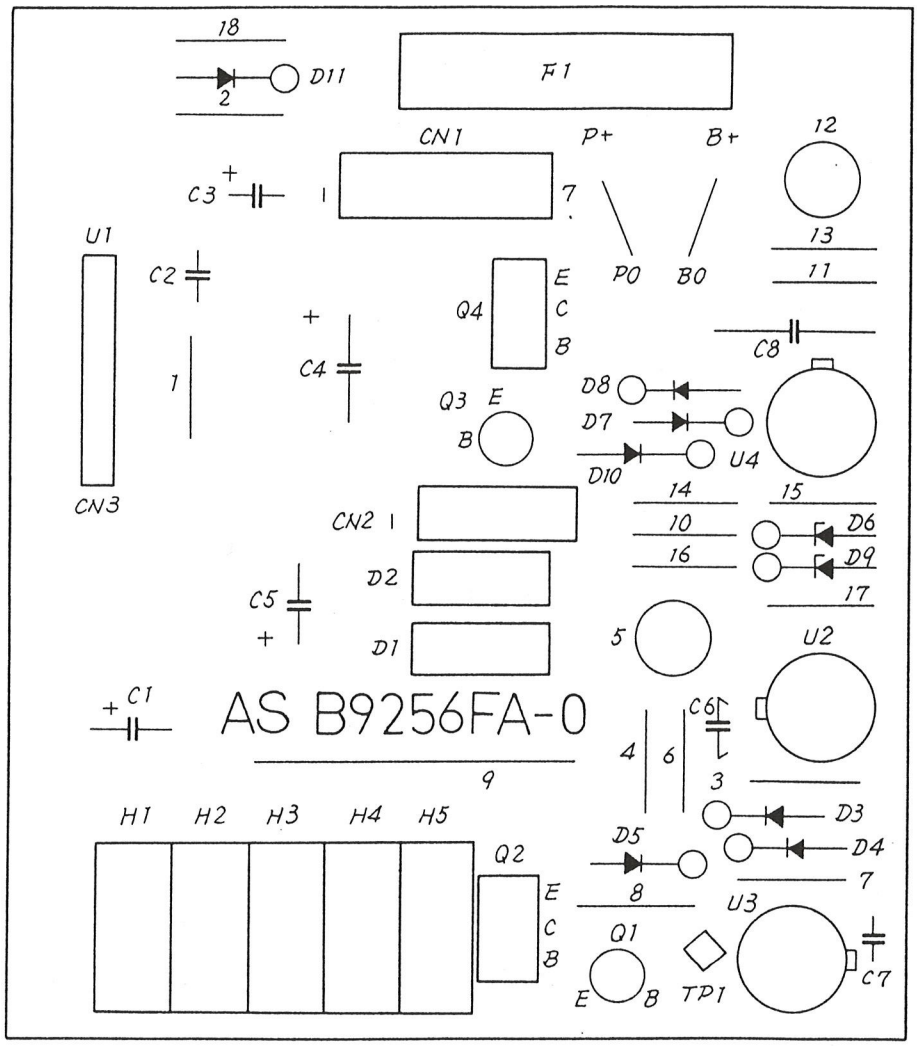


Fig. 4-1b
Internal Connection



('76. 01)

Fig. 4-2a
Power Supply Ass'y
B9256F4 Circuit Diagram



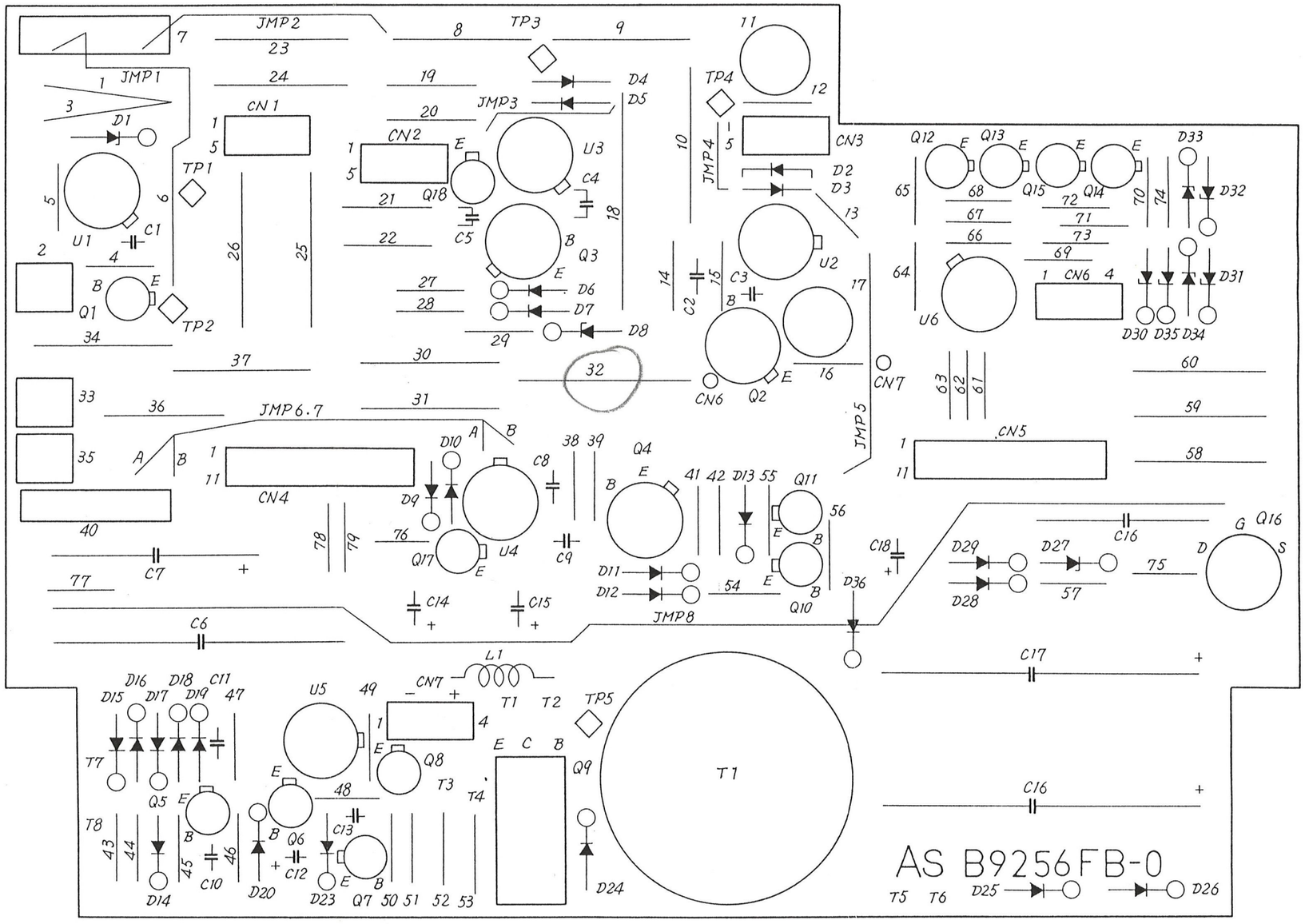
('75. 09)

Fig. 4-2b Power Supply Ass'y B9256PA Parts Location

niederohmig ! 10mV & 100mV falsch !

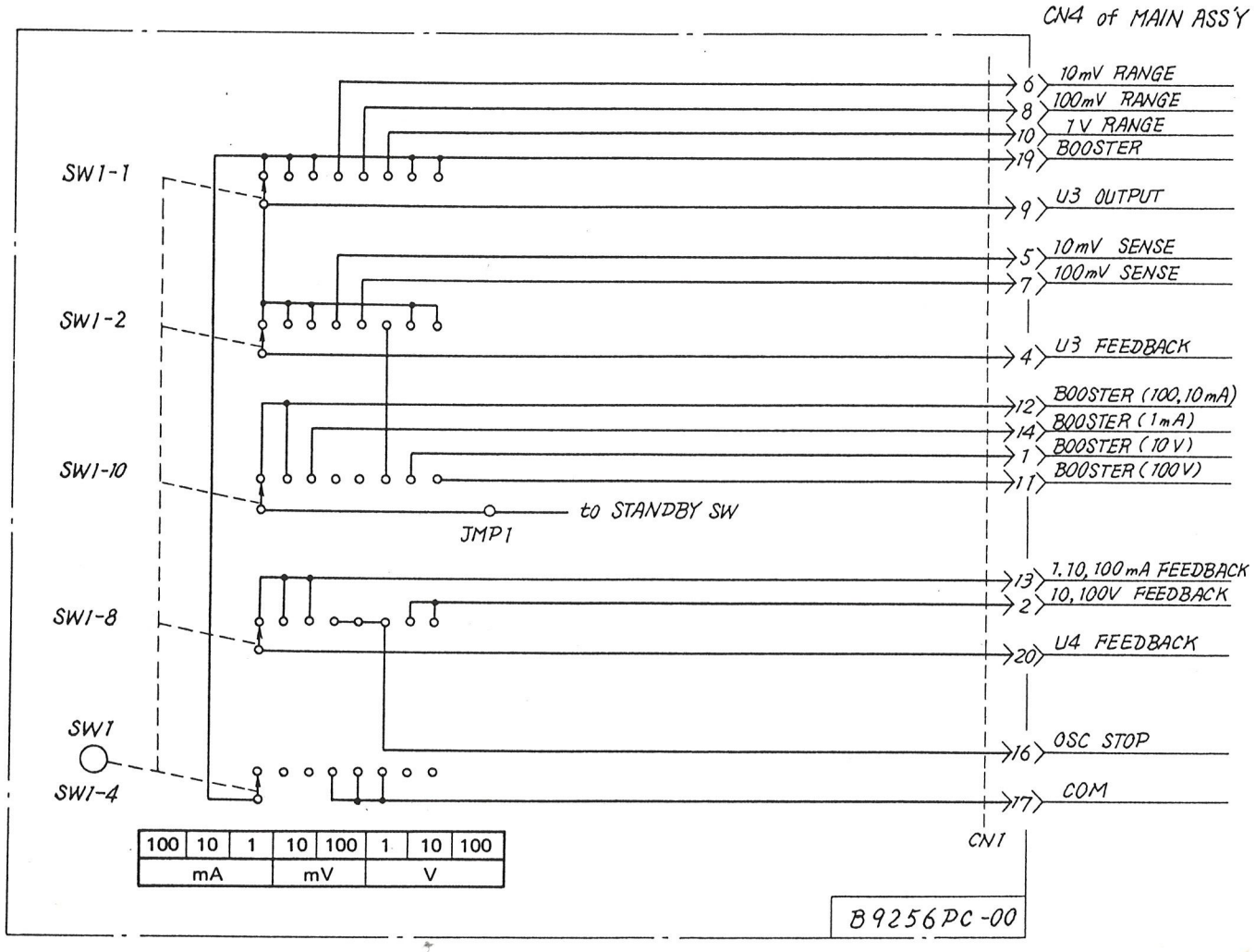
(Low impedance, 10mV and 100mV wrong!)

Fig. 4-3a
Main Ass'y B9256FB Circuit Diagram



('75.10)

Fig. 4-3b
Main Ass'y B9256FB Parts Location



('75. 10)

Fig. 4-4a Range Ass'y 1/2 B9256FC PWB B9256PC-00

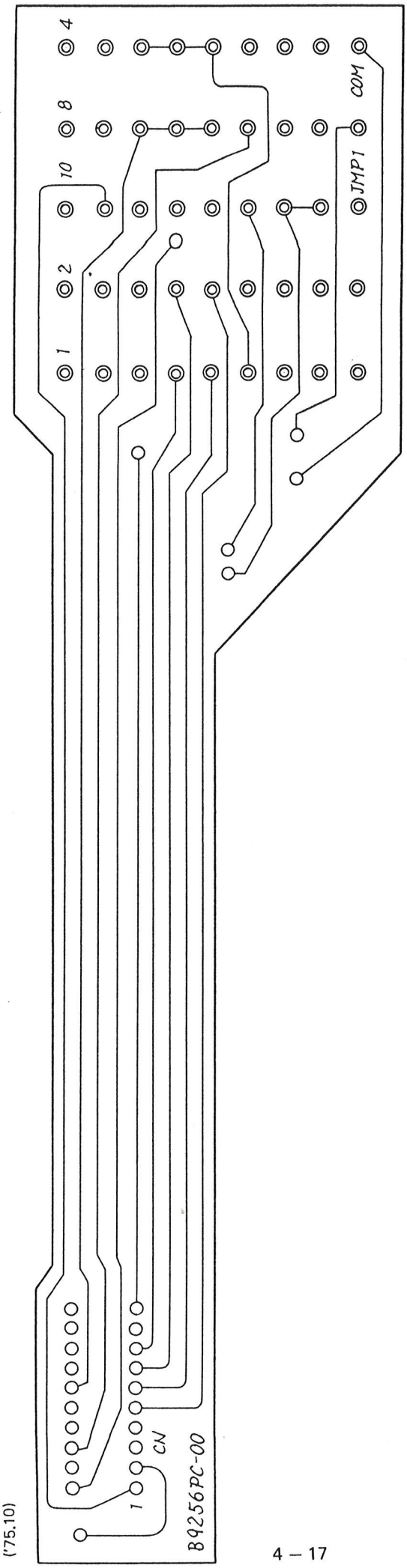
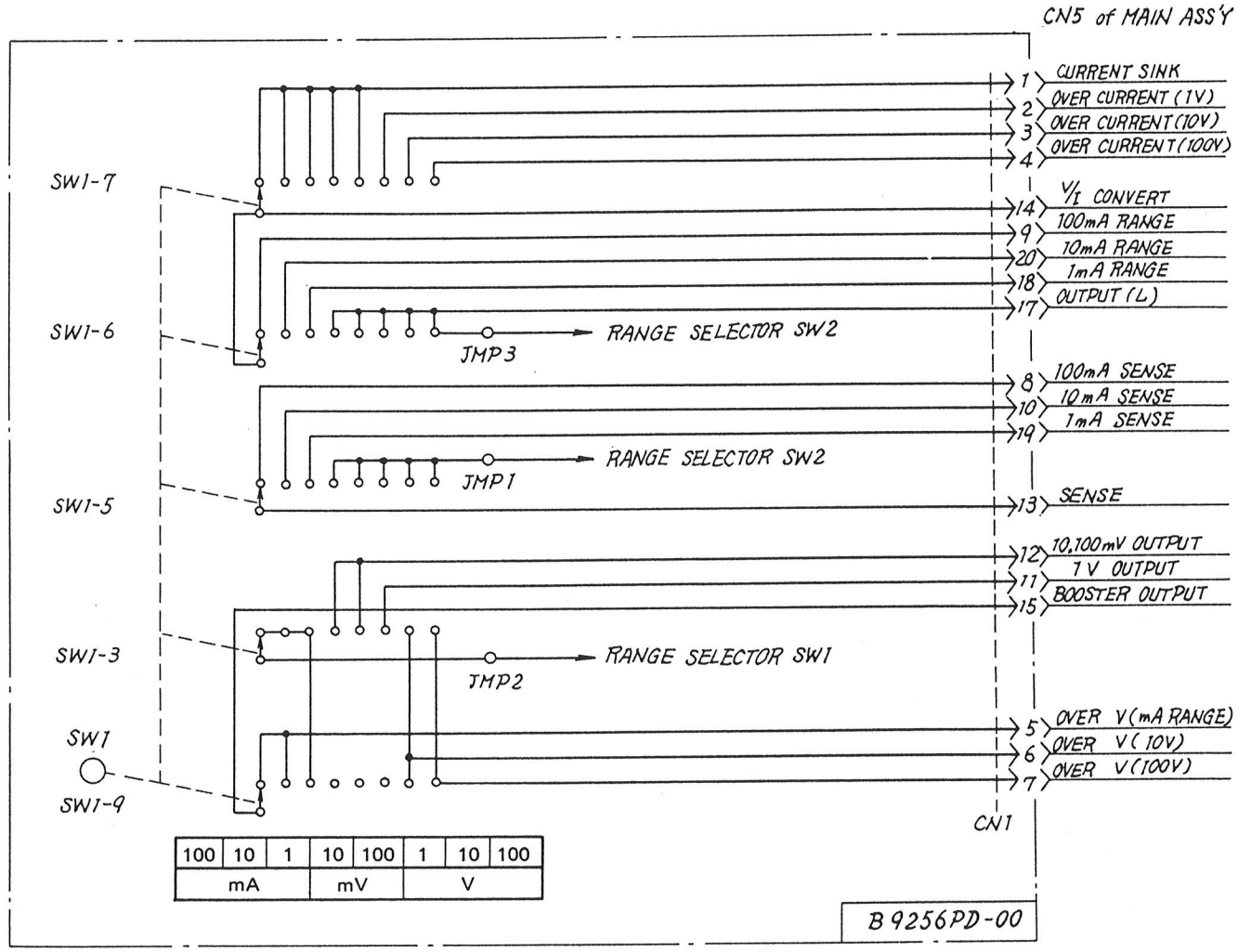
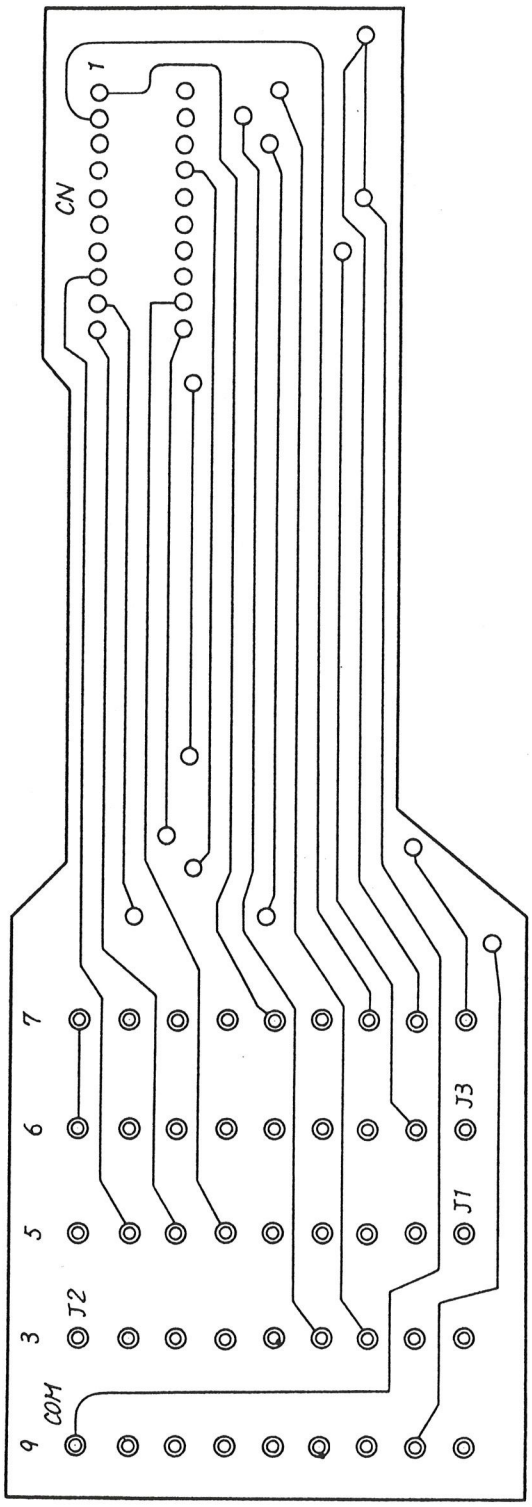


Fig. 4-4b Range Ass'y Flexible PWB B9256PC



('75.10)

Fig. 4-5a Range Ass'y 2/2 B9256FC PWB B9256PD-00



('75.10)

Fig. 4-5b Range Ass'y Flexible PWB B9256PD

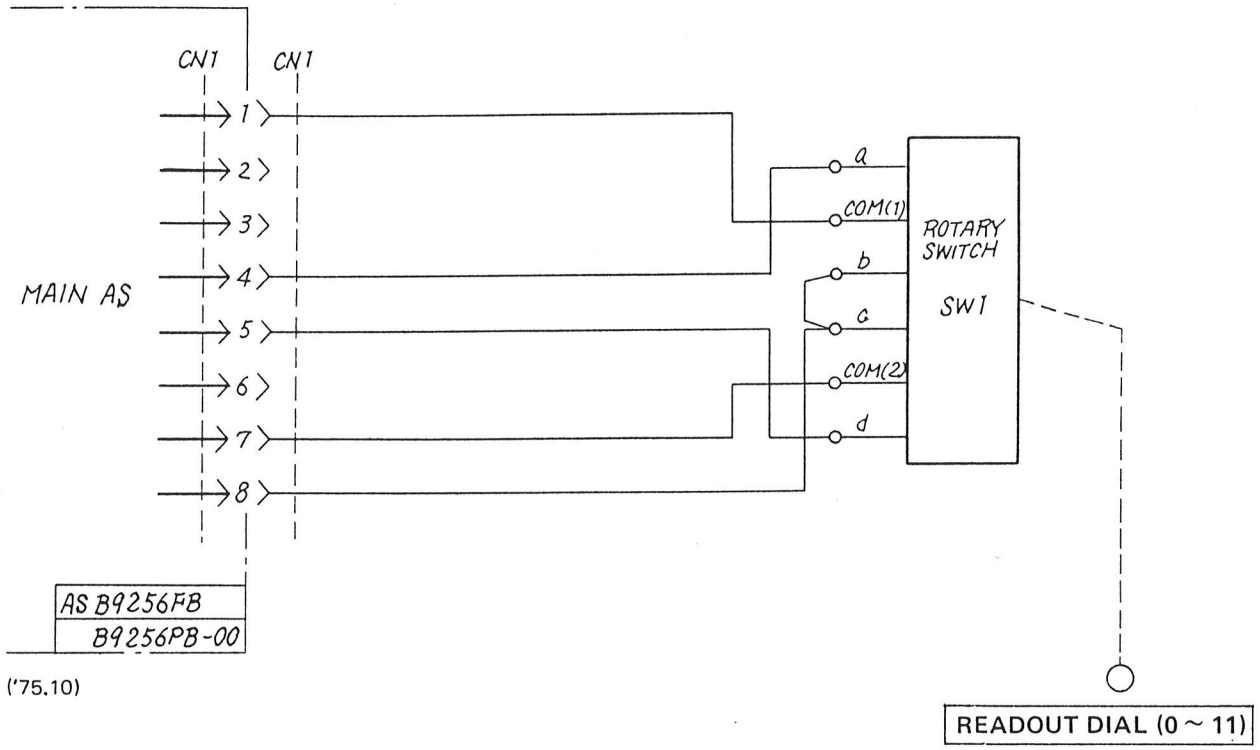


Fig. 4-6 Dial-1 Ass'y B9256FF

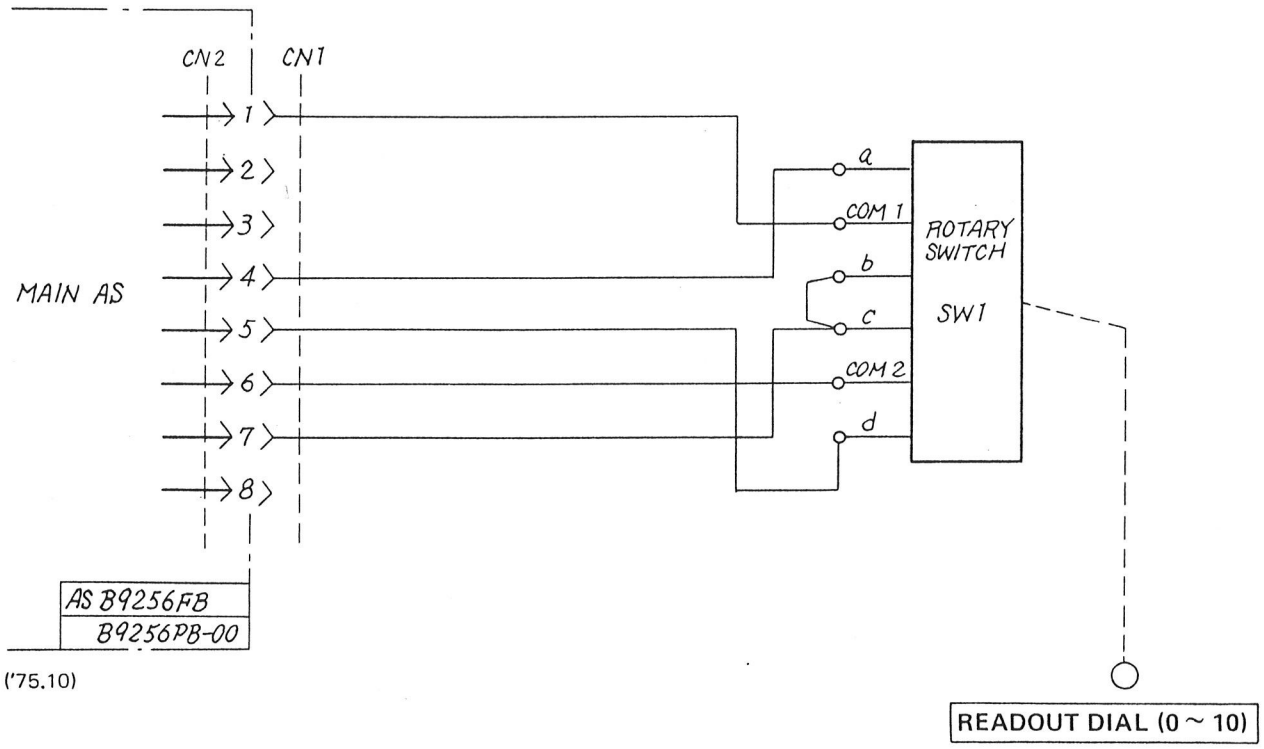


Fig. 4-7 Dial-2 Ass'y B9256FG

5. PARTS LIST AND STRUCTURAL DIAGRAMS

Contents of Parts List

*1. Refer to Fig. 5-3
*2. Refer to Fig. 4-1

INDEX

List of abbreviations

ac = alternating current
Ag = silver (ed)
Al = aluminum
amp = amplifier
ass'y = assembly
Au = gold
car flm = carbon film
cap = capacitor
cct = circuit
cer = ceramic
coef = coefficient
com = common
comp = composition
conn = connector
dc = direct current
dia = diameter
elect = electrolytic
FET = field effect transistor
flm = film
fxd = fixed
Ge = germanium
gnd = ground
IC = integrated circuit
JIS = Japanese Industrial Standard
L = inductor
met = metal (lized)
mfr = manufacturer
Ne = neon
nom val = nominal value
OSC = oscillator
pc = printed circuit
pcb = printed circuit board
plstc = plastic
polye = polyester
polys = polystyrene
pot = potentiometer
prec = precision (temperature coefficient, long term stability, and/or tolerance)
res = resistor
rng = range
rtry = rotary
Se = selenium
sect = section(s)
Si = silicon
sub-ass'y = sub-assembly
sw = switch
sys = system
sply = supply
Ta = tantalum
temp = temperature
trim = trimmer
TSTR = transistor
trans = transformer
var = variable
ww = wire wound
YEW spec = special specification of Yokogawa Electric Works, Ltd. - YEW.

† = Request the item marked with † to YEW.
†† = Replace the item marked with †† as a complete part set even when one of its parts is damaged. Request the complete part set to YEW.
††† = Replace the item marked with ††† as an assembly even when a part of it is damaged. Request the assembly to YEW.
†††† = Optimum value selected at factory, average value shown (part may be omitted).

Example

Conn : multi = multi connector
Cap : fxd Al elect = Fixed aluminum electrolytic capacitor
Cap : fxd met polye flm = Fixed metallized polyester film capacitor
PC Ass'y or PC-Ass'y = Printed circuit assembly (with parts)
Res : fxd car flm = Fixed carbon film resistor
Ress : var ww = Wirewound variable resistor
Temp coef = Temperature coefficient

5. VOLTAGE ST'D ASS'Y (refer to Fig. 5-1)

('75-03)

Item	Part No.	Part Name & Description			Manufacturer	Remarks
	B9256BB	Case ass'y			YEW	see 5.1
	B9256BL	Case ass'y			YEW	see 5.2
	B9256DA	Frame ass'y			YEW	see 5.3
	Y9335JB	Screw	(4 pcs)	φ3ℓ35P0.5JB	YEW	

5.1 CASE ASS'Y: B9256BB (refer to Fig. 5-2)

('75-03)

Item	Part No.	Part Name & Description			Manufacturer	Remarks
	B9256BC	Case			YEW	
	B9256BD	Rod	(4 pcs)		YEW	
	B9256BE	Spring	(2 pcs)		YEW	
	B9250BF	Net			YEW	
	Y9304JB	Screw	(2 pcs)	φ3ℓ4P0.5JB	YEW	
	Y9300SP	Washer	(2 pcs)	φ3	YEW	

5.2 CASE ASS'Y: B9256BL (refer to Fig. 5-3)

('75-03)

Item	Part No.	Part Name & Description			Manufacturer	Remarks
	B9256BM	Case			YEW	
	B9256BN	Bracket ass'y			YEW	
	B9256BT	Handle ass'y			YEW	
	B9256BV	Shaft	(2 pcs)		YEW	
	B9256BW	Plate			YEW	
	A9001KX	Retainer	(2 pcs)		YEW	
	B9256CA	Block	(2 pcs)		YEW	
	B9256FD	Battery ass'y			YEW	
	B9401BM	Spacer	(2 pcs)		YEW	
	B9256BQ	Spring			YEW	
	Y9305LB	Screw	(2 pcs)	φ3ℓ5P0.5LB	YEW	
	Y9305EB	Screw	(4 pcs)	φ3ℓ5P0.5EB	YEW	

5.2.1 BATTERY ASS'Y: B9256FD (refer to Fig. 5-3)

('75-09)

Item	Part No.	Part Name & Description		Manufacturer	Remarks
	A9017ED	Battery	8N-1200 8SC-S-YG(A)	Sanyo Denki	
	A9306KC	Conn: jack	1625-P2	Kyoritsu	
	A9307KC	Pin-terminal	1560	Kyoritsu	

5.3 FRAME ASS'Y: B9256DA (refer to Fig. 5-4)

('75-03)

Item	Part No.	Part Name & Description			Manufacturer	Remarks
	B9256DB	Plate			YEW	
	B9256DC	Plate			YEW	
	B9256DD	Shaft			YEW	
	B9256DE	Spring			YEW	
	Y9910YA	Collar			YEW	
	B9256DG	Dial ass'y			YEW	
	B9256DH	Dial ass'y			YEW	
	B9256DJ	Dial ass'y			YEW	
	B9256DP	Shaft			YEW	
	B9256DT	Frame ass'y			YEW	
	B9256EA	Panel ass'y			YEW	
	B9256EL	Panel ass'y			YEW	
	B9252BD	Block	(4 pcs)		YEW	
	B9250DE	Collar	(3 pcs)		YEW	
	B9250DF	Collar	(3 pcs)		YEW	
	B9250DB	Terminal ass'y			YEW	
	B9250DV	Terminal ass'y	(2 pcs)		YEW	
	A9146ZH	Short bar			YEW	
	A9022YC	Bracket	(4 pcs)		YEW	
	A9037KU	Knob	(3 pcs)		ELMA	
	A9027KU	Knob			ELMA	
	A9036KU	Cap			ELMA	
	A9162KC	Conn: receptacle			Tokai Tsushin	black
	A9163KC	Conn: receptacle			Tokai Tsushin	red
	A9061KX	Nut	(2 pcs)		Tokai Tsushin	
	Y9250ET	Retainer	(2 pcs)		YEW	
	Y9306WB	Washer	(2 pcs)	ϕ3	YEW	
	Y9206SA	Screw	(2 pcs)	ϕ2.3ℓ6SA	YEW	
	Y9304SJ	Screw	(6 pcs)	ϕ3ℓ4P0.5SJ	YEW	
	Y9306JB	Screw	(9 pcs)	ϕ3ℓ6P0.5JB	YEW	
	Y9306EB	Screw	(6 pcs)	ϕ3ℓ6P0.5EB	YEW	
	Y9310EB	Screw	(2 pcs)	ϕ3ℓ10P0.5EB	YEW	
	Y9310JB	Screw	(4 pcs)	ϕ3ℓ10P0.5JB	YEW	
	Y9316JB	Screw		ϕ3ℓ16P0.5JB	YEW	
	Y9410LB	Screw	(2 pcs)	ϕ4ℓ10P0.7LB	YEW	
	Y9300SP	Washer	(8 pcs)	ϕ3	YEW	
	Y9400SP	Washer	(2 pcs)	ϕ4	YEW	
	Y9300WB	Washer	(3 pcs)	ϕ3	YEW	
	Y9400WB	Washer	(2 pcs)	ϕ4	YEW	
	Y9301BB	Nut		ϕ3	YEW	
	Y9401BB	Nut		ϕ4	YEW	
	B9256FA	Power supply ass'y			YEW	
	B9256FB	Main ass'y			YEW	
	B9256FC	Range ass'y			YEW	
	B9256FD	Battery ass'y			YEW	
	B9256FE	Panel ass'y			YEW	
	B9256FF	Dial-1 ass'y			YEW	
	B9256FG	Dial-2 ass'y			YEW	

5.3.1 POWER SUPPLY ASS'Y: B9256FA (refer to Fig. 4-2)

('75-09)

Item	Part No.	Part Name & Description	Manufacturer	Remarks
R1	A9005RS	Res: fxd car comp 4.7Ω ±10% ¼W RC¼GF4.7ΩK		
R2	A9162RS	Res: fxd car comp 22Ω ±10% ½W RC½GF22ΩK		
R3	A9044RS	Res: fxd car comp 8.2kΩ ±10% ¼W RC¼GF8.2kΩK		
R4	A9047RS	Res: fxd car comp 15kΩ ±10% ¼W RC¼GF15kΩK		
R5	A9557RV	Res: var ww 5kΩ ±10% 0.25W WR6T5kΩ	Japan Resistor	
R6	A9035RS	Res: fxd car comp 1.5kΩ ±10% ¼W RC¼GF1.5kΩK		
R7	A9042RS	Res: fxd car comp 5.6kΩ ±10% ¼W RC¼GF5.6kΩK		
R8	A9059RS	Res: fxd car comp 150kΩ ±10% ¼W RC¼GF150kΩK		
R9	A9377RA	Res: fxd ww 1.8Ω ±5% 5W SL5W1.8Ω	Japan Resistor	
R10	A9033RS	Res: fxd car comp 1kΩ ±10% ¼W RC¼GF1kΩK		
R11	A9044RS	Res: fxd car comp 8.2kΩ ±10% ¼W RC¼GF8.2kΩK		
R12	A9558RV	Res: var ww 10kΩ ±10% 0.25W WR6T10kΩ	Japan Resistor	
R13	A9044RS	Res: fxd car comp 8.2kΩ ±10% ¼W RC¼GF8.2kΩK		
R14	A9046RS	Res: fxd car comp 12kΩ ±10% ¼W RC¼GF12kΩK		
R15	A9059RS	Res: fxd car comp 150kΩ ±10% ¼W RC¼GF150kΩK		
R16	A9045RS	Res: fxd car comp 10kΩ ±10% ¼W RC¼GF10kΩK		
R17	A9033RS	Res: fxd car comp 1kΩ ±10% ¼W RC¼GF1kΩK		
R18	A9025RS	Res: fxd car comp 220Ω ±10% ¼W RC¼GF220ΩK		
C1	A9046CA	Cap: fxd Al elect 470μF +75% −10% 25V ECEA25V470L	Matsushita	
C2	A9066CY	Cap: fxd polye flm 2200pF ±10% 100V MFL1003-222K	Matsuo	
C3	A9022CA	Cap: fxd Al elect 330μF +50% −10% 16V ECEA16V330L	Matsushita	
C4	A9256CA	Cap: fxd Al elect 3300μF +50% −10% 16V ECET16R3300S	Matsushita	
C5	A9046CA	Cap: fxd Al elect 470μF +75% −10% 25V ECEA25V470L	Matsushita	
C6	A9019CN	Cap: fxd mica 33pF ±10% 100V DM05C330K1	Nitsuko	
C7	A9019CN	Cap: fxd mica 33pF ±10% 100V DM05C330K1	Nitsuko	
C8	A9084CY	Cap: fxd polye flm 1500pF ±10% 100V MXT-1003-152K	Matsuo	
D1	A9007HL	Diode: module 10DC1N	IRC Japan	
D2	A9008HL	Diode: module 10DC1R	IRC Japan	
D3	A9180HD	Diode: zener RD4.3E-B	NEC	
D4	G9001HD	Diode 1S953	NEC	
D5	A9066HD	Diode S-1.5-01	Origin	
D6	G9014HD	Diode: zener RD5A-N	NEC	
D7	G9001HD	Diode 1S953	NEC	
D8	G9001HD	Diode 1S953	NEC	
D9	A9178HD	Diode: zener RD3.9E-B	NEC	
D10	G9001HD	Diode 1S953	NEC	
D11	G9004HR	Diode 10D4	IRC Japan	
Q1	A9143HQ	TSTR 2SC943	NEC	hfe 150 to 240
Q2	A9287HQ	TSTR 2SC1061 Ⓚ-C	Hitachi	
Q3	G9141HQ	TSTR 2SA603	NEC	
Q4	A9045HQ	TSTR 2SA671-C	Hitachi	
U1	A9019LH	IC EHD-RD3093R	Matsushita	
U2	G9033LA	IC μpc 157A	NEC	
U3	G9034LA	IC μpc 157A(1)	NEC	
U4	G9033LA	IC μpc 157A	NEC	
S1	A9052KH	Socket IC-66-22-2	Yamaichi	

5.3.2 MAIN ASS'Y: B9256FB (continued)

Item	Part No.	Part Name & Description	Manufacturer	Remarks
R34	A9185RP	Res: fxd met flm 44.5kΩ ±0.5% ¼W SFB44.5kΩD T-11	Tama Denki	±5 ppm
R35	A9568RV	Res: var ww 10kΩ ±10% WR6S10kΩ	Japan Resistor	
R36	A9186RP	Res: fxd met flm 490kΩ ±0.5% ¼W SFB490kΩD T-11	Tama Denki	±5 ppm
R37	A9187RP	Res: fxd met flm 5kΩ ±0.25% ¼W SFB5kΩC T-11	Tama Denki	±5 ppm
R38	A9009RS	Res: fxd car comp 10Ω ±10% ¼W RC¼GF10ΩK		
R39	A9015RS	Res: fxd car comp 33Ω ±10% ¼W RC¼GF33ΩK		
R40	A9616RV	Res: var cermet 200kΩ ±20% 0.5W WTJ200kΩ	Japan Resistor	
R41	A9005RS	Res: fxd car comp 4.7Ω ±10% ¼W RC¼GF4.7ΩK		
R42	A9034RS	Res: fxd car comp 1.2kΩ ±10% ¼W RC¼GF1.2kΩK		
R43	A9051RS	Res: fxd car comp 33kΩ ±10% ¼W RC¼GF33kΩK		
R44	A9049RS	Res: fxd car comp 22kΩ ±10% ¼W RC¼GF22kΩK		
R45	A9047RS	Res: fxd car comp 15kΩ ±10% ¼W RC¼GF15kΩK		
R46	A9042RS	Res: fxd car comp 5.6kΩ ±10% ¼W RC¼GF5.6kΩK		
R47	A9039RS	Res: fxd car comp 3.3kΩ ±10% ¼W RC¼GF3.3kΩK		
R48	A9055RS	Res: fxd car comp 68kΩ ±10% ¼W RC¼GF68kΩK		
R49	A9051RS	Res: fxd car comp 33kΩ ±10% ¼W RC¼GF33kΩK		
R50	A9047RS	Res: fxd car comp 15kΩ ±10% ¼W RC¼GF15kΩK		
R51	A9046RS	Res: fxd car comp 12kΩ ±10% ¼W RC¼GF12kΩK		
R52	A9041RS	Res: fxd car comp 4.7kΩ ±10% ¼W RC¼GF4.7kΩK		
R53	A9030RS	Res: fxd car comp 560Ω ±10% ¼W RC¼GF560ΩK		
R54	A9051RS	Res: fxd car comp 33kΩ ±10% ¼W RC¼GF33kΩK		
R55	A9042RS	Res: fxd car comp 5.6kΩ ±10% ¼W RC¼GF5.6kΩK		
R56	A9040RS	Res: fxd car comp 3.9kΩ ±10% ¼W RC¼GF3.9kΩK		
R57	A9045RS	Res: fxd car comp 10kΩ ±10% ¼W RC¼GF10kΩK		
R58	A9457YA	Res: fxd ww 1kΩ ±0.02% STB16 1kΩ	YEW	
R59	A9458YA	Res: fxd ww 100Ω ±0.02% STB16 100Ω	YEW	
R60	A9507YA	Res: fxd ww 9.99Ω ±0.05% STB16 9.99Ω	YEW	
R61	A9017RS	Res: fxd car comp 47Ω ±10% ¼W RC¼GF47ΩK		
R62	A9005RS	Res: fxd car comp 4.7Ω ±10% ¼W RC¼GF4.7ΩK		
R63	A9005RS	Res: fxd car comp 4.7Ω ±10% ¼W RC¼GF4.7ΩK		
R64	A9051RS	Res: fxd car flm 33kΩ ±10% ¼W RC¼GF33kΩK		
R65	A9046RS	Res: fxd car comp 1MΩ ±10% ¼W RC¼GF1MΩK		
R66	A9069RS	Res: fxd car comp 33kΩ ±10% ¼W RC¼GF33kΩK		
R67	A9046RS	Res: fxd car comp 12kΩ ±10% ¼W RC¼GF12kΩK		
R68	A9046RS	Res: fxd car comp 12kΩ ±10% ¼W RC¼GF12kΩK		
R69	A9035RS	Res: fxd car comp 1.5kΩ ±10% ¼W RC¼GF1.5kΩK		
R70	A9047RS	Res: fxd car comp 15kΩ ±10% ¼W RC¼GF15kΩK		
R71	A9034RS	Res: fxd car comp 1.2kΩ ±10% ¼W RC¼GF1.2kΩK		
R72	A9042RS	Res: fxd car comp 5.6kΩ ±10% ¼W RC¼GF5.6kΩK		
R73	A9035RS	Res: fxd car comp 1.5kΩ ±10% ¼W RC¼GF1.5kΩK		
R74	A9030RS	Res: fxd car comp 560Ω ±10% ¼W RC¼GF560ΩK		
R75	A9033RS	Res: fxd car comp 1kΩ ±10% ¼W RC¼GF1kΩK		
R76	A9033RS	Res: fxd car comp 1kΩ ±10% ¼W RC¼GF1kΩK		
R77	A9040RS	Res: fxd car comp 3.9kΩ ±10% ¼W RC¼GF3.9kΩK		
R78	A9035RS	Res: fxd car comp 1.5kΩ ±10% ¼W RC¼GF1.5kΩK		
R79	A9047RS	Res: fxd car comp 15kΩ ±10% ¼W RC¼GF15kΩK		
C1	A9032CN	Cap: fxd mica 330pF ±10% 100V DM05C331K1	Nitsuko	
C2	G9016CY	Cap: fxd polye flm 0.047μF ±10% 50V MFL5002-473K	Matsuo	
C3	G9011CY	Cap: fxd polye flm 0.022μF ±10% 50V MFL5002-223K	Matsuo	

5.3.1 POWER SUPPLY ASS'Y: B9256FA (continued)

Item	Part No.	Part Name & Description			Manufacturer	Remarks
HS1 ~ 7	A9054KH	Heat sink	(7 pcs)	HS-SB-7-AN-0	OS	
CN1	A9212KP	Conn: receptacle		5048-7	MOLEX	
CN2	A9211KP	Conn: receptacle		5048-5	MOLEX	
	B9256FK	Bracket				
F1	S9028KF	Fuse		S-M1101-5A	Showa Musen	
	A9000YC	Holder		FH01	YEW	
TP1	A9030YC	Test point			YEW	
	B9256PA	PWB			YEW	

5.3.2 MAIN ASS'Y: B9256FB (refer to Fig. 4-3)

('75-09)

Item	Part No.	Part Name & Description				Manufacturer	Remarks
R1	A9180RP	Res: fxd met flm	20kΩ	±0.5%	1/8W MFA20kΩDT1	Tama Denki	
R2	A9563RV	Res: var ww	200Ω	±10%	¼W WR6S200Ω	Japan Resistor	
R3	A9197RP	Res: fxd met flm	1110Ω	±1%	1/8W MFA1110ΩFT1	Tama Denki	
R4	A9042RS	Res: fxd car comp	5.6kΩ	±10%	¼W RC¼GF5.6kΩK		
R5	A9057RS	Res: fxd car comp	100kΩ	±10%	¼W RC¼GF100kΩK		
R6	A9198RP	Res: fxd met flm	50Ω	±1%	1/8W MFA50ΩFT1	Tama Denki	
R7	A9601RV	Res: var ww	1kΩ	±10%	0.5W WT0.5W1kΩ	Japan Resistor	
R8	A9459YA	Res: fxd ww	2750Ω	±1%	STB16 2750Ω	YEW	
R9	A9461YA	Res: fxd ww	10.5Ω	±1%	STB16 10.5Ω	YEW	
R10	A9460YA	Res: fxd	2990Ω	±1%	STB16 2990Ω	YEW	
R11	A9620RV	Res: var ww	100Ω	±10%	WR6R100Ω	Japan Resistor	
R12	A9061RS	Res: fxd car comp	220kΩ	±10%	¼W RC¼GF220kΩK		
R13	A9035RS	Res: fxd car comp	1.5kΩ	±10%	¼W RC¼GF1.5kΩK		
R14	A9009RS	Res: fxd car comp	10Ω	±10%	¼W RC¼GF10ΩK		
R15	A9015RS	Res: fxd car comp	33Ω	±10%	¼W RC¼GF33ΩK		
R16	A9033RS	Res: fxd car comp	1kΩ	±10%	¼W RC¼GF1kΩK		
R17	A9615RV	Res: var cermet	100kΩ	±20%	0.5W WTJ0.5W100kΩ	Japan Resistor	
R18	A9449YA	Res: fxd ww	30kΩ	±0.02%	STB15 30kΩ	YEW	
R19	A9320RP	Res: fxd met flm	200Ω	±0.25%	1/8W MFA200ΩCT2	Tama Denki	±50 ppm
R20	A9319RP	Res: fxd met flm	100Ω	±0.25%	1/8W MFA100ΩCT2	Tama Denki	±50 ppm
R21	A9321RP	Res: fxd met flm	400Ω	±0.25%	1/8W MFA400ΩCT2	Tama Denki	±50 ppm
R22	A9179RP	Res: fxd met flm	800Ω	±0.1%	1/8W MFA800ΩBT1	Tama Denki	±25 ppm
R23	A9322RP	Res: fxd met flm	1kΩ	±0.1%	¼W MFB1kΩBT1	Tama Denki	±25 ppm
R24	A9323RP	Res: fxd met flm	2kΩ	±0.05%	¼W MFB2kΩAT1	Tama Denki	±25 ppm
R25	A9452YA	Res: fxd met flm	4kΩ	±0.02%	STB16 4kΩ	YEW	
R26	A9453YA	Res: fxd ww	8kΩ	±0.02%	STB16 8kΩ	YEW	
R27	A9005RS	Res: fxd car comp	4.7Ω	±10%	¼W RC¼GF4.7ΩK		
R28	A9034RS	Res: fxd car comp	1.2kΩ	±10%	¼W RC¼GF1.2kΩK		
R29	A9030RS	Res: fxd car comp	560Ω	±10%	¼W RC¼GF560ΩK		
R30	A9454YA	Res: fxd ww	198Ω	±0.02%	STB16 198Ω	YEW	
R31	A9455YA	Res: fxd ww	18Ω	±0.02%	STB16 18Ω	YEW	
✕ R32	A9447YA	Res: fxd ww	2Ω	±0.02%	STB15 2Ω	YEW	
R33	A9565RV	Res: var ww	1kΩ	±10%	WR6S 1kΩ	Japan Resistor	

5.3.2 MAIN ASS'Y: B9256FB (continued)

Item	Part No.	Part Name & Description	Manufacturer	Remarks
C4	A9032CN	Cap: fxd mica 330pF ±10% 100V DM05C331K1	Nitsuko	
C5	A9019CN	Cap: fxd mica 33pF ±10% 100V DM05C330K1	Nitsuko	
C6	S9108CM	Cap: fxd polye flm 2.2μF ±10% 200V FNX-H2003-225K	Matsuo	
C7	A9128CT	Cap: fxd Ta elect 100μF +20% −28% 25V TAC-B2502-107K	Matsuo	
C8	G9016CY	Cap: fxd polye flm 0.047μF ±10% 50V MFL5002-473K	Matsuo	
C9	G9011CY	Cap: fxd polye flm 0.022μF ±10% 50V MFL5002-223K	Matsuo	
C10	A9019CN	Cap: fxd mica 33pF ±10% 100V DM05C330K1	Nitsuko	
C11	G9005CY	Cap: fxd polye flm 0.033μF ±10% 50V MFL5002-333K	Matsuo	
C12	A9066CT	Cap: fxd Ta elect 47μF ±10% 16V DT-A1602-476K	Matsuo	
C13	A9019CN	Cap: fxd mica 33pF ±10% 100V DM05C330K1	Nitsuko	
C14	A9023CA	Cap: fxd Al elect 470μF +50% −10% 16V ECEA16V470L	Matsushita	
C15	A9023CA	Cap: fxd Al elect 470μF +50% −10% 16V ECEA16V470L	Matsushita	
C16	A9077CA	Cap: fxd Al elect 100μF +100% −10% 160V ECEA160V100	Matsushita	
C17	A9077CA	Cap: fxd Al elect 100μF +100% −10% 160V ECEA160V100	Matsushita	
C18	A9022CA	Cap: fxd Al elect 330μF +50% −10% 16V ECEA16V330L	Matsushita	
C19	S9103CM	Cap: fxd polye flm 0.33μF ±10% 200V FNX-H2003-334K	Matsuo	
D1	A9160HD	Diode: zener 1N825A	DICKSON	
D2	G9001HD	Diode 1S953	NEC	
D3	G9001HD	Diode 1S953	NEC	
D4	G9001HD	Diode 1S953	NEC	
D5	G9001HD	Diode 1S953	NEC	
D6	G9001HD	Diode 1S953	NEC	
D7	G9001HD	Diode 1S953	NEC	
D8	G9025HD	Diode RD9A(M)	NEC	
D9	G9001HD	Diode 1S953	NEC	
D10	G9001HD	Diode 1S953	NEC	
D11	G9001HD	Diode 1S953	NEC	
D12	G9001HD	Diode 1S953	NEC	
D13	G9005HR	Diode SH-1Z	Sanken	
D14	G9001HD	Diode 1S953	NEC	
D15	G9001HD	Diode 1S953	NEC	
D16	G9001HD	Diode 1S953	NEC	
D17	G9001HD	Diode 1S953	NEC	
D18	G9001HD	Diode 1S953	NEC	
D19	G9001HD	Diode 1S953	NEC	
D20	G9001HD	Diode 1S953	NEC	
D21		not assigned		
D22		not assigned		
D23	G9001HR	Diode 1S953	NEC	
D24	S9001HR	Diode 1S955	NEC	
D25	S9001HR	Diode 1S955	NEC	
D26	S9001HR	Diode 1S955	NEC	
D27	A9158HD	Diode: zener RD35A(E)	NEC	
D28	A9158HD	Diode: zener RD35A(E)	NEC	
D29	A9158HD	Diode: zener RD35A(E)	NEC	

5.3.2 MAIN ASS'Y: B9256FB (continued)

Item	Part No.	Part Name & Description		Manufacturer	Remarks
D30	A9161HD	Diode: zener	RD15F(B)	NEC	
D31	G9052HD	Diode: zener	RD35A(E)	NEC	
D32	G9052HD	Diode: zener	RD35A(E)	NEC	
D33	G9052HD	Diode: zener	RD35A(E)	NEC	
D34	A9180HD	Diode: zener	RD4.3E-B	NEC	
D35	A9187HD	Diode: zener	RD16F(B)	NEC	
D36	G9005HR	Diode	SH-1Z	Sanken	
D37	G9001HR	Diode	1S953	NEC	
D38	G9001HR	Diode	1S953	NEC	
D39	G9001HR	Diode	1S953	NEC	
Q1	G9141HQ	TSTR	2SA603	NEC	
Q2	A9222HQ	TSTR	2SB504(K)	NEC	
Q3	G9100HQ	TSTR	2SD78K	NEC	
Q4	G9089HQ	TSTR	2SC 756 Ⓢ 3-2	SONY	
Q5	A9285HQ	TSTR	2SC1216-F	NEC	
Q6	A9285HQ	TSTR	2SC1216-F	NEC	
Q7	A9285HQ	TSTR	2SC1216-F	NEC	
Q8	A9285HQ	TSTR	2SC1216-F	NEC	
Q9	A9287HQ	TSTR	2SC1061(K)-C	Hitachi	
Q10	A9285HQ	TSTR	2SC1216-F	NEC	
Q11	A9214HQ	TSTR	2SC1706 Ⓗ	Hitachi	
Q12	G9141HQ	TSTR	2SA603	NEC	
Q13	A9143HQ	TSTR	2SC943	NEC	hfe 150 to 240
Q14	A9143HQ	TSTR	2SC943	NEC	hfe 150 to 240
Q15	A9143HQ	TSTR	2SC943	NEC	hfe 150 to 240
Q16	A9286HQ	TSTR: FET	2SK63-A	SONY	
Q17	A9268HQ	TSTR	2SC1010-L	NEC	
Q18	A9268HQ	TSTR	2SC1010-L	NEC	
U1	G9034LA	IC	μPC157A(1)	NEC	
U2	A9049LA	IC	RC725-S	RAYTHEON	
U3	G9022LA	IC	LM308AH	NSC	
U4	A9049LA	IC	RC725-S	RAYTHEON	
U5	G9033LA	IC	μPC157A	NEC	
U6	G9033LA	IC	μPC157A	NEC	
	A9036KH	Socket (6 pcs)	IC-03-3A	Yamaichi	
L1	A9011EC	L	SP0406L-102K	TDK	
	B9256FM	Pulse Trans Ass'y		YEW	T1 ass'y
CN1	A9146KP	Conn: receptacle	PS-8PA-D4T1A1	JAE	
CN2	A9146KP	Conn: receptacle	PS-8PA-D4T1A1	JAE	
CN3	A9146KP	Conn: receptacle	PS-8PA-D4T1A1	JAE	
CN4	A9147KP	Conn: receptacle	PS-20PA-D4T1A1	JAE	
CN5	A9147KP	Conn: receptacle	PS-20PA-D4T1A1	JAE	
CN6	A9140KP	Conn: receptacle	3022-4A	MOLEX	
CN7	A9140KP	Conn: receptacle	3022-4A	MOLEX	
CN8	A9172KP	Pin contact plug	PS-PA-T1-1	JAE	
CN9	A9172KP	Pin contact plug	PS-PA-T1-1	JAE	
		Pin contact jack (2 pcs)	PS-SC-C2-1		

5.3.2 MAIN ASS'Y: B9256FB (continued)

Item	Part No.	Part Name & Description		Manufacturer	Remarks
TP1 ~ TP5	A9030YC	Test point	(5 pcs)	YEW	
	A9050KP	Feedthrough	FT-E-12	FUSO	
	B9256PB	PWB		YEW	

5.3.3 RANGE ASS'Y: B9256FC (refer to Fig. 4-4 & 4-5)

('75-09)

Item	Part No.	Part Name & Description		Manufacturer	Remarks
SW1	A9197SR	Sw: rtry	RSPP-500N 5-10-8	TOSOKU	
	B9256PC	PWB		YEW	
	B9256PD	PWB		YEW	
CN1	A9173KP	Conn: receptacle	PS-20SD-D4T1-1	JAE	
CN2	A9173KP	Conn: receptacle	PS-20SD-D4T1-1	JAE	

5.3.4 PANEL ASS'Y: B9256 FE (refer to Fig. 4-1)

('75-09)

Item	Part No.	Part Name & Description		Manufacturer	Remarks
SW1	A9049SS	Sw: toggle	MSD206N	Fujisoku	white
SW2	A9049SS	Sw: toggle	MSD206N	Fujisoku	white
SW3	A9049SS	Sw: toggle	MSD206N	Fujisoku	white
D1	A9018HP	Diode: LED	OLD719D	Oki	
D2	A9017HP	Diode: LED	OLD419	Oki	
D3	A9017HP	Diode: LED	OLD419	Oki	
T1	A9368MT	Trans	TRANS2554	YEW	
F1	S9025KF	Fuse	S-M1101-1A	Showa Musen	
	A9020KF	Holder	S-N1301	Showa Musen	
TM1	A9019ZH	Terminal ass'y		YEW	see Fig.
R1	A9619RV	Res: var	1kΩ ±5% 1W WF22-1kΩ	Japan Resistor	
R2	A9033RS	Res: fxd car comp	1kΩ ±10% ¼W RC¼GF1kΩK		
CN1	A9172KC	Conn: jack	EAC-301	SWITCHCRAFT	
CN2	A9207KP	Conn: jack	5047-4	MOLEX	
CN3	A9207KP	Conn: jack	5047-4	MOLEX	
CN4	A9208KP	Conn: jack	5047-5	MOLEX	
CN5	A9209KP	Conn: jack	5047-7	MOLEX	
CN6	A9145KP	Conn: jack	PS-8SD-D4C2	JAE	
P1 ~ P20	A9144KP	Pin-terminal	(20 pcs) 2759-(1)	MOLEX	
P21 ~ P26	A9110KP	Pin-terminal	(6 pcs) PS-SD-C2-1	JAE	

5.3.4 PANEL ASS'Y: B9256FE (continued)

Item	Part No.	Part Name & Description		Manufacturer	Remarks
	A9118KP	Position key	PS-SD-PK1	JAE	
	Y9641TM	Contact		YEW	
	B9550BX	Cover		YEW	
	A9009WD	Power cord set		Hanai Densen	

5.3.5 DIAL-1 ASS'Y: B9256FF (refer to Fig. 4-6)

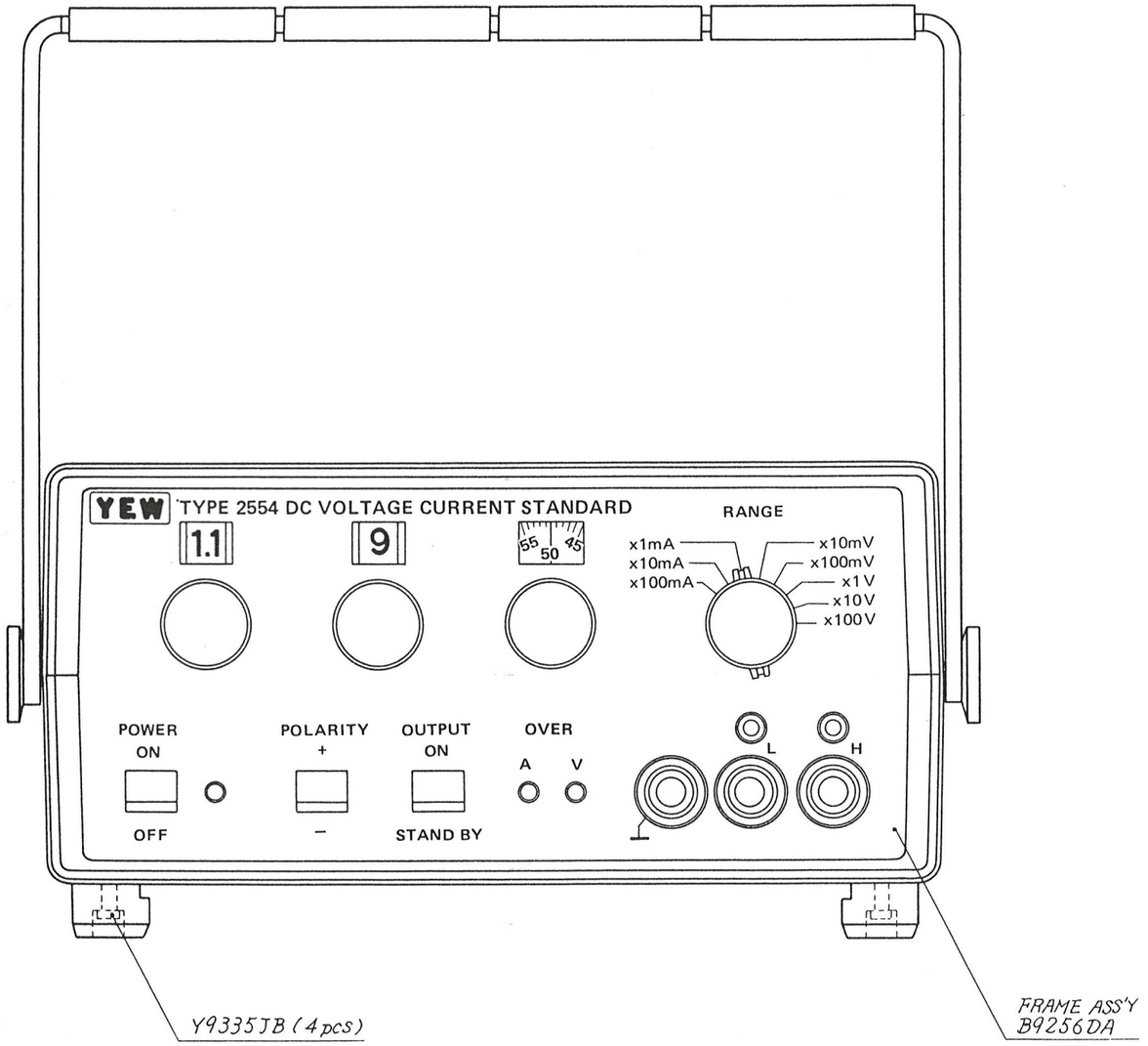
('75-09)

Item	Part No.	Part Name & Description		Manufacturer	Remarks
SW1	A9221SR	Sw: rtry	RS-600NET 1-1-12 (30°)	TOSOKU	
CN1	A9145KP	Conn: jack	PS-8SD-D4C2	JAE	
P1 ~ P7	A9110KP	Pin-terminal (7 pcs)	PS-SD-C2-1	JAE	
	A9118KP	Position key	PS-SD-PK1	JAE	

5.3.6 DIAL-2 ASS'Y: B9256FG (refer to Fig. 4-7)

('75-09)

Item	Part No.	Part Name & Description		Manufacturer	Remarks
SW1	A9222SR	Sw: rtry	RS-600NET 1-1-12(30°) ENDLESS	TOSOKU	
CN1	A9145KP	Conn: jack	PS-8SD-D4C2	JAE	
P1 ~ P7	A9110KP	Pin-terminal (7 pcs)	PS-SD-C2-1	JAE	
	A9118KP	Position key	PS-SD-PK1	JAE	



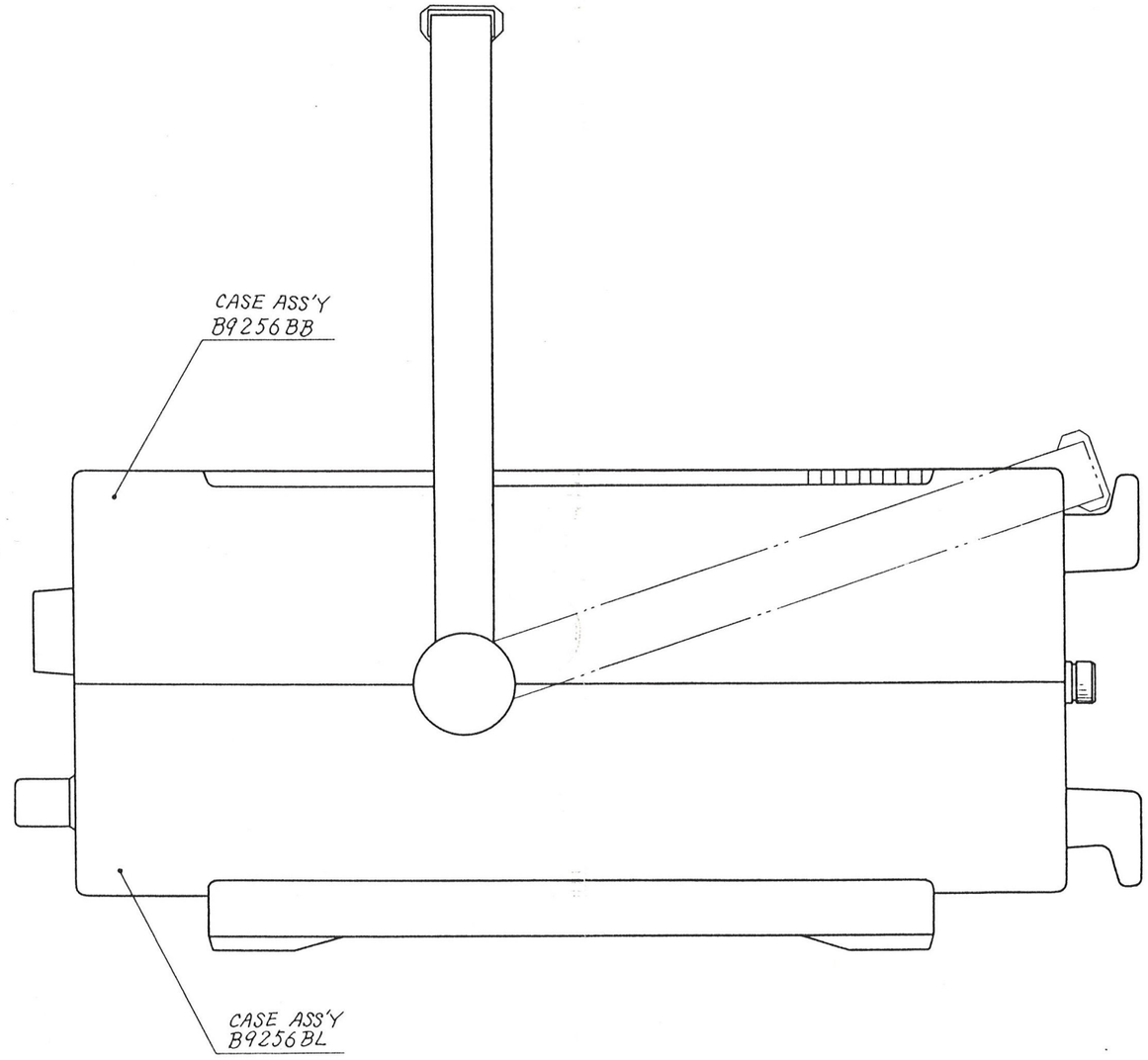


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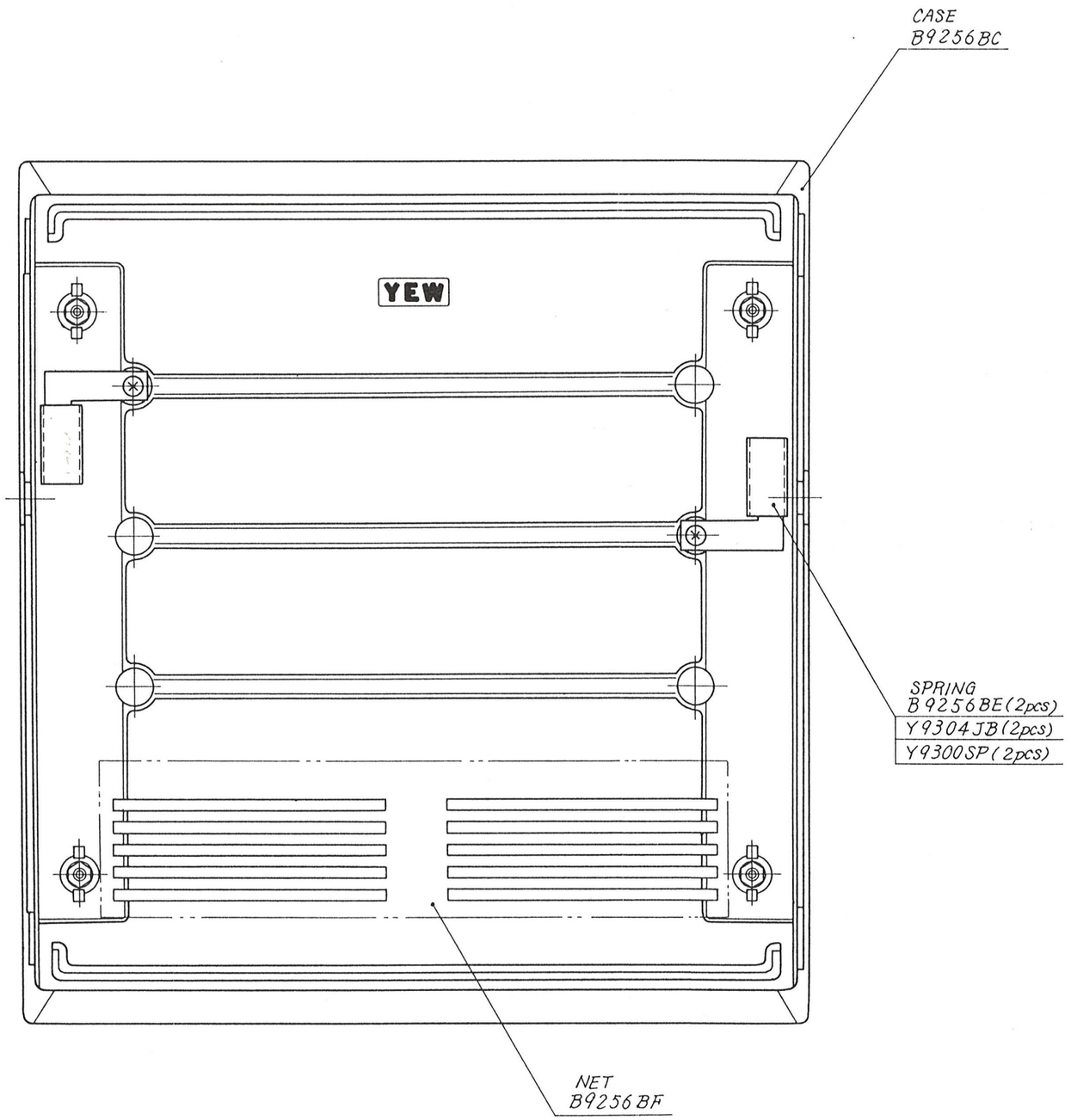
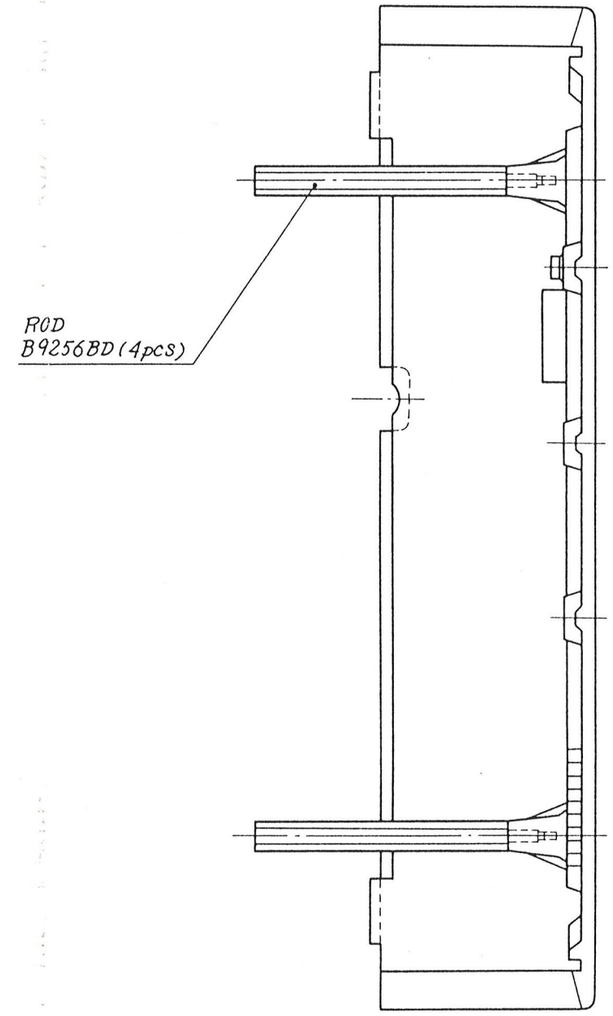
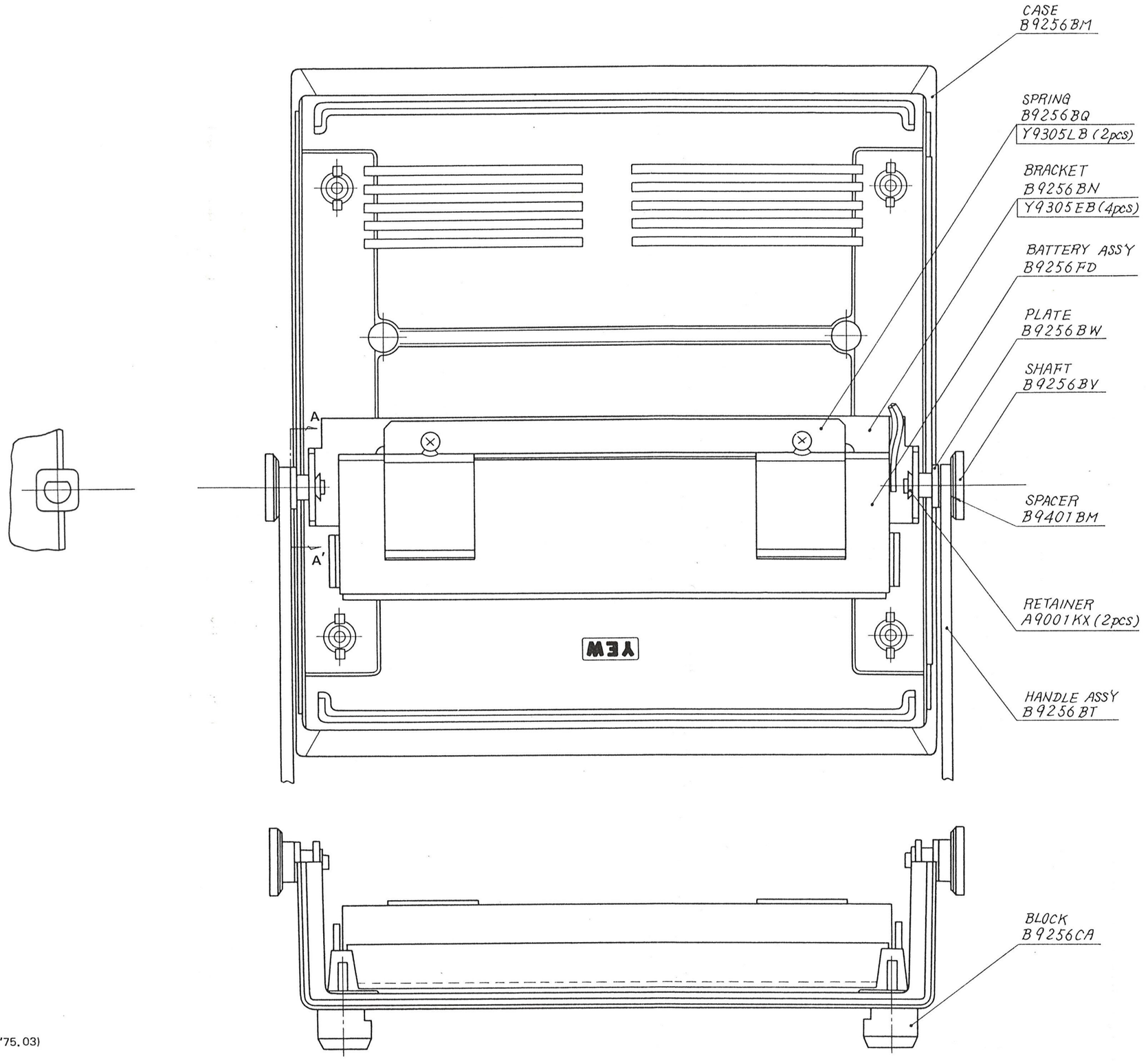
Fig. 5-1 Voltage St'd Ass'y B9256BA





('75.03)

Fig. 5-2 Case Ass'y B9256BB



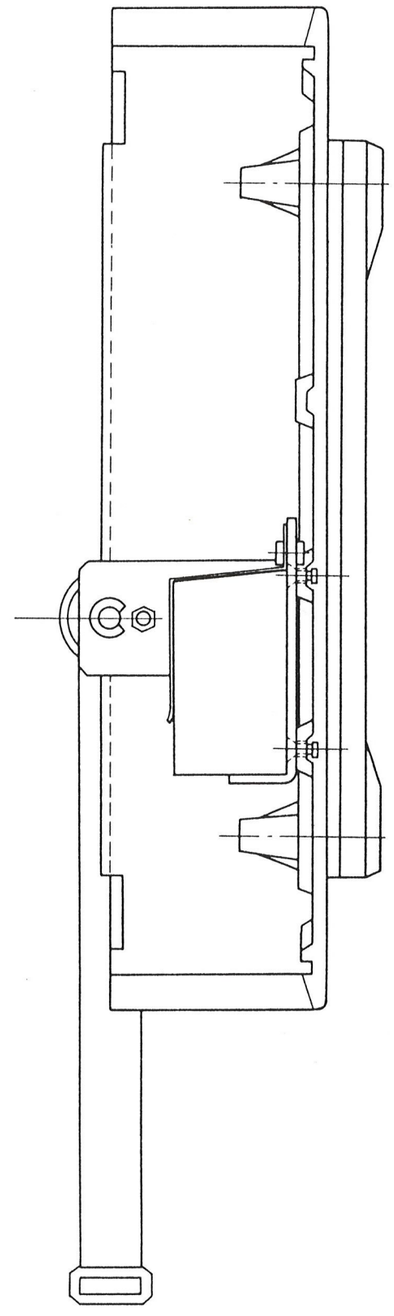


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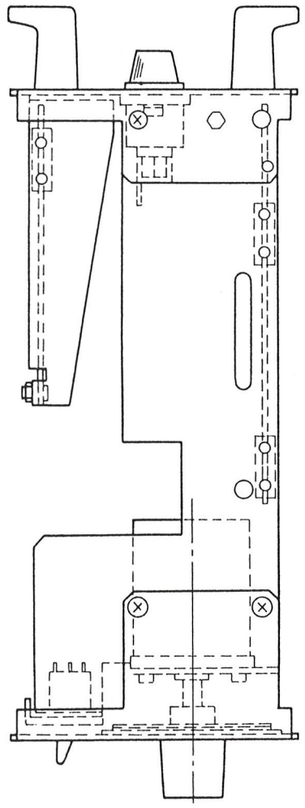
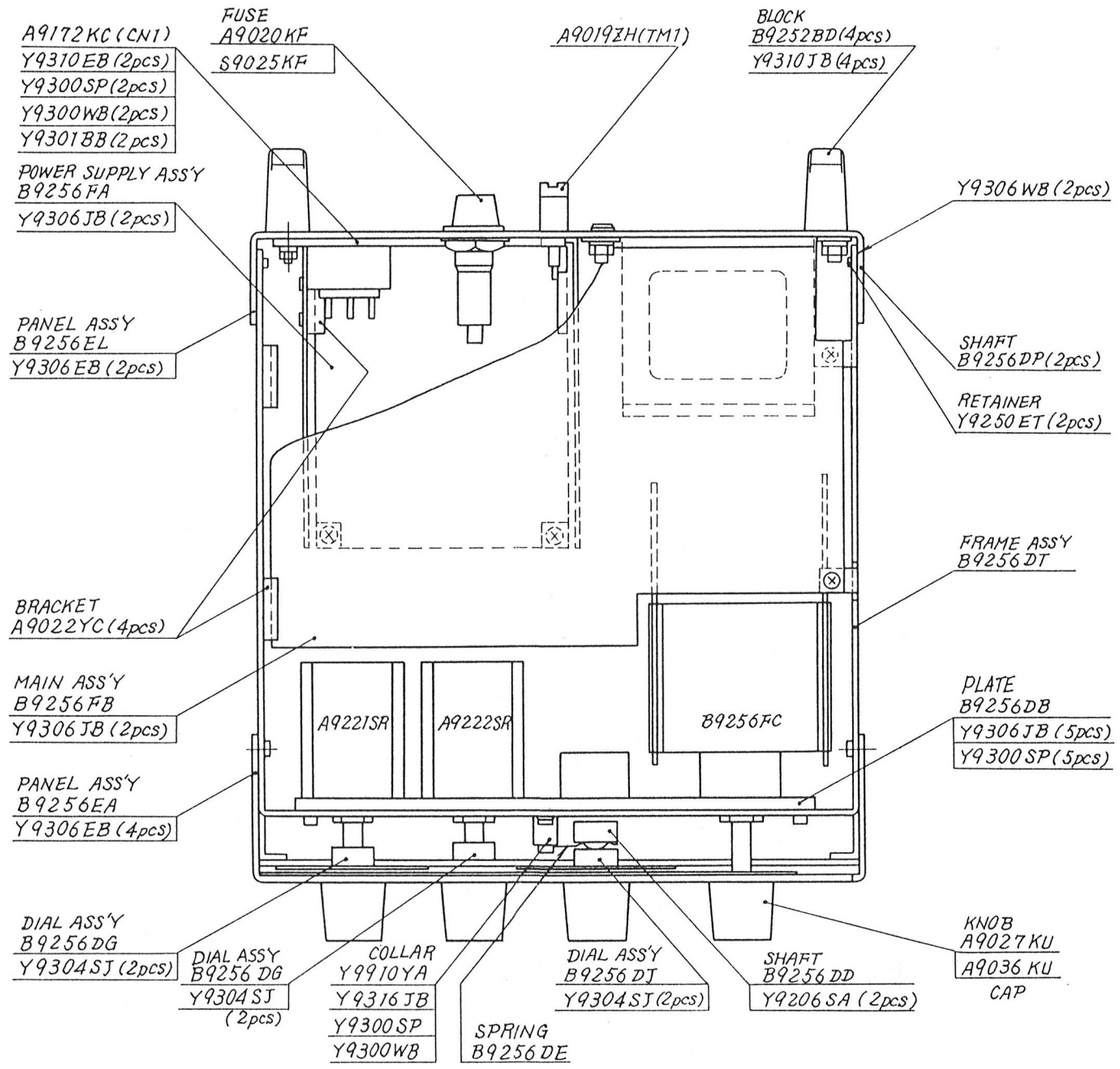
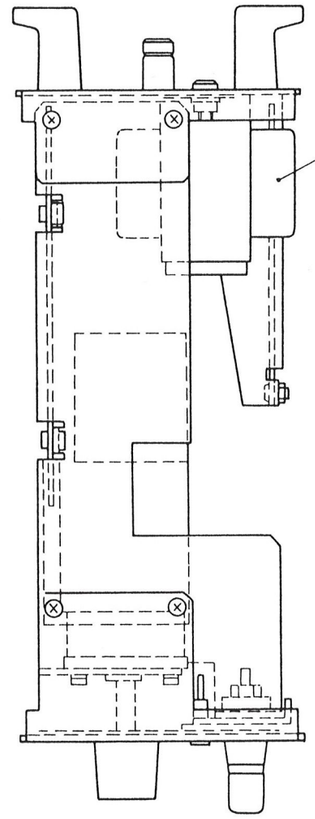
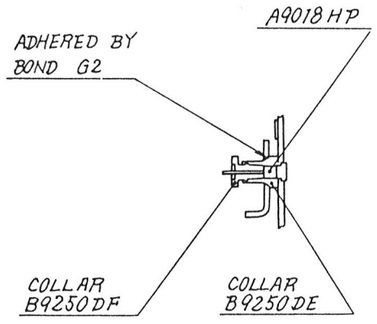
Fig. 5-3 Case Ass'y B9256BL









('76. 01)

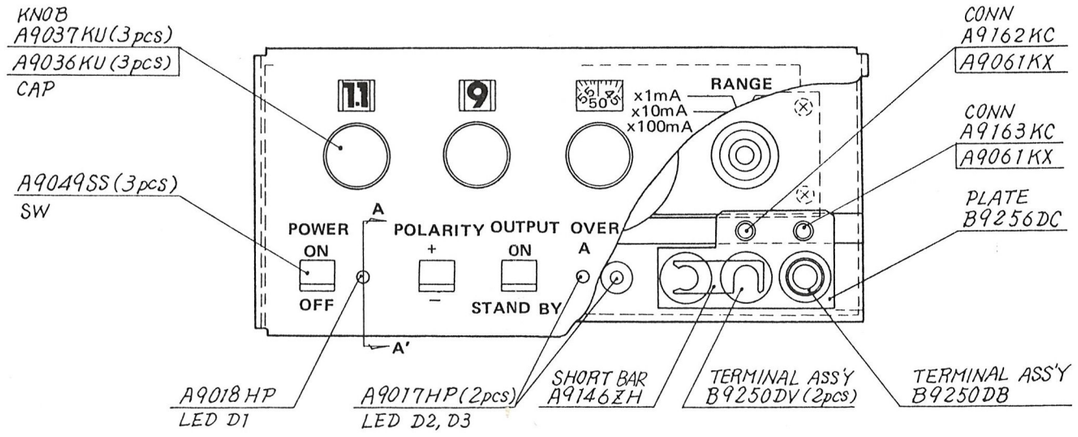


Fig. 5-4 Frame Ass'y B9256DA