MAINTENANCE MANUAL

EP-A SERIES

MODELS: EP-12KA
EP-20KA
EP-40KA
EP-41KA
EP-60KA
EP-22KA

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CHAPTER 1. OUTLINE

There are six types of EP precision industrial balances: 12KA, 20KA, 22KA (dual-range), 40KA, 41KA, and 60KA. They are shown below.

	Capacity	Resolution
12KA	12kg	0.1g
20KA	20kg	0.1g
40KA	40kg	0.5g
41KA	40kg	1g
60KA	60kg	1g
22KA	Low range 2kg	0.1g
	High range 20kg	1g

* Only the 22KA type has two ranges.

The units available are grams (g), percent (%), peaces (p.c.), pounds (lbs), pounds and ounces (lbs. and ozs.), ounces (ozs.), and ounces troy (ozs.t).
The weight of an object can be represented in up to three units (grams and any other two units) at the same time.
The DATA OUT pins are RS-232C serial output (with a current loop).
Under-hook weighing is also possible (optional).

CHAPTER 2. OPERATION

2.1 Weighing Principle

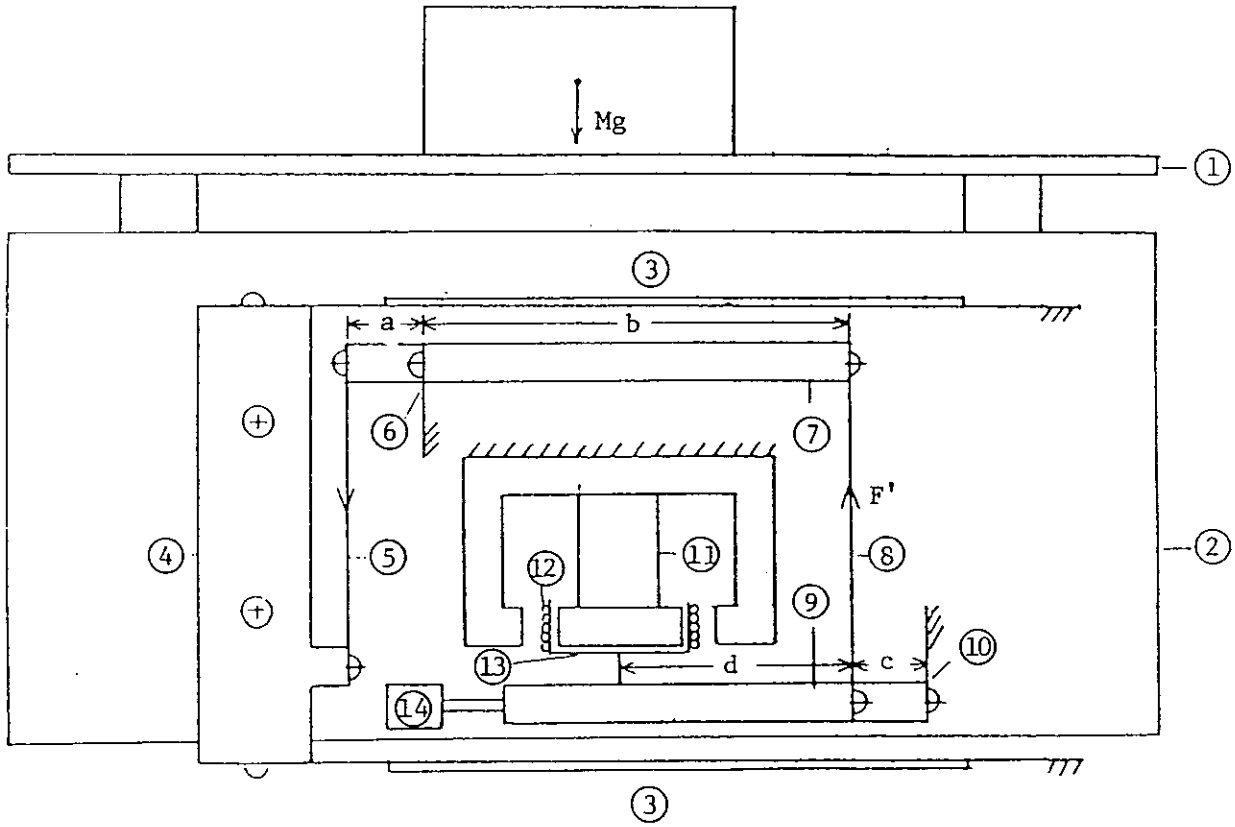
The electronic balance has a Roberval mechanism consisting of two links and a load frame. A pan bearing bracket with a pan is mounted on the frame at both ends of it.
The gravitational force (weight) of an object (Mg) is transferred to one end of beam 1 ⑦ by means of flexible connector 1 ⑤. Beam 1 ⑦ works as a level having a fulcrum (pivot 1) at the point that divides the beam a:b.
The effort F' on the other end of beam 1 ⑦ is expressed by

$$F' = \frac{a}{b} \times Mg$$

The effort F' is transmitted as a load to one end of beam 2 ⑨ by means of flexible connector 2 ⑧. Beam 2 works as a lever having a fulcrum (pivot 2) at the point that divides the beam c:d. The effort F" on the other end of beam 2 ⑨ is expressed by

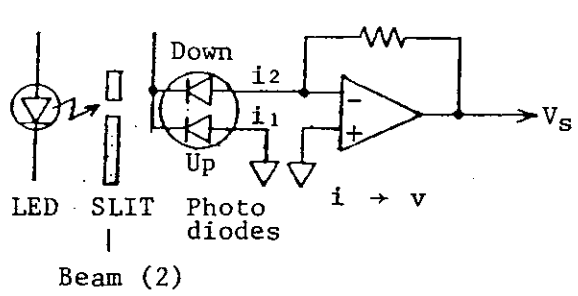
$$F'' = \frac{c}{d} \times F' = \frac{c}{d} \times \frac{a}{b} \times Mg$$

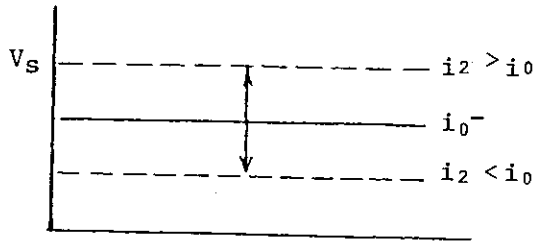
The effort F" moves coil ⑫ on bobbin ⑬, causing opposing electromagnetic force F by a current flowing through the coil and magnet ⑪. The current flowing through the coil ⑫ is controlled by position sensor ⑭ provided at one end of beam 2 ⑨ so that the bobbin may be maintained at a fixed position. The weight (Mg) of the object is indicated by the current.



①	Pan	⑧	Flexible connector (2)
②	Pan bearing bracket	⑨	Beam (2)
③	Link	⑩	Flexible pivot (2)
④	Frame	⑪	Magnet
⑤	Flexible connector (1)	⑫	Coil
⑥	Flexible pivot (1)	⑬	Bobbin
⑦	Beam (1)	⑭	Position sensor

Position Sensor





The position sensor is so designed that the light from a light emitting diode (LED) is incident to two photo diodes through a slit provided at one end of beam 2 ⑨. The two photo diodes respectively generate current proportional to the magnitude of the incident light. In equilibrium, the amount of light that the higher photo diode receives is equal to that the lower photo diode receives.

$$i_1 = i_2 = i_0$$

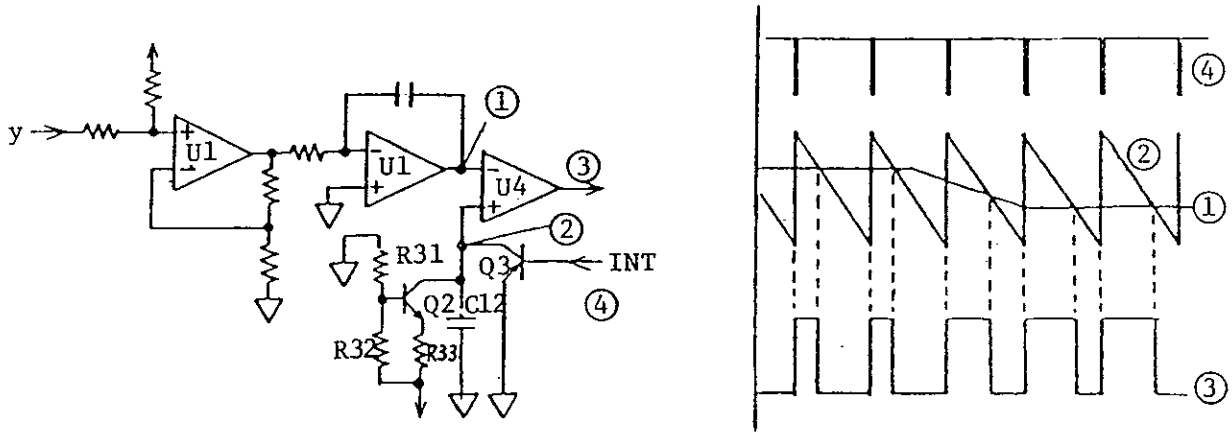
When an object is placed on the pan, the slit unit of beam 2 is lifted up by means of two flexible connectors. As the result, the lower photo diode receives less light from the LED.

$$i_2 < i_0$$

When the object is removed from the pan, the slit unit goes down and the lower photo diode receives more light.

$$i_2 > i_0$$

The sensor unit converts the changing current into a changing voltage and sends it to the main PC board.



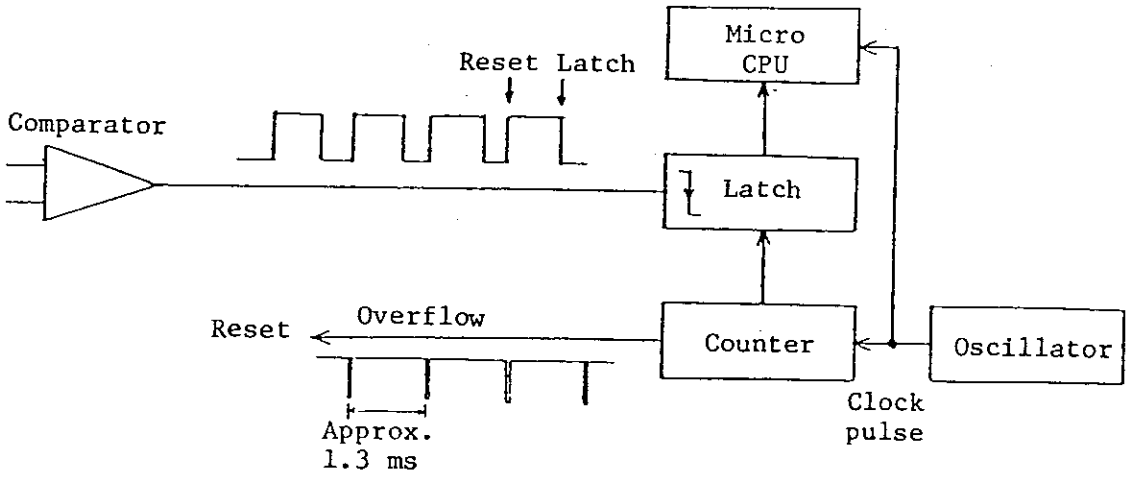
Amplifier Vs receives a voltage from the position sensor.

Vs = 0 (in equilibrium)
Vs > 0 (excessive load)
Vs < 0 (insufficient load)

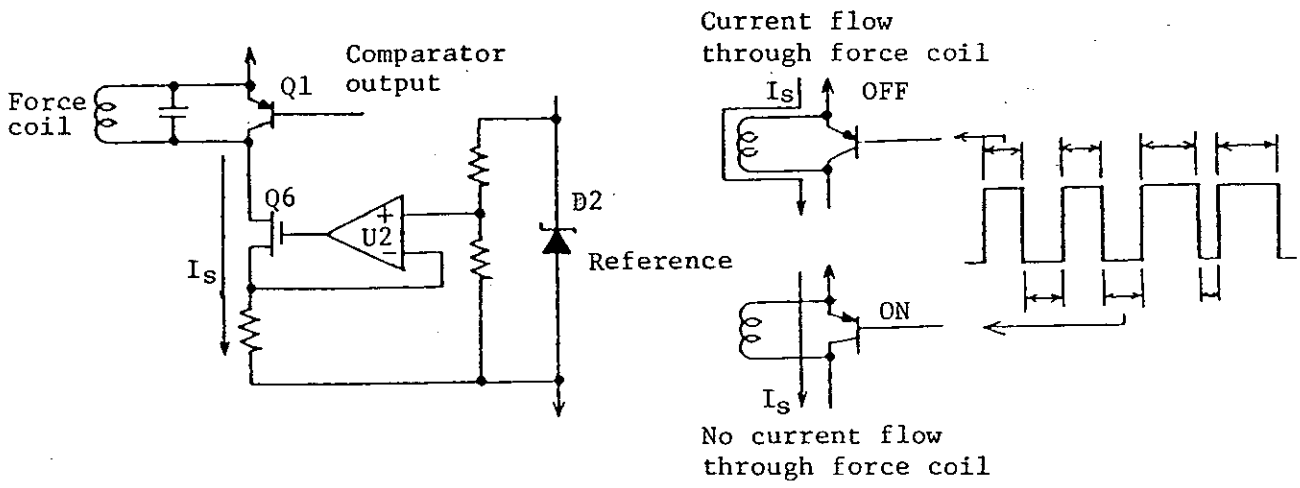
The succeeding amplifier U1 receives the amplified voltage and outputs ①.

No change (in equilibrium)
Positive-to-negative transition (excessive load)
Negative-to-positive transition (insufficient load)

Comparator U4 receives output ① and a ramp voltage ② (generated by charging capacitor C12 by a constant-current source consisting of registors R31, R32, R33, and Q2). Capacitor 12 is periodically reset by transistor switch Q3 that operates by an overflow signal (INT) from the counter.
When a load is placed on the pan in a certain equilibrium, output ① makes a positive-to-negative transition and comparator output ③ has longer pulse width (with respect to that of a pulse of ramp voltage at resetting).
When a load is reduced, the pulse becomes shorter. The weight of the object is obtained by counting the pulse width.

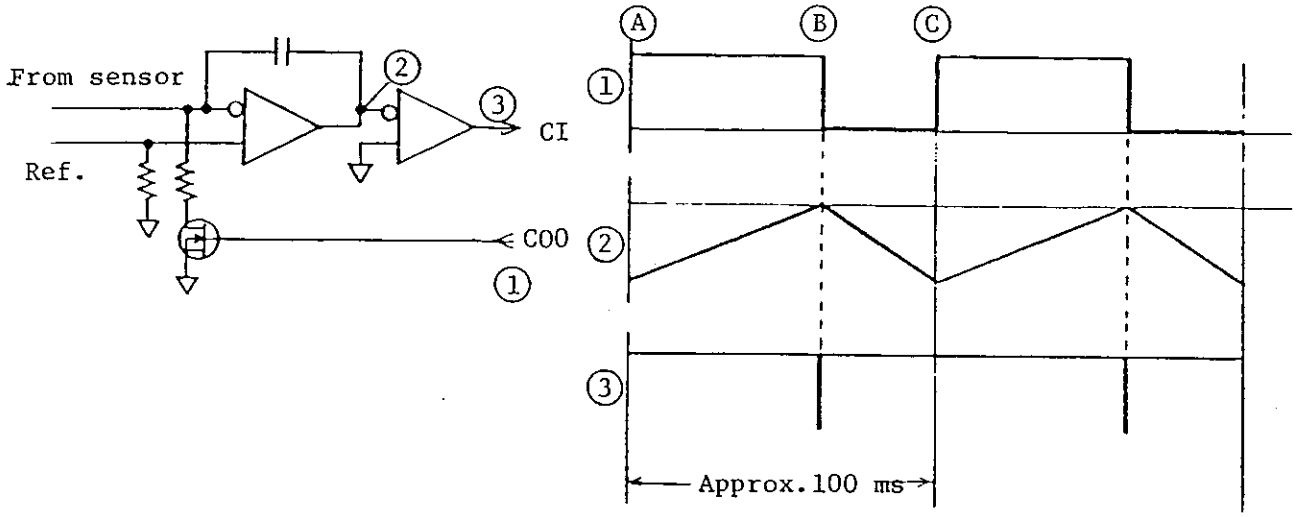


The pulse width (time during which a current flows through the force coil) of the comparator output is proportional to the weight of an object so that the digital weight value can be known from the number of clock pulses from the oscillator during the pulse width.
The output of the comparator rises by a reset signal (overflow of the counter) and falls at the weight value.
Reset signals are periodically generated so that the weight value can be digitally obtained by latching the content of the counter at the fall of the comparator output. The microprocessor reads the content of the latch.



Transistor switch Q1 is turned on and off by the output of the comparator and source current I_S flows as shown above.
As the load becomes greater, the pulse width of the comparator becomes longer and the current flowing through the force coil becomes greater.
Thus the resulting electromagnetic force becomes greater to return the slit unit to the original position ($i_2 = i_0$).
When a load becomes less, the above steps are reversed.

Operation of Temperature A/D Circuit



The temperature A/D circuit operates as follows:

(1) Integrates the output of the position sensor while COO ① is high.

(2) (The CPU clears and starts the timer at point A.)

(3) Inverts CI ③ (at point B) at the end of integration.

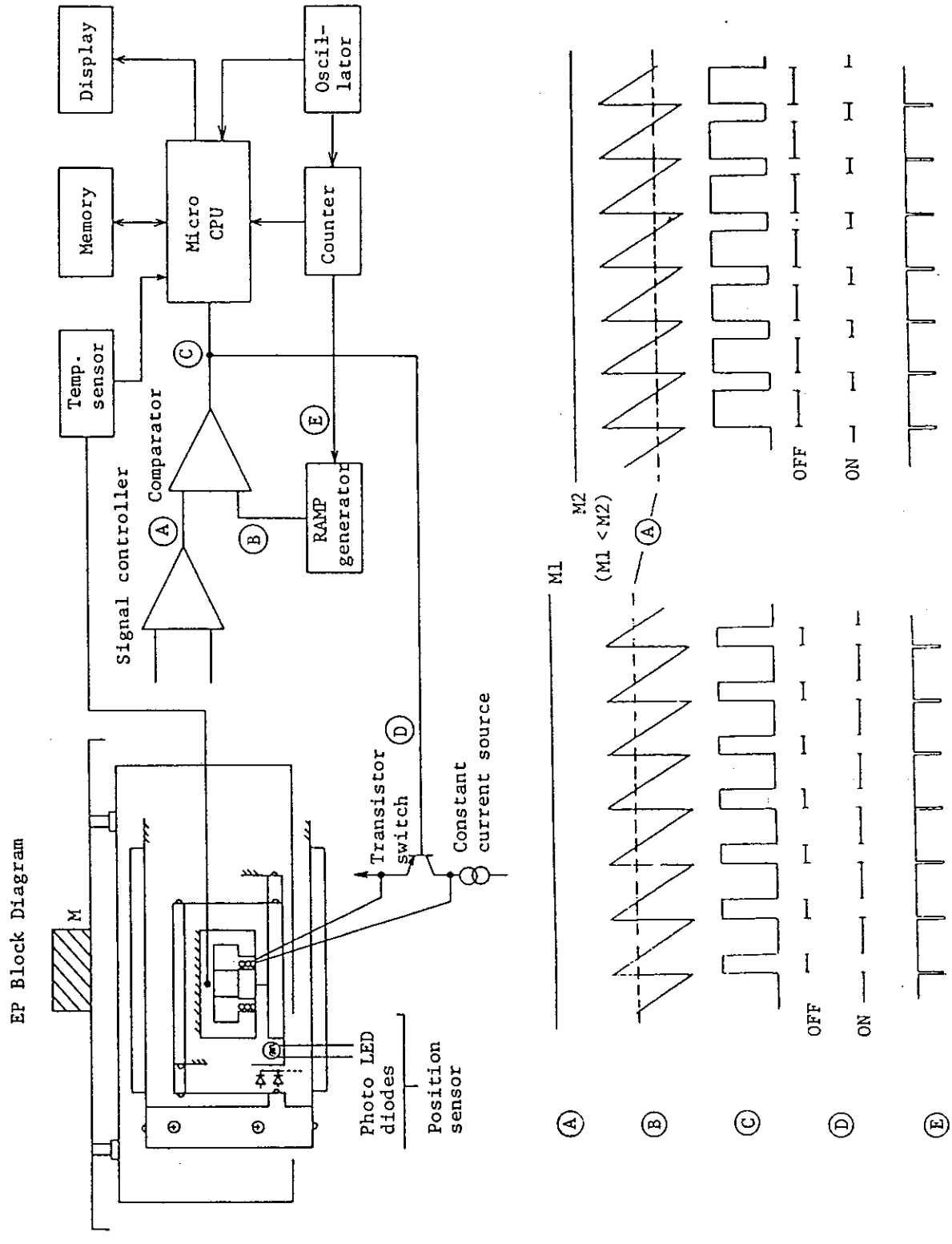
(4) The CPU stores the content of the timer (Temperature A/D value) at the rise of the CI input and inverts the COO output.

(5) Integrates the reference voltage while COO ① is low.

(6) Inverts CI ③ at the same time.

(7) And inverts the COO output about 100 ms after point A. Thus one cycle of the temperature A/D circuit is completed.

2.2 Block Diagram of EP Balance

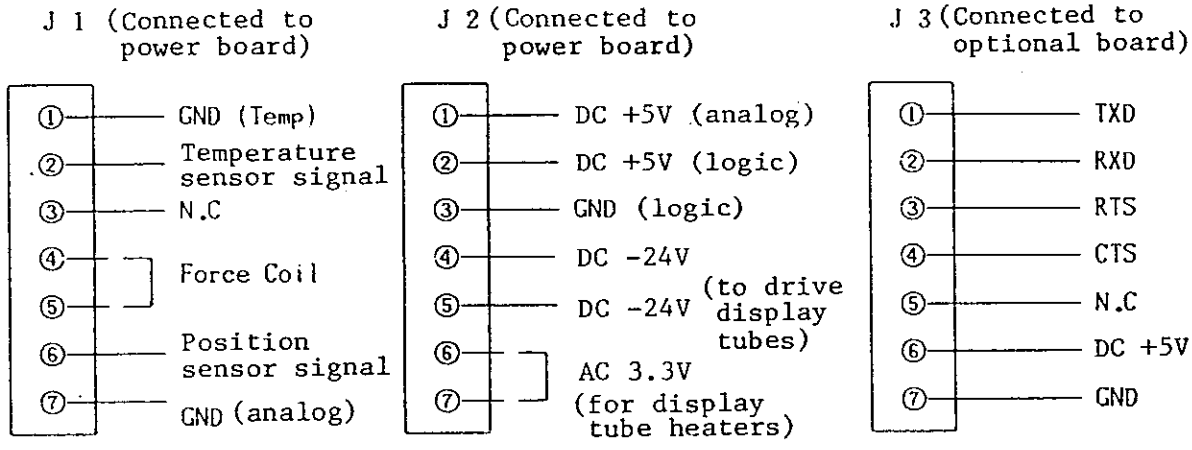


2.3 Boards

2.3.1 Main PC Board (PZ: 791)

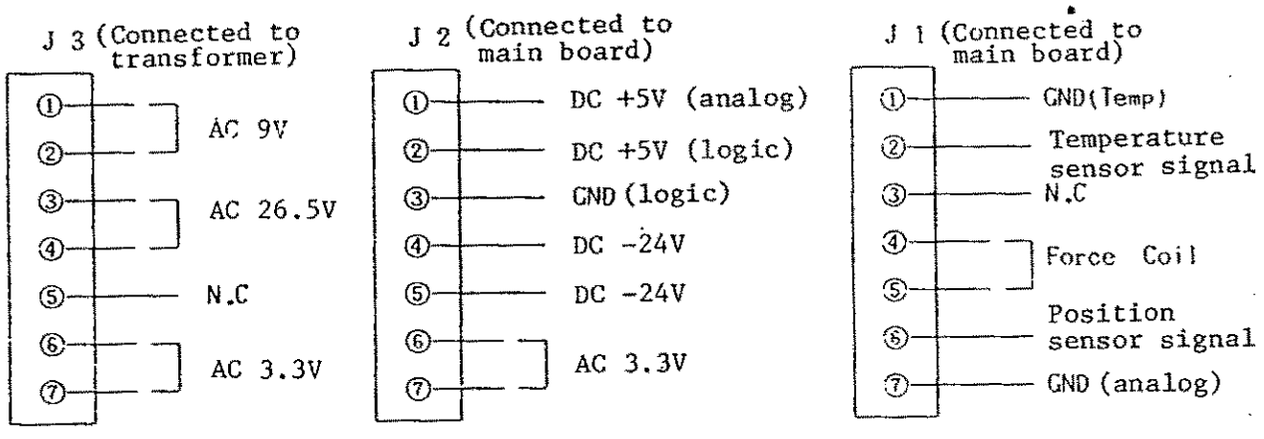
Components U1 (TL072) to U4 (C311C) on the main PC board convert the position sensor signal from pin 6 of connector J1 into pulses and component U15 (MB111SI105) counts the pulses.
Component U15 outputs a Counter Overflow signal (low every about 1.3 ms) from pin 10 and a signal for controlling the force coil current from pin 21.
Component U15 reads the status of diodes D9 to D15.
Component D2 (399H) generates a reference voltage. Components U2 (OP07) and Q6 (VN66AF) form a constant current source.
Component Q1 (A1153) turns on and off the force coil current by the control signal from U15. (+5 V appears at pin 5 of connector J1. Approx. 6.3 V is present between TP5 and TP6.)
Component U3 (TL072) converts a Temperature Sensor signal from pin 2 of connector J1 into pulses and component U14 (CPU: 7810G) counts the pulses.
Ports D and F (PD and PF) of component U14 are address lines and component U7 (LS374) latches the low-order eight bits of the address.
According to the address, component U9 (LS138) selects ROM (U6: 27128), RAM (U5: 5518BPL), gate array (U15: MB111S105), and LED (U11: LS174).
Port A (PA) is for segment signals for display tubes and port B (PB) is for grid signals. The display tubes turn on by segment signals and low grid signals.
The grid signal is output from low to high every interrupt (every about 1.3 ms).
Read key switches according to the grid signals. (AN0, AN1, and AN2)
The ON/OFF key corresponds to pin 25 (NMI pin) of U14.
Port C (PC) has data out pins (serial data: OP to 03). PC0 (pin 17) works as a signal output (TXD) and PC1 (pin 18) works as a signal input (RXD).

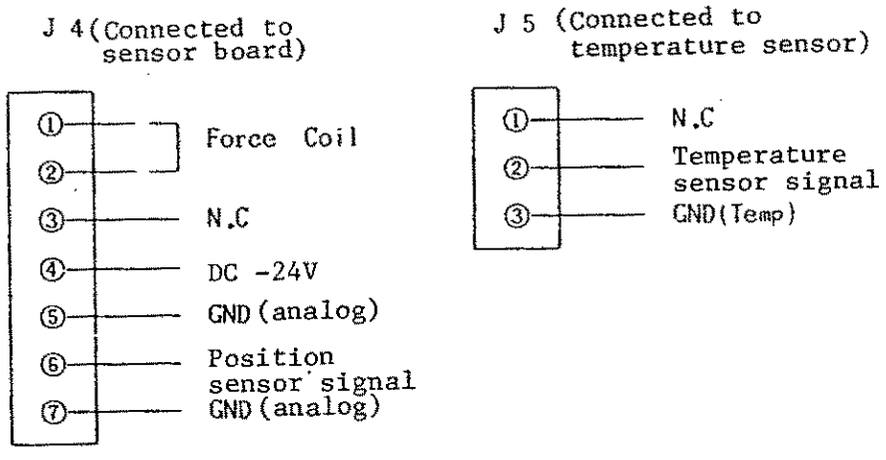
RAM (U5: 5518BPL) has the area that can be always written and the area that can be written only when the CAL switch is turned on. U8 and U10 (40H000) performs the control by the CAL switch. (U5: pin 21) RAM is backed up by a lithium cell so that the content of RAM can be kept when power is not supplied to the EP. (The minimum backup voltage is 2.0 V.)



2.3.2 Power Board (PZ: 792)

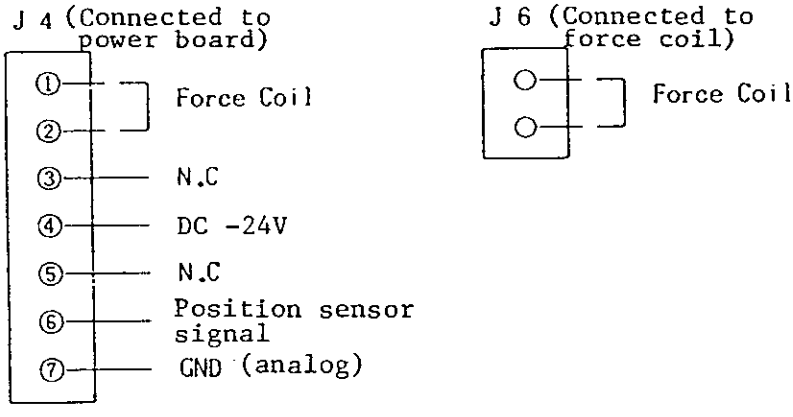
The power board receives 9 VAC at pins 1 and 2 of connector J3 and converts it to +5 VDC by rectifier D1 (3B4B41) and regulator U1 (7805). This board also receives 26.5 VAC at pins 3 and 4 of connector J3 and converts it to -24 VDC by rectifier D2 (W02) and regulator U2 (7824).
The power board connects the main board to the sensor board (via J1 to J4) and to the temperature sensor (via J1 and J5).





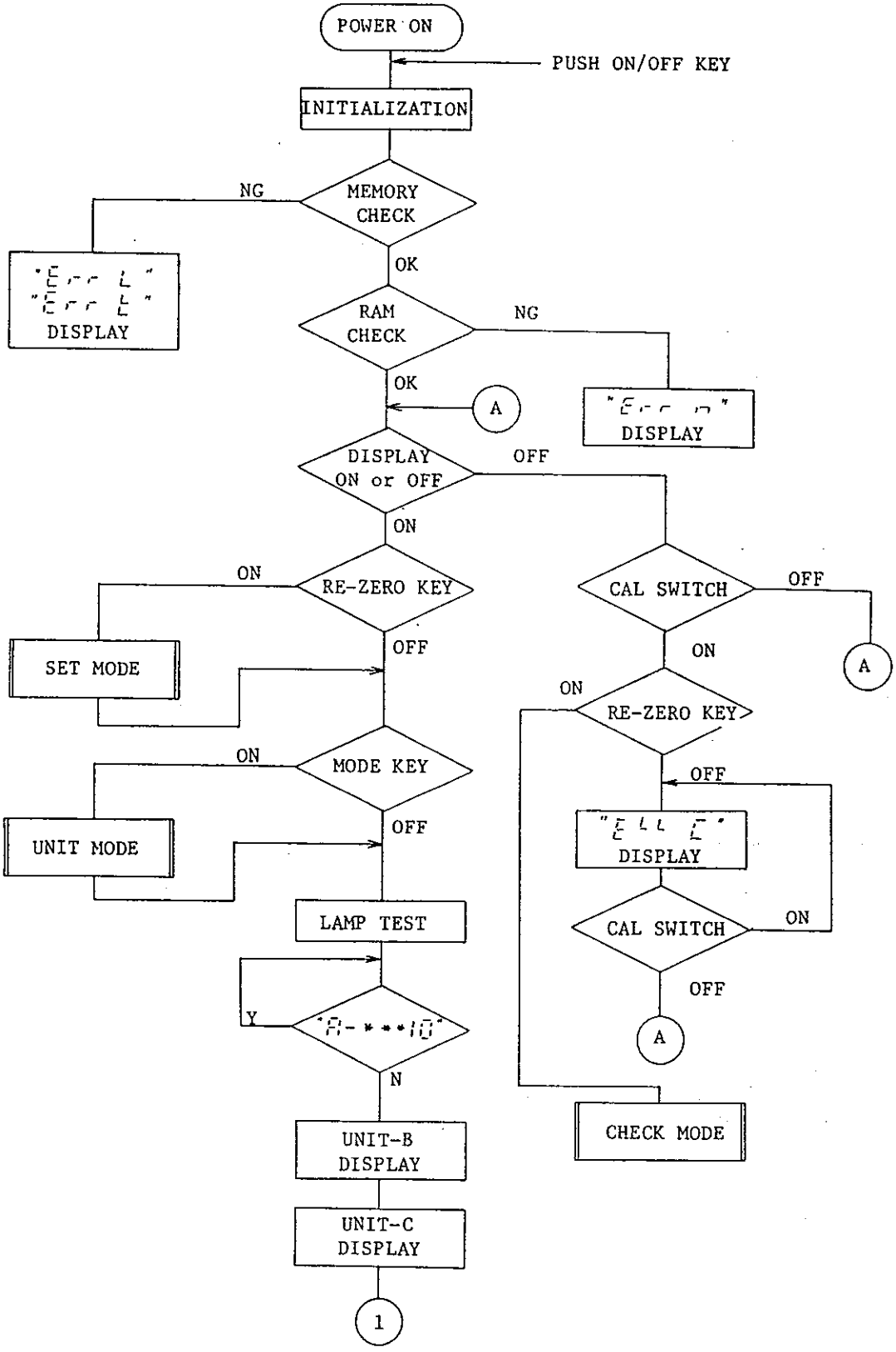
2.3.3 Sensor Board (PZ: 793)

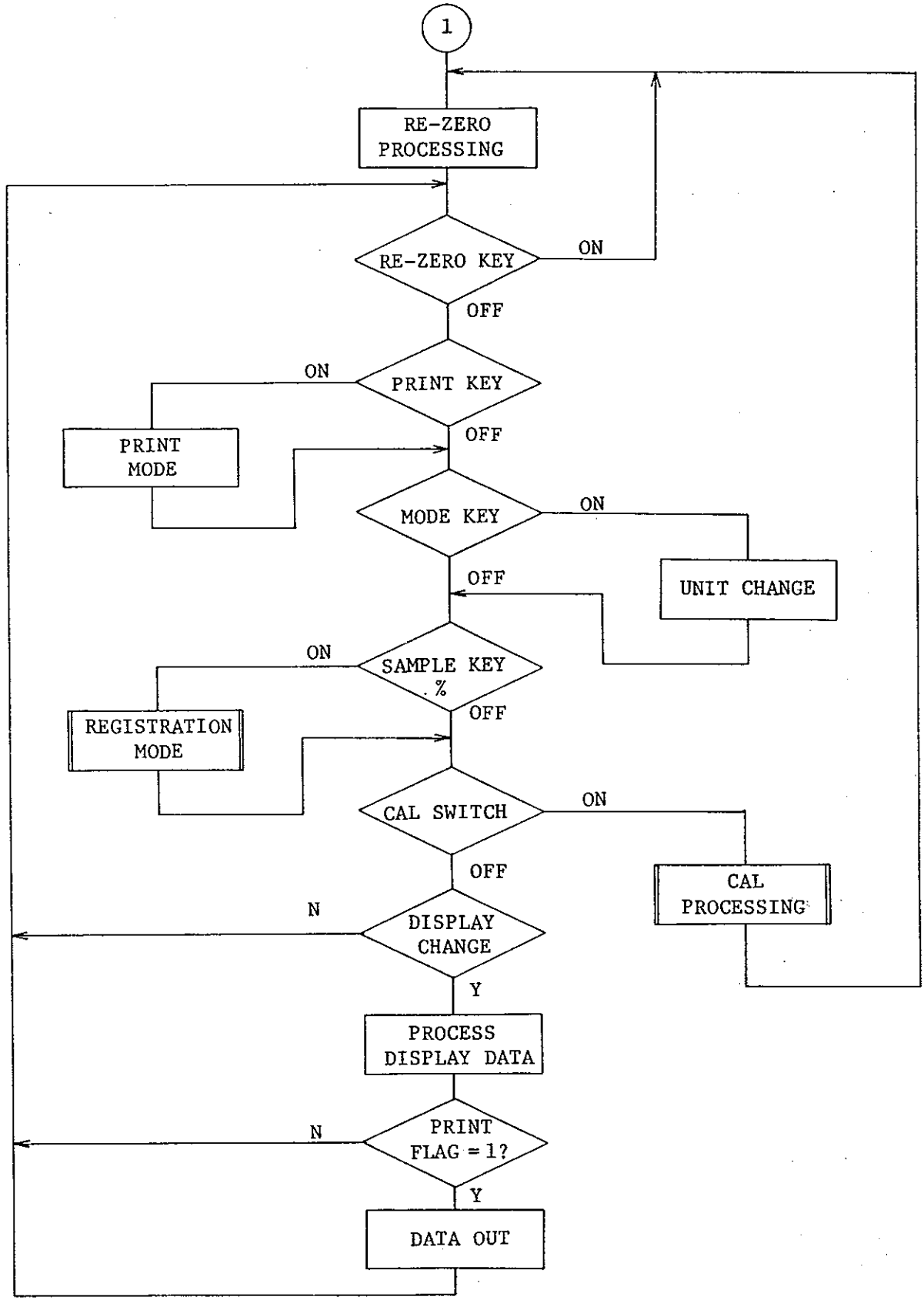
The constant current source consisting of U1 (TL072) energizes infrared emitting diode D1 (TLN108) to emit an infrared ray. Photo diodes D3 (MI-33H-2D) receive the ray through the slit unit and outputs currents proportional to the magnitude of incident rays. U1 converts the output currents into voltages. Variable resistor R6 controls the mechanism.
The sensor board passes a current for the force coil from J1 to J6.

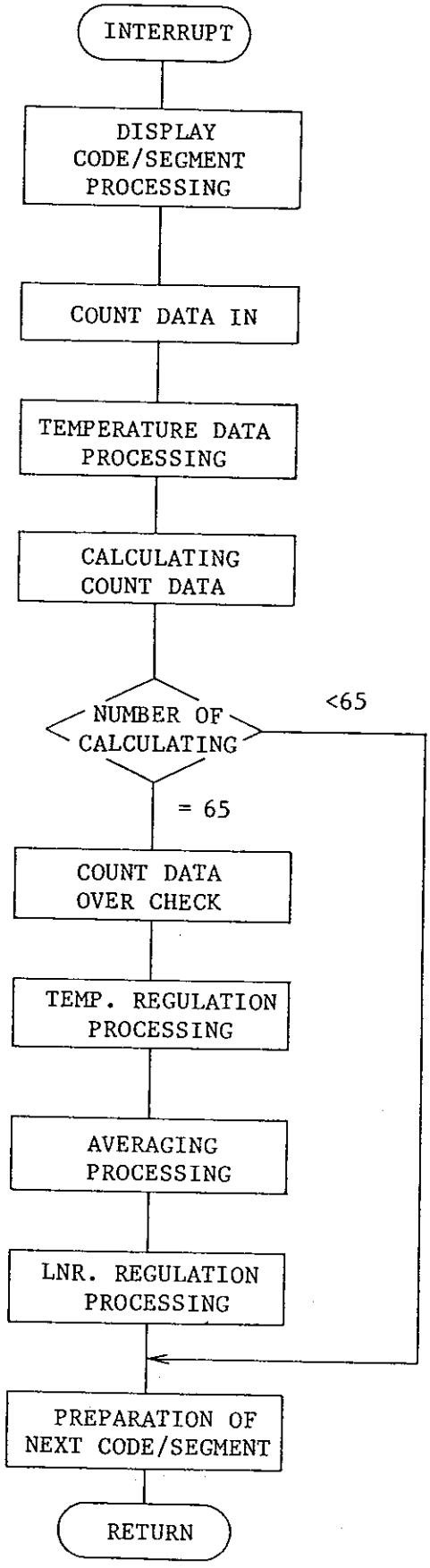


2.4 Flowchart

EP Flowchart




1
RE-ZERO PROCESSING
RE-ZERO KEY
ON
OFF
PRINT KEY
ON
PRINT MODE
OFF
MODE KEY
ON
UNIT CHANGE
OFF
SAMPLE KEY . %
ON
REGISTRATION MODE
OFF
CAL SWITCH
ON
CAL PROCESSING
OFF
DISPLAY CHANGE
N
Y
PROCESS DISPLAY DATA
PRINT FLAG = 1?
N
Y
DATA OUT


INTERRUPT
DISPLAY CODE/SEGMENT PROCESSING
COUNT DATA IN
TEMPERATURE DATA PROCESSING
CALCULATING COUNT DATA
NUMBER OF CALCULATING
<65
= 65
COUNT DATA OVER CHECK
TEMP. REGULATION PROCESSING
AVERAGING PROCESSING
LNR. REGULATION PROCESSING
PREPARATION OF NEXT CODE/SEGMENT
RETURN

CHAPTER 3. MAINTENANCE

3.1 Troubleshooting

1. Error messages (Err ○)

(1) Err 0

- o This message is displayed when the POWER switch is turned on or at display ON/OFF time.
- o This message indicates that a RAM read or write error has occurred.
- o RAM (U5, UC: 5518BPL) or RAM Chip Enable circuit (U8, U10, UC: 40H000) may be defective.
- o When RAM is replaced, the temperature and linearity circuits must be adjusted.

(2) Err E (ROM number: from AG1)

- o This message is displayed when the POWER switch is turned on and at display ON/OFF time.
- o This message indicates that protection data (for controlling temperature) has been destroyed.
- o When this message is displayed (when power is supplied to the system), the RAM backup circuit may be defective. Check the backup cell (EB: CR2032WT-5) for reversed polarities and power-down (under 2 V) and check transistor (Q7: C1815Y) and diodes (D42 and D43).
- o Reset, then adjust.

(3) Err L (ROM number: from AG1)

- o Same as Err E(where data for controlling linearity has been destroyed)
- o Reset, then adjust.

(4) Err E

- o This message is displayed when the POWER switch is turned on and at display OFF time.
- o This message indicates that the CAL switch (Protect switch) is on while the display is off.
- o Turn off the CAL switch. (Raise the lever of the CAL switch.)
  If this message is displayed in OFF state, check the CAL switch (S21) or gate array (U15, UT: MB111S105).

(5) Err 5

- o This message is displayed when a temperature control error (small temperature difference) has occurred.
- o Set the temperature difference 30°C or higher, then control temperature.

(6) Err U

- o This message is displayed when a temperature control error (reversed high and low temperature data) has occurred.
- o Enter high and low temperature data correctly.

2. Other error messages

(a) All "▼" marks

- o The screw for fixing the display tube is fastened too tight and the leads of the display driver Q4 are short-circuited.
- o Hold the display driver (Q4, QT: A1015Y) 8 mm high or lower.

(b) Linearity error

- o A small deviation (±4 counts or less) in the 1/4 and 3/4 Span modes can be adjusted by the Linearity control (⊟).
- o For a deviation in the 1/2 Span mode, adjust the linearity (Lnr).

(c) Unsteady display (except influence by vibration, wind, etc.)

- o When the lowest two digits or more in message " ▼▼▼ " (AFTER 65) in the check mode are unsteady and this trouble persists even after a board replacement, the EP mechanism may be defective. If the display is steady after a board replacement, a circuit may be defective.
- o When the lowest two digits or more in message " ▼▼▼▼ " (AFTER TEMP) in the check mode are unsteady, the temperature control circuit may be defective.
  When message " ▼▼ " (TEMP A/D COUNT) is unsteady, the temperature sensor circuit may be defective.
- o When the other display is unsteady, the linearity circuit may be defective.

(d) Calibration error

- o ±E in CAL 0,F (no error in the ordinary measurement)
  If the ROM number is AF1 or younger, set the Check mode, then exit the mode immediately.
  If the ROM number is AF1 or older, press the MODE key according to the SEt message.
  Then perform calculation.

CHAPTER 4. CHECK AND ADJUSTMENT

4.1 Adjustments

4.1.1 Single Board Check

(1) Power board (PZ: 792)

Install and connect the power board in the EP equipment (leaving the other boards unconnected).

① Insulation check

Check the insulation between the heat sinking fin and the heat sink of regulator U1 (and U2).
The insulating resistance should be 100 MΩ or more (at 500 V).

② Voltage check

Connect the cable of the transformer to connect J3 of the power board, supply power to the power board, then check the following voltages:

- With pin 7 of connector J1 as GND,
  +4.75 to +5.25 V on pin 1 of connector J2
  -22.8 to -25.2 V on pin 5 of connector J2
- Check the voltage on the 3.3 VAC terminal of the power transformer.
  2.95 to 3.65 VAC

Note: Insert the power cable into the wall outlet to supply power to the board. (The power board has no POWER switch.)

(2) Main board (PZ: 791)

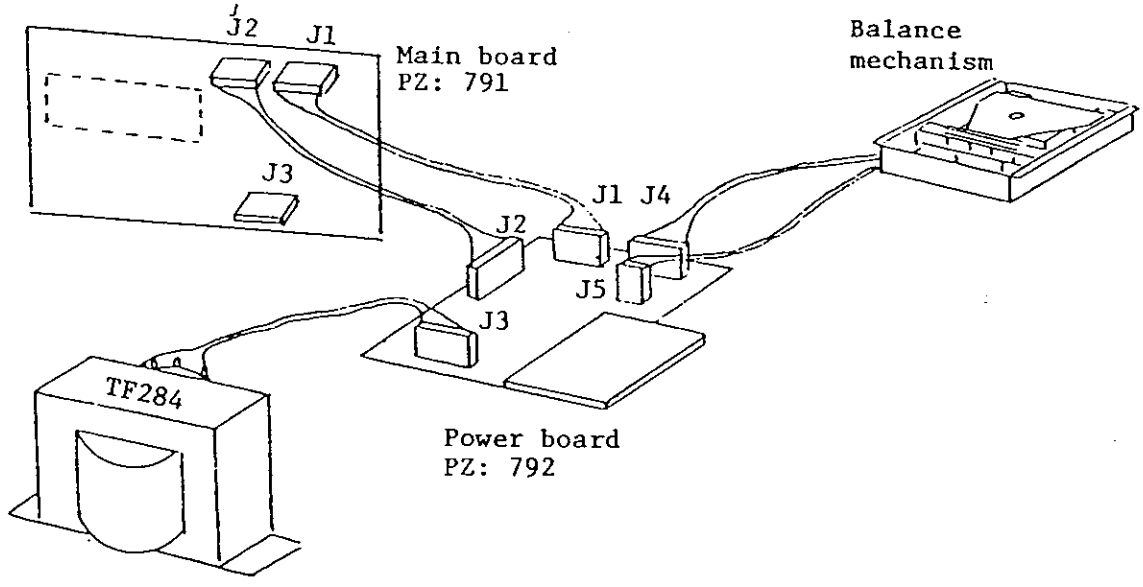
① Check of memory backup current (No power supply is required.)

Check the voltage across resistor R52 (2.2 kΩ) near the lithium cell.
The voltage should be a maximum of 0.4 mV (10 to 12 μV typical).

② Check of memory backup voltage (No power supply is required.)
Check the voltage between TP2 (GND) and pin 24 of U5 (UC: 5518BPL).
The voltage must be +2.75 V or higher.

4.1.2 Check of Main Board Operation

(1) Connection for operation check



(2) Check procedure

① Insert the power cable plug into the wall outlet (100 VAC). Confirm that the indicator on the ON/OFF key on the main board lights.

② Voltage check
Check the following voltages:

GND - Vcc (between TP3 and TP1)	+4.75 to +5.25 V
GND - Vee (between TP2 and TP4)	-22.8 to -25.2 V
AC 3.3 V (pins 6 and 7 of J2)	2.95 to 3.65 V (a.c.)

③ Initialization (See 4.1.5)
Initialize linearity and temperature data.

④ Count check (See Operation 2 in each mode.)
The count displayed should change in each check mode. The last digit in the display of the EP-22KA type is not displayed. To display the digit, press the HOLD key.

⑤ Display check
A decimal point must be present in the last-but-one digit (the 10^1 digit) of the display (except that of the 41KA and 60KA types) in the check and "▼" (Zero Track Off) mode.

⑥ Temperature A/D check
Set the check mode and the Temperature A/D display mode ("▼▼").
The last digit (the 10^0 digit) of the display must change in the range of 35000 to 14000 (at 20°C to 30°C).

- Temperature A/D value
  Increasing at low temperature
  Decreasing at high temperature

⑦ Switch check
Press the SAMPLE key and the % key in the Unit Register mode. The "▼" marks and the LED of the display tube must change.

Check Item List

Check point	Description	Judgement	
		OK	NG
GND-Vcc	DC +4.75 - +5.25V		
GND-Vee	DC -22.8 - -25.2V		
Filament voltage	AC 2.95 - 3.65V		
RE-ZERO	Check mode enabled?		
CAL SW	Check mode enabled?		
PRINT SW	Display value changes in Check mode?		
ON/OFF	Exits the Check mode?		
Count Zero	Internal count: 12,20,22KA 200 - 110; 40,41,60KA 350 - 1100		
Count Span	Internal count: 12K 5200 - 10000; 20,22,40,41K 12000 - 15500; 60K 11000 - 15500		
Display	Zero track off, display of decimal point, value change		
Temperature A/D	30000 to 14000 (at 20°C to 30°C) in the Temperature A/D display		
MODE	Unit Register mode enabled?		
SAMPLE %	Units B and C switchable?		
LED segment	Turned on by depression of the display ON key?		
HOLD SW (EP-22KA only)	The 10^0 digit lights in Check mode?		
Backup voltage	+2.75V or higher		

4.1.3 Total Adjustment

(1) Diode Setting

Model	Diode setting D13	D14	D15
20KA	▼	▼	▼
40KA	▼		▼
60KA		▼	▼
12KA	▼		
41KA	▼	▼	
22KA		▼	

A space in the "Diode Setting" field indicates ommission of a diode (1S1588).
Mount the specified number of span control resistors, Initialize. Thus, the registration of is completed.

(2) Count check

Check the following counts in the check mode and in the Display Internal Count mode:

Model	Span	Zero	Remarks
40KA, 41KA	12000 - 15500	350 - 1100	
60KA	11000 - 15500		
12KA (10 kg weight)	5200 - 10000	200 - 1100	
20KA, 22KA	12000 - 15500		

(3) Temperature A/D check

14000 to 35000 in the Check mode and in the Temperature A/D mode ("▼▼")

(4) Temperature adjustment (See 4.1.6 — (1))

Temperature difference of 30°C or more at test point (near 40°C as high temperature or near 5°C as low temperature)
When "tH" (for high temperature) or "tL" (for low temperature) is displayed, read zero and span data.

(5) Linearity adjustment (See 4.1.6 — (2))
Read data at four points in the "Lnr" display.

Lnr	0	1	2	F	tH, tL, CAL, F
20KA	0	10kg	10kg	20kg	20kg
40KA		20kg	20kg	40kg	40kg
60KA		30kg	30kg	60kg	60kg
12KA		5kg	5kg	10kg	10kg
41KA		20kg	20kg	40kg	40kg
22KA		10kg	10kg	20kg	20kg

(6) Span control
Calibrate with zero span.

(7) Linearity check
Caribrate in the normal measuring mode, then measure.

	0	1	2	3	4	5
20KA	0	2kg	5kg	10kg	15kg	20kg
40KA	0	5kg	10kg	20kg	30kg	40kg
60KA	0	5kg	15kg	30kg	45kg	60kg
12KA	0	1kg	2kg	5kg	10kg	
41KA	0	5kg	10kg	20kg	30kg	40kg
22KA	0	2kg	5kg	10kg	15kg	20kg

Allowance ± digit

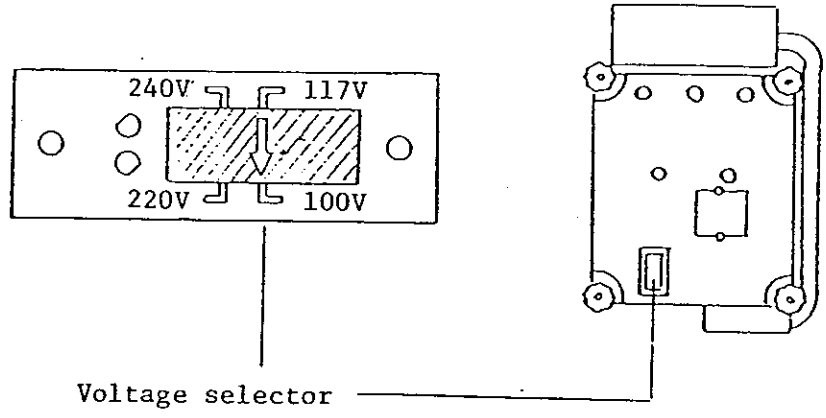
(8) Corner load adjustment/check

Set the Check mode and the Zero Track Off mode ("▼").

20KA, 22KA	10kg
40KA, 41KA	20kg
60KA	30kg
12KA	5kg

Allowance ± 2 digits.

(9) check of supply voltages



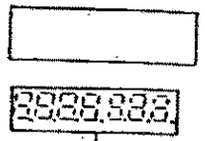
Pull out the voltage selector (at the rear of the equipment), match the arrow head with the desired supply voltage, and plug the voltage selector into the socket.

Symbol on the selector	Nominal supply voltage
100 V	100 V
117 V	120 V
220 V	220 V
240 V	240 V

4.1.4 Check Mode

① Switch off the display.

② Slide CAL switch on while pressing RE-ZERO.



etc.

③ Slide CAL switch off. — Internal count mode.

④ Press the PRINT key. — Zero tracking off mode.

⑤ Press the PRINT key. — Temperature A/D mode.

⑥ Press the PRINT key. — After 65.

⑦ Press the PRINT key. — After Temp.

⑧ Press the PRINT key.

⑨ Press the PRINT key.

⑩ Press the PRINT key.

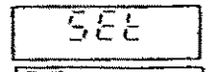
⑪ Press the PRINT key. — Goes back to ③.

To return to the normal display, press ON/OFF key.

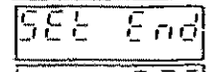
4.1.5 Initialization

①～③ Same as 4.1.4 (1)～(3).

④ Slide CAL switch on.

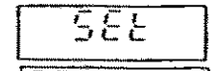


⑤ Press the RE-ZERO key.

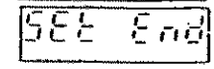


⑥ Slide CAL switch off.

⑦ Slide CAL switch on.



⑧ Press the PRINT key.



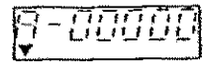
⑨ Slide CAL switch off.

Internal count mode.

4.1.6 Temperature and Linearity Adjustment Mode.

① Switch off the display.

② Press the ON/OFF key while pressing the RE-ZERO key.

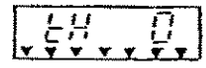


③ Slide CAL switch on. The display alternate between "A" "Lor" "tH" and "tL". (Alternate mode)
The following (1)～(3) will stant from this state.

(1) Temperature Adjustment

Depending on whether you are doing the high or low calibration temperature poing, press the RE-ZERO key when the appropriate "tH" (Temperature High) or "tL" (Temperature Low) appears. We will show about the "tH"

① Press the RE-ZERO key when "CH" appears.



② Press the RE-ZERO key with on load.

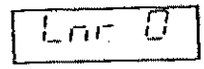
③ Place the calibration weight on the pan and press the RE-ZERO key.
After a brief pause, the display will be the alternate mode again.

Alternate mode

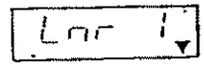
④ Slide CAL switch off.

(2) Linearity Adjustment

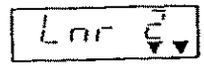
① Press the RE-ZERO key when "Lnr" appears.
TO ENTER THE LINEARISATION ROUTINE.



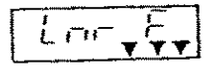
② Press the RE-ZERO key with no load.



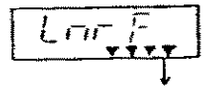
③ Place the Lnr 1 weight on the pan, and press the RE-ZERO key.



④ Leave the Lnr 1 weight on the pan, and press the RE-ZERO key.



⑤ Place the Lnr f (=calibration) weight, and press the RE-ZERO key.
The display will return to the alternate mode.

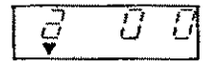


Alternate mode

⑥ Slide CAL switch off.

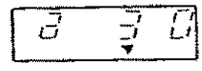
(3) Linearity Control " 2 "

① Press the RE-ZERO key when " 2 " appears.



② Press the PRINT key.

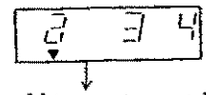
③ Press the RE-ZERO key until the number reaches the appropriate amount of compensation at the 1/4 span.



④ Press the PRINT key.

⑤ Press the RE-ZERO key and change the number for the 3/4 span.

⑥ Press the PRINT key.



⑦ Press the RE-ZERO key. Now the display will return to the alternate mode.

Alternate mode

⑧ Slide CAL switch off.

CHAPTER 5. PARTS LIST

EP-A
MAIN BOARD-1/3

CIRCUIT SYMBOL OR DRWG. NO.	PARTS NAME	DESCRIPTION	Q'TY
	7PZ:791A-1	MAIN BOARD FUULLY ASSEMBLED (For EP-12/20/40/41K)	1
	7PZ:791A-2	MAIN BOARD FUULLY ASSEMBLED (For EP-20K)	1
	7PZ:791A-3	MAIN BOARD FUULLY ASSEMBLED (For EP-22K)	1
	PC:791C	PRINTED CIRCUIT BOARD	1
C 5	CC:0.001U	CAPACITOR 0.001μF 50V	1
C 11	CC:0.01U	CAPACITOR 0.01μF 50V	1
C 3,6,21,27,28 C 30~38,43	CC:0.022U	CAPACITOR 0.022μF 50V	15
C 1	CC:0.047U	CAPACITOR 0.047μF 50V	1
C 13,22,23	CC:10P	CAPACITOR 10pF 50V	3
C 4,20	CC:470P	CAPACITOR 470pF 50V	2
C 14,15	CK:SM10VB100	CAPACITOR 100μF 10V	2
C 16,17	CK:SM35VB100	CAPACITOR 100μF 35V	2
C 41	CK:SM50VB10	CAPACITOR 10μF 50V	1
C 9	CM:E1105KN	CAPACITOR 1μF 100V	1
C 44	CM:E1224KN	CAPACITOR 0.22μF 100V	1
C 8,12	CM:5002103K1	CAPACITOR 0.001μF 50V	2
C 7	CM:5002333K1	CAPACITOR 0.0033μF 50V	1
C 26	CT:1A4R7	CAPACITOR 4.7μF 10V	1
C 2,18,24,25,42	CT:1V010	CAPACITOR 1μF 35V	5
D 3,6,7,42	DI:1SS53	DIODE	4
D 43	DI:1SS97	DIODE	1
D 4,5,9~15,31~34 43,44	DI:1S1588	DIODE	14
D 35,39,40,41	DL:TLUG144	LED	4
D 45	DZ:RD3.3EB1	ZENER DIODE	1
D 8	DZ:RD5.1FB	ZENER DIODE	1
E 1	ED:FIP7B13	DISPLAY PANEL	1
J 6	JS:10328-01-445	CONNECTOR	1
J 1~3	JT:171825-7	CONNECTOR	3
	QA:AC256-1674	INSULATING PLATE	1
Q 6	QF:VN66AF	FET	1
Q 8	QF:2N7000	FET	1
Q 3~5	QT:A1015Y	TRANSISTOR	3

EP－A
MAIN BOARD－2／3

CIRCUIT SYMBOL OR DRWG. NO.	PARTS NAME	DESCRIPTION	Q'TY
Q 1	QT:A1153	TRANSISTOR	1
Q 2,7	QT:C1815Y	TRANSISTOR	2
R 27	RC:1/21M	RESISTOR 1MΩ 1/2W	1
R 17,21,35,63	RC:1K	RESISTOR 1KΩ 1/4W	4
R 25	RC:10K	RESISTOR 10KΩ 1/4W	1
R 5,18,37,38	RC:100R	RESISTOR 100Ω 1/4W	4
R 34	RC:12K	RESISTOR 12KΩ 1/4W	1
R 40	RC:15K	RESISTOR 15KΩ 1/4W	1
R 76	RC:150R	RESISTOR 150Ω 1/4W	1
R 1,52,61,62,74	RC:2.2K	RESISTOR 2.2KΩ 1/4W	5
R 41,42	RC:22K	RESISTOR 22KΩ 1/4W	2
R 77	RC:220R	RESISTOR 220Ω 1/4W	1
R 24	RC:33K	RESISTOR 33KΩ 1/4W	1
R 28	RC:330K	RESISTOR 330KΩ 1/4W	1
R 64～68,70,71	RC:4.7K	RESISTOR 4.7KΩ 1/4W	7
R 20,47～49	RC:470R	RESISTOR 470Ω 1/4W	4
R 78	RC:560K	RESISTOR 560KΩ 1/4W	1
R 39,59,60	RC:560R	RESISTOR 560Ω 1/4W	3
R 30,36	RC:6.8K	RESISTOR 6.8KΩ 1/4W	2
R 31	RC:68K	RESISTOR 68KΩ 1/4W	1
R 26,29	RC:82K	RESISTOR 82KΩ 1/4W	2
R 8	RF:1/468KSF	RESISTOR 68KΩ 1/4W ±50ppM/℃	1
R 3	RF:1KSF	RESISTOR 1KΩ 1/8W ±50ppM/℃	1
R 69	RF:3.3KSF	RESISTOR 3.3KΩ 1/8W ±50ppM/℃	1
R 2	RF:4.3KSF	RESISTOR 4.3KΩ 1/8W ±50ppM/℃	1
R 4	RF:4.7KSF	RESISTOR 4.7KΩ 1/8W ±50ppM/℃	1
R 6,7	RF:6.8KSF	RESISTOR 6.8KΩ 1/8W ±50ppM/℃	2
R 9～10	RL:5000B	RESISTOR 500Ω 3/10W ±5ppM/℃	2
R 32	RM:11KF	RESISTOR 11KΩ 1/4W ±100ppM/℃	1
R 33	RM:18KF	RESISTOR 18KΩ 1/4W ±100ppM/℃	1
R 22	RM:2.61KF	RESISTOR 2.61KΩ 1/4W ±100ppM/℃	1
R 23	RM:5.11KF	RESISTOR 5.11KΩ 1/4W ±100ppM/℃	1
R 55～58	RN:IHR-4-223MA	RESISTOR NETWORK	4
R 43,51	RN:IHR-4-472MA	RESISTOR NETWORK	2

EP-A
MAIN BOARD-3/3

CIRCUIT SYMBOL OR DRWG. NO.	PARTS NAME	DESCRIPTION	Q'TY
R 53,54	RN:IHR-8-103MA	RESISTOR NETWORK	2
S 15,16,18～20	SK:TM1-01/0010	SWITCH	5
S 21	SS:2NB2X2-A	SWITCH	1
TP 1～6	TM:CP-10	TEST TERMINAL	6
U 4	UA:C311C	VOLTAGE COMPARATOR	1
D 2	UA:LM399H	VOLTAGE REFERENCE	1
U 2	UA:OP07DP	OP AMP	1
U 16	UA:PST518B	VOLTAGE COMPARATOR	1
U 1,3	UA:TL072CP	DUAL OP AMPS	2
U 8,10	UC:40H000	CMOS IC	2
U 12,13	UC:5067	CMOS IC	2
U 5	UC:5518BPL	CMOS IC	1
U 14	UN:D7810G	CPU	1
D 46	UR:TL4310LPB	SHUNT REGULATOR	1
U 9	UT:LS138	TTL IC	1
U 11	UT:LS174	TTL	1
U 7	UT:LS374	TTL	1
U 15	UT:MB111S105	TTL GATE ARRAY	1
X 1	XT:HC18/U12MHZ	XTAL(12MHz)	1
D 26	DI:1S1588	DIODE (For EP-22K)	1
D 37	DL:TLUG144	LED (For EP-22K)	1
R 45	RC:1K	RESISTOR 1K (For EP-22K)	1
S 11	SK:TM1-01/0010	SWITCH (For EP-22K)	1
	04:A45540	HEAT SINK	1
	06:A41868A	SHEET	2
	07:A41827		1
R 11	RL:5000B	RESISTOR 500Ω 3/10W ±5ppM/℃ (For EP-60K)	1

EP-A
POWER BOARD

CIRCUIT SYMBOL OR DRWG. NO.	PARTS NAME	DESCRIPTION	Q'TY
	PZ:792	POWER BOARD FULLY ASSEMBLED	1
	PC:792B	PRINTED CIRCUIT BOARD	1
C 5,6,7	CC:0.047U	CAPACITOR 0.047μF 50V	3
C 2,3	CC:0.1U25V	CAPACITOR 0.1μF 25V	2
C 1	CK:SM16VB4700	CAPACITOR 4700μF 16V	1
C 4	CK:SM50VB1000	CAPACITOR 1000μF 50V	1
C 8,9,10	CM:E1106KN	CAPACITOR 10μF 50V	3
D 2	DI:W02	DIODE BRIDGE	1
D 1	DI:3B4B41	DIODE BRIDGE	1
J 5	JT:171825-3	CONNECTOR	1
J 1～4	JT:171825-7	CONNECTOR	4
QA 1,2	QA:AC256-1674	FLAT WASHER	2
QA 3	QA:AC316A	NYLON WASHER	2
R 1	RC:3.9K	RESISTOR 3.9KΩ 1/4W	1
U 1	UR:TA78005AP	VOLTAGE REGULATOR	1
U 2	UR:TA78024AP	VOLTAGE REGULATOR	1
	04:A45539	HEAT SINK	1

EP-A
SENSOR BOARD

CIRCUIT SYMBOL OR DRWG. NO.	PARTS NAME	DESCRIPTION	Q'TY
	PZ:793	SENSOR BOARD FULLY ASSEMBLED	1
	PC:793A	PRINTED CIRCUIT BOARD	1
C 1,3	CC:0.022U	CAPACITOR 0.022μF 50V	2
C 2	CC:100P	CAPACITOR 100pF 50V	1
D 2	DI:MI-33H-2D	PHOT DIODE	1
D 3	DI:1S1588	DIODE	1
D 1	DL:TLN108	LED	1
	KO:102-7S50	CONNECTOR CABLE	1
Q 1	QT:C1815Y	TRANSISTOR	1
R 4	RC:1.8K	RESISTOR 1.8KΩ 1/4W	1
R 7	RC:1K	RESISTOR 1KΩ 1/4W	1
R 3	RC:220K	RESISTOR 220KΩ 1/4W	1
R 2	RC:3.3K	RESISTOR 3.3KΩ 1/4W	1
R 5	RM:237KF	RESISTOR 237KΩ 1/4W ±100ppM/℃	1
R 1	RM:261KF	RESISTOR 261KΩ 1/4W ±100ppM/℃	1
R 6	RV:V503	VOLUME	1
U 1	UA:TL072CP	DUAL OP AMPS	1
	07:A41842C	SENSOR HOLDER	1

EP－A
SERIAL INTERFACE OP－03

CIRCUIT SYMBOL OR DRWG. NO.	PARTS NAME	DESCRIPTION	Q'TY
	PZ:796	OPTION-03 FULLY ASSEMBLED	1
	PC:796	PRINTED CIRCUIT BOARD	1
C 4,5	CC:0.022U	CAPACITOR 0.022μF 50V	2
C 6	CC:150P	CAPACITOR 150pF 50V	1
C 10,11	CC:330P	CAPACITOR 330pF 50V	2
C 1	CK:SM10VB47	CAPACITOR 47μF 10V	1
C 7,8	CK:SM35VB33	CAPACITOR 33μF 35V	2
C 9	CT:1A4R7	CAPACITOR 4.7μF 10V	1
C 2,3	CT:1D2R2	CAPACITOR 2.2μF 20V	2
D 1	DF:TLP521-1	PHOTO COUPLER	1
D 2	DI:W02	DIODE BRIDGE	1
D 3,4	DI:1S1588	DIODE	2
J 8	JA:TCS0270	CONNECTOR	1
J 7	JA:25-30-335S	CONNECTOR	1
J 3	JT:171825-7	CONNECTOR	1
	K0:102-7W10	CONNECTOR CABLE	1
L 1	LR:H5AT7-14-3.5	COIL	1
Q 1	QT:C1815Y	TRANSISTOR	1
R 5	RC:220R	RESISTOR 220Ω 1/4W	1
R 3	RC:270R	RESISTOR 270Ω 1/4W	1
R 4	RC:330R	RESISTOR 330Ω 1/4W	1
R 1,2	RC:4.7K	RESISTOR 4.7KΩ 1/4W	2
R 7	RM:1.21KF	RESISTOR 1.21KΩ 1/4W ±100ppM/℃	1
R 6	RM:1/21RF	RESISTOR 1Ω 1/2W ±100ppM/℃	1
R 8	RM:11KF	RESISTOR 11KΩ 1/4W ±100ppM/℃	1
	TM:CP-10	TEST PIN	3
U 3	UR:TL497ACN	VOLTAGE REGULATOR	1
U 2	UT:LS368	TTL	1
U 1	UT:75188	TTL	1
U 4	UT:75189A	TTL	1
	01:A46191	PLATE	1
	04:A46192	BOARD MOUNT PLATE	2

PARTS LIST

EXPLODED VIEW－1／3

CIRCUIT SYMBOL OR DRWG. NO.	PARTS NAME	DESCRIPTION	Q'TY
(1)	04:A33218B	WEIGHING PAN	
(2)	7PB:EP20KA-7	PAN SUPPORT UNIT EP-12/20/21K	
〃	7PB:EP40KA-7	PAN SUPPORT UNIT EP-40/41K	
〃	7PB:EP60KA-7	PAN SUPPORT UNIT EP-60K	
(3)	07:A20476B	UPPER CASE	
(4)	04:A33213	LOCKING BAR	
(5)		M4×8 HEX SCREW	
(6)		M4 SPRING WASHER	
(7)		PAN BEARING BRACKET EP-12/20/21K	
〃		PAN BEARING BRACKET EP-40/41K	
(8)		M5×20 HEX SCREW EP-12/20/21K	
〃		M5×25 HEX SCREW EP-40/41K	
(9)		M5 CONVEX WASHER	
(10)	7PB:EP20KA-2	FLEXIBLE BEARING ASS'Y (TOP)	
〃	7PB:EP60KA-2	FLEXIBLE BEARING ASS'Y (TOP)	
(11)		M4×10 HEX SCREW	
(12)		M4 CONVEX WASHER	
(13)	04:A44775D	FITTING PLATE	
(14)		M5×10 HEX SCREW	
(15)	04:A45538A	FITTING PLATE	
(16)	04:A43012	FLEXIBLE BEARING EP-12/20/21K	
〃	04:A44241A	FLEXIBLE BEARING EP-40/41/60K	
(17)	05:A43181	FITTING PLATE	
(18)	04:A43299	ALUMINUM WASHER T=1	
(19)	04:A43014	FLEXIBLE BEARING EP-12/20/21K	
〃	04:A44243	FLEXIBLE BEARING EP-40/41/60K	
(20)	03:A20456-1	BEAM(1)-20K	
〃	03:A20456-2	BEAM(1)-40K	
(21)		M4×30 HEX SCREW	
(22)		M5×40 HEX SCREW	
(23)	05:A43178	ADJUSTMENT BOLT	
(24)	04:A44482-2	FITTING PLATE	
(25)	04:A44984	FLEXIBLE BEARING	
(26)	04:A45385	GUIDE ANGLE	

PARTS LIST

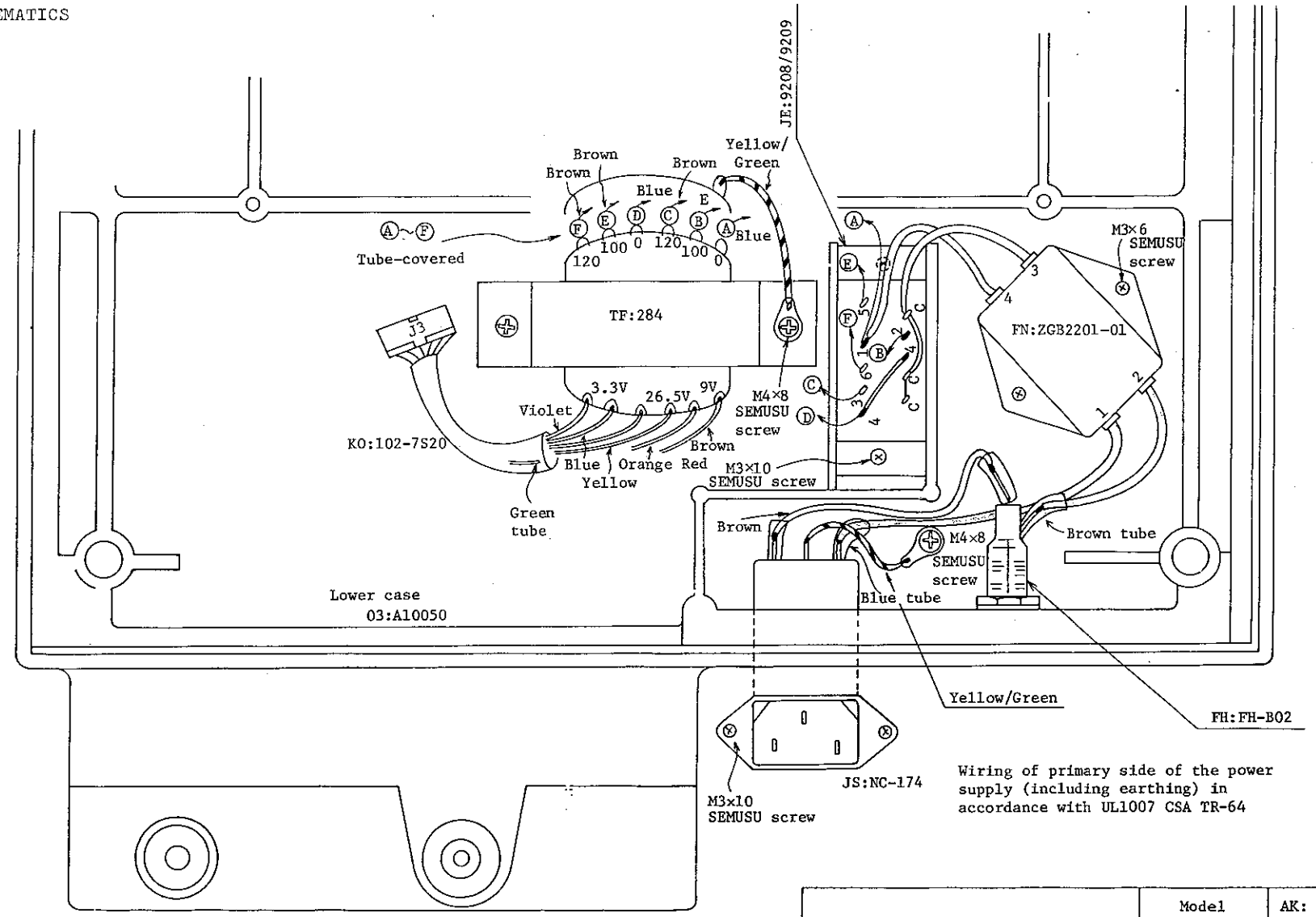
EXPLODED VIEW－2／3

CIRCUIT SYMBOL OR DRWG. NO.	PARTS NAME	DESCRIPTION	Q'TY
(27)	03:A10047A	FRAME	
(28)		5φ×10 PIN	
(29)	06:A43885	GROMMET	
(30)	04:A45005	CABLE HOLDER	
(31)	PB:EP20KA-1	MAGNET ASS'Y	
(32)		M4×12	
(33)			
(34)		M3 WASHER SCREW	
(35)		M3×8	
(36)		NYLON CRAMP	
(37)		M5×10 SCREW	
(38)	05:A41749A	STOP BOLT	
(39)	04:A41915A	STOPPER PLATE	
(40)	09:A33203C	FORCE COIL BOBBIN	
(41)	04:A46006	ALUMINUM WASHER	
(42)	03:A33202	BEAM (2)	
(43)		M5 NUT	
(44)	04:A44993	FLEXIBLE BEARING	
(45)	05:A46474A	BALANCE WEIGHT EP-12/20K	
〃	05:A45004A	BALANCE WEIGHT EP-40/60K	
(46)	04:A45003	BALANCE PLATE	
(47)		M3×8	
(48)	7PB:EP20KA-3	FLEXIBLE BEARING ASS'Y(BOTTOM)	
〃	7PB:EP60KA-3	FLEXIBLE BEARING ASS'Y(BOTTOM)	
(49)	05:A44543	SPACER FOR BEARING	
(50)		M4×18 HEX SCREW	
(51)		M3×10 SCREW	
(52)	09:A46000C	BOLT	
(53)	05:A45470B	LEVEL	
(54)		M6 CONVEX WASHER	
(55)	07:A10048	UPPER DISPLAY CASE	
(56)	01:A33637	ACRYIC PLATE	
(57)	01:A33720	KEY BOARD FASCIA EP-12K	
〃	01:A33632	KEY BOARD FASCIA EP-20K	

PARTS LIST

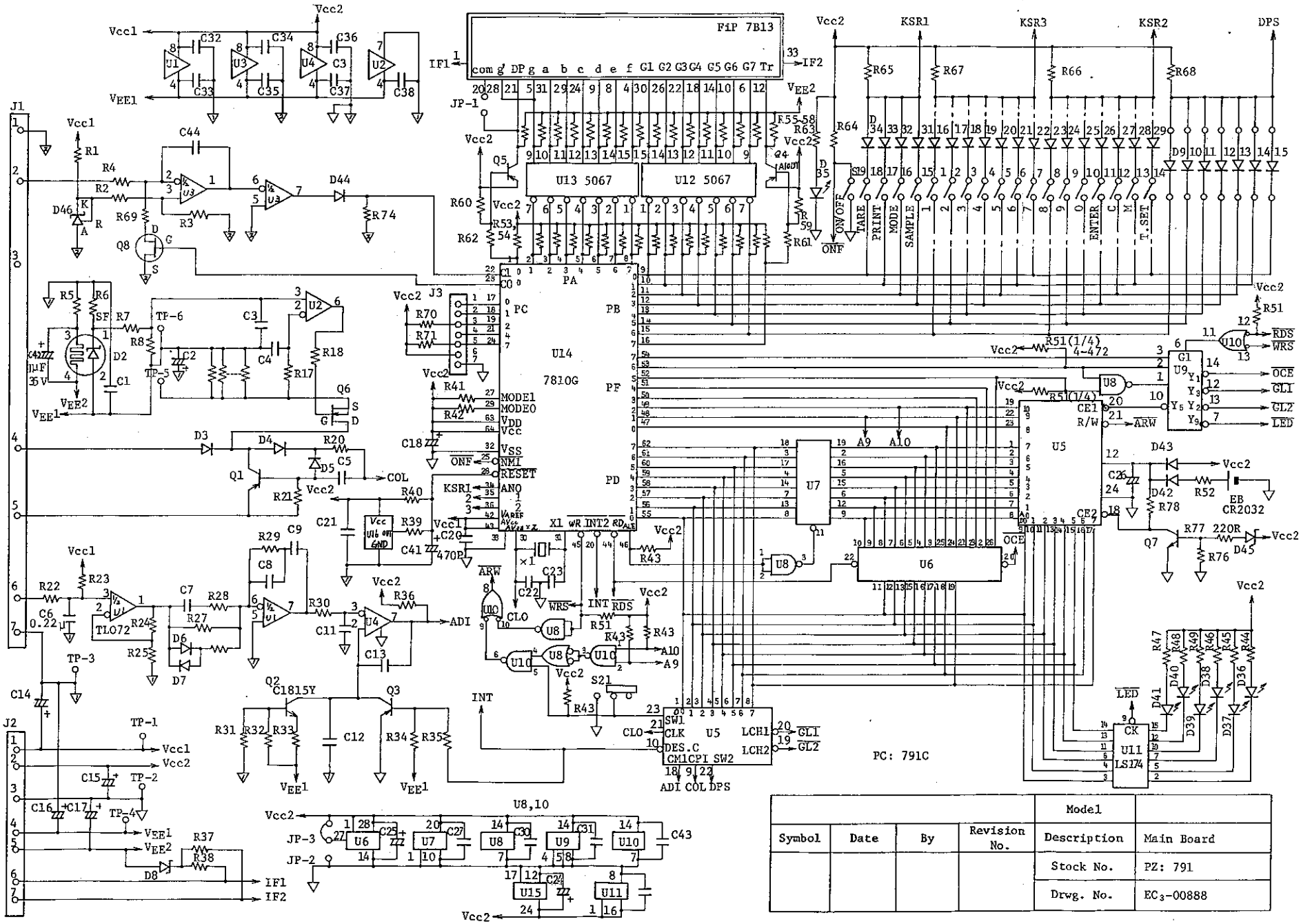
EXPLODED VIEW－3／3

CIRCUIT SYMBOL OR DRWG. NO.	PARTS NAME	DESCRIPTION	Q'TY
(57)	01:A33636	KEY BOARD FASCIA EP-22K	
〃	01:A33633	KEY BOARD FASCIA EP-40K	
〃	01:A33635	KEY BOARD FASCIA EP-41K	
〃	01:A33634	KEY BOARD FASCIA EP-60K	
(58)	07:A46979	CAP	
(59)	05:A45541B	SPACER	
(60)		M3 NUT	
(61)	07:A10049	LOWER CASE OF DISPLAY	
(62)	04:A45067A	ARM CRAMPER	
(63)	04:A45085A-2	ARM CRAMPER	
(64)		M4 WASHER	
(65)	04:A45018A	ARM CRAMPER	
(66)	02:A45474	COVER PLATE	
(67)	10:KT-BM6L40	KNOB BOLT M6×40	
(68)	07:A45469D	ADJUSTABLE FOOT	
(69)	06:A45509A	ADJUSTABLE FOOT RUBBER	
(70)		M5×12 HEX SCREW	
(71)		SPRING WASHER	
(72)		M3×10 HEX SCREW	
(73)	05:A33407E	DISPLAY ARM	
(74)	04:A41899A	COVER PLATE	
(75)		M5×10 SCREW	
(76)	04:A45085A	ARM CRAMPER	
(77)		M6×12 HEX SCREW	
(78)	04:A33234	COVER PLATE	
(79)	04:A45562	SHIELD PLATE	
(80)	05:A45122A	HOLDING ARM	
(81)	03:A10060	LOWER CASE	
(82)		M4×8 SCREW	

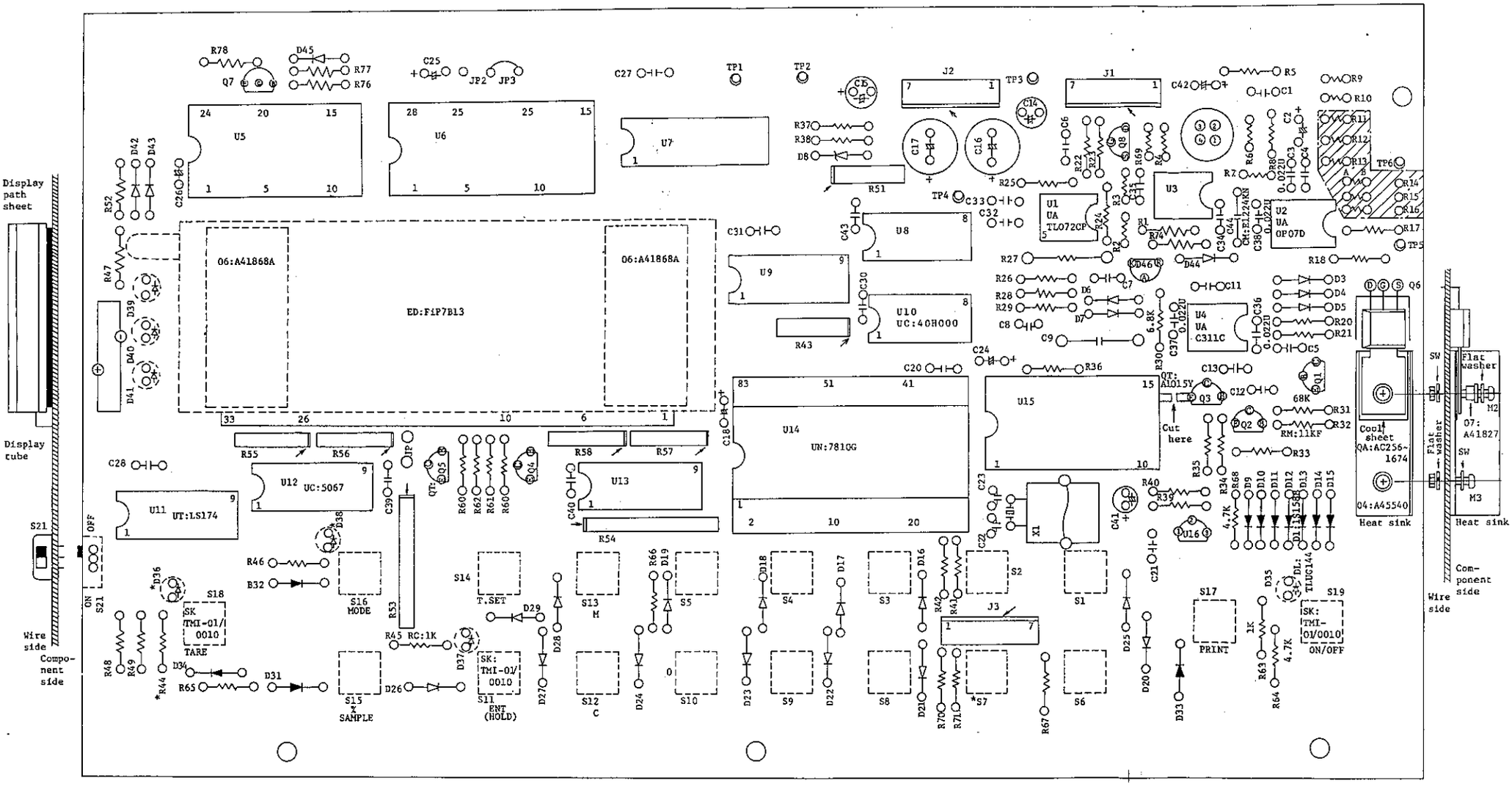


Wiring of primary side of the power supply (including earthing) in accordance with UL1007 CSA TR-64

				Model	AK: EP Series
Symbol	Date	By	Revision No.	Description	Wiring
				Stock No.	
				Drwg. No.	KZ3-00491

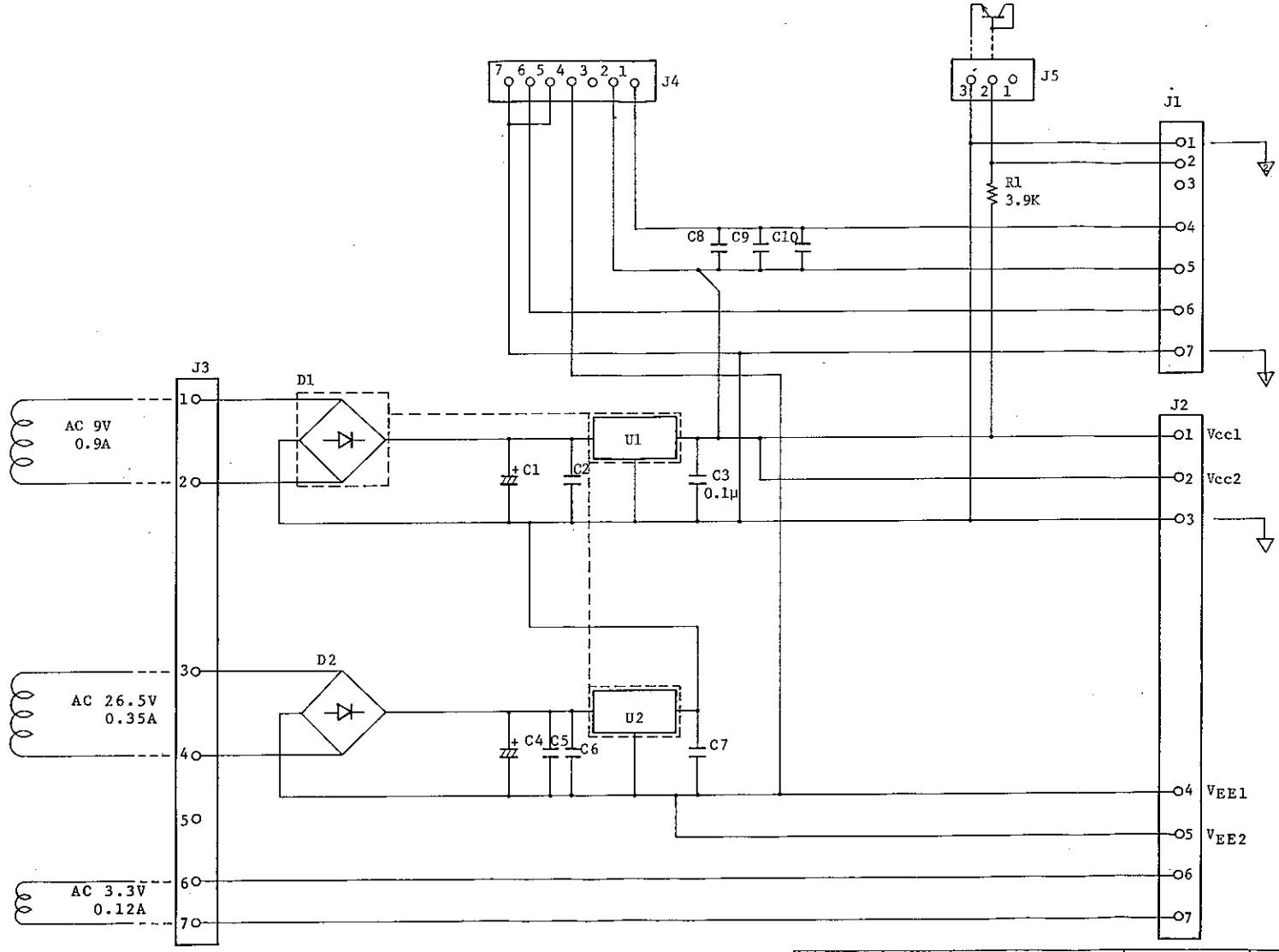


				Model	
Symbol	Date	By	Revision No.	Description	Main Board
				Stock No.	PZ: 791
				Drwg. No.	EC$_3$-00888

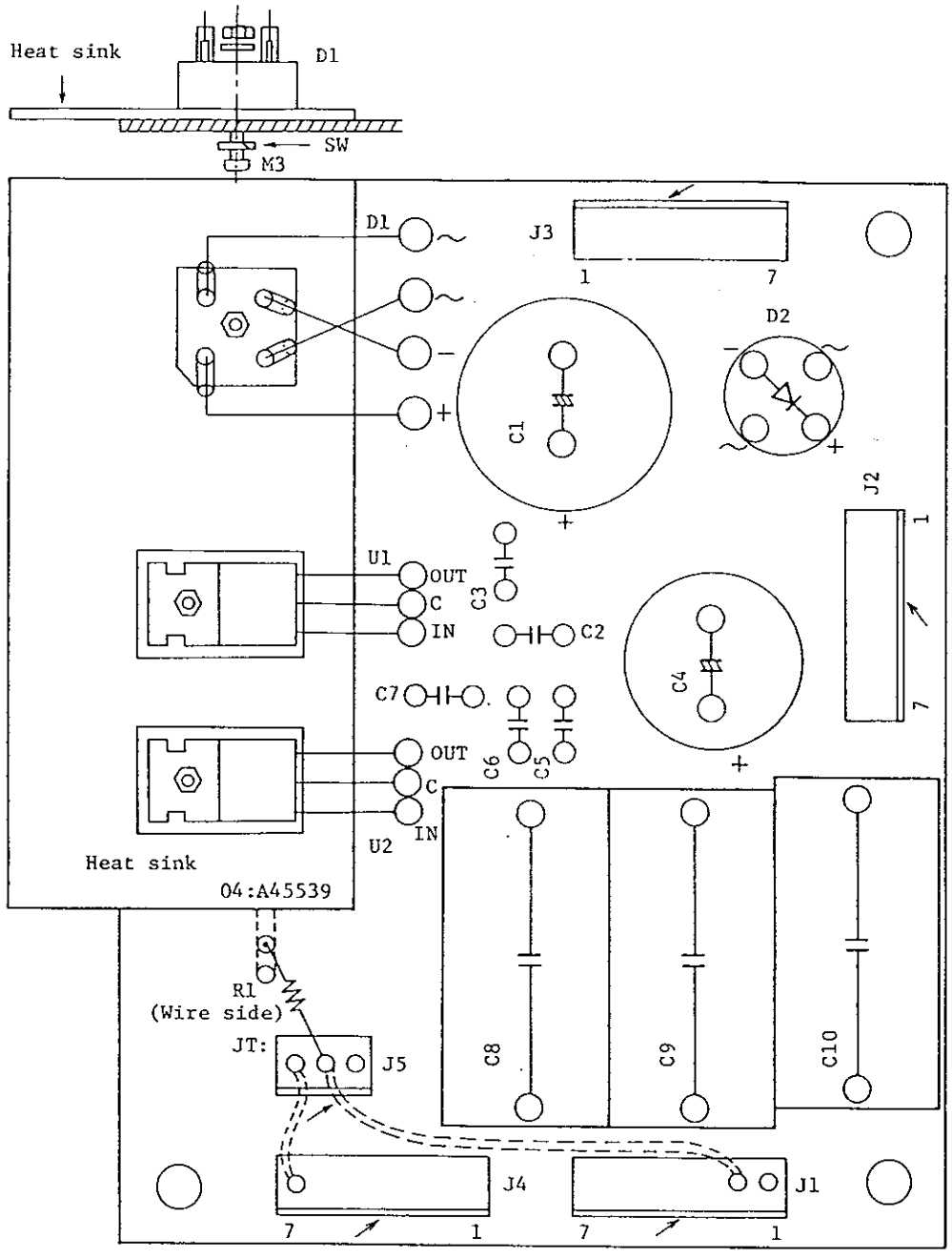


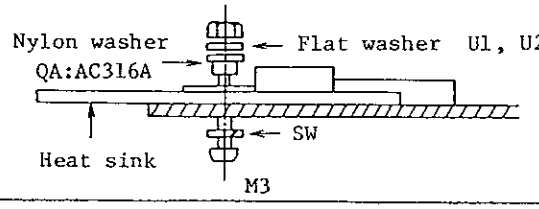
PC: 791C

				Model	AK: EP Series
Symbol	Date	By	Revision No.	Description	Component Layout on Main Board
				Stock No.	PZ: 791
				Drwg. No.	KZ2-00274



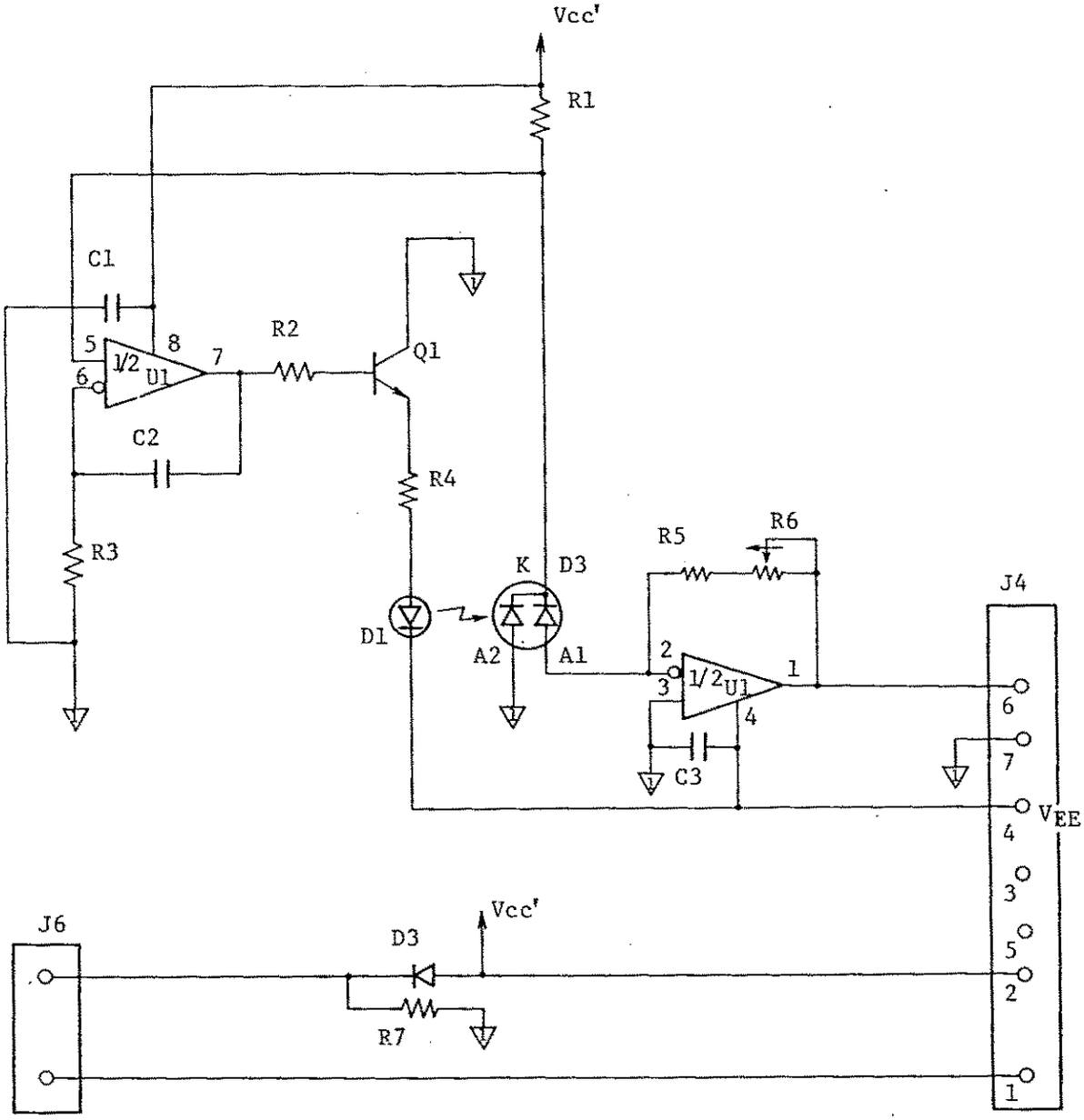
				Model	
Symbol	Date	By	Revision No.	Description	Power Board
				Stock No.	PZ: 792
				Drwg. No.	EC3-00887





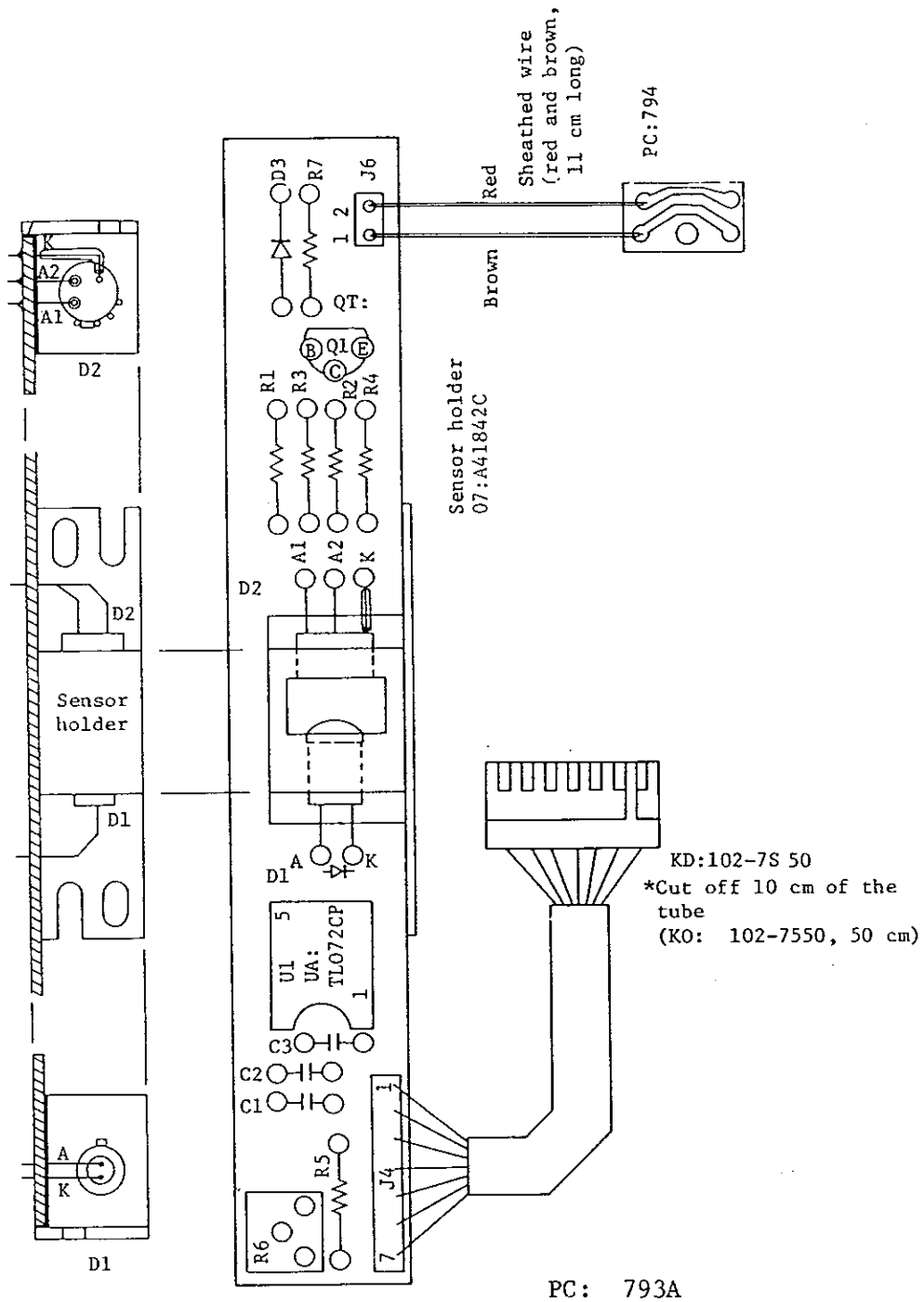
PC: 792A

				Model	AK: EP Series
Symbol	Date	By	Revision No.	Description	Component Layout on Power Board
				Stock No.	PZ: 792
				Drwg. No.	



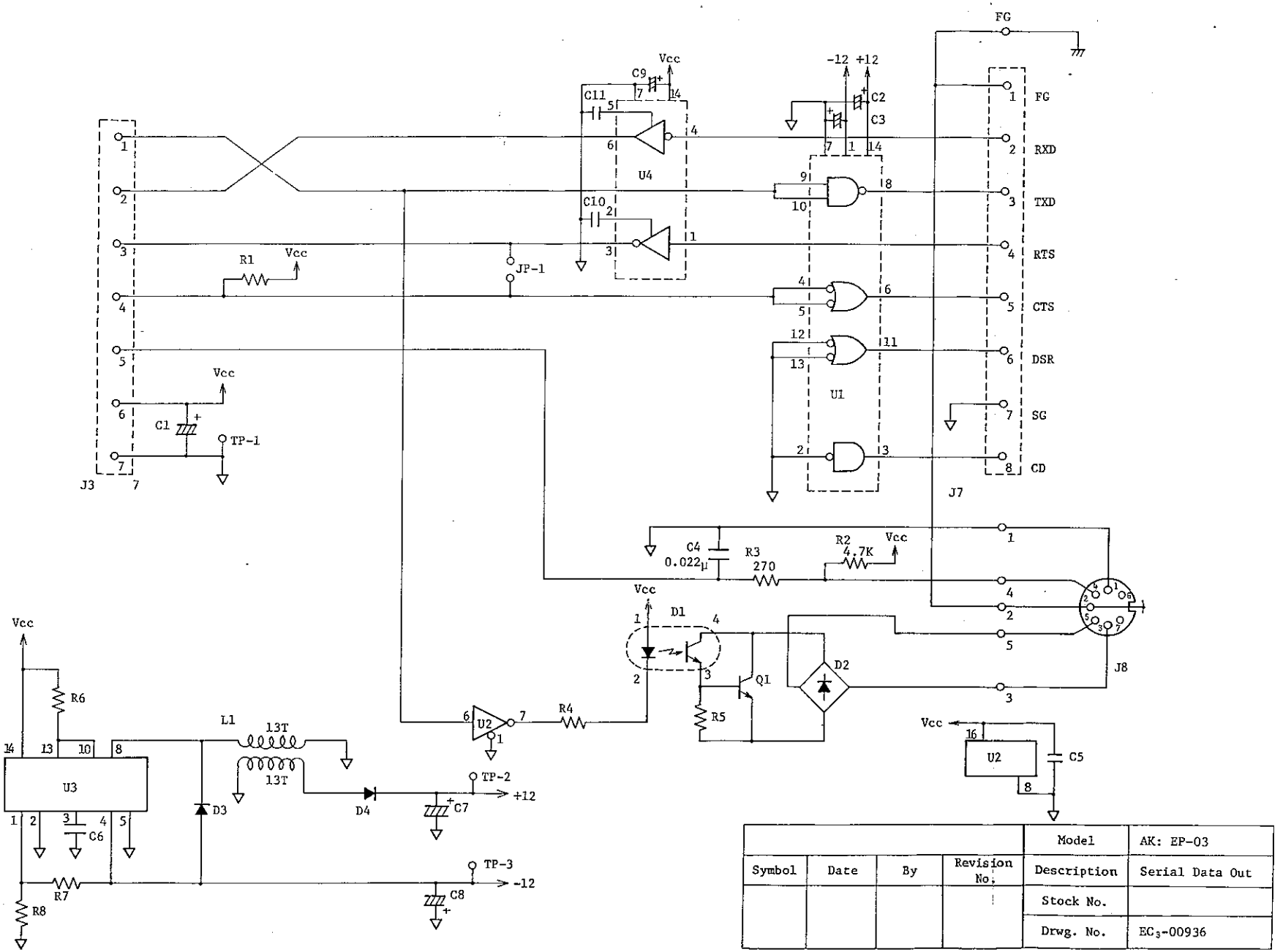
D3 M1-33H-2D

				Model	
Symbol	Date	By	Revision No.	Description	Sensor Board
				Stock No.	PZ: 793
				Drwg. No.	EC_4-00129

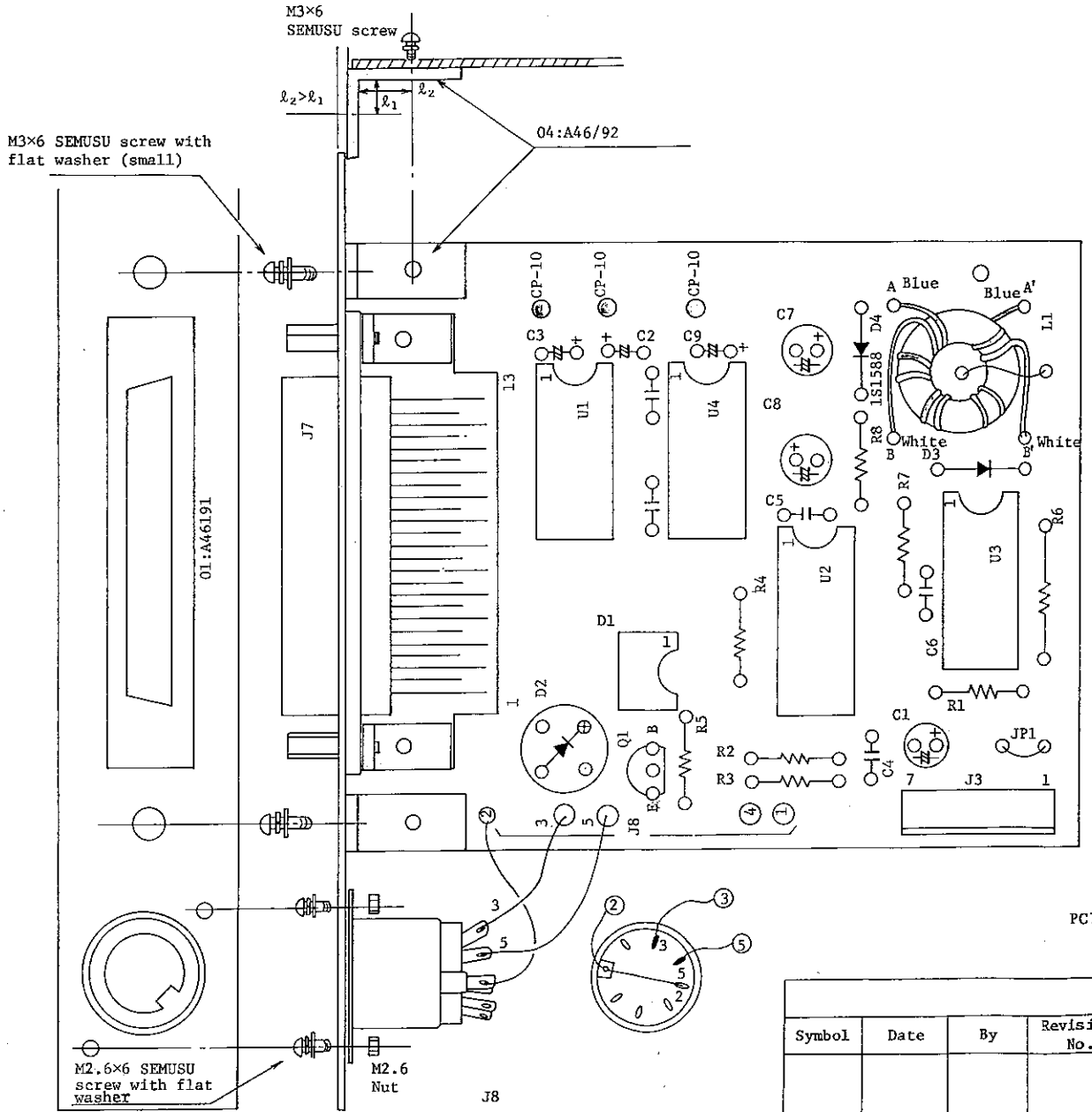


PC: 793A

				Model	AK: EP Series
Symbol	Date	By	Revision No.	Description	Component Layout on Sensor Board
				Stock No.	PZ: 793
				Drwg. No.	KZ_4-00301



				Model	AK: EP-03
Symbol	Date	By	Revision No.	Description	Serial Data Out
				Stock No.	
				Drwg. No.	EC_3-00936



PC796

				Model	AK: EP-03
Symbol	Date	By	Revision No.	Description	Component Layout on P8: 796
				Stock No.	
				Drwg. No.	KZ_3-00506