FR MARK II

BALANCE

MAINTENANCE MANUAL

maintenance-FR MARK II-v.2.b

MULTI-FUNCTION ANALYTICAL BALANCE

A&D Company, Limited

CONTENTS

1. PRINCIPLE OF OPERATION

① The FR balance works on the principle of "Force Restoration." Any change in the load on the weighing pan causes the Position Beam Lever to pivot on two fulcrum flexible bearings (see the Force Motor Block Diagram). Attached to this beam is a bobbin (wound with fine wire), called the "Force Coil," which floats in a Magnetic field. This assembly is called the force motor called the "Force Motor." At the end of the position beam lever, there is a small hold through which light from a light-emitting diode (LED) is passed to two photodiodes (light measuring diodes) during up or down movement.. At zero weight, the light detected by the upper photodiode is equal to that detected by the lower photodiode. These three diodes make up the Position Detector.

When the force coil is pulled up by the leverage exerted by a mass on the weighing pan, the Position Detector detects a change in force coil position as the light reaching the upper photodiode exceeds that reaching the lower one. The balance then feeds the force coil with more force coil current flows to pull it back until the light measured by both photodiodes is balanced again.

When there is no load, the light detected at the upper photodiode is balanced with that detected at the lower photodiode. The Position Detector consists of these three diodes. (As the figure shows, pulse width modulation [PWM] increases the ratio of time which during the force coil current flows.) The light current received from the photodiode is converted into voltage. Current then flows through the force coil for a longer time and the total coil current increases. As the total coil current increases, the electromagnetic force also increases. Then the force coil is pulled down until the position detector detects that the upper and lower sections are equal.

Since the total current through the force coil is proportional to the weight on the pan, the time signal (time ratio) of the current after pulse width modulation is also proportional to the weight. The pulse wave modulator consists of a comparator and a constant-cycle sawtooth generator. Output time signals are synchronized with the clock signals as shown in the figure and counted by a counter for digital conversion (A/D conversion by the modulator and counter).

The digital value (proportional to the load) is then sent to the microprocessor (CPU).

② Since the magnetic force is affected by temperature, temperature correction is also required. The sensors positioned near the magnet detect the temperature and a dedicated A/D converter converts the sensor signals from analog to digital. The CPU fetches the digital signals and executes temperature correction based on the weight data.

Likewise, the non-linearity of each balance is stored in digital format for linearity correction by the CPU.

The absolute value of each internal weight is also stored in EEPROM to correct the span for calibration.

(In the auto self-calibration mode, temperature changes are detected by temperature sensors ① [magnet section] and ② [analog section]. The sensor signals are converted from analog to digital and fetched by the CPU for processing.

1.1 EXPLANATION OF EACH BLOCK

1) Power section

The power section obtains -12, +5, and -25VDC and 4.2VAC from the AC adapter output (about 15V) through the regulator and DC/DC converter.

2) CPU

The CPU is an 8-bit microprocessor for communications with memory (ROM, RAM, or EEPROM), and executes various operations, display control, RS-232C control, and internal weight increase/decrease control.

3) Gate array

The gate array contains a clock oscillator, counter, and latch for A/D conversion. It also decodes signals for remote control (optional).

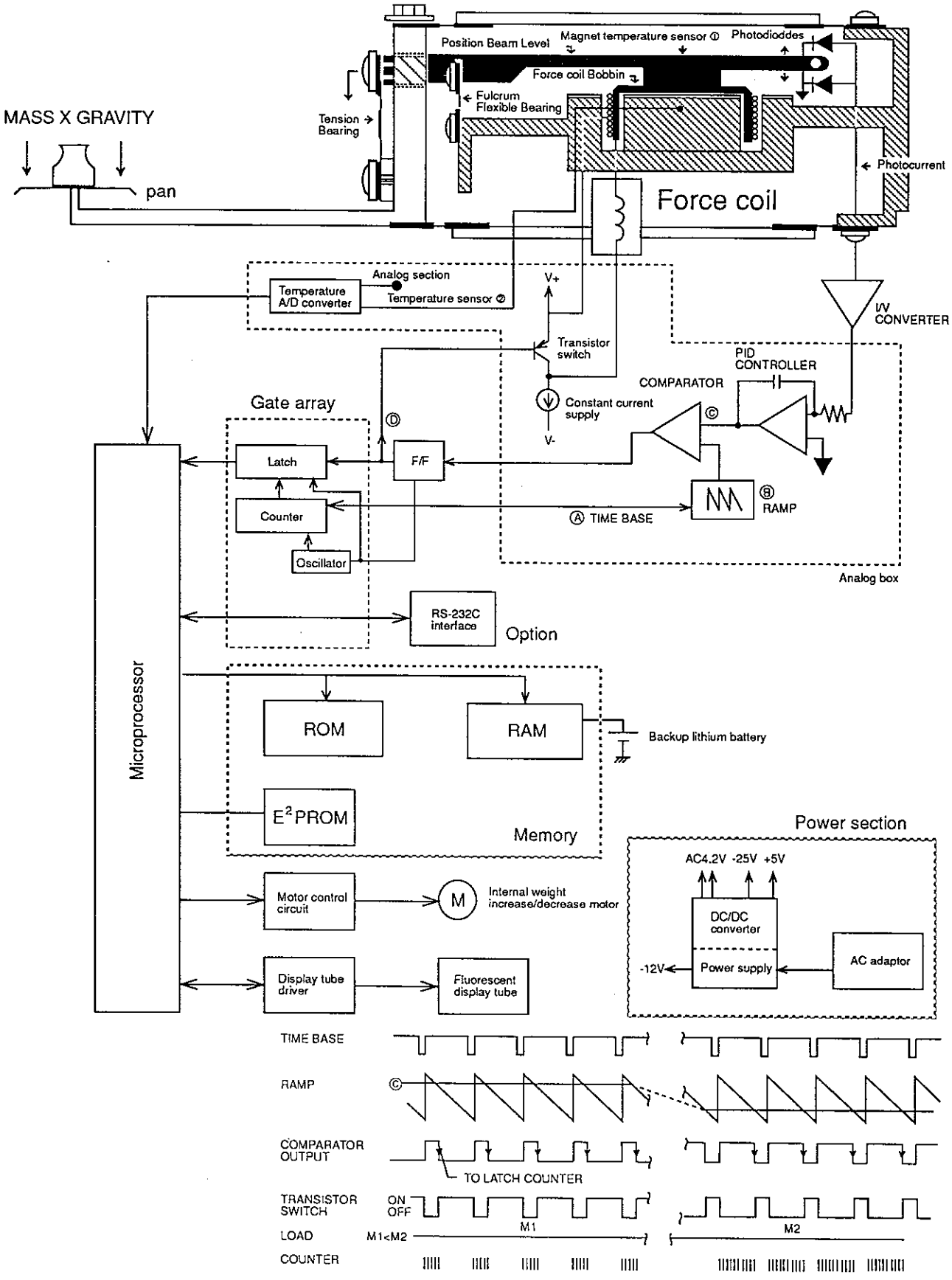
4) Memory

ROM	····· 23K bytes	
RAM	····· 8K bytes	(backed up by battery)
E^2PROM	····· 1K bits	(to store temperature correction and other temperature data)

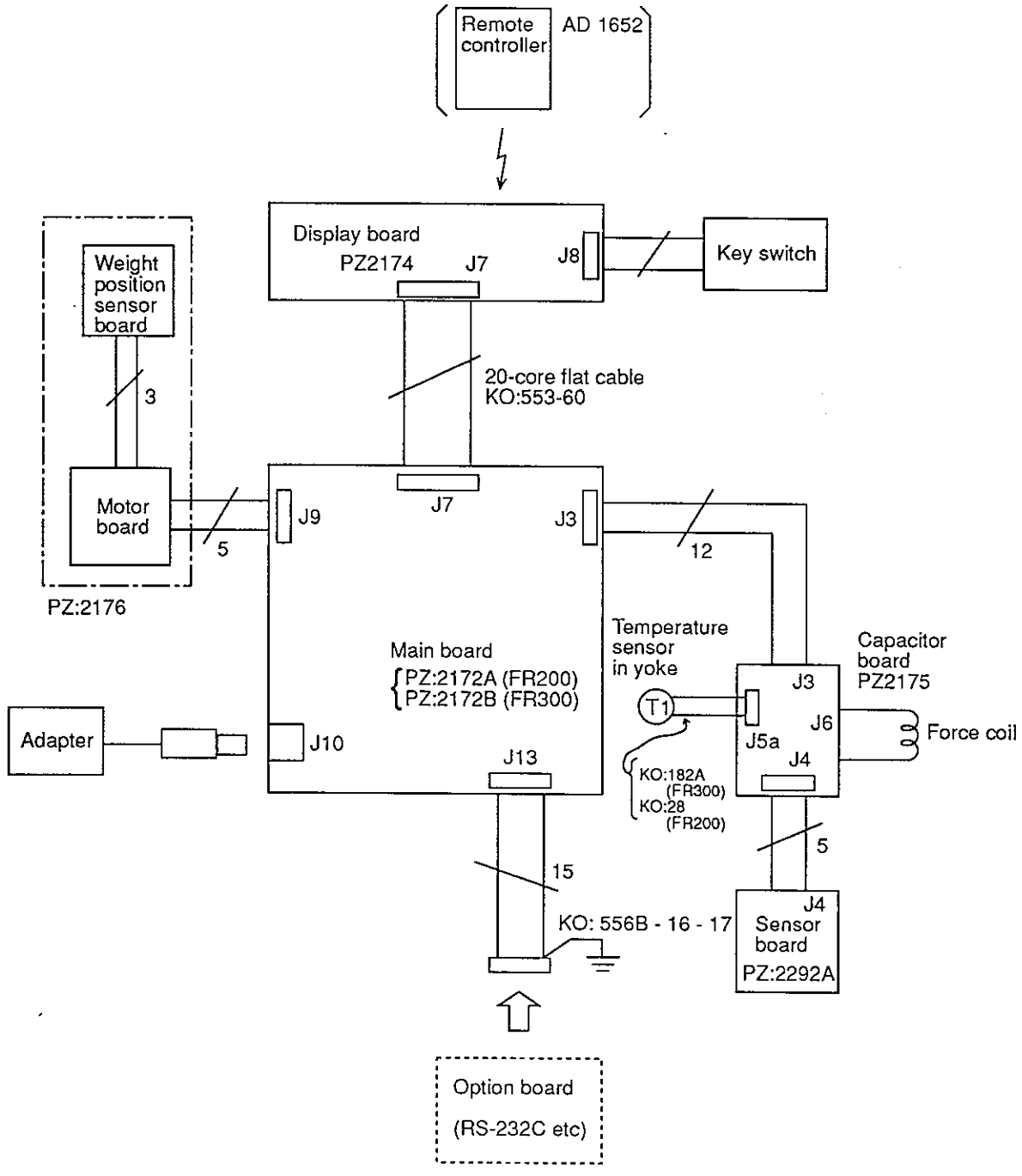
5) Analog box

Analog box supplies force coil current in direct proportion to weight. force coil current is converted into digital weight data by sawtooth wave.

1.2 FORCE MOTOR BLOCK DIAGRAM



1.3 CONFIGURATION



Main Board (See page 67 for layout)

U10: Single-chip microcomputer for digital circuit control

U18: ROM containing programs

U17: Battery-backed RAM usually storing the following data :

(1) Rezero data

(2) Percentage counting data

(3) Internal set data

(4) User set unit

U16: EEPROM, stores unique product characteristics. If this IC is replaced or damaged, the product can not operate accurately.

U11: A&D's custom-made IC

This IC converts the weight signals into digital count data, using the pulse width and clock pulses.

Power supply circuit: This circuit generates the following voltages by using a DC/DC converter.

V_{DD} = +5VDC

V_{EE} = -12VDC

Vss1 = -25VDC

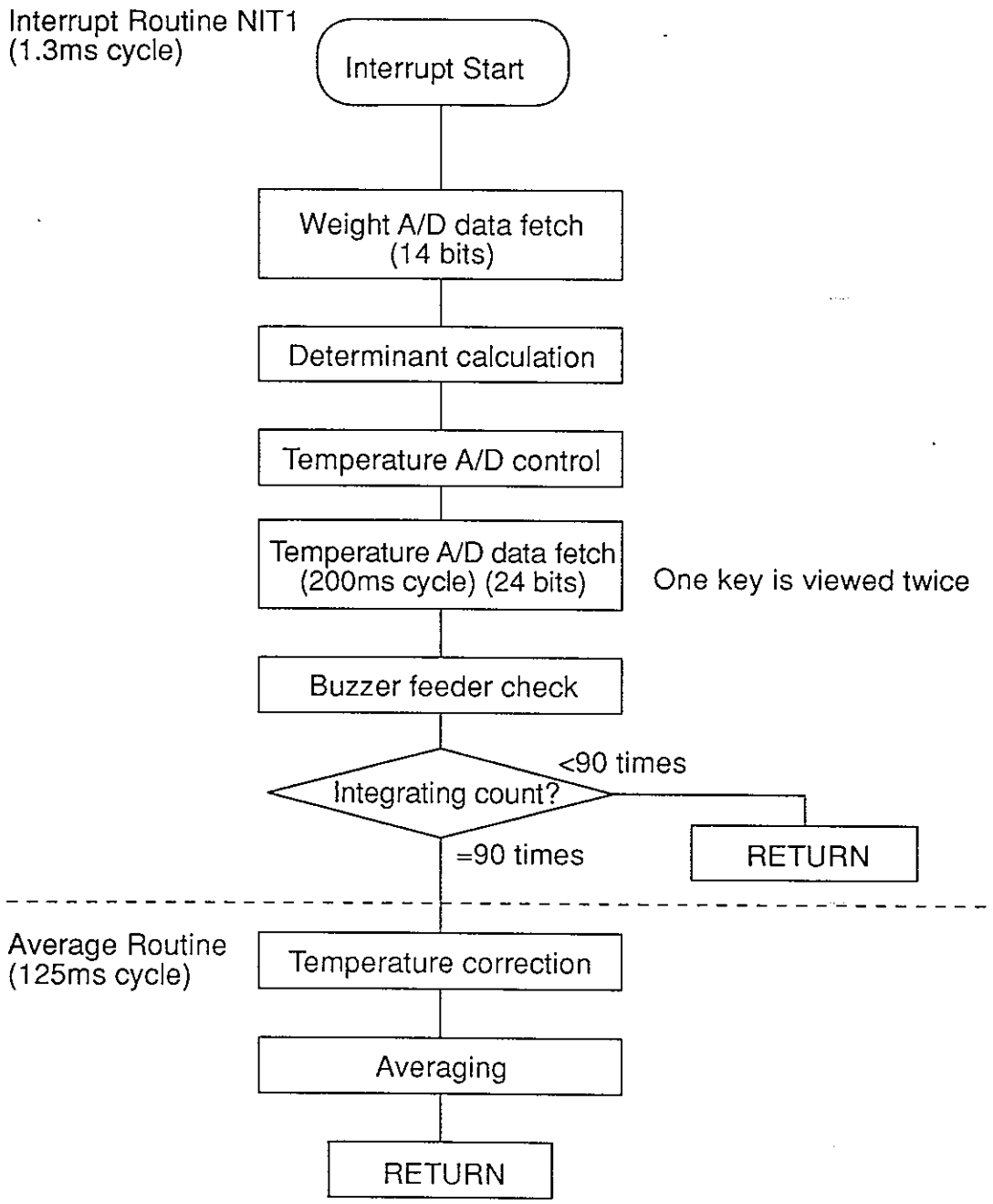
For fluorescent lamp: Vss = -27V, f_{12} = AC 4.2V

Display Board

U2: IC to receive remote control signals

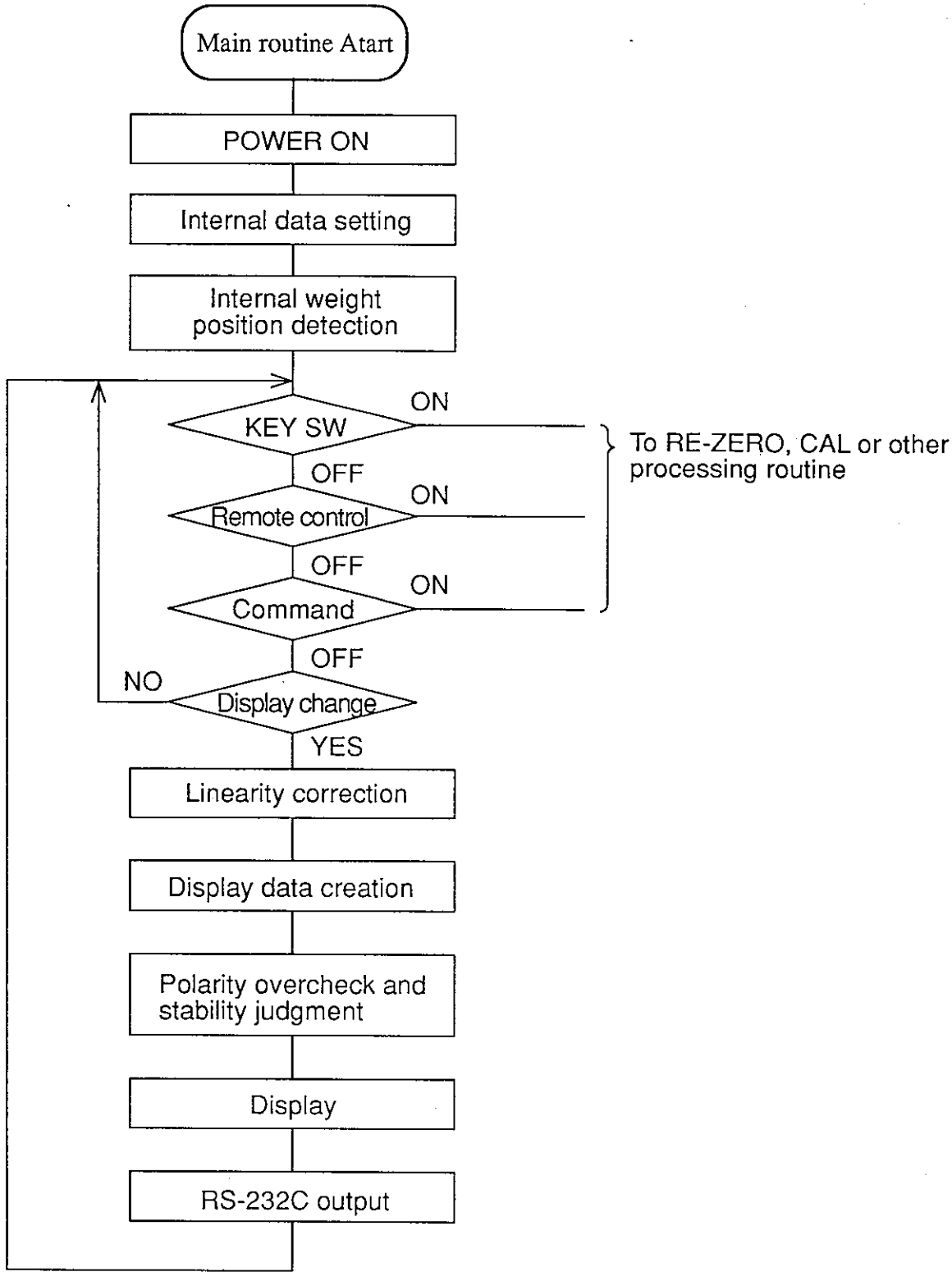
U1: Fluorescent lamp driver

1.4 FLOW CHART (1)



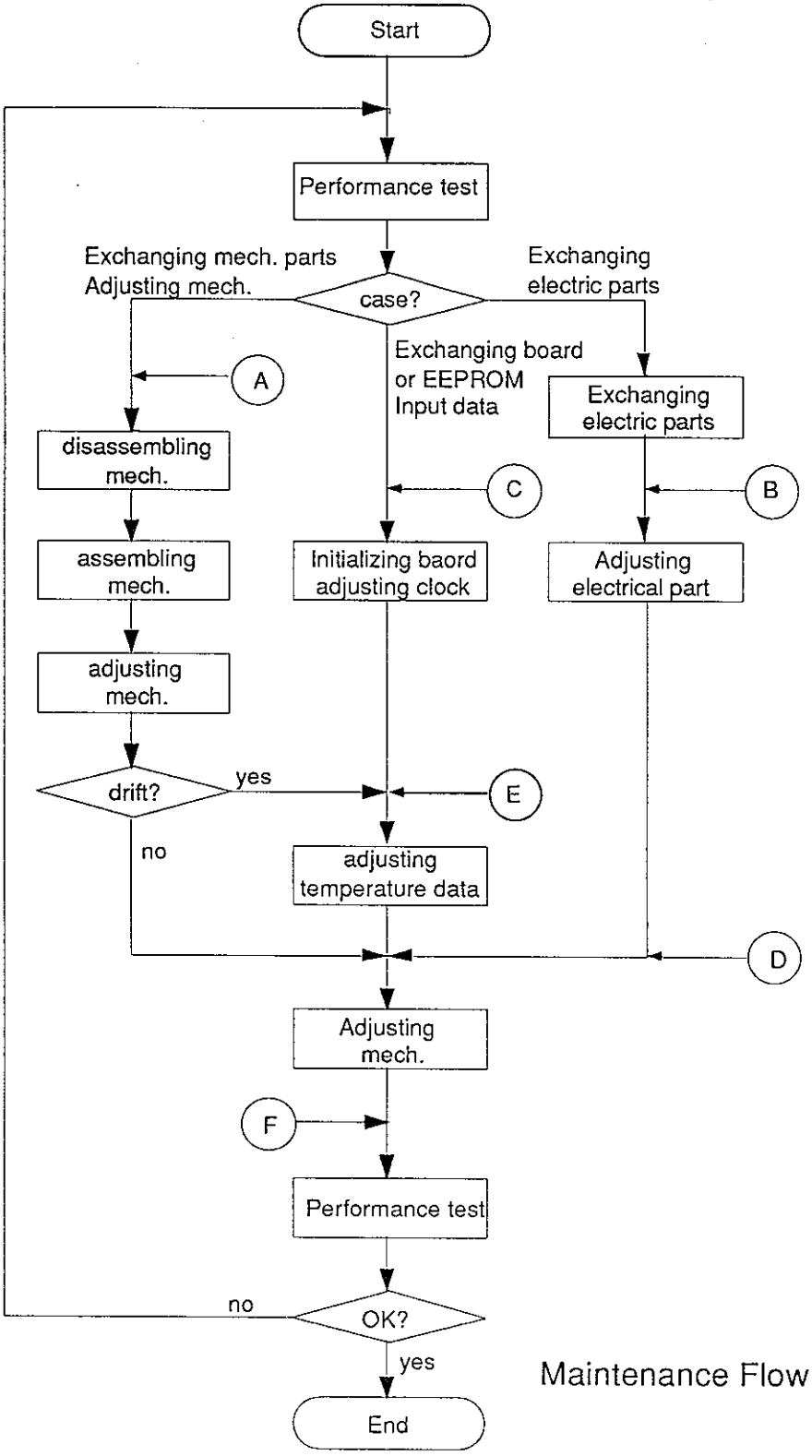
1.5 FLOW CHART (2)

Main Routine



2. MAINTENANCE

Carry out maintenance procedure as follows : troubleshooting analysis, troubleshooting and performance test. Troubleshooting analysis is explained in section 2.1~2.3. Troubleshooting is explained in section 3.1~4.5. ~~carry out~~ Carry out performance test using section 2.2~2.3 after troubleshooting.



Maintenance Flow chart

Please refer to Section 2 to explain maintenance flow chart .

2.1 MAINTENANCE FLOW CHART

Please refer to maintenance flowchart on page 8.

Explanation of node.

A : This type of maintenance includes disassembling mechanical unit, exchanging parts and assembling mechanical unit.

B : This type of maintenance concerns troubleshooting of electronic circuits and includes adjusting characteristics by inputing software data.

C : This type of maintenance includes initialization of the main board and adjustment of characteristics by inputing software data.

D : This type of maintenance includes inputing temperature data by software.

E : This type of maintenance carries out performance test.

Necessary Equipments List

Maintenance equipment needed:

Mass	50g, 50g, 100g, 100g, 200g±0.2mg(Mass was weighed absolute value before use).
Tools	Jig set for Mechanical unit , 3M driver, soldering iron, adhesive paper tape, spanner 7mm, spanner 5.5mm, digital voltage meter, oscilloscope.
Room	Temperature controlled room, stable to within (+) or (-) 1 degree C at: 10°C and 30°C. Allow eight hours at each temperature for the unit to stabilize. If you need to adjust temperature data, prepare this room.

2.2 PERFORMANCE TEST

Warm up the balance for at least eight hours prior to diagnoses.

Checklist and test procedures:

- General view
  - ❑ Door will open and close smoothly.
  - ❑ Confirm weighing pan does not slope.
  - ❑ Confirm gap between weighing pan and draft ring is 1 mm(0.039in.).
  - ❑ Confirm weighing pan is not bent or out of position.
  - ❑ Confirm weighing pan is 0.5mm~2mm (0.020~0.078in.) higher than draft ring.
  - ❑ Confirm balance is level using the bubble spirit level.
- Function
  - ❑ Confirm click sound by pushing the [SAMPLE] key in Display off state.
  - ❑ Confirm click sound by pushing the [PRINT] key in Display off state.
  - ❑ Confirm operation by pushing the [ON/OFF] key.
  - ❑ Confirm operation by pushing the [RE-ZERO] key.
  - ❑ Confirm operation by pushing the [MODE] key.
  - ❑ Confirm weighing units using the following table.

Distinction	Weighing units
Japan	g Pct cnt
Metric area	g Pct cnt
International	g Pct cnt oz ozt dwt ct mm GN
Hong Kong	g Pct cnt oz ozt dwt ct mm GN t TL
China	g Pct cnt oz ozt dwt ct mm GN t TL
Singapore	g Pct cnt oz ozt dwt ct mm GN t TL
Taiwan	g Pct cnt oz ozt dwt ct mm GN t TL
Iran	g Pct cnt ct t MS
India	g Pct cnt oz ozt dwt ct mm GN t

- ❑ Confirm operation by pushing the [CAL] key.
- ❑ Confirm plus and minus indicators are displayed.
- ❑ Confirm point indicator is displayed. (note " . " or " , ".)
- ❑ Confirm stability indicator is displayed.
- ❑ Confirm internal calibration mass to be 200g within ±0.2mg.

  Test using external 200g mass and by repeating two times.
- ❑ Confirm normal motor operation. (If you can hear scraping sound, this is NG.)

○ Performance

- ❑ Hysteresis error

  The difference between weighing readings for the same applied load, one reading obtained by increasing the load from minimum load and the other by decreasing the load from maximum load.

  Check point are 100g, 150, 200g for FR-200.

  Check point are 100g, 200, 300g for FR-300.

  Repeat test two times.

  Confirm hysteresis error to be within ±3 counts.
- ❑ Repeatability error

  The difference between weighing readings taken from consecutive tests under identical loading and environmental conditions.

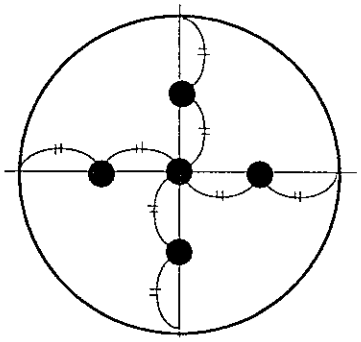
  Repeat test five times.

  Confirm repeatability error using the following table.

Check point	Specification for repeatability error
200g load	within 3 counts for FR-300
Minimum dead load	within 0±2 counts for FR-300
100g load	within 2 counts for FR-200
Minimum dead load	within 0±2 counts for FR-200

❑ Four corner error (eccentricity tests)

The difference between weighing readings for the same applied load, one reading obtained with mass applied to center position of weighing pan, others with mass applied to four corners as shown below.



Front

Repeat test two times.

Confirm four corner error using the following table.

Check point	Specification for four corner error
150g load	within ±2 counts for FR-300
100g load	within ±2 counts for FR-200

❑ Non-linearity

The deviation of an increasing load curve from a straight line.

Repeat test two times.

Confirm Non-linearity using the following table.

Check point	procedure
specification	readings of B and C must be within ±3 counts for FR-300
0g	push Re-zero key.
100g	applied mass A of 100g, read weighing value A.
200g	applied offset mass of 100g. push Re-zero key. applied mass A of 100g, read weighing value B.
300g	applied offset mass of 200g. push Re-zero key. applied mass A of 100g, read weighing value C.

Check point	procedure
specification	readings of B , C and D must be within ±2 counts for FR-200.
0g	push Re-zero key
50g	applied mass A of 50g, read weighing value A.
100g	applied offset mass of 50g. push Re-zero key. applied mass A of 50g, read weighing value B.
150g	applied offset mass of 100g. push Re-zero key. applied mass A of 50g, read weighing value C.
200g	applied offset mass of 150g. push Re-zero key. applied mass A of 50g, read weighing value D.

- Creep

  A change in weighing reading occurring with time while under constant load and with all environmental conditions and other variables remaining constants.

  The load is 100g for FR-200.

  The load is 200g for FR-300.

  Confirm that creep is within ±10 counts for ten minutes

Performance test Check List

General view

- ❑ Door will open and close smoothly. OK❑ NG❑
- ❑ Weighing pan does not slope. OK❑ NG❑
- ❑ Gap between weighing pan and draft ring is 1 mm (0.039in). OK❑ NG❑
- ❑ Weighing pan is not bent or out of position. OK❑ NG❑
- ❑ Weighing pan is 0.5mm~2mm (0.020~0.078in) higher than draft ring. OK❑ NG❑
- ❑ The blance is level using the bubble spirit level. OK❑ NG❑

Function

- ❑ Click sound by pushing the [SAMPLE] key in Display off state. OK❑ NG❑
- ❑ Click sound by pushing the [PRINT] key in Display off state. OK❑ NG❑
- ❑ Operation by pushing the [ON/OFF] key. OK❑ NG❑
- ❑ Operation by pushing the [RE-ZERO] key. OK❑ NG❑
- ❑ Operation by pushing the [MODE] key. OK❑ NG❑
- ❑ Weighing units as described by the table on page 10. OK❑ NG❑
- ❑ Operation by pushing the [CAL] key. OK❑ NG❑
- ❑ Plus and minus indicatiors are displayed. OK❑ NG❑
- ❑ Point indicatior is displayed. (note " . " or " , ".) OK❑ NG❑
- ❑ Stabiltiy indicator is displayed. OK❑ NG❑
- ❑ Internal caliblation mass to be 200g within ±0.2mg. OK❑ NG❑
- ❑ Confirm that motor operates correctly. OK❑ NG❑

Performance

❑ Hysteresis error Specifications : must be within ±3 counts. OK❑ NG❑

FR-300 once

0g		
100g		
200g		
300g		

twice

0g		
100g		
200g		
300g		

FR-200 once

0g		
100g		
150g		
200g		

twice

0g		
100g		
150g		
200g		

❑ Repeatability error Specifications are as follows. OK❑ NG❑

times	Zero	Full
1		
2		
3		
4		
5		

FR-300	200g load	within 3 counts
	Minimum dead load within 0±2 counts	
FR-200	100g load	within 2 counts
	Minimum dead load within 0±2 counts	

❑ Four corner error (eccentricity tests) Specifications: must be within ±2 counts OK❑ NG❑

FR-300 load 150g. once ( ) ( ) ( ) twice ( ) ( ) ( )

FR-200 load 100g. once ( ) twice ( )

❑ Non-linearity Specifications: must be within ±2 counts for FR-300, within ±2 counts for FR-200. OK❑ NG❑

FR-300 once

0g	
100g	
200g	
300g	

twice

0g	
100g	
200g	
300g	

FR-200 once

0g	
50g	
100g	
150g	
200g	

twice

0g	
50g	
100g	
150g	
200g	

❑ Creep Specifications: must be within ±10 counts for ten minutes. OK❑ NG❑

FR-300 load 200g.

FR-200 load 100g.

	start	end
onec		
twice		

2.3 TROUBLESHOOTING

The best method for diagnosing the FR MARK-II is to exchange subassemblies with a known good instrument. Also try readjustment.

The next table shows principal defective symptoms, possible cause and action to be taken. See flowchart on page 8.

Defective symptoms	Cause	Action to be taken
Error 1 , Error 2 , CAL no or unstable	Electric unit is N.G. . Dust particle in the force motor	Test using new main board. If performance is OK, go to B. If performance is N.G., clean mech., go to A.
Error 3	Missing operation of remote control.	Operate remote control again. If operation is N.G., exchange main board. go to F
Error 4	Electric unit is N.G. . Discrepancy of inner mass. Foreign object in the force motor. Mech. unit is damaged.	Test using new main board. If performance is OK, go to B. If performance is N.G., clean mech., test mech. , go to A.
Error 5	Wiring of motor unit is N.G. .	Investigate motor unit. go to B.
Error 6 Error r	RAM is N.G. .	Exchange RAM.go to B.
Error 7	EEPROM is N.G. .	Exchange EEPROM.go to C.
Error t	Sensor for temperature is N.G. .	Exchange defective parts.go to C or E.
CAL -E or CAL E	Linearity data is missing or incorrect.	Input data for linearity.go to D.
-E or E	Upper or lower flexible bearing assembly, Fulcrum bearing or Tension bearing is damaged.	Exchange the bearing.go to A.
Hysteresis error	Sensor out of adjustment	Adjust hysteresis error.go to A.
No displayi	Fuse, AC adaptor or fluorescent display tube is N.G. .	Exchange defective parts.go to F.
flushing g sign	Matter interrupting auto-self-calibration, is weight on the weighing pan, operation, etc.	Refer to Instruction manual. Investigate around weighing pan and inner mass.go to F.

Defective symptoms	Cause	Coping with the trouble-shooting
Repeatability error	Analog circuit. Foreign object in the force motor assembly. Flexible bearing is damaged.	Test using new main board. If performance is OK, go to B. If performance is N.G., clean mech., test mech. , go to A.
Four corner error (Eccentricity error)	Adjustment error. Flexible bearing assembly. is damaged.	Carry out four corner error adjustment. If it is OK, go to D. If it is N.G., exchange flexible bearing assembly . go to A.
Non-linear	Linearity data missing or incorrect. Flexible bearing is damaged.	Input linearity data. If it is OK, go to D. If it is N.G., exchange flexible bearing. go to A.
Creep	Creep data missing or incorrect.	Input creep data. If it is OK, go to D. If it is N.G., go to E.
Weight error of inner mass	Internal mass data missing or incorrect.	Input data. of inner mass. Repeat performance test. Go to F.

3. DISASSEMBLY AND ASSEMBLY

If the mechanical section of FR become faulty, the mechanical section must be disassembled, repaired, then reassembled. This section explains how to remove the bobbin, clean the magnet , and reassemble.

: When the mechanical unit is disassembled, note that temperature, linearity, and shift error characteristics may deteriorate. This might be caused by stress, screw torque or component failure. To correct the problem, the temperature characteristic may require readjustment. If you do not have a temperature controlled room to adjust temperature manually, do not disassemble the mechanical unit.

3.1 PREPARATION

- Always work on area clean.
- Be careful not to damage the bobbin or wire.
- Prepare the following jigs.

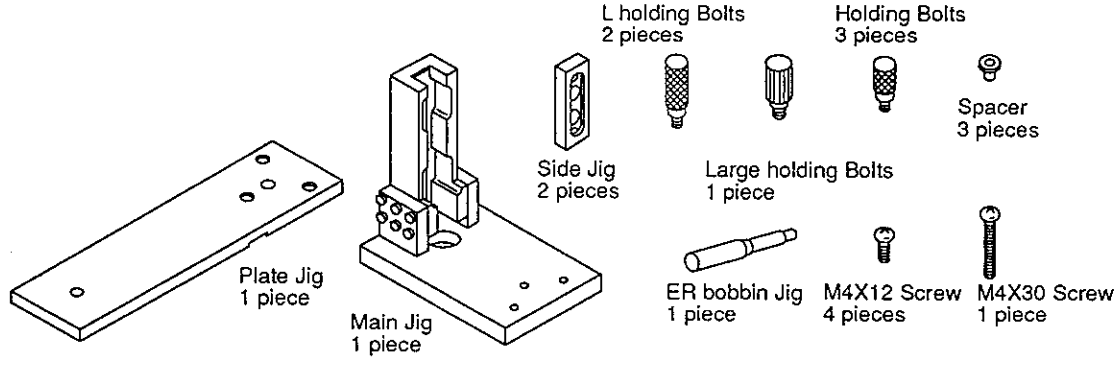
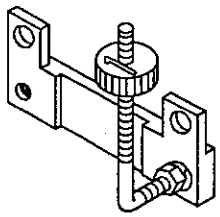


Figure Jig set

3.2 DISASSEMBLY

1. Remove the mechanical unit from the balance. Carefully place the mechanical unit on the plate jig, using care to align the underhook with the hole in the plate. Figure A
2. Remove the center-gravity weight assembly.
3. Remove the four screws and detach the shock absorber from the suspension B.
4. Remove the adjustment weight from the suspension B.
5. Insert the suspension B into the main jig. Figure B.



Center-gravity weight

6. Fasten the beam with two M4 x 12 screws and one M4 x 30 screw.

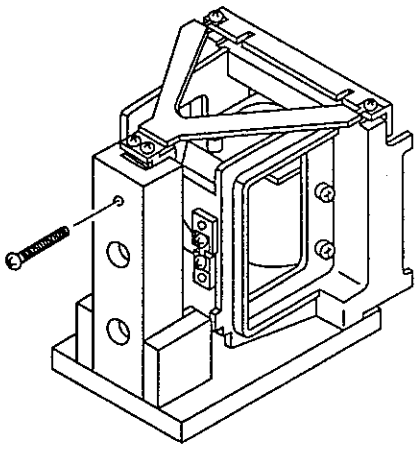


Figure B

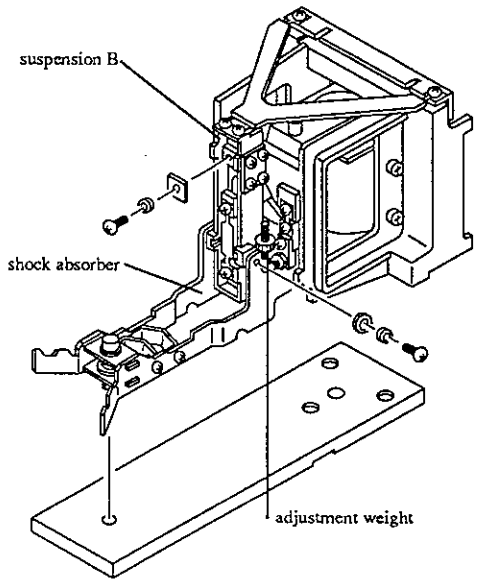


Figure A

7. Gently secure the mechanical unit on the main jig. Figure C
8. Fasten the M4 x 12 screws into the mechanical unit through the main jig. Be careful not to bend the fulcrum flexible bearing.
9. Cover the fulcrum flexible bearing with the side jig and secure using the M4 x 12 screws. Figure D
10. Remove the upper flexure assembly.
11. Remove the lower flexure assembly. Figure E

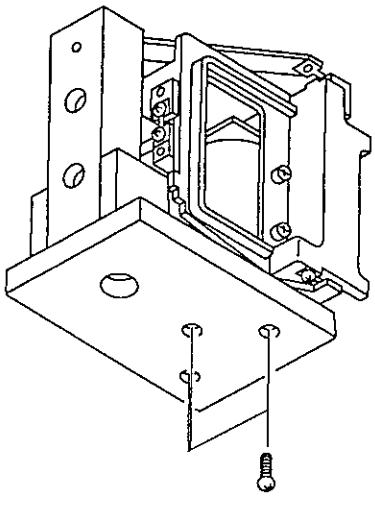


Figure C

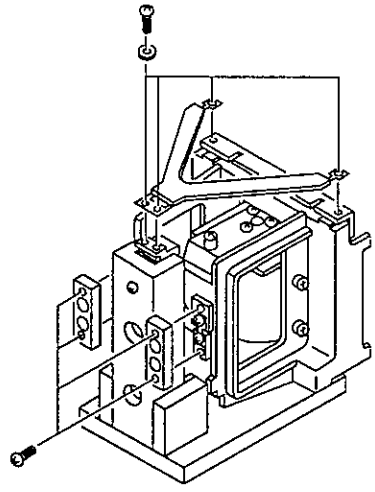


Figure D

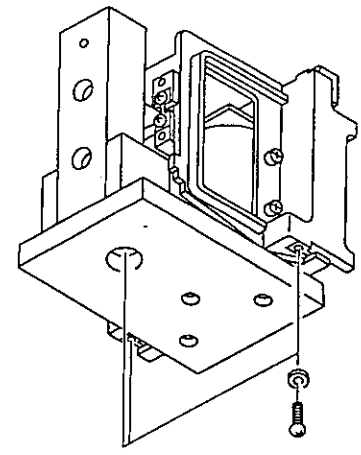


Figure E

12 Remove the tension flexible bearing from the suspension B. Figure F

13 Remove the M5 x 12 screws.

14 Lift up the force motor, and remove the force motor from the main jig.

15 Replace the upper screws of the fulcrum flexible bearing with holding bolts. Figure G

16 Replace the lower screws of the fulcrum flexible bearing with L holding bolts.

17 Insert the centering post and remove the screw of the bobbin. Figure H

18 Remove the fulcrum flexible bearing. Figure I

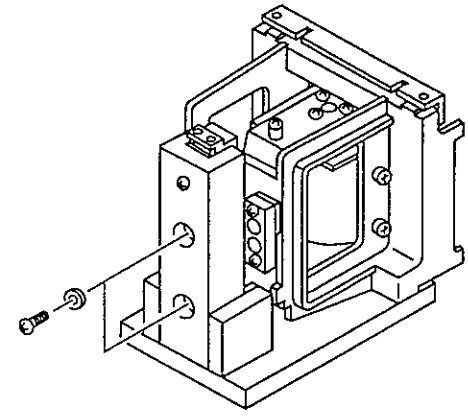


Figure F

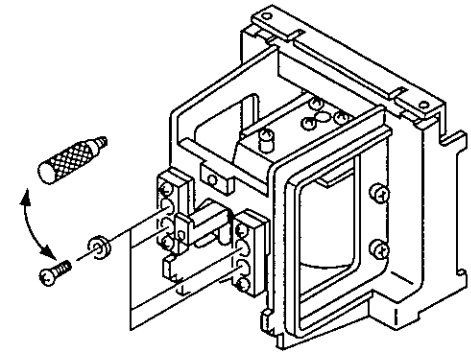


Figure G

19 Remove the position beam and magnet shield. Figure J

20 Disconnect the force coil bobbin wire by using a soldering iron.

21 Remove the bobbin from mechanical frame. This completes the disassembly procedure.

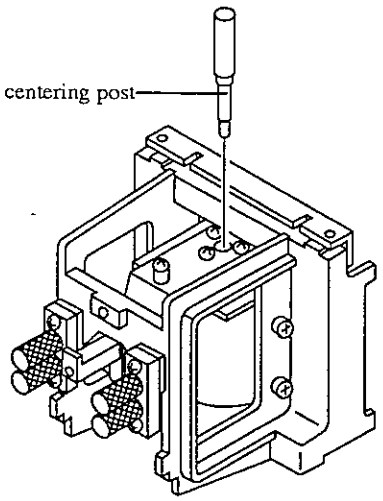


Figure H

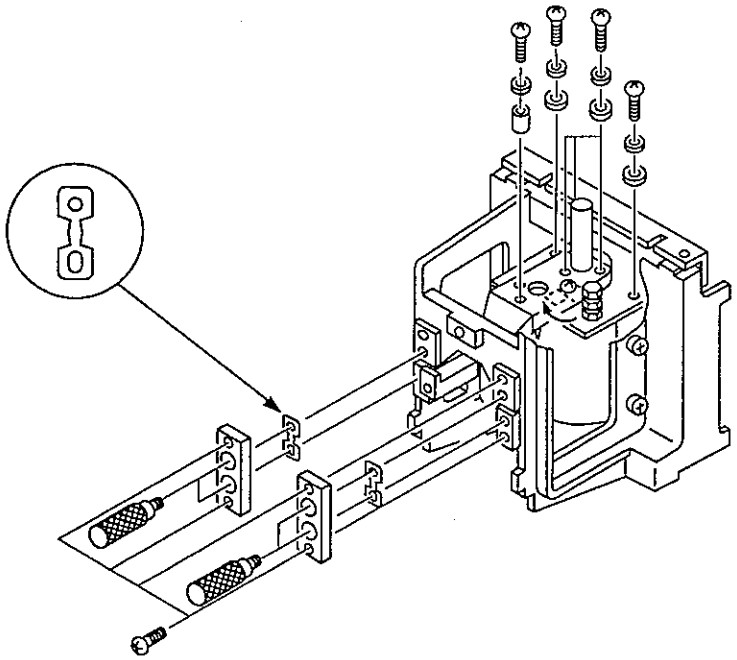


Figure I

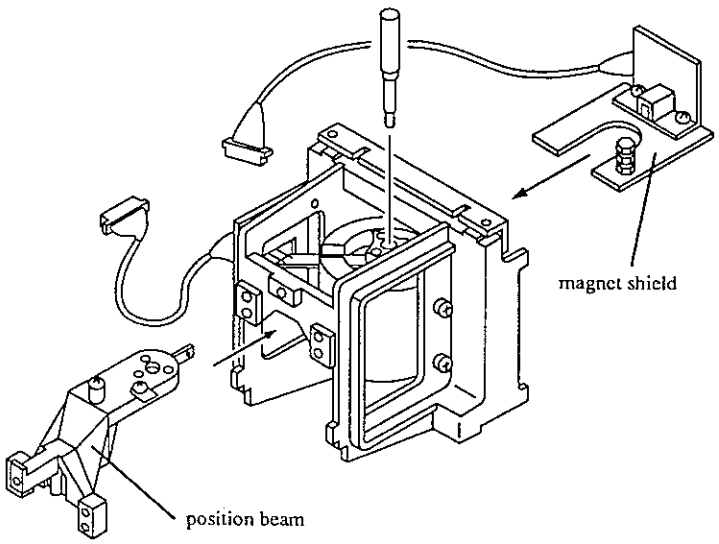


Figure J

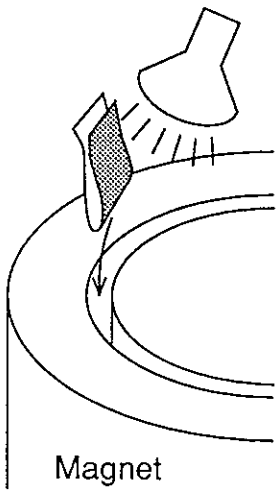
3.3 CLEANING THE BOBBIN

The magnet and bobbin of the mechanical unit must be kept clean. If the components become dirty, be sure to clean as follows :

For cleaning, prepare 5cm of adhesive paper tape, cleaning alcohol and cotton swabs. To prevent metal particles from scattering over the magnet, do not use compressed air.

Do not smoke while working.

1. After completing disassembly, carefully lift the bobbin out. Be careful not to damage it.
2. Under strong light, collect dust from the magnet channel by using the adhesive tape. Use new tape when cleaning inside, outside, or other parts of the magnet channel.
3. Clean the wire wound around the bobbin by using a cotton swab moistened with alcohol.
4. Clean inside the bobbin with a cotton swab.
5. Under strong light, check that there is no dust left.
6. Carefully reinstall the bobbin.
7. Solder the bobbin wire.
8. Reassemble the mechanical unit again.



3.4 ASSEMBLY

1. Carefully install the position beam. Figure A
2. Secure the magnet shield with screws.
3. Insert the centering post into the bobbin.
4. Temporarily secure the bobbin with screws. Figure B
5. Temporarily secure the fulcrum flexible bearing with the holding bolts and large holding bolt so that the fulcrum flexible bearing is flat.

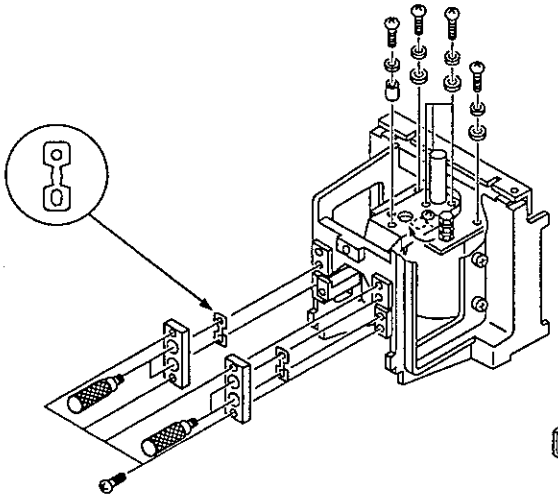


Figure B

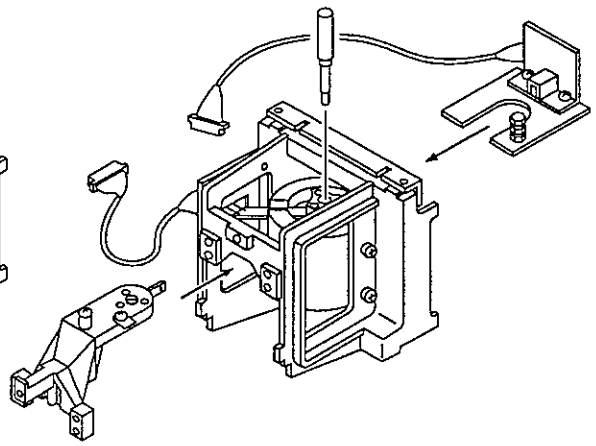


Figure A

6. Check that the fulcrum flexible bearing is flat and the bobbin does not touch the magnet. Secure the bobbin with screws. Secure the fulcrum flexible bearing through side jig with the holding bolt and L holding bolt .
7. Check that the tension bearing is flat. If it is not, replace the bearing.
8. Place the lower flexure assembly on the main jig. Figure C
9. Insert a large holding bolt into the upper hole of the tension bearing and a holding bolt into the lower hole through the main jig.
10. Secure the suspension B and tension bearing with a large holding bolt.
11. Fasten the mechanical unit with three M5 x 12 screws at the bottom of the main jig. Figure D

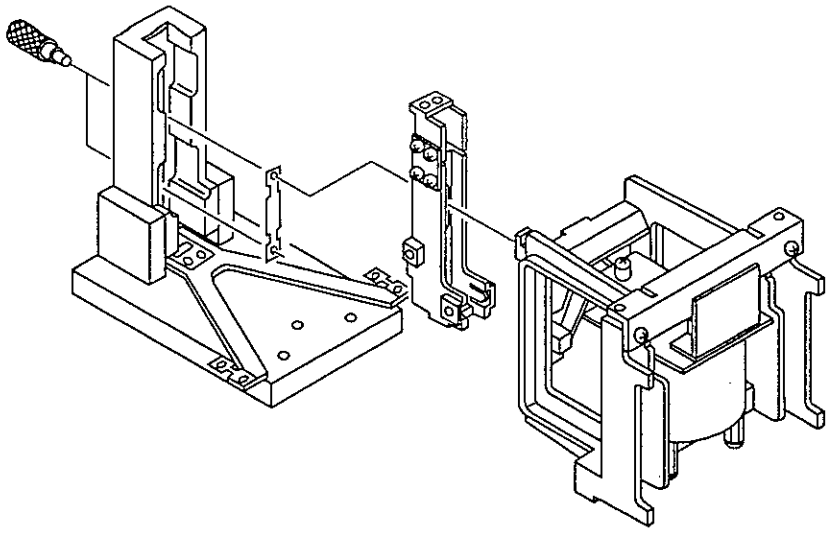


Figure C

12 Secure the lower flexure assembly with screws.

13 Secure the tension bearing Figure E

14 Secure the upper flexure assembly with screws. Figure F

15 Remove the side jig.

16 Transfer the mechanical unit from the main jig to the plate jig and secure it there. Figure G

17 Mount the adjustment weight.

18 Place the shock absorber assembly on the plate jig. Use care to align the underhook with the hole in the plate. Figure G

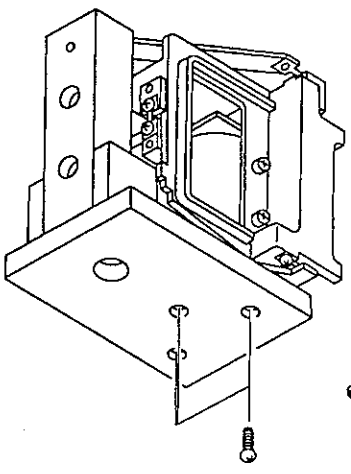


Figure D

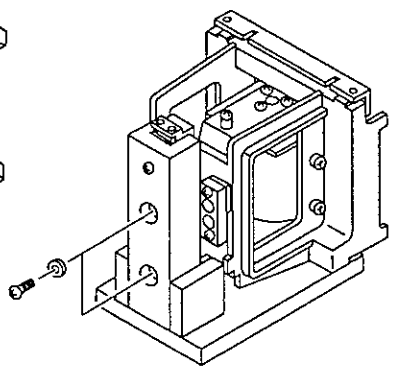


Figure E

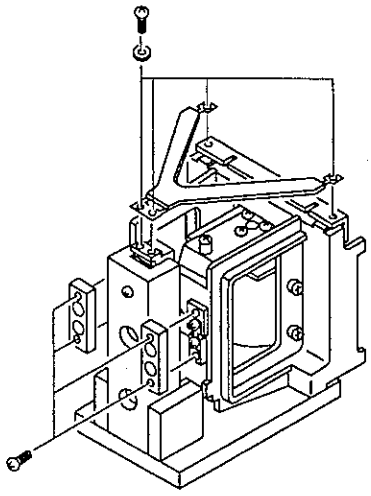


Figure F

19 Secure the shock absorber with screws.

20 Replace the stopper plate.

21 Mount the center-gravity weight. Figure H

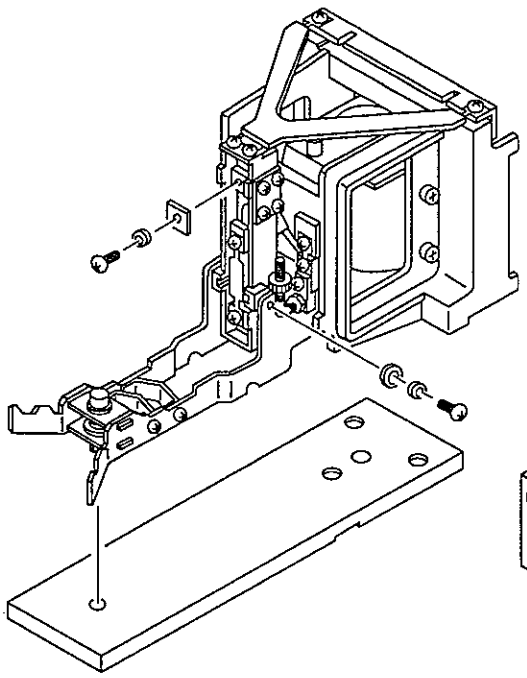


Figure G

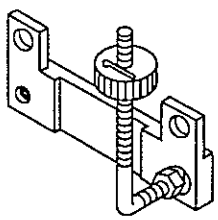


Figure H

4. ADJUSTMENT

Adjustment of the FR MARK II requires the use of the check mode. The check mode uses the performance test also.

Adjustment and test are shown as follows :

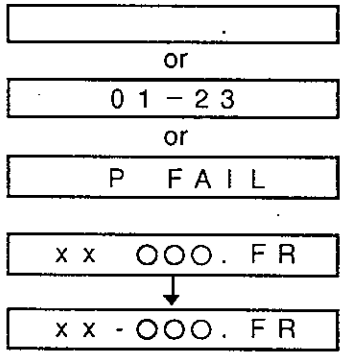
Item of adjustment and test	Adjustment	Test
Adjustment of mechanical part		
4.2.1. Stopper	do	do
4.2.2. Center of gravity	do	do
4.2.3. Balance	do	do
4.2.4. Creep	do	n/a
4.2.5. Four corner error (eccentricity error)	do	do
4.2.6. Hysteresis error	do	do
4.2.7. Repeatability error	n/a	do
4.2.8. Non-linearity	do	do
4.2.9. Internal weight error input	do	do
Temperature adjustment		
4.3 Temperature adjustment	do	do
Adjustment of electrial part		
4.4.1 Voltage check	n/a	do
4.4.2 Temperature sensor	n/a	do
4.4.3 Clock adjustment	do	do
Initializing main board		
4.5 Initializing main board	do	do

4.1 ACTIVATING THE CHECK MODE

1) Turn the display off.

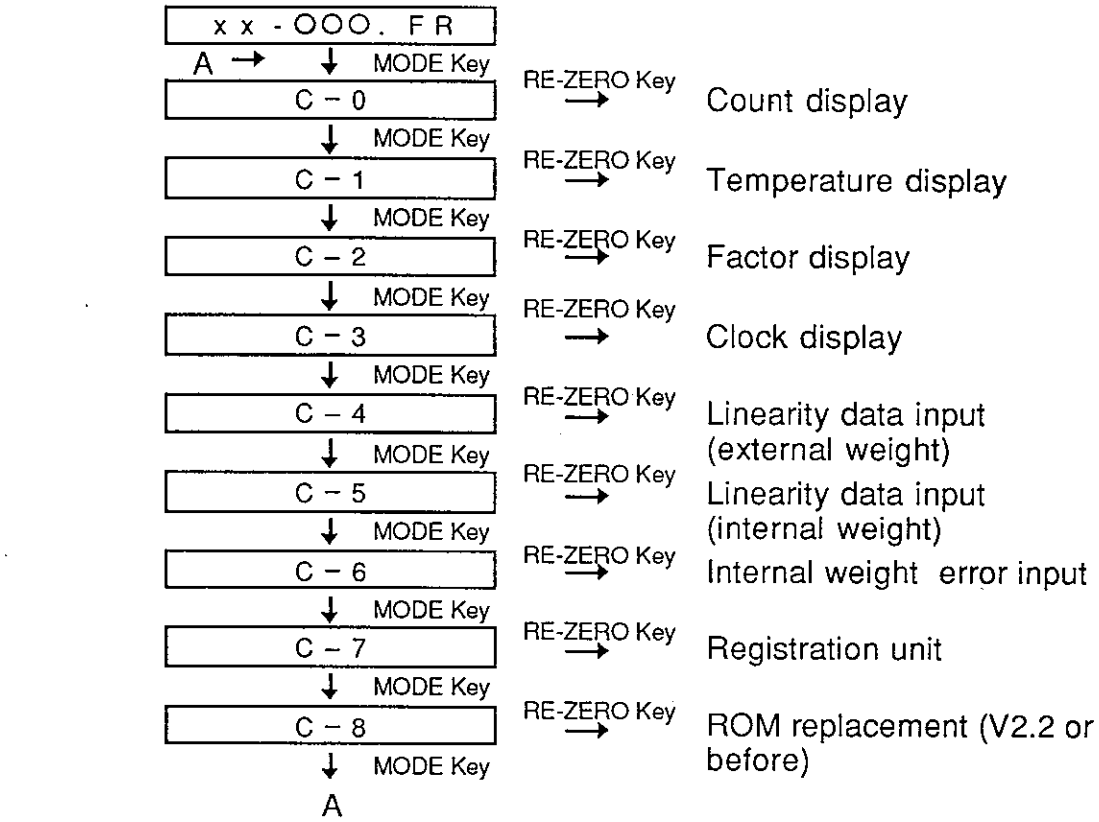
2) Press [ON/OFF] key while pressing [RE-ZERO] key and [CAL] key down.

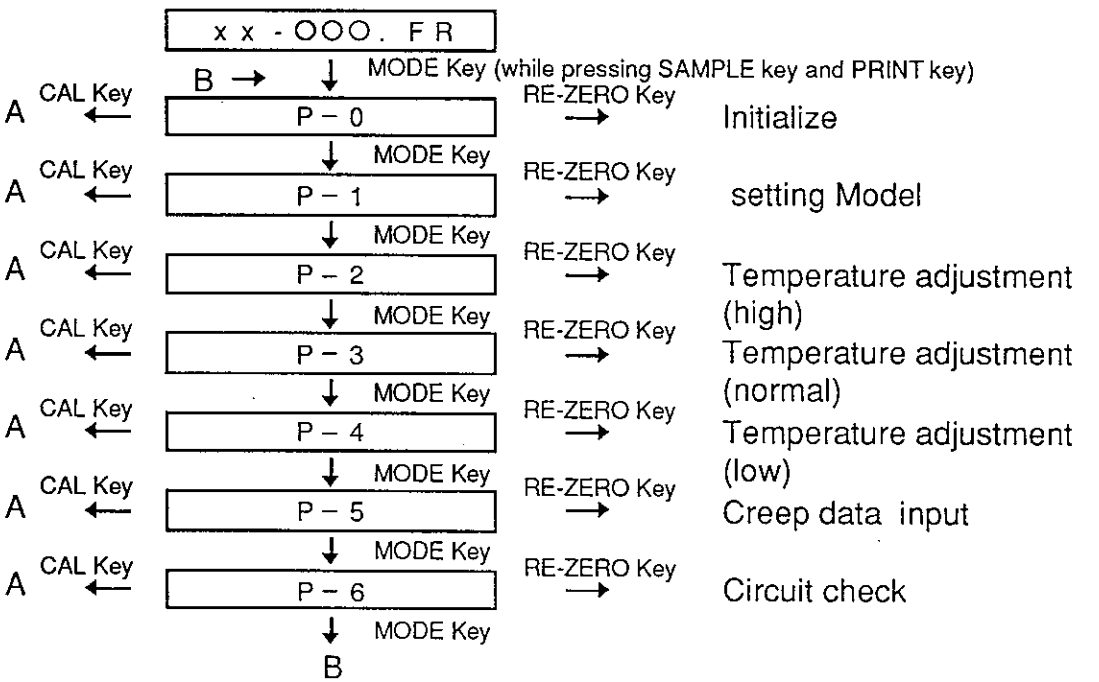
   Then press [CAL] key twice within one second without releasing [RE-ZERO] key.



"xx" denotes the ROM version and "000" denotes the model.

4.1.1 CHECK MODE CONFIGURATION





4.2 MECHANICAL ADJUSTMENT

4.2.1 Stopper adjustment

1) Change the display to C-0.

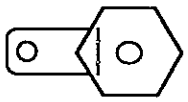
C – 0

2) Press the [RE-ZERO] key to display the message shown at the right.

＊＊＊＊＊D 0

3) Do not load any thing on weighing pan.

4) Set the stopper plate and bolt as follows :



Stopper plate does not touch the shaft of stopper bolt.

5) Secure the screw of stopper plate.

6) Rotate the stopper bolt counterclockwise until the balance display indicates"16321". (stopper bolt is raising)

7) Rotate the stopper bolt clockwise until the display indicates between "300 ~ 600".

8) Place enough mass on the weighing pan to cause the display to indicate "16321". Remove the mass and load it again. Note the time required for the display to indicate "16321".

9) Remove the mass again and note the time required for the display to return to "300 ~ 600".

10) Adjust the stopper bolt until both times are equal.

11) Secure the Nut of stopper bolt.

12) Repeat steps 7) through 11). If the times are equal, the adjustment is completed.

4.2.2 Center of gravity adjustment

1) Change the display to C-0.

C – 0

2) Press the [RE-ZERO] key.

＊＊＊＊＊D 0

3) Press the [SAMPLE] key to display the message shown at the right.

＊＊＊＊＊D 5

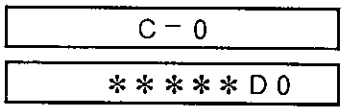
4) Adjust the center of gravity so that the display does not deviate more than -10 digit, when the rear of the balance is lifted 3mm.

4.2.3 Balance adjustment

1) Change the display to C-0

2) Press the [RE-ZERO] key.

3) Adjust the zero point until 450 to 550 is displayed.



4.2.4 Creep

(1)Creep data input

With nothing on the weighing pan, warm up the balance for at least one hour. When creep data must be re-entered, wait at least one hour with nothing on the weighing pan.

Model	Weight
FR-200	200g
FR-300	300g

Entering creep data

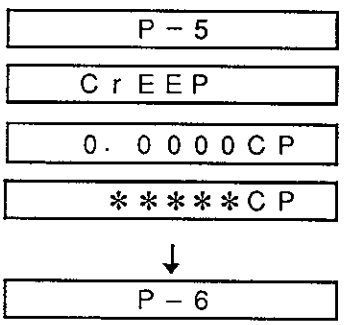
1) Change the display to P-5.

2) Press the [RE-ZERO] key.

3) Press the [CAL] key.

4) Place the prepared weigh on the weighing pan.

5) After the display stabilizes, press the [RE-ZERO] key to move the decimal point, allow about eight minuets for creep.



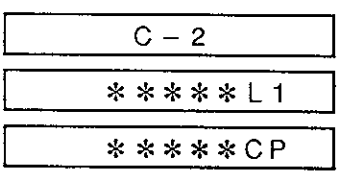
(2)Checking Creep data

1) Change the display to C-2.

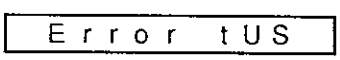
2) Press the [RE-ZERO] key.

3) Press the [SAMPLE] key to display the message at the right.

4) Check that CP reads ±20 digit. or less.



If the external temperature sensors are not stable, the message at the right is displayed. Check the external temperature sensors and temperature A/D circuits.



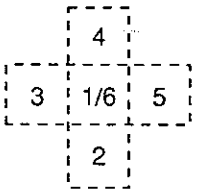
4.2.5 Four corner error (eccenricity error)

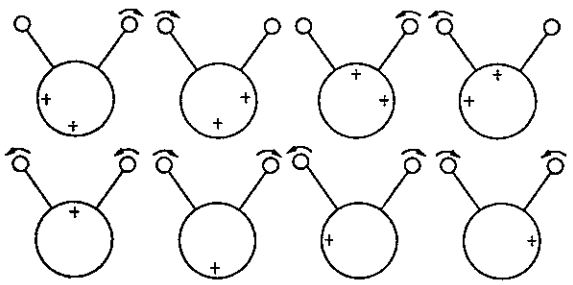
1) Change the display to C-0.
2) Press the [RE-ZERO] key.
3) Press the [SMAPLE] key to display the message shown at the right.
4) By using the following weights, perform shift adjustment so that the error at each place is (+) or (-) 2 digits or less.

C – 0
＊＊＊＊＊D 0
＊＊＊＊＊D 5

Model	Weight	Specification
FR-200	150g	±2digit
FR-200	200g	±2digit

Weight loading order





Top view (Combination of adjustments)

4.2.6 Hysteresis error

1) Do not change the display from D5. Place weight 1 on the weighing pan.
2) Press the [RE-ZERO] key.
3) Place weight 2 on the weighing pan with weight 1.
4) Remove weight 2.
5) Check hysteresis error is within the following specifications :

0. 0 0 0 0 D 5
＊＊＊＊＊D 5
＊＊D 5

Model	Weight 1	Weight 2	Specification
FR-200	150g	50g	±3 digit.
FR-300	200g	100g	±3 digit.

4.2.7 Repeatability error

1) Change the display to C-0.

C – 0

2) Press the [RE-ZERO] key.

* * * * * D 0

3) Press the [SAMPLE] key several times to display the message shown at the right.

* * * * * D 5

4) Remove the weight . Write down the reading.

5) Replace the weight. Write down the reading.

6) Repeat five times step 4) and 5).

7 Check the diffrence between each weighing. The weight displayed must be within the following specifications.

Model	Weight	Specification
FR-200	100g	±2 digit
FR-300	200g	±3 digit.

4.2.8 Non-linearity (using external weights)

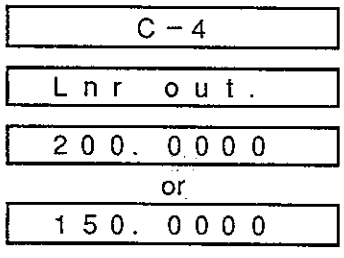
(1) Linearity data input

Enter linearity data by using the following weights:

Model	Weight 1	Weight 2
FR-200	50g	150g
FR-300	100g	200g

Precision of weight 1: ±30mg
Precision of weight 2: ±3mg

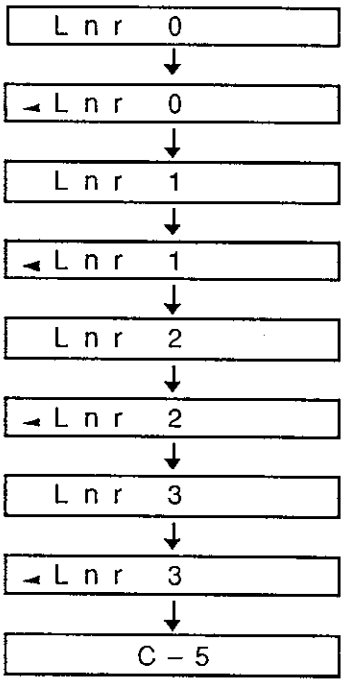
1) Change the display to C-4.
2) Press the [RE-ZERO] key.
3) Press the [CAL] key.



(FR300)

(FR200)

4) Press the [RE-ZERO] key.
5) Check that the scale has nothing on the weighing pan, then press the [RE-ZERO] key.
6) Place weight 1 on the weighing pan and press the [RE-ZERO] key.
7) Remove weight 1 and place weight 2 on the weighing pan, then press the [RE-ZERO] key.
8) Place both weight 1 and weight 2 on the weighing pan, then press the [RE-ZERO] key.
9) Remove both weights from the weighing pan.



(2) Linearity check

Prepare the following external weights :

Model	Weight 1	circle weight 1	circle weight 2	circle weight 3
FR-200	50g	50g	100g	150g
FR-300	100g	100g	200g	- - - -

1) Change the display to C-0.

C – 0

2) Press the [RE-ZERO] key.

＊＊＊＊＊D 0

3) Press the [SAMPLE] key to display the message at the right.

＊＊＊＊＊D 5

4) Check that the internal weights are up (unloaded).

   Press the [RE-ZERO] key to clear the display to zero.

5) Place weight 1 on the weighing pan and write down the reading (DL0 in this example).

6) Remove weight 1, place circle weight 1 on the weighing pan. Press the [RE-ZERO] key to reset the reading to 0.

7) Also place weight 1 on the weighing pan and write down the reading (DL1 in this example).

8) Remove both weights, place circle weight 2 on the weighing pan, then press the [RE-ZERO] key to reset the reading to 0.

9) Also place weight 1 on the weighing pan and write down the reading (DL2 in this example).

10) Remove both weights, place circle weight 3 on the weighing pan, then press the [RE-ZERO] key to reset the reading to 0. (FR-200 only)

11) Also place weight 1 on the weighing pan and write down the reading (DL3 in this example) do not exceed. (FR-200 only)

12) Check the difference of DL0 ~ DL3 to be within following specifications :

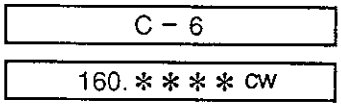
Model	Specification
FR-200	±2 digit.
FR-300	±3 digit.

4.2.9 Internal weight error input

(1) Internal weight error input

Prepare a weight of 200g to be weighed percisely before use.

1) Change the display to C-6.

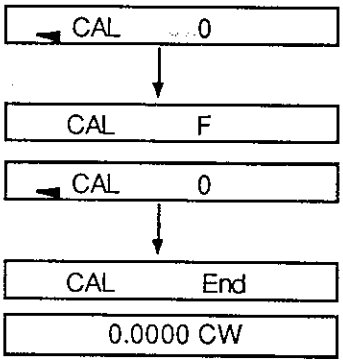


2) Press the [RE-ZERO] key. The balance indicates present internal weight value.

3) Press the [CLA] key. The balance indicates calibration weight .

4) To set the calibration weight error, use the following keys:

[SAMPLE] key	Increasing 50g.
[MODE] key	Increasing 10 digits.
[PRINT] key	Increasing 1 digit.



5) Press the [CLA] key.

6) Place the calibration weight on the weighing pan.

7) Remove calibration weight

8) Press the [PRINT] key. The balance will store the internal weight error automatically.

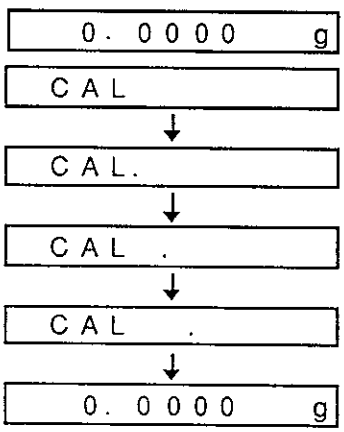
(2) Internal weight error check

1) Change the display to normal weight display (g).

2) Press the [CAL] key for calibration using the internal weight.

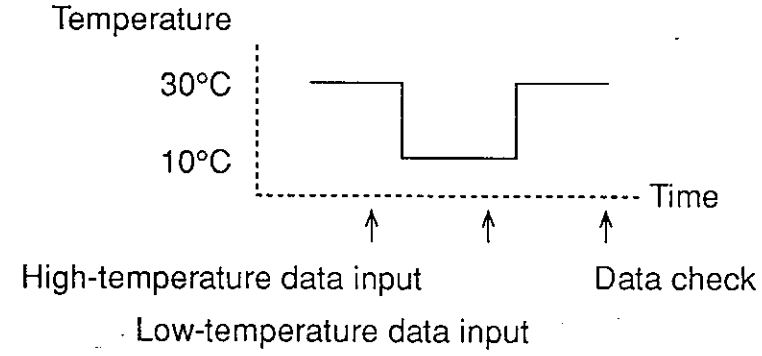
3) Place the 200g weight used in step 1 (INTERNAL WEIGHT ERROR INPUT) on the weighing pan.

4) Compare the reading with the weight value to verify that the error is ±2 digit.



4.3 TEMPERATURE ADJUSTMENT

(1) Adjust temperature according to the following temperature cycle:



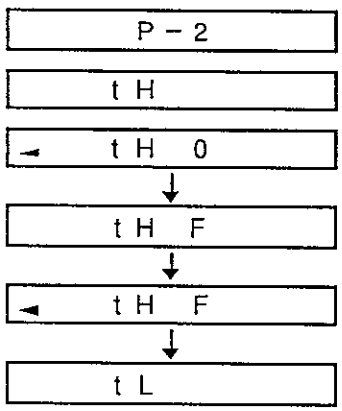
After changing the temperature setting, wait at least eight hours before entering high/low-temperature data or checking the data.

(2) High/low-temperature data input

1) Change the display to P-2.

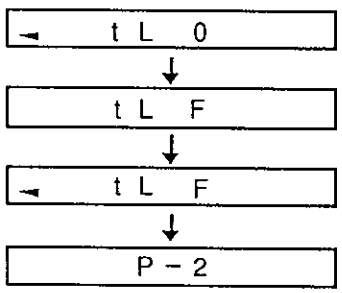
2) Press the RE-ZERO key.

3) Press the CAL key (to input high-temperature data).



4) Set the temperature to 10°C, then wait at least eight hours.

5) Press the CAL key (to input low-temperature data).



(3) Data check

After entering low-temperature data, sample and compare zero-span data at the low and high temperatures to verify that specifications are met.

1) Change the display to C-0.

C – 0

2) Press the [RE-ZERO] key.

＊＊＊＊＊D0

3) Press the [SAMPLE] key to display the message shown at the right.

＊＊＊＊＊D5

4) Press the [CAL] key to display the minimum value (internal weights up).

5) Press the [RE-ZERO] key.

0. 0000D5

6) Press the [CAL] key.

＊＊＊＊＊D5

Write down the D5 reading ("Stl" in this example).

7) Press the [CAL] key twice (internal weights up).

0. 0000D5

8) Set the temperature to 30°C, then wait at least eight hours.

9) Write down the D5 reading ("Zth" in this example).

＊＊＊＊＊D5

10) Press the [CAL] key. Write down the D5 reading ("Sth" in this example)

＊＊＊＊＊D5

11) The readings must be within the following specifications:

Zth	±50 digit. or less
Sth - Zth - Stl	±30 digit. or less

If the specifications are not met re-enter temperature data.

(4) Should the external sensors detect abnormal temperature, the message at the right is displayed after low/high-temperature data input. Check the external temperature sensors and temperature A/D circuits.

Error tSP

4.4 ELECTRONIC ADJUSTMENTS

4.4.1 VOLTAGE CHECK

(1)Checking lithium battery voltage (*Do not turn the power on.)

VRAM - LG: 2.5V or more

Both ends of R60: 1mV or less

(2)Checking supply voltage

Prepare an FR set (excluding the main board) whose operation has already been checked. Mount ROM (U18) on the main board to be checked, then connect the board to the FR. Turn the power on from the AC adapter.

VCC - GND +5V ±5%

VEE - GND -12V ±5%

VSS - GND -25V ±5%

4.4.2 TEMPERATURE SENSOR

1) Set the display to C-1.

C – 1

2) Press the [RE-ZERO] key.

＊＊＊＊＊T F

3) Press the [SAMPLE] key to display the message shown at the right.

＊＊＊＊＊T A

Verify that the reading of TA is between 460000 and 520000.

4) Press the [SAMPLE] key to display the message shown at the right.

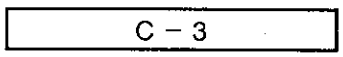
＊＊＊＊＊T 1

Verify that the readings of T1 is between 490000 and 550000.

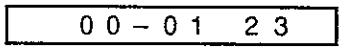
4.4.3 CLOCK ADJUSTMENT

If the values of AJ.1 ~ AJ.4 are pasted on analog module, enter these values into the balance. If the main board or the crystal oscillator have been exchanged, see APPENDIX A for a program example to acquire the values for AJ.1-AJ.4. Enter the results of (1) (AJ.1 to AJ.4) at C-3.

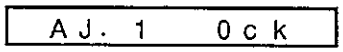
1) Change the display to C-3.



2) Press the [RE-ZERO] key.



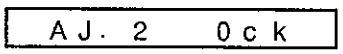
3) Press the [CAL] key.



4) Enter the calculation result (AJ.1) by using the keys.

   [RE-ZERO] to increment the setting by one.

   [PRINT] to increment the setting by ten.



5) Press the [SAMPLE] key to store the settings.

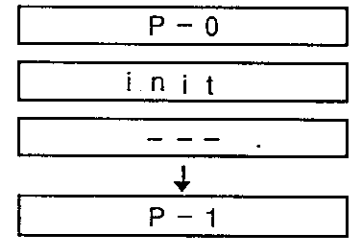
6) Repeat steps 4) and 5) to input AJ.1 to AJ.4 completely.

7) Paste the results of AJ.1 to AJ.4 on the analog module case.

4.5 INITIALIZING MAIN BOARD

If you initialize main board, you need to re-enter creep data and linearity data, etc.

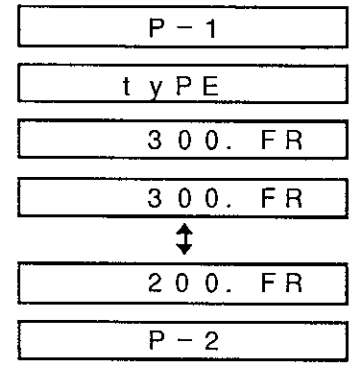
(1)Initializing the board



1) Set the display to P-0 (refer to "Check Mode" in 5).
2) Press the [RE-ZERO] key.
3) Press the [CAL] key.

* Check that the buzzer sounds each time a key is pressed.

(2)Setting the unit model.



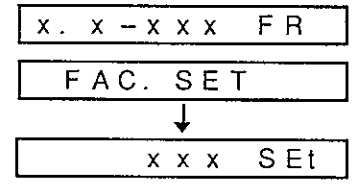
1) Set the display to P-1.
2) Press the [RE-ZERO] key.
3) Press the [CAL] key.
4) Select a unit model by using [SAMPLE].
5) Press the [MODE] key.

(3)Export specification settings

The following settings must be changed for export.

1 Decimal point shape
2 Date order
3 Registration unit

According to the specifications, change the settings as follows:



1) Enter the check mode.
2) Press the [RE-ZERO] key.
3) The three digits (xxx) indicate the current setting.
4) By using the following keys, change or set the contents listed in the table below.

[MODE] Changes the setting sequentially. Hold the key down for quick changing.

[RE-ZERO] Registers the setting and turns the display off.

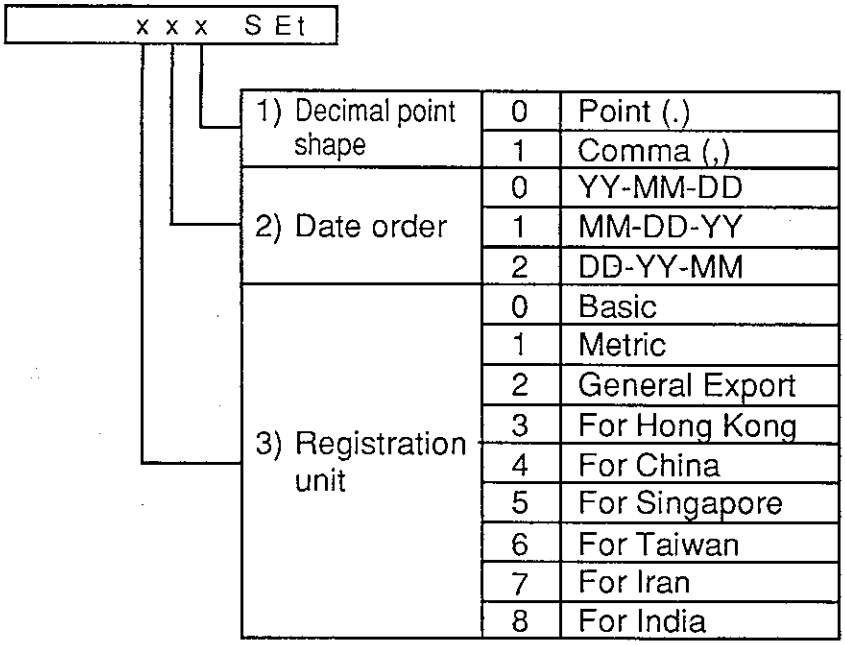


Table of registration unit

	g	Pct	cnt	oz	ozt	dwt	ct	mm	GN	t	TL				MS
											TH	TC	TS	TT	
Basic	○	○	○				○								
Mteric	○	○	○												
General Export	○	○	○	○	○	○	○	○	○						
For Hong Kong	○	○	○	○	○	○	○	○	○	○	○				
For China	○	○	○	○	○	○	○	○	○	○		○			
For Singapore	○	○	○	○	○	○	○	○	○	○			○		
For Taiwan	○	○	○	○	○	○	○	○	○	○				○	
For Iran	○	○	○				○			○					○
For India	○	○	○	○	○	○	○	○	○	○					

APPENDIX A.

If the values of AJ.1 ~ AJ.4 are missing or If the main board or the crystal oscillator have been exchanged, carry out from step (1) and enter the new value of AJ.1 ~ AJ.4. Refer to 4.4.3. CLOCK ADJUSTMENT.

(1) Measure the period between GND and TP2 with a frequency counter and calculate the value by using the following program. The results are from AJ.1 to AJ.4. (For instance, this program use NEC basic.)

```
10 INPUT "period.    ";Period input
   (msec)
20 M=T*90
30 '
40 E=M*8
50 F=1000
60 G=F - E
70 IF G=0 THEN A=256 : GOTO 110
80 A=INT (M/G)
90 IF A>256 THEN A=256
100 '
110 E=E*A+M
120 F=F*A
130 G=ABS (F - E)
140 IF G=0 THEN B=256 : GOTO 180
150 B=INT (M/G)
160 IF B>256 THEN B=256
170 '
180 E=E*B - M
190 F=F*B
200 G=F - E
210 IF G=0 THEN C=256 : GOTO 250
220 C=INT (M/G)
230 IF C>256 THEN C=256
240 '
250 E=E*C+M
260 F=F*C
270 G=ABS (F - E)
280 IF G=0 THEN D=256 : GOTO 320
290 D=INT (M/G)
300 IF D>256 THEN D=256
310 '
320 AJ1=A - 1
330 AJ2=B - 1
340 AJ3=C - 1
350 AJ4=D - 1
360 '
370 PRINT "AJ.1 = ";AJ1
380 PRINT "AJ.2 = ";AJ2
390 PRINT "AJ.3 = ";AJ3
400 PRINT "AJ.4 = ";AJ4
410 '
420 GOTO 10
```

F R MARK II SCREW

screw name	size	qts.
CONTINUOUS-THREAD STUD SCREW	M3×4	5
HEXAGON HEAD SCREW	M5×12	3
HEXAGON HEAD WITH DOUBLE WASHERS	M5×12	4
INSIDE TOOTHED LOCK WASHER	M4	1
INSIDE TOOTHED LOCK WASHER	M5	3
NUT	M3	2
PAN HEAD SCREW	M3×4	6
PAN HEAD SCREW	M3×6	4
PAN HEAD SCREW	M3×30	2
PAN HEAD·SCREW	M4×5	15
PAN HEAD SCREW	M4×8	1
PAN HEAD SCREW	M4×10	3
PAN HEAD SCREW	M4×30	4
PAN HEAD SCREW	M3.6×8	2
PAN HEAD SCREW WITH DOUBLE WASHERS	M3×6	39
PAN HEAD SCREW WITH DOUBLE WASHERS	M3×8	9
PAN HEAD SCREW WITH DOUBLE WASHERS	M4×6	6
PAN HEAD SCREW WITH DOUBLE WASHERS	M4×8	1
PAN HEAD SCREW WITH DOUBLE WASHERS	M4×10	2
PAN HEAD SCREW WITH DOUBLE WASHERS	M4×12	4
SPRING WASHER	M3	2
TRUSS HEAD TAPPING SCREW	M3×8	6

PZ：2172A／B

CIRCUIT SYMBOL	PARTS NAME	DESCRIPTION	Q'TY
	04:A32996	SHIELD BOX	1
	04:A36471	SHIELD BOX	1
	04:A44676	HEAT SINK	1
C3,200～203	CC:0.001U	CERAMIC CAPACITOR 0.001μF 50V	5
C5,12,14,50,56,62,72,204	CC:0.01U	CERAMIC CAPACITOR 0.01μF 25V	8
C100	CC:0.01U1KV	CERAMIC CAPACITOR 0.01μF	1
C36,37,40～45,110,111～114,116	CC:0.022U	CERAMIC CAPACITOR 0.01μF 500V	14
C6,98,99	CC:0.047U	CERAMIC CAPACITOR 0.047μF 50V	3
C48,49,52,101,102	CC:0.1U25V	CERAMIC CAPACITOR 0.1μF 25V	5
C104	CC:100P	CERAMIC CAPACITOR 100pF 50V	1
C13	CC:33P	CERAMIC CAPACITOR 33pF 50V	1
C59	CC:470P	CERAMIC CAPACITOR 470PF 50V	1
C2	CC:68P	CERAMIC CAPACITOR 68PF 50V	1
C61,63～71,74,75	CC:FK16Y5V1H104	CERAMIC CAPACITOR 0.1μF	12
C16,21,22,29,30,31,32,33,115	CC:YF102P12	CERAMIC CAPACITOR 1000pF	9
C19,20,25～28,34,35,105	CC:YN101M12	CERAMIC CAPACITOR 100pF	9
C57	CK:SM50VB100	ELECTROLYTIC CAPACITOR 100μF 50V	1
C60	CK:SM50VB3R3	ELECTROLYTIC CAPACITOR 3.3μF 50V	1
C54,55	CK:SME16VB100	ELECTROLYTIC CAPACITOR 100μF 16V	2
C53	CK:SME16VB220	ELECTROLYTIC CAPACITOR 220μF 16V	1
C51	CK:SME25VB470	ELECTROLYTIC CAPACITOR 470μF 25V	1
C47	CK:SME35VB100	ELECTROLYTIC CAPACITOR 100μF 35V	1
C46	CK:SME50VB1000	ELECTROLYTIC CAPACITOR 1000μF 50V	1
C58	CK:SXE35VB100	ELECTROLYTIC CAPACITOR 100μF 35V	1
C10,15	CM:5002103K1	MYLAR CAPACITOR 0.01μF	2
C9	CM:5002223K1	MYLAR CAPACITOR 0.022μF 50V	1
C11	CM:E1105KN	FILM CAPACITOR 1μF 100V	1
C1	CM:E1225KN	FILM CAPACITOR 2.2μF 100V	1
C80	CM:E1474KN	FILM CAPACITOR 0.47μF 100V	1
C205	CT:1A4R7	TANTALUM CAPACITOR 4.7μF 10V	1
C81,106	CT:1D2R2	TANTALUM CAPACITOR 2.2μF 20V	2
C7	CT:1V010	TANTALUM CAPACITOR 1μF 35V	1
D1～4,8～10,15	DI:1S1588	DIODE	8
D5,6,13,16	DI:1SS53	DIODE	4
D14	DI:1SS97	DIODE	1
D11,101,102	DZ:05Z5.6	ZENER DIODE	3
D7	DZ:05Z9.1	ZENER DIODE 9.1V	1
D12	DZ:RD3.3EB1	ZENER DIODE	1
D100	DZ:RD3.6EB	ZENER DIODE 3.6V	1
BATT	EB:CR2032-WT12	LITHIUM BATTERY	1
J10	EJ:0470-01-230	CONNECTOR	1
BUZ1	ET:MEB-12C-5	BUZZER	1
FH	FH:F-105	FUSE HOLDER	1
	FS:EAWK-500MA	FUSE 500mA T	1
	HT:6073PB	HEAT SINK	2
J11	JE:0922-01-040	3P CONNECTOR	1
J7	JI:20PA-2.54DSA	CONNECTOR	1
U19	JS10328-01-445	IC SOCKET	1
J3,4	JT:1-172429-2	CONNECTOR	2
J13	JT:1-172429-5	CONNECTOR	1
J12	JT:171825-3	CONNECTOR	1

PZ：2172A／B

CIRCUIT SYMBOL	PARTS NAME	DESCRIPTION	Q'TY
J9	JT:172429-5	SPRING HEADER	1
L98,99	LL:SF-T8-40S	COIL	2
	NF:FB-43-101	FERRITIC BEADS	3
	PC:2172C	PRINTED CIRCUIT BOARD	1
	QA:AC256-1674	MICA SPACER	2
	QA:AC316A	WASHER	2
Q6	QF:IRFD120	FET	1
Q5,201	QF:K30ATM-GR	FET	2
Q1,2,9,13,14,100～104	QT:A1015Y	TRANSISTOR	10
Q3	QT:A1153	TRANSISTOR	1
Q11	QT:C1173	TRANSISTOR	1
Q8,10,12,15～18,106	QT:C1815Y	TRANSISTOR	8
Q4,200	QT:C2235	TRANSISTOR	2
R33	RC:1/21M	CARBON RESISTOR 1MΩ 1/2W	1
R61	RC:NAT1.2K	CARBON RESISTOR 1.2KΩ 1/4W	1
R67	RC:NAT1.5K	CARBON RESISTOR 1.5KΩ 1/4W	1
R17～19,47,108,109,110	RC:NAT100R	CARBON RESISTOR 100Ω 1/4W	7
R5,9,10,14,64,71,73	RC:NAT10K	CARBON RESISTOR 10KΩ 1/4W	7
R44	RC:NAT12K	CARBON RESISTOR 12KΩ 1/4W	1
R7,8,15	RC:NAT15K	CARBON RESISTOR 15KΩ 1/4W	3
R12,55,56,101,107	RC:NAT1K	CARBON RESISTOR 1KΩ 1/4W	5
R11,36,45,60,69	RC:NAT2.2K	CARBON RESISTOR 2.2KΩ 1/4W	5
R70	RC:NAT2.7K	CARBON RESISTOR 2.7KΩ 1/4W	1
R35	RC:NAT220K	CARBON RESISTOR 220KΩ 1/4W	1
R58,59,74	RC:NAT220R	CARBON RESISTOR 220Ω 1/4W	3
R62,76,79,80,86	RC:NAT22K	CARBON RESISTOR 220KΩ 1/4W	5
R51,52	RC:NAT270R	CARBON RESISTOR 270Ω 1/4W	2
R16,72,201,202	RC:NAT3.3K	CARBON SESISTOR 3.3KΩ 1/4W	4
R65,100	RC:NAT3.9K	CARBON RESISTOR 3.9KΩ 1/4W	2
R50	RC:NAT33K	CARBON RESISTOR 33KΩ 1/4W	1
R32	RC:NAT390K	CARBON RESISTOR 390KΩ 1/4W	1
R34	RC:NAT39K	CARBON RESISTOR 39KΩ 1/4W	1
R46	RC:NAT4.7K	CARBON RESISTOR 4.7KΩ 1/4W	1
R13	RC:NAT470R	CARBON RESISTOR 470Ω 1/4W	1
R75	RC:NAT47K	CARBON RESISTOR 470KΩ 1/4W	1
R105	RC:NAT5.6K	CARBON RESISTOR 5.6KΩ 1/4W	1
R53,54	RC:NAT5.6R	CARBON RESISTOR 5.6Ω 1/4W	2
R57	RC:NAT560R	CARBON RESISTOR 560Ω 1/4W	1
R200	RC:NAT7.5K	CARBON RESISTOR 7.5KΩ 1/4W	1
R102,104,106	RC:NAT8.2K	CARBON RESISTOR 8.2KΩ 1/4W	3
R66,68	RC:NAT820	CARBON RESISTOR 820Ω 1/4W	2
R103	RF:5.11KSF	METAL FILM RESISTOR 5.11KΩ 1/8W	1
R20,21	RF:RR172	RESISTOR NETWORK	1
R42	RM:RNM18RNM	METAL FILM SESISTOR 18KΩ 1/4W	1
R43	RM:RNM39KF	METAL FILM SESISTOR 39KΩ 1/4W	1
R41	RM:RNM47KF	METAL FILM RESISTOR 47KΩ 1/4W	1
R78	RN:IHR-4-223MA	RESISTOR NETWORK 22KΩ×4	1
R77,85	RN:IHR-8-223MA	RESISTOR NETWORK 22KΩ×8	2
R83	RN:IHR-8-563JA	RESISTOR NETWORK 56KΩ×8	1
	TF:352	TRANSFORMER	1
	TM:CP-10	TEST PIN	7

PZ：2172A／B

CIRCUIT SYMBOL	PARTS NAME	DESCRIPTION	Q'TY
U7	UA:C311C	OP AMP	1
U2, 6, 21	UA:C4072C	OP AMP	3
U4	UA:LM399H	REF IC NS	1
U3, 22	UA:OP07DP	OP AMP	2
U13	UA:S-8054ALR	VOLTAGE COMPARATOR	1
U23	UC:4001	CMOS	1
U1	UC:4066	CMOS IC TC4066BP	1
U17	UC:5564APL-15	RAM 8K×8	1
U11	UC:D65013GC-388	GATE ARRAY	1
U10	UC:D78C10G-1B	CMOS CPU	1
U14	UC:HC367	CMOS IC	1
U12	UC:HC540	CMOS TC74HC540P	1
IU15	UC:HC573	8 BIT LATCHES	1
U18	UC:HC74	CMOS IC	1
U16	UC:RP93C46	EEPROM	1
U9	UR:TA78DL05S	VOLTAGE REGULATOR	1
U8	UR:TA78DL12S	VOLTAGE REGULATOR	1
U20	UT:LS04	TTL	1
X1	XT:C4SB-12M-L02	CERAMIC 12MHz	1
R25	RL:2000B	FILM RESISTOR 200Ω	1
R26	RL:100R3A	METAL FILM SESISTOR 100Ω FOR FR300	1
R26	RL:2000B	METAL FILM RESISTOR 200Ω FOR FR200	2

P Z : 2 1 7 4

CIRCUIT SYMBOL	PARTS NAME	DESCRIPTION	Q'TY
	04:B42516B	SHIELD CASE BASE	1
	04:B42517A	SHIELD CASE	1
	06:A47138	DISPLAY SEAT	2
	06:B42514A	RUBBER SPACER	1
	07:A46734B	STAND	1
	07:B47411	ABSOLUTE SHEET	1
C11～16	CC:0.0047U	CERAMIC CAPACITOR 0.0047μF 50V	6
C1	CC:0.022U	CERAMIC CAPACITOR 0.01μF 500V	1
C101	CC:220P	CERAMIC CAPACITOR 220pF 50V	1
C3,4	CK:SM50VB10	ELECTROLYTIC CAPACITOR 10μF 50V	2
C2	CK:SM50VB3R3	ELECTROLYTIC CAPACITOR 3.3μF 50V	1
C102	CK:SRA50VB-2.2	ELECTROLYTIC CAPACITOR 2.2μV 50V	1
C103	CK:SRA50VB-3.3	ELECTROLYTIC CAPACITOR 3.3μF 50V	1
C105	CK:SRA6.3VB47	ELECTROLYTIC CAPACITOR 47μF 6.3V	1
C104	CM:92PP2A331J	FILM CAPACITOR 0.033μF	1
D101	DL:TPS703	PHOTO DIODE	1
D1	DZ:05Z9.1	ZENER DIODE 9.1V	1
	ED:FIP11C11	Fluorescent Character Display Tube	1
J8	JD:230-07-30	CONNECTOR	1
J7	JI:1-163749-7	CONNECTOR	1
	JS:26-2004-GS4	IC SOCKET	1
	PC:2174C	PRINTED CIRCUIT BOARD	1
R11～16	RC:10K	CARBON RESISTOR 10K 1/4W	6
R4,103	RC:NAT22K	CARBON RESISTOR 220KΩ 1/4W	2
	RC:NAT47R	CARBON RESISTOR 47Ω 1/4W	1
R101	RC:NAT5.6R	CARBON RESISTOR 5.6Ω 1/4W	1
R3	RC:NAT56K	CARBON RESISTOR 56KΩ 1/4W	1
	RM:RNM158KF	METAL FILM RESISTOR 158KΩ 1/4W	1
R1,2	RN:IHR-8-563JA	RESISTOR NETWORK 56KΩ×8	2
U101	UA:C1490HA	PRE AMP	1
U1	UC:7516HG606-12	DISPLAY CONTROLER	1
X1	XT:C4SB-6M-L02	RESONATOR 6MHz	1

P Z : 2 1 7 5

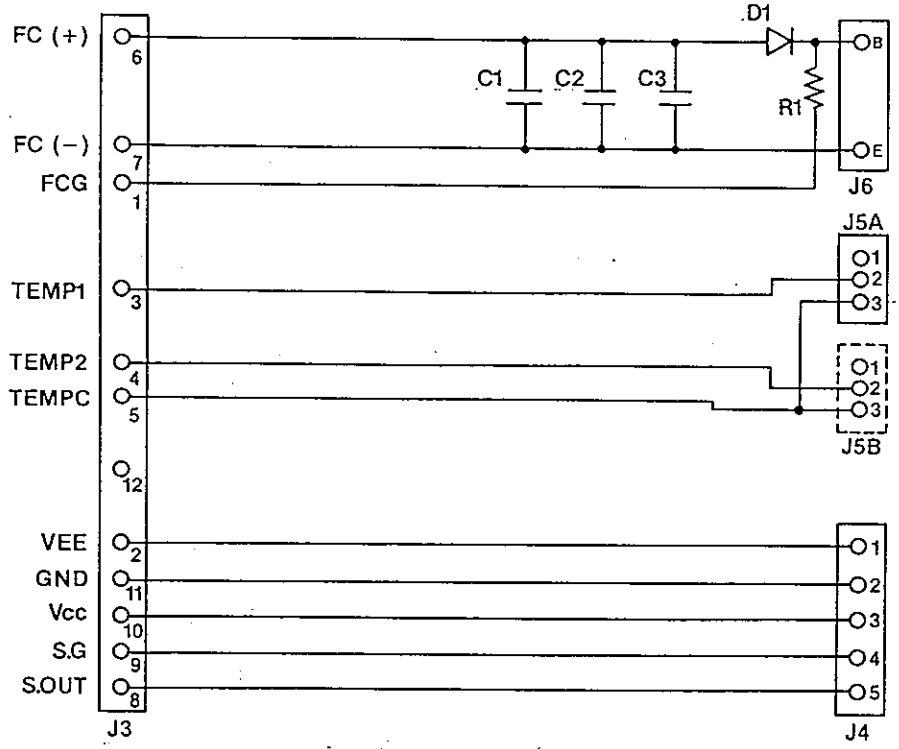
CIRCUIT SYMBOL	PARTS NAME	DESCRIPTION	Q'TY
C1, 2, 3	CM:E1106KN	FILM CAPACITOR 10μF 100V	3
D1	DI:1S1588	DIODE	1
J5, 12	JT:171825-3	CONNECTOR	2
J4	JT:172429-5	SPRING HEADER	1
	KO:440-12S-30	CABLE	1
	PC:2175A	PRINTED CIRCUIT BOARD	1
R1	RC:NAT1K	CARBON RESISTOR 1KΩ 1/4W	1

PZ : 2176

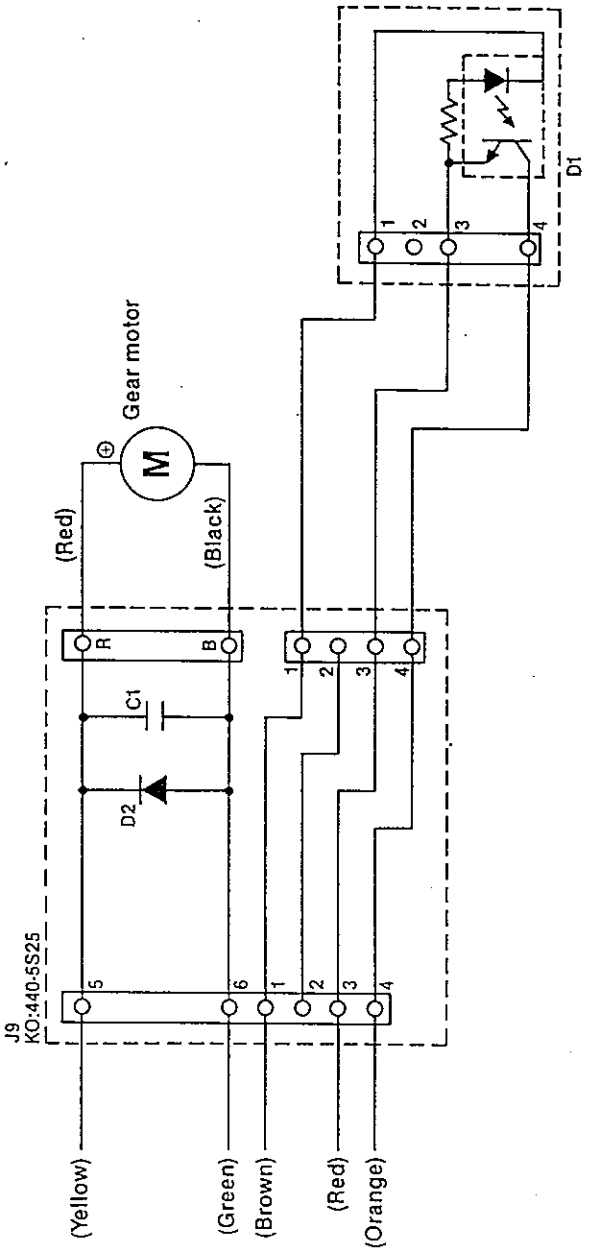
CIRCUIT SYMBOL	PARTS NAME	DESCRIPTION	Q'TY
C1	CC:0.01U	CERAMIC CAPACITOR 0.01μF 25V	1
D1	DF:TLP801A	PHOTO INTERRUPTER	1
D2	DI:1S1588	DIODE	1
	KO:440-5S35	CABLE	1
	PC:2176A	PRINTED CIRCUIT BOARD	2
	RC:NAT1.2K	CARBON RESISTOR 1.2KΩ 1/4W	1

P Z : 2 2 9 2 A

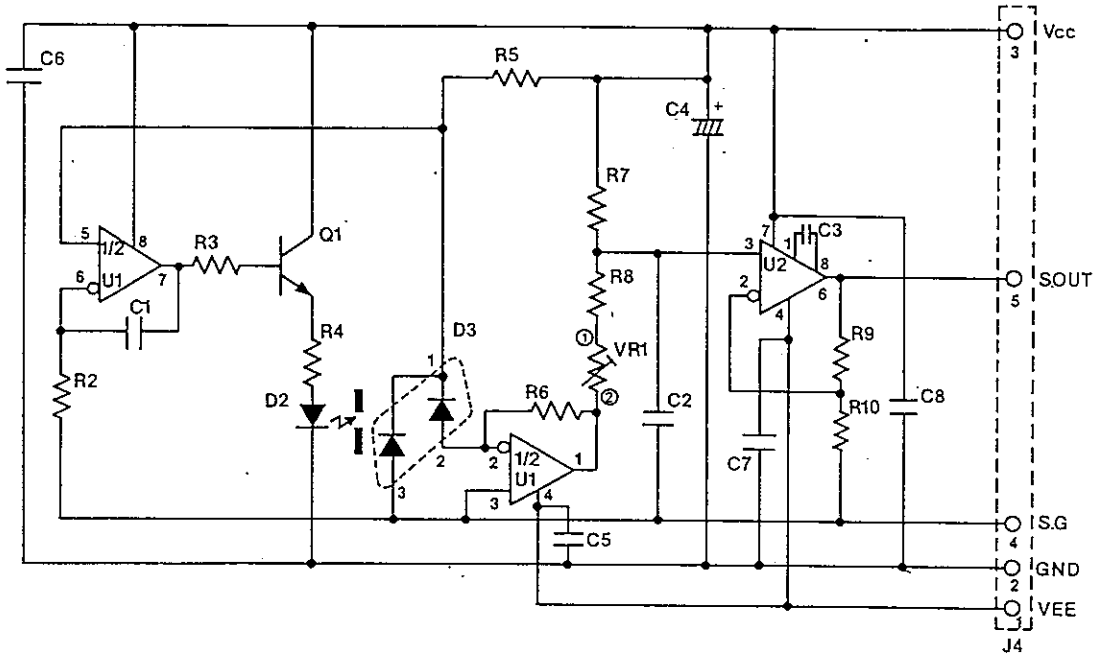
CIRCUIT SYMBOL	PARTS NAME	DESCRIPTION	Q'TY
	07:A41842C	SENSOR HOLDER	1
C2,5,6,7,8	CC:0.022U	CERAMIC CAPACITOR 0.01μF 500V	5
C1	CC:100P	CERAMIC CAPACITOR 100pF 50V	1
C3	CC:33P	CERAMIC CAPACITOR 33pF 50V	1
C4	CT:1D2R2	TANTALUM CAPACITOR 2.2μF 20V	1
D3	DI:MI-33H-2D	PHOTO DIODE	1
D2	DL:TLN108	LED	1
	KO:440-5S25	CABLE	1
	PC:2292	PRINTED CIRCUIT BOARD	1
Q1	QT:C1815Y	TRANSISTOR	1
R10	RC:NAT10K	CARBON RESISTOR 10KΩ 1/4W	1
R4	RC:NAT220R	CARBON RESISTOR 220Ω 1/4W	1
R9	RC:NAT22K	CARBON RESISTOR 220KΩ 1/4W	1
R3	RC:NAT3.3K	CARBON RESISTOR 3.3KΩ 1/4W	1
R2	RC:NAT680K	CARBON RESISTOR 680KΩ 1/4W	1
R7	RM:RNM16.9KF	METAL FILM RESISTOR 16.9KΩ 1/4W	1
R8	RM:RNM20.5KF	METAL FILM RESISTOR 20.5KΩ 1/4W	1
R5	RM:RNM200KF	METAL FILM RESISTOR 100KΩ 1/4W	1
R6	RM:RNM680KF	METAL FILM RESISTOR 680KΩ 1/4W	1
VR1	RV:5W10K	VOLUME	1
U2	UA:C301AC	OP AMP	1
U1	UA:C4072C	OP AMP	1

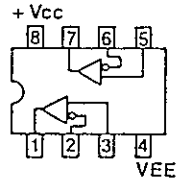


MODEL	FR series
DESCRIPTION	Capacitor Board
STOCK No.	PZ:2175A
DRWG. No.	EC4-00172

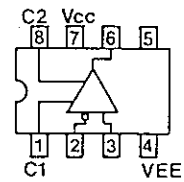


MODEL	FR series
DESCRIPTION	Motor Board
STOCK No.	PZ:2176
DRWG. No.	EC4-00173

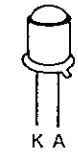




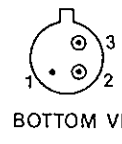
U1 C4072



U2 C301AC

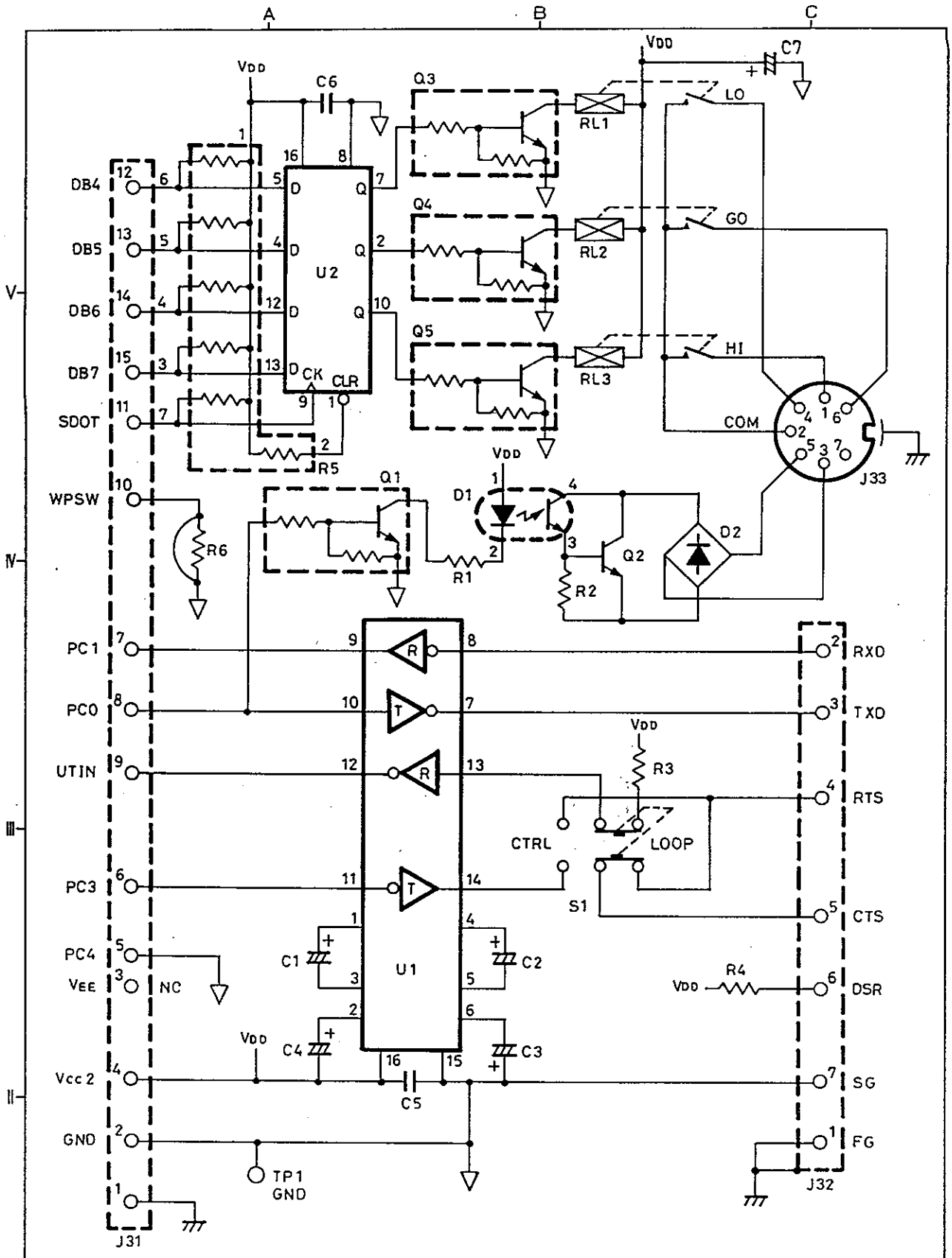


D1 TLN108

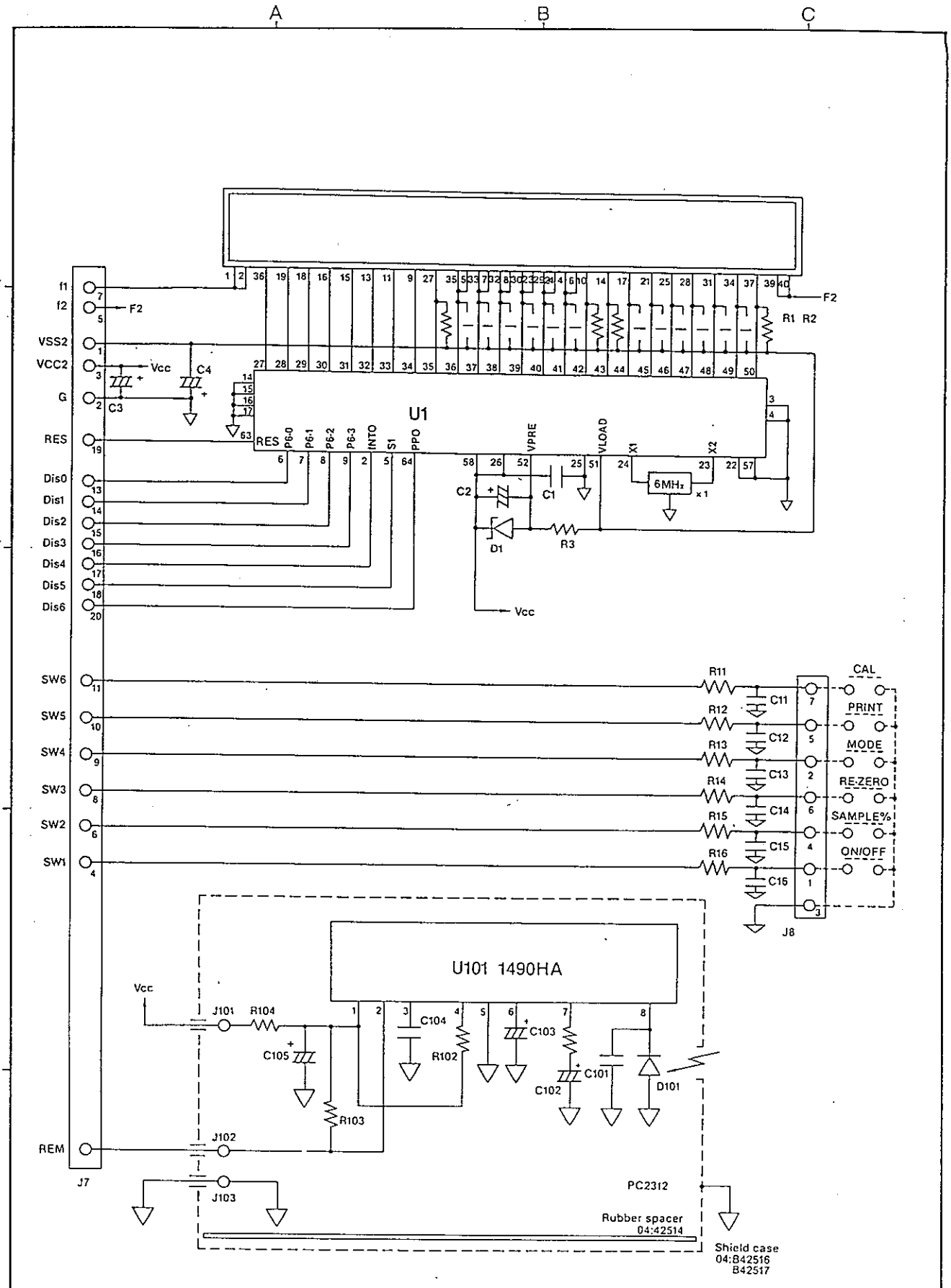


D3 MI-33H-2D

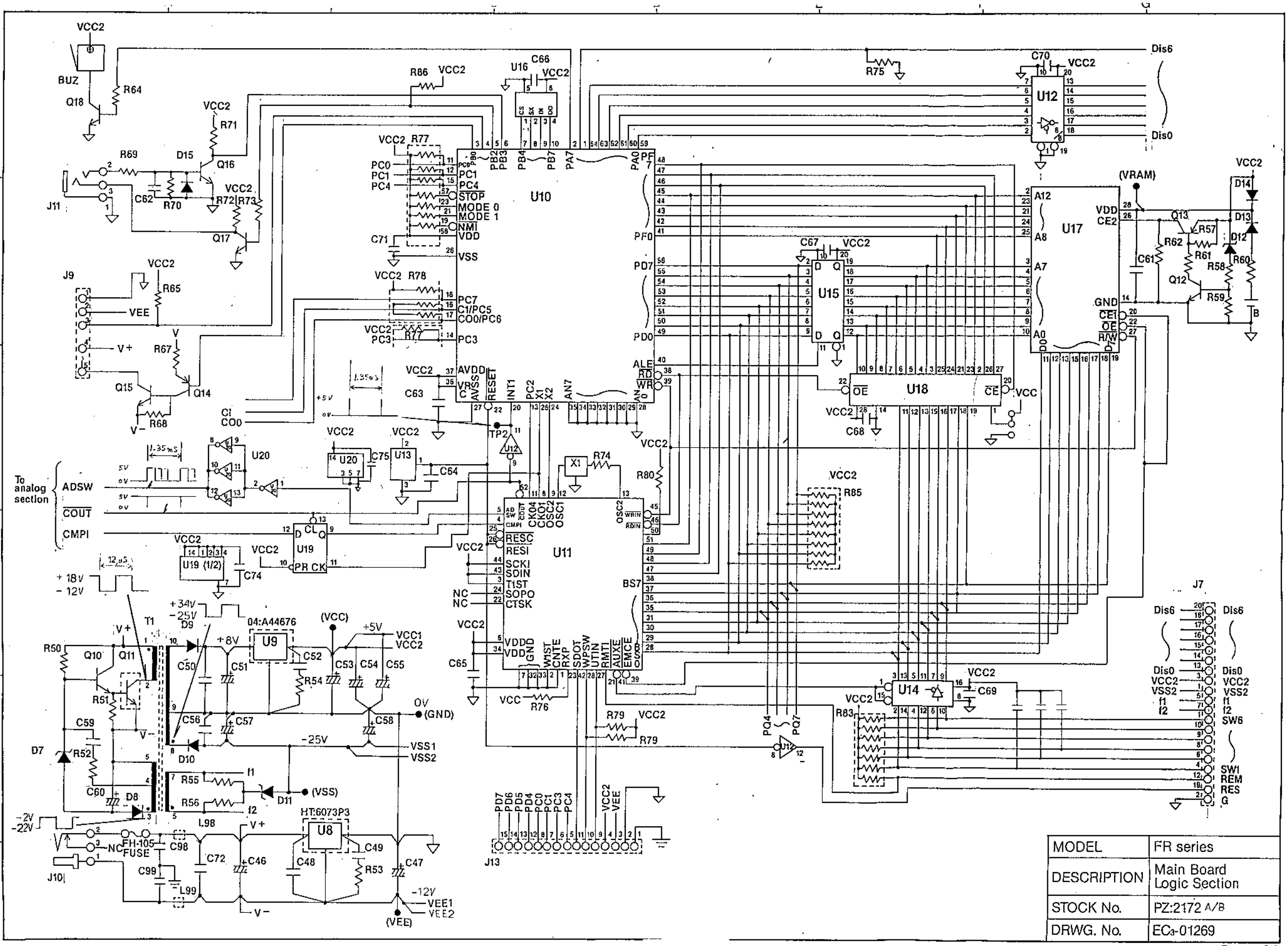
MODEL	FR series
DESCRIPTION	Sensor Board
STOCK No.	PZ:2292A
DRWG. No.	EC4-00186



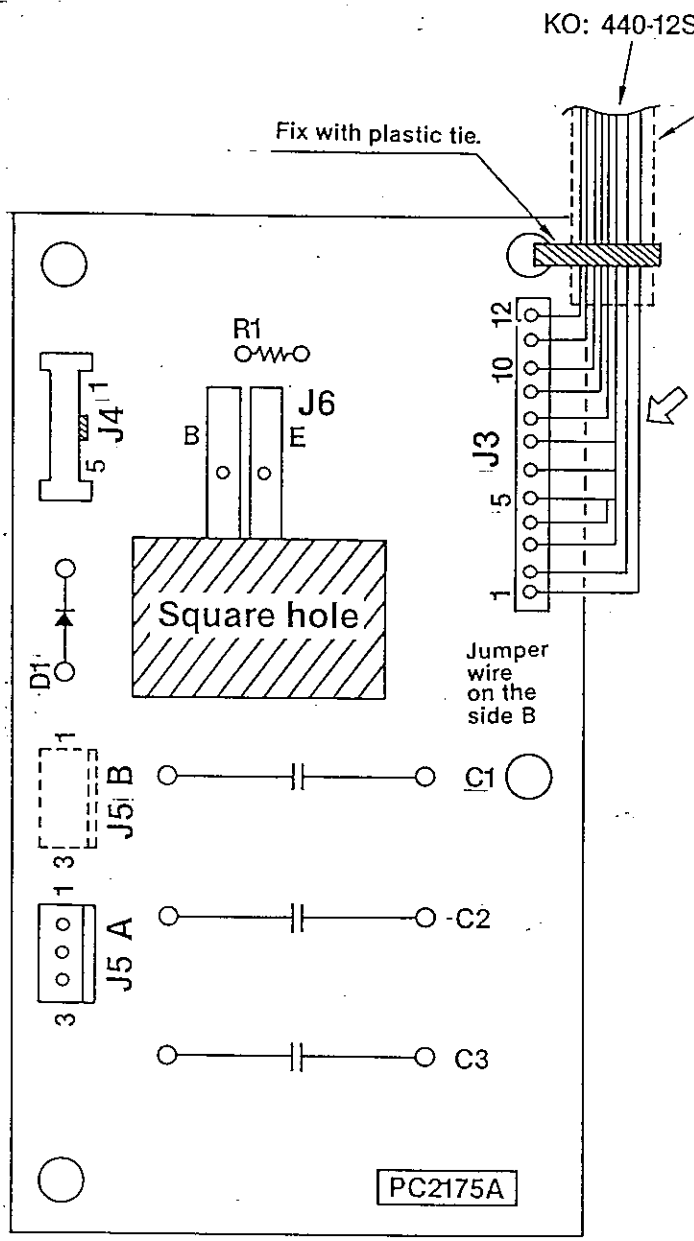
				Model	AD : FR-03
Symbol	Date	By	Revision No.	Description	PZ : 2177
				Stock No.	SERIAL INTERFACE & COMPARATOR
				Drwg.No.	EC4-00174



MODEL	FR series
DESCRIPTION	Display Board
STOCK No.	PZ:2174
DRWG. No.	EC4-00171

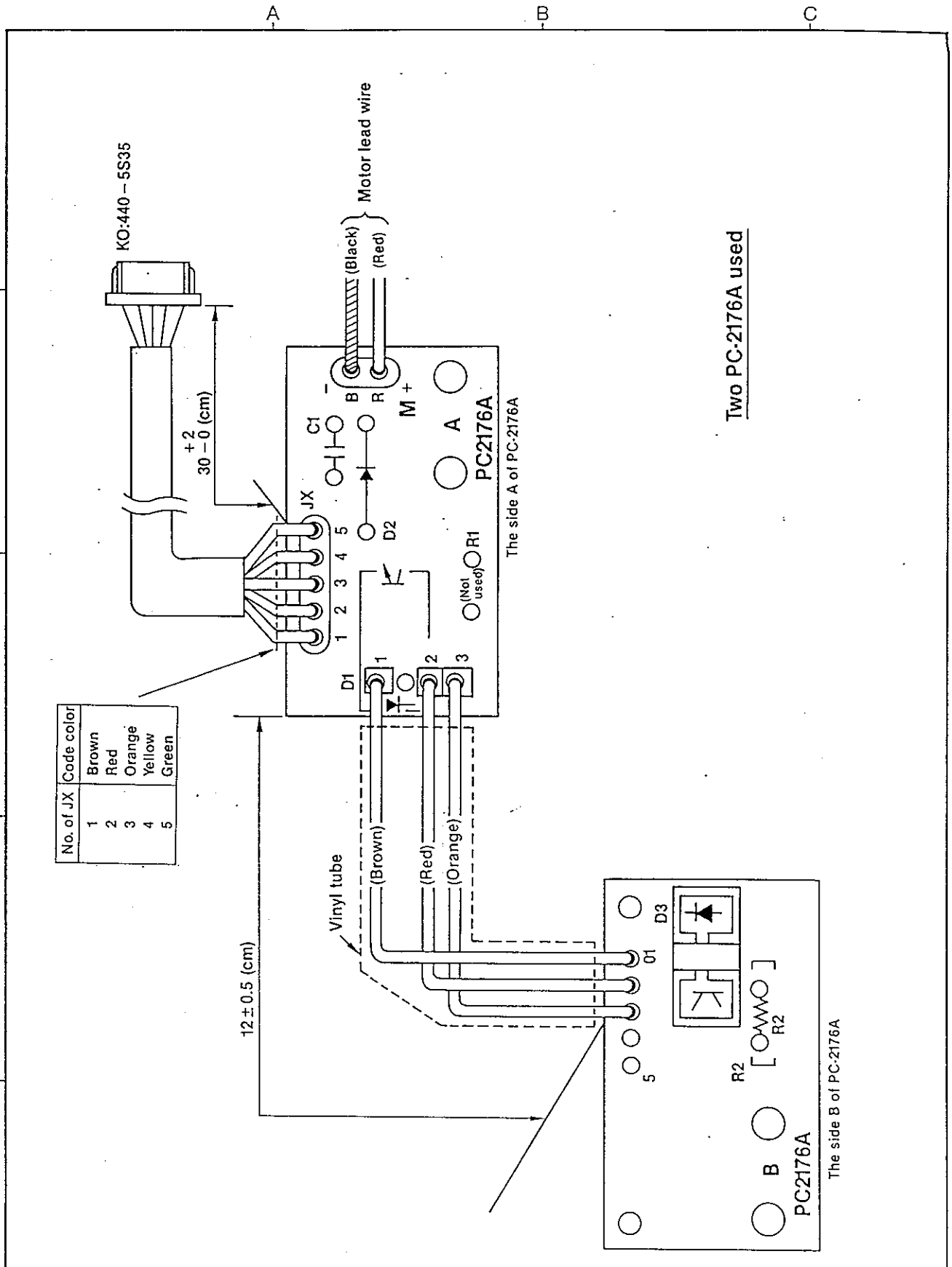


MODEL	FR series
DESCRIPTION	Main Board Logic Section
STOCK No.	PZ:2172 A/B
DRWG. No.	EC3-01269

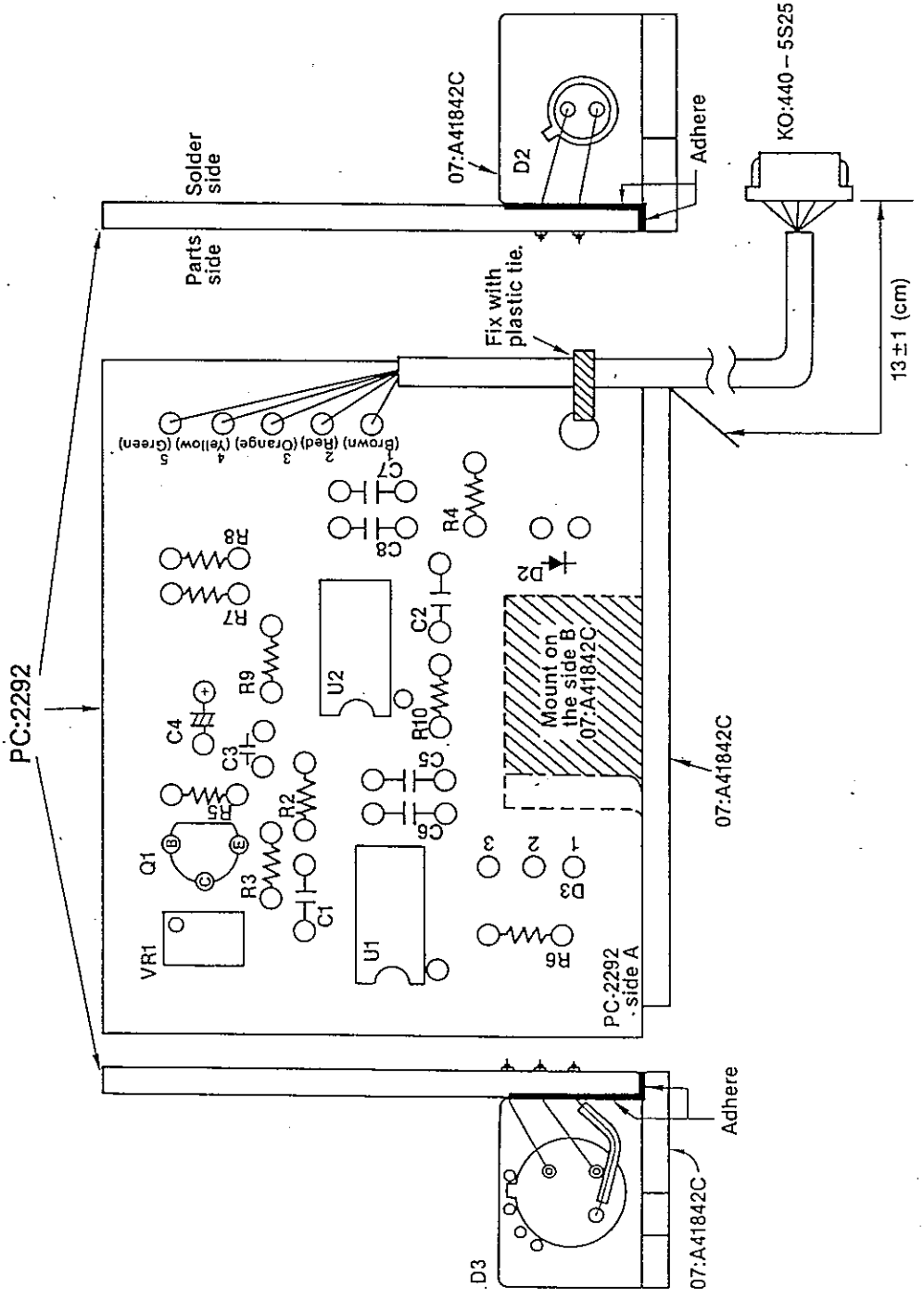


No. of J3	Code color
1	Brown
2	Red
3	Orange
4	Yellow
5	Green
6	Blue
7	Purple
8	Gray
9	White
10	Black
11	Pink
12	Light Blue

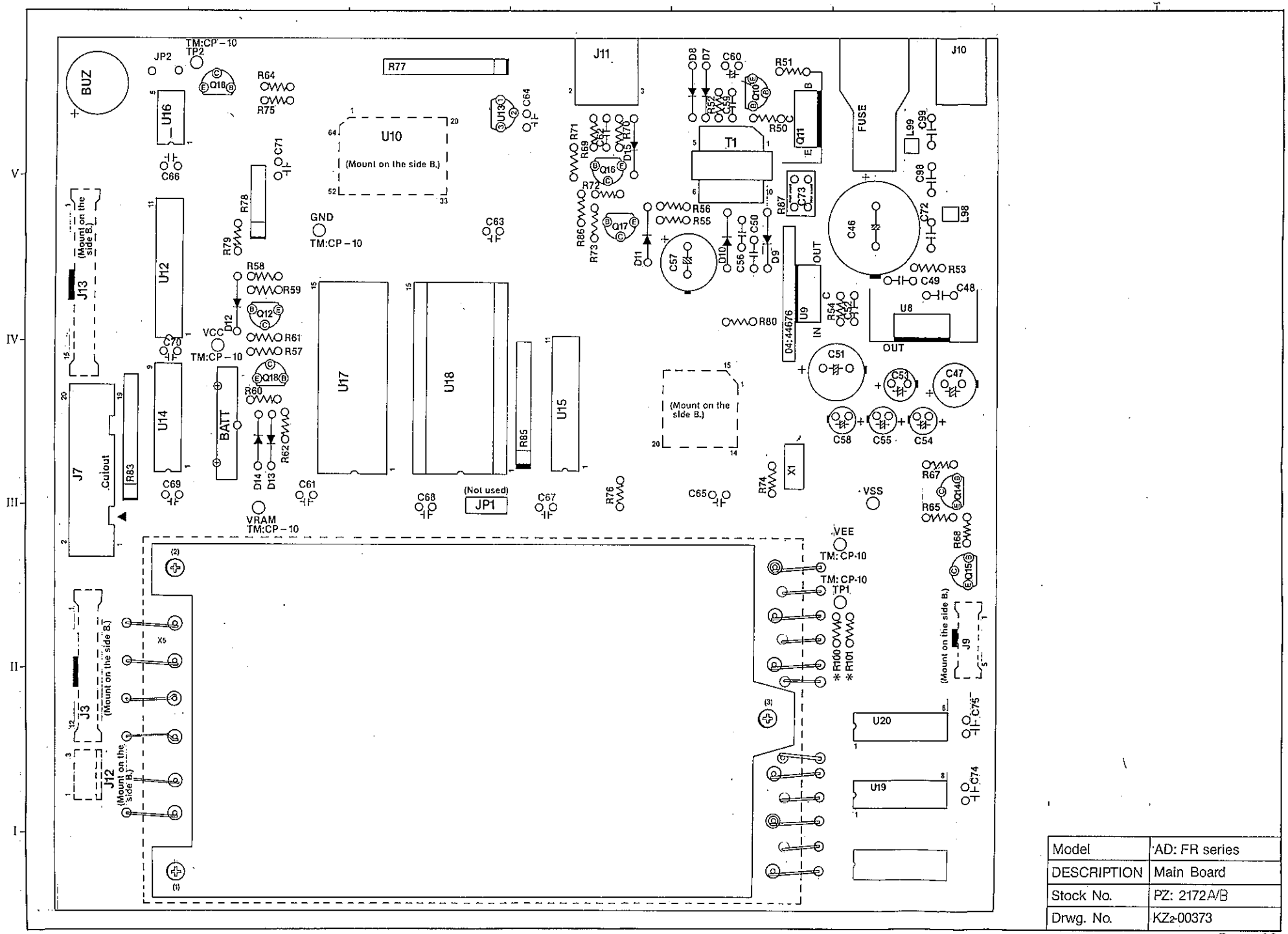
MODEL	FR series
DESCRIPTION	Component Layout on Capacitor Board
STOCK No.	PZ:2175
DRWG. No.	KZ4-00402



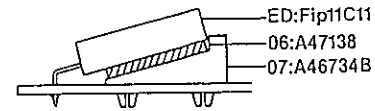
MODEL	FR series
DESCRIPTION	Component Layout on Monitor Unit
STOCK No.	PZ:2176
DRWG. No.	KZ3-00766

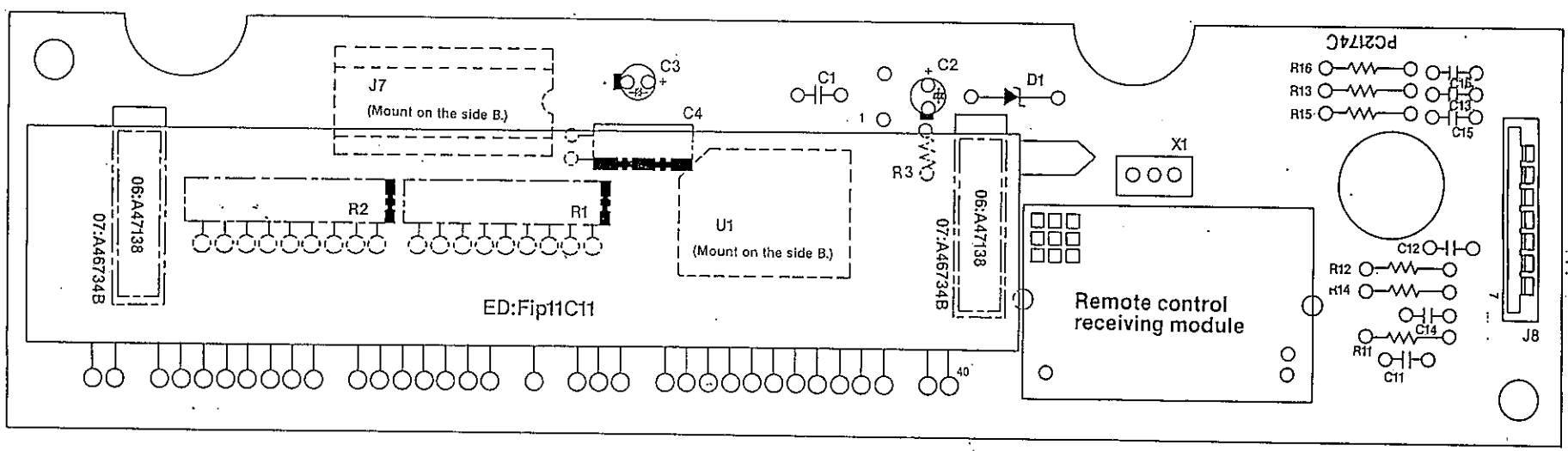


MODEL	FR series
DESCRIPTION	Component Layout on Sensor Board
STOCK No.	PZ:2292A
DRWG. No.	KZ4-00408



Model	AD: FR series
DESCRIPTION	Main Board
Stock No.	PZ: 2172A/B
Drwg. No.	KZ2-00373





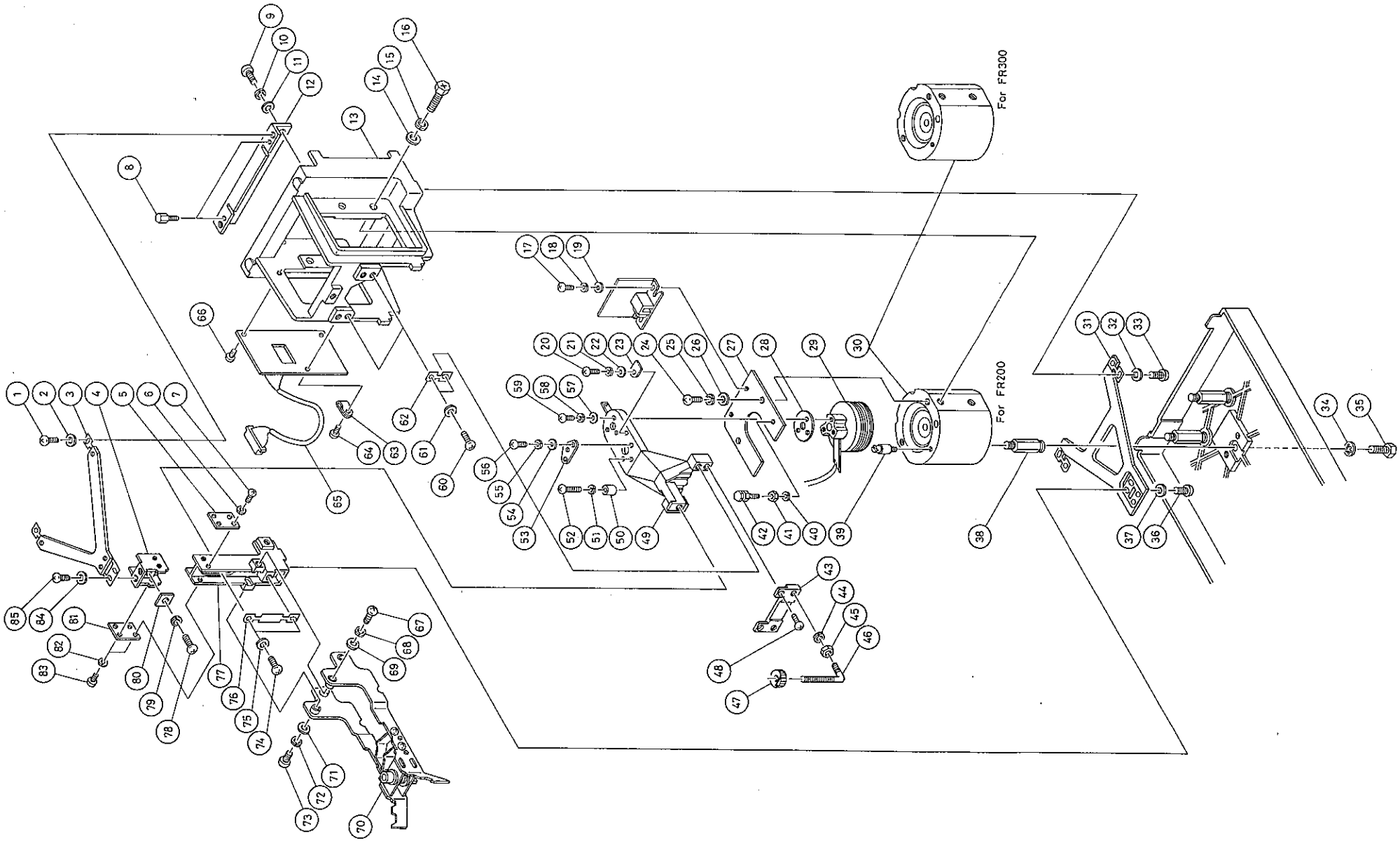
MODEL	FR series
DESCRIPTION	Component Layout on Display Board
STOCK No.	PZ:2174
DRWG. No.	KZ3-00765

EXPLODED VIEW 1

NO.	PARTS NAME	DESCRIPTION
1		SCREW M4×5
2	10:S-NO-1-SUS	CONVEX WASHER
3	PB:FR300-2	FLEXURE ASS'Y
4		SUSPENSION A
5		SUSPENSION ATTACHMENT
6		SPRING WASHER M3
7		SCREW M3×6
8	05:A44845B	ADJUSTMENT BOLT
9		SCREW M4×10
10		SPRING WASHER M4
11		WASHER M4
12	05:A44844B	FLEXURE BRANCKET
13	03:A21240	MAGNET FRAME
14		WASHER M5
15		SPRING WASHER M5
16		BOLT M5×12
17		SCREW M3×6
18		SPRING WASHER M3
19		WASHER M3
20		SCREW M3×6
21		SPRING WASHER M3
22		WASHER M3
23	04:A41746B-2	STOPPER PLATE
24		SCREW M3×6
25		SPRING WASHER M3
26		WASHER M3
27	04:B40475	YOKE PLATE
28	804:B41414B-2	SPACER
29	09:A35390A	FORCE COIL
30	PB:FR300-1	FORCE MOTOR FOR 300
30	PB:FR200-1	FORCE MOTOR FOR 200
31	PB:FR300-3	FLEXURE ASS'Y
32	10:S-NO-1-SUS	CONVEX WASHER
33		SCREW M4×5
34		LOCK WASHER M5
35		BOLT M5×12
36		SCREW M4×5
37	10:S-NO-1-SUS	CONVEX WASHER
38	05:A49056	FORCE MOTOR PILLAR
39	05:B40514	BEAM STOPPER SCREW
40		SPRING WASHER M3
41		NUT M3
42	05:A43630D	STOP BOLT
43	05:B44162	ADJUSTOR FOR CENTER OF GRAVITY
44		SPRING WASHER M3
45		NUT M3
46	06:B44657A	ARM FOR CENTER OF GRAVITY
47	09:A45376	COUNTER BALANCE
48		SCREW M4×5
49	03:A32656H	FORCE COIL BEAL
50	05:B44770	WEIGHT
51		SPRING WASHER M3
52		SCREW M3×30
53	04:B40498A	BEAM STOPPER PLATE
54		WASHER M3 (S)
55		SPRING WASHER M3

EXPLODED VIEW 1

NO.	PARTS NAME	DESCRIPTION
56		SCREW M3×12
57		WASHER M3 (S)
58		SPRING WASHER M3
59		SCREW M3×8
60		SCREW M4×5
61	10:S-NO-1-SUS	CONVEX WASHER
62	04:B40476;B	FLEXIBLE BEARING
63	10:N-1	CABLE CLAMPPER
64		SCREW M4×5
65		CAPAITOR BOARD
66		SCREW M3×8
67		SCREW M4×12
68		SPRING WASHER M4
69		WASHER M4
70	PB:FR300-4	SHOCK ABSORBER
71		WASHER M4
72		SPRING WASHER M4
73		SCREW M4×12
74		SCREW M4×5
75	10:S-NO-1-SUS	CONVEX WASHER
76	04:B40477;B	TENTSION FLEXIBLE BEARING
77		SUSPENSION B
78		SCREW M4×5
79	10:S-NO-1-SUS	CONVEX WASHER
80		SQUARE WASHER
81		SUSPENSION ATTACHMENT
82		SPRING WASHER M3
83		SCREW M3×6
84	10:S-NO-1-SUS	CONVEX WASHER
85		SCREW M4×5



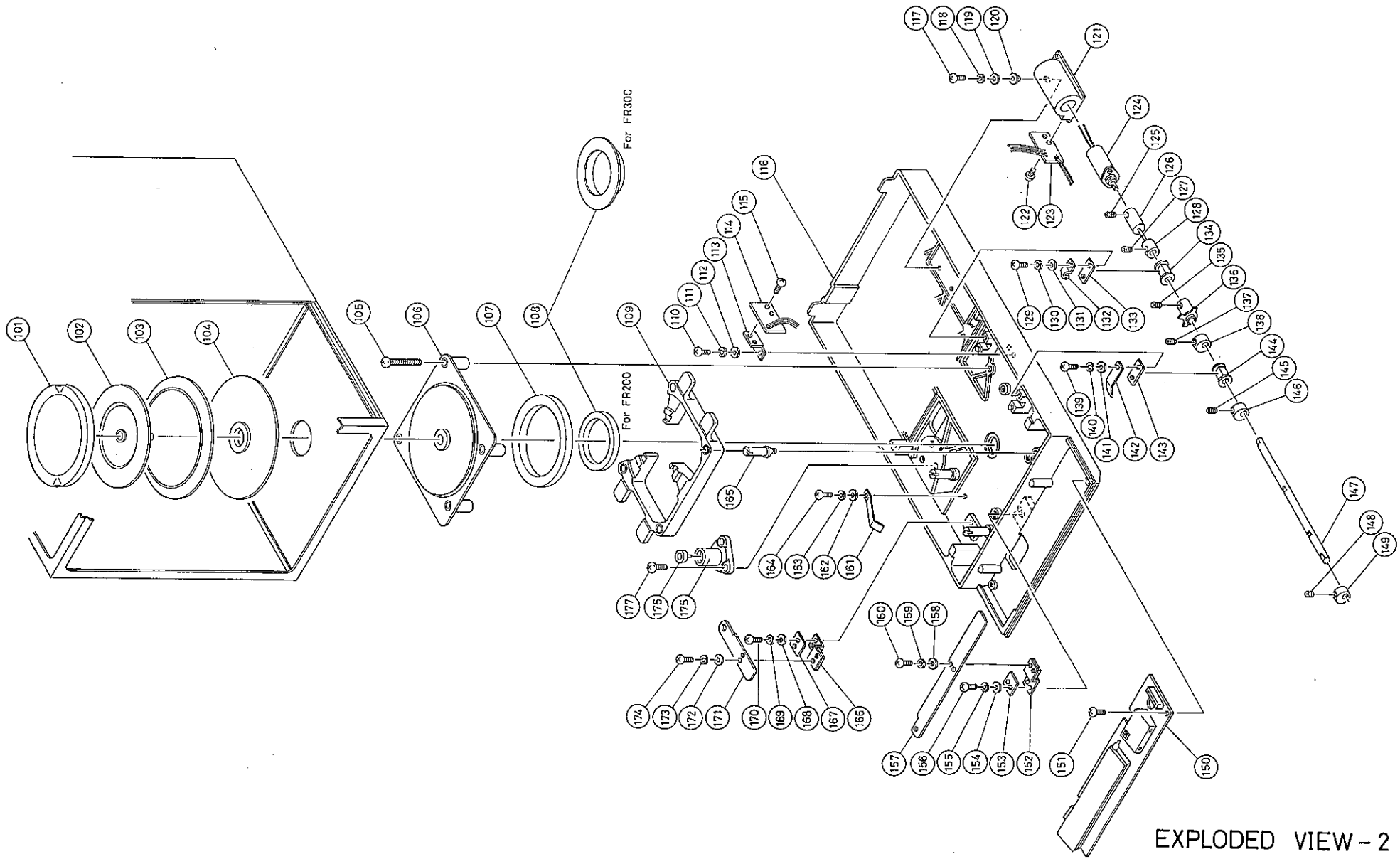
EXPLODED VIEW - 1
FR MARK II SERIES

EXPLODED VIEW 2

NO.	PARTS NAME	DESCRIPTION
101	04:B40478A	WEIGHING PAN
102	09:B40479	PAN SUPPORT
103	04:B40243	DRAFT RING
104	09:B40500	DUST GUARD
105		SCREW M4×30
106	09:B40331B	CAL. WT. HOLDER
107	05:A49718	CAL. WEIGHT
108	05:A49717C	STD WEIGHT FOR FR200 (40G)
108	05:A45700C	STD WEIGHT FOR FR300 (65G)
109	09:B41898B	CAL. WT. SUPPORT
110		SCREW M3×6
111		SPRING WASHER M3
112		WASHER M3 (S)
113	04:B40546	INTER RAPTER HOLDER
114		MOTOR BAORD
115		SCREW M3×4
116	03:A10106	LOWER CASE
117		SCREW M3×8
118		SPRING WASHER M3
119		WASHER M3
120	8QA:AC310	WASHER NYLON
121	09:B44747	MOTOR HOLDER UNIT
122		SCREW M3×4
123		SAME MOTOR BAORD AS NO.114
124	10:A35234	MOTOR
125		SETSCREW M3×4
126	05:B40277	COUPLED RING
127		SETSCREW M3×4
128	07:A49721A	CAM
129		SCREW M3×6
130		SPRING WASHER M3
131		WASHER M3
132	04:B40416	CABLE STOPPER
133	04:B40464	AXLE BRACKET
134	07:B40278	SHAFT HOLDER
135		SETSCREW M3×4
136	09:B40470C	SWITCHING CAM
137		SETSCREW M3×4
138	07:A49721A	CAM
139		SCREW M3×6
140		SPRING WASHER M3
141		WASHER M3
142	04:B45515	WEIGHT SUPPORTER
143	04:B40464	AXLE BRACKET
144	07:B40278	SHAFT HOLDER
145		SETSCREW M3×4
146	07:A49721A	CAM
147	05:A49724	CAMSHAFT
148		SETSCREW M3×4
149	07:A49721A	CAM
150		DISPLAY BAORD
151		SCREW M3×6
152	09:B42615	LEAF SPRING
153	04:B40281A	AXLE BRACKET
154		WASHER M3 (S)
155		SPRING WASHER M3

EXPLODED VIEW 2

NO.	PARTS NAME	DESCRIPTION
156		SCREW M3×6
157	04:A49726	LEVEL VIAL (L)
158		WASHER M3 (S)
159		SPRING WASHER M3
160		SCREW M3×6
161	04:B44736	WEIGHT SUPPORTER
162		WASHER M3 (S)
163		SPRING WASHER M3
164		SCREW M3×6
165	05:B40322	SLIDE PIVOT
166	09:B42615	LEAF SPRING
167	04:B40281A	AXLE BRACKET
168		WASHER M3 (S)
169		SPRING WASHER M3
170		SCREW M3×6
171	04:A49727	LEVEL VIAL (S)
172		WASHER M3 (S)
173		SPRING WASHER M3
174		SCREW M3×6
175	03:A49716	LEVEL VIAL SUPPORT
176	00:B40469	LEVEL VIAL
177		SCREW M4×10



EXPLODED VIEW - 2

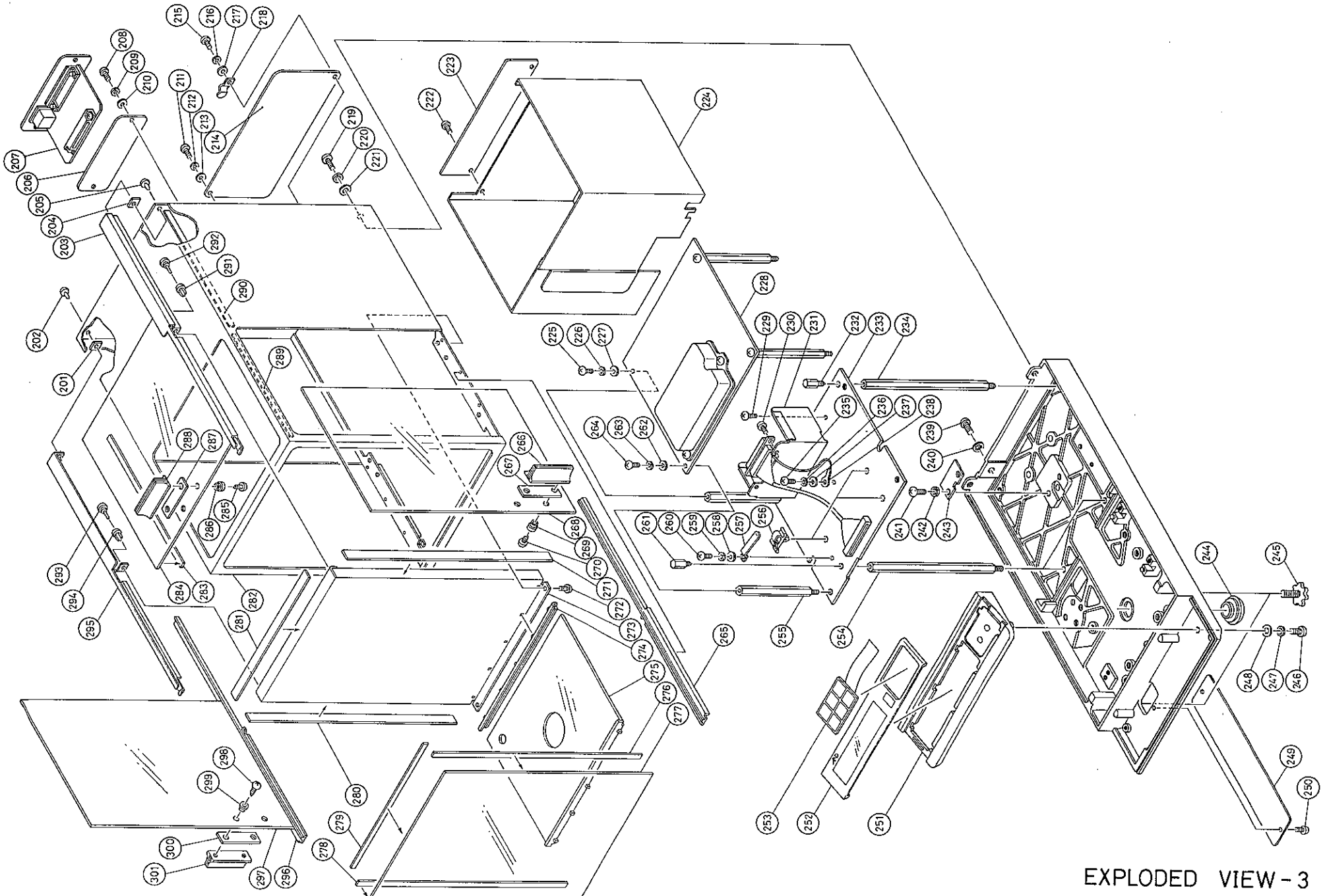
FR MARK II SERIES

EXPLODED VIEW 3

NO.	PARTS NAME	DESCRIPTION
201	06:B42152	SPACER, SPONGE
202	10:NO-85-N6	BUSH
203	04:A35216A-1	DOOR CASE GUIDE (RIGHT)
204	06:B42152	SPACER, SPONGE
205	10:NO-85-N6	BUSH
206	02:B40717	OPTION BRANK PANEL
207		OPTION UNIT
208		SCREW M3×6
209		SPRING WASHER M3
210		WASHER M3
211		SCREW M3×6
212		SPRING WASHER M3
213		WASHER M3
214	02:B40414	BRANK PANEL
215		SCREW M3×6
216		SPRING WASHER M3
217		WASHER M3
218	04:B40416	CABLE STOPPER
219		SCREW M4×5
220		SPRING WASHER M4
221		WASHER M4
222		SCREW M3×6
223	04:B40415	INNER CASE BLANK PANNEL
224	04:A35212A	INNER CASE
225		SCREW M3×6
226		SPRING WASHER M3
227		WASHER M3
228		MAIN BOARD
229		SCREW M3×6
230		SCEW M1.4×4
231	04:A35642A	CONNECTOR STAND
232	05:B40473	NUT
233	04:A35213C	SHIELD
234	05:A49732	SUPPORT PILLAR
235		SCREW M3×6
236		SPRING WASHER M3
237		WASHER M3
238	KO:556B-16-07	CABLE
239		SCREW M4×5
240		LOCK WASHER M4
241		SCREW M4×6
242		SPRING WASHER M4
243	04:A43230A	PILLAR GUIDE PLATE
244	07:A46858	UNDEHOOK CHASSIS PLUG
245	07:A46735A	LEVELING FOOT
246		SCREW M4×8
247		SPRING WASHER M4
248		WASHER M4
249	04:B40416	CABLE STOPPER
250		SCREW M3×6
251	07:A35208	DISPLAY CASE
252	01:A35209	FILTER
253	09:A35421	KEY PAD
254	05:A49732	SUPPORT PILLAR
255	05:A49733	SPACER
256	10:NO-573-N6	CABLE CRIP

EXPLODED VIEW 3

NO.	PARTS NAME	DESCRIPTION
257	04:B41517	FLAT CABLE CRANPER
258		WASHER M3
259		SPRING WASHER M3
260		SCREW M3×6
261	05:B40473	NUT
262		WASHER M3
263		SPRING WASHER M3
264		SCREW M3×6
265	07:A35217-1	PLASTIC DOOR RUNNER (R)
266	07:A43749D	DOOR KNOB
267	07:A44229C	CUSHION
268	00:A49738A	SIDE FLOOR PLATE
269	8QA:AC310	WASHER NYLON
270		SCREW M3×8
271	07:B44772-1	WINDOW BRAKER TAPE (1)
272		SCREW M3×4
273	02:A35215A	WEIGHTING CHAMBER REAR PANEL
274	07:A49745	PLATE HOLDER
275	00:A49739	GLASS FLOOR PLATE
276	06:A49743	DOOR STOP
277	00:A49736A	FRONT WINDOW
278	06:A49743	DOOR STOP
279	06:A49742	DOOR STOP
280	07:B44772-1	WINDOW BRAKER TAPE (1)
281	07:B44772-2	WINDOW BRAKER TAPE (2)
282	02:A10105A	UPPER CASE
283	07:B40468	SLIDE TAPE
284	00:A49737A	UPPER DOOR
285		SCREW M3×8
286	8QA:AC310	WASHER NYLON
287	07:A44229C	CUSHION
288	07:A43749D	DOOR KNOB
289	07:B44748	SLIDE TAPE (1)
290	07:B44749	SLIDE TAPE (2)
291	10:NO-1507-N6	BUSH
292	10:NO-1507-N6	BUSH
293	10:NO-1507-N6	BUSH
294	10:NO-1507-N6	BUSH
295	04:A35216A-2	DOOR CASE GUIDE (LEFT)
296	07:A35217-2	PLASTIC DOOR RUNNER (L)
297	00:A49738A	SIDE FLOOR PLATE
298		SCREW M3×8
299	8QA:AC310	WASHER NYLON
300	07:A44229C	CUSHION
301	07:A43749D	DOOR KNOB



EXPLODED VIEW - 3
FR MARK II SERIES