FA SERIES

MAINTENANCE MANUAL

Technical Document FA Series-V.1a

PRECISION ELECTRONIC BALANCES

MODELS:FA-200
FA-2000
FA-6000

A&D

Contents

Introduction

This technical informationl covers three different models from the A&D FA balance series, the: FA-200, FA-2000 and the FA-6000.

The FA series of high resolution multi-function balances is the product of years of research, design, development and in-field testing. It incorporates the latest advances in electronic and mechanical engineering and offers increased features, increased functions, high resolution and portability.

The FA series has three single range balances:
- FA-200 (210g x 0.001g)
- FA-2000 (2100g x 0.01g)
- FA-6000 (6100g x 0.1g)

Options include:
- OP-03 RS-232C - Current Loop Interface
- OP-04 NiCd battery packs for the FA Series
- OP-06 Glass breeze break for the FA Series (except the FA-6000)
- OP-09 Animal weighing pan for the FA-2000

FA Specifications	Capacity x Resolution		
	FA-200	FA-2000	FA-6000
Gram	210 x 0.001g	2100 x 0.01g	6100 x 0.1g
Repeatability/St. Dev.	0.001g	0.01g	0.1g
Linearity	±0.002g	±0.02g	±0.2g
Sens. Drift (10°-30°)	±3ppm/°C	±3ppm/°C	±8ppm/°C
Stabilization Time		2.5 sec (approx)	
Pan Size (mm)	ø105	ø150	185 x 210
Pan Size (inches)	ø4.1	ø5.9	7.3 x 8.3
Net Weight (approx.)	4 kg	4 kg	4.7 kg
Calibration Mass	200g	2000g	5000g

Principles of Operation

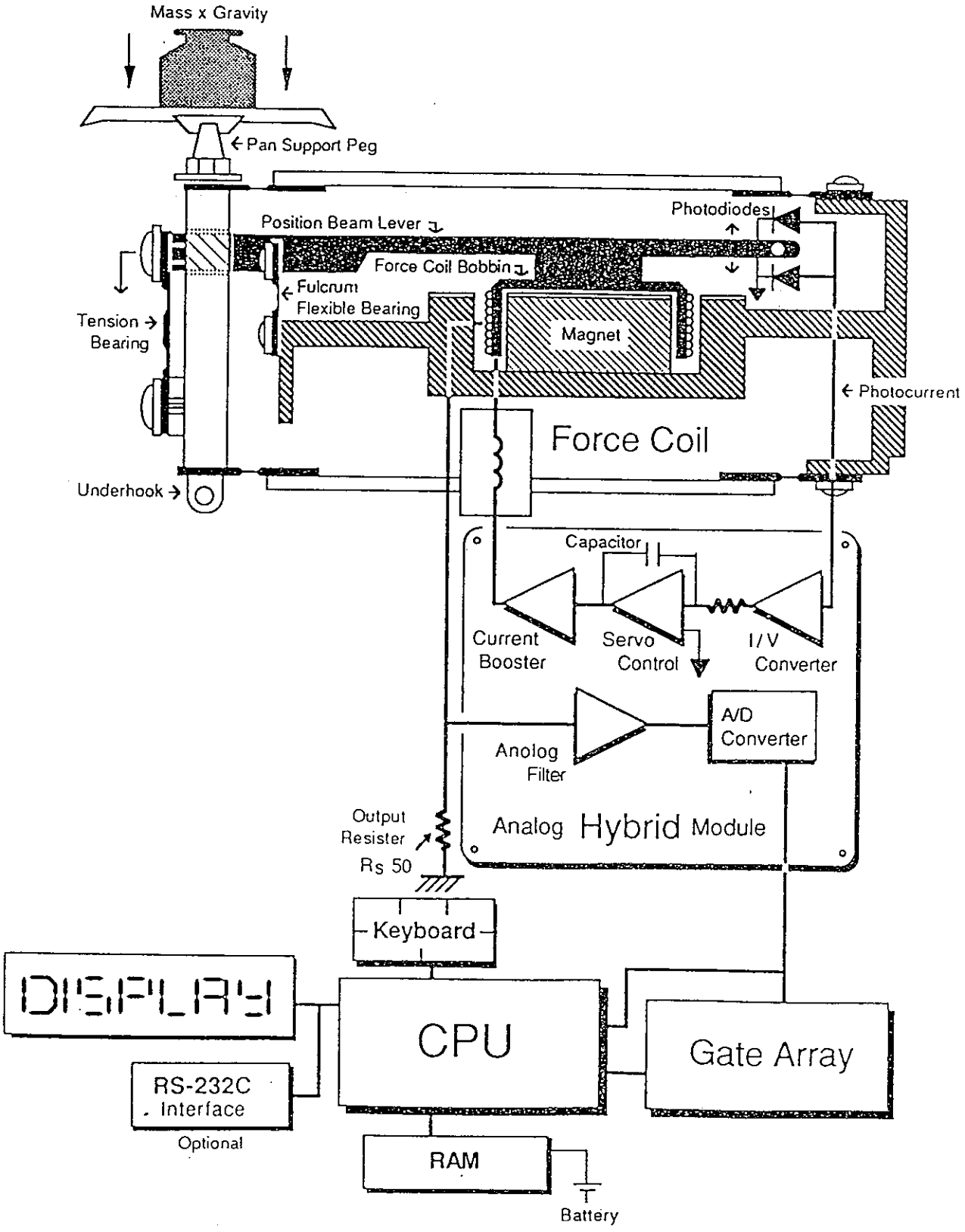
The FA balances work on the principle of "Force Restoration". Any change in the load on the weighing pan causes a Position Beam Lever to pivot on two Fulcrum Flexible Bearings (please see the FORCE MOTOR BLOCK DIAGRAM on the following page). Attached to this beam is a bobbin (wound with fine wire), called the "Force Coil", which floats in a permanent magnet, called the "Force Motor". At the end of the Position Beam Lever there is a small hole which allows light from a Light-Emitting Diode (LED) to pass through to two Photodiodes (light measuring diodes) as it moves up or down. 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 from a mass on the weighing pan, the Position Detector detects a change in the position of the Force Coil as the light reaching the upper Photodiode will be greater than that reaching the lower one. The balance then feeds the force coil with more voltage to pull it back until the light measured by the two Photodiodes is equal again. This is accomplished by the Analog HYBRID Module receiving photocurrent from the Photodiodes, converting it to voltage, and boosting it back to the Force Coil. As the voltage increases, so does the magnetic power, pulling the Force Coil back until the Position Detector reads equilibrium.

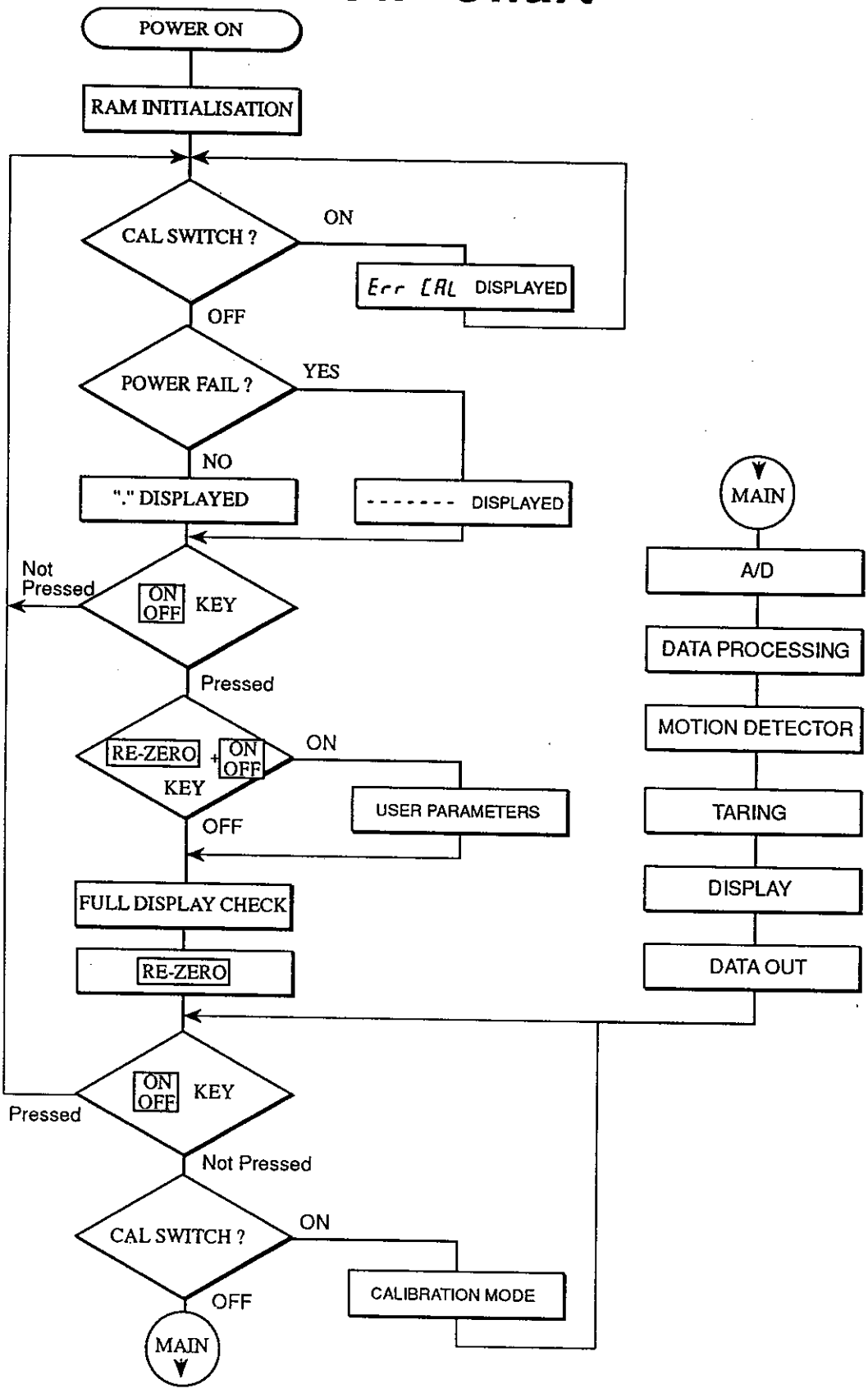
The current flowing through the Force Coil generates a voltage proportional to the load weight on the pan. This is read back through the HYBRID, first being filtered - then the Analog-Digital (A/D) Converter digitalizes this measuring voltage, the resulting value is counted and then fed to the microprocessor (CPU).

The CPU performs a multitude of commands and mathematical operations in conjunction with parameter and calibration information stored in random access memory (RAM) which is backed up by a long lasting Lithium Battery. Also, the user can specify how the calculated information should be displayed by using the keyboard. For example: the user can have the CPU perform special functions such as conversion into other measuring units, or counting of small parts. Finally, the results are displayed on the Fluorescent Display, or sent through the optional RS–232C interface.

Force Motor Block Diagram



Software Flow Chart

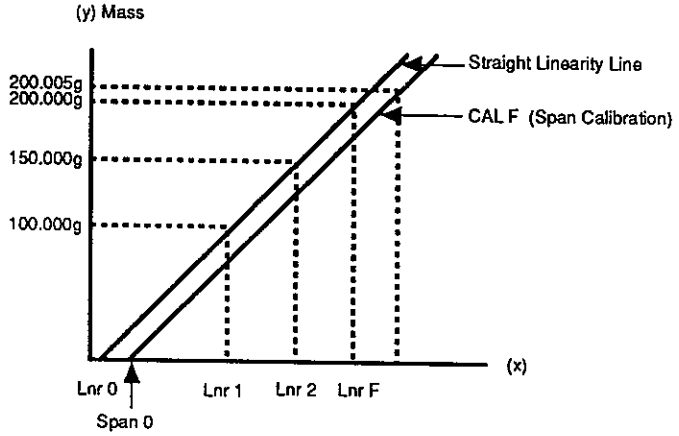


Calibration Introduction

Calibration of the balance is required when it is initially installed, when changing the installation site, and additionally every 90 days or so. It is necessary because the weight of a mass in one location is not necessarily the same in another location. Also, with time and use, mechanical deviations can occur. "Weight" equals mass times acceleration due to Earth's field of gravity. The internationally adopted value for gravitational acceleration is 9.80665 m/s^2 (32.174 ft/s^2) in a vacuum. However, this varies by about ±0.3 percent depending on how far you are from the Earth's center of mass. Mass distorts space in such a way that the gravitational power of attraction is inversely proportional to the square of the distance between material objects (if non-gravitational forces are ignored). So, gravitational acceleration is greatest at the poles, least at the equator and decreases with altitude. The sun and the moon exert inconstant forces of gravitational attraction. Air buoyancy (approx 0.0012g ±10% of air displaced per cm^3 at 20°C [68°F]) and other factors also vary from location to location and from time to time.

There are a number of calibrations that will need to be done in the life of an FA Balance, they are briefly explained below. The actual calibration procedures are contained throughout this manual, please see the TABLE OF CONTENTS.

Linearity Calibration means that when an FA-200 (for example) has been calibrated for span at 200g, an exact weight of 100g will display 100.000g and an exact weight of 200g will display 200.000g. That is, if you imagine a graph with the X axis representing the displayed weight and the Y axis the "true" weight of the mass on the pan, an accurate mass of any weight value will be plotted on a linear (straight line) path from zero to the maximum capacity. However, although a straight line will be generated in Linearity Calibration, this line must be correctly placed by the balance in Span Calibration.



Span Calibration: A very real problem is that the calibrating mass may not be as accurate as the balance. With Span Calibration we are shifting the straight line generated in Linearity Calibration (so that it will accurately read true weight) by giving it the exact known weight of the calibration mass as a reference point (see graph above). It is important to understand that an electronic balance is only as accurate as the accuracy of the mass used to calibrate it - for example:

If a FA-200 was calibrated with a 200g mass that actually had a true weight value of 200.005, then the balance would have been calibrated out of specifications: ±0.001d (one minimum division) at 200g. The error would be in the nature of 200.000 into 200.005 (=1.000025), instead of 200.005 into 200.005 (=1.0). This would result in a minimum division error at weights above 20g. This problem is avoided by entering in the true weight of the calibration mass when calibrating the balance.

Since the FA Balances are exceptionally accurate instruments, they should receive extremely accurate calibration. Span Calibration should be carried out when the balance is initially installed, when changing the installation site, and additionally every 90 days or so.

RAM: If the RAM is lost (by lithium battery failure, short, or component replacement) then all initialization and calibration data is cleared. The balance must then have the RAM re-initialized, plus Linearity and Span Calibration, and setting the Legal Functions - also, the user's needs may require resetting the Temperature Compensation Calibration.

Temperature Compensation Calibration: This procedure is considered an option. When the Initialization of RAM occurs, averages for temperature compensation are also reset. For average users and climates, this should suffice. However, since these are only averages, they might not be precise enough if the user requires a highly accurate balance, or if there are great changes in the ambient temperature.

As further explained in the PRINCIPLES OF OPERATION section (page 3), the FA Force Motors operate by a force coil moving in a permanent magnet. A change in ambient temperature causes a change in the temperature of the Force Motor, in turn altering the characteristics of the magnet. Unless this is compensated for, it will cause sensitivity drift problems. The FA balances use a transistor temperature sensor in the Force Motor to detect these changes in temperature. The temperature compensation settings, to match the temperature characteristics of the Force Motor sensor, are stored in random access memory (RAM) protected by a long lasting lithium battery.

If the balance is not calibrated for temperature compensation, then it will not be able to meet the FA sensitivity drift specifications. Also, if the Force Motor is replaced it includes a new Temperature Sensor, and Temperature Sensor Calibration should be carried out if the user requires a highly sensitive balance.

The Complete Initialization/Calibration Cycle for the FA Series:

Step 1. RAM Initialization.
Step 2. "Lnr", Linearity Calibration at 20~25°C (68~77°F).
Step 3. Span/Zero calibration at 20~25°C (68~77°F).
Step 4. Place in temperature testing chamber at about 5°C (40°F) for 4 hours.
Step 5. "tL", (temperature Low) calibration at 5°C (40°F).
Step 6. Turn up the heat and keep the balance at 35°C (95°F) for at least 4 hours.
Step 7. "tH". (temperature High) calibration at 35°C (95°F).
Step 8. Return balance to room temperature at 20~25°C (68~77°F) for 4 hours.
Step 9. "Lnr", Linearity Calibration at 20~25°C (68~77°F).
Step 10. Span/Zero calibration at 20~25°C (68~77°F).
Step 11. Priming the Balance for Legal Functions.

Calibration Masses: An FA balance is a high resolution instrument, so a high quality non-magnetic stainless steel mass should be used for calibration - OIML class F_2 or better. By international convention, weight in air is measured against the buoyant weight of steel in air. Steel has a density of about 8.0g/cm^3, Brass has about 8.4g/cm^3. So, 100g of steel would occupy: 100g ÷ 8g/cm^3 = 12.5cm^3. Since air buoyancy is 0.0012g/cm^3, we can calculate that 12.5cm^3 X 0.0012g/cm^3 = 0.015g of air displaced. Whereas a brass weight would only displace about 0.014g (100g ÷ 8.4g/cm^3 = 11.9cm^3, 11.9cm^3 X 0.0012g/cm^3 = 0.014g) of air unless it had been adjusted via a cavity to mimic steel density. By using a brass mass instead of steel, it would cause a one division error on the FA-200.

Table A Calibration/Adjustment Masses Required

FA MODEL	LINEARITY CALIBRATION MASSES		SPAN CALIBRATION MASSES	TEMPERATURE COMPENSATION CALIBRATION MASSES	CORNERLOAD ADJUSTMENT MASSES
Series	A	B	Span	Maximum Capacity **C** (A+B)	
FA-200	100g	100g	200g	200g	100g
FA-2000	1kg	1kg	2kg	2kg	1kg
FA-6000	1kg	5kg	5kg	6kg	2kg

Linearity Calibration

Linearity Calibration should be carried out during servicing of an FA Balance at a temperature of 20~25°C (68~77°F). The balance must be fully warmed-up (plugged in for 30 minutes) and all of the BEST CONDITIONS FOR WEIGHING should be met (see following page). After Linearity Calibration, the balance must be calibrated again for Span. An FA balance is a high resolution instrument so please use a high quality non-magnetic, metric, stainless steel, "Standard Mass" for calibration (≈8.0g/cm^3) OIML class F$_2$ or better (see CALIBRATION INTRODUCTION, pages 6-7).

Step 1. Start with no weight on the pan (0g) and the display *OFF*.

Step 2. Press and hold **RE–ZERO**, then press **ON/OFF**. Release **RE–ZERO.**

DISPLAY The display will come on with all segments illuminated.

Step 3. Press MODE.

DISPLAY The display will change to either "C0-(number)" or "C1-(number)". These are not important here, see owner's Instruction Manual for parameter definitions.

Step 4. Slide the **CAL** switch on⇑.

DISPLAY The display will now alternate between "Lnr", "tH' and "tL".

Step 5. Press **RE–ZERO** when "Lnr" (linearity) is displayed. (if you press at the wrong time, press **ON/OFF** and start over, do not press **RE–ZERO**)

DISPLAY "Lnr 0" will be displayed.

Step 6. Press **RE–ZERO.**

DISPLAY After a pause, "Lnr 1" will be displayed.

Step 7. Place the "A" mass for your balance (see Table A-1 below) on the weighing pan.

Table A-1 Linearity Calibration Masses

FA MODEL	LINEARITY CALIBRATION MASSES	
Series	**A**	**B**
FA-200	100g	100g
FA-2000	1kg	1kg
FA-6000	1kg	5kg

Step 8. Wait for stability and press **RE–ZERO**.

DISPLAY After a pause, "Lnr 2" will be displayed.

Step 9. Place the "B" mass for your balance (see Table A-1 above) on the weighing pan.

Step 10. Wait for the triangle to appear indicating stability, and press **RE–ZERO**.

DISPLAY After a pause, "Lnr F" will be displayed.

Step 11. Place the both the "A" and "B" masses for your balance on the weighing pan.

Step 12. Wait for stability and press **RE–ZERO**.

DISPLAY The display will now alternate between "Lnr", "tH' and "tL" again.

Step 13. Slide the **CAL** switch off⇓, press **ON/OFF** twice.

Step 14. Carry out Span Calibration (see following page).

Span Calibration

•Titled "CALIBRATING YOUR BALANCE" in the owner's Instruction Manual•

The Balance should be calibrated when it is first installed and then every 90 days or so. An FA balance is a high resolution instrument so please use a high quality non-magnetic, metric, stainless steel, "Standard Mass" for calibration (≈8.0g/cm^3) OIML class F_2 or better (see CALIBRATION INTRODUCTION, pages 6-7). Also, the balance must be fully warmed-up (plugged in for 30 minutes) and all of the BEST CONDITIONS FOR WEIGHING below should be met.

If your calibration mass is not exact but is known (eg: 200.05g instead of 200.00g with the FA-200) then we must set the balance to accept this value. When "CAL 0" is displayed (after Step 2.) press PRINT and "200.00" will be displayed. You may adjust the display to "200.05" by pressing the **MODE** key 5 times; next press **RE-ZERO** (Step 3.) and proceed with normal calibration. The value "200.05" will not be recalled next time you calibrate the balance, so be sure to set it again.

The complete cycle is Calibration Mass ±15 minimum divisions - for example: For an FA-200, the calibration mass is 200.00. The cycle progresses in the following order: 200.00, 200.01, 200.02, 200.03, 200.04, 200.05, 200.06, 200.07, 200.08, 200.09, 200.10, 200.11, 200.12, 200.13, 200.14, 200.15, then, 199.85, 199.86, 199.87, 199.88, 199.89, 199.90, 199.91, 199.92, 199.93, 199.94, 199.95, 199.96, 199.97, 199.98, 199.99, 200.00.

Step 1. Start with no weight on the pan (0g) and the display *ON*.

Step 2. Slide the **CAL** switch on⇑.

DISPLAY "CAL 0" will be displayed.

Step 3. Press **RE-ZERO.**

DISPLAY After a pause, "CAL F" will be displayed.

NOTE: If known: enter true weight of mass at this time (see above).

Step 4. Place the "**B**" mass for your balance (see Table A-1, preceding page) on the weighing pan.

Step 5. Wait for the triangle to appear indicating stability, and press **RE-ZERO**.

DISPLAY After a pause, "CAL End" will be displayed.

Step 6. Slide the **CAL** switch off⇓, press **ON/OFF** twice.

Notes: * "Err CAL" means Error in Calibration method (display was off?).
* "-CAL E" means the calibration mass is too light (check requirement).

Best Conditions for Weighing

* The Balance must be level (check the spirit level on the Balance).
* Best temperature is about 20°C (68°F), at about 50% Relative Humidity.
* The weighing room should be kept clean and dry.
* The weighing table should be of a solid construction.
* Corners of rooms are best, as they are less prone to vibrations.
* Don't install the balance near heaters or air conditioners.
* Don't install the balance in direct sunshine.
* Keep equipment containing magnets away from the balance.
* Use a breeze break to keep out drafts.
* Try to ensure a stable AC power supply.
* Clean the balance with a damp cloth only (don't use solvents).
* Warm-up before use or leave on standby (display off) overnight.

Temperature Compensation Cal.

• OPTIONAL - See CALIBRATION INTRODUCTION, pages 6-7 •

Temperature Compensation Calibration is necessary for the FA to be highly accurate. This is because a temperature change in the Force Motor alters the characteristics of the permanent magnet. Unless it is compensated for, this will cause sensitivity drift problems. The FA balances use a transistor Temperature Sensor integrated into the Force Motor assembly to detect temperature changes. The Temperature Compensation Calibration settings are then stored in random access memory (RAM) protected by a long lasting lithium battery. If the RAM is lost, then this calibration procedure will need to be performed again.

This is a lengthy procedure, and should not be rushed. Please take the time to read and study the order of all the steps below that must be undertaken for successful calibration.

Full Temperature Compensation Calibration Cycle:

Step 1. "Lnr", Linearity Calibration at 20~25°C (68~77°F).

Step 2. Span/Zero calibration at 20~25°C (68~77°F).

Step 3. Place in temperature testing chamber at about 5°C (40°F) for 4 hours.

Step 4. "tL", (temperature Low) calibration at 5°C (40°F).

Step 5. Turn up the heat and keep the balance at 35°C (95°F) for at least 4 hours.

Step 6. "tH". (temperature High) calibration at 35°C (95°F).

Step 7. Return balance to room temperature at 20~25°C (68~77°F) for 4 hours.

Step 8. "Lnr", Linearity Calibration at 20~25°C (68~77°F).

Step 9. Span/Zero calibration at 20~25°C (68~77°F).

A room or large temperature chamber with the range of 5°C (41°F) to 35°C (95°F) is required to carry out the Temperature Compensation Calibration. These temperatures do not have to be exact, but within a 6°C (10°F) range. If you have a room that can be adjusted to these temperatures it would be ideal - if not, then a temperature chamber will have to be used which is large enough so that the insertion of the technician's hand into the chamber to press the keyboard will not have an effect on the Temperature Sensor. Warm-up and cool-down time between temperatures is at least four hours, with the power connected.

PREPARATION: Complete a Linearity and Span Calibration before starting the following procedure. You may start with either the high or low calibration temperature point, but make sure that the balance has been adjusting to the ambient chamber temperature for at least four hours. This is imperative as the entire balance must reach the ambient chamber temperature. The balance itself must do its internal temperature warm up also. This can be accomplished by either the normal 30 min. warm-up prior to use, or leave the balance on during the four hour temperature change. DO NOT USE THE BATTERIES, IF INSTALLED, DURING THIS PROCEDURE. Initially, there should be nothing on the pan. Obtain the appropriate Temperature Calibration mass for your balance (see Table A-2, below). You must use the same physical mass(es) for both the high and low temperature calibration.

Step 1. With the display *OFF*, press and hold **RE-ZERO**.

Step 2. Press the **ON/OFF** key. Release **RE-ZERO**.

DISPLAY The display will come on with all segments illuminated.

Step 3. Press **MODE**.

DISPLAY The display will change to either "C0-(number)" or "C1-(number)". These are not important here, see user's Instruction Manual for parameter definitions.

Step 4. Slide the **CAL** switch on⇑.

DISPLAY The display will now alternate between "Lnr","tH" and "tL". These abbreviations are for Linear Calibration, Temperature High, and Temperature Low respectively.

Step 5. Depending on whether you are doing the high or low calibration temperature point, press **RE-ZERO** when the appropriate "tH" or "tL" appears. For this description we will describe "tH 0".

If you miss and press **RE-ZERO** for the wrong setting, simply slide the **CAL** switch off⇓, press **MODE** and slide the **CAL** switch on⇑. The display will again alternate between "Lnr","tH" and "tL".

DISPLAY "tH 0" ("tL 0" next time) will be displayed.

Step 6. Press **RE-ZERO.**

DISPLAY After a brief pause, "tH F" ("tL F" next time) will be displayed.

Step 7. Place the appropriate Temperature Calibration mass for your balance on the pan (see Table A-2, below). You must use the same physical mass(es) for both "tH F" and "tL F".

Table A-2 Temperature Compensation Masses

FA MODEL	TEMPERATURE COMPENSATION CALIBRATION MASSES
Series	Maximum Capacity **C** (A+B)
FA-200	200g
FA-2000	2kg
FA-6000	6kg

Step 8. Press **RE-ZERO.** Wait for the triangle to appear indicating stability.

DISPLAY After a brief pause, the display will now again alternate between "Lnr","tH" and "tL".

Step 9. Now, if you have not completed the Temperature Compensation Calibration ("tH" temperature high, and, "tL" temperature low) repeat the above steps after the balance has been four hours in the appropriate temperature. If you have completed the Temperature Compensation Calibration, let the balance sit at room temperature (20~25°C [68~77°F]) for four hours and proceed with Linearity and Span Calibration.

Troubleshooting-Operation

PROBLEM	POSSIBLE SOLUTIONS
Display Remains Dark	A) AC adaptor is not the correct one, or not plugged in. B) Internal fuse has blown. C) AC power voltage is too low. D) Battery switch is OFF. E) If battery switch is ON, then adaptor is connected to balance but is not plugged in F) Battery is discharged. G) Battery is dead - no longer able to hold a charge.
"-------"	A) Power supply was cut off during measurement.
"Lb" is displayed	A) AC adaptor is not the correct one. B) AC power line voltage is too low. C) Battery is discharged. D) Battery is dead (no longer able to hold charge).
"Err CAL" is Displayed	A) The CAL (Calibration) Switch was turned ON (slid up) while the display was off.
Balance will not work from the battery.	A) Battery switch is OFF. B) Battery is discharged. C) Battery is dead (no longer able to hold charge).
Weighing Values are Unstable	A) Weighing table is not stable. B) There is a draft or vibration. C) The pan, or pan support, is touching something. D) The object being weighed is touching the Breeze Break, or the upper case. E) The filter strength is weak.
Repeatability Error (Balance does not consistently display the same value for the same weight.)	A) The pan, or pan support, is touching something. B) The object being weighed is touching the Breeze Break, or the upper case.
Measurement Value is Wrong	A) The display wasn't at zero before the object was placed upon the pan.
Display remains at "E" or "-E"	A) The pan, pan support or balance weight is missing. B) The pan, pan support or balance weight is not correctly installed.
"CAL E" or "-CAL E" is displayed When Calibrating	A) Calibration weight is too heavy (CAL E) or too light (-CAL E).
After pressing RE-ZERO the display remains "." for Longer than Normal	A) The weighing table is not stable. B) There is a draft or vibration. C) The pan, or pan support, is touching something. D) The object being weighed is touching the Breeze Break or the upper case. E) The filter strength is weak.
NiCd Battery will not Recharge	A) Battery switch is ON.

Troubleshooting-Repair

Display Remains Dark	A) AC adaptor is not the correct one. B) Plug KO:441, or battery cable, is not plugged in. C) The connection cables between the main board and the CAL switch board are defective. D) Power circuit section on the main board is defective.
The Fuse Blows Often	A) Fuse rating is wrong. B) AC adaptor is the wrong one. C) Power circuit section on the main board is defective.
Display Shows Chaotic Symbols (can't read them as numbers/letters)	A) Fluorescent Display is defective. B) Poor soldering of the CPU pins, dry solder joints. C) CPU is defective.
Display Remains "E" or "-E"	A) Something is touching the Weighing Pan. B) Stopper Plate is not correctly adjusted. C) Force Coil Bobbin is out of adjustment. D) Flexible Bearing Assemblies are defective. E) The connection cables between the main board and the CAL switch board are defective. F) Lithium battery is dead (RAM values are lost). G) Poor soldering of the CPU pins. H) Connection cables to the Force Motor are defective. J) Zero resistor or Span resistor soldering is poor. K) Zero resistor or Span resistor is not correct. L) Power circuit section on the main board is defective. M) CPU is defective. N) Hybrid is defective.
Weighing Values are Unstable	A) Dust on the Force Motor magnet assembly. B) Loose screws on the Force Motor. C) Flexible Bearing Assemblies are defective. D) Tension/Fulcrum Flexible Bearings or Links are improperly mounted or defective. E) Lithium battery is dead (RAM values are lost) F) Temperature Sensor wire is broken, or grounding. G) RAM is defective.
Repeatability Error (Balance does not consistently display the same value for the same weight)	A) Dust on the Force Motor magnet assembly. B) Cornerload is not adjusted. C) Flexible Bearing Assemblies are defective. D) Tension/Fulcrum Flexible Bearings or links are improperly mounted or defective.
Stabilisation Time Varies Greatly	A) Stopper plate is not adjusted corectly.
Cornerload Can't Be Adjusted	A) Loose screws on the Force Motro. B) Flexible Bearing Assemblies are defective. C) Tension/Fulcrum Flexible Bearings or links are improperly mounted or defective.
Linearity is not within tolerance	A) Test masses are not accurate. B) Cornerload is not adjusted.
Linearity can't be adjusted	A) Loose screws on the Force Motor. B) Cornerload is not adjusted. C) Tension/Fulcrum Flexible Bearings or links are improperly mounted or defective.

Electronic Fault Finding

Power/Battery Check

Electronic

√ **Adaptor:** The adaptor that was supplied with the FA series is the one that should be used. If "Lb" is displayed while using the power adaptor then it is providing too little voltage to the balance.

√ **Batteries:** The life of the rechargeable battery will vary greatly with frequency of charge and use of the balance. A display "Lb" means that the battery level is too low for the balance to work correctly. If the battery cannot seem to hold a charge, check it by: charging for fifteen hours, and if the FA cannot run for 5 hrs, (≈50% of normal), then replace battery.

√ **Fuse:** If the fuse (0.5amp) keeps blowing, then there is a short. Check circuitry for objects touching, or broken circuit paths (see VISUAL CHECK). Also, check the power supply electronics as they are suspect.

Visual Check

Electronic

√ Look for dirt, or foreign objects anywhere in the balance.

√ Check for dust on the Force Motor, or anything touching it.

√ Check for anything touching circuity. Look carefully at the circuity for possible grounding, broken circuit paths, solder dry joints, or damage to the board.

√ Look at suspect units for broken connections.

RAM Check

Electronic

√ If the RAM has been lost, then the balance at start-up will read "–E" when weighing is attempted, not "0.0 g" as it should be.

√ You can also check what Span Calibration mass is in memory by doing a **Print Check** (see page 17). It should match the Span Calibration mass for your balance, if not, then RAM has been lost.

√ To check if the RAM memory is defective, set a different user parameter (see **Setting User Parameters** in the owner's Instruction Manual) such as "C0–1", then disconnect the power supply. After reconnecting the power supply, check the parameter setting. If it is different, then there is something wrong with the RAM memory.

√ If RAM memory is defective, do a LITHIUM BATTERY CHECK (page 17). If it's OK, check all circuitry, and finally replace the RAM if nothing wrong is found with the battery or circuitry.

A/D Converter Check

Electronic

When checking the A/D Converter we will be looking at the inner A/D count from the Force Motor. Two weighing conditions will be tested, and at the appropriate step you will be reading a number on the display and comparing it to Table B. below.

Step 1. Start with nothing on the pan (0g).

Step 2. With the display on, and the **CAL** switch off⇓, press and hold **RE–ZERO**.

Step 3. Slide the **CAL** switch on⇑. Release **RE–ZERO**.

DISPLAY "CCCCCCC" for Check Mode will be displayed.

Step 4. Slide the **CAL** switch off⇓.

DISPLAY This will give the internal A/D Converter value. Vibrations or drafts may cause fluctuations, disregard.

Step 5. Place Maximum Capacity mass for the balance on the pan (see Max. Cap. Masses, in Table B., below). Let the displayed number equal **X** (Maximum Capacity = X).

Step 6. Now, remove all weight. Let the displayed number equal **Y** (0g = Y).

Calc Subtract: Maximum Capacity minus 0g, let it equal **Z**. (**Z = X - Y**).

Step 7. Check Table B. below for the appropriate A/D Converter value for X, Y and Z. If the numbers are in the correct table range, go to the VOLTAGE CHECK section.

If the X, Y, and Z values are not in the proper range, then the A/D Converter or Force Motor is not working correctly.

Table B Internal A/D Convertor Value

Model	Max. Cap. Masses	Max. Capacity = X	0 g = Y	Z = X - Y
FA-200	300g	X ≤ 900,000	60,000 ≤ Y ≤ 150,000	650,000 ≤ Z ≤ 800,000
FA-2000	3kg	X ≤ 900,000	60,000 ≤ Y ≤ 150,000	650,000 ≤ Z ≤ 800,000
FA-6000	6kg	X ≤ 750,000	Y ≥ 300,000	270,000 ≤ Z ≤ 350,000

Step 8. Try cleaning the Force Motor assembly and check all wiring and circuits, make sure that nothing is touching the Force Motor assembly - then run the check again. Continue if there is still a problem.

If you are testing the FA, turn the board over and look at Register 53. If there is nothing there, determine and attach the appropriate resistor. Also check for the proper resistors in registers 50,51, and 52 (see DETERMINING FA SERIES RESISTORS, page 21) change or add as needed, run the check again. If everything checks correctly, change the HYBRID Unit, as the servo control would be suspect, run the check again, replace the main board if there is still a problem.

Voltage Check
Electronic

√ **Check Voltage:** There are a number of voltage checks that can be carried out on the main board for pinpointing faulty electronics. If the voltage is out of the ranges below, replace connecting electronics.

Location		Voltage Range
GND	U1 Case	-11 V ~ -9V
GND	VCC	9 V ~ 11V
GND	LG (logic ground)	-5.9 V ~ -5.4V
GND	VSS	-34 V ~ -30V
LG	VDD (top of R:28)	4.5 V ~ 5.5V

√ **Display Panel Filament:** If needed, see **Display Panel Filament Check** at the end of this section.

Waveform Check
Electronic

If everything is correct in the **Voltage Check** section above but the displayed value is still incorrect, then either the CPU or the Gate Array is at fault. We will be able to tell by the waveform that is generated during testing. See the Waveform table, page 19, for the testing points (also see Main Board Drawing, page 18). If an incorrect waveform is found, then replace the unit (either CPU or Gate Array) that is the generator of the signal.

ANALOG HYBRID MODULE Check
Electronic

When checking the HYBRID module we will be looking at the inner, or naked A/D count - free of any readings from the Force Motor or Temperature Sensor. At the appropriate step you will be reading a number on the display and comparing it to Table C., below.

Step 1. Disconnect the following cables from the main board: (J4) from the Force Motor assembly, and (J5) from the Temperature Sensor.

Step 2. With the display on, and the **CAL** switch off⇓, press and hold **RE-ZERO**.

Step 3. Slide the **CAL** switch on⇑. Release **RE-ZERO.**

DISPLAY "CCCCCCC" for Check Mode will be displayed.

Step 4. Slide the **CAL** switch off⇓.

DISPLAY This will give the naked offset voltage from the HYBRID , the internal A/D Converter value. Sometimes "-E" will come on and off, this is okay.

The last digits of the displayed number could be fluctuating, disregard.

Step 5. Check Table C. below for the appropriate A/D Converter value. If the number displayed is in the correct range on the table, go to the Temperature Sensor check.

Table C. Naked Internal A/D Convertor Value

Model	Range
FA-200 with R53=5.2kRF	350,000<Display<370,000
FA-2000 with R53=10kRF	280,000<Display<300,000
FA-6000 with R53=Short	490,000<Display<520,000

If the displayed value is not in the proper range, then either the HYBRID or A/D Converter is not working correctly.

Step 6. If you are testing the FA, turn the board over and look at Register 53. If there is nothing there, then put in the appropriate resistor (see DETERMINING FA SERIES RESISTORS, page 21). Repeat the above test procedure and if it still does not read correctly, then the HYBRID unit will have to be replaced.

Temperature Sensor Check
Electronic

It would be very rare for the Temperature Sensor to become defective. But, if it is defective, the entire Force Motor assembly will have to be replaced since the Temperature Sensor is an integral part. If the HYBRID unit has checked out correctly, and things are still not right, then check the Temperature Sensor as follows:

Step 1. If disconnected, reconnect the cables from the Force Motor assembly (J4) and the Temperature Sensor (J5), and replace the weighing pan.

Step 2. With the display on and the **CAL** switch off⇓, press and hold **RE–ZERO**.

Step 3. Slide the **CAL** switch on⇑. Release **RE–ZERO.**

DISPLAY "CCCCCCC" for Check Mode will be displayed.

Step 4. Slide the **CAL** switch off⇓.

DISPLAY This will give the voltage from the HYBRID, disregard.

Step 4. Press **MODE.**

DISPLAY At room temperature (approx. 25°C [77°F]) the display should read between "450000" and "550000". If the displayed values are correct, then go to Step 6.

Step 5. If the displayed values are not in the correct range, cool the balance and then watch the display as the balance warms. For every one degree increase in the temperature of the balance, the display should decrease by –"002000". If this happens, then the Temperature Sensor is okay. Go to Step 6.

I am sorry to say if you are still here, then the Temperature Sensor is not working correctly and the Force Motor Magnet assembly, containing a new sensor, will have to be replaced.

Step 6. Return to the normal display by pressing **ON/OFF**.

Lithium Battery Check
Electronic

The life of the Lithium Battery should be about eight years. If the user cannot seem to keep the calibration parameters stored, or if they have just disappeared altogether there might be a problem with the Lithium Battery. The Lithium Battery is a flat round metal object, with plastic coated trim. It sits perpendicular to the main board by the HYBRID unit and U7 (see Main Board Drawing, page 19).

Step 1. Make sure all power is off to the main board. Disconnect the power cord, and, if the optional battery pack is installed, make sure the switch is turned off.

Step 2. Test with voltmeter (5V range) at D11 and LG (see Main Board Drawing, page 19). Let the voltage equal A.

Step 3. Test point between LG and U7 (RAM #24), let the voltage equal B.

CALC B minus A should be less than 1mV, and voltage B should be more than 2.5V. If your readings correspond, then the battery is okay.

If B is less than 2.5V then replace the battery.

If B minus A is more than 1mV then the battery is being drawn too fast indicating a problem with Q4 (see Circuit Diagram) or the surrounding diodes. Check for shorts in leads and board, replace all parts in loop (see Circuit Diagram) Recheck, and if the reading is still wrong, replace RAM U7.

Print Key Check
Electronic

Sometimes it is difficult to tell if the print key is working without (or with) the optional RS-232C interface. There is a simple check for the **PRINT** key:

Step 1. Turn the display on.

Step 2. Slide the **CAL** switch on⇑.

Step 3. Press **PRINT**.

DISPLAY If the **PRINT** key is working correctly, the Span Calibration mass for your balance will be displayed, eg: 200.000g for the FA-200 (see Table A, page 7). If nothing is displayed then the **PRINT** key is defective and the entire keyboard will have to be replaced.

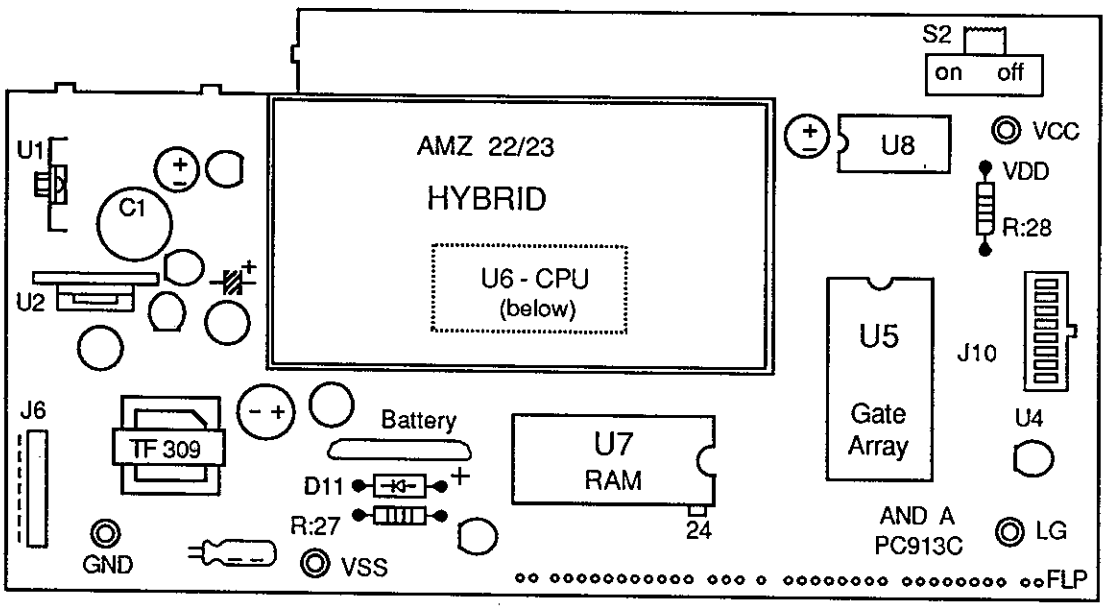
Display Panel Filament Check

Electronic

√ The voltage check for the Display Panel Filament is at pins #1 and #40, the voltage should be AC 3.0V~3.5V.

√ If the voltage is correct, then with the power on, look at the display panel in the dark and look at the wire filaments running horizontally through the panel. If the filaments look dim red, then the display panel is okay.

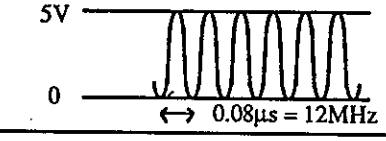
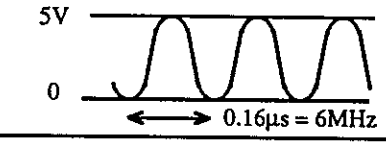
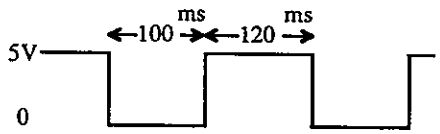
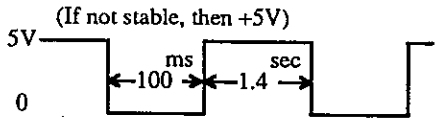
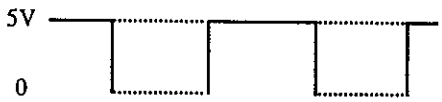
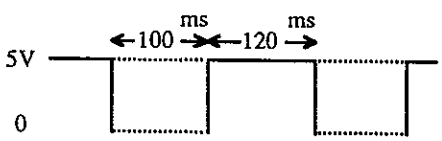
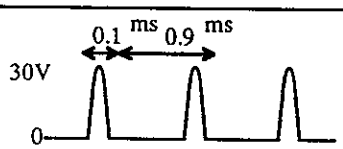
√ If the Display Panel is already removed from the main board, the you can check the filaments by connecting an Ohm meter at pins #1 and #40. The value should be 40Ω ±5Ω.



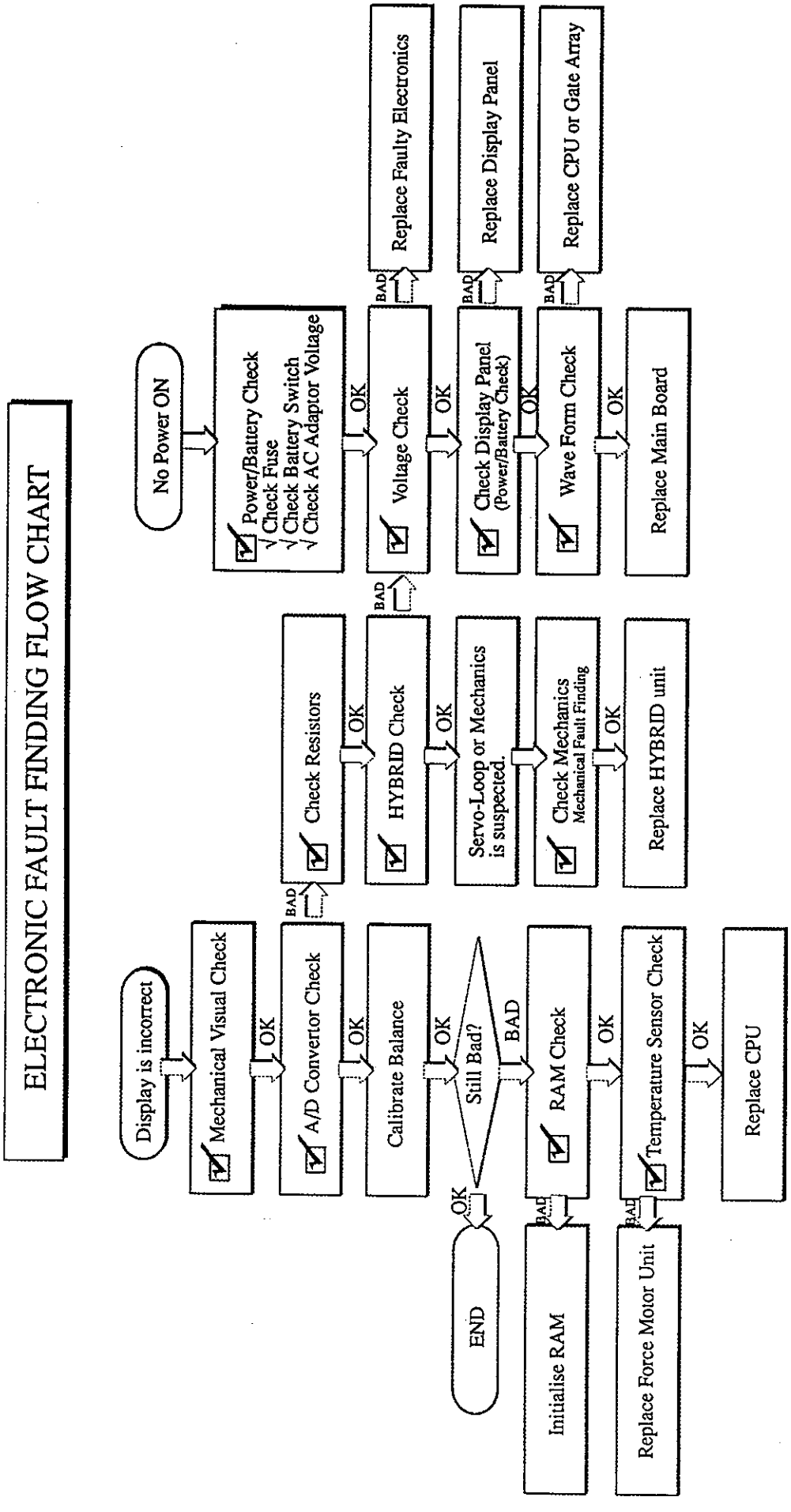
Main Board Drawing

Waveform Check - LOGIC WAVEFORM

Electronic

	No.	Signal Name	Test Points	Wave Form	Comments
Clock for CPU + Gate Array	1	OSCI $\overline{OSC2}$	U5(10) U5(12) ~LG		Gate Array (U5) Clock Input
	2	X_1 X_2	U5(9),U6(24) U5(8),U6(23) ~LG		CPU (U6) Clock Input
A/D Converter Signal	3	$\overline{AZ}$	U6(9) ~ LG		A/D Auto Zero
	4	$\overline{WIST}$	U5(4) U6(8) ~ LG		Weighing A/D 1st Signal
	5	$\overline{TIST}$	U5(15) U6(7) ~ LG		Temperature A/D 1st Signal (When Stable)
	6	$\overline{CNTE}$	U5(16) U6(6) ~ LG		A/D Count Enable
	7	EVENT	U5(7) U6(22) ~ LG		A/D Count Pulse 2^8 bit.
	8	$\overline{CMP\ I}$	U5(17) ~ LG		Comparator Input from HYBRID to Gate Array
	9	$T_0 \sim T_9$	U6(41-50) FLP 1G~11G ~VSS		Display Timing
	10	$\overline{CSW\ I}$	U5(33) ~ LG	If CAL is OFF, then H (+5) If CAL is On, then L (0)	CAL switch Input Reading
	11	$\overline{KSWE}$	U5(28) ~ LG		Key Switch Enable

Electronic Fault Finding Flow



Determining FA Series Resistors

When an FA balance main board is replaced you will need to determine and install the proper output resistors for the balance. This is accomplished by going into a Resistor Check Mode, determining a value, comparing that value to a test, and then choosing and install the proper resister. If you install new resistors, then you will also need to Initialize the balance when finished, and do Linearity and Span Calibration (you may also want to do Temperature Compensation Calibration). Please: read CALIBRATION INTRODUCTION, page 6; and see INITIALIZATION OF RAM, page 24.

Determining if Resistor is attached at Register R_S 53

Step 1. With the display on and the **CAL** switch off⇓, press and hold **RE–ZERO**.

Step 2. Slide the **CAL** switch on⇑. Release **RE–ZERO.**

DISPLAY "CCCCCCC" for Check Mode will be displayed.

Step 3. Slide the **CAL** switch off⇓.

Step 4. Place Maximum Capacity mass on scale (see Maximum Capacity Masses, Table D., below)

DISPLAY Find the permissible range for your balance with Maximum Capacity in Table D., below. Compare with the displayed number.

If it is not correct, check register R_s53, and if the resistor below has not been installed, do so at this time. Recheck.

FA-200 = RF:5.2kRF
FA-2000 = RF:10kRF
FA-6000 = RF:

If the value is still not correct, check the mechanical unit and recheck the value. If that does not correct the problem, do a **HYBRID Check**, page 15 - or, replace the board.

Table D. A/D Convertor Value

Model	Max. Cap. Mass	Max. Capacity	0 g
FA-200	300g	X≤900,000	60,000 ≤ Y ≤ 150,000
FA-2000	3kg	X≤900,000	60,000 ≤ Y ≤ 150,000

Determining the Span Resistors R_S 50 › 52

Step 6. Empty the balance pan (0g).

DISPLAY Let the displayed value equal D_1.

Step 7. Place Maximum Capacity Mass on the balance pan (Table D. above).

DISPLAY Let the displayed value equal D_2.

CALC If $650{,}000 \leq (D_2 - D_1) \leq 800{,}000$ then R_s51 is open ($R_s51 = \infty$).

If $800{,}000 \leq (D_2 - D_1) \leq 900{,}000$ then perform the following calculation:

FA-200	$\mathbf{R51} = \dfrac{1}{\dfrac{D_2 - D_1}{780{,}000} - 1} \times 86\ (\Omega)$	RF= 490k RF, 1k RF, 2k RF
	First Calculate	**Then Match Result to Closest**
FA-2000	$\mathbf{R51} = \dfrac{1}{\dfrac{D_2 - D_1}{780{,}000} - 1} \times 34\ (\Omega)$	RF= 490k RF, 1k RF
	First Calculate	**Then Match Result to Closest**

Match the calculated result from the left to the nearest resistor value listed on the right.

Step 8. Install the appropriate resistor into register R_s51.

Step 9. Enter Check Mode again by performing Steps 1-3.

Step 10. Empty the balance pan (0g).

DISPLAY Let the displayed value equal V_1.

Step 11. Place Maximum Capacity Mass on scale.

DISPLAY Let the displayed value equal V_2.

CALC Subtract V_1 from V_2 (V_2-V_1). Check to make sure that $650{,}000 \leq (V_2 - V_1) \leq 800{,}000$.

If not, check the Force Motor Assembly for dirt or anything touching it, and check the applicable electronic leads, then repeat from Step 9. If things are still wrong, do a board check (see ELECTRONIC FAULT FINDING, page 20) - or replace board.

Determining the Span Registers R_S 53 , 54

CALC a) If $60,000 \leq V_1 \leq 150,000$ then R_s53 equals:

FA-200 = RF:5.2kRF
FA-2000 = RF:10kRF

then R_s54 should have nothing attached ($R_s54 = \infty$).

b) If $V_1 \geq 150,000$, then change R_s53 to:

FA-200 = RF:10kRF
FA-2000 = RF:20kRF

and leave R_s54 open ($R_s54 = \infty$).

c) If $V_1 \leq 60,000$, then let R_s53 equals:

FA-200 = RF:5.2kRF
FA-2000 = RF:10kRF

and calculate for R_s54:

FA-200	$R_S54 = 20 \times \frac{20,000}{100,000 - V_1}$ (kΩ) **First Calculate**	RF = 3.9kRF / 5.2kRF / 10kRF **Then Match Result to Closest**
FA-2000	$R_S54 = 20 \times \frac{30,000}{100,000 - V_1}$ (kΩ) **First Calculate**	RF = 5.2kRF / 10kRF / 20kRF **Then Match Result to Closest**

Match the calculated result from the left to the nearest resistor value listed on the right.

Step 12. After the appropriate resistors have been determined, install them. Then, Initialize the balance, and do Linearity and Span Calibration (you may also want to do Temperature Compensation Calibration). See: CALIBRATION INTRODUCTION, page 6; and INITIALIZATION OF RAM, page 24.

Initialization of RAM

This procedure is to be done only by an authorized representative of A&D, and is necessary only when a loss of memory has occurred. A loss of memory can occur from a battery failure, a short circuit, or component replacement. To successfully complete this procedure you will need to Initialize the RAM, do Linearity and Span Calibration, and you may also want to reset the Temperature Compensation Calibration. Please read the CALIBRATION INTRODUCTION chapter, page 6, and see the **The Complete Initialization/Calibration Cycle for the FA Series** section in it.

Step 1. With the display on, and the **CAL** switch off⇓, press and hold **RE–ZERO**.

Step 2. Slide the **CAL** switch on⇑. Release **RE–ZERO**.

DISPLAY "CCCCCCC" for Check Mode will be displayed.

Step 3. Slide the **CAL** switch off⇓.

DISPLAY Inner A/D count numbers will be displayed, they are to be ignored here.

Step 4. Slide the **CAL** switch on⇑.

DISPLAY "4","6","L" will flash by repeatedly in one second intervals. These numbers correspond to the following model numbers:

"4"	=	FA-200	NOTE: If you select the wrong
"6"	=	FA-2000	number, press **ON/OFF** and
"L"	=	FA-6000	start over.

Step 5. When the number corresponding to your balance flashes by on the display, press **RE–ZERO**.

DISPLAY "FFFFFFF" for Function initialization will be displayed.

Step 6. Press **SAMPLE** and **MODE** together.

DISPLAY "PPPPPPP" for Parameter initialization will be displayed.

Step 7. Press **SAMPLE** and **MODE** together.

DISPLAY "EEEEEEE" for Exit will be displayed.

Step 8. You can now get back to the normal display by sliding the **CAL** switch off⇓.

Step 9. You have now completed the initialization process, and it is necessary to complete Linearity and Span Calibration. You may also want set the Temperature Compensation Calibration if needed (see page 10).

Mechanical Fault Finding

This section can be photocopied and used as a check sheet -
Simply mark the boxes provided after each step is successfully completed.

Visual Check
Mechanical

√ If any damage is found in the following visual checks, replace the damaged unit.

❑ **Balance Case and Chassis:** There should be no cracks or gaps in the balance housing. Check that all housing screws are in place.

❑ **Adaptor:** The adaptor that was supplied with the FA is the one that should be used. Check the wire for kinks, breaks, holes in the wire insulation, and good connection with the wall plug.

❑ **Keyboard:** The Keyboard pad should be free of cracks or tears. When a key is depressed, contact should be felt, and a faint clicking sound heard.

❑ **Weighing Pan:** The Weighing Pan should be free of dents or bends, and parallel to the balance. The pan support leaf spring should not be bent. Also, the Pan Guard should lie flat against the case, and its lip should not be touching the Weighing Pan or support.

❑ **Protective Cover:** The protective plastic cover should lie flat against the case, be free of cracks or gaps, and not interfere with the movement of the Weighing Pan.

❑ **Level Vial:** The level vial should be filled with fluid and the leveling bubble should be within the circle at the top. Use the front Adjustable Feet to level.

❑ **Adjustable Feet:** The Adjustable Feet dials should be parallel with the chassis, and turn smoothly.

❑ **RS-232C:** (Option OP-03) Check for any damage, including dirt in the connectors.

Function Check
Mechanical

√ Perform the following check to see if the Keyboard functions are working correctly.

Step 1. Press **ON/OFF** – The display should show: " . " or " ----------". ❑

Step 2. Press **RE–ZERO** – The display should blank, and then read zero. ❑

Step 3. Press **MODE** and select "Pct" or "cnt". The display should read: " ## cnt", or " #.## Pct", then press **SAMPLE • %**. The display should read: " 10 0 cnt" or " 100 0 Pct". ❑

Step 4. Press **SAMPLE • %** – "Lo" should be displayed. ❑

Step 5. Slide the **CAL** switch on⇑ – "CAL 0" should be shown. ❑

Step 6. Press **PRINT** – The calibration mass value should be displayed (see Table A., page7). ❑

Step 7. Slide the **CAL** switch off⇓.

Cornerload Check

Mechanical

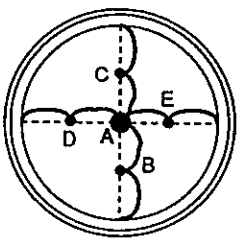
√ After the normal Cornerload adjustment has been performed (see CORNERLOAD ADJUSTMENT), carry out the following check.

Step 1. Place the Test Mass for your balance (Table E.) at point "A".

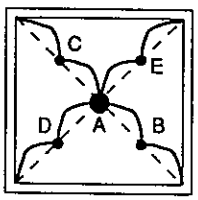
Step 2. Press **RE–ZERO**.

Step 3. Next move the mass to the four points "B" through "E" (the points are halfway between the center of the pan and the rim).

MODEL	TEST MASS	TOLERANCE
FA-200	100 g	±0.002g
FA-2000	1 kg	±0.02g
FA-6000	2 kg	±0.1g



FA-200, FA-2000



FA-6000

Table E Cornerload Check

Step 4. Check the deviation from the listed Tolerance (above).

√ If the results are <u>not</u> within tolerance, check for:

A) Loose screws on the Force Motor.

B) Defective Flexible Bearing Assemblies.

C) Defective Fulcrum Flexible Bearings, Tension Bearings, or links that are improperly mounted or defective.

Linearity Check
Mechanical

√ Test the Balance with the masses listed below, and check that the display reads in the acceptable tolerance range.

NOTE: Before checking the linearity:

1) The balance must be calibrated.

2) The cornerload error should be within tolerance.

3) Test weights must be accurate.

4) Take care to place the weight on the center of the pan.

Table F Linearity Check

MODEL	TEST MASSES	TOLERANCE
FA-200	75g 150g 200g	±0.002g
FA-2000	750g 1500g 2000g	±0.02g
FA-6000	2000g 4000g 6000g	±0.1g

√ If the results are <u>not</u> within tolerance, check the items listed below. If the items listed below are okay, then disassemble and reassemble the balance.

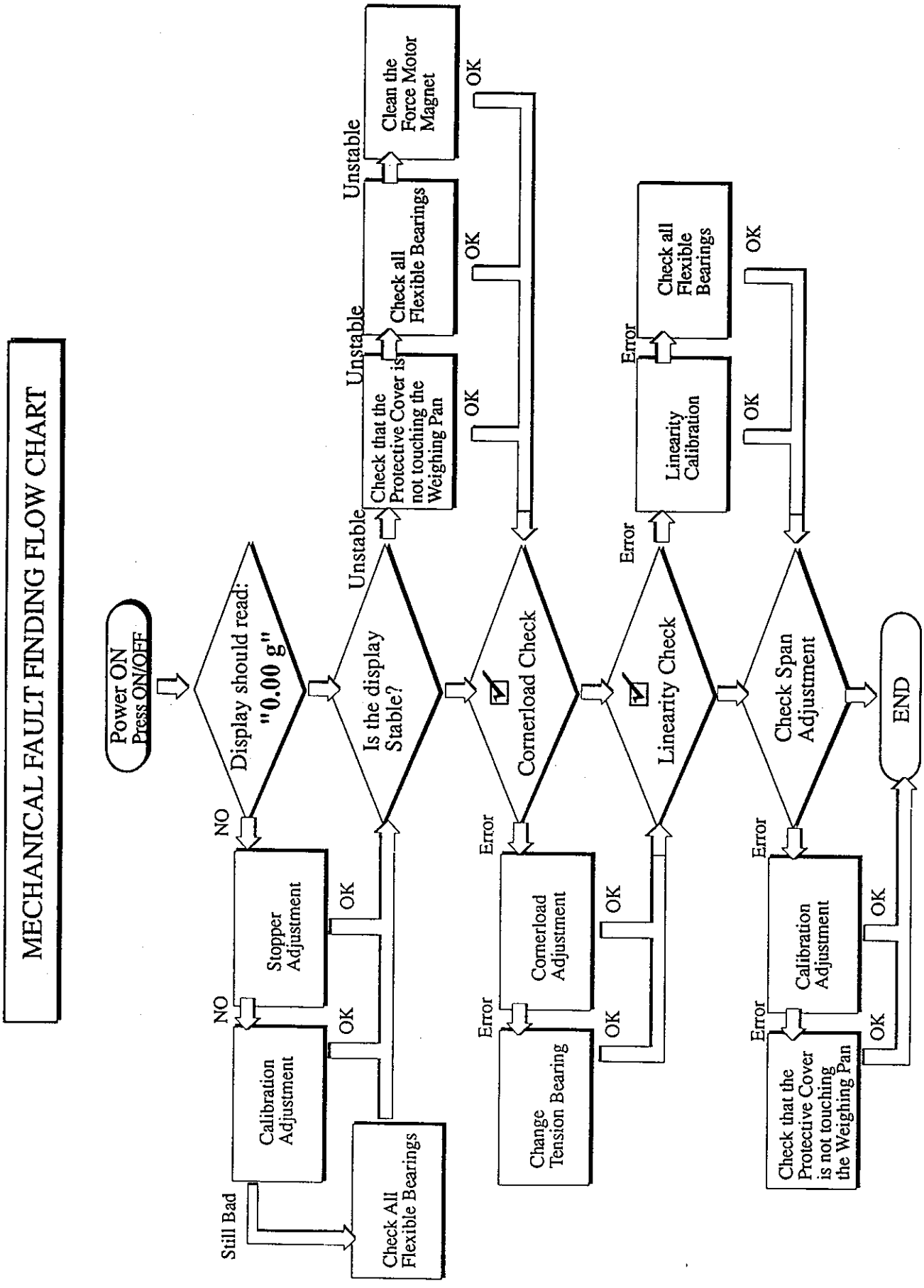
A) The Cornerload not adjusted properly.

B) Loose screws on the Force Motor.

C) Defective Flexible Bearing Assemblies.

D) Defective Fulcrum Flexible Bearings, Tension Bearings, or links that are improperly mounted or defective.

Mechanical Fault Finding Flow Chart



FA - Disassembly / Assembly

NOTE: Please make sure that *NO* short circuits take place with screwdrivers, or shorting to the die-cast aluminum chassis of an FA balance.

NOTE: When removing screws that are holding the same object, loosen them all first, then remove - and when attaching, get all of them firm, then tighten.

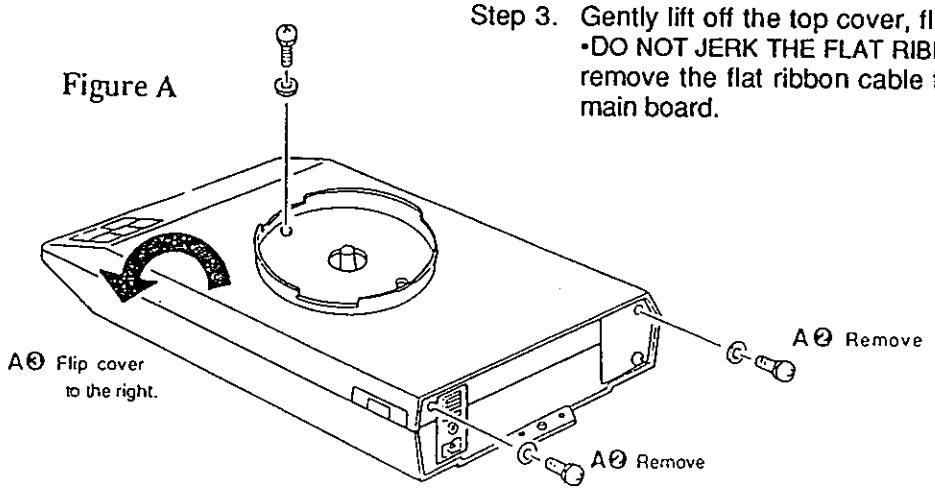
FA - Opening the Case

Step 1. Unplug the AC adaptor from the balance (if NiCd Batteries have been installed, the Battery Power/Charger Switch should be OFF). Remove the Weighing Pan and Pan Support (the FA-6000 also has a pan support screw to be removed). Remove the front screw on the Pan Guard (Figure A, A1).

Step 2. Remove the two top screws in the back upper corners (A2).

Step 3. Gently lift off the top cover, flipping it to the right (A3).
•DO NOT JERK THE FLAT RIBBON CABLE LEAD. Gently remove the flat ribbon cable from its connector on the main board.

Figure A

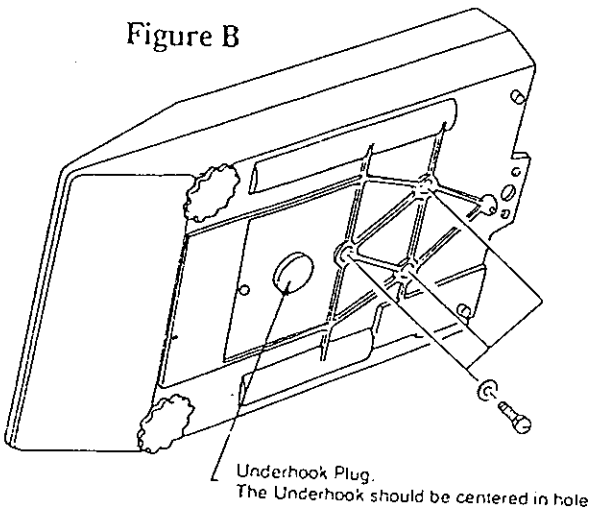


FA - Removing the Force Motor

Step 1. Grasping the Force Motor Assembly firmly (it is heavy!), turn the chassis on its side and remove the three screws holding the Force Motor Assembly to the chassis (Figure B). Carefully place the chassis back on its feet.

Step 2. Disconnect connectors J4 and J5 (Figure C).

Figure B



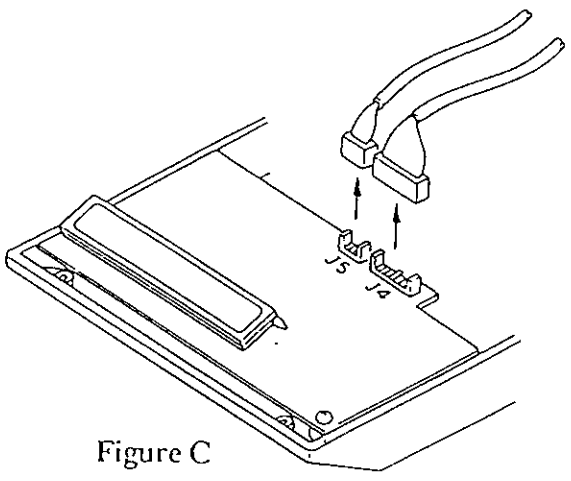
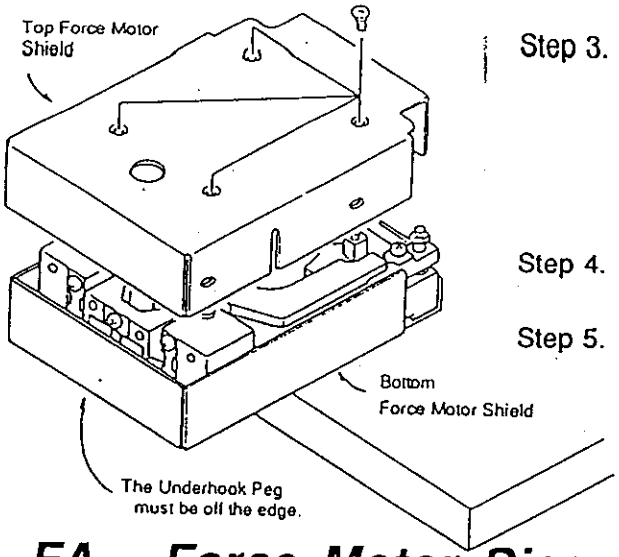


Figure C

Figure D

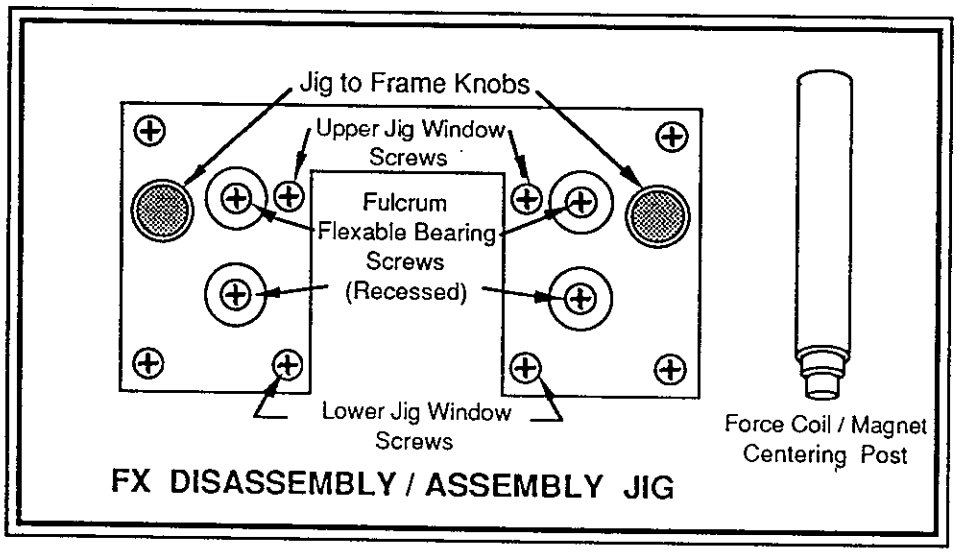


Step 3. Lift the Force Motor Assembly out of the chassis, and set it down making sure that the Underhook Peg is off the edge of the repair surface. • THE FORCE MOTOR WILL BE DAMAGED IF THE PAN SUPPORT PEG OR THE UNDERHOOK PEG COME IN CONTACT WITH THE SAME SURFACE THAT SUPPORTS THE FORCE MOTOR ASSEMBLY.

Step 4. Remove the four screws holding the top Force Motor shield and lift it off (Figure D).

Step 5. Lift the Force Motor Assembly out of the bottom shield and set it down making sure that the Underhook Peg is off the edge of the repair surface.

FA - Force Motor Disassembly



Step 1. Tightly attach the FX Disassembly/Assembly Jig to the Force Motor Assembly by the Jig to Frame Knobs (Figure E, E1).

Step 2. Firmly, but not tightly, attach the Upper and Lower Jig Window Screws (about 1/2 turn turn before tight) (E2).

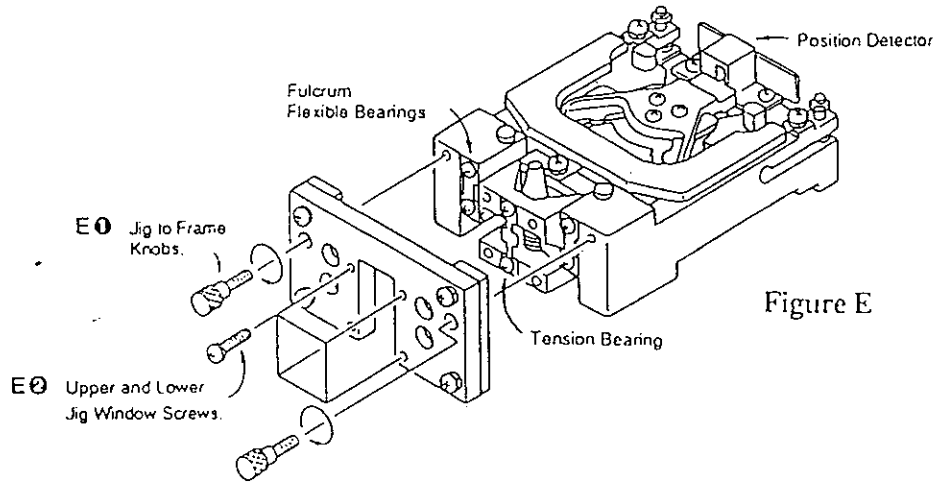


Figure E

Step 3. Loosen the four recessed Fulcrum Flexible Bearing screws 1/2 turn (ref. Fig H, H2).

Step 4. Loosen the three screws on the Upper Flexible Bearing Assembly (Figure F).

Step 5. Place the Force Motor Assembly on its end, loosen the three Flexible Bearing Screws on the Lower Flexible Bearing Assembly (Figure G).

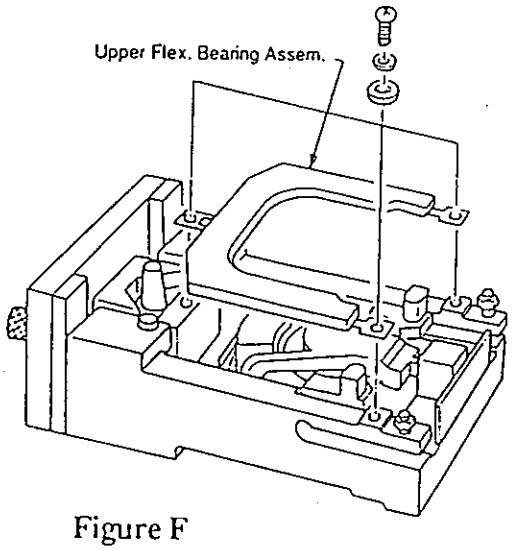


Figure F

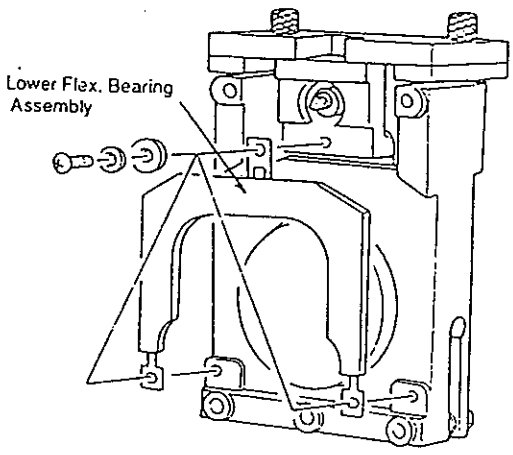


Figure G

Step 6. Tighten the Upper and Lower Jig Window Screws.

Step 7. Remove the Upper Flexible Bearing Assembly and then the Lower Flexible Bearing Assembly (ref. Figures F & G).

Step 8. Remove the Tension Bearing (Figure H, H1) and fixing plates.

Step 9. Fully unscrew the four recessed Fulcrum Flexible Bearing screws (loosened in Step 3) (H2), then remove them by tilting the whole Force Motor Assembly forward and catching everything in your hand. There will be 4 screws, washers, and 2 Fulcrum Flexible Bearings dropping out. Take careful note of the relationship of each for reassembly, keeping the correct washers with the corresponding screws.

Step 10. Loosen and remove the Lower Jig Window Screws, then carefully remove the Suspension Frame (Figure J, J1).

Step 11. Unsolder the two short wires, coming from the circuit board on the Position Beam Lever, on the PC919 circuit board (Figure J, J2).

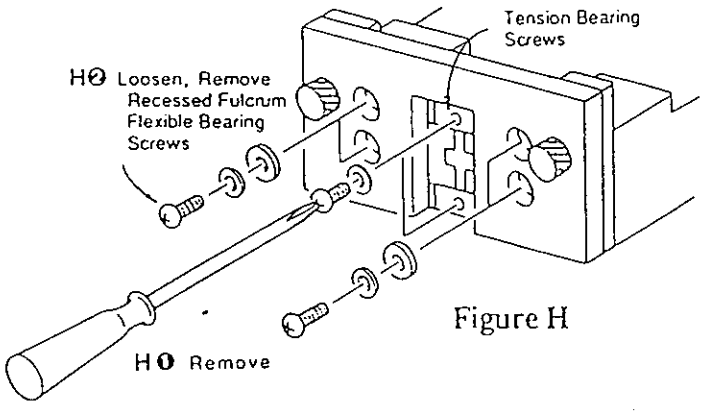


Figure H

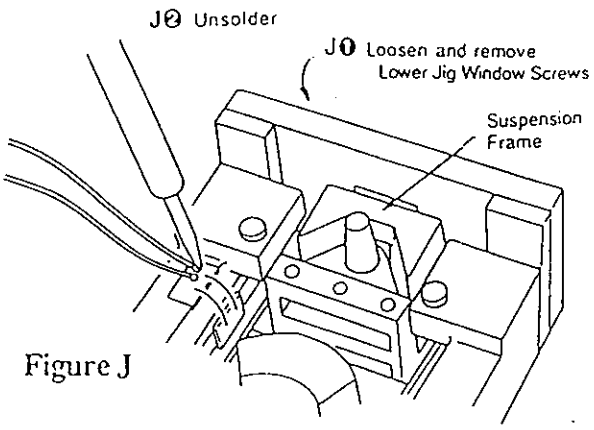


Figure J

Step 12. Loosen and remove the two screws on the Position Detector Assembly. Make careful note of which holes the screws are in, it is important for reassembly. Remove the Position Detector Assembly (Figure K, κ1).

Step 13. Loosen the screw holding the Stopper Plate and slide the Stopper Plate away from the Stopper Plate Restricter Bolt (κ2).

Step 14. Loosen and remove the Upper Jig Window Screws (κ3).

Step 15. Loosen and then remove the Jig (κ4).

Step 16. Carefully remove the Position Beam Lever by gently lifting up on the end with the bobbin, guiding it out of the Magnet Assembly, then out from the main frame (κ5).

Step 17. Remove the three screws holding the Force Motor Magnet Assembly to the frame (κ6). Lift the frame up and away from the Magnet Assembly .

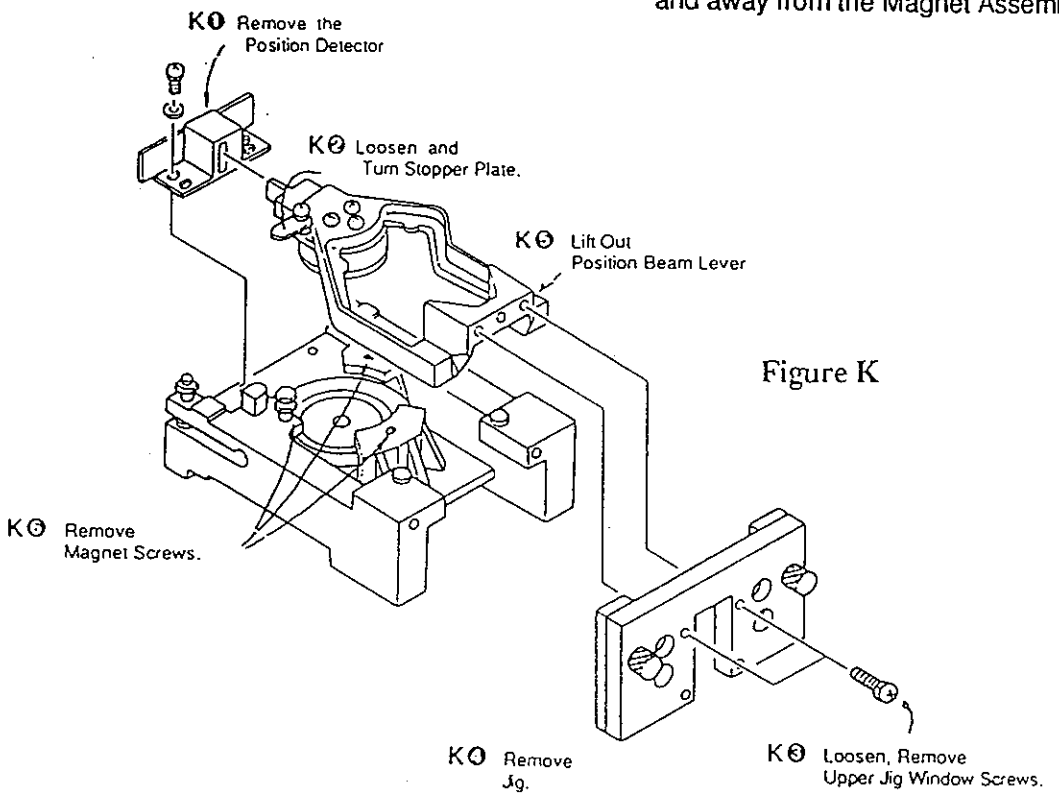


Figure K

FA - Reassembly

NOTE: Please remember to first attach all screws holding an object, then tighten them

Step 1. Carefully place the frame back over the Magnet Assembly (clean the Magnet and Force Coil Bobbin first! See CLEANING THE FORCE MOTOR, page 36). Reattach the three screws that hold the Magnet Assembly to the Force Motor.

Step 2. Replace the Position Beam Lever.

Step 3. Check that the Fulcrum Flexible Bearings are flat, then attach them, do not tighten.

Step 4. Attach the FA Disassembly/Assembly Jig to the Force Motor Assembly by the Jig to Frame Knobs.

Step 5. Loosen the three screws on the Position Beam Lever that holds the Force Coil bobbin (Figure L, L1).

Step 6. Attach the Position Beam Lever to the jig by the Lower Jig Window Screws.

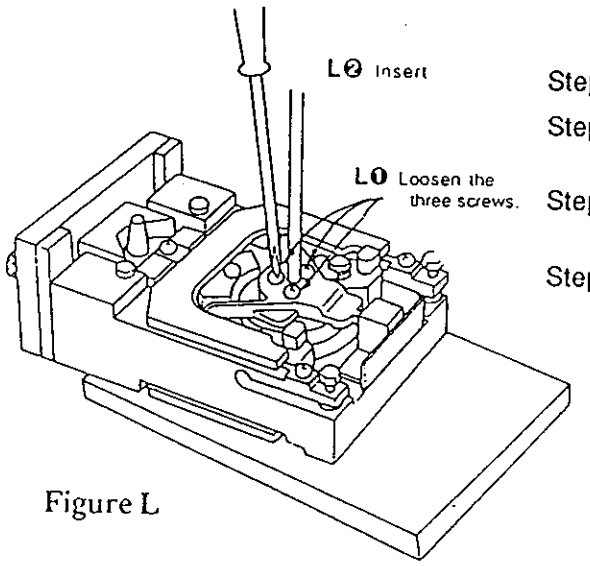


Figure L

Step 7. Insert the Centering Shaft through the hole on the Position Beam, jiggle it until it until it slips into the hole on top of the Magnet Assembly (L2).

Step 8. Tighten the three screws and remove shaft.

Step 9. Resolder the short Force Coil leads to the PC919 circuit board. (ref. Fig. J, J2)

Step 10. Attach the Suspension Frame to the jig by the Upper Jig Window Screws.

Step 11. Reattach the Position Detector Assembly. The end of the Position Beam Lever should be centered in the Position Detector hole.

Step 12. Check that the Upper Flexible Bearing Assembly is flat, then reattach (ref. Fig. F).

Step 13. Turn the assembly on its end.

Step 14. Check that the Lower Flexible Bearing Assembly is flat, then reattach (ref. Figure G) - turn the assembly back down.

Step 15. Check that the Tension Bearing is flat, then attach it along with the fixing plates (ref. Fig. H, H1).

Step 16. Tighten the Fulcrum Flexible Bearing Screws (ref. Fig. H, H2).

Step 17. Remove the Jig.

Step 18. Turn the Force Motor Assembly on its side and check the motion of the Position Beam Lever. It should be smooth flowing and free of any friction.

Step 19. Place the Assembly into the bottom Force Motor shield, reattach the top Force Motor shield (see Figure D).

Step 20. Position the Force Motor Assembly into its place in the chassis. Grasp the Force Motor Assembly firmly and turn the chassis on its side. Replace the three screws holding the Force Motor Assembly (see Figure B). Make sure that the Underhook is centered in its chassis hole. Carefully place the chassis back on its feet.

Step 21. Remove the top Force Motor shield.

Step 22. Reconnect connectors J4 and J5 (see Figure C).

Step 23. Reconnect the AC Power Adaptor. Press **ON/OFF**.

Step 24. Reposition the Stopper Plate in the Stopper Plate Restricter Bolt (make sure the Stopper Plate does not touch the Restricter Bolt shaft) (Figure M, ⓫), and tighten the screw holding the Stopper Plate (M2).

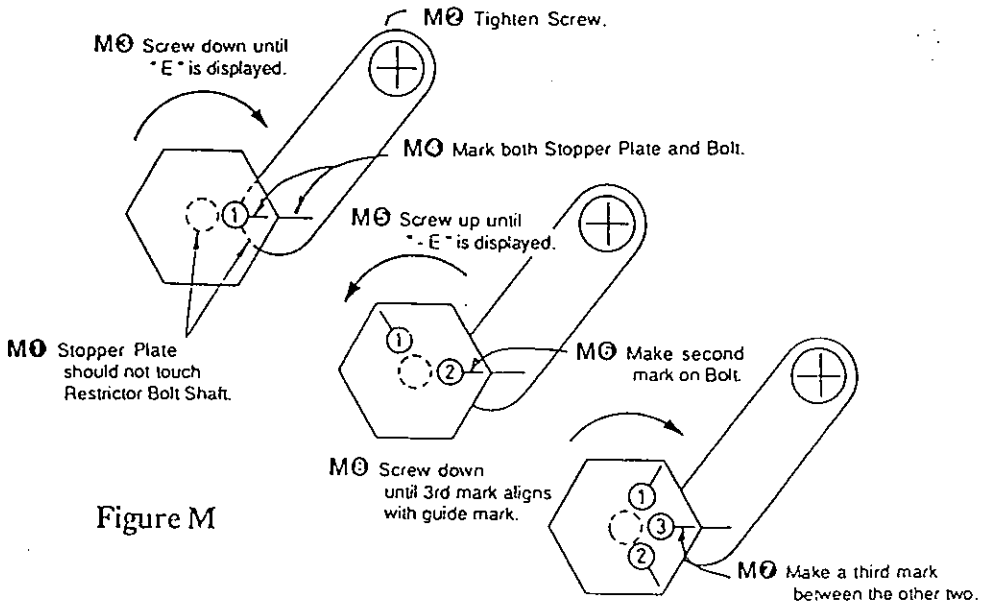


Figure M

Step 25. Screw down the Stopper Plate Restricter Bolt until "E" is displayed on the Fluorescent Display (M3).

Step 26. Make a guide mark on the Stopper Plate and Stopper Plate Restricter Bolt (M4).

Step 27. Screw up the Stopper Plate Restricter Bolt until "-E" is displayed (M5).

Step 28. Make a second guide mark on the Stopper Plate Restricter Bolt from the guide mark on the Stopper Plate (M6).

Step 29. Make a third guide mark on the Stopper Plate Restricter Bolt between the other two (M7). Screw down the Stopper Plate Restricter Bolt until the center mark aligns with the guide mark on the Stopper Plate (M8).

Step 30. Disconnect the AC Power Adaptor.

Step 31. Replace the top Force Motor shield, and attach the four screws.

FA - Closing the Case

Step 1. Reconnect the flat ribbon cable to its connector on the main board, and flip the top cover back onto the chassis (reference Figure A).

Step 2. Reattach the front screw on the Pan Guard. Replace the two top screws on the back upper corners (on the FA-6000, also attach the pan support).

Step 3. Replace the weighing pan. Reattach the AC Power Adaptor. • If the NiCd Batteries have been installed, remember to return the Battery Power/Charger Switch to **ON**.

Step 4. Do Cornerload Adjustment (see page 37).

Cleaning the Force Motor

It is important that no dust or dirt enter into the Force Motor Assembly, and especially the Magnet. If it is suspected that there might be dust or dirt in the Force Motor, or you have worked on the Force Motor - clean it with the following procedure. You will need adhesive tape (not cloth, ≈5cm (2") square pieces), a strong light, denatured alcohol, and lint free gauze. Do not use high pressure air, as it will not remove metal particles on the Magnet.

WORK AREA MUST BE FREE FROM DIRT	NO SMOKING

Step 1. Complete the **Opening the Case**, and **Removing the Force Motor** procedures in the DISASSEMBLY/ASSEMBLY section for your balance. Make careful note of disassembly as you will need to reverse it for reassembly.

Step 2. Unsolder the wires from J5 to PC919.

Step 3. Loosen and remove the three screws holding the Magnet to the Main Frame.

Step 4. Gently lift the Main Frame off of the Magnet, taking care not to entangle the Temperature Sensor wires.

Step 5. Take a strip of the tape and insert it into the Magnet assembly channel where the force coil was located. Touch the tape against the channel wall and remove.

Step 6. Repeat this until the both walls of the channel have been cleaned. Change the tape about every other time, or when a particle is detected.

Step 7. Take a gauze swab, wet it with alcohol, and clean the inside of the Force Coil bobbin.

Step 8. Take another gauze swab, wet it with alcohol, and gently clean the wrapped wire of the Force Coil bobbin.

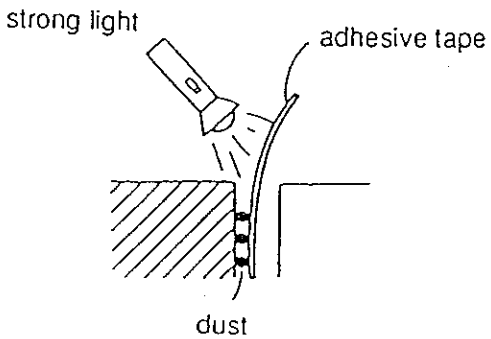
Step 9. Take a strong light and inspect everything again. If there is any dust found, remove it with adhesive tape.

Step 10. Place the Main Frame gently back over the Magnet.

Step 11. Insert the Force Coil/Magnet Centering Post through the hole in the Position Indicator Beam to the hole in the Magnet. Gently wiggle the post until the Magnet is aligned. Firm, then tighten, the three Main Frame to Magnet screws.

Step 12. Resolder the wires from J5 to PC919.

Step 13. Reassemble by reversing the disassembly performed in Step 1.



Cornerload Adjustment

Since the weighing pan is connected to the balance through one central point, as you move away from the center (towards the outer rim of the pan) mechanical distortions can occur, reducing accuracy. To compensate, we perform Cornerload Adjustment.

Table A-3 Cornerload Masses

FA MODEL Series	CORNERLOAD ADJUSTMENT MASSES
FA-200	150g
FA-2000	1500g
FA-6000	2000g

NOTE: The balance must be fully warmed-up (plugged in for 30 minutes) before starting.

Step 1. Open the case as described in the DISASSEMBLY/ASSEMBLY section for your balance - except don't remove the keyboard flat ribbon cable from its main board connector.

Step 2. Remove the four screws holding the top Force Motor shield and lift it off.

Step 3. Replace the weighing pan.

Step 4. Make sure the balance is level.

Step 5. With the display on, and the **CAL** switch off⇓, press and hold **RE–ZERO**.

Step 6. Slide the **CAL** switch on⇑. Release **RE–ZERO.**

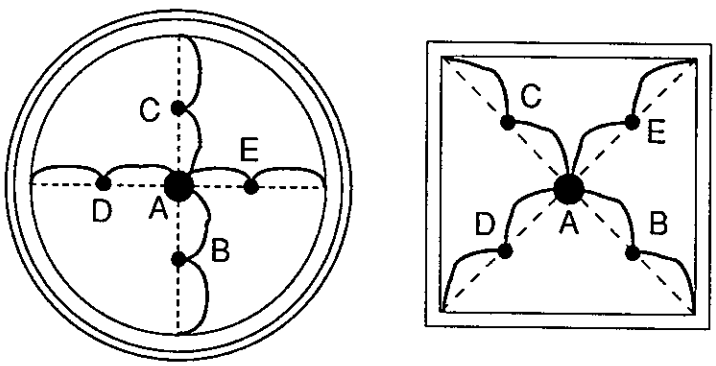
DISPLAY "CCCCCCC" for Check Mode will be displayed.

Step 7. Slide the **CAL** switch off⇓.

Step 8. Press **MODE**.

Step 9. Press **MODE** again. This will put you off Zero Tracking Mode

Step 10. Place the Cornerload Adjustment mass (see Table A-3, above) in the center of the weighing pan, point "A" (Figure A).



FA-200, FA-2000 FA-6000

Figure A

Step 11. Press **RE–ZERO**.

Step 12. Next move the weight to the four points "B" through "E" making note if the reading is "+", "0", or "-" as shown in Figure B (the points are halfway between the center of the pan and the rim).

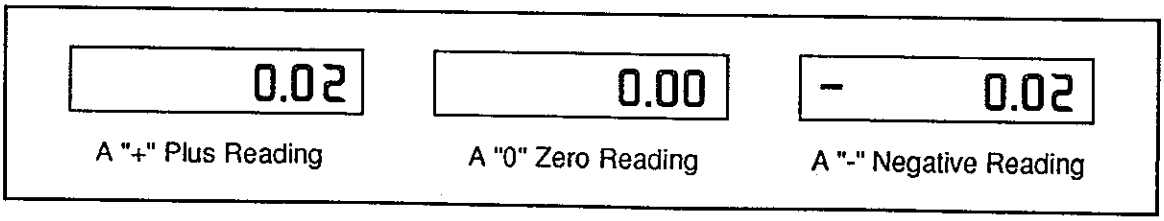


Figure B

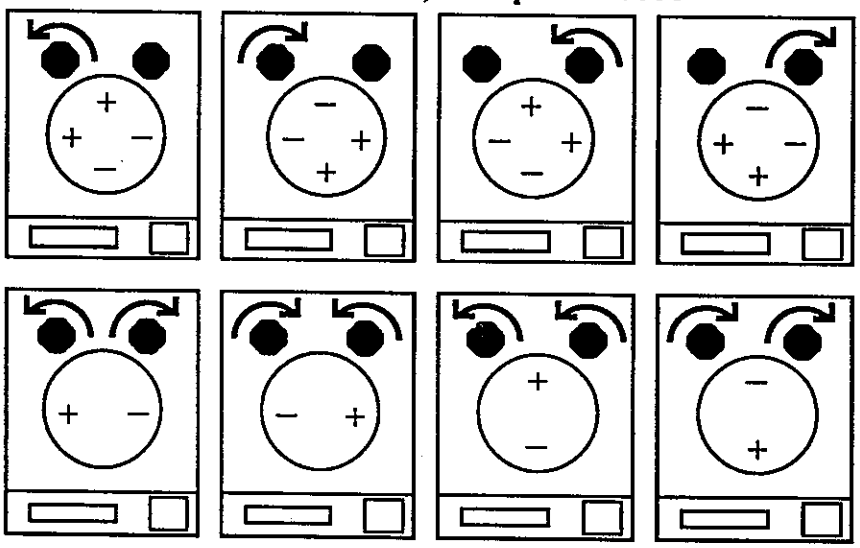
Step 13. Find the corresponding diagram below matching your results, and turn the cornerload adjusting screws slightly in the direction indicated.

Step 14. Repeat (from Step 10) until zero, or ± 1 minimum division, is read at all five points.

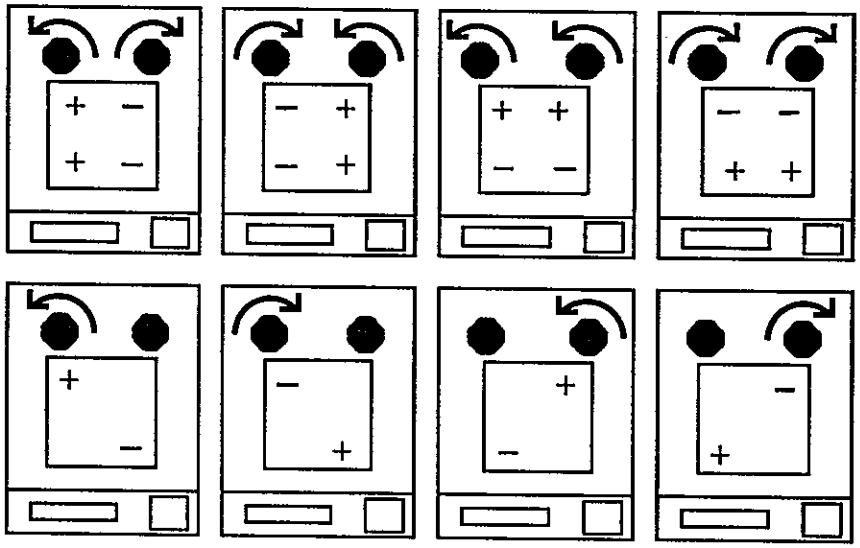
Step 15. Press **ON/OFF**.

Step 16. Remove the pan, reattach the upper Force Motor shield, and close as described in the DISASSEMBLY/ASSEMBLY section for your balance.

All FA Balances, except FA-6000



FA-6000



Optional Battery Pack Installation

This is option OP-04 for the FA. The Battery Packs should not be installed by the end-user, as an incorrect installation could damage the balance. Please explain the following points to the customer, along with the tips on preserving battery life at the end of this section.

THINGS TO KNOW:

- The Battery Power/Charger Switch positions:
  - "ON" •With the AC adaptor connected - means normal balance operation, power from the AC adaptor. The batteries can not be used while the AC adaptor is connected.
    •With the AC adaptor disconnected - means normal balance operation, power from the batteries.
  - "OFF" •With the AC adaptor connected - means battery recharging.
    •With the AC adaptor disconnected - means no power to the unit.
- When the AC adaptor is connected, the balance will draw power from it. Only when the adaptor is unplugged from the balance (not the wall), will the unit switch to battery operation.
- When using the AC adaptor, turning the Battery Power/Charger Switch **OFF** is for recharging only. •SERIOUS DAMAGE TO THE BATTERIES WILL RESULT from leaving the balance plugged in with the Battery Power/Charger Switch **OFF** for long periods!.
- The Battery Packs will recharge in about 15 hours (with the AC adaptor plugged in, and the Battery Power/Charger Switch OFF).
- Do not overcharge the Battery Packs. 15 HOURS CHARGING MAXIMUM.

BATTERY LIFE:

- The packs can be expected to offer 9 hours of continuous operation between charges.
- A display of "Lb" (Low battery) indicates that the battery power has become too low for reliable weighing.
- The life of the rechargeable battery will vary greatly with frequency of charge and use of the balance. If the battery cannot seem to hold a charge, check it by: charging for 15 hours, and if the FA cannot run for 5 hrs (≈50% of normal), then replace battery.

Installation Procedure

NOTE: Please make sure that ***NO*** short circuits take place with screwdrivers, or shorting to the die-cast aluminum chassis of an FA balance. Please take special care when installing the printed circuit board of the Battery Power/Charger Switch (PC 925) that shorts do not occur.

Step 1. Complete the OPENING THE CHASSIS procedure in the DISASSEMBLY/ASSEMBLY section for your balance.

Step 2. Lift out the entire Fuse / Cal Switch Assembly printed circuit board from the back of the chassis by sliding it upwards.

Step 3. Remove the J2 connector plug (KO: 661) on the Fuse / Cal Switch circuit board (Figure A).

Step 4. Position the two Battery Packs on either side of the Force Motor Assembly. Keep all leads well away from moving Force Motor parts to prevent entanglement.

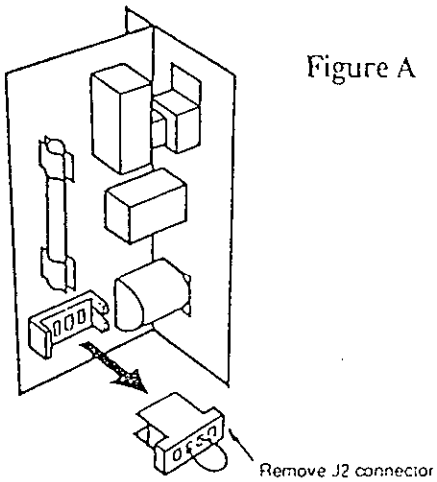


Figure A

Step 5. Remove the plastic plate that is in the Battery Power/Charger Switch slot from the right side of the top case.

Step 6. Take the Battery Power/Charger Switch circuit board and slide the switch into the opened case slot (Figure B), making sure that it is switched **OFF**.

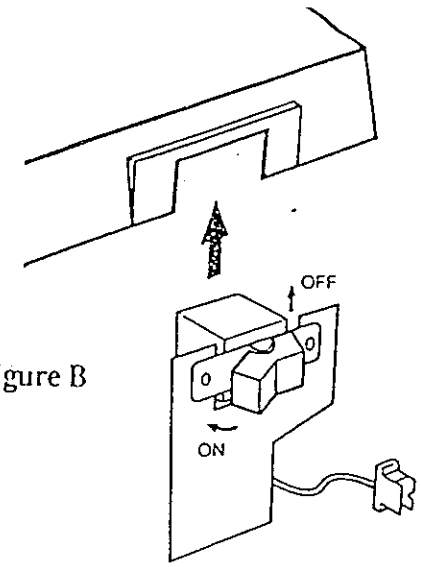


Figure B

Step 7. Plug the connector from the Battery Power/Charger Switch circuit board into the J2 connector on the Fuse / Cal Switch circuit board where the J2 connector plug [KO: 661] was removed from in Step 3.

Step 8. Return the fuse holder circuit board to its slot in the chassis (reversing Step 2.).

Step 9. Complete the CLOSING THE CASE procedure in the DISASSEMBLY/ASSEMBLY section for your balance.

NOTE: Keep the Battery Power/Charger Switch **OFF** with the adaptor connected for about 10 minutes before testing the Battery Packs (this allows the charges from the individual cells to equalize).

Step 10. Remove the adaptor and turn the Battery Power/Charger Switch **ON**.

DISPLAY The standby decimal point or the power failure "-------" indication should be displayed.

Step 11. Press **ON/OFF** to test weighing with the Battery Packs.

NOTE: If "Lb" (Low battery) is displayed, try charging the Battery Packs for an hour before testing them again. If the problem persists, or a buzzing sound is heard, there may be a problem with the Battery Packs. Try again with new packs.

NOTE: If the keyboard doesn't work after you have closed the case, check the keyboard flat ribbon cable and its connector for damage. Other areas of trouble during installation may be the cable to the J2 connector and the connector itself. No power may indicate a blown fuse.

PLEASE TELL YOUR CUSTOMERS TO PRESERVE BATTERY LIFE:

- When using the AC adaptor, turning the Battery Power/Charger Switch **OFF** is for recharging only. If you want to cut the balance power without recharging, unplug the AC adaptor from the wall, or, unplug the AC adaptor from the balance, and turn the Battery Power/Charger Switch **OFF**. •SERIOUS DAMAGE TO THE BATTERIES WILL RESULT from the customer leaving the balance plugged in with the Battery Power/Charger Switch **OFF** for long periods!.
- Do not overcharge the Battery Packs. 17 HOURS CHARGING MAXIMUM.
- Do not try to operate the balance in very cold temperatures using the battery pack (batteries don't work well in low temperatures)
- Do not try to operate the balance in very hot temperatures above 30°C (86°F) using the battery pack. At temperatures of 40°C (104°F), the life of the Battery Packs will be reduced to 40 percent of normal.
- Switch **OFF** the battery pack as soon as "Lb" is displayed and recharge as soon as possible.
- Do not use the Battery Packs needlessly since the number of times that rechargeable batteries can be recharged is not limitless.

FA-200/2000/6000
PARTS LIST

EXPLODED VIEW

CIRCUIT SYMBOL OR DRWG. NO..	PARTS NAME	DESCRIPTION	QTY
1	04:A46794	Weighing Pan (for FA-200)	
(1)	04:A46795	Weighing Pan (for FA-2000)	
(1)	04:A33969	Weighing Pan (FA-6000 only)	
2	PB:FX300-4	Pan Support Unit (for FA-200)	
(2)	PB:FX3000-4	Pan Support Unit (for FA-2000)	
(2)	PB:FX6000-4	Pan Support Unit (FA-6000 only)	
3	7PB:FX300-A	Top Cover (FA-200 only)	
(3)	7PB:FX320-A	Top Cover (FA-2000 only)	
(3)	7PB:FX3000-A	Top Cover (FA-6000 only)	
4		Screw M4x10 + Spring Washer	
5		Washer M4	
6		Screw M4x6 + Spring Washer	
7	09:A20605C	Keypad	
8	04:A34222B-1	Top Force Motor Shield (FA-200/2000)	
(8)	04:A34222B-2	Top Force Motor Shield (FA-6000 only)	
9		Screw M3x8 + Spring Washer	
10		Washer M3	
11		Flat Scre M3x8	
12		Screw M4x8	
13	10:H-NO-1-SUS	Convex Washer	
14	05:A46367A	Aluminium Washer T=1.0	
15	PB:FX300-2	Flexible Bearing Assy (FA-200)	
(15)	PB:FX3000-2	Flexible Bearing Assy (FA-2000)	
(15)	PB:FX6000-2	Flexible Bearing Assy (FA-6000 only)	
16		Screw M3x6 + Spring Washer	
16		Screw M3x6	
17	04:A47002A	Stopper Plate	
18	03:A20565A-2	Position Beam Lever (FA-200)	
(18)	03:A20565B-1	Position Beam Lever (FA-2000)	
(18)	03:A20565A-3	Position Beam Lever (FA-6000 only)	
19	PB:FX300-5	Suspension Frame (FA-200)	
(19)	PB:FX3000-5	Suspension Frame (FA-2000)	
(19)	PB:FX6000-5	Suspension Frame (FA-6000 only)	
20	04:A47695:B	Tension Bearing (for FA-200)	
(20)	04:A47909:B	Tension Bearing (for FA-2000/6000)	
21	04:A46703A	Fitting Plate	
22	04:A47793:B	Flexible Bearing (for FA-200)	
(22)	04:A47644A:B	Flexible Bearing (for FA-2000/6000)	
23		Screw M4x12 + Spring Washer	
24	09:B43219A-2	Force Coil Bobbin	
25	03:A20566D-2	Main Frame (for FA-200)	
(25)	03:A20566D-1	Main Frame (for FA-2000/6000)	
26	PB:FX300EC-1	Force Motor Magnet	
27	04:A34316B	Bottom Force Motor Shield	
28	02:A46923B	Option Cover Plate	
29	04:A47459	Chassis to Cover Post	
30	03:A10063D	Chassis	
31	07:A46858	Underhook Chassis Plug	

32	07:A46735A	Levelling Foot	
33	00:A46916	Level Vial	
34	07:A34022B	Level Vial Stand	
35	05:A46740A	Hex Stud	
36	05:A46919	Underhook Peg	
37	04:A47006 and 04:A47007	Counter Weight (FA-6000 only)	
38		Screw M3x5 (FA-6000 only)	
39	04:A47288A	Pan Sway Suppressor (FA-6000 only)	
40		Screw M4x6 + S.W. (FA-6000 only)	
41		Screw M4x15 (FA-6000 only)	
42		Bolt M4x6 + S.W. + W. (FA-6000 only)	
43		Bolt M4x12 + S.W. (FA-6000 only)	
101		Position Detector	
102		Fuse/Cal Switch Assembly	
103		Main Circuit Board	
104		RS-232C Optional Connector	

FA MAIN BOARD

CIRCUIT SYMBOL OR DRWG. NO..	PARTS NAME	DESCRIPTION	QTY
	7PZ:913A	Main Board FA200	
	7PZ:913B	Main Board FA2000	
	7PZ:913D	Main Board FA6000	
	PC:913E	Printed Circuit Board	
C10.23.24	CC:0.01U	Capacitor 0.01µF 50V	
C17~22	CC:0.022U	Capacitor 0.022µF 50V	
C2.3.5.12.13	CC:0.1U25V	Capacitor 0.1 µF 25V	
C8	CC:470P	Capacitor 470pF 50V	
C7	CK:SM10VB100	Capacitor 100µF 10V	
C4.14	CK:SM25VB100	Capacitor 100µF 25V	
C11	CK:SM25VB220	Capacitor 220 µF 25V	
C1	CK:SM35VB1000	Capacitor 1000µF 35V	
C15	CK:SM50VB10	Capacitor 10µF 50V	
C9.16	CK:SM50VB3R3	Capacitor 3.3µF 50V	
C6	CT:1V010	Capacitor 1µF 35V	
D11	DI:1SS53	Diode	
D1,2,4~6,9,12~15	DI:1S1588	Diode	
D7,10	DZ:RD3.6EB	Zener Diode 3.6V	
D3,8	DZ:05Z9.1	Zener Diode 9.1V	
LiBatt	EB:CR2032-WT12	Lithium Battery	
	ED:FIP11C11	Display Tube	
J1	EJ:0470-01-230	Connector	
FH	FH:85PN0819	Fuse Holder	
FS	FS:EAWK-500MA	Fuse 500mA T	
	HT:6073PB	Heat Sink	
J6	JD:230-07-30	Connector	
J3	JE:HSJ0785-01	Connector	
J2	JT:172429-4	Connector	
J10	JT:172429-8	Connector	
Q1	QT:A1015Y	Transistor	
Q3	QT:C1173	Transistor	
Q2.4	QT:C1815Y	Transistor	
R23	RC:1/21M	Resistor 1MΩ 1/2W	
R2,9,10	RC:1K	Resistor 1KΩ 1/4W	
R12~16,16,17,22	RC:15K	Resistor 15KΩ 1/4W	
R26	RC:150R	Resistor 150Ω 1/4W	
R3	RC:18K	Resistor 18KΩ 1/4W	
R27	RC:2.2K	Resistor 2.2KΩ 1/4W	
R6,7,25,29	RC:270R	Resistor 270Ω 1/4W	
R5	RC:33K	Resistor 33KΩ 1/4W	
R15,37	RC:4.7K	Resistor 4.7KΩ 1/4W	
R1,8	RC:5.6K	Resistor 5.6KΩ 1/4W	
R4,11,18,28,33,34	RC:56K	Resistor 56KΩ 1/4W	
R24	RC:560K	Resistor 560KΩ 1/4W	
R20,21,30	RN:1HR-4-223MA	Resistor Network 22KΩx4 1/8W	
R19	RN:1HR-8-223MA	Resistor Network 22KΩx8 1/8W	
R35,36	RN:1HR-8-563JA	Resistor Network 56KΩx8 1/8W	
S1,2	SS:SSP1x2NB5x8	Switch	
T1	TF:309	Transformer	
	TM:CP-10	Test Pin	
U8	UA:C339C	Voltage Comparator	
U4	UA:S-8054ALR	Voltage Comparator	

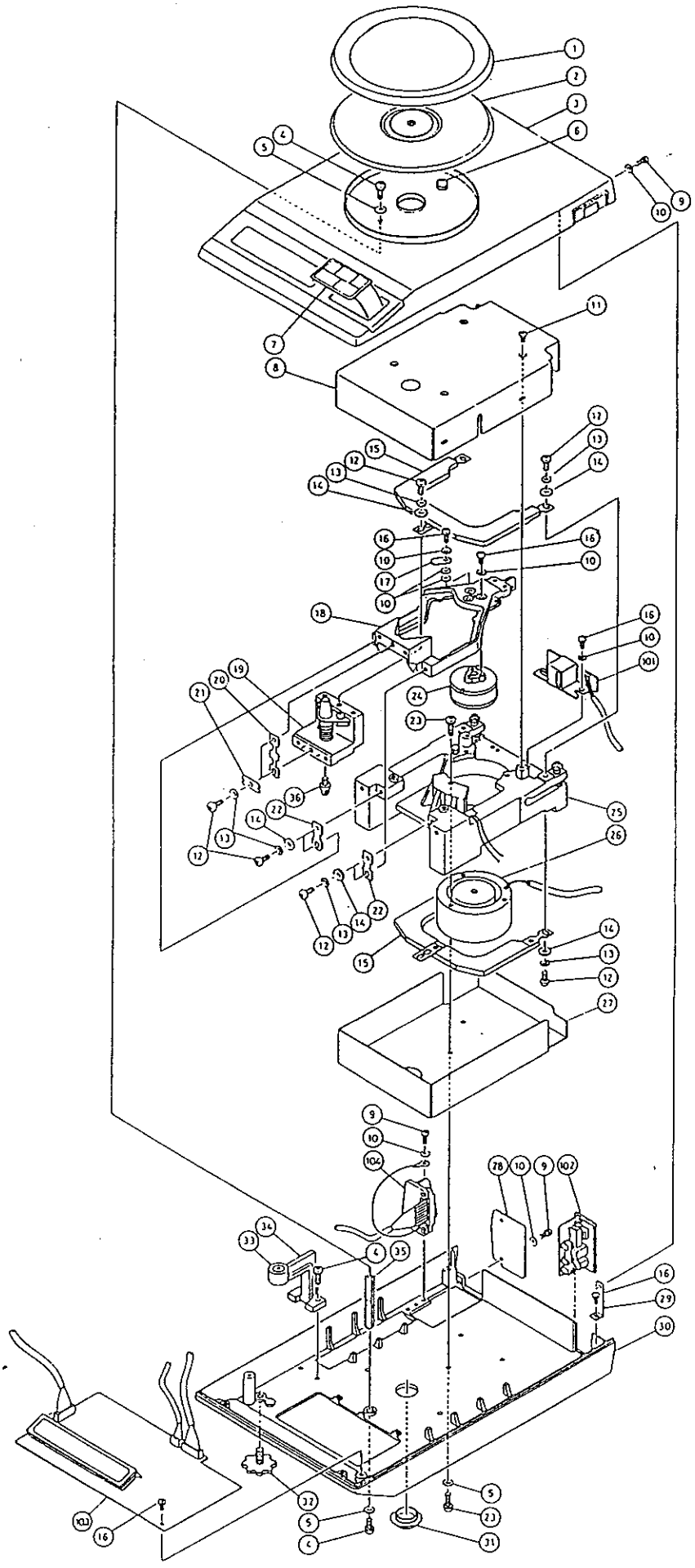
U5	UC:MB64II433	CMOS Gate Array	
U7	UC:5518BPL	CMOS Static Ram	
U6	UC:7516HG574-12	CMOS CPU	
U1,3	UR:TA78DL10P	Voltage Regulator 10V 1A	
U2	UR:TA79L005P	Voltage Regulator 5V 150mA	
	XT:C4SB-12M-L02	Ceramic Resonator	
	04:A44676	Heat Sink	
	06:A47138		
	07:A46734B	Pillow	
	07:A46998		
	BE:AMZ22	Hybrid IC for 7PZ:913/A/B/C	
	BE:AMZ23	Hybrid IC for 7PZ:913D	
R50	RL:86ROF	Metal Foil Resistor for 7PZ:913A	
R50	RL:23ROF	Metal Foil Resistor for 7PZ:913B	
R50	RL:10ROF	Metal Foil Resistor for 7PZ:913C	
R50	RL:FBY20ROF	Metal Foil Resistor for 7PZ:913D	
R53	RF:5.2KRF	Resistor 5.2KΩ 1/8W ± 100ppm/°C for 7PZ:913A	
R53	RF:10KRF	Resistor 10KΩ 1/8W ± 100ppm/°C for 7PZ:913B	
R100		Resistor 2.kkΩ Nat	
C100,101		0.1µF Ceramic Capacitor	

FA OP-03
RS232 BOARD

CIRCUIT SYMBOL OR DRWG. NO..	PARTS NAME	DESCRIPTION	QTY
	PZ:915	Option-03 Fully Assembled	
	PC:915B21	Printed Circuit Board	
C35	CC:0.022U	Capacitor 0.022μF 50V	
C31~34	CK:SM25VB47	Capacitor 47μF 25V	
D31	DF:PS-2403-1	Photo Coupler	
D32	DI:W02	Diode Bridge	
J12	JA:TCS0274	Connector	
J11	JA:25-30-335S	Connector	
J10	J1:CL535-002-8	Connector	
Q31	QT:C1815Y	Transistor	
R32	RC:1K	Resistor 1KΩ 1/4W	
R31	RC:5.6K	Resistor 5.6KΩ 1/4W	
S31	SS:2NB2X2-N	Switch	
TP	TM:CP-10	Test Pin	
U31	UC:MAX232CPE	RS-232C Driver/Receiver	
	02:A46936A	Board Mount Plate	

FA OP-04
BATTERY BOARD

CIRCUIT SYMBOL OR DRWG. NO..	PARTS NAME	DESCRIPTION	QTY
	PZ:925A	Option-04 Fully Assembled	
	PC:925A	Printed Circuit Board	
D41	DI:F14A	Diode	
BATT	EB:10KR-2000C	NiCd Battery	
J2	KO:440-4S10	Connector Cable	
R42	RC:1/21K	Resistor 1KΩ 1/2W	
R41	RE:RGB5-10R	Resistor 10Ω 5W	
S41	SW:500F-W2-K-S	Switch	



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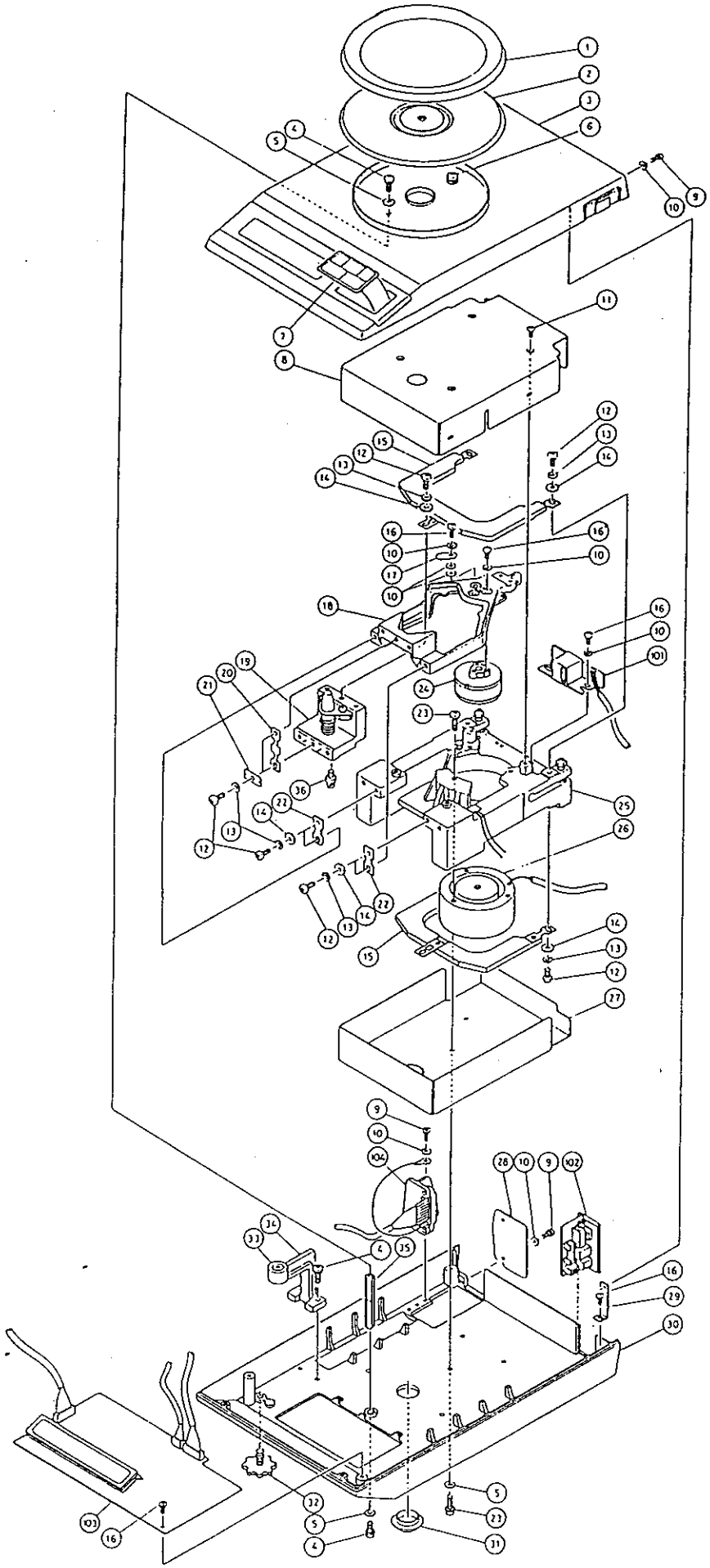

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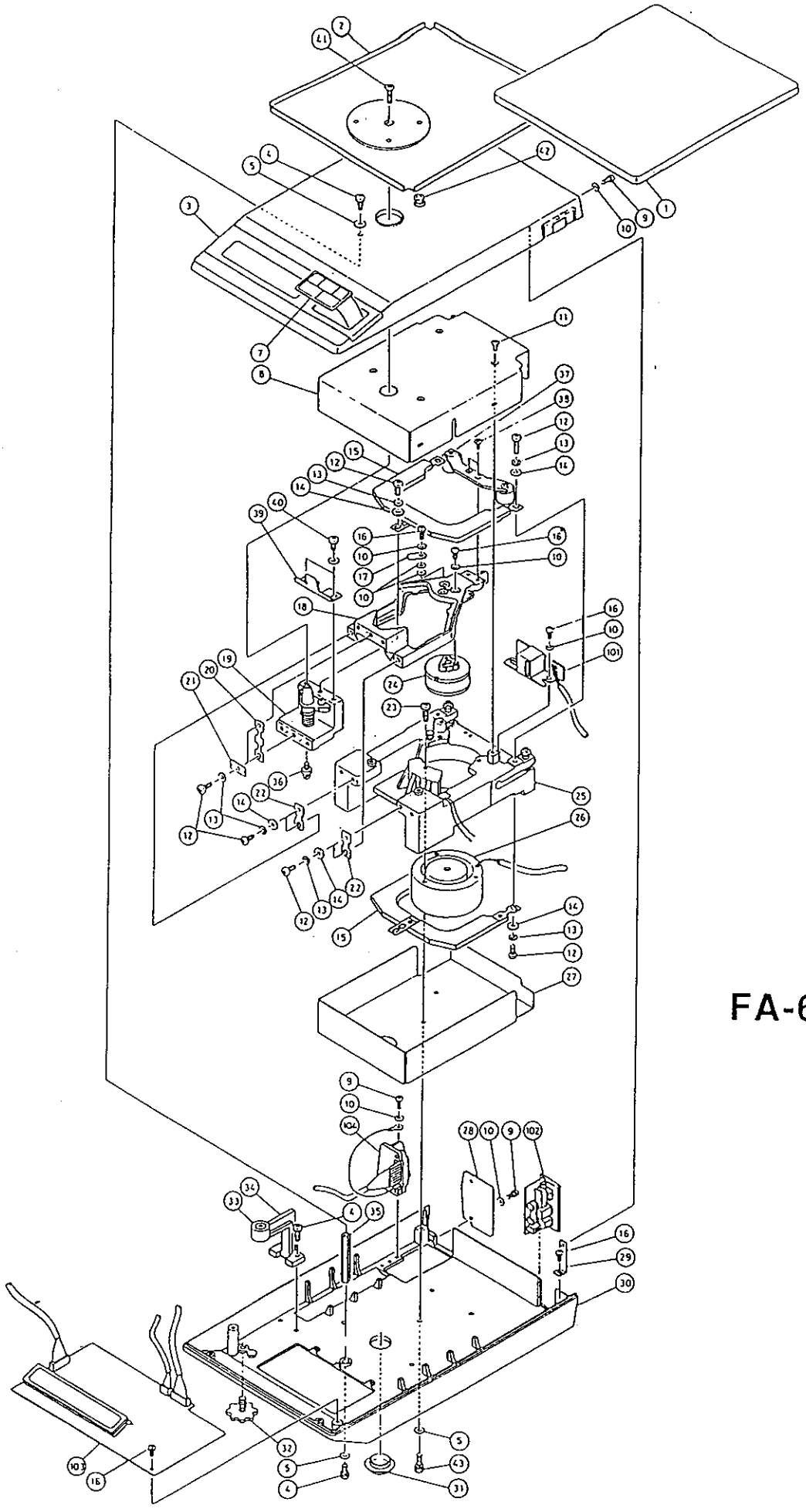

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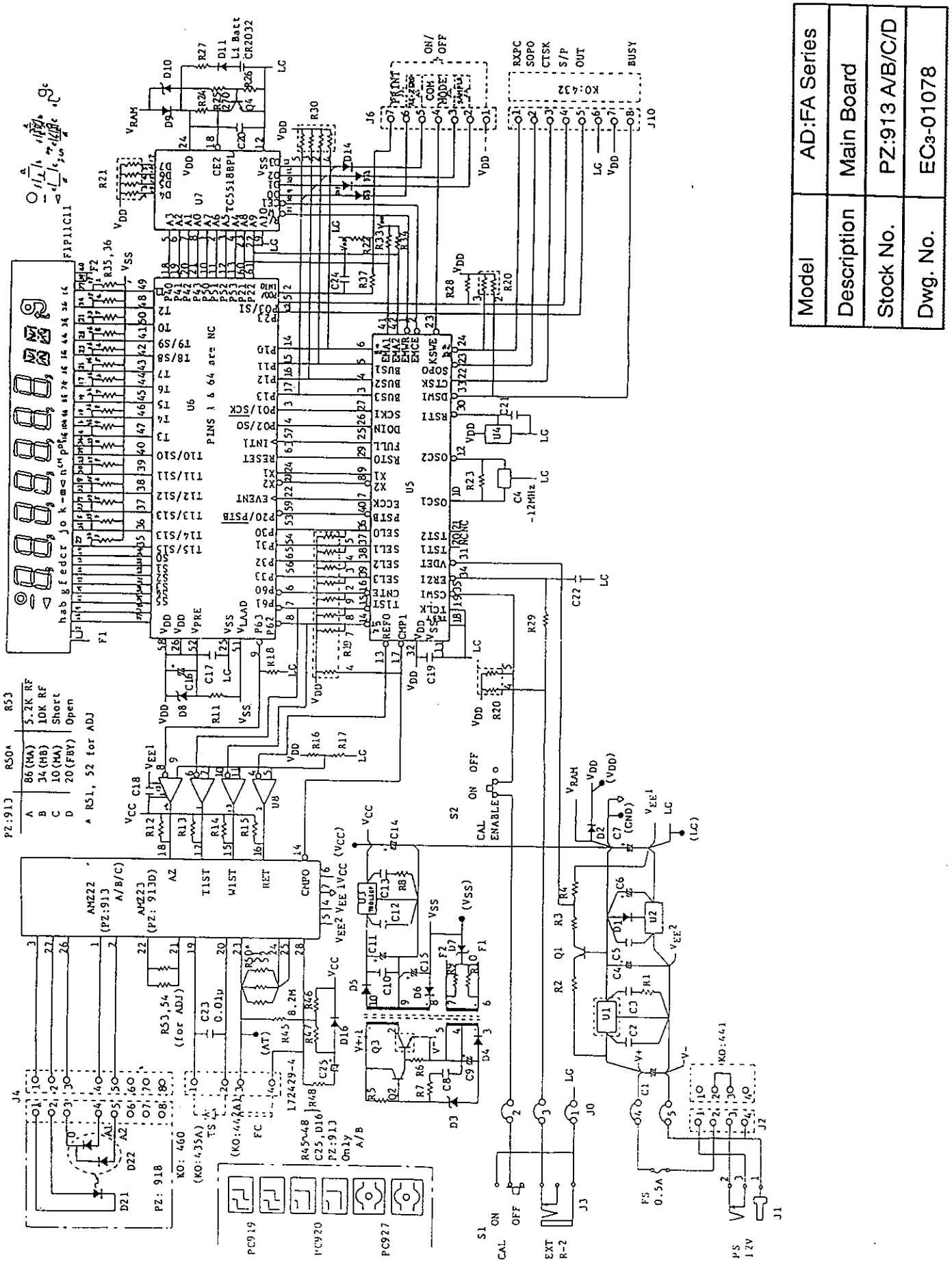
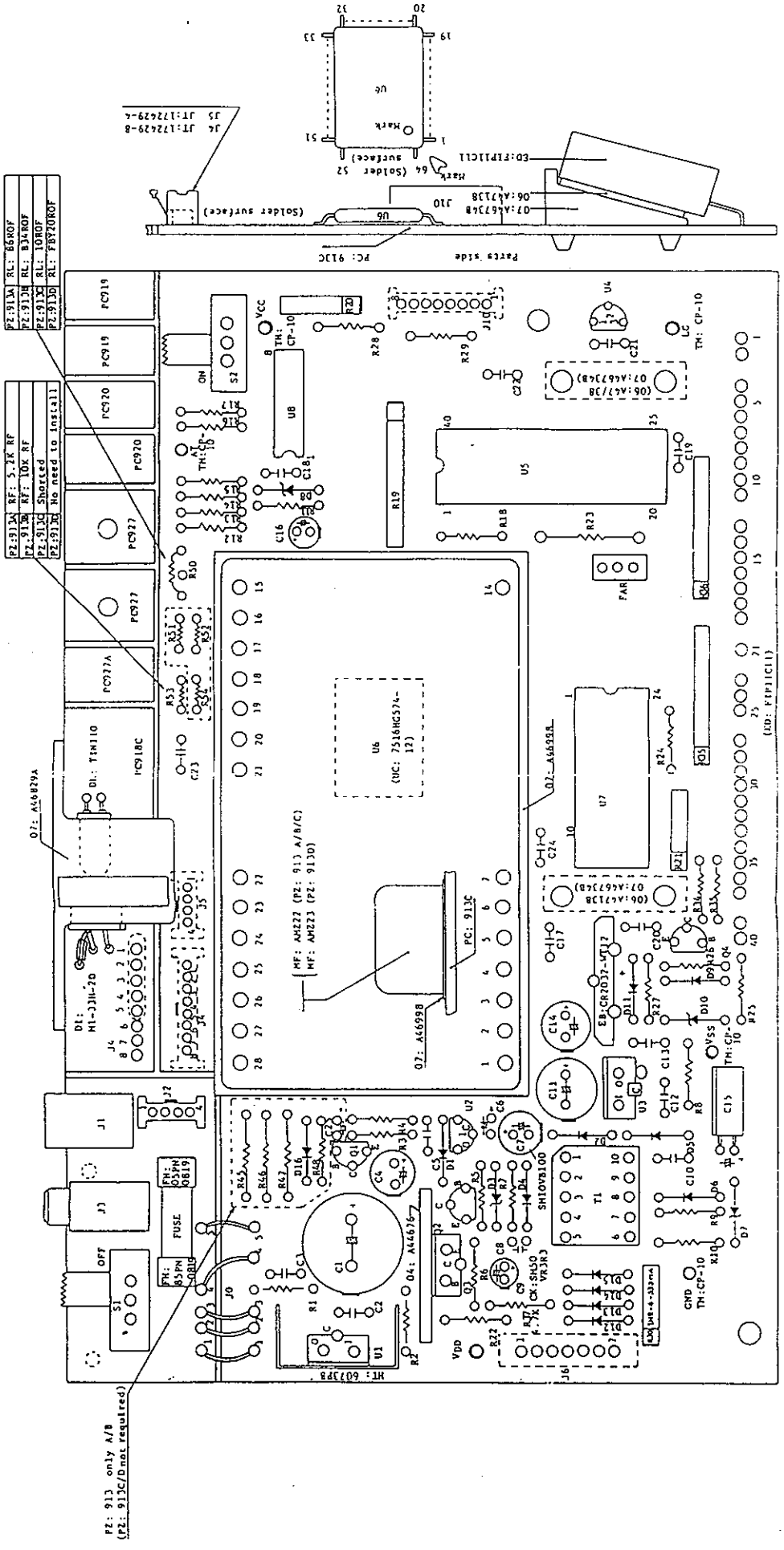
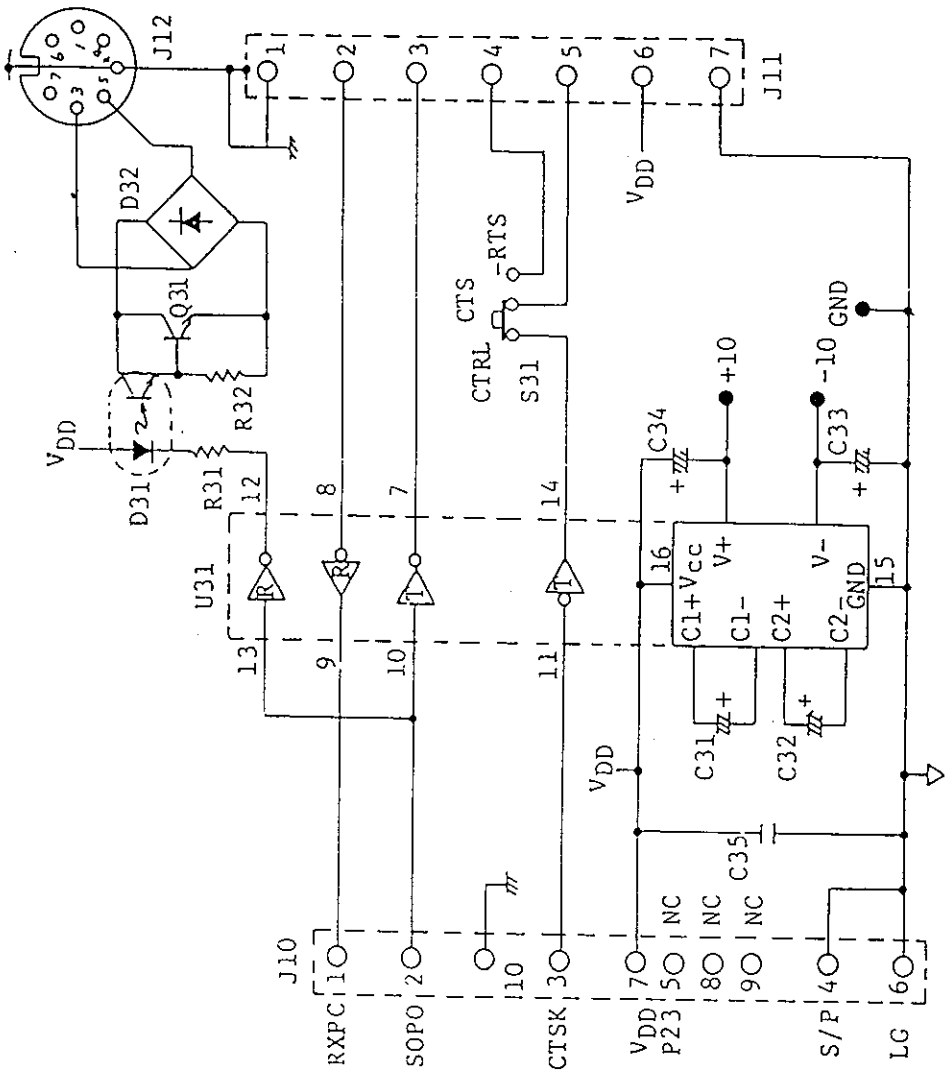


Model	AD:FA Series
Description	Main Board
Stock No.	PZ:913 A/B/C/D
Dwg. No.	EC3-01078

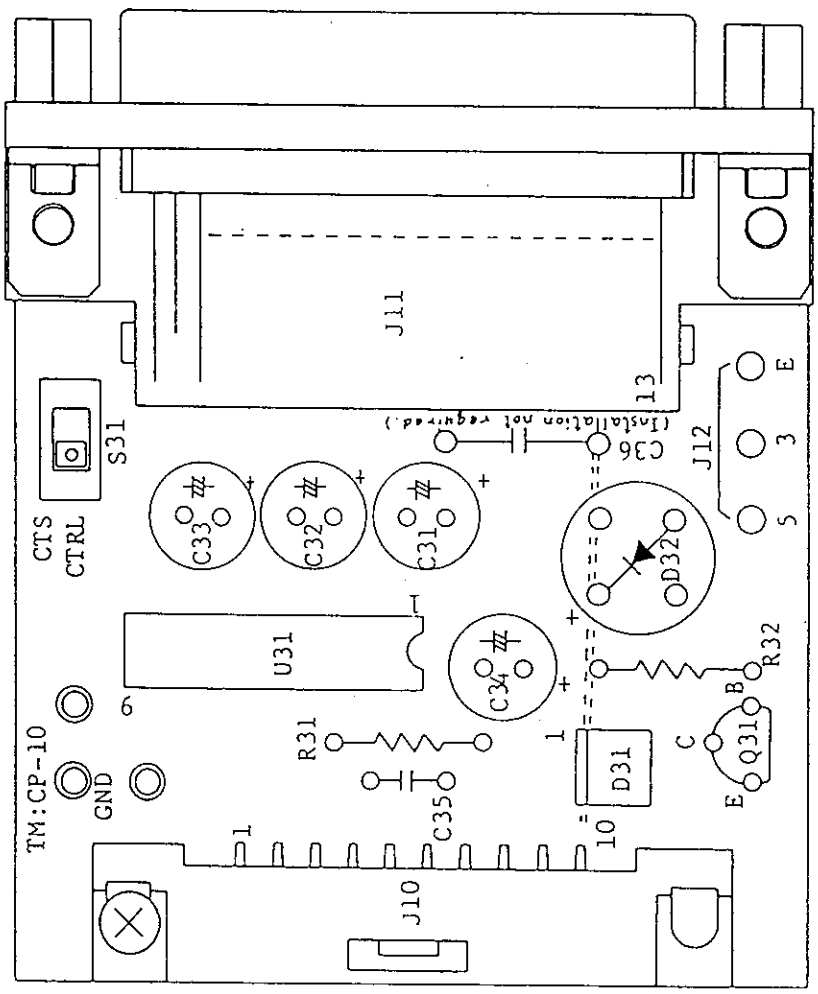


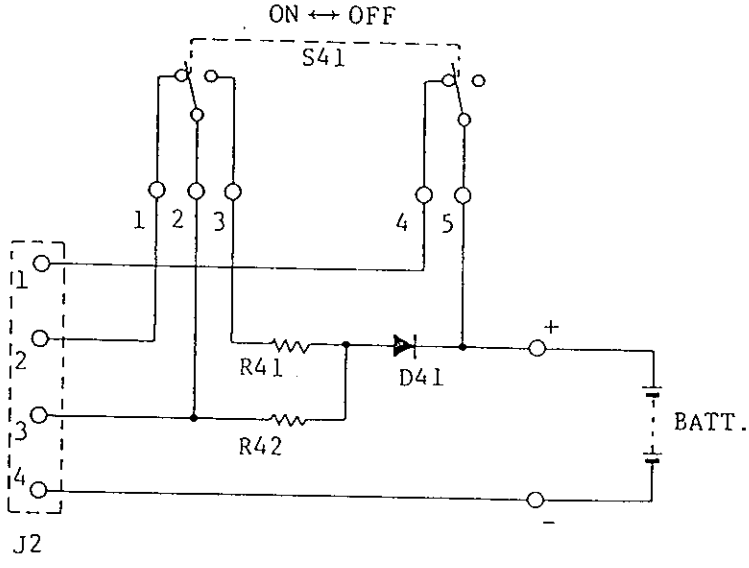
Model	AD:FA Series
Description	Main Board
Stock No.	PZ:913 A/B/C/D
Dwg. No.	KZ4-00307



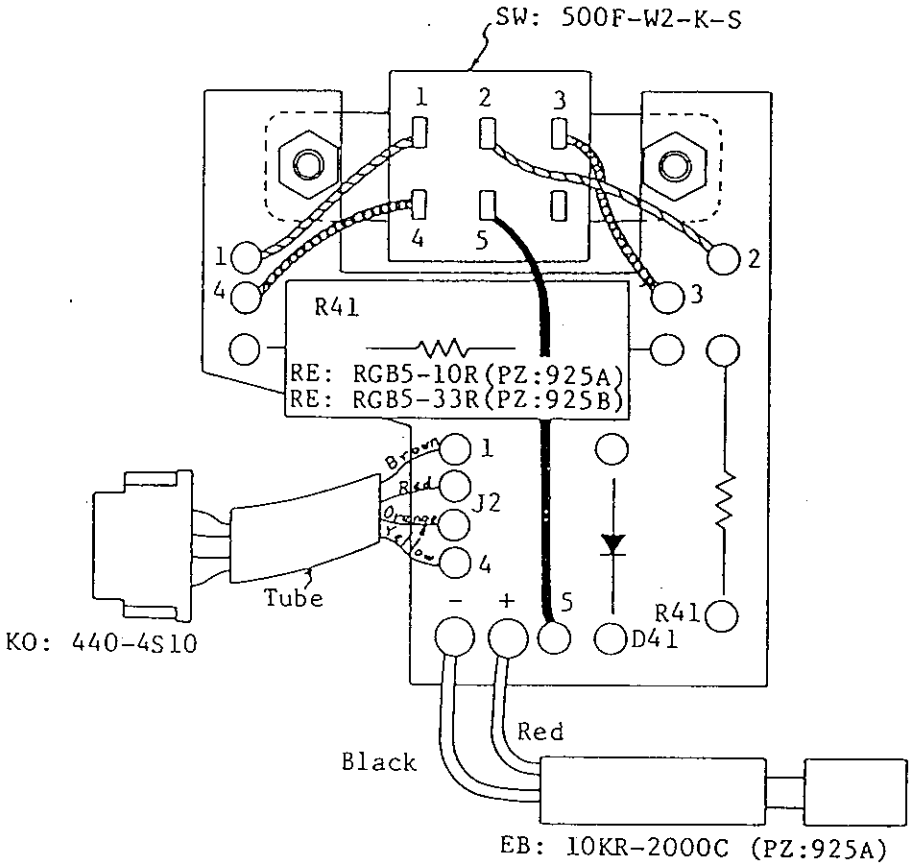
Model	AD:FA-OP-03
Description	Serial Interface
Stock No.	PZ:915
Dwg. No.	

Model	AD:FA-OP-03
Description	Interface Board
Stock No.	PZ:915
Dwg. No.	KZ3-000573





Model	AD:FA-OP-04
Description	Battery Unit
Stock No.	PZ:925A
Dwg. No.	EC4-00143



Model	AD:FA-OP-04
Description	Battery Unit
Stock No.	PZ:925A
Dwg. No.	KZ4-00322