INSTRUCTION MANUAL

FX/FY Series

PRECISION ELECTRONIC BALANCES

MODEL: FX-200
FX-2000
FY-200
FY-2000

imno-FX/Y-200-V.1

A&D *Mercury*
PTY.LTD.

A&D MERCURY PTY. LTD.
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INTRODUCTION

THANK YOU FOR BUYING THIS BALANCE MADE BY A&D

Every care has been taken during the manufacturing process of this balance to ensure that it will perform accurately and reliably for many years.

Electronic Balances are in one sense extremely simple products, that is they are very easy to use. In another sense they are rather complex in that they are high technology products ..... this manual will try to tell you in simple language how this balance works and how to get the most out of it in terms of performance.

The FX/FY series of high resolution multi-function balances are the product of years of research, design, development and in-field testing. They incorporate the latest advances in electronic and mechanical engineering and offer increased features, increased functions, high resolution and portability; all in a low profile balance at a reduced cost. Options include rechargeable NiCd battery packs, an RS-232C/Current Loop interface and glass breeze breaks for all capacities.

In the FX series there are two single range balances:
* FX-200 (210g x 0.001g)
* FX-2000 (2100g x 0.01g)

In the FY series there are two low cost single range balances:
* FY-200 (210g x 0.01g)
* FY-2000 (2100g x 0.1g)

UNPACKING YOUR BALANCE

*   MODELS: FX-200, FX-2000, FY-200, FY-2000.

*   Unpack the balance carefully and keep the packing material if you are likely to want to transport the balance again in the future.

*   In the carton you should be able to find this manual and:
    *   The balance
    *   The pan and pan support
    *   A free protective plastic cover for the balance
    *   An AC/DC adaptor (check that the AC input rating is correct)
    *   A spare fuse (0.5A)
    *   A free plastic breeze break for FX-200
    *   A free jack plug for connecting an external RE-ZERO switch

*   Place the balance on a firm weighing table and turn the adjustable feet until the spirit level shows that the balance is level. Install the pan and pan support on the balance and plug in the AC/DC adaptor. The AC input requirements could be 100, 120, 220 or 240 Volts (50/60Hz) depending on the area in the world so please check that the adaptor is correct. The DC output should be 12 Volts (please note that an alternative 12 V DC power supply might not be stable enough for this balance).

*   Press the **ON/OFF** key, all the display segments will switch on and then the display will zero in preparation for you to place a weight on the pan. At this stage any weight reading will not be very accurate because the balance has not been "calibrated". Please leave the balance switched on to "warm-up" for at least 30 minutes and finish reading this manual.
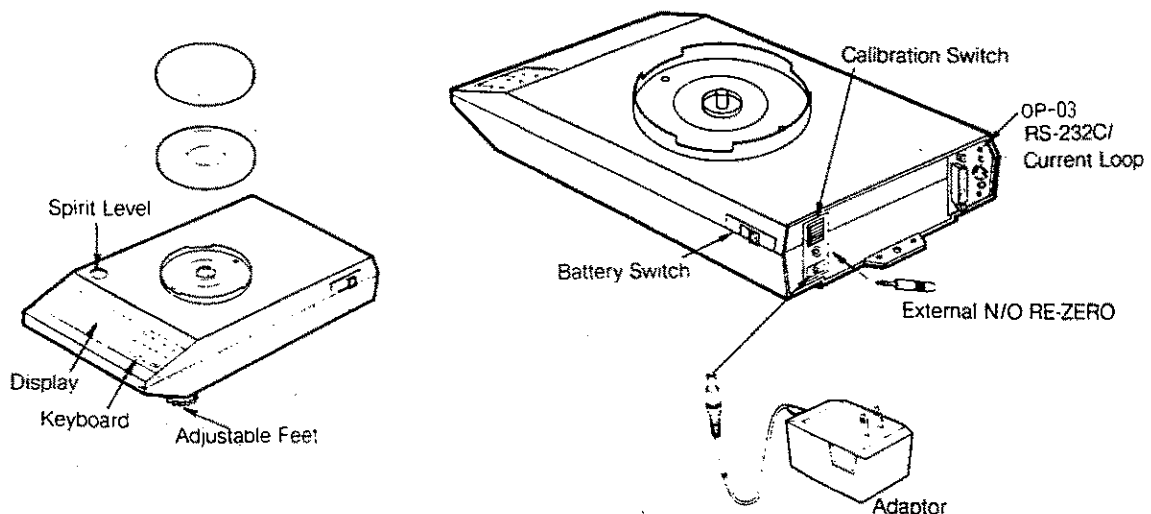
UNDERSTANDING YOUR BALANCE

If you know about weighing and electronic balances then you can skip this page but if you don't know anything about it then please read on:

* How does the balance work?
When you put an object on the weighing pan it is pulled downwards under the action of gravity. This balance operates on a principle called "force restoration" which means it attempts to restore (push up) the object which is being pulled down. The balance uses an electromagnet to do this so if we know how much force (electricity) is needed to push against an object we know how heavy it is (how much it is being pulled down). In future we will call the object a "mass" and the measurement of its massiveness on Earth its "weight" (weight=mass X acceleration due to "g").

* What is gravity?
Gravity is a force of attraction between material objects in space. The Earth is a large material object (mass) in space and things on its surface accelerate towards its center at a speed (sea level, in a vacuum) of about $9.80665 m/s^2$ ($32.174 ft/s^2$). Fortunately they don't get there because the surface of the Earth stops them. Unfortunately this value for "g" changes from location to location by about ±0.3% because the force decreases with altitude above sea level or, more correctly, the distance from the center of the Earth *("g" is inversely proportional to the square of the distance between masses)*. The North and South poles are closer to the center of the Earth than the equator so "g" is greater at the poles and changes with latitude. The sun and the moon have an inconsistent effect with regards to gravity. Air buoyancy acts against gravity by making a mass float upwards at a rate of about 0.0012g per cm^3 of air displaced (±10% @ 20°C), but this also varies.

* What is calibration?
When we weigh a mass we are trying to find its weight expressed as grams or kilograms. Because "g" and other factors vary from location to location, we must calibrate the balance whenever we move it otherwise a mass of 1kg might display 1000.00g in one location and 1002.56g in another (ie: "g" may have changed by +0.256%. w=m X g). This would be an error but it can be prevented by placing an accurate mass on the balance (say 2kg) and then telling the balance, in effect, "this is what 2kg weighs at this location so please display 2000.00g"..... this is calibration.

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% Rel. 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

CALIBRATING YOUR BALANCE

Your Balance should be calibrated when it is first installed and then every 30 days or so. Please use a high quality non-magnetic, metric, stainless steel, "Standard Mass" for calibration ($\approx 8.0 g/cm^3$) OIML class F_2 or better.

* Standard Mass required for FX-200 and FY-200 is 200g.
* Standard Mass required for FX-2000 and FY-2000 is 2,000g.

STEP1　Warm-up before calibration for at least 30 minutes
STEP2　Slide the rear calibration switch up (display must be on)
STEP3　"CAL O" will be displayed, press **RE-ZERO**
STEP4　After a pause "CAL F" will be displayed, put the Mass on pan
STEP5　Press **RE-ZERO** and after a pause "CAL End" will be displayed
STEP6　Slide the rear calibration switch down, calibration is over

NOTES:
* "Err CAL" means Error in Calibration method (display was off?).
* "-CAL E" means calibration mass is too light, check requirement.
* If your calibration mass is not exact but is known (eg: 200.05g instead of 200.00g) then set the balance to accept this value. When "CAL O" is displayed 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** 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 ±15 minimum divisions so goes:- 200.00, 200.01, 200.02, 200.03.........200.14, 200.15, 199.85, 199.86.........199.99, 200.00 etc.

UNDERSTANDING THE DISPLAY

The FX and FY balances use a cobalt blue fluorescent display. You can make sure that all the display segments are working properly by pressing **RE-ZERO** while simultaneously turning the display on via the **ON/OFF** key. Please do this now and whenever the segments seem to be burning with an uneven intensity (in which case leave it on for about 12 hours). Press **ON/OFF** again to restore the normal display.

Starting at the left end of the display you will see a circular stability indicator, a minus weight display symbol and the triangular Automatic Counting Accuracy Improvement (ACAI™) symbol. Next you can see the main display "8.8.8.8.8.8.8." used to display the weight, the final decimal point acts as a standby indicator and remains on when power is connected.

The final three character spaces are made up of two 14 segment displays which can display any letter in the alphabet and one two segment display which can display "t" or "g". These three character spaces are used to inform you which weighing mode the balance is in. Apart from weighing in grams "g", this balance can also weigh in counting mode "cnt" or percentage mode "Pct". Alternative weighing units are:- carat "ct"; pennyweight "dwt"; troy ounces "OZt"; ounces (avoir) "OZ"; pounds (avoir) "Lb"; pound/ounce "**L**.**OZ**"; grains "GN"; animal weight "A -g"; Tael "TL" (Hong Kong, Singapore or Taiwan versions); momme "mm"; tola "t".
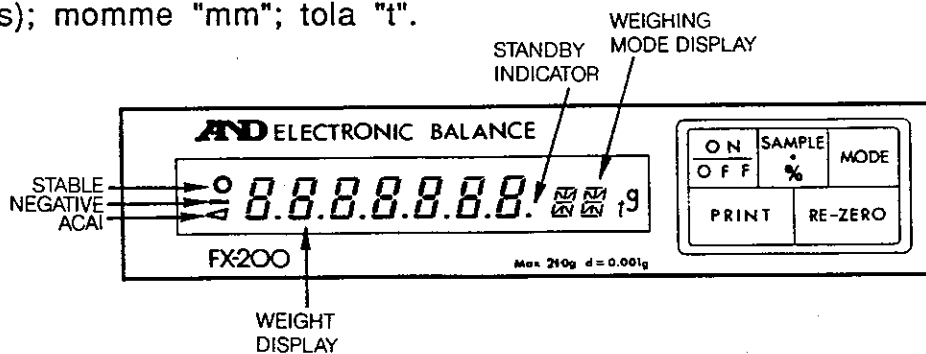
* **NOTE:** In some countries your dealer may be required to disable (by law) some of the alternative weighing units. Please ask your dealer for details.
* The **ON/OFF** key switches the display on and off but does not cut the power to the balance so the balance will remain on standby while the adaptor remains connected. The final decimal point will stay on.
* The **SAMPLE/%** key can be used to register a sample count (eg: 10) in counting "cnt" mode or register 100% in percentage "Pct" mode.
* The **PRINT** key can be used to transmit data to the AD-8117 printer, or to a computer, via the optional RS-232C interface.
* The **RE-ZERO** key can be used to zero the display or "Tare" the weight of a container (range is from zero to maximum capacity).

UNDERSTANDING THE FUNCTIONS

FX/FY balances are multi-function instruments. The software in the balance contains the following weighing modes and switching between the modes is carried out by pressing the **MODE** key. Do not press these touch sensitive keys too hard, press them until you feel a "click" and then hold them for about half a second until they operate. If the law in your country permits you to be able to use all of the functions then the complete mode cycle will be as follows (if some are missing please refer to your dealer):-

g $\Rightarrow$ cnt $\Rightarrow$ Pct $\Rightarrow$ OZ $\Rightarrow$ Lb $\Rightarrow$ **L**.**OZ ("LO"=lb/oz) $\Rightarrow$ ct $\Rightarrow$ dwt $\Rightarrow$ OZt $\Rightarrow$ GN $\Rightarrow$ A -g $\Rightarrow$ mm $\Rightarrow$ t $\Rightarrow$ TL $\Rightarrow$ g (etc). A total of 14 modes.

If you do not wish to use some of these modes then it is possible for you to disable some of them in the following way (please try it now):
* Switch off the display
* Press **MODE** and while holding **MODE** press **ON/OFF**
* "g" only will be displayed
* Press **SAMPLE/%** if you wish to select "g" as a mode
* Press **MODE** and "cnt" will be displayed
* Press **SAMPLE/%** to select "cnt" or press **MODE** again to deselect
* Continue selecting or deselecting modes in this manner until "g" returns
* Press **RE-ZERO** when your selection has been completed
* When you press **MODE** in future only selected modes will be displayed

ABBREVIATION	NAME IN FULL	CONVERSION
OZ	OUNCE (AVOIR)	28.349 523 125g
Lb	POUND (AVOIR)	453.592 37g
OZt	TROY OUNCE	31.103 476 8g
GN	GRAIN (UK)	0.064 798 91g
dwt	PENNYWEIGHT	1.555 173 84g
ct	METRIC CARAT	0.2g (5 = 1 gram)
mm	MOMME (JAPAN)	3.75g (10 = 1 TAEL)
TL	TAEL (TAIWAN)	37.5g
TL	TAEL (HK)	37.437g
TL	TAEL (Sing.)	37.793g
t	TOLA (INDIA)	11.663 803 8g

HELP, What if?

* "HELP, What if "-------" is displayed?" Answer: The power supply to the balance was cut during weighing. Press ON/OFF and start again.

* "HELP, What if the standby decimal point is not on when the adaptor is plugged in and the display doesn't switch on when I press ON/OFF?" Check external fuses and if they have not blown check the internal fuse. Open the balance carefully as shown in the diagrams below. If the internal fuse has not blown, check that the adaptor is working. If the internal fuse has blown and blows again immediately, have the balance repaired.
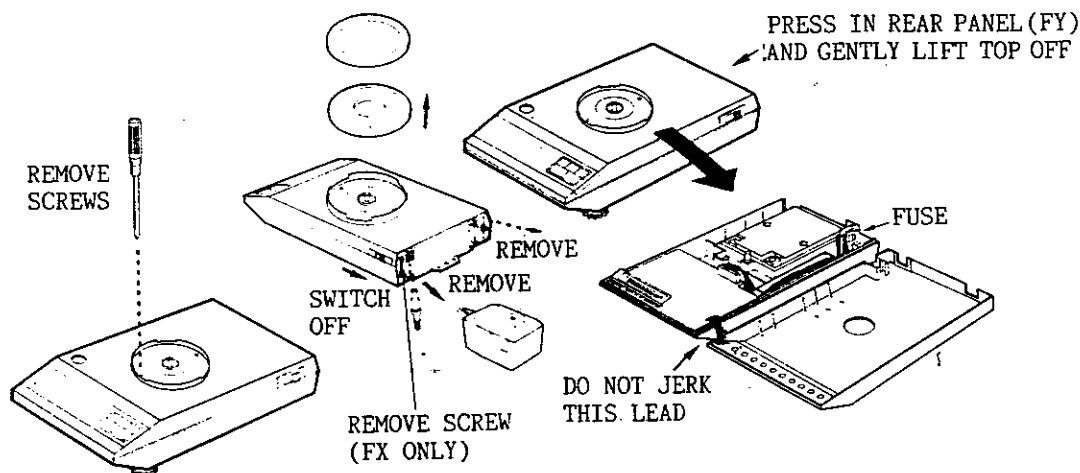
* "HELP, What if "Lo" is displayed in "cnt" or "Pct" mode after I press SAMPLE/%?" The weight of the sample was too low. In counting mode you will be prompted to increase the sample size from 10 units to 20, 50 or 100 units but remember that the minimum unit weight cannot be less than the resolution of the balance. In percentage mode you can place a sample on the pan which is only 100 times the basic resolution but you will not be able to weigh to a percentage resolution of 0.01% until you use a sample which is 10,000 times the basic resolution (100.00% is 10,000 counts).

* "HELP, What if the weighing result is not stable?" Check that the weighing table is stable. Check that there are no drafts. Check that the breeze break (if any) is installed correctly. Check that the power supply voltage is stable.

* "HELP, What if the weight displayed is obviously incorrect?" Check that the balance is level. Check that it has been accurately calibrated. Check that the display started from zero before the mass was placed on the pan. Check that the mass is not overhanging and touching something else, like the sides of the breeze break or the top cover of the balance.

WEIGHING SOMETHING

* Simple   Weighing.
Keep the balance on standby to keep it warmed-up. If you are operating the balance on the battery pack then remember to switch off the battery after use. Turn the display on via the **ON/OFF** key. Weigh in grams or select a different mode with the **MODE** key. Place the object(s) on the pan and read the weight when stable.
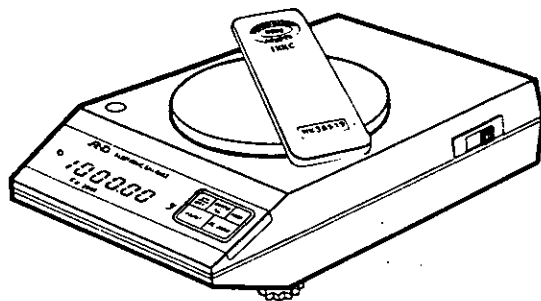
* Calibration (also see page 5).
With display on slide CAL switch up. "CAL O" display. Press **RE-ZERO**. "CAL F" display. Place mass on pan. Press **RE-ZERO**. "CAL End" display. Slide CAL switch down.
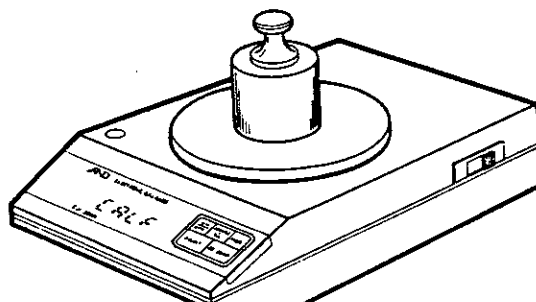
* Weighing into a container.
Place the container on the pan. **RE-ZERO** to cancel the weight. Fill the container until the target weight is reached. When adding more than one ingredient to the container, press **RE-ZERO** after each one.
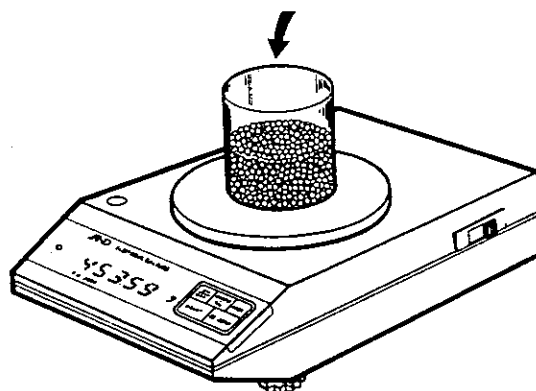
* Weighing out of a container.
Place the full container on the pan. **RE-ZERO** to cancel the weight. Scoop the amount of material you need out of the container with reference to the negative display.
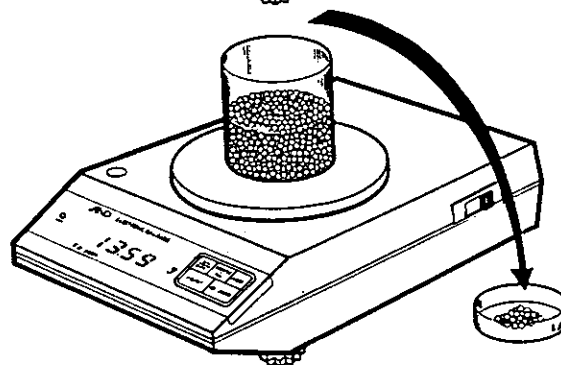
* Deviational   Weighing.
Place a reference object on the pan. **RE-ZERO** to cancel the weight. Comparative objects placed on the pan will now show their deviation from the reference weight (zero) in terms of a ± weight display. In percentage mode it would be ± "Pct".
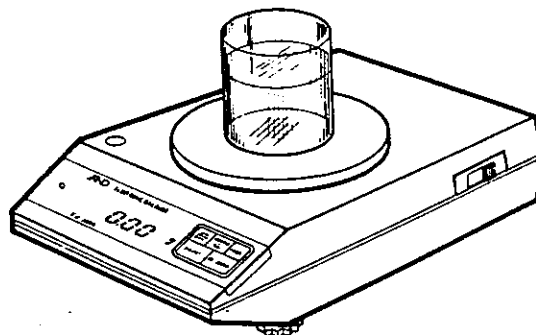
* Percentage Mode, "Pct".

Select "Pct" with the **MODE** key.
Press **RE-ZERO** to zero the display.
Press **SAMPLE/%** and "100. 0 Pct" will be displayed. Place the sample on the pan and press **SAMPLE/%** again. "100.00Pct" will be displayed. As well as being useful as a % of deviation check weigher, percentage weighing can turn this balance into a moisture determination system. If you enter a moist sample as 100% via the **SAMPLE/%** key and then dry the sample in an infra-red or microwave oven, you can find the percentage of water that was in the moist sample from the percentage weight loss. If you make a note of the gram weight before and after drying, you will also know the volume of water because $1g=1ml\approx1cm^3$ (1liter=1.000028dm³).

* Counting Mode, "cnt".

Select "cnt" with the **MODE** key.
Press **RE-ZERO** to zero the display.
Press **SAMPLE/%** and "10   0 cnt" will be displayed. Place 10 units on the pan and press **SAMPLE/%** again. If 10 units are enough you may proceed but if the balance calls for 20, 50 or 100 units as a sample you must hand count these onto the pan. The next display will be "10 cnt" and you should add approximately 10 more units (double the sample). The display might then be "20 cnt" at which point the ACAI triangle should switch on, flash three times and then switch off. If you add more than double the previous count you may fall outside ACAI parameters and the final count may not be completely accurate. Continue to approximately double the previous count until you reach your target.

Display		Key / Note
$100. - Pct$		MODE
$100. 0 Pct$		RE-ZERO
$100. - Pct$		Moist Sample
$100.00 Pct$		SAMPLE %
$0.00 Pct$		Remove
$75.00 Pct$		After Dry (25% Water)

Alternatively if you RE-ZERO after establishing the 100.00% weight, the dry weight will be displayed as " -   25.00 Pct".

Display		Key / Note
$10 0 cnt$		SAMPLE %
$10 cnt$		Count Sample
$20 cnt$		ACAI on
$40 cnt$		ACAI on
$200 cnt$		Too much for ACAI

ACAI can only continue to update the average unit weight if you do not add too many units at a time.

DENSITY DETERMINATION

* Weighing with the built-in "underhook".
The FX/FY series are equipped with a standard built-in underhook. This makes density determination a relatively simple matter. You can find the underhook behind the plastic plug in the under-side of your balance --- it is a hole through the lower end of the riser beam, directly below the pan support peg (lateral force cannot be applied to this beam). You may hang a light-weight weighing harness from this hole or thread a strand of thin string/wire through it. For best results re-calibrate the balance with the harness fitted. Place the balance on a weighing table with a hole cut in it or place it on a firm metal stand designed for underhook weighing. In either event take care to exclude drafts with a breeze break around the apparatus.

You can find the relative density (specific gravity) of a metal or some other material from its loss in weight when weighed in water. Because one gram of water is almost exactly one cubic centimeter in volume, the loss in weight (floating weight through displacement) associated with weighing an object in water is in proportion to the object's volume. By dividing the object's weight in air by the loss in weight in water (volume), you can find the relative density of the object (expressed as g/cm³).

AN EXPERIMENT WITH A BAR OF SILVER COLORED METAL
* Press **RE-ZERO** to zero the display.
* Find the weight of the bar in air. It weighs 1000.00g in air.
* Press **RE-ZERO** to zero the display.
* Lower the bar into water at 4°C (maximum density).
* Display reads "-   46.50 g" which is almost the same as 46.5cm³.
* 1000.00g ÷ 46.5cm³ ≈ 21.5g/cm³; thus the metal is probably platinum.
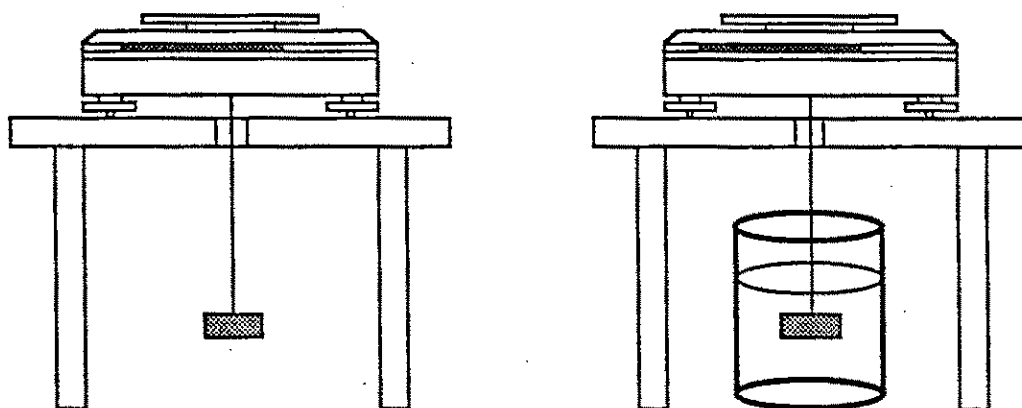
OPTIONAL GLASS BREEZE BREAK

A breeze break may be required in drafty environmental conditions when balances are being used to weigh to a resolution of 1mg or 10mg. If you order the glass breeze break separately from your balance order, please be sure to specify Option-06 for an FX balance or Option-07 for an FY balance.

* Installing the breeze break (OP-06/07)
* Remove the pan/pan support and the two screws shown below.
* Remove the dust ring on FX balances (impossible on FY balances).
* Place the breeze break on top of the balance.
* Replace the dust ring inside the breeze break (FX balances only).
* Replace the two screws and the pan/pan support.
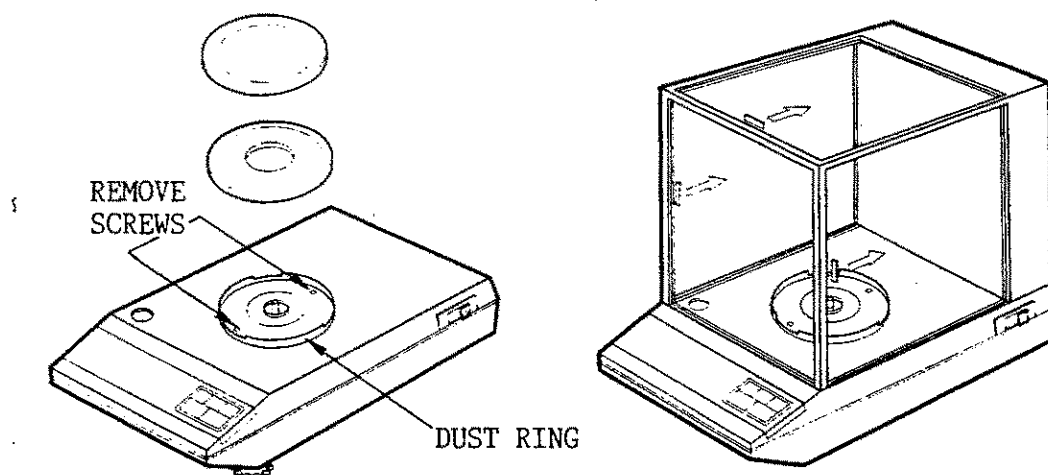
OPTIONAL NiCd BATTERY PACK

OP-04 for FX and OP-05 for FY balances. This battery pack should not be installed by the end-user as incorrect installation could damage the balance. Please ask your dealer to carry out the installation procedure.

With the AC adaptor plugged in and the battery switch OFF the battery pack will recharge in about 15 hours *(do not overcharge as it will cause damage)*. In normal use with the adaptor plugged in, keep the battery switch ON. When the balance is operated on the battery pack the switch should, of course, be ON. The pack can be expected to offer between 6 (FY) and 9 (FX) 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 OPTIONAL RS-232C
INTERFACE

* Installing the optional RS-232C Interface (Option-03)
* Unplug the AC/DC adaptor and switch OFF the battery pack (if any).
* Remove the blanking plate held by two screws.
* Slide the Interface into the slot and push until the connector mates.
* Replace the two screws and restore power to the balance.
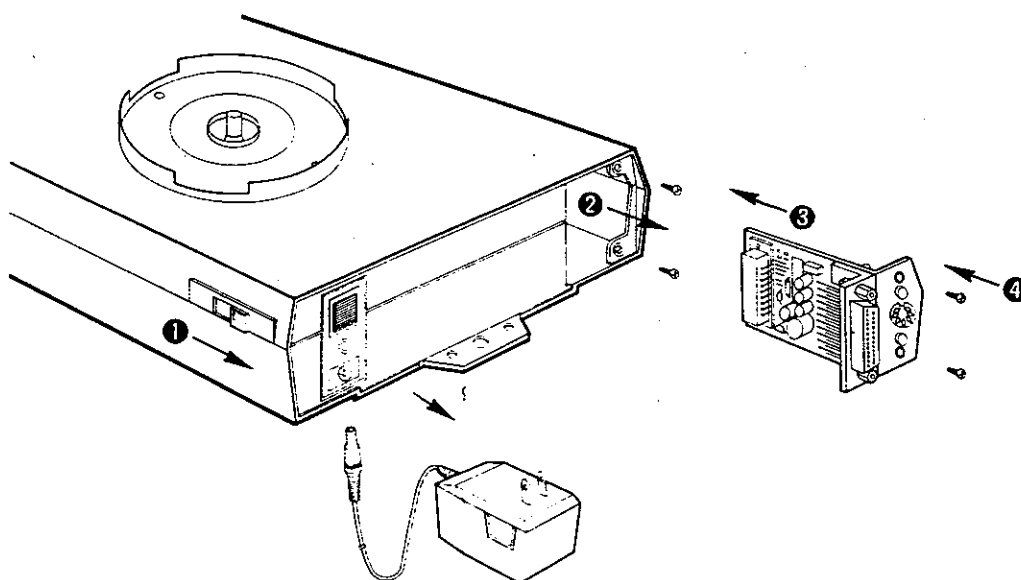
* EIA-RS-232C/Passive 20mA Current Loop Specifications.
    * Half-duplex, Asynchronous Transmission, Bi-directional
    * 600, 1200, 2400 and 4800 baud rates selectable.
    * 7 data bits.
    * 1 Even Parity Bit.
    * 1 Stop Bit.
    * ASCII code.
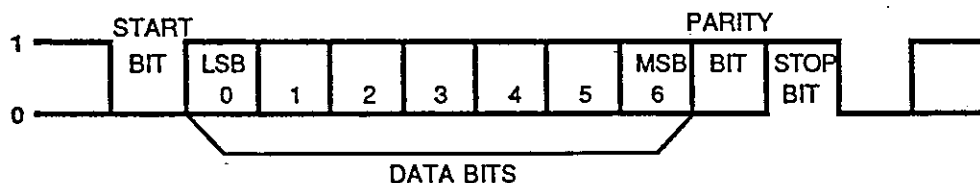
RS-232C			CURRENT LOOP
1	= -5 -	-15V	20mA
0	= +5 -	+15V	0mA

DATA FORMAT

One Transmission Data Set consists of 17 characters (x=space)

CONDITION	DISPLAY	TRANSMISSION DATA
STABLE	o 300.000 g	ST, +0300.000 xxg CR LF
UNSTABLE/ NEGATIVE	- 1.25 Pct	US, -00001.25 xx% CR LF
OVERLOAD ERROR	E	OL, +9999999E +19 CR LF
UNDERLOAD ERROR	-E	OL, -9999999E +19 CR LF
COUNTING STABLE	o 12000 cnt	QT, +00012000 xPC CR LF
OUNCE UNIT	o 10.00000 OZ	ST, +10.00000 xoz CR LF
POUND UNIT	o 1.00000 Lb	ST, +01.00000 xlb CR LF
POUND/ OUNCE	o 1L 0.00 OZ	ST, +00016.00 xoz CR LF
CARAT	o 1000.000 ct	ST, +1000.000 xct CR LF
PENNYWEIGHT	o 180.000 dwt	ST, +0180.000 dwt CR LF
TROY OUNCE	o 8.00000 OZt	ST, +08.00000 ozt CR LF
GRAIN UNIT	o 4000.00 GN	ST, +04000.00 xGN CR LF
ANIMAL WEIGHT	o 300.00 A -g	ST, +00300.00 xxg CR LF
MOMME	o 80.0000 mm	ST, +080.0000 xmm CR LF
TAEL	o 8.00000 TL	ST, +08.00000 xTL CR LF
TOLA	o 16.0000 t	ST, +016.0000 xxt CR LF

* Four types of HEADER are transmitted:
  * OL ---- Overload (E, -E)
  * ST ---- Display is stable in weighing and % mode
  * US ---- Display is unstable (in-motion)
  * QT ---- Display is stable in counting mode
* Terminator will always be <CR> <LF> for transmission data
* Weight data is transmitted in ASCII including these four codes:
  * 2D (HEX) ---- "-" Minus
  * 2B (HEX) ---- "+" Plus
  * 2E (HEX) ---- "." Decimal Point
  * 45 (HEX) ---- "E" Exponent

* Transmission Modes (see Software Parameter settings C3-0/1/2/3/4)
You will learn how to set these transmission modes later. There are five possible transmission modes, two are designed for communication with computers and three are designed for communication with the AD-8117 Compact Printer (2400 baud only).
* **C3-0** Balance print key will work only when the data is stable.
* **C3-1** Print accepted but is executed after the data becomes stable.
* **C3-2** Auto-print once per weighing event when data becomes stable.
* **C3-3** Data will be transmitted only on command from external device.
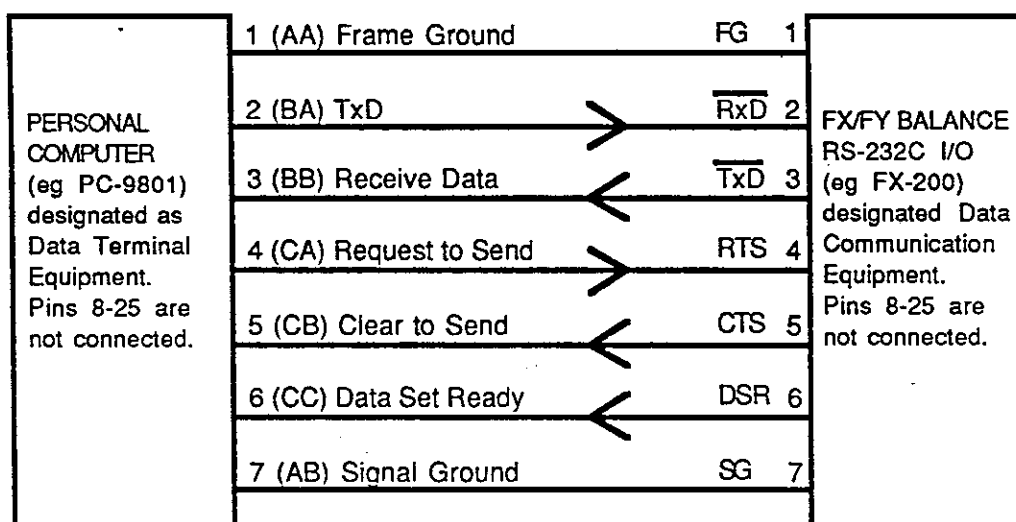* **C3-4** Transmit data in a continuous stream (RS-232C/Current Loop).

C3-3 and C3-4 are designed for communication with computers. C3-3 is called COMMAND Mode and when in this mode the balance can accept various commands from an external device (eg. computer).
These are as follows:
* <P> <CR> <LF> Power ON/OFF (remote **ON/OFF** control). (50 0D 0A HEX)
* <Q> <CR> <LF> Question the balance for data at any time. (51 0D 0A)
* <R> <CR> <LF> RE-ZERO the balance (remote **RE-ZERO**). (52 0D 0A)
* <S> <CR> <LF> Stable balance data only to be transmitted. (53 0D 0A)
* <U> <CR> <LF> Unit change (remote **MODE** change). (55 0D 0A)

C3-4 is called STREAM Mode and data will be transmitted continuously from the RS-232C I/O port and from the passive Current Loop connector (provide external 20mA power). If you connect AD-8117 (RS-232C) in STREAM mode and a computer to the Current Loop then the balance PRINT key will not function and you must use the AD-8117 DATA key (Mode 2). See the Parameter Setting section for baud rate (600, 1200, 2400, 4800) selection but remember that AD-8117 requires data at 2400 baud for RS-232C or CL reception with the CL adaptor cable.

RS-232C I/O PIN CONNECTIONS

PERSONAL COMPUTER (eg PC-9801) designated as Data Terminal Equipment. Pins 8-25 are not connected.	1 (AA) Frame Ground	FG 1	FX/FY BALANCE RS-232C I/O (eg FX-200) designated Data Communication Equipment. Pins 8-25 are not connected.
	2 (BA) TxD →	RxD 2	
	3 (BB) Receive Data ←	TxD 3	
	4 (CA) Request to Send →	RTS 4	
	5 (CB) Clear to Send ←	CTS 5	
	6 (CC) Data Set Ready ←	DSR 6	
	7 (AB) Signal Ground	SG 7	

* Use high quality modem type cable between computer and balance.
* AD-8117 is supplied with a cable for connection to the balance.

CIRCUIT DIAGRAM

RS-232C

- 1 FG
- 2 $\overline{RxD}$
- 3 $\overline{TxD}$
- 4 RTS
- 5 CTS
- 6 DSR
- 7 SG

CONTROL

+5V

OTHER PIN NUMBERS FOR THE RS-232C OR CURRENT LOOP INTERFACES ARE NOT CONNECTED.

Current Loop

- 3 CL
- 2 FG
- 5 CL
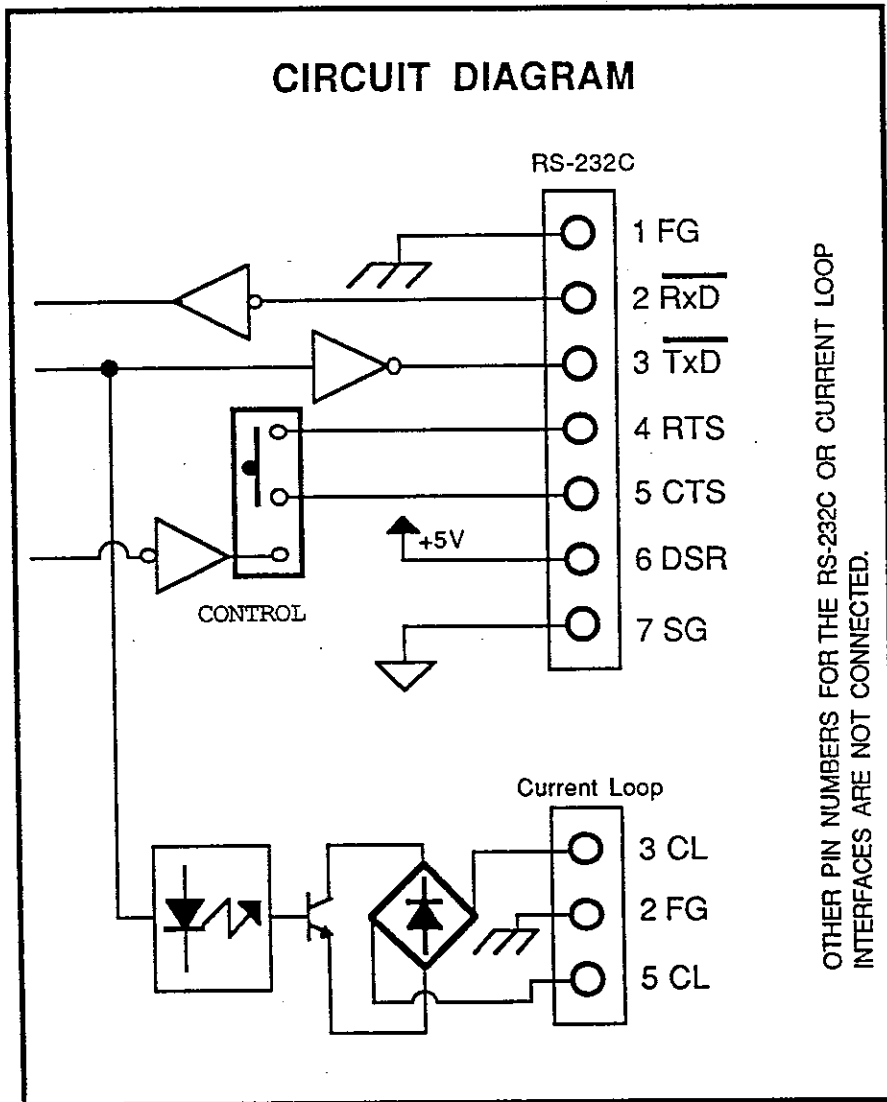
A 25-pin RS-232C male connector and cover (HDB-25P & HDB-CTF) is not provided with this option. A 7-pin DIN male Current Loop connector (TCP 0576) is provided for the passive Current Loop.

RS-232C

13 12 11 10 9 8 7 6 5 4 3 2 1
25 24 23 22 21 20 19 18 17 16 15 14
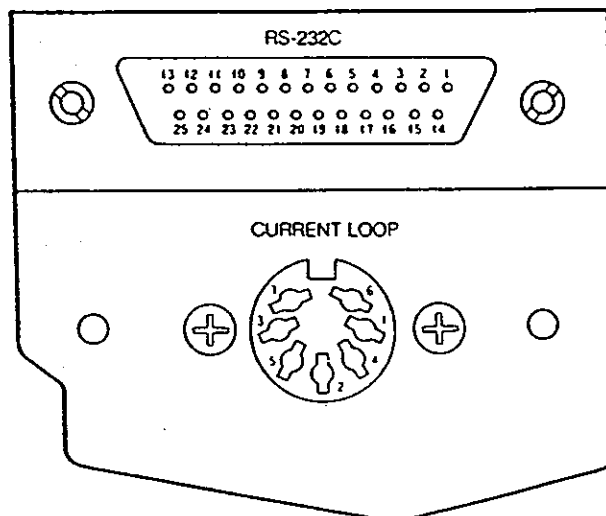
Bi-directional (Command Mode) RS-232C Interface.

CURRENT LOOP

Unidirectional (Send Data Only) Passive Current Loop.

* SAMPLE COMPUTER PROGRAMS TO LOAD WEIGHT DATA

Microsoft BASIC running on NEC PC-9801. Balance set to:
Command mode (C3-3), at 2400 baud (C4-2), <CR> <LF> Terminator
(C5-0), Time Out On (C6-0) **NOTE:** HD$=Header string, DT=Data, UT$=Unit/MODE

```
10   OPEN "COM:E71NN" AS #1        (NN=PC-9801 BASIC only)
20   FOR J=1 TO 100: NEXT J        (Delay after buffer open)
30   PRINT #1, "R"                 (RE-ZERO the balance)
40   FOR J=1 TO 5000: NEXT J       (Delay after RE-ZERO)
50   PRINT #1, "Q"                 (Question the balance)
60   INPUT #1, HD$, DT, UT$        (Receive the data strings)
70   PRINT HD$, DT, UT$            (Display the data strings)
80   CLOSE                         (Close the file #1)
90   END                          (Stop)
```

BASIC D3.10 running on IBM PC-XT under DOS 3.10.
Balance set to: Stream mode (C3-4), at 4800 baud (C4-3),
<CR> <LF> Terminator (C5-0), Time Out On (C6-0)

```
10    T5:ON ERROR GOTO 100
20    OPEN "COM1:4800,,,,CS" AS #1
30    LINE INPUT #1,A$
40    INPUT #1,HD$,DT$
50    IF HD$<>"OL" THEN GOTO 70
60    DT$="   "+LEFT$(DT$,1)+"E":GOTO 90
70    IF HD$<>"US" THEN GOTO 90
80    DT$=LEFT$(DT$,9)
90    PRINT HD$,DT$:GOTO 40
100   T=T-1:IF T<>0 THEN GOTO 30
110   END
```

BASIC D3.10 running on IBM PC-XT under DOS 3.10.

Balance set to: Command mode (C3-3), at 4800 baud (C4-3),

<CR> <LF> Terminator (C5-0), Time Out On (C6-0)

```
10   OPEN "COM1:4800,,,,LF" AS #1
20   PRINT #1, "R"+CHR$(&HD);
30   FOR I=1 TO 1000:NEXT
40   Print #1, "Q"+CHR$(13);
50   INPUT #1, HD$, DT$
60   IF HD$<> "OL" THEN GOTO 80
70   DT$="   "+LEFT$(DT$,1)+"E":GOTO 100
80   IF HD$<>"US" THEN GOTO 100
90   DT$=LEFT$(DT$,9)
100  PRINT HD$, DT$
110  GOTO 30
120  END
```

* PRINTING WITH AD-8117 (RS-232C, 2400baud)

AD-8117 cannot accept mixed resolution/unit data in statistical mode. The first data block sent to the printer decides the resolution and MODE (eg: g, oz, cnt etc). If either the resolution or weighing unit is subsequently changed, the end result will be inaccurate because the data will not be read correctly.

* C3-0 balance print key works when data stable. AD-8117 Mode 1.

* C3-1 print executed after data becomes stable. AD-8117 Mode 1.

* C3-2 stable data is automatically transmitted to the printer once per weighing event. A "weighing event" is defined as a stable weight of more than +10 minimum divisions in gram mode. The auto-print function will be reset when the weight data falls below 10 min. div. (Grams) again, on the way to zero, at the end of the current weighing event. AD-8117 compact printer Mode 1.

* C3-4 use the AD-8117 DATA key only. AD-8117 Mode 2.

SETTING THE SOFTWARE PARAMETERS

Most users of the FX and FY balances will not need to enter this software parameter setting mode. If you do need to change a parameter setting (after connecting a printer or computer for instance) then please follow this procedure:

* Switch OFF the display.
* Press **RE-ZERO** and, while continuing to press **RE-ZERO**, press **ON/OFF**.
* The display will come on with all segments illuminated.
* Press **MODE** and the display will change to C1-1.
* If you wish to change this parameter to C1-1 or C1-2, press **RE-ZERO**.
* Press **MODE** again and the display will change to C2-1.
* **RE-ZERO** may be used to switch between C2-1, C2-0 and C2-2.
* Continue setting the parameters in this way and end by pressing **ON/OFF**.

C#	FUNCTION	#	DESCRIPTION	NORMAL SETTING	NOTES
C1-	STABILITY BAND WIDTH	0	NARROW BAND	C1-1	MOTION DETECTION BAND WIDTH
		1	NORMAL BAND		
		2	WIDE BAND WIDTH		
C2-	FILTER STRENGTH	0	WEAK/GOOD E.C.	C2-1	ENVIRONMENTAL CONDITIONS. WIND, VIBRATIONS ETC.
		1	NORMAL/FAIR E.C.		
		2	STRONG/BAD E.C.		
C3-	RS-232C/CL DATA OUTPUT (OPTION-03) ONLY	0	PRINT IF STABLE	C3-0	PLEASE READ THE PREVIOUS CHAPTER CONCERNING THE RS-232C INTERFACE
		1	PRINT ACCEPTED		
		2	AUTO-PRINT		
		3	COMMAND MODE		
		4	STREAM MODE		
C4-	DATA OUTPUT BAUD RATE	0	600 baud	C4-2	MUST BE SET TO C4-2 FOR AD-8117 COMPACT PRINTER
		1	1200 baud		
		2	2400 baud		
		3	4800 baud		
C5-	TERMINATOR	0	<CR> <LF>	C5-0	COMMAND MODE
		1	<CR>		
C6-	TIME OUT	0	TIME LIMIT ON	C6-0	COMMAND MODE
		1	TIME LIMIT OFF		

SPECIFICATIONS

CAPACITY x RESOLUTION	FX-200	FX-2000	FY-200	FY-2000
GRAM	210x0.001g	2100x0.01g	210x0.001g	2100x0.1g
DECIMAL OUNCE (av)	7x0.00005	74x0.0005	7x0.0005	74x0.005
DECIMAL POUND (av)	0.4x0.000005	4.6x0.00005	0.4x0.00005	4.6x0.0005
POUND/OUNCE (x 0.01oz)	7.40oz	4lb 10.08oz	7.40oz	4lb 10.08oz
CARAT	1050x0.005	10500x0.05	1050x0.05	10500x0.5
PENNYWEIGHT	135x0.001	1350x0.01	135x0.01	1350x0.1
TROY OUNCE	6.7x0.00005	67x0.0005	6.7x0.0005	67x0.005
GRAIN	3240x0.02	32407x0.2	3240x0.2	32408x2
MOMME	56x0.0005	560x0.005	56x0.005	560x0.05
TAEL (HONG KONG)	5x0.00005	56x0.0005	5x0.0005	56x0.005
TAEL (SINGAPORE)	5x0.00005	56x0.0005	5x0.0005	56x0.005
TAEL (TAIWAN)	5x0.00005	56x0.0005	5x0.0005	56x0.005
TOLA (INDIA)	18x0.0001	180x0.001	18x0.001	180x0.01
REPEATABILITY/std.dev.	0.001g	0.01g	0.01g	0.1g
LINEARITY	±0.002g	±0.02g	±0.01g	±0.1g
SENS DRIFT (10°-30°C)	±3ppm/°C	±3ppm/°C	±10ppm/°C	±10ppm/°C
STABILIZATION TIME	2.5sec (approx)	2.5sec (approx)	2.0sec (approx)	2.0sec (approx)
PAN SIZE mm	ø105mm	ø150mm	ø105mm	ø150mm
PAN SIZE inches	ø4.1"	ø5.9"	ø4.1"	ø5.9"
NET WEIGHT (approx)	4kg/8.8lb	4kg/8.8lb	3kg/6.6lb	3kg/6.6lb
CALIBRATION MASS	200g	2000g	200g	2000g
BEST TEMP/REL. HUMIDITY	20°C 50%RH	20°C 50%RH	20°C 50%RH	20°C 50%RH

imno-FX/Y-200-v.1

FUNCTION DESCRIPTION

* **Gram/gramme**. This is a unit of mass in the metric (SI) system and is defined as a thousandth part of the International Prototype Kilogram. One gram is approximately the weight of one cm³ of water at 4°C.

* **Carat**. This is a metric weight for weighing diamonds and other precious stones. There are 5 metric carats to one gram.

* **Pound** (avoirdupois). There are 16 ounces and 7000 grains to one pound. The abbreviation "lb" comes from the Latin "libra" meaning pound. FX/FY balances can weigh in decimal pounds or traditional pounds and ounces.

* **Ounces** (avoir). There are 16 ounces to one pound and 16 drams to one ounce. One ounce is the weight of one imperial fluid ounce of water at 62°F (20fluid oz=1 pint; 8 pints=1 imp.gal.=10lb). "oz" (437¹/2 GN) is from "onza".

* **Troy Ounces**. One ozt = 480 GN = 20dwt = 24 scruples = 8 drachms (apothecary). Troy ounces are used for weighing gold and silver etc. One troy pound = 12 ozt = 5,760 grains.

* **Grains**. (GN or gr.) Originally the weight of one grain of wheat, it is now used for weighing small quantities of drugs and explosives. It is the fundamental weight unit of the Troy/Apothecary and Avoirdupois systems.

* **Pennyweight**. (dwt=denarius weight). English money was based on £.s.d. (librae/pounds, solidi/shillings, denarii/pence) with 20 twelve-penny shillings to the pound (money/240 pence) or 240 silver pennyweights to a troy pound of sterling silver. The dwt is used for weighing precious metals.

* **Momme**. This is one tenth of the metrically linked 37.5 gram tael and it is used for weighing pearls.

* **Tael**. This is a traditional Chinese weight value for gold. The metric conversion rate is not standard between countries. FX and FY balances can display one of three different tael units depending on the country.

* **Tola**. This is a traditional weight unit in India. It was standardised in the past to link with the British "grain" based weight system and is equal to 180 grains (180 GN x 0.064 798 91 g =11.663 803 8 grams).

* ACAI™. Automatic Counting Accuracy Improvement continually updates the average unit weight divisor in counting mode. Imagine 10 units weigh 10 grams but the sum of 20 units weighs 20.2 grams.....ACAI will automatically update the average unit weight divisor from 1.0g to 1.01g. You should not add too many units at a time because without ACAI small variations in unit weights could accumulate into a counting error.

* Stability Band Width. Narrow band means that the STABLE annunciator will switch on if the display is stable in a band of ±1 minimum division digits from the correct display. Normal = ±2 digits and Wide is ±4 digits. The band widths are thus 2, 4 and 8 minimum division digits respectively.

* Animal Weighing. The Animal Weight mode, "A - g", permits operators to weigh (grams only) living animals. Live animals, such as mice, tend to move around a lot when conscious and this movement normally means that: (a) not only will the display never be stable but (b) it will also be very difficult to figure out what the animal's true weight might be. The animal weighing mode tries to overcome this problem by working out the average downward force exerted by the animal over an extended period of time and then holding/freezing the display once the calculation has been completed. Naturally the less excited the animal is the better since any movement on the weighing pan makes for less than ideal weighing conditions.

* Weighing an animal:
Select "A - g" (Animal - grams) with the **MODE** key.
Place the cage or animal container on the weighing pan and press **RE–ZERO**.
Place the animal in the container and the animal weighing software will be automatically triggered by the increase in weight. After averaging has been completed the display will hold and the stability symbol will switch on. If the printer is connected via the optional RS-232C interface then, generally, the C3-2 Auto-print function will be used to transmit stable weight data one time for each weighing event.
You may also set software parameters C1-2 and C2-2 to cope with the more energetic organisms you wish to weigh. In "A - g" mode the software functions a little differently from the normal weighing mode but the relationship remains the same with the averaging band (CI) long (C1–0=4sec), medium (C1–1=2sec) or short (C1–2=1sec) and the motion band width (C2) --- which depends on the weight of the animal --- permitting rough or precise data to be used for display calculations (C2–0 means width=6% of the animal's weight, C2–1=12%, C2–2=24%).
Triggering for animal weighing software takes place at (and above):

"0.400 A - g"   for FX-200
" 4.00 A - g"   for FX-2000
" 1.00 A - g"   for FY-200
" 10.0 A - g"   for FY-2000

* Relative Density Experiments. If you wish to use your FX/Y balance to find the relative density of gold or some other metal then you may find the following notes of some interest.

NOTES CONCERNING GOLD AND R.D. VALUES:

Pure gold bullion is 24-carat (over 99% pure) with "fineness" stated in parts per thousand like Fineness 9963 or 9999. It is generally traded in grams or troy ounces. One troy ounce is equal to 480grains, 20dwt or 31.1034768grams. When gold is alloyed with another metal such as silver (R.D. 10.53 g/cm^3) or copper (R.D. 8.93 g/cm^3) the carat/karat value falls. For example: Krugerrand coins were struck in 22-carat gold with 22 parts out of 24 as gold and 2 parts out of 24 as copper but Maple Leaf coins are struck in 24-carat gold (Fineness 9999). Both coins are traded as one troy ounce of gold but in order for an ounce Krugerrand to contain 31.10grams of gold it must have a mass of 33.93grams --- 33.93 ÷ 24 = 1.41375 x 22 = 31.10grams. That is, one Krugerrand contains 2.83grams of copper at an R.D. of 8.93g/cm^3 with a volume is 0.32cm^3. It also contains 31.10grams of gold at an R.D. of 19.3g/cm^3 with a volume of 1.61 cm^3. If you add the volume of the copper to the gold you will find a theoretical volume of 1.93cm^3 for the coin which means it should have a relative density of about 17.58g/cm^3 instead of the 19.3g/cm^3 relative density of a Maple Leaf.

RELATIVE DENSITY OF PURE GOLD IS 19.3g/cm^3				
GOLD	FINENESS	SILVER	COPPER	SILVER/
K24	999/1000	ALLOY	ALLOY	COPPER
K22	916/1000	18.04	17.60	17.73 g/cm^3
K20	835/1000	16.96	16.20	16.42 g/cm^3
K18	750/1000	15.96	14.96	15.24 g/cm^3
K14	585/1000	14.31	13.01	13.38 g/cm^3

RELATIVE DENSITY OF PLATINUM IS 21.45g/cm^3				
Pt.	CONTENT	NICKEL	PALLADI-	AVERAGE
1000	1000/1000	ALLOY	UM ALLOY	REL. DEN.
950	950/1000	20.04	20.64	20.34 g/cm^3
900	900/1000	18.80	19.88	19.34 g/cm^3
850	850/1000	17.71	19.18	18.45 g/cm^3
800	800/1000	16.73	18.53	17.63 g/cm^3
750	750/1000	15.86	17.92	16.89 g/cm^3

RELATIVE DENSITY OF SOME OTHER METALS. 20°C			
Note "White Gold" can be an alloy of yellow gold with nickel or platinum or palladium.			
Pure Silver	10.53	Tantalum	16.60
Sterling Ag	10.40	Osmium	22.48
Coin Silver	10.35	Uranium	18.68
Palladium	12.02	Mercury	13.60
Lead	11.37	Steel	08.00
Nickel	08.90	Tungsten	19.10
Iridium	22.40	Copper	08.93

We hope that you have found this Instruction Manual useful and informative. If you have any suggestions for product improvement or if you would like more information concerning this product, please don't hesitate to contact your nearest A&D office.

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