INSTRUCTION MANUAL

ER Series

ELECTRONIC ANALYTICAL BALANCES

MODELS: ER-60A
ER-120A
ER-180A
ER-182A

imno-ER-A-030a/b-v.2

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(I) COMPLIANCE WITH FCC RULES

Please note that this equipment generates, uses and can radiate radio frequency energy. If this equipment is not installed and used in accordance with the instruction manual you are warned that it may cause interference to radio communications. This unit has been tested and has been found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules. These rules are designed to provide reasonable protection against interference when equipment is operated in a commercial environment. However if this unit is operated in a residential area it is likely to cause interference and under these circumstances the user will be required to take whatever measures are necessary to eliminate the interference, at his own expense.

(II) WARRANTY

A & D Engineering, Inc. (hereinafter called the "COMPANY") warrants that articles, materials and work furnished by them will conform to specifications, drawings and to other data cited, further stipulating that such material and workmanship shall be free from defect. The COMPANY will repair or replace at its discretion, free of charge, any equipment covered by this warranty which is returned within one year of initial delivery and which upon examination proves to be defective in nature or workmanship.

This warranty does not apply to any COMPANY product that has been: -
a) Repaired or modified by anyone other than someone authorized by the COMPANY if in their judgment such repair or modification has detrimentally affected the performance or reliability of the product.
b) Improperly installed or not adjusted in accordance with instructions provided by the COMPANY.
c) Mishandled, abused or in the judgment of the COMPANY has been exposed to an environment for which the product was not designed.

All products returned for warranty claim should be sent freight prepaid to the San Jose facility with a brief description of the problem. The COMPANY will notify the customer about the results of the factory inspection. If warranty repair is confirmed the unit will be repaired or replaced (at the COMPANY's discretion) at no extra cost to the customer and it will then be returned to him freight prepaid.

N. B. FCC RULES & WARRANTY ONLY APPLY TO THE U.S.A. THIS PAGE SHOULD BE DISREGARDED IN ANY OTHER COUNTRY AND PLEASE REFER TO LOCAL CONSUMER PROTECTION LEGISLATION CONCERNING WARRANTY RIGHTS.

A. INTRODUCTION

This instruction manual concerns four different models from the A & D range of electronic precision analytical balances; ER-60A, ER-120A, ER-180A & ER-182A.

The ER series of high precision, analytical class balances is the product of years of research, design, development & in-field testing. Every component has been carefully chosen to permit optimum performance from the entire unit and each balance undergoes several levels of quality control before leaving the factory.

ER-182A is a dual range, semi-micro balance with an extra range key on the front panel and a resolution of 0.01mg in the 32g range, but apart from this it is almost the same as ER-180A. ER series balances are housed in attractively styled cases with draught proof weighing chambers and have the following features:-

1. Ultra stable weighing and strong, reliable construction.
2. Automatic calibration via an internal standard weight.
3. Convenient optional output interfaces, serial EIA-RS-232C I/O + Current Loop or parallel BCD (binary-coded-decimal) output.
4. Ability to tare up to the max. capacity of the balance via soft-touch key switch or via remote contact closure.
5. Easy-to-read cobalt blue fluorescent display.
6. Clear annunciators to indicate the status of various functions.
7. Under-hook weighing capability for relative density experiments.

SPECIFICATIONS

BALANCE	ER-180A	ER-182A	ER-120A	ER-60A
MAX. CAPACITY	180g	32g/180g	120g	60g
RESOLUTION	0.1mg	0.01mg/0.1mg	0.1mg	0.1mg
REPEATABILITY	0.1mg (Standard Deviation) max cap., 0.02mg for ER-182A in the 32g range			
NON-LINEARITY	±0.1mg(Δ10g) ±0.2mg(0-180g)	±0.03mg(32g rng) ±0.2mg(180g rng)	±0.1mg(Δ10g) ±0.2mg(0-120g)	±0.1mg(Δ10g) ±0.2mg(0-60g)
TEMPERATURE DRIFT	±2ppm/°C (10°C→30°C)			
STABILISATION TIME	APPROX. 5 sec. (8 sec. for ER-182A)			
OPERATING TEMP.	5°C→40°C (41°F→104°F)			
PAN DIAMETER	85mm/3·35" (75mm/2·95" for ER-182A)			
WEIGHING CHAMBER	178mm(W) X 154mm(D) X 186mm(H) 7·0" X 6·1" X 7·3" (inches)			
EXT. DIMENSIONS	195mm(W) X 411mm(D) X 266mm(H) 7·7" X 16·2" X 10·5" (inches)			
WEIGHT	APPROX. 11kg/24lb 4oz			
AC INPUT/PRESET	100,115,220,240,VAC (50/60Hz) 11VA			
CALIBRATION WEIGHT	100g	100g	100g	50g

** Specifications may be changed to improve performance without notice.*

please read this manual carefully before you start to use your new balance!

B INSTALLATION

1. UNPACKING

Please unpack the balance carefully making sure that no parts are mislaid during the process, including this manual! After unpacking the balance remove the plastic stoppers protecting the weighing chamber doors and install the pan support and weighing pan. Keep the plastic stoppers to use when moving the balance.

ACCESSORY LIST

1. Balance
2. Weighing Pan/Pan Support
3. Power Cable
4. 0.2A/0.1A Fuse (anti-surge)

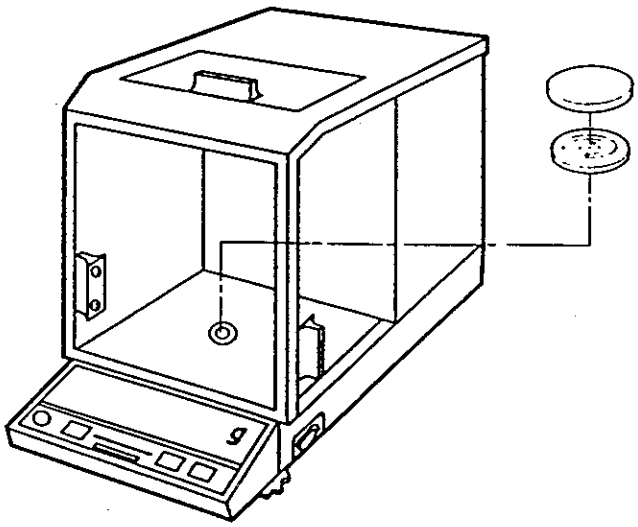


fig. no. 1

2. POWER REQUIREMENTS

This balance will accept AC input voltages of:- 100, 115, 220 or 240V AC ±10% The AC power requirements of your balance are unchangeable, depend upon the original shipping destination of the balance and are clearly marked on the case. Power frequency can be either 50 or 60Hz. 0.2A Fuse=100/115V & 0.1=220/240V. Please note that the balance ON/OFF key-switch only switches the display on and off, not the power supply for the balance.

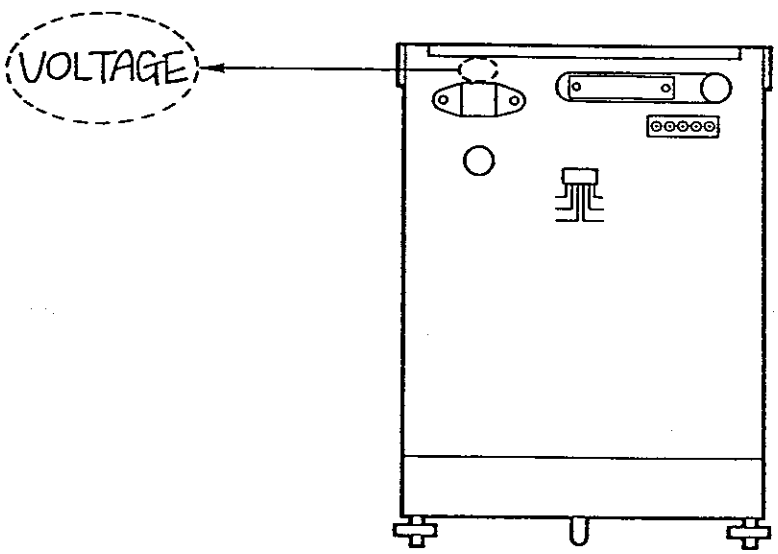


fig. no. 2

3. CHANGING THE FUSE

**If the display is blank & the light-emitting diode on the ON/OFF key-switch is not illuminated, a fuse may have blown. Unplug the power cable.*

a) If an external AC fuse has not blown and you are certain that the balance is receiving power, the fuse in the balance fuse holder may have blown.

b) The fuse holder must be pressed in & turned anticlockwise when opening and pressed in & turned clockwise when closing.

c) If the fuse has blown, replace it with a 0.2A (100/115V) or 0.1A (220/240V) fuse only. If this fuse immediately blows again, have the balance repaired.

NOTE: Uneven illumination of the display segments.

This condition may be mistaken as a fault but is in fact simply a result of the display not having been run for some time. It may be rectified by running the display with all the segments on until all the segments are evenly illuminated. With the display either off or indicating *P-FAIL* (power failed) switch ON segment number 5 of the dip-switch assembly located on the rear panel of the balance and then switch the display on. All the display segments will remain illuminated until segment number 5 is switched off. Incidentally P-FAIL is a display which is designed to warn you that there has been a power failure and that tare data may have been lost during it.

CONVERSION TABLE

The ER series of analytical balances provides weight readings in grams with a resolution of 0.1mg. For certain applications you may wish to convert a gram display to that of another unit (with a calculator) and for this reason we have provided a conversion table. The troy/apothecary and avoirdupois units are both based on the minimum unit of one grain; one pound avoir. = 7000 grains and has been defined in the UK as being equal to 0.45359237kg. If this figure is divided by 7000 we arrive at a grain weight of 64.79891mg (0.0648g). In the U.S.A. the pound was defined as being equal to 0.453592427 7kg so the grain weight conversion factor would be consequently very slightly greater.

A gram display divided by the conversion factor equals the alternative unit.

CONVERSION FACTOR	ALTERNATIVE UNIT
0.200	CARAT (1 metric carat=about 3·086grains)
1.29597820	SCRUPLE apoth. (20 grains per scruple)
1.55517384	PENNYWEIGHT/dwt (24 grains per dwt)
3.88793460	DRACHMS apoth. (60grains/8 drachms per t.oz)
31.10347680	TROY OUNCES (20dwt per oz & 12oz per t.lb)
28.349523125	OUNCES avoir. (16oz per lb avoir=7000grains)
1.771845195	DRAMS avoir. (16drams per oz avoirdupois)
3.750	CHEN/MONME (about 1/10thof a tael, not std.)

4. CALIBRATION

Calibration of the balance is required when it is initially installed, when changing the installation site and additionally whenever the location conditions change. "Weight" = Mass × acceleration due to Earth gravity. The internationally adopted value for gravitational acceleration is 9·806 65 m/s² in a vacuum however this varies by about ±0·3% depending on how far you are from the Earth's centre 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 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 attraction. Air buoyancy (about 1·2mg ±10% of air displaced per cm³ @ 20°C) and other factors also vary from location to location and from time to time.

4-1 PREPARATION

a) Check that the balance is horizontal and that the weighing pan is clean.

b) Connect the power cable, turn on and allow a warm-up period of at least 30 minutes.

c) Try to observe as many location requirements as possible.

4-2 PROCEDURE

a) With the display reading "*0.0000*" press the "CAL"/calibration key-switch.

b) The display will now show "*CAL in*"/in calibration mode, for about 1 second.

c) This will be followed by "*CAL . . .*", do nothing but wait.

d) The next display will be "*CAL dn*"/calibration weight down, at this time you should gently lower the calibration weight on to the weighing mechanism via the lever located on the right hand side of the balance.

e) The display will show "*CAL. . .*" again and you should wait as before.

f) The next display will be "*CAL up*"/calibration weight up and you should gently lift the internal weight off the weighing mechanism via the same lever.

g) Again the display will show "*CAL. . .*" and you should wait. After a pause the display will change to "*CAL End*" which will be displayed for about 1 second.

h) The display will revert to "*0.0000*" but this time the balance will be calibrated and another standard weight placed on the weighing pan should confirm this with an exact weight display. If there is a disagreement you might like to consider factors such as dirt or condensed moisture adding to the mass of your checking weight or alternatively a slight loss of mass over time due to wear. One possibly important factor is material density of the checking weight as the less dense a material is, the more it is affected by air buoyancy. The internal calibration weight is made of non-magnetic stainless steel. Platinum-Iridium has a density of about 21·5g/cm³, Brass about 8·4g/cm³ and Steel about 8·0g/cm³ (100g volume ≒12·5cm³ displacing about 15mg of air @ 1·2mg/cm³).

NOTE:
A display of "*CAL no*"/no calibration, indicates that there has been a failure in the calibration procedure due to some external factor. If this occurs you should turn the display off and then on again via the ON/OFF key, and start again. ER-182A is calibrated in the 180g range as the internal weight is 100g.

5. LOCATION REQUIREMENTS

These analytical balances are precision instruments and, like all precision instruments, must be treated with care.

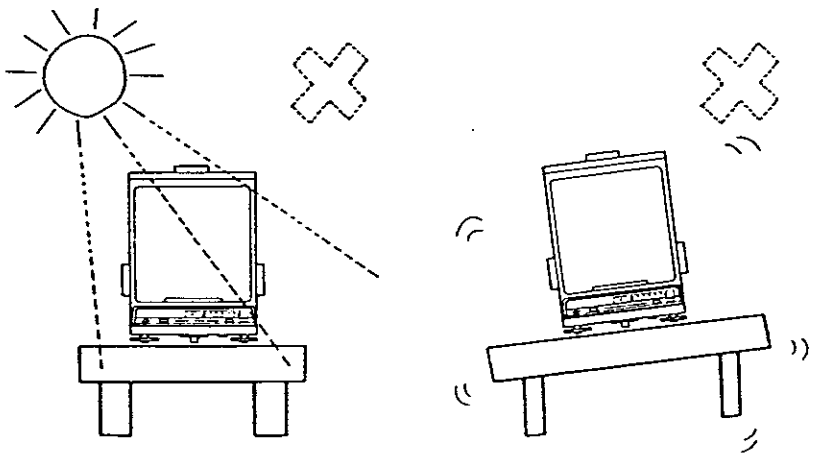
a) The weighing table must be of a solid construction and preferably made of a dense non-resonant material. The table should not be used for any other purpose but weighing.

b) The table should preferably be located in a corner of the room away from doors and windows. Corners of rooms are structurally firm and less prone to floor and air movement. People use doors (!) and thereby cause vibrations and air movements. Windows should preferably face north in the northern hemisphere or south in the southern hemisphere so that sunshine will not enter the room directly or cause the walls to radiate heat. The table should not touch the walls as it might pick up extra vibrations.

c) The air temperature should be kept at about 20°C/68°F at all times with a relative humidity level of about 50→60% (install a thermometer & hygrometer), it would be clearly undesirable to have dew forming on the calibration weight! A barometer will be necessary to find the atmospheric pressure in order to calculate the degree of air buoyancy (from the air density) exerted upon a mass of a given density. A mass will suffer a loss in weight when weighed in a gas equal to the weight of gas it displaces and this loss must be added to the weight of the sample in order to find the quantity of mass present.

d) The air should be kept as clean as possible with all air cleaners, coolers and heaters kept as far away from the weighing table as possible. Keep objects containing magnets (like loudspeakers) or radiating electromagnetic waves away from the table. Use fluorescent artificial lights as they are relatively cool. The balance should be earthed and samples to be weighed should be electrostatically discharged before weighing; static electricity, like magnetism can exert an extra, unadjusted for, force of attraction or repulsion which will contaminate weighing results.

e) The balance must be as level as you can make it so that the mass on the weighing pan can accelerate straight downwards. If the weighing table is not level turn the adjustable feet on the balance until the level vial indicates that the balance is horizontal.



6. DIP-SWITCH FUNCTIONS

This section concerns a group of 6 dip-switch segments located on a dip-switch assembly found on the rear panel of the balance. When the balance is shipped all these segments are switched OFF. In addition to having an effect on the various functions listed in the table below, these 6 segments may be used to redefine the value of the internal calibration weight. It is possible that over a period of time the internal calibration weight could permanently acquire or lose a small quantity of mass. Obviously you should be certain that any change is a permanent one and not transient (e. g. condensed water) and that the mass of the checking weights (test with at least two) has not altered. Observe all of the location requirement conditions before concluding that any change has taken place.

SEGMENT	FUNCTION	SWITCH OFF	CAL DISPLAY	SWITCH ON	CAL DISPLAY
1	PRINT COMMAND	CONTINUOUS	*1*	AUTO-PRINT	*0*
2	DISPLAY RATE	3 per sec.	*1*	10/sec (6/s)	*0*
3	NO-MOTION SYM	ON=STABLE	*1*	OFF=STABLE	*0*
4	NO-MOTION BAND	±2 DIGITS	*2*	±4 DIGITS	*4*
5	CAL.WT.RE-DEF.	NOT ACTIVE	*1*	ACTIVE	*0*
6	AVERAGING TIME	6 secs (12s)	*6 (1)*	3 secs (6s)	*3 (0)*

** The numbers above in parentheses apply to ER-182A only.*

The "CAL DISPLAY" is to indicate the condition (ON/OFF) of the dip-switch segments after the the internal calibration weight has been re-defined (CAL.WT.RE-DEF.) when segment number 5 was switched ON with the display *ON*. As already mentioned (on page 5) this dip-switch may also be used to illuminate the display segments if it is switched ON when the display is *OFF* or indicating P-FAIL. If all the dip-switch segments (6-5-4-3-2-1) are OFF then the "CAL DISPLAY" will be "*d 6 (or 1) 1 2 1 1 1*" and if ON then "*d 3 (or 0) 0 4 0 0 0*" (*d*=dip-switch).

1. PRINT COMMAND
   If "CONTINUOUS" is selected (segment 1=OFF) then a print command will be sent once every display cycle (3 per second when the display is stable).
   If "AUTO-PRINT" is selected (segment 1=ON) then the balance will transmit one print command only when the object placed on the weighing pan renders a stable/not-in-motion weight display. It will not be ready to transmit another print command unless the display has returned to within ±10 digits of zero and thereby reset the auto-print function. The balance will then send one print command as before when the next object weighed renders a stable display.

2. DISPLAY RATE (3 or 10 [3 or 6 for ER-182A] display updates per second)
   Will be automatically 3 per second if the load (or balance) is not oscillating.

3. NO-MOTION SYMBOL (normally set so that ON means the display is stable)
   Can be set to indicate either stability (no-motion) or instability (in-motion).

4. NO-MOTION BAND
   "Stability" band width, ±2 or 4 least significant digits in 1 second.

5. CALIBRATION WEIGHT RE-DEFINED
   Only re-define the value of the internal weight if it is absolutely necessary!!

6. AVERAGING TIME (period in seconds at about 10 samples added per second)
   Balance can be set to find the average (arithmetic mean) from about 60 or 30 samples (or 120 or 60 samples for ER-182A).

RE-DEFINING THE VALUE OF THE INTERNAL CALIBRATION WEIGHT

ER-180A and ER-120A have internal Calibration Weights of 100grams and ER-60A has an internal Calibration Weight of 50grams. If, over a period of time, these Weights either gain or lose a small amount of mass (±1·5mg maximum) it is possible to re-program the balance so that the balance bases its calculations on the fact that the new weight value of the internal mass is, for instance, 100.0008g instead of the old value of 100.0004g.

"Standard Weights" are seldom exact to 0·1mg so you will need to know the exact mass (× g) of your alternative Standard (which should be made of steel) before you can set about re-defining the mass (× g) of the internal Calibration Weight. Thus it is essential that your alternative Standard should have its exact "weight" established to 0·01mg by means of another, more accurate, balance located near the ER balance so that the alternative Standard mass is weighed by ER and the other balance under identical air-density conditions.

Having established the exact weight value for your alternative Standard mass, which might be, for example 100.00059g, you can set about re-defining the exact weight value for the internal mass. The first thing you will find when you go through the procedure outlined later, is the old value for the internal mass "C100.0004g", this must be changed to show the value of the alternative Standard mass which is 100.0006g. Refer to page 6 for the Calibration procedure and you should next recalibrate the ER balance with the alternative Standard . . . i.e. when the display reads "CAL dn" you should put the alternative Standard on the weighing pan and you should not touch the lever on the right hand side of the balance. After re-calibration is complete you can weigh the internal mass by gently lowering it onto the weighing assembly and at this point you will find that it now weighs 100.0008g (an increase in mass of 0.4mg). You should again go through the procedure outlined on the next page and change the memorized value for the external Standard mass (100.0006g) to the newly found value for the internal mass . . . 100.0008g.

The balance will now remember and base its calculations on the fact that the weight value for the internal calibration mass is 100.0008g. Recalibrate the balance with the internal Calibration Weight and then re-weigh the alternative Standard, the display should read 100.0006g.

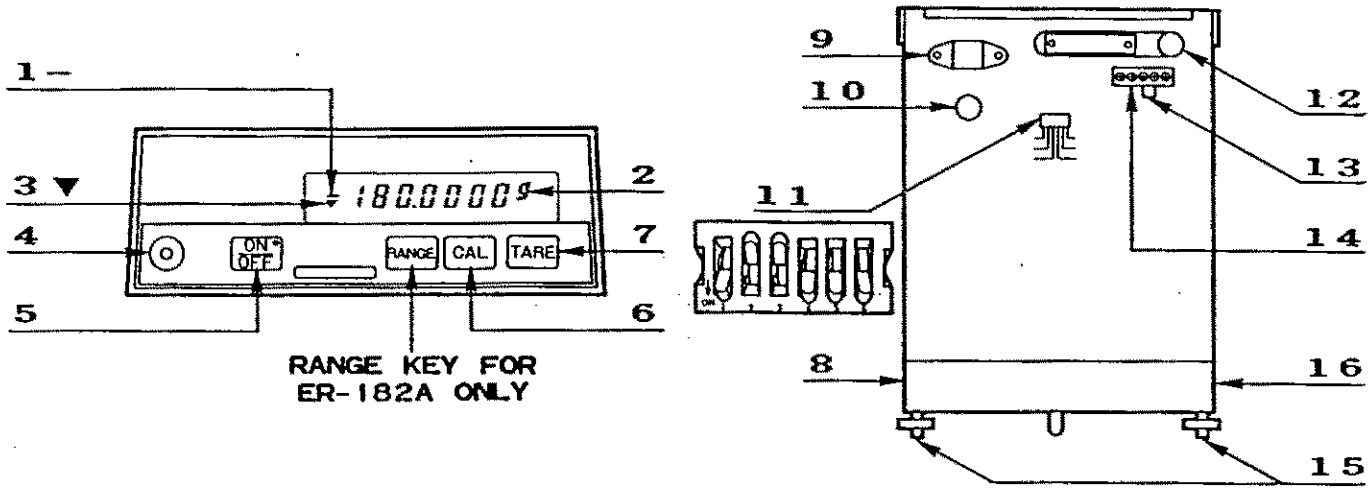
PROCEDURE FOR CHANGING THE VALUE STORED IN MEMORY

With the display ON, switch dip-switch segment number 5 ON. The display will then show the compensated value for the internal weight which had been previously committed to the non-volatile memory in the balance. If the "CAL" key-switch is now pressed, the display will flash, show the current state of the dip-switches with a "CAL DISPLAY" and the remaining dip-switch segments 1→4 & 6 will change their functions to permit the re-setting of the stored weight value within the parameters of 99.9985g and 100.0015g, a deviation of ±1.5mg maximum. Setting dip-switch segment 6 ON will give you correction in the area less than 100.0000g (99.9999g to 99.9985g) and setting it OFF will give you correction in the area greater than 100.0000g (100.0000g to 100.0015g).

Set the dip-switches 1→4 with reference to the table below. If, for instance, you wish to change the weight value in memory from 100.0006g to 100.0008g you will have to switch 6 OFF---- 1, 2 & 3 ON and 4 OFF. After you have correctly set the dip-switches 1→4 & 6 you should switch OFF dip-switch segment number 5. The display will stop flashing, will display the new value "C100.0008g" and will then revert to showing the state of the dip-switches with a "CAL DISPLAY". Reset the normal functions you require from the balance via the dip-switches with reference to the table on page 8. Next press "TARE", the display will read "0.0000g" and the balance will be ready for re-calibration with the internal Calibration Weight, the weight value for which has just been re-defined.

COMPENSATION	SWITCH 1	SWITCH 2	SWITCH 3	SWITCH 4
0.0mg	ON	ON	ON	ON
0.1mg	OFF	ON	ON	ON
0.2mg	ON	OFF	ON	ON
0.3mg	OFF	OFF	ON	ON
0.4mg	ON	ON	OFF	ON
0.5mg	OFF	ON	OFF	ON
0.6mg	ON	OFF	OFF	ON
0.7mg	OFF	OFF	OFF	ON
0.8mg	ON	ON	ON	OFF
0.9mg	OFF	ON	ON	OFF
1.0mg	ON	OFF	ON	OFF
1.1mg	OFF	OFF	ON	OFF
1.2mg	ON	ON	OFF	OFF
1.3mg	OFF	ON	OFF	OFF
1.4mg	ON	OFF	OFF	OFF
1.5mg	OFF	OFF	OFF	OFF

C PANEL DESCRIPTION



1. POLARITY ANNUNCIATOR (— NEGATIVE, if not negative, assume positive)
2. WEIGHT DISPLAY (Up to max. capacity +1mg. Overload display="*E*" *error*)
3. NO-MOTION ANNUNCIATOR (selectable meaning, stability or instability)
4. LEVEL VIAL (balance must be level for weighing)
5. ON/OFF KEY-SWITCH WITH POWER CONNECTED PILOT LAMP
6. CALIBRATION KEY-SWITCH (see calibration instructions)
7. TARE KEY (Tare band is +1 Min. Division/0.1mg to Max. Capacity)
8. CALIBRATION LEVER (to raise and lower the internal Calibration Weight)
9. AC POWER INPUT SOCKET (correct AC power level only please!)
10. FUSE (0.2A=100/115V & 0.1A=220/240V AC)
11. DIP-SWITCHES (see dip-switch section of manual)
12. OPTIONAL INTERFACE SLOT (OP-01 BCD or OP-03 RS-232C)
13. EXTERNAL TARE TERMINALS (Remote taring via normally open switch)
14. CASE GROUND TERMINAL (normally earth via the power cable)
15. ADJUSTABLE FEET (to help you to level the balance)
16. WEIGHT VALUE OF THE INTERNAL CALIBRATION WEIGHT

NOTE: "— E" displayed indicates that the weighing pan is missing.

D OPERATION

1. WEIGHING

a) Press TARE to zero the display.

b) Place the object (s) to be weighed on the pan.

c) Read the displayed weight after the display is stable (i. e. when the no-motion symbol indicates stability by switching off or on).

2. WEIGHING-IN

a) Place a container on the pan.

b) Press the TARE key or use a remote switch (eg. SW:128) to zero the display.

c) Fill the container until the target weight is reached.

d) When mixing ingredients in a container press TARE after each addition.

3. WEIGHING-OUT

a) Place a full container on the pan.

b) Press TARE to zero the display.

c) When anything is subsequently removed from the container the amount removed will be displayed as weight loss.

4. WEIGHING A DEVIATION

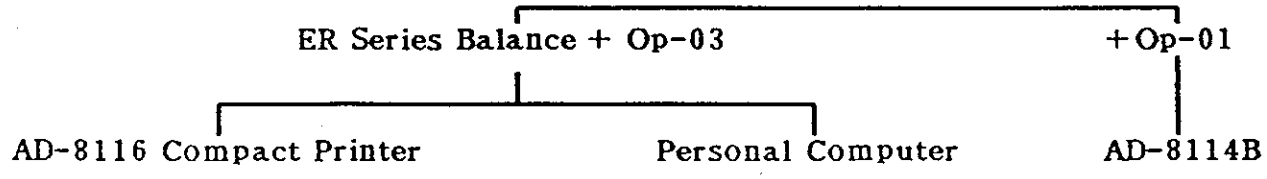
a) Place a reference or standard sample weight on the pan.

b) Press TARE and then remove the weight, weight loss will be displayed.

c) Now any sample weight (to be compared with the reference weight) placed on the pan will indicate its deviation from reference (zero display) in terms of a positive or negative display. This function is useful in check-weighing operations.

5. PRINTING

An ER series balance can be coupled to an AD-8116 Compact Printer when the Op-03 RS-232C interface is installed in the balance. AD-8116 can print out weight data transmitted by the balance and statistical information (sequence #, total, maximum, minimum, average & standard deviation) concerning that data. Alternatively the data could be transmitted to a personal computer to be operated on, printed and stored by the computer. With Op-01 BCD output installed in the balance it is possible to connect the AD-8114B Digital Printer. Op-01 & Op-03 may not be installed simultaneously.



6. UNDER-HOOK WEIGHING

An under hook is required for weighing objects which have to be suspended. One application for under hook weighing is finding the floating weight of an object when it is suspended in a liquid. An object immersed in a fluid will suffer a loss in weight (tare before immersion) equal to the weight of fluid it displaces.

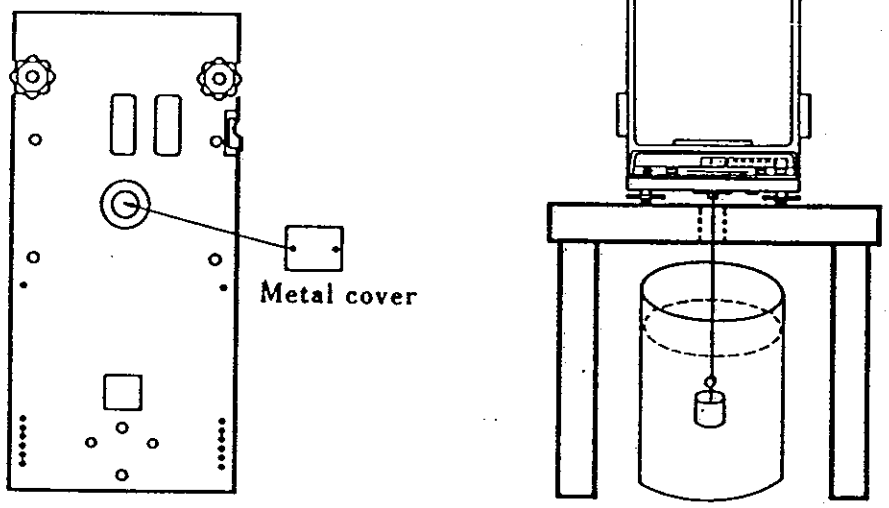
The relative density (specific gravity) of an object is found by the ratio of the mass of a given volume of the substance to the mass of an equal volume of pure water at (maximum density) 4°C; that is, the mass of a given volume of a material object divided by the mass of an equal volume of water. 1 litre = 1kg & 1 litre = 1·000028dm³ at standard atmospheric pressure of $1{\cdot}01325 \times 10^5$ N/m². Thus the density of water at 4°C is almost exactly 1 kg per cubic decimetre (1000 kg/m³).

Please recalibrate the balance for weighing in suspension.

INSTALLATION METHOD

1. Remove the pan and pan support, secure the weighing chamber doors and preferably ask another person to hold the balance up-side-down.
2. Remove the small metal cover you will find underneath the balance directly below the seating peg for the pan support.
3. Turn the balance the right way up and place it on solid weighing table with a hole cut in it through which a suspension harness connected to the under-hook can freely protrude.
4. Replace pan & pan support, install the suspension harness and recalibrate the balance.

NOTE: When you are weighing objects in suspension you should preferably erect a transparent plastic shelter around the apparatus to protect it from air movements.



E OPTIONS

OP-01 BCD OUTPUT

OP-03 RS-232C & CURRENT LOOP

1. Option-01 is a parallel BCD (binary-coded-decimal) output card for interfacing the balance to peripherals with a BCD input capability. A & D printer AD-8114B may be used when this option is installed.

BCD OUTPUT TABLE

Pin No.	Signal	Pin No.	Signal
1	GROUND	26	1×10^6
2	1×10^0	27	2×10^6
3	2×10^0	28	4×10^6
4	4×10^0	29	8×10^6
5	8×10^0	30	$\overline{\text{Decimal Point } 10^5}$ (Hi)
6	1×10^1	31	$\overline{\text{Decimal Point } 10^6}$ (Hi)
7	2×10^1	32	$\overline{\text{Decimal Point } 10^7}$ (Hi)
8	4×10^1	33	Not-in-motion (Hi)
9	8×10^1	34	Lo
10	1×10^2	35	Lo
11	2×10^2	36	Lo
12	4×10^2	37	Hi
13	8×10^2	38	Hi
14	1×10^3	39	Hi
15	2×10^3	40	Hi
16	4×10^3	41	Hi
17	8×10^3	42	Polarity (+ Hi)
18	1×10^4	43	$\overline{\text{Decimal Point } 10^1}$ (Hi)
19	2×10^4	44	$\overline{\text{Decimal Point } 10^2}$ (Hi)
20	4×10^4	45	$\overline{\text{Decimal Point } 10^3}$ (Hi)
21	8×10^4	46	$\overline{\text{Decimal Point } 10^4}$ (Lo)
22	1×10^5	47	$\overline{\text{OVERLOAD}}$
23	2×10^5	48	No Polarity (Norm.Hi)
24	4×10^5	49	PrintCommand
25	8×10^5	50	$\overline{\text{BUSY}}$ (Input)

TTL level, positive logic, fan out 3.

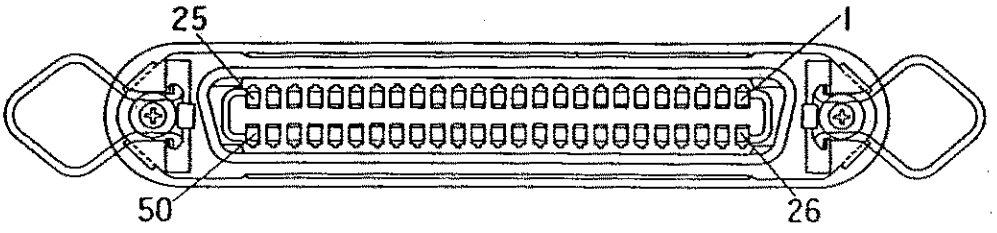
Mating connector---AMPHENOL: 57-30500

Print command--- Positive pulse with 1-3m. sec. width. Pin 49.

No polarity---"Lo" when the display is zero, -E or being Tared.

Busy---Fan in 1, latches output data when input is low.

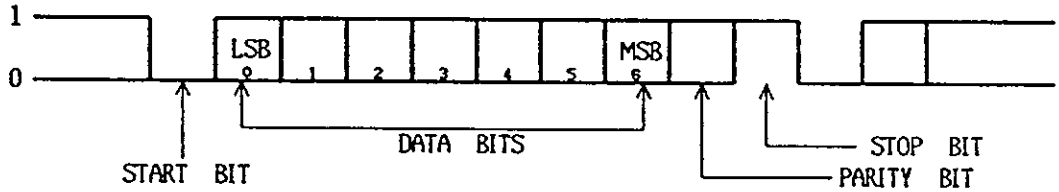
OP-01



2. Option-03 is a serial RS-232C interface card for interfacing ER balances to an AD-8116 Compact Printer or to another external device such as a computer.

a) Specifications

Type----------EIA-RS-232C
Passive 20mA Current Loop
Method---------Half-duplex, asynchronous transmission
Format---------Baud rate : 600, 2400 or 4800 (dip-switch selectable)
Data bit : 7
Parity bit : 1 (EVEN)
Stop bit : 1
Code : ASCII



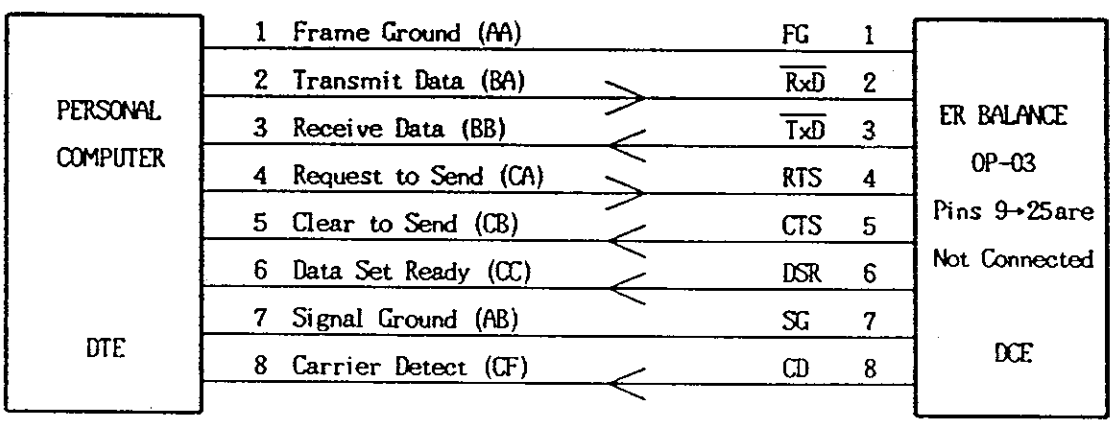
RS-232C	20mA Cur.Loop
1 = −5V → −15V	20mA
0 = +5V → +15V	0mA

b) Transmission modes

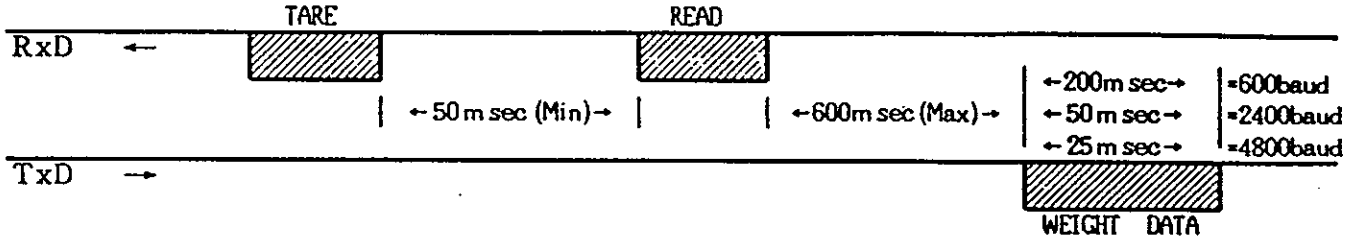
Two transmission modes are available, one from both RS-232C and Current Loop, "Stream" Mode, and one, "Command" Mode, is only available from RS-232C. In Stream Mode data will be transmitted continuously and in Command Mode data will only be sent when a "READ" command is received from an external device.

c) Connection: AD-8116 and other devices.

AD-8116 uses a KO:256 interface cable. Select Stream Mode at 2400 baud. ER balances are designated as Data Communication Equipment for other devices.



d) Command Mode Timing (RS-232C only)



i) READ Command. RxD----- (READ) (CR) (LF)

e. g.

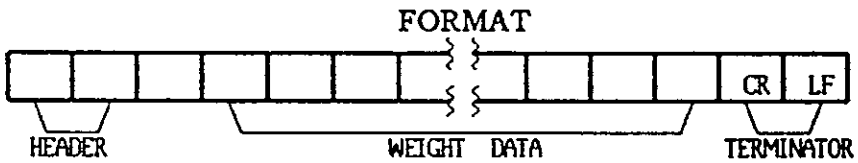
52	45	41	44	0D	0A
R	E	A	D	CR	LF

When this READ command is received, a weight data sample immediately following the command will be transmitted. No further commands will be accepted during the 600m sec. (Max) delay preceding Weight Data Transmission or during such transmission (200, 50 or 25m sec. depending on baud rate).

ii) TARE Command. RxD----- (TARE) (CR) (LF)

When this TARE command is received the TARE function of the balance will be activated. There is minimum delay period of 50m sec. following TARE during which a READ command should not be sent.

e) Data Format



Four types of HEADER are transmitted:

OL----------Overload

ST----------Display is Stable (not-in-motion)

US----------Display is Unstable (in-motion)

EC----------Etc. (other types of Data)

Weight Data samples are transmitted by ASCII numerals including the following codes:

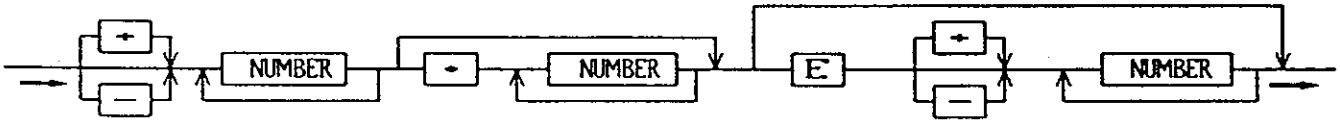
2D (HEX) --------- "-" (minus)

2B (HEX) --------- "+" (plus)

2E (HEX) --------- "." (decimal point)

45 (HEX) --------- "E" (exponent)

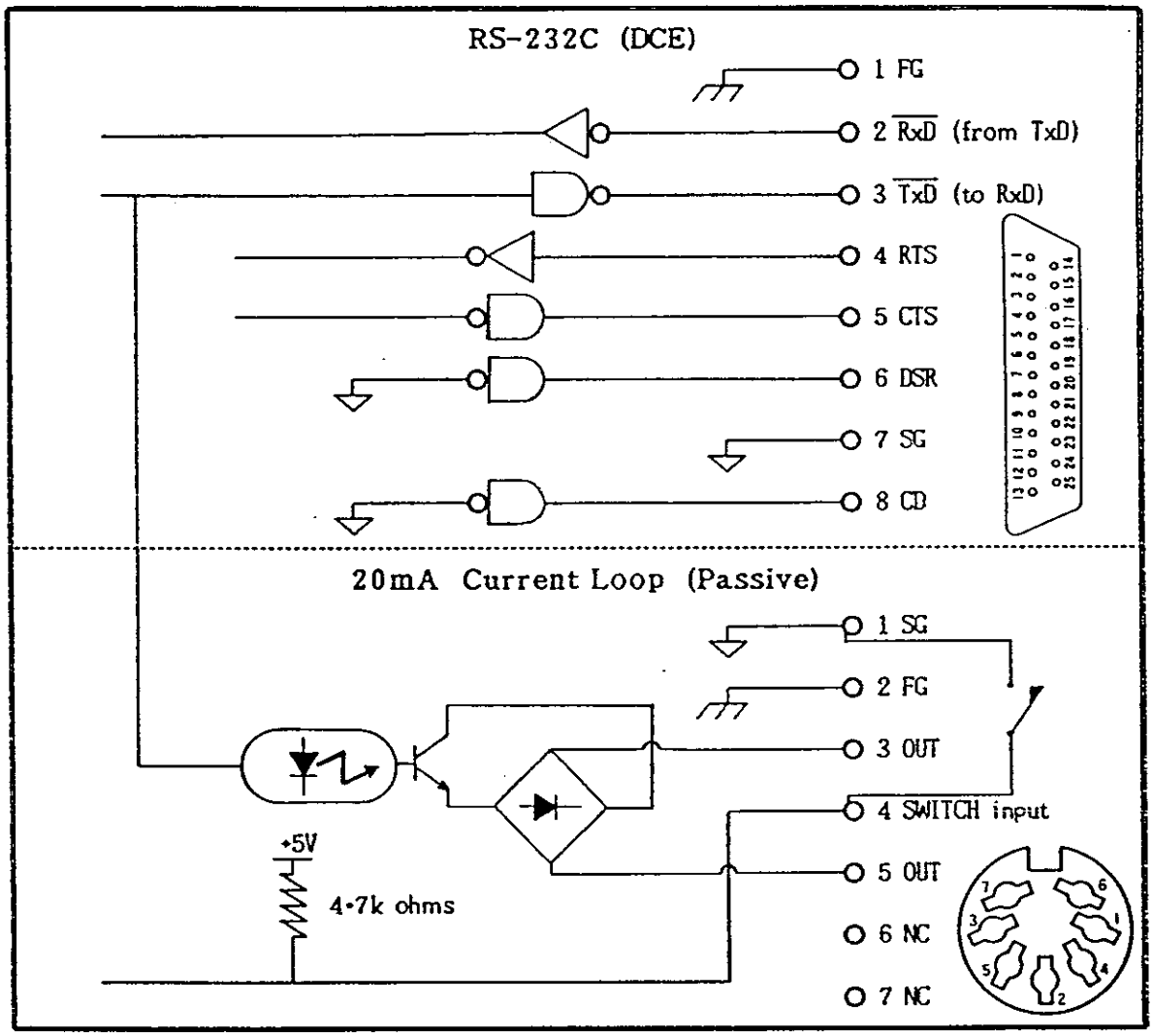
Data may be represented by the following flow diagram:



DISPLAY	TRANSMISSION DATA
0.0000	*+000.0000*
12.0000	*+012.0000*
-100.7890	*-100.7890*
E	*+9999999E+19**
-E	*-9999999E+19**

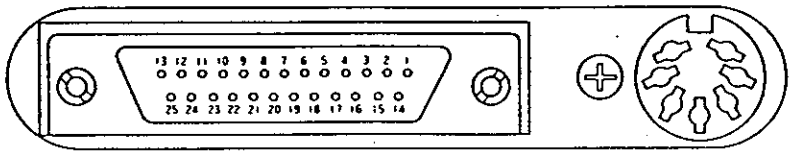
* HEADER reads OL for overload.

f) CIRCUIT DIAGRAMS



An RS-232C connector plug and cover (8JA:HDB-25P & 8JA:HDB-CTF) is not provided with this option but a 7 pin DIN Current Loop connector (TCP0576) is provided as an accessory. Please note that pins 6 & 7 are not connected and that a passive Current Loop requires an external 20mA power source.

OP-03



g) DIP-SWITCH SELECTIONS

Transmission Mode, baud rate and terminator may be selected via a 6 segment dip-switch assembly located on the Op-03 RS-232C I/O card.

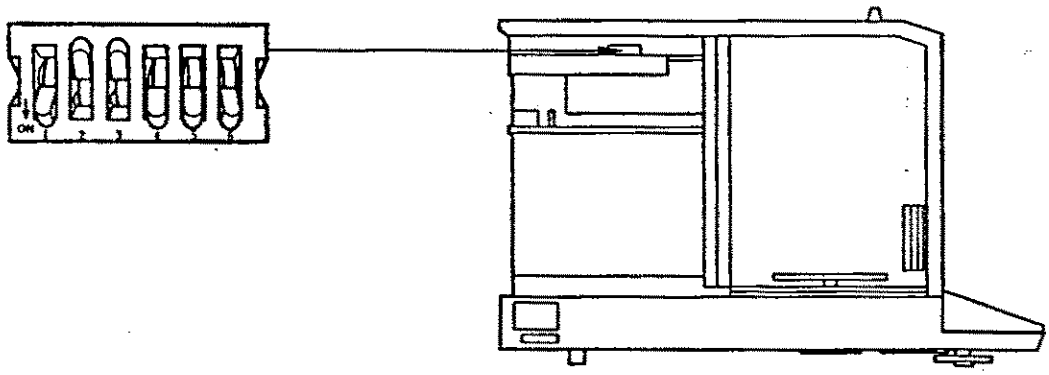
Access is gained to this dip-switch assembly by removing the panelling which surrounds the sides and rear of the balance.

i) Disconnect the power cable.

ii) Unscrew the recessed cross headed screw which holds the panelling in place. This screw is located in a hole formed in the balance's chassis, behind the single rear foot, underneath the balance. If you allow the rear end of the balance to overhang the edge of a table (supported by the rear foot) it is possible to unscrew this screw without having to tip the balance. This has the advantage of not endangering the glass weighing chamber doors.

iii) Slide the panelling backwards, remove and put to one side.

iv) The dip-switch assembly is located on the left hand side of the balance as you look at the front.



v) When the RS-232C card is shipped to the customer the dip-switch segments are set as 1 and 2 segments ON with 3 to 6 segments OFF.

vi) Changing the setting of the segments has the following effects upon various transmission protocols.

SW N°	FUNCTION	OFF	ON
1	BAUD RATE 1	600 baud	2400 or 4800 (see 6)
2	MODE	COMMAND	STREAM
3	TERMINATOR	⟨CR⟩ ⟨LF⟩	⟨CR⟩ only
4	STREAM MODE DO NOT TxD Control	SWITCH input	RTS signal
	COMMAND MODE Tx ERROR Code	No Transmission	Transmit (Tx)
5	STREAM MODE	STOP CONTROL	SINGLE TRANSMISSION
	COMMAND Md.Time out	300ms	NO RESTRICTION
6	BAUD RATE 2	2400 baud	4800 baud

vii) If segment number one is off then segment number six is non-functional and the baud rate will be 600. If segment 1 is ON then you may select 2400 or 4800 baud via segment 6.

viii) Command Mode (RS-232C only, external command of transmission) or Stream Mode (RS-232C & Current Loop/continuous unless stopped) may be selected via segment number 2.

ix) Terminator selection is for both transmission modes when the end of transmission of weight data or commands may be signalled by ⟨CR⟩ and ⟨LF⟩ (carriage return/line feed) or just ⟨CR⟩, depending on the computer.

x) Do not transmit data (TxD) control may applied to Stream Mode RS-232C transmissions via the RTS (request to send) signal going negative or by pulling pin 4 on the 7 pin DIN connector low by shorting to signal ground, pin 1 (SWITCH input). In Stream Mode weight data will be transmitted continuously without need of a data request, unless it is stopped.

SW N° 4	SW N° 5	STREAM MODE TRANSMISSION
OFF	OFF	No transmission when SWITCH input is closed
ON	OFF	No transmission when RTS goes negative
---	ON	SWITCH input OFF→ON=one Data sample transmitted

h) COMMAND LIST—COMMAND MODE—RS-232C only

⟨TERM⟩ can be ⟨CR⟩ ⟨LF⟩ or just ⟨CR⟩

1. ⟨ON⟩ ⟨TERM⟩ and ⟨OFF⟩ ⟨TERM⟩

   These commands will switch the balance on or off just like the ON/OFF key-switch on the front panel of the balance.

2. ⟨TARE⟩ ⟨TERM⟩

   This command will trigger the balance TARE function. The balance takes about 1 second to execute this command.

3. ⟨READ⟩ ⟨TERM⟩

   When this READ command is received a weight data sample, immediately following the moment of reception, will be transmitted by the balance.

4. ⟨CAL⟩ ⟨TERM⟩

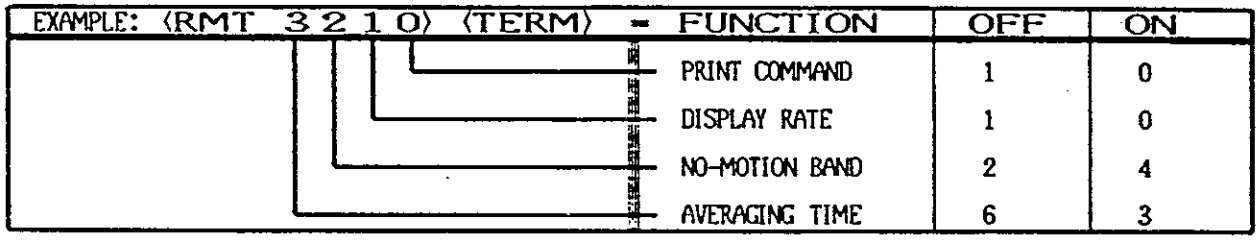
   This command will trigger the calibration software in the balance but the calibration weight must be lowered onto the weighing assembly by hand.

5. ⟨CWT ± @.@⟩ ⟨TERM⟩

   This command is for transmitting the new value of the calibration weight after its value has been re-defined (see page 9), ±1.5mg maximum. If you wish the balance to understand that the new value is, for instance, 100.0003g you would input ⟨CWT + 0.3⟩ ⟨TERM⟩ and this value will then be stored in the non-volatile memory of the balance.

6. ⟨RMT ⓐ ⓑ ⓒ ⓓ⟩ ⟨TERM⟩

This command may be used to program the balance for print command, display rate, no-motion band width and sample averaging period (see page 8).



EXAMPLE: ⟨RMT 3 2 1 0⟩ ⟨TERM⟩	= FUNCTION	OFF	ON
	PRINT COMMAND	1	0
	DISPLAY RATE	1	0
	NO-MOTION BAND	2	4
	AVERAGING TIME	6	3

7. ⟨LOC⟩ ⟨TERM⟩

This command will cancel an ⟨RMT⟩ command and return the balance to the dip-switch settings. Switching the balance off and then on again via commands or the key-switch will also cancel ⟨RMT⟩ settings.

8. ⟨MON⟩ ⟨TERM⟩

This command will interrogate the balance to ascertain the status of the four functions which can be set via the dip-switches or ⟨RMT⟩ command. Thus a reply might be ⟨EC, 3210⟩ ⟨TERM⟩.

9. ⟨WTM⟩ ⟨TERM⟩

This command will interrogate the balance to ascertain the exact weight value of the internal calibration weight which can be changed via the dip-switches or ⟨CWT⟩ command. Thus a reply might be ⟨EC, +0.3⟩ ⟨TERM⟩.

COMMAND	OPERATION
ON	Display On
OFF	Display Off
TARE	Zero the display
CAL	Run the calibration software
CWT±ab	Reset the weight value
RMTcdef	Reset the balance switch values
LOC	Cancel RMT reset values
READ	Interrogate weight data
MON	Interrogate cdef status
WTM	Interrogate ab value

i) INVALID COMMANDS

1. When the balance is off, all commands other than ON will be invalid.
2. When the balance is in "CAL", "CWT" and "TARE" mode, the "OFF" command is the only command which will be valid (all others invalid).
3. During a "CAL DISPLAY" of the dip-switch settings, all commands other than "OFF" and "TARE" will be invalid.
4. When a command has been transmitted and received, all subsequent transmissions of any other commands will remain invalid until execution of the first command has been completed.

j) ERROR CODES

1. **E0** PARITY ERROR
   The receiver has detected a disagreement between the state of the parity bit and the state of parity for the incoming signal.
2. **E1** UNDEFINED COMMAND
   Command has not been received in a form which can be understood.
3. **E2** BALANCE CANNOT EXECUTE RECEIVED COMMAND
   Command is currently invalid so cannot be executed.
4. **E3** TIME OUT ERROR
   With dip-switch segment number 5 set off (page 18) this time out error code will be sent if there is a delay of more than 300milli secs between the reception of the last character (other than terminator) and the reception of the next start bit.
5. **E4** CHARACTER OVER ERROR
   If the terminator has not been received within 10 characters, too many characters have been transmitted.
6. **E5** TERMINATOR ERROR
   If the terminator has been set for ⟨CR⟩ ⟨LF⟩ and only ⟨LF⟩ is received then this error code will be transmitted.

k) COMPUTER PROGRAMS (NEC PC-9801 and EPSON HC-20 Microsoft BASIC)
OP-03 RS-232C card set to:- Command Mode;
600, 2400 or 4800 baud;
Terminator (CR) (LF);
No Transmission of Error Code;
Time out, 300m secs.

i) PC-9801, Type in the following:-
"M" "O" "N" "CR"
"S" "S" "W" "2" "CR"
"Ø" "4" "CR" (600 baud), "Ø" "6" "CR" (2400 baud) or
"Ø" "7" "CR" (4800 baud)
"CTRL" "B"

```
10  OPEN "COM:E71NN" AS # 1     (NN=PC-9801 BASIC dialect)
20  FOR I=1 TO 100:NEXT I       (DELAY after buffer open)
30  PRINT #1, "TARE"            (TARE the balance)
40  FOR I=1 TO 100:NEXT I       (DELAY after TARE input)
50  PRINT #1, "READ"            (Transmit READ)
60  INPUT #1, HD$,DT            (Receive weight data)
70  PRINT HD$,DT                (Display weight data)
80  CLOSE
90  END
```

ii) HC-20

```
10  OPEN "O", #1, "COMØ:(37E15)"    *NOTE
15  OPEN "I", #2, "COMØ:"
20  FOR I=1 TO 100:NEXT I
30  PRINT #1, "TARE"
40  FOR I=1 TO 100:NEXT I
50  PRINT #1, "READ"
60  INPUT #2, HD$,DT
70  PRINT HD$,DT
80  CLOSE
90  END
```

** NOTE: (37E15)=600 baud, (57E15)=2400 baud & (67E15)=4800 baud.*

F PRINTERS

1. DIGITAL PRINTER AD-8114B

This printer may be interfaced to A & D balances via a BCD output interface card and a KO:145 interface cable; use input A of the printer.

The switches in the printer should be programmed as follows:-

SW 1	ON/OFF	SW 2	ON/OFF
1	ON	1	OFF
2	ON	2	OFF
3	OFF	3	OFF
4	OFF	4	OFF
5	ON	5	OFF
6	ON	6	ON
7	OFF	7	ON
8	OFF	8	OFF

2. COMPACT PRINTER AD-8116

This compact printer must be connected to an A & D balance via an RS-232C interface card set to stream mode at 2400 baud. The printer uses a KO:256 interface cable.

The dip-switches on the interface card should be set to 1 & 2 ON with 3 to 6 OFF.

3. MANUAL PRINTING OR AUTO-PRINTING

Manual printing means that the print switch on the printer must be pressed. Auto-printing means that the weight value of each sample will be printed automatically when the sample renders a stable display on the balance.

SETTING	MANUAL	AUTO-PRINT
ER-A REAR PANEL Dip-switch N° 1	OFF	ON
AD-8114B MAN/EXT switch	MAN	EXT
AD-8116 MODE switch	2	1

RS-232C/BCD INSTALLATION

Instructions for installing either the Option-03 RS-232C or Option-01 BCD interface in the Electronic Analytical Balances.

1. Disconnect the power cable and remove the single recessed cross headed screw at the rear of the balance (Fig 1). Then remove the panelling (Fig 2) and weighing pan/pan support.
2. Remove the glass side doors by sliding backwards (Fig 3). Please note that the wide guide in Fig 4 is for the glass doors and the narrow guide is for the case.
3. Turn the balance on its side or rear end and remove the 4 screws indicated in Fig 5. These screws hold the weighing chamber to the chassis so be careful not to pick the balance up by the top half of the case when you turn it the right way up!
4. Remove the weighing chamber as shown in Fig 6. Plug the 2 RS-232C connectors or 1 BCD connector into the main board of the balance (Fig 7) and attach the board to the balance frame with the 3 screws indicated in Fig 8.
5. Reassemble the balance in reverse order, taking extra care when you replace the weighing chamber (don't damage the weighing mechanism) and glass doors.

Fig 1

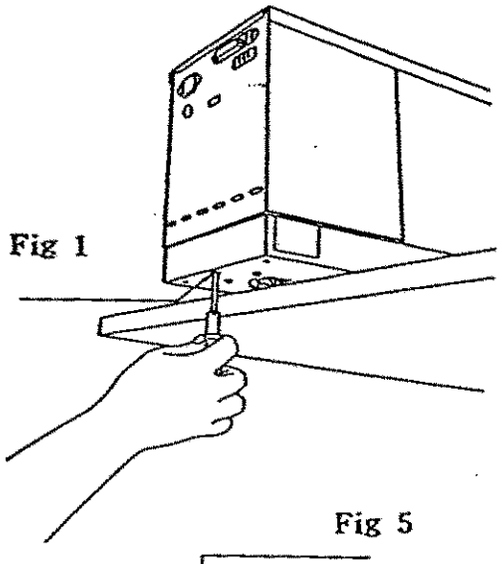


Fig 2

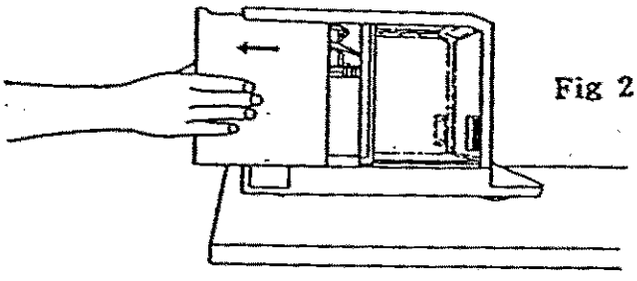


Fig 3

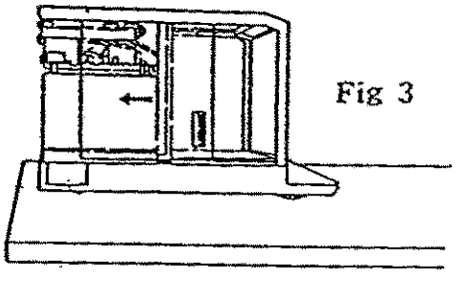


Fig 4

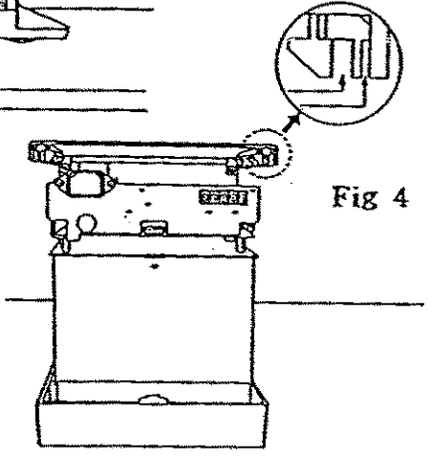


Fig 5

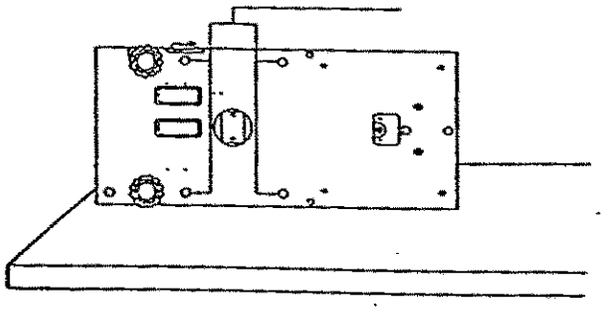


Fig 6

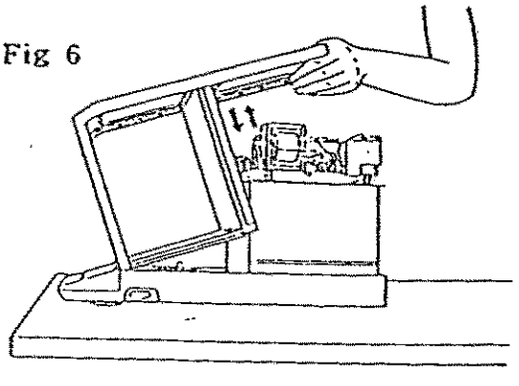


Fig 7

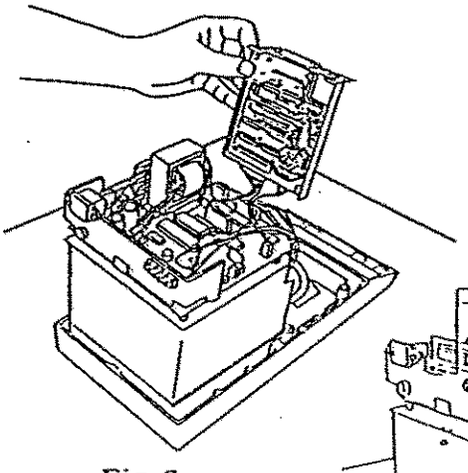
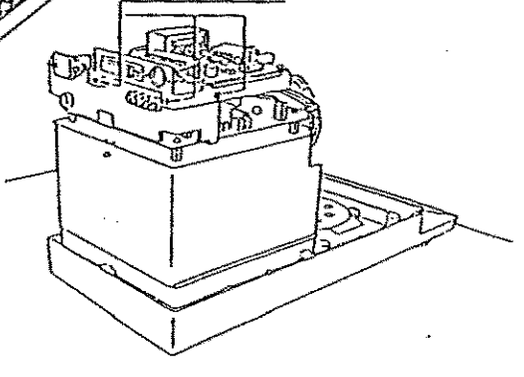


Fig 8



APPENDIX

LINEARITY ADJUSTMENT (NEW TYPE ER SERIES)

Linearity adjustment means that when an ER-180A balance (for instance) has been calibrated with a weight of 100grams, an exact weight of 50grams will display 50.0000g and an exact weight of 150grams will display 150.0000g. That is, if you imagine a graph with the X axis representing the displayed weight and the Y axis the "true" weight of exact weight Standards on the pan, any Standard placed on the pan will plot a linear (straight line) path at 45° from zero to max. capacity. It goes without saying that linearity adjustment must only be carried out under the most carefully controlled conditions. Please read pages 6~10 of the instruction manual for more information concerning weighing conditions.

As the internal calibration weight is made of steel please make sure that your exact standard weights are made of austenitic steel with a density of about 8000kg/m³ (8·0g/cm³). Air density at 20°C (68°F) is normally around 1·2kg/m³ (1·2mg/cm³) ±10%. Thus 100 grams of steel will occupy a volume of about 12·5cm³ and displace about 15mg of air. However 100g of brass (at ≒8·4g/cm³) will occupy about 11·9cm³ and displace only 14·28mg of air. A mass of 100g of brass will therefore seem to weigh 0·72mg more than a mass of 100g of steel. A mass of 100g of platinum-iridium (21·5g/cm³, volume 4·65cm³) displacing 5·58mg of air would seem to weigh 9·42mg more than an equal mass of steel.

METHOD OF LINEARITY ADJUSTMENT:-

1. Switch on and warm the balance up for at least 30 minutes.
2. Press the ON/OFF switch to switch off the display.
3. While pressing both CAL and TARE with your right hand, press the ON/OFF switch with your left hand in order to switch the display on.
4. Keep pressing TARE with your second finger and now press CAL two times with your index finger. After this you may release both switches and the display should change to read "*8. 8. 8. 8. 8. 8. 8.*".
5. Press CAL once more and the display should change to "*Lnr in*" (linearity in), do nothing but wait.
6. The next display should be "*Lnr . . .*", do nothing but wait.
7. The next display should be "*Lnr 50*" and at this point in time you should place your Standard accurate to 50.0000g ±0.9mg (when weighed in air) on the weighing pan and close the chamber door.
8. Press TARE and the display will change to "*Lnr . . .*" followed by "*Lnr 100*" at which point in time you should remove the 50g weight and replace it with the internal 100g weight (lower the internal weight via the lever). *N.B.* ER-60 will display 50g again for this step as the internal weight is 50g. Remove the external weight and lower the internal weight.
9. Press TARE and the display will change to "*Lnr . . .*" followed by "*Lnr 150*" for ER-180/182A and ER-120A balances. ER-60A will display "*Lnr 100*".
10. Place the 50g weight on the pan, with the 100g internal wt. =150g or with the 50g internal wt. =100g, and press TARE. The display will change to "*Lnr . . .*" and then "*Lnr End*". After linearity adjustment is at an end you may remove the weights and then recalibrate the balance with the internal calibration weight. Afterwards check balance linearity with steps of 10grams; specifications are ±0.2mg from zero to maximum capacity.