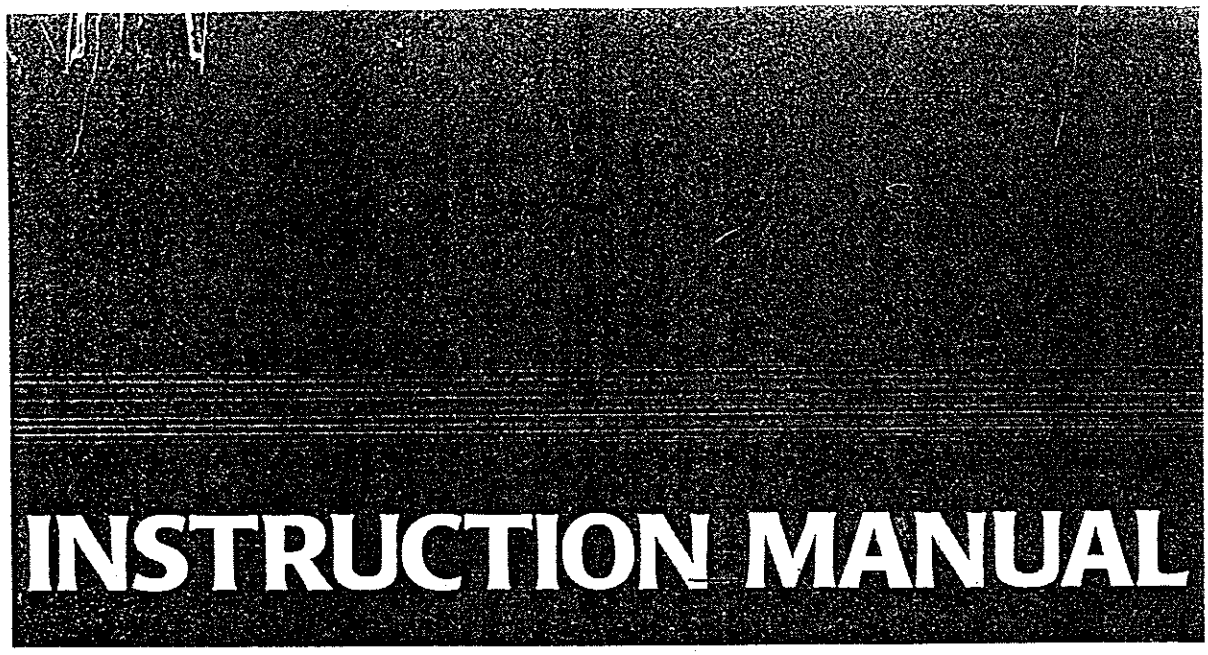


INSTRUCTION MANUAL

EP Series

PRECISION INDUSTRIAL BALANCES

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

imno-EP-a/b-v.1

A&D Mercury

A&D MERCURY PTY. LTD.
32 DEW ST, THEBARTON, S.A., 5031
TEL.(08) 352 3033 FAX.(08) 352 7409

CONTENTS

A. INTRODUCTION

This instruction manual concerns six different models from the A & D range of electronic precision industrial balances; EP-12KA, EP-20KA, EP-22KA, EP-40KA, EP-41KA and EP-60KA.

The EP series of high precision industrial balances is the end product of years of research, design, development and 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.

EP-22KA is an auto dual range balance (in gram mode only) with a range hold key on the front panel. It offers a resolution of 0.1g in the 2kg range and 1g in the 20kg range. All the other balances in the industrial series are single range models. Each balance boasts full digital calibration, unit conversion to pounds (avoir) and a host of other features which make for unrivaled specifications.

FEATURES:-

1. Ultra stable weighing, high resolution and strong, reliable construction.
2. Simple calibration via "*F*ull *D*igital *C*alibration" function.
3. Convenient standard output interface, serial RS-232C I/O and Current Loop.
4. Ability to re-zero up to the max. capacity of the balance via soft-touch key.
5. Easy-to-read, cobalt blue fluorescent display.
6. Clear annunciators to indicate the status of various functions.
7. Optional under-hook weighing capability for relative density experiments.
8. Swing-Arm feature to place the display panel in the most covenient position.
9. Standard counting software with "*A*utomatic *C*ounting *A*ccuracy *I*mprovement".
10 Percentage function and unit conversion to lb/oz or decimal pound display.

SPECIFICATIONS

BALANCE	EP-12	EP-20	EP-22	EP-40	EP-41	EP-60
MAX. CAPACITY GRAMS	12,000g	20,000g	2kg/20kg	40,000g	40,000g	60,000g
RESOLUTION GRAMS	0.1g	0.1g	0.1g/1g	0.5g	1g	1g
REPEATABILITY STD.DEV.	0.1g	0.1g	0.1g/0.5g	0.5g	0.5g	0.5g
LINEARITY (GRAMS)	±0.2g	±0.2g	±0.1/±1g	±1g	±1g	±1g
SENSITIVITY DRIFT 10~30°C	±5ppm/°C	±3ppm/°C	±10ppm/°C	±6ppm/°C	±10ppm/°C	±6ppm/°C
RESOLUTION POUNDS	0.0005lb	0.0005lb	0.005lb	0.002lb	0.005lb	0.005lb
RESOLUTION lb/oz	0.1oz	0.1oz	0.1oz	0.1oz	0.1oz	0.1oz
SAMPLE 100% MIN. WEIGHT	50g/0.01%	50g/0.01%	50g/0.01%	250g/0.01%	500g/0.01%	500g/0.01%
SAMPLE COUNTING (10 PCS)	10g MIN	10g MIN	10g MIN	50g MIN	100g MIN	100g MIN
COUNTING CAPACITY (MAX)*	120,000pcs	200,000pcs	200,000pcs	80,000pcs	40,000pcs	60,000pcs
STABILIZATION TIME	Approximately 3 seconds					
OPERATING TEMP.	0°C ~ 40°C (32°F ~ 104°F)					
PAN DIMENSIONS	284mm(W) x 344mm(D) / 11·2"(W) x 13·5"(D)					
EXTERNAL DIMENSIONS	351mm(W) x 434mm(D) x 637mm(H) / 13·8"(W) x 17·1"(D) x 25·1"(H)					
WEIGHT	Approximately 18kg / 39lb 11oz					
AC INPUT/FACTORY SET	100, 115, 220, 240 ±15% VAC (50/60Hz) 12VA					

** MAX count if minimum unit weight placed on pan. Min. unit wt = resolution.*

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

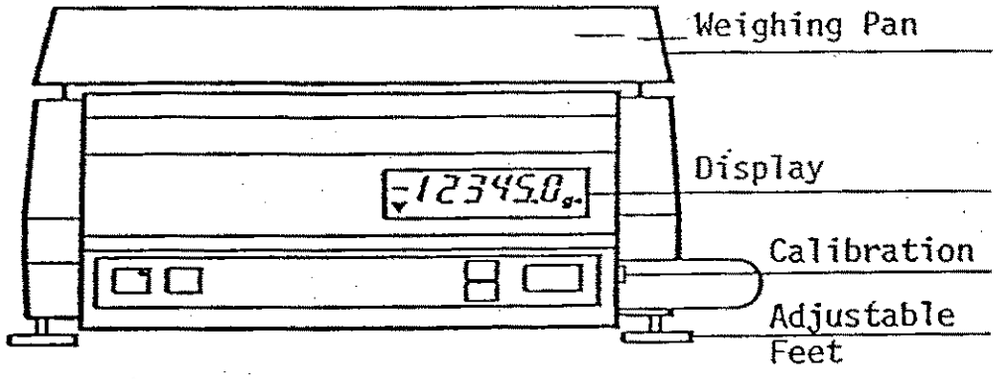
B INSTALLATION

1. UNPACKING

Please unpack the balance carefully making sure that no parts are mislaid during the process, including this manual!

PARTS LIST

1. Balance
2. Weighing Pan/Pan Support
3. Power Cable
4. 0.3A/0.2A Fuse (anti-surge)
5. Unit stickers ("PC" = pieces, "%" = percent, "lb" = pound, "oz" = ounce)



2. POWER REQUIREMENTS

This balance will accept AC input voltages of: 100, 115, 220 or 240V AC. 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. 0.3A Fuse=100/115V & 0.2=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 (note that the power LED stays on). The balance may be kept connected to the electricity supply overnight so that a warm up period will not be required each morning.

3. CHANGING THE FUSE

**If the display is blank and 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) Turn the fuse holder counterclockwise when opening, clockwise when closing.

c) If the fuse has blown, replace it with a 0.3A (100/115V) or 0.2A (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. See section B-6 for Parameter Settings to learn how to run the display with all the display segments illuminated.

4. CALIBRATION

Calibration of the balance is required when it is initially installed, when changing the installation site and additionally every 90 days or so. "Weight" = Mass × acceleration due to the field of gravity of the Earth. The internationally adopted value for gravitational acceleration is 9·806 65 m/s^2 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 (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 (at about 0·0012g ±10% of air displaced per cm^3 @ 20°C) and other factors also vary from location to location and from time to time.

An EP balance is a high resolution instrument so a high quality non-magnetic steel weight should be used for span (maximum capacity) calibration. Steel has a density of about 8·0g/cm^3 which means that a 20,000g weight has a volume of about 2,500cm^3. 2,500cm^3 × 0·0012g 3·0 grams of air displaced whereas a brass weight would only displace about 2·8 grams of air unless it had been adjusted via a cavity to mimic steel density. By international convention, weight in air is measured against the buoyant weight of steel in air and EP-20 has a sensitive resolution of 0.1g. EP balances have a very easy calibration method called FDC (full digital calibration) which means that the zero weight point and maximum capacity weight point are acquired digitally at the press of a button. EP-12 requires a calibration weight of 10kg, EP-20 & 22 require weights of 20kg, EP-40 & 41 require 40kg weights and EP-60 requires a weight of 60kg. EP-22 is calibrated in the 20,000g (20kg) range. Observe all the location requirements before calibration; check that the weighing pan is clean, that the balance has been warmed up for at least 30 mins, that it is as level as you can make it and that it is weighing in "g" gram mode.

CALIBRATION METHOD

1. With a stable display reading and nothing on the weighing pan, remove the plastic calibration plug on the right side of the display pod. Slide the calibration switch ON (downwards). Do not switch on the calibration switch when the display is off, or "Err C" (for Error in Calibration method) will be displayed.

2. The display will show "CAL O" which means that you should enter the zero weight point by pressing the RE-ZERO key. After this the display will blank for a few seconds. The "CAL O" display then returns while the zero weight point is automatically entered by the FDC function.

3. After zero calibration the display will change to "CAL F" which means that you should place the Full Load on the balance (the 10, 20, 40 or 60kg weight). Place the Full Load (maximum capacity weight) on the balance and press RE-ZERO again. As before the display will blank for a few seconds. The "CAL F" display then returns while the maximum capacity weight point is entered.

4. Finally the display will show "CAL End" to show that calibration has ended. Switch the calibration switch off and replace the plastic plug, the display will blank and then revert to normal weighing mode. Calibration was easy wasn't it!

NOTE: If you observe a display of "CAL E" it means Calibration Error because there is too much weight on the pan. Likewise a display of "-CAL E" means Calibration Error because there is too little weight on the weighing pan. A display like this would occur if you placed an incorrect weight on the weighing pan.

5. LOCATION REQUIREMENTS

These industrial balances are precision instruments and, like all precision instruments, should be treated with a reasonable amount of 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. If the balance is placed on the floor then care should be taken in its location to make sure that it will not be damaged by vehicles etc.

b) Corners of rooms are structurally firm and less prone to vibrations.

c) Optimum temperature is about 20°C/68°F with about 50% relative humidity.

d) The environment should be kept reasonably clean and dry but do not install the balance near a heater or in direct sunshine.

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 or floor is not level, turn the adjustable feet on the balance until the level vial indicates that the balance is horizontal.

f) Use a damp cloth and mild soap to clean the balance. Do not use solvents.

6. PARAMETER SETTINGS

When the balance is shipped all the parameter settings are set to status 0 for groups "A" and "b" (see table below) and they may not need to be changed. Group "A" settings cover the motion detection band width, the display update rate, the integration time and running the display segments continuously for even illumination. Group "b" settings cover the printing mode, data output baud rate, parity setting and data format concerning the built-in RS-232C interface.

To enter parameter setting "A" and "b" mode you should switch OFF the display via the ON/OFF key. Next press the RE-ZERO key and while continuing to press RE-ZERO you should switch the display ON again via the ON/OFF key.

The display will show "A - 00000" with a flashing triangle below the "A". If you now press the RE-ZERO key the triangle will move one step to the right and will be placed below the first (left hand) "0". This means that you can now set this digit to the number you want (with reference to the table below) by pressing the PRINT key once for the figure 1 and twice for the figure 2 etc. eg. "A - 20000".
Press RE-ZERO to move the triangle cursor to the right and set the next digit. Finally when all the digits are set for group "A" you should return the cursor underneath the letter "A" and press PRINT to imprint the memory of the balance with your settings. The display will change to "b - 00000" for setting the parameters of the RS-232C interface. Set these parameters as before and imprint in memory when the cursor is under the "b" letter.

A –	0	0	0	0	0
Group A Settings	Motion Band Width	Display Update Rate	Integration Time Setting	All Segments Illuminated	Not Used for "A"
A -	0=±1digit	0=1/3 sec	0=6 sec	0=OFF	Not Applicable
A -	1=±2digits	1=1/6 sec	1=3 sec	1=ON	N/A
A -	2=±4digits	N/A	2=1.5 sec	N/A	N/A
b –	0	0	0	0	0
Group b Settings	Not Used for "b"	Print Mode Auto/Manual	Data Output baud rate	Parity Bit Setting	Data Format/ Stop bit
b -	N/A	0=Stable Print	0=2,400baud	0=EVEN	0=7bit/1bit
b -	N/A	1=Print Accept	1=1,200baud	1=ODD	1=7bit/2bit
b -	N/A	2=Auto Print	2=600baud	2=Nothing	2=8bit/1bit
b -	N/A	3=Command Md	N/A	N/A	3=8bit/2bit
b -	N/A	4=Stream Mode	N/A	N/A	N/A

BRIEF EXPLANATION OF PARAMETER "A" & "b" SETTINGS

From the preceding explanation you will understand that if you wish to change nothing in group "A" or "b" then you can simply press PRINT right away while the cursor is still under the letter. You may at some time wish to enter parameter setting mode to check the present settings without changing any of the settings.

Group "A" Settings:-

a) Motion Band Width. In a perfect world an object resting on a weighing pan would be completely immobile. Regrettably this is not a perfect world so we must tell the balance how much motion should nevertheless be considered as no-motion. This setting is the Motion Band Width and if the movement of the object on the weighing pan is small enough to be inside this band then the balance will regard the motion as no-motion and switch on the No-Motion Symbol. The no-motion symbol is the triangle at the far left end of the display panel. If the digit at position "A - X0000" is set to 1 then the display will be regarded as stable if the amount of movement when weighing is less than ±2 digits. The position of the changing digits referred to here is of course the far right end of the display, technically known as the "minimum division" position. The minimum division in the case of EP-20 is 0.1 because the balance weighs to a resolution of 0.1g in gram weighing mode. Thus with a setting of ±2 digits the display of EP-20 can change between 1000.2g and 999.8g with the no-motion symbol remaining on. Incidentally if the maximum capacity of an EP balance is exceeded by more than +10 minimum divisions, then the display will blank and "E" will come on to indicate an overload error. A "-E" display indicates an underload error.

b) Display Update Rate. This is a rather technical setting designed for busy people who consider a display data update rate of 3 times per second a bit slow. Anyway it is possible to increase the display update rate to 6 times per second with a setting of 1 at position "A - 0X000".

c) Integration Time Setting. This is the period of time in seconds during which the balance adds weight data samples to produce an average sample for display. The number of samples per second is 10⅔ so during a 6 second period 64 samples will be added to produce an average (arithmetical mean) sample. A setting of 2 at position "A - 00X00" would mean that only 16 samples would be added during a 1½ second period. Theoretically a longer period would be better.

d) All Segments Illuminated. A setting of 1 at position "A - 000X0" will keep all the display segments on in order to make the display burn evenly (see page 2).

Group "b" Settings:-

a) Print Mode - Auto/Manual. In fact all of the group "b" settings can be ignored unless you wish to connect a printer of computer to the RS-232C interface. If you connect a printer (eg: Compact Printer AD-8116) or computer, then you can set one of the following five options at position "b - 0X000".

"0" = The balance print key will only work when the display is stable/no-motion.
"1" = The balance will accept a print key command but will wait for stable data.
"2" = The balance will automatically output stable data once per weighing event.
"3" = The balance will output data only when a computer commands it to.
"4" = The balance will output a stream of data at the speed of display update rate.

b) Data Output - baud rate. Different devices require data to be fed to them at different speeds. Some computers may require data at a speed of 600 baud while others may require 2,400 baud. AD-8116 requires data at 2,400 baud.

c) Parity Bit Setting. This is an error checking system for RS-232C transmission and the setting should be matched to the requirements of the receiving equipment. AD-8116 requires an EVEN parity bit setting; (setting 0 at "b - 000X0").

d) Data Format/Stop Bit. Different equipment will require different data formats. AD-8116 requires 7 data bits and 1 stop bit; (setting 0 at "b - 0000X").

WEIGHING UNIT, PERCENTAGE FUNCTION AND COUNTING FUNCTION

After setting the parameters of group "A" and "b" (if they need to be changed) you should proceed to set the status of the two extra weighing modes in addition to the basic gram weighing mode. At any one time the balance MODE key can be used to switch the display from weighing in grams to two of the following four extra weighing modes --- "PC" (pieces/counting), "%" (percentage), "lb" (decimal pounds avoirdupois) or "lb/oz" (pounds and ounces avoirdupois). Unit stickers have been provided with the balance for sticking on the display panel next to two extra LED's located above the gram LED. The two extra weighing modes which you choose to select will depend on the use to which you will put the balance. Some customers will wish to weigh in grams (compulsory mode) or counting or percentage modes while others will wish to weigh in grams or lb/oz or decimal pound modes etc.

Top LED = "%" or "PC" or "lb" or "oz"
Middle LED = "%" or "PC" or "lb" or "oz"
Bottom LED = "g" (cannot be changed)

To enter unit/function setting mode you should switch OFF the display via the ON/OFF key. Next press the MODE key and, while continuing to press MODE, you should switch the display ON again via the ON/OFF key.

The display will show " ---" with the middle LED lit. This means that you may now define the weighing unit or function for the middle LED. If you now press the MODE key the display will change to " 100" for the percentage mode. If you press MODE twice the display will change to " PC" (counting mode), three times " Lb" (decimal lb mode) and four times " Lb. o" (lb/oz mode).

Choose the mode you wish to have at the middle LED position and press the SAMPLE/% key to register your choice in the memory of the balance. Stick the correct unit sticker next to the middle LED.

The display will show " ---" with the top LED lit. This means that you may now define the weighing unit or function for the top LED. If you now press the MODE key the display will change to " 100" for the percentage mode. If you press MODE twice the display will change to " PC" (counting mode), three times " Lb" (decimal lb mode) and four times " Lb. o" (lb/oz mode).

Choose the mode you wish to have at the top LED position and press the SAMPLE/% key to register your choice in the memory of the balance. Stick the correct unit sticker next to the top LED.

Next press the TARE key and all the display segments will switch on for a short period of time. The balance will remember your choice of units even if the power is disconnected. In normal everyday use you will simply have to press the MODE key to switch between the standard gram mode (bottom LED) and the two other modes which you have defined for the middle and top LED's.

BRIEF EXPLANATION OF THE WEIGHING MODES

GRAMS. The primary weighing mode of an EP industrial balance is "g" for grams. This is a unit of mass in the metric (SI) system and is defined as a thousandth part of the International Prototype Kilogram. It is almost, but not quite, the weight of a cubic centimeter of water at 4°C. In fact one litre, one kilogram, of water occupies a volume of $1{\cdot}000028 dm^3$ at standard atmospheric pressure of $1{\cdot}01325 \times 10^5 N/m^2$. The kilogram (1,000 grams) is the SI base unit of mass and is the mass of a platinum-iridium cylinder at BIPM, Paris. An EP balance must be calibrated with a high quality steel weight of the correct number of kilograms (do not calibrate the balance with pound weights).

BRIEF EXPLANATION OF THE USER SELECTABLE · WEIGHING MODES

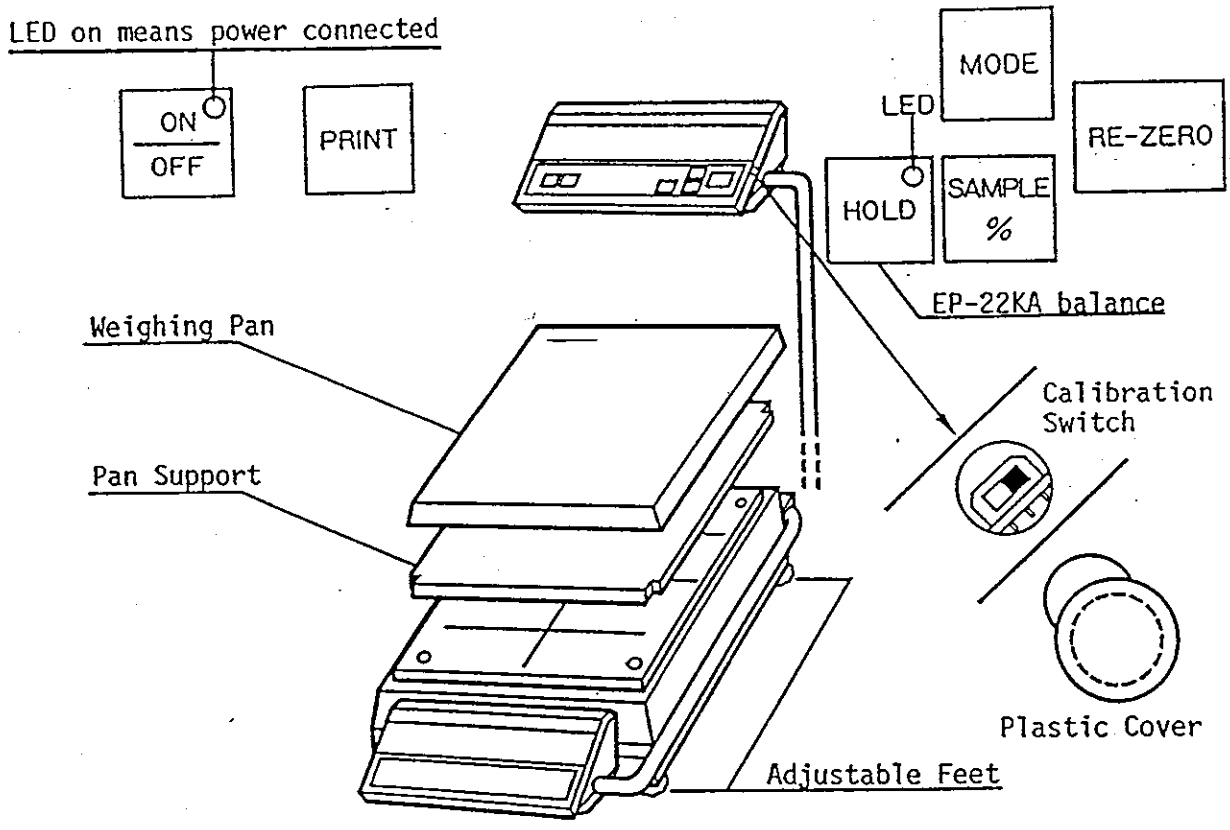
% OR PERCENTAGE. The % weighing mode permits you to use the industrial balance as a sophisticated check weigher. If you use the % mode you may place a sample weight on the weighing pan and press the SAMPLE/% key to tell the balance that the sample weight is the 100% ideal target weight. Subsequently any items placed on the balance will show their deviation from the reference weight in terms of a positive or negative percentage display. Alternatively this mode can be used to turn the balance into a moisture balance --- if you enter a moist sample as representing 100% and then dry the sample (via infra-red or microwave oven) you will be able to see the percentage of water contained in the moist sample from the percentage weight loss. If you make a note of the gram weight before and after drying the sample, you will also know the volume of water lost because one gram of water equals one milliliter (and virtually equals one cm^3).

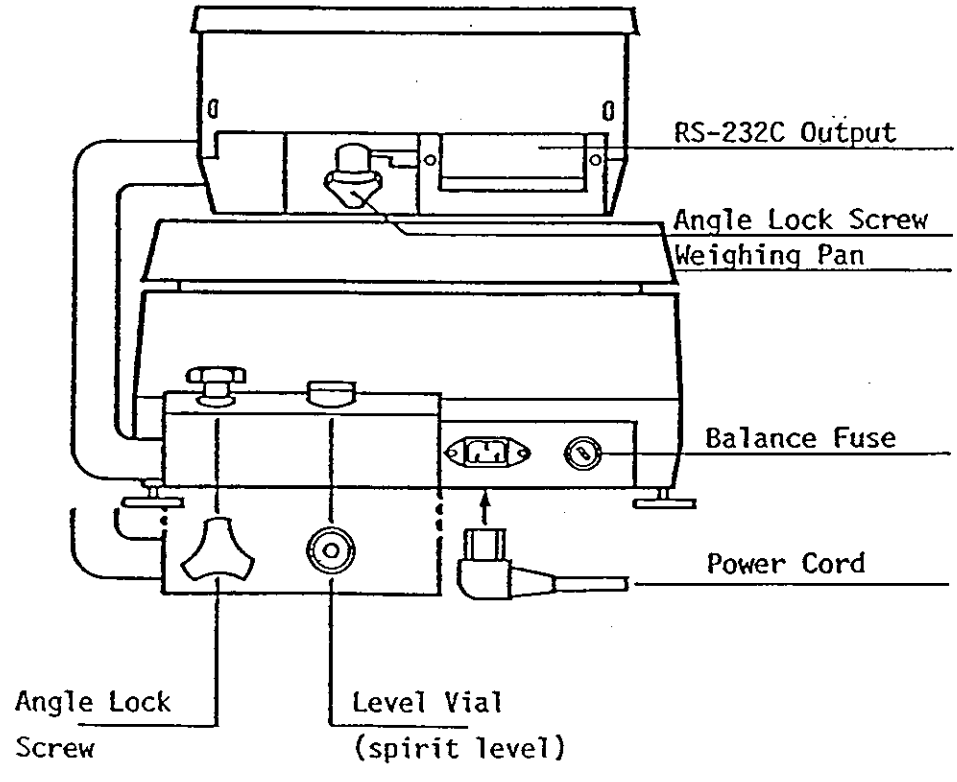
PC OR COUNTING. The counting weighing mode permits you to use the industrial balance as a sophisticated pieces/parts counter in stock control departments. The balance can be used to count leaflets, electronic components or mechanical components. The way the balance does this is by dividing a sample of 10 pieces by 10 to arrive at the average unit weight for each piece. As you continue to add more pieces to the initial sample of 10, the balance modifies the average unit weight divisor through a software function called ACAI, or "*A*uto*m*atic *C*ounting *A*ccuracy *I*mprovement". Imagine that 10 pieces weigh 10.0 grams but a further 10 pieces doesn't weigh 20.0 grams in total but instead weighs 20.2 grams --- the ACAI function will automatically revise the average unit weight from 1.0 gram to 1.01 grams. In fact ACAI is more sophisticated than this but you will understand that without a function like ACAI, small variations in unit weights could rapidly accumulate into a counting error.

lb OR DECIMAL POUNDS. Decimal pounds are a relatively modern invention since pounds (avoirdupois) are traditionally divided by units of 16 rather than 10. The pound can be traced back to Roman times when it was known as the "libra" weight unit and the "lb" abbreviation comes from this ancient unit. The lb is based on the average weight of 7000 grains of English corn (wheat not maize) and one grain unit (gr.) equals 0.006479891 grams. One pound has been defined as being equal to 453.59237 grams so this is the conversion factor used to convert from grams to a decimal pound display. Decimal pounds are used in various industries because of the simple arithmetic involved in adding units of ten. Because 1kg (or 1,000g) is nearly equal to 2·2 lb, the following represents the maximum capacities of EP balances in lb mode: EP-12 = 26 lb, EP-20 = 44 lb, EP-22 = 44 lb, EP-40 = 88 lb, EP-41 = 88 lb and EP-60 = 132 lb.

lb/oz OR POUND/OUNCE. This is the more traditional configuration for the pound (avoirdupois) unit with one pound being divided into 16 ounce units. On the display panel the lb abbreviation has been further abbreviated to "L." so that 10 lb 15·1oz will be expressed as "10L 15.1" with the "oz" being provided by a sticker next to the middle or top LED. Incidentally data cannot be output via the RS-232C interface in this lb/oz format so it is output as "175.1" ounces instead. One ounce avoir is equal to 437½ grains or 28.349523125 grams and it is also the weight of one imperial fluid ounce of water at 62°F. There are 20 imperial fluid ounces to one pint and 8 pints to one gallon so one gallon weighs 10 lb or 160oz. One US gallon equals about 3.785 liters (3.785 kg) so weighs about 8 lb 5·5oz. Pounds and ounces are used for weighing foodstuffs, mail and other general items. In hospitals EP balances could be used as child/baby scales. The abbreviation "oz" comes from "onza", meaning ounce, in old Italian.

C PANEL DESCRIPTION





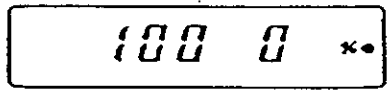
D OPERATION

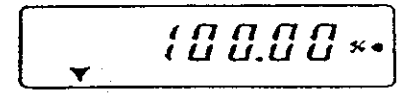
1. WEIGHING
a) Press the ON/OFF key to switch on the display.
b) Weigh in grams or select lb or lb/oz mode (if available) via the MODE key.
c) Zero the display via the RE-ZERO key.
d) Place the object (s) on the pan and read the weight display when it is stable.

2. WEIGHING-IN
a) Place a container on the pan.
b) Zero the display via the RE-ZERO key.
c) Fill the container until the target weight is reached.
d) When mixing ingredients in a container press RE-ZERO after each addition.

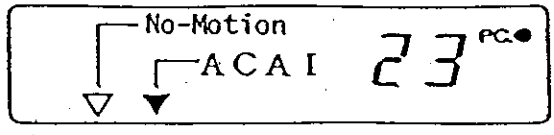
3. WEIGHING-OUT
a) Place a full container on the weighing pan.
b) Press RE-ZERO to zero the display.
c) Remove the weight of material you need with reference to the negative display.

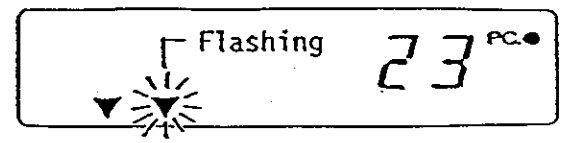
4. PERCENTAGE WEIGHING
a) Press the MODE key to select the "%" percentage function.
b) "100 0" should be displayed but if "100 -" is displayed press RE-ZERO.
c) Place the 100% sample on the weighing pan.
d) The display will show "100 -". Press the SAMPLE/% key.
e) The display will blank and then show "100.00", you can remove the sample.
f) The display will zero and subsequent weights will show a percentage deviation from the weight of the initial 100.00% sample.
g) If "Lo " is displayed then the weight is too little to be accepted as a 100% sample. Minimum sample weight is 50g for EP-12/20/22, 250g for EP-40 and 500g for EP-41/60. The resolution is to 0.01% for all models.





5. COUNTING FUNCTION
a) Press the MODE key to select the "PC" counting function.
b) The display should show "10 0" but if "10 -" is displayed press RE-ZERO.
c) Place your sample of 10 pieces on the weighing pan.
d) The display will show "10 -". Press the SAMPLE/% key.
e) The display will blank and then show " 10" for 10 pieces.
f) Add about another 15 pieces and the display will change to show the number of pieces on the pan. The ACAI annunciator will start to flash to show that a new average unit weight is being calculated.
g) If you add slightly more than double the count again you will stay within ACAI parameters but if you add too many pieces at once then the balance can only make an estimated count based on the initial average unit weight. If you exceed ACAI limits then the ACAI annunciator will not flash when you stop adding pieces. Remove enough pieces so that the annunciator starts to flash.
h) If the weight of the initial sample shows less than the minimum unit weight required for 10 pieces (which is 10 times the resolution or 1g for EP-20), then the balance will prompt you to offer a larger sample. The minimum unit weight possible equals the resolution (eg 0.1g for EP-20) but then you will have to hand count a large sample onto the pan (eg 200 pieces for EP-20).





6. PRINTING WITH AD-8116

Connect the optional compact printer AD-8116 to the balance via the printer's KO:256 interface cable. Read the following table in conjunction with the Parameter Setting information on pages 4 and 5.

PRINT METHOD	PARAMETER	AD-8116 MODE KEY
BALANCE PRINT KEY	b - 00000	MODE 1
BALANCE PRINT KEY	b - 01000	MODE 1
AUTO-PRINT (1 per event)	b - 02000	MODE 1
AD-8116 PRINT KEY	b - 04000	MODE 2

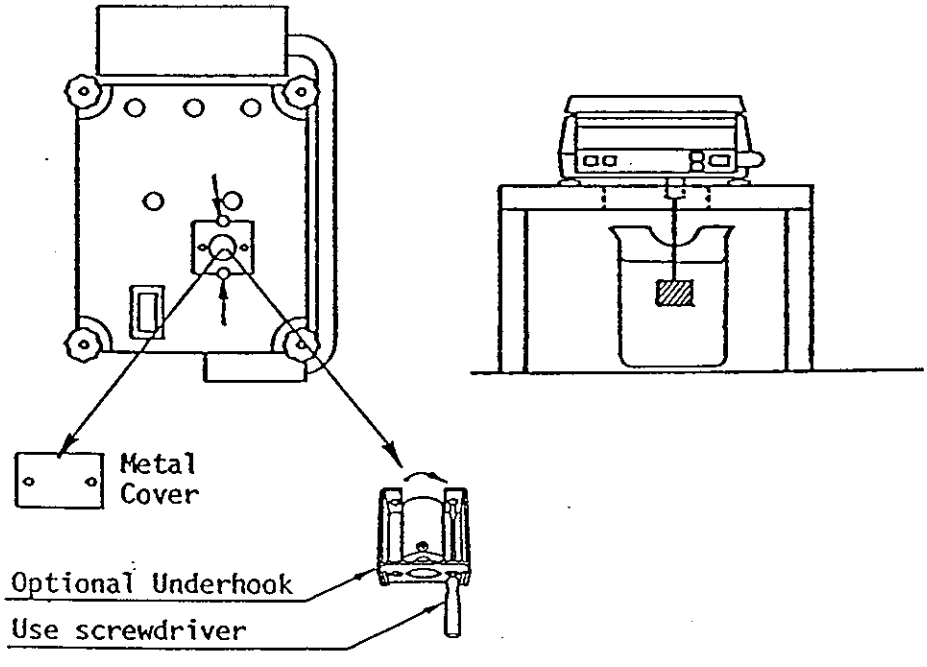
b - 00000 The printer will only print when the data is stable.
b - 01000 The printer will only print after the data has become stable.
b - 02000 The printer will auto-print stable data once per weighing event.
b - 04000 The printer will only print when the printer PRINT key is pressed.

7. UNDERHOOK WEIGHING

An optional underhook is available for use with your EP Industrial Balance. If you remove the metal cover underneath the balance you will see the attachment point for the underhook. Attach the underhook and place the balance on a weighing table with a hole cut in it through which the underhook and harness can freely protrude. Underhook weighing is necessary if you wish to find the relative density (specific gravity) of a metal or some other material. Because one gram of water is almost exactly one cubic centimeter in volume, the loss in weight (displacement) associated with weighing an object in water is in proportion to its volume. By dividing the object's weight in air by the loss in weight in water, the volume, you can find the object's relative density (expressed as g/cm^3).

AN EXPERIMENT WITH A BAR OF SILVER COLORED METAL

a) Press RE-ZERO to zero the display.
b) Find the weight of the bar in air. Bar weighs 1000.0g in air.
c) Press RE-ZERO to zero the display.
d) Lower the bar into water at 4°C (maximum density).
e) Display reads "- 46.5"g which is almost the same as $46.5cm^3$.
f) $1000.0g \div 46.5cm^3 \fallingdotseq 21.5g/cm^3$ ∴ metal is probably platinum.



E INTERFACE

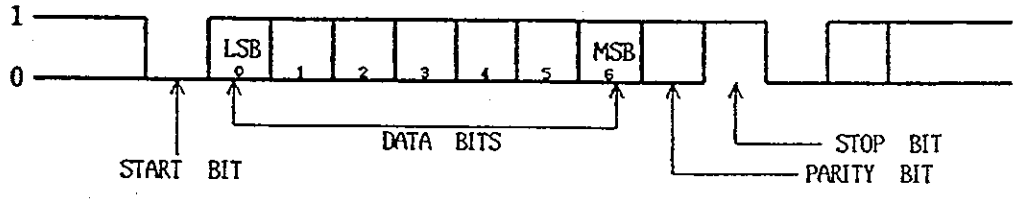
The built-in interface is a serial RS-232C I/O (+CL) card for connecting EP balances to an AD-8116 Compact Printer or to an external device like a computer.

a) Specifications

Type----------EIA-RS-232C
Passive 20mA Current Loop

Method---------Half-duplex, asynchronous transmission

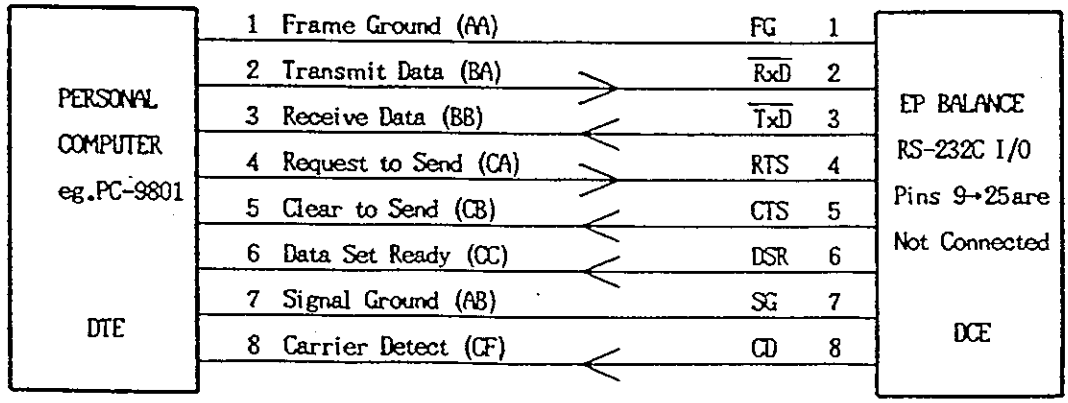
Format---------Baud rate : 600, 1200 or 2400 (selectable b – OOXOO)
Data bit : 7 or 8 (b – OOOOX)
Parity bit : 1 (EVEN/ODD/NOTHING) (b – OOOXO)
Stop bit : 1 or 2 (b – OOOOX)
Code : ASCII



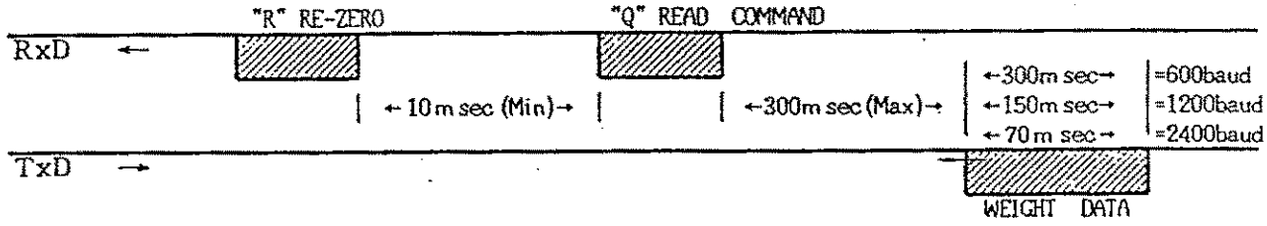
RS-232C	20mA Cur.Loop
1 = –5V → –15V	20mA
0 = +5V → +15V	0mA

b) Transmission modes (Parameter Setting location b – OXOOO)
Two transmission modes are available for computers, 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. The other three transmission modes are primarily designed for sending data to the AD-8116 compact printer. See the Parameter Setting section on pages 4 and 5 to learn how to set the RS-232C Parameters.

c) Connection: AD-8116 and other devices.
The AD-8116 Compact Printer uses a KO:256 interface cable, requires data at 2400 baud, 7 data bits, 1 stop bit and an EVEN parity bit.
EP balances are designated as Data Communication Equipment for other devices.



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



COMMANDS AND HEX CODES

51	53	52	55	0D	0A
Q	S	R	U	CR	LF

HEX CODE
COMMAND

Q CR LF = READ the data. It is a command to the balance to transmit.

S CR LF = READ the data only when the data is stable.

R CR LF = RE-ZERO the balance to zero the display.

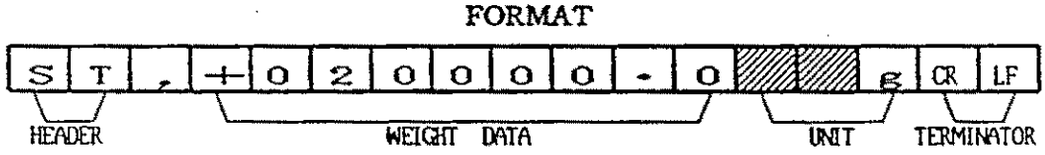
U CR LF = MODE change to change the weight unit or function.

When a "Q" READ command is received, a weight data sample immediately following the command will be transmitted and no further commands should be sent until after the command has been executed and the data has arrived.

When an "R" RE-ZERO command is received the RE-ZERO function of the balance will be activated. Do not send any further commands until at least 10msec later.

e) Data Format

FORMAT



Four types of HEADER are transmitted:

OL----------Overload (E, -E)

ST----------Display is Stable in %, g, lb or oz mode

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

QT----------Display is Stable in counting mode

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

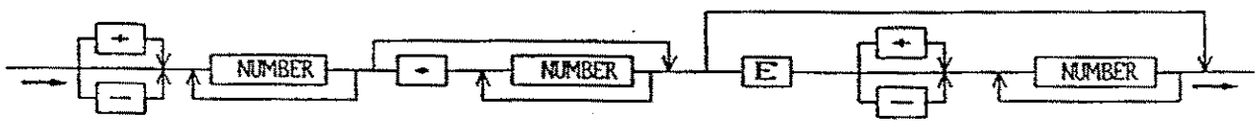
2D (HEX)---------- "-" (minus)

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

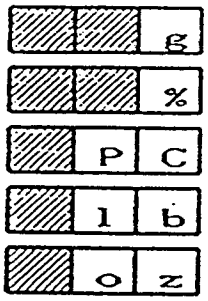
2E (HEX)---------- "." (decimal point)

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

Data may be represented by the following flow diagram:



Five types of UNIT are transmitted:



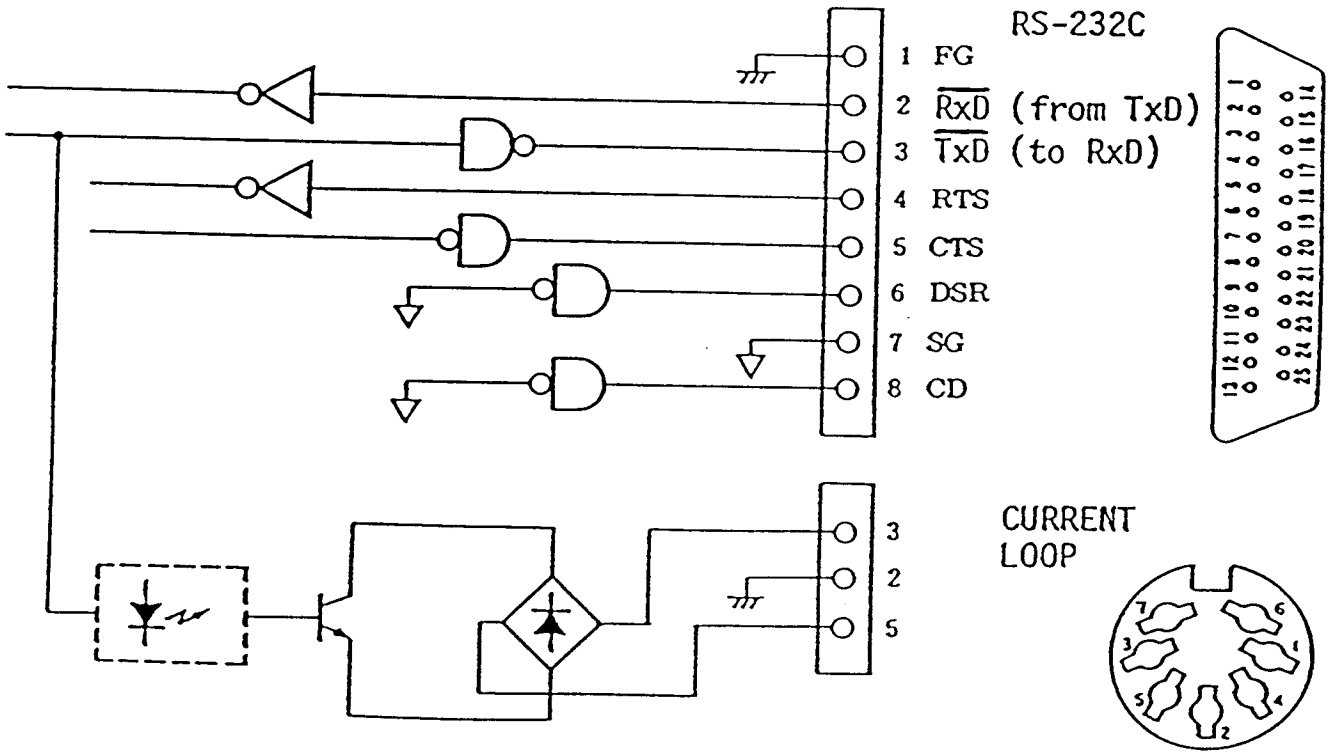
space/space/ grams
space/space/ percent
space/ pieces
space/ pounds
space/ ounces

DISPLAY	TRANSMISSION DATA
0.0g	+000000.0 xxg
86.00%	+00086.00 xx%
120000PC	+00120000 xPC
-5432.0g	-005432.0 xxg
10.00001b	+010.0000 xlb
10L00.0oz	+000160.0 xoz
E	+9999999E +19
-E	-9999999E +19

For E or -E HEADER reads OL for overload.

f) Circuit Diagram

An RS-232C connector is not provided with the balance because the Compact Printer AD-8116 is provided with a cable and connector. A 7 pin DIN Current Loop connector is provided so that you may connect a computer. Please note that this is a passive current loop which requires an external 20mA power source. If you use AD-8116 and a computer together then place the balance in stream mode and the printer in Mode 2; the balance PRINT key will not work so use the printer key.



g) Computer Programs

If you connect a computer to the balance via the RS-232C interface rather than the Current Loop, then the computer can control data output when the balance is in Command Mode. The programs below are written in Microsoft BASIC for the NEC PC-9801 or the Epson HC-20. They show how to send a READ command to the balance but please note that your computer may have a different BASIC dialect. The baud rate should be set to 2400 in command mode (b – 03000).

PROGRAM FOR PC-9801

```
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, "R"                   (RE-ZERO the balance)
40  FOR I=1 TO 100:NEXT I           (DELAY after TARE input)
50  PRINT #1, "Q"                   (READ the weight data)
60  INPUT #1, HD$, DT, UT$          (RECEIVE the weight data)
70  PRINT HD$, DT, UT$              (DISPLAY the weight data)
80  CLOSE
90  END
```

HD$=Header string, DT=Data, UT$=Unit string

PROGRAM FOR HC-20

```
10  OPEN "O",#1, "COMØ:(57E15)"
15  OPEN "I",#2, "COMØ:"
20  FOR I=1 TO 100:NEXT I           (DELAY after buffer open)
30  PRINT #1, "R"                   (RE-ZERO the balance)
40  FOR I=1 TO 100:NEXT I           (DELAY after TARE input)
50  PRINT #1, "Q"                   (READ the weight data)
60  INPUT #2, HD$, DT, UT$          (RECEIVE the weight data)
70  PRINT HD$, DT, UT$              (DISPLAY the weight data)
80  CLOSE
90  END
```