

INSTRUCTION MANUAL

EK Series

MULTI-FUNCTION COMPACT BALANCES

MODELS: EK-120A
EK-1200A
EK-12KA

imno-EK-a/b-v.1

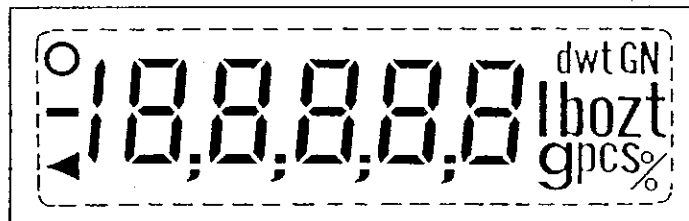
A&D
A&D Company, Limited

EK SERIES INITIALIZATION

Thank you very much for purchasing your new EK series balance. With care your balance will give you years of reliable service. Before you start to use the balance please be sure to remove any expanded polystyrene packing between the weighing pan support and upper case. Please also read the instruction manual.

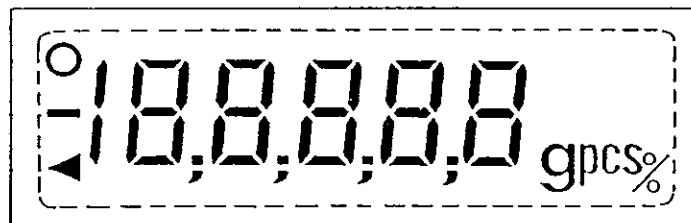
The EK series are MULTI-FUNCTION balances and when they are shipped to the customer all the functions should be available when you switch on the display. To check this please switch on the display to see that all the display segments come on. The function required can be selected via the MODE key and the complete mode cycle is as follows: g → pcs → % → oz → lb → dwt → ozt → GN → g (etc.).

ALL FUNCTIONS AVAILABLE



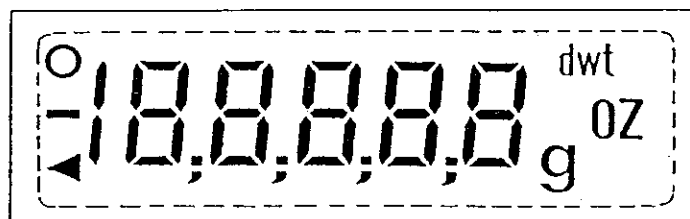
Some customers may want to disable some of these functions because they will never wish to use them. If a customer only ever uses say g → pcs → %, then there would be no point in retaining oz → lb → dwt → ozt → GN because it would slow down mode change between % and g. With oz → lb → dwt → ozt → GN disabled the complete mode cycle will be limited to g, pcs and %. Under these circumstances the display will show the following when the display is switched on.

LIMITED SELECTION AVAILABLE



To enable certain functions and disable other functions, please follow this Initialization Procedure. Switch on the display via the power switch while simultaneously pressing the MODE key on the front panel. You will notice that the display remains blank apart from "g" being displayed. If you wish to enable the "g" function then press the SAMPLE/% key. Please remember that even if you do not normally weigh objects in gram mode, you must nevertheless always calibrate the balance with the correct gram/kilogram weight. Next press MODE again and the display will change to show "pcs". If you wish to enable "pcs" then press SAMPLE/%, but if you wish to disable this function press MODE again and the display will jump to "%" with the "pcs" function disabled. Continue through the mode cycle enabling desired functions with the SAMPLE/% key and skipping functions you wish to disable with the MODE key. Finally press RE-ZERO when your selection is complete. Your selection might be as follows: g → oz → dwt.

LIMITED FUNCTION EXAMPLE



NOTE: THE CALIBRATION SWITCH MUST BE ON FOR THIS INITIALIZATION PROCEDURE.

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(I) COMPLIANCE WITH FCC RULES

Please note that this equipment generates, employs 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 the equipment is operated in a commercial environment. If this unit is operated in a residential area, however, it is likely to cause interference. In this eventuality, 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 the articles, materials and work which they have furnished will conform to the specifications, drawings and to other stipulations cited, and further warrants that the material and workmanship shall be free from defect. The COMPANY will repair or replace at its discretion, without charge, any equipment covered by this warranty which is returned within one year of initial delivery and is proven upon examination 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 an authorized agent of the COMPANY if in the COMPANY's judgment such repair or modification has detrimentally affected the performance or reliability of the product
- b) Improperly installed or adjusted in ways at variance with instructions provided by the COMPANY
- c) Mishandled, abused or in the judgement of the COMPANY, exposed to an environment for which the product was not designed Any product 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 concerning the factory inspection results. If repair covered by warranty is needed, the unit will be repaired or replaced (at the COMPANY's discretion) at no extra cost to the customer and will be returned freight prepaid.

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

A. INTRODUCTION

This instruction manual covers three different models; EK-120A, EK-1200A, and EK-12KA from the range of A & D electronic compact balances.

The EK series of high-precision, top-loading balances benefits from years of research, design, development and in-field testing. Every component has been carefully chosen to produce optimum performance from the entire unit. In addition, each balance undergoes several levels of quality control testing before leaving the factory.

Due to their functional superiority and competitive price, A&D electronic balances are replacing conventional balances everywhere. In addition to their capacity to operate in six weight units (grams, grains, ounces, pounds, pennyweights, and troy ounces), our balances feature percentage calculations and a counting function. When linked to a computer, any EK-series balance can work as a checker on a production line.

Our computerized balances are housed in compact cases and have the following features:

1. Ultra stable weighing, rounding an extra undisplayed digit, and filtering
2. Convenient optional output interface, serial EIA-RS-232C
3. RE-ZEROing ability up to the maximum capacity of the balance with a soft-touch key switch
4. Easy-to-read seven-segment liquid crystal display
5. Low-profile, high-accuracy load cell and state-of-the-art hybrid technology
6. Portability, with the entire EK series operational for up to eight hours on an optional internal rechargeable Nickel-Cadmium battery pack (6 hours with Op-02/03 included)

Specifications

		EK-120A	EK-1200A	EK-12KA
Capacity/ Readability	Gram	120 X 0.01	1200 X 0.1	12000 X 1
	Ounce (avoird)	4.2330 X 0.0005	42.330 X 0.005	423.30 X 0.05
	Pound (avoird)	0.26455 X 0.00005	2.6455 X 0.0005	26.455 X 0.005
	Pennyweight	77.16 X 0.01	771.6 X 0.1	7716 X 1
	Ounce (troy)	3.8580 X 0.0005	38.580 X 0.005	385.80 X 0.05
	Grain	1851.8 X 0.2	18518 X 2	185180 X 20
Parts counting	Sample size	10, 20, 30 or 100 pieces, auto-prompt for correct sample size		
	Minimum unit weight	0.01g	0.1g	1g
	Maximum number of parts/pieces	12000		
Percentage resolution		0.1%		
Sensitivity drift		less than ± 20 ppm/ $^{\circ}$ C (5 $^{\circ}$ C ~ 35 $^{\circ}$ C)		
Operating temperature		-5 $^{\circ}$ C ~ 35 $^{\circ}$ C (23 $^{\circ}$ F ~ 95 $^{\circ}$ F)		
Pan size		100mm ϕ (3.8" ϕ)	133X170mm (6.7"X5.2")	195X140mm (7.7"X5.5")
Weight		650g (1.4 lb)	900g (2.0 lb)	3.1kg (6.8 lb)
Dimensions	mm	185(W) X 185(D) X 64(H)	185(W) X 185(D) X 64(H)	217(W) X 205(D) X 87(H)
	Inch	7.3(W) X 7.3(D) X 2.5(H)	7.3(W) X 7.3(D) X 2.5(H)	8.5(W) X 8.1(D) X 3.4(H)
Power		100, 115, 220 or 240 VAC as required, (factory preset) 50/60Hz 4VA 8 hours continuous operation with rechargeable battery pack option		
Standard accessories		AC adaptor (1), Fuse (1), Instruction Manual (1)		

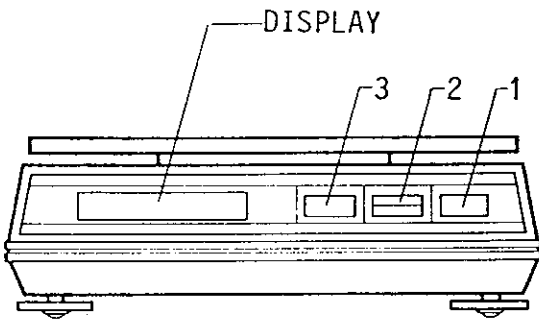
*Tael weighing unit (instead of troy ounce unit) versions are also available. Capacities and resolutions are:
EK-120A - 3.2050t X 0.0005t, EK-1200A - 32.050t X 0.005t, EK-12KA - 320.50t X 0.05t (t = tael)

Please read this manual carefully before unpacking or using your new balance!

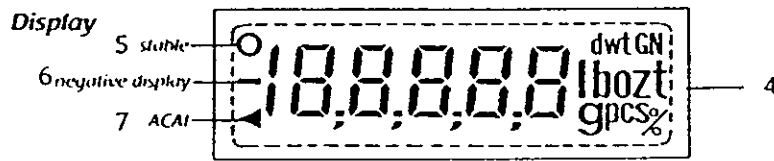
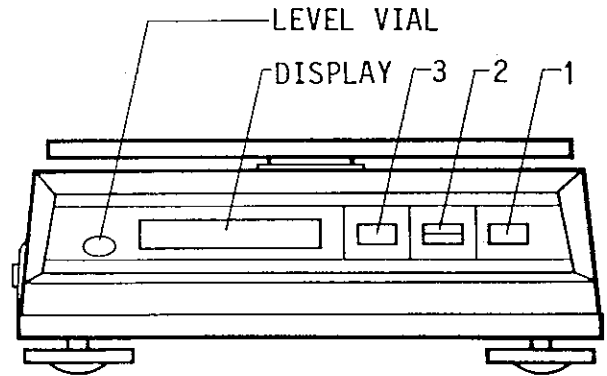
B PANEL DESCRIPTION

FRONT PANEL

EK-120A/1200A



EK-12KA



1. RE-ZERO KEY (RE-ZERO capability extends from +1Minimum Division to Maximum Capacity)

The key is used to re-zero the display in order to account for the weight of a container. The tare weight, or the weight of the container, is added to the net weight to yield total gross weight, which must not exceed the maximum capacity. This key only functions when the display is stable.

2. SAMPLE/PERCENT KEY

This key is used to enter the weight of a sample in counting or percentage weighing modes.

3. MODE KEY

This key is used to switch the weighing unit of the display

between grams and other units. While the balance is calibrated in grams, it can internally convert gram readings to any of the other weight units.

4. WEIGHT UNIT DISPLAY

Display of the selected weight unit appears using the following notation: dwt__pennyweight, oz__ounce(avoirdupois), pcs__pieces, GN__grain, ozt__ounce(troy), %__percentage, lb__pound(avoirdupois), g__gram(see Appendix B: Weight Units).

5. STABLE DISPLAY

The circle indicates that the display is stable and that the weight load is not in motion.

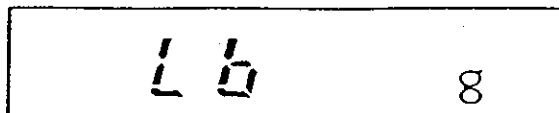
6. NEGATIVE DISPLAY

Shows loss in weight from a previously set zero point(see section D-3: Operations-weighing out). This symbol also has specific meanings when calculating percentages, counting, and weighing with the underhook(see sections D-4,5 and 7 respectively).

7. ACAI INDICATOR (Automatic Counting Accuracy Improvement)

This indicator shows if the averaging function for the counting mode is in effect. (See APPENDIX B: weight units - pcs or counting.)

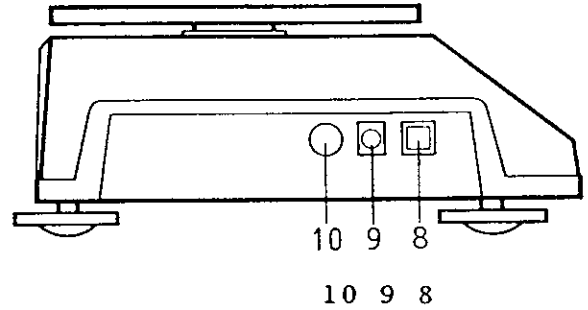
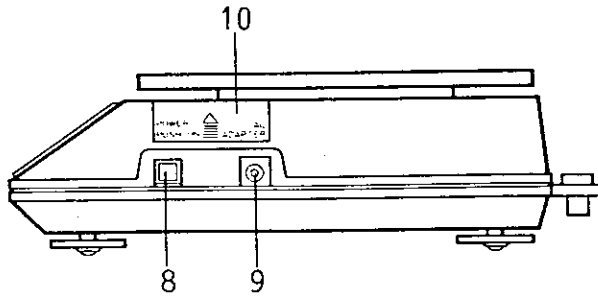
NOTE: "Lb" appearing as the first two digits of the number display means "low battery."(op-04/05)



SIDE PANEL EK-120A/1200A/12KA

EK-120A/120A (RIGHT)

EK-12KA (LEFT)



8. POWER SWITCH

Pushing this switch once activates the power, while pushing it again turns it off. The battery charging circuit is deactivated when the balance is switched ON and the battery pack will recharge only when the balance is switched off (but the adaptor is plugged in).

9. 12VDC INPUT SOCKET

Input for the AC/DC adapter supplied with the balance.

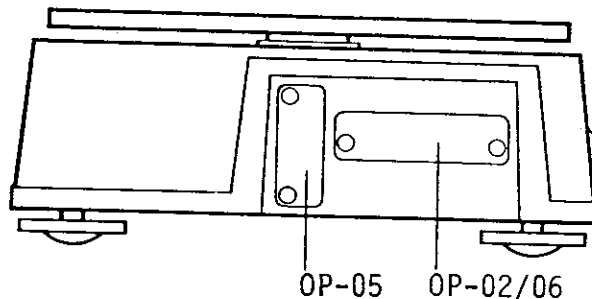
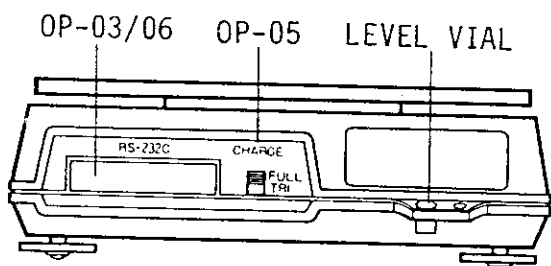
10. CALIBRATION SWITCH

On EK-120A and EK-1200A, this cover slides off vertically to reveal the calibration slide switch. On the EK-12KA model, the calibration switch is mounted on the left side panel.

REAR PANEL EK-120A/1200A/12KA

EK-120A/1200A

EK-12KA



11. OPTION-02/03 OUTPUT CONNECTOR

An RS-232C output connector is used to interface the balance with the AD-8116 Compact Printer or with a personal computer. (See APPENDIX A: Options.)

12. EK-A SERIES CHARGE SWITCH FOR OPTIONAL BATTERY PACK

This switch is normally set at TRI (trickle charge). FULL may be used for fast recharging from total discharge. This takes about 14 hours. **DO NOT** leave this switch permanently on FULL as overcharging the battery pack will damage it. Trickle charging compensates for power leakage as long as the AC/DC adapter is plugged in. Also, if the battery pack is only partially discharged the trickle charge is sufficient. (See section C-2: Installation - power requirements.)

13. SECURITY POINT EK-120A/1200A ONLY

This is provided so that the user can secure the balance to something immovable and/or connect the balance to an anti-theft alarm.

C. INSTALLATION

C-1. UNPACKING

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

LIST OF CONTENTS

1. Balance
2. Weighing Pan
3. AC Adapter
4. 0.2A Fuse

C-2. POWER REQUIREMENTS

The balances can be supplied with an AC adapter for 100, 117, 220, or 240V AC \pm 10%, converted to approx. DC12V @ 80mA. The internal DC fuse is 0.2A. The AC power requirements of your adapter are clearly marked on the adapter case and will depend upon the original shipping destination of the balance. Power frequency can be either 50 or 60Hz.

If you connect the balance to an alternative 12V DC power source (e.g., via a car cigarette lighter adapter) make sure that the polarity is never reversed.

With the optional battery pack, the recharging switch should normally be set to trickle charge in order to keep the power level "topped up." Fast recharging from "flat" (total discharge) may be achieved by setting the switch to "FULL," but the switch should not be set to "FULL" for more than 10 to 14 hours. Overcharging will damage the battery pack. Therefore, if the battery pack is only partially discharged, trickle charge is recommended since it can fully recharge the battery pack in about 24 hours.

C-3. FUSE CHANGING

If the display is blank, the internal fuse may have blown.

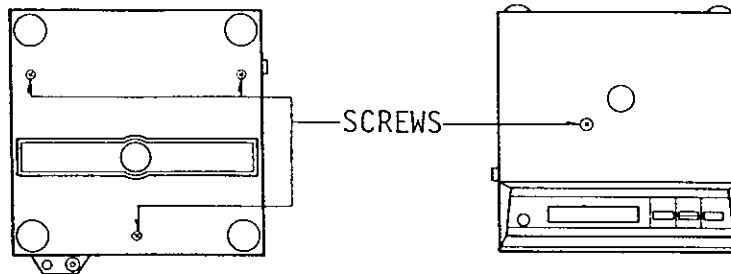
- (a) If an AC fuse has not blown and you are certain that the balance is receiving power, the internal DC fuse may have blown.
- (b) To open the EK-120A/1200A case to change the internal DC fuse, remove the weighing pan. Take care not to exert leverage on the load cell by twisting and rocking the pan. (Also be careful when you replace the weighing pan). Then turn the balance up-side-down.
- (c) Unscrew the three recessed Phillips screws which connect the two halves of the case together.
- (d) Hold the case together and turn the balance the right way up. Gently lift off the top half of the case. The keyboard lead will keep the top half of the case connected to the bottom half so do

not jerk or strain this lead by attempting to pull the case apart quickly.

- (e) If the fuse has blown, replace it with a 0.2A fuse only. If this fuse immediately blows again, have the balance repaired.

EK-120A/1200A (BOTTOM)

EK-12KA(TOP)



The case of EK-12KA is opened by removing the pan and pan support and then unscrewing the single cover screw which holds the two halves of the case together. When the pan support is replaced, the azimuth angle can be adjusted via the use of HEX key screws on the mounting block.

C-4. SITE SELECTION

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

- a) Try to ensure a reasonably clean and dry environment.
- b) Avoid direct sunlight or excessive temperature fluctuations.
- c) The balance must be installed on a solid surface free from vibrations.
- d) The balance must be level. Turn the adjustable feet until the level vial indicates that the unit is properly level.
- e) Do not drop heavy objects onto the weighing pan! Also, avoid subjecting the sensitive load cell to unusual strains. For instance, do not lift the balance by the pan support or rock or twist the weighing pan.
- f) Because EK-120A/1200A are so portable, a final siting requirement might be to secure the balance to something immovable via the tie-down hole at the rear of the unit. An anti-theft alarm wire or fiber optic cable may also be fed through this hole.

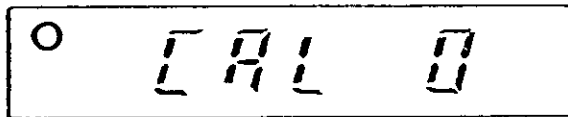
C-5. CALIBRATION

Calibration of the balance is required when it is first installed, and when its location is changed. In addition, regular adjustments should be made every 90 days or so.

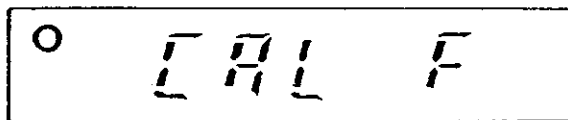
"Weight" = mass x acceleration due to the earth's field of gravity. The internationally adopted value for gravitational acceleration is 9.806 65 m/s² in a vacuum. However, this varies by about ±0.3% depending on how far you are from the center of the earth. Mass distorts space in such a way that gravitational acceleration is greatest at the poles, least at the equator and decreases with altitude. In addition, the sun and the moon exert inconstant forces of gravitational attraction. Air buoyancy (at about 0.0012g ±10% of air displaced per cm³ @ 20°C) and other factors also vary from location to location and from time to time.

CALIBRATION METHOD

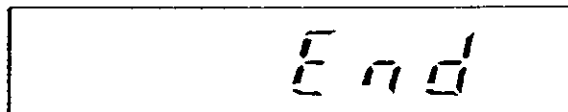
1. First, make sure that the location complies with all requirement noted in section B-4 Site Selection. Disregarding these requirements can lead to significant inaccuracies. After a warm-up period of 30 minutes, make sure the weight unit display reads "0" for grams. The balance can only be calibrated in the gram mode. Obtain calibration weights of 100g, 1kg, 10kg for EK-120A, EK-1200A, and EK-12KA respectively. With a stable display reading and nothing on the weighing pan, slide the calibration switch to ON. (For EK-12KA model, use the toggle switch on the left hand side.) Press MODE and RE-ZERO keys simultaneously.
2. The display will show "CAL 0." Wait for the stable "0" mark.



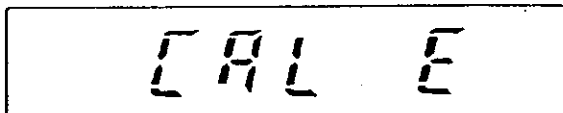
3. Press RE-ZERO and display changes to "CAL F," indicating that you should place the Full Load on the balance (the 100g, 1kg, or 10kg weight). Place the Full Load on the balance, wait for stable mark and press RE-ZERO again.



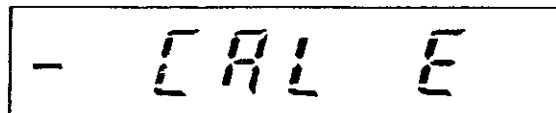
4. After a few seconds the display changes to "End." Take off weight and press the MODE Key. The display will change to zero. Slide the calibration switch off. Calibration is always just this easy.



Note: A display of "CAL E" signifies a Calibration Error because there is too much weight on the pan. Likewise a display of "-CAL E" signifies a Calibration Error caused by too little weight on the weighing pan. These displays occur only if an incorrect weight has been placed on the weighing pan.



CAL E



-CAL E

D. OPERATION

D-1. WEIGHING

- a) Press the POWER key to activate the display.
- b) Weigh in grams or select one of the other weighing units. (See section B-3,4: MODE KEY, Weight Unit Display and APPENDIX B: weight units.)
- c) At this point, you can compensate for the weight of the container by pressing RE-ZERO after putting the empty container on the balance. (See section B-1: Panel Display, RE-ZERO key.)
- d) Place the object(s) on the pan and read the weight display after it has stabilized.

D-2. WEIGHING-IN

To add material until a certain weight is reached-

- 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) In order to weigh-in ingredients while mixing them in a container, press RE-ZERO after each addition.

D-3. WEIGHING-OUT

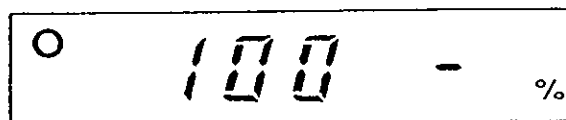
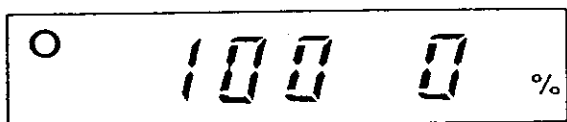
To remove a specified amount of material-

- a) Place a full container on the weighing pan.
- b) Press RE-ZERO to zero the display.
- c) Remove the precise weight of material you need by referring to the negative display.

D-4. PERCENTAGE WEIGHING

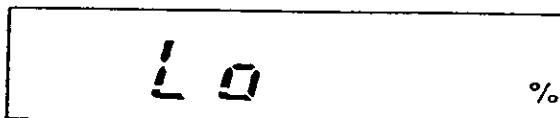
To calculate weights in terms of percentages -

- a) Select the "%" (percentage) function by pressing the MODE key.
- b) "100 0%" should then appear. If "100 -%" appears instead, press RE-ZERO.



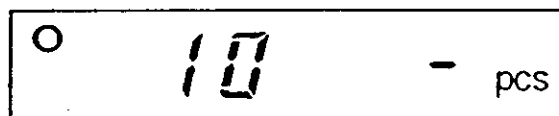
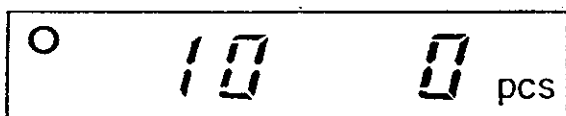
- c) Place the 100% sample on the weighing pan.

- d) The display will show "100 -%". Press the SAMPLE/% key.
- e) The display will then show "100.0%". The sample can now be removed.
- f) The display will zero and subsequent weighing will show a percentage deviation from the weight of the initial 100.0% sample.
- g) A flashing display reading "Lo " signifies that the weight is too low to be accepted as a 100% sample. The minimum sample weight is 1g for EK-120A, 10g for EK-1200A, and 100g for EK-12KA. The resolution is to 0.1% for all models.



D-5. COUNTING

- a) Select the "pcs" counting function by pressing the MODE key.
- b) "10 0pcs" should appear but if the display reads "10 - pcs", press RE-ZERO.



- c) Place your sample of 10 pieces on the weighing pan.
- d) The display will show "10 - pcs". Press the SAMPLE/% key.
- e) The display will go blank and then show " 10pcs" meaning ten pieces.
- f) If more than 10 pieces are put on the balance, the display will register the new total on the pan. The ACAI indicator will start to flash to showing that a new average unit weight is being calculated.
- g) If slightly more than twice the original count is added, the total will stay within ACAI parameters. If too many pieces are added at once, however, then the balance will only make an estimated count based on the initial average unit weight. If you exceed ACAI limits, the ACAI indicator will not flash when you stop adding pieces. Remove enough pieces so that the indicator 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 EK-1200A), then the balance will prompt you to use a larger sample. The minimum unit weight possible depends upon the resolution (e.g. 0.1g for EK-1200A) but then you will have to hand count a larger sample onto the pan.

D-6. PRINTING (WITH OPTIONAL PRINTER AD-8116)

Connect the optional compact printer AD-8116 to the balance using the printer's KO:256 interface cable.

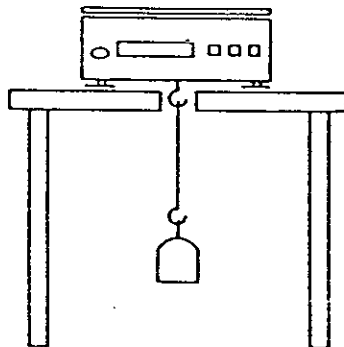
D-7. UNDERHOOK WEIGHING (OPTIONAL FOR EK-12KA ONLY)

An optional underhook is available for use with the EK-12KA Balance. The metal cover underneath the balance can be removed to reveal an attachment point for the underhook. Attach the underhook and place the balance on a weighing table with a hole. Allow the underhook and harness to pass freely through the hole.

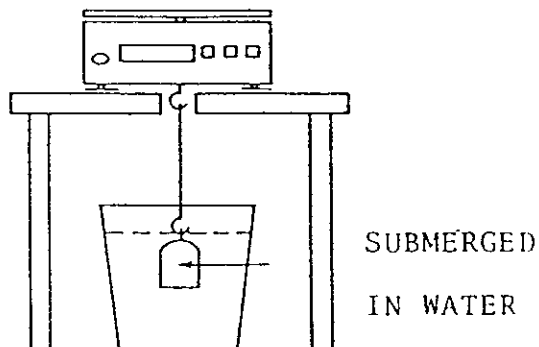
Underhook weighing is necessary for determining the relative density (the specific gravity) of a metal or some other material. Because one gram of water is almost exactly one cubic centimeter in volume, the loss in weight (displacement) associated with weighing an object in water is proportional to its volume. These calculations treat the weight of air displaced as negligible. By dividing the object's weight in air by its loss of weight in water (expressed as the volume), it is possible to find the object's relative density (expressed in g/cm^3).

AN EXAMPLE WITH A BAR OF SILVER COLORED METAL

- a) RE-ZERO the balance, causing zero to appear in the display.
- b) Determine the weight of the bar in air. In our example, the bar weighs 10000g in air.



- c) RE-ZERO the balance, causing zero to appear in the display.
- d) Lower the bar into water at 4°C (maximum density).



- e) The display reads "- 465"g, almost exactly convertible to 465 cm³.
- f) $10000g/465cm^3 \approx 21.5g/cm^3$. Based upon these results, it is possible to deduce that the metal is probably platinum.

D-8. RS-232C INTERFACE:OPTION 02/03

a) Specifications

Type: EIA-RS-232C

Method: Half-duplex asynchronous transmission (send only)

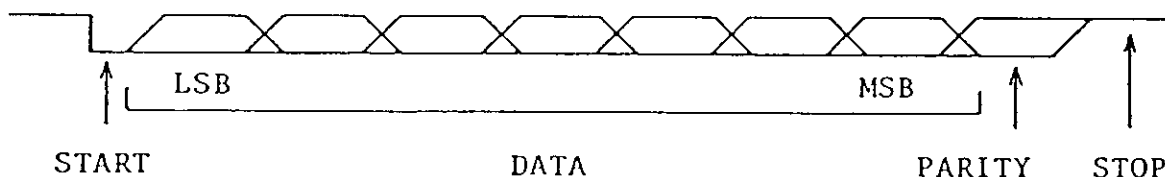
Format: Baud rate 2400

Data bit 7

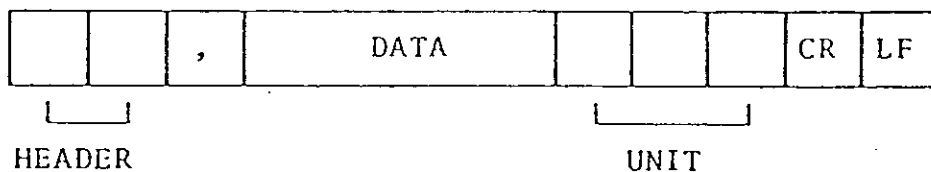
Parity bit 1 (EVEN)

Stop bit 1

Code ASCII



b) Data Format



Four types of HEADER are transmitted:

OL: Overload (E -E)

WT: WEIGHT (g, %, oz, ozt, lb, dwt, GN)

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)

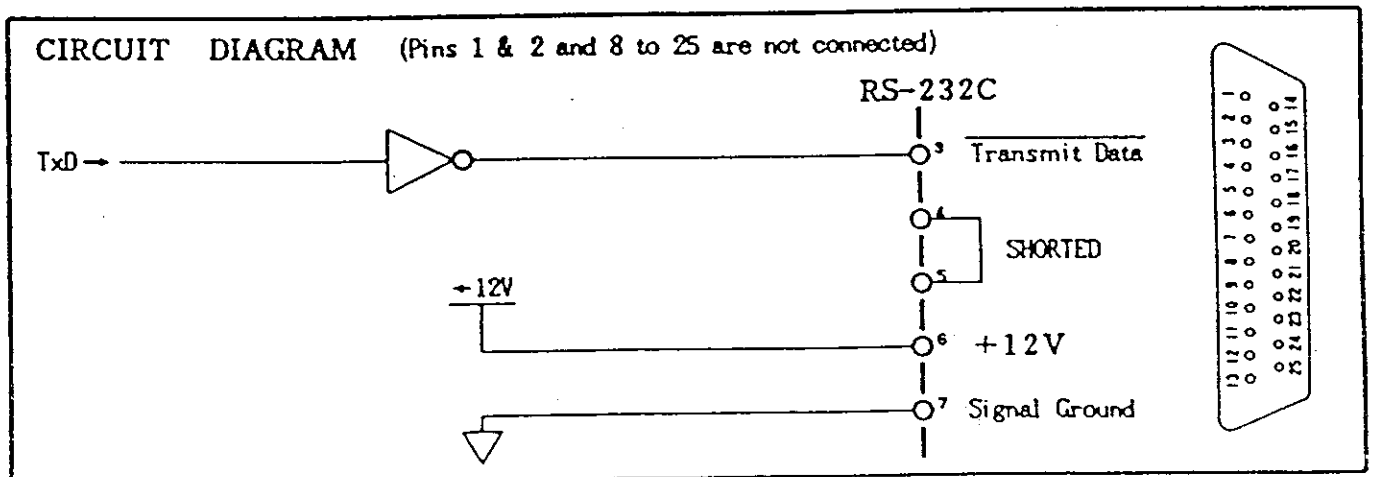
"." (decimal point)

Eight types of UNIT are transmitted:

<input type="checkbox"/> <input type="checkbox"/> g	space/space/grams
<input type="checkbox"/> <input type="checkbox"/> %	space/space/percent
<input type="checkbox"/> p <input type="checkbox"/> c <input type="checkbox"/> s	pieces
<input type="checkbox"/> l <input type="checkbox"/> b	space/pounds
<input type="checkbox"/> o <input type="checkbox"/> z	space/ounces
<input type="checkbox"/> d <input type="checkbox"/> w <input type="checkbox"/> t	pennyweight
<input type="checkbox"/> G <input type="checkbox"/> N	space/grains
<input type="checkbox"/> o <input type="checkbox"/> z <input type="checkbox"/> t	troy ounces

For E or -E, HEADER reads OL for overload.

c) Circuit Diagram



d) SAMPLE COMPUTER PROGRAM FOR AN EK BALANCE EQUIPPED WITH OPTION-02/03

When interfacing an EK personal balance to an NEC PC-9801 computer or the Epson HC-40, connect the TxD output line (connector pin 3) of the RS-232C interface to the RxD input line of the computer.

The following computer program is an example for use with the NEC PC-9801 and Epson HC-40 and is written in these computers' dialects of Microsoft BASIC.

```
10 OPEN "COM1:E71NN" AS #1           (FOR PC-9801)
10 OPEN "I",#1,"COM0:(C7E1)"       (FOR HC-40)
20 INPUT #1,HD1$,DT$
30 N=LEN(DT$)
40 DT=VAL(LEFT$(DT$,N-3))
50 HD2$=RIGHT$(DT$,3)
60 CLOSE #1
```

EXPLANATIONS

```
10 Opening for PC-9801
10 Opening for HC-40
20 Data input (HD1$=Header, DT$=Data)
30 Format weight values
40 Format weight values
50 Format unit values (HD2$=Unit)
60 Close
```

E. APPENDIX

APPENDIX A: OPTIONS

- OP-02 = RS-232C Data Output Board for EK-12KA
- OP-03 = RS-232C Data Output Board for EK-120A or EK-1200A
- OP-04 = Rechargeable NiCd battery pack for EK-120A or EK-1200A
- OP-05 = Rechargeable NiCd battery pack for EK-12KA
- OP-06 = Comparator Unit for any EK series balance
- OP-07 = Underhook for EK-12KA only

NOTE:

OP-04 or OP-05 should not be installed by the end user because of the risk involved to balance through improper installation. If the OP-04/05 connector is plugged into the RS-232C or Comparator connector then the balance could be destroyed. If the end user elects to install the RS-232C option then he must take care to read the printed circuit board legend which will inform him which connector is which. Likewise care should be taken when installing the Comparator.

OP-06 is a Comparator option for use with an EK balance weighing in percentage mode. A buzzer will sound inside the balance and a relay will close to "make" two contacts on the rear panel of the balance. In addition the buzzer will give a short "beep" when you switch the balance on and off. This Comparator will activate when the display exceeds $\pm 100.0\%$ by 0.1% and can be used to give an audible warning that the target weight has been reached or to automatically stop a mechanical container filling operation through the relay. The input specifications for this relay are 50W (max), 200V DC (max) at 1A (max).

Although the internal connections for the Comparator and RS-232C interface are different (so that they could theoretically be used simultaneously) they do in fact occupy same space in the balance so cannot be installed together. In practice customers with the RS-232C option are likely to require more sophisticated forms of control than the Comparator offers anyway.

APPENDIX B: WEIGHT UNITS FOR EK

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. It is almost, but not quite, the weight of a cubic centimetre of water at 4°C. In fact one litre, one kilogram, of water occupies a volume of 1.000028dm³ at standard atmospheric pressure of 1.01325×10^5 N/m² so the gram is no longer defined in terms of one cm³ of water. The kilogram is the SI base unit of mass and is the mass of a platinum-iridium cylinder at BIPM, Paris. Platinum-iridium has a density of about 21.5g/cm³ but OIML standards are generally measured against austenitic steel weights at a density of about 8.0g/cm³. Brass weights should be adjusted via cavity to mimic steel density as they would otherwise be less affected by air buoyancy (brass \approx 8.4g/cm³). The abbreviation for gram is "g".

GRAINS. This is the fundamental unit of weight for the Troy/Apothecary and Avoirdupois weight systems. There are 7000 grains to one avoirdupois pound weight. One pound avoirdupois was defined in the UK (1963) as being equal to 453.59237grams and so one grain equals 0.06479891gram. In the USA the pound was defined as 453.5924277grams but this gives a grain weight of $0.0647989182 + \frac{3}{4} \times 10^{-12}$ gram so the UK factor is generally preferred. The accepted abbreviation of grain is gr. but, because this might be confused with grams, the EK balance has adopted the abbreviation of "GN". Grains are used for weighing medical drugs and for other purposes like weighing black powder (gun powder).

OUNCES (avoirdupois). There are 16 ounces to one pound and 16 drams to one ounce. One pound is 7000 grains so one ounce is 437½ grains or 28.349523125g. One dram is 1.771845195 grams. One ounce is the weight of one imperial fluid ounce of pure water at a temperature of 62°F (1 imp. gallon = 10lb). The abbreviation of ounce "oz" comes from "onza" in old Italian. The avoirdupois ounce unit is used for weighing food and other general items.

POUNDS (avoirdupois). There are 7000grains and 16 ounces to one pound. Pound weights are derived from the old Roman weight unit "libra" and hence the abbreviation "lb". It was the weight used to measure corn in England, which is to say grains of wheat and not maize (North America) or oats (Scotland). An average pound weight sack of corn was said to contain 7000grains of corn. The EK balance has a decimal pound display which means that the pound is divided in units of 10 rather than 16. Multiply the digits to the right of the decimal point by 16 (with a calculator) to convert to pounds, ounces and drams.

dwt (PENNYWEIGHT). There are 24 grains to one dwt (denarius weight) and 20 dwt to one troy ounce. One grain = 64.79891mg so one dwt = 1.55517384grams. Old English money was based on £. s. d. (*librae/pounds, solidi/shillings, denarii/pence*) with 240 pence to one pound sterling (money) or 240 pennyweights/240 silver pennies to one troy pound (weight) of sterling silver (which is at least 92.5% pure). The "dwt" is used for weighing precious metals.

TROY OUNCES. One troy ounce = 480grains = 31.1034768g. There are 12 troy ounces to one troy pound weight (5760 grains) and 20 dwt to one ounce. In the related apothecary system there are 8 drachms of 60 grains each, and 24 scruples of 20 grains each, to one troy ounce. Troy ounces are mainly used for weighing gold and silver. The abbreviation adopted in EK for the troy ounce is "oz t".

TAEL. This is a Chinese weight for gold. The metric weight value for a tael is not standard between different countries. One tael can equal 37.437g and EK uses this conversion factor in the special version of the balance which does not contain the troy ounce unit. The abbreviation adopted in EK for tael is "t".

EK COUNTING & PERCENTAGE FUNCTIONS

% OR PERCENTAGE. The % weighing mode permits you to use your EK Compact 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 cm³).

See Appendix A for use of the Comparator Option (OP-06) in percentage mode.

PC OR COUNTING. The counting weighing mode permits you to use your EK 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 "Automatic Counting Accuracy Improvement". 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.

AND

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