110001M31

High-Precision Analytical Electronic Balance

AF Series

Operation Manual

IMPORTANT

- To ensure safe and proper use of the balance, please read this manual carefully.
- After reading this manual, store it in a safe place near the balance, so you can review it as needed.

ViBRA

SHINKO DENSHI CO., LTD.

PREFACE

Thank you for purchasing an AF Series electronic balance.

This balance can automatically be calibrated (span adjustment) at any time by a simple keystroke. The balance is provided with a function for displaying the right timing for performing calibration under various environmental conditions. This function enables the user to calibrate the balance as required by the usage situation.

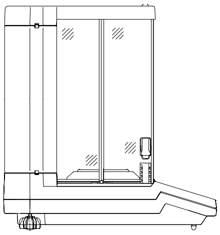
Furthermore, the balance comes standard with an output function that complies with ISO/GLP/GMP, calendar and clock function, and applied measurement functions, including the piece-count, percentage, and addition modes.

Meanwhile, this balance provides excellent usability represented by such facilities as a windshield that allows the user to open/close the desired door, an easy-to-clean measuring chamber with removable windshield doors and floor plate.

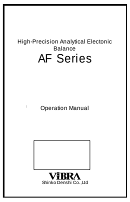
Contents of package

Take the balance and accessories out of the shipping carton carefully, and make sure that all of the following items are included in the package.

(1) Main unit of balance



(2) Operation manual (One)



High-Precision Analytical Electonic Balance
AF Series
Operation Manual
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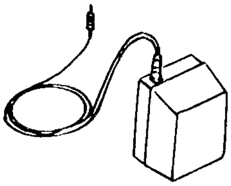
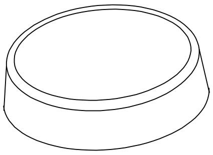
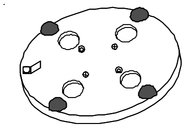
(3) AC adapter (One)



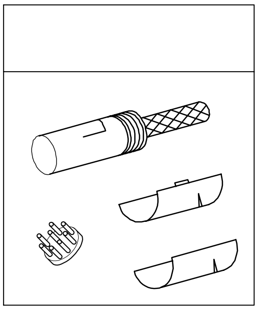
(4) Measurement pan (One)



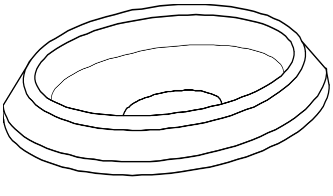
- Pan base (One)



(5) DIN8P plug set
(For output to peripherals)



- Windshield ring (One)



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1. Precautions on the Use

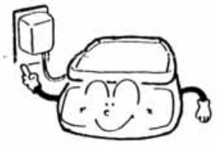
- This Section “Precautions Relating to Use” sets forth precautionary notes that the user should observe in order to prevent physical injury to the user and/or damage to property.
- The nature of problems that may result in the event of improper operation, and consequential effects on the quality and performance of the balance, are indicated under the two categories of “Caution” and “Recommended,” and explained using symbols.

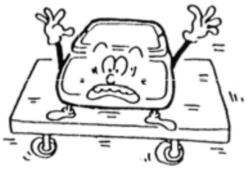
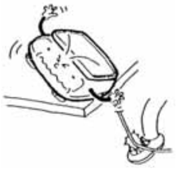
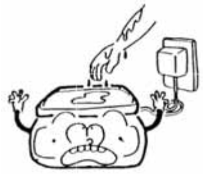
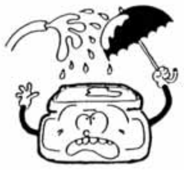
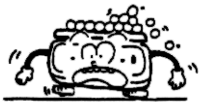
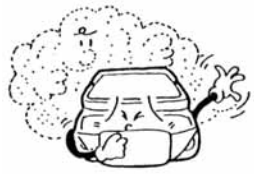
⚠ CAUTION	This symbol indicates a risk of injury or property damage if the balance is used improperly. Be sure to observe these notes to ensure safe use of the balance as the improper use may cause serious results.
RECOMMENDED	This term indicates steps that the user should take to ensure the quality and reliability of the balance.

Meanings of Symbols Each symbol is accompanied by an instruction.

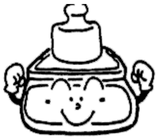
❗ **Mandatory Symbol:**	Indicates a “mandatory” action that should be executed without fail.	❗ **Check Level**
🛇 **Prohibitive Symbol:**	Indicates a “prohibited” action that must not be executed.	🛇 **Do not Use**

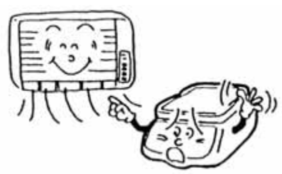
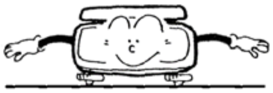
⚠ CAUTION

🛇 **Do Not Disassemble**		◆ **Do not disassemble or modify the unit.** • Could cause malfunction or heat generation • Contact our Marketing Division or Technical Service Division.
🛇 **Do Not Deviate from Ratings**		◆ **Only AC power (rated value) should be used.** ◆ **Only use the dedicated AC adapter.** • Use of other types of power or adapters may result in heat generation or malfunction of the balance.
🛇 **Do Not Move**		◆ **Do not move the balance when a sample is loaded.** • The loaded sample may fall off the measurement pan and cause an injury.

Do Not Use		◆ **Do not place the balance on an unstable base or use the balance in a location where it may be subjected to shock.** • The loaded sample may fall off the measurement pan. • Accurate measurement may be rendered impossible.
Do Not Drop		◆ **Do not lay the AC adapter cable on the surface of the passage.** • Somebody may trip on the cable, causing the balance to fall off, thereby causing injury and/or damage to the balance.
Do not Handle with Wet Hands		◆ **Do not touch the AC adapter or balance with wet hands.** • Danger of electric shock
Keep Dry		◆ **Do not use the balance in a location were it may be subjected to excess moisture.** • Electric shock or short-circuiting could occur. • The balance may be corroded, with resultant malfunction.
Do Not Leave Afloat		◆ **Do not use the balance with its adjusters lifted.** • The balance will become unstable, preventing accurate measurement.
Avoid Dust		◆ **Do not use the balance in a location where it may be subjected to excess dust.** • Risk of explosion or fire • Short-circuit or lack of continuity may occur, leading to a malfunction of the balance.

RECOMMENDED

Calibrate Balance		◆ **Calibrate the balance after installation or relocation.** • Measurement values may contain errors, preventing accurate measurement from being conducted.

Do Not Apply Force		◆ **Avoid applying excess force or impact to the balance.** • Place the sample to be measured on the balance carefully to prevent breakage or malfunction.
Do Not Use		◆ **Do not use the balance in a location were it may be subjected to abrupt changes in ambient temperature or humidity.** • Accurate measurement may not be obtained. • Use the balance in an ambient temperature range from 10°C to 30°C.
Do Not Overload		◆ **Do not use the balance when [o - Er r] (Overloaded) is displayed.** • Take down the loaded sample immediately to prevent breakage or malfunction.
Do Not Use		◆ **Do not use the balance in a location where it is subject to direct sunlight.** • The indications would be illegible. • An internal temperature increase in the balance may lead to inaccurate measurement.
Unplug Adapter		◆ **If the balance is to be unused for an extended period of time, unplug the adapter.** • This conserves power and prevents deterioration.
Do Not Use		◆ **Do not use volatile solvents for cleaning.** • The body may be distorted. • To clean the unit of stains, use a piece of dry cloth or cloth soaked in a small quantity of neutral detergent.
Do Not Use		◆ **Do not use the balance in a location where it may be subject to air from an air-conditioning unit.** • Extreme changes in the ambient temperature may result in inaccurate measurements.
Do Not Use		◆ **Do not use the balance on a soft floor.** • When loaded with a sample, the balance may tip or move, preventing accurate measurements from being conducted.
Check Level		◆ **Do not use the balance when it is tilted.** • An inclined balance is likely to produce errors, preventing accurate measurements from being conducted. Place the balance on a level surface.

2. Specifications

1. Common Specifications

1. Measurement system ....Electromagnetic force balancing system
2. Tare range ....Total capacity
3. Liquid-crystal display (LCD).........Indication in max. 8 digits (Weight indications produced in 7 digits, in characters 18 mm high)
4. Calibration (Span Adjustment).....Span adjustment with built-in weight (Auto-span adjustment)*
   Span adjustment with external weight.
5. Measuring function ....Weight mode, counting mode, percentage mode, addition mode, and density mode.
6. Various functions ....ISO/GLP/GMP functions. (Compatible printer:CSP-160)
   Calendar and clock function
7. Overload indication......................[o-Err] is displayed if the weighing capacity + 9 graduations are exceeded.
8. Operating temperature and humidity ranges
   ....10°C to 30°C, 80%RH or less.
9. AC adapter ....Dedicated AC adapter: UM019 (9 VDC, 700 mA/120 VAC), or UM069 (9 VDC, 600 mA/230 VAC)
10. Output..Bidirectional RS232C output
    Output for peripherals

* Applies only to models with the built-in weight

2. Specifications by Model

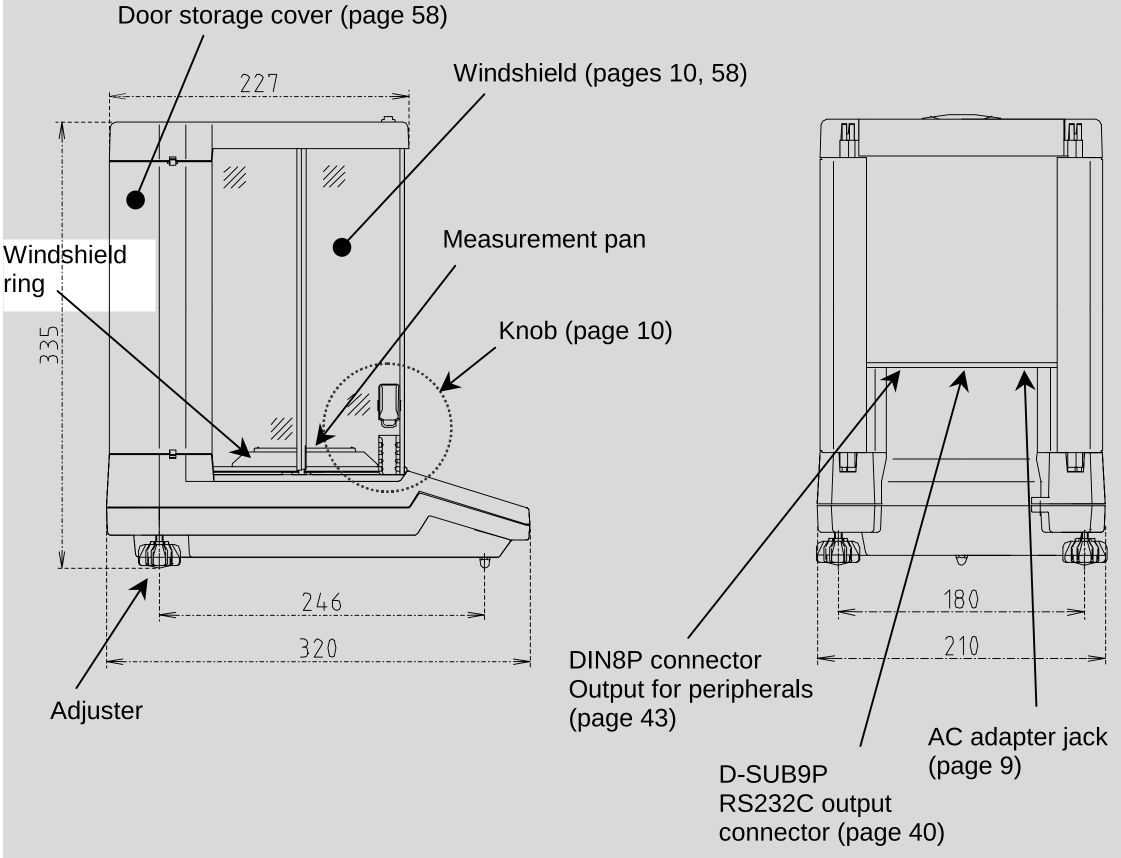
Model	AF-R220	AF-220
Capacity	220 g	220 g
Scale interval*	0.0001 g/0.0002 g/0.0005 g/0.001 g/0.002 g	
Measurable unit weight	0.0001 g	0.0001 g
%-limit weight value	0.01 g	0.01 g
Size of measurement pan	ϕ80 mm	
Weight of main unit	Approx. 5.5 kg	Approx. 5 kg
Built-in weight	Provided	Not provided

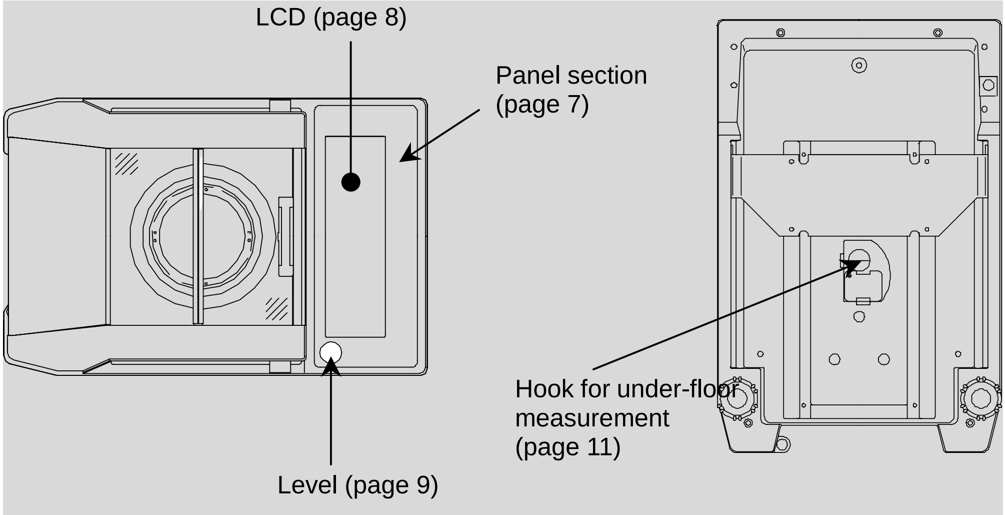
* Changeable by switching Function 1

3. Names of Component Parts

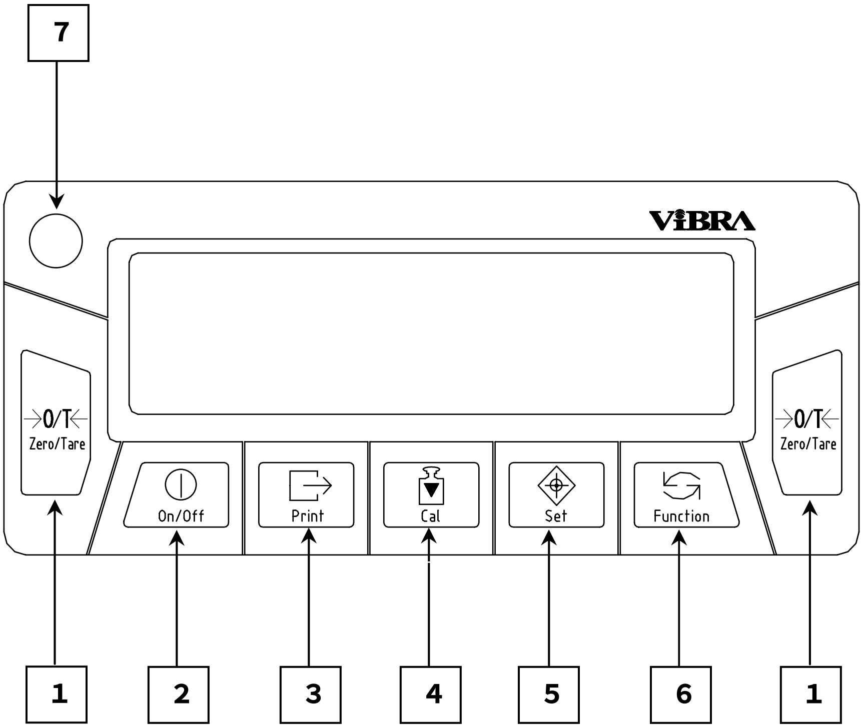
3.1 Main Unit

The relevant reference pages are given in parentheses ( ) to the right of (or under) the component names.


Door storage cover (page 58)
Windshield (pages 10, 58)
Measurement pan
Windshield ring
Knob (page 10)
227
335
246
320
Adjuster
180
210
DIN8P connector
Output for peripherals
(page 43)
AC adapter jack
(page 9)
D-SUB9P
RS232C output
connector (page 40)

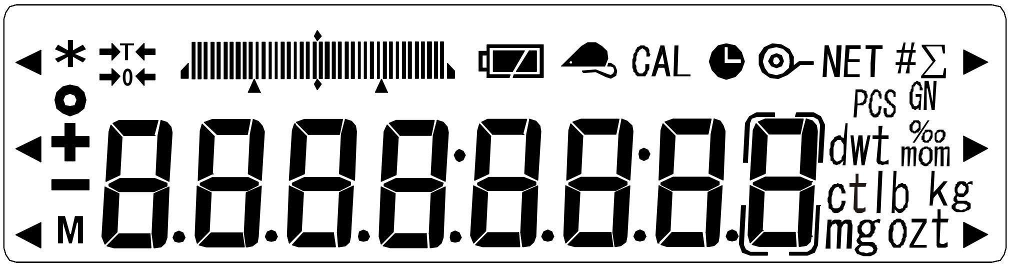

LCD (page 8)
Panel section
(page 7)
Hook for under-floor
measurement
(page 11)
Level (page 9)

3.2 Panel Section



No.	Name	Description
1	Zero/Tare key	Operation key for zero-setting and tare range. Selection key for choosing set values of various functions.
2	On/Off key	Key to turn on/off the unit power
3	Print key	Key to start print or output Key to cancel a time, date, or ID No. setting
4	Cal key	Key to start span adjustment or span test
5	Set key	Key to set various functions and to end the setup Key to invoke the interval function
6	Function key	Key to invoke various functions and to select items
7	Level	Used to check the level of the balance during installation. (The adjusters should be turned so that the bubble is positioned in the center of the red circle.)

3.3 LCD Section

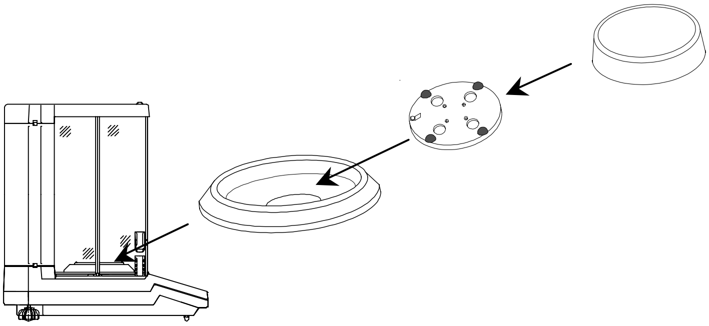


Display	Description
mg	Milligram
g	Gram
ct	Carat
mom	Momme
oz	Ounce
lb	Pound
ozt	Troy Ounce
dwt	Pennyweight
GN	Grain
tl ▶ (Top right)	Tael (Hong Kong)
tl ▶ (Center right)	Tael (Singapore、 Malaysia)
tl ▶ (Bottom right)	Tael (Taiwan)
tl ▶ (Top right) ▶ (Center right)	Tola
NET Σ	Addition mode
PCS	Counting mode
%	Percentage mode
⊚	Data output
M	Display of set values from memory (If a value is flashing, it is being saved.)
○	Indication of stable balance (If this light is off, the balance is unstable.)
→0←	Zero point
→T←	Tare being subtracted
CAL	Stays on and flashes while span adjustment, span test, or calibration of the built-in weight is in progress. Flashes during Advice CAL operation.
◔	Stays on while the time and date are displayed, or flashes while an interval output is in progress.
∗	Balance powered up (Lights up when the power is turned off).
◀ (Top left)	Lights up when an ID No. is indicated. Lights up when an interval output time is displayed or set.
◀ (Center left)	Lights up when a weight error is displayed
	Bar graph (Visual presentation of the range represented by the weight of the sample within the capacity)

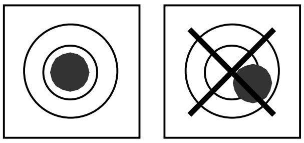
4. Installation

4.1 Main Unit

(1) Installs the windshield ring, pan base, and the measurement pan on the main unit, in that order. Clean these components before installation.

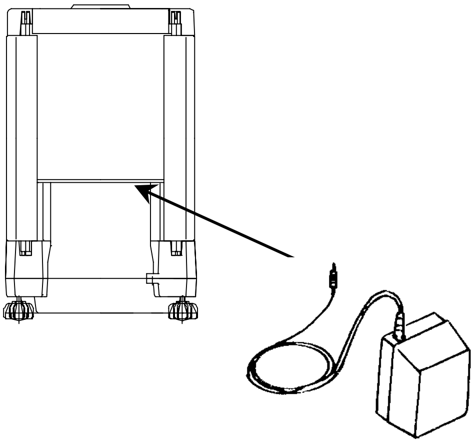


(2) Place the balance at a specified level. Turn the adjusters to bring the bubble of the level to the center of the red circle.



Correct Position of the Level Bubble

(3) Connect the AC adapter to the balance and plug the other end into a power outlet.



4.2 Windshield

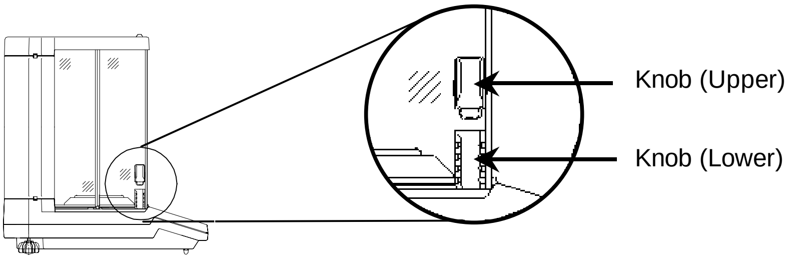
The right and left doors can be opened/closed freely when the upper and lower knobs on both sides of the windshield are properly combined. There are two types of knobs: a knob (upper) fixed to the door and a knob (lower) that simultaneously slides right and left. When the knob (lower) is raised or lowered so as to be locked into or unlocked from the knob (upper), the windshield can manipulated freely, depending on whether the user is right-handed or left-handed, how the sample is to be loaded on the measurement pan, etc.

Moreover, the right and left doors can easily be removed for cleaning of the interior of the measurement chamber.

1. Opening/closing of windshield doors

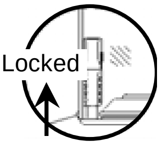
To handle the windshield doors with the alternative hand while one hand is used to load/unload samples:

Push up the knob (lower) on the side where samples are to be loaded/unloaded, and lock it into the knob (upper). On the other side, push down the knob (lower) to free it. In this way, the windshield on the loading/unloading side can be opened/closed with the knob of the other side[*1].



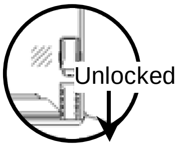
Example: To load/unload a sample with the right hand and to open/close the right-hand door with the left hand:

(1) Right-hand side



Push up the knob (lower) to lock it into the knob (upper).

(2) Left-hand side



Push down the knob (lower) to unlock it.

In this way, the door on the right-hand side can be opened/closed with the knob on the left-hand side. The doors are opened/closed with the knob (lower).

---

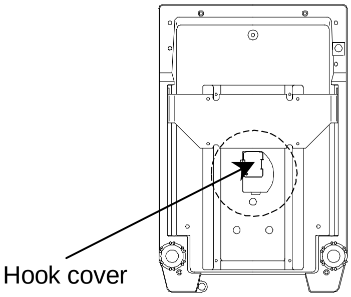
*1 To open/close the right and left doors independently, push down both knobs (lower) to unlock them. In this case, the doors are opened/closed with the knobs (upper).

4.3 Under-floor Measurement

This balance is provided with a hook designed for under-floor measurement. This lets you conduct measurement with a lower pan or other device suspended from the hook. In case a sample does not allow accurate measurement when placed on the measurement pan, such as in the presence of a magnetic material or strong static electricity, use the following under-floor measurement procedure.

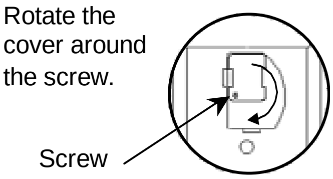
(1) First, unplug the AC adapter. Fully open all windshield doors and remove the measurement pan, pan base, windshield ring, and floor plate. To detach the floor plate, hold it by the sides with both hands and pull it up.

(2) Turn the balance down and lay it on its back.



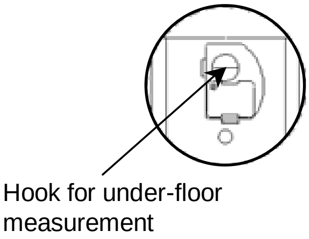
(3) Loosen the screw of the hook cover and rotate the hook cover 90 degrees around the screw.

(4) Retighten the screw.



(5) Put the floor plate, windshield ring, pan base, and measurement pan back in place, and close all the windshield doors.

The balance is now ready for under-floor measurement.



Cautions:

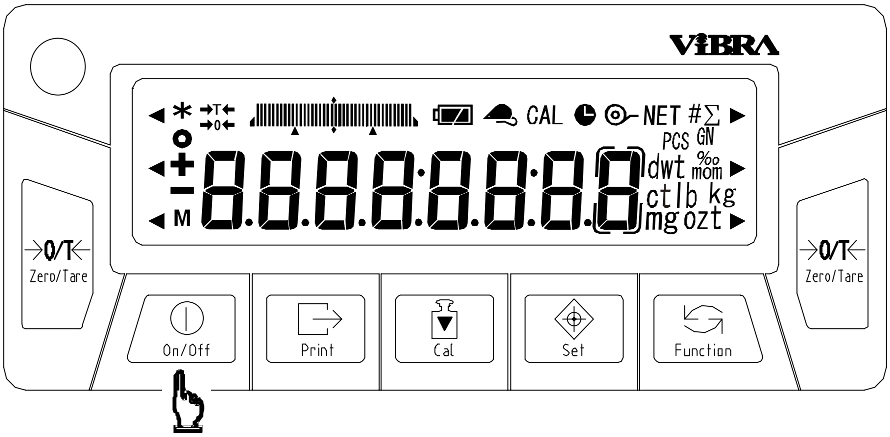
1. Since the device suspended (lower pan) from the hook is treated as a tare, measurement equivalent to the full weighing capacity cannot be conducted. The measurable weight will be as follows:

   Measurable Weight = Weighing Capacity - Weight of Suspended Device

2. If you are not going to conduct under-floor measurement any soon, keep the hook cover closed to minimize dust.

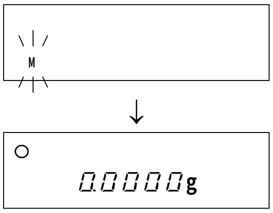
5. Operation Check

5.1 Start


VIBRA
CAL
NET
PCS
GN
dwt
‰
mom
ct
lb
kg
mg
ozt
M
→0/T←
Zero/Tare
On/Off
Print
Cal
Set
Function

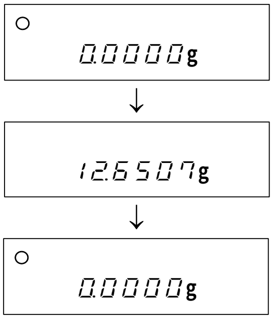
Press the On/Off key. All the indications start flashing. Check the indications to ensure that no indication is missing or unlit.

Only the [M] mark will flash for several seconds, and the balance will change to measurement mode.



5.2 Operation Check

Push the measurement pan lightly by hand and make certain that the weight indication does vary and that it returns to the original indication after you release your hand. (If the zero-point is deviated, press the Zero/Tare key to adjust the zero-point.)


0.0000g
12.6507g
0.0000g

* For the balance to perform stable measurement, start measurement after 30 minutes has elapsed (warming-up) following the power-up. During this process, leave the right and left doors open halfway to allow the interior of the windshield to be acclimatized to the external air temperature. A temperature difference between the inside and the outside of the windshield may give rise to convection when the doors are opened/closed, thereby preventing accurate measurements from being conducted.

6. Time and Date Setup

The time, date and ID No. (see “10.2 Setup of ID No.” on page 33) are used when printing is made in compliance with ISO/GLP/GMP. When this data needs to be printed, make the necessary settings or verify the current settings.

6.1 Time Setup

While the time is displayed, --- stays on. The time is displayed in 24-hour mode [Hour: Minute: Second]. Do not set any unreal time.

1. Time display and setup

(1) Press and hold down the Function key for several seconds. Release the key when the display changes from [Func] to [C - SEt].

(2) Press the Function key again. The display automatically changes to indicate time after briefly showing [t IME].

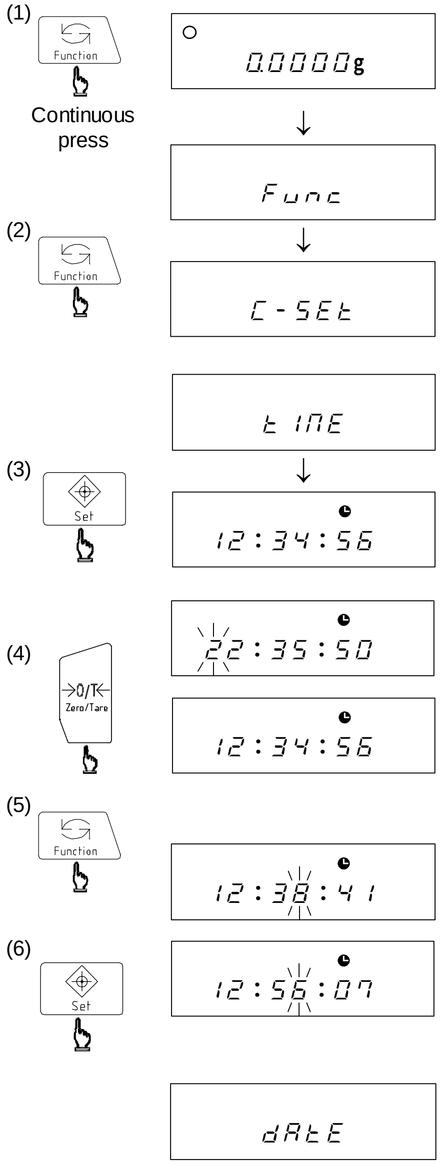
To go back to measurement mode without setting the time, press the Print key.

(3) Press the Set key to setup/change the time. First, the leftmost position flashes, indicating the digit that can be altered.

(4) Change the flashing digit by pressing the Zero/Tare key.

(5) Press the Function key. Pressing the key once moves the cursor one step to the right. If the cursor is at the final digit, it will return to leftmost position when the key is pressed.

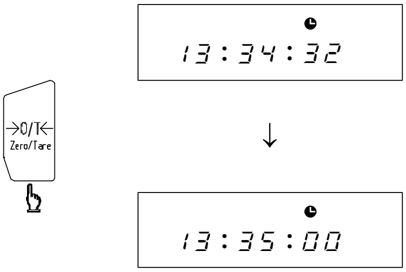
(6) Save the set value by pressing the Set key[*1]. This saves the changes and brings up the date display screen.


(1)
Function
Continuous press
0.0000g
Func
(2)
Function
C - SEt
t IME
(3)
Set
12:34:56
(4)
→0/T←
Zero/Tare
22:35:50
12:34:56
(5)
Function
12:38:41
(6)
Set
12:56:07
dAtE

[*1] Pressing the Print key restores the original time display.

2. ±30-sec adjustment function

The ±30-sec adjustment function serves to make fine adjustment to the internal clock. Namely, when the current time display shows less than 30 seconds, this function discards the seconds and advances the time by one full minute.


13:34:32
→0/T←
Zero/Tare
13:35:00

(1) Display the time. (See (1) and (2) in 1. Time display and setup.)

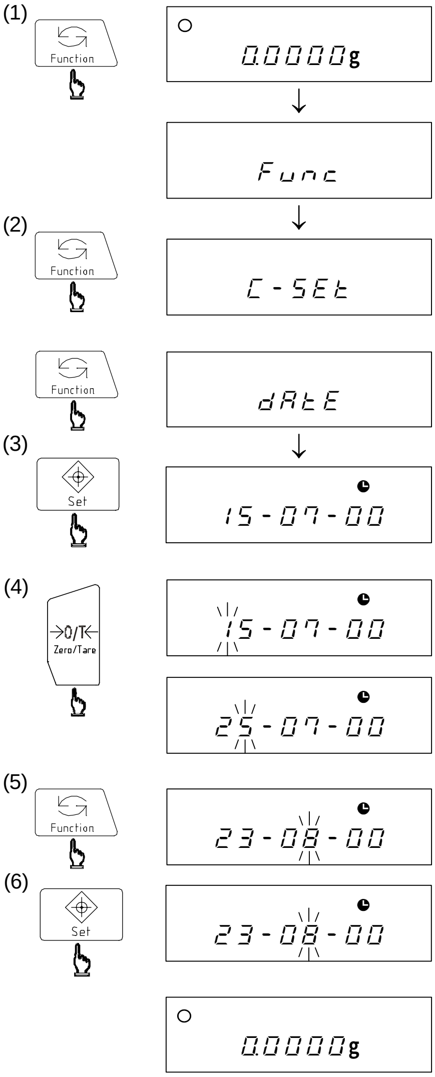
(2) Press the Zero/Tare key.

(3) Press the Print key to return to measurement mode.

6.2 Date Setup

When the display shows the date, · comes on. The year is represented by the last 2 digits. The display order can be altered using Function 1. (See “9. Functions of Function 1” on page 31.)

Do not set any unreal date.


(1)
Function
0.0000g
Func
(2)
Function
C-SEt
Function
dAtE
(3)
Set
15-07-00
(4)
→0/T←
Zero/Tare
15-07-00
25-07-00
(5)
Function
23-08-00
(6)
Set
23-08-00
0.0000g

(1) Press and hold down the Function key for several seconds. Release the key when the display changes from [Func] to [C-SEt].

(2) Press the Function key twice. The display shows [dAtE] for 2 seconds and automatically changes to indicate the date.
To return to measurement mode without setting a date, press the Print key.

(3) Press the Set key. The leftmost position starts flashing. The cursor denotes the digit that can be altered.

(4) Press the Zero/Tare key. Each press rotates the digit.

(5) Press the Function key. Each press moves the cursor to the right. If the cursor is at the final digit, it will return to leftmost position when the key is pressed

(6) Press the Set key. This saves the changes you have made, and returns you to measurement mode[*1].

[*1] Pressing the Print key restores the original date display.

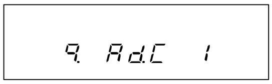
7. Calibration of Balance

7.1 Advice CAL

To ensure conduct accurate measurement under varying environmental conditions, it is essential to calibrate the balance (span adjustment). “Advice CAL” denotes the function that indicates the suggested timing of calibration (span adjustment) by causing the [CAL] mark to flash. If the [CAL] mark starts flashing, execute calibration (span adjustment) of the balance as soon as possible.

(1) Display [9. AdC ☐] by using “9. Functions of Function 1” (page 30) as the guide.

(2) Set the rightmost digit to [1][*1] by pressing the Zero/Tare key.



(3) Press the Set key to go back to measurement mode.

*1 To deactivate the function, display [9. AdC 0].

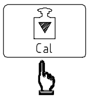
7.2 Span Adjustment with Built-in Weight (Auto-Span Adjustment)

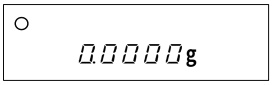
This function enables the user to practice the span adjustment automatically by simply pressing the Cal key. This function is effective when the function is set to Span Adjustment with Built-in Weight (Auto-Span Adjustment) [8. CA. 1]. (See “9. Functions of Function 1” on page 30.) While the span adjustment is in progress, a [CAL] mark will flash.

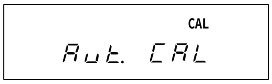
* This function is not available on models without the built-in weight.

(1) Start of span adjustment

Make sure that there is nothing loaded on the measurement pan, and that the windshield doors are completely closed. Then, press the Cal key. The balance displays [Aut. CAL] and, then, initiates the span adjustment.

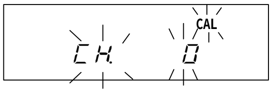






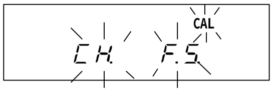
(2) Setup of zero-point

The display begins to flash [CH. 0], and the balance automatically sets a zero-point.



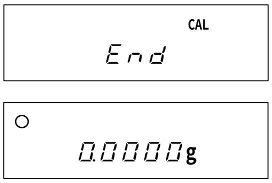
(3) Setup of weighing capacity point

When the zero-point setup is over, the balance now displays [CH. F.S.]. Several seconds later, the display begins to flash and the balance automatically sets a weighing capacity point.



(4) End of span adjustment

When the setup of a weighing capacity point is over, the balance displays [End], and returns you to measurement mode.



Cautions:

1. While the adjustment is in progress, do not touch the measurement pan and protect the balance from shock or movement. If the balance is moved, the processing may be halted at the stage of the flashing [CH. 0].
2. To cancel the adjustment midway, press the Print key. The balance returns to measurement mode after briefly displaying [StOP].
3. Avoid conducting the span adjustment immediately after the balance has been powered up. Always wait for at least 30 minutes before conducting the adjustment.

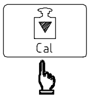
7.3 Span Test with Built-In Weight

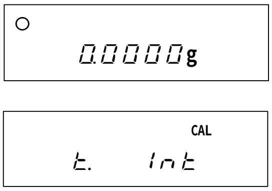
This function enables the user to conduct the span test automatically by simply pressing the Cal key. Conduct this test after setting the function to Span Test with Built-In Weight [8. CA. 2]. (See "9. Functions of Function 1" on page 30.) While the span test is in progress, a [CAL] mark will flash.

* This function is not available on models without the built-in weight.

(1) Start of span test

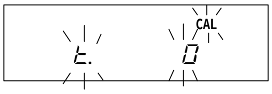
Make sure that there is nothing loaded on the measurement pan and that the windshield doors are completely closed. Press the Cal key. The balance displays [t. Int] and initiates the span test.





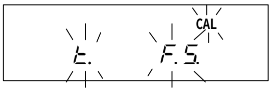
(2) Setup of zero-point

The display begins to a flash [t. 0], and the balance automatically checks the zero-point.



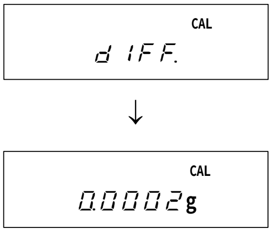
(3) Check of weighing capacity point

When the zero-point check is over, the balance now displays [t. F.S.]. Several seconds later, the display flashes and the balance automatically checks the weighing capacity point.



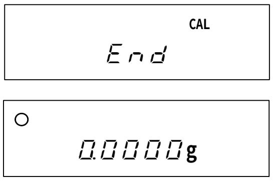
(4) Display of span test result

When the weighing capacity point check is completed, the balance displays [dIFF.] and then the result (error) of the span test in a weight value.



(5) End of span test

After the balance finishes displaying the span test result, it displays [End] and returns to measurement mode.



Cautions:

1. While the adjustment is in progress, do not touch the measurement pan and protect the balance from shock or movement. If the balance is moved, the processing may be halted at the stage of the flashing [t. 0].
2. To cancel the adjustment, press the Print key. The balance returns to measurement mode after briefly displaying [StOP].
3. Avoid conducting the span test immediately after powering up the balance. Always wait for at least 30 minutes before conducting the test.

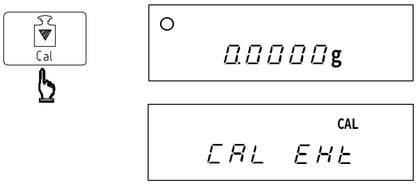
7.4 Span Adjustment with External Weight

Conduct this adjustment after setting the function to Span Adjustment with External Weight [8. CA. 3]. (See “9. Functions of Function 1” on page 30.) While the span adjustment is in progress, a flashing [CAL] mark will flash.

For this adjustment, prepare a weight[*1] equivalent to the weighing capacity. Also, a more accurate adjustment may be conducted when the instrumental error of the weight to be used is set. (See “10.3 Setup of Instrumental Error of Weight in Use” on page 34 and “10.5 Use of Instrumental Error” on page 37.)

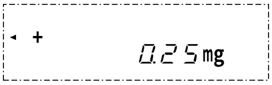
(1) Start of span adjustment

Make sure that there is nothing loaded on the measurement pan and that the windshield doors are completely closed, then press the Cal key. The balance displays [CAL EXt] and initiates the span adjustment.

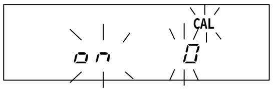


(2) Setup of zero-point

The display begins to flash [on 0], and the balance automatically checks the zero-point. If Setup and Use of Instrumental Error was selected (see pages 34 and 37), the balance displays the instrumental error of the weight entered before the zero-point setup.



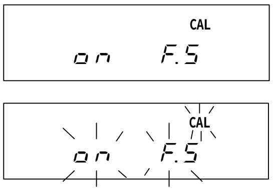
Displayed when “Use Instrumental Error of Weight” is selected



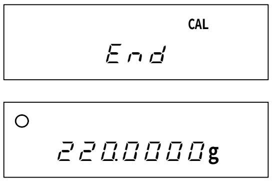
(3) Setup of weighing capacity point

After the zero-point has been adjusted, the balance displays [on F.S]. Load the span adjustment weight[*1] quietly on the measurement pan. The display begins to flash, and the balance automatically sets a capacity point.

Weight loaded



(4) End of span adjustment



When the adjustment of the capacity point is over, the balance displays [End] and ends the span adjustment. Once you are back in measurement mode, unload the span adjustment weight.

*1 Use a span adjustment weight of Class E_2 (or equivalent) or better under OIML Standard.

Cautions:

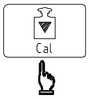
1. While the adjustment is in progress, do not touch the measurement pan and protect the balance from shock or movement. If the balance is moved, the processing may be halted at the stage of the flashing [on 0] or [on F.S].
2. To cancel the adjustment, press the Print key. The balance returns to measurement mode after briefly displaying [StOP].
3. Avoid conducting the span adjustment immediately after the balance has been powered up. Always wait for at least 30 minutes before conducting the adjustment.

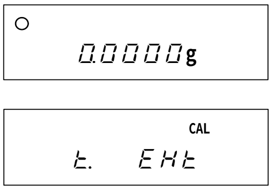
7.5 Span Test with External Weight

Conduct this test after setting the function to Span Test with External Weight [8. CA. 4]. (See “9. Functions of Function 1” on page 30.) While the span test is in progress, a [CAL] mark will flash.

For the span test, use a weight[*1] equivalent to the weighing capacity. Also, a more accurate adjustment will be conducted when the error of the weight to be used is set. (See “10.3 Setup of Error of Weight in Use” on page 34 and “10.5 Use of Weight Errors” on page 37.)

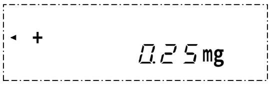
(1) Start of span test

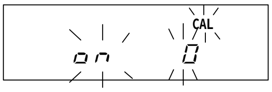




Make sure that there is nothing loaded on the measurement pan and that the windshield doors are completely closed, then press the Cal key. The balance displays [t. EHt] and initiates the span test.

(2) Check of zero-point

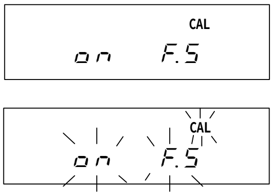




The display begins to flash [on 0], and the balance automatically checks the zero-point. If Setup and Use of Instrumental Error was selected (see pages 34 and 37), the balance displays the instrumental error of the weight entered before the zero-point setup.

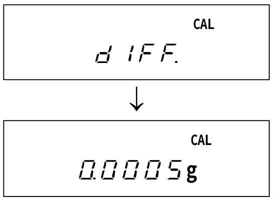
(3) Check of capacity point

When [on F.5] is displayed, load the span test weight[*1] on the measurement pan. The display changes to flash, and the balance automatically checks the capacity point.



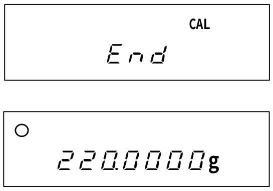
(4) Display of span test result

When the capacity point check is completed, the balance displays [dIFF.] and indicates the result (error) of the span test in a weight value.



(5) End of span test

After displaying the span test result, the balance now shows [End] and returns to measurement mode. Once you are back in measurement mode, unload the weight.



*1 Use a span test weight of Class E_2 (or equivalent) or better under OIML Standard.

Cautions:

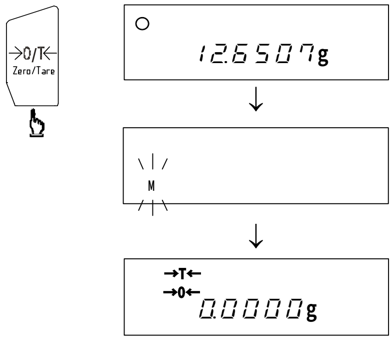
1. While the span test is in progress, do not touch the measurement pan and protect the balance from shock or vibration. If the balance is moved, the processing may be hated at the stage of the flashing [on 0] or [on F.5].
2. To cancel the adjustment, press the Print key. The balance returns to measurement mode after briefly displaying [StOP].
3. Avoid conducting the span test immediately after the balance has been powered up. Always wait for at least 30 minutes before conducting the test.

8. Basic Operations of Balance

8.1 Operation for Tare Range

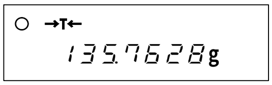
(1) Load a container on the measurement pan and press the Zero/Tare key.
Only the [M] mark at the lower left lights up and flashes, and the tare is subtracted, the balance indicating zero. The [→T←] (mark indicating that the tare is being subtracted) lights up.

(1)



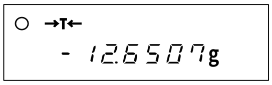
(2) Put the sample in the tare. Only the weight of the sample will be shown.

(2)



(3) When the sample is unloaded along with the tare from the measurement pan, the weight of the tare is displayed as a negative (-) value.

(3)



Cautions:

1. Load and unload samples only after the safety mark [○] in the left corner of the display lights up. If the loading or unloading is made before the safety mark comes on, the balance may not be able to perform accurate measurement.
2. When the tare is subtracted, the measurable range is reduced. (Measurement Range = Capacity - Tare Weight) Conduct measuring operations while checking the Measurement Range on the bar graph.
3. When the balance indicates an exact zero-point, the zero-point mark [→0←] lights up.

8.2 Example of Application

The method for measuring the difference between products made with a given constant weight will be explained below. If the Auto-Zero function is working properly, errors may be result during the measurement of difference. Deactivate the Auto-Zero function in advance. (See “9. Functions of Function 1” on page 30.)

(1) Load the reference sample and execute the tare range operation.

(2) Unload the sample, and replace it with the product to be checked. The difference from the sample is displayed.

Caution:

Load and unload samples only after the safety mark [○] in the left corner of the display lights up. If the loading or unloading is made before the safety mark comes on, the balance may not be able to perform accurate measurement.

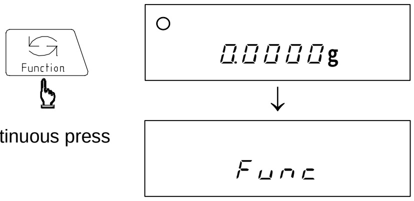
8.3 Minimum Indication Switching Function

This function changes the minimum indications. Make settings under Function 1 (see page 30); the weighing speed will increase as a rougher minimum indication is chosen. The minimum indications vary from one unit of measurement to another.

1. Minimum indication switching method

(1) Press and hold the Function key and release the key when [Func] appears. The display changes to [1. SEt. 1].

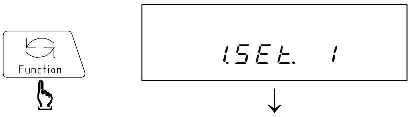
(1)



Continuous press

(2) Press the Function key twice to cause [3. d. i. 1*1] to be displayed.

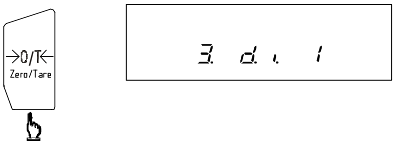
(2)



Pressed twice

(3) Change the rightmost digit with the Zero/Tare key to switch the minimum indication. The digit can be changed by following steps [1] to [5]. [1] gives the finest indication, and roughness increases as a larger digit is chosen.

(3)



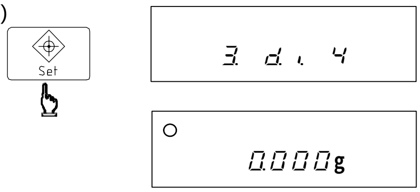
Example: When the unit of measurement displayed is [g], the following minimum indications are produced:

3. d. i.	Min. Indication
1	0.0001g
2	0.0002g
3	0.0005g
4	0.001g
5	0.002g

For minimum indications corresponding to the other units, refer to the next page.

(4) When setup is complete, press the Set key to return to measurement mode.

(4)



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*1 [3. d. i. 1] is a factory-setting.

2. Table of Minimum Indications by Unit of Measurement

3. d. i.	Milligram [mg]	Gram [g]	Carat [ct]	Momme [mom]	Ounce [oz]	Pound [lbA]	Troy Ounce [ozt]
1	0.1	0.0001	0.001	0.00005	0.000005	0.000001	0.000005
2	0.2	0.0002	0.002	0.0001	0.00001	0.000002	0.00001
3	0.5	0.0005	0.005	0.0002	0.00002	0.000005	0.00002
4	1	0.001	0.01	0.0005	0.00005	0.00001	0.00005
5	2	0.002	0.02	0.001	0.0001	0.00002	0.0001

3. d. i.	Penny-weight [dwt]	Grain [GN]	Tael (Hong Kong) [tl ▸]	Tael (Singapore, Malaysia) [tl ▸]	Tael (Taiwan) [tl ▸]	Tola [tl ▸▸]
1	0.0001	0.002	0.000005	0.000005	0.000005	0.00001
2	0.0002	0.005	0.00001	0.00001	0.00001	0.00002
3	0.0005	0.01	0.00002	0.00002	0.00002	0.00005
4	0.001	0.02	0.00005	0.00005	0.00005	0.0001
5	0.002	0.05	0.0001	0.0001	0.0001	0.0002

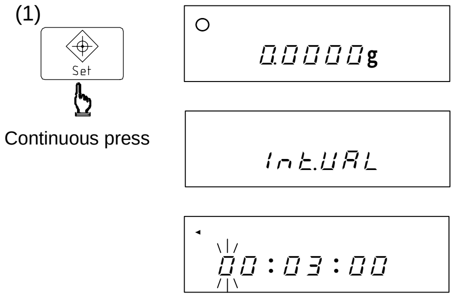
* Characters in parentheses denote a unit symbol.

8.4 Interval Function

This function outputs data at a constant interval. It can also output the time of day simultaneously. (See “8.5 Time Output Function” on the following page.) The interval time is expressed in [Hour: Minute: Second].

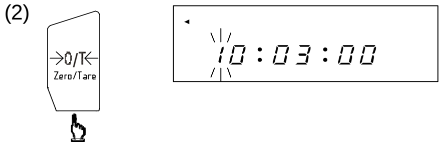
1. Setup of interval time

(1) Press and hold down the Set key and release the key when [Int.UAL] appears.
The interval time is displayed, and the leftmost digit flashes. The flashing digit is the one that can be altered.



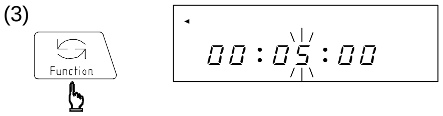
(1)
Set
Continuous press
0.0000g
Int.UAL
00:03:00

(2) Set a digit in the flashing position by pressing the Zero/Tare key.



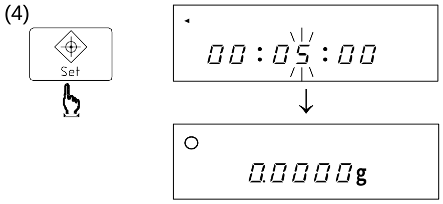
(2)
→0/T←
Zero/Tare
10:03:00

(3) Press the Function key. Each press to the key moves the cursor one space to the right. If the lowest digit is flashing, the cursor flashing will return to the leftmost position once the key is pressed.



(3)
Function
00:05:00

(4) Press the Set key. The balance saves[*1] the set value and returns you to measurement mode.



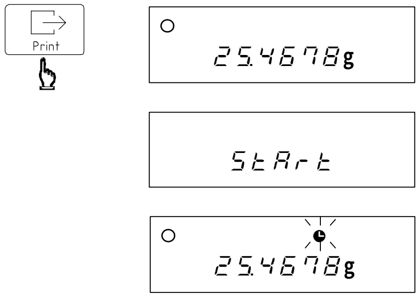
(4)
Set
00:05:00
0.0000g

*1 Pressing the Print key restores the original interval time indication.

2. Start of interval output

(1) Conduct the interval output after setting Interval to [7 l.o.c. A] or [7 l.o.c. b] (see page 31).

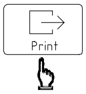
(2) Press the Print key once.
The balance displays [StArt] and initiates the interval output. While the interval output is in progress, the [◔] mark flashes. Also, the [◎] mark lights up when data is output.

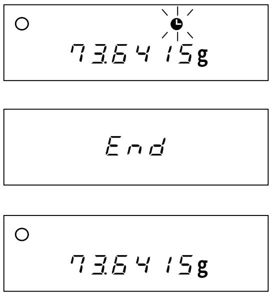


Print
25.4678g
StArt
25.4678g

3. End of interval output

Press the Print key once. The balance displays [End] and returns you to measurement mode.





Cautions:

Set the interval time in a range from [00:00:03] to [23:59:59].

While an interval output continues, do not make changes to the time setting. If you specify a function setting, the output will be interrupted during, disabling the balance from executing the output at the specified interval.

8.5 Time Output Function

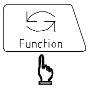
This function outputs the current time simultaneously with the output of measurement data. Execute this function after specifying the time setting. (See “6.1 Time Setting” on page 13.)

(1) Press and hold the Function key and release the key when [Func] appears.

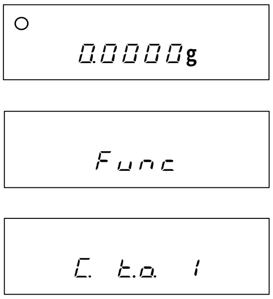
(2) Press and hold down the Function key until [C. t.o.] is displayed.

(3) Set the rightmost digit to [1] by pressing the Zero/Tare.

(4) Press the Set key to return to measurement mode.



Continuous press



8.6 Counting Mode

Use this function after setting measurement mode to Counting Mode [1. SEt. 2]. (See “9. Functions of Function 1” on page 30.)

1. Sampling operation (Storage of unit weight values)

(1) Press the Zero/Tare key to reset the indication to zero.
Follow the same procedure when a container is used.

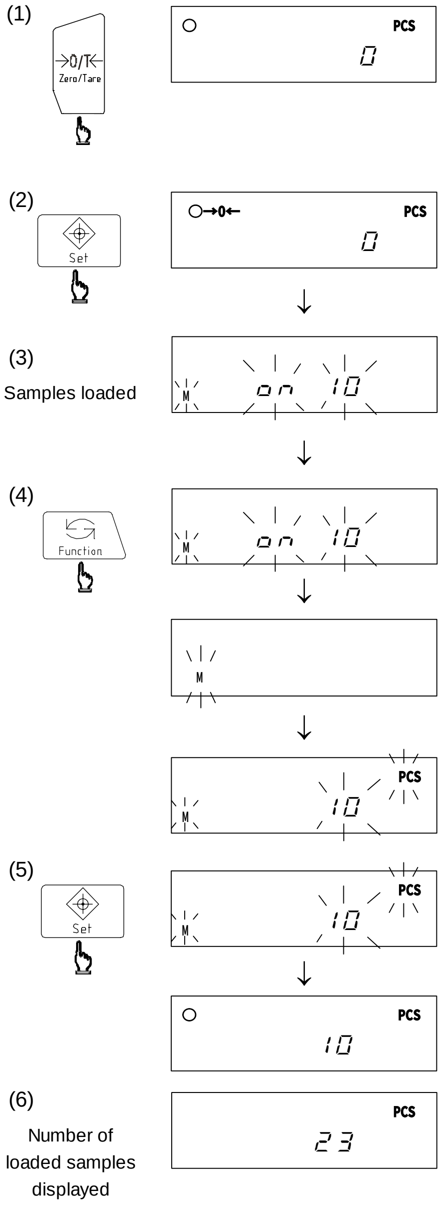
(2) Press the Set key. The display changes to flash [on 10], which means that ten samples are going to be loaded. Pressing the Zero/Tare key in this condition allows you to change the number of samples, as follows: 10 → 30 → 50 → 100 → 10.[*1]

(3) Count the samples precisely, according to the displayed number and load them on the container.

(4) Press the Function key. Only the [M] mark flashes for several seconds, and the saved number of samples flashes.[*2]

(5) Press the Set key. The unit weight values are saved and you are returned to measurement mode.

(6) If additional samples are loaded, the total number of samples loaded will be displayed.



*1 The greater the number of samples, the more averaged weight is saved, contributing to the reduction of counting errors.

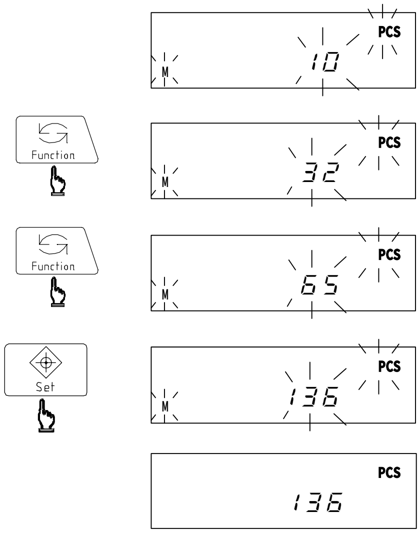
*2 If [Add] appears in the operations of (3) and (4) and, thereafter, the [◀] mark lights up at the lower left of the display, it indicates a potential for counting errors due to lightweight samples. If that is the case, executing the “Memory Update Method” described in the following subsection will help improve the counting accuracy.

Caution:

If the unit weights of samples are too light to conduct the counting operation, the balance will display [L - Err].

2. Memory Update Method (Improvement of Counting Accuracy)

If the unit weights of samples are so light that [Add] is displayed, or a large number of articles are going to be counted (more than five times the sampled number), executing the “Memory Update Method” will help improve the counting accuracy.



(1) Perform the sampling operation. (See Steps (1) through (4) in the preceding subsection.)

(2) Add a few times the current number of samples. (No need to count.)
Press the Function key. The unit weight is saved (updated), the number of samples flashes again, and the Memory Update Method continues.

(3) Add more samples and repeat step (2). Save about one half to one-fifth the quantity to be measured.

(4) Press the Set key. The balance saves the unit weight values and restores measurement mode.

* Counting errors will decrease if you repeat the Memory Update Method as many times as necessary, until the [◀] mark at the lower left of the display disappears.
(Press the Set key to terminate sampling even during displaying of [◀] mark.)

Caution:

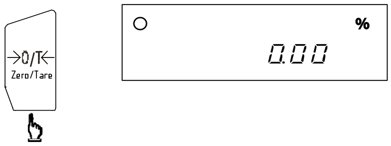
If the unit weights of samples are too light to conduct the counting operation, the balance will display [L - Err].

8.7 Percentage Mode

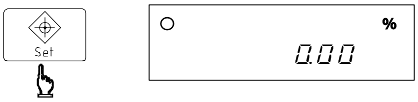
This function saves the weight of the reference sample as 100% and displays the measurement value in a percentage (%) value relative to the reference sample. The unit of measurement to be displayed is automatically selected according to the weight of the reference sample.

Execute the function after setting measurement mode to Percentage Mode [1. SEt. 3]. (See “9. Functions of Function 1” on page 30.)

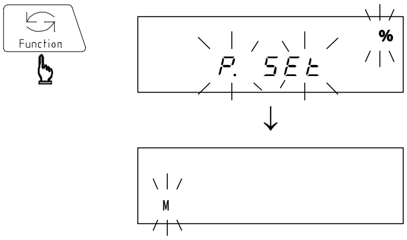
(1) Press the Zero/Tare key to reset the indication to zero.
Follow the same procedure when a container is used.



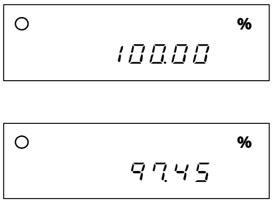
(2) Press the Set key. The display changes to flashing [P. SEt]. The balance is now ready for the reference value setup.



(3) Load the reference sample and press the Function key.
Only the [M] mark flashes, and the balance displays [100.00%] and activates the percentage measurement mode.



(4) Unload the sample and replace it with the object to be measured. The balance indicates the weight of the object under measurement in a percentage (%) value with respect to the reference sample.



* Unit Displayed in Percentage Mode (Automatically selected according to the weight of the reference sample.)

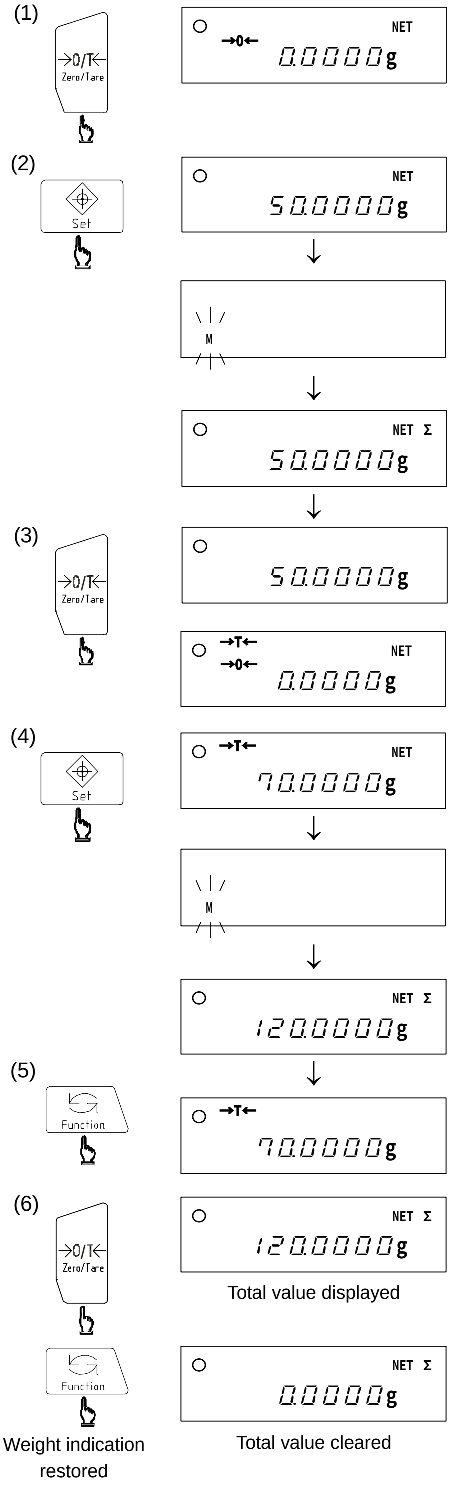
Displayed Unit	Reference Weight Value (Percentage with respect to the %-limit weight value)
L-Err	Below the %-limit weight
1%	Over the %-limit weight up to the %-limit weight × 10
0.1%	Over the %-limit weight × 10 up to the %-limit weight × 100
0.01%	Over the %-limit weight × 100

For %-limit weight value, refer to “2. Specifications” (Page 5).

8.8 Addition Mode

The Addition Mode adds up the weight results of measurements conducted in subdivided groups. It serves to check the total weight of fillings, compoundings, etc., or to check the total weight of consecutive weighing operations. Execute the function after setting measurement mode to Addition Mode [1. 5Et. 4] . (See “9. Functions of Function 1” on page 30.)

1. Addition of loadings


(1)
→0/T←
Zero/Tare
NET
→0←
0.0000g
(2)
Set
NET
50.0000g
M
NET Σ
50.0000g
50.0000g
(3)
→0/T←
Zero/Tare
→T←
→0←
NET
0.0000g
(4)
Set
→T←
NET
70.0000g
M
NET Σ
120.0000g
(5)
Function
→T←
70.0000g
(6)
→0/T←
Zero/Tare
NET Σ
120.0000g
Total value displayed
Function
NET Σ
0.0000g
Weight indication restored
Total value cleared

(1) Press the Zero/Tare key to reset the indication to zero.
Follow the same procedure when a container is used.
When [NET] lights up at the upper right, the balance is now ready for addition.

(2) After verifying the above lighting, load a sample on the measurement pan and press the Set key.
After [M] begins flashing, [NET Σ] at the upper right of the display comes on. At the same time, the balance displays the total value for about 4 seconds and then goes back to the current weight.

(3) Press the Zero/Tare key again to set a zero-point.

(4) Load a next sample and press the Set key. As in (2), the balance displays the total value for about 4 seconds and, then goes back to the current weight. Repeat the same operations of (3) and (4) to enable the addition function.

(5) Display of total value
Press the Function key. The balance displays the total value while [NET Σ] lights up at the upper right of the display. Pressing the Function key again displays the current weight.

(6) Clearing of total value
While the total value is displayed, press the Zero/Tare key.
The indication is reset to zero and the total value is cleared. Press the Function key to return to the weight indication.

Cautions:

1. The adding operation will not be effective unless the indication is reset to zero.
2. The [t - Err] indication appears when you press the Set key in the case where you have made a double adding operation, made a negative addition, or added a zero.

2. Addition when a total value exceeds the capacity

(1) Press the Zero/Tare key to reset the indication to zero. Follow the same procedure when a container is used. When [NET] lights up at the upper right, the balance is now ready for addition. When the light comes on, load a sample.

(2) Load a sample on the balance and press the Set key. After [M] begins flashing, [NET Σ] lights up at the upper right of the display. At the same time, the balance shows the total value for about 4 seconds and then goes back to the current weight.

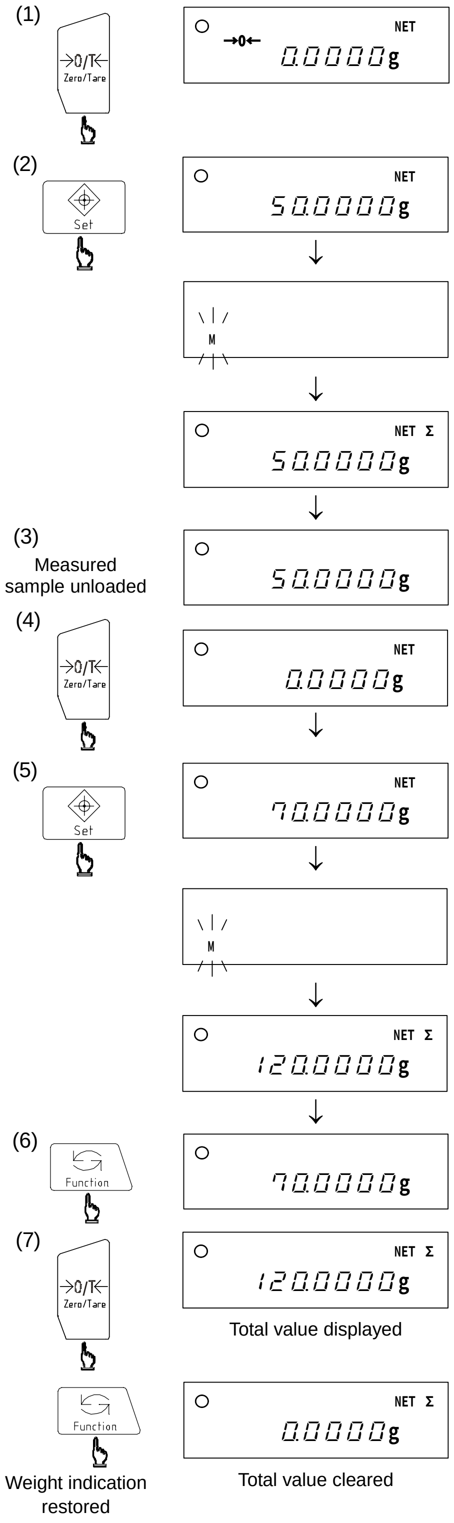
(3) Unload the measured sample.

(4) Press the Zero/Tare key to reset a zero-point.

(5) Load a next sample and press the Set key. As in (2), the balance displays the total value for about 4 seconds and, then goes back to the current weight. Repeat steps (3) through (5) to perform an addition function.

(6) Displaying the total value
Press the Function key. The balance displays the total value while [NET Σ] lights up at the upper right of the display. Pressing the Function key again displays the current weight.

(7) Clearing the total value
While the total value is displayed, press the Zero/Tare key. The indication is reset to zero and the total value is cleared. Press the Function key to return to the weight indication.


(1)
Zero/Tare
NET
0.0000g
(2)
Set
NET
50.0000g
M
NET Σ
50.0000g
(3)
Measured sample unloaded
50.0000g
(4)
Zero/Tare
NET
0.0000g
(5)
Set
NET
70.0000g
M
NET Σ
120.0000g
(6)
Function
70.0000g
(7)
Zero/Tare
NET Σ
120.0000g
Total value displayed
Function
Weight indication restored
NET Σ
0.0000g
Total value cleared

Cautions:

1. The adding operation will not be effective unless the indication is reset to zero.
2. The [t-Err] indication appears when you press the Set key in the case where you have made a double adding operation, made a negative addition, or added a zero.

8.9 Density Mode

Density measurement for solid and liquid is possible by using an optional density kit. For the procedure, read the operation manual of the density kit.

9. Functions of Function 1

9.1 Description of Function 1

Item	Set Value		Description
Measurement Mode	1.SEt.	1	Weight mode
		2	Counting mode
		3	Percentage mode
		4	Addition mode
		5	Density mode for solid
		6	Density mode for liquid
Unit Selection Mode	2. un.	0	mg
		1	g
		2	ct
		3	mom
		4	oz
		5	lb
		6	ozt
		7	dwt
		8	GN
		9	tl (Hong Kong)
		A	tl (Singapore, Malaysia)
		b	tl (Taiwan)
		C	tola
Min. Indication Switching	3. d.i.	1	
		2	Fine
		3	↓
		4	Rough
		5	
Auto-Zero	4. A.0	0	Disable
		1	Enable
Stability Judgement	5. S.d.	1	Wide (Mild)
		2	↓
		3	Narrow (Strict)
		4	
Responsibility	6. rE.	0	Measurement by consecutive weighings
		1	
		2	Fast
		3	↓
		4	Slow
		5	
Interface	7. IF.	0	Stop input/output
		1	Numerical 7-digit format
		2	Special format
Span Adjustment/ Span Test	8. CA.	0	Disable Cal key
		1[*2]	Span adjustment with built-in weight (Auto-span adjustment)
		2[*2]	Span test with built-in weight
		3[*1]	Span adjustment with external weight
		4	Span test with built-in weight
Advice CAL	9. AdC.	0	Disable function
		1	Enable
Compliance with ISO/GLP/GMP	A. GLP	0	Disable function
		1	Enable

Item	Set Value		Description
Date Display	b. dA.	1	Display and print in Year-Month-Day format
		2	Display and print in Month-Day-Year format
		3	Display and print in Day-Month-Year format
Time-Adding Function	C. t.o.	0	Disable function
		1	Output time with measurement data

The ▨ denotes a factory-setting.

*1 Factory settings on models without built-in weight.

*2 Not displayed on models without built-in weight.

9.2 Functions in Density Mode

The following items are displayed when [I.SEt. ⬚] is set to [5] or [6].

Item	Set Value		Description
Reference liquid	11.nEd.	0	Water
		1	Other liquid
Output data	12.d.o.d.	0	Density only
		1	Density, weight, water temperature (or density of the reference) density, volume
Automatic output	13.Ao.	0	Disable (output by pressing Print key)
		1	Enable (once after a density measurement)

The ▨ denotes a factory-setting.

9.3 Interfaces

The following items are displayed when [7. IF. ⬚] is set to [1] or [2].

Item	Set Value		Description
Special Format[*1]	7. IF.	21	Special format 1
		22	Special format 2
		23	Special format 3
		24	Special format 4
		25	Special format 5
Output Control	71. o.c.	0	Stop output
		1	Output continuous at all times[*2]
		2	Output continuously if stable(Stop output if unstable)
		3	Output once when Print key is pressed
		4	Output once if stable (Automatic output)[*3]
		5	Output once if stable (Stop output when unstable)
		6	Output once if stable (Output continuously when unstable)
		7	Output once if stable, after Print key is pressed
		A	Output once when the preset time of the interval function has elapsed
		b	Output once if stable, every time the preset time of the interval function has elapsed
Baud Rate	72. bL.	1	1200 bps
		2	2400 bps
		3	4800 bps
		4	9600 bps
Parity	73. PA.	0	None
		1	Odd
		2	Even
Data Length[*1]	74. dL.	0	7 bits
		1	8 bits
Stop Bit[*1]	75. St.	1	1 bit
		2	2 bits

The ▨ denotes a factory-setting.

*1 Special Format, Data Length, and Stop Bit are displayed only when [7. IF. 2] is selected. If [7. IF. 1] is chosen, the data length will be set to 8 bits and the stop bit to 2 bits.

*2 The data interval in continuous output is 0.1 to 1 second. (The interval varies depending on the state of weighing and other factors.)

*3 Outputs once when the balance is stable, after zero (0) or a negative (-) value has been indicated.

9.4 Description of Compliance with ISO/GLP/GMP

When [A. GLP 1] is selected, the following [A 1.out.] - [A3. P.F.] are displayed before [b. dA.].

Item	Set Value		Description
Output of Calibration Result	A 1.out.	0	Stop output
		1	Output result
Data Compliant with ISO/GLP/GMP	A2. o.d.	0	Disable function
		1	Comply
Print Character	A3. P.F.	1	English
		2	Japanese (Katakana)

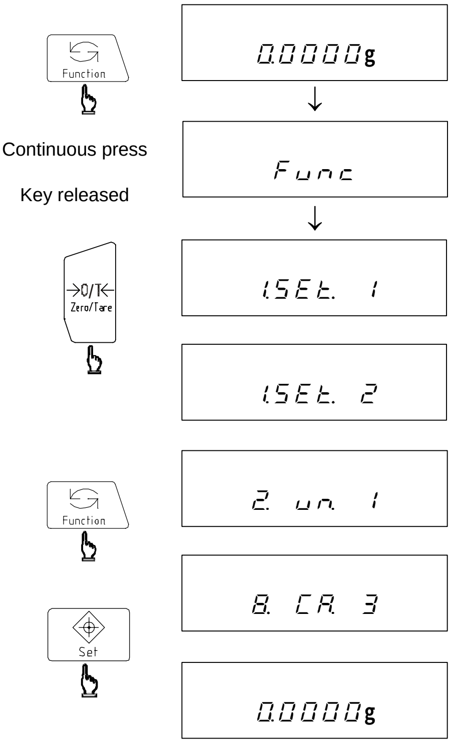
The ▨ denotes a factory-setting.

9.5 Setup and Check of Function 1

(1) Invoking Function 1
Press and hold the Function key for several seconds. When [Func] appears, release the key. The display changes to the indication of the first item [1.SEt. 1].

(2) Selecting function items and changing settings
Pressing the Function key switches the indication to the following function item [2. un. 1]. To change the setting, press the Zero/Tare key and alter the digit (rightmost digit). Each press of the Function key displays a different function item. Select the item you want to check or change and press the Zero/Tare key to change the setting.

(3) Returning to measurement mode
Press the Set key. The settings are updated and you are returned to measurement mode.



10. Functions of Function 2

10.1 Description of Function 2

Item	Set Value		Description
Setup of ID No.	1 Id	0	Disable function
		1	Enable
Setup of Instrumental Error of Weight in Use	2 o.M.P.	0	Disable function
		1	Enable
Calibration of Built-in Weight*	3 r.C.A.	0	Disable function
		1	Enable
Use of Weight Error	4 M.E.H.	0	Do not use.
		1	Use the weight error specified in the span adjustment/span test with an external weight.

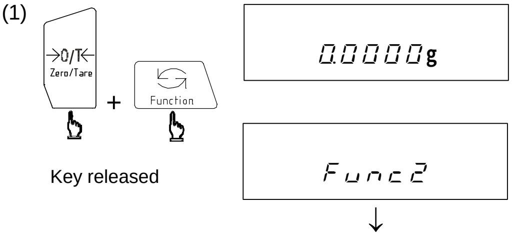
The ▨ denotes a factory-setting.

* Not displayed on models without built-in weight.

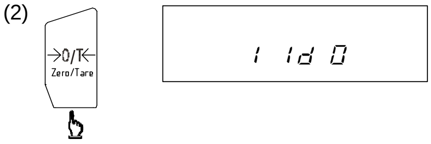
10.2 Setup of ID No.

The ID No. is used to conduct printing in compliance with ISO/GLP/GMP. When printing is required, specify the necessary settings and check the current settings. When the ID No. is displayed, [◀] lights up at the top left of the display, and a maximum of 6 digits can be set. [_] denotes a blank space. The characters that can be used for this setting are: [_] (Blank space), [0～9,A～F], and [-].

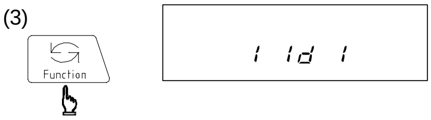
(1) Keep pressing the Function key while holding down the Zero/Tare key. When [F u n c 2] appears, release the key. The display changes to [1 Id 0].



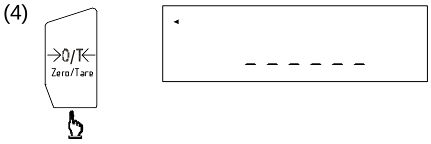
(2) Set the rightmost digit to [1] by pressing the Zero/Tare key.



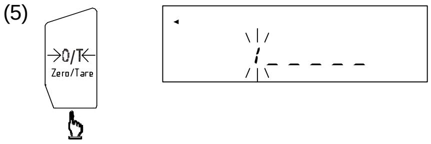
(3) Press the Function key. The display changes from [1 Id 1] to the ID No. indication*1.



(4) Press the Zero/Tare key to begin setting or changing the ID No. The leftmost digit flashes first. The flashing cursor denotes the digit that can be altered.

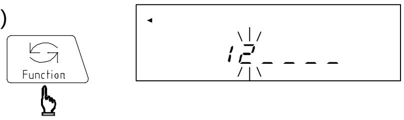


(5) Change the digit indicated by the flashing cursor. Press the Zero/Tare key to alter the digit indicated by the flashing cursor. Each press increases the number by one.



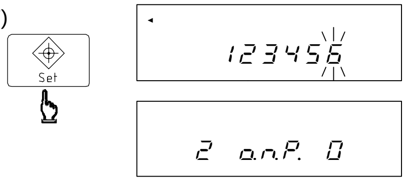
(6) Move the flashing cursor.
Press the Function key. Each press moves the flashing cursor (digit that can be altered) to the right. If the cursor is at the rightmost position, pressing the key returns the cursor to the left end.

(6)



(7) Save the set value[*2].
Press the Set key. The changes are saved and the balance enters error input mode for the weight in use [2. o.n.P. 0] in the following item.

(7)



*1 If you only checked the settings and made no changes, press the Print key and the following item [2. o.n.P. 0] appears.

*2 Pressing the Print key returns you to the previous ID No. indication.

10.3 Setup of Error of Weight in Use

By entering a weight error, you will be able to calibrate the balance more accurately. Enter the weight error given by the following equation: (Error in units of mg)

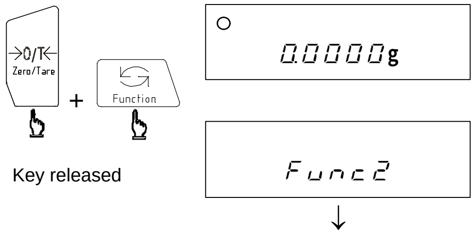
Weight Error = Actual Weight - Nominal Value

Example: Weight error = 220.00012 - 220

= 0.00012g = +0.12mg

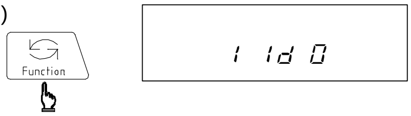
(1) Keep pressing the Function key while holding down the Zero/Tare key. When [Func2] appears, release the key. The display changes to [1 1d 0].

(1)



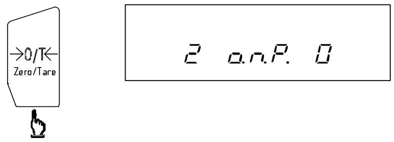
(2) Press the Function key to display [2. o.n.P. 0].

(2)

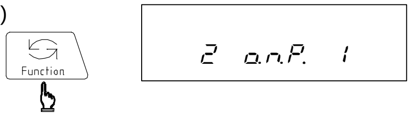


(3) Set the rightmost digit to [1] by pressing the Zero/Tare key.

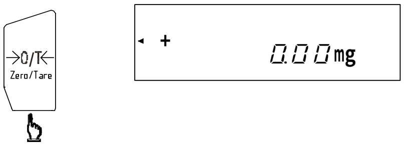
(3)



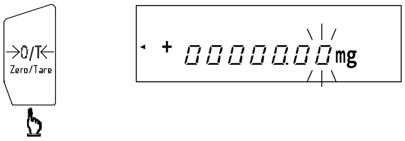
(4) Press the Function key to display the current weight error*1.

(4)


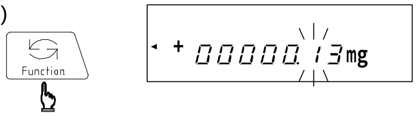
(5) Press the Zero/Tare key. The rightmost digit flashes first. The flashing cursor denotes the digit that can be altered.

(5)


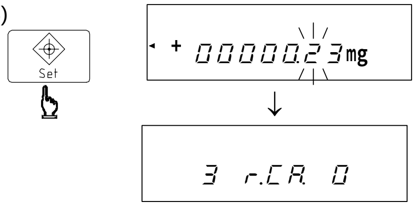
(6) Set a digit in the flashing cursor by pressing the Zero/Tare key.

(6)


(7) Press the Function key. Each press of the key moves the flashing cursor to the left. If the cursor is at the leftmost position, pressing the key will return the cursor to the right end.

(7)


(8) Press the Set key. The digit is saved and the balance transits to the following item [3. r.CA. 0]*2.

(8)


*1 If you only checked the setting and made no changes, press the Print key, and the following item [3. r.CA. 0] appears.

*2 Pressing the Print key returns you to the weight error indication that appeared prior to the setting.

Caution:

Set the weight error in a range of ±1.50 mg. If you attempt to set an error outside the said range, [r - Err] will be displayed, disabling the setting function.

10.4 Calibration of Built-In Weight

This function calibrates the weight incorporated in the balance with reference to another weight you have[*1]. When conducting the calibration, set the error of the weight you are going to use.

* This function is not available on models without the built-in weight.

(1) Keep pressing the Function key while holding down the Zero/Tare key. When [Func2] appears, release the key. The display changes to [1 Id 0].

(2) Press the Function key twice to display [3 r.CA. 0].

(3) Set the rightmost digit to [1] by pressing the Zero/Tare key.

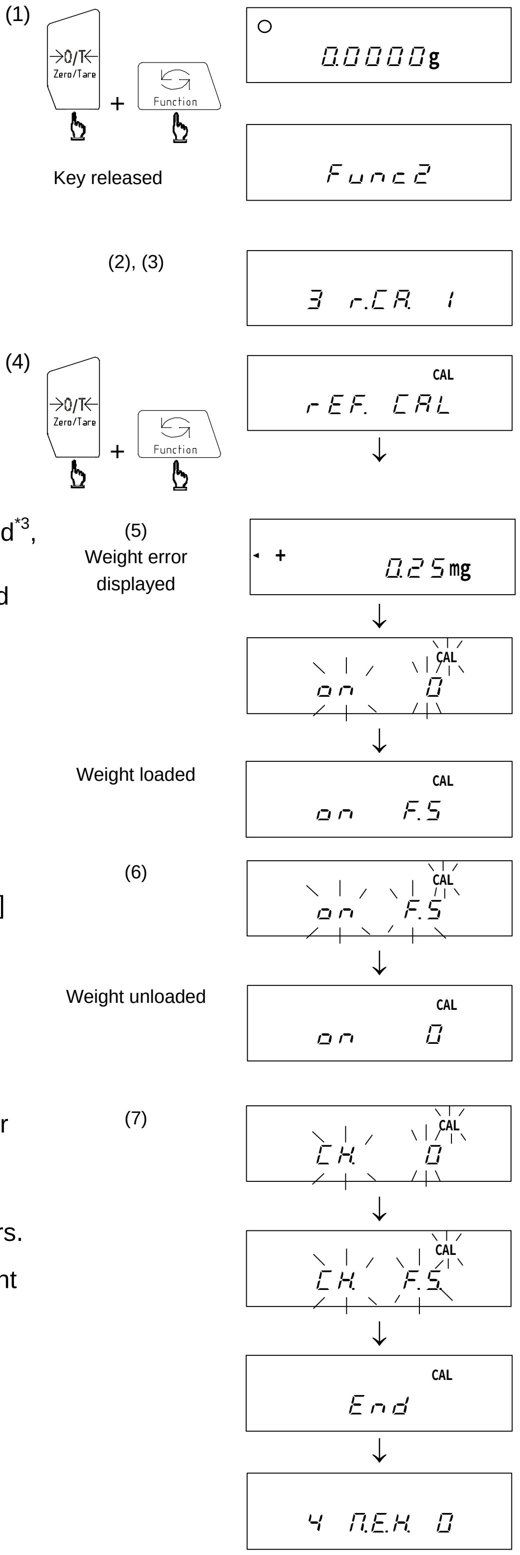
(3) Press the Function key to display [rEF. CAL][*2].

(4) Press the Function key while holding down the Zero/Tare key, then release the key.

(5) After the specified error of the weight is displayed[*3], [on 0] flashes, the display changes to [on F.S]. When [on F.S] appears, load the weight onto the measurement pan.

(6) [on F.S] flashes and the display changes to [on 0]. When [on 0] appears, unload the weight.

(7) The display changes from flashing [CH. 0] to [CH. F.S.], which also flashes for several seconds. Then the balance displays [End] and automatically transits to the following item [4 n.E.H. 0].


(1)
→0/T←
Zero/Tare
+
Function
0.0000 g
Key released
Func2
(2), (3)
3 r.CA. 1
(4)
→0/T←
Zero/Tare
+
Function
CAL
rEF. CAL
(5)
Weight error displayed
+ 0.25 mg
CAL
on 0
Weight loaded
CAL
on F.S
(6)
CAL
on F.S
Weight unloaded
CAL
on 0
(7)
CAL
CH. 0
CAL
CH. F.S
CAL
End
4 n.E.H. 0

[*1] For the calibration of the built-in weight, use a weight of Class E_2 (or equivalent) or better under OIML Standard.

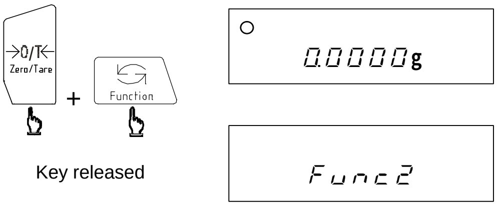
[*2] To cancel the calibration, press the Print key. The following item [4 n.E.H. 0] now appears.

[*3] For details, refer to “10.3 Setup of Error of Weight in Use” (page 34).

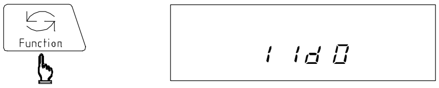
10.5 Use of Weight Error

When a span adjustment or span test is conducted with an external weight, its weight error is specified so it may be taken into consideration in the adjustment or test. (See “10.3 Setup of Error of Weight in Use” on page 34.)

(1) Keep pressing the Function key while holding down the Zero/Tare key. When [Func2] appears, release the key. The display changes to [1 1d 0].

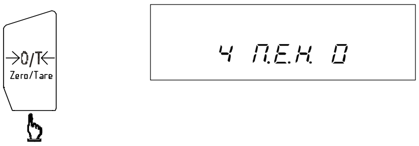

→0/T←
Zero/Tare
+
Function
0.0000g
Key released
Func2

(2) Press the Function key several times to display [4 n.E.H. 0].

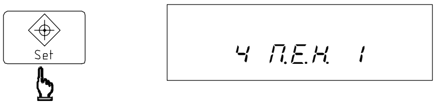

Function
1 1d 0

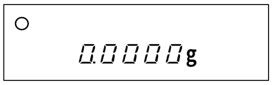
Key pressed several times

(3) Press the Zero/Tare key to set the rightmost digit to [1].


→0/T←
Zero/Tare
4 n.E.H. 0

(4) Press the Set key to return to measurement mode.





Caution:

If you chose the option “Do not Use Weight Error ([0]),” the weight error is automatically interpreted as 0.00 mg.

11. Using the Printer

11.1 Setting up the Printer

(1) Set “Interface” to [7. IF. 1] using “9. Functions of Function 1” (page 30) as a reference.

(2) Set the print function (print control) to Balance Control by referring to the instruction manual of the printer. The printer was set to Manual Print (Printer Control) at the factory prior to its shipment.

(3) Check the settings of the balance and those of the printer, including the baud rate.

11.2 Printing in Compliance with ISO/GLP/GMP

(1) For the printer, use the CSP-160.

(2) Check the time and date of the balance. (See “6. Date and Time Setup” on page 13.)

* The year will be printed in 4 digits.

* Do not press any keys on the printer during printing.

11.3 Recording Calibration Results

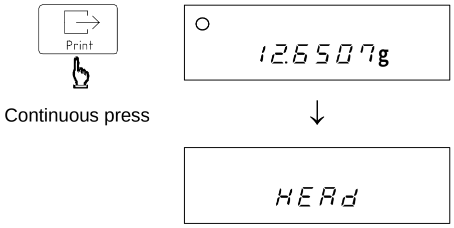
(1) Set the Print Control of the printer to the balance side.

(2) Refer to “9. Functions of Function 1” (page 30) and verify that the item “Compliance with ISO/GLP/GMP” is set to Enable([A. GLP 1]) and the item “Output of Calibration Result” to Output Result([A 1.out. 1]).

(3) Conduct the ordinary span adjustment or span test. (See “7. Calibration of Balance” on page 15.) The result is output (printed).

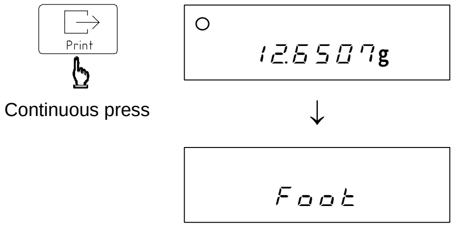
11.4 Outputting Measurement Data in Compliance with ISO/GLP/GMP

When the statistical operation function of the printer is to be utilized, match the print characters (English or Japanese) between the balance and the printer.



(1) Set the Print Control of the printer to the balance side.

(2) Refer to “9. Functions of Function 1” (page 30) and verify that the item “Compliance with ISO/GLP/GMP” is set to Enable ([A. GLP 1]), and the item “Measurement Data Compliant with ISO/GLP/GMP” is set to Comply ([A2. o.d. 1]).



(3) Output of header
Hold down the Print key. When [HEAd] appears, release the key. The header is printed.

After printing the header, the printer outputs the measurement data.

(4) Output of footer
Hold down the Print key. When [Foot] appears, release the key. The footer is printed.

Caution:

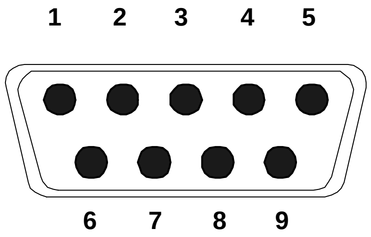
The footer is output after the header is printed. However, if any changes are made in the item “Compliance with ISO/GLP/GMP” or the item “Measurement Data Compliant with ISO/GLP/GMP,” or if the balance is powered off, the print will resume from the header.

12. Input/Output Functions

12.1 RS232C Output

1. Pin Nos. and Functions

Pin No.	Signal Name	Input/Output	Function & Remarks
1	—	—	—
2	RXD	Input	Receiving data
3	TXD	Output	Transmitting data
4	DTR	Output	HIGH (When balance is powered up)
5	GND	—	Signal ground
6	—	—	—
7	—	—	—
8	—	—	—
9	—	—	—



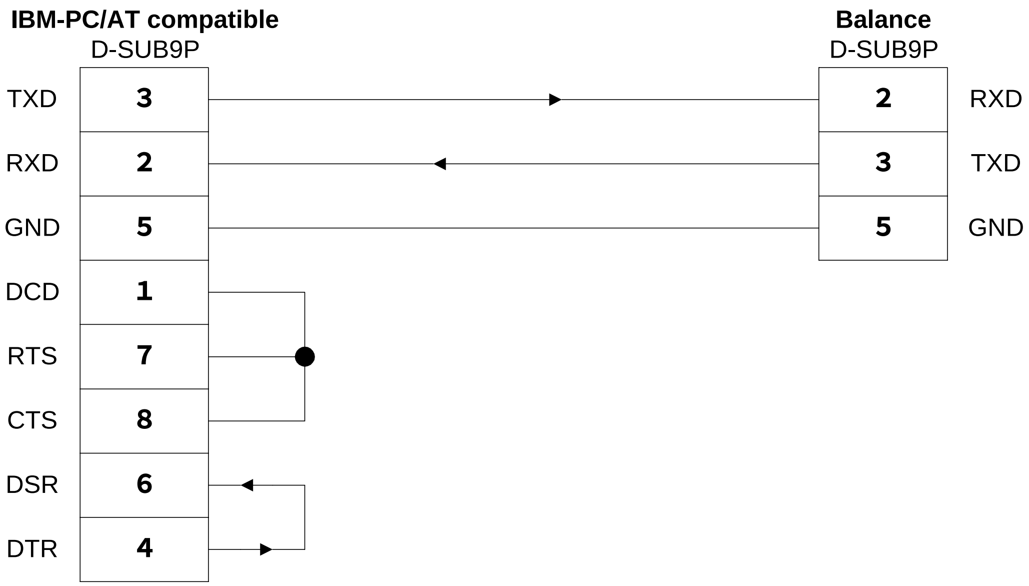
D-SUB 9-Pin Male Connector: Rear Panel

Caution:

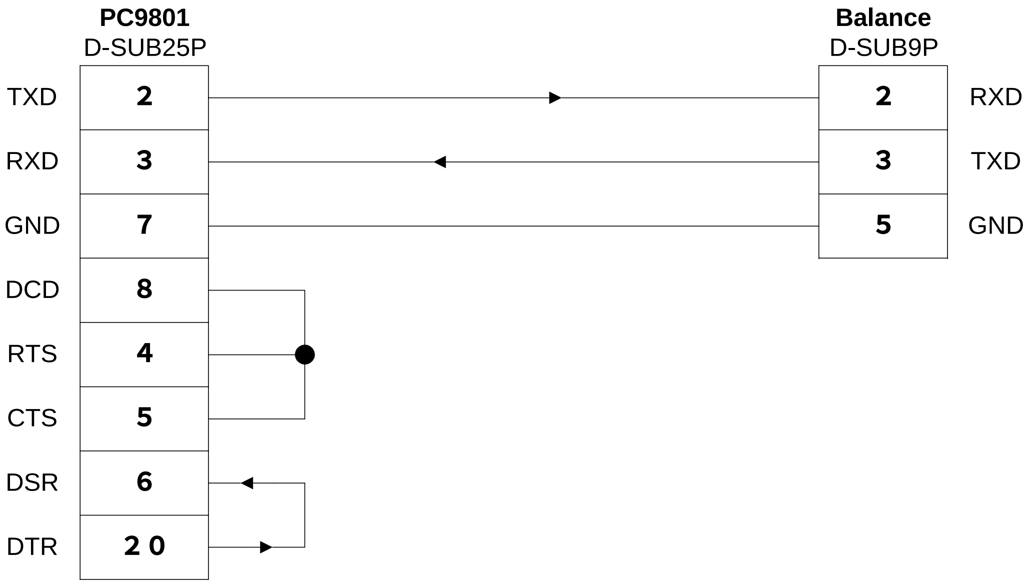
Be sure to disconnect the AC adapter from the power outlet before plugging or unplugging the connector.

2. Connection between the balance and the PC

■■■ Sample connection with an IBM-PC/AT compatible ■■■

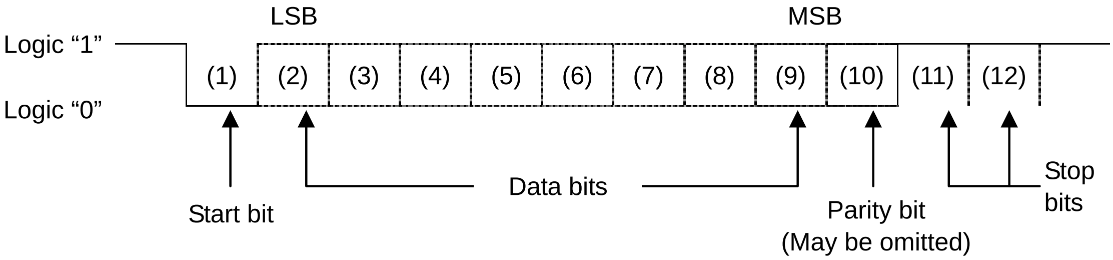

IBM-PC/AT compatible
D-SUB9P
TXD 3
RXD 2
GND 5
DCD 1
RTS 7
CTS 8
DSR 6
DTR 4
Balance
D-SUB9P
2 RXD
3 TXD
5 GND

■■■ Sample connection with PC9801 ■■■


PC9801
D-SUB25P
TXD 2
RXD 3
GND 7
DCD 8
RTS 4
CTS 5
DSR 6
DTR 2 0
Balance
D-SUB9P
2 RXD
3 TXD
5 GND

3. Interface Specifications

(1)	Transmission system	Serial transmission. Start-stop synchronization.	
(2)	Transmission rate	**1200/2400/4800/9600 bps**	
(3)	Transmission codes	ASCII codes (8-bit)	
(4)	Signal level	Compliant with EIA RS-232C.	
		HIGH Level (Data logic 0)	+5 – +15V
		LOW Level (Data logic 1)	-5 – -15V
(5)	One-character bit configuration		
		Start bit	1 bit
		Data bit	8 bits
		Parity bit	0/1 bit
		Stop bit	2 bits
(6)	Parity bit	None/Odd/Even	


LSB
MSB
Logic “1”
Logic “0”
(1)
(2)
(3)
(4)
(5)
(6)
(7)
(8)
(9)
(10)
(11)
(12)
Start bit
Data bits
Parity bit
(May be omitted)
Stop
bits

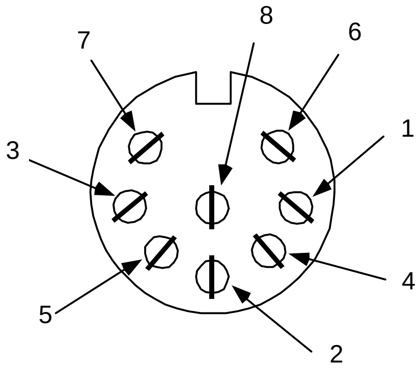
12.2 Output to Peripherals

Standard peripheral units can be connected to the balance[*1].

Our compatible peripheral units: CSP-160

1. Pin Nos. and Functions

Pin No.	Signal Name	Input/Output	Function & Remarks
1	EXT.TARE	Input	External tare[*2] range
2	—	—	[*3]
3	—	—	[*3]
4	TXD	Output	Transmitting data
5	GND	—	Signal ground
6	—	—	[*3]
7	—	—	[*3]
8	—	—	[*3]



DIN8P Connector for Output to Peripherals

[*1] For connection with the balance, use the connection cable supplied with each peripheral unit.

[*2] When the external tare range input and the signal ground are connected through contacts or a transistor switch, tare range operation (zero-setting) can be performed. Confirm that the connection (ON) time is at least 400 msec. (Voltage at max. 15 V when OFF, and synch current at 20 mA when ON).

[*3] Cannot be used due to internal connections

Caution:

Be sure to disconnect the AC adapter from the power outlet before plugging or unplugging the connector.

12.3 Type of Communication Texts

This interface function uses the following three types of communication texts:

(1) Output data

Data, such as weight values, that is output from the balance to an external unit

(2) Input commands

Commands to control the balance from an external unit

(3) Response

Response that is output from the balance to an input command

Cautions:

1. Communication texts (1) through (3) can be used through the RS232C output.
2. Only output data (1) can be used through the peripheral unit output.

12.4 Output Data

When the functions of the balance main unit are switched over, the following formats may be selected. (See “9. Functions of Function 1” on page 30.)

1 Numeric 7-digit format

The format is composed of 15 characters, including the terminators (CR=0DH, LF=0AH), and a parity bit can also be added.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P1	D1	D2	D3	D4	D5	D6	D7	D8	U1	U2	S1	S2	CR	LF

2. Polarity (P1: 1 character)

P1	Code	Description
+	2BH	When data is 0 or positive.
-	2DH	When data is negative.
(SP)	20H	When data is 0 or positive.

3. Numeric data (D1 - D8: 8 Characters)

P1	Code	Description
0 – 9	30H – 39H	Digits 0 – 9
●	2EH	Decimal point (floating position). * When the data is an integer, it may be omitted, and a blank space (SP) may be output instead in the lowest position.
(SP)	20H	Blank space: 0 of leading part of value (Leading zero suppress)

4. Units (U1, U2: 2 characters)

U1	U2	Code		Meaning	Display	U1	U2	Code		Meaning	Display
M	**G**	4DH	47H	Milligram	**mg**	G	R	47H	52H	Grain	GN
(SP)	**G**	20H	47H	Gram	**g**	T	L	54H	4CH	Tael (HongKong)	tl Top
C	**T**	43H	54H	Carat	ct	T	L	54H	4CH	Tael (Singapore) (Malaysia)	tl Center
M	**O**	4DH	4FH	Momme	mom	T	L	54H	4CH	Tael (Taiwan)	tl Bottom
O	**Z**	4FH	5AH	Ounce	oz	t	o	74H	6FH	Tola	tl Top, center
L	B	4CH	42H	Pound	lb	P	C	50H	43H	Pieces	PCS
O	**T**	4FH	54H	Troy Ounce	ozt	(SP)	%	20H	25H	Percentage	%
D	**W**	44H	57H	Pennyweight	dwt						

5. Data Types (S1: 1 character)

S1	Code	Description
T	54H	Total value
(SP)	20H	No data type specified

6. Statuses (S2: 1 character)

S2	Code	Description
S	53H	Data stable
U	55H	Data unstable (Varying)
E	45H	Data error (Data other than S2 is invalid.) (When “o-Err”, “u-Err”, etc. are displayed)
(SP)	20H	No status specified

12.5 Other Output Data

1. Interval output

A header and footer are output when the interval output is started and terminated.

(1) Header (One line, [−] is output in spaces equivalent to 15 characters.)

−	−	−	−	−	−	−	−	−	−	−	−	−	−	−

(2) Footer (Two blank lines are output.)

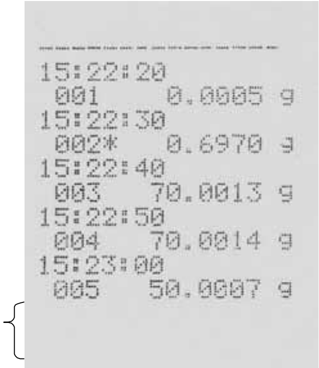
2. Time output

When the time output function (see page 24) is activated, time is output ahead of the measurement data.

h	h	:	m	m	:	s	s							

* hh: Hour, mm: Minute, ss: Second

Sample output obtained through the combination of the interval function and time output function:


Header →
Footer

```
-----------------
15:22:20
 001    0.0005 g
15:22:30
 002*   0.6970 g
15:22:40
 003   70.0013 g
15:22:50
 004   70.0014 g
15:23:00
 005   50.0007 g
```

* The sample output shown on the right was printed on the CSP-160. When printed on other printer, the output may vary.

12.6 Control with Commands

The balance can be controlled from the outside with external commands. The following six different control commands are available:

1 Tare range command (T∆) ∆: Space

2 Output control setup (O0–OB)

3 Date output request (DD)

4 Time output request (DT)

5 Interval time setup (IA)

6 Span adjustment/test command (C0–C4)

Annotation in parentheses denotes the command main body.

1. Command transmission method

(1) A command is transmitted to the balance from an external unit. Since the communication (transmission and reception) is implemented in full-duplex mode, the command can be transmitted regardless of the data transmission timing from the balance.

(2) When the balance has executed a received command, it sends back an “executed” response or the data requested with the transmitted command. If the command could not be executed, or the received command was ineffective (error), the balance sends back an error-end response.

When the balance is in normal display mode, it usually transmits a response within one second following the command transmission. If the balance receives a command while it is being operated (e.g., when a function is being set, span adjustment is in progress), the balance will send back a response after that operation has ended.

(3) When the balance receives a command from an external unit, do not transmit a next command until a response has been received from the balance.

2. Command format

The command is composed of a command main body, numeric parameter, and terminators (CR = 0DH, LF = 0AH). The command main body and the parameters are coupled to each other with “,” (Code:2CH).

Command Main Body <, Numeric Parameters> (CR) (LF)

The portion in parentheses “<>” may be omitted depending on the type of command.

(1) Command main body

The content of the command is represented by two characters (ASCII codes).

1	2
C1	C2

(2) Numeric parameter

When the interval time is specified, the Hour, Minute, and Second (2 characters each) are marked off with “,”.

1	2	3	4	5	6	7	8
h	h	,	m	m	,	s	s

* hh: Hour, mm: Minute, ss: Second.

3. Response output

(1) Response output format

The response is composed of 5 characters, including the terminators (CR = 0DH, lF = 0AH).

1	2	3	4	5
A1	A2	A3	CR	LF

(2) Types of response outputs

A1	A2	A3	Code			Description
A	0	0	41H	30H	30H	Executed
E	0	1	45H	30H	31H	Command error (Abnormal command received and other errors)
E	0	2	45H	30H	32H	Numeric format error

4. Tare range (zero-setting) command

Command Main Body				Description	Value	Response
C1	C2	Code				
T	Δ	54H	20H	Tare range (zero-setting) command	None	A00: Executed E01: Tare range operation cannot be performed due to an error contained in the weight value.

Δ: Space

5. Output control setup

Command Main Body				Description	Value	Response
C1	C2	Code				
O	0	4FH	30H	Disable output (Commands may be entered.)	None	A00: Executed
O	1	4FH	31H	Output continuously at all times		
O	2	4FH	32H	Output continuously if stable (Stop output if unstable)		
O	3	4FH	33H	Output once when Print key is pressed		
O	4	4FH	34H	Automatic output		
O	5	4FH	35H	Output once if stable (Stop output if unstable)		
O	6	4FH	36H	Output once if stable (Output continuously if unstable)		
O	7	4FH	37H	Output once if stable after the Print key is pressed.		
O	8	4FH	38H	Output once immediately		
O	9	4FH	39H	Output once after stabilizing		
O	A	4FH	41H	Interval function Output once every time the output time elapses		
O	B	4FH	42H	Interval function Output once if stable every time the output time elapses		

- * The controls enabled using the commands “00” through “07” and “0A” through “0B” work in the same manner as the output controls executed with the function settings on the balance.

  The commands “08, 09” are data request commands to the balance.

- * If any of the commands “00” through “07” and “0A” through “0B” have been executed, that state will be retained until the next command is entered. However, if the balance is powered down, the output control will return to the initial value (function set value).
- * When the command “0A” or “0B” is entered, the balance initiates the interval function, and when the same command is entered again, the balance terminates the function.

6. Various data output requests[*1]

Command Main Body				Description	Value	Response
C1	C2	Code				
D	D	44H	44H	Date output	None	If normal: Date data E01: Command error
D	T	44H	54H	Time output		If normal: Time data E01: Command error

* The printer control command is appended to the date and time output data.

(1) Date output data[*2]

DATE:	mm.dd.yyyy (CR) (LF)	English
ヒツ゛ケ:	mm.dd.yyyy (CR) (LF)	Japanese (Katakana)

(2) Time output data

TIME:	ΔΔΔΔhh:mm (CR) (LF)	English
シ゛コク:	ΔΔΔΔhh:mm (CR) (LF)	Japanese (Katakana)

Δ: Space

[*1] Either English or Japanese notation can be selected for the output data. Check the setting at “Print Character.”
(See “9.4 Description of Compliance with ISO/GLP/GMP” on page 32.)

[*2] The order of the Year, Month, and Day varies depending on the setting for the function.

7. Setup of various data

Command Main Body				Description	Value	Response
C1	C2	Code				
I	A	49H	41H	Interval time setup	Interval time	A00: Executed E01: Command error

* Mark off the interval time between the command, hour, minute, second with “,”; e.g., IA, hh, mm, ss.

8. Span adjustment and test command

Command Main Body				Description	Value	Response
C1	C2	Code				
C	0	43H	30H	Command input ineffective	None	A00: Executed E01: Command error
* C	1	43H	31H	Span adjustment with built-in weight (Auto-span adjustment)		
* C	2	43H	32H	Span test with built-in weight		
C	3	43H	33H	Span adjustment with external weight		
C	4	43H	34H	Span test with external weight		

* Do not use this command on models without the built-in weight.

9. Actual samples of commands

(1) TΔ (CR) (LF)	Execute tare range operation (Δ: Space).
(2) O1 (CR) (LF)	Set the balance to continuous output.
(3) O0 (CR) (LF)	Stop the balance output.
(4) O8 (CR) (LF)	Output data from the balance.
(5) IA, 12, 34, 56 (CR) (LF)	Set the interval time to 12 hrs.34 min. 56 sec.
(6) DD (CR) (LF)	Output the date.
(7) DT (CR) (LF)	Output the time.
(8) C1 (CR) (LF)	Execute span adjustment with the internal weight.

13. Output in Compliance with ISO/GLP/GMP

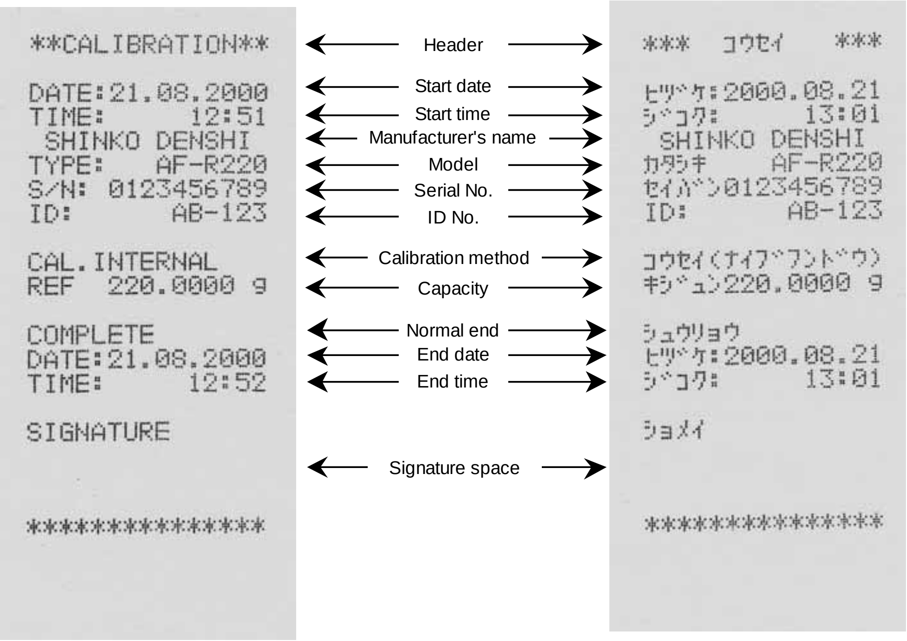
The results of a span adjustment/test conducted under ISO/GLP/GMP and measurement data can be printed to the CSP-160 connected to the balance. (Sample prints (1) through (6)) This data is output in ASCII codes.   Since the printer command may be output, process independently if other units are used.

The print characters (English output or Japanese output) can be switched over under Function 1. For details, refer to “9.4 Description of Compliance with ISO/GLP/GMP” (page 32).

(1) Span adjustment with built-in weight (Auto-span adjustment)*

Output in English

Output in Japanese (Katakana)



```
**CALIBRATION**

DATE:21.08.2000
TIME:      12:51
 SHINKO DENSHI
TYPE:    AF-R220
S/N: 0123456789
ID:       AB-123

CAL.INTERNAL
REF  220.0000 g

COMPLETE
DATE:21.08.2000
TIME:      12:52

SIGNATURE


***************
```

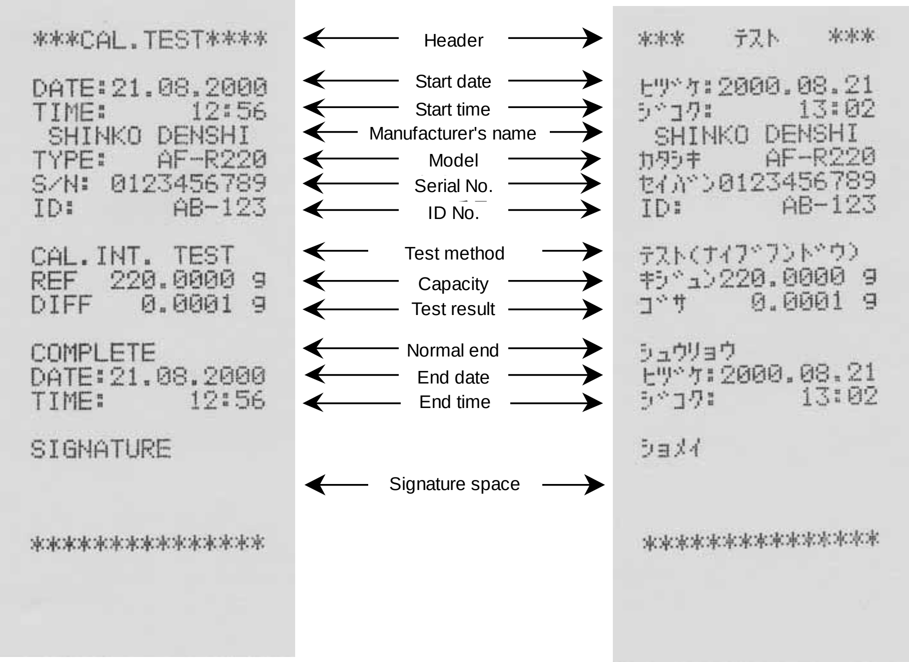
```
***  ｺｳｾｲ   ***

ﾋﾂﾞｹ:2000.08.21
ｼﾞｺｸ:      13:01
 SHINKO DENSHI
ｶﾀｼｷ    AF-R220
ｾｲﾊﾞﾝ0123456789
ID:       AB-123

ｺｳｾｲ(ﾅｲﾌﾞﾌﾝﾄﾞｳ)
ｷｼﾞｭﾝ220.0000 g

ｼｭｳﾘｮｳ
ﾋﾂﾞｹ:2000.08.21
ｼﾞｺｸ:      13:01

ｼｮﾒｲ


***************
```

Header
Start date
Start time
Manufacturer's name
Model
Serial No.
ID No.
Calibration method
Capacity
Normal end
End date
End time
Signature space

(2) Span test with built-in weight*

Output in English

Output in Japanese
(Katakana)



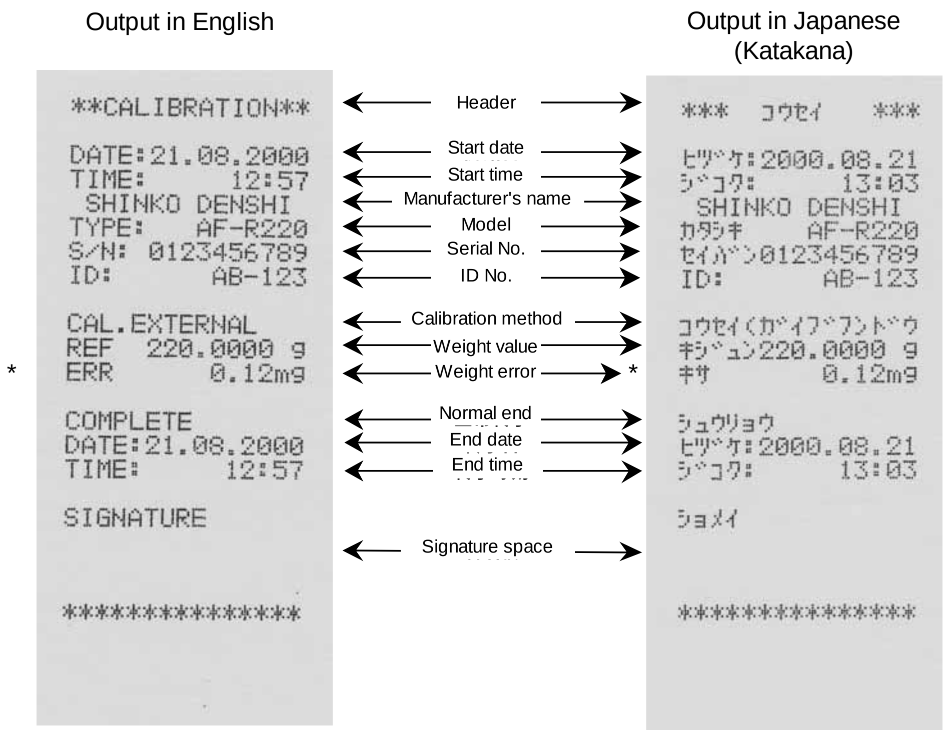
```
***CAL.TEST****

DATE:21.08.2000
TIME:      12:56
 SHINKO DENSHI
TYPE:    AF-R220
S/N: 0123456789
ID:       AB-123

CAL.INT. TEST
REF   220.0000 g
DIFF    0.0001 g

COMPLETE
DATE:21.08.2000
TIME:      12:56

SIGNATURE



***************
```

```
***    ﾃｽﾄ    ***

ﾋﾂﾞｹ:2000.08.21
ｼﾞｺｸ:       13:02
 SHINKO DENSHI
ｶﾀｼｷ     AF-R220
ｾｲﾊﾞﾝ0123456789
ID:       AB-123

ﾃｽﾄ(ﾅｲﾌﾞﾌﾝﾄﾞｳ)
ｷｼﾞｭﾝ220.0000 g
ｺﾞｻ      0.0001 g

ｼｭｳﾘｮｳ
ﾋﾂﾞｹ:2000.08.21
ｼﾞｺｸ:       13:02

ｼｮﾒｲ



***************
```

Header
Start date
Start time
Manufacturer's name
Model
Serial No.
ID No.
Test method
Capacity
Test result
Normal end
End date
End time
Signature space

*   This print operation is not available on models without the built-in weight.

(3) Span adjustment with external weight


Output in English
Output in Japanese (Katakana)
Header
Start date
Start time
Manufacturer's name
Model
Serial No.
ID No.
Calibration method
Weight value
Weight error
*
*
Normal end
End date
End time
Signature space

```
**CALIBRATION**

DATE:21.08.2000
TIME:     12:57
 SHINKO DENSHI
TYPE:   AF-R220
S/N: 0123456789
ID:      AB-123

CAL.EXTERNAL
REF  220.0000 g
ERR     0.12mg

COMPLETE
DATE:21.08.2000
TIME:     12:57

SIGNATURE



***************
```

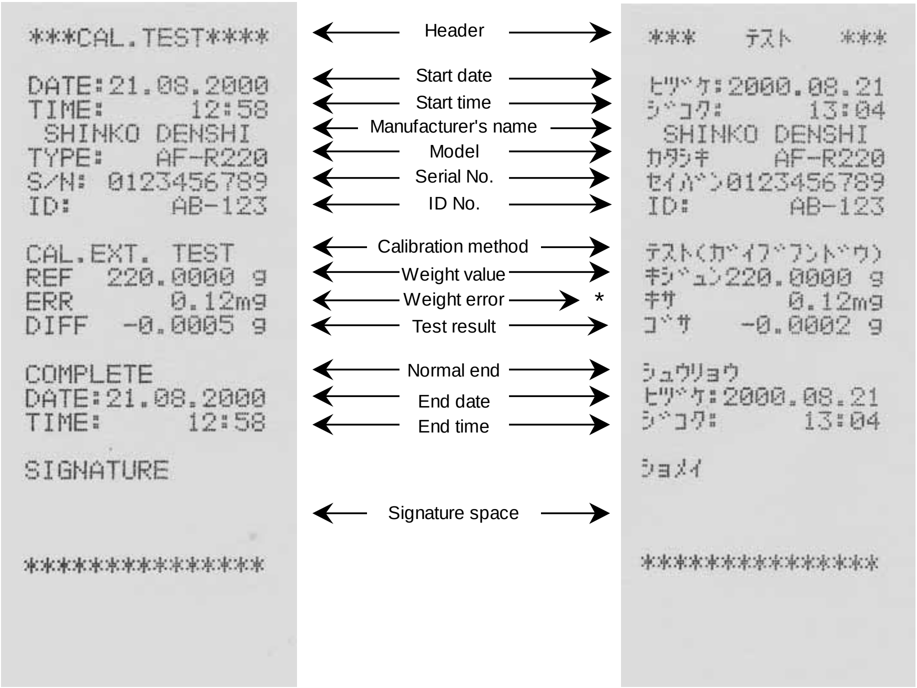
```
***  ｺｳｾｲ   ***

ﾋﾂﾞｹ:2000.08.21
ｼﾞｺｸ:     13:03
 SHINKO DENSHI
ｶﾀｼｷ    AF-R220
ｾｲﾊﾞﾝ0123456789
ID:      AB-123

ｺｳｾｲ(ｶﾞｲﾌﾞﾌﾝﾄﾞｳ
ｷｼﾞｭﾝ220.0000 g
ｷｻ      0.12mg

ｼｭｳﾘｮｳ
ﾋﾂﾞｹ:2000.08.21
ｼﾞｺｸ:     13:03

ｼｮﾒｲ



***************
```

* “ERR” or “weight error” denotes an error of the weight specified. This message will be output only if the option “Use specified weight error ([4. n.E.H. 1])” was previously selected. (See page 37.)

(4) Span test with external weight

Output in English

Output in Japanese
(Katakana)



```
***CAL.TEST****

DATE:21.08.2000
TIME:      12:58
 SHINKO DENSHI
TYPE:    AF-R220
S/N: 0123456789
ID:       AB-123

CAL.EXT. TEST
REF   220.0000 g
ERR      0.12mg
DIFF  -0.0005 g

COMPLETE
DATE:21.08.2000
TIME:      12:58

SIGNATURE


***************
```

```
***    ﾃｽﾄ    ***

ﾋﾂﾞｹ:2000.08.21
ｼﾞｺｸ:      13:04
 SHINKO DENSHI
ｶﾀｼｷ     AF-R220
ｾｲﾊﾞﾝ0123456789
ID:       AB-123

ﾃｽﾄ(ｶﾞｲﾌﾞﾌﾝﾄﾞｳ)
ｷｼﾞｭﾝ220.0000 g
ｷｻ          0.12mg
ｺﾞｻ    -0.0002 g

ｼｭｳﾘｮｳ
ﾋﾂﾞｹ:2000.08.21
ｼﾞｺｸ:      13:04

ｼｮﾒｲ


***************
```

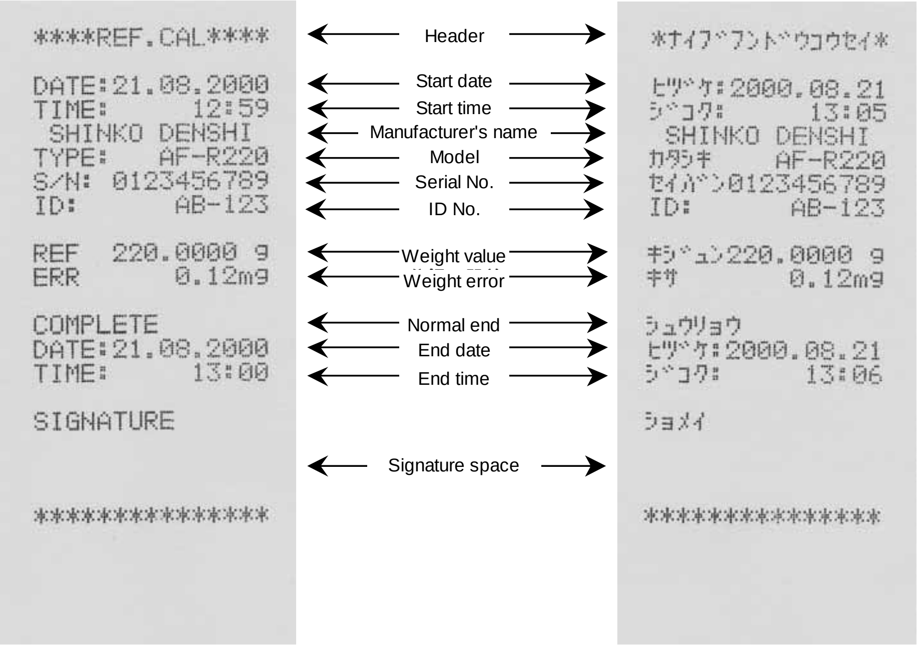
Header
Start date
Start time
Manufacturer's name
Model
Serial No.
ID No.
Calibration method
Weight value
Weight error
Test result
Normal end
End date
End time
Signature space
*
*

* “ERR” or “Weight error” denotes the instrumental error of the weight specified. This message will be output only if the option “Use specified weight error ([4. n.E.H. 1])” was previously selected. (See page 37.)

(5) Calibration of internal weight

Output in English

Output in Japanese
(Katakana)



```
****REF.CAL****

DATE:21.08.2000
TIME:      12:59
 SHINKO DENSHI
TYPE:   AF-R220
S/N: 0123456789
ID:       AB-123

REF  220.0000 g
ERR       0.12mg

COMPLETE
DATE:21.08.2000
TIME:      13:00

SIGNATURE



***************
```

Header
Start date
Start time
Manufacturer's name
Model
Serial No.
ID No.
Weight value
Weight error
Normal end
End date
End time
Signature space

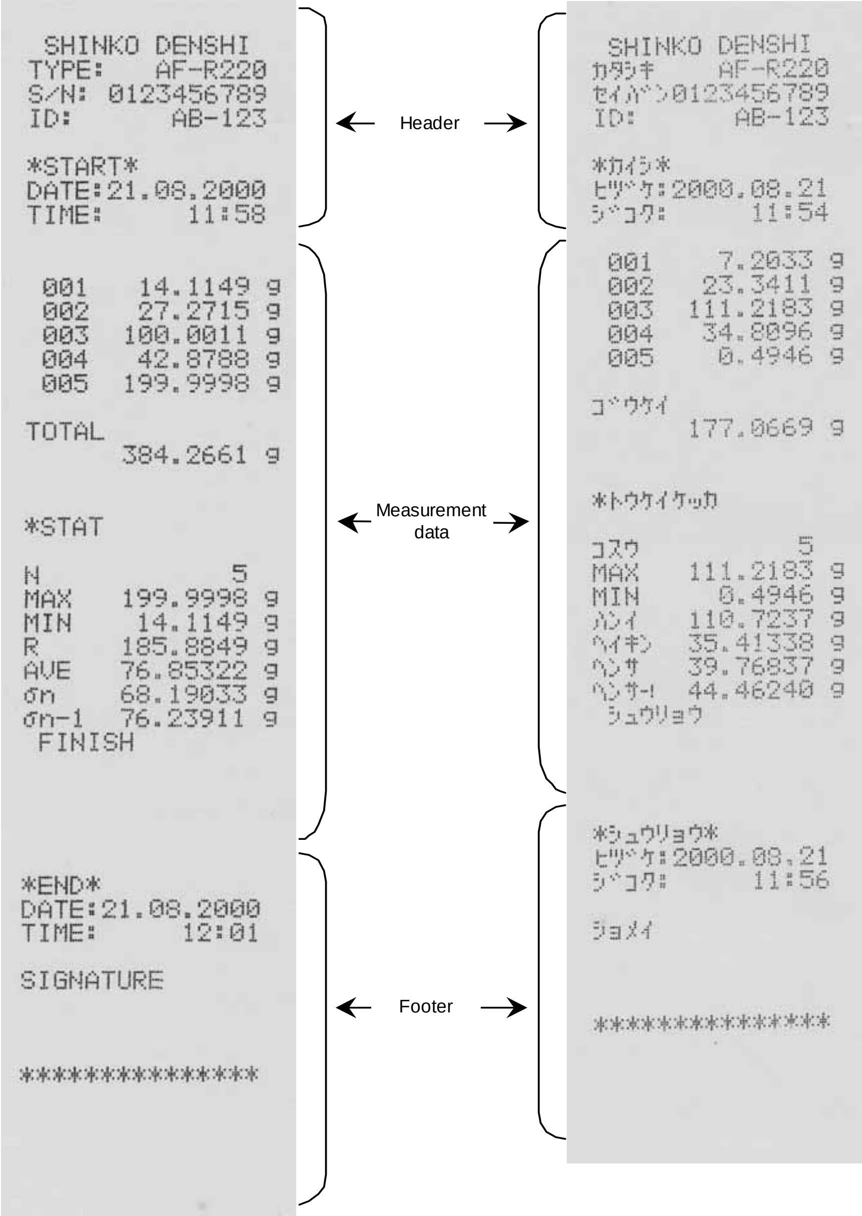
```
*ﾅｲﾌﾞﾌﾝﾄﾞｳｺｳｾｲ*

ﾋﾂﾞｹ:2000.08.21
ｼﾞｺｸ:      13:05
 SHINKO DENSHI
ｶﾀｼｷ    AF-R220
ｾｲﾊﾞﾝ0123456789
ID:       AB-123

ｷｼﾞｭﾝ220.0000 g
ｷｻ        0.12mg

ｼｭｳﾘｮｳ
ﾋﾂﾞｹ:2000.08.21
ｼﾞｺｸ:      13:06

ｼｮﾒｲ



***************
```

*　This print operation is not available on models without the built-in weight.

(6) Measurement data compliant with ISO/GLP/GMP

Output in English

Output in Japanese
(Katakana)


Header
Measurement
data
Footer

```
 SHINKO DENSHI
TYPE:    AF-R220
S/N: 0123456789
ID:       AB-123

*START*
DATE:21.08.2000
TIME:      11:58

 001    14.1149 g
 002    27.2715 g
 003   100.0011 g
 004    42.8788 g
 005   199.9998 g

TOTAL
       384.2661 g


*STAT

N              5
MAX    199.9998 g
MIN     14.1149 g
R      185.8849 g
AVE    76.85322 g
σn     68.19033 g
σn-1   76.23911 g
 FINISH



*END*
DATE:21.08.2000
TIME:      12:01

SIGNATURE


***************
```

```
 SHINKO DENSHI
ｶﾀｼｷ     AF-R220
ｾｲﾊﾞﾝ0123456789
ID:       AB-123

*ｶｲｼ*
ﾋﾂﾞｹ:2000.08.21
ｼﾞｺｸ:      11:54

 001      7.2033 g
 002     23.3411 g
 003    111.2183 g
 004     34.8096 g
 005      0.4946 g

ｺﾞｳｹｲ
        177.0669 g


*ﾄｳｹｲｹｯｶ

ｺｽｳ            5
MAX     111.2183 g
MIN       0.4946 g
ﾊﾝｲ     110.7237 g
ﾍｲｷﾝ    35.41338 g
ﾍﾝｻ     39.76837 g
ﾍﾝｻ-1   44.46240 g
 ｼｭｳﾘｮｳ


*ｼｭｳﾘｮｳ*
ﾋﾂﾞｹ:2000.08.21
ｼﾞｺｸ:      11:56

ｼｮﾒｲ


***************
```

Caution:

These output samples were all printed on the CSP-160. When the data is printed using other printers, the results may vary.

14. Servicing of Balance

The right and left windshield doors, measurement pan in the measurement chamber, pan base, windshield ring, and floor plate can easily be removed for cleaning of the balance. Be sure to disconnect the AC adapter before cleaning the balance.

1. Removing the windshield doors[*1]

(1) Push down the knob (lower) to unlock the door on the side of the door to be removed.

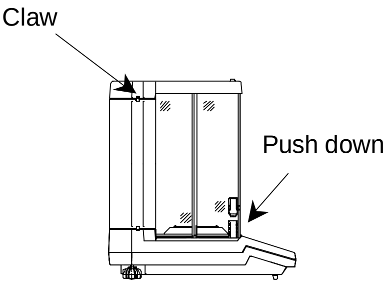
(2) Remove the door storage cover. To remove the cover, push down the claw and tilt the cover toward you.

(3) Remove the doors by pushing them out to the rear.

(4) The doors can be put back by reversing the removal procedure. When reassembling the doors, put the door (fitted with knobs) on the other and install them together by laying them on top of each other.

*1 All four doors have different shapes. To avoid an error during reassembly, remove the doors one by one. When reassembling the doors, note their proper orientation.

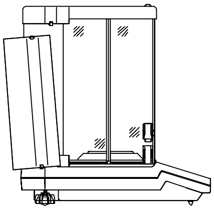
(1)



↓

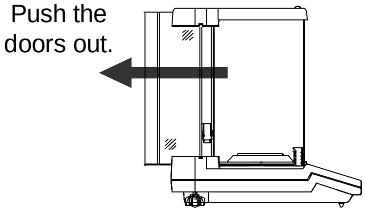
(2)

Remove the door storage cover.



↓

(3)



2. Removing the measurement pan in the measurement chamber, pan base, windshield ring, and floor plate.

Raise the windshield ring. The pan base and measurement pan can be removed at the same time.

To remove the floor plate, hold it by the sides with both hands and pull it up.

To put those components back in place, install them in this order: floor plate → windshield ring → pan base → measurement pan.

3. Cleaning the balance

Wipe off dirt on the body of the balance with a soft damp cloth. Commercial cleaners may be used, but refrain from using strong solvents or cleaners containing abrasives. Moreover, when cleaning the balance, use caution to avoid the entrance of liquid or dirt into the interior of the body (mechanism section).

15. Conversion Table of Units

Unit	Gram [g]	Milligram [mg]	Carat [ct]	Momme [mom]	Ounce [oz]	Pound [lb]	Troy Ounce [ozt]
1g	1	1000	5	0.26667	0.03527	0.00220	0.03215
1mg	0.001	1	0.005	0.00027	0.00004	0.000002	0.00003
1ct	0.2	200	1	0.05333	0.00705	0.00044	0.00643
1mom	3.75	3750	18.75	1	0.13228	0.00827	0.12057
1oz	28.34952	28349.5231	141.74762	7.55987	1	0.0625	0.91146
1lb	453.59237	453592.37	2267.96185	120.95797	16	1	14.58333
1ozt	31.10348	31103.4768	155.51738	8.29426	1.09714	0.06857	1
1dwt	1.55517	1555.17384	7.77587	0.41471	0.05486	0.00343	0.05
1GN	0.06480	64.79891	0.32399	0.01728	0.00229	0.00014	0.00208
1tl (Hong Kong)	37.429	37429	187.145	9.98107	1.32027	0.08252	1.20337
1tl (Singapore, Malaysia)	37.79936	37799.3642	188.99682	10.07983	1.33333	0.08333	1.21528
1tl (Taiwan)	37.5	37500	187.5	10	1.32277	0.08267	1.20565
1tl	11.66380	11663.8038	58.31902	3.11035	0.41143	0.02571	0.375

Unit	Penny-weight [dwt]	Grain [GN]	Tael (Hong Kong) [tl ▸]	Tael (Singapore, Malaysia) [tl ▸]	Tael (Taiwan) [tl ▸]	Tola [tl ▸]
1g	0.64301	15.43236	0.02672	0.02646	0.02667	0.08574
1mg	0.00064	0.01543	0.00003	0.00003	0.00003	0.00009
1ct	0.12860	3.08647	0.00534	0.00529	0.00533	0.01715
1mom	2.41131	57.87134	0.10019	0.09921	0.1	0.32151
1oz	18.22917	437.500	0.75742	0.75	0.75599	2.43056
1lb	291.66667	6999.99984	12.11874	12	12.09580	38.88889
1ozt	20	480	0.83100	0.82286	0.82943	2.66667
1dwt	1	24	0.04155	0.04114	0.04147	0.13333
1GN	0.04167	1	0.00173	0.00171	0.00173	0.00556
1tl (Hong Kong)	24.06741	577.61773	1	0.99020	0.99811	3.20899
1tl (Singapore, Malaysia)	24.30556	583.33332	1.00990	1	1.00798	3.24074
1tl (Taiwan)	24.11306	578.71343	1.00190	0.99208	1	3.21507
1tl	7.5	180	0.31162	0.30857	0.31103	1

* Characters in parentheses denote a unit symbol.

16. Troubleshooting

Symptom	Cause	Remedial Action
The display does not light up.	• The AC adapter is not connected.	→ Ensure that the AC adapter is connected (9).
The display is slow in stabilizing. M (left end) remains flashing, without further progress.	• The balance is subject to shock or vibrations. • The base on which the balance is placed is unstable. • The weighing pan, tare, or sample under measurement is in contact with something. • The mechanism section was damaged.	→ Check the installation site. → Examine the measurement pan and its surroundings (9). → Contact our technical service personnel or your local dealer.
Weight indication contains an error.	• The balance is subject to shock or vibrations. • The base on which the balance is placed is unstable. • The weighing pan, tare, or sample under measurement is in contact with something. • The span shifted after long hours' use. • The mechanism section was damaged.	→ Examine the measurement pan and its surroundings (9). → Execute span adjustment of the balance (15). → Contact our technical service personnel or your local dealer.
Poor linearity	• A variation in the characteristics or an error was produced in the mechanism section.	→ Contact our technical service personnel or your local dealer.
[o-Err] appears before the capacity is reached.	• Gross weight exceeded the capacity. (Weighing range = Container + Weight of sample) • The mechanism section was damaged.	→ Check the total weight. → Review the container (20). → Contact our technical service personnel or your local dealer.
[u-Err] is displayed.	• The measurement pan is being lifted by something. • There is a foreign object trapped between the measurement span (pan base) and the balance.	→ Examine the measurement pan and its surroundings. → Remove the measurement pan (pan base) and examine the surface on which the pan was placed.
[b-Err] is displayed.	• The balance is subject to static electricity or noise. • The electrical section of the balance malfunctioned.	→ Contact our technical service personnel or your local dealer.
[1-Err] is displayed.	• The reference weight does not reach 50% of the capacity.	→ Reperform the span adjustment and span test using a weight that is more than 50% of the capacity (15).

Figure in parentheses ( ) denotes the reference page.

Symptom	Cause	Remedial Action
[2-Err] is displayed.	• The balance was subjected to shock or vibrations during span adjustment.	→ Reperform the span adjustment while taking care to shield the balance from shock or vibrations (15). → Contact our technical service personnel or your local dealer.
[3-Err] is displayed.	• Span adjustment or span test was conducted with an object loaded on the measurement span.	→ Ensure that there is nothing loaded on the measurement pan, and reperform the span adjustment or span test (15).
[4-Err] is displayed.	• The balance was subjected to shock or vibrations during span adjustment.	→ Reperform the span adjustment while taking care to shield the balance from shock or vibrations (15). → Contact our technical service personnel or your local dealer.
[A-Err] is displayed.	• Malfunction of the built-in calibration weight device.	→ Contact our technical service personnel or your local dealer.
[C-Err] is displayed.	• Malfunction of the built-in clock.	→ Contact our technical service personnel or your local dealer.
[L-Err] is displayed.	• Counting mode: The samples' unit weight was insufficient. • %-mode: Conducted with a sample that is lighter than the %-limit weight.	→ Conduct with a sample that is heavier than the countable unit weight. → Conduct with a sample that is heavier than the limit weight value (27).
[t-Err] is displayed.	• Addition mode : Double addition was made. : Negative addition was made. : Zero was added.	→ Try again in the addition mode (28).
[r-Err] was displayed.	• A weight error in excess of the ±1.50 mg range was specified.	→ Check the weight to be used (use a weight with an weight error within the ±1.50mg) (34).

The number in parentheses ( ) denotes the reference page.