ViBRA®
Measure the Future

High-Precision Tuning Fork Carat Balance

CTB703

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.

SHINKO DENSHI CO., LTD.

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PREFACE

Thank you for purchasing a High-Precision Tuning Fork Carat Balance model CTB703.

This product can measure in carats, which is appropriate for weighing gemstones.

Instructions

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- The description of this document is subject to change without notice.
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- Documents of which pages are missing or irregularly bound will be exchanged. Please inform the store where you purchased the product.
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Important Notice

WARNING	・It should be known that this product contains potential danger. And so please be sure to observe this document when installing, operating or servicing this product. ・If the product is used in a manner not specified by the manuals or other accompanying documents, the protection provided by the product may be impaired. ・SHINKO DENSHI CO., LTD. will not take any responsibility for any injury or damage caused by the non-observance of this document or misuse or unauthorised modification of this product.

- Potential dangers are increasing in the industrial equipment industries due to the advent of new materials and processing methods, and speeding up of machines. It is impossible to foresee all situations related to these dangers. In addition, there are so many “impossible” and “don’ts” and so writing all of them in the operation manual is impossible. Therefore, it is safe to think that what is not written in the operation manual “cannot be performed” unless the operation manual positively writes “it is possible.” When performing installation, operation, maintenance or inspection of this product, not only observe what is written or indicated in this document or on the product surface but also pay adequate consideration to safety measures.
-
- For any question or further information concerning this document, please contact the store where you purchased the product with its model (type) name and serial number informed.
- Manufacturer: SHINKO DENSHI CO., LTD.
  Address: 1-52-1 Itabashi, Itabashi-ku, Tokyo 173-0004 Japan

How to read this manual

■Symbols used in this document

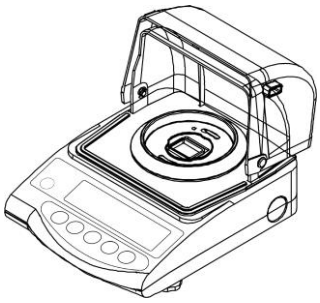
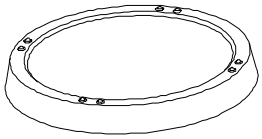
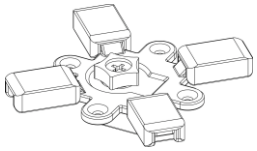
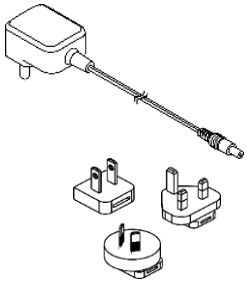
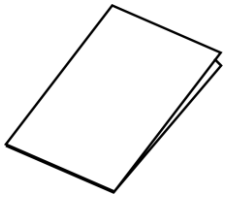
Understand the meaning of the following symbols and observe the instructions of this document.

Symbols	Meaning
DANGER	Used for the situation that invites an imminent risk of death or severe injury if proper precautions are not taken.
WARNING	Used for the situation that invites a risk of death or serious injury if proper precautions are not taken.
CAUTION	Used for caution concerning operations that may lead to a light physical injury to persons if proper precautions are not taken.
Note	Used for notation concerning operations that may lead to damage of the products/facilities/data if proper precautions are not taken. Used for accurate weighing and appropriate usage of the equipment.
Reference	Used for reference information on operation.
	Used for “Prohibition” items.
	Used for “Mandatory” items requiring positive action.
	Used for prohibition items to avoid “Electrical shock”.

This product/ The product/ The balance	Refers to the product.
[On/Off] key	The name of an operation key located in front of the main unit is represented in square brackets “[ ]”.
<message>	A message on the display is represented in angle brackets “< >”.
Press the key/ Brief press the key	Signifies pressing lightly an operation key once.
Press and hold down the key	Signifies keeping pressing an operation key until the designated indication appears.

Bundled Items

Before using the balance, please check that the following items have been included in the package. Should you find any missing parts, please contact your local dealer.

(1) Main unit of balance 	(2) Measurement pan 	(3) Pan base 
(4) AC adapter and AC plug set (Optional) 	(5) Operation manual 	

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1. Prior to use

1.1 Operating precautions

DANGER

	■ **Do not wet the AC adapter.** That may cause an electric shock, short-circuiting or failure.
	■ **Do not handle the AC adapter with wet hands.** That may cause an electric shock, short-circuiting or failure.
	■ **Do not use the balance in a dusty location.** That may cause dust explosion or fire. That may cause short-circuit or malfunction of the balance.
	■ **Do not use the balance in explosive atmosphere.** That may cause explosion or fire. Please order our explosive-proof balances to weigh in such a hazardous area.
	■ **Obey the SDS of the object to be weighed.** Measuring dangerous materials such as flammable liquid could cause an explosion or fire.

WARNING

	■ **Do not disassemble or modify the product.** Doing so could result in injury, electric shock, fire and other accidents or failures. For inspection and adjustment, contact the retailer where you purchased the product.
	■ **Do not move the product with a sample to be weighed set on the balance.** That may cause the sample to fall from the measurement pan, leading to a bodily injury or destruction of the sample.
	■ **Do not route the cables across passages.** The cables could be tripped on by a passerby and the balance and sample could fall down and break or injure someone.
	■ **Do not use the product on an unstable table or a place that is subject to vibration.** That may cause the sample to fall from the measurement pan, leading to a bodily injury or destruction of the sample. Besides inaccurate weighing may result.
	■ **Do not place an unstable sample on the measurement pan.** The sample may fall down, giving rise to a danger. Put an unstable sample in a container (tare) before weighing it.
	■ **Do not use the product in an abnormal condition.** If it should happen that an abnormal event such as smoking or unusual odor occurs, ask the store where you purchased the product or our sales department for repair. Keeping using the product may result in an electric shock or fire. In addition, do not ever try to repair it for yourself, or very dangerous situation is likely to occur.
	■ **Only use the dedicated AC adapter.** Use of other types of power or adapters may result in fire, electric shock, heat generation or malfunction of the balance.

CAUTION

	■ **Do not handle the balance with wet hands.** That may cause short-circuiting or failure.
	■ **Do not use the balance in a wet location.** That may cause short-circuiting or failure.
	■ **Do not connect to the AC adapter cord or communication cable with its connector or jack being wet.** That may cause short-circuiting or failure.

Note

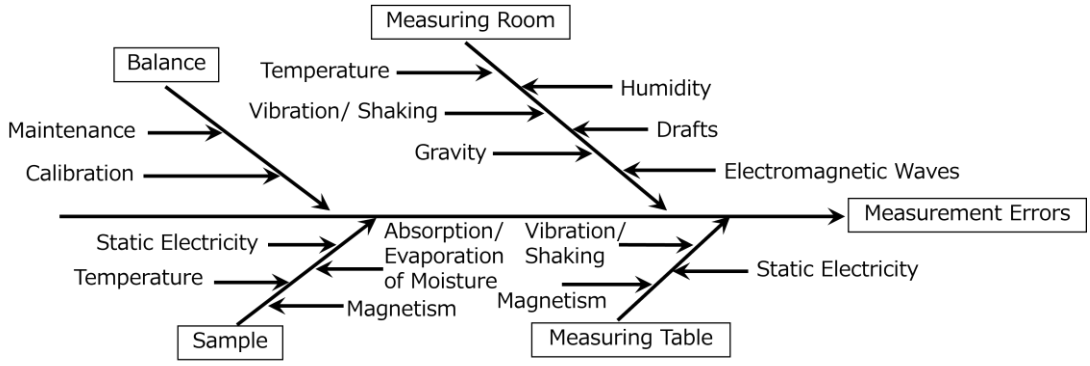
	■ **Do not apply excessive force to or impact the balance.** Doing so could damage or result in failure of the balance. Carefully place samples on the balance.
	■ **Do not use volatile solvents.** The main unit could deform. Wipe the main unit using dry cloth or a cloth moistened with a small amount of neutral detergent.
	■ **Do not install the balance in a place where it is directly exposed to airflow from air-conditioning or heating equipment.** Due to changes in the ambient temperature, the balance could fail to accurately weigh samples.
	■ **Do not install the balance in a place exposed to direct sunlight.** The internal temperature of the balance could rise and the balance could fail to accurately weigh samples.
	■ **Do not install the balance in a place where the ambient temperature or humidity change significantly.** The balance could fail to accurately weigh samples.
	■ **Adjust (calibrate) the balance when it is installed or relocated.** Failure to do so might result in measurement errors. To ensure accurate measurements be sure to adjust (calibrate) the balance.
	■ **Check for an error periodically.** Use environment and chronological change cause an error in measured value, leading to an inaccurate measurement.
	■ **Unplug the AC adapter from the receptacle when the balance is not going to be used for a long period of time.** Unplug the balance from the receptacle to save energy and prevent degradation.
	■ **Always adjust the level of the balance before use.** A tilted balance generates errors which might cause inaccurate weighting.

Note

	■ **For proper disposal** This product including accessories may not be disposed of in domestic waste in conformance with the specific requirements in your country, such as the European Directive 2012/19/EU on waste electrical and electronic equipment (WEEE). When you dispose of this product, please contact your local dealer and ask for the correct method of disposal.

1.2 For More Precise Measurements

To make more accurate measurement, it is necessary to lessen error-causing factors in measurement to the extent possible. Error-causing factors include not only an instrument error and performance of the balance itself but also the nature and condition of a sample, measuring environment (vibration, temperature, humidity, etc.) and the like. These factors will directly affect measurement result in the case of a balance with high resolution capability.



Factor Analysis Chart for Measurement Errors

1.2.1 Precautions on the Measuring Room

- Temperature/ Humidity/ Atmospheric pressure	• Try to keep the room temperature constant to the extent possible in order to avoid condensation and indication drift due to change in temperature. • Low humidity is likely to cause generation of static electricity, resulting in inaccurate measurement. • Change of atmospheric pressure is likely to cause change of buoyancy of the air on the sample, tare and mechanism of the balance, resulting in inaccurate measurement.
- Vibration/Shaking	• The measuring room should preferably be located on the ground floor or in the basement. Higher floors are more susceptible to heavy vibration and shaking, which make such locations less suitable for measurement. A room facing a railway or road with heavy traffic should also be avoided as much as practicable.
- Draught	• Avoid choosing a location subject to a direct draught of airflow from an air-conditioning unit or exposed to direct sunlight, which may cause abrupt fluctuations in temperature. • Also avoid a room subject to a heavy flow of people, since fluctuations in draughts and temperature are likely to occur in such a location.
- Gravity	• The gravity acting on a sample varies depending on the latitude and altitude of the location where measurement is being conducted. For this reason, the same sample may show different weight indications from one place to another. Therefore, make it a rule to calibrate the balance every time it is relocated.
- Electromagnetic Wave	• When the balance is located near an object that generates intense electromagnetic waves, it may be hindered from showing accurate weight due to the effects of such waves. Therefore, avoid placing the balance in such a location.

1.2.2 Precautions on the Measuring Bench

- Vibration/Shaking	• If the balance is subjected to vibration during measurement, its indications will become unstable, thus preventing accurate measurement from being conducted. To avoid this situation, select a solid measuring bench that is less susceptible to vibration. (A bench in a vibration-proof structure or one made of concrete or stonework will be suitable.) Moreover, do not conduct measurement with a soft cloth or paper placed under the balance, since the balance may be rocked out of its precise level positioning. • Place the measuring bench in a location free from vibration as much as possible. A corner rather than the centre of a room is less affected by vibration and therefore more suitable for installation of the balance.
- Magnetism/Static Electricity	• Avoid operating the balance on a bench that is susceptible to the effects of magnetism or static electricity.

1.2.3 Precautions on the Samples

- Static Electricity
  - In general, synthetic resin- and glass-made samples are high in electric insulation, and so easily charged electrically. Weighing an electrically charged sample makes the indication value unstable, reducing the reproducibility of the test result. Therefore, neutralise an electrically charged sample before measurement.
- Magnetism
  - A sample affected by magnetism indicates different weight values depending on where it is located on the measurement pan, along with resultant poor reproducibility of the results. When a magnetised sample must be measured, first demagnetise it or place an appropriate pedestal on the measurement pan to adequately separate the mechanism part of the balance from the magnetised sample for avoiding the effects of magnetism.
- Absorption/ Evaporation of Moisture
  - Measuring a sample with moisture absorbed or evaporated (volatilised) continuously increases or decreases the values indicated. In such case, measure the sample in a container with a small opening and sealed airtight with a cap.
- Sample Temperature
  - A difference in temperature between a sample and the interior of a windshield may cause convection to occur inside the windshield, resulting in erroneous measurement. Therefore, measure a very hot or cold sample only after allowing time for its temperature to acclimatise to room temperature. Moreover, to prevent convection inside the windshield, allow time for the interior of the windshield to acclimatise to room temperature.
  - The body heat of a person conducting measurement can also affect measurement results. Avoid holding the sample with bare hands, and use long tweezers or a similar tool instead. Also refrain from putting your hands inside the windshield while measurement is in progress.

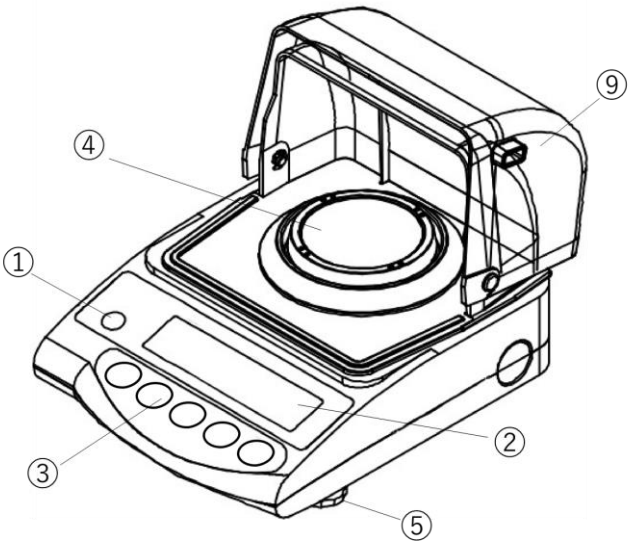
1.2.4 Precautions on the Main Unit of the Balance

- Precautions on Use
  - The balance is supplied with a transparent dust cover. The dust cover may be statically charged immediately after removal from the packing box or under low humidity conditions. Unstable indications by the balance may be due to statically charged dust cover. In such case, wipe the dust cover with a damp cloth or use a commercial antistatic agent.
  - For more stable measurement, it is recommended to energise the balance for longer than 30 minutes and load the balance a few times with a weight equivalent to the maximum capacity before measurement.
- Calibration
  - Periodically calibrate the balance to ensure accurate measurement at all times.
  - For more precise calibration, use an external calibration weight that approximates the maximum capacity. Moreover, calibrate the balance only after allowing time for proper acclimation to ambient temperature following power-up.
  - Energise the balance for longer than 30 minutes and load the balance a few times with a weight equivalent to the maximum capacity before adjustment.
  - Calibration is also required in the following cases:
    - When operating the balance for the first time;
    - When not using the balance for a long time;
    - When relocating the balance; or
    - When there is wide fluctuation in temperature, humidity or atmospheric pressure.
- Maintenance
  - When the measurement pan or pan base is contaminated with powder or liquid, erroneous weight values may result or indications may remain unstable. Therefore, be sure to frequently clean them. When cleaning the balance body, be very careful not to allow dirt or liquid to penetrate inside the enclosure.

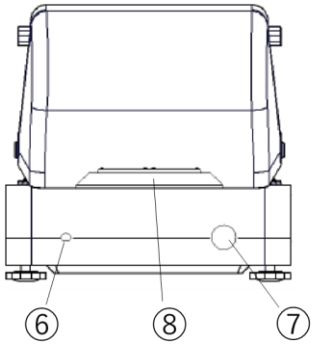
2. Name of Each Section

2.1 Main Unit

Front View



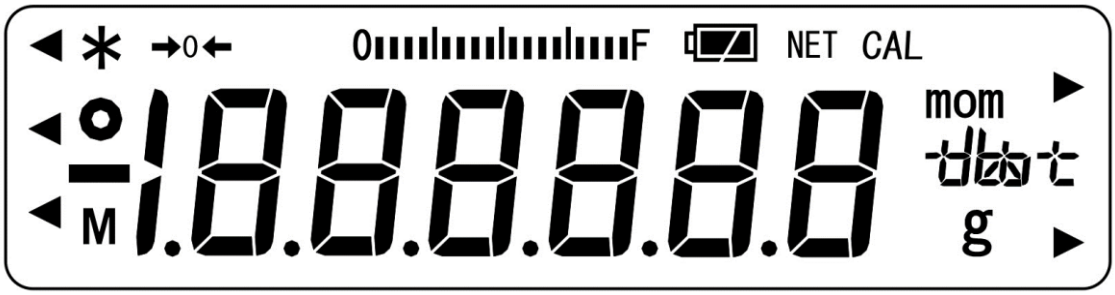
Rear view



① Level	② LCD indicator	③ Operation keys
④ Measurement pan	⑤ Adjuster legs	⑥ AC adapter jack
⑦ RS232C connector (5-pin female DIN 41524)	⑧ Windshield ring	⑨ Windshield

2.2 LCD Indicators and Operating Keys

2.2.1 Symbols Displayed



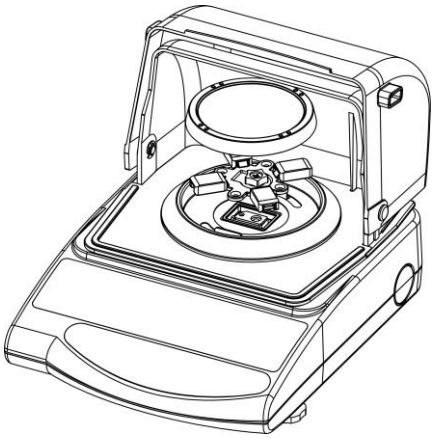
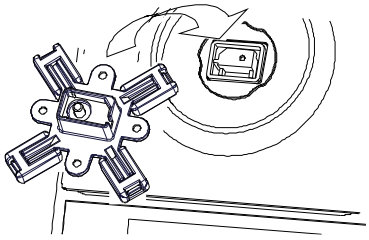
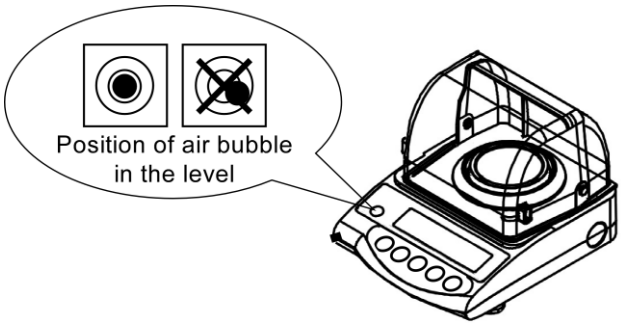
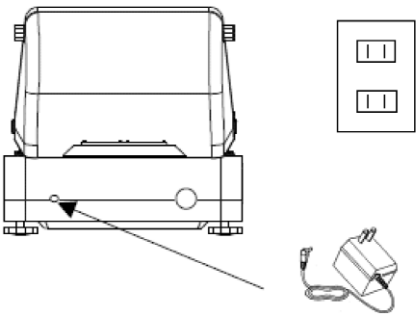
Display	Description
g	gram
→0←	Zero point indicator
NET	Net weight indication when tare is being subtracted
o	Stable state indicator (Indicates that readout is stable.)
*	- Indicates standby status. - Indicates that data being transmitted.
mom	momme
M	Indicates that the balance is in processing.
CAL	Indicates that the balance is processing span adjustment.
F	Bar graph - Shows the rate of gross weight to the weighing capacity.
▶	Lights up to indicate each weighing unit. (Refer to “12.2 Display, Scale interval and Capacity by Each Unit of Weighing ” for indication of each unit.)
	Lights up when the balance is equipped with optional built-in rechargeable battery and battery-operated. The indication changes to < > when the battery capacity decreased and charging is required. (See “9. Operating the Balance with the Battery”.)

2.2.2 Names and Functions of Operating Keys

Operating Key		Function	
	[On/Off] key	Turns the balance on or off.	
	[Print] key	Brief press:	Initiates output.
	[Set] key	Brief press:	Saves the function setting.
	[Function] key	Brief press: Brief press: Press and hold down: Press and hold down:	Switches the weighing units. Selects an item when setting the function. Invokes function setting mode. Invokes span adjustment mode.
→0/T←	[Zero/Tare] key	Brief press: Brief press:	Resets the indication to zero when using zero-point adjustment or tare subtraction. Selects a function when operating the balance in the function setting mode.

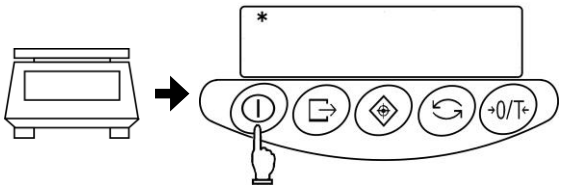
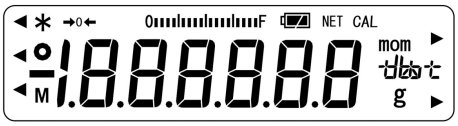
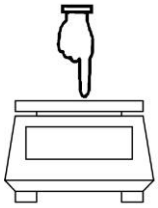
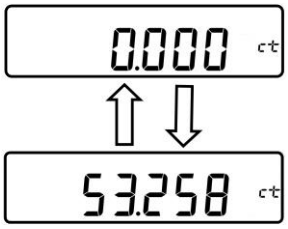
3. Assembling and Installation

3.1 Assembling and installation of the balance

1 Attach the pan base and place the measurement pan. 	First, mount the pan base on the main unit of the balance and tighten the screw to fix it to the load receptor. Then place the measurement pan on top of it. Be sure to mount the pan base in the correct direction, as illustrated below. 
2 Securing the exact level of the balance. 	Turn the adjuster legs until the bubble rests in the centre circle of the level.
3 Put the AC plug to the AC adapter, then connect the AC adapter. 	Connect the AC adapter to the balance, as illustrated at left. **Reference** If the balance is equipped with optional built-in rechargeable battery, refer to “9. Operating the Balance with the Battery ”.

4. Basic Operations

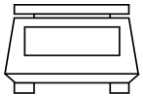
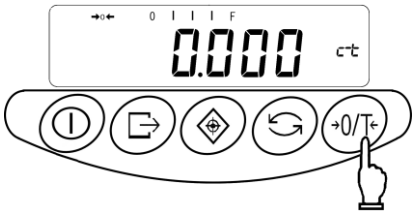
4.1 Start-Up and Operation Check

1 Turning on the power.   ➡ **“Self-check”** ➡ **“Initial zero adjustment”** ➡ 	When the balance has the AC adapter connected, it enters standby and displays <✱>. Make sure that there is nothing on the measurement pan and press the [On/Off] key. All displays on the LCD lights, followed by the self-check of the balance. Check that there are no missing indications or unlit areas on the display. Completion of the self-check then initial zero adjustment is followed by the measuring mode. For accurate measurement, energise the balance for longer than 30 minutes and load the balance a few times with a weight equivalent to the maximum capacity.
2 Verifying changes in the read-out indicator.  	Press the measurement pan lightly and make sure that the read-out indicator changes. Also, ensure that the read-out indicator is reset to zero when you release your hand.

Reference	(1) If the balance is equipped with optional built-in rechargeable battery pack and AC adapter is not connected, the balance does not enter standby mode and <✱> will not be displayed when the power is switched off. (2) When warming up the balance with optional built-in rechargeable battery, set <4. A.P.> (Auto power off) to “0” (disabled) or connect the AC adapter.

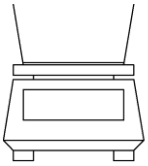
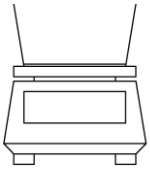
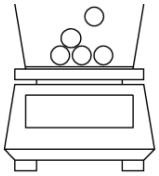
4.2 Zero-Point Adjustment

Adjusting the indication to zero is called "Zero-point adjustment".

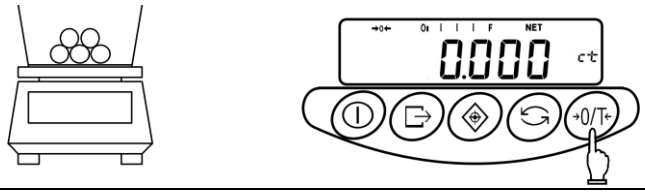
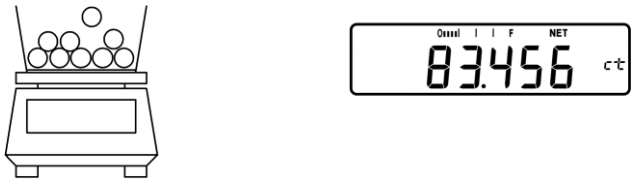
1 Unload the balance. 	Make sure that nothing is placed on the measurement pan.
2 Execute zero-point adjustment. 	Press the [Zero/Tare] key. The readout becomes zero, and <→ 0 ←> is displayed (zero-point adjustment).

4.3 Tare Subtraction

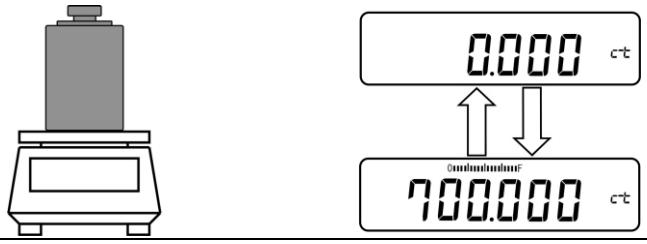
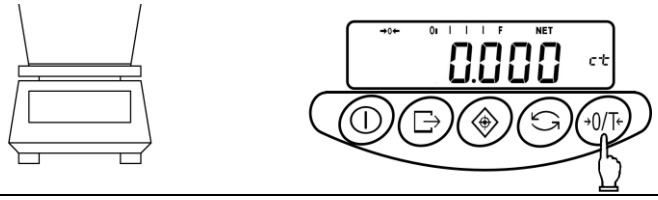
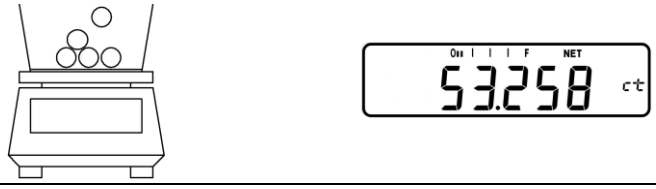
When measuring weight with the sample in a container (tare), only the sample is weighed by subtracting the weight of the container. This is called “tare” or “tare subtraction”.

1 Place the tare (container) on the balance.  	As the tare is placed on the measurement pan, the balance indicates its weight.
2 Reset read-out indication to zero.  	Press the [Zero/Tare] key. The tare is subtracted, the balance indicates zero and <NET> symbol appears. **Reference** When the tare weight is within the zero-point adjustment range, zero point adjustment is activated instead of tare subtraction.
3 Load the sample to be weighed.  	The balance will now indicate only the weight of the sample loaded in the tare.

☆ Weighing only the weight of an added sample

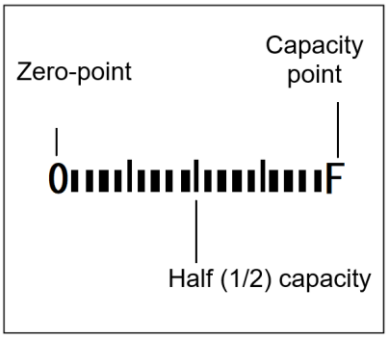
1 Resetting the indication to zero. 	Press the [Zero/Tare] key. The indication changes to zero and <NET> symbol appears.
2 Adding samples to be measured. 	The balance indicates only the weight of added samples.

4.4 Weigh the sample

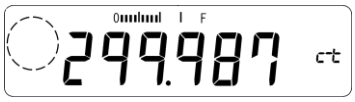
1 Ensure that the balance is in the intended weighing unit.	Ensure that the balance is in the intended weighing unit. If not, switch the weighing unit by reffering “6. Switching of Weighing Unit”.
2 Preload the balance. 	Pre-load the balance several times with a load near the maximum capacity of the balance.
3 Execute zero-point adjustment or tare subtraction as appropriate. 	Refer to “4.2 Zero-Point Adjustment” or “4.3 Tare Subtraction” as appropriate.
4 Load the sample to be weighed. 	The balance will indicate the weight of the sample loaded.

☆ Key Points of the Procedure ☆

1. The bar graph shows the current gross load status with respect to the maximum capacity of the balance. The nearer the <F> mark draws, the smaller the measurable weight becomes.
   *Even when the display currently indicates zero with the tare subtracted, the weight corresponding to the subtracted tare is indicated on the bar.



2. When the balance remains stable, the stable state indicator <○> remains on. If the balance becomes unstable, the stable state indicator <○> will disappear. When a displayed value flickers or the stable state indicator flashes on and off, it is likely that the balance is being affected by wind or other vibrations. Use the windshield or vibration dampers to protect against such adverse effects.



Unstable

Stable

3. When the zero-point adjustment is executed or the tare is subtracted, the balance indicates zero and <→ 0 ←> indicator appears. If the tare is subtracted, the <NET> indicator also appears.

If the measurement value deviates from the true zero point by 1/4 of the actual scale interval or more, <→0←> disappears.

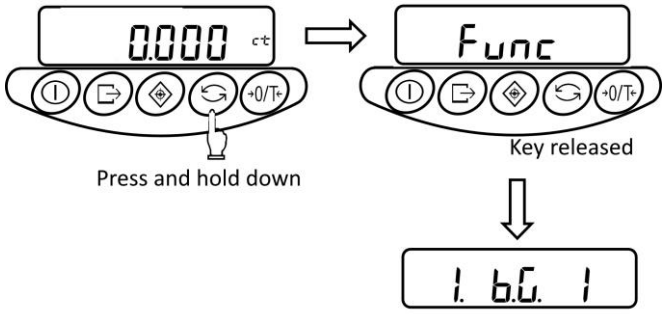
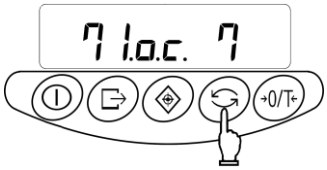
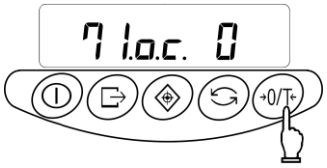
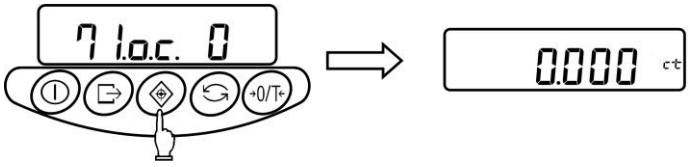
If zero-point adjustment is performed or tare is subtracted, the balance indicates zero, and <→0←> indicator appears.

4. When the tare is subtracted, the measurable range is reduced.
   Measurable Range = Maximum Capacity - Tare Weight

5. If <o-Err> appears when a sample is loaded, the gross weight exceeds the capacity of the balance.

5. Function Setting Mode

5.1 Setup and Checking of Functions

1 Invoking the function setting mode.  	Press and hold down the [Function] key until the indicator changes to <Func>, then release the key. The function setting mode is activated, and the first item, <1. b.G. 1>(Bar graph display) appears. (See “5.2 Description of Functions” .)
2 Selecting the function item.  	Press the [Function] key several times to select the function item to be set.
3 Changing the content of an item.  	Each press of the [Zero/Tare] key changes the digit on the right end. Select the desired one.
4 Save the setting.  	Press the [Set] key to complete the setting. The balance returns to measuring mode.

5.2 Description of Functions

☆: default factory settings

Item	Set Value		Description	
Bar graph display	1. b.G.	0	Disable	
		☆1	Enable	
Auto zero tracking	3. A.0	0	Disable	This function automatically sets the zero point exactly to zero to prevent slight deviations.
		1	±0.5 d	
		2	±1.0 d	
		☆3	±2.0 d	
		4	±4.0 d	
Auto power-off	4. A.P.	0	Disable (balance operates continuously)	This function activates only when the balance is battery-operated.
		☆1	Enable (balance powers off in approximately 3 minutes)	
Response speed	5. rE.	0	Sensitive mode	
		1	Fast ↓ Slow	
		2		
		☆3		
		4		
		5		
Stability parameters	6. S.d.	1	Wide (mild) ↓ Narrow (strict)	
		☆2		
		3		
		4		
Interface	7. I.F.	0	Disable input/output	
		☆1	Six-digit numeric format	
		2	Seven-digit numeric format	
Output Control	71.o.c.	0	Stop output.	Displayed only when <7. I.F.> is set to “1” or “2”.
		1	Output continuously at all times.	
		2	Output continuously if stable (stop output if unstable).	
		3	Output once by pressing [Print] key (irrespective of whether the balance is stable or not).	
		4	Output once when the balance is loaded and stable. The next output for another sample loading is executed once the indication becomes stable at less than or equal to zero by unloading and zero-point adjustment.	
		5	Output once every time when the balance reaches stable (Stop output at unstable times).	
		6	Output continuously at unstable times and output once every time when the balance reaches stable.	
		☆7	Output once after [Print] key is pressed and the balance reaches stable.	
Baud Rate	72. b.L.	☆1	1200 bps	Displayed only when <7. I.F.> is set to “1” or “2”.
		2	2400 bps	
		3	4800 bps	
		4	9600 bps	
Parity	73. PA.	☆0	None	Displayed only when <7. I.F.> is set to “2”.
		1	Odd	
		2	Even	

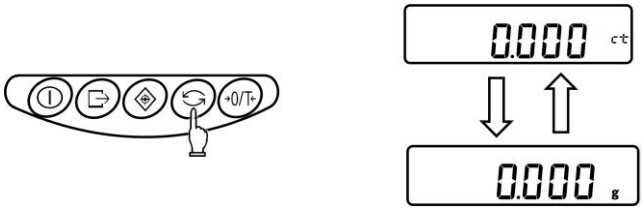
☆: default factory settings
★1 to ★5: default settings of <81.S.u.> to <85.S.u.>

Item	Set Value		Description	
Setup of weighing unit assignment which is switched by [Function] key	81.S.u. | 85.S.u.	★2 01	gram	Weighing mode
		★1 02	carat	
		15	ounce	
		16	pound	
		17	ounce troy	
		18	pennyweight	
		19	grain	
		1A	tael troy (Hong Kong)	
		1b	tahil (Singapore,Malaysia)	
		1C	tael (Taiwan)	
		1d	momme	
		1E	tola (India)	
		★3,4,5 00	No unit set	

6. Switching of Weighing Unit

Pressing the [Function] key switches the weighing unit to “gram”, “carat” and so on.

6.1 Switching Weighing Unit by Key Operation

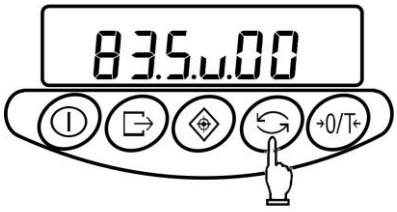
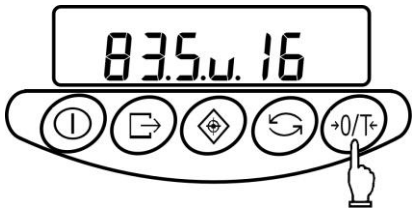
Switching the weighing unit. 	Press the [Function] key. Each press switches the weighing unit.

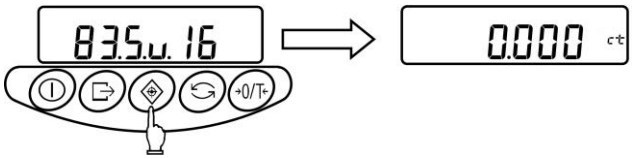
Reference	The weighing unit that is activated when the balance is switched on will be the one that was active when last switched off. For example, if the balance was switched off in gram unit, this gram unit will be reactivated the next time the balance is switched on.

6.2 Setup of Weighing Unit Assignment

When values of <81.S.u.> to <85.S.u.> are entered prior to use, the desired unit of weighing to be displayed can be chosen simply by pressing the [Function] key. For more information on the units of weighing that can be set here, please refer to “5.2 Description of Functions”.

Example:To change setting value of <83.S.u.> to “pound”.

1 Display the function item <83.S.u.>. 	Press and hold down the [Function] key. Release the key as <Func> appears on the display. The function setting mode is now activated and the first item is displayed. Press the [Function] key several more times, until <83.S.u.> appears. <83.S.u.> is set to “00” as a default factory setting.
2 Setting the unit to a pound. 	Press the [Zero/Tare] key several times to set <83.S.u.> to “16”.

3 Pressing the [Set] key to save the setting. 	Press the [Set] key to complete the setting. The balance returns to measuring mode.

☆ Key Points of the Procedure ☆

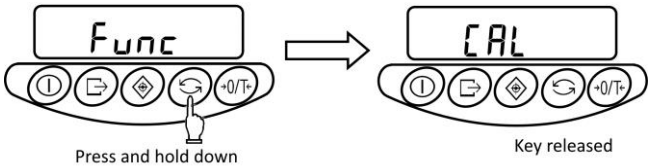
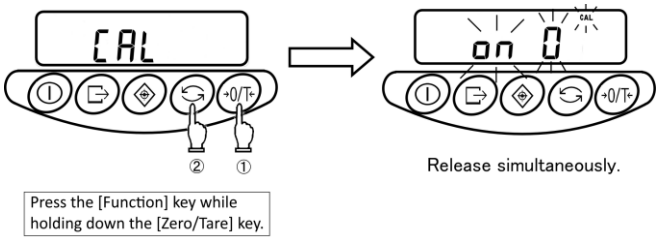
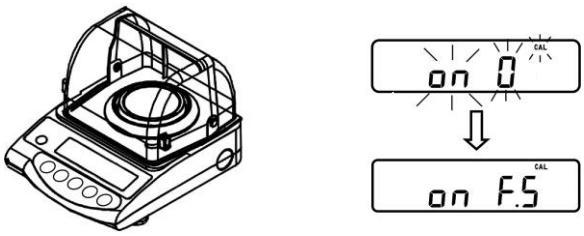
1. The order of switching units switching by [Function] key is the same as the settings of <81.S.u.> to <85.S.u.>.
2. Items with "00" set and subsequent set values are excluded from the screen switching by the [Function] key.
3. “00” cannot be set in <81.S.u.>.
4. If the same unit of weighing is registered in duplicate, the second will be ignored when the display switches.

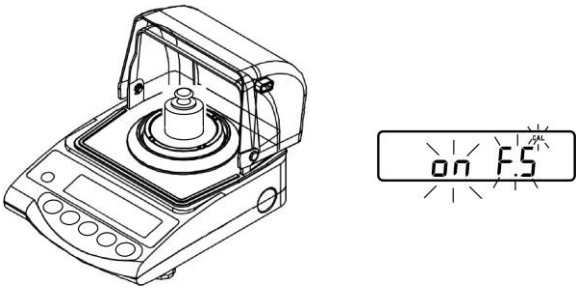
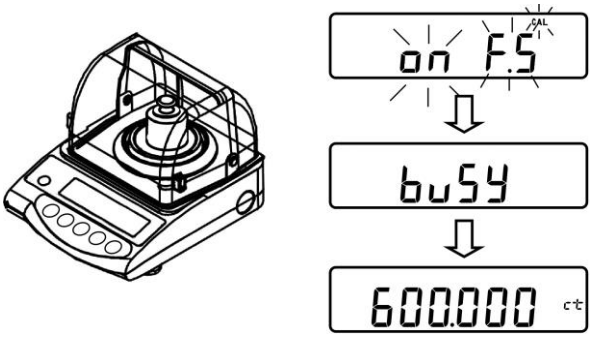
7. Adjusting the Balance

A balance is influenced by the acceleration of gravity, temperature, air pressure, etc. For this reason, you should adjust your balance every time you relocate it. You should also adjust it after a long time of use or when it does not indicate correct values.

7.1 Span adjustment with external calibration weight

Note	(1) To ensure that the span adjustment is carried out accurately, please note the following before starting this function: - Ensure that the balance installed properly levelled; - Check that no load is on the measurement pan; - Ensure that the equipment is not subject to environmental influences such as wind, vibration, temperature changes and changes in air pressure; - Energise the balance for longer than 30 minutes and load the balance a few times with a weight equivalent to the maximum capacity. (2) Use calibration weights that weigh heavier than 50% of the maximum capacity of the balance. To adjust more accurately, use a weight that is equivalent to the maximum capacity. (3) An external weight used for the span adjustment is preferred to be the one equivalent to OIML E2 class. Please contact your local dealer if you wish inquire about or place an order for calibration weights.

1 Invoke the span adjustment function.  	Press and hold down the [Function] key. Release the key when the display changes from <Func> to <CAL>.
2 Launch the span adjustment secuence.  	Press the [Function] key while holding down the [Zero/Tare] key, then release both keys simultaneously. The display flashes <on 0> and <CAL> mark, indicating that zero-point calibration is underway.
3 Zero-point calibration.  	Once zero-point calibration is completed, display switches to <on F.S> and <CAL> mark. Proceed to the calibration of the capacity point.

4	Calibration of the weighing capacity point.  	Load the calibration weight on the centre of the measurement pan. The display starts flashing and the balance calibrates the weighing capacity point.
5	Span adjustment is completed.  	Span adjustment sequence is completed and the indication reverts to measuring mode.

☆ Key Points of the Procedure ☆

1. Pressing the [Function] key in Step 2 interrupts the span adjustment sequence and the indication reverts to measuring mode.

2. If problems arise during span adjustment, one or more of the following error messages will appear:
   (1) <o-Err>: The calibration weight exceeds the maximum capacity of the balance.
   (2) <1-Err>: The calibration weight is less than approximately 10% of the maximum capacity of the balance.
   (3) <2-Err>: The difference between before and after calibration values is too large (1.0% or more).

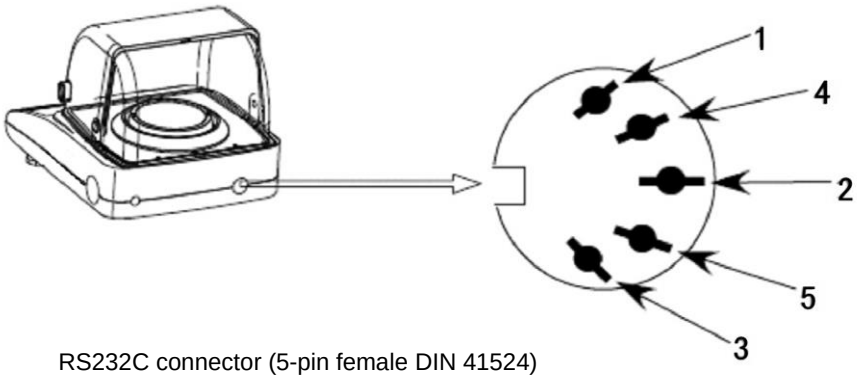
   If error messages are displayed, span adjustment cannot take place. Check the weight and re-execute. If the same error continues after repeated span adjustments using the correct weight, please contact your local dealer.

3. Wind or vibration affecting the balance may result in the process not proceeding beyond the flashing display of <on 0>.

8. Input/Output Functions

8.1 Terminal Numbers and Functions

Terminal Number	Signal	Input/output	Function & remarks
1	EXT.TARE	Input	External tare-subtraction/zero-point-adjustment*
2	DTR	Output	This signal is fixed to “HIGH” while the balance is powered on.
3	RXD	Input	Receiving data
4	TXD	Output	Transmitting data
5	GND	—	Signal ground



RS232C connector (5-pin female DIN 41524)

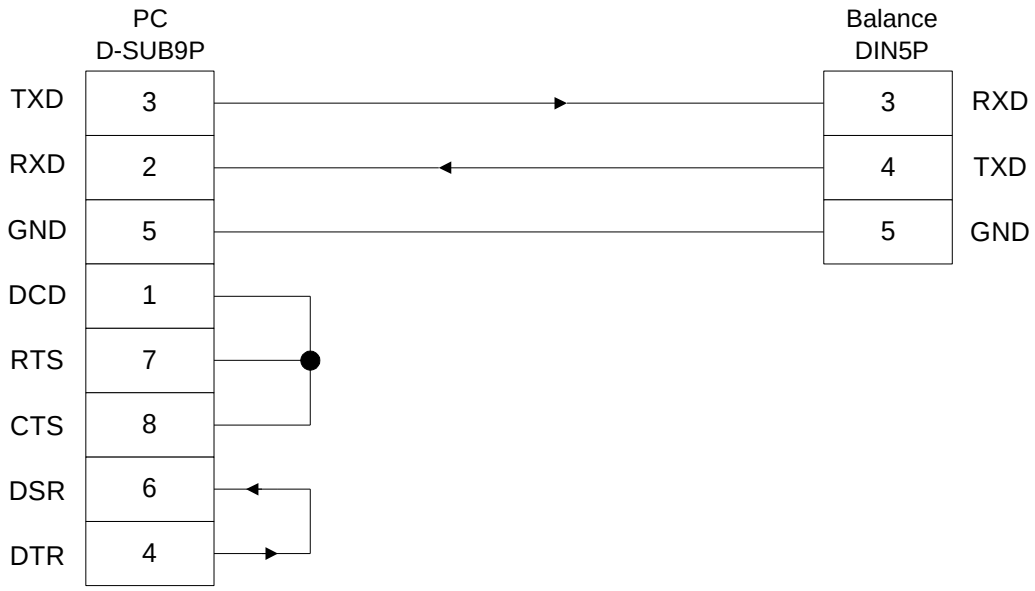
Note	Take care not to short-circuit the pin 2 (DTR) to the ground.

Reference	- DIN 5-pin plug set is available from your local dealer. - You can execute tare subtraction or zero-point adjustment from an external device by connecting a contact or a transistor switch between the pin 1 and pin 5. In this case, allow at least 400 ms for connection (ON) time. Open circuit voltage: 15 V Sink current: 20 mA

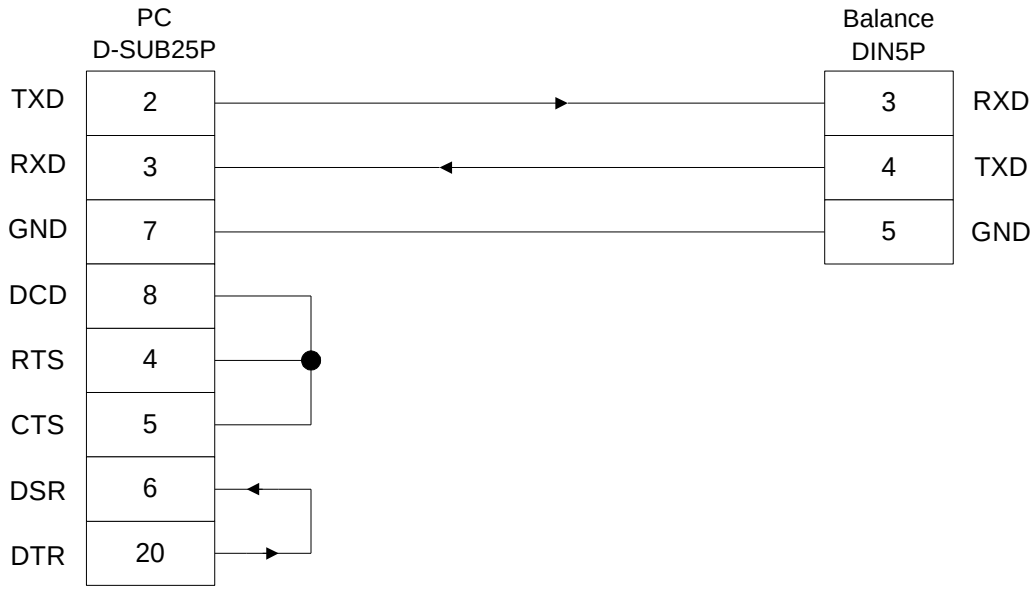
8.2 Connection between Balance and Peripheral

Note	(1) Disconnect the AC adapter of the balance before connecting external devices. (2) Use shielded cable up to 15 m length.

■■■ Sample connection with D-SUB9P ■■■



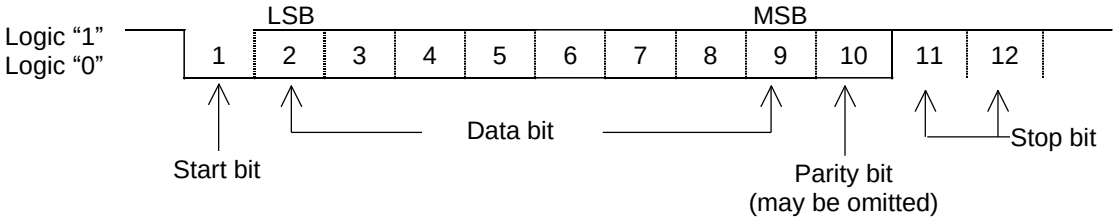
■■■ Sample connection with D-SUB25P ■■■



8.3 Interface Specifications

(1)	Transmission system:	Serial transmission with start-stop synchronisation
(2)	Transmission rates:	1200/2400/4800/9600 bps.
(3)	Transmission codes:	ASCII codes
(4)	Signal levels:	Compliant with EIA RS-232C HIGH level (Data logic 0) +5 to +15 V LOW level (Data logic 1) -5 to -15 V
(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

Reference	The parity bit can be appended only when <7. I.F.> is set to “2”.



8.4 Output Data

The two formats — “Six-digit numeric format” and “Seven-digit numeric format” — are available.

Refer to “5.2 Description of Functions” for the function settings.

Reference	All the codes are ASCII codes.

8.4.1 Data Composition

- Six-digit numeric format:
  Composed of 14 characters, including the terminators (CR = 0DH, LF = 0AH).

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

- Seven-digit numeric format:
  Composed of 15 characters, including the terminators (CR = 0DH, LF = 0AH).

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

(1) Polarities (P1: one character)

P1	Code	Description
+	2BH	When data is zero or positive
-	2DH	When data is negative

(2) Numeric data (D1 to D7/D8: seven or eight characters)

- Six-digit numeric format: 7 characters, from D1 to D7
- Seven-digit numeric format: 8 characters, from D1 to D8

D1 to D7/D8	Code	Description
0–9	30H–39H	Numerical value 0–9 0 is also used to fill the leading portion of value. (leading zero padding)
•	2EH	Decimal point (floating position) *When the data is an integer, it may be omitted and replaced with a blank space in the lowest-order place.
Space	20H	Space Used to fill the leading portion of value. (leading zero suppress)

(3) Units (U1, U2: two characters)

U1	U2	Code		Meaning	Balance indication
C	T	43H	54H	carat	ct
Space	G	20H	47H	gram	g
O	Z	4FH	5AH	ounce	oz
L	B	4CH	42H	pound	lb
O	T	4FH	54H	ounce troy	oz t
D	W	44H	57H	pennyweight	dwt
G	R	47H	52H	grain	▶ of the lower right
T	L	54H	4CH	tael troy (Hong Kong)	tl
T	L	54H	4CH	tahil (Singapore, Malaysia)	tl and ▶ of the upper right
T	L	54H	4CH	tael (Taiwan)	tl and ▶ of the lower right
M	O	4DH	4FH	momme	mom
t	o	74H	6FH	tola (India)	to

(4) Status (S1, S2: two characters)

S1	S2	Code		Description
Space	S	20H	53H	Data stable
Space	U	20H	55H	Data unstable
Space	E	20H	45H	Data error (data other than S2 is invalid.) <o-Err>, <u-Err>
Space	Space	20H	20H	No status specified

8.5 Input Commands

Users can control the balance remotely by transmitting commands from an external device.
Two types of control commands are available:

(1) Instruction for tare subtraction / zero-point adjustment

(2) Setup of output control

8.5.1 Command Transmission Method

(1) A command is transmitted to the balance from an external device. Since the data flow (transmission and reception) is stored by a full-duplex system, commands can be transmitted regardless of their data-transmission timing.

(2) When the balance has executed the received command, it activates a normal end response or transmits the requested data, via the transmitting command. If the balance was unable to execute the command or received an erroneous command, it transmits an error end response. If the balance is working properly, it usually returns a response within a second after it receives the transmitted command. If the balance receives a transmission while it is conducting a procedure (such as the setup of a function or a span adjustment), it will transmit a response when the procedure finishes.

(3) When transmitting more than one command to the balance from a remote device, wait until you have received a confirmation on the first transmission before transmitting the next.

8.5.2 Command format

Composed of four characters (ASCII), including the terminators (CR=0DH, LF = 0AH)

1	2	3	4
C1	C2	CR	LF

(1) Instruction for tare subtraction / zero-point adjustment

C1	C2	Code		Description	Value	Response
T	(SP)	54H	20H	Instruction for tare subtraction / zero-point adjustment	None	A00: Normal end E01: Tare subtraction / zero point adjustment cannot be executed due to an error.

(2) Setup of output control

C1	C2	Code		Description
O	0	4FH	30H	Stop output.
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 by pressing [Print] key (irrespective of whether the balance is stable or not).
O	4	4FH	34H	Output once when the balance is loaded and stable. The next output for another sample loading is executed once the indication becomes stable at less than or equal to zero by unloading and zero-point adjustment.
O	5	4FH	35H	Output once every time when the balance reaches stable (Stop output at unstable times).
O	6	4FH	36H	Output continuously at unstable times and output once every time when the balance reaches stable.
O	7	4FH	37H	Output once after [Print] key is pressed and the balance reaches stable.
O	8	4FH	38H	Output once immediately.
O	9	4FH	39H	Output once after stable.

Reference	(1) The output controls executed with commands “O0” to “O7” work the same as the output controls executed through function setting mode on the balance. (2) The commands “O8” and “O9” are data request commands issued to the balance. After the “O8” or “O9” command has executed and balance has performed an output, the balance stops outputting until the next output command comes along. (3) Once any command from “O0” to “O7” is executed, the balance runs that function until another command is entered. However, if the balance is switched off and on again, the output control is reset to the initial function setting.

8.5.3 Response Output

Composed of five characters, including the terminators (CR = 0DH; LF = 0AH)

1	2	3	4	5
A1	A2	A3	CR	LF

Types of response outputs

A1	A2	A3	Code			Description
A	0	0	41H	30H	30H	Normal end
E	0	1	45H	30H	31H	Command error (Abnormal command received; other errors)

9. Operating the Balance with the Battery

This chapter is for the balance equipped with optional built-in rechargeable battery pack.

CAUTION	(1) Be sure to use the AC adapter supplied with the balance. A different AC adapter may cause the battery to generate heat or explode. (2) The removal or replacement of the battery by the user is not permitted. Please contact your local dealer for removal or replacement of the battery. (3) To avoid overcharging, use the balance without the AC adapter when the battery is fully charged.

9.1 Specifications

- Installation: Factory option, built-in type
- Type: Nickel-Metal Hydride (NiMH)
- Ratings: 6.0 V⎓, 2100 mAh
- Charging time: Approximately 12 hours
- Drive time: Approximately 24 continuous hours
- Number of charge/discharge cycles: 300 or more

9.2 Charging Method

While the balance is battery-operated, <▮>stays on. The indicator flashes <▯> (charging required) when battery capacity decreases. If the balance flashes <▯>, charge the battery by following procedure:

(1) Connect the dedicated AC adapter to the balance.

(2) Turn the balance off.

(3) Charging takes approximately 12 hours, with power switched off.

9.3 User Precautions

1. When the balance is used for the first time after purchase, the operating time may be shorter than when using a fully charged battery. This is due to natural discharge of the battery. Although the balance can be used while <▯> is flashing, it should be recharged as soon as possible.

2. When the battery displays no indication, or an indication disappears quickly after the balance is switched on, battery capacity is low. In these cases, either charge the battery immediately or plug in the AC adapter.

3. Charging the battery while <▮> is displayed reduces battery life.

10. Cleaning the balance

DANGER	Do not wet the AC adapter.

CAUTION	(1) Do not remove any parts other than those described in this chapter. If the equipment needs to be dismantled and repaired, e.g. if foreign objects have been introduced inside, contact your local dealer. (2) Do not wash the balance with water.

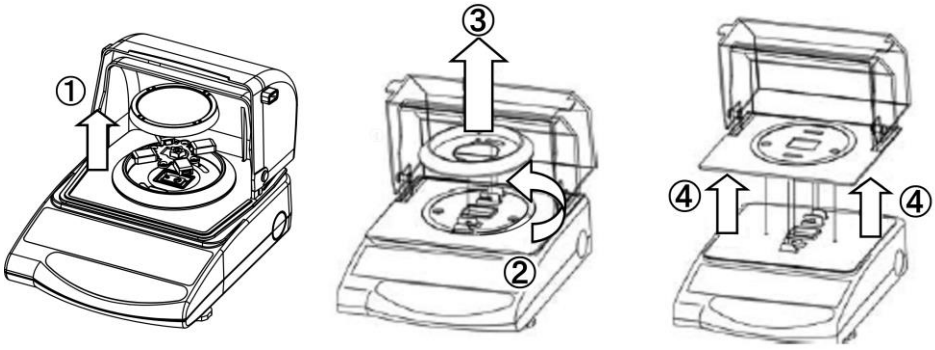
Note	(1) Take care not to let dust or liquid get inside the balance. (2) Take care not to apply excessive force to or impact the balance, especially the load-receptor. (3) Do not use volatile solvents to resin parts of the balance. If volatile solvents are used to clean the metal parts, care should be taken to ensure that they never contact the resin parts.

1 Disconnect the AC adapter from AC mains.

2 Disconnect the AC adapter and output cables.
If the area around the connector is contaminated with dust, remove the dust first and then disconnect the connectors, taking care not to let the dust get inside the connectors.

3 Remove the measurement pan, pan base, windshield ring and windshield, and clean them respectively.
If they are washed in water, wipe them well and allow them to dry.

> **Note**
> Spilled liquids remained on pan base and measurement pan will affect the weighing accuracy.



4 Wipe dirt from the balance with dry and soft cloth.
In the case of heavy soil, clean it with a piece of cloth slightly wet with neutral detergent.

11. Troubleshooting

Reference	If the trouble persists after following the procedures below, please contact the store you purchased.

Symptom	Cause	Possible remediation
There is no indication on the display.	• The AC adapter is not connected.	→ Check that the AC adapter is connected. cf. “3. Assembling and Installation”
The display is unstable. [M] remains flashing without changing.	• The balance is exposed to various environmental factors such as air currents, vibrations, electromagnetic wave etc.. • The balance is situated on an unstable surface. • A foreign object is contacting the sample being measured, the measurement pan, or the tare. • The pan base is not properly secured.	→ Review the measurement environment. cf. “1.2 For More Precise Measurements” → Ensure that no foreign objects are in contact. → Ensure that the pan base is firmly screwed to the load receptor. cf. “3. Assembling and Installation”
Weight indication contains an error.	• Not correctly levelled. • The pan base is not properly secured. • The balance is exposed to various environmental factors. • The balance has been moved to a new location. • Temperature or air pressure have changed since the last span adjustment.	→ Check the level. cf. “3. Assembling and Installation” → Ensure that the pan base is firmly screwed to the load receptor. cf. “3. Assembling and Installation” → Review the measurement environment. cf. “1.2 For More Precise Measurements” → Execute span adjustment. cf. “7. Adjusting the Balance”
<o-Err> is displayed.	• The gross weight exceeded the maximum capacity of the balance (Measurable Range = Maximum Capacity - Tare Weight).	→ Check the gross weight. → Replace the tare with a lighter one.
<u-Err> is displayed.	• The negative-value load is below the lower limit of indication.	→ Ensure that the pan base and measurement pan are properly set. cf. “3. Assembling and Installation” → Ensure that no foreign objects are in contact.
<b-Err> is displayed. <d-Err> is displayed.	• System error.	→ Contact your local dealer.
At span adjustment: <o-Err> is displayed. <1-Err> is displayed. <2-Err> is displayed.	• The calibration weight is heavier than the maximum capacity. • The calibration weight is less than approximately 10% of the maximum capacity. • Calibration produced an error of 1.0% or more.	→ Check the correct span adjustment procedure and use the appropriate calibration weight. cf. “7. Adjusting the Balance”

For balances with optional built-in rechargeable battery pack: The indication disappears. <▯> flashes. No indication is produced.	• The automatic power-off function is activated. • The battery capacity is low.	→ Switch on the power again. Deactivate the Automatic power-off function, if necessary. cf. “5.2 Description of Functions” → Recharge the battery. cf. “9. Operating the Balance with the Battery” → Operate the balance with the AC adapter.

12. Specifications

12.1 Metrological Specifications

Model	Max	Scale interval (d)	Calibration method	Pan size
CTB703	700 ct 140 g	0.001 ct 0.001 g	Span adjustment with external calibration weight	Ø118 mm

(1) Type of weighing sensor:
Tuning fork sensor
(2) Overload indication:
<o-Err> is displayed if the indication exceeds weight capacity by 9 scale intervals
(3) Zero-point adjustment:
(3-1) Initial zero setting
(3-2) Semi-automatic zero-setting with [Zero/Tare] key
(3-3) Automatic zero-tracking (Can be disabled via setting)
(4) Tare device:
Semi-automatic tare balancing with [Zero/Tare] key
- Type: Subtractive tare (Tare reduces the weighing range for net loads)
- Range: Beyond the zero-setting range and up to the maximum capacity (Max)
(5) Guaranteed temperature range for metrological performance:
5 °C to 35 °C

12.2 Display, Scale interval and Capacity by Each Unit of Weighing

Unit of measurement		Max	Scale interval
Name	Indication		
carat	ct	700	0.001
gram	g	140	0.001
ounce	oz	4.2	0.00005
pound	lb	0.26	0.00001
ounce troy	oz t	3.8	0.00005
pennyweight	dwt	77	0.001
grain	▶ of the lower right	1800	0.02
tael troy (Hong Kong)	tl	3.2	0.00005
tahil (Singapore / Malaysia)	tl and ▶ of the upper right	3.1	0.00005
tael (Taiwan)	tl and ▶ of the lower right	3.2	0.00005
momme	mom	32	0.0005
tola (India)	to	10	0.0001

12.3 Functional Specifications

(1) Liquid-crystal display (LCD)..... Seven segments (two segments in leading part)
Maximum digits indication: seven digits
Segment height: 16.5 mm
With backlight

(2) Operating temperature and humidity ranges .. 5 °C to 35 °C, 80%rh or less

(3) Altitude range..... 2000 m and under

(4) Pollution degree..... 2 and under

(5) Location of use ..... Indoor use only

(6) Input ratings..... AC adapter jack: 12 V⎓ / 1 A
Built-in rechargeable battery (optional): 5-12 V⎓

(7) AC adapter..... Dedicated AC adapter
100-240 V∼ ±10% / 50-60 Hz / 0.6 A

(8) Built-in rechargeable battery (optional)..... 6 V⎓ (nominal), 2100 mAh

(9) Output ..... RS-232C compliant output
(5-pin female DIN 41524 connector)

Manufacturer: SHINKO DENSHI CO., LTD.
Address: 1-52-1 Itabashi, Itabashi-ku, Tokyo 173-0004 Japan
If you need any support for this product, please contact your local dealer.

13. Conversion Table of Units

unit	gram	carat	ounce	pound	ounce troy	pennyweight
1 gram	1	5	0.03527	0.00220	0.03215	0.64301
1 carat	0.2	1	0.00705	0.00044	0.00643	0.12860
1 ounce	28.34952	141.74762	1	0.06250	0.91146	18.22917
1 pound	453.59237	2267.96185	16	1	14.58333	291.66667
1 ounce troy	31.10348	155.51738	1.09714	0.06857	1	20
1 pennyweight	1.55517	7.77587	0.05486	0.00343	0.05	1
1 grain	0.06480	0.32399	0.00229	0.00014	0.00208	0.04167
1 tael troy (Hong Kong)	37.429	187.145	1.32027	0.08252	1.20337	24.06741
1 tahil (Singapore, Malaysia)	37.79936	188.99682	1.33333	0.08333	1.21528	24.30556
1 tael (Taiwan)	37.5	187.5	1.32277	0.08267	1.20565	24.11306
1 momme	3.75	18.75	0.13228	0.00827	0.12057	2.41131
1 tola (India)	11.66380	58.31902	0.41143	0.02571	0.37500	7.5

unit	grain	tael troy (Hong Kong)	tahil (Singapore, Malaysia)	tael (Taiwan)	momme	tola (India)
1 gram	15.43236	0.02672	0.02646	0.02667	0.26667	0.08574
1 carat	3.08647	0.00534	0.00529	0.00533	0.05333	0.01715
1 ounce	437.5	0.75742	0.75	0.75599	7.55987	2.43056
1 pound	7000	12.11874	12	12.09580	120.95797	38.88889
1 ounce troy	480	0.83100	0.82286	0.82943	8.29426	2.66667
1 pennyweight	24	0.04155	0.04114	0.04147	0.41471	0.13333
1 grain	1	0.00173	0.00171	0.00173	0.01728	0.00556
1 tael troy (Hong Kong)	577.61774	1	0.99020	0.99811	9.98107	3.20899
1 tahil (Singapore, Malaysia)	583.33333	1.00990	1	1.00798	10.07983	3.24074
1 tael (Taiwan)	578.71344	1.00190	0.99208	1	10	3.21507
1 momme	57.87134	0.10019	0.09921	0.1	1	0.32151
1 tola (India)	180	0.31162	0.30857	0.31103	3.11035	1