

SV-10

Vibro Viscometer

INSTRUCTION MANUAL



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CONTENTS

1. INTRODUCTION	2
1-1 Features	2
1-2 Compliance	3
2. UNPACKING THE VISCOMETER	4
2-1 Unpacking	4
2-2 Installing the Viscometer	5
3. PRECAUTIONS.....	6
3-1 General Precautions	6
3-2 During Use	6
3-3 After Use	7
3-4 Measuring the Absolute Value of Viscosity	8
4. DISPLAY AND KEYS	9
4-1 Display	9
4-2 Keys	10
4-3 Displaying the Viscosity Values	11
5. MEASUREMENT.....	12
5-1 Preparing the Sample	12
5-2 Basic Measurement Procedure.....	13
5-3 Changing Units.....	14
6. VISCOSITY CALIBRATION.....	15
6-1 Notes on Viscosity Calibration	15
6-2 Calibration Procedure	15
7. FUNCTION SETTING	19
7-1 Operation	19
7-2 Details of the Function Items	21
7-3 Description of Items	22
7-4 Data Output Format Examples	31
8. CONNECTION TO A PERSONAL COMPUTER	37
9. CONNECTION TO A PRINTER	37
10. RS-232C SERIAL INTERFACE	38
11. COMMAND LIST.....	39
12. TROUBLESHOOTING	40
13. Error Display	42
14. SPECIFICATIONS.....	43
15. EXTERNAL DIMENSIONS	44

1. INTRODUCTION

This manual describes how the viscometer SV-10 works and how to get the most out of it in terms of performance.

Read this manual thoroughly before using the viscometer and keep it at hand for future reference.

1-1 Features

High accuracy

Achieves a measurement accuracy of $\pm 3\%^{*1}$ in the range of 1 to 1000 mPa·s and repeatability (standard deviation) of $1\%^{*1}$, with Sine-wave Vibro Viscometer.

^{*1} Right after calibration using a standard viscosity fluid

Wide range continuous measurement

Continuous measurement over a wide range of viscosity, from a low of 0.3 mPa·s up to 10000 mPa·s is possible, without replacing the viscosity detection sensor plates.

Standard temperature sensor

The temperature sensor to measure the sample temperature is installed as standard. The temperature sensor is located between the two sensor plates. So, the accurate detection of the relation between temperature and viscosity is possible.

Accurate measurement

Due to the low heat capacity of the viscosity detection unit (sensor plates and temperature sensor), the time required for temperature equilibrium is short. Thus, the sample viscosity can be measured accurately.

Long continuous measurement time

The sensor plates, with a low frequency of 30 Hz and an amplitude of less than 1 mm, apply very little load to the sample. So, almost no rise in the sample temperature occurs during measurement. This allows continuous measurement of viscosity for long periods of time.

Measurement of a non-Newtonian fluid/sample containing bubbles

A thin plate type sensor does not deform the sample composition. Thus, non-Newtonian fluid can be measured in a stable way. And, a sample containing bubbles can be measured without breaking the bubbles.

Measurement of a stirred or flowing sample

The two sensor plates oscillate in the opposite direction. So, even when a sample is in motion, errors are eliminated. This allows measurement of a sample while being stirred. The viscometer can be used for a flowing product line, so data management, which is compatible to on-site and the laboratory, is possible.

Calibration

The viscometer can be calibrated using a standard viscosity fluid or a sample of a known viscosity. Calibration allows the viscometer to maintain the accuracy constantly.

By calibrating an actual sample, using the viscosity value obtained by another type of viscometer as a correction value, the measurement data obtained by the SV-10 can be combined into those obtained by the other type of viscometer.

Standard windows communication tools WinCT-Viscosity

Windows communication tools WinCT-Viscosity (CD-ROM) is provided as standard. The CD-ROM contains the graphing program RsVisco, which sends the data to a personal computer, which can display the results as a graph in real time. With RsVisco, changes in viscosity over time and temperature dependency of viscosity can be observed easily and the obtained data can be saved in files.

1-2 Compliance

Compliance with FCC Rules

Please note that this equipment generates, uses and can radiate radio frequency energy. This equipment has been tested and has been found to comply with the limits of a Class A computing device pursuant to Subpart J of Part 15 of FCC rules. These rules are designed to provide reasonable protection against interference when equipment is operated in a commercial environment. If this unit is operated in a residential area, it might cause some interference and under these circumstances the user would be required to take, at his own expense, whatever measures are necessary to eliminate the interference.

(FCC = Federal Communications Commission in the U.S.A.)

Compliance with Council Directives



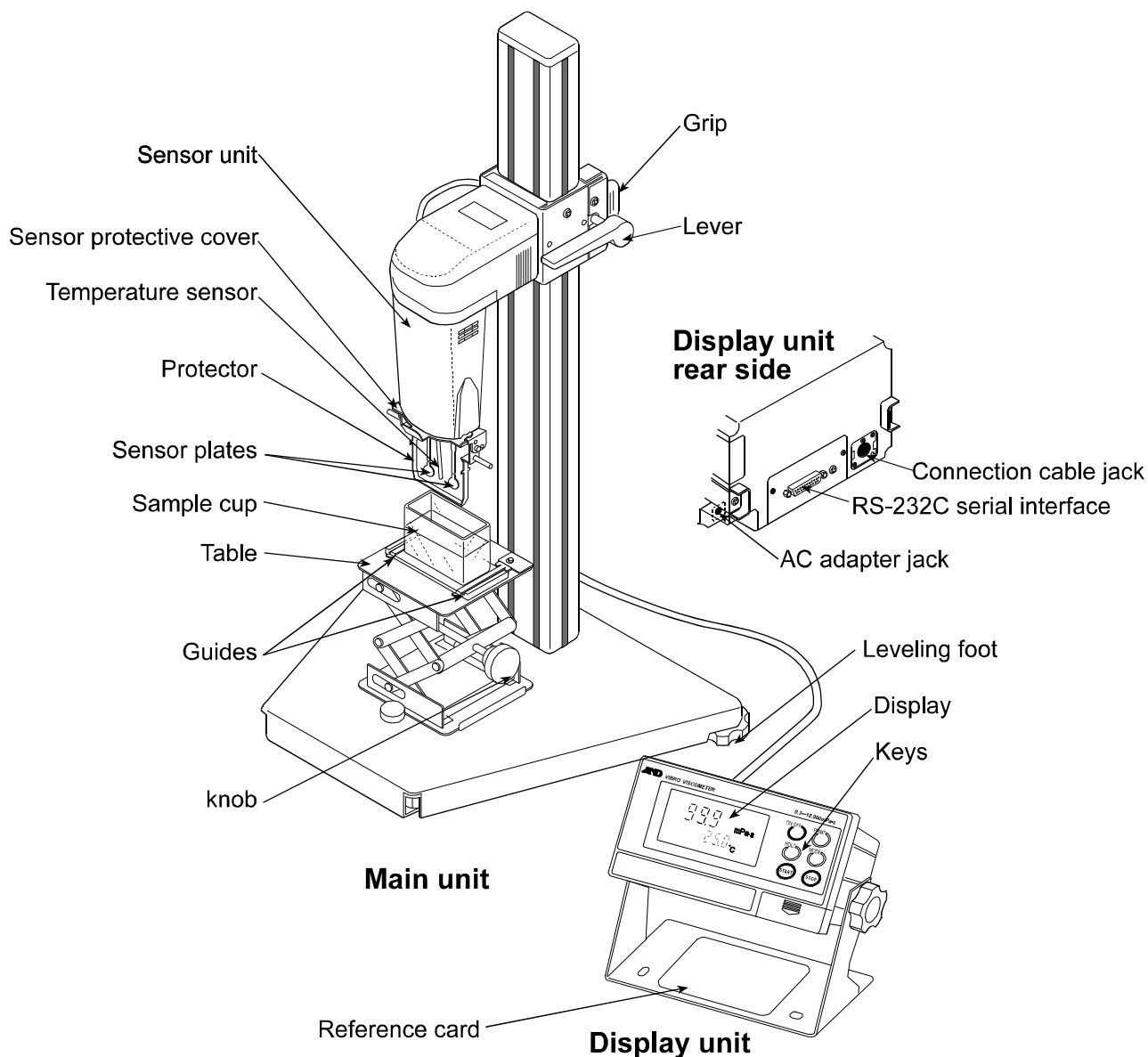
This device features radio interference suppression and safety regulation in compliance with the following Council Directives.

Council Directive 89/336/EEC EN61326 EMC Directive

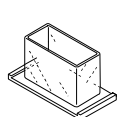
2. UNPACKING THE VISCOMETER

2-1 Unpacking

- ✎ The viscometer is a precision instrument. Unpack the viscometer carefully. Keep the packing material to be used for transporting the viscometer in the future.



Accessories



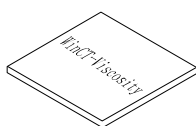
Sample cup (4 pcs)



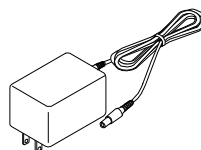
Connection cable (1 pc)



RS-232C cable (1 pc)
25P-9P for modem



Windows communication tools
WinCT-Viscosity (1 pc)



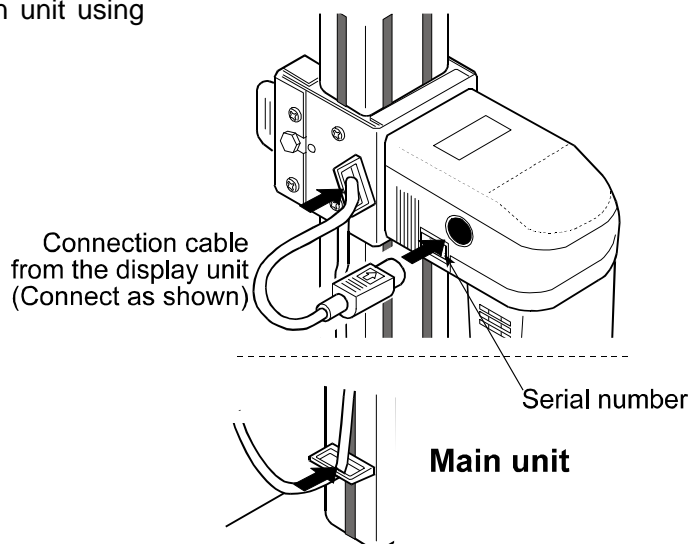
AC adapter (1 pc)

Note
Please confirm that the
AC adapter type is correct
for your local voltage and
receptacle type.

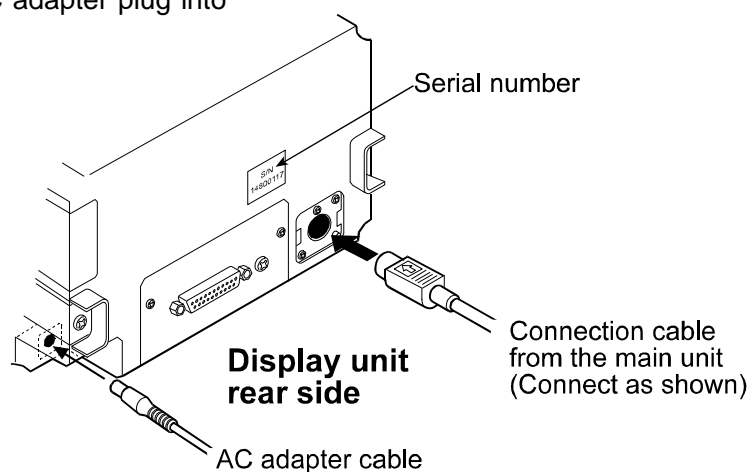
2-2 Installing the Viscometer

Install the viscometer as follows:

- 1 Connect the display unit to the main unit using the connection cable.



- 2 Insert the AC adapter plug into the AC adapter jack located on the rear side of the display unit. Insert the other end of the AC adapter plug into an electrical outlet.



Note:

- ? Confirm that the adapter type is correct for the local voltage and power receptacle type.
- ? The main unit and the display unit have been adjusted in pairs. For accurate viscosity measurement, before use, confirm that the main unit and the display unit have the same serial number.

3. PRECAUTIONS

To get the optimum performance from the viscometer and acquire accurate measurement data, note the following:

3-1 General Precautions

- ✂✂ Install the viscometer in an environment where the temperature and humidity are not excessive. The best operating temperature is 25°C±2°C at 45-60% relative humidity.
- ✂✂ Install the viscometer where it is not exposed to direct sunlight and it is not affected by heaters or air conditioners.
- ✂✂ Install the viscometer where it is free of dust.
- ✂✂ Install the viscometer away from equipment which produces magnetic fields.
- ✂✂ The viscometer uses the Tuning-fork Vibration method. So, avoid external vibration. Use a solid operation table.
- ✂✂ Install the viscometer in a stable place avoiding vibration and shock. Corners of rooms on the first floor are best, as they are less prone to vibration.
- ✂✂ Protect the internal parts from liquid spills and excessive dust.
- ✂✂ Do not disassemble the viscometer.

3-2 During Use

- ✂✂ To level the surface of the measuring sample, adjust the leveling feet so that the center of the narrow part of the right and left sensor plates is on the liquid surface.
- ✂✂ Ensure a stable power source when using the AC adapter.
- ✂✂ Do not use a sharp instrument such as a pencil to press the keys. Use only your finger.

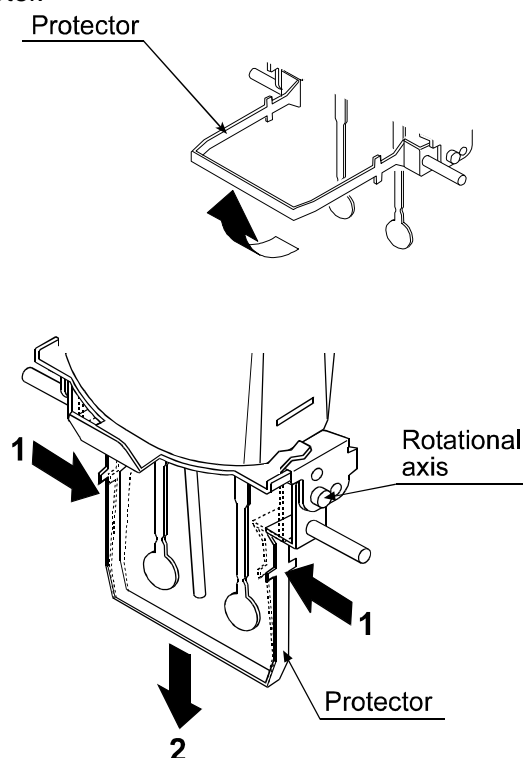
- ✂✂ The sample cup is made of polycarbonate (PC) and is not appropriate for organic solvents. When organic solvents are used as a sample fluid, do not use the accessory sample cup, but use a beaker.

The protector can be raised. So, even when a beaker is used, the viscosity can be measured with a small amount of sample.

The protector can also be removed as shown to the right.

How to remove the protector:

Press the left and right side frames lightly in the direction indicated as 1 to remove the rotational axis. Pull the protector in the direction indicated as 2 to remove.



3-3 After Use

✂✂ Remove any residual sample material from the sensor plates, temperature sensor and protector using solvents. Using the sensor plates, temperature sensor and protector with residue of an old sample left on will cause a measurement error.

Clean the sensor plates carefully to avoid bending them.

The sensor plates, temperature sensor and protector are made of stainless steel (SUS304).

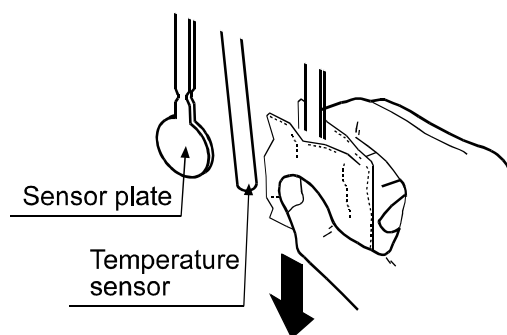
✂✂ Clean the sample cup as necessary.

✂✂ Unlock the cable connector before disconnecting the connection cable.

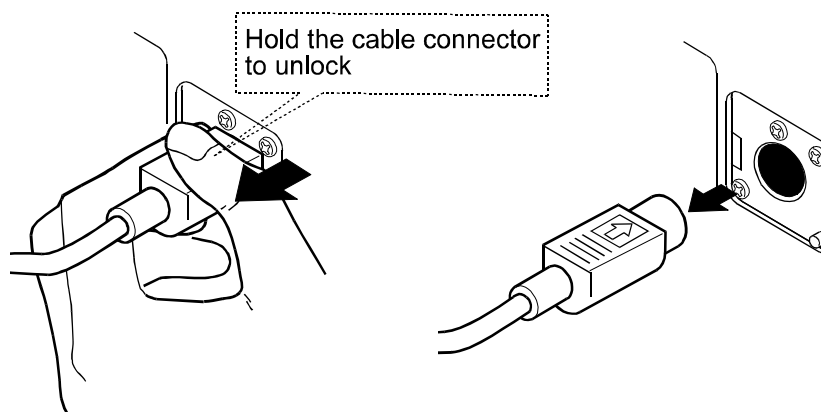
How to clean the sensor plates and temperature sensor

Hold the sensor plate or temperature sensor with tissue paper. Move the tissue paper downward to remove the sample.

Then, use tissue paper moistened with a solvent, to remove any residual sample material.



How to unlock the cable connector



3-4 Measuring the Absolute Value of Viscosity

The SV-10, Sine-wave Vibro Viscometer, detects the product of viscosity and specific gravity as a measuring principle. The viscometer was adjusted before shipment to display the viscosity at a liquid specific gravity of 1 (apparent viscosity).

To obtain the absolute viscosity value of the Newtonian fluid precisely, do as follows:

At measurement

Divide the displayed viscosity value (η_D) by the sample specific gravity (γ_M) to obtain the absolute value of viscosity (η_M).

Example (1) Measure the sample and confirm the displayed viscosity value (η_D).

Here, 73.6 mPa·s as an example.

(2) Check the sample specific gravity (γ_M) at the temperature when the sample is measured.

Here, 0.856 as an example.

(3) Divide the displayed viscosity value (η_D) by the sample specific gravity (γ_M) to obtain the absolute value of viscosity (η_M).

Here, 86.0 mPa·s is obtained as the absolute viscosity value.

$$\begin{aligned}\text{Absolute value of viscosity } (\eta_M) &= \frac{\text{Displayed viscosity value}}{(\eta_D)} \\ &= \frac{73.6}{0.856} \approx 86.0 \text{ mPa}\cdot\text{s}\end{aligned}$$

At calibration

Enter the product of the absolute viscosity value (η_R) and the specific gravity (γ_R) of the standard viscosity fluid used for calibration, as a correction value.

Example (1) Check the absolute viscosity value (η_R) of the standard viscosity fluid at the temperature when the calibration is performed.

Here, 436 mPa·s as an example.

(4) Check the sample specific gravity (γ_R) at the temperature when the calibration is performed.

Here, 0.871 as an example.

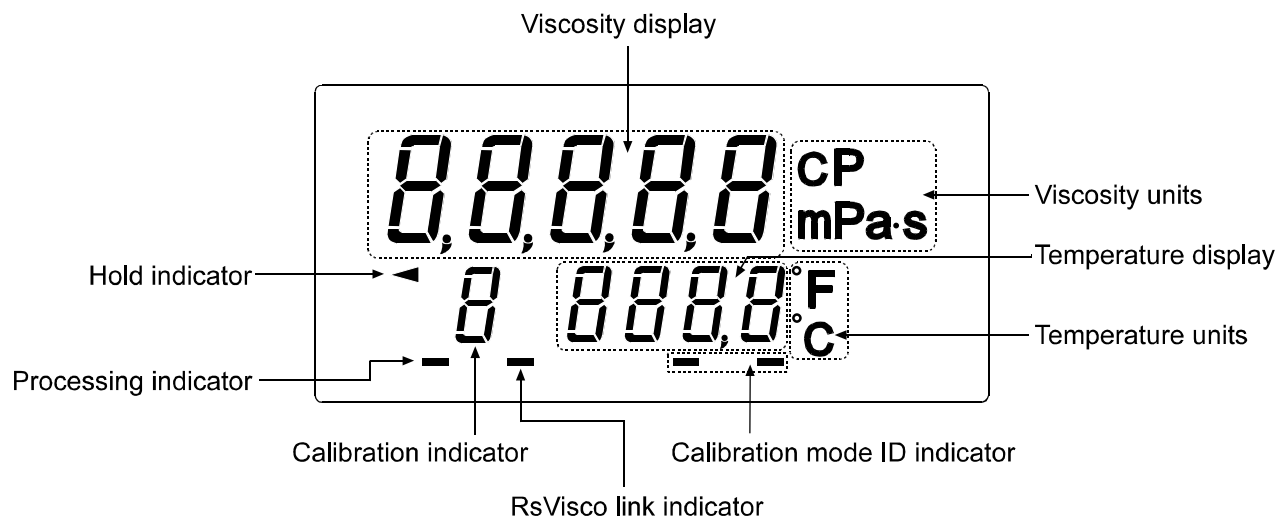
(5) Enter the product of the viscosity value (η_R) and the specific gravity (γ_R) as a correction value.

Here, 380 mPa·s is obtained as the correction value.

$$\begin{aligned}\text{Correction value} &= \text{Viscosity of the standard viscosity fluid } (\eta_R) \times \text{Specific gravity of the} \\ &\quad \text{standard viscosity fluid } (\gamma_R) \\ &= 436 \times 0.871 \approx 380 \text{ mPa}\cdot\text{s}\end{aligned}$$

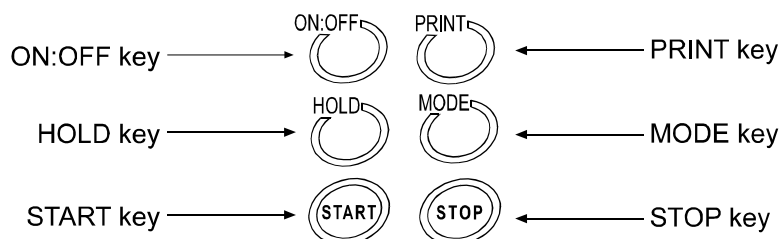
4. DISPLAY AND KEYS

4-1 Display



Name	Description		
Viscosity display	Standby mode	Displays [- - - -].	
	Measurement mode	Displays the viscosity value in real time.	
	Data hold mode	Freezes the display of the viscosity value.	
Viscosity units	Displays the unit of viscosity.		
Temperature display	Standby mode	Displays the temperature value in real time.	
	Measurement mode		
	Data hold mode	Freezes the display of the temperature value.	
Temperature units	Displays the unit of temperature.		
Processing indicator	Blinks while the measurement is being performed. (While the sensor plates are in vibrating motion)		
Hold indicator	Illuminates while the viscometer is in the data hold mode.		
RsVisco link indicator	Illuminates while measurement is performed using RsVisco, the graphing program contained in the WinCT-Viscosity (CD-ROM).		
Calibration indicator	Displays " C " in the calibration mode.		
Calibration mode ID indicator	At one-point calibration		Blank display []
	At two-point calibration	Inputting first point	Displays [-].
		Inputting second point	Displays [- -].

4-2 Keys



Key	Description
ON:OFF Power	Turns the power on and off. When the power is turned on, the viscometer enters the standby mode ([- - - -] is displayed.)
START Start measurement	Start a measurement. (The processing indicator blinks.) Displays the viscosity and temperature values in real time during measurement.
STOP Stop measurement	Stops the measurement (The processing indicator is off) and freezes the display of the viscosity and temperature values at the time the STOP key is pressed during measurement. When the STOP key is pressed again, the viscometer enters the standby mode.
HOLD Data hold	Freezes temporarily the display of the measurement data (viscosity and temperature) at the time the HOLD key is pressed during measurement. (The hold indicator is on.) In the above condition, the measurement is continued. (The processing indicator blinks.) Pressing the HOLD key again releases the data hold mode. ?1
MODE Change units	Changes viscosity units. ?1 (By the function setting "fnc 1", the measurement elapsed time can be displayed.)
PRINT Output data	Outputs the measurement data.

?1 While the measurement is being performed using the graphing program RsVisco, the data hold mode using the **HOLD** key and unit changes using the **MODE** key are not available. RsVisco is contained in the accessory Windows communication tools, WinCT-Viscosity.

While data are being output continuously (function setting "prt 2" or SIR command), the data hold mode using the **HOLD** key is not available.

4-3 Displaying the Viscosity Values

The viscosity values are displayed as below, depending on the unit selected and the viscosity range.

Use the **[MODE]** key to switch between mPa·s (Millipascal second) and Pa·s (Pascal second), or between cP (Centipoise) and P (Poise).

The unit selected at the factory before shipment is mPa·s.

When the viscosity unit is mPa·s or Pa·s:

Viscosity measured	Unit selected							
	mPa·s				Pa·s			
	Display	Minimum display	Unit	Remarks	Display	Minimum display	Unit	Remarks
1	0.03 ? 1.00 9.99	0.01	mPa·s		0.0003 0.0010 0.0099	0.0001	Pa·s	Digit indicating 0.01 mPa·s is not displayed
10	10.0 99.9	0.1			0.0100 0.0999	0.0001		
100	100 999	1			0.100 0.999	0.001		
1000	1.00 10.00	0.01			1.00 10.00	0.01		
10000			Pa·s	Switches to Pa·s				

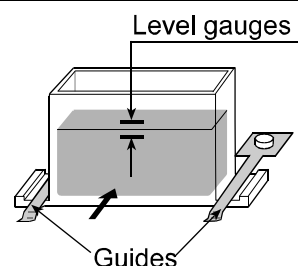
When the viscosity unit is cP or P:

Viscosity measured	Unit selected							
	cP				P			
	Display	Minimum display	Unit	Remarks	Display	Minimum display	Unit	Remarks
1	0.03 1.00 9.99	0.01	cP		0.0030 0.0100 0.0999	0.0001	P	
10	10.0 99.9	0.1			0.100 0.999	0.001		
100	100 999	1			1.00 9.99	0.01		
1000	1 0.0 100.0	0.1			10.0 100.0	0.1		
			P	Switches to P				

5. MEASUREMENT

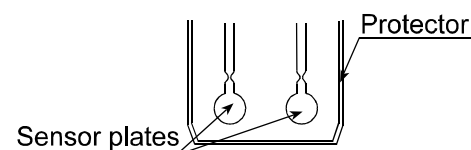
5-1 Preparing the Sample

- 1 Pour the sample into the cup until its surface reaches between the level gauges. The level gauges indicate 35 and 45 mL.
- 2 Attach the cup on the table along the guides.

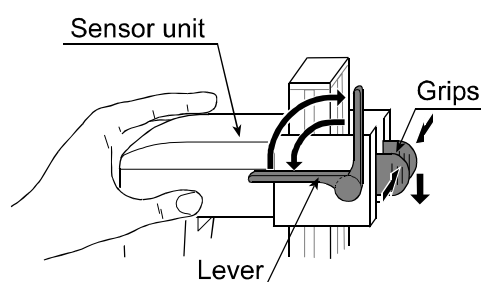


- 3 Confirm that the protector is in the position as shown in the figure.

Raise the lever to release the sensor plates.

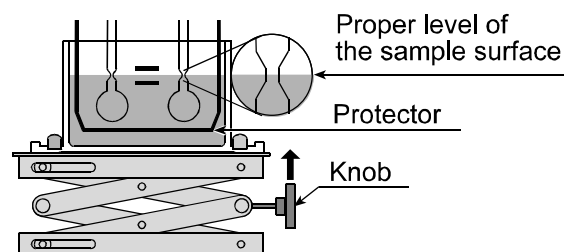


- 4 Pinch the grips, support the front side of the sensor unit and gently lower the sensor plates above the sample surface.



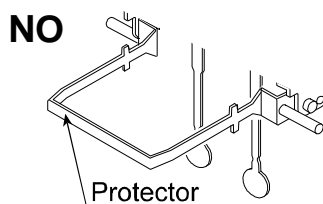
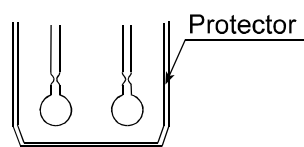
- 5 Lower the lever to secure the sensor plates.

- 6 Turn the knob so as to adjust the sample surface to the center of the narrow part of the sensor plates.



Note

Use the protector in the position as shown below. If the protector is not used, a measurement error may occur, especially in measuring a viscosity over 5000 mPa·s.



When the positions of the sensor plates in the liquid surface are not the same, level the viscometer using the leveling feet so that the liquid surface will be leveled.

5-2 Basic Measurement Procedure

- 1 With the power turned off, press the **ON:OFF** key.

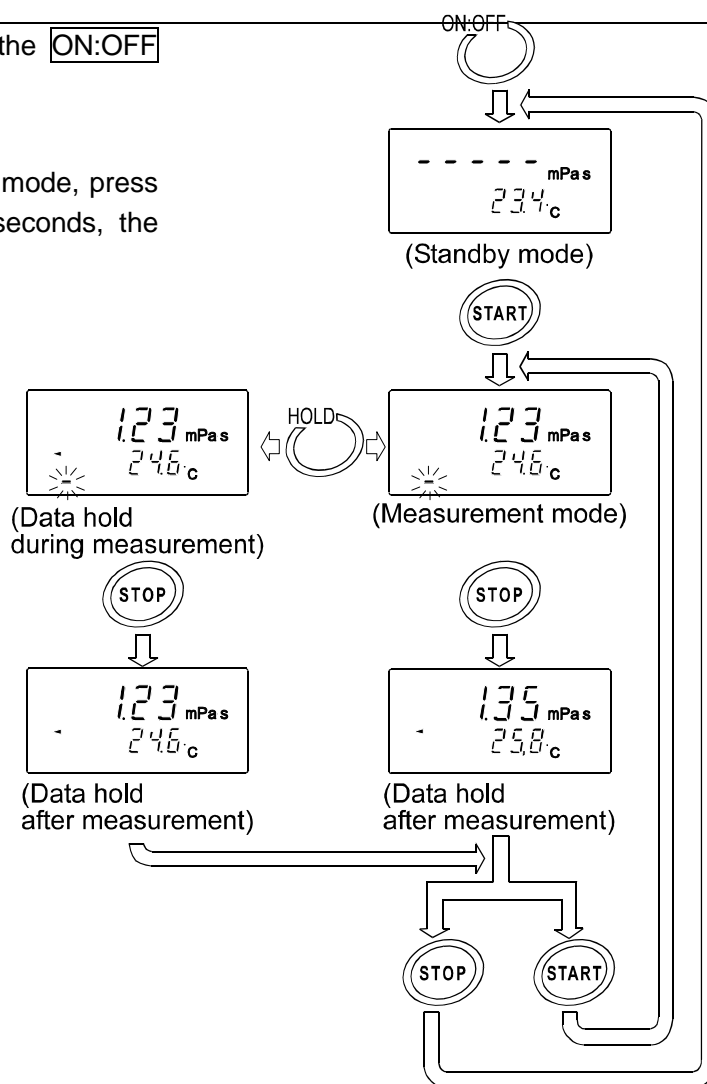
- 2 When the display is in the standby mode, press the **START** key. After about 15 seconds, the measurement values are displayed.

- 3 During measurement, press the **HOLD** key as necessary, to freeze the display temporarily.

To release the data hold mode, press the **HOLD** key again. *1

- 4 Press the **STOP** key to stop the measurement. The measurement results freeze and are displayed.

- 5 To stop the measurement, press the **STOP** key. To go on to the next measurement, set the sample and press the **START** key.



When the viscosity value is below the measuring range, **S1 TOP** is displayed.

When the viscosity value exceeds the measuring range, **SH TOP** is displayed.

If the sensor plates are not in vibrating motion for about 20 seconds, for example, when the sample solidifies, the measurement will stop automatically.

- ?1 While the measurement is being performed using the graphing program RsVisco or data are being output continuously (function setting "prt 2" or SIR command), the data hold mode using the **HOLD** key is not available.

5-3 Changing Units

The units of viscosity available are: mPa·s (millipascal second),

Pa·s (Pascal second),

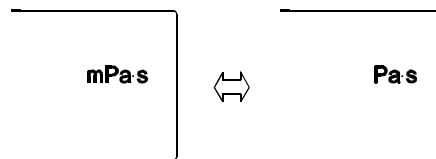
cP (Centipoise),

P (Poise).

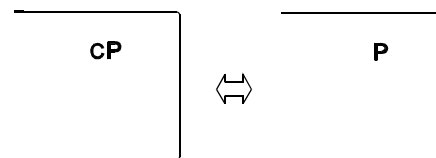
Units which can be changed by key operation depend on the function setting. Note that the unit of temperature is fixed in the function setting.

Use the **MODE** key to change units. Each time the **MODE** key is pressed, units are switched as below:

Ex In the function setting, mPa·s or Pa·s is selected:



Ex In the function setting, cP or P is selected:



The correlation of the units are as follows: 1 mPa·s = 0.001 Pa·s = 1 cP = 0.01 P

Note

While the measurement is being performed using the graphing program RsVisco, the data hold mode using the **HOLD** key is not available.

With the function setting "fnc 1", pressing the **MODE** key during measurement will display the measurement elapsed time.

6. VISCOSITY CALIBRATION

- ✂✂ Viscosity calibration is to correct the deviation of the measured value.
- ✂✂ In the calibration mode, viscosity of a fluid with a known viscosity, such as a standard viscosity fluid, is measured, displayed, corrected digitally and saved using the SV-10.
- ✂✂ It is recommended that calibration be performed using a viscosity value which is close to the sample viscosity.
- ✂✂ Two calibration methods are available: one-point calibration and two-point calibration.
Two-point calibration is recommended when the measuring range is great.
For two-point calibration, two standard viscosity fluids (high viscosity and low viscosity) appropriate for the measuring range are required.
- ✂✂ If the wrong calibration data such as the viscosity value have been entered, the viscometer condition can be restored. For details, refer to "Initialization (CLr)" of the function setting.

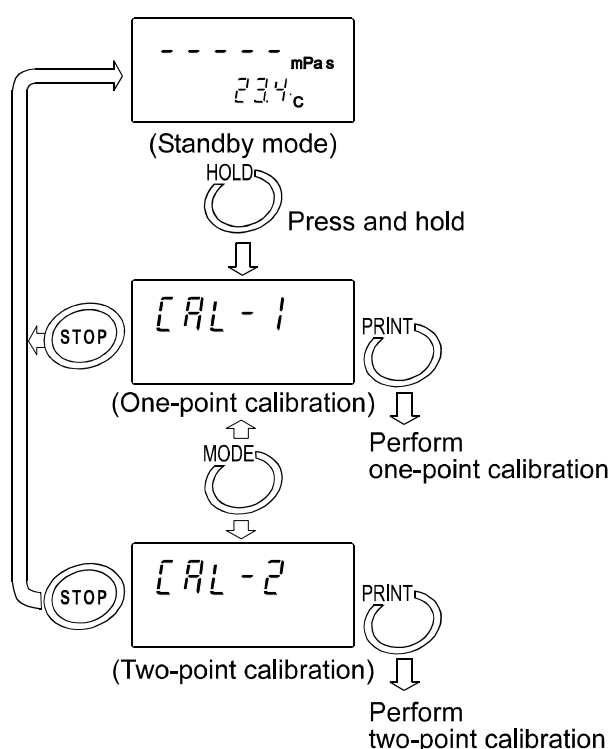
6-1 Notes on Viscosity Calibration

- ✂✂ Enter the temperature-compensated viscosity value. Even a standard viscosity fluid has a viscosity change of 5%/°C when the room temperature changes.
- ✂✂ The temperature of the standard fluid must be the same as the temperature of the sensor plates and the temperature sensor. Allow the displayed temperature to stabilize before calibration.
- ✂✂ In the calibration mode, the units of viscosity and temperature are fixed to mPa·s and °C.
- ✂✂ The viscometer has been calibrated with the protector attached when shipped. Please note that the value, obtained when the viscometer is calibrated without the protector, is different from that upon shipment.

6-2 Calibration Procedure

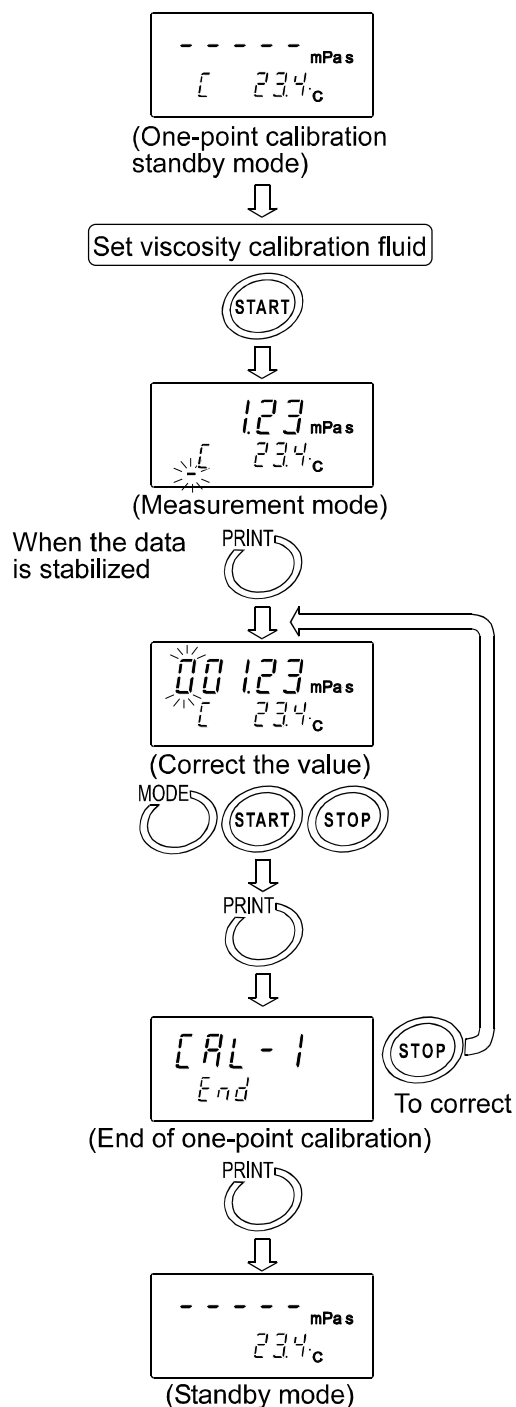
Selecting the Calibration Mode

- 1 In the standby mode, press and hold the **HOLD** key to enter the calibration mode ("Cal" appears.)
- 2 Use the **MODE** key to switch between the calibration modes, one-point calibration (Cal-1) or two-point calibration (Cal-2).
Press the **PRINT** key to select the calibration mode. The standby mode of the selected calibration mode appears.
- 3 Press the **STOP** key to exit the calibration mode. The display returns to the standby mode.



Performing One-point Calibration

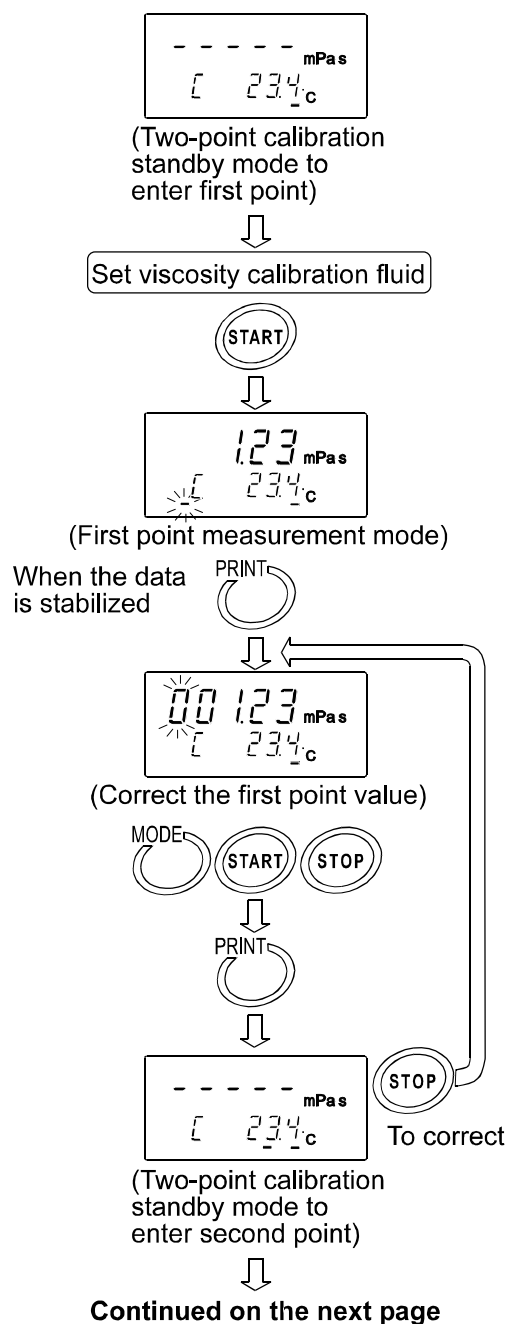
- 1 Make sure that the display is in one-point calibration standby mode.
- 2 Set the viscosity calibration fluid. Press the **START** key to start a measurement.
- 3 After the measurement, wait for the display to be stable and press the **PRINT** key. The measurement value blinks and is ready to be corrected.
- 4 Correct the value using the following keys:
 - MODE** key Switches the blinking digits.
 - START** key Changes the setting of a blinking digit.
 - STOP** key Moves the decimal point.
- 5 Press the **PRINT** key to confirm the correction value.
- 6 To exit the calibration mode:
 - With "end" being displayed, press the **PRINT** key to return to the standby mode.
 - To correct the value:
 - With "end" being displayed, press the **STOP** key and correct the value.



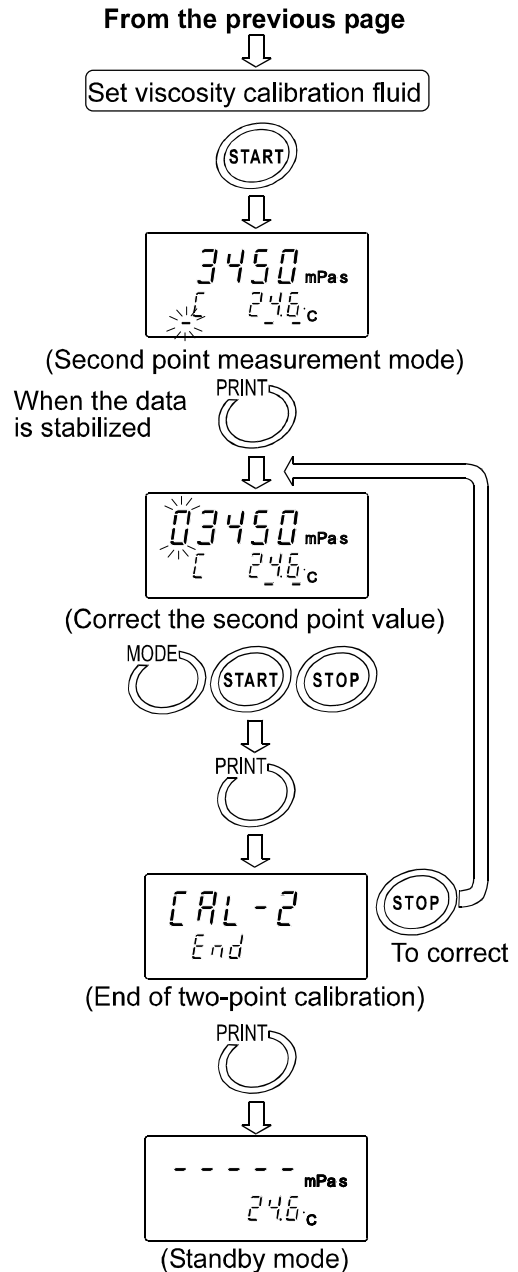
Performing Two-point Calibration

- 1 Make sure that the display is in two-point calibration standby mode. In two-point calibration mode, the calibration mode ID indicator (-) appears below the temperature display.
- 2 Set the viscosity calibration fluid. Press the **START** key to start the measurement of the first point.
- 3 After the measurement, wait for the display to become stable and press the **PRINT** key. The measurement value blinks and is ready to be corrected.
- 4 Correct the value using the following keys:

MODE key	Switches the blinking digits.
START key	Changes the setting of a blinking digit.
STOP key	Moves the decimal point.
- 5 Press the **PRINT** key to confirm the correction value.
- 6 To correct the value:
In the calibration standby mode to enter the second point, press the **STOP** key and correct the value.
- 7 When calibration of the first point has completed, clean the sensor plates, temperature sensor and protector and prepare the second viscosity calibration fluid.



- 8 Set the second viscosity calibration fluid, press the **START** key to start the measurement of the second point.
- 9 After the measurement, wait for the display to become stable and press the **PRINT** key. The measurement value blinks and is ready to be corrected.
- 10 Correct the value using the following keys:
 - MODE** key Switches the blinking digits.
 - START** key Changes the setting of a blinking digit.
 - STOP** key Moves the decimal point.
- 11 Press the **PRINT** key to confirm the correction value.
- 12 To exit the calibration mode:
 - With "end" being displayed, press the **PRINT** key to return to the standby mode.
 - To correct the value:
 - With "end" being displayed, press the **STOP** key and correct the value.



7. FUNCTION SETTING

The viscometer, by selecting functions to be used in the function setting, can specify the performance appropriate to the usage.

Each function is assigned parameters. The performance of a function is specified by changing the parameter.

The parameters saved, even if the power is turned off, are maintained in non-volatile memory.

7-1 Operation

The operational procedure of the function setting is as follows:

- 1 In the standby mode, press and hold the **MODE** key to enter the function setting mode.
- 2 Press the **MODE** key to select a function item.
- 3 Press the **PRINT** key to confirm the function item. The changeable digit blinks.
- 4 Press the **START** key or **HOLD** key to change the blinking digit.
START key Increases the value of the blinking digit. When the value reaches the upper limit of the setting range, the minimum value appears again.
HOLD key Decreases the value of the blinking digit. When the value reaches the lower limit of the setting range, the maximum value appears again.
- 5 To save the new setting, press the **PRINT** key. After " end ", the next item is displayed.
To cancel the new setting, press the **STOP** key. The next item is displayed.
- 6 To change other settings, repeat the procedure starting at step 2.
- 7 To exit the function setting mode, press the **STOP** key. The viscometer returns to the standby mode.

Note

The operational procedures for setting the date and time ("Cladj"), ID number ("id") and initialization ("Clr") are not the same as the procedure described above. Refer to "7-3 Description of Items".

"Date/Time" pages 22-24

"Device ID Number" pages 28-29

Example of the function setting procedure

To change the setting of "Unit upon power-on (Unit)" to the viscosity: cP (Centipoise) and the temperature: °C (Celsius).

- 1 In the standby mode, press and hold the **MODE** key to enter the function setting mode. "Cladj" appears.

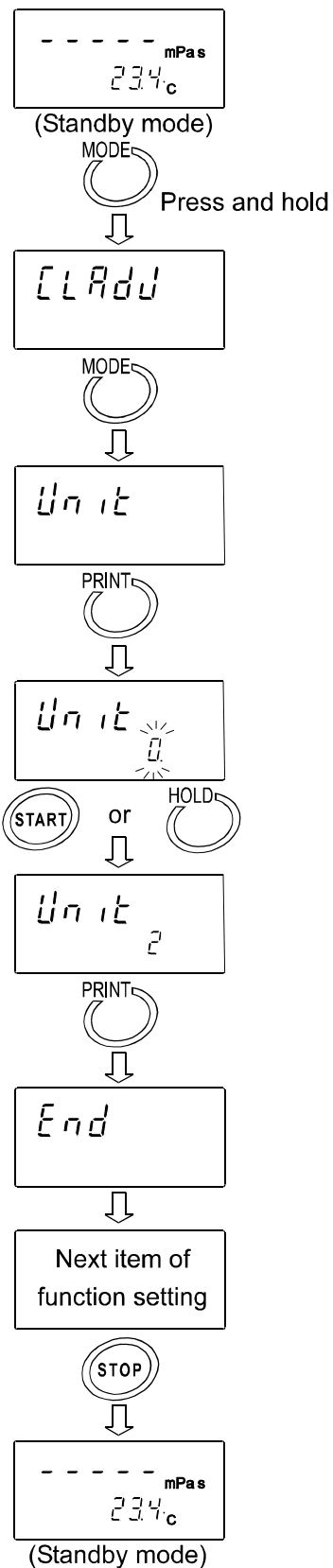
- 2 Press the **MODE** key to select "Unit".

- 3 Press the **PRINT** key to confirm the item.
(The decimal point illuminates when the setting currently saved is displayed.)

- 4 Press the **START** key or **HOLD** key to select the unit to be used.
(In this example, "2" is selected. Viscosity: cP, Temperature: °C)

- 5 Press the **PRINT** key to save the setting.
After "end", the next item is displayed.

- 6 Press the **STOP** key to return to the standby mode.



7-2 Details of the Function Items

Function	Parameter	Description					
Cladj Date/Time		Sets the order of the date (YMD,MDY,DMY) and the date/time.					
Cond	0	Follows the viscosity changes quickly. (Prone to vibration)					
Condition	1 ?	<div>↓</div>					
	2						
Unit	0 ?	Viscos-ity	mPa's	Temper-ature	°C	MODE key *1	Switches between mPa's/Pa's.
Unit upon power-on	1		Pa's				Switches between cP/P.
	2		cP				Switches between mPa's/Pa's.
	3		P				Switches between mPa's/Pa's.
	4		mPa's		°F		Switches between mPa's/Pa's.
	5		Pa's				Switches between cP/P.
	6		cP				Switches between cP/P.
	7		P				Switches between cP/P.
pnt	0 ?	Dot				With "Comma" selected, the separator for CSV format will be ";" (semicolon).	
Decimal point	1	Comma					
fnc	0 ?	Switches viscosity units.					
MODE key function during measurement	1	Switches between the temperature display and the measurement elapsed time display.					
prt	0 ?	Key mode				Press the PRINT key to output data.	
Data output mode	1	Auto print mode				Outputs automatically when the STOP key ends the measurement.	
	2	Stream mode				Continuous output during measurement. Outputs the viscosity only when D.P. format is selected.	
type	0	A&D standard format				For AD-8121 MODES 1&2	
Data output format	1 ?	D.P. format				For AD-8121 MODE 3	
	2	CSV format				For a personal computer	
	3	RsVisco format				For graphing program RsVisco	
5-at	0	No output				Available only for D.P. format	
Measurement elapsed time output	1 ?	Output					
5-td	0	No output				Available only for D.P. and CSV formats	
Date/time output	1 ?	Output					
5-ed	0	No output				Available only for D.P. format	
Other output	1	Outputs remarks.					
	2 ?	Outputs remarks, Device ID information and signature.					
	3	Outputs ID number.				Available only for CSV format	
pU5e	0	No pause					
Pause at data output	1 ?	Pause (Approx. 2 seconds)					
erfnc	0 ?	Usually use this parameter.					
Reserved	1						
	7						
id		Set the device ID number.				With "5-ed", the device ID information is added to the measurement data.	
Device ID number							
Clr		Restores to the factory setting.					
Initialization							

? Factory setting

*1 While the measurement is being performed using the graphing program RsVisco, unit

changes using the **MODE** key is not available.

RsVisco is contained in the accessory Windows communication tools, WinCT-Viscosity.

7-3 Description of Items

Date/Time (Cladj)

The upper two digits of the year are not displayed. For example, the year 2003 is displayed as "03".

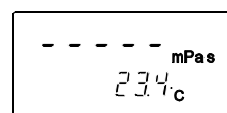
The time is set using the 24-hour system.

Do not enter a non-existing date and time.

Set the order of the date, the date and time as follows:

(Example: To change April 5, 2003, 11:22:33 to June 8, 2004, 12:34:00)

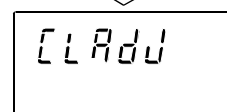
- 1 In the standby mode, press and hold the **MODE** key to enter the function setting mode. "Cladj" appears.



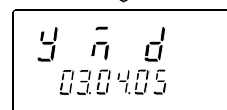
(Standby mode)



Press and hold



- 2 Press the **PRINT** key to display the current date. When the date is not to be changed, press the **MODE** key to display the current time.



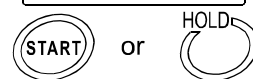
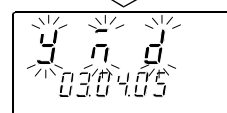
(Current date display)



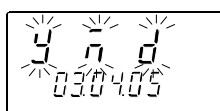
To current time display (Go to page 24)

Changing the order of the date

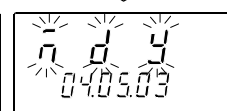
- 3 Press the **PRINT** key. "Y" (Year), "m" (Month) and "d" (Day) blink.



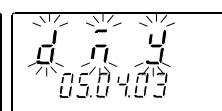
- 4 Press the **START** key or **HOLD** key to change the order of displaying the date.



(Year/Month/Day)



(Month/Day/Year)



(Day/Month/Year)



Continued on the next page

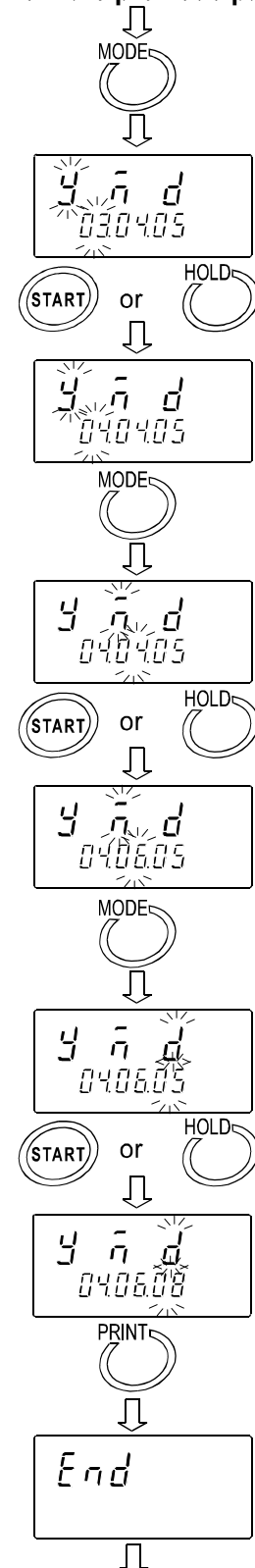
Changing the date

The date is changed in the selected displaying order.

The following is an example when the order of " y " (Year), " m " (Month) and " d " (Day) is selected.

- 5 Press the **MODE** key to select the setting value of " y " (Year). (Example:03)
- 6 Press the **START** key or **HOLD** key to change the year. (Example:03? 04)
START key Increases the value of the blinking digit by one.
HOLD key Decreases the value of the blinking digit by one.
- 7 Press the **MODE** key to select the setting value of " m " (Month). (Example:04)
- 8 Press the **START** key or **HOLD** key to change the month. (Example:04? 06)
- 9 Press the **MODE** key to select the setting value of " d " (Day). (Example:05)
- 10 Press the **START** key or **HOLD** key to change the day. (Example:05? 08)
- 11 Press the **PRINT** key to save the date.
 After " end ", the current time is displayed.

From the previous page



Continued on the next page

Changing the time

- 12 The current time is displayed. Press the **MODE** key to display the current date.

To current date display
(Go to page 22)

From the previous page

- 13 Press the **PRINT** key to select the setting value of the hour. (Example:11)

- 14 Press the **START** key or **HOLD** key to change the hour. (Example:11? 12)

- 15 Press the **MODE** key to select the setting value of the minute. (Example:22)

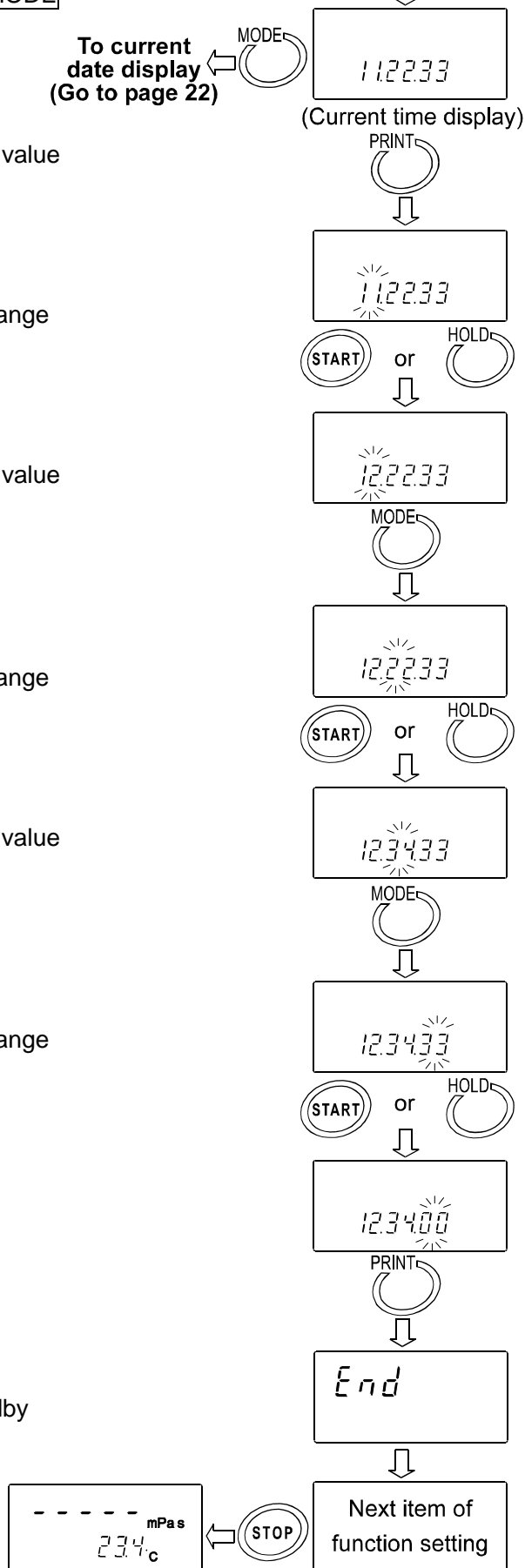
- 16 Press the **START** key or **HOLD** key to change the minute. (Example:22? 34)

- 17 Press the **MODE** key to select the setting value of the second. (Example:33)

- 18 Press the **START** key or **HOLD** key to change the second. (Example:33? 00)

- 19 Press the **PRINT** key to save the time.
After " end ", the next item is displayed.

- 20 Press the **STOP** key to return to the standby mode.



Condition (Cond)

The stability of the viscosity measurement results can be adjusted, taking ambient conditions such as vibration into consideration.

Parameter	Settings	Description
0	Follows the viscosity changes quickly. (Prone to vibration)	When the viscosity value is unstable due to external vibration, set a greater parameter.
1 ?	↑	To measure while following the rapid changes in viscosity, set a smaller parameter.
2	Follows the viscosity changes slowly. (Stable values)	With a smaller setting, the measurement is prone to external vibration. Consider the ambient conditions of the installation site.

Unit Upon Power-on (Unit)

Parameter	Settings				Description
0 ?	Viscos-ity	mPaʒ (Millipascal second)	Temper-ature	°C (Celsius)	The units of viscosity and temperature displayed when the power is turned on are specified. In the standby mode, pressing the MODE key switches the viscosity unit. mPaʒ? Paʒ, cP? P With "fnc 0" selected, units can be switched even during measurement. *1
1		Paʒ (Pascal second)			
2		cP (Centipoise)			
3		P (Poise)			
4		mPaʒ (Millipascal second)		°F (Fahrenheit)	
5		Paʒ (Pascal second)			
6		cP (Centipoise)			
7		P (Poise)			

*1 While the measurement is being performed using the graphing program RsVisco, unit changes using the **MODE** key is not available.

For the viscosity over 1000 mPaš, the unit is fixed to Paš.

For the viscosity over 1000 cP, the unit is fixed to P.

Decimal Point (pnt)

Parameter	Settings	Description
0 ?	Dot "."	The decimal point format for the displayed measurement data and the decimal point code for measurement data output via RS-232C are specified.
1	Comma ","	

With "Comma" selected, the separator for CSV format and RsVisco format will be ";" (semicolon).

MODE Key Function during measurement (fnc)

Parameter	Settings	Description
0 ?	Switches the viscosity units.	<p>Each time the MODE key is pressed, the viscosity unit is switched.</p> <p>When mPa·s or Pa·s is selected in "Unit" of the function setting, pressing the MODE key switches between mPa·s and Pa·s.</p> <p>When cP or P is selected in "Unit" of the function setting, pressing the MODE key switches between cP and P.</p> <p>Note Regardless to the selected unit, for the viscosity over 1000 mPa·s, the unit is fixed to Pa·s and for the viscosity over 1000 cP, the unit is fixed to P.</p>
1	Switches between the temperature display and the measurement elapsed time display	<p>Each time the MODE key is pressed, the display is switched between the temperature display and the measurement elapsed time display.</p> <p>Upon a measurement start, the temperature display is selected.</p> <p>When the elapsed time reaches 100 hours, the display returns to 0. (99.59.59? 00.00.00)</p>

Data Output Mode (prt)

The condition to output the measurement data via RS-232C is set.

Parameter	Settings	Description
0 ?	Key mode	During measurement or in the data hold mode, pressing the PRINT key outputs the current measurement values. *2
1	Auto print mode	<p>The measurement values are output automatically when the STOP key ends the measurement.</p> <p>Pressing the PRINT key outputs the current measurement values. *2</p>
2	Stream mode	<p>The measurement values are output continuously during measurement.</p> <p>When D.P. format is selected in "Output format (type)" of the function setting, only the viscosity value is output, regardless of the settings of "5-at", "5-td" and "5-ed".</p> <p>When this mode is selected, the data hold mode using the HOLD key is not available.</p>

*2 When A&D standard format is selected in "Output format (type)" of the function setting, pressing the **PRINT** key in the standby mode will not output the measurement data.

Data Output Format (type)

The output format appropriate for the device connected to RS-232C can be selected.

Parameter	Settings	Description
0	A&D standard format	Used with the printer MODE 1 or MODE 2 when the optional compact printer AD-8121 is connected. Only the viscosity value is output.
1 ?	D.P. format	Used with the printer MODE 3 when the optional compact printer AD-8121 is connected. With "prt 0" or "prt 1" selected for "Data output mode (prt)", output contents can be selected by the settings of "5-at", "5-td" and "5-ed". With "prt 2" selected for "Data output mode (prt)", only the viscosity value is output.
2	CSV format	Appropriate when a personal computer is used to collect data. Measurement values are output in comma separated format. With "5-td" and "id" settings, the date/time and ID number can be added to the measurement data. When a comma is selected as the decimal point by "pnt 1", a semicolon ";" is used as a data separator. The viscosity value and the temperature are output using the internal resolution.*3
3	RsVisco format	Used with the graphing program RsVisco. When a measurement is started using RsVisco, the viscometer automatically selects this format. The viscosity value and the temperature are output using the internal resolution.*3

*3 The relation between the measuring unit and the internal resolution is as follows:

	Viscosity				Temperature	
	mPa·s	Pa·s	cP	P	°C	°F
Internal resolution	0.01	0.0001	0.01	0.0001	0.01	0.01

Measurement Elapsed Time Output (5-at)

Parameter	Settings	Description
0	No output	With D.P. format selected, whether or not to add the measurement elapsed time (the time elapsed from a measurement start) to the measurement data can be selected. For examples of output format, refer to "7-4 Data Output Format Examples".
1 ?	Output	

Date/time Output (5-td)

Parameter	Settings	Description
0	No output	With D.P. format or CSV format selected, whether or not to add the date and time to the measurement data can be selected. For examples of output format, refer to "7-4 Data Output Format Examples".
1 ?	Output	

Other Output (5-ed)

Parameter	Settings	Description
0	No output	
1	Outputs remarks.	With D.P. format selected, whether or not to add remarks, Device ID information or signature to the measurement data can be selected. For examples of output format, refer to "7-4 Data Output Format Examples".
2 ?	Outputs remarks, Device ID information and signature.	
3	Outputs ID number.	With CSV format selected, whether or not to add ID number to the measurement data can be selected. For examples of output format, refer to "7-4 Data Output Format Examples".

Pause at Data Output (pU5e)

Parameter	Settings	Description
0	No pause	Whether or not to take a pause of two seconds each time one line is output can be selected, when the data are output via RS-232C. When MODE 3 of the optional compact printer AD-8121 is used, select "1".
1 ?	Pause (Approx. 2 seconds)	

Device ID Number (id)

✍ The ID number is used to identify the viscometer.

✍ Whether or not to add the ID number to the measurement data can be selected by "5-ed" of the function setting.

✍ The ID number is six characters long. The following characters are available for the ID number.

Character	0	1	2	3	4	5	6	7	8	9	(Space)	-(hyphen)	A	B	C	D	E
Display	0	1	2	3	4	5	6	7	8	9	(Space)	-	a	b	c	d	e

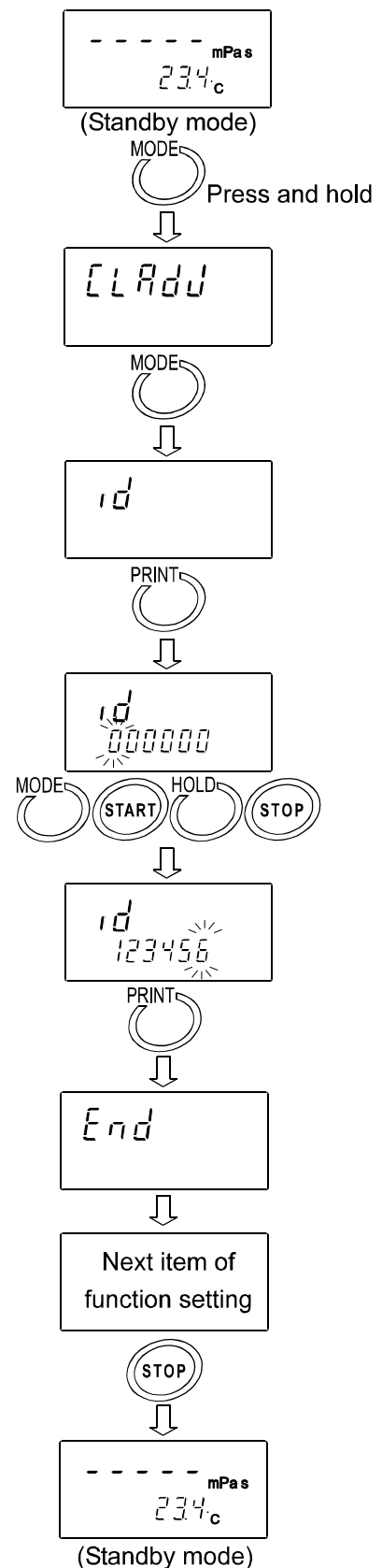
Character	F	G	H	I	J	K	L	M	N	O	P	Q	P	Q	R	S	T	U	V	W	X
Display	f	g	h	i	j	k	l	m	N	o	p	q	r	5	t	U	v	w	x	y	z

For examples of output format, refer to "7-4 Data Output Format Examples".

Setting the ID number

- 1 In the standby mode, press and hold the **MODE** key to enter the function setting mode. "Cladj " appears.
- 2 Press the **MODE** key to select " id ".
- 3 Press the **PRINT** key to enter the ID number setting mode.
- 4 Set the ID number using the following keys:

MODE key	Switches the blinking digits.
START key	Increases the value of the blinking digit by one.
HOLD key	Decreases the value of the blinking digit by one.
STOP key	Cancel the operation.
- 5 Press the **PRINT** key to save the setting.
After " end ", the next item is displayed.
- 6 Press the **STOP** key to return to the standby mode.



Initialization (Clr)

Restores the following data to the default setting.

Function setting

Calibration data

- 1 In the standby mode, press and hold the **MODE** key to enter the function setting mode. "Cladj" appears.

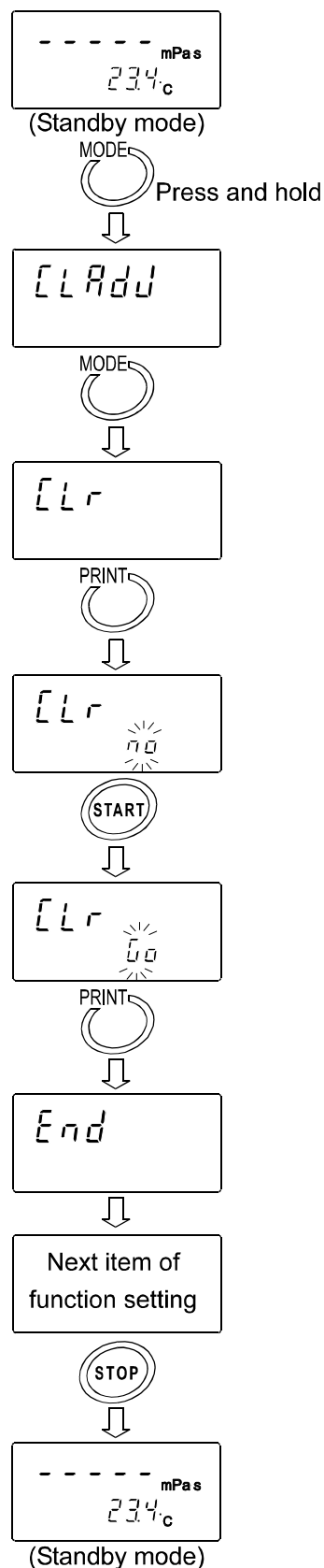
- 2 Press the **MODE** key to select "Clr".

- 3 Press the **PRINT** key to display "Clr no".

- 4 Press the **START** key to select "Clr go".

- 5 Press the **PRINT** key to execute initialization.
After "end", the next item is displayed.
Initialization has completed.

- 6 Press the **STOP** key to return to the standby mode.



7-4 Data Output Format Examples

A&D Standard Format

Used with the printer MODE 1 or MODE 2 when the optional compact printer AD-8121 is connected.
Only the viscosity value is output.

Output format

Viscosity unit	Display	Output format	Remarks
mPa·s	L mPas	0L, -99999999mPs	Below measuring range error
	0.30mPas	ST, +00000. 30mPs	
	10.0 mPas	ST, +00010. 00mPs	The digit of 0.01 mPaš is always zero.
	100 mPas	ST, +00100. 00mPs	The digit of 0.01/0.1 mPaš is always zero.
	1.00 Pas	ST, +01000. 00mPs	For 1000 mPaš or greater, the displayed unit is Paš, but the output unit remains mPaš. The digit of 0.01/0.1/1 mPaš is always zero.
	H Pas	0L, +99999999mPs	Above measuring range error
Pa·s	L Pas	0L, -99999999Pas	Below measuring range error
	0.0003 Pas	ST, +000. 0003Pas	
	0.0100 Pas	ST, +000. 0100Pas	
	0.100 Pas	ST, +000. 1000Pas	The digit of 0.0001 Paš is always zero.
	1.00 Pas	ST, +001. 0000Pas	The digit of 0.0001/0.001 Paš is always zero.
	H Pas	0L, +99999999Pas	Above measuring range error
cP	L cP	0L, -99999999cP	Below measuring range error
	0.30 cP	ST, +00000. 30cP	
	10.0 cP	ST, +00010. 00cP	The digit of 0.01 cP is always zero.
	100 cP	ST, +00100. 00cP	The digit of 0.01/0.1 cP is always zero.
	10.0 P	ST, +01000. 00cP	For 1000 cP or greater, the displayed unit is P, but the output unit remains cP. The digit of 0.01/0.1/1 cP is always zero.
	H P	0L, +12000. 00cP	Above measuring range error
P	L P	0L, -99999999P	Below measuring range error
	0.0030 P	ST, +000. 0030P	
	0.100 P	ST, +000. 1000P	The digit of 0.0001 P is always zero.
	1.00 P	ST, +001. 0000P	The digit of 0.0001/0.001 P is always zero.
	10.0 P	ST, +010. 0000P	The digit of 0.0001/0.001/0.01 P is always zero.
	H P	0L, +99999999P	Above measuring range error

□ : Space (ASC 20h)

D.P. Format

Used with the printer MODE 3 when the optional compact printer AD-8121 is connected.

With "prt 0" or "prt 1" selected for "Data output mode (prt)", output contents can be selected by the settings of "5-at", "5-td" and "5-ed".

With "prt 2" selected for "Data output mode (prt)", only the viscosity value is output

Printing format example (1)

Function setting (?=Output Blank=No output)			
5-at	1	Measurement elapsed time	?
5-td	1	Date/time	?
5-ed	2	Remarks	?
		Device ID information	?
		Signature	

①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬	⑭	⑮	⑯
A & D															Device ID information
MODEL SV-10															Manufacturer
S/N 14800000															Model
ID LAB-12															Serial number
00:12:34															ID number
25.6 C															Measurement elapsed time
12.3 mPa s															Sample temperature
DATE 2003/03/31															Viscosity
TIME 12:34:56															Date (*)
REMARKS															Time
SIGNATURE															Remarks
															Signature

Printing format example (2)

Function setting (?=Output Blank=No output)			
5-at	1	Measurement elapsed time	?
5-td	1	Date/time	?
5-ed	1	Remarks	?
		Device ID information	
		Signature	

①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬	⑭	⑮	⑯
00:12:34															Measurement elapsed time
25.6 C															Sample temperature
12.3 mPa s															Viscosity
DATE 2003/03/31															Date (*)
TIME 12:34:56															Time
REMARKS															Remarks
SIGNATURE															

Printing format example (3)

Function setting (?=Output Blank=No output)			
5-at	1	Measurement elapsed time	?
5-td	1	Date/time	?
5-ed	0	Remarks	
		Device ID information	
		Signature	

①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬	⑭	⑮	⑯
00:12:34															Measurement elapsed time
25.6 C															Sample temperature
12.3 mPa s															Viscosity
DATE 2003/03/31															Date (*)
TIME 12:34:56															Time
REMARKS															

(*) The displaying order of the date (YMD/DMY/MDY) depends on the setting of "Date/Time (Cladj)".

Printing format example (4)

Function setting (?=Output Blank=No output)			
5-at	1	Measurement elapsed time	?
5-td	0	Date/time	
5-ed	0	Remarks	
		Device ID information	
		Signature	

Diagram illustrating the data bus structure for the 16-bit data bus. The bus is divided into three sections:

- Measurement elapsed time:** Bits 0 to 4.
- Sample temperature:** Bits 5 to 8.
- Viscosity:** Bits 9 to 12.

Printing format example (5)

Function setting (?=Output Blank=No output)			
5-at	0	Measurement elapsed time	
5-td	0	Date/time	
5-ed	0	Remarks	
		Device ID information	
		Signature	

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
									2	5	6	C			
									1	2	3	m P a			

← Sample temperature

← Viscosity

CSV Format

Appropriate when a personal computer is used to collect data. Measurement values are output in comma separated format.

With "5-td" setting, the date and time can be added to the measurement data.

When a comma is selected as the decimal point by "pnt 1", a semicolon ";" is used as a data separator.

With CSV format selected, the viscosity value and the temperature are output using the internal resolution.

The relation between the measuring unit and the internal resolution is as follows:

	Viscosity				Temperature	
	mPa·s	Pa·s	cP	P	°C	°F
Internal resolution	0.01	0.0001	0.01	0.0001	0.01	0.01

Output format example (1)

Function setting (?=Output Blank=No output)			
5-td	1	Date/time	?
5-ed	3	Device ID number	?

Outputs in the order of ID number, date, time, temperature, temperature unit, viscosity and viscosity unit.

The output data are 52 characters long excluding the terminator.

Viscosity / Temper- ature	Display	Output format example	Remarks
mPa·s / °C	L mPa·s	LAB- 12, 2003/03/19, 12: 34: 56, +025. 67, C, +00000. 00, mPaUs	Zeroes are output for below measuring range error.
	0.30mPa·s	LAB- 12, 2003/03/19, 12: 34: 56, +025. 67, C, +00000. 30, mPaUs	
	10.0 mPa·s	LAB- 12, 2003/03/19, 12: 34: 56, +025. 67, C, +00010. 00, mPaUs	
	100 mPa·s	LAB- 12, 2003/03/19, 12: 34: 56, +025. 67, C, +00100. 00, mPaUs	
	1.00 Pa·s	LAB- 12, 2003/03/19, 12: 34: 56, +025. 67, C, +01000. 00, mPaUs	For 1000 mPa's or greater, the displayed unit is Pa's, but the output unit remains mPa's.
	H Pa·s	LAB- 12, 2003/03/19, 12: 34: 56, +025. 67, C, +12000. 00, mPaUs	12000 is output for above measuring range error.
Pa·s / °F	L Pa·s	LAB- 12, 2003/03/19, 12: 34: 56, +051. 23, F, +000. 0000, uPaUs	Zeroes are output for below measuring range error.
	0.0003 Pa·s	LAB- 12, 2003/03/19, 12: 34: 56, +051. 23, F, +000. 0003, uPaUs	
	0.0100 Pa·s	LAB- 12, 2003/03/19, 12: 34: 56, +051. 23, F, +000. 0100, uPaUs	
	0.100 Pa·s	LAB- 12, 2003/03/19, 12: 34: 56, +051. 23, F, +000. 1000, uPaUs	
	1.00 Pa·s	LAB- 12, 2003/03/19, 12: 34: 56, +051. 23, F, +001. 0000, uPaUs	
	H Pa·s	LAB- 12, 2003/03/19, 12: 34: 56, +051. 23, F, +012. 0000, uPaUs	12 is output for above measuring range error.
cP / °C	L cP	LAB- 12, 2003/03/19, 12: 34: 56, +025. 67, C, +000. 0000, ucPUs	Zeroes are output for below measuring range error.
	0.30 cP	LAB- 12, 2003/03/19, 12: 34: 56, +025. 67, C, +00000. 30, ucPUs	
	10.0 cP	LAB- 12, 2003/03/19, 12: 34: 56, +025. 67, C, +00010. 00, ucPUs	
	100 cP	LAB- 12, 2003/03/19, 12: 34: 56, +025. 67, C, +00100. 00, ucPUs	
	10.0 P	LAB- 12, 2003/03/19, 12: 34: 56, +025. 67, C, +01000. 00, ucPUs	For 1000 cP or greater, the displayed unit is P, but the output unit remains cP.
	H P	LAB- 12, 2003/03/19, 12: 34: 56, +025. 67, C, +12000. 00, ucPUs	12000 is output for above measuring range error.
P / °F	L P	LAB- 12, 2003/03/19, 12: 34: 56, +051. 23, F, +000. 0000, uPUs	Zeroes are output for below measuring range error.
	0.0030 P	LAB- 12, 2003/03/19, 12: 34: 56, +051. 23, F, +000. 0030, uPUs	
	0.100 P	LAB- 12, 2003/03/19, 12: 34: 56, +051. 23, F, +000. 1000, uPUs	
	1.00 P	LAB- 12, 2003/03/19, 12: 34: 56, +051. 23, F, +001. 0000, uPUs	
	10.0 P	LAB- 12, 2003/03/19, 12: 34: 56, +051. 23, F, +010. 0000, uPUs	
	H P	LAB- 12, 2003/03/19, 12: 34: 56, +051. 23, F, +120. 0000, uPUs	120 is output for above measuring range error.

␣ : Space (ASC 20h)

Output format example (2)

Function setting (?=Output Blank=No output)			
5-td	1	Date/time	?
5-ed	0	Device ID number	

Outputs in the order of date, time, temperature, temperature unit, viscosity and viscosity unit.
The output data are 46 characters long excluding the terminator.

Viscosity / Temperature	Display	Output format example
mPa·s / °C	1.23 mPa·s	, 2003/03/19, 12: 34: 56, +025. 67, C, +00000. 30, mPa·s

□ : Space (ASC 20h)

Output format example (3)

Function setting (?=Output Blank=No output)			
5-td	0	Date/time	
5-ed	0	Device ID number	

Outputs in the order of temperature, temperature unit, viscosity and viscosity unit.
The output data are 28 characters long excluding the terminator.

Viscosity / Temperature	Display	Output format example
mPa·s / °C	1.23 mPa·s	, , , +025. 67, C, +00000. 30, mPa·s

□ : Space (ASC 20h)

RsVisco Format

Used with the graphing program RsVisco. Measurement data are output in comma separated format. When a comma is selected as the decimal point by "pnt 1", a semicolon ";" is used as a data separator.

When a measurement is started using RsVisco, the viscometer automatically selects this format.

Measurement data are output in the order of viscosity, viscosity unit, temperature and temperature unit.

The output data are 25 characters long excluding the terminator

With RsVisco format selected, the viscosity value and the temperature are output using the internal resolution.

The relation between the measuring unit and the internal resolution is as follows:

	Viscosity				Temperature	
	mPa·s	Pa·s	cP	P	°C	°F
Internal resolution	0.01	0.0001	0.01	0.0001	0.01	0.01

Output format example

Viscosity / Temper- ature	Display	Output format example	Remarks
mPa·s / °C	L mPa·s	+00000. 00, mPa <u>s</u> , +025. 67, C	Zeroes are output for below measuring range error.
	0.30 mPa·s	+00000. 30, mPa <u>s</u> , +025. 67, C	
	10.0 mPa·s	+00010. 00, mPa <u>s</u> , +025. 67, C	
	100 mPa·s	+00100. 00, mPa <u>s</u> , +025. 67, C	
	1.00 Pa·s	+01000. 00, mPa <u>s</u> , +025. 67, C	For 1000 mPa's or greater, the displayed unit is Pa's, but the output unit remains mPa's.
	H Pa·s	+12000. 00, mPa <u>s</u> , +025. 67, C	12000 is output for above measuring range error.
Pa·s / °F	L Pa·s	+000. 0000, <u>Pa</u> s, +051. 23, F	Zeroes are output for below measuring range error.
	0.0003 Pa·s	+000. 0003, <u>Pa</u> s, +051. 23, F	
	0.0100 Pa·s	+000. 0100, <u>Pa</u> s, +051. 23, F	
	0.100 Pa·s	+000. 1000, <u>Pa</u> s, +051. 23, F	
	1.00 Pa·s	+001. 0000, <u>Pa</u> s, +051. 23, F	
	H Pa·s	+012. 0000, <u>Pa</u> s, +051. 23, F	12 is output for above measuring range error.
cP / °C	L cP	+000. 0000, <u>cP</u> , +025. 67, C	Zeroes are output for below measuring range error.
	0.30 cP	+00000. 30, <u>cP</u> , +025. 67, C	
	10.0 cP	+00010. 00, <u>cP</u> , +025. 67, C	
	100 cP	+00100. 00, <u>cP</u> , +025. 67, C	
	10.0 P	+01000. 00, <u>cP</u> , +025. 67, C	For 1000 cP or greater, the displayed unit is P, but the output unit remains cP.
	H P	+12000. 00, <u>cP</u> , +025. 67, C	12000 is output for above measuring range error.
P / °F	L P	+000. 0000, <u>P</u> , +051. 23, F	Zeroes are output for below measuring range error.
	0.0030 P	+000. 0030, <u>P</u> , +051. 23, F	
	0.100 P	+000. 1000, <u>P</u> , +051. 23, F	
	1.00 P	+001. 0000, <u>P</u> , +051. 23, F	
	10.0 P	+010. 0000, <u>P</u> , +051. 23, F	
		+120. 0000, <u>P</u> , +051. 23, F	120 is output for above measuring range error.

8. CONNECTION TO A PERSONAL COMPUTER

Using the standard RS-232C serial interface and the RS-232C cable provided, the viscometer can be connected to a personal computer.

In addition, using the graphing program RsVisco, contained in the accessory Windows communication tools WinCT-Viscosity, measurement data are sent to a Windows-based personal computer to display a graph in real time.

For details, refer to "? English? ReadMe.txt" on the CR-ROM.

9. CONNECTION TO A PRINTER

✂✂ The viscometer can be connected to the optional compact printer AD-8121 using the standard RS-232C interface and the measurement results can be printed.

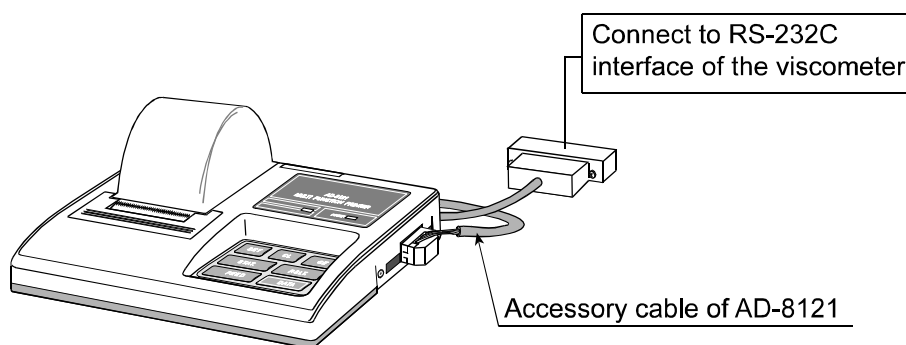
✂✂ The statistical calculation data of the results and the changes in the viscosity value per a certain time can be printed using the function of the AD-8121.

✂✂ Use the AD-8121 accessory cable to connect the printer to the viscometer.

Setting list

What to print	Viscometer function settings						AD-8121 settings
	p _{rt}	type	5-at	5-td	5-ed	pU5e	
Measurement results	0、1	1	0、1	0、1	0、1、2	1	MODE 3
Statistical calculation	0、1	0	?	?	?	?	MODE 1
Changes in the viscosity value per a certain time	2	0	?	?	?	0	MODE 2 (Interval printing is used.)

? :: Not applicable.

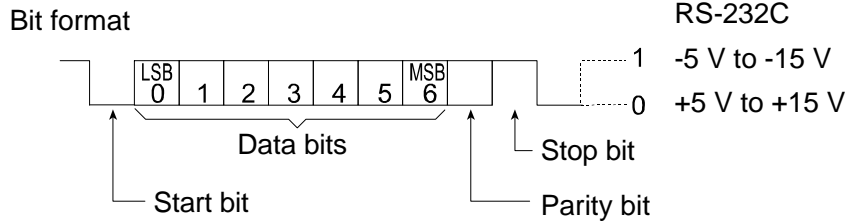


Compact printer AD-8121

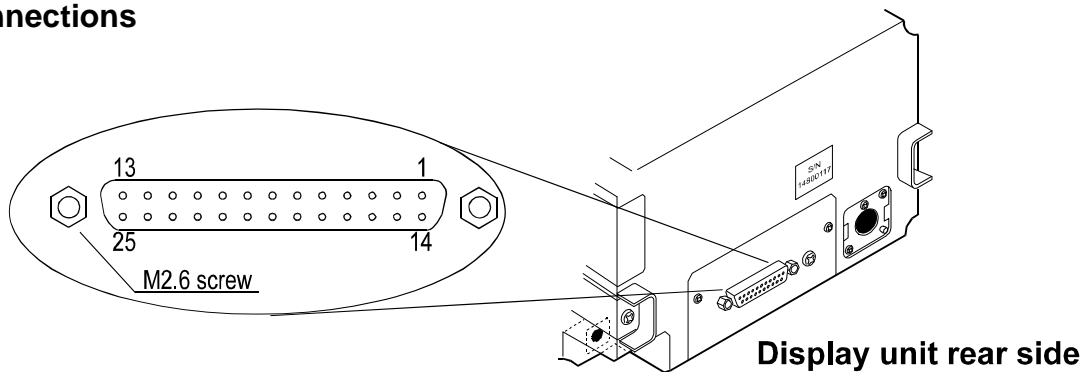
10. RS-232C SERIAL INTERFACE

RS-232C Serial Interface

Transmission system EIA RS-232C
 Transmission form Asynchronous, bi-directional, half duplex
 Data format Baud rate 2400 bps
 Data bits 7 bits
 Parity EVEN
 Stop bit 1 bit
 Code ASCII
 Terminator CR LF (CR: 0Dh, LF: 0Ah)



Pin Connections



Pin No.	SV-10 (DCE)		Computer (DTE)	
	Signal Name *1	Description	Direction	Signal Name
1	FG	Frame ground	-	FG
2	RXD	Receive data	?	TXD
3	TXD	Transmit data	?	RXD
4	RTS	Ready to send *2	?	RTS
5	CTS	Clear to send *2	?	CTS
6	DSR	Data set ready	?	DSR
7	SG	Signal ground	-	SG
16, 18, 19, 21, 23	Internal use		Do not connect *3	
Others	Not used			

*1: Signal names of the viscometer side are the same as the DTE side with TXD and RXD reversed.

*2: RTS and CTS flow control are not used. CTS output is HI always.

*3: Normal DOS/V cables do not use these terminals.

11. COMMAND LIST

The viscometer can be controlled by the following commands from the computer.

Add a terminator C_RL_F (0Dh, 0Ah) to each command.

Command	Description
Q	Outputs the current data.
SIR	Outputs data continuously
C	Stops data output by SIR command.
QM	Outputs the data during measurement. (Effective only during measurement.)
START	Same as the START key
STOP	Same as the STOP key
HOLD	Same as the HOLD key
MODE	Same as the MODE key
PRINT	Same as the PRINT key

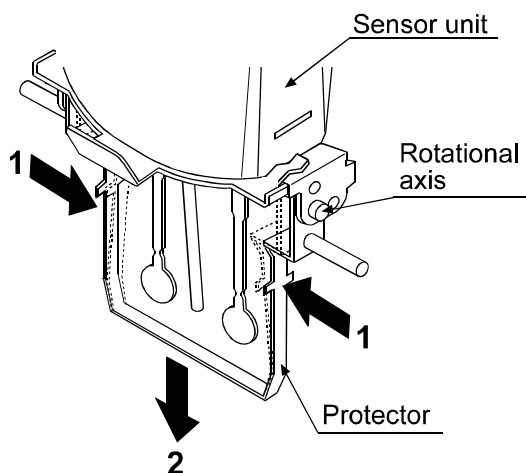
12. TROUBLESHOOTING

The viscometer is a precision instrument. When the operating environment or the operating method is inadequate, correct values can not be obtained. If measurement values do not become stable or they seem to be incorrect, check as described below. If improper performance persists after checking, contact the local A&D dealer for repair.

When measurement values do not become stable:

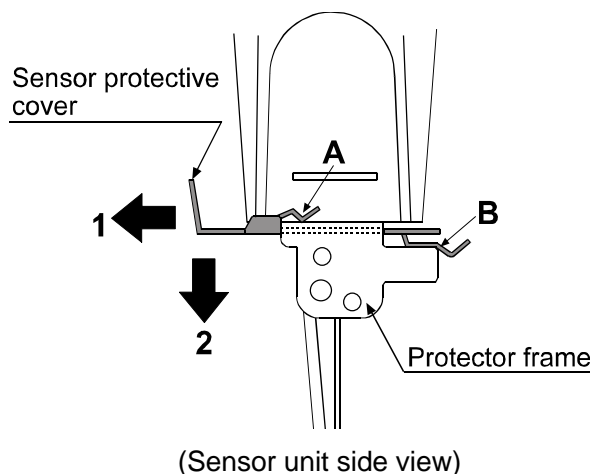
- ✍ Is the ambient environment free from vibration and drafts?
 - ✍ Use a solid operation table.
 - ✍ Avoid direct drafts in the vicinity of the viscometer.
 - ✍ Reconsider the setting of "Condition (Cond)" of the function setting.
- ✍ Is there a strong electrical or magnetic noise source such as a motor near the viscometer?
- ✍ Are the protector or the sensor protective cover in contact with the sensor plates or the temperature sensor?
 - ✍ Attach the protector and the sensor protective cover properly so that they do not touch the sensor plates or the temperature sensor.
 - ✍ Remove the protector or the sensor protective cover when necessary.

How to remove the protector



Press the left and right side frames lightly in the direction indicated as 1 to remove the rotational axis. Pull the protector in the direction indicated as 2 to remove.

How to remove the sensor protective cover



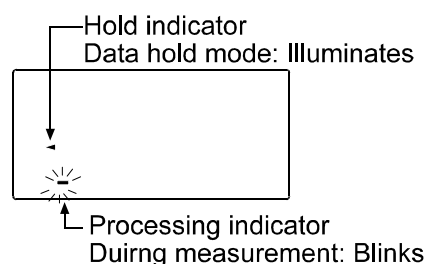
Pull the sensor protective cover in the direction indicated as 1 to release the portions A (two) and B from the protector frame. Pull the sensor protective cover in the direction indicated as 2 to remove.

Note

When removing the sensor protective cover, it may touch the sensor plates and the temperature sensor. Use much care not to damage them.

When measurement values are not correct:

- ✍ Has the sample surface been adjusted to the center of the narrow part of the sensor plates?
 - ✍ Adjust the table height by turning the knob so that the center of the narrow part of the sensor plates is on the sample surface.
- ✍ Are the positions of the left and right sensor plates in the sample surface the same?
 - ✍ If not the same, level the viscometer using the leveling feet so that the liquid surface will be leveled.
- ✍ Are the sensor plates clean?
 - ✍ Remove any residual sample material from the sensor plates using solvents.
 - ✍ When any residual sample material is on the portion of the sensor plates above the sample surface, changes in the mass cause the vibration frequency to shift, which will result in a measurement error.
- ✍ Are the sensor plates bent?
 - ✍ If bent, contact the local A&D dealer for repair.
- ✍ Does the sample generate bubbles because of the differences in the sample temperature and the ambient temperature and do the bubbles stick to the sensor plates?
- ✍ The sample viscosity depends on the temperature.
 - ✍ Generally, most liquids are temperature dependent and the viscosity may change by negative 2 to negative 10 percent, per degree Celsius.
- ✍ Is the sample surface lowered?
 - ✍ In a measurement that takes a long time, the sample may evaporate causing the sample surface to be lowered. Try to reduce the evaporation and maintain the sample surface level.
- ✍ Do the main unit and the display unit have the same serial number?
 - ✍ The main unit and the display unit have been adjusted in pairs. Confirm that the main unit and the display unit have the same serial number.
- ✍ Is the viscometer in the data hold mode?
 - ✍ To release the data hold mode, press the **HOLD** key.
 - ✍ The processing indicator blinks while a measurement is performed.
- ✍ Is calibration performed?
 - ✍ When the absolute viscosity value is important, it is recommend that a periodic calibration be performed using a standard viscosity fluid.





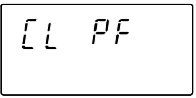
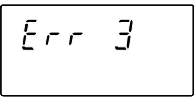
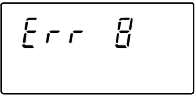
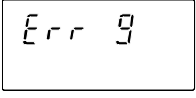
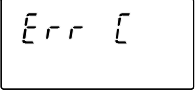
When the temperature values are not correct:

- ✍ Is the display unit connected to the main unit properly using the connection cable?
 - ✍ Refer to "2-2 Installing the Viscometer" on page 5 to make a connection between the display unit and the main unit.

When water viscosity is to be measured:

- ✍ When tap water is poured into the sample cup directly and is measured, bubbles are generated on the sensor plates due to the difference in pressure and temperature and the viscosity may increase. It is recommended that distilled or purified water be used.
- ✍ In a measurement that takes a long time, the sample viscosity may increase due to water contamination. Perform a periodic check on water quality.

13.Error Display

Error display	Description
	Above measuring range error The viscosity value exceeds the upper limit of the viscosity measuring range (11.99 Pa·s). The viscosity of the sample can not be measured. This error may occur when the display unit is not connected to the main unit.
	Below measuring range error The viscosity value is below the lower limit of the viscosity measuring range (0.30 mPa·s). The viscosity of the sample can not be measured. This error may occur when the display unit is not connected to the main unit.
	The power supply for the internal clock is depleted. Press any key to enter the clock correction mode. Setting the clock enables the viscometer to be used temporarily. If the error occurs frequently, contact the local A&D dealer for repair.
   	Internal IC error Turn the power off. Then, turn the power on again. If this does not release the error, contact the local A&D dealer for repair.

14. SPECIFICATIONS

Measurement method : Sine-wave Vibro Viscometer using the Tuning-fork Vibration method
Vibration frequency 30 Hz

Viscosity measuring range : 0.3 to 10000 mPa·s

Viscosity measurement accuracy : Accuracy $\pm 3\%$, Repeatability 1% (Standard deviation)
(Viscosity range 1 to 1000 mPa·s/Temperature range 20 to 30°C/
No condensation
Right after calibration using a standard viscosity fluid in the environment described above)

Minimum display :

Range mPa·s	Minimum display mPa·s	Minimum display Pa·s
0.3 to 10	0.01	0.0001
10 to 100	0.1	0.0001
100 to 1000	1	0.001
1000 to 10000	10*	0.01

* Here, the unit changes to Pa·s.

Unit (Viscosity) : mPa·s, Pa·s, cP, P

Operating temperature : 10 to 40°C

Minimum sample amount : 35 mL

Temperature display : 0 to 100°C/0.1°C,
32 to 212°F/0.1°F

Temperature measurement accuracy:

Range	Accuracy
0 to 20°C/32 to 68°F	$\pm 1^\circ\text{C}/\pm 1.8^\circ\text{F}$
20 to 30°C/68 to 86°F	$\pm 0.5^\circ\text{C}/\pm 0.9^\circ\text{F}$
30 to 100°C/86 to 212°F	$\pm 2^\circ\text{C}/\pm 3.6^\circ\text{F}$

Display : Vacuum fluorescent display (VFD)

Connection cable length : 1.5 m (between the main unit and the display unit)

Communication : RS-232C standard

Power supply : AC adapter (Confirm that the adapter type is correct for the local voltage and power receptacle type.)

Power consumption : Approx. 14 VA (Including the AC adapter)

External dimensions/mass : Main unit 332 (W) x 314 (D) x 536 (H) mm/Approx. 5.0 kg
Display unit 238 (W) x 132 (D) x 170 (H) mm/Approx. 1.3 kg

Standard accessories : AC adapter (1 pc.)

Windows communication tools for viscosity (WinCT-Viscosity) CD (1 pc.)

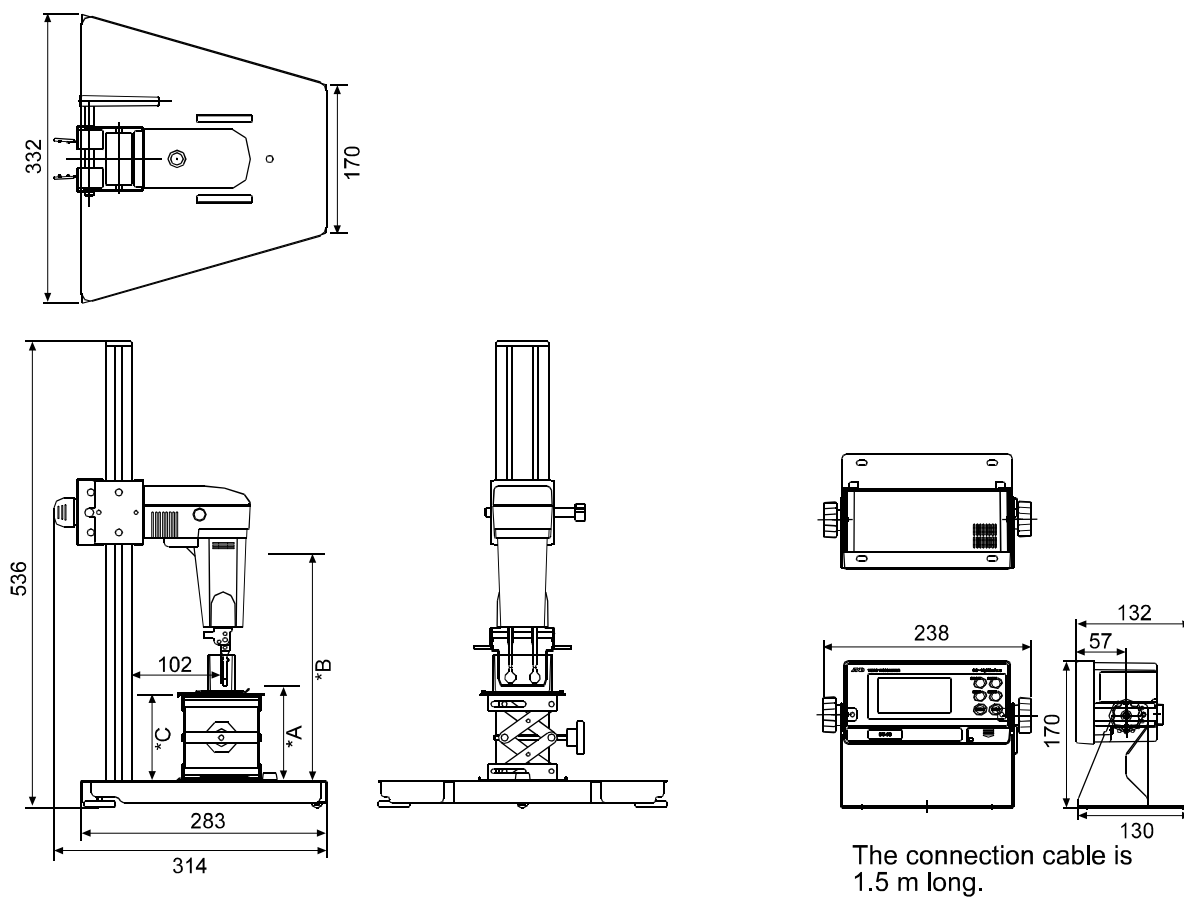
Sample cups (4 pcs.)

RS-232C cable (25P-9P, 1 pc.)

Connection cable (1.5 m, 1pc.)

Options : AD-8121 compact printer

15. EXTERNAL DIMENSIONS



*A=Sensor plates lowest position 3.5 mm (With protector used, no table)

*B=Sensor plates highest position 268 mm

*C=Table height 54 to 140 mm

Unit: mm