LEVELNIC

DL-S3

OPERATION MANUAL

Thank you for adopting the Niigata Seiki LEVELNIC.

To bring the intrinsic performance of this device to full play when you use it, please read this manual carefully through the end and acquire a sure grip on its correct use, so that the device will serve you for many years to come.

This product contains certain elements that correspond to the strategic commodities (or, services) defined under the Foreign Exchange and Foreign Trade Control Law of Japan. Therefore, an export permit is required to export the product in accordance with the said Law.

[Contents]

[General]

This is a pendulum type high sensitivity and precision class electronic level with a built-in microcomputer.

It picks up, as an electric signal, a minute displacement of the pendulum produced according to an angle of inclination, and allows the user to take direct reading of the inclination by way of a digital indication of the grade in mm/m or the angle in DEG (º).

[Features]

- Thanks to the differential transformer incorporated, the device offers an extremely high sensitivity and is highly stable.

- The device allows measurements over a broader range than bubble tube type levels.
  (±5 mm/m, ±0.286º)

- The device responds faster than bubble type levels.
  (Response time: Approx. 10 sec. when a full-scale displacement is given)

- Since the device produces digital indications, it does not require skill for taking readings.

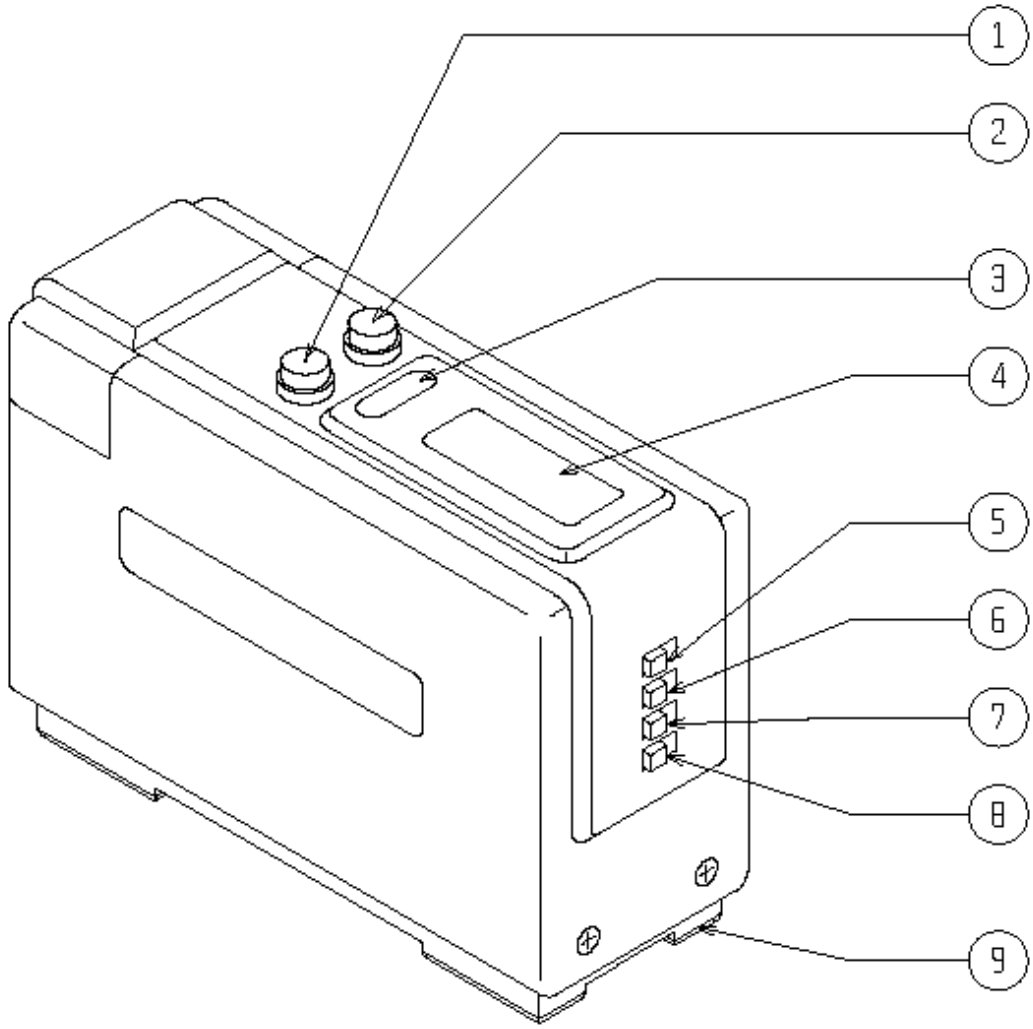
- The 0-Call and 1/2-Call switches enable such operations as deciding a reference, halving an indication, and so on, to be conducted at one touch of the buttons.

- An inclination can be indicated in two different ways: mm/m and DEG (º), selectable via a switch.

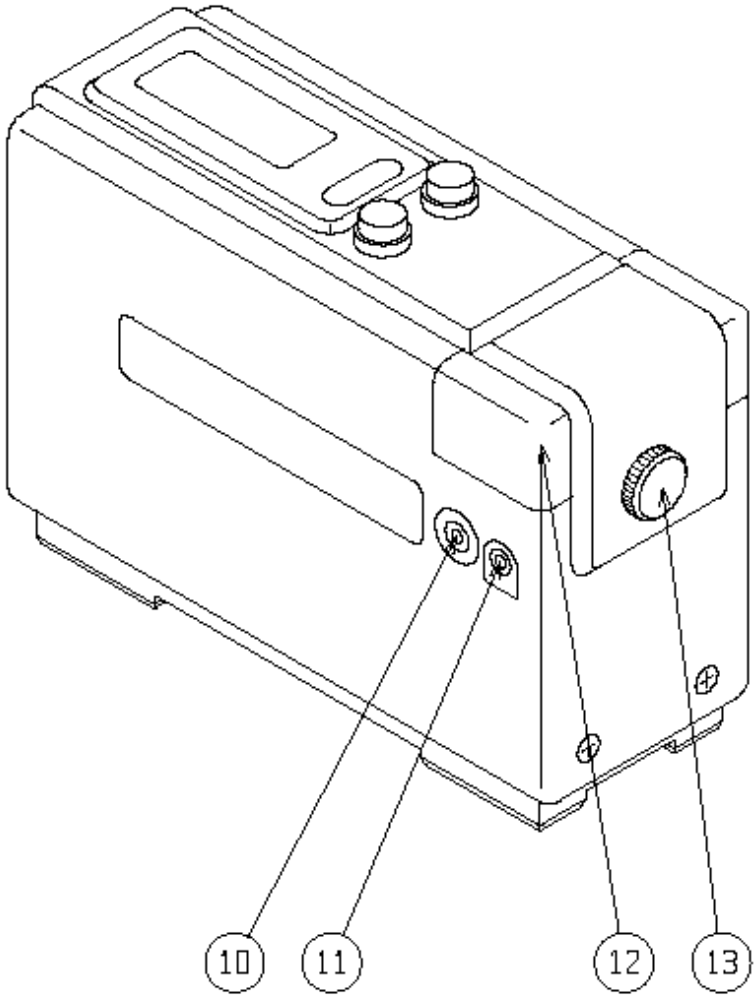
- The mode switch allows the user to select the minimum places of reading.

- The device can be linked to a computer and printer through the signal output (conforming to RS-232C).

[Names of Component Parts]



(1) 0-Call switch
(2) 1/2-Call switch-cum-signal output switch
(3) Auxiliary bubble tube
(4) Display panel
(5) Power switch
(6) Unit selector switch
(7) Mode switch
(8) Function selector switch
(9) Level base



(10) Signal output jack
(11) AC adapter jack
(12) Battery case
(13) Battery case knob

[Functions of Component Parts]

(1) 0-Call switch

Pressing the 0-Call switch resets the indication to zero.

The 0-Call switch changes the indication the moment it is released.

Operate the switch by pressing it rather leisurely for a second or so.

(2) 1/2-Call switch-cum-signal output switch

The switch functions as the 1/2-Call switch and also as the signal output switch. The function selector switch is provided to choose the function in which the switch is to work.

As 1/2-Call switch:

Pressing the 1/2-Call switch halves the indication value as at the time when the switch is pressed.

The 1/2-Call switch changes the indication value the moment it is released.

Operate the switch by pressing it rather leisurely for a second or so.

As signal output switch:

This switch is intended to instruct the output of signals on the side of this device.

Pressing the signal output switch causes the measured value to be output in RS-232C-conformant signals through the signal output jack.

The signal output takes place the moment the switch is released.

Operate the switch by pressing it rather leisurely for a second or so.

If the cable is not connected properly or some abnormal condition occurs during communication, an error (E1, E2) will be displayed for approximately three seconds.

For details, see Section [External Signal Output].

(3) Auxiliary bubble tube

This is designed to check for inclinations in the roll direction (direction perpendicular to the measurement axis).

(4) Display panel

The panel displays inclinations and shows low battery voltage and communication glitches.

Inclinations:

Indication values can be displayed in either the unit of mm/m or the unit of DEG (º), as selected with the unit selector switch.

To distinguish between indications in mm/m and those in DEG (º), 0 of the place to the left of the decimal point is not displayed when indications are produced in DEG (º).

If an inclination surpasses the measuring range, an error will be displayed. If the error is in the positive direction, EEEE will be shown, and if the error is in the negative direction, -EEEE will appear. As the inclination comes back to be covered within the measuring range, the normal operation will be restored.

Low battery voltage:

If the battery voltage falls below the working range, the indication value will blink by the action of the automatic battery check function. Should you find the indication value blinking, replace the battery with a new one, or use the AC adapter supplied with the device.

Communication glitches:

In the event that the cables are not properly connected or a glitch takes place during communication, an error (E1, E2) will be displayed for about three seconds.

For details, see Section [External Signal Output].

(5) Power switch

The device gets to function normally approximately five seconds after the power switch is turned on.

The reference point you may have established with the 0-Call switch or 1/2-Call switch will be cleared when the power switch is turned off.

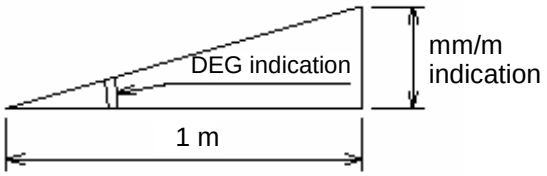
When you turn on the power switch again, the reference point will have to be freshly set up.

(6) Unit selector switch

The switch selects the unit in which indication values are to be displayed, mm/m or DEG (º).

The unit of mm/m indicates a difference of elevation per meter in millimeters. The measuring range is ±5 mm/m.

DEG (º) indicates a difference of elevation in an angle.
The measuring range is ±0.286º.



(7) Mode switch

This switch specifies the minimum place of reading to be indicated when the measured value is ±1.999 mm/m or ±0.1145º, or smaller.

The minimum place of reading of 0.001 is 0.001 mm/m or 0.0001º.

The minimum place of reading of 0.01 is 0.01 mm/m or 0.001º.

The place that disappears when 0.01 is specified is rounded off.

When the desired place is satisfied enough with 0.01 mm/m or 0.001º, the indications become easy to view, free from heavy flickering.

By the way, even when 0.001 was specified, the minimum place of reading will automatically become 0.01 mm/m or 0.001º if the measured value surpasses the above ranges.

(8) Function selector switch

This switch designates the function with which the 1/2-Call switch-cum-signal output switch is to work.

When 1/2 is selected, the switch works as the 1/2-Call switch. Selection of OUT allows the switch to function as the signal output switch.

(9) Level base

The level base comes with two M5 screw holes in the bottom surface.

These holes can be utilized to mount a special base manufactured separately or a jig.

The screw holes are 8 mm deep and spaced by 130 mm.

(10) Signal output jack

Through this jack, the measured value currently displayed can be output, together with its unit, in RS-232C conformant signals.

The signals can be delivered directly to a computer and printer equipped with an RS-232C input.

For details, see Section [External Signal Output].

(11) AC adapter jack

This is a jack designed to feed power to the device from outside.

Use the AC adapter supplied with the device.

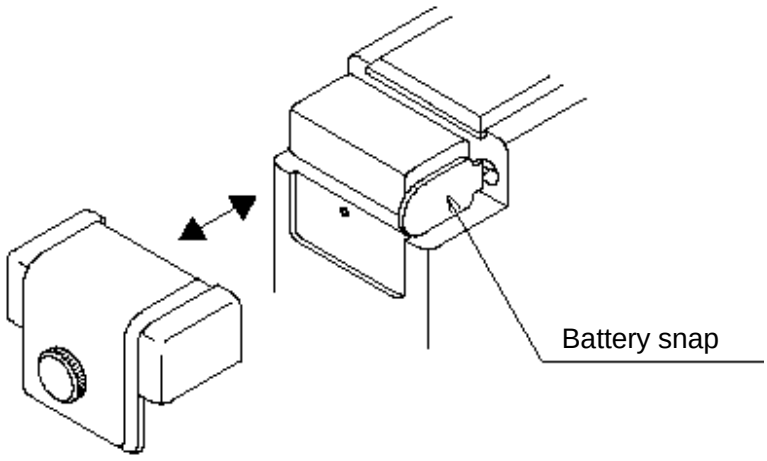
When the output plug of the AC adapter is inserted into the AC adapter jack, the battery of this device is isolated from the internal circuit.

(12) Battery case

The battery is accommodated in this case.

(13) Battery case knob

When the battery needs to be installed or replaced, turn the battery case knob counterclockwise to detach the battery case. It is made in screw type. The battery case will come off along with the battery case knob.



[Variation of Measuring Range due to Movement of Reference Point]

By operating the 0-Call switch or 1/2-Call switch, zero indication can be produced on a given indication value or the indication value can be halved, thereby allowing the reference point of indication to be moved.

However, the measuring range is limited by the indication value and the internal value possessed inside by the device (the value that is first displayed when the device is switched on).

This device does not have a zero point of level.

The numeric value zero that is first displayed when the device is switched on (internal value) does not necessarily coincide with the zero point of level.

Therefore, if a zero point of level is required for some measurement, it will be necessary to set up a zero point of level anew every time the device has been switched on. This brings about the advantage that measurement is conducted each time with reference to the zero point properly adjusted, and thus errors resulting from deviation of a zero point are prevented.

To set up a zero point of level, operations of 0-Call and 1/2-Call are performed.

For details, see Section [Zero-Point Setting].

To secure the measuring ranges of ±5 mm/m and ±0.286º with their center at the zero point of level (explanation from here on refers to the unit of mm/m), the device has been set to operate in a range of ±5.25 mm/m in internal value, which figures in the deviations of the zero-point of internal values and zero-point of level.

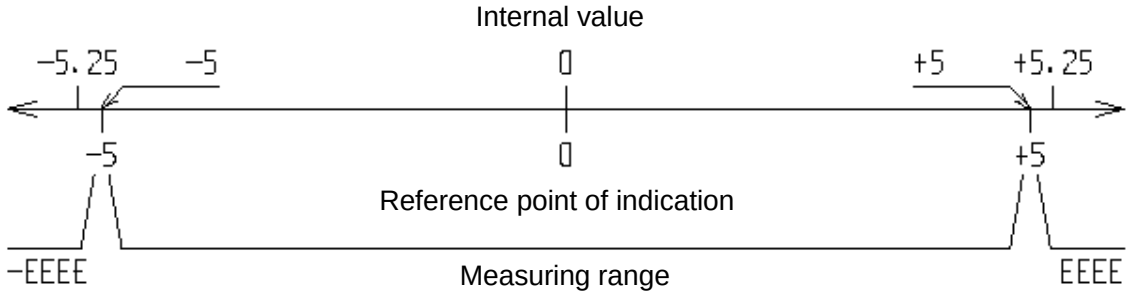
Indication values are given over an indication range of ±5 mm/m.

The measuring range is restricted by these two conditions.

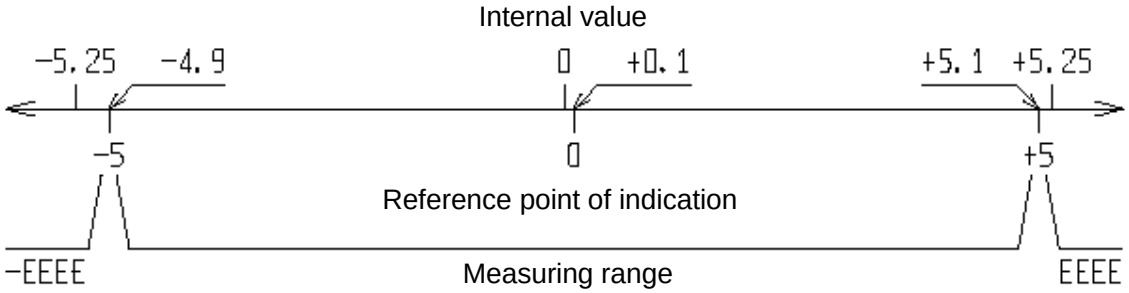
In the figures illustrating the measuring ranges, the number shown above represents the internal value possessed inside by the device, while the number indicated below is the value that is output on the display panel or delivered as an external signal.

(In the explanation, the values are all in the unit of mm/m.)

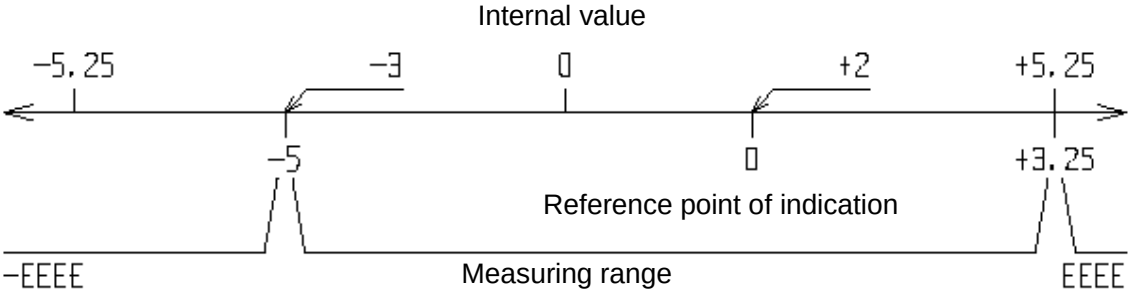
◈ When 0-Call and 1/2-Call have not been practiced
(The reference point of indication is situated at the zero point of the internal value.)



◈ When the reference point of indication has been moved
by +0.1 mm/m due to 0-Call and 1/2-Call
(For example, 0-Call was made on +0.1 mm/m; 1/2-Call was made on +0.2 mm/m, etc.)



◈ When the reference point of indication has been moved
by +2 mm/m due to 0-Call and 1/2-Call
(For example, 0-Call was made on +2 mm/m; 1/2-Call was made on +4 mm/m, etc.)



[Operation Method]

This is a precision measuring instrument. Exert extreme care in handling it so as not to drop it, hit it against something or otherwise inflict shocks to it.

Before using the device, wipe off dirt and oil films thoroughly from the measuring surface of the base, as well as from that of the object to be measured with the device, using a clean piece of glass paper or cloth impregnated with Ligroin or alcohol.

Place this device on the measuring surface of the object under measurement.

Turn on the power switch.

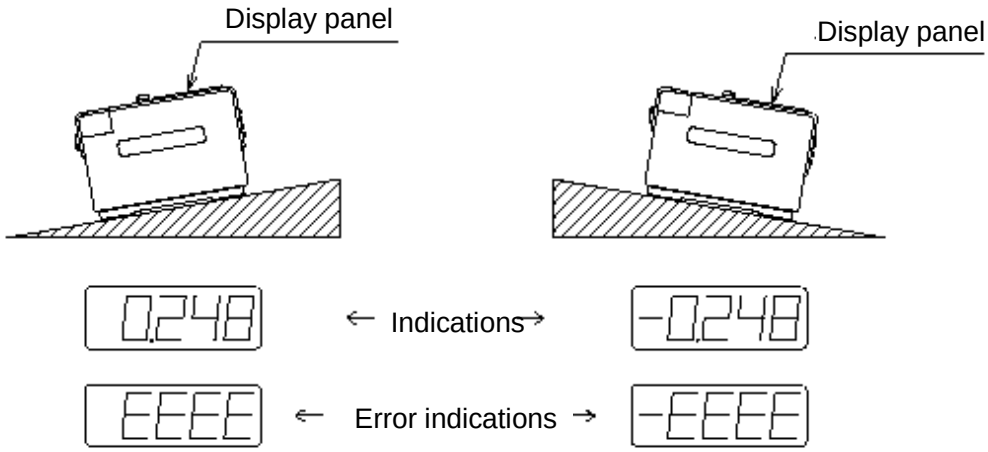
The internal circuit stabilizes in about 20 minutes. Then, start measuring. During the first 20 minutes following the power-on, zero-point displacement will take place in an amount of 0.01 mm/m or less. If this amount of displacement does not affect your intended measurement, you might want to initiate the measurement forthwith.

Try to eliminate any temperature difference between the device and the object under measurement. If more accurate measurement is required, it is recommended to use the device in a temperature-controlled room, similarly to the cases where other precision measurements are conducted.

After the use of the device, apply rust-inhibitive oil to the measurement surface of the base before storing it.

When the display panel side (right-hand side as viewed from front) of the device is raised, it indicates an inclination in a positive value, and when that side is lowered, the device shows an inclination in a negative value.

Even if an error is currently displayed due to an inclination exceeding the measuring range, it can be known toward which side the device is inclined, because an error on the negative side is preceded by a negative sign.



For indications of this device, selection can be made between the unit of mm/m, which expresses an inclination in a difference of elevation per meter, and the unit of DEG (º), which produces an indication in an angle.

If the unit of mm/m is chosen, the actual difference of elevation in a measurement pitch is calculated from the reading by the following equation:

$$\text{Difference of elevation in measurement pitch} = \text{Reading} \times \frac{\text{Measurement pitch}}{1000} \text{ [mm]}$$

When measured in a measurement pitch of 100 mm:

$$\text{Difference of elevation in measurement pitch} = \text{Reading} \times \frac{100}{1000} \text{ [mm]}$$

$$= \text{Reading} \times 0.1 \text{ [mm]}$$

[Zero-Point Setting]

This device does not have a zero point of level.

The numeric value zero that is first displayed when the device is switched on (internal value) does not necessarily coincide with the zero point of level.

Therefore, if a zero point of level is required for some measurement, it will be necessary to set up a zero point of level anew every time the device is switched on. This brings about the advantage that measurement is conducted with reference to the zero point properly adjusted each time, and thus errors resulting from deviation of the zero point are prevented as a result.

To set up a zero point of level, the operations of 0-Call and 1/2-Call are conducted.

A) To conduct comparative measurement of inclinations:

   (1) Place the device on the inclined surface to be taken as the reference.

   (2) After the indication has stabilized, perform 0-Call to set the indication to zero.

   The above operation has set up a zero point for comparison.

B) When a flat surface with adjusted level is available:

   (1) Place the device on the flat surface with adjusted level.

   (2) After the indication has stabilized, perform 0-Call to set the indication to zero.

   The above operation has set up a zero point of level.

C) When it is not clear whether a flat surface is level or not:

   (1) Place the device on the flat surface.

   (2) After the indication has stabilized, perform 0-Call to set the indication to zero.

   (3) Turn the device around 180º and place the device again in the same location.

   (4) After the indication has stabilized, perform 1/2-Call to halve the indication.

   The above operation has set up a zero point of level.

   The indication value appearing during the above process represents the amount of inclination of the flat surface on which the device is placed.

Basically, it would be enough to conduct this operation just once. However, if there is an inclination in the roll direction (direction perpendicular to the measurement axis) in C) above, it is likely that the indication value contains an error. Therefore, to seek a more accurate zero point of level, perform leveling in two directions as described in Section [Leveling].

<Functions of 0-Call and 1/2-Call>

Since the level works acutely on the gravity of the earth, the zero point of level can be known by the following way of thinking.

Suppose there is a slope of angle θ with respect to the horizontal plane.

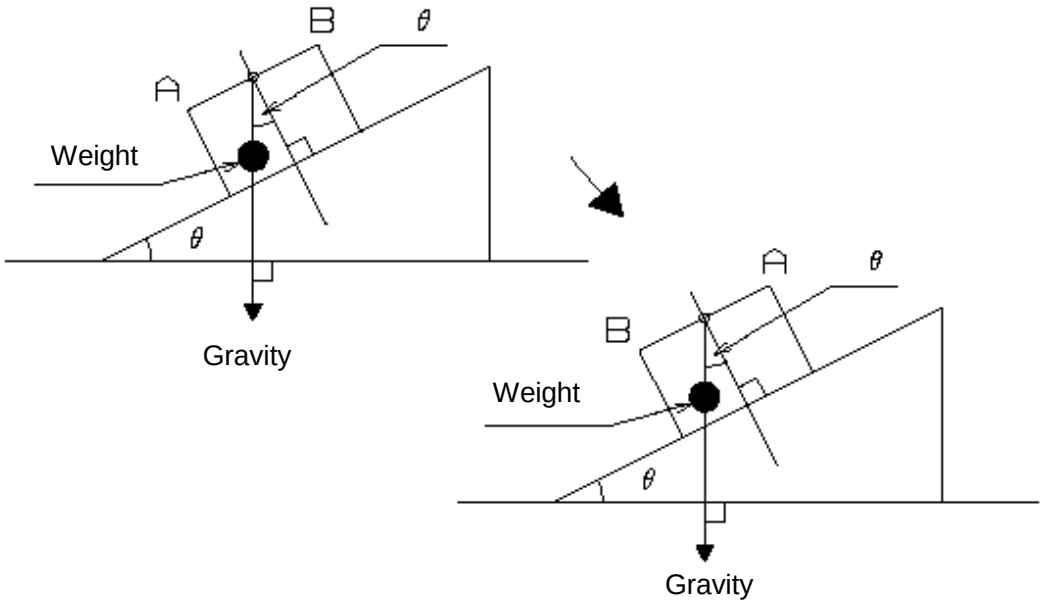
Place on that slope a board with a weight suspended on thread.

Then, the weight inclines toward side A of the board by angle θ from the line extended orthogonally from the slope.

When the board is turned over 180º, the weight now inclines toward side B of the board by angle θ from the line extended orthogonally from the slope.

Consequently, it results that the board can detect an angle of 2 x θ when it is turned over 180º, even if there is no absolute reference (line extended orthogonally from the slope) available. Since θ can be known when 2 x θ is halved, the horizontal plane is also found. It is for this reason that, when the board is turned over 180º, the actual inclination is indicated twice as large, assuming that one inclined side is at zero in the leveling. When this double indication is halved, the product will represent the inclination of that location, and if we adjust the inclination of the slope (object under measurement) in such a manner that the halved indication will become zero, that plane will become level.

Conversely, if a device that possesses an absolute reference gets to have that reference deviated for any reason, it is likely that we may be using the device without knowing the presence of that deviation.



[Leveling]

Leveling in one direction:

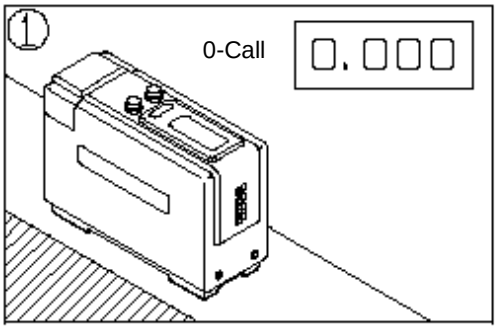
(1) Place the device on the object under measurement. Check the position of the bubble in the auxiliary bubble tube, and perform 0-Call, so that the indicator will show zero.

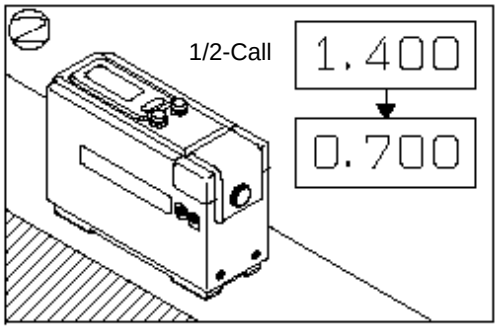
(2) Turn the device around 180º, and check to make sure that the bubble in the auxiliary bubble tube stays in the same position. Then, perform 1/2-Call to halve the indication value. If the position of the bubble in the auxiliary bubble tube is different, adjust the object under measurement, since it is likely that an error may be produced due to the inclination in the roll direction (direction perpendicular to the measurement axis).

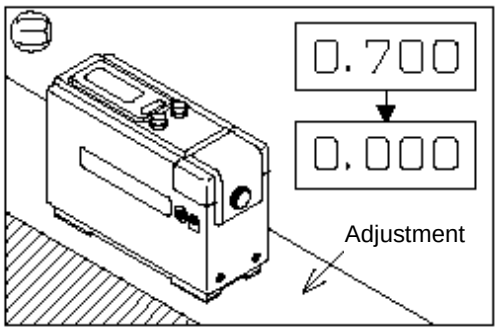
(3) Adjust the inclination of the object under measurement, so that the indication will become zero.

(4) Turn the device around 180º once again, and check to see if the indication is zero or not. If it is zero, it means that leveling has been accomplished.

If the indication is not zero, freshly redo Steps (1) through (4).







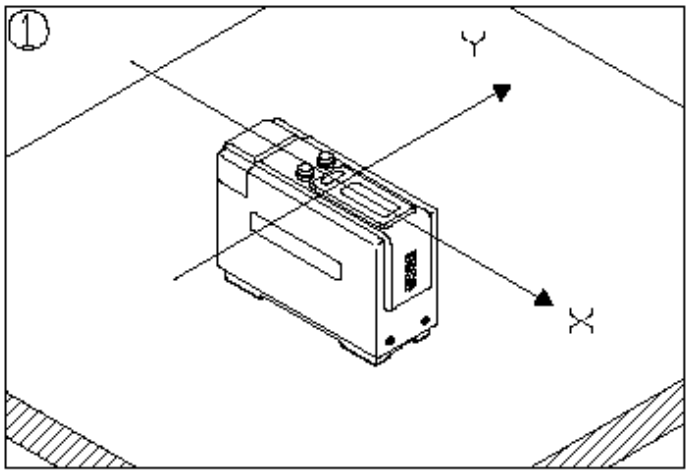
Leveling in two directions (x- and y-directions):

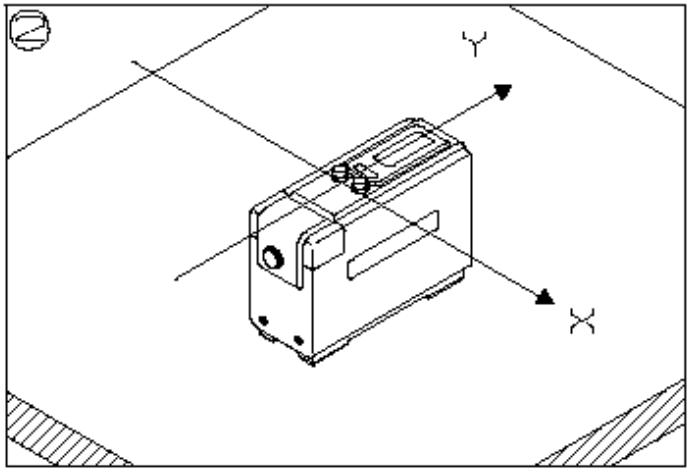
(1) Perform leveling in one direction (x-direction, for example) by the method of "Leveling in one direction."

(2) Practice leveling in the other direction (y-direction) by the same procedure.

(3) When the object under measurement is moved in seeking leveling in one direction, the level in the other direction may be disrupted. However, repeating Steps (1) and (2) several times will gradually bring the indication closer to zero in both directions.

When you always have a zero indication, it means that leveling in two directions has been achieved.



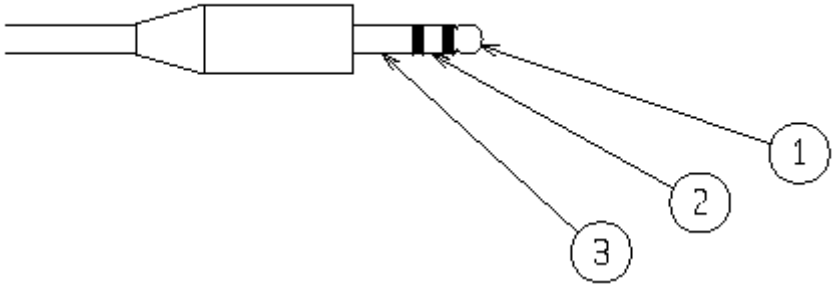


[External Signal Output]

Indication values can be output together with their units through the signal output jack which is located on the back of the device.

Since the signals conform to the RS-232C, they can be connected to a computer and printer that have an RS-232C input interface incorporated.

For this connection, a mini-stereo plug is employed.



(1) TD (Output): Transmitting data
(2) CTS (Input): Transmittable
(3) GND: Ground

Communication method:	Start-stop synchronization (Asynchronous) system
Communication control:	Hardware (Controlled with CTS)
Baud rate:	1200 bps
Data length:	8 bits
Stop bit:	1
Parity bit:	None
Output Signal Level:	±5 V to ±10 V
Input signal level:	±3 V to ±15 V

TD sends 16 character signals (Japanese character set) in one communication.

The signals are broken down as follows:

1st to 14th signals:	Measurement data including spaces and measurement unit
15th signal:	Carriage return (CR)
16th signal:	Line feed (LF)

①②③④⑤⑥⑦⑧⑨⑩⑪⑫⑬⑭ ⑮ ⑯	(Symbol △ denotes a space.)
△△△△1.234△mm/M CR LF	Output in the unit of mm/m
△△△△1.23△△mm/M CR LF	Output in the unit of mm/m
△△△−1.234△mm/M CR LF	Output in the unit of mm/m
△△△0.0707△° △△△ CR LF	Output in the unit of DEG (º)
△△△0.071△△° △△△ CR LF	Output in the unit of DEG (º)
△△−0.0707△° △△△ CR LF	Output in the unit of DEG (º)
△△+Error△△△△△△ CR LF	Error output
△△−Error△△△△△△ CR LF	Error output

Signal output is basically controlled with CTS.

CTS is an instruction signal that tells the device from the outside whether it should deliver or not deliver data.

When function selector switch is set in 1/2:

If the CTS terminal is at High Level, measurement data is output through the TD terminal.

If the CTS terminal is at Low Level or not connected, no measurement data is output.

If the CTS terminal is continuously at High Level, output takes place consecutively every time the data is updated.

When function selector switch is set in OUT:

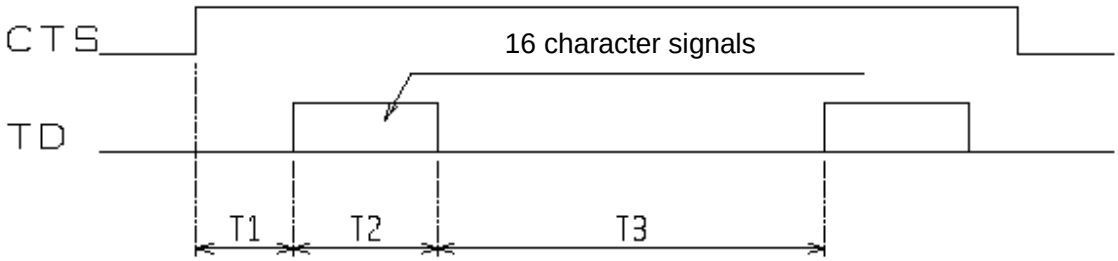
When the signal output switch (serving also as the 1/2-Call switch) is pressed, with the CTS terminal at High Level, measurement data is output through the TD terminal. The signal output switch is designed to deliver measurement data the moment it is released after being depressed, so that two or more measurement data will not be sent out at a time in each operation. Holding down the signal output switch continuously will not prompt measurement data to be output.

Note 1. If the CTS terminal turns to Low Level and remains in that status for about three seconds or longer during the transmission of 16 character signals, causing the transmission to be interrupted, E1 will appear on the display panel for about three seconds, and then, the normal operation will be restored.

Note 2. If the signal output switch is pressed when the CTS terminal is at Low Level, E2 will appear on the display panel for about three seconds, and then, the normal operation will be restored.

Note 3. If the indication is blinking because the battery voltage is low, no measurement data will be output.

<Timing Chart>



T1: 85 µsec to approx. 400 msec
T2: Approx. 140 msec
T3: Approx. 400 msec

[Transportation Method]

Since this is a precision measuring instrument, be careful not to inflict impact, excessive pressure or vibration to the device when carrying it or transporting it.

Carrying by human:

To carry the device, put it in the carrying case which was supplied with the device.

Avoid carrying it laid on its side or turned upside down.

As a positioning device to be used in storing the device in the carrying case, the case comes fitted with a frame that is a little larger than the level base of the device. Put the device in the frame in such a fashion that its level base will be accommodated snugly inside the frame.

When carrying the device by automobile, etc., place the carrying case flat on a passenger seat, as far as possible, to protect the device from vibration.

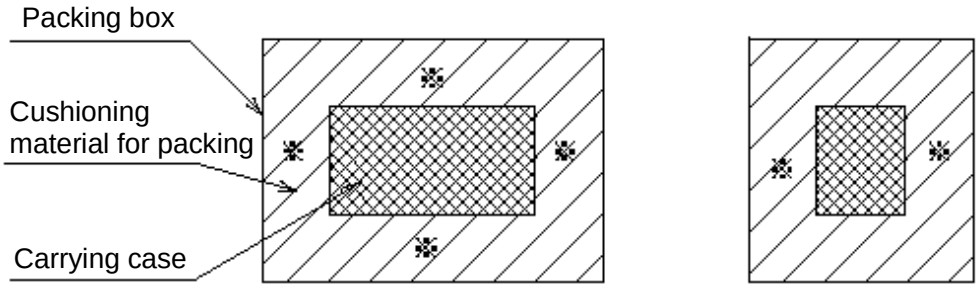
Avoid transporting the case placed in a slant posture or upside down.

Transporting by truck, etc.

For transportation of the device, prepare a sturdy box that is larger than the carrying case by approximately 20 cm in the internal dimensions of height, width and length.

First, put the device in the carrying case, and then, pack the case in the center of the box you have prepared using cushioning material for packing (a lump of paper cut into small pieces by shredder or the like will do), in such a manner that the case will remain afloat in the middle of the packing material.

The packing box should be properly marked to indicate its upside and downside in order to prevent the device from being transported in tilted or inverted posture.



Pack the case isolated from the six sides marked ※ by approximately 10 cm.

[Precautions]

Since this device is a precision class measuring instrument, exercise good caution in using it and carrying it, so that no impact or exceedingly large pressure will be applied to its measuring surface or main body.

The measuring surface at the bottom of the level base is a particularly critical part for its function. Exert extreme care about rust inhibition.

After you have used the device, clean it of dirt and stains, and apply rust-inhibitive oil to the measuring surface at the bottom of the level base, before storing it in the carrying case.

If the device is not going to be used for an extended period of time, be sure to remove the battery.

For storage, avoid a location under direct sunlight or susceptible to high temperature, and select a place with little temperature variation and low humidity.

Presence of burrs and dirt on the object to be measured could leave nicks in the measuring surface of the device and the object under measurement. Remove such foreign matters beforehand.

Avoid using the device near a magnet or in a location where intense magnetic field is generated.

Notice that, if the device is used as a sort of supplementary utensil, it will readily be nicked or rusted.

Do not use the device for any other purpose than for its original application.

[Specifications]

Model	DL-S3
Measuring range	±5.00 mm/m, ±0.286º
Minimum reading (*1)	0.001 mm/m, 0.0001º 0.01 mm/m, 0.001º
Operating temperature range	0 – 40°C
Reading accuracy (*2)	[17 – 23°C] ±0.85%rdg (0 – ±2 mm/m, 0 – ±0.115º) ±1.0%rdg (±2 – ±5 mm/m, 0.115 – ±0.286º) [0 – 40°C] ±2.6%rdg (0 – ±2 mm/m, 0 – ±0.115º) ±2.7%rdg (±2 – ±5mm/m, ±0.115 – ±0.286º)
Repeat accuracy	±0.005 mm/m within ±0.0003º
External signal output	Conforming to RS-232C
Power supply	9V dry cell (JIS S-006P): 1 100~240V AC adapter
Continuous operation time (*3)	Manganese dry cell: Approx. 10 hours Alkaline dry cell: Approx. 20 hours
External dimensions	172 (L) x 65 (W) x 120 (H) mm
Size of base	150 (L) x 55 (W) mm
Weight	2.2 kg
Accessories	100VAC adapter 9V dry cell Carrying case Instruction manual

(*1) When indication in DEG (º) is selected, 0 to the left of the decimal point is not displayed. The indication ranges in which the minimum readings of 0.001 mm/m and 0.0001º can be taken are ±1.999 mm/m and ±0.1145º or less.

(*2) %rdg denotes a percentage of a reading.

(*3) Somewhat varies depending on the operating conditions.

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