≪Precision Electronic Level≫

Compact Digital Display

DL-D3

LEVELNIC Owners Manual

新潟精機株式会社

Thank you for purchasing Niigata Seiki LEVELNIC.

Please read this manual thoroughly before use to insure proper operation and a long service life.

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[INTRODUCTION]

This digital display unit has built in microprocessor for advanced functionality.
The output can be switched to display as mm/m, or DEG(°).

[FEATURES]

◎ Connected to the Sensor Unit (Gauge) with a cable（DL-P1,）to use as a remote-display angle meter.

◎ Easy set-up with dedicated digital cable so no need to pair or configure for Sensor.

◎ Separate display allows you to work in tight spaces and on large equipment where display panel on the Sensor would be hard to read.

◎ Easy to read digital readout reduces user fatigue and errors.

◎ Units switchable on display can show measured angle in mm/m, or DEG(°).

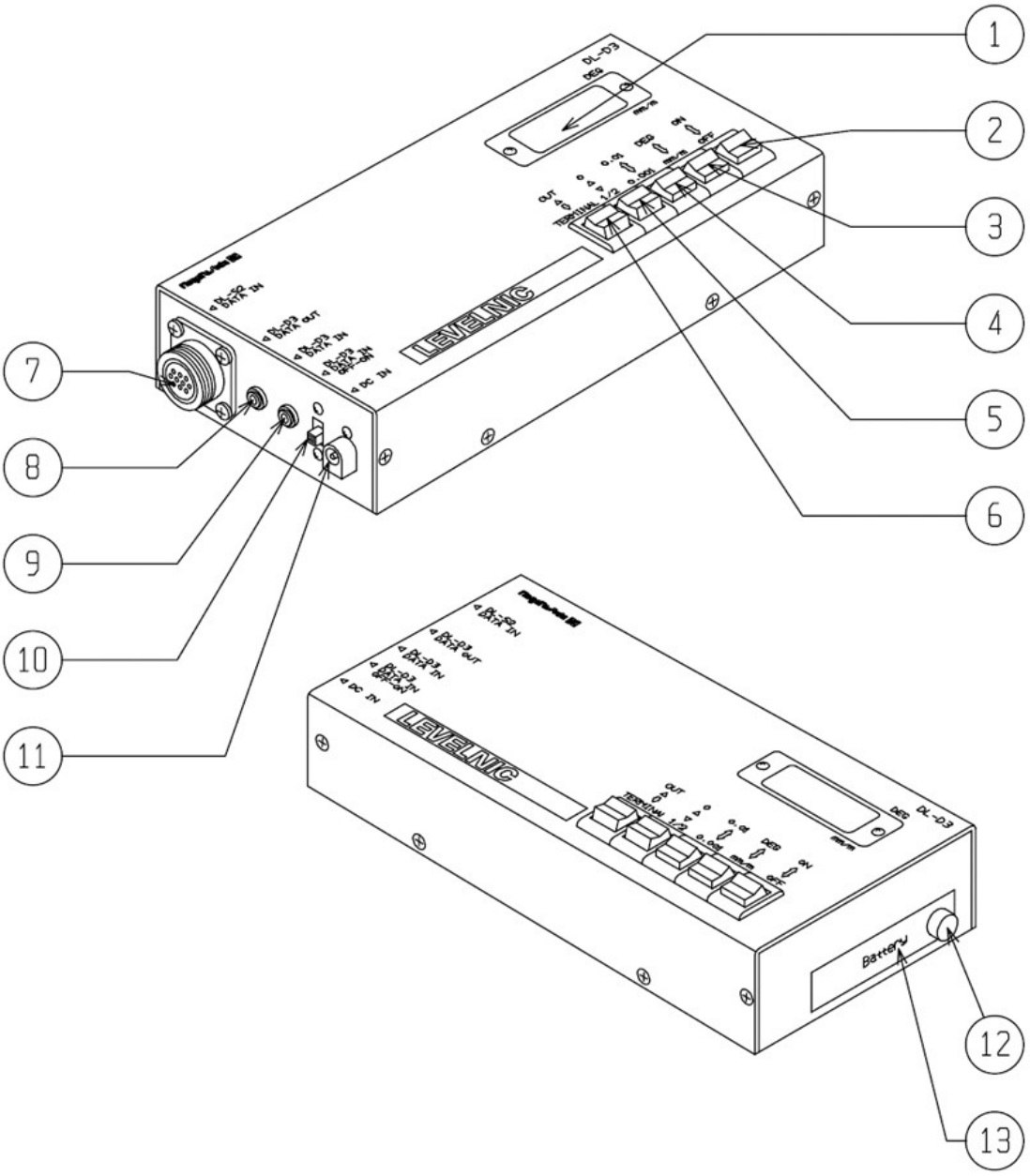
◎ Reference point easily set using 0-Cal and 1/2-Cal Buttons.

◎ Mode switch for controlling the resolution of the displayed value.

◎ RS-232C output signal for connection to computer or printer.

◎ Output signals for 2 or more systems can be combined into one output. This simplifies data recording and processing when using 2, 3, 4 or more systems.

[PART IDENTIFICATION]



(1) Display
(2) Power Switch
(3) Units Switch
(4) Mode Switch
(5) 0-Cal, 1/2-Cal Switch
(6) Data Out Switch
(7) DL-S2 Data In Connector
(8) Data Out Jack
(9) Data In Jack
(10) Data In Switch
(11) DC In Jack
(12) Battery Cover Screw
(13) Battery Cover

[DESCRIPTION]

(1) Display

Display shows angle reading, battery status, and communication status.

Angle

The displayed angle can be switched between units of mm/m, or DEG (°) using the Units Switch on the front panel.

When displaying units as DEG (°), the leading 0 in front of the decimal point is not shown on the display in order to differentiate from display of mm/m.

If the angle exceeds the measurement range, an error message is displayed.

For a positive out-of-range error, "EEE" is displayed, and for a negative out-of-range error, "−EEE" is shown.

When the angle is reduced to within the measurement range, normal operation will continue.

Battery Status

When Battery level is getting low, the displayed value will blink.

If the value on the display blinks, please replace battery or switch to the included AC adapter.

Communication Status

If an error occurs during data transmission, or if cable is not properly connected, an error message (E1, E2, E3, or E4) will be displayed for about 3 seconds.

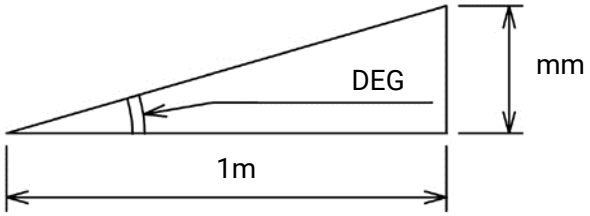
Refer to "Output Signal" section for details.

(2) Power Switch

Unit is ready for use about 5 sec. after being switched ON.
If the Sensor is not connected the display panel will not display a valid reading.
0-Cal and 1/2-Cal settings are not stored when power is turned off; when power is turned back on the reference point will need to be reset.

(3) Units Switch

Switches between units of mm/m, or DEG (°).
mm/m is the change in height, measured in mm, over a distance of 1 m.
Measurement Range is ±5mm/m
Measured in DEG(°), the range is ±0.2865°



(4) Mode Switch

When set to 0.001, the displayed resolution will be 0.001mm/m、or 0.0001°
When set to 0.01, the displayed resolution will be 0.01mm/m、or 0.001°
For 0.01setting, the measured value is rounded off for display.
This feature allows you to reduce number flickering, making the value easier to read when full resolution is not required.

（5）0-Cal, 1/2-Cal Switch

0-Cal Side

When pressed in this direction, the displayed measurement is set to zero.
Switch requires deliberate press of about 1 sec.

1/2-Cal Side

When pressed in this direction, the displayed reading is divided by 2.
Value is changed when released.
Switch requires deliberate press of about 1 sec.

（6）Data Out Switch

Controls when displayed data is output on the Data Out Jack to the connected devices.
When in neutral position and not pressed toward OUT, or TERMINAL side, no signal is output.
If the cable is not properly connected, or if there is a problem during communication, an error message will be displayed (E1, E2, E3, or E4) for about 3 seconds.
Please refer to the "Output Signal" section for more details.

Display Unit control of data output.

When the switch is pressed in the OUT direction, the Display Unit will send data to the connected device. Used when connected to a printer, or when connected to a computer and recording control is on the Display Unit side.
Data is sent when Switch is released.
Switch requires deliberate press of about 1 sec.

Data output controlled by downstream connected device

Move the switch to the TERMINAL position for continuous output of data from the Display. This is used when the connected device will control the recording, or updating of data points.

(7) Data In Connector

Connection for the Sensor using the DL-P1 connection cable. This connection provides signal input, and power supply output to the Sensor.
Rotate the ring on the cable end to screw the ring onto the threads and secure the cable to the connector.

(8) Data Out Jack

RS-232C port for sending the displayed value and units to a remote device for recording or display.
Signal can be output directly to a computer or printer equipped with an RS-232C port.
Please refer to "Output Signal" section for details.

(9) Data In Jack

For connecting multiple DL-D3 Display Units, this input receives the data from the other displays. The data from all connected displays can then be sent to a single printer or computer. The data from multiple connected systems is sent out on the Data Out Jack, if connected.
Please refer to "Connection Diagrams" section for details.

(10) Data In Switch

When connected to a second Display Unit (DL-S3) move the switch into the ON position to enable receiving data on the Data In Jack. When not connected to an additional Gauge, move the switch to the OFF position.
Please refer to "Connection Diagrams" section for details.

(11) DC In Jack

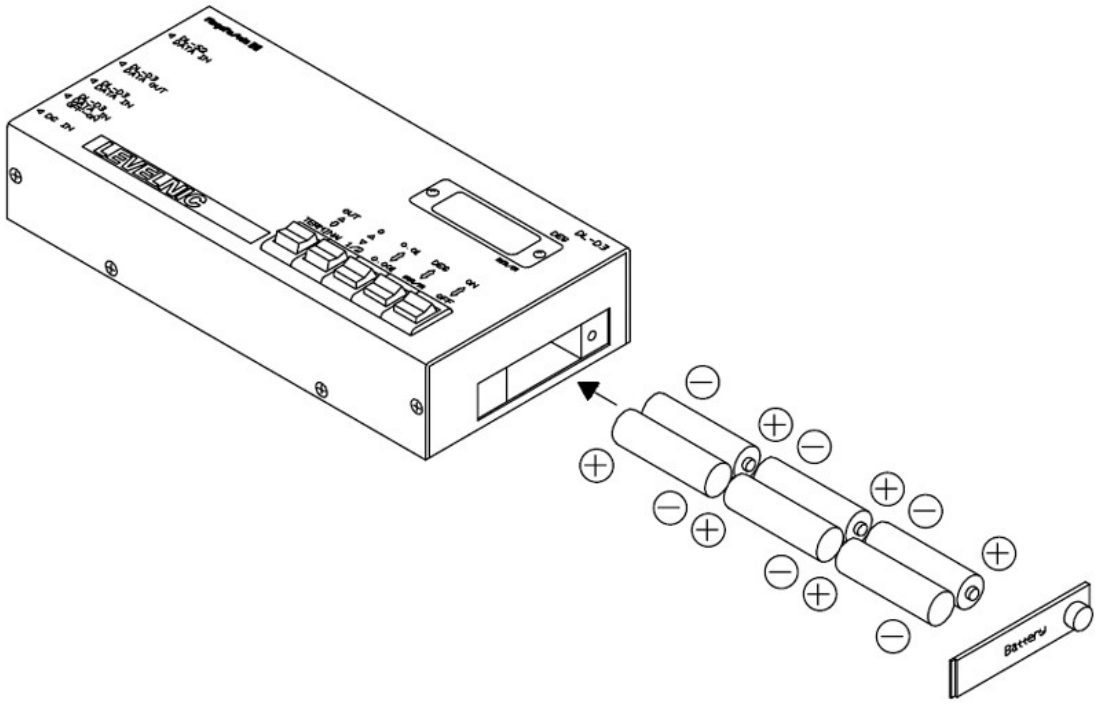
For connecting the included AC adapter for external power.
When AC adapter is plugged in, the battery power is disconnected from the internal circuit.

(12) Battery Cover Screw

When replacing battery, turn counter clockwise to remove.

(13) Battery Cover

Requires six AA type batteries.
Please install with proper polarity, as shown.



[MEASUREMENT RANGE AND ZERO POINT]

The instrument can be set to display a reference point of "0" at any angle using the 0-Cal and 1/2-Cal buttons.
However, the measuring range of the Sensor is limited by the range of the internal variable measured by the device. (This value can be seen when the system is first turned ON, before changing reference point.)

The Sensor does not have internal reference to true horizontal so the zero value displayed when the Gauge is first turned on and connected does not necessarily show true horizontal.
When an absolute reference to horizontal is needed, the zero-point must be set each time it is turned on.
In this way, the zero-point is accurate with each use with the advantage that any error due to drift in the zero-point is eliminated.
Refer to the section "Zero-Point Setting" below and follow the 0-Cal and 1/2-Cal procedures to set the zero-point.

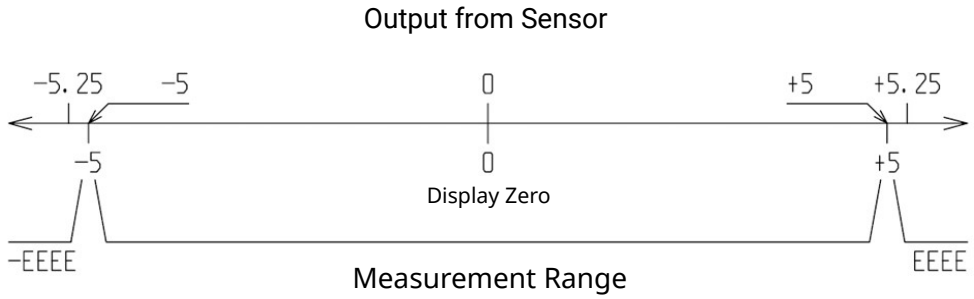
The operating range of the Display Unit is ±5.25mm/m [± 0.285°, units of mm/m will be used for remaining discussion.] This wider range ensures that the system will have a range of ±5mm/m around true horizontal allowing for some deviation between the internal zero point of the Sensor the zero point set at true horizontal.
The system has a measurement range of ±5mm/m, and is limited by both the range of the Sensor, and the Display Unit.

> The zero adjustment range on the Gauge body is greater than ± 0.25 mm/m, so to ensure that the measurement range at the Display is the full ± 5 mm/m the Gauge adjustment should be centered. To do this, turn the 10 turn 0-ADJUST potentiometer to the stop in one direction, then turn back 5 full rotations.

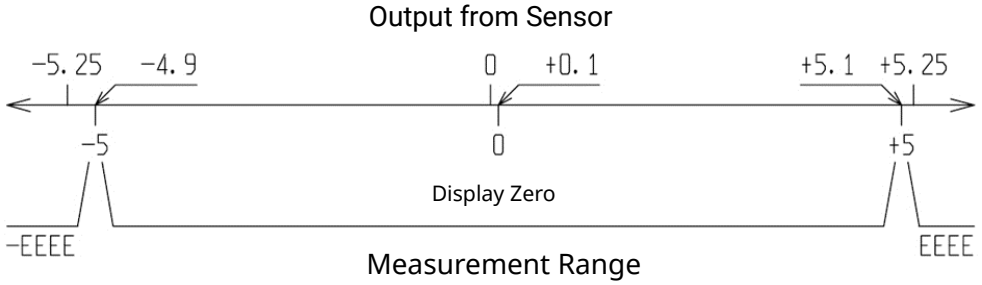
The following diagrams represent the two measurement ranges for various conditions. The internal measurement range is shown on the number line at the top of each diagram, and the displayed range shown below.

(all values shown in units of mm / m.)

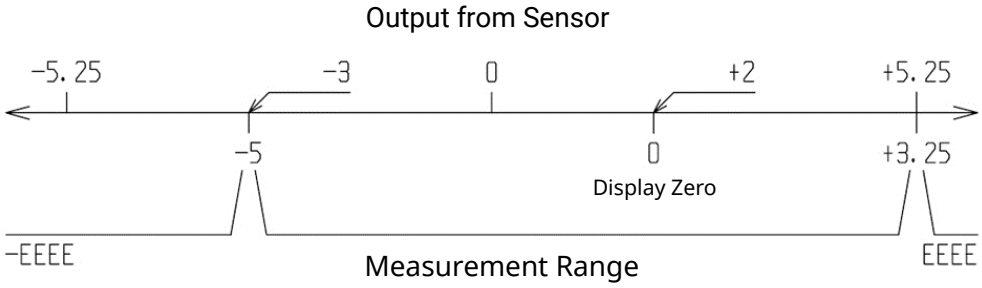
◎ 0-Cal, 1/2-Cal operations have not been performed.
（Zero reference point for displayed value is same as internal reference.）



◎ Reference point moved 0.1 mm/m using the 0-Cal, 1/2-Cal operations.
(For example, initial reading was 0.1 mm/m when 0-Cal is performed,
or 0.20 mm/m before 1/2-Cal is performed.)



◎ Reference point moved 2 mm/m using the 0-Cal, 1/2-Cal operations.
（For example. display reads ＋2mm/m when 0-Cal is performed,
or ＋4mm/m when 1/2-Cal is performed）



[HOW TO USE]

The Digital Sensor Unit is a precision instrument. Please handle with care and avoid any shock or mishandling.
Please also handle the Display Unit with care and protect from rough handling.

Connect the Display Unit to the Senor Unit using the connection cable (DL-P1).

Before use, wipe the gauge base and the surface of object to be measured using a soft cloth or lens cloth moistened with mineral spirits or alcohol to remove any grease and contamination.

Turn on the display using the Power Switch.

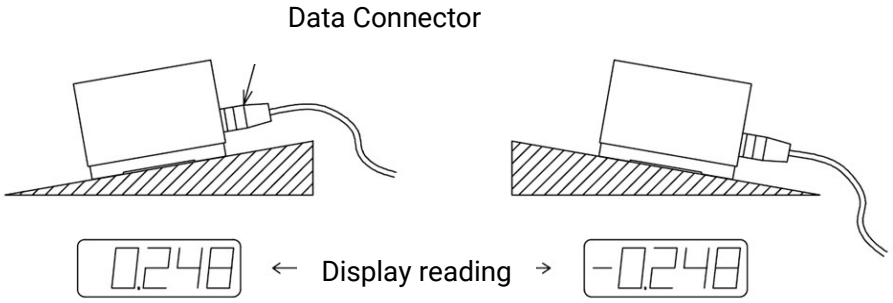
For best results, wait about 20 min. after power on for internal circuitry to stabilize.

The zero-point will shift up to 0.01mm/m when first turned on as the system warms up. If this level of precision is not needed, you can begin measurements as soon as it is turned on.

Make sure there is no difference in temperature between the instrument and the surface to be measured.
For the highest precision, perform measurements in a climate controlled room as is general practice for all precision measurements.

After use, protect the base of the Sensor by coating with rust-preventive oil before storage.

When the Gauge is viewed with the data connector on the right side, if the right side is elevated the angle reading will be an increasing positive number.
If the angle is out of range, an error message will be displayed. For negative angles, a "−" sign is also shown. In the error message, the "E" on the elevated side will also blink to indicate the direction of the out-of-range error.



The display can be set to show the angle in units of DEG (°), or in units of mm/m (height difference in mm over 1 m.)

For the case of mm/m, to determine the height difference over a certain distance or pitch, use the following equations.

$$\text{Height Difference / Pitch} = \text{Reading} \times \frac{\text{Pitch}}{1000} \quad [\text{mm}]$$

For the example with the measurement pitch = 100mm,

$$\text{Height Difference / Pitch} = \text{Reading} \times \frac{100}{1000} \quad [\text{mm}]$$
$$= \text{Reading} \times 0.1 \quad [\text{mm}]$$

[ZERO-POINT SETTING]

The Sensor does not have a preset absolute zero-point.
When the Display is first turned on, a reading of zero will not necessarily indicate that the gauge is at true horizontal position. If a zero-point is required, it must be set each time the Display is switched on.
In this way, calibration error is eliminated and the zero-point is set accurately each time.
Setting the zero-point to true horizontal is accomplished using the 0-Cal and 1/2-Cal Operations.

> Zero-point can also be set using the 0-Cal, 1/2-Cal adjustment procedure on the Gauge. A zero-point can not be set if the reference plane is beyond the adjustment range. In that case, please adjust the surface to reduce the slope to within the adjustment range for setting the zero-point.

A) For comparing relative slope of different surfaces.
(1) Place the Sensor on the surface to be used as the reference.
(2) When the display has settled, press the 0-Cal Switch to set the display to zero.
A relative zero-point has now been set for use in comparative angle measurements

B) If there is a true horizontal reference surface available.
(1) Place the Sensor on the surface to be used as the reference.
(2) When the display has settled, press the 0-Cal Switch to set the display to zero.
Zero-point has now been set for absolute measurements.

C) If surface is not known to be level.
(1) Place the Sensor on the surface to be used as the reference.
(2) When the display has settled, press the 0-Cal Switch to set the display to zero.
(3) Rotate the Sensor 180° in the same spot on the surface.
(4) When the display has settled, press the 1/2-Cal Switch to divide the display reading by 1/2.
Zero-point is now set at true horizontal.
The display will show the absolute tilt of the surface the instrument is on.

The zero-point is now set. However, if the reference surface is not level in the roll direction (perpendicular to the measurement axis,) there is a possibility of introducing some error to the measurement so make sure the surface is first leveled to reduce roll.

≪ 0-Cal, 1/2-Cal Operation ≫

The zero-point reference is set without an absolute reference by using the direction of Earth's gravity as a reference. This can be understood from the following procedure.

Suppose a slope having an angle θ with respect to the horizontal plane.

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

As seen in the diagram below, the weight will move toward side A of the board at an angle θ from the line perpendicular to the slope.

When the board is turned 180°, the weight now moves toward side B of the board by angle θ from the line perpendicular to the slope.

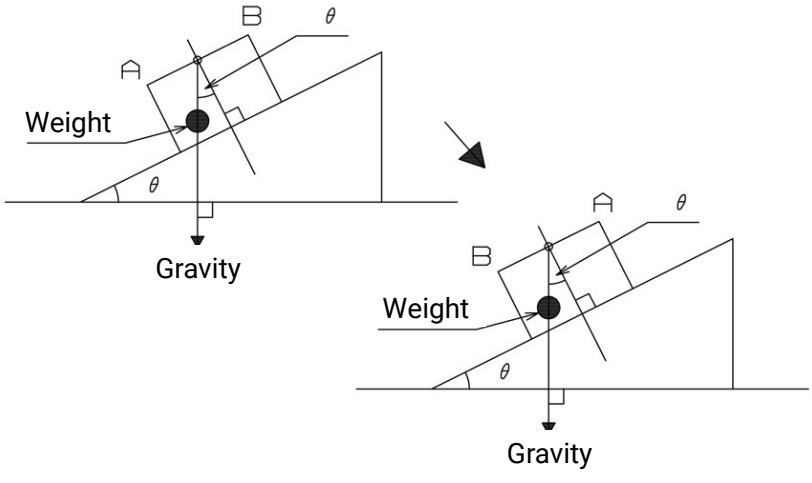
Using this method, even without a true horizontal reference we can determine the value of the angle 2×θ, where θ is the angle of the slope in reference to the horizon.

By dividing by two, we can determine θ, the tilt of the slope.

If the gauge is set to zero on a slope, then when the gauge is rotated 180° it will show the angle twice the actual tilt of the slope.

If the reading is then halved, it will show the tilt of the slope, and by adjusting the slope until that reading is zero, we can adjust the surface to horizontal.

Using this method for setting the horizontal reference, the reference set is always accurate and the gauge reliable. For an instrument with built in reference, there is a chance that it will be inaccurate and yet will continue to be used without knowing of the deviation.



[LEVELING A SURFACE]

Leveling in one direction.

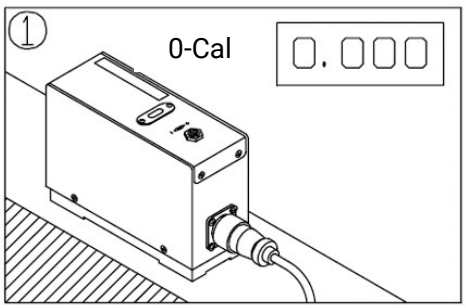
（1）Place the Sensor on the surface, and once the display has stabilized (while also checking bubble tube level reading.) Press the 0-Cal Switch to zero the reading.

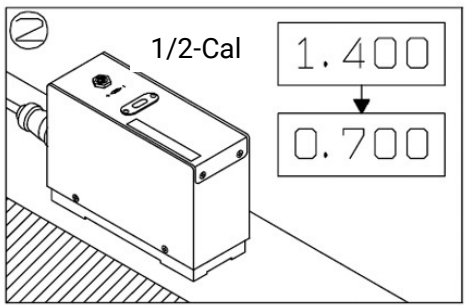
（2） Rotate the Sensor 180° in the same location on the surface. Check the bubble tube level -- it should read the same. Press the 1/2-Cal Switch.
If the reading on the bubble tube level changes, it indicates that the surface has tilt in the roll direction (perpendicular to the direction being measured,) and this may lead to error.

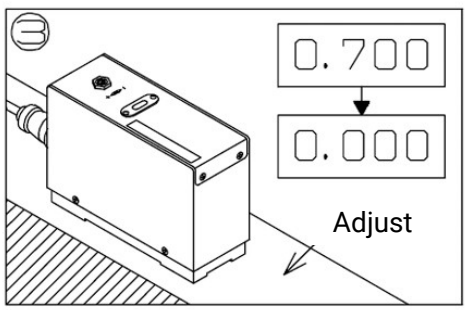
（3）Adjust the tilt of the surface to make the instrument's display read zero.

（4）Rotate the gauge 180° again to confirm that the reading is zero and the surface is level.
If it does not read zero after rotating, then repeat steps (1) ~ (4) above.

Note: If there is a large tilt in the roll direction (perpendicular to the measurement axis) there will be some display error and it will be difficult to level the surface. In this case, please also adjust the surface so that the roll direction is also level.





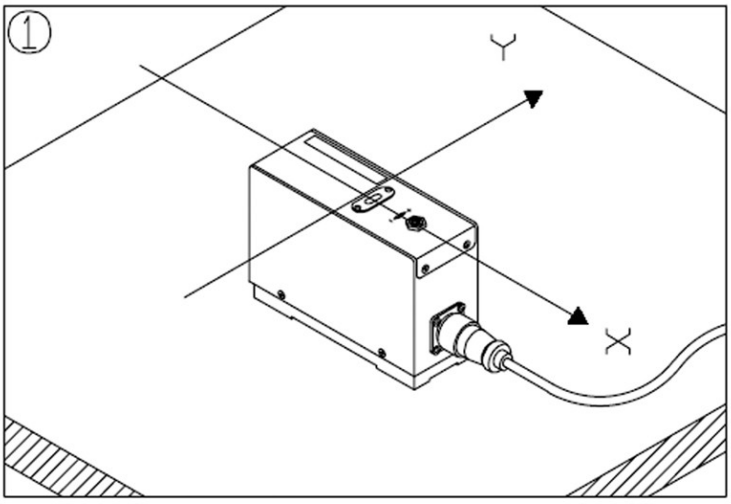


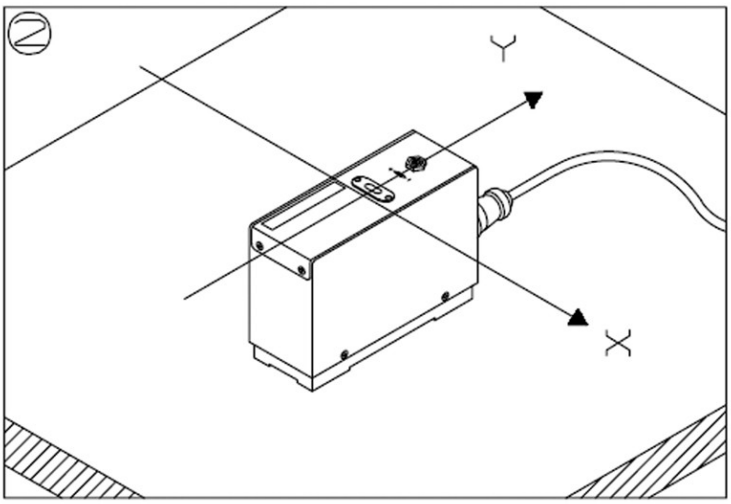
Leveling in two directions（X、Y direction）

（1）For one direction (for example the X-direction,) follow the above procedure for “Leveling in one direction.”

（2）Repeat the procedure for the other direction (the Y-direction.)

（3）When adjusting in one direction, it is possible that the perpendicular direction will be affected and no longer level. It may be necessary to repeat steps (1), (2), several times to bring the two axis into level.
When the reading is zero for the level placed in any position, the surface is level.



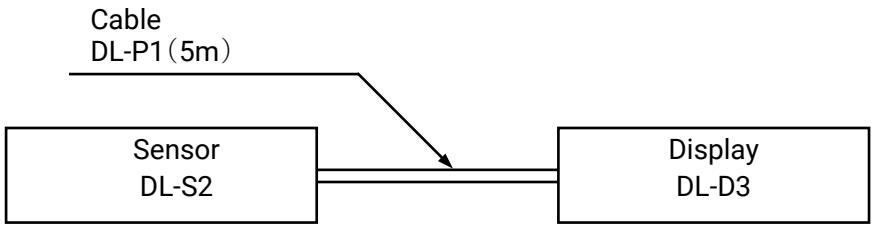


[CONNECTION DIAGRAMS]

Display Unit connection examples with switch settings shown.

＜ Basic configuration ＞

Display connected to digital sensor

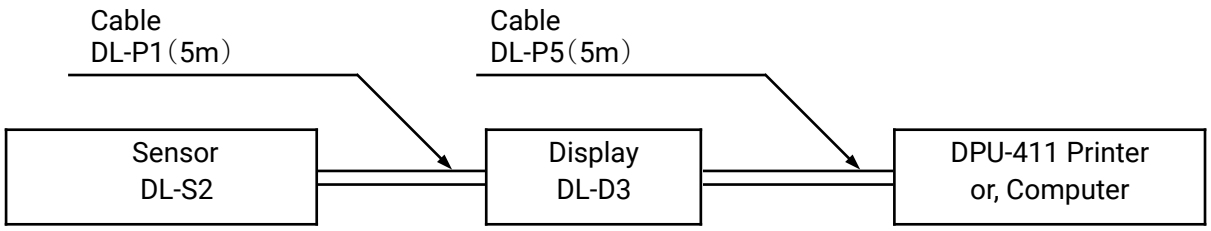


Data Out Switch：Neutral（OFF）
Data In Switch： OFF

＜ Printer / Computer connection ＞

Adding a printer or computer to basic configuration.

Connect the output DL-P5 cable to the Data Out Jack.

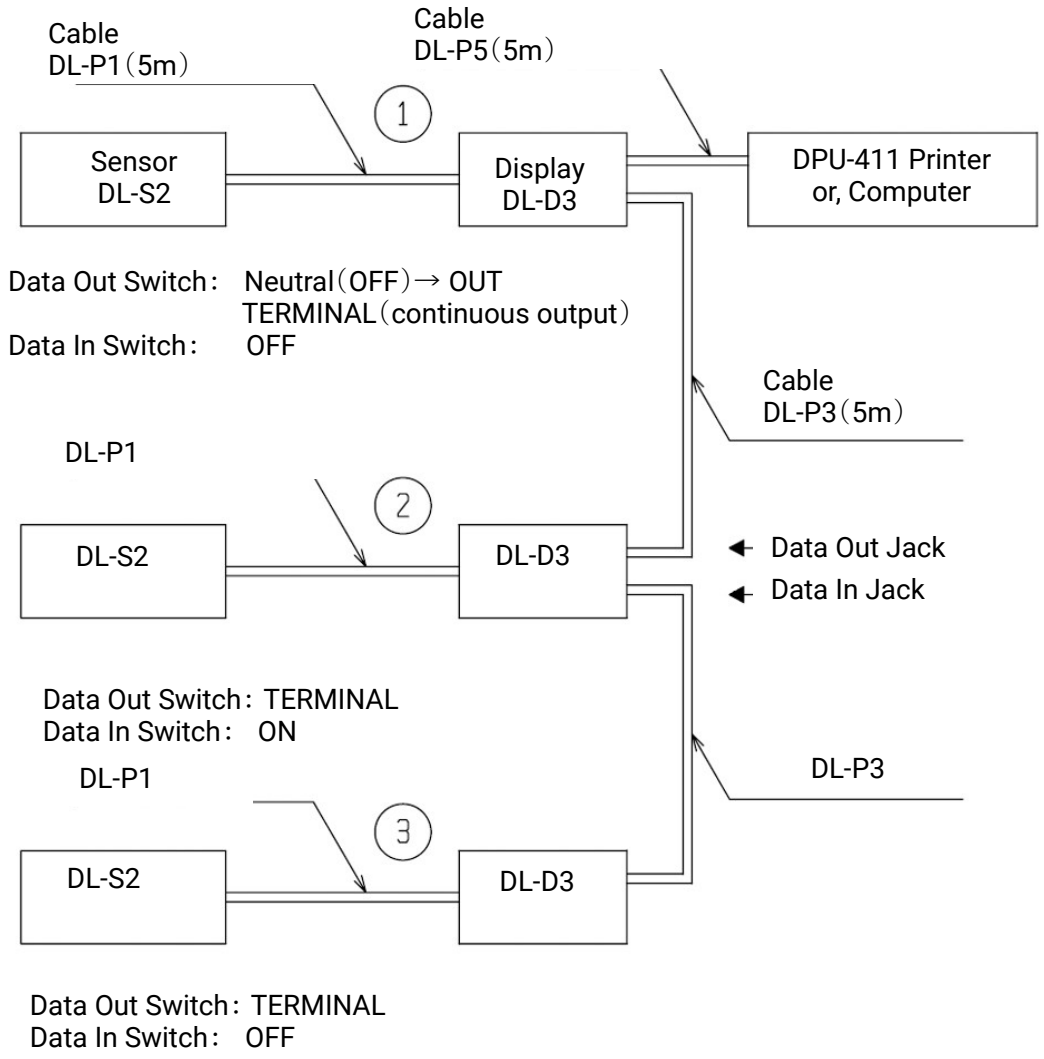


Data Out Switch：Neutral（OFF）→ OUT
TERMINAL（continuous output）
Data In Switch： OFF

If the Data In Switch is in the ON position, "NO CONNECT" will be output to indicate that there was no data present on the Data In Jack.

＜ Multiple Units Connected ＞

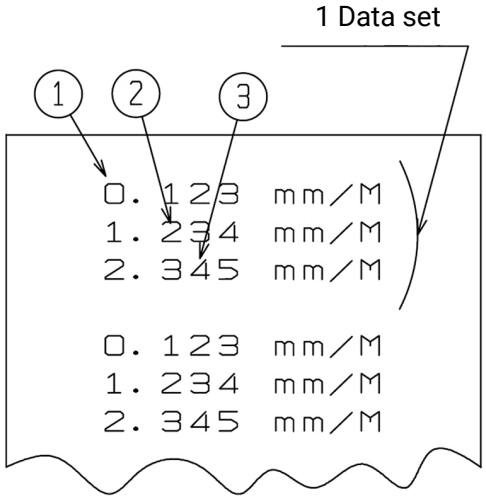
Connection of multiple Display units daisy chained on the Data Out and Data In jacks.



Printer output for 3 system configuration:

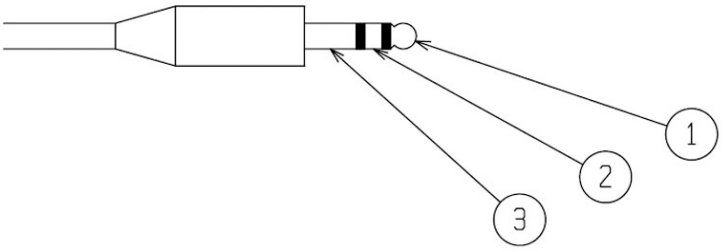
The data from multiple systems is printed out as shown on right, with the output printed in order of connection starting with the system closest to the printer hookup.

For each additional system connected to the chain, one line is added to the output.



[Output Signal]

Displayed measurement value and units are output on the Data Out Jack.
The signal is RS-232C compatible so can be connected to any computer or printer with an RS-232C port available.
Signal is also used to connect to another DL-D3 when connecting multiple systems.
Use an audio type mini-plug for connecting cable to Data Out Jack.
（Connection Cables DL-P3,DL-P5 available from manufacturer）



（1）TD（Output）	Transmitted Data
（2）CTS（Input）	Clear to Send
（3）GND	Ground

Comm method	Asynchronous
Comm Control	Hardware (CTS controlled)
Baud Rate	1200 bps
Data Length	8 bit
Stop Bits	1
Parity Bit	No
Output signal	±5 V to ±10 V
Input Signal	3 V to ±15 V

Transmitted data will be 16 characters in each string (Japanese character set..)
In addition, when the Data In Switch is OFF an EOF will be sent as the 17th character.
The data contents are as follows:

Character 1~14	Measurement data and units, including spaces
Character 15	Carriage Return (CR)
Character 16	Line Feed (LF)
Character 17	EOF

①②③④⑤⑥⑦⑧⑨⑩⑪⑫⑬⑭ ⑮ ⑯ ⑰	（△symbol = space）
△△△△1.234△mm/M CR LF EOF	Output units of mm/m
△△△△1.23△△mm/M CR LF EOF	〃
△△△−1.234△mm/M CR LF EOF	〃
△△△0.0707△°△△△ CR LF EOF	Output units of DEG（°）
△△△0.071△△°△△△ CR LF EOF	〃
△△−0.0707△°△△△ CR LF EOF	〃
△△+Error△△△△△ CR LF EOF	Error output
△△−Error△△△△△ CR LF EOF	〃

Signal output is controlled by the CTS signal.
CTS tells the system when to transmit, or not to transmit data.

If the Data Out Switch is set to “TERMINAL”.

For CTS level “high”, measurement data is sent on TD with each data update..

For CTS level “low”, or not connected, measurement data is not sent.

If CTS is continuously “high”, measurement data will be sent continuously.

If the Data Out Switch is in center, neutral position.

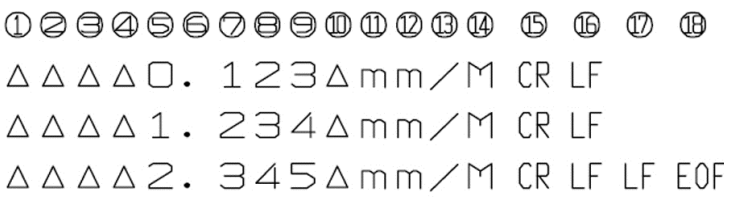
For CTS level “high”, measurement data is sent on the TD line each time the Data Out Switch is pushed in the OUT direction.

In order to prevent multiple data from being sent, the Data Out Switch will only send out data upon release.

Data will not be output if Data Out Switch is continuously held down.

Example for multiple units connected（3 systems）

Data for 3 connected systems.
After the last data string, LF, EOF characters are sent..



（△Symbol = space）
Data from unit 1
Data from unit 2
Data from unit 3

Note 1: If CTS goes "low" and stays low for about 3 sec. during the data transmission (before the EOF is sent,) the transmission will be interrupted and the display will show “E1” for about 3 sec. before returning to normal operation.

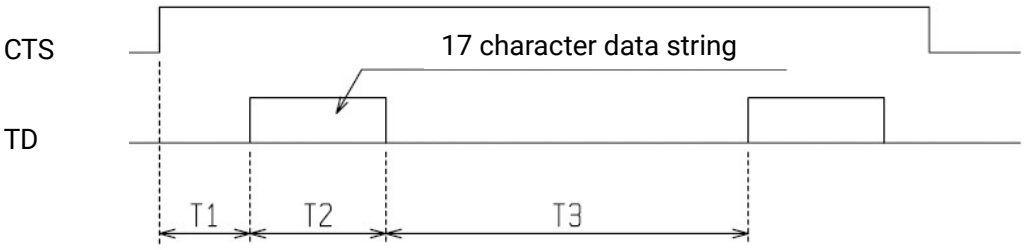
Note 2: If CTS is “low” when OUT on the Signal Output Switch is pressed, the display will show “E2” for about 3 sec., and then return to normal.

Note 3: When receiving data in multiple system configuration, If data is not received for about 3 sec. during a transmission (before the EOF is received,) then following the characters which had been received the "NO CONNECT" characters will be sent followed by CR LF LF EOF, and the display will show “E3” for about 3 sec. After which, it will return to normal operation.

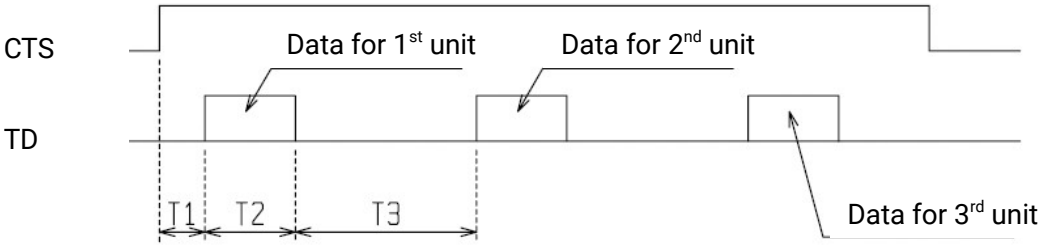
Note 4: When in multiple system configuration, if there is no data received for about 3 sec., then the "NO CONNECT" characters will be sent followed by CR LF LF EOF, and the display will show “E4” for about 3 sec. After which, it will return to normal operation.

Note 5: If battery voltage is low, display will blink and data can not be output.

＜ Timing Chart ＞



T1 : 85μsec to ~400msec
T2 : ~140msec
T3 : ~400msec



T1 : 85μsec to ~400msec
T2 : ~140msec
T3 : 85μsec to ~400msec

[SHIPPING]

The Sensor Unit is a precision instrument; when carried or shipped care must be taken to avoid damage. Please be careful not so subject instrument to shock, vibration, or excessive forces during shipping.

Hand Carrying

Always transport in supplied case.

Transport in upright position and not on side or upside down.

When transported by automobile, reduce unnecessary vibration as much as possible by placing on upright on passenger seat during transport.

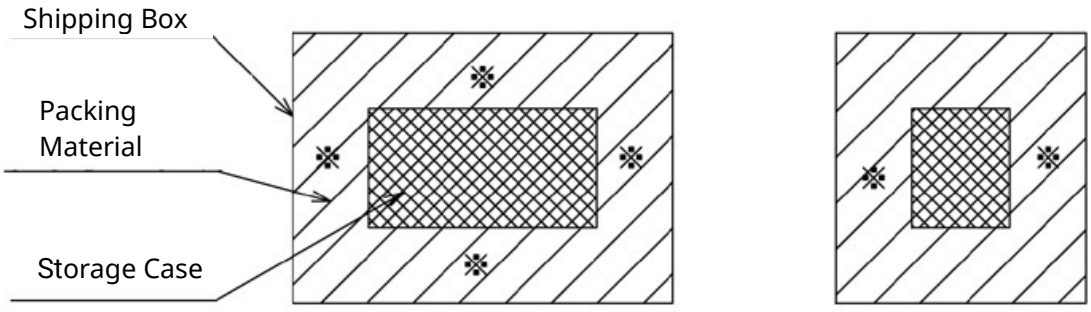
When placing the Level Gauge into the storage case, use care since the outer body is larger than the base and will get stuck.

Shipping via Truck or Carrier

Please prepare a shipping box with internal size approximately 20cm larger than the storage case in all dimensions.

Place the instrument in the storage case, and place the case in the box with all sides protected with appropriate packing material (such as shredded paper or similar cushioning material.) Pack with enough material to ensure the case will stay centered in the box and will be protected from shock.

The case should be right-side up, and the box marked to insure the box is kept upright during shipping, and not on side or upside down.



※ Leave room for 10cm of packing material on all six sides

[NOTICES]

This is a precision instrument, handle with care. While in use and during transport protect from excessive shock, vibration, or excessive force.

If not used for a long period, remove batteries.

Store in cool, dry location out of direct sunlight and protect from high humidity or severe temperature changes.

Keep away from magnets and strong magnetic fields.

When used in a support capacity for other equipment, it can easily be damaged; please use care to avoid scratches or corrosion.

Do not modify or use for purpose other than original intended use.

[SPECIFICATIONS]

Model	DL-D3
Display Range	±5.000 mm/m、±0.2865°
Resolution	0.001mm/m、0.0001°
（※1）	0.01mm/m、0.001°
Operating Temp. range	0 ~ 40℃
Output Signal	RS-232C compatible
Power	6x AA Batteries
	AC100V Adapter
Continuous Use Time	Zinc-Carbon battery　approx. 27 hours
（※2）	Alkaline battery　approx. 55 hours
Dimensions	235 (L)　×　106 (W)　×　51 (H) mm
Weight	1.0kg
Accessories	AC100V Adapter
	Storage Case
	Owner's Manual

（※1）When DEG（°）is selected for display, the O left of decimal is not shown.

（※2）Some variation depending on usage conditions.

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