



Operating instructions  
Inductive conductivity sensor G1½ all-plastic device  
**LDL400**

**GB**

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# 1 Preliminary note

You will find instructions, technical data, approvals and further information using the QR code on the unit / packaging or at [documentation.ifm.com](https://documentation.ifm.com).

## 1.1 Symbols used

- ✓ Requirement
- Instructions
- ▷ Reaction, result
- [...] Designation of keys, buttons or indications
- Cross-reference
-  Important note  
Non-compliance may result in malfunction or interference.
-  Information  
Supplementary note

## 1.2 Warnings

Warnings indicate the possibility of personal injury and damage to property. This enables safe product handling. Warnings are graded as follows:



### **WARNING**

Warning of serious personal injury

- ▷ If the warning is not observed, fatal and serious injuries are possible.



### **CAUTION**

Warning of minor to moderate personal injury

- ▷ If the warning is not observed, minor to moderate injuries are possible.

### **ATTENTION**

Warning of damage to property

- ▷ If the warning is not observed, damage to property is possible.

## 2 Safety instructions

- The unit described is a subcomponent for integration into a system.
  - The system architect is responsible for the safety of the system.
  - The system architect undertakes to perform a risk assessment and to create documentation in accordance with legal and normative requirements to be provided to the operator and user of the system. This documentation must contain all necessary information and safety instructions for the operator, the user and, if applicable, for any service personnel authorised by the architect of the system.
- Read this document before setting up the product and keep it during the entire service life.
- The product must be suitable for the corresponding applications and environmental conditions without any restrictions.
- Only use the product for its intended purpose (→ Intended use).
- If the operating instructions or the technical data are not adhered to, personal injury and/or damage to property may occur.
- The manufacturer assumes no liability or warranty for any consequences caused by tampering with the product or incorrect use by the operator.
- Installation, electrical connection, set-up, operation and maintenance of the product must be carried out by qualified personnel authorised by the machine operator.
- Protect units and cables against damage.
- Only use the product for permissible media (→ Technical data).
- The unit complies with the standard EN 61000-6-4 and is a class A product. The unit may cause radio interference in domestic areas. If interference occurs, the user must take appropriate actions.

### 3 Intended use

The device detects the conductivity and the temperature of liquids in pipes.

The device also determines the salt concentration for NaCl solutions (common salt solutions).

[Application area \(→ □ 5\)](#), [Restriction of the application area \(→ □ 5\)](#)

The device is designed for direct contact with the medium.

#### 3.1 Application area

- Water and waste water industry
- Desalination plants (seawater environment, low temperatures)
- Salt water / seawater applications
- Air conditioning systems and cooling tower monitoring (desalination control)
- Rinsing baths
- Concentration monitoring
- Determining the concentration of NaCl solutions (common salt solutions)



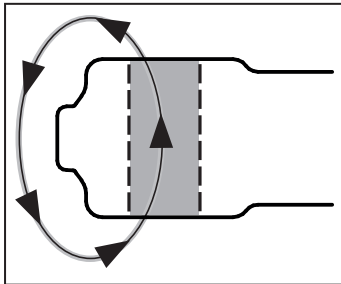
The device calculates the concentration (mass fraction of NaCl in water) from the measured conductivity value. The value determined is only valid for NaCl solutions in pure and ultrapure water and only to a limited extent for NaCl solutions in water with higher conductivity. Further information and notes on determining the concentration → Technical data sheet.

#### 3.2 Restriction of the application area

- Use the device only for media to which the wetted materials are sufficiently resistant (→ Technical data sheet).
- Only use the device in temperature ranges for which it is sufficiently suitable (→ Technical data sheet).
- The device is not suitable for liquids with a low electrical conductivity (e.g. oils, greases, highly purified water).
- The device is not suitable for applications where the probe is subjected to permanent and high mechanical stress (e.g. abrasive media or fast flowing media containing solid particles).
- Not suited for media prone to formation of deposit.
- Determining the concentration of NaCl solutions is only suitable for NaCl solutions in water.  
[Application area \(→ □ 5\)](#)
- The determined concentration value is only available via the IO-Link communication interface with acyclical data request. [IO-Link \(→ □ 7\)](#)

## 4 Function

### 4.1 Measuring principle



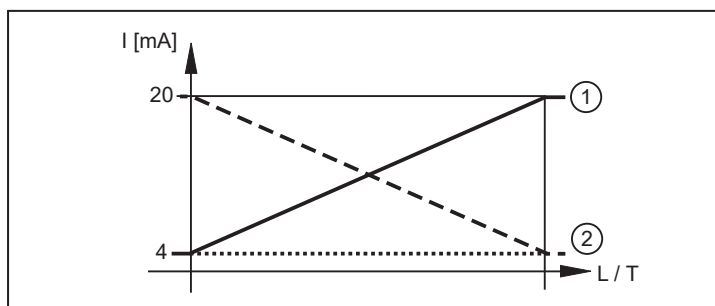
The unit operates on the inductive measuring principle. It measures the electrical conductivity of the medium to be monitored by means of an induced current flow in a measuring channel through which the medium flows.

To compensate the influence of the temperature, the process temperature is detected by a temperature probe in the sensor tip.

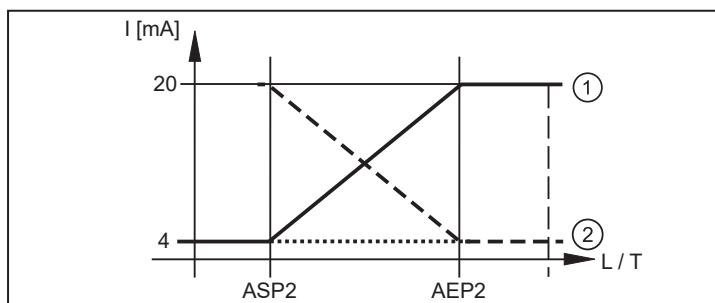
### 4.2 Analogue function

The unit provides an analogue signal proportional to the conductivity or (as option) the temperature. The analogue output (OUT2) can be configured.

**Curve of the analogue signal (factory setting):**



**Curve of the analogue signal (measuring range scaled):**



L: conductivity:  
 T: temperature  
 1: [ou2] = [I]  
 2: [ou2] = [InEG]  
 ASP2: analogue start point  
 AEP2: analogue end point

### 4.3 Defined state in case of a fault

If a fault is detected or if the signal quality is below a minimum value, the output OUT2 passes into a defined state according to Namur recommendation (NE43).

For this case, the response of the output can be set via the parameter [FOU2].

## 4.4 IO-Link

IO-Link is a communication system for connecting intelligent sensors and actuators to automation systems. IO-Link is standardised in the IEC 61131-9 standard.



General information on IO-Link at [io-link.ifm](https://io-link.ifm.com)



Input Output Device Description (IODD) with all parameters, process data and detailed descriptions of the device at [documentation.ifm.com](https://documentation.ifm.com)

IO-Link offers the following advantages:

- Interference-free transmission of all data and process values
- Parameter setting in the running process or presetting outside the application
- Parameters for identifying the connected devices in the system
- Additional parameters and diagnostic functions
- Automatic backup and restore of parameter sets in case of device replacement (data storage)
- Logging of parameter sets, process values and events
- Device description file (IODD - Input Output Device Description) for easy project planning
- Standardised electrical connection
- Remote maintenance

## 5 Installation



Before installing and removing the device:

- ▶ Make sure that no pressure is applied to the system and there is no medium in the pipe or tank.



The sensor is supplied without installation / connection accessories.



Only use accessories from ifm electronic gmbh! The optimum function is not ensured when using components from other manufacturers.



Available accessories: [www.ifm.com](http://www.ifm.com).

### 5.1 Installation location / environment



A correct fit and function of the unit and ingress resistance of the connection are only ensured using ifm adapters.



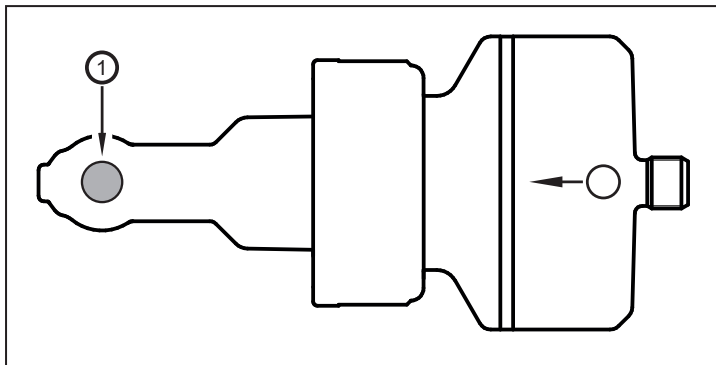
When process connections from other manufacturers are used:

- ▶ Ensure mechanical compatibility, function and tightness.
- ▶ To avoid malfunctions and damage to the sensor and plant, adhere to a distance of at least 5 mm from the sensor tip to neighbouring objects (e.g. pipe and container walls, structures).

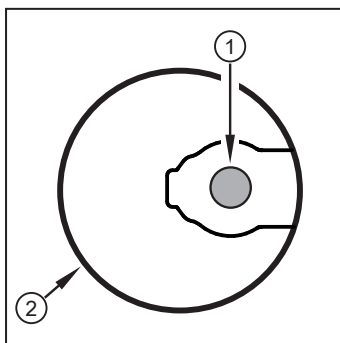


Orientation of the measurement channel:

- ▶ The measuring channel must be correctly aligned. Observe the marking on the sensor housing. When using ifm adapters, correct alignment is ensured thanks to mechanical coding. [Mounting the device in the adapter \(→ 9\)](#)
- ▷ This ensures correct flow through the measuring channel.

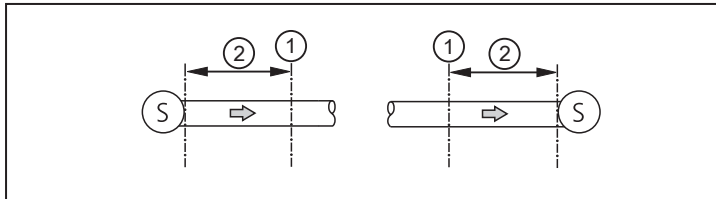


1: measurement channel



1: measurement channel  
2: Pipe

- ▶ Installation preferably before or in rising pipes.
- ▶ Provide for inlet and outlet pipe lengths (2) (minimum 3 x DN, optimum 5 x DN).
- ▷ Disturbances caused by bends, valves or pipe reductions, etc. are then eliminated.



S: Interference  
 DN: Pipe diameter  
 1: Sensor  
 2: Inlet and outlet pipe lengths

## 5.2 Installation procedure

The device is installed using a T-adapter (→ Accessories).

## 5.3 Mounting the adapter in pipes



Install the adapter using standard procedures and the recognised rules of technology.

- ▶ Remove the protective packaging only just before mounting.
- ▶ Ensure cleanliness of the sealing areas.
- ▶ If the sealing surfaces are damaged, replace the device or the adapter.

## 5.4 Mounting the device in the adapter



Only use adapters from the ifm accessories.

- ▶ Place the O-ring in the groove on the T-adapter.
- ▶ Insert the device into the T-adapter and position it so that the groove on the device fits over the guide pin on the wall.
- ▷ This ensures the correct installation position and correct flow through the measuring channel.
- ▶ Screw the coupling nut onto the thread of the T-adapter and tighten hand-tight.
- ▶ After installation, check the entire system for ingress resistance.

## 6 Electrical connection



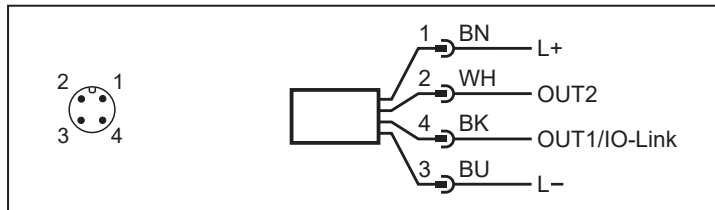
The unit must be connected by a qualified electrician.

Observe the national and international regulations for the installation of electrical equipment.

Voltage supply according to SELV, PELV.

► Disconnect power.

► Connect the unit as follows:



| Pin                         | Core colour |       |
|-----------------------------|-------------|-------|
| 1:                          | BN          | Brown |
| 2:                          | WH          | White |
| 3:                          | BU          | Blue  |
| 4:                          | BK          | Black |
| OUT1: IO-Link               |             |       |
| OUT2: Analogue output       |             |       |
| Colours to DIN EN 60947-5-2 |             |       |



The connection accessories are not supplied with the device.

Available accessories: [www.ifm.com](http://www.ifm.com)

### 6.1 For the cULus scope of validity

The electrical supply must only be made via SELV/PELV circuits.

A class 2 power supply can also be used and is not excluded.

The device must be supplied via a limited energy circuit according to section 9.4 of UL standard 61010-1, 3rd issue, or equivalent.

The external circuits connected to the device must be SELV/PELV circuits.

The device is designed to be safe at least under the following conditions:

- Indoor use
- Altitude up to 2000 m
- Relative air humidity up to max. 90 %, non condensing
- Pollution degree 3
- Use UL-certified approved cables of category PVVA or CYJV with data suitable for the application.
- No special treatment is needed for cleaning the device. (This note does not apply to hygienic applications).

## 7 Parameter setting

Parameters can be set before installation or during operation.



If you change parameters during operation, this will influence the function of the plant.

► Ensure that there will be no malfunctions in your plant.

During parameter setting the unit remains in the operating mode. It continues to monitor with the existing parameter until the parameter setting has been completed.



Depending on the parameter setting, the parameters available in the menu may change.

Requirements for parameter setting via the IO-Link interface:

- ✓ A suitable parameter setting software, e.g. ifm moneo|configure
- ✓ The Input Output Device Description (IODD) for the device, see [documentation.ifm.com](https://documentation.ifm.com)
- ✓ One IO-Link master
- Connect the IO-Link master to a parameter setting software.
- Set the port of the master to the IO-Link operating mode.
- Connect the device to a free port of the IO-Link master.
- ▷ The unit switches to IO-Link mode.
- Change parameter settings in the software.
- Write parameter settings to the unit.



Notes on parameter setting → Manual of the parameter setting software

### 7.1 Parameter setting during operation



Parameter setting during operation is only possible with an IO-Link-capable module (master).

Setting parameters can be directly adjusted via the controller.

Example: Media-specific parameters such as temperature coefficient [T.Cmp] can be adjusted to improve accuracy.

Recipes and settings can be stored in the controller during operation.

By parameter setting via the controller, a check of the units via a bit in parameter setting is ensured.

### 7.2 Adjustable parameters and system commands

#### 7.2.1 General parameters

|                                        |                                                                                                                                                                                                                                                        |
|----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Reset the application (system command) | The parameters of the technology-specific application are set to default values. The identification parameters remain unchanged. If activated in the port configuration of the master, an upload will be carried out to the data memory of the master. |
| Back-to-Box (system command)           | The device parameters are set to the factory default values and communication is blocked until the next time the device is switched on and off. Note: Disconnect the device directly from the master port!                                             |
| uni.C                                  | Selection of the unit for conductivity displayed in the parameter setting tool<br>[S/m] - conductivity is displayed in S/m<br>[µS/cm] - conductivity is displayed in µS/cm.                                                                            |

|               |                                                                                                                                                                                                                                 |                         |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| CGA-COND      | Calibration gain (cell constant correction factor). With this factor the sensor can be calibrated to a present system, or to a system optimised to a certain conductivity value. Setting range: 80...120 %<br>Reference values: |                         |
|               | Installation in                                                                                                                                                                                                                 | Correction factor [CGA] |
|               | DN32                                                                                                                                                                                                                            | 102 %                   |
|               | DN40                                                                                                                                                                                                                            | 100 %                   |
| T.Cmp-COND    | Temperature compensation. The conductivity is determined according to the standard temperature ([rEF.T]) when the temperature coefficient (medium-specific characteristic value) is entered. Setting range: 0...5 %             |                         |
| rEF.T-COND    | Standard temperature (25 °C) = reference temperature for measuring the conductivity. The standard temperature can be adjusted by the user, if necessary. Setting range: 15...35 °C                                              |                         |
| Offset TEMP   | Zero-point calibration (calibration offset) / temperature. Setting range: +/- 5 K.                                                                                                                                              |                         |
| Concentration | Display of the mass fraction of NaCl in water, calculated from the current conductivity measured value. <a href="#">Intended use</a> (→ <a href="#">5</a> )                                                                     |                         |

## 7.2.2 More settings

|                                      |                                                                                                                                                                                                                                                                                                             |
|--------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ou2                                  | Output configuration for the analogue output (OUT2):<br>[I] = measuring range is provided as 4...20 mA<br>[InEG] = measuring range is provided as 20...4 mA<br>[OFF] = output OFF (high impedance)                                                                                                          |
| SEL2                                 | Assignment of the analogue output to the process value:<br>[COND] = conductivity<br>[TEMP] = temperature                                                                                                                                                                                                    |
| FOU2                                 | Response of OUT2 in case of a fault:<br>[OU] = analogue output reacts according to process value, if possible.<br>Otherwise: analogue output goes to [OFF].<br>[On] = analogue output switches to value > 21 mA in case of a fault<br>[OFF] = analogue output switches to value < 3.6 mA in case of a fault |
| ASP2-COND                            | Analogue start point conductivity; setting range: 0...1000000 µS/cm.<br>Distance to AEP2-COND: ASP2-COND must not be higher than 50 % AEP2-COND.                                                                                                                                                            |
| AEP2-COND                            | Analogue end point conductivity; setting range: 500...2000000 µS/cm.<br>Distance to ASP2-COND: AEP2-COND must be at least two times ASP2-COND.                                                                                                                                                              |
| ASP2-TEMP                            | Analogue start point temperature; setting range: -25...70 °C.<br>Distance to AEP2-TEMP: min. 30 °C                                                                                                                                                                                                          |
| AEP2-TEMP                            | Analogue end point temperature; setting range: 10...100 °C.<br>Distance to ASP2-TEMP: min. 30 °C                                                                                                                                                                                                            |
| Lo.COND                              | Minimum value memory for conductivity                                                                                                                                                                                                                                                                       |
| Hi.COND                              | Maximum value memory for conductivity                                                                                                                                                                                                                                                                       |
| Reset [Hi.COND] and [Lo.COND] memory | Reset maximum and minimum value memory (button to activate the system command).                                                                                                                                                                                                                             |
| Lo.TEMP                              | Minimum value memory for the temperature                                                                                                                                                                                                                                                                    |
| Hi.TEMP                              | Maximum value memory for the temperature                                                                                                                                                                                                                                                                    |
| Reset [Hi.TEMP] and [Lo.TEMP] memory | Reset maximum and minimum value memory (button to activate the system command)                                                                                                                                                                                                                              |
| dAP-COND                             | Damping of the measured signal, setting range: 0...20 s                                                                                                                                                                                                                                                     |
| S.Tim                                | Simulation; entering the simulation time, setting range: 1...60 min                                                                                                                                                                                                                                         |
| S.COND                               | Simulation; selection of the conductivity value to be simulated, setting range: 0...2000000 µS/cm                                                                                                                                                                                                           |
| S.TEMP                               | Simulation; selection of the temperature value to be simulated, setting range: -25...150 °C                                                                                                                                                                                                                 |
| S.On                                 | Simulation; status of the simulation:<br>[OFF] = simulation OFF<br>[On] = simulation ON                                                                                                                                                                                                                     |
| Start simulation                     | Start simulation (button to activate the system command)                                                                                                                                                                                                                                                    |

|                 |                                                         |
|-----------------|---------------------------------------------------------|
| Stop simulation | Stop simulation (button to activate the system command) |
|-----------------|---------------------------------------------------------|

For further information and parameter description, especially about SSC-related parameters, please refer to the IODD description ([www.ifm.com](http://www.ifm.com)) or to the context-specific parameter descriptions of the used parameter setting software.

### 7.2.3 Example parameter setting

- ▶ Set the temperature compensation (parameter [T.Cmp-COND]) to a medium with the temperature coefficient 3.0 %/K. Example: [T.Cmp-COND] = [3,0].
- ▶ Make all other settings.
- ▶ Transfer the sensor data to the device.

## 7.3 Temperature influence and temperature coefficient

### 7.3.1 Influence of the medium on the temperature

The conductivity depends on the temperature. When the temperature increases, the conductivity changes. This temperature influence depends on the respective medium and can be compensated by the unit if the temperature coefficient (tempco) of the medium is known. The temperature compensation is set via the parameter [T.Cmp-COND]. Then the temperature-compensated conductivity value corresponds to the conductivity at standard temperature (25 °C; factory setting of the parameter [rEF.T-COND]).



For medium that is not changed the same tempco value has to be set for all sensors (unit-independent characteristic value). There is no further dependence on the measuring principle, the lot or the manufacturer of the sensors.



If the temperature coefficient of the medium is not known, it can be determined.  
See: Determination of the temperature coefficient tempco



In an IO-Link environment, existing tempcos of the media can be stored as recipe in the controller so that the accuracy of the values to be detected is improved.

## 7.4 Determination of the temperature coefficient tempco

1. Set the parameters [T.Cmp-COND] and [dAP-COND] to zero: [T.Cmp-COND] = [0], [dAP-COND] = [0].

▶ Write the changed values to the sensor.

1. Adjust the medium to 25 °C, for example, and take down the value of the conductivity after 2 min.
2. Heat up the medium to 45 °C, for example, and take down the value of the conductivity after 2 min.

#### Example of values taken down:

medium at 25°C = 500 µS/cm; medium at 45°C = 800 µS/cm  
temperature change = 20 K

1. Calculate the change of the conductivity in percent.  
The conductivity has increased by 300 µS/cm.  
The percentage change is  $300/500 = 60\%$ .
  2. Calculate the temperature coefficient tempco: The tempco is calculated from the change in percent and the temperature change:  $T_k = 60\% / 20\text{ K} = 3\% / \text{K}$
  3. The calculated tempco can now be adopted into the parameter [T.Cmp-COND].  
Example: [T.Cmp-COND] = [3]. If necessary, set the damping (parameter [dAP-COND]) again.
- ▶ Write values to the sensor.

## 8 Operation

### 8.1 Function check

After power-on the device is in the operating mode. It carries out its measurement and evaluation functions and generates process data (via IO-Link) according to the set parameters.

► Check whether the unit operates correctly.

### 8.2 Operating and diagnostic messages via IO-Link

IODD and IODD descriptive text as a PDF file at: [www.ifm.com](http://www.ifm.com)

### 8.3 Output response in different operating states

|                  | OUT1 *)                                               | OUT2                                                                                 |
|------------------|-------------------------------------------------------|--------------------------------------------------------------------------------------|
| Initialisation   | process value invalid                                 | OFF                                                                                  |
| Normal operation | process value according to conductivity / temperature | according to conductivity / temperature and setting [ou2]                            |
| Fault            | process value invalid                                 | < 3.6 mA at [FOU2] = [OFF]<br>> 21 mA at [FOU2] = [On]<br>no change at [FOU2] = [OU] |

\*) process value via IO-Link

## 9 Maintenance, repair, transport and disposal

- ▶ Avoid the formation of deposits and soiling at the sensor element.
- ▶ To avoid damage to the sensor, no hard or sharp objects must be used when cleaning the sensor manually.
- ▶ It is not possible to repair the unit.
- ▶ After use, dispose of the unit in an environmentally friendly way in accordance with the applicable national regulations.
- ▶ In case of return shipment, ensure that the unit is free from soiling, especially from dangerous and toxic substances.
- ▶ For transport only use appropriate packaging to avoid damage of the unit.



When the medium is changed, it may also be necessary to adapt the device settings for a higher accuracy (parameter [T.Cmp-COND]).

## 10 Factory setting

|             | Factory setting     | User settings |
|-------------|---------------------|---------------|
| uni.C       | μS/cm               |               |
| CGA-COND    | 100 (%)             |               |
| T.Cmp-COND  | 2 (%)               |               |
| rEF.T-COND  | 25 (°C)             |               |
| Offset TEMP | 0 (K)               |               |
| ou2         | I                   |               |
| SEL2        | COND (conductivity) |               |
| FOU2        | OFF                 |               |
| ASP2-COND   | 0 (μS/cm)           |               |
| AEP2-COND   | 2000000 (μS/cm)     |               |
| ASP2-TEMP   | -5 (°C)             |               |
| AEP2-TEMP   | 80 (°C)             |               |
| Lo.COND     | ---                 |               |
| Hi.COND     | ---                 |               |
| Lo.TEMP     | ---                 |               |
| Hi.TEMP     | ---                 |               |
| dAP-COND    | 1 (s)               |               |
| S.Tim       | 3 min               |               |
| S.COND      | 500 (μS/cm)         |               |
| S.TEMP      | 20 (°C)             |               |
| S.On        | OFF                 |               |