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INSTRUCTION MANUAL

WATER QUALITY CHECKER U-10

CODE: 040801000HK-5

WARNING

The DO sensor contains a strong alkaline solution. Should any of this solution come in contact with your clothing or skin, wash it away immediately with plenty of water.

Be especially careful not to allow any of the alkaline liquid in the DO sensor to get in your eyes.

⚠CAUTION

Insert the battery with ample care to the polarity. Reverse insertion on the polarity will make damage to the inner PCB.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provede reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

The U-10 Water Quality Checker is a state-of-the-art instrument for simultaneous multiparameter measurement of water quality. The HORIBA U-10 measures six different parameters of water samples: *pH, conductivity, turbidity, dissolved oxygen, temperature*, and *salinity*.

The U-10 is compact enough to be held in one hand while taking measurements. It has a large easy-to-read LCD readout. Measurements are taken simply by immersing the probe right into the water sample.

The U-10 is extremely versatile and sophisticated, yet easy to use. You will find it a valuable addition to on-site water control operations, whatever your needs—from testing factory discharges to urban drainage, river water, lake and marsh water, aquatic culture tanks, agricultural water supplies, and sea water.

To get the most out of your U-10 Water Quality Checker, please read this *Instruction Manual* carefully before you begin to take measurements.

Note that Horiba cannot be held responsible for any equipment malfunction or failure should the U-10 Water Quality Checker be operated incorrectly or in a manner other than specified in this *Instruction Manual*.

Horiba's aim is to produce the best possible equipment and documentation for our products. We welcome comments, questions, or suggestions for improvement concerning both our products and the accompanying documentation, such as this *Instruction Manual*.

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Note that the contents of this Instruction Manual are subject to change without prior notice as design changes are made on the instrument.

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Section 1
Getting Started

This section first gives an overview of the U-10. It then shows how to set up your U-10 by inserting the DO sensor and the battery.

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Configuration of the U-10

Main unit

Probe

*1. Removable
DO (Dissolved oxygen)
Reference
pH

*2. Non-removable
COND (Conductivity)
TEMP (Temperature)
TURB (Turbidity)

The Readout

The readout has two main functions: (1) it displays the results of measurements, and (2) it serves as a message board to show the operating status of the U-10.

① Data input/output

OUT ▬▬► Data output

◄▬▬ IN Data input

② MEAS or MAINT modes

The U-10 may be used in one of two modes: Measurement (MEAS) mode or Maintenance mode.

MEAS the U-10 is ready to make 6-parameter measurements

MAINT the U-10 is ready for other operations, e.g., calibration, data input/recall, or salinity setting

③ Data displayed in MEAS mode

- 6-parameter results:
  pH, conductivity, turbidity, DO, temperature, and salinity
- Designated value for salinity setting
- Error codes

④ Parameters measured

Value displayed on readout is highlighted by upper cursor.

pH	pH
COND	Conductivity
TURB	Turbidity
DO	Dissolved-Oxygen
TEMP	Temperature
SAL	Salinity

⑤ MAINT Sub-Modes

One of six Sub-Modes selected is highlighted by lower cursor.

AUTO	Automatic 1-point calibration
ZERO	Manual zero calibration
SPAN	Manual span calibration
IN	Data input
OUT	Data output (recall)
S.SET	Salinity setting correction

The Keypad

The U-10 is operated by the keypad on the main unit, which has eight surface-sealed keys, as illustrated.

Power Key (POWER)
Turns the main unit ON/OFF.

When this key is pressed to turn the U-10 ON, the readout comes in the MEAS mode, showing the parameter last displayed in the previous measurement. If the U-10 is left with the power ON for 30 minutes without any of the keys being activated, the power will be turned OFF automatically.

Parameter-Select Key (SELECT)
Use this key to move the upper cursor to the measured parameter you want to show on the readout. It toggles through the six parameters in order:

Mode Key (MODE)
Toggles back and forth between MEAS and MAINT modes. When in the MAINT mode, this key toggles the lower cursor through the six maintenance Sub-Modes.

Expanded-Readout Key (EXP)
Toggles between (1) standard readout value and (2) expanded readout, for greater resolution, with decimal point moved one digit to the left.

Enter Key (ENT)
This acts like the RETURN Key or Enter Key on a computer keyboard. The U-10 Enter Key has four main functions, depending on which mode the unit is in.

1. In the AUTO Sub-Mode: Press this key to start automatic calibration.
2. In either the ZERO or SPAN Sub-Modes: Used in manual calibration to set the value for the standard solution being used.
3. In the IN Sub-Mode: Inputs data being measured to memory.
4. In the OUT Sub-Mode: Recalls values from one of the 20 Data-Set Nos. that is now shown on the readout. Prints data when a printer is connected.

Clear Key (CLR)
This acts like the ESCAPE Key on a computer keyboard. It has three main functions, depending on which mode the unit is in.

1. In the AUTO Sub-Mode: Aborts the auto-calibration now in progress.
2. In the IN Sub-Mode: Deletes data in memory from all 20 Data-Sets.
3. When the readout shows an error code: Clears the error code from the readout.

UP/DOWN keys
Use these keys to select values when in one of the MAINT Sub-Modes. They have two main functions.

1. In either the ZERO or SPAN Sub-Modes: Use these keys to select value for the standard solution.
2. In the OUT mode: Used to toggle through the 20 Data-Set Nos. to select the one you wish to recall.

Setting up the U-10

Preparations of the pH sensor and the reference sensor

1. Remove the protective rubber cap from the pH sensor.
2. Remove the sealing tape from the reference sensor.

Inserting the DO sensor

WARNING

The DO sensor contains a strong alkaline solution. Should any of this solution come in contact with your clothing or skin, wash it away immediately with plenty of water. Be especially careful not to allow any of the liquid in the DO sensor to get in your eyes.

The Dissolved-Oxygen (DO) sensor has a delicate membrane that can easily be ruptured. For safety's sake, the U-10 is shipped to you with the DO sensor packed separately. You should insert the DO sensor when you unpack your U-10 unit.

1. Make sure that the DO sensor has the correct O-ring, as shown.

2. First, fit the DO sensor lightly into its socket, and then put on the probe guard to align it correctly.

3. Then, tighten the DO sensor securely to the probe body. When doing this, be especially careful not to damage the membrane, which is located in the front of the DO sensor.

Inserting the battery

The U-10 is shipped from the factory with the battery packed separately.

The battery may be inserted by loosening the set-screw on the battery cover and pulling up the cover. Make sure that the plus and minus poles of the battery match the terminals correctly.

If the readout shows the message Er 1, it means that the battery is defective or exhausted and should be replaced.

If you are replacing the battery and already have data stored in the U-10 memory that you wish to save, be sure to turn OFF the POWER Key before you remove the old battery. This will assure that data stored in memory will be maintained by the internal backup battery.

* Use a 9V-battery.

Attaching the carrying strap

Hook both ends of the strap through the metal fitting on back of the main unit, as illustrated.

Section 2

Making Measurements

Making a measurement with the U-10 Water Checker is extremely simple. Just turn on the power and place the probe in the sample of water you wish to measure.

All six parameters are measured simultaneously. These parameters may be stored in memory, printed out, or viewed one-by-one on the LCD readout. For printing and data storage, see the appropriate sections following this one. To view the parameters one-by-one on the readout, use the SELECT Key to toggle the upper cursor through them.

While the U-10 is both rugged and precise, the key to accurate measurements is cleanliness and frequent calibration. It is essential to clean the U-10 thoroughly after each measurement, and it is recommended that you re-calibrate your U-10 as frequently as possible. For best results, you should recalibrate it before each measurement session. Cleaning and calibration procedures are described below in this section and in the following one.

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How to make a measurement

1 Turn the power on.

2 Gently place the probe into the water sample.

Basically, that's all there is to it: just turn it on and put the probe in the sample. Of course, the U-10 can do many sophisticated things with the sample data, and for best results, you should be careful about calibrating the unit and maintaining it in good condition. This is explained in detail below and in the next section.

Be careful!
Never drop or throw the probe into the water. It is a precision instrument containing five delicate sensors and five pre-amps; you can damage it beyond repair by unnecessary rough handling.

Initial readout

When you first turn the power on, the U-10 will be in the MEAS mode, the readout will look like this, with all the LCD segments activated.

After about two seconds, the readout will change to show that a new measurement is being made. The readout will show the last parameter that the upper cursor was on when the previous measurement was made, i.e., pH as illustrated here.

(Expanded readout shown)

The display of the decimal point in the readout mode will also be in the same format as was selected with the EXP Key in the previous measurement, i.e., standard or expanded (as illustrated here).

Select the parameter you want shown on the readout of the measured data

All six parameters are automatically measured at once. Use the SELECT Key to toggle the upper cursor to the parameter you want.

pH	: pH
COND	: Conductivity
TURB	: Turbidity
DO	: Dissolved oxygen
TEMP	: Temperature
SAL	: Salinity

To get a uniform reading, slowly move the probe up and down to circulate the water through it. (Move it 1 foot (30 cm) per sec.) Then wait for the readout to stabilize while doing this.

Expanded readout

Use the EXP readout mode when you wish to see the results with one additional decimal place of accuracy. The EXP Key toggles the readout back and forth between standard to expanded display. The table below shows the result of using the EXP readout mode for each of the six parameters.

Table 1. Accuracy of expanded readout

Parameter	Range of measurement	Accuracy	
		Standard readout	Expanded readout
pH	0-14 pH	0.1 pH	0.01 pH
COND	0-1 mS/cm	0.01 mS/cm	0.001 mS/cm
	1-10 mS/cm	0.1 mS/cm	0.01 mS/cm
	10-100 mS/cm	1 mS/cm	0.1 mS/cm
TURB	0-800 NTU	10 NTU	1 NTU
DO	0-19.9 mg/*l*	0.1 mg/*l*	0.01 mg/*l*
TEMP	0-50°C	1°C	0.1°C
SAL	0-4%	0.1%	0.01%

Note that the salinity parameter is the only value not measured directly with its own sensor. The U-10 obtains salinity by converting the conductivity value. If large amounts of conductive ions other than salt-water components are present in the sample, an error may occur. Be cautious when interpreting the salinity results.

Measuring fresh water or salt water?

The U-10 can be set to the salinity for either fresh water or salt water when measuring DO. This is done by using the S.SET Sub-Mode.

Measuring fresh water

1. First, use the MODE Key to put the U-10 in the MAINT mode. Keep pressing the MODE Key to toggle the lower cursor to the S.SET Sub-Mode.

2. Once you are in the S.SET Sub-Mode, use the UP/DOWN Keys to select the salinity value. For fresh water, set the salinity to 0.0%.

3. Finally, press the ENT Key to complete the salinity setting while in the S.SET Sub-Mode.

4. When the salinity setting has been made, switch back to the MEAS mode by pressing the the MODE Key.

Measuring salt water

1. First, use the MODE Key to put the U-10 in the MAINT mode. Keep pressing the MODE Key to toggle the lower cursor to the S.SET Sub-Mode.

2. For salt water, set it to *A i.e.*, for auto-salinity.
   The *A* setting should be sufficient for measurements of normal sea water with a salinity value close to 3.3%. For sea water of an unusual salinity, however, and where the value is otherwise known, you may wish set the value manually to any salinity within the range of 0.0%-4.0%. (You may also possibly want to use a manual setting if, for example, the COND sensor is malfunctioning but it is still desirable to take readings of the other parameters.)

3. Finally, press the ENT Key to complete the salinity setting while in the S.SET Sub-Mode.

4. When the salinity setting has been made, switch back to the MEAS mode by pressing the the MODE Key.

After measurement: Cleaning and storing the U-10

1. Turn OFF the power.

2. Wash the probe thoroughly with tap water. Be sure to flush off all of sample solution from the probe.

Storing the U-10 for brief periods, *i.e.*, about 1 week or less:

Fill the calibration beaker with tap water and fit the probe over it.

For longer storage

The pH sensor must always be kept moist. Fill the small rubber cap with water and use it to cover the pH sensor.

The KCl internal solution in the reference sensor may seep out over time. Place vinyl tape around the O-ring portion to prevent this.

If you are going to store the U-10 for a prolonged period without using it, remove the battery from the main unit.

Section 3
Calibrating the U-10

The U-10 Water Checker may be calibrated either manually or automatically. The 4-parameter auto-calibration procedure is quite handy and should be sufficient for most measurement operations.

Manual calibration for each of the four parameters is more accurate but, of course, also more time-consuming. This method should be used for more precise measurement. The manual calibration procedure is explained below in detail, following the description of the auto-calibration procedure.

The auto-calibration procedure is extremely simple. The U-10 Water Checker uses just a single solution to do a simultaneous calibration of four parameters: *pH*, *COND*, *TURB*, and *DO*. Your U-10 comes with a bottle of standard phthalate pH solution and a calibration beaker for this purpose.

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2.Span calibration 33

Auto-calibration procedure

Fill the calibration beaker to about 2/3 with the standard solution. Note the line on the beaker.

Fit the probe over the beaker, as illustrated. Note that the beaker is specially shaped to prevent the DO sensor from being immersed in the standard solution. This is because the DO auto-calibration is done using atmospheric air.

MODE

With the power on, press the MODE Key to put the unit into the MAINT mode. The lower cursor should be on the AUTO Sub-Mode; if it is not, use the MODE Key to move the lower cursor to AUTO.

ENT

With the lower cursor on AUTO, press the ENT Key. The readout will show CAL. Wait a moment, and the upper cursor will gradually move across the four auto-calibration parameters one-by-one: *pH, COND, TURB,* and *DO.* When the calibration is complete, the readout will briefly show End and then will switch to the MEAS mode.

The upper cursor will blink while the auto-calibration is being made. When the auto-calibration has stabilized, the upper cursor will stop blinking.

First, pH is being auto-calibrated

Then, COND is being auto-calibrated

Next, TURB is being auto-calibrated

Finally, DO is being auto-calibrated

Auto-calibration now ends

And the readout switches to the MEAS mode

Note: If you wish to abort the auto-calibration for any reason, press the CLR Key. The parameters auto-calibrated so far will be stored in memory.

Auto-calibration error

After the DO auto-calibration, if the unit does not switch to the MEAS mode as it should, and the readout shows either Er3 or Er4, an auto-calibration error has occurred. Parameters will blink where an error occurred.

pH auto-calibration error

If this happens, re-do the auto-calibration. First, press the CLR Key to cancel the error code.

Then press the ENT Key to re-start the auto-calibration. Restart the auto-calibration beginning again with pH.

Manual (2-point) calibration procedures

For normal measurements, the 4-parameter auto-calibration described above is sufficiently accurate. However, you may wish to do a parameter-by-parameter, 2-point manual calibration of one or more of the four parameters. This is recommended either for high-accuracy measurements, especially when using the expanded readout mode. It is necessary if a new probe is being used for the *first time*.

Parameters to be calibrated manually.

pH	• Zero	(see page 24.)
	• Span	(see page 25.)
COND	• Zero	(see page 28.)
	• Span	(see page 29.)
TURB	• Zero	(see page 31.)
	• Span	(see page 31.)
DO	• Zero	(see page 32.)
	• Span	(see page 33.)

Parameters not to be calibrated.

Sample temperature
Salinity

pH calibration

pH calibration on the U-10 is done using two commercially-available standard solutions of different pH values, one for the zero calibration, the other for the span calibration. Note that the temperature characteristics of the various standard solutions that are available may differ; therefore, before using these two solutions to make the pH calibration, carefully measure the temperature and determine the temperature characteristics of each.

Preparation

Wash the probe 2-3 times, using de-ionized or distilled water. Place it in a beaker of each standard solution.

1. Zero calibration

Use a pH7 standard solution for the zero calibration.

Operation

1. With the power on, press the MODE Key to put the unit into the MAINT mode.

2. Press the MODE Key again to move the lower cursor to ZERO.

3. Use the SELECT Key to move the upper cursor to pH.

4. When the readout has stabilized, use the UP/DOWN Keys to select the value of the pH 7 standard solution at the temperature of the sample. Refer to Table 2 for pH values of standard solutions at various temperatures.

5. Press the ENT Key to complete the zero calibration for pH.

2. Span calibration

Use either a pH4 or a pH9(10) standard solution for the span calibration.

Operation

1. Use the MODE Key to move the lower cursor to SPAN.

2. As in Step 4. above in zero calibration, when the readout has stabilized, use the UP/DOWN Keys to select the value of the standard solution (i.e., either pH4 or pH9) at the temperature of the sample. Again, refer to Table 2 for pH values of standard solutions at various temperatures.

3. Press the ENT Key to complete the span calibration for pH.

Table 2 pH values of standard solutions at various temperatures*

Temperature ℃ / ℉	pH2[a]	pH4[b]	pH7[c]	pH9[d]	pH10[e]	pH12[f]
0 / 32	1.67	4.01	6.98	9.46	10.32	13.43
5 / 41	1.67	4.01	6.95	9.39	10.25	13.21
10 / 50	1.67	4.00	6.92	9.33	10.18	13.00
15 / 59	1.67	4.00	6.90	9.27	10.12	12.81
20 / 68	1.68	4.00	6.88	9.22	10.06	12.63
25 / 77	1.68	4.01	6.86	9.18	10.01	12.45
30 / 86	1.69	4.01	6.85	9.14	9.97	12.30
35 / 95	1.69	4.02	6.84	9.10	9.93	12.14
40 / 104	1.70	4.03	6.84	9.07	9.89	11.99
45 / 113	1.70	4.04	6.83	9.04	9.86	11.84
	1.71	4.06	6.83	9.01	9.83	11.70

a : oxalate, b : phthalate, c : neutral phosphate, d : borax,
e : carbonate, f : Sat.calcium hydroxide solution

* These pH valves are for Japanese standard solutions. Should you prefer to use different standard solutions, be sure to make the proper adjustments in calibration.

COND calibration

The U-10 can measure conductivity in the range of 0-100 mS/cm. Depending on the sample concentration, however, the U-10 automatically selects the proper range out of its three possible ranges of 0-1 mS/cm, 1-10 mS/cm, and 10-100 mS/cm.

Therefore, if you are doing a manual calibration for COND, this must be done for each of the three ranges. However, since the zero point is common for all three ranges, only the three one-point span calibrations need be done separately.

Preparing the standard solution for COND span calibration

This solution uses a potassium chloride as a reagent. For greater accuracy, the solution should be freshly prepared each time. If it is unavoidable to use a stored solution, be sure to keep it tightly capped in a polyethylene or hard glass bottle. The shelf life of this solution is six months. Date-stamp the bottle for reference. Never use a KCl standard solution that has been stored for more than six months: the calibration accuracy may be adversely affected.

Use potassium chloride powder of the best quality commercially available. Dry the powder for two hours at 105°C, and cool it down, in a desiccator. Weigh out an appropriate amount of dried and cooled potassium chloride powder according to the table below. Make the potassium chloride standard solution as shown.

Table 3 Making the potassium chloride standard solution

KCl standard solution	KCl weight g	Conductivity* mS/cm	Range to be calibrated mS/cm
0.005N	0.373	0.718	0-1
0.05N	3.73	6.67	1-10
0.5N	37.28	58.7	10-100

* Value at the temperature, 25°C

To prepare the standard solution, use a 1-liter volumetric flask. First, dissolve the KCl in a small amount of de-ionized or distilled water. Then fill the flask with de-ionized or distilled water up to the 1-liter line. Finally, shake the solution to mix it thoroughly.

1. Zero calibration

This calibration is carried out in atmospheric air; no solution is needed.

Preparation

Wash the probe 2-3 times, using de-ionized or distilled water. Shake the probe to remove any water droplets from the COND sensor. Then allow it to dry by exposing it to fresh air.

Operation

1. Use the MODE Key to move the lower cursor to ZERO.

2. Use the SELECT Key to move the upper cursor to COND.

3. Use the UP/DOWN Keys to set the readout to zero.

4. Press the ENT Key. This completes the zero calibration for COND.

2. Span calibration

This procedure uses a standard solution of potassium chloride. For best results, a fresh batch of the solution should be prepared each time. See page 27 for details.

Preparation

Wash the probe 2-3 times using de-ionized or distilled water. Following this, wash it 2-3 times in the KCl standard solution you have prepared. Then place the probe in a beaker of the KCl solution maintained at a temperature of 25±5°C.

Operation

1. Use the MODE Key to move the lower cursor to SPAN.

2. After the readout stabilizes, as you did for the pH calibration, use the UP/DOWN Keys to select set the value of the KCl standard solution, referring to the KCl table.

3. Press the ENT Key to complete the span calibration for this COND range.

4. Repeat this procedure for the three ranges, using each of three values of KCl standard solutions.

TURB calibration

Use good-quality de-ionized water, which may be considered as having a turbidity of zero. If that is not readily available, distilled water may be used instead. When doing the turbidity zero calibration, it is particularly crucial that you clean the probe thoroughly. Never use a dirty probe; otherwise the calibration will be unreliable.

Preparing the standard solution for TURB span calibration

1. Weigh out 5.0 g of hydrazine sulfate.
2. Dissolve this in 400 m*l* of de-ionized or distilled water.
3. Then weigh out 50 g of hexamethylenetetramine, and dissolve it in 400 m*l* of de-ionized or distilled water.
4. Mix these two solutions, add enough de-ionized or distilled water to make 1,000 m*l*, and stir the mixed solution thoroughly.
5. Allow this solution to stand for 24 hours at a temperature of 25±3°C.

   The turbidity of this solution is equivalent to 4000 NTUs. The shelf-life of this solution is six months; i.e., this 4,000-NTU value will remain accurate for a maximum of six months.

   Each time you carry out this calibration, it is necessary to dilute the 4,000-NTU standard solution to prepare an 800-NTU standard solution for calibration. To do this, measure out 50 m*l* of the 4,000-NTU solution into a 250-m*l* measuring flask.

   It is recommended that you use a rubber pipette aspirator for this. Then add de-ionized or distilled water up to the 250-m*l* line.

   The standard solution used here for the turbidity calibration will precipitate easily. Therefore, be sure to stir the solution thoroughly before use.

1. Zero calibration

Preparation

Wash the probe thoroughly 2-3 times using de-ionized or distilled water. Shake off excess water droplets, and then place it in a beaker of de-ionized or distilled water.

Operation

1. Use the MODE Key to move the lower cursor to ZERO.

2. Use the SELECT Key to move the upper cursor to TURB.

3. After the readout has stabilized, set it to 0.0, using the UP/DOWN Keys.

4. Press the ENT Key to complete the zero calibration for TURB.

2. Span calibration

Preparation

Wash the probe thoroughly, using de-ionized or distilled water. Shake off excess water droplets. Then place it in a beaker of the 800-NTU solution you have prepared for this purpose.

Operation

1. Stir this 800-NTU span standard solution thoroughly.

2. Use the MODE Key to move the lower cursor to SPAN.

3. After readout has stabilized, i.e., about 60 to 90 seconds, set the readout to "800" NTU, which is the value for this standard solution.

4. Press the ENT Key to complete the span calibration for TURB.

DO calibration

Unlike the other calibration procedures, the solution for the DO calibration cannot be stored for use; because the amount of dissolved oxygen in the solution is crucial, a fresh batch must be prepared each time, just before it is used in the DO calibration.

1. Zero calibration

Use a solution of sodium sulfite dissolved in either de-ionized water or tap water.

Preparation

1. Add about 50g of sodium sulfite to 1,000 ml of water (either de-ionized water or tap water will do). Stir this mixtuer to dissolve.

2. Wash the probe 2-3 times in tap water, and place it in the zero standard solution.

Operation

1. Use the MODE Key to move the lower cursor to ZERO.

2. Use the SELECT Key to move the upper cursor to DO.

3. After the readout has stabilized, set it to 0.0, using the UP/DOWN Keys.

4. Press the ENT Key. This completes the zero calibration for DO.

2. Span calibration

Use either de-ionized water or tap water that has been saturated with oxygen in air.

Preparation

1. Put 1 or 2 liters of water in a container (either de-ionized water or tap water will do). Use an air pump to bubble air through the solution until it is oxygen-saturated.

2. Wash the probe 2-3 times in tap water, and put it in the span calibration solution.

Operation

1. First, be sure the U-10 is set for fresh water readings. To do this, set the S.SET Sub-Mode to 0.0%.

2. Then, use the MODE Key to move the lower cursor to SPAN.

3. After the readout has stabilized, while slowly moving the probe up and down in the solution, set the readout value to the appropriate DO value for the temperature of this solution. For DO values at various temperatures, refer to Table 4.

4. Press the ENT Key to complete the span calibration for DO.

Table 4 Amounts of saturated dissolved oxygen in water at various temperatures, salinity = 0.0%

Temperature	DO	Temperature	DO
0 °C	14.16 mg/*l*	21 °C	8.68 mg/*l*
1	13.77	22	8.53
2	13.40	23	8.39
3	13.04	24	8.25
4	12.70	25	8.11
5	12.37	26	7.99
6	12.06	27	7.87
7	11.75	28	7.75
8	11.47	29	7.64
9	11.19	30	7.53
10	10.92	31	7.42
11	10.67	32	7.32
12	10.43	33	7.22
13	10.20	34	7.13
14	9.97	35	7.04
15	9.76	36	6.94
16	9.56	37	6.86
17	9.37	38	6.76
18	9.18	39	6.68
19	9.01	40	6.59
20	8.84		

Section 4

Data Storage and Printout

The U-10 can store up to 20 sets of data, 120 data points, of the values measured for each of the six parameters: pH, COND, TURB, DO, TEMP, and SALINITY. Values stored in memory can be recalled to the readout as desired.

If a printer is connected to the U-10 printer port, whenever a Data-Set is either stored in memory or recalled to the readout, it can also be simultaneously output to the printer.

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Storing data

1. Press the MODE Key to put the U-10 in the MAINT mode.

2. Continue to press the MODE Key to move the lower cursor to IN, the *Input* Sub-Mode.

3. Use the SELECT Key to move the upper cursor to the parameter you wish to see on the readout.

4. When the readout stabilizes on a value, press the ENT Key. This will automatically input the set of six parameters for this measurement into memory.

The readout will first show the Data-Set No. for about two seconds. At the top right-hand corner, a dashed arrow points to IN, showing that data is being input. Then each parameter is automatically read into memory, one-by-one from pH to salinity. The upper cursor skips along to show this. If a printer is connected, these six values will also be printed out at the same time.

The upper cursor then returns to pH, with the U-10 still in the IN Sub-Mode.

5. You may now continue and input another set of data: simply press the ENT Key again.

The Data-Set No. will automatically advance one digit, and the next set of six parameters will be read into memory in the same manner. This procedure can be repeated for up to a total of 20 Data-Sets.

If 20 Data-Sets have been read into memory, the storage capacity is full and no more data may be input. The U-10 will beep three times to indicate the memory is full.

6. To return the readout to the previous setting in the MEAS mode, press the MODE Key again.

Recalling data

1. Press the MODE Key to put the U-10 in the MAINT mode.

2. Continue to press the MODE Key to move the lower cursor to OUT, the *Output* Sub-Mode. The readout will show d.1, meaning Data-Set No. 1.
   At the top left-hand corner, a dashed arrow points to OUT, showing that data can be output now to the readout.

3. Use the UP/DOWN Keys to display the Data-Set No. of the values you wish to recall.

4. Use the SELECT Key to move the upper cursor to the parameter you wish to view.

5. Press the ENT Key to display the data on the readout.

If a printer is connected, all six parameters in this Data-Set will also be printed out at the same time.

6. When the ENT Key is pressed again, the next Data-Set No. is displayed in order, i.e., d2, if two data sets are in memory. At this point, you can either press the ENT Key again to view the contents of this Data-Set, or you can use the UP/DOWN Keys to go up or down to another Data-Set No.

   If a particular Data-Set is empty, three dashes appear on the readout.

7. To return the readout to the previous setting in the MEAS mode, press the MODE Key again.

Deleting data

Set the U-10 as if you were going to input data:

1. Press the MODE Key to put the U-10 in the MAINT mode.

2. Continue to press the MODE Key to move the lower cursor to IN, the Input Sub-Mode.

3. Then, to erase all the data from all the Data-Sets in memory, press the CLR Key. The readout will show the message CLr for about two seconds.

Be careful!
You cannot delete individual Data-Sets. The CLR Key always erases all data from memory.

Printing out data

If a printer is connected to the U-10 printer port, whenever a Data-Set is either stored in memory or recalled to the readout, it is also simultaneously output to the printer.

The U-10 printer port is a standard Centronics parallel port. To connect a parallel printer to the U-10: Open the rubber printer-port cover, located directly over the readout on the main unit, and connect the printer cable.

Note:
When a printer is not being used, disconnect the cable from the U-10 printer port, and close the cover tightly.

- **Sample printout**

```
NO. 1 DATE  /  /
 pH      5.0
 COND    1.5    mS/cm
 TURB 390       NTU
 DO      0.5    mg/l
 TEMP  23       °C
 SAL     3.8    %
NO. 2 DATE  /  /
 pH      3.1
 COND    1.3    mS/cm
 TURB 270       NTU
 DO      0.7    mg/l
 TEMP  25       °C
 SAL     0.1    %
NO. 3 DATE  /  /
 pH      3.1
```

Section 5

Daily Maintenance and Troubleshooting

For accurate measurements and prevention of malfunction, routine careful maintenance of the U-10 is important. In particular, failure to maintain the sensors properly can lead to serious trouble or incorrect measurements. The U-10 is provided with error-code functions for the ready detection of potential problems.

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Error Codes

The U-10 has an easy-to-understand error message function so you can spot trouble readily. Error codes are displayed on the readout and the unit will beep if an error occurs.
(Note that if you press an incorrect sequence of keys, the unit will beep three times to indicate you have pushed the wrong key.)

Error Code	Cause	Action
Bad battery Er 1	• Defective or low battery	• Replace battery
Failure in main unit Er 2	• Malfunction of memory backup IC	• Push POWER Key to turn the U-10 ON again. If this error code is still displayed, contact your Horiba dealer for repair or replacement.
Zero-calibration error Er 3	*for all parameters*	
	• Poor connection in probe-to-main unit cable	• Connect the cable securely.
	• Water in one of the sensor sockets	• Dry out the sensor sockets.
	• Temperature of sample exceeds maximum scale of U-10	• Replace the probe.
	for pH	
	• Contaminated pH sensor.	• Clean the pH sensor.
	• Improper concentration of reference solution in reference sensor	• Replace the reference solution.
	for COND	
	• Contaminated COND sensor	• Clean the sensor, using tooth brush and neutral detergent.

Error Code	Cause	Action
	for TURB • Contaminated or defective LED sensor	• Clean out the tube containing the LED turbidity sensor, using test tube brush and neutral detergent. Never use an abrasives or cleansers for this.
	for DO • Broken DO sensor membrane.	• Check the LED turbidity sensor. If it defective, the entire probe must be replaced. Check DO sensor. If defective, replace.
Span-calibration error Er4	*for all parameters* • Poor connection in probe-to-main unit cable • Water in one of the sensor sockets • Temperature of sample exceeds maximum scale of U-10	• Connect the cable securely. • Dry out the sensor sockets. • Replace the probe.
	for pH • Contaminated pH sensor. • Improper concentration of reference solution in reference sensor	• Clean the pH sensor. • Replace the reference solution.
	for COND • Contaminated COND sensor	• Clean the sensor, using tooth brush and neutral detergent.
	for TURB • Contaminated or defective LED sensor	• Clean out the tube containing the LED turbidity sensor, using test tube brush and neutral detergent. Never use an abrasives or cleansers for this. • Check the LED turbidity sensor. If it defective, the entire probe must be replaced.

Error Code	Cause	Action
Span-calibration error		
Er4	*DO Auto-calibration*	
	• Broken DO sensor membrane.	• Check DO sensor membrane. If defective, replace.
	• Excessive difference between DO sensor temperature and atmospheric temperature.	• Leave DO sensor in atmosphere for 30-60 min.
	DO aqueous solution calibration	
	• Broken DO sensor membrane.	• Check DO sensor membrane. If defective, replace.
	• Contaminated electrode.	• Clean the electrode using a soft brush, taking care not to scratch membrane.
	• Insufficient agitation of solution.	• Agitate solution thoroughly.
Memory full		
Er5	• Data-sets for 20 samples are already in memory.	• To delete all data from memory, put the U-10 in the IN Sub-Mode mode and press the CLR Key.
Printer error		
Er6	• Jammed printer paper.	• Eliminate jamming of printer paper.
	• Poor cable connection .	• Replace the cable.
	• Wrong printer.	• Use proper parallel Centronics printer.
	• Defective printer.	• Replace the printer as necessary.

Normal probe maintenance

Washing the turbidity sensor

The sensor is a glass tube. Wash out the tube and remove stains carefully, using tap water and a test tube brush.

Be careful not to scratch the inside of the glass tube. Never use abrasives or cleansers.

Cleaning the conductivity sensor

Remove COND sensor guard, and carefully use a soft brush to clean off any dust from the sensor unit.

Be sure to replace the COND sensor guard before taking measurements.

Recharging the reference sensor with reference solution

Recharge the reference sensor with reference solution about once every two months, as follows.

1. Remove the liquid-junction rubber cap from the reference sensor, and pour out the old solution.

2. Fill the reference sensor completely with new reference solution. Make sure there are no air bubbles.

3. Replace the liquid-junction rubber cap.

4. Carefully wash off all excess reference solution from the probe.

Replacing faulty sensors

Three of the U-10's sensors are replaceable: the *pH sensor*, the *reference sensor*, and the *DO sensor*.
These may be replaced as follows.

1. Wipe off any water droplets from the probe.
2. Remove faulty sensor.
3. Insert the new sensor carefully with your fingers.
4. Be careful not to let the sensor sockets get wet.

* When replacing the DO sensor, use the sensor tool provided as an accessory.

Replacing a faulty probe

Disconnect the cable from the main unit

1. Loosen the cable gasket cap, and remove cap from gasket.

2. Slide back the gasket.

3. Back off the two screws on the cable-connector cover.

4. Slide off the cable-connector cover to expose the connector lock claws.

5. Press lock claws on both sides with your fingers to release the connector. Pull out the connector from the main unit.

Connect the new probe

1. Insert the connector until it clicks.

2. Re-attach the cable-connector cover to the main unit.

3. Slide the cable gasket toward the cable-connector cover, and screw on the cable gasket cap.

   Before you use a new probe for the first time, it is necessary to calibrate it manually for all four parameters. Refer to Section 3, "Calibrating the U-10," for instructions on manual calibration.

Section 6
Reference Materials

The following descriptive information is provided for a better understanding of the U-10 Water Checker and its functions.

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Conductivity (COND)

Principle of measurement

Conductivity is an index of the flow of electrical current in a substance.

Salts dissolved in water are separated into cations and anions. Such a solution is called an electrolytic solution. An electrolytic solution has the property of allowing the flow of current according to Ohm's law. This property is referred to *ionic conductivity*, since current flow is due to ion movement in an electrolytic solution. Metals, on the other hand, allow the flow of current by means of electrons. This property is called *electronic conductivity*, which is distinguished from ionic conductivity.

A cube 1 cm on each side, as each shown in **Fig. 1**, is used to demonstrate an electrolytic solution. Two electrode plates are placed on opposite sides, and the cube is filled with a solution. If the resistance between these two electrode plates represented by r (Ω), the conductivity of the solution L ($S.cm^{-1}$) is $L=1/r$. S stands for *Siemens*, a unit of measurement of conductance.

Fig. 1 Definition of conductivity

The most general method for measuring conductivity is based on the above principle, and is called the 2-electrode method. In this method, to take a measurement, it is necessary to allow flow of alternating current between the two electrode plates.

If direct current is sent between them, it will cause electroplating or decomposition, i.e., polarization; this results in inaccurate measurement of conductivity.

Even a flow of alternating current will also cause a certain amount of polarization. Measures must be taken to minimize the effect of this polarization, such as the application of platinum black plating to the electrode surfaces. In spite of such measures, however, the effect of polarization cannot be neglected in conductivity measurements of a high-conductivity solution. This makes accurate measurement difficult. Furthermore, depositions or stains on the electrode surfaces can cause a large apparent resistance, also making accurate conductivity measurement difficult.

The U-10 Water Checker has adopted the 4-electrode method to overcome these disadvantages of the the 2-electrode method. As shown in **Fig. 2**, the U-10 Water Checker uses two voltage-detecting electrodes and two voltage-applying electrodes, for a total of total four electrodes.

The voltage-detecting electrodes are for detecting AC voltage, and the voltage-applying electrodes are for applying AC voltage.

Fig. 2 Principle of the 4-electrode method

Let us assume that the current, *I(A)*, flows in a sample of conductivity *L*—under automatic control of the voltage-applying electrodes—so that the voltage at the voltage detecting-electrodes, *E(V)*, remains constant at all times. Then, the resistance of the sample, *R* (Ω), across the voltage-detecting electrodes is *R=E/I*. The resistance, *R*, of the sample is inversely proportional to its conductivity, *L*. That is, the conductivity, *L*, is proportional to the current, *I*. Accordingly, calibration of a standard solution of known conductivity, *Ls*, enables calculation of conductivity of a sample according to the formula *L=Ls(I/Is)* from the relation of *L:Ls=I:Is*.

Even in the 4-electrode method, polarization occurs, since *AC* current flows in the voltage-applying electrodes. The voltage-detecting electrodes are, however, free from the effects of polarization, since they are separated from the voltage-applying electrodes, and furthermore, current flow is negligible. Therefore, the 4-electrode method is an excellent method to enable measurement of conductivity covering a very high range.

Temperature compensation

In general, the conductivity of a solution varies largely with its temperature. The conductivity of a solution depends on ionic conductivity, described earlier. As the temperature rises, conductivity becomes higher, since ions begin to move more actively.

The temperature coefficient shows the change in % of conductivity per °C, with a certain temperature taken as the reference temperature. This is expressed in units of %/°C. The temperature coefficient assumes the premise that the conductivity of a sample changes linearly according to temperature. Strictly speaking, with actual samples, however, conductivity changes along a curve.

Furthermore, these curves form different shapes depending on the type of sample. In the ranges of smaller temperature changes, however, samples are said to have the temperature coefficient of 2%/°C; this holds for most samples, except in certain special cases. The U-10 Water Checker uses an automatic temperature conversion function to calculate conductivity at 25°C at a temperature coefficient of 2%/°C, based on the measured value of the temperature. Results are displayed on the readout. The U-10's temperature conversion function is based on the following formula.

$$L_{25}=L_t / \{1+0.02(t-25)\}$$

Where,

L_{25}: Conductivity of solution converted to 25°C (value displayed on U-10)

t: Temperature of solution at time of measurement (°C)

L_t: Conductivity of solution at t (°C)

Turbidity (TURB)

Principle of measurement

From among several types of turbidity-measuring methods available, the U-10 uses the light-absorption-scattering method, shown in Fig. 3.
Irradiation of a beam of light onto a sample brings about separation of the beam into (1) the light transmitted by the solution and (2) the light scattered by turbidity components in the sample. In the light-absorption-scattering method, the intensity of both transmitted light and the scattered light are measured using separate receptors, and the turbidity is obtained based on the ratio of the two.

With the U-10, the light source is a pulse-lighting infrared-emission diode. The scattered light is measured at a point 30° offset from the light source. This light-absorption-scattering method has several advantages, including the fact that (1) the actual color of the sample fluid has little effect on the measurement of turbidity, (2) fluctuations in light quantity from the light source are easily compensated for, and (3) it allows the U-10 to be operated with relatively low-power consumption.

Fig. 3 Principle of the light-absorption-scattering method

NTUs (Nephelometric Turbidity Units)

For the calibration of turbidity, the U-10 uses a standard formazine solution.

Kaolin has been the conventional standard solution for many years. However, the composition of kaolin solutions often vary depending on the country of origin, and turbidity varies with the degree of purify. Furthermore, there is often individual error in preparing the solution. Kaolin is thus known for bringing about very large disparity in measurement results. As a turbidity standard solution, formazine standard solution is now increasingly being used internationally. In view of these facts, the U-10 uses the formazine standard solution for its calibration of turbidity.

In addition, the U-10 uses *NTUs* as the unit of turbidity. Other units conventionally used are formazine degrees and *FTUs*. When the measurement of turbidity is based on the phenomenon of scattering, the use of *NTUs* is preferable, and in fact, these are being used increasingly. It should be noted that *NTUs* used as turbidity units of the formazine standard solution are equivalent to formazine degrees and to *FTUs*.

Salinity (SAL)

The U-10 is designed to measure salinity as well as the other parameters.

Note that the "salinity" referred to here is the salinity of sea water. There is a constant relation between conductivity and salinity at certain temperatures.

Therefore, if data on the conductivity and temperature are available, the corresponding salinity is known. In other words, the salinity measurement of the U-10 is based on the principle of calculating the salt content, making use of the measured values of conductivity and temperature.

Note carefully, therefore, that measured results of all substances whose conductivity is detected are displayed as salinity. For example, the measured result is displayed as NaCl concentration, even if in fact the sample component is, for example, hydrochloric acid (HCl).

Temperature

Temperature changes in water have extreme biological effects on the life cycles of fish and seaweed, as well as on that of the minute organisms that cleanse the water of organic pollutants. In general, as the temperature of water increases, the amount of oxygen dissolved in the water decreases and there is a tendency for the amount of pollutants to increase.

The U-10 uses a thermistor to measure temperature. A thermistor also measures the change in electrical resistance accompany changes in temperature; these changes in resistance are measured by the thermistor and are used to calculate the temperature.

This temperature data is used by the U-10 in four different ways: (1) in pH temperature compensation, (2) in conductivity temperature conversion, (3) in the calculation of salinity, and (4) in dissolved-oxygen temperature compensation.

Dissolved-Oxygen (DO)

Principle of measurement

The "DO" referred to here means the concentration of oxygen dissolved in water.

Fig. 4 shows the principle of measurement using a DO sensor.

Fig. 4 Principle of DO sensor

A noble metal (silver) is fitted closely to an oxygen-permeable diaphragm to make the cathode; a base metal (lead) is used as the anode. Both are immersed in an alkaline electrolyte with the anode-to-cathode external circuit complete. Oxygen diffusing through the oxygen-permeable membrane causes a reduction reaction at the cathode; this allows flow of current in the external circuit:

$$O_2 + 2H_2O + 4e^- = 4OH^-$$

At the anode, oxidation reaction occurs as follows:

$$2Pb = 2Pb^{2+} + 4e^-$$

The current is proportional to the quantity of oxygen diffusing through the oxygen-permeable diaphragm. Accordingly, measurement of the current makes the DO in a sample known.

The DO measuring method based on this principle is called the *membrane-electrode method.* This method allows convenient measurement of DO, especially when compared with chemical-analysis methods, which need complicated pre-treatment to eliminate the effects of oxidizing or reducing substances.

DO correction for salinity

When a solution and air are in contact and in complete equilibrium (saturated), DO:C[mg/*l*] in the solution, and the oxygen partial-pressure:Ps[MPa] in air are in the following relation:

$$C = Ps/H$$

H [*MPa*/(mg/*l*)] is referred to as Henry's constant, which depends on the composition of the solution. In general, *C* becomes smaller as the salinity in the solution increases, since *H* becomes larger.

A DO sensor is intended to detect *Ps* in the above expression. Therefore, the DO measurement of an aqueous solution containing salt would be in error if the DO electrode were standardized either on air-saturated pure water or on air. To settle this problem, it is necessary to correct the DO reading based on the salinity of the sample.

Conventional DO meters make this salinity correction by inputting a known salinity value. This poses no problems if the salinity of the sample is known. In practice, however, the salinity of the sample is usually not known, unless measured by a device such as the U-10. Therefore, until now, DO meters have not been practical, even if they were provided with a salinity-correcting function.

The U-10 is capable of measuring the salinity of a sample and automatically correcting the DO reading for the amount salinity measured in the sample.

pH

Principle of measurement

The following is the basic equation for obtaining pH:

$$pH = -\log aH^+$$

Where,

aH^+ : the activity of hydrogen ions

If a thin glass membrane is used to separate two liquids of differing pH values, an electric current will be generated in proportion to the difference between these two pH values. The value of this electrical current, *E(V)* , is shown by the folowing Nernst equation:

$$E = 0.0001983T\ (pH_1 - pH_0) + e$$

Where,

T : the temperature of the liquids

pH_1 : the pH of the internal liquid (i.e., inside the glass membrane)

pH_0 : the pH of the sample liquid (i.e., the iliquid outside the glass membrane)

e : the assymetric potential

A conventional glass electrode for measuring pH contains a fluid inside the electrode with a pH of 7. If this is used to measure a sample that also has a pH value of 7, the assymetric potential will be close to 0V. Consequently, when a glass pH electrode is immersed in an acid solution, a positive electric current is generated; when it is immersed in an alkaline solution, a negative electric current is generated.

For actual use in a pH meter, a pair of reference electrodes with extremely stable characteristics is used. These are configured as shown in **Fig. 5**. As shown in **Fig. 5**, it can be seen that the electrical potentials generated in the internal electrodes, *E'* and *E"*, are canceled out by each other, so that the only electrical potential difference obtained is the current generated by the glass membrane, *E*, through the resistance of the membrane, *r*, and transmitted to terminals *G* and *R*.

In pH meters a readout of this voltage between the two terminals is obtained by increasing it with an amplifier. In actual practice, the pH meter is first calibrated using a standard reference solution of known pH, then the pH of the sample liquid is measured.

Fig. 5 Principle for Measuring pH

Specifications

pH

Principle	Glass electrode
Range	pH0-14
Resolution	Standard : 0.1pH Expanded : 0.01pH
Repeatability	±0.05pH
Temperature compensation	0°-50°C
Readout	LCD
Calibration	1-point auto (Zero) Manual 2-point

Temperature

Principle	Thermistor
Range	0°-50°C
Resolution	Standard : 1°C Expanded : 0.1°C
Repeatability	±0.3°C
Temperature compensation	—
Readout	LCD
Calibration	—

DO

Principle	Membrane galvanic cell
Range	0-19.9mg/*l*
Resolution	Standard : 0.1mg/*l* Expanded : 0.01mg/*l*
Repeatability	±0.1mg/*l*
Temperature compensation	0°-40°C
Readout	LCD
Calibration	1-point auto (Span) Manual 2-point

Conductivity

Principle	4-electrode
Range	0-100ms/cm
Resolution	Standard: 0-1mS/cm : 0.01mS/cm 0-10mS/cm : 0.1mS/cm 10-100mS/cm : 1mS/cm Expanded: 0-1mS/cm : 0.01mS/cm 0-10mS/cm : 0.1mS/cm 10-100mS/cm : 1mS/cm
Repeatability	±1%/F.S. within each measurement range
Temperature compensation	0°-50°C
Readout	LCD
Calibration	1-point auto (Span) Manual 2-point

Turbidity

Principle	Scattered/Transmitted light
Range	0-800 NTU
Resolution	Standard : 10 NTU Expanded : 1 NTU
Repeatability	±3%/F.S.
Temperature compensation	—
Readout	LCD
Calibration	1-point auto (Zero) Manual 2-point

Salinity

Principle	Conversion based on conductivity
Range	0-4%
Resolution	Standard : 0.1% Expanded : 0.01%
Repeatability	±0.1%
Temperature compensation	0°-30°C
Readout	LCD
Calibration	—

Common specification

Data storage	Max. 20 samples
Printer output	Centronics specs.
Power	Battery 9V, with auto power-off function
Operating temperature	0° - 45°C
Weight	Main unit: Approx. 400g Probe, with 2-m cable: Approx. 800g

- Output connector pin layout

Pin No.	Name	Pin No.	Name
1	STB	8	DB_6
2	DB_0	9	DB_7
3	DB_1	10	Not used
4	DB_2	11	BUSY
5	DB_3	12	Not used
6	DB_4	13	Not used
7	DB_5	14	GND

This equipment is in conformity with the following directive (s) and standard (s);

Directive (s)	the EMC Directive 89/336/EEC as amended by 91/263/EEC, 92/31/EEC and 93/68/EEC, in accordance with the Article 10 (1) of the Directive
Standard (s)	EN55011:1991 Class B Group 1 and EN50082-1:1992

Parts List

The following expendable parts are available for the U-10 Water Checker.

Part name	Model No.	P / N
Probe		9037-0047-00
pH sensor	#7112	9037-0048-00
DO sensor	#7542	9037-0049-00
pH reference sensor		9037-0050-00
Liquid junction (1 pair)	#7210	9037-0051-00
Reference solution	#330	9037-0052-00
pH standard solution pH2	100-2	9003-0015-00
pH standard solution pH4	100-4	9003-0016-00
pH standard solution pH7	100-7	9003-0017-00
pH standard solution pH9	100-9	9003-0018-00
Calibration beaker		9037-0053-00

Circuit Diagram

U1 MB3773
VCC
RESET
RESET
VREF
CK
GND VS
PC2
PC3
C1 0.47M 35V
U5 647180-MD0
C2 22P
XTL 1
CSA-1M
C3 22P
+5V
PC6
EXT
XT
RST
CK
MP1
MP0
NMI
INT0
INT1
INT2
TO1
TO2
TO3
IC
TXO
RXO
CKO
RSO
CSO
CDO
PA0
PA1
PA2
PA3
PA4
PA5
PA6
PA7
PG0
PG1
PG2
PG3
PG4
PG5
PB0 (D-0)
PB1 (D-1)
PB2 (D-2)
PB3 (D-3)
PB4 (D-4)
PB5 (D-5)
PB6 (D-6)
PB7 (D-7)
PC0
PC1
PC2
PC3
PC4
PC5
PC6
PC7
PD0
PD1
PD2
PD3
PD4
PD5
PD6
PD7
PE0 (A-7)
PE1
PE2
PE3
PE4
PE5
PE6
PE7
PF0 (A-6)
PF1 (A-5)
PF2 (A-4)
PF3 (A-3)
PF4 (A-2)
PF5 (A-1)
PF6
PF7
U6 HC00
FRQ
R52 10K
U7 TSC500
SIG
R58 100K
C18 1000P/25V
IN+
IN-
COM
R24 680K
C5
C4
0.1MF/25V
BUF
CAZ
INT
+V
PC14
+2.5V
R38 3.3K
R37 100K
R36 100K
REFH
REFL
CREF
CREF
COMP OUT
GND
-V
-5V
PC13
C6
0.1MF/25V
R20 1K
R19 100K
U2 M6M80041
R62 100K
RDY
R
DI
DO
CK
CS
CONDB
CONDA
MUXC
MUXB
MUXA
R56 10K
R55 10K
R54 10K
R57 10K
R53 10K
R63 10K
(A-1)
(A-2)
(A-3)
(A-4)
(A-5)
(A-6)
(A-7)
(A LINE)
TURB

+5V
R42 10K
R43 10K
R48 10K
R46 10K
R44 10K
R47 10K
R45 10K
R41 10K
R25 1K
R26 1K
R27 1K
R28 1K
R29 1K
R30 1K
R31 1K
R32 1K
C11 470P
C12 470P
C17 470P
C15 470P
C13 470P
C16 470P
C14 470P
C10 470P
CN2
2
3
8 EXP
7 CLR
5 ENT
9 SELECT
6 MODE
4 POWER
1 COM
D2
1S2837
BZ 1
PKB24SP-3301
+5V
R1 10K
R3 10K
R4 100
R2 100
CN1
11 BUSY
1 STROB
2 DATA 0
3 DATA 1
4 DATA 2
5 DATA 3
6 DATA 4
7 DATA 5
8 DATA 6
9 DATA 7
14 0V
57-20140-8
U3
HC374
1D 2D 3D 4D 5D 6D 7D 8D
1Q 2Q 3Q 4Q 5Q 6Q 7Q 8Q
CK G
R9 100
R10 100
R11 100
R12 100
R8 100
R7 100
R6 100
R5 100
(D-0)
(D-1)
(D-2)
(D-3)
(D-4)
(D-5)
(D-6)
(D-7)
U6
HC00
+5V
R18 100K

U4
HD61602
+5V
PC5
VDD
VSS
R13
330K
OSC 1
OSC 2
PC 9
VC 1
VC 2
PC10
PC11
V 1
V 2
V 3
PC8
R14
1M
VREF 1
VREF 2
R17
100K
D0
D1
D2
D3
D4
D5
D6
D7
S8
RE
WE
CS
READY
SYNC
SEG 0
SEG 50
CON 3
CON 2
CON 1
CON 0
LCD 1
FRD-8C73
COM 2
COM 1
OUT
IN
MEAS
MAINT
pH
°C %
mV
mg/l
µmS/cm

Exploded Views—main unit

NO.	PARTS NO.	PARTS NAME	DESCRIPTION
1	H357911-01	SHEET SWITCH	WATER CHECKER U-10
2	U800842300	CASE ASSY, TOP	U-10 including ①
3	H357944-01	PRT COVER	U-10 METER
4	H542233-01	WINDOW, LCD	U-10 H357887-01
5	F020527500	TAPPING SCREWS	M3X6 (S-ZN3)
6	U800842400	PCB ASSY	U-10
7	H357945-01	CASE PACKING	U-10 METER
8	U800842500	CASE ASSY, BOT	U-10
9	U800842600	COVER ASSY, BAT	U-10
10	H543958-01	SEAR WASHER	U-10 METER
11	H544105-01	METER STRAP	U-10 20×1300 T=1.8
12	H542137-01	BATTERY PACKING	U-10 METER
13	F020911500	SCREW, PANHEAD	JISB1111 M3×6 (S-ZN3)

Exploded Views—prove

NO.	PARTS NO.	PARTS NAME	DESCRIPTION
3	F020911500	SCREW, PANHEAD	JISB1111 M3×6 (S-ZN3)
4	F020518700	O-RING	NOK S 11.2 (SI)
5	9037004900	DO SENSOR	
6	9037005000	REFERENCE	
7	F020246900	O-RING, S18	NOK S18 FPM
8	F020009500	SCREW, PANHEAD	M3-6L SUS304
9	H542141-01	COND GUARD	
10	F020058000	O-RING, P9	B2401 P9 FPM
11	9037004800	PH TIP	
12	F020058100	O-RING, P5	B2401 P5 FPM
13	H358290-01	PROTECTING TUBE	

Unpacking the U-10

The following items are included with your U-10 Water Quality Checker.
When you unpack the probe and main unit, confirm that all the other accessories are included as well.

- Main unit

- Probe

- DO sensor

- Standard solution (pH 4 standard solution, 100-4) 500 m*l* bottle

- Reference solution 250m*l* bottle

- Calibration breaker

- 9V battery (6F22)

- Carrying strap for main unit

- DO sensor tool

- This Instruction Manual

- Carrying Case

Precautions when using the U-10

The U-10 Water Quality Checker is carefully designed for trouble-free operation. However, it is a sophisticated electronic instrument, and it can be damaged if used carelessly. Please read the following precautions and observe them when using your U-10 Water Checker.

- Do not swing or jerk the probe by its cable.
- Do not subject the cable connector to stress by pulling or stretching it.

- Do not drop either the U-10 probe or main unit. Never subject either component to sudden impact.

- Do not store the U-10 where it may be exposed to prolonged direct sunlight. Never leave the U-10 inside a vehicle with the windows closed.

- Never immerse the main unit directly in water.
  The main unit is water-resistant and may be safely used in the rain; however, it is not of waterproof construction. Immersing the main unit in water or any other liquid can damage the internal electronic circuits

- Never allow any organic solvent to come in contact with either the probe or the main unit. This includes such organic solvents as methylethyl ketone (MEK) and acetone.
  (The probe is made of polyphenylene ether (PPE); the main unit case is acrylic resin.)

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