取 A-0045-01

RINKO Ⅱ W

Digital Output Version Optical DO Sensor with Wiper

AROW2-CAR (RS-232C)

AROW2-CAD (RS-485)

Operation Manual

infinity

For your safe use

1. Prior to use, read this manual carefully.
2. Unsuitable handling causes some accident.
3. Store this manual with caution.

JFE Advantech Co., Ltd.

Introduction

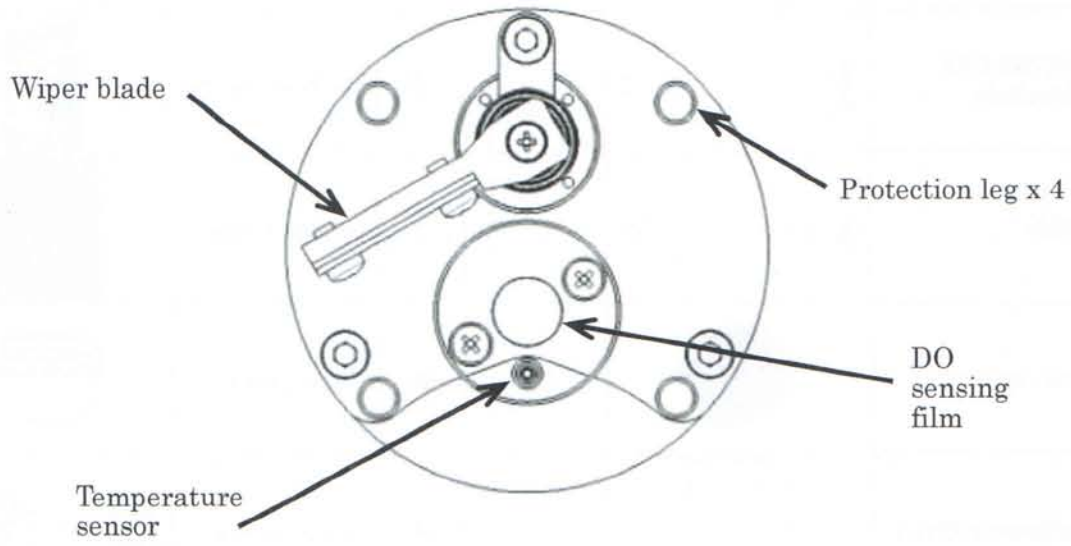
The AROW2-CAR/CAD is a small, lightweight DO sensor for continuous, long-term measurements with a micro-controller.

- Employs an optical DO sensor.
- 30 second response speed, 1 year calibration interval by the use of a stable oxygen sensing film.
- Equipped with a wiper mechanism to remove biofouling on the optical sensor surface. Capable of long-term measurements in fresh water and coastal waters.
- Wear-resistant, shock-resistant, corrosion-resistant titanium body.
- Work with external power.
- RS-232C or RS-485 communication to PC (or control system).
- Data output by commands.

Contents

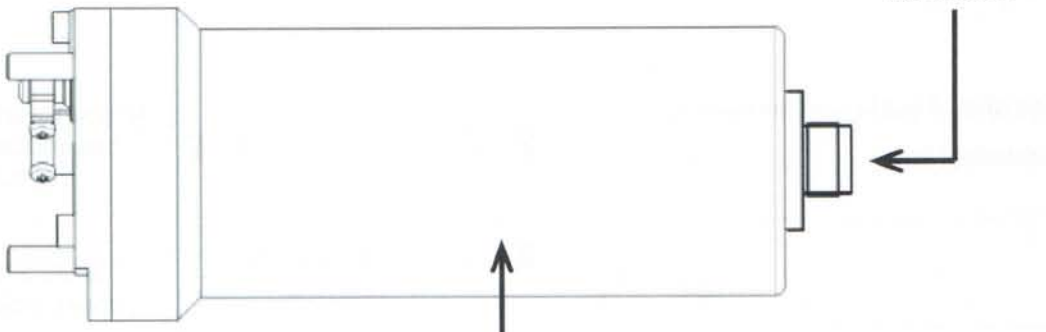
1. Part Names

1.1 Sensor area



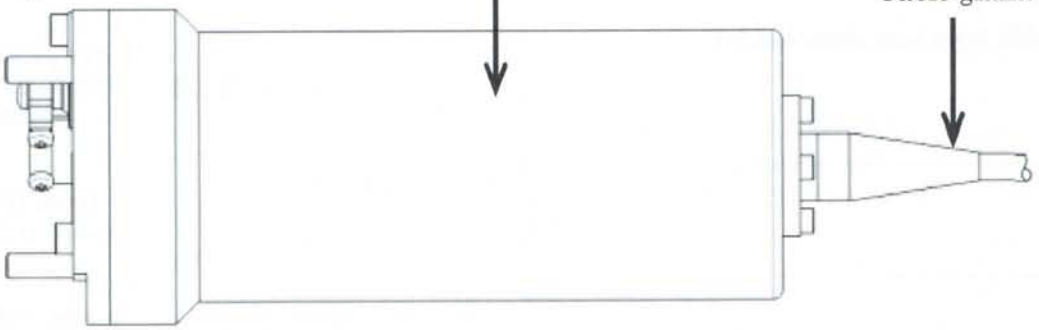
1.2 External diagram

(a) Connector type



Pressure case

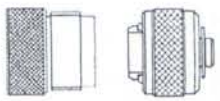
(b) Cable type



2. Packing List

2.1 AROW2-CAR contents list[1]

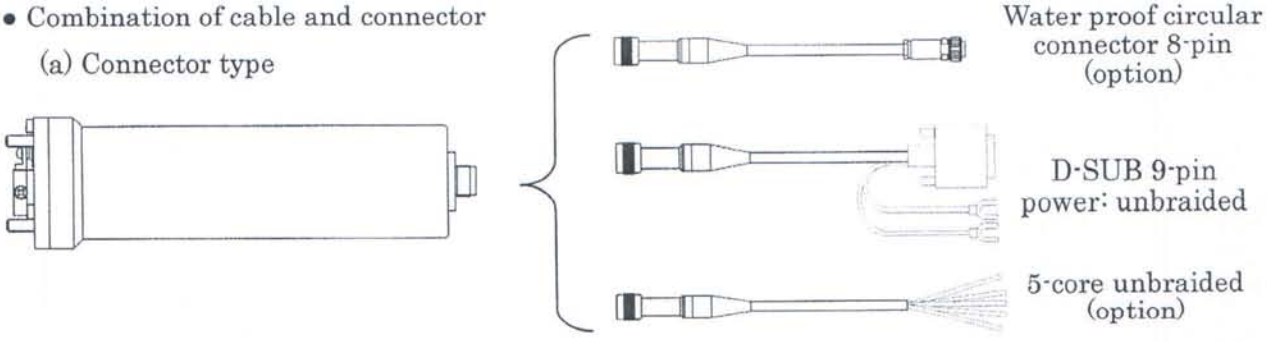
No.	Name	Appearance[2]	Count
1	AROW2-CAR Main body		1
2	Cable		1
3	Protection cap		1
4	Calibration Sheet		1
5	Operation Manual (this manual)		1

No.	Name	Appearance	Count
6	DO bubbling set		1
7	Sodium sulfite		1
8	Silicone grease		3
9	Connector cap		1 set

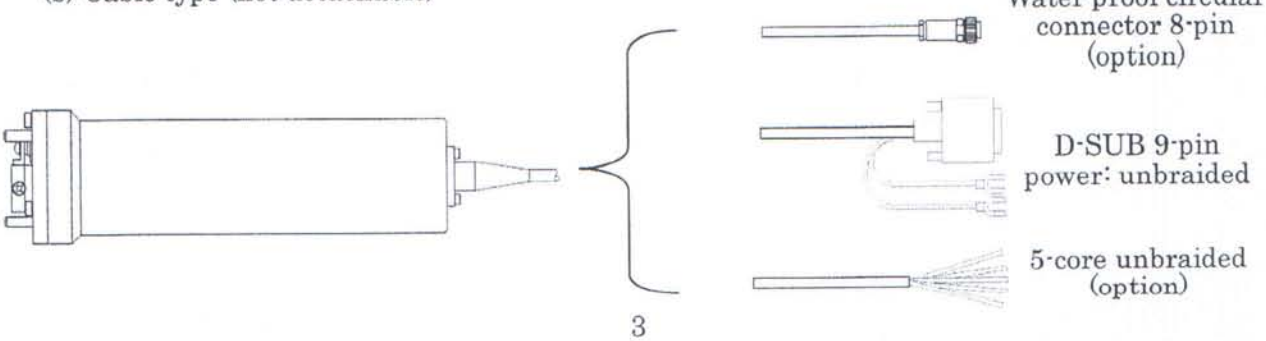
Note[1] This list is the standard package. The contents may differ according to customer requests.
Note[2] Package designs may differ.

- Combination of cable and connector

(a) Connector type

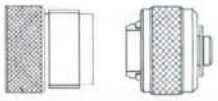


(b) Cable type (not detachable)



2.2 AROW2-CAD contents list[1]

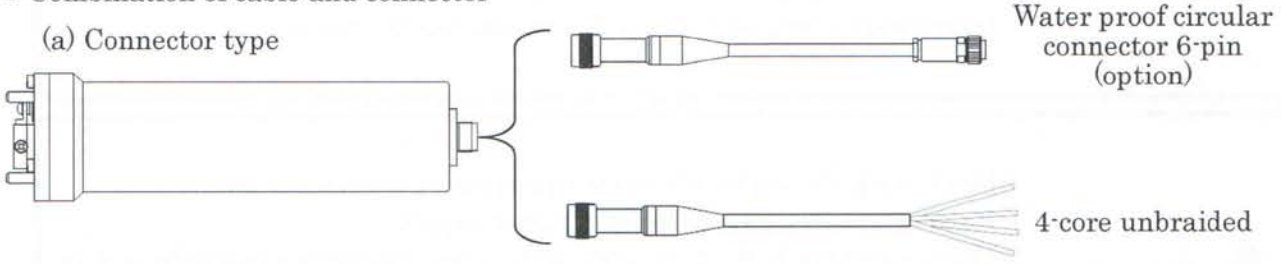
No.	Name	Appearance[2]	Count
1	AROW2-CAR Main body		1
2	Cable		1
3	Protection cap		1
4	Calibration Sheet		1
5	Operation Manual (this manual)		1

No.	Name	Appearance	Count
6	DO bubbling set		1
7	Sodium sulfite		1
8	Silicone grease		3
9	Connector cap		1 set

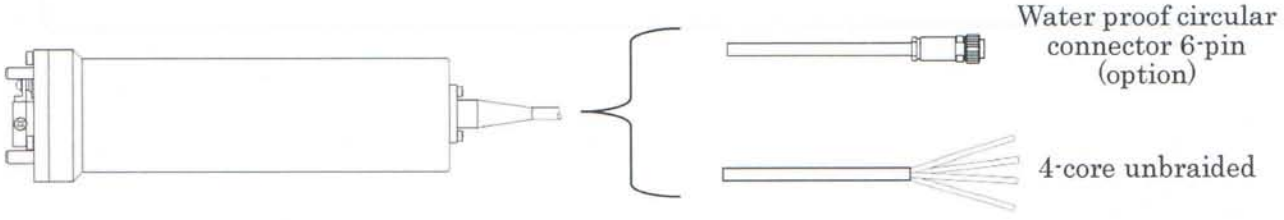
Note[1] This list is the standard package. The contents may differ according to customer requests.
Note[2] Package designs may differ.

• Combination of cable and connector

(a) Connector type



(b) Cable type (not detachable)



3. Safety Notation

Danger	Improper operation will result in serious personal injury or death, and also when danger occurs, warning urgency (degree) is high and definite.
Warning	Improper operation may result in serious personal injury or death.
Caution	Improper operation may result in slight personal injury or property damage only.

Please read before use

Danger

- When working on the water, fully ensure a safe working environment that prevents fall accidents.

Warning

- When installing or recovering the instrument, take care not to injure your lower back by assuming an unnatural posture.
- When mooring the instrument with a wire, wear gloves so you do not injure your hands on burrs or protrusions on the cable.

Caution

- Don't touch the wiper when it is operating.
- Do not connect wrong polarity of power supply.
- The instrument is slippery when wet, so use caution when handling it in this state.
- When mooring the instrument, take care so that the instrument and cable does not come in contact with surrounding obstacles.

4. Usage Precautions

4.1 Device usage

(1) When taking measurements, take care not to forget to remove the DO sensor protective cap.
(2) When taking measurements, install the DO sensor facing down so that it is not exposed to direct sunlight. When storing the instrument, always attach the protective cap.
(3) When the instrument was stored unused for a long period of time, calibrate the DO sensor before use (within 1 or 2 weeks). (See 8. DO Calibration) The oxygen sensing film naturally deteriorates a little bit at a time, so we recommend regular calibration.
(4) Use caution when handling the oxygen sensing film as it is extremely delicate. (See 9. Maintenance) If the oxygen sensing film receives a large scratch, it may no longer acquire accurate data and it will need to be replaced. Be especially careful when taking measurements near the bottom of the water and during maintenance and cleaning.
(5) When putting the instrument in water, shake the sensor to remove air bubbles. The DO sensor cannot measure data accurately if air bubbles are adhered to it.
(6) When using sodium sulfite (Na_2SO_3), carefully read the Material Safety Data Sheet (MSDS).
(7) Do not expose the instrument to excessive shocks.
(8) Use care not to apply force to the water temperature sensor. There is a risk of it becoming unable to take measurements because of deformation or wire break.
(9) Use care not to apply force to the wiper section. There is a risk that the wiper becoming unable to function normally because of deformation or damage.
(10) Do not open the pressure case and do not disassemble the instrument. There is a risk of malfunction.
(11) Pay attention not to allow moisture inside the joint point when attach and detach the underwater connector. There is a risk that the instrument becomes unable to communicate, etc.

4.2 Disposal

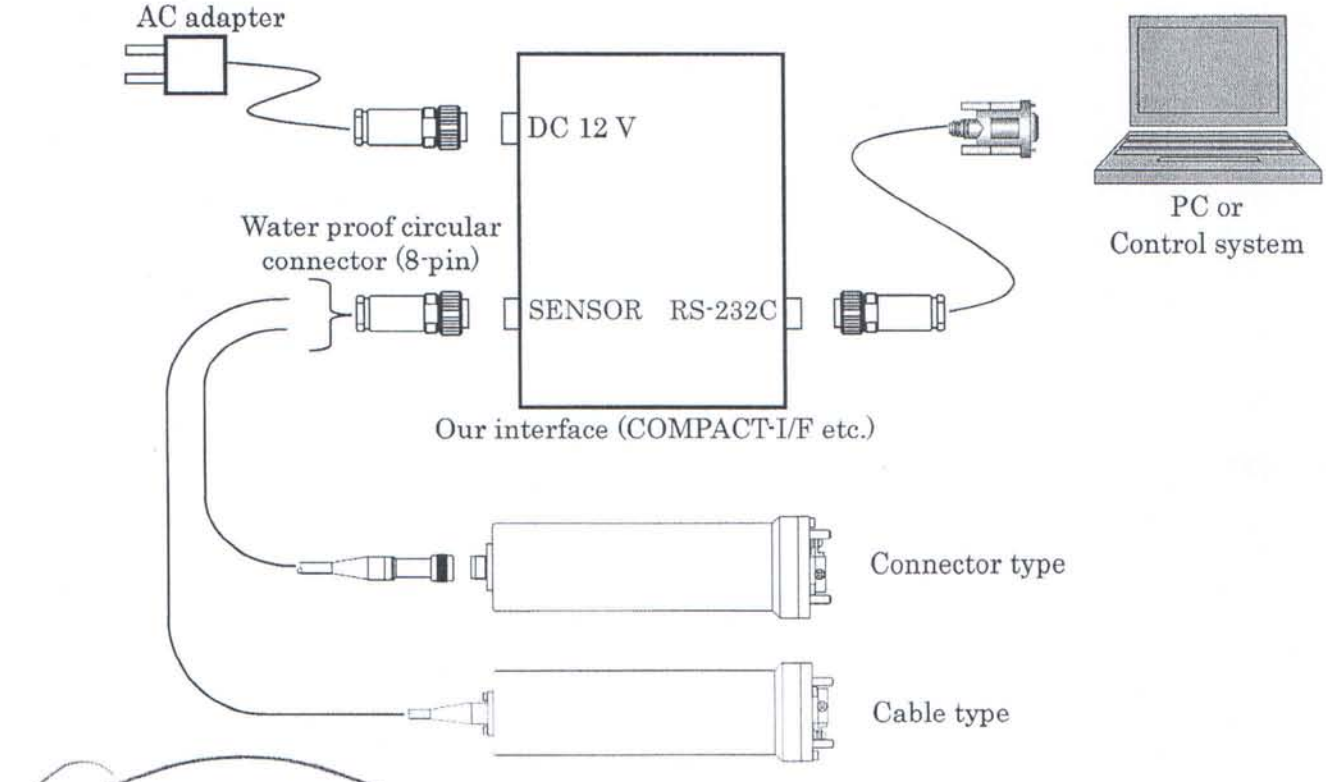
When disposing of this product, do so in the appropriate manner following all laws and regulations.

5. Connection Outline

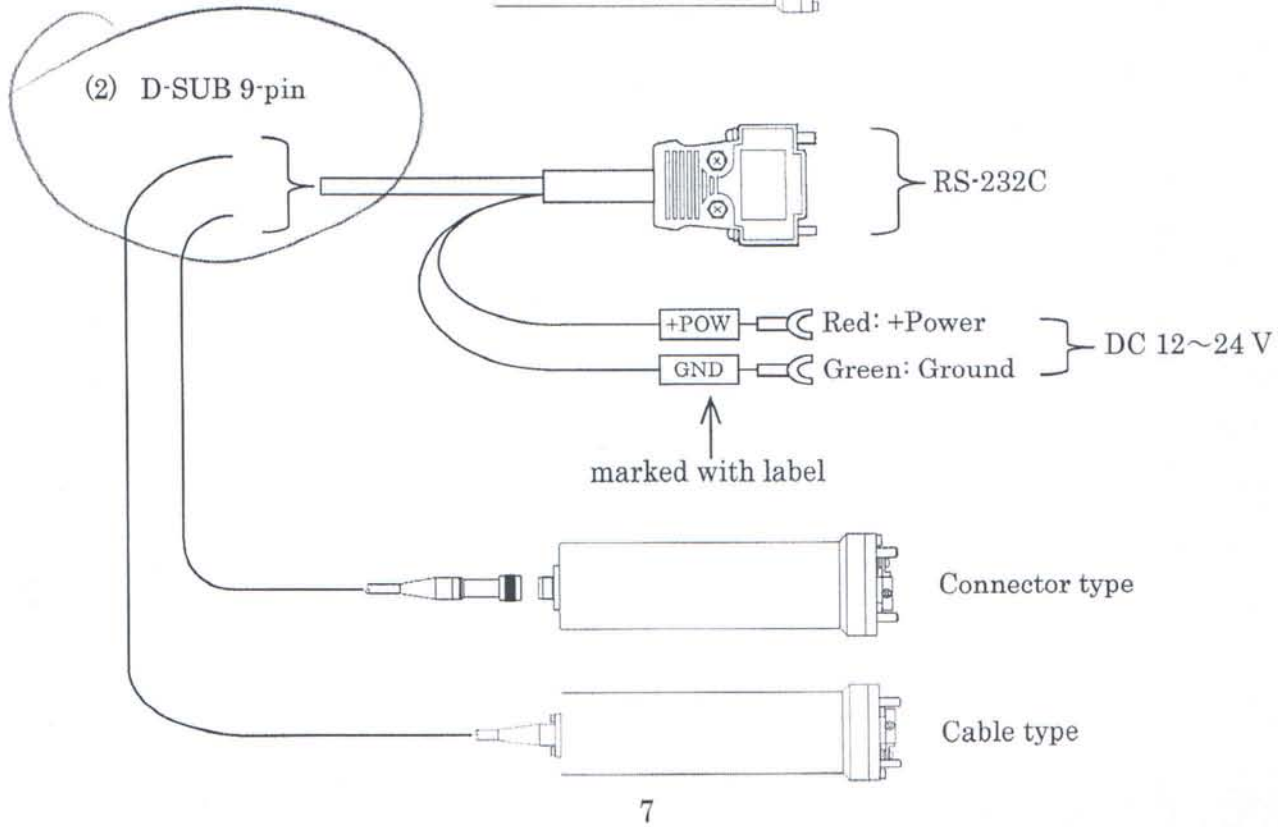
5.1 RS-232C

(1) Water proof circular connector (8-pin)

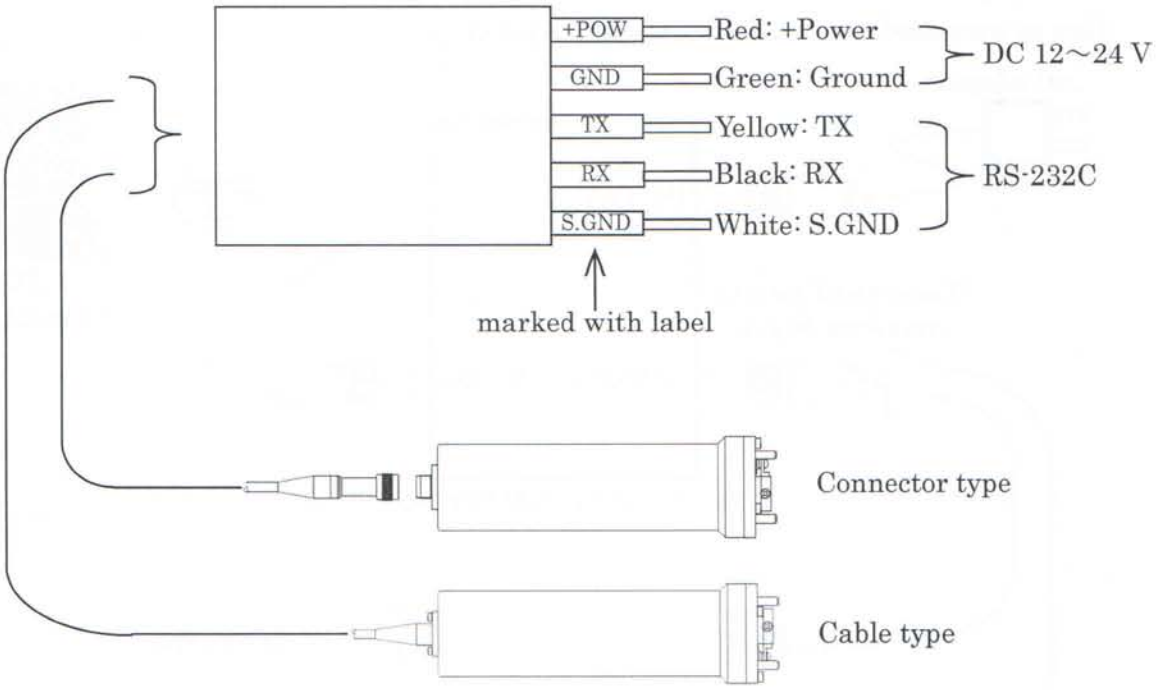
Can be connected to our interface (selling separately).



(2) D-SUB 9-pin



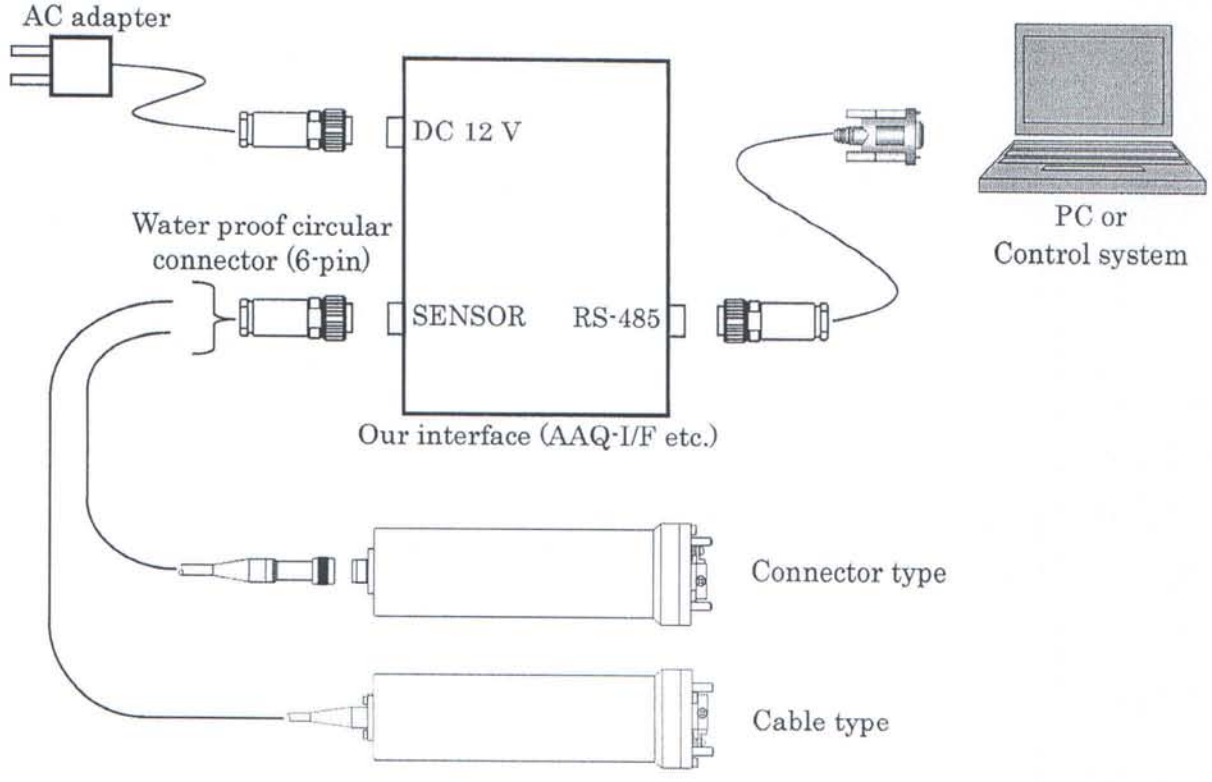
(3) 5-core unbraided



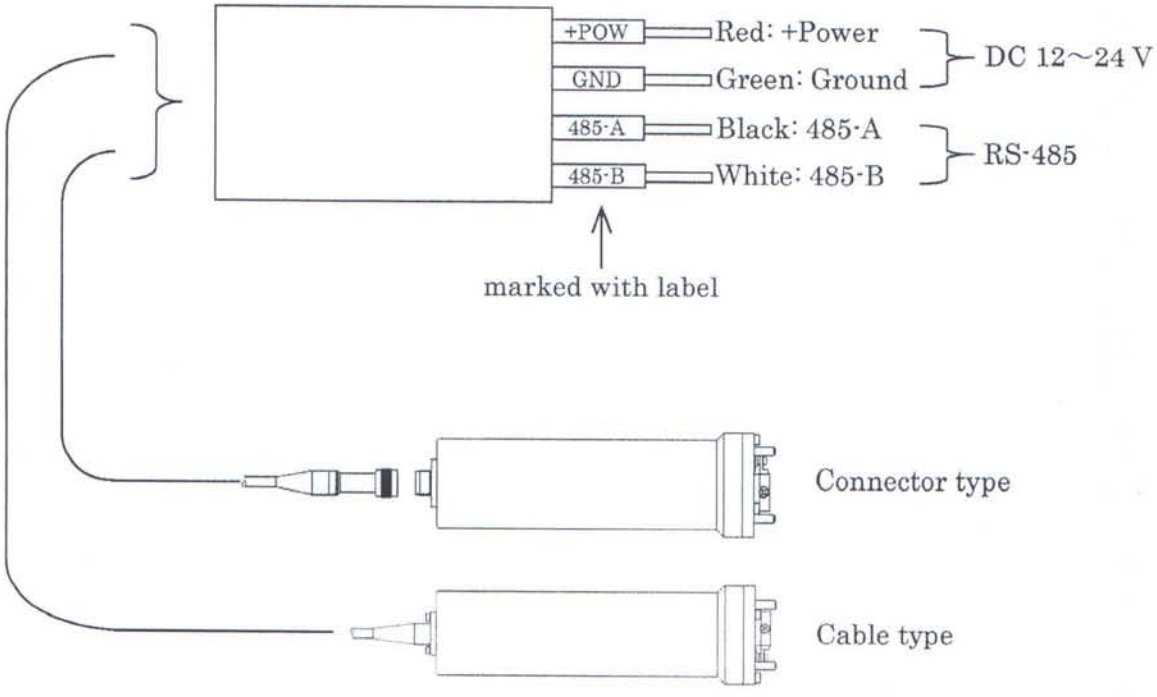
5.2 RS-485

(1) Water proof circular connector (6-pin)

Can be connected to our interface (selling separately).

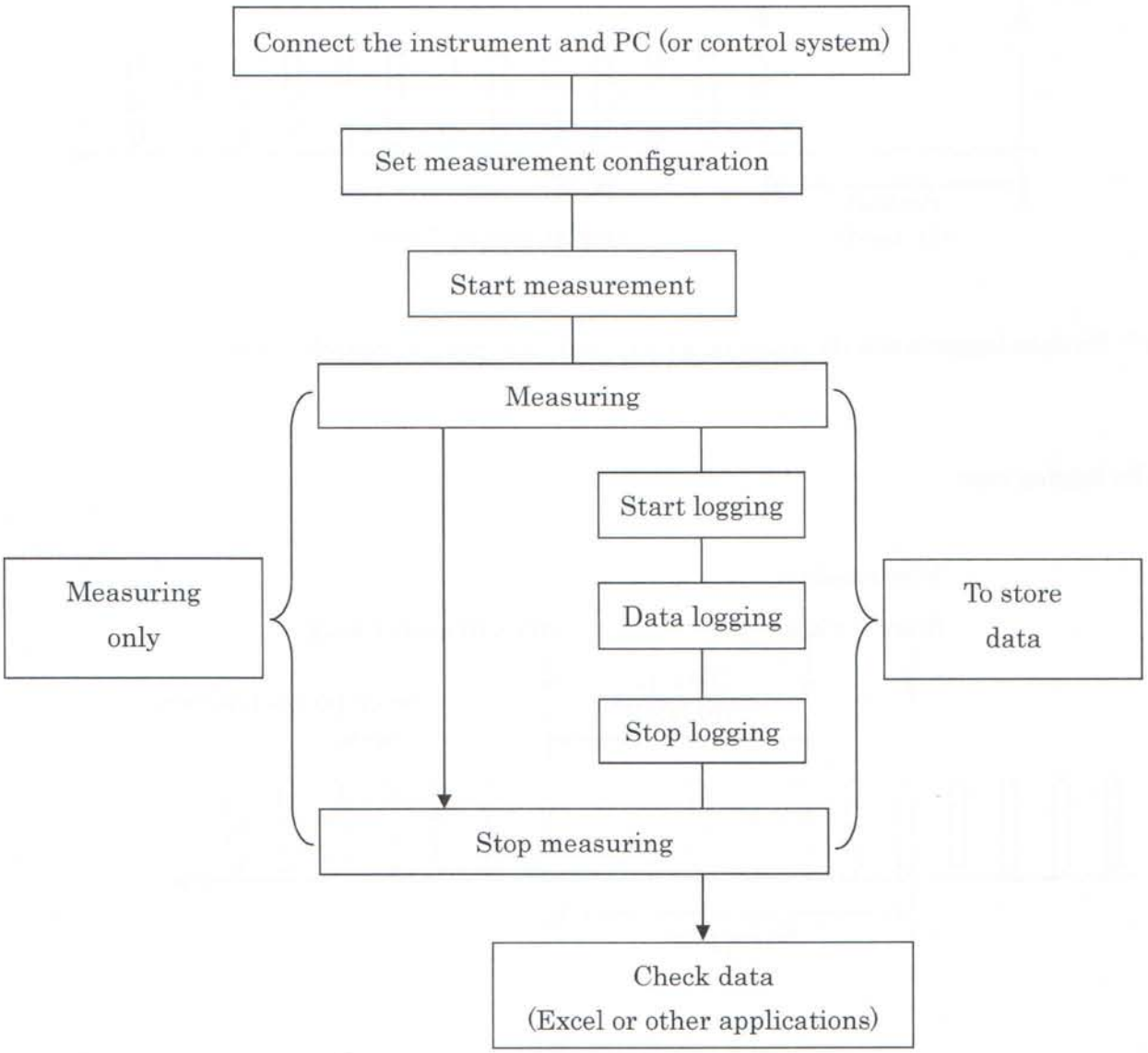


(2) 4-core unbraided



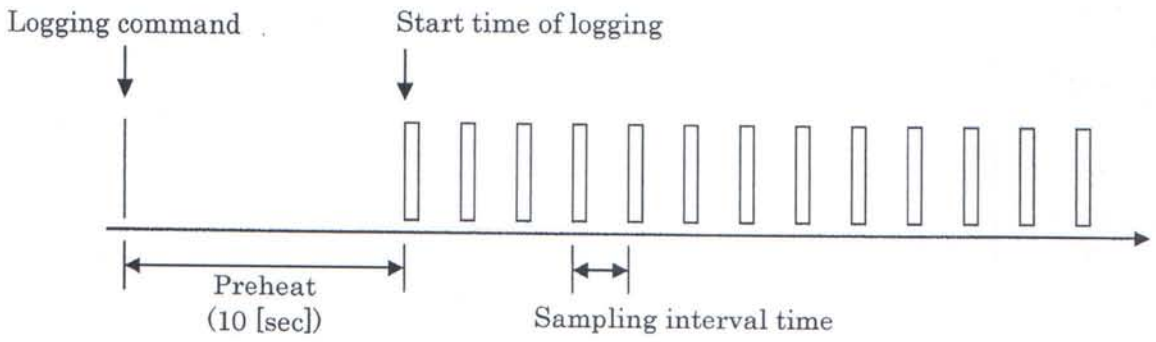
6. Measurement Flow

The measurement flow is shown below. Connect the instrument to power supply and to PC (or control system) with RS-232C (or RS-485) before measurement.



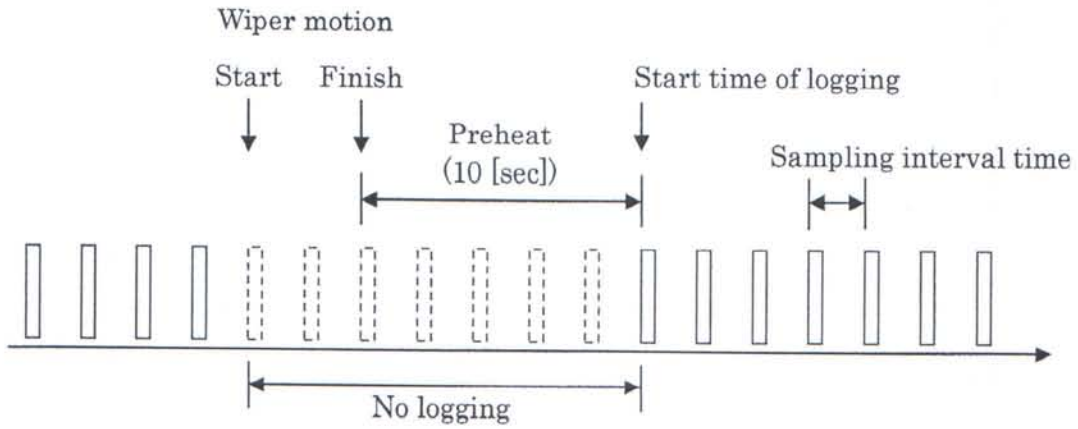
7. Measurement Mode

Measurements will be retrieved at continuously 0.5 [sec] interval.(1)



Note(1): No data logged when the wiper is moving or the instrument is preheating.

e.g.) No logging time



8. DO Calibration

8.1 Executing calibration

Check the SPAN and ZERO values before use and calibrate the instrument as required.

8.2 Calibration method

You will calibrate two points, SPAN and ZERO.
When calibrating both values, calibrate SPAN first(1).
Use the solutions below for calibration.

SPAN solution	Air saturated water (100% bubbling water)
ZERO solution	Sodium sulfite aqueous solution (25 g/500 ml, hereafter "Na_2SO_3 aqueous solution")

Note(1) To prevent the sodium sulfite aqueous solution from mixing with the air saturated water.

8.3 Calibration procedure

(1) Materials to prepare
- ① Configuration PC or control system
- ② Bubbling set (accessory)
- ③ Stirrer

(2) Solutions to prepare

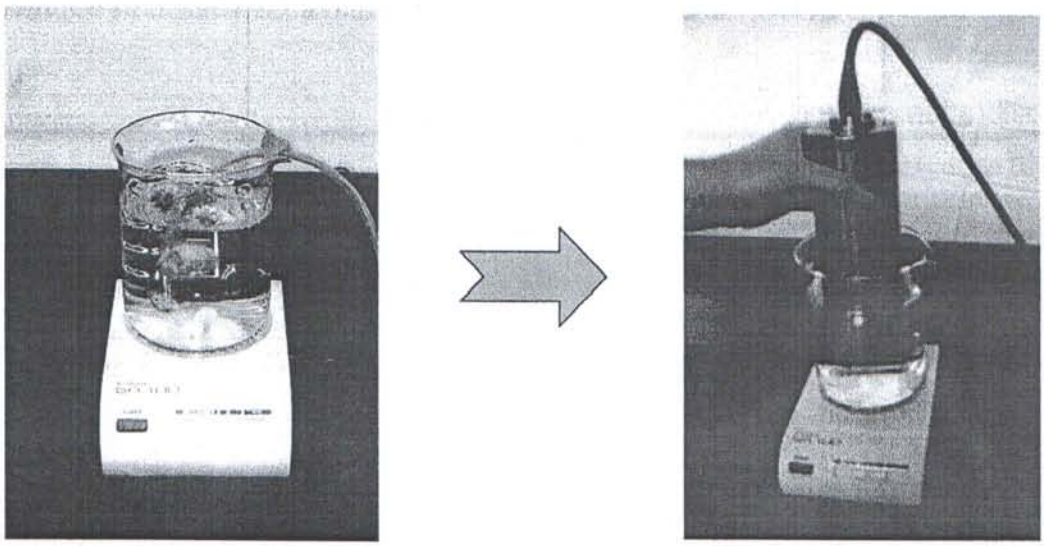
SPAN solution (air saturated water)	Create by fully stirring about 500 ml of tap water while pumping in a sufficient amount of air. This bubbling is usually complete in about 20 to 30 minutes.
ZERO solution (Na_2SO_3 aqueous solution)	Create by dissolving 25 g of Na_2SO_3 in 500 ml of distilled water.

Caution
- If the Na_2SO_3 aqueous solution accidentally enters your mouth or eyes, immediately stop working and take the appropriate measures listed on the MSDS.
- If the Na_2SO_3 aqueous solution comes into contact with your skin, promptly wash it off with a large volume of water.

(3) SPAN calibration
- ① Using the bubbling set, prepare the air saturated water. (Immediately before measuring, bubble the water for 20 to 30 minutes while stirring. We recommend using a stirrer.)

To accurately calibrate the instrument, we recommend measuring the atmospheric pressure. p[hPa] indicates the atmospheric pressure. It is used at (5) Calculations of the calibration coefficients.

② Remove the bubbling tube and immerse the instrument for calibration into the solution about halfway.

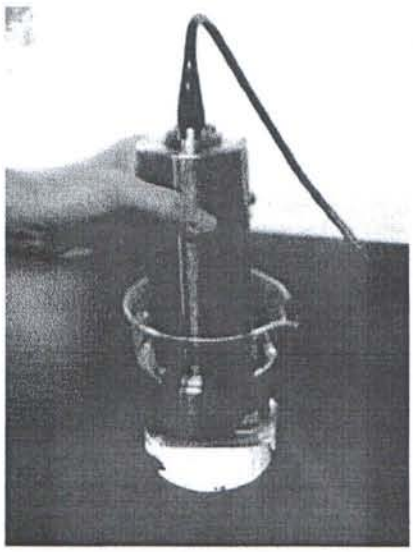


③ Remain still until the DO display value is stable. P_1[%] indicates DO of the instrument output for SPAN solution. t[℃] indicates water temperature when SPAN solution is measured. They are used at (5) Calculations of the calibration coefficients.

> **Caution** • During measurements, take care that air bubbles do not adhere to the oxygen sensing film.

(4) ZERO calibration

① Prepare the Na_2SO_3 aqueous solution in a container and place the sensor as shown in the diagram.
The amount of liquid should be sufficient to immerse the sensor about 3 cm.



② Remain still until the DO display value is stable. P_0[%] indicates DO of the instrument output for ZERO solution. It is used at (5) Calculations of the calibration coefficients.

> **Caution** • Wash the sensor off well with water after finishing calibration.

(5) Calculations of the calibration coefficients

Coefficients of G and H are used for calibration (example of calibration sheet is shown below).

A=	-44.8522
B=	148.888
C=	-0.653942
D=	0.0058
E=	0.0035
F=	0.150
G=	α
H=	β

Hereinafter, 2-points calibration process to achieve the new G_{new} and H_{new} values is described.

Calibrated output of oxygen saturated level (P_c[%]) can be calculated as follows:

$$P_c = G_{new} + H_{new} \times \frac{P - \alpha}{\beta}$$

where P[%] shows output value of the instrument before calibration. (P[%] and P_c[%] must be physical values with a unit of "%".) Here are procedures to obtain new coefficients of G and H (G_{new}, H_{new}):

$$G_{new} = \frac{\alpha - P_0}{P_1 - P_0} \times O_{sat}$$

$$H_{new} = \frac{O_{sat}}{P_1 - P_0} \times \beta$$

where P_1[%] and P_0[%] shows output value at SPAN solution and output value at ZERO solution, respectively.

O_{sat}[%] indicates correct level of oxygen saturation for air saturated water at (3) SPAN calibration. It can be calculated as follows. p[hPa], p_v[hPa], and t[℃] indicates the atmospheric presser, the saturation vapor pressure, and water temperature, respectively at (3) SPAN calibration. α and β indicates coefficient G and H of calibration sheet.

$$O_{sat}\,[\%] = \frac{p - p_v}{1013.25 - p_v} \times 100$$

$$p_v = 6.11 \times 10^{\frac{7.5 \times t}{237.3 + t}}$$

9. Communication

9.1 Specifications

Communication specifications

Item	Specification
Baudrate	Default: 38400 (configurable to 4800,9600,19200,38400 at factory shipment)
Character length	8bit, fixed
Stop bit	1, fixed
Parity	None, fixed
Interface	RS-232C (AROW2-CAR), RS-485 (AROW2-CAD)
Busy control	none

Control codes

Notation	Code
<d1>	11h (DC1 of ASCII)
<cr>	0Dh

All characters are ASCII.

PC means a personal computer or a control system.

(1) Update calendar information

- When the date information is not required, it's not necessary to setup.
- Calendar information is initialized when power is turned off.
- Send "go" commando after each command (data or time).

  No data is overwritten only by sending date or time command. New information becomes effective after the "go" command.

(a) Date Setup

PC→instrument	<d1><d1>date,YEAR,MONTH,DAY,<cr>	
PC←instrument	<d1><d1>ak,date,YEAR,MONTH,DAY,<cr>	acknowledgement
PC←instrument	<d1><d1>er,date,YEAR,MONTH,DAY,<cr>	error

e.g.)	PC→instrument	<d1><d1>date,2012,10,17,<cr>	
	PC←instrument	<d1><d1>ak,date,2012,10,17,<cr>	acknowledgement
	PC←instrument	<d1><d1>er,date,3456,13,45,<cr>	error

(b) Time Setup

PC→instrument	<d1><d1>time,HOUR,MINUTE,SECOND,<cr>	
PC←instrument	<d1><d1>ak,time,HOUR,MINUTE,SECOND,<cr>	acknowledgement
PC←instrument	<d1><d1>er,time,HOUR,MINUTE,SECOND,<cr>	error

e.g.)	PC→instrument	<d1><d1>time,23,59,00,<cr>	
	PC←instrument	<d1><d1>ak,time,23,59,00,<cr>	acknowledgement
	PC←instrument	<d1><d1>er,time,45,13,45,<cr>	error

(c) Execution

PC→instrument	<d1><d1>go,<cr>
PC←instrument	<d1><d1>ok,<cr>

e.g.)	PC→instrument	<d1><d1>go,<cr>
	PC←instrument	<d1><d1>ok,<cr>

(2) Achieve calendar information

(a) Date

PC→instrument <d1><d1>date?,<cr>

PC←instrument <d1><d1>date,YEAR,MONTH,DAY,<cr>

e.g.) PC→instrument <d1><d1>date?,<cr>

PC←instrument <d1><d1>date,2012,10,17,<cr>

(b) Time

PC→instrument <d1><d1>time?,<cr>

PC←instrument <d1><d1>time,HOUR,MINUTE,SECOND,<cr>

e.g.) PC→instrument <d1><d1>time?,<cr>

PC←instrument <d1><d1>time,23,59,00,<cr>

(3) Achieve header information

- Header information contains serial No., preheat time, calibration coefficients (Ch1: temperature, Ch2: DO, Ch3: power supply voltage), etc. ("dummy": No use)
- Calibration coefficients of header information 1 are A to D of Ch1 to Ch3, and calibration coefficients of header information 2 are E to H of Ch1 to Ch3.

(a) Header information 1

PC→instrument <d1><d1>head1?,<cr>

PC←instrument <d1><d1>TYPE,SERIAL,VERSION,dummy,dummy,dummy,dummy,dummy,
dummy,dummy,dummy,dummy,dummy,dummy,
PREHEAT[millisecond],dummy,
Ch1A,Ch1B,Ch1C,Ch1D,Ch2A,Ch2B,Ch2C,Ch2D,
Ch3A,Ch3B,Ch3C,Ch3D,<cr>

(b) Header information 2

PC→instrument <d1><d1>head2?,<cr>

PC←instrument <d1><d1>TYPE,SERIAL,VERSION,dummy,dummy,dummy,dummy,dummy,
dummy,dummy,dummy,dummy,dummy,dummy,
PREHEAT[millisecond],dummy,
Ch1E,Ch1F,Ch1G,Ch1H,Ch2E,Ch2F,Ch2G,Ch2H,
Ch3E,Ch3F,Ch3G,Ch3H,<cr>

(4) Data output

(a) Physical data

- A physical data is the value into which N-value is converted.
- The number of decimal places is three. The number of display digit of integer is variable.
- <stat> shows status of instrument.

PC→instrument <d1><d1>pval,<cr>
PC←instrument <d1><d1>pval,TEMPERATURE[℃],DO[%],
POWERSUPPLY[V],<stat>,<cr>

e.g.) PC→instrument <d1><d1>pval,<cr>
PC←instrument <d1><d1>pval,23.682,85.254,11.278,0,<cr>

(b) N-value data

- N-value is output raw data of the instrument (16bit A/D conversion).
- <stat> shows status of the instrument.

PC→instrument <d1><d1>real,<cr>
PC←instrument <d1><d1>real,TEMPERATURE,DO,POWERSUPPLY,<stat>,<cr>

e.g.) PC→instrument <d1><d1>real,<cr>
PC←instrument <d1><d1>real,12345,23456,34567,0,<cr>

* Status: Even-number appears when wiper is stopped, and odd-number appears when wiper is working.

(5) Wiper operation

- Do not send another command while wiper is working.

PC→instrument <d1><d1>wipe,0,<cr>
PC←instrument <d1><d1>wipe,0,<cr>

9.3 AROW2-CAD communication command list

All characters are ASCII.

Main instruction	ID	,	Command	,	SUB command	,	End
? : read ! : write = : response	ID for the instrument (00-99, 00: common ID)						<cr>

(1) Setup

(a) Update the ID information

PC→instrument !ID,HEAW,87,ID,<ID>,1,<cr>

PC←instrument =ID,HEAW,87,ID,<ID>,1,<cr>

<ID> a value to setup (01 to 99)

e.g.) Change ID from 01 to 03

PC→instrument !01,HEAW,87,ID,03,1,<cr>

PC←instrument =01,HEAW,87,ID,03,1,<cr>

(b) Check ID

PC→instrument ?ID,HEAR,87,<cr>

PC←instrument =ID,HEAR,ID,<ID>,1,<cr>

e.g.) PC→instrument ?03,HEAR,87,<cr>

PC←instrument =03,HEAR,ID,03,1,<cr>

(2) Calendar information

(a) Update

PC→instrument !ID,DATE,<YEAR><MONTH><DAY><HOUR><MINUTE><SECONDO>,<cr>

PC←instrument =ID,DATE,<YEAR><MONTH><DAY><HOUR><MINUTE><SECONDO>,<cr>

<YEAR>	yyyy	4 digits	<MONTH>	mm	2 digits	<DAY>	dd	2 digits
<HOUR>	hh	2 digits	<MINUTE>	mm	2 digits	<SECONDO>	ss	2 digits

e.g.) October 17, 2012 3:30 PM

PC→instrument !01,DATE,20121017153000,<cr>

PC←instrument =01,DATE,20121017153000,<cr>

(b) Check

PC→instrument ?ID,DATE,<cr>

PC←instrument =ID,DATE,<YEAR><MONTH><DAY><HOUR><MINUTE><SECONDO>,<cr>

e.g.) PC→instrument ?01,DATE,<cr>

PC←instrument =01,DATE,20121017153000,<cr>

(3) Achieve the number of channels

- As for AROW2-CAD, the number of channels is 3.

PC→instrument ?ID,CHAN,<cr>

PC←instrument =ID,CHAN,<Ch-number>,<cr>

<Ch-number> ccccc 5 digits Length is fixed (00000-00016)

e.g.) PC→instrument ?01,CHAN,<cr>

PC←instrument =01,CHAN,00003,<cr>

(4) Achieve serial No.

PC→instrument ?ID,SERI,<cr>

PC←instrument =ID,SERI,<S-No>,<cr>

e.g.) PC→instrument ?01,SERI,<cr>

PC←instrument =01,SERI,0001,<cr>

(5) Achieve calibration coefficients

- calibration coefficients: 3 (Ch1, Ch2, Ch2) × 8 (A, B, C, D, E, F, G, H)

PC→instrument ?ID,COFE,<cr>
PC←instrument =ID,COFE,Ch1A,Ch1B,Ch1C,Ch1D,Ch1E,Ch1F,Ch1G,Ch1H,…,Ch3H,<cr>

e.g.) PC→instrument ?01,COFE,<cr>
PC←instrument =01,COFE,1.2345E-02,2.4561,1.234E-08,
…0.00000E-00,<cr>

(6) Achieve the firmware version

PC→instrument ?ID,VERS,<cr>
PC←instrument =ID,VERS,<F-ver>,<cr>

e.g.) PC→instrument ?01,VERS,<cr>
PC←instrument =01,VERS,Ver0.05,<cr>

(7) Data output

(a) Physical data

- A physical data is the value into which N-value is converted.
- The number of decimal places is three. The number of display digit of integer is variable.
- <stat> shows status of the instrument.

PC→instrument ?ID,PVAL,<cr>
PC←instrument =ID,PVAL,TEMPERATURE[℃],DO[%],POWERSUPPLY[V],<stat>,<cr>

e.g.) PC→instrument ?01,PVAL,<cr>
PC←instrument =01,PVAL,23.682,85.254,11.876,0,<cr>

(b) N-value data

- N-value is output raw data of the instrument (16bit A/D conversion).
- <stat> shows status of the instrument.

PC→instrument ?ID,NVAL,<cr>
PC←instrument =ID,NVAL,TEMPERATURE,DO,POWERSUPPLY,<cr>

e.g.) PC→instrument ?01,NVAL,<cr>
PC←instrument =01,NVAL,12345,23456,34567,<cr>

* Status: Even-number appears when wiper is stopped, and odd-number appears when wiper is working.

(8) Wiper operation

- Do not send another command while wiper is working.

PC→instrument ?ID,WIPE,0,<cr>
PC←instrument =ID,WIPE,0,<cr>

e.g.) PC→instrument ?01,WIPE,0,<cr>
PC←instrument =01,WIPE,0,<cr>

10. Maintenance

10.1 Precautions before usage

When the instrument was stored unused for a long period of time, check operation before use.

Check that the cable does not break.

10.2 Maintenance after use

(1) After washing the instrument, wipe off the moisture on the instrument before storing it.

(2) To remove fouling on the oxygen sensing film, first wash it off well with freshwater, and then gently wipe it off under water with a soft cloth. Use caution as the oxygen sensing film is extremely thin. The film may break if scrubbed with force.

(3) Check that the sensing film is not scratched or damaged. If you find a large scratch, we recommend that you contact us for inspection.

10.3 Storage

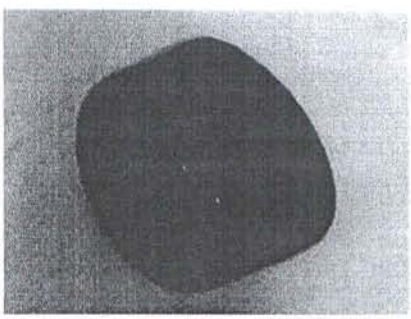
(1) After washing the instrument, wipe off the moisture on the instrument before storing it.

(2) When storing the instrument, avoid locations with high temperatures, high humidity, and that are exposed to direct sunlight.

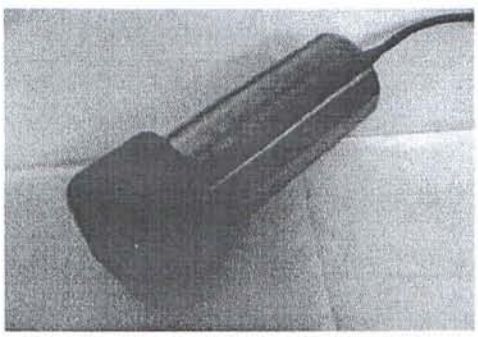
(3) To protect the oxygen sensing film and prevent deterioration, always attach the sensor protective cap when storing the instrument.

(4) Do not store the instrument in high temperature of 40°C or higher because this will speed up the deterioration of the oxygen sensing film.

How to attach the sensor protective cap



Protective cap



When attached

10.4 Regular maintenance

(1) To maintain the instrument 's accuracy and so it can be reliably used for many years, we recommend the instrument be overhauled (internal inspection, replacement of the oxygen sensing film and the wiper rubber, and recalibration) at our factory once a year.

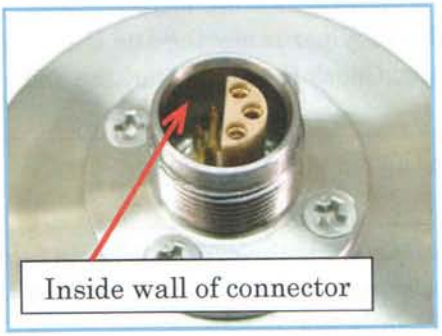
(2) The oxygen sensing film and the wiper rubber are consumable parts. We recommend replacement and recalibration once a year.

10.5 Magnet-style wiper blade precautions

(1) Communication cable (cable plug part)

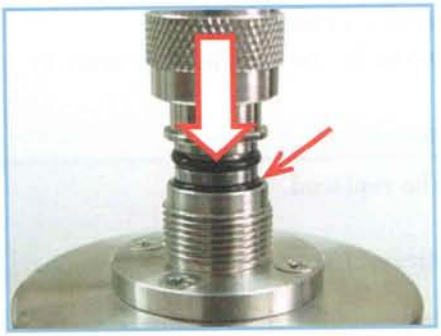
Check that dust or dirt doesn't adhere to O-ring.

Apply a little grease to O-ring part. There is a risk that dust contaminates grease, when the quantity of grease is large.



(2) Instrument (inside wall of connector)

Check that there is no adhesion of dust or dirt.



(3) Connect the instrument and the cable.

Insert the cable straightly to the instrument.

Adjust a position so that male and female connectors combine correctly.

(4) Insert firmly

Insert until the 2nd O-ring is entered completely.

(5) Tighten firmly until the screw stops.

When removing cable, attach a cap to prevent adhesion of dust to cable plug or connector, and to prevent water leakage.

11. Troubleshooting

No.	Problem	Action
1	Cannot communicate with PC (or control sysmtem).	Check the power supply and the connecting port number.
2	Measurements do not start.	Check the power supply voltage and connection.
3	Lack of data.	In case that the wiper is operated during measurement, data is not logged while the wiper is moving and the instrument is preheating. Check the wiper working and preheat time.
4	The wiper does not operate smoothly.	Disassemble and clean the magnet-type wiper. Contact us.(1)
5	The oxygen sensing film is scratched.	You may be able to continue using the oxygen sensing film if the scratch is relatively small. Check if the saturation output value is normal before use. (See 8. DO Calibration in this manual) If the output is very unsteady, the sensing film must be replaced. Contact us in this situation.(1)
6	The oxygen sensing film has been greatly damaged.	The sensing film must be replaced. Contact us.(1) (The sensing film is delicate. Use extreme care when handling)
7	The saturation value has deviated.	Calibrate the sensor. (See 8. DO Calibration in this manual)
8	The water temperature sensor is bent.	There is a possibility the sensor is not outputting the correct water temperature value. We recommend an inspection at our factory.(1)
9	As the depth of the sensor gets deeper, the DO value gets larger and the analysis result differs.	Are you taking measurements with the protective cap still attached? Remove the protective cap. After you are finished taking measurements, store the sensor with the protective cap attached.
10	DO output is not stable.	When the sensor is put in the water while the oxygen sensing film is dry, it may take a few minutes for output to stabilize. This is not a malfunction.

Note(1) Please let us know model name, serial number, place of measurement, measuring conditions, etc.

12. Specifications

(1) Sensor specifications

	Measurement item	Specifications	
		AROW2-CAR	AROW2-CAD
Sensor	Water temperature	Thermistor	
	Saturation	Phosphorescence measurement	
Range	Dissolved oxygen	0 to 20 [mg/l](1)	
	Saturation	0 to 200 [%](1)	
	Water temperature	–3 to 45 [°C]	
	Battery voltage	DC 12 to 24 [V]	
Resolution	Dissolved oxygen	0.001 to 0.004 [mg/l](2)	
	Saturation	0.01 to 0.04 [%](2)	
	Water temperature	0.001 [°C](3)	
Accuracy(4)	Saturation	±2.0 [%] F.S. (1 atmosphere, 25°C)	
	Water temperature	±0.02 [°C]	
Reproducibility(5)	Saturation	Drift Within ±0.5 [%] F.S. (24 hours) Within ±5.0 [%] F.S. (1 year)	
		Temperature/water pressure correction Within ±2.5 [%] F.S.	
Response time	Saturation	Within 30 [sec] (90% response standard value)	
	Water temperature	Within 30 [sec] (90% response standard value)	

(2) Transmit data specifications

Model name	AROW2-CAR	AROW2-CAD
Communication	RS-232C	RS-485
A/D converter	16-bit digital conversion	
Communication interval	0.5 [sec] or above	
Preheat time	10 [sec]	

(3) Power supply/exterior/other specifications

Model name	AROW2-CAR	AROW2-CAD
Wiper operation method	Direct-axis	Direct-axis
Power supply	DC 12 to 24 [V]	
Current consumption	During measurements 40 [mA] (Cable: 20m standard, Power supply: DC12V)	
Primary materials	Main body: Titanium (JIS 2) Optical window: Transparent acrylic resin (PMMA)	
Dimensions	Total length 173 [mm][6], Diameter 70 [mm] (flange diameter), diameter 60 [mm] (pressure case external diameter)	
Weight	Weight in water 450 [g], weight in air 910 [g]	
Max. depth	200 [m] water depth equivalent	
Cable length	20m, standard	
Communication of the instrument and the cable	Underwater cable grand or underwater connector.	
Treatment of cable-end	1. Communication: DSUB 9pin Power supply: unbraided 2. Unbraided 3. Water proof circular connector (8pin)	1. Unbraided 2. Waterproof circular connector

Note[1] This instrument measures the change in phosphorescence time by the change in the partial pressure of oxygen. Phosphorescence time is affected by water temperature and water pressure, so to convert it to saturation, these values must also be simultaneously measured during the measurement.
Water temperature is measured simultaneously by this instrument, but water pressure must be separately input by the user.
When converting to the amount of dissolved oxygen, salinity must also be separately input by the user.
These calculations are automatically performed by the software.

Note[2] Resolution decreases the more the partial pressure of oxygen increases (inverse proportion).

Note[3] Resolution is a theoretical value at 25[°C].

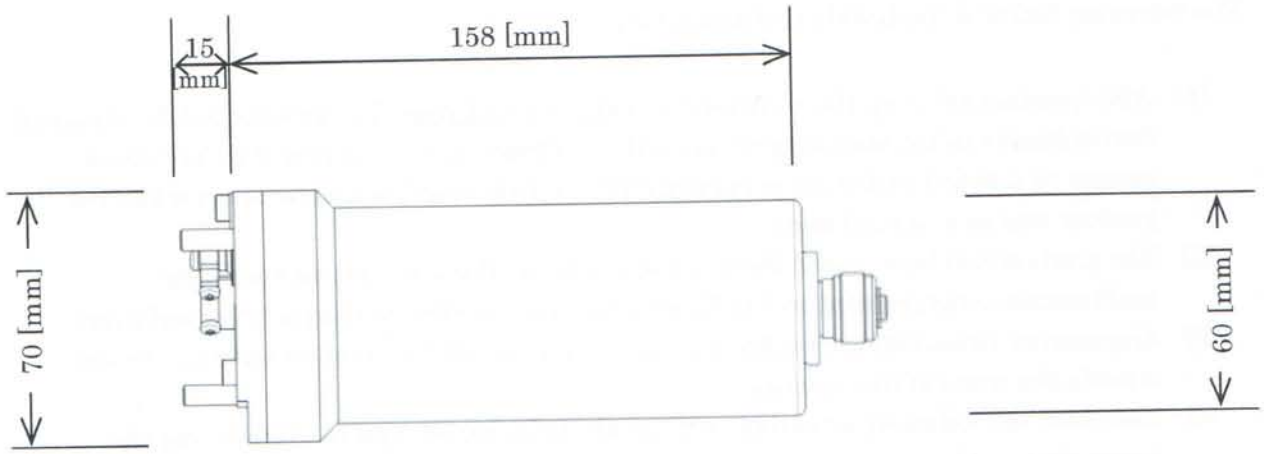
Note[4] The water temperature accuracy guarantee range is 3 to 31[°C].
The accuracy for dissolved oxygen and saturation displays a linearity error.

Note[5] Saturation is a 0 to 100[%] range.

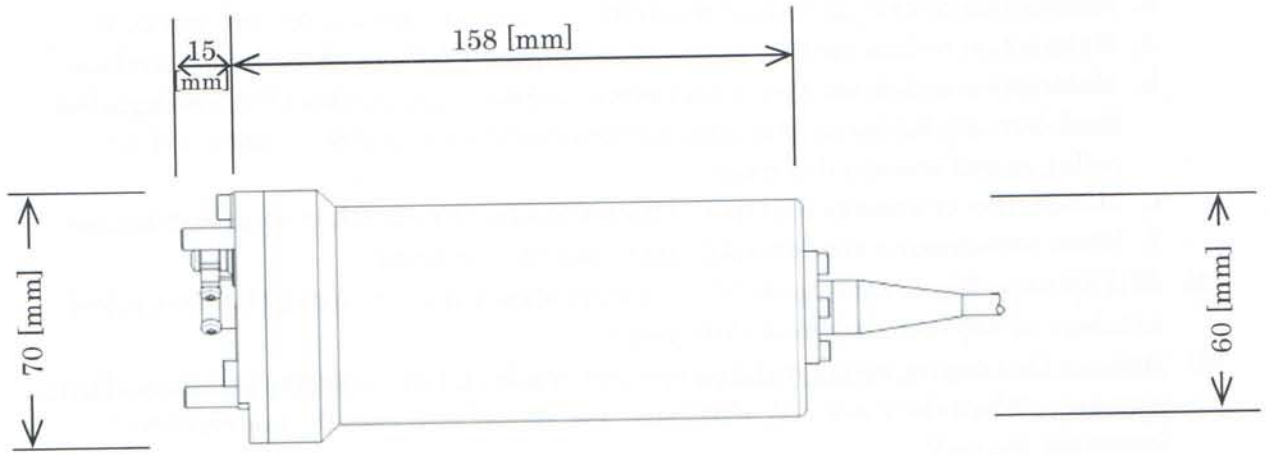
Note[6] The total length is the dimension including the sensor guard and without the cable connector section.

(4) Dimensional outline drawing

(a) Connector type



(b) Cable type



13. Warranty

The warranty below is applicable to this product.

(1) After product delivery, the warranty period is set at 1 year. The product will be repaired free of charge in the warranty period if the malfunction is determined to have been caused by a defect in design or manufacture or if the malfunction occurred when the product was in a normal state.

(2) The product will be repaired free of charge outside the warranty period if the malfunction is determined to have been caused by a defect in design or manufacture.

(3) Accessories, consumables, packaging, and scratches, dirt, or rust on the exterior are outside the scope of this warranty.

(4) Note that the following situations will result in fee-based repairs even during the warranty period.

1. Damage that occurs during installation, mooring, or storage
2. Malfunction or damage that occurs from incorrect operation or carelessness
3. Malfunction or damage that occurs from unwarranted repairs or modifications
4. Malfunction or damage that occurs from transport, falls, or shocks after purchase
5. Malfunction or damage that occurs from external causes such as fire, earthquakes, flood damage, lightning, and other natural disasters, and other causes such as pollution and abnormal voltage
6. Malfunction or damage that occurs from abnormalities in other connected devices
7. When consumables are damaged and require replacement

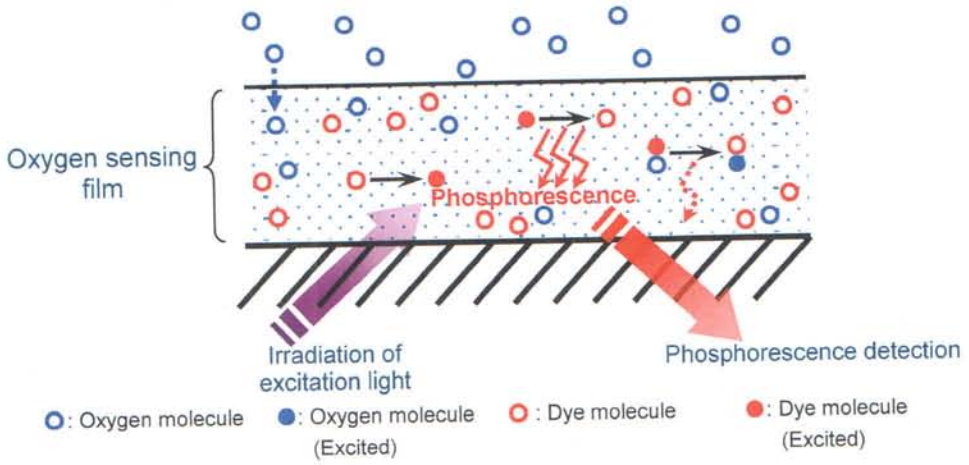
(5) JFE Advantech is never responsible for any damage caused by using this device, lost earnings, or any demands from third parties.

(6) Damage that occurs during installation or during operation is outside the scope of this warranty. When there is a risk of damage, you should purchase the appropriate insurance yourself.

14. Sensor Principle

14.1 Optical DO sensor

When the oxygen sensing film is exposed with the excitation pulsed light, the dye in the sensing film is excited and emits red phosphorescence (see the figure below). Oxygen molecules are moving freely in the sensing film, and when they react with the excited dye, they take that energy and the phosphorescence time and strength decreases. Therefore, in an oxygen-free environment, the phosphorescence time is the longest and its intensity is strongest. However, when the partial pressure of oxygen increases, both of these decrease. The optical DO sensor detects the change in this phosphorescence time and calculates the oxygen density.



Oxygen measurement conceptual diagram

14.2 Water temperature sensor

The water temperature sensor uses a thermistor with a fast response speed. However it should be slow down the response time by using a filter. It follows the response of the optical DO sensor to perform temperature correction.