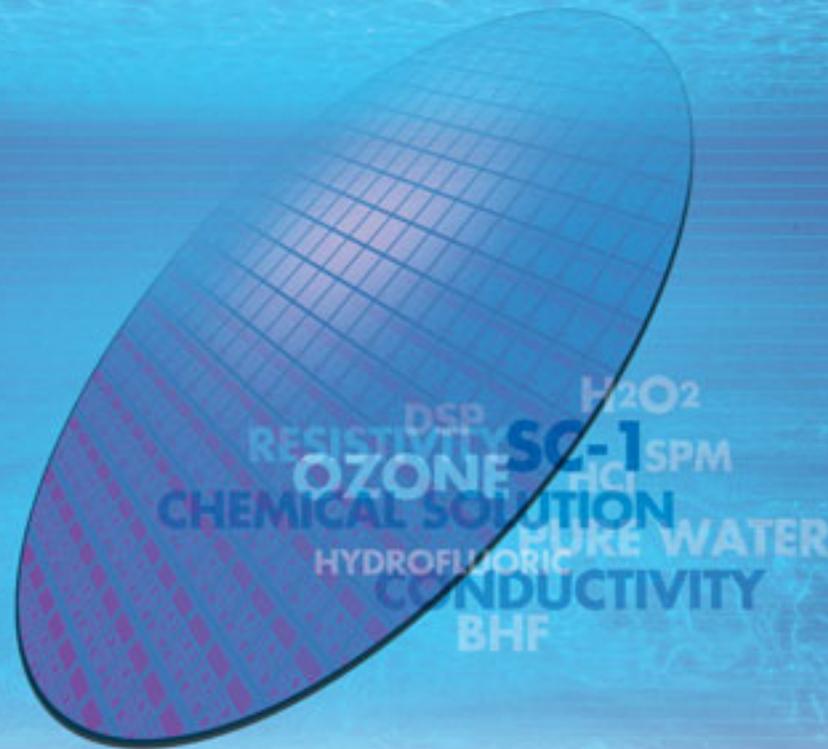


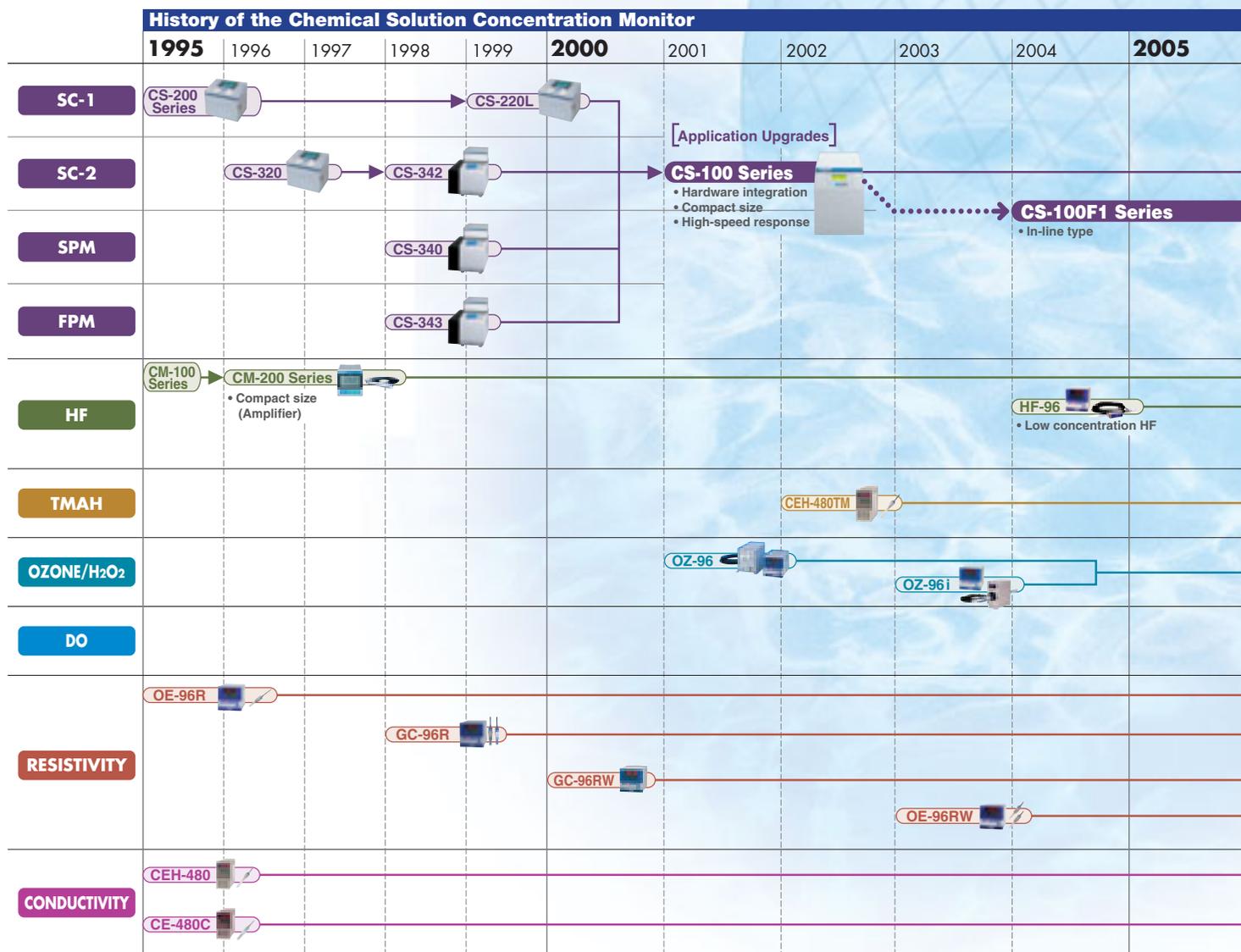
Semiconductor
Analyzers for
Wet Process



HORIBA Group Delivers Comprehensive Solutions to the Evolution of Semiconductor/FPD Wet Processes

Since the introduction of the chemical solution concentration monitor in 1995, HORIBA has developed a wide range of analyzers for wet processes using unique technologies. The chemical solution concentration monitor boasts a world-leading market share*1 in 300 mm semiconductor wafer cleaning processes and continues to be the industry leader. And now, the concentration monitoring of chemical solutions must play a more advanced role as a vital part of the "monitor → feedback → control" process control according to the evolution of semiconductor processes. In response to next generation equipment, HORIBA Group draws upon and incorporates the ideas of specialists in various fields. HORIBA has also developed an IPA gas concentration monitor for measuring IPA vapors generated during wafer drying processes. The IPA gas concentration monitor makes it possible for HORIBA to offer total wet process density control solutions that meet all of its customers needs.

*1 From HORIBA's 2010 research.



HORIBA

[HORIBA] Overall analysis technology specialist

HORIBA proprietary analysis technology is fully demonstrated in a wide range of fields - semiconductors, medicine, environment, science, and engine measurements. In semiconductors, HORIBA provides an extensive selection of process monitors for integration into manufacturing lines that aid the safe production of higher performance semiconductors.

[HORIBASTECH] Mass flow control technology specialist

A core company in the HORIBA Group's semiconductor business, HORIBA STEC boasts a world-leading market share*2 in industry-standard mass flow controllers and liquid source vaporization control systems, important devices that are vital in semiconductor manufacturing lines.

[HORIBAJOBIN YWON] Optical analysis technology specialist

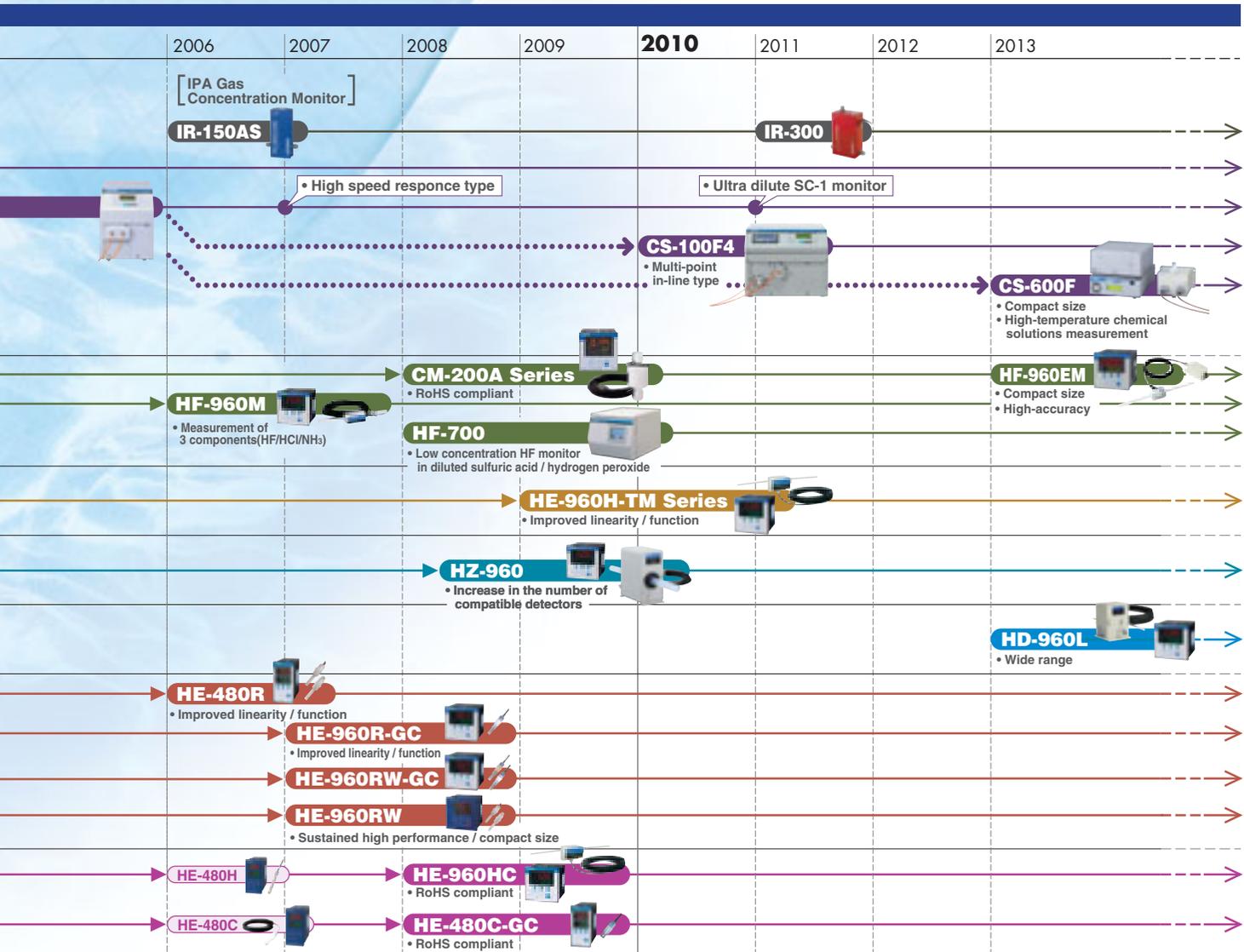
Based in France, this company is the leading manufacturer of spectroscopic ellipsometers and was welcomed into the HORIBA Group in 1997. Fusing proprietary HORIBA technology with spectroscopy that covers the infra-red to visible light ranges has established an analysis technology that covers the entire wavelength range.

[HORIBAAdvancedTechno]

Water measurement technology specialist

HORIBA Advanced Techno manufactures leading edge products for the fields of environment, measurement and semiconductor cleaning. In semiconductors, its main products include equipment for measuring the concentration of Hydrofluoric Acid required in wafer etching and various other liquids, and equipment for measuring the purity of ultra-pure water that is vital in wafer cleaning processes.

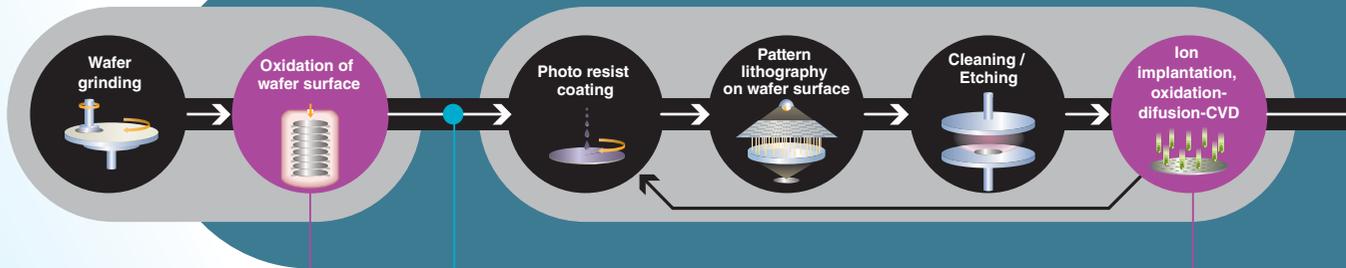
*2 From HORIBA STEC's 2011 research.



FEOL & BEOL Chemical Solution/Gas Concentration Monitoring in Wet Process

Semiconductor Processes

Front-end of Line



Developing

TMAH Concentration Monitor
HE-960H-TM Series

RCA Cleaning Full Process

Organic material removing
 H_2SO_4/H_2O_2

SPM Monitor CS-150

Dissolved Ozone Monitor HZ-960

Support for Multi-Bath, Single-Bath, and Single-Wafer Cleaning Systems

Diluted HF rinsing

Fiber Optic Type Chemical Solution Concentration Monitor CS-600F

TMAH/H₂O₂ Monitor CS-139E

Particle removing
 $NH_4OH/H_2O_2/H_2O$

Diluted HF rinsing

Alternate RCA Monitor CS-100 Series
*Please consult HORIBA concerning chemical solutions.

Metal removing
 $HCl/H_2O_2/H_2O$

Diluted HF rinsing

SC-2 Monitor CS-152

DIW rinsing

Spin/IPA drying

IPA Gas Monitor IR-300

BHF Monitor CS-137

Hydrofluoric Acid Monitor HF-960EM

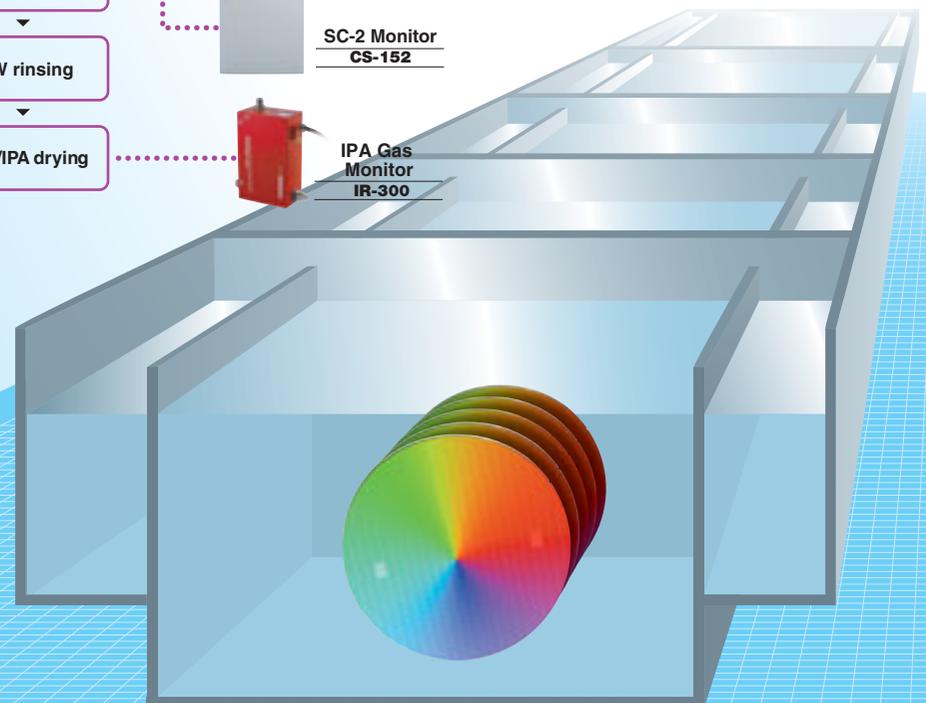
Dissolved Oxygen in Low Concentration HF Monitor HD-960L

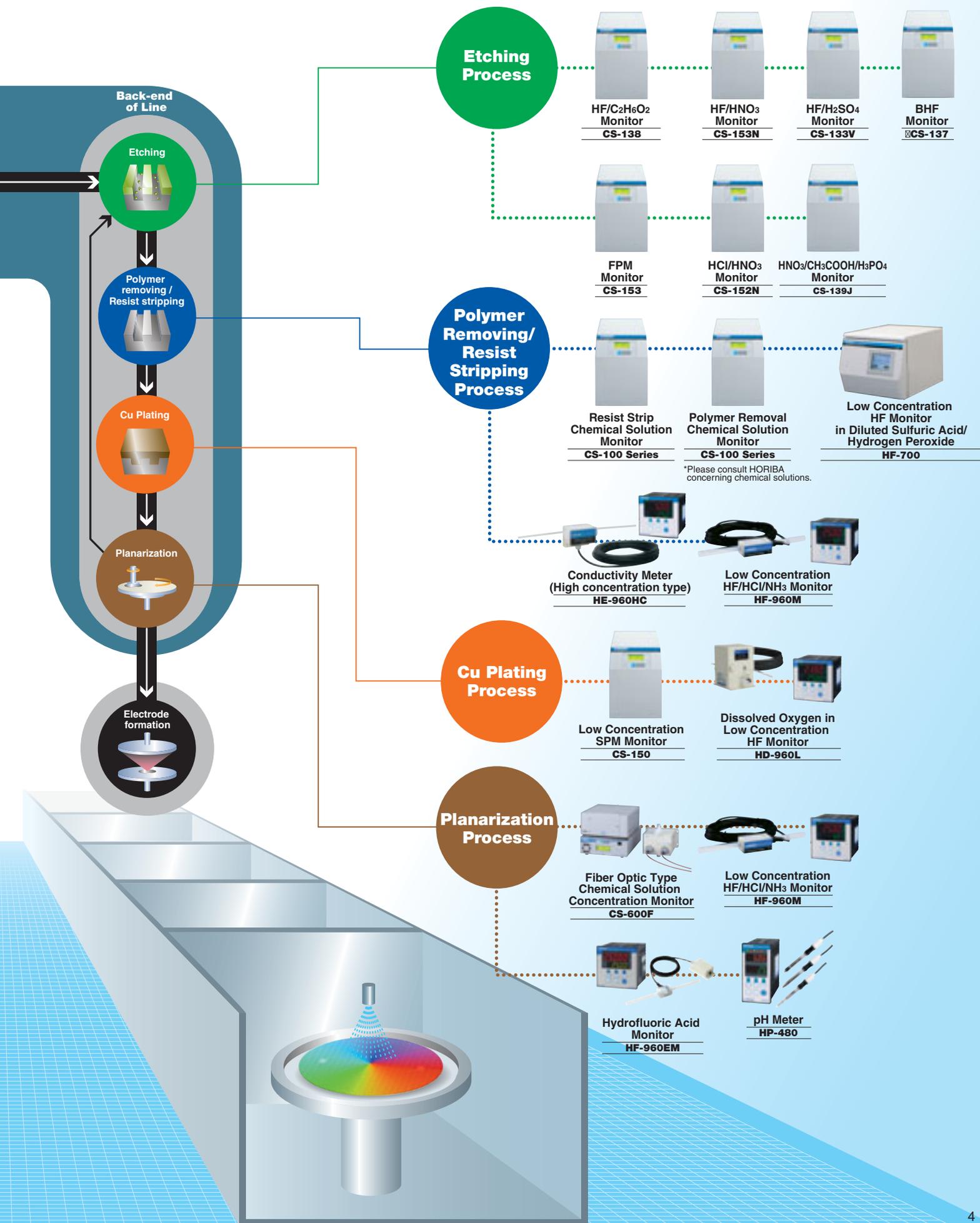
Low Concentration HF/HCl/NH₃ Monitor HF-960M

Conductivity Meter (Low concentration type) HE-480C-GC

Resistivity Meter HE-480R

Carbon Sensor Resistivity Meter HE-960R-GC





Etching Process

- HF/C₂H₆O₂ Monitor CS-138
- HF/HNO₃ Monitor CS-153N
- HF/H₂SO₄ Monitor CS-133V
- BHF Monitor CS-137

Polymer Removing/Resist Stripping Process

- FPM Monitor CS-153
- HCl/HNO₃ Monitor CS-152N
- HNO₃/CH₃COOH/H₃PO₄ Monitor CS-139J
- Resist Strip Chemical Solution Monitor CS-100 Series
- Polymer Removal Chemical Solution Monitor CS-100 Series
- Low Concentration HF Monitor in Diluted Sulfuric Acid/Hydrogen Peroxide HF-700

*Please consult HORIBA concerning chemical solutions.

Cu Plating Process

- Conductivity Meter (High concentration type) HE-960HC
- Low Concentration HF/HCl/NH₃ Monitor HF-960M
- Low Concentration SPM Monitor CS-150
- Dissolved Oxygen in Low Concentration HF Monitor HD-960L

Planarization Process

- Fiber Optic Type Chemical Solution Concentration Monitor CS-600F
- Low Concentration HF/HCl/NH₃ Monitor HF-960M
- Hydrofluoric Acid Monitor HF-960EM
- pH Meter HP-480

CHEMICAL SOLUTION CONCENTRATION

Fiber Optic Type

In-line/
Realtime
Measurement

Chemical Solution Concentration Monitor

CS-100F1 Series

The CS-100F1 Series is equipped with fiber optics cable based on the CS-100 Series. It offers real-time, in-line measurements by directly integrating the sample cell into the cleaning system piping and by using a fiber optic cable for light signal transmission. A single concentration monitor can take up to four measurements and monitoring of multiple chemical solutions in a single-bath or single-wafer cleaning system is also possible.



In-line cell



Cell unit

Concentration follow-up in real-time using in-line cells

Real-time concentration monitoring is made possible by using an in-line cell that directly connects to the main piping of the cleaning system.

Multi monitoring of up to four types

A single monitor can measure up to four types of chemical solutions or ranges. You can monitor the concentrations of more than one chemical solution (or differing chemical solution ratios) in a single lot, like single-bath or single-wafer cleaning system.

Cell unit type for higher accuracy

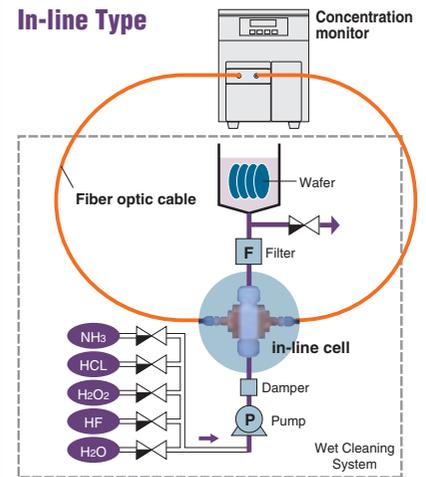
Emphasizing stability, a cell unit type is also available that supports feedback control using a monitor output. It is also possible to keep the chemical solution concentration within an accepted range and eliminate unnecessary chemical solution changes.

Safe installation by complete isolation of electrical and measurement sections

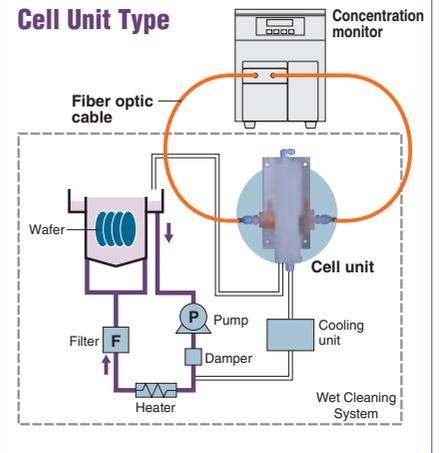
RoHS compliant

Example of installation

In-line Type



Cell Unit Type



New model measures ultra-dilute SC-1 with high precision

Both in-line and cell unit types available.

Ultra-dilute SC-1 Monitor

Ultra-dilute
SC-1

CS-121F1

Capable of accurately measuring ultra-dilute SC-1

[Measurement Range]

NH₃: 0 to 1000 ppm

H₂O₂: 0 to 1000 ppm

H₂O: 99.8 to 100.0%

[Repeatability (peak to peak)]

NH₃: ±50 ppm

H₂O₂: ±50 ppm

H₂O: ±1.5%



In-line cell for CS-121F1



Cell unit for CS-121F1

High stability

In-line cell (CS-10-7S)

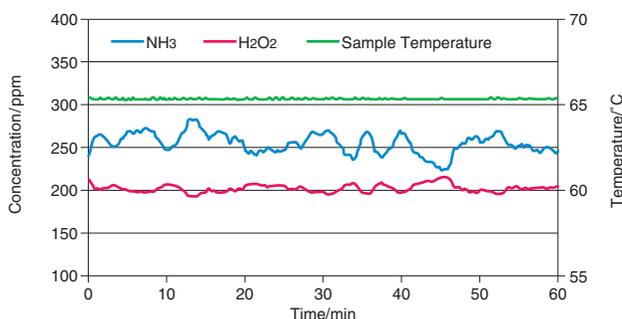
Sample: 250ppm NH₃ + 200 ppm H₂O₂

Sample temperature: 65.0°C

Measurement interval: Approx. 3 sec.

Moving average: 10 times

| | NH ₃ /ppm | H ₂ O ₂ /ppm |
|------------------------|----------------------|------------------------------------|
| Average | 255 | 203 |
| Max | 285 | 216 |
| Min | 222 | 193 |
| Standard Deviation | 12 | 4 |
| Max error from Average | 33 | 13 |



Cell unit (CS-10-7SU)

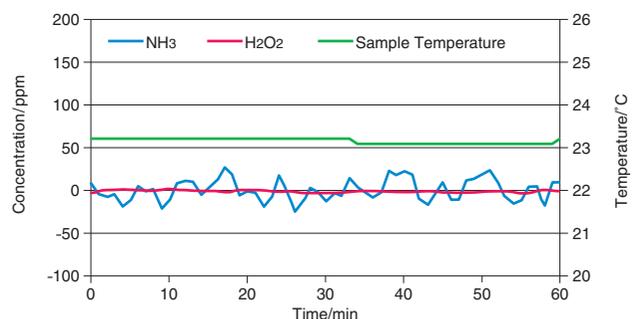
Sample: DIW

Sample temperature: 23.0°C

Measurement interval: Approx. 3 sec.

Moving average: 16 times

| | NH ₃ /ppm | H ₂ O ₂ /ppm |
|------------------------|----------------------|------------------------------------|
| Average | 0 | -1 |
| Max | 27 | 2 |
| Min | -25 | -3 |
| Standard Deviation | 13 | 1 |
| Max error from Average | 27 | 3 |



Fiber Optic Type

NEW

High temperature
Chemical
Measurement

Stable
operation

Compact
body size

Chemical Solution Concentration Monitor

CS-600F Series

HORIBA's fiber optic type chemical solution concentration monitor, the CS-600F, achieves a higher level of functionality best suited for manufacturing, such as the ability to perform in-line measurement of high temperature chemical solutions in various applications, stable operation for reduced downtime, and compact size for improved space productivity in order to meet the precise chemical solution concentration management required in leading-edge semiconductor wet processes.

Reduced Sizes for More Flexible Layout

The CS-600F monitor is compact in size; height has been reduced by 36%, volume by 40%, and the space required by the cell cables by 46% compared to previous models (CS-100F1 Series). The light source unit and monitor main body can be installed remotely and in separate locations, which allows installation flexibility based on the locations of the chemical solution unit and cleaning equipment.

High-stability, In-line Measurement of High Temperature Chemical Solutions (20 to 80°C)

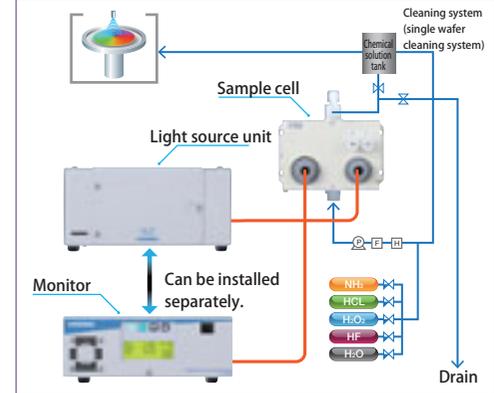
The all-new optical system and improved processing algorithms enable in-line measurement of high temperature chemical solutions, a critical step for leading-edge wet processes. This eliminates the need to cool-down the chemical sample., HORIBA's CS-600F provides a high-stability, enables more efficient and precise chemical solution management.

Significantly Reduced Background Correction Frequency

The regular correction frequency is significantly reduced compared to the previous model (CS-100F1 Series), which in turn significantly reduces unit downtime and greatly contributes to improved throughput.



Example of installation



Chemical Solution Concentration Monitor

Plug-in/
Plug-out

CS-100 Series

The CS-100 Series offers a complete lineup of high precision chemical solution concentration monitors for various solutions in cleaning and etching processes during semiconductor manufacturing. In addition to the high-speed response and compact design, measurement of each component concentration is conducted in real-time and the timing of chemical solution changes and automatic supply is warned with an alarm. The ability to perform short measurement cycles allows for accurate monitoring of concentration changes.



CS-100 Series



CS-100 Series
(Integrated cooling unit)

Concentration follow-up in real-time

Concentration control for the 300 mm process with an approximately 3 second measurement cycle is achieved. Frequent feedback is possible for both multi-bath and single-bath cleaning systems.

Fully automatic measurements

Measurement is fully automatic, so no measurement control is required once the measurements have begun. The operator needs only to prepare the chemical solution. In addition, air is used for the reference spectral measurement, so a utility water supply used for usual measurements is unnecessary.

Comprehensive measure to eliminate air bubble during sequential measurements

A unit with air bubble removing capability is installed upstream of the flow cell, allowing for consecutive measurements to be taken without abnormalities in the solution flow.

A higher safety assurance by using 24 V DC

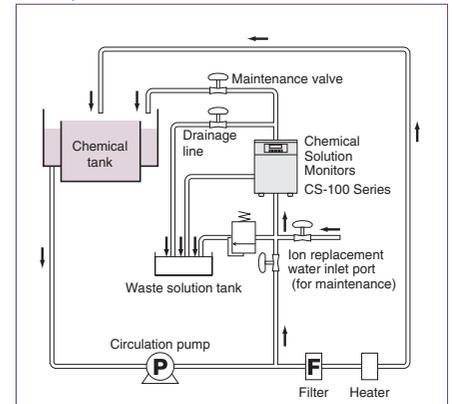
Lightweight and compact design

A higher overall yield

Output from the monitor is used for replenishment control of chemical solutions, enabling cleaning with a high reproducibility rate. There are fewer defects in the cleaning process, and this helps to boost the overall yield.

RoHS compliant

Example of installation



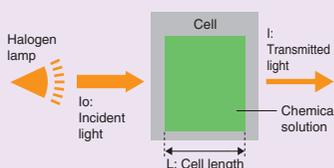
Measurement principle CS-100F1 Series / CS-121F1 / CS-100F4 Series / CS-100 Series

Example of chemicals can be measured
CS-100F1 Series / CS-121F1 / CS-100F4 Series / CS-100 Series

Lambert-Beer's Law

$$A(\lambda) = \text{Log} [I_0(\lambda) / I(\lambda)] = \alpha(\lambda) \cdot L \cdot c \dots (1)$$

$I_0(\lambda)$: incident light $I(\lambda)$: light passed through the chemical solution
 $\alpha(\lambda)$: proportionality coefficient L : measurement cell thickness
 c : the concentration of the chemical solution



When light is irradiated into the water and chemical solution, absorption occurs of a specific wavelength that is dependent on the structure and type of substance. This level of absorption is called absorbance and the absorbance $A(\lambda)$ of wavelength λ is expressed in (1), based on Lambert Beer's Law. It is now possible to perform quantitative analysis using the proportional relationship of concentration c and the absorbance $A(\lambda)$ to find the concentration. Separation of the components that use absorbance data is required in order for the multiple components of the mixed solution to equal the light absorption of individual components. The CS Series allows the user to conduct chemical solution separation for up to four components using multivariate chemometrics analysis technique.

SC-1 SC-2 SPM BHF

FPM HF / HNO₃ TMAH / H₂O₂

HF / EG H₂SO₄ / HF

HNO₃ / CH₃COOH / H₃PO₄

Refer to the chemical solution monitor list on pages 13 and 14 for information on other chemical solution monitor models.

HYDROFLUORIC ACID

HF Concentration Monitor

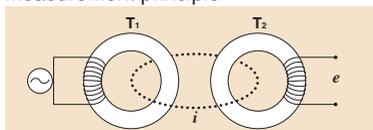
HF-960EM/CM-520

The HF-960EM is equipped with a sensor for which the wetted part is only made from PFA, so the model completely complies with the cleanliness requirement of semiconductor processes. The sensor size has been reduced as much as possible, making it possible to install the model in a small space for single wafer processing in semiconductor wet processes. The stability and repeatability have been improved compared to previous models. The HF-960EM can provide wide measurement ranges of up to HF50% and it also achieves the rather wide range of 0 to 2,000 mS/cm of conductivity. These traits make this model most appropriate for measuring concentrations in various applications, required for introduction into the development stage of semiconductor processes as well as electric conduction management of special chemical solutions.



Measurement sample: Hydrofluoric acid
Measurement method: Electromagnetic induction method
Measurement range:
 HF: 0 to 2/0 to 5/0 to 20/0 to 50%
 HCl: 0 to 5/0 to 10%
Repeatability: ±0.5% of full scale
Response time:
 90% response within 0.5 seconds
 Please consult HORIBA for measuring other chemicals than hydrofluoric acid.

Measurement principle



Two ring-core solenoids – excitation transformer T_1 and detection transformer T_2 – are molded inside the plastic shell of the sensor. When the sensor is immersed in the sample solution, the solution creates a closed circuit between the two solenoids. If a constant alternating current is then passed through the coil of solenoid T_1 , a constant magnetic field is generated in the core and a current, i , flows through the sample solution in accordance with the conductivity of the sample. A magnetic field is generated in solenoid T_2 in accordance with current i and an inductive electromotive force, e , (voltage) is proportional to the conductivity of the sample solution. Conductivity can be ascertained by measuring e . Conductivity calculated in this way shows extremely high correlation with hydrofluoric acid concentration. The hydrofluoric acid concentration is calculated using the known reference curve and then displayed.

Wide range of up to 50% HF concentration

The automatic range-setting function provides the most appropriate measurement performance at each target concentration from low to high concentration.

Compact size and lightweight sensors

The size has been reduced to two thirds (2/3) of the previous model and the weight has also been significantly reduced, allowing the HF-960EM to be placed more freely, for example, in front of the single wafer injection nozzle.

Contamination free and chemical resistant sensor

Uses sensors for which the wetted parts are only made of PFA. The chemical resistant sensors can be used to measure various chemical solutions used in semiconductor processes.

High stability and repeatability

The HF-960EM has a built-in sensor for measuring temperature, so it can measure HF samples up to 80°C, achieving a reproducibility accuracy of FS ± 0.5%.

Low Concentration HF/HCl/NH₃ Monitor*

HF-960M

With the evolution of 45 nm and 28 nm devices, RCA cleaning requires greater and greater low-concentration control. The HF-960M supports this need. It uses sensors that offer outstanding corrosion resistance for high-precision, high-speed measurement of low concentrations of hydrofluoric acid, hydrochloric acid and ammonia, and is thus perfect for single-bath and wafer cleaning.



Measurement method:
 Carbon flow-through conductivity measurement and concentration conversion
Cell constant: Approx. 4/cm
Temperature sensor specifications:
 Platinum resistance 1000°C/0°C 3850 ppm/°C
Measurement range:
 HF: 0 to 5000 ppm
 HCl: 0 to 5000 ppm
 NH₃: 0 to 5000 ppm
 Conductivity: 0 to 50.00/0 to 2.000 mS/cm
 Temperature: 0°C to 100°C
 (Selectable from one and two for the number of digits after the decimal point)

Repeatability: ±25 ppm
Linearity:
 Within ±0.5% of the full scale (in equivalent input)

◆ Other models can measure various ranges are available

| Model name | | Measurement range | Repeatability |
|-------------|-----------|-------------------|---------------|
| HF-960M-400 | HF | 0 to 5000 ppm | ±25 ppm |
| | | 0 to 10000 ppm | ±50 ppm |
| | | 0 to 15000 ppm | ±75 ppm |
| | | 0 to 20000 ppm | ±100 ppm |
| HF-960H | HF HCl | 0 - 10.00% | ±0.05% |

Highly precise measurements of low HF concentrations

The HF-960M provides highly precise measurement with ±25 ppm reproducibility. It supports control in the semiconductor etching process where the need for evermore detailed processing continues to increase. The 5000 ppm display resolution is equivalent to 0.5%. This ppm display is an answer to the demands for lower and lower concentrations.

Five types of measurements available: HF, HCl & NH₃ concentrations, conductivity, and temperature

Temperature compensation measurement is carried out for HF, HCl & NH₃ concentrations based on the data for each temperature characteristic. The HF-960M can even be used as a conductivity meter for low-concentration dilution control of other chemical solutions as well.

The analog output range can be arbitrarily specified between 0 and 400% of the measurement range

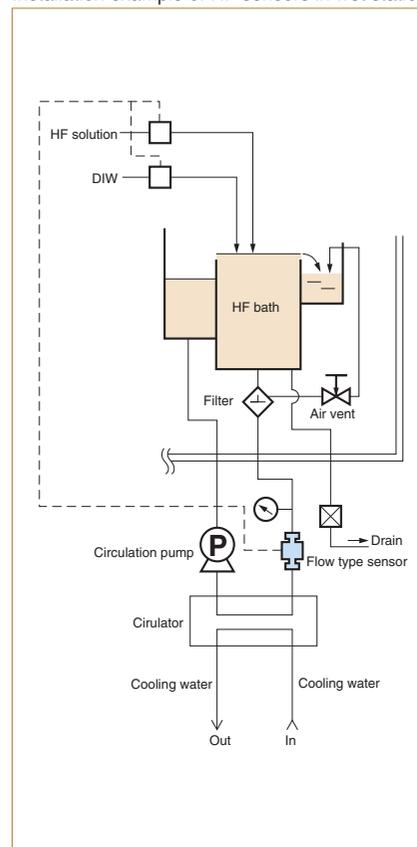
The HF-960M provides a diverse range of outputs; not only upper and lower concentration limits, but concentration errors outputs, and more

Three transmission output systems allowing the desired data to be assigned

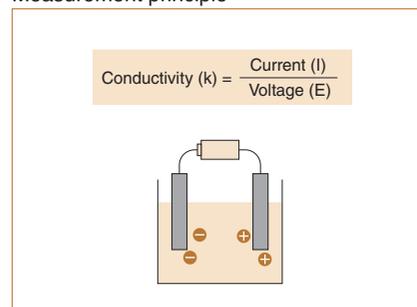
Communication device ability (RS-485)

RoHS compliant

Installation example of HF sensors in wet station

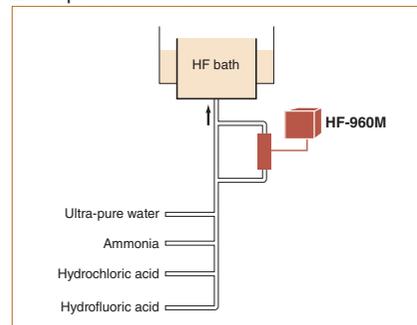


Measurement principle



The conductivity obtained for each hydrofluoric acid, hydrochloric acid and ammonia water at 25°C after the relevant temperature compensation is then converted to a concentration value. Corrosion-resistant glass carbon is used for the electrodes.

Example of installation



HF in DSP

Low Concentration HF Monitor in Diluted Sulfuric Acid/ Hydrogen Peroxide*

HF-700

The HF-700 provides continuous and precise measurement of the low hydrofluoric concentration in the solution of diluted sulfuric acid, hydrogen peroxide and hydrofluoric acid that is used effectively in the removal of the polymer residue following the etching process.

Stable and continuous measurement

Continuous and precise measurement of the fluoride ion (ionized hydrofluoric acid) is achieved using automatic neutralizing function to neutralize the sample water continuously.

Multiple measurement modes to fit the application

The standard mode that gives priority to the response speed (NORMAL) and a reagent-saving mode that saves on reagent consumption (ECO) can be selected. In addition, the user can select a continuous measurement mode that measures concentrations and an intermittent measurement mode.

Built-in automatic calibration function

Calibration is done automatically with an external input signal.

Easy operation with a touch panel

The HF-700 adopts a graphical LCD touch panel screen. The easy-to-read and interactive display improves operation.



Measurement method: Fluoride ion electrode method

Measurement range: 0 to 1000 mg/L

Number of transmission output: 3

Number of contact output: 18

Number of contact input: 8

Communication function: RS-232C

Sample condition:

Sulfuric acid concentration: 2 to 15 wt%

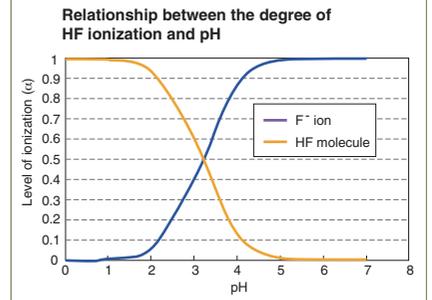
Peroxide concentration: 0 to 20 wt%

Temperature: 10 to 35°C

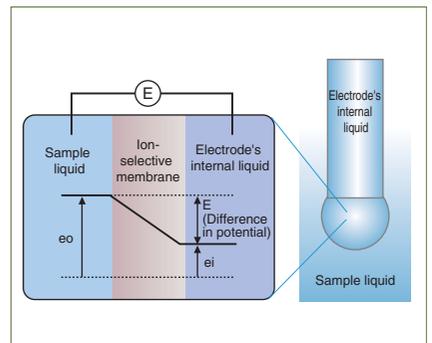
Flow rate: 20 to 200 ml/min

Pressure: 0.05 to 0.1 Mpa

Measurement principle

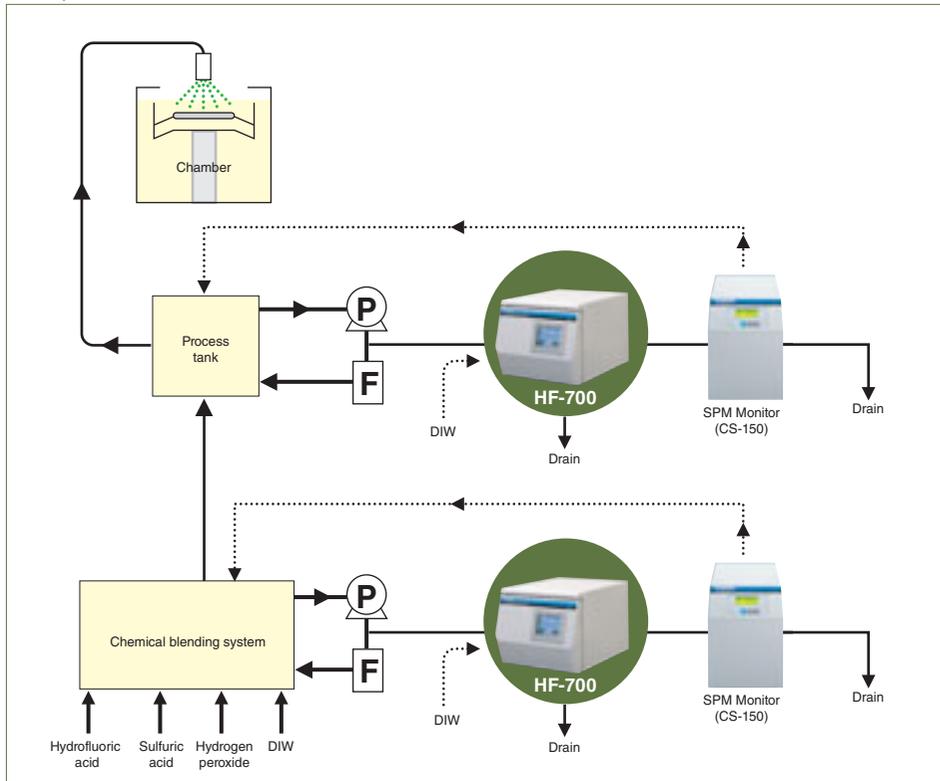


HF in an acid state goes no ionization. However, once it approaches a neutral state, the molecules are ionized and, at around pH 7, become almost 100% F⁻ ions. The F⁻ ion is measured with a fluoride ion electrode.



Based on the measurement of difference in potential generated by the ion concentration difference on either side of the ion-selective membrane. The difference in potential is measured on the basis of the comparison electrode immersed simultaneously in the sample liquid.

Example of installation

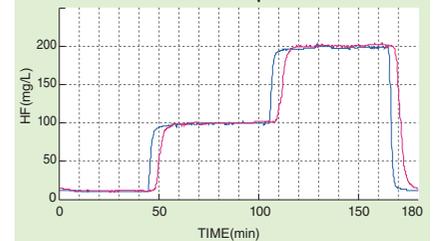


Response time comparison (NORMAL/ECO)

H₂SO₄: 10 wt%
H₂O₂: 2 wt%
HF: 10-100-200 ppm

— NORMAL : Response speed priority measurement mode
— ECO : Reagent consumption saving priority measurement mode

HF-700 Response data



TMAH

TMAH Concentration Monitor*

HE-960H-TM Series

The HE-960H-TM Series offers high precision measurement of the conductivity of TMAH solutions, the main component of the photo resist developer, that is used in semiconductor and liquid crystal processes. It also comes equipped with a 4-electrode, highly chemical resistant FES-510 Series (dedicated sensor) to offer a wide range of measurements.

- Automatic decimal point adjustment enables a wide range of TMAH measurement, from 0.000 to 10.00%
- Automatic range switching from high to low concentrations
- Enables three type of measurements: TMAH concentration, conductivity, and temperature
- Chemical resistant four-electrode glassy carbon sensor
- 4-channel transmission output
- 24 V DC power supply
- RoHS compliant



Measurement method:
Electrode method (4-electrode method)

Cell constant: 1.0/cm

Measurement range/repeatability:

| Model name | Measurement range | Repeatability |
|--------------|-------------------|---------------|
| HF-960H-TM | 0.000 - 10.00% | ±0.05% |
| HF-960H-TM-S | 0.000 - 3.000% | ±0.003% |

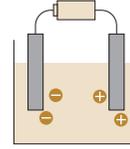
Conductivity: 0 to 100 mS/cm (measurement range without temperature conversion)
Temperature: 0 to 100°C (the number of decimal place displayed can be select at 1 or 2)

Linearity:

Within ±0.5% of full scale (in equivalent input)

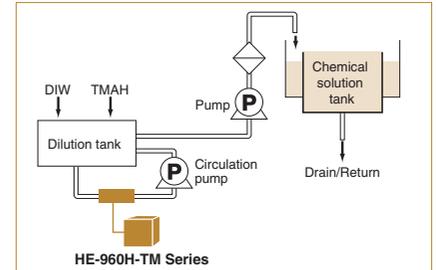
Measurement principle

$$\text{Conductivity (k)} = \frac{\text{Current (I)}}{\text{Voltage (E)}}$$



Combined with the 4-polar electric conductivity sensor, the conductivity of the 25°C TMAH is output using a method for measuring the current that flows when the applied voltage undergoes amplitude control to stabilize the detected voltage.

Example of installation



OZONE/H₂O₂

Dissolved Ozone Monitor*

HZ-960

From the perspective of reducing costs and reducing the burden on the environment through chemical-less processes, the use of ozonated water is expected to be more and more effective. It monitors processes using a detector that can accurately monitor ozonated water in-situ at both high and low concentrations.

- Also available HZ-96i-HPO for H₂O₂ 0-5.000%
- Select between 2 types of detectors

Select from 2 types of detectors: sampling and in-line. The available detectors have pipe diameters of 1 inch, 3/4 inch, 1/2 inch and 1/4 inch. Selectable to fit the application and equipment environment.

- Wide measurement range

Starting with standard specifications in the 0 to 100 mg/L range, the HZ-960 offers 4 different measurement ranges, enabling control from low to high concentrations in accordance with the purpose of use. (in-line type)

- High precision measurement

With zero point change stability within ±0.05% FS/day and reproducibility within ±0.2% FS/day, the HZ-960 makes it possible to maintain stabilized ozone water processes. (in-line type)

- Remote input and diverse output

- Easy-to-understand icon display for indicating instrument status

- Preventive of measurement errors and inadvertent operation with superior security functions

- CE Marking compliant

- RoHS compliant



Measurement method: UV absorption (254 nm)

Measurement range:

ZH-10: 0 to 10 mg/L (Indicator resolution: 0.01 mg/L)
ZH-40: 0 to 40 mg/L (Indicator resolution: 0.01 mg/L)
ZH-100: 0 to 100 mg/L (Indicator resolution: 0.1 mg/L)
ZH-500: 0 to 500 mg/L (Indicator resolution: 0.1 mg/L)

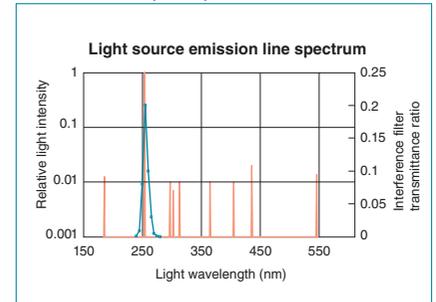
Repeatability:

Within ±0.2% of full scale

Stability:

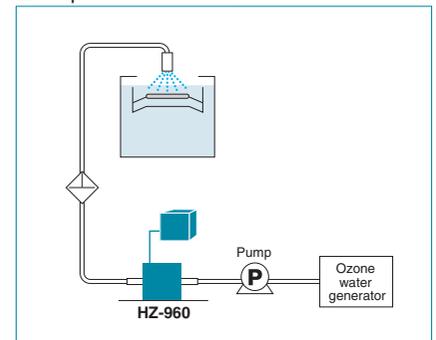
Within ±0.5% of full scale/day
(in equivalent zero point drift)

Measurement principle



With the absorbance of 253.7 nm emission line from the low-pressure mercury lamp, concentration is converted to be output. There are 5 kinds of detectors available for different cell lengths according to concentration range.

Example of installation



* Products of HORIBA Advanced Techno, Co., Ltd.

CONDUCTIVITY

Conductivity Meter* (High concentration type)

HE-960HC

The HE-960HC features a measurement range that is five times greater than existing systems, enabling it to measure the conductivity of a wide variety of chemicals. The sensor is a glassy carbon electrode that is highly resistant to chemicals. This allows the system to perform in-line measurements in high-stress environments. The concentration conversion feature makes it possible to operate the system in % display mode.

- **Wide range compatibility**
- **Concentration conversion function**
(e.g. H₂SO₄, H₃PO₄, KOH, NaOH, etc.)
- **Equipped with a variety of control features, including transmission output (4 points), contact output (5 points) and contact input (1 point)**
- **Uses a chemical-resistant glassy carbon sensor (four-electrode type)**
- **in-line system can accommodate a wide range of applications, from small to large flow rate conditions**
- **RoHS compliant**



Measurement method: 4-electrode method

Temperature sensor specifications:

Platinum resistance 1000°C/0°C
Coefficient 3850 ppm/°C standard

Measurement range:

Cell constant: 1.0/cm
Conductivity: 0 to 1000 mS/cm
Temperature: 0 to 100°C

Repeatability:

Within ±0.5% of full scale
Within ±1.0% of full scale at 200 to 100 mS/cm

Linearity:

Within ±0.5% of full scale
Within ±1.0% of full scale at 200 to 100 mS/cm

Conductivity Meter* (Low concentration type)

HE-480C-GC

The length of the sensor has been reduced by 50% as compared to existing systems to reduce space requirements. At the same time, the measurement range has been increased tenfold, enabling the system to measure even samples with comparatively high concentrations. Two different types of chemical-resistant glassy carbon sensors can be used, making the system ideal for chemical dilution/recovery management and pure water recycling as well.

- **Designed especially for low- and medium-range conductivity measurements**
- **Compact unit design**
- **High pressure and chemical resistance**
- **Direct contact sensor design (ESH-1L-GC9 series)**
- **RoHS compliant**



Measurement method: 2-electrode method

Temperature sensor specifications:

Platinum resistance 1000°C/0°C
Coefficient 3850 ppm/°C standard

Measurement range:

Cell constant: 0.1/cm
Conductivity: 0 to 9999 µS/cm
Temperature: 0 to 100°C

Repeatability:

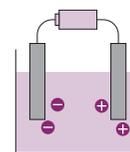
Differs depending on specifications.
Contact a HORIBA customer service representative for more information.

Linearity:

Differs depending on specifications.
Contact a HORIBA customer service representative for more information.

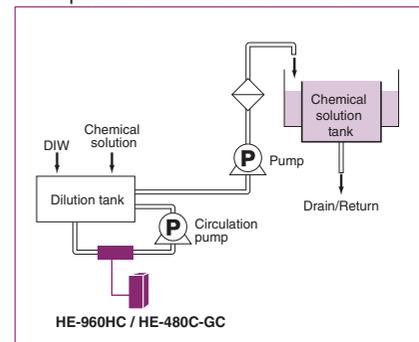
Measurement principle HE-960HC / HE-480C-GC

$$\text{Conductivity (k)} = \frac{\text{Current (I)}}{\text{Voltage (E)}}$$



This is a method using the alternate current 2-polar electric conductivity sensor for measuring the current that flows when the applied voltage undergoes amplitude control to stabilize the detected voltage.

Example of installation HE-960HC / HE-480C-GC



RESISTIVITY

Carbon Sensor Resistivity Meter*

HE-960R-GC

The HE-960R-GC is a resistivity meter to use glassy carbon for its sensor. A glassy carbon sensor is not contaminated by metal elution and is chemically resistant to wet cleaning solutions such as hydrofluoric acid and hydrogen peroxide. The glassy carbon surface of its sensor is specially processed so that particle elution is also kept extremely small. It is especially effective for resistivity measurements in the rinse process of single-bath cleaning systems and it enables high quality control in the cleaning process.

- Superior chemical resistance allows for high quality control in single-bath cleaning
- Excellent high-speed response
- Selectable temperature compensation function
- Easy-to-understand icon display and superior security function
- 24 V DC power source
- CE Marking compliant
- RoHS compliant

2-channel Resistivity Meter*

HE-960RW-GC

The converter employs two independent built-in circuits that can be connected with two sensors allowing simultaneous measurement and simultaneous output of the resistivity of 2 different locations. Two transmission output systems are built-in. It is possible to assign the desired data from among two channels. High performance with an accuracy within $\pm 0.2^\circ\text{C}$ in temperature compensation can be obtained.

- Simultaneous measurement and simultaneous output of the resistivity of 2 different locations for a cost efficient performance
- Chemically resistant glassy carbon sensor
- Easy-to-understand icon display and superior security function
- 24 V DC power source
- CE Marking compliant
- RoHS compliant

Resistivity Meter*

HE-480R

The HE-480R's onboard microprocessor calculates the temperature compensation coefficient based on the temperature characteristics of the ultra-pure water and automatically converts it to 25°C resistivity and precisely measures ultra-pure water during the process. This allows for highly precise temperature compensation in the range of 0 to 100°C . The HE-480R provides support for the close monitoring of ultra-pure water that is essential as part of the final process for cleaning silicon wafers.

- Perfect for monitoring resistivity of ultra-pure water in the final rinsing process
- Selectable temperature compensation function
- Selectable setting for standard temperature
- Simultaneous display of measured and set parameter values
- Easy-to-understand icon display and superior security function
- CE Marking compliant
- RoHS compliant



Measurement method: 2-electrode method
Sensor input: 1-channel
Cell constant: Approx. 0.1/cm
Temperature sensor specifications:
 Platinum resistance $1000 \Omega / 0^\circ\text{C}$
 Temperature coefficient $3850 \text{ ppm}/^\circ\text{C}$ standard
Measurement range:
 Measurement unit:
 0 to 2.00, 0 to 20.00, 0 to 200.0, 0 to $1000^* \text{ k}\Omega\text{-m}$
 0 to 0.200, 0 to 2.00, 0 to 20.00, 0 to $100.0^* \text{ M}\Omega\text{-cm}$
 *: Measurable without temperature compensation
 Temperature: 0 to 100°C
 (Select your desired decimal point from 0, 1, and 2 digits)
Repeatability:
 Within $\pm 0.5\%$ of full scale (in equivalent input)
Linearity:
 Within $\pm 0.5\%$ of full scale (in equivalent input)



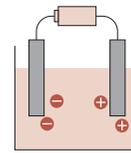
Measurement method:
 Electrode method (2-electrode method)
Temperature compensation element:
 Platinum resistance $1000 \Omega / 0^\circ\text{C}$
 Temperature coefficient $3750 \text{ ppm}/^\circ\text{C}$ standard
Measurement range:
 Resistivity: 0 to 0.200, 0 to 2.00, 0 to 20.00 $\text{M}\Omega\text{-cm}$
 (0 to 2.00, 0 to 20.00, 0 to 200.00 $\text{k}\Omega\text{-m}$)
 Temperature: 0 to 100°C
Repeatability:
 Within $\pm 0.5\%$ of full scale (in equivalent input)
Linearity:
 Within $\pm 0.5\%$ of full scale (in equivalent input)



Measurement method: 2-electrode method
Temperature sensor specifications:
 Platinum resistance $1000 \Omega / 0^\circ\text{C}$
 Temperature coefficient $3850 \text{ ppm}/^\circ\text{C}$ standard
Measurement range:
 Resistivity: 0 to 2.00, 0 to 20.0, 0 to 200.0, 0 to $1000^* \text{ k}\Omega\text{-m}$
 0 to 0.200, 0 to 2.00, 0 to 20.00, 0 to $100.0^* \text{ M}\Omega\text{-cm}$
 *: Measurable without temperature compensation
 Temperature: 0 to 100°C
 (Select your desired decimal point from 0, 1, and 2 digits)
Repeatability:
 Within $\pm 0.5\%$ of full scale (in equivalent input)
Linearity:
 Within $\pm 0.5\%$ of full scale (in equivalent input)

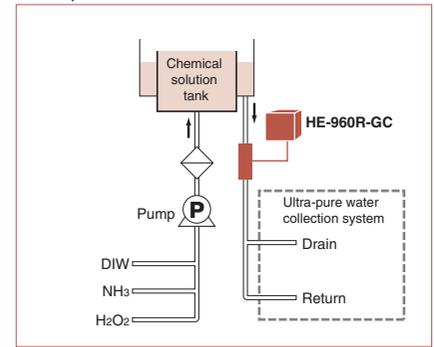
Measurement principle

$$\text{Resistance (R)} = \frac{\text{Voltage (I)}}{\text{Current (E)}}$$



Applying alternate current voltage to the electrodes and reference resistor, the distribution voltage is measured and the solution resistance is measured. The cell constant and the revised purified water temperature compensation are added and then the 25°C resistivity is output. The superior, chemically resistant, glass carbon electrodes are available with the chemical solution rinse monitor.

Example of installation HE-960R-GC



* Products of HORIBA Advanced Techno, Co., Ltd.

ULTRA-PURE WATER

Silica Monitor*

SLIA-300

The SLIA-300 High Sensitivity Silica Monitor perfectly meets the need for measurement below 1 µg/L (1 ppb) in ultra-pure water silica concentrations. It employs newly-developed, unique cell technology, allowing high sensitivity for handling measurements at low concentrations.

- High sensitivity in a compact body for silica analysis of ultra-pure water
- Reagent consumption reduced by 80%
- Up to 6-point measurement possible (option)
- Automatic calibration allows for superior maintainability
- Reliable light source eliminating need for replacement



Measurement method: Molybdenum blue method
Measurement range: 0 to 2/0 to 20 µg/L or 0 to 5/0 to 50 µg/L (specified when ordering)
Repeatability: ±2% of full scale
Measurement time: 5 minutes
Measurement cycle: 5 to 995 minutes
Indication: Measuring value: 3.5 digits, 7-segment LCD
 Guidance: 16 characters x 4 lines, dot matrix LCD
Measurement point: 1 to 6 points (specified when ordering)
Calibration: Standard calibration solution (from factory)

Silica Analyzer

SLIA-2000

The SLIA-2000 brings about high-speed, highly repeatable measurement results through improved analysis area cell construction, reagent pump, sampling flow and the standardization of the 10 µg/L range for ultra-pure water.

- HORIBA's achievements and technical knowledge keep silica analysis on the cutting edge
- Five-minute measuring with repeatability of ±2% of full scale
- Automatic switching of measuring cycle
- JIS reagent compliant
- Automatic calibration for superior maintainability
- Automatic switching of redundant line



Measurement method: Molybdenum blue method
Reagents: A: Sulfuric acid ammonium molybdate
 B: Oxalic acid
 C: Ascorbic acid
Light source: LED
Detector: Silicon photo diode
Measurement range: Dual range. Specify when ordering.
 0 to 10/100 µg/L
 0 to 50/500 µg/L
 0 to 100/1000 µg/L
 0 to 200/2000 µg/L
 0 to 0.50/5.00 µg/L
Measurement points: 1 to 4 points. Specify when ordering.
Repeatability: ±2% of full scale

Dissolved Oxygen Monitor*

SD-300

The portable and conveniently designed SD-300 provides precise measurements of DO concentrations in ultra-pure water.

- Portable and highly sensitive, perfect for ultra-pure water quality control
- Flat panel design for use in clean rooms
- Durable internal liquid replacement sensor
- Standard-feature analog/serial output



Measurement object: Dissolved oxygen
Measurement method: Membrane polarography
Measurement range: 0 to 20 µg/L, 0 to 200 µg/L, 0 to 2 mg/L, 0 to 20 mg/L
Response time: 90% response within 30 seconds (at 20°C or more)
Repeatability: ±1% of full scale
Temperature compensation: 5 to 50°C

For Ultra-pure Water Resistivity Meter*

HE-960RW

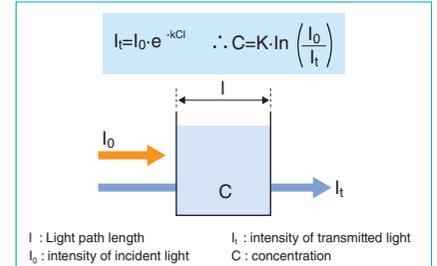
The HE-960W utilizes high precision, high stability temperature measurement circuit and a vastly improved temperature compensation function that is an important element for measuring the resistivity of ultra-pure water.

- Highly precise, highly stable temperature compensation function
- Fifty meters extension possible for sensor cables
- High temperature response of resistivity sensor
- Flexible analog transmission output
- Two-channel simultaneous measurement
- Four contact alarms
- Communication device ability (RS-485)



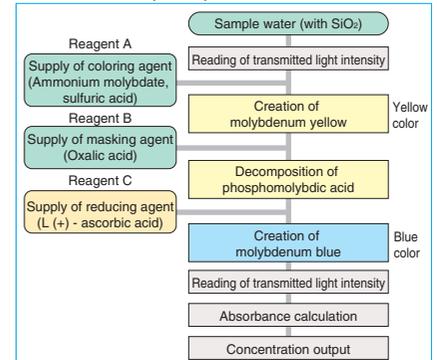
Measurement method: 2-electrode method
Sensor input: 2-channel (for concurrent measurement with sensor isolated each other)
Cell constant: Approx. 0.01/cm
Temperature sensor specifications: Platinum resistance 1000 Ω/0°C
 Temperature coefficient 3850 ppm/°C standard
Measurement range: Resistivity: 0 to 2.00, 0 to 20.00, 0 to 1000.0* MΩ·cm
 0 to 20.00, 0 to 200.0, 0 to 1000* kΩ·m
 *: Measurable without temperature compensation
 Temperature: 0 to 100°C
 (Select your desired decimal point from 0, 1, and 2 digits)
 Desalination rate: 0% to 100%
Repeatability: Within ±0.1% of full scale (in equivalent input)
Linearity: Within ±0.5% of full scale (in equivalent input)

Measurement principle SLIA-300



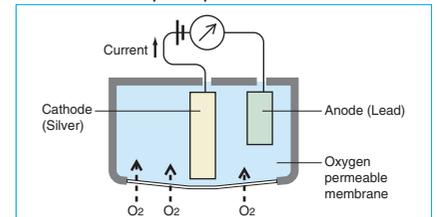
A molybdenum blue solution that responds to silica concentrations is fed to a long pathlength fiber cell. The absorption of near-infrared light (approximately 830 nm) is converted to silica concentration.

Measurement principle SLIA-2000



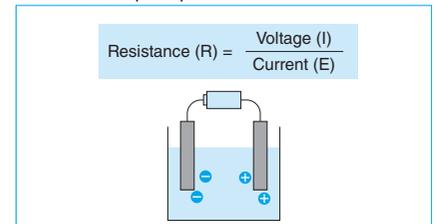
The temperature of sample water fed into the unit is first stabilized before going to the measurement cell so that a stable coloring is obtained. Inside the cell, a solution of sulfuric acid and ammonium molybdate is added in order to produce a greenish yellow color (molybdate yellow). To mask the effect of phosphoric acid, oxalic acid is added. Reduction is then induced using ascorbic acid in order to produce molybdenum blue. The concentration of silica in the sample water is obtained by measuring the absorbance of this blue color (approximately 830 nm).

Measurement principle SD-300



The dissolved oxygen concentration in the water is measured using the membrane polarographic method. The oxygen that permeates the membrane comes into contact with the cathode, and reduction occurs producing the hydroxide ion. Simultaneously, the oxygen surrounding the anode becomes oxidized. When this occurs, current is generated and is measured. The membrane permeability and the temperature dependence of the saturated-dissolved oxygen concentration is corrected and then converted to the dissolved oxygen concentration.

Measurement principle HE-960RW



Applying alternate current voltage to the electrodes and reference resistor, the distributed voltage is measured and the solution resistance is measured. The cell constant and the revised purified water temperature compensation are added and then the 25°C resistivity is output. The HE-960RW is an ultra-pure water resistivity meter with a 2-channel simultaneous measuring circuit and high precision temperature compensation.

CHEMICAL SOLUTION CONCENTRATION MONITORS

| PROCESS | CHEMICAL | Model | Measurement Range (%) | | | | | |
|---------------------|--|--------------------------------------|---------------------------------|--------------------------------------|---------------------------|--------------------------------------|-------------------------------------|-----------------------------------|
| Particle removal | SC-1 (APM) | CS-131 * | NH ₃ 0-1 | H ₂ O ₂ 0-1 | H ₂ O 98-100 | | | |
| | | | 0-1 | 0-5 | 94-100 | | | |
| | | | 0-3 | 0-7 | 90-100 | | | |
| | | | 0-0.3 | 0.5-1 | 98.7-99.5 | | | |
| | | | 0.2-0.8 | 0.2-0.8 | 98.4-99.6 | | | |
| | | | 0-5 | 0-10 | 85-100 | | | |
| Particle removal | Alkali / H ₂ O ₂ | CS-151 | NH ₃ 0-0.3 | H ₂ O ₂ 0-0.3 | H ₂ O 99.4-100 | | | |
| | | | 0.5-1.5 | 0-0.5 | 98-98.5 | | | |
| | | | Particle removal | TMAH / H ₂ O ₂ | CS-121F1 | NH ₃ 0-0.1 | H ₂ O ₂ 0-0.1 | H ₂ O 0-99.8 |
| | | | | | | CS-159B | Alkali 0-0.5 | H ₂ O ₂ 0-3 |
| | | | Particle removal | TMAH / H ₂ O ₂ | CS-139E | TMAH 0-0.5 | H ₂ O ₂ 0-2 | H ₂ O 97.5-100 |
| | | | | | | CS-152 | HCl 0-2 | H ₂ O ₂ 0-2 |
| Metallic removal | SC-2 (HPM) | CS-152 | 0-10 | 0-10 | 80-100 | | | |
| | | | 0-15 | 0-5 | 80-100 | | | |
| | | | Post RCA | AM-1 | CS-131 | Shown above * | | |
| Post RCA | MC-1 / MC-1-SP | CS-131 | CS-131 | Shown above * | | | | |
| | | | Reps-203 | CS-131 | Shown above * | | | |
| | | | Organic removal | SC-1 (APM) | CS-131 | CS-131 | Shown above * | |
| Organic removal | Alkali / H ₂ O ₂ | CS-159B | | | | Alkali 0-0.5 | H ₂ O ₂ 0-3 | H ₂ O 96.5-100 |
| | | | | | | CS-139E | TMAH 0-0.5 | H ₂ O ₂ 0-2 |
| Organic removal | SPM | CS-150 ** | | | | H ₂ SO ₄ 0-1 | H ₂ O ₂ 0-1 | H ₂ O 98-100 |
| | | | | | | 0-10 | 0-10 | 80-100 |
| | | | | | | 10-20 | 20-30 | 50-70 |
| | | | | | | 30-60 | 10-20 | 20-60 |
| | | | | | | 50-90 | 0-10 | 8-50 |
| | | | | | | 70-96 | 0-5 | 4-30 |
| | | | | | | 90-98 | 0-1 | 2-10 |
| Organic removal | HCl | CS-152S | HCl 0-5 | | H ₂ O 95-100 | | | |
| | | | 0-15 | | 85-100 | | | |
| Organic removal | H ₂ O ₂ | HE-960M | HCl 0-0.5 | | | | | |
| | | | CS-152H | H ₂ O ₂ 0-10 | | H ₂ O 90-100 | | |
| | | | | 0-30 | | 70-100 | | |
| Organic removal | O ₃ | HZ-960 | O ₃ 0-0.01/0.02/0.04 | | | | | |
| | | | Polysilicon etching | NH ₃ | HF-960M | NH ₃ 0-0.5 | | |
| CS-131S | NH ₃ 0-0.2 | | | | | | | |
| | H ₂ O 99.8-100 | | | | | | | |
| | 0-1 | | | | | | | |
| | 99-100 | | | | | | | |
| Polysilicon etching | NH ₃ | CS-131S | 0-5 | | | | | |
| | | | 95-100 | | | | | |
| | | | 0-29 | | | | | |
| Polysilicon etching | NH ₃ | CS-131S | 71-100 | | | | | |
| | | | Resist removal | SPM | CS-150 | Shown above ** | | |
| Resist removal | CLK-888 | CS-139K | | | | XXXX 0.5-2 | H ₂ O ₂ 1-5 | Others 93-99 |
| | | | BSG removal | H ₂ SO ₄ / HF | CS-133V | H ₂ SO ₄ 83-93 | HF 0-5 | H ₂ O 2-17 |
| 80-96 | 1-5 | 4-19 | | | | | | |
| HF 0.5-1.5 | H ₂ O 2-4.5 | H ₂ SO ₄ 94-98 | | | | | | |

| PROCESS | CHEMICAL | Model | Measurement Range (%) | | | |
|------------------|---|----------------|------------------------|---------------------------------------|--------------------------------------|---------------------------|
| Oxide removal | BHF | ● CS-137 | NH ₄ F 0-10 | HF 0-3 | H ₂ O 87-100 | |
| | | | 4-5 | 0.5-1.5 | 93.5-95.5 | |
| | | | 15-21 | 0-3 | 76-85 | |
| | | | 15-25 | 0-3 | 72-85 | |
| | | | 16-18 | 0-0.5 | 81.5-84 | |
| | | | 19-21 | 4-6 | 73-77 | |
| | | | 19-21 | 5-8 | 71-76 | |
| | | | 25-30 | 0-1 | 69-75 | |
| | | | 29-31 | 5-7 | 62-66 | |
| | | | 32-34 | 3-5 | 61-65 | |
| | | | 35-38 | 3-5 | 57-62 | |
| | | | 37-39 | 1-3 | 58-62 | |
| | | | | 39-40 | 0-0.5 | 59.5-61 |
| | FPM | ● CS-153 | HF 0-0.5 | H ₂ O ₂ 0-9 | H ₂ O 90.5-100 | |
| | | | 0-1.5 | 0-1 | 97.5-100 | |
| | | | 0-10 | 0-10 | 80-100 | |
| | DHF | ● CS-133U-O2P2 | HF 0-2 | H ₂ SiF ₆ 0-0.2 | H ₂ O 97.8-100 | |
| | | | ● CS-133U-1002 | HF 0-10 | H ₂ SiF ₆ 0-2 | H ₂ O 88-100 |
| | | | ● CM-210 | HF 0-1/2/5/10/20/50 | | |
| | | | ● HF-960H | HF 0-10 | | |
| | | | ● HF-960M | HF 0-0.1/0.5/2 | | |
| Oxide/Ni etching | HF/Ethylene glycol | ● CS-138 | HF 0-5 | H ₂ O 0-10 | EG 85-100 | |
| | | | 5-10 | 7-12 | 78-88 | |
| | | ● CS-138W | HF 0-5 | EG 85-100 | H ₂ O 0-10 | |
| | | | 0-5 | 0-10 | 85-100 | |
| Al etching | HNO ₃ /CH ₃ COOH/H ₃ PO ₄ | ● CS-139J | HNO ₃ 0-5 | CH ₃ COOH 0-3 | H ₃ PO ₄ 65-75 | |
| | | | 1-3 | 8-12 | 70-75 | |
| | | | 1.5-5.5 | 9-11 | 65-75 | |
| | | | 4-6 | 8-10 | 65-70 | |
| | | | 4-7 | 7.5-10.5 | 69-75 | |
| | | | 8-13 | 8-13 | 60-65 | |
| Polymer removal | HNO ₃ /HF | ● CS-153N | HNO ₃ 60-70 | HF 0-5 | H ₂ O 25-45 | |
| | | | 50-60 | 5-10 | 30-45 | |
| | | | 57-65 | 3-8 | 27-40 | |
| | | | 69-70 | 0-0.5 | 29.5-31 | |
| | | | 68.5-70 | 0-1 | 29-31 | |
| | H ₂ O/Amine | ● CS-135B | H ₂ O 26-50 | A.B.F 3-10 | AMINE 45-71 | |
| | | | ● CS-135D | H ₂ O 10-30 | Others 70-90 | |
| | EF-1 | ● CS-135E | | HF 0-0.2 | H ₃ PO ₄ 0.2-5 | Others 94.8-99.8 |
| | | | ● CS-139R | ALKALI 2-3 | H ₂ O ₂ 0-3 | Others 94-98 |
| Low-K etching | LK-1 | ● CS-135A | | H ₂ O 90-100 | XXX 0-10 | |
| | | | ● CS-152N | HNO ₃ 5-12 | HCl 15-25 | H ₂ O 63-80 |
| | | 8-10 | | 17-21 | 69-75 | |
| Others | HF/HCl | ● CS-133A-12 | HF 0-1 | HCl 0-2 | H ₂ O 97-100 | |
| | | | ● CS-133A-15 | HF 0-1 | HCl 0-5 | H ₂ O 94-100-2 |
| | | | ● CS-133A-55 | HF 0-5 | HCl 0-5 | H ₂ O 90-100-2 |
| | TMAH | ● CS-139ES | TMAH 0-25 | H ₂ O 75-100 | | |
| | | | ● HE-960H-TM | TMAH 0-10 | | |

Notes: ● Please contact HORIBA as to the details of the specifications of each model as well as regarding the possible chemicals and ranges to be measured.
 ● Fiber type models are also available for all models in the above list.

Our worldwide service network ensures speedy support, when and where you need it.

U.K.

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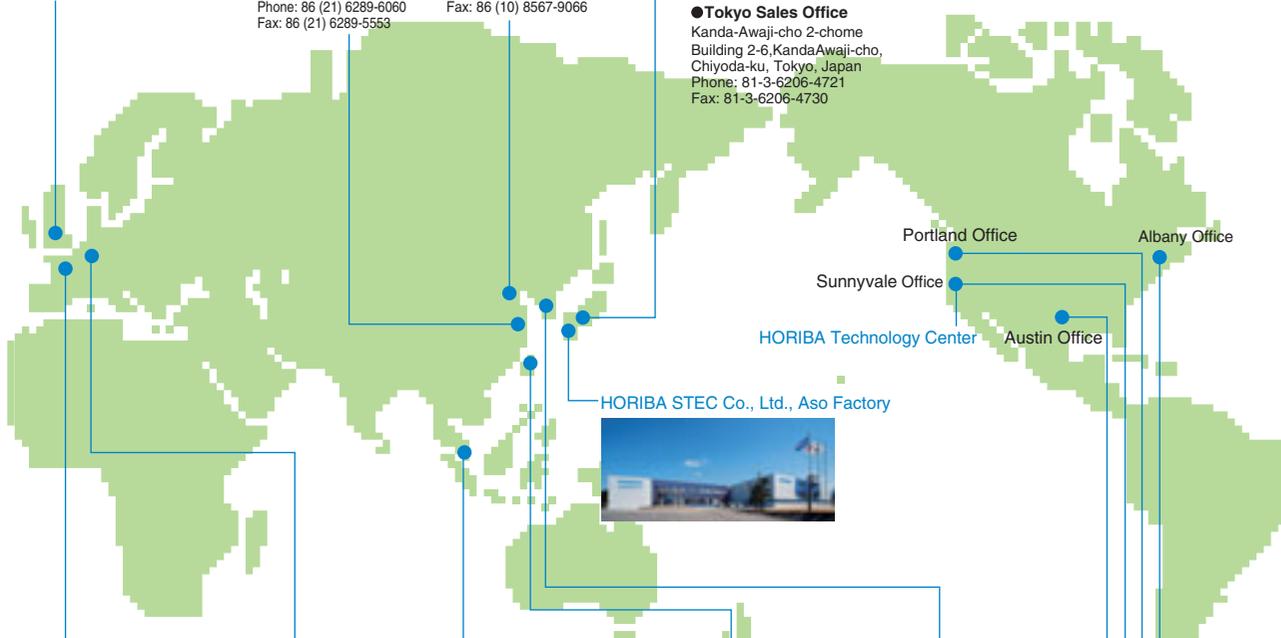


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