User's Manual

Model FC500G Free Available Chlorine Analyzer

(Non-Reagent Type) [Style: S2]

IM 12F5A2-01E

YOKOGAWA
Yokogawa Electric Corporation

IM 12F5A2-01E
7th Edition

◆ Introduction

This user's manual describes the specifications, installation, operation, maintenance, and troubleshooting for Model FC500G Free Available Chlorine Analyzer. Read this manual thoroughly to understand the contents before operating the equipment.

■ Notes on Hardware

● Appearance and Accessories

Check the following when you receive the product:

- Appearance
- Standard accessories

Contact our sales representative or your local distributor if the product's coating has come off, it has been damaged, or there is shortage of required accessories.

● Model and Suffix Codes

The name plate on the product contains the model and suffix codes. Compare them with those in the general specification to make sure the product is the correct one. If you have any questions, contact our sales representative or your local distributor.

Media No. IM 12F5A2-01E 7th Edition : Feb. 2020 (YK)

◆ Safety Precautions

■ Safety, Protection, and Modification of the Product

- In order to protect the system controlled by the product and the product itself and ensure safe operation, observe the safety precautions described in this user's manual. We assume no liability for safety if users fail to observe these instructions when operating the product.
- If this instrument is used in a manner not specified in this user's manual, the protection provided by this instrument may be impaired.
- Be sure to use the spare parts approved by Yokogawa Electric Corporation (hereafter simply referred to as YOKOGAWA) when replacing parts or consumables.
- Modification of the product is strictly prohibited.

■ Signal Words

The following words are used in this manual.

CAUTION

This symbol gives information essential for understanding the operations and functions.

NOTE

This symbol indicates information that complements the present topic.

■ Notes on Handling User's Manuals

- Please hand over the user's manuals to your end users so that they can keep the user's manuals on hand for convenient reference.
- Please read the information thoroughly before using the product.
- The purpose of these user's manuals is not to warrant that the product is well suited to any particular purpose but rather to describe the functional details of the product.
- No part of the user's manuals may be transferred or reproduced without prior written consent from YOKOGAWA.
- YOKOGAWA reserves the right to make improvements in the user's manuals and product at any time, without notice or obligation.
- If you have any questions, or you find mistakes or omissions in the user's manuals, please contact our sales representative or your local distributor.

■ Warning and Disclaimer

The product is provided on an "as is" basis. YOKOGAWA shall have neither liability nor responsibility to any person or entity with respect to any direct or indirect loss or damage arising from using the product or any defect of the product that YOKOGAWA can not predict in advance.

■ Trademark Acknowledgments

- EXA FC is a trademark of Yokogawa Electric Corporation.
- All other company and product names mentioned in this user's manual are trademarks or registered trademarks of their respective companies.
- We do not use TM or ® mark to indicate those trademarks or registered trademarks in this user's manual.

After-sales Warranty

- **Do not modify the product.**

- **During the warranty period, for repair under warranty consult the local sales representative or service office. Yokogawa will replace or repair any damaged parts. Before consulting for repair under warranty, provide us with the model name and serial number and a description of the problem. Any diagrams or data explaining the problem would also be appreciated.**
  - If we replace the product with a new one, we won't provide you with a repair report.
  - Yokogawa warrants the product for the period stated in the pre-purchase quotation Yokogawa shall conduct defined warranty service based on its standard. When the customer site is located outside of the service area, a fee for dispatching the maintenance engineer will be charged to the customer.

- **In the following cases, customer will be charged repair fee regardless of warranty period.**
  - Failure of components which are out of scope of warranty stated in instruction manual.
  - Failure caused by usage of software, hardware or auxiliary equipment, which Yokogawa Electric did not supply.
  - Failure due to improper or insufficient maintenance by user.
  - Failure due to modification, misuse or outside-of-specifications operation which Yokogawa does not authorize.
  - Failure due to power supply (voltage, frequency) being outside specifications or abnormal.
  - Failure caused by any usage out of scope of recommended usage.
  - Any damage from fire, earthquake, storms and floods, lightning, disturbances, riots, warfare, radiation and other natural changes.

- **Yokogawa does not warrant conformance with the specific application at the user site. Yokogawa will not bear direct/indirect responsibility for damage due to a specific application.**

- **Yokogawa Electric will not bear responsibility when the user configures the product into systems or resells the product.**

- **Maintenance service and supplying repair parts will be covered for five years after the production ends. For repair for this product, please contact the nearest sales office described in this instruction manual.**

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Free Available Chlorine Analyzer
(Non-Reagent Type)
[Style: S2]

IM 12F5A2-01E 7th Edition

CONTENTS

1. OVERVIEW

Model FC500G Free Available Chlorine Analyzer (Non-Reagent Type) is used for continuous measurement of free available chlorine in tap water distribution. This analyzer consists of a detector and a converter as shown in Figure 1.1.

This chapter describes the FC500G free available chlorine analyzer specifications and its measuring principle.

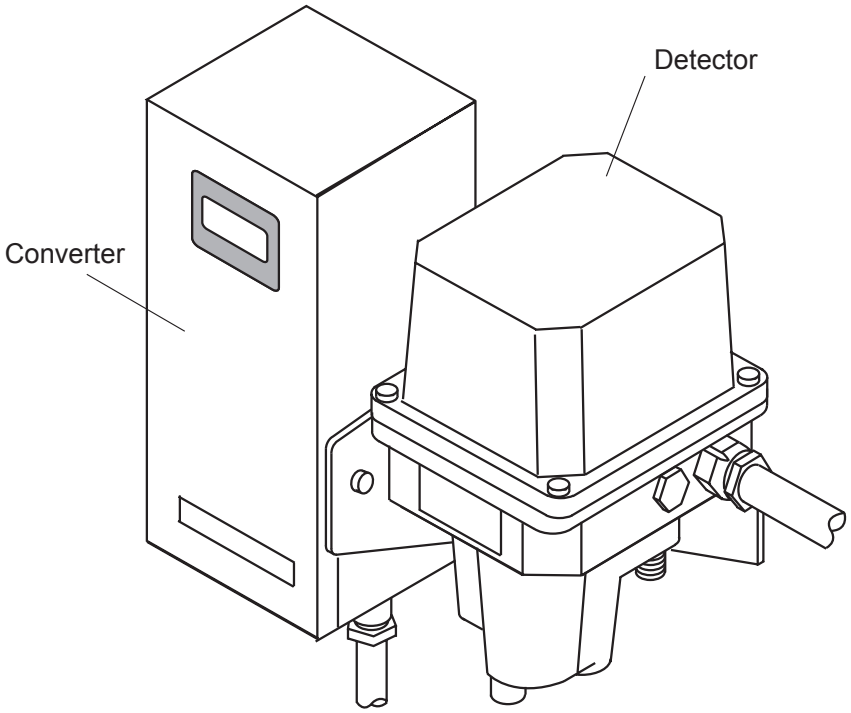


Figure 1.1 Appearance of Model FC500G Free Available Chlorine Analyzer

1.1 Standard Specifications

Measured Object: Free available chlorine contained in tap water

Measuring System: Polarographic method using rotating electrode

Measuring Ranges: 0 to 1 / 0 to 2 / 0 to 3 mg/L (Model FC500G-1)

0 to 5 / 0 to 10 mg/L (Model FC500G-5) (Air purge is necessary.)

Indication: Digital (3 1/2 LCD)

Output Signal: 4 to 20 mA DC (Load resistance: Maximum 500 Ω)

Operating pH Range of Sample Solution:

pH 6.5 to 7.5: For measured liquids whose pH exceeds the above limits, error increases (refer to the following figure).

Sample Solution:

- Temperature: 0 to 40°C (temperature compensation range 5 to 35°C).
- Pressure: 1 to 30 kPa (for without VALVE)

  1 to 150 kPa (with VALVE)
- Flow Rate: 0.1 to 2.5 L/min (at tank inlet)
- Conductivity: 100 to 300 µS/cm
- SS (Suspended Solid): 10 mg/L or less

Air Purging (for only 0 to 5 / 0 to 10 mg/L Range)

- Supply Air Pressure: About 50 to 140 kPa
- Air Consumption: About 5 L/min

Electrode:

- Indicator Electrode: Rotating gold electrode
- Counter Electrode: Silver electrode (with Pt 1000 installed)

Electrode Cleaning: Glass beads used for cleaning

Wetted Part Materials:

- Measuring Tank: Acrylic resin (molding)
- Piping: Flexible PVC and PE

Color: Muncell 5Y7/1

Finish: Baked polyurethane resin coating

Mounting: On the wall or 2 inch pipe (OD 60.5 mm)

Ambient Temperature: -5 to 50°C

Power Supply: 100 or 110 V AC; or 200 or 220 V AC as per order ±10%, 50 or 60 Hz

Power Consumption: Approximately 15 VA (100 or 110 V), 20 VA (200 or 220 V)

Weight: Approximately 6.5 kg

EMC Regulatory Arrangement in Australia and New Zealand (RCM)

EN 55011 Class A, Group 1

Characteristics:

- Reproducibility: 2% of full scale
- Linearity: ±5% of full scale
- Stability: Zero Drift: Within ±1% of full scale/month

  Span Drift: Maximum -10% of full scale/month

Response Time: Approximately 2 minutes (time required to obtain a value within 90% of final value)

Ambient Temperature Influence:

±0.5% of full scale/10°C

Power Voltage Fluctuation Influence:

±0.5% of full scale/10% of rated voltage

Sample Solution Temperature Compensation Error:

±3% of full scale/5 to 35°C

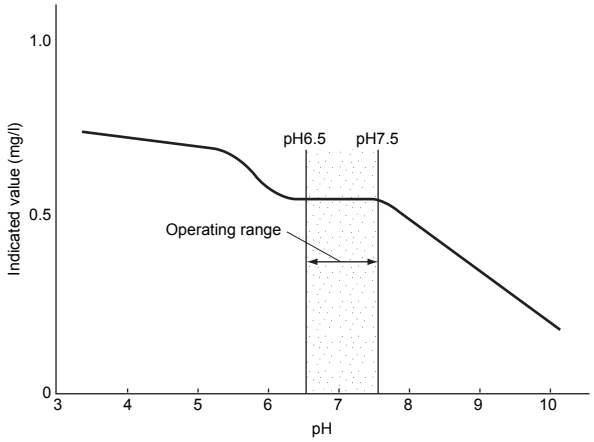


Figure 1.2 Sensitivity characteristics of diffusion current by pH value

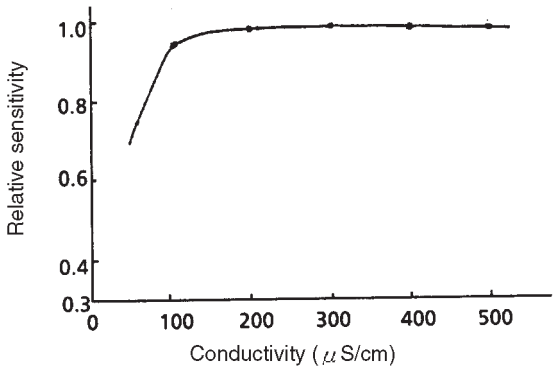


Figure 1.3 Sensitivity characteristics of diffusion current by conductivity

Note: If conductivity exceeds 300 µS/cm, default value of applied voltage should be changed.

Accessories

Fuse (1 A) .....4 pcs.

Glass Beads .....1 (2 bags)

Allen Wrench .....2 pcs.

Screwdriver (flat blade) ....1 pc.

Polishing Powder .....1 bottle

Belt tension adjuster plate...1 pc.

1.2 Model and Suffix Codes

[Style: S2]

Model	Suffix Code	Option Code	Description
FC500G	·····	·····	Free Available Chlorine Analyzer
Range	-1	·····	0 to 1 / 0 to 2 / 0 to 3 mg/L Switchable
	-5	·····	0 to 5 / 0 to 10 mg/L Switchable
Output signal	1	·····	4 to 20 mA DC
Power	3	·····	100 V ±10%, 50/60 Hz
	4	·····	110 V ±10%, 50/60 Hz
	5	·····	200 V ±10%, 50/60 Hz
	6	·····	220 V ±10%, 50/60 Hz
Inlet valve	0	·····	Without Valve
	1	·····	With Valve
Language	-E	·····	English

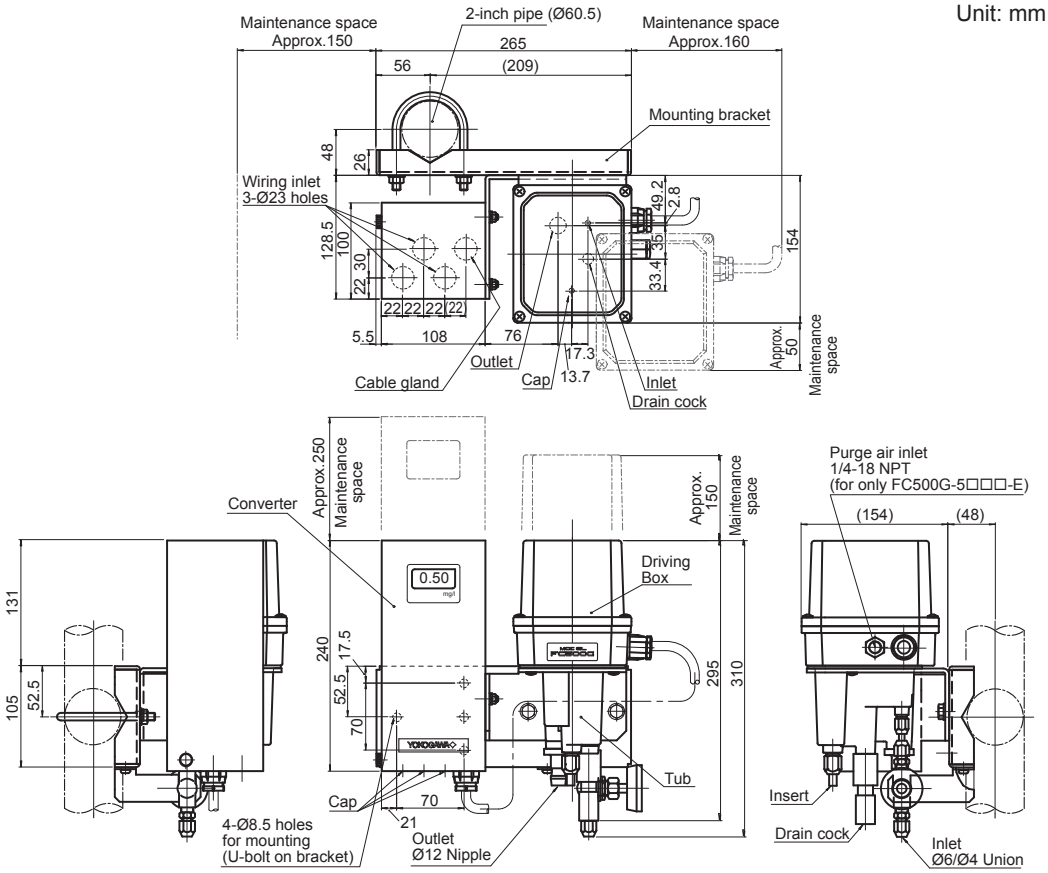
Spare Parts

Name	Parts No.	Note
Indicator Electrode	K9332MB	Rotating Electrore
Counter Electrode	K9332MK	Reference Electrode
Glass Beads	K9332ZJ	Washing Indicator Electrode (2 bags)
Polishing Powder	K9088PE	Polishing Indicator Electrode
Rotating contact	K9332SR	Part for electrode mechanism
Grease	K9044FX	

1.3 External Dimensions

(1) With Inlet Valve (FC500G-□□□1-E)

Unit: mm



(2) Without Inlet Valve (FC500G-□□□0-E)

Unit: mm

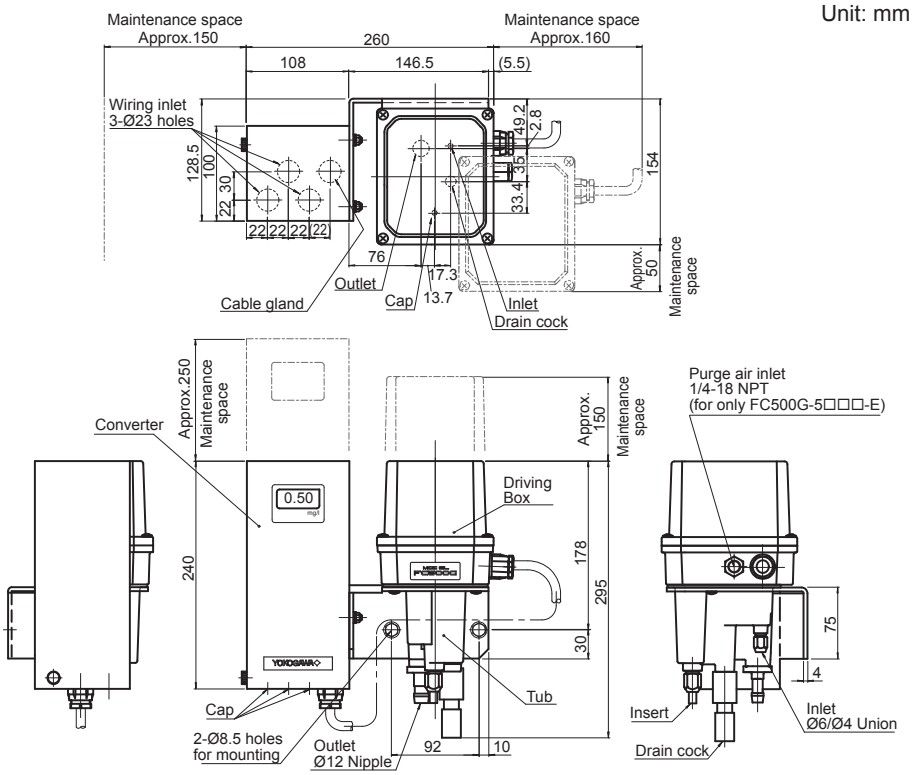


Figure 1.4 Model FC500G Free Available Chlorine Analyzer External Dimensions

1.4 Measuring Principle

The FC500G free available chlorine analyzer (non-reagent type) is used for measuring concentration of free available chlorine present in sample water, such as chlorine (Cl_2) hypochlorous acid (HClO), and hypochlorite ion (ClO^-).

The measuring principle of this analyzer is analysis determination using the rotating electrode polarographic method. Free available chlorine concentration is determined by measuring the current (diffusion current) which flows when free available chlorine is subjected to electrolytic reduction by applying a voltage (applied voltage) between the indicator electrode (rotating electrode) and the counter electrode. The applied voltage is set in a region where concentration polarization occurs (plateau region) in polarography. In the plateau region, the diffusion current does not change even if the applied voltage changes.

In measurement practice, since the plateau region changes with free available chlorine concentration, the applied voltage is compensated so that measurement can always be performed in the plateau region. Also, since the diffusion current is affected by the sample water temperature, temperature is compensated using a temperature sensor (Pt1000Ω) incorporated in the counter electrode.

Figure 1.5 shows the block diagram for the FC500G free available chlorine analyzer (non-reagent type) operation. The analyzer determines the free available chlorine concentration by applying an applied voltage corresponding to the diffusion current between the indicator and counter electrodes and by applying temperature compensation to the diffusion current.

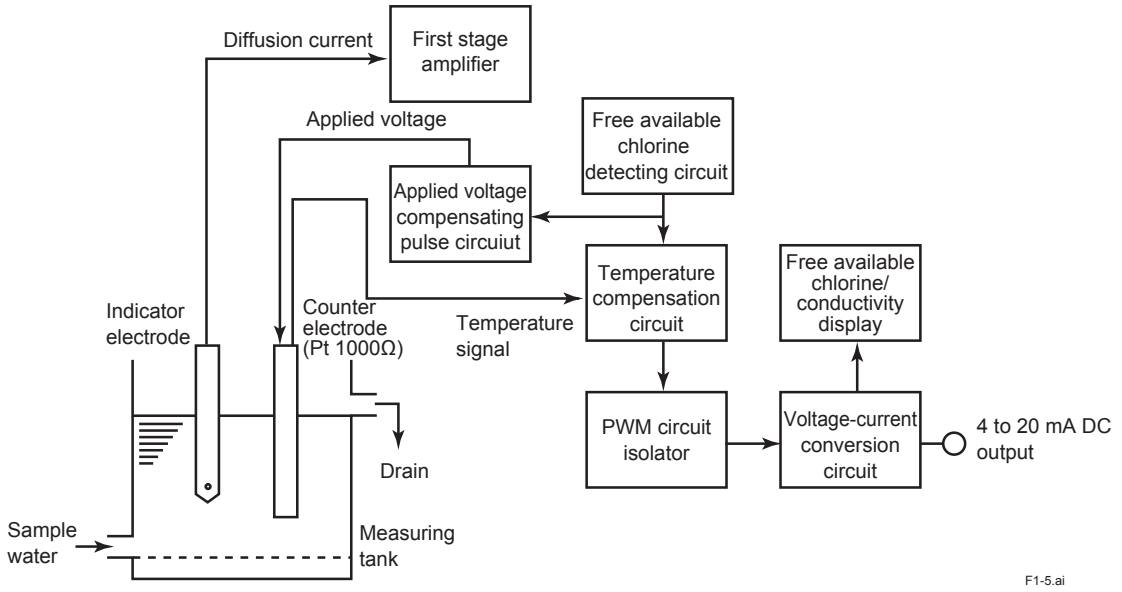


Figure 1.5 Block Diagram for FC500G Free Available Chlorine Analyzer Operation

2. COMPONENTS AND FUNCTIONS

2.1 Detector

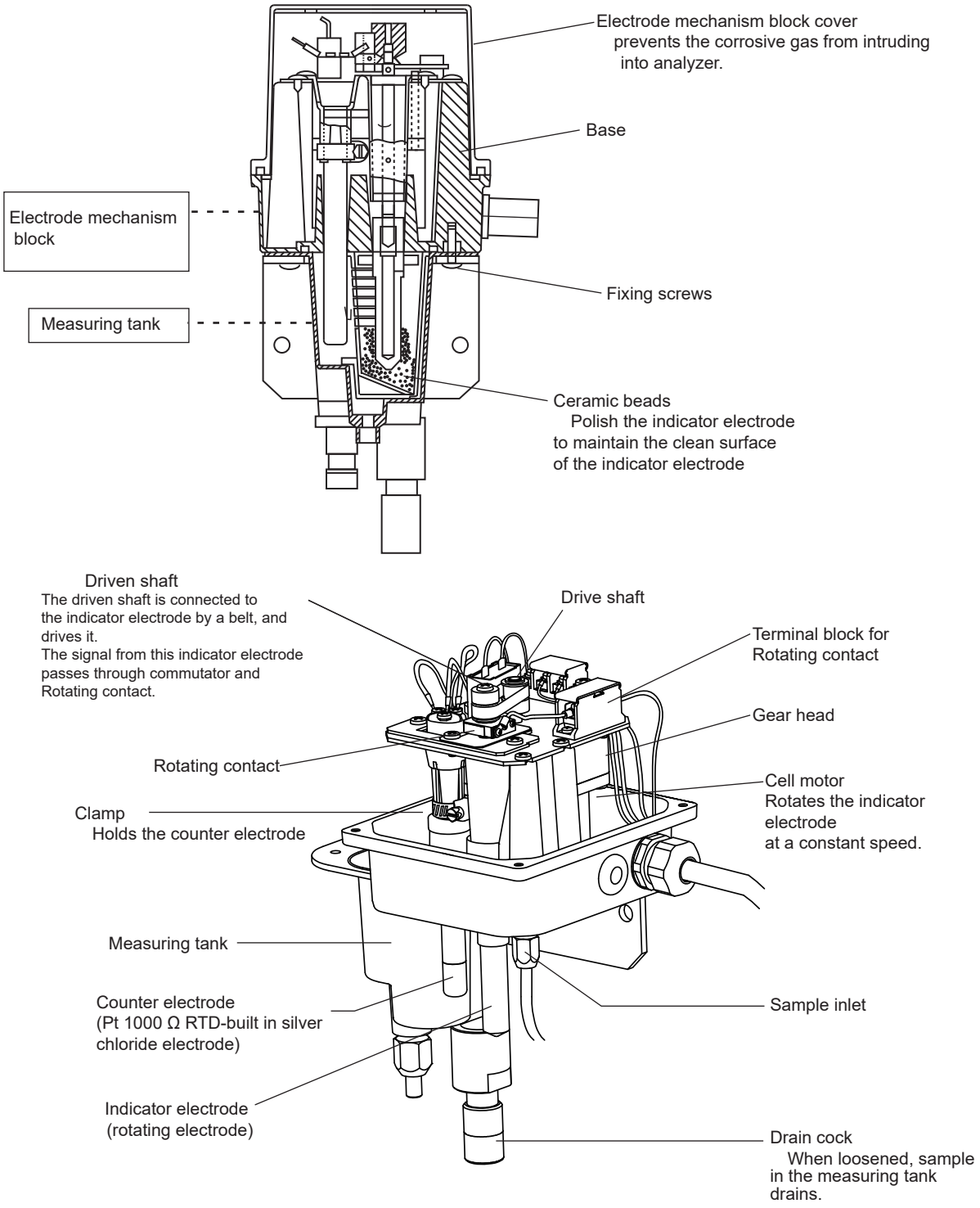


Figure 2.1 Component Names and Functions of the Detector

2.2 Converter

Figure 2.2 shows the converter component names and their functions.

Figure 2.2 is a figure with the cover removed. Measuring range selection should be performed in this state.

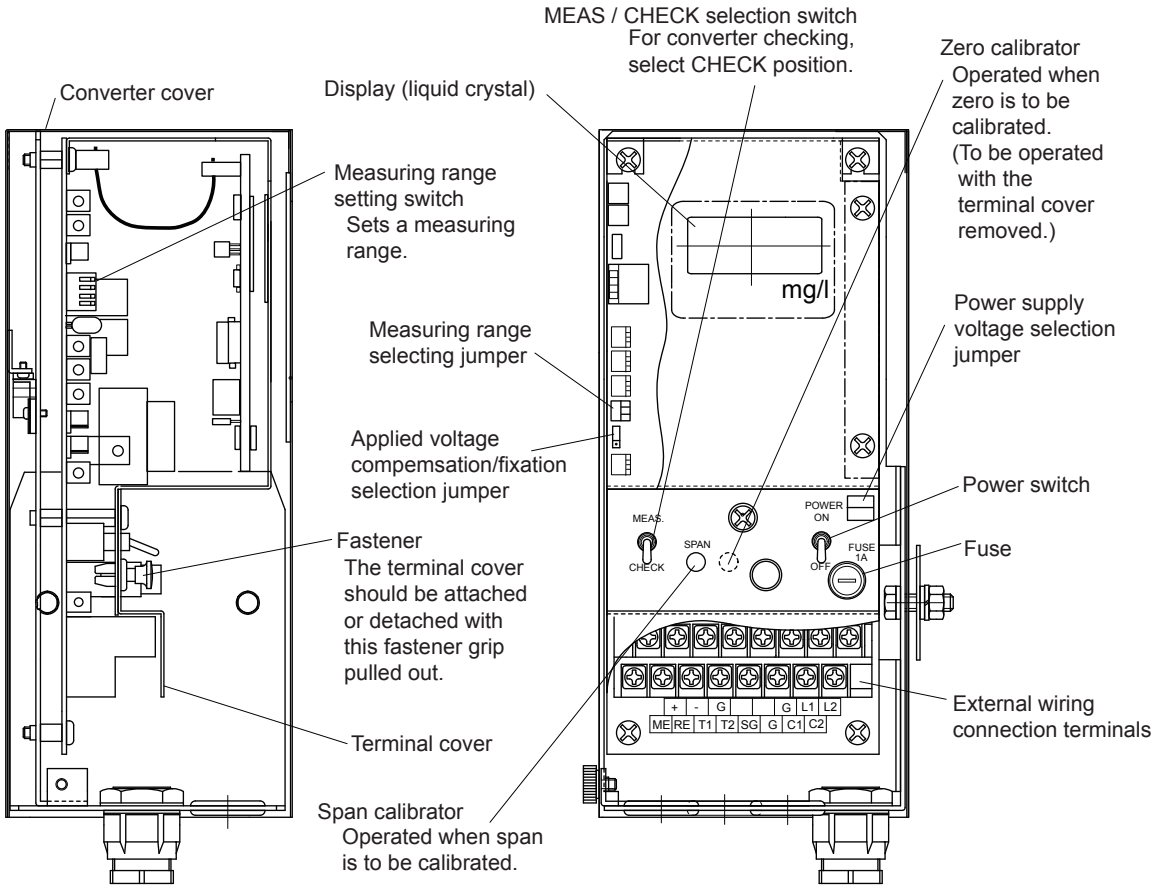


Figure 2.2 Converter Component Names and Their Functions

NOTE

The measuring range selection jumper and the power supply voltage selection jumper are shipped with these set based on the desired specifications.
The specifications cannot be changed by jumper selection.

3. INSTALLATION, PIPING, AND WIRING

This chapter describes procedures for the FC500G free available chlorine analyzer installation, piping, and wiring.

3.1 Installation

3.1.1 Location

Install the FC500G free available chlorine analyzer (non-reagent type) in a location which meets the following conditions:

- Free from rain water such as an indoor location or in a cabinet
- Low vibration
- No exposure to direct sunshine
- Little dust
- Absence of corrosive gas
- Easy maintenance

Figure 3.1 shows maintenance spaces.

Unit: mm

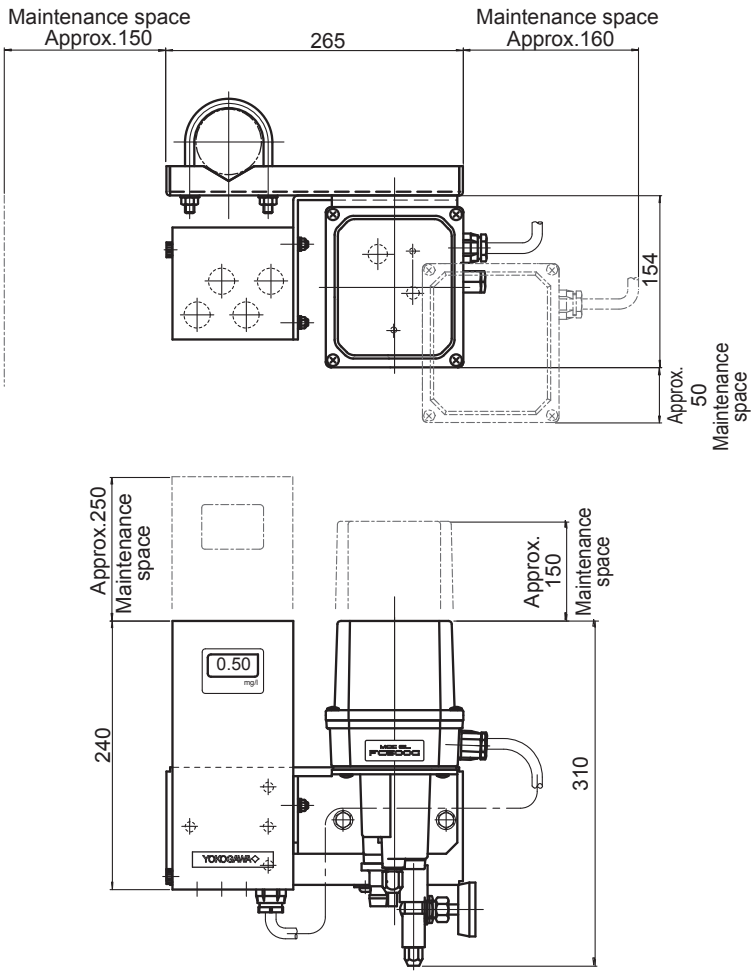


Figure 3.1 Maintenance Spaces for the FC500G Free Available Chlorine Analyzer

3.1.2 Mounting

Mount the FC500G free available chlorine analyzer (non-reagent type) on a wall surface. For mounting holes, see section 1.3.

3.2 Piping

3.2.1 Sample Water Piping

Connect a 6 mm OD X 4 mm ID polyethylene tube to the sample water inlet. Set the sample water pressure at the sample water inlet to 1 to 30 kPa (flow rate: 0.1 to 2.5 l/min).

Note: If a sample water inlet valve is used, set the pressure at the valve inlet to 10 to 150 kPa.

Connect a hose of 12 mm ID to the sample outlet. Make piping so that no drain stagnates in the hose.

3.2.2 Air Purge Piping

Make the air purge piping only when the FC500G-5 free available chlorine analyzer is used.

The air purge piping connecting port (1/8 NPT female) is located at the electrode assembly. Exercise care in piping because the electrode assembly must be removed in implementing inspection or maintenance (see Figure 3.2).

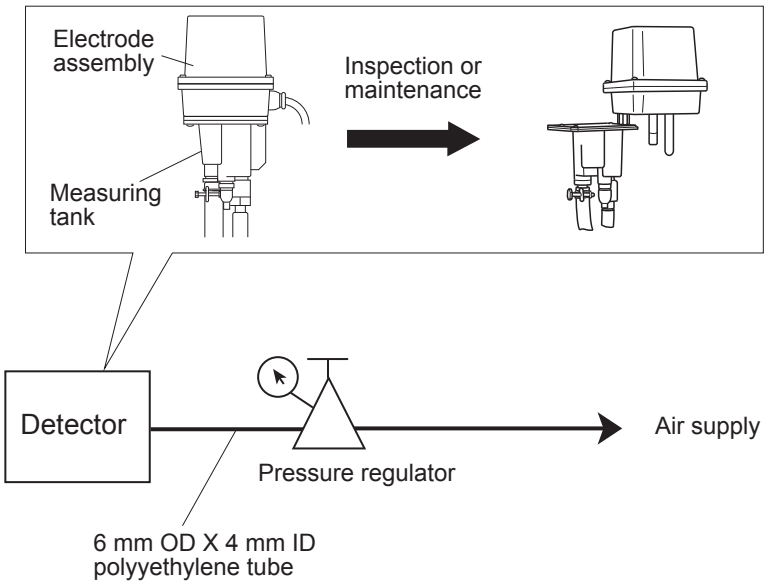
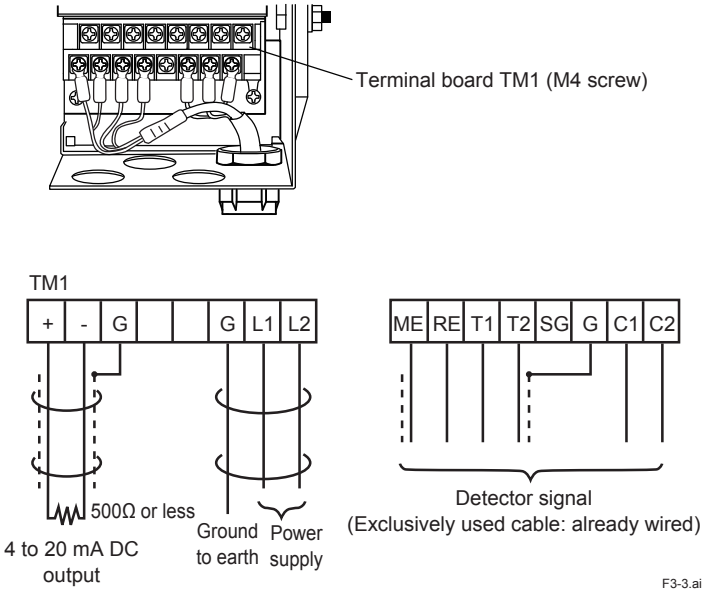


Figure 3.2 Air Purge Piping

3.3 Wiring

Make wiring for power supply and output signal. Figure 3.3 shows the symbols on the converter terminals and the types of wiring to be connected.



Note: Make grounding to earth (grounding resistance 100 Ω or less).

Figure 3.3 Symbols on the Converter Terminals and the Types of Wiring to be Connected

3.3.1 Wiring for Power Supply and Grounding

Use a three-conductor cable of 9 to 12 mm OD, each conductor having a cross section of 1 mm^2 or more.

Make grounding to earth (grounding resistance 100 Ω or less).

3.3.2 Analog Output Wiring

Use a two-conductor shielded cable of 9 to 12 mm OD, each conductor having cross section of 0.5 mm^2 or more. The shield should be connected to terminal “G”.

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4. OPERATION

This chapter chiefly describes the preliminary work to be performed prior to putting into operation.

4.1 Preparation for Operation

4.1.1 Inspection of Piping and Wiring Status

Confirm that wiring and piping are made properly.

4.1.2 Fill with Glass Beads for Electrode Polishing

Put glass beads (accessories) for cleaning the indicator (rotating) electrode into the beads case in the measuring tank in the following procedure:

(1) As shown in Figure 4.1, mount the electrode assembly to the holding stud. The electrode assembly is fixed to the measuring tank assembly using two screws.

In doing this, exercise care so that the indicator (rotating) electrode and the counter electrode are not struck by the measuring tank. Also, do not touch the surface of the indicator electrode with the fingers.

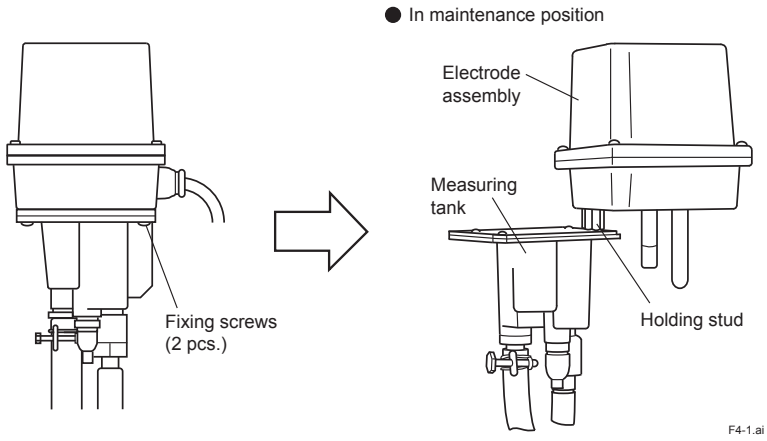

Figure 4.1 Removal of Electrode Assembly

(2) Remove the beads case from the measuring tank. The new glass beads are normally filled up to the bottommost notch of the beads case when the indicator electrode is inserted.

Taking care that glass beads do not drop from the beads case. Mount the beads case so that its slits face the counter electrode.

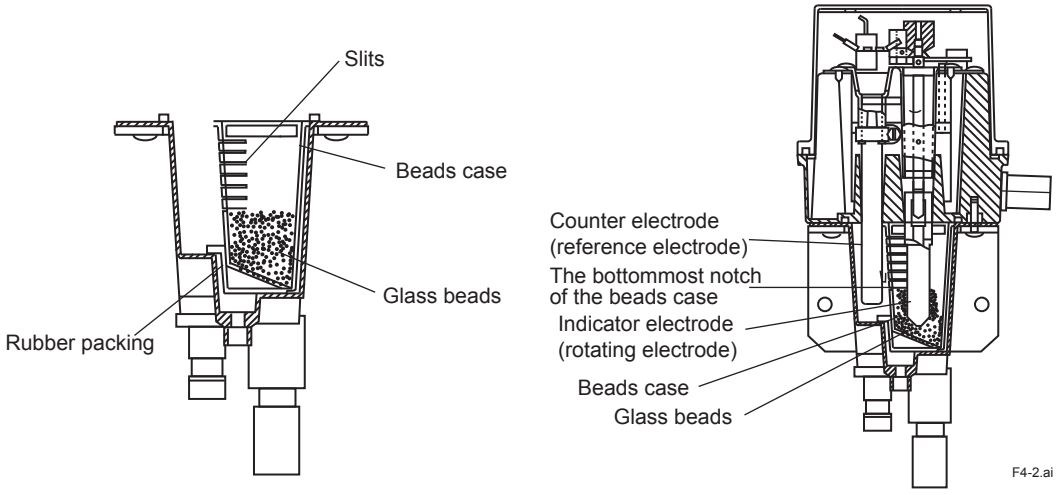

Figure 4.2 Amount of Glass Beads to be Put into the Beads Case

(3) Return the electrode assembly to the measuring tank and tightly secure it using the fixing screws.

4.1.3 Measuring Range Setting

Select the measuring range using the setting switch. Set it as shown in Table 4.1. Operate the setting switch using a small flat blade screwdriver.

Table 4.1 Switch Setting Corresponding to Measuring Range

Model	Measuring range	DIP switch position			
		1	2	3	4
FC500G-1	0 to 1 mg/l 0 to 2 mg/l 0 to 3 mg/l	ON OFF OFF	OFF OFF OFF	OFF ON OFF	OFF OFF ON
FC500G-5	0 to 5 mg/l 0 to 10 mg/l	OFF OFF	ON OFF	OFF OFF	OFF ON

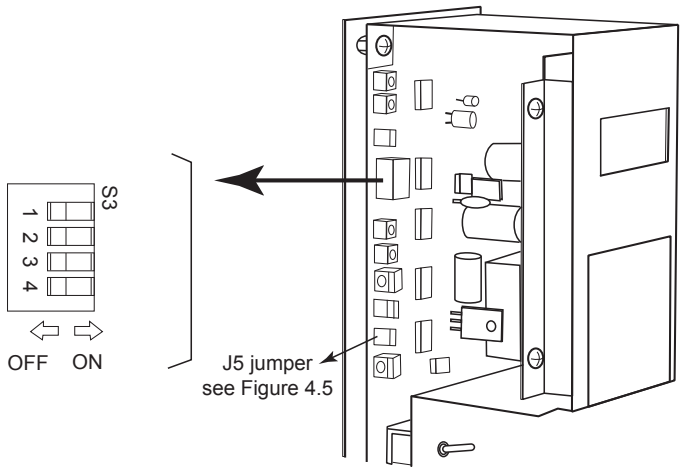

Figure 4.4 Measuring Range Setting Switch

NOTE

For the FC500G-1, measuring ranges of 0 to 5 and 0 to 10 mg/l cannot be used. For the FC500G-5, measuring ranges of 0 to 1, 0 to 2, and 0 to 3 mg/l cannot be used.

4.1.4 Setting of “Applied Voltage Compensation/Applied Voltage Fixation” Selection Jumper

The applied voltage can be fixed to a definite value without applied voltage compensation. When the applied voltage compensation/applied voltage fixation transfer jumper shown in Figure 4.5 is set to the side B (lower), the applied voltage is fixed to the starting voltage value.

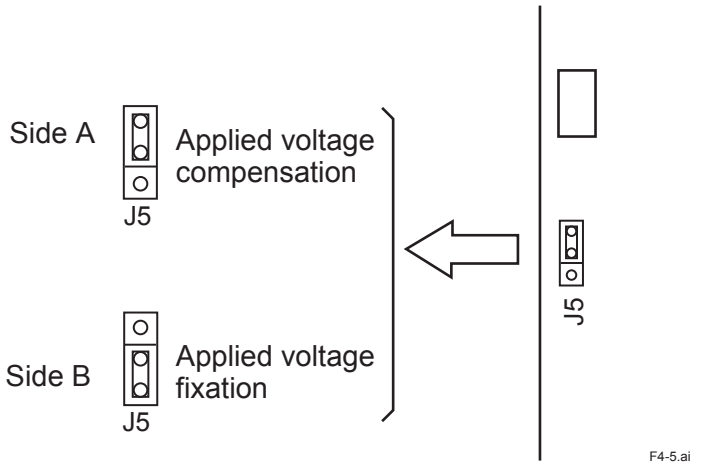

Figure 4.5 “Applied Voltage Compensation/Applied Voltage Fixation” Selection Jumper

NOTE

If conductivity exceeds 300 µS/cm, applied voltage should be changed to fixation.

4.2 Start-Up

4.2.1 Supplying Sample Water

<Sample inlet valve is not provided>

Confirm that the sample water pressure is within the range of 1 to 30 kPa and supply sample water at the flow rate of 0.1 to 2.5 l/min. After supplying sample water, confirm that the sample water level does not contact the top of the measuring tank.

<Sample inlet valve is provided>

First, fully close the sample inlet valve. Then, supply sample water at the pressure of 10 to 150 kPa. After supplying sample water, open the sample inlet valve so that the sample water flow rate is 0.1 to 2.5 l/min.

4.2.2 Confirmation of “Power Supply Voltage” and “Measuring Range” Selection Jumpers Setting Status

If power supply specification for the free available chlorine analyzer (non-reagent type) used is the 100 V system, confirm that the “power supply voltage” selection jumper is set as shown in Figure 4.6 (1).

If the power supply specification is the 200 V system, confirm that the jumper is set as shown in Figure 4.6 (2).

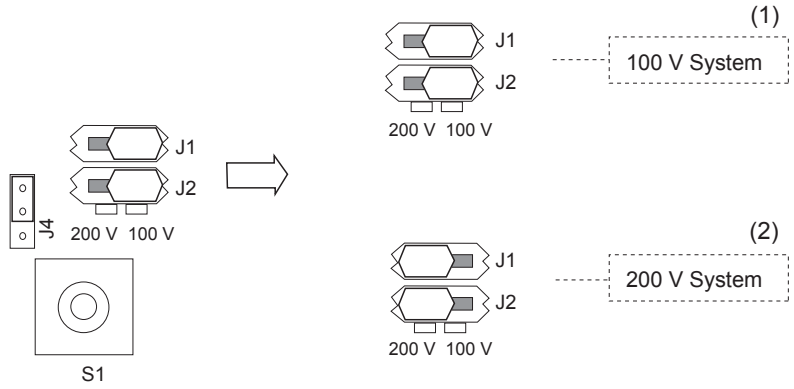

Figure 4.6 “Power Supply Voltage” Selection Jumper

If the FC500G-1 free available chlorine analyzer is used, confirm that the “measuring range” selection jumper is set as shown in Figure 4.7 (1).

For the FC500G-5 free available chlorine analyzer, confirm that the jumper is set as shown in Figure 4.7 (2).

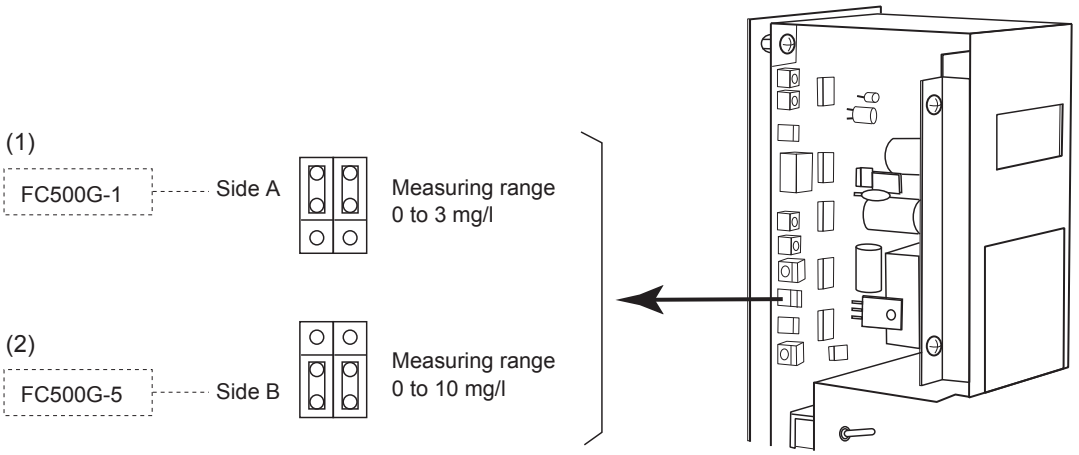

Figure 4.7 “Measuring Range” Selection Jumper

4.2.3 Supplying Power

Arrange a power supply whose voltage and frequency confirm to the specifications. Confirm that the fuse holder cap in the converter is tight and then turn ON the power switch.

4.2.4 Operation Check

Confirm that a measured value is displayed in the display.

Also, visually confirm that there is no irregularity or significant deflection when the indicator electrode revolves.

4.2.5 Calibration

Implement zero and span calibration referring to chapter 5.

4.3 Steady State Operation

There is no need for special action during analyzer operation except for executing inspection and maintenance described in chapter 6. If a failure occurs, dispose of it referring to chapter 7.

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5. CALIBRATION

Perform zero and span calibration when the analyzer is to be initially started up and also when re-operated after prolonged shutdown.

During operation, perform span calibration periodically (approx. once a month). When span is to be calibrated, first polish the indicator electrode (see subsection 6.1.1) and then perform running-in operation for approx. one hour.

Zero calibration is virtually unnecessary during operation if it is performed once at start-up. However, merely confirm periodically that the zero point is correct during operation.

5.1 Zero Calibration

There are two methods for calibrating zero: the “open input circuit method” using which the calibration is performed by pulling up the rotating and counter electrodes from the sample water and the “chlorine-free water method” using water free from chlorine (e.g., water filtered through activated carbon). Normally calibrate zero using the “open input circuit method”. However, if free available chlorine of low concentration is always to be measured (e.g., approx. 0.1 mg/l), use the “chlorine-free water method” for zero calibration.

5.1.1 Zero Calibration Procedure Using the Open Input Circuit Method

(1) Remove the electrode assembly from the measuring tank with the indicator electrode rotated and fix it to the holding studs. (Remove the electrode assembly by loosening the two fixing screws.)

It is not necessary to stop the sample water.

(2) After display of the free available chlorine concentration has stabilized, perform zero calibration. First, remove the terminal cover.

Next, slowly turn the zero calibrator (potentiometer) using the attached flat blade screwdriver to adjust display to zero.

(3) Mount the terminal cover. Return the electrode assembly to the measuring tank and tightly fix the assembly using the two fixing screws.

5.1.2 Zero Calibration Procedure Using Chlorine-Free Water Method

(1) Prepare two to three litre of chlorine-free water (prepared by adding 10 ml/l of pH 7 buffer solution and 50 mg/l of NaCl to purified water).

(2) Stop supply of sample water and wait until the sample water level in the measuring tank decreases to below the sample water inlet. Then disengage the sample water inlet piping.

(3) Introduce the chlorine-free water into the measuring tank.

Connect a tube to the sample water inlet and pour the chlorine-free water contained in a suitable vessel into the measuring tank by utilizing a head from the inlet. If a pump is used for supply, use a flow rate of 100 ml/min or more.

(4) After the free available chlorine concentration display has stabilized, perform zero calibration. First, remove the terminal cover.

Next, slowly turn the zero calibrator (potentiometer) using an attached flat blade screwdriver to adjust display to zero.

(5) Mount the terminal cover. Also stop supply of the chlorine-free water.

After the solution level in the measuring tank decreases to below the sample water inlet, remove the tube and restore the sample water piping connection.

Supply sample water.

5.2 Span Calibration

There are two span Calibration methods: “sampling method” using which calibration is performed based on the manually analyzed free available chlorine concentration of sample water, and the “standard solution method” which allows calibration using a standard calibration solution having a free available chlorine concentration of approximately 80 % of the measuring range.

Calibrate the analyzer span using the “sampling method” unless the chlorine concentration of sample water is near zero. (Span calibration can be performed without removing the terminal cover).

Note: Before performing span calibration, confirm that the electrode does not remain exposed to the air as after zero calibration, and the electrode rotates normally in the measuring tank.

5.2.1 Span Calibration Procedure Using the Sampling Method

(1) Confirm that the free available chlorine concentration in the sample water is stable by observing displayed values.

(2) Sample the sample water by loosening the drain cock at the bottom of the measuring tank.
When sampling the sample water, exercise care so that the tip of the counter electrode is not exposed to air above the level of the sample water.

(3) Quickly measure the free available chlorine concentration of the sampled sample water, using a manual analysis such as amperometric titration (AT method).

(4) Slowly turn the span calibrator (potentiometer) using the attached flat blade screwdriver to adjust display to the manually analyzed value.

5.2.2 Span Calibration Procedure Using Standard Solution Method

(1) Prepare diluting solution which is obtained by adding 10 ml/l of pH 7 buffer solution and 50 mg/l of NaCl to purified water (sample water can also be used instead of purified water).

(2) Prepare 2 to 3 liter of the standard solution conditioned to a free available chlorine concentration of approximately 80 % of the measuring range. To obtain this solution, dilute commercially available sodium hypochlorite (NaClO) solution using the diluting solution prepared in step (1).

(3) Stop supply of sample water and wait until the sample water level in the measuring tank decreases to below the sample water inlet. Then disengage the sample water inlet piping.

(4) Introduce the standard solution into the measuring tank.
Connect a tube to the sample water inlet and pour the solution contained in a suitable vessel into the measuring tank by utilizing a head from the inlet. If a pump is used for supply, use a flow rate of 100 ml/min or more.

(5) After the free available chlorine concentration display has stabilized, loosen the drain cock to sample the standard solution.
In sampling the solution, exercise care so that the tip of the counter electrode is not exposed to air above the level of the solution.

(6) Quickly measure the free available chlorine concentration of the sampled sample water, using a manual analysis such as amperometric titration (AT method).

(7) Slowly turn the span calibrator (potentiometer) using the attached flat blade screwdriver to adjust display to the manually analyzed value.

(8) Stop supply of the standard solution.
After the solution level in the measuring tank decreases to below the sample water inlet, remove the tube and restore the sample water piping connection.
Supply sample water.

6. INSPECTION AND MAINTENANCE

To continue good operating status, perform inspections and maintenance as shown in Table 6.1.

Determine the implementation cycle in accordance with the individual operation conditions. Table 6.1 is a guide for the implementation cycle.

Table 6.1 Inspection and Maintenance Items and Implementation Cycle

Inspection and maintenance item	Implementation cycle
Indicator electrode polishing	Once/month
Glass beads cleaning	Once/three months
Measuring tank cleaning	Once/three months
Rotating contact	Once/year
Calibration	Once/month
Converter checking	Once/month
Fuse replacement	Once/year

6.1 Mechanical System

6.1.1 Indicator Electrode Polishing

Indicator electrode contamination influences the measured values. Accordingly, the indicator electrode (rotating electrode) is always rotated to polish its surface using glass beads.

However, the surface very gradually becomes contaminated with time elapse. Thus, periodically polish the electrode surface using a polisher (alumina).

Polish the electrode surface using the following procedure:

(1) Remove the converter cover and turn OFF the converter power switch.

(2) Remove the electrode assembly from the measuring tank and fix it to the holding stud. It is not necessary to stop the sample water.

(3) Remove the electrode assembly cover.

(4) Insert an Allen wrench (accessories) into the hole on the side of the rotating shaft below the drive belt and manually fix the shaft. Remove the indicator electrode by turning it counter-clockwise. Do not touch the rotating contact or the indicator electrode surface.

(5) Apply polisher (alumina) attached as an accessory to a wet gauze and carefully polish the electrode surface until all contamination is completely removed. After polishing, wash off the polisher using clean water. Once the surface is clean, it will wet uniformly without repelling water.

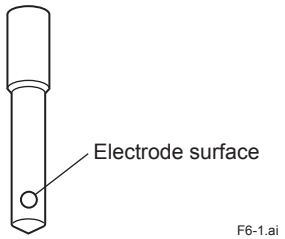


Figure 6.1 Indicator (Rotating) Electrode

(6) Similar to electrode removal, insert an Allen wrench into the hole and manually fix the rotating shaft so that it does not turn. Fully screw in the indicator electrode (turn clockwise).

CAUTION

Do not touch the rotating contact or the indicator electrode surface.

(7) Mount the electrode assembly cover and restore the electrode assembly in the measuring tank. Tightly secure the assembly using the two fixing screws.

(8) Turn the converter power switch ON and confirm that the indicator electrode revolves normally. Also confirm that the concentration display presents an approximately proper value.

(9) Mount the converter cover.
In addition, after the electrode is polished, perform running-in operation for one hour or longer. Then, calibrate span without fail.

Note: Polish the electrode surface (gold electrode) by following the instructions below when it has become corrugated or deformed from the original shape (about 3 mm in diameter).
Polish the electrode surface with sandpaper (about #600) until the surface becomes finally rounded. Then, polish it with sandpaper (about #2000), and lastly with polishing powder (alumina). Make sure the electrode surface is clean and then install the indicator electrode. Reduce the amount of ceramic beads if the electrode has deformed greatly. The ceramic beads should be filled up to 5 mm under the bottommost notch of the beads case when the indicator electrode is inserted.

6.1.2 Glass Beads and Measuring Tank Cleaning

If the glass beads are contaminated, cleaning effect deteriorates. Periodically clean the glass beads and the measuring tank.

The procedure follows:

(1) Turn OFF the converter power switch. Stop sample water supply.

(2) Remove the two fixing screws of the electrode assembly and secure the assembly to the holding studs.

(3) Remove the beads case from the measuring tank with the rubber packing attached. In this case, exercise care so as not to drop glass beads into the measuring tank.

(4) Clean the inside of the measuring tank using a brush with detergent on it. Use dilute hydrochloric acid if manganese or iron adheres. Do not use organic solvent.
After cleaning, completely wash out the detergent (or acid) using clean water or sample water.

(5) Move the glass beads to another vessel and clean them using dilute hydrochloric acid. After that, completely wash out the acid using clean water or sample water. For the beads case and rubber packing, remove dirt using detergent or dilute hydrochloric acid. After that, completely wash out the detergent or acid using clean water or sample water.

(6) Set the beads case to the rubber packing and load the cleaned glass beads in the case. If the beads have obviously become smaller in size (much smaller than a diameter of 1.7 to 2.3 mm), replace them with new ones. Glass beads are worn in long-term use, thereby reducing the ability of polishing indicator electrode.
For optimum polishing, the new glass beads are normally filled up to the bottommost notch of the beads case when the indicator electrode is inserted (See Figure 4.2). The polishing ability cannot be recovered by replenishing the beads only by volume reduced by wear.

(7) Restore the beads case and rubber packing in the measuring tank.

(8) Restore the electrode assembly to the measuring tank and secure it using the two fixing screws.

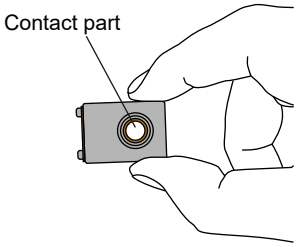
(9) Supply sample water. Turn ON the converter power switch. Confirm that the indicator electrode normally revolves and the concentration display presents approx. the proper value. Finally, mount the converter cover.
The cleaning effect of the glass beads deteriorates owing to abrasion of the beads themselves over prolonged use. Recommended practice is to replace the beads once or twice a year.

6.1.3 Checking Rotating contact

CAUTION

Never touch Rotating contact except when replacement is performed.

When you hold Rotating contact, pinch it with two fingers and never touch the center contact part. Never drop it or gives a shock.



CAUTION

The storage limit for Rotating contact is 1 year after the purchase, considering degradation of the lubricant used inside. Store it in room temperature and keep it away from direct sunlight.

[Checks and Maintenance]

Rotating contact does not need inspection. Never contact the rotating contact except when the replacement is performed.

[Replacing the Rotating contact]

If they are replaced by the customer, follow the steps below.

(1) Shut off the power fed to the free available chlorine analyzer to stop the operation.

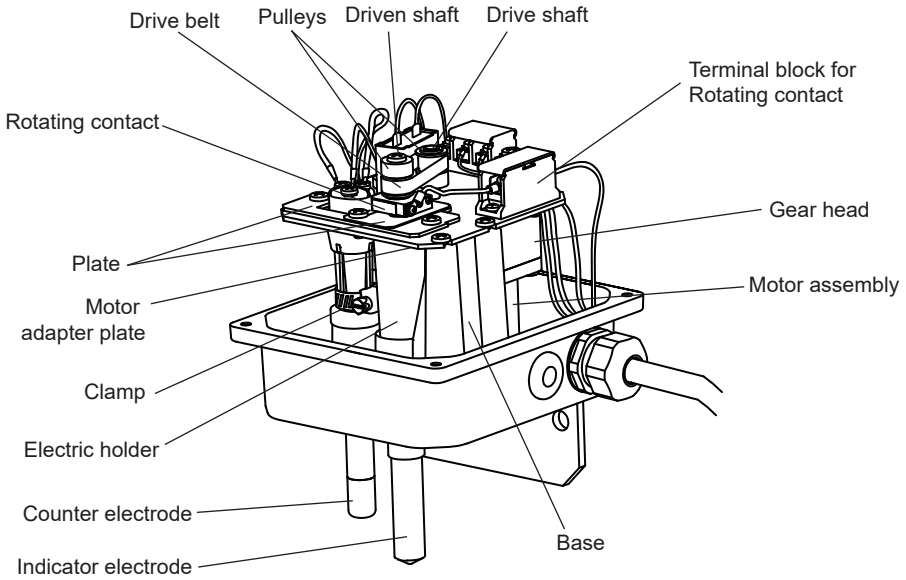


Figure 6.2 Electrode Mechanism Block

(2) Remove the two pulleys of the drive shaft (cell motor shaft) and driven shaft (indicator electrode-mounting shaft).
The driven shaft pulley can be removed by inserting a 2 mm nominal size Allen wrench (accessory) into the hole in the shaft, which is used as a lock, and unscrewing the end of the driven shaft. The drive shaft pulley can be removed by unscrewing two set screws using a 1.5 mm nominal size Allen wrench (accessory).
Remove the pulleys together with the drive belt.

(3) Unscrew the screws fixed on the terminal block of Rotating contact. Unplug the cable terminals of Rotating contact. Remove Rotating contact from Driven shaft. Hold a new rotating contact, with its metal top facing toward you, while the cable being on your right side. Then put the driven shaft throught the center hole.

(4) Install the pulleys and drive belt in place.

(Note) Mount drive shaft pulley so that the tip of the shaft can project out 0.3 to 0.7 mm from the end of the pulley.

(5) Install wiring terminals of Rotating contact on the block terminal of Rotating contact. Be sure that the wiring never contacts the drive belt.

(6) Feed power to FC500G. Confirm that the driven shaft/drive shaft/drive belt/rotates smoothly, and that there are no abnormal sounds, like vibration or discontinuous noises.

This completes the replacement procedure.

CAUTION

When you shut the cover of electrode mechanism, be careful not to get the cables caught that run inside the analyzer.

6.2 Electrical System

6.2.1 Span Calibration

Perform span calibration at the rate of once every one or two weeks during the initial operation start period and check the sensitivity changes owing to indicator electrode contamination or the like to establish a reference for determining the calibration period. After the calibration period is determined, perform span calibration in an appropriate interval using the above period as a guide. When the indicator electrode is polished, perform span calibration without fail.

6.2.2 Converter Checking

Check the converter periodically.

The converter check function means to check the converter circuit operation.

Converter checks can be performed using switch operations. Placing the MEAS./CHECK selector switch in the “CHECK” position transfers the converter input (current input and temperature input) from connection to the detector to connection to the simulated input. When the converter is normal, the free available chlorine concentration display indicates 0.90 to 1.10 mg/l regardless of the measuring range. In this case, the analog output is sent out in the range shown in Table 6.2 corresponding to the measuring range setting.

Table 6.2 Analog Output in Checking

Measuring range	Output current	Approximate position
0 to 1 mg/l	18.4 to 21.6 mA	Approx. 100 % point of full scale
0 to 2 mg/l	11.2 to 12.8 mA	Approx. 50 % point of full scale
0 to 3 mg/l	8.8 to 9.9 mA	Approx. 33 % point of full scale

6.2.3 Fuse Replacement

For preventive maintenance, it is recommended to replace the power supply fuse once a year. The fuse rating is 250 V, 1 A.

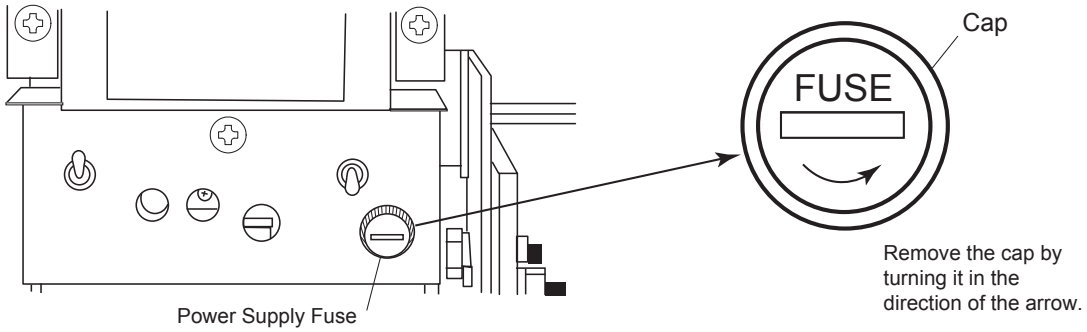


Figure 6.3 Power Supply Fuse

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7. TROUBLESHOOTING

If any operation abnormality appears, take measures using the following procedures.

Abnormalities	Cause	Countermeasures
No indication	1. The fuse is blown. 2. Converter connector poor contact	1. Replace the fuse. 2. Once turn OFF power and re-engage the relevant connector.
Indication shows hunting.	1. Poor contact in the indicator (rotating) electrode mounting position	1. Coat conductive grease (auxiliary).
Abnormal chlorine concentration displayed.	1. Poor contact of the electrode terminals with connecting leadwires 2. Miss-wiring of leadwires to be connected to electrode terminals 3. Poor continuity between the indicator (rotating) electrode and the contactor 4. Deterioration of RTD insulation 5. Sample water flow rate is out of range (0.1 to 2.5 l/min). 6. Calibrated value deviation 7. Electrical circuit failure	1. Correctly connect leadwires to the counter electrode terminals (RE, T1, T2) and the indicator electrode terminals (ME). 2. Check the leadwire symbols and correctly connect the leadwires. 3. Clean the rotating contact. Replace the rotating contact. (see subsection 6.1.3). 4. Disconnect leadwires to the counter electrode terminals T1 and T2, and check that the resistance across terminals T1 and T2 is approx. 1 kΩ at room temperature and the resistance across the terminals RE and T1 (or T2) is 1 MΩ or more. If these are not satisfied, replace the counter electrode. 5. Adjust the flow rate. (Adjust so that sample water just overflows the weir in the measuring tank.) 6. Perform zero and span calibration. 7. Place the MEAS./CHECK selector switch in CHECK position and check if the display indicates 0.9 to1.1 mg/l. If it is not satisfied,contact Yokogawa.
Abnormal analog output	1. The load resistance is larger than 500 Ω. 2. Electrical circuit failure	1. Adjust the load resistance to 500 Ω or less. 2. Contact Yokogawa.
The indicator electrode does not revolve or irregularly rotates.	1. The belt is broken. 2. The motor fails. 3. The rotating shaft bearing has corroded.	1. Replace the belt. 2. Replace the motor. 3. Replace the bearing.
Sample water leakage	1. Drain cock is inadvertently not closed. 2. Piping joint loosened.	1. Re-tighten the drain cock. 2. Re-tighten the piping joint fittings.

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8. AUXILIARIES AND CONSUMABLES

8.1 Auxiliaries and Consumables List

Table 8.1 shows auxiliaries and consumables.

Table 8.1 Auxiliaries and Consumables

Item	Part number	Remarks
Indicator electrode	K9332MB	Rotating gold electrode
Counter electrode	K9332MK	Reference elctrode
Glass beads	K9332ZJ	Washing indicator electrode (2 bags)
Polishing powder	K9088PE	Polishing Indicator electrode alumina, 30 g
Rotating contact	K9332SR	Part for electrode mechanism block
Grease	K9044FX	One bottle 3 ml, for continuity stabilization at the base of indicator electrode
Fuse (1 A)	A1109EF	250 V, 1 A

8.2 Auxiliaries and Consumables

8.2.1 Polisher (Part number: K9088PE)

This is used for polishing the indicator electrode surface.

8.2.2 Glass Beads (Part number: K9332ZJ)

The cleaning capability of glass beads in prolonged use deteriorates owing to abrasion. Normally, replace the beads once or twice a year.

8.2.3 Indicator Electrode (Part number: K9332MB)

The electrode is gradually abraded by cleaning using glass beads. Generally, the electrode can be used for around three or four years. However, it is recommended that one spare electrode should be stored for unforeseen accident.

8.2.4 Grease (Part number: K9044FX)

The grease is applied to stabilize continuity at the mounting base part (screw connection) when the indicator electrode is replaced. Apply the grease to the indicator electrode screw thread referring to the procedure manual attached to the auxiliaries.

8.2.5 Counter Electrode (Part number: K9332MK)

Not subject to any abrasion, this electrode can be used for a prolonged period. However, it is recommended to store one electrode as a spare.

8.2.6 Rotating contact (Part number: K9332SR)

Normally, one year is considered the replacement interval.

CAUTION

Do not touch the rotating contact when replacement is performed.

The rotating contact is in mechanism consisting of ring and brush together that obtain signals. It becomes worn out over long period of continuous use. Lubricant used for the part also needs to be concerned about its quality degradation after the long period of use. Therefore, standard replacement interval is one year.

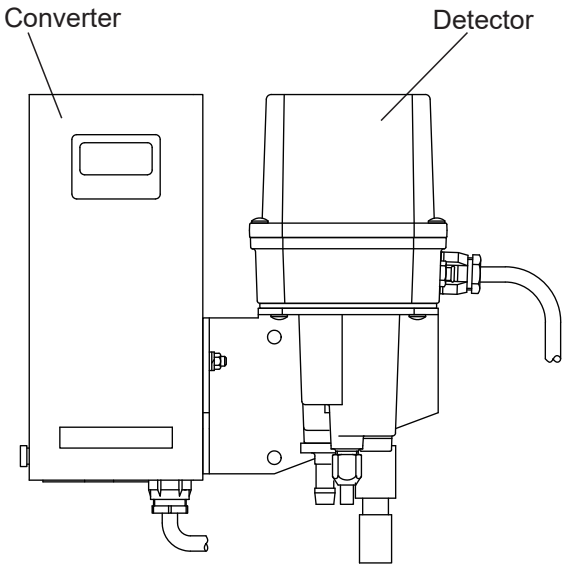
CAUTION

The storage limit for Rotating contact is one year after the purchase, considering degradation of the lubricant used inside. Store it in normal temperature and keep it away from direct sunlight.

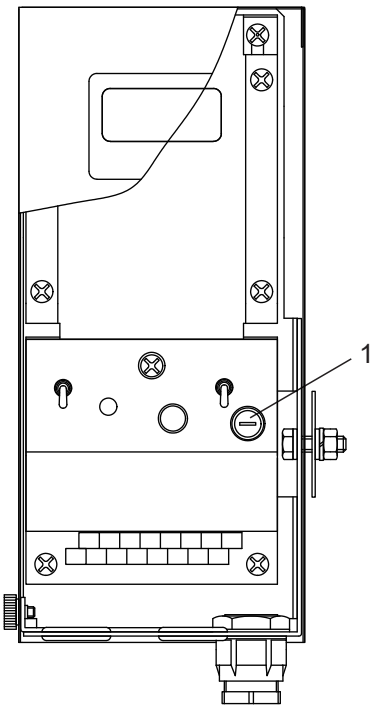
Customer Maintenance Parts List

Model FC500G
Free Available Chlorine Analyzer (Non-Reagent Type)

[Style: S2]



CONVERTER



Item	Part No.	Qty	Description
1	A1109EA	1	Fuse (1A)

YOKOGAWA
Yokogawa Electric Corporation

CMPL 12F05A02-02EN
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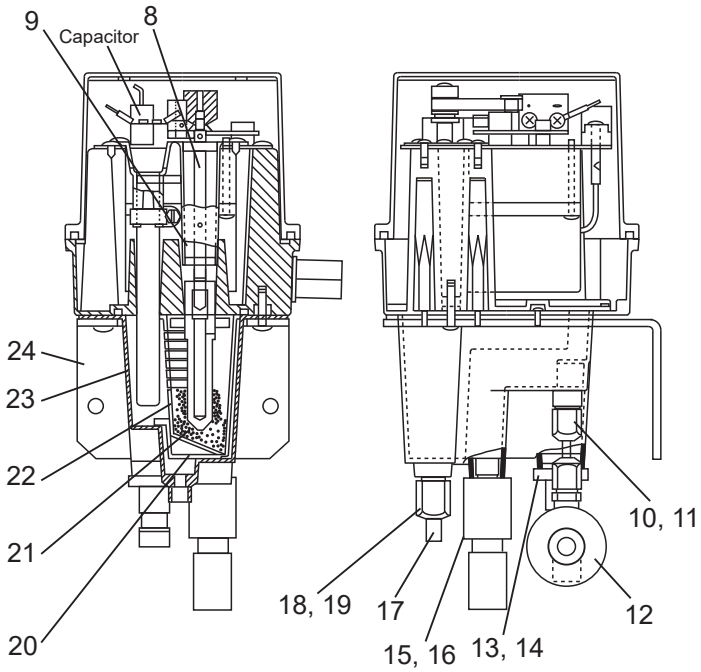
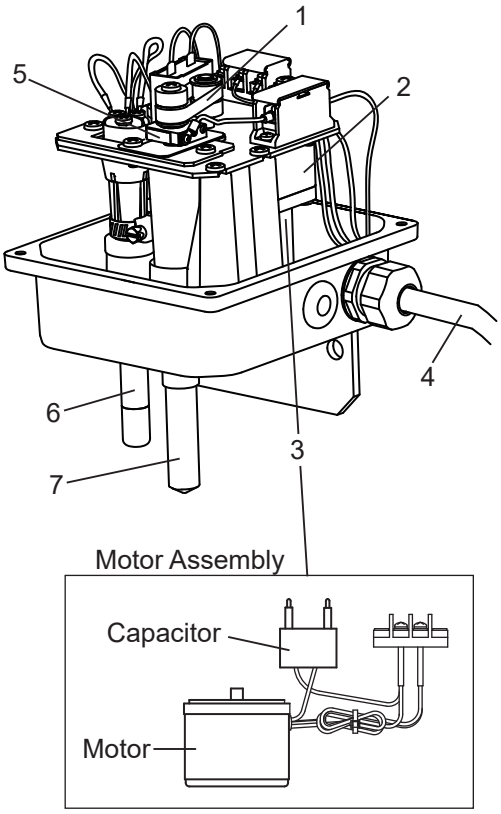
DETECTOR





Item	Part No.	Qty	Description
1	L9804UK	1	Drive Belt
2	——	1	Gear Head
	K9332JP		(For 100/110 V AC power supply)
	K9334VA		(For 200/220 V AC power supply)
3	——	1	Motor Assembly
	K9334JY		(For 100 V AC power supply)
	K9334VQ		(For 110 V AC power supply)
	K9334VR		(For 200 V AC power supply)
	K9334VS		(For 220 V AC power supply)
4	K9334KD	1	Cable
5	K9332SR	1	Rotating contact
6	K9332MK	1	Counter Electrode
7	K9332MB	1	Indicator Electrode
8	K9334JV	1	Shaft Assembly
9	Y9115XB	1	O-Ring

Item	Part No.	Qty	Description
10	L9831HC	1	Nut
11	L9831HE	1	Sleeve
12	L9852CB	1	Valve
13	K9332KQ	1	Nipple
14	Y9114XB	1	O-Ring
15	K9332KR	1	Cock Assembly
16	Y9110XB	1	O-Ring
17	K9332KP	1	Insert
18	L9831KL	1	Nut
19	L9831KN	1	Sleeve
20	K9332KZ	1	Beads Case Cover
21	K9332ZJ	1	Beads
22	K9332KX	1	Beads Case
23	K9332KL	1	Measuring Cell
24	K9332MS	1	Bracket

Revision Information

- Title : Model FC500G Free Available Chlorine Analyzer (Non-Reagent Type)
- Manual No. : IM 12F5A2-01E

Feb. 2020/7th Edition
CMPL 12F05A02-02EN was revised. (2nd edition)

Apr. 2019/6th Edition
Style change to S2 (pages 1-4, 2-1, 6-1, 6-2, 6-3, 7-1, 8-2)
CMPL 12F05A02-02EN newly released

July 2018/5th Edition
Revision according to the suppliment
Added EMC(Australia and New Zealand) (p.1-2)
Note (p.6-2)
Revised description (p.3-3)

Aug. 2012/4th Edition Page layout changed
All page layout changed by the standard template; p.1-5, Deletion of conductivity measurement in subsection 1.4 Measuring Principle; p.2-2, Deletion of some conductivity measurement description in Figure 2.2; p.3-3, Deletion of subsection 3.3.3 Contact Output Wiring (this function doesn't exist); p.4-2, Deletion of subsection 4.1.3 Setting of Display (Free Available Chlorine or Conductivity) Selection Jumper; p.4-6, Deletion of subsection 4.3.1 "Out-of-Sample Detection" Contact Signal Output; p.7-1, Deletion of "conductivity display shows abnormality", and "Abnomal out-of sample detection" in chapter 7. TROUBLESHOOTING table; p.8-1, Some revision of subsection 8.1 Auxiliaries and Consumables List (P/N of fuse changed).

Oct. 2009/3rd Edition Editted by InDesign
Change the package of glass beads (p.1-3)

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Everything is reviewed.

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