FUJI ELECTRIC

Service Manual

INFRARED GAS ANALYZER

TYPE: ZKJ-2

Fuji Electric Co.,Ltd.

INZ-TN513328-E

PREFACE

This service manual describes the infrared gas analyzer (Type: ZKJ).
This service manual is intended for use with the instruction manual to help you in understanding maintenance and inspection for the infrared gas analyzer (ZKJ). However, the basic operation of the analyzer is not covered in this manual.
This manual provides information about the parameter settings in the factory mode, adjustment and precautions for parts replacement, and troubleshooting for the infrared gas analyzer (ZKJ) which are not covered in the instruction manual.
This service manual gives you useful hints to take immediate remedy for after-sales service.

- First read the instruction manual and service manual carefully until an adequate understanding is acquired, and then proceed to installation, operation and maintenance of the gas analyzer. Wrong handling may cause an accident or injury.
- The specifications of this analyzer will be changed without prior notice for further product improvement.
- Modification of this gas analyzer is strictly prohibited unless a written approval is obtained from the manufacturer. Fuji Electric will not bear any responsibility for a trouble caused by such a modification.

Manufacturer:	Fuji Electric Instruments Co., Ltd.
Type:	Described in Fuji Electric's company nameplate on main frame
Date of manufacture:	Described in Fuji Electric's company nameplate on main frame
Product nationality:	Japan

Issued in January, 2002

CONTENTS

CAUTION ON SAFETY

First of all, read this "Caution on safety" carefully, and then use the analyzer in the correct way.

- The cautionary descriptions listed here contain important information about safety, so they should always be observed. Those safety precautions are ranked in 2 levels, "DANGER" and "CAUTION".

DANGER	Wrong handling may cause a dangerous situation, in which there is a risk of death or heavy injury.
CAUTION	Wrong handling may invite a dangerous situation, in which there is a possibility of medium-level trouble or slight injury or only physical damage is predictable.

Caution on installation and transport of gas analyzer	
DANGER	• This unit is not explosion-proof type. Do not use it in a place with explosive gases to prevent explosion, fire or other serious accidents.
CAUTION	• This product must be installed in a place that meets the conditions specified in the "instruction manual." Use of the analyzer in a place that does not meet the above conditions may result in electric shocks, fire or malfunction. • During installation work, attention should be paid not to allow entrance of wire fragments or other foreign matter into the product. Otherwise, a fire, trouble or malfunction may be caused. • When the gas analyzer needs to be lifted, be sure to put on protective gloves. Don't hold the analyzer with bare hands to prevent injury. • Before transporting the analyzer, fix its casing so as not to open. If the casing is separated and falls, injury may be caused. • The gas analyzer is heavy. For carrying the analyzer manually, have at least two persons conduct it with utmost care. If this caution is ignored, body damage or injury may be caused.

Caution on piping	
⚠ DANGER	**In piping, the following precautions should be observed. Wrong piping may cause gas leakage.** **If the leaking gas contains a toxic component, there is a risk of serious accident being induced.** **Also, if combustible gas is contained, there is a danger of explosion, fire or the like occurring.** • Connect pipes correctly referring to the instruction manual. • Exhaust should be led outdoors so that it will not remain in the locker and installation room. • Exhaust from the analyzer should be relieved in the atmospheric air in order that an unnecessary pressure will not be applied to the analyzer. Otherwise, any pipe in the analyzer may be disconnected to cause gas leakage. • For piping, use a pipe and a pressure reducing valve to which oil and grease are not adhering. If such a material is adhering, a fire or the like accident may be caused.

Caution on wiring	
⚠ CAUTION	• The specified grounding construction is a requisite. Negligence of grounding may cause electric shocks or malfunction. • Be sure to use a power supply of correct rating. Connection of power supply of incorrect rating may cause fire. • Wiring work must be performed with the main power set to OFF to prevent electric shocks. • Wires should be the proper one meeting the ratings of this instrument. If using a wire which cannot endure the ratings, a fire may occur.

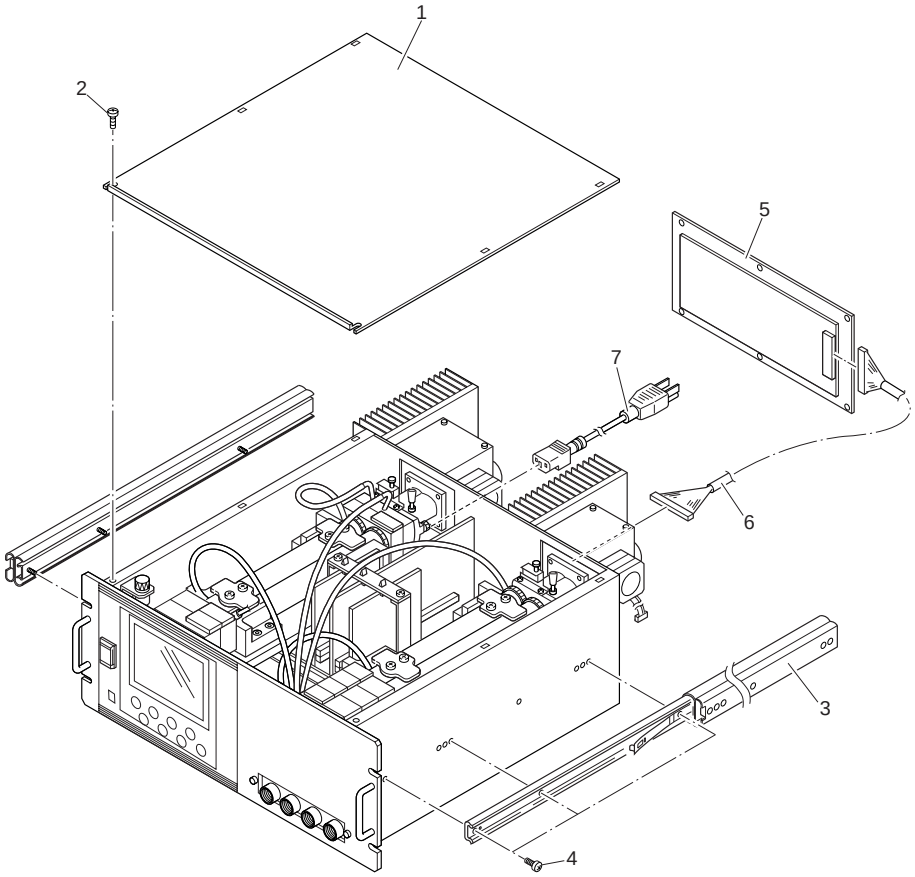
Caution on use	
⚠ DANGER	• When handling standard gas such as calibration gas, read the instruction manual for the standard gas for correct handling.
⚠ CAUTION	• Avoid continuous operation with the casing drawn out. Otherwise, the casing may fall to cause injury. • During operation, never touch the inside with the casing open, because there is a danger of burns or electric shocks.

Caution on maintenance and check	
DANGER	• Before accessing the inside of analyzer with the casing open for capillary replacement or the like purpose, be sure to turn off power supply and purge not only the analyzer inside but also the measuring gas line and auxiliary gas line adequately with the air or N_2 gas. Also, carefully prevent oil, etc. from sticking to the capillary, filter, packing and the like parts. This is required for preventing poisoning, fire and explosion due to gas leak, etc.
CAUTION	• Before starting the work, take off metallic parts such as wrist watch and ring, and never touch the device with wet hands. Otherwise, electric shocks may be caused. • When the fuse is blown, detect its cause and use a new fuse of the same type and capacity as those of the old one to prevent electric shocks or other trouble.

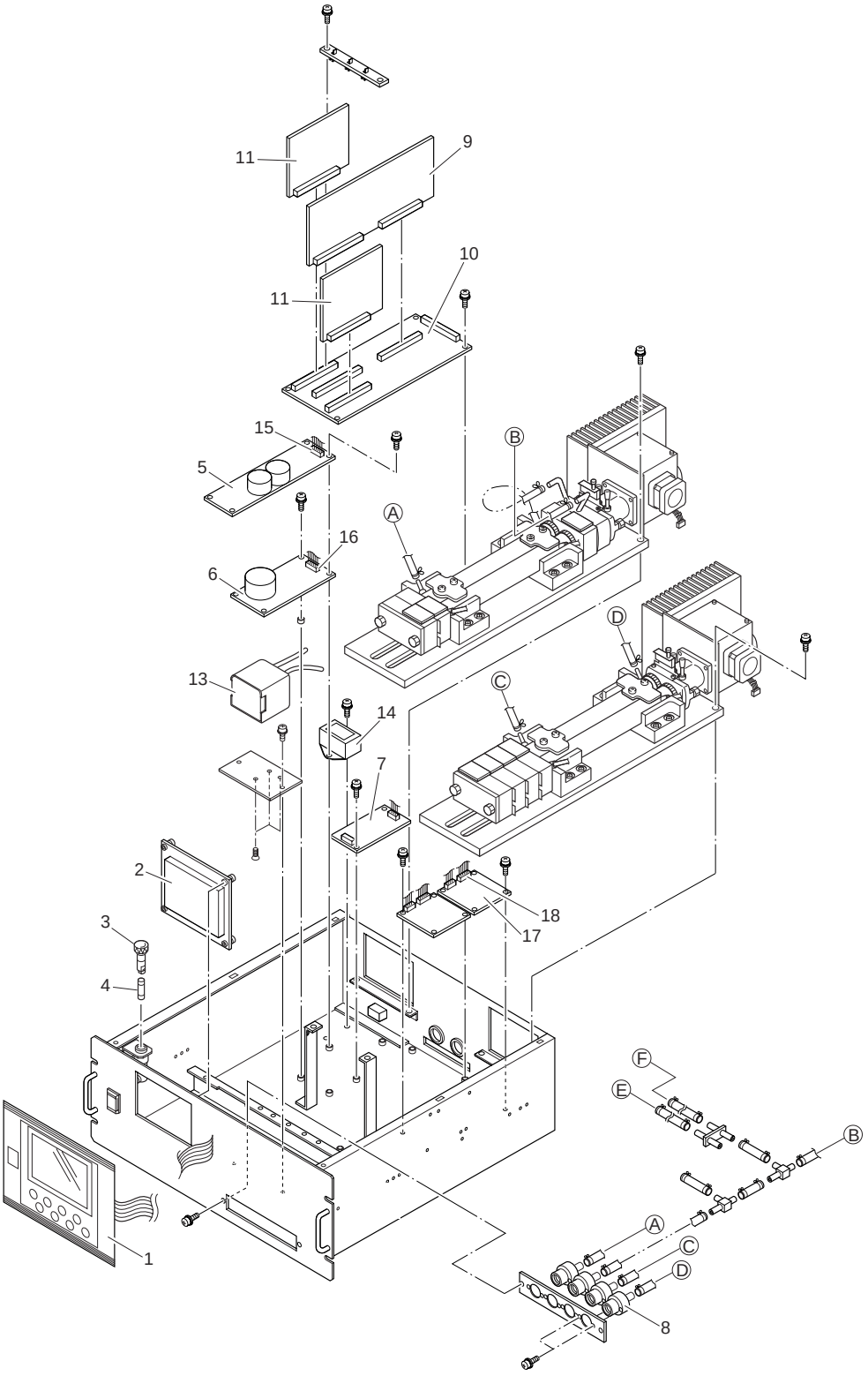
Others	
CAUTION	• If the cause of any fault cannot be determined despite reference to the instruction manual, be sure to contact your dealer or Fuji Electric's technician in charge of adjustment. If the instrument is disassembled carelessly, you may have a shock hazard or injury. • Don't use replacement parts which are not specified by Fuji Electric. Use of such parts will not only degrade performance but also result in an accident or trouble. • The old parts after replacement due to maintenance, etc. must be disposed of as incombustible waste.

1. STRUCTURE OF ANALYZER AND NAMES OF PARTS

(1) Analyzer main unit



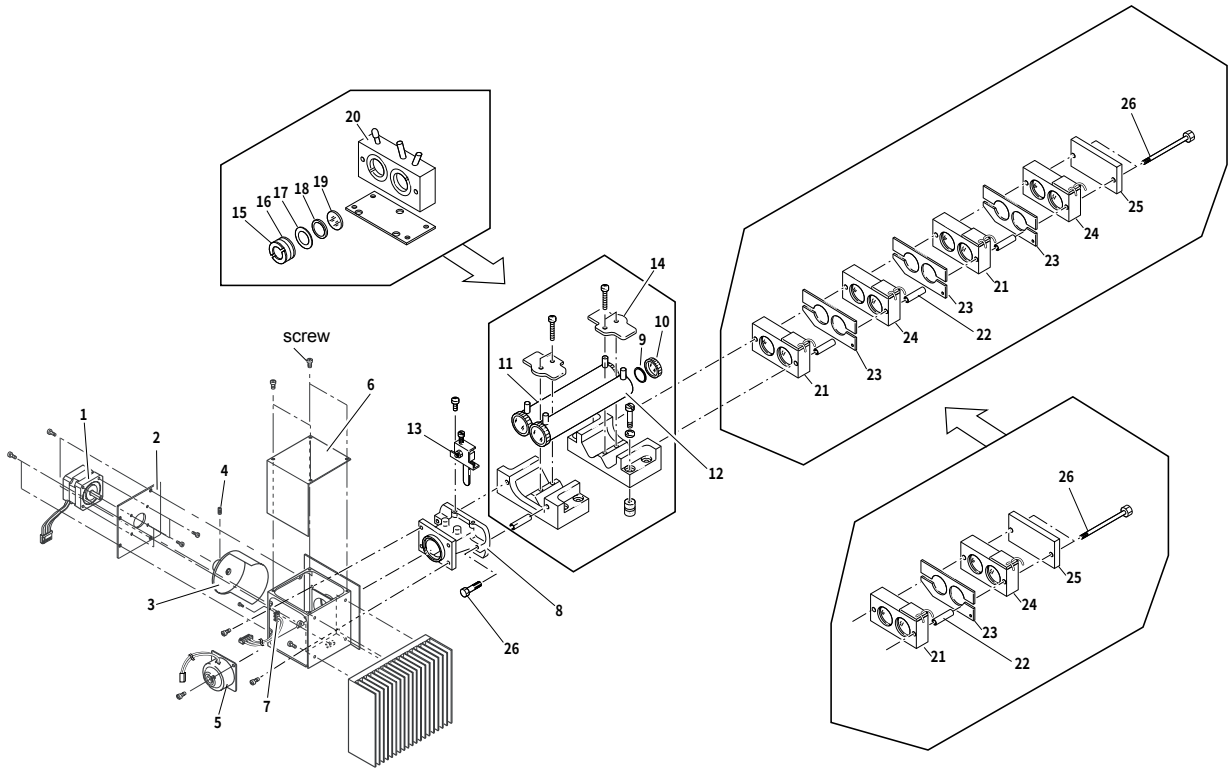
Parts No.	Part name
1	Top cover
2, 4	Mounting screw
3	Slide rail
5	Input/output terminal
6	Input/output cable
7	Power supply cable



Parts No.	Part name	Parts No.	Part name
1	Decorative sheet (with built-in keys)	8	Gas inlet/outlet fittings
2	LCD panel	9	Main P.C.B
3	Fuse holder	10	Mother P.C.B
4	Glass-tube fuse	11	Amplifier P.C.B
5, 6, 7	Switching power supply	13	Built-in paramagnetic O_2 sensor

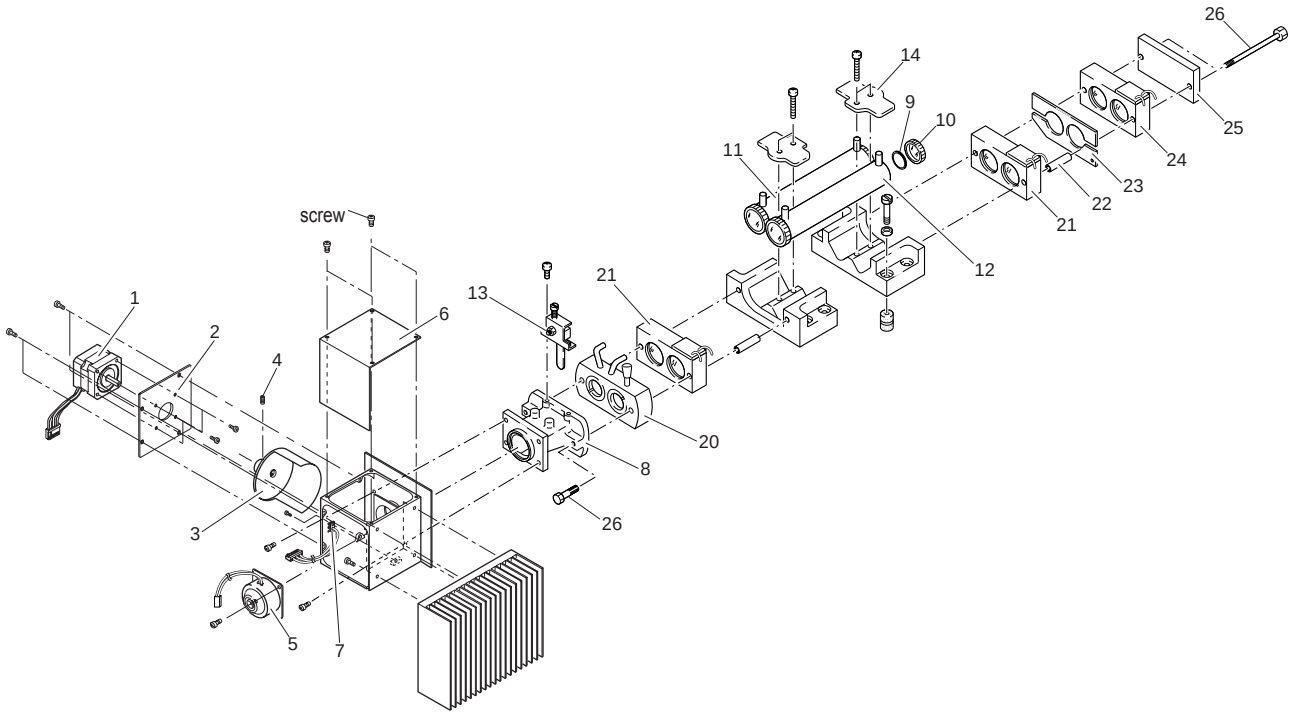
(2) Measuring element

For combination of 1 optical block with one sample cell



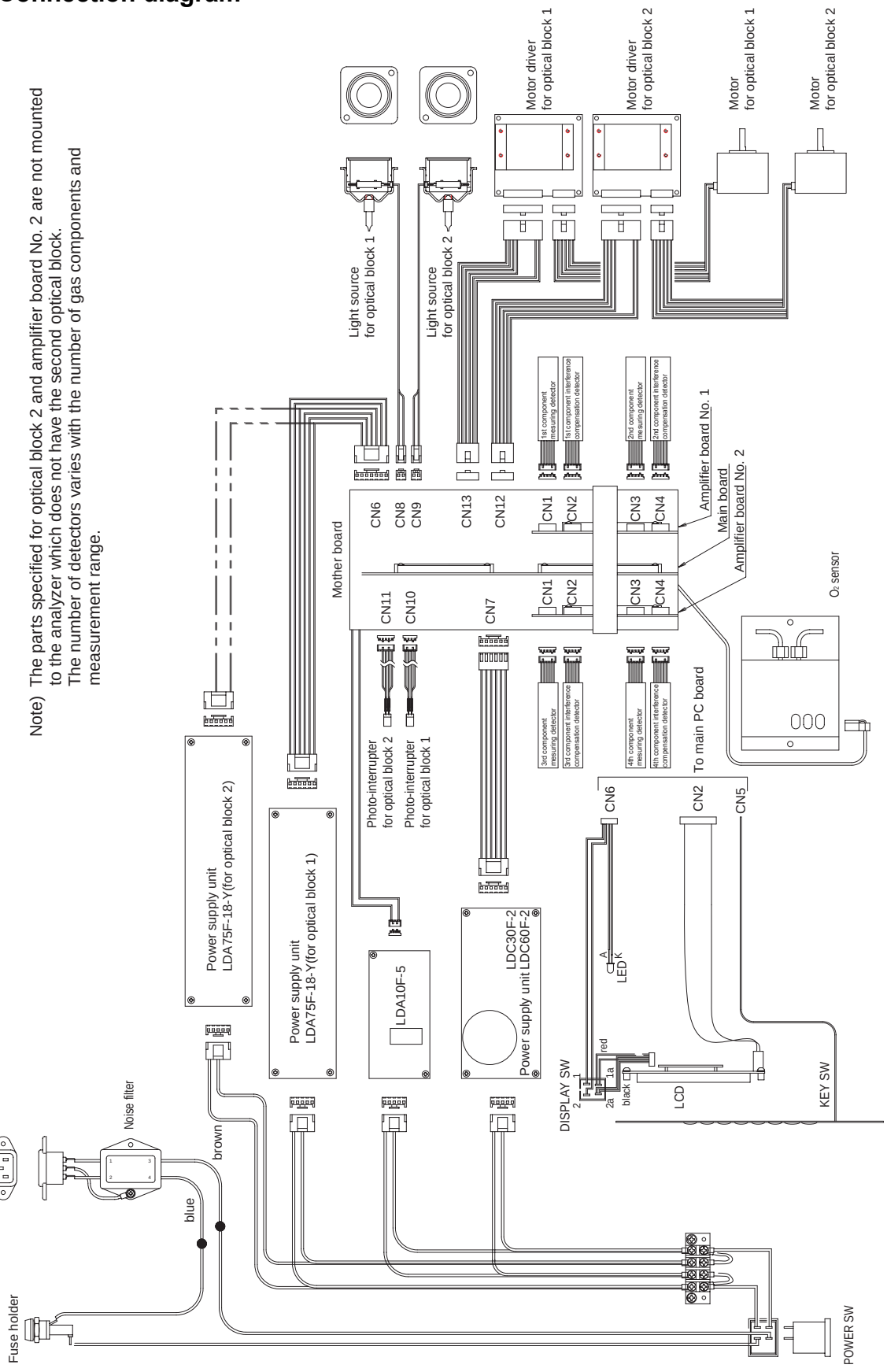
Parts No.	Part name	Parts No.	Part name	Parts No.	Part name
1	Sector motor	10	Cell window (for pipe cell)	18	O-ring 2 (for block cell)
2	Motor mounting plate	11	Reference cell	19	Cell window (for block cell)
3	Sector	12	Sample cell	20	Block cell
5	Infrared light source	13	Trimmer assembly	21	Measurement detector
6	Light source unit cover	14	Cell pushing	23	Light control plate
7	Photo-interrupter	15	Window pushing	24	Interference compensation detector
8	Distribution cell	16	O-ring 1 (for block cell)	25	Light shielding plate
9	O-ring (for pipe cell)	17	Washer		

For combination of 1 optical block with 2 sample cells

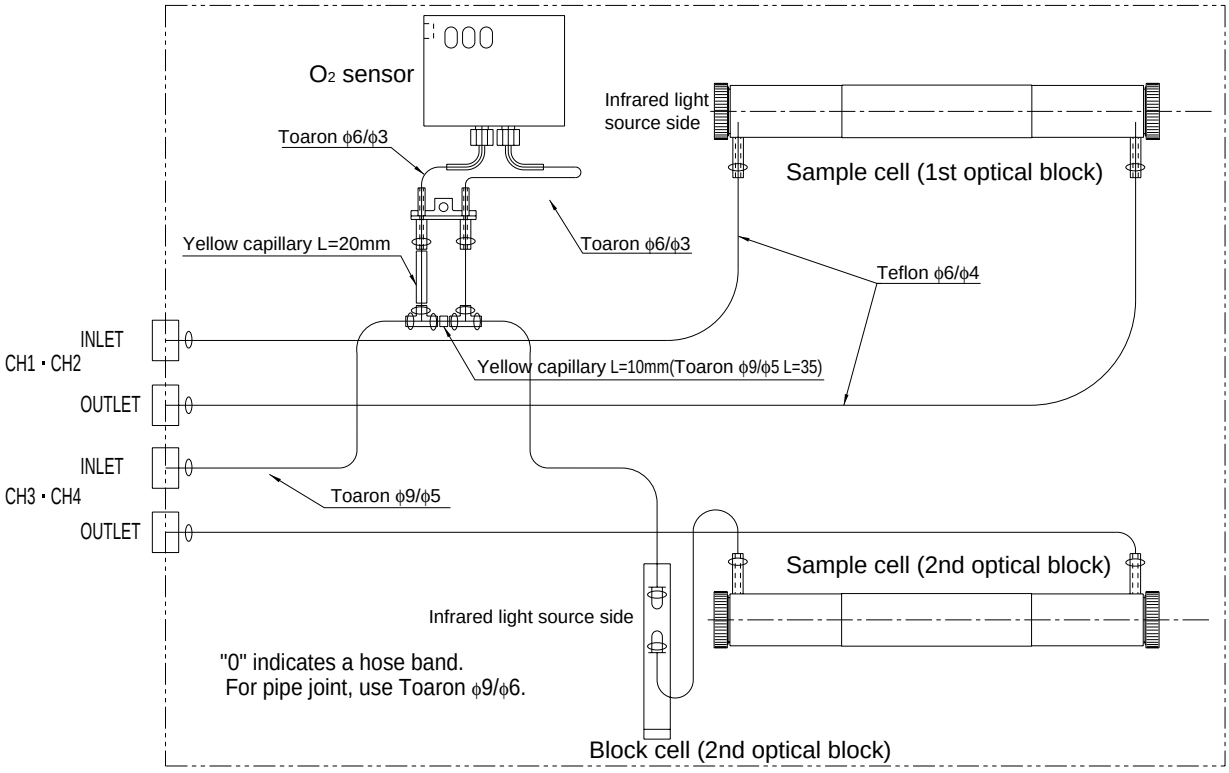


(3) Connection of parts

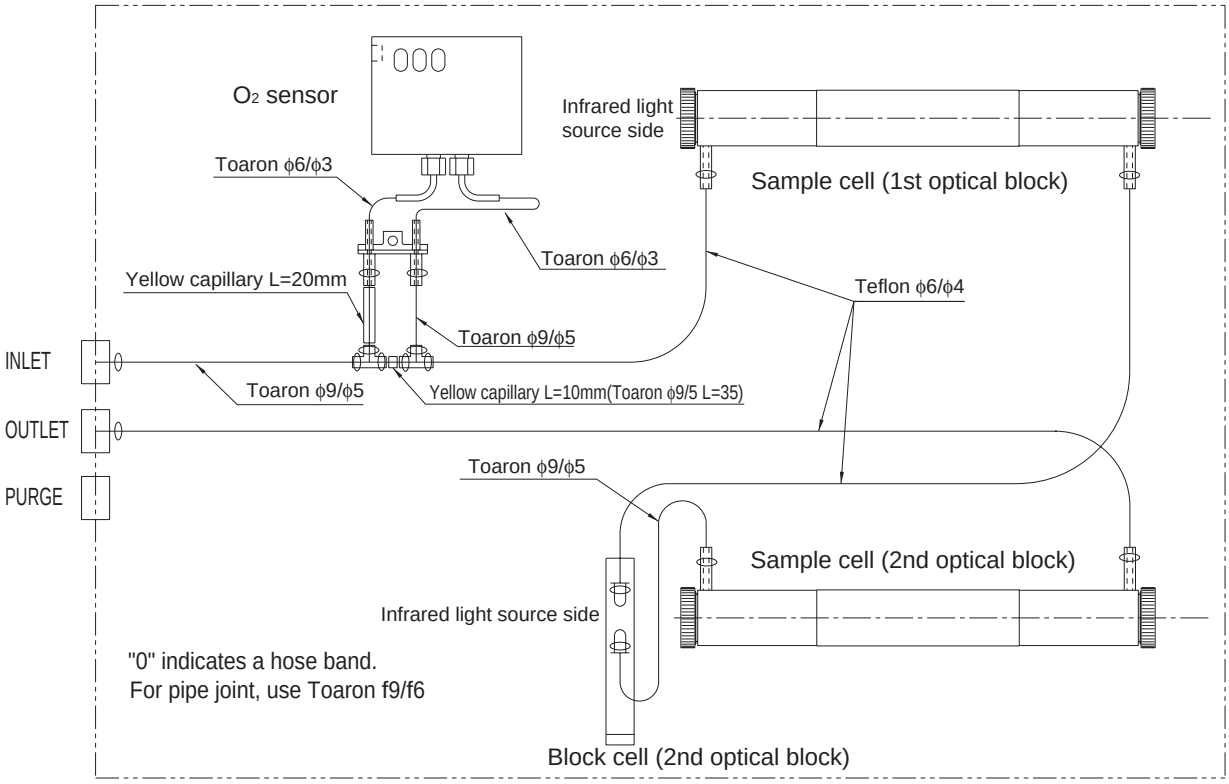
- **Connection diagram**



- **Piping diagram**



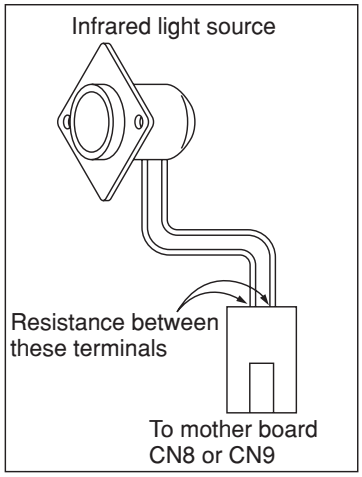
This is a piping diagram of the analyzer without a purging line.
When the O_2 meter and the second optical block are not provided,
pipes must be connected by bypassing them.



This is a piping diagram of the analyzer with a purging port.
When the O_2 meter and the second optical block are not provided,
pipes must be connected by bypassing them.

2. MAINTENANCE AND INSPECTION, AND REPAIR AND ADJUSTMENT AT REPLACEMENT OF MEASURING UNITS

(1) Light source



- Recommended period of replacement : 5 years

  1) Error mode : Short circuit in and disconnection from the light source electrically heated wire.
  Phenomena : Scale-out indication of analyzer.
  Check : Turn OFF the power of the analyzer and remove the power cable connected to the light source. (Unplug the CN8 and CN9 connectors on the mother board.)
  Make sure a voltage of 19.8 ± 0.5 V is output between pins 1 and 2 of CN8 or CN9 on the mother board.
  Measure the resistance between the terminals of the connector (having 2 pins) on the light source side.
  The measured value is normally 20 Ω ± 2 Ω.
  When the resistance value is infinite, cabling is discontinuous.
  As the resistance value decreases, the span narrows (sensitivity is degraded).

  2) Error mode : Sealed gas in light source leaks.
  Phenomena : Fluctuated indication
  Check : If the analyzer output is drifted due to ambient conditions around the analyzer and other units are normal except for the light source, sealed gas may leak.

  3) Error mode : Separation of light source fixing spring
  Phenomenon : Analyzer's indication of measured value is unstable or surpasses the scale, and optical balance cannot be adjusted.
  Check : Remove the light source unit and check it visually.

- Measures : If the light source is found defective, replace the light source unit.
- Replacement : Unplug connectors CN8 (for 1st optical block) and CN9 (for 2nd optical block) on the mother board. Open the light source unit cover, remove the two screws which fasten the light source and replace the light source unit with a normal one.
- Adjustment after replacement : Optical balance adjustment and zero/span calibration

(2) Sector motor and sector

- Recommended period of replacement : 2 years (Sector motor)
  1) Error mode : Motor rotation stop
     Phenomena : Analyzer's measured value surpasses the scale or indicated value does not change, and ERROR-1 occurs.
     Check : With the analyzer powered on, remove the light source cover and make sure the sector is rotating.
  2) Error mode : Unstable rotation or stop of a sector
     Phenomena : Scale-out indication of analyzer: Error- 1 occurs.
     Indication is fluctuated.
     Check : With the analyzer power ON, check if unusual noise is generated from the motor due to metal contact. (Sound at a constant high frequency is not abnormal.) If no noise is heard, remove the light source unit cover. Turn ON the power of the analyzer and check the rotation of motor shaft and sector
- Measures : If the sector motor is defective, it must be replaced with a new one.
- Replacement : Detach the light source unit cover. Unplug the connector which is connected from the motor to the motor driver and pull the cable out of the cubicle through the grommet hole. Remove four screws (M4) from the motor mounting plate which is fastened to the base of light source unit, and the motor and sector can be pulled out. The sector can be separated by removing the sector setscrew which fastens the sector to the motor shaft, and then the motor can be separated by removing four screws from the motor mounting plate. Fasten a replacement motor to the mounting plate and mount the motor by reversing the demounting procedure. For mounting the motor, rotate the sector manually before fixing the motor cover, and make sure the sector does not come in contact with the light source base, light source, photo-interrupter, wires, etc. (frictional sound must not be emitted). Finally, fix the light source unit cover.
- Adjustment after replacement:
  Check of optical balance (adjust if significantly deviated) and calibration of zero/span points

(3) Reference cell

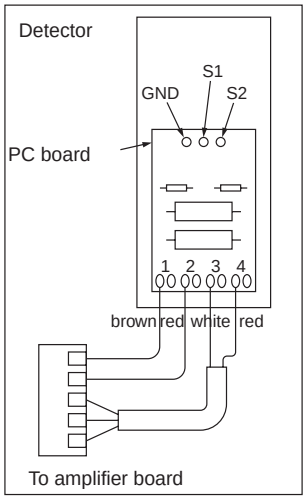
- Recommended period of replacement: 5 years
  Error mode : Leakage of gas filled in cell
  Phenomenon : Analyzer's measured value is unstable (in particular, stability against change in ambient temperature is degraded).
- Measures : Replacement of reference cell
- Replacement : Remove the reference cell and mount a new one.
- Adjustment after replacement:
  Optical balance adjustment, moisture interference adjustment and zero/span calibration

(4) Cell, cell window and O-ring

- Service life : Usable unless contaminated or corroded.
- Recommended period of replacement : 2 years with O-ring
  1) Error mode : Contamination of cell, mixture of foreign matter, and contamination of cell window
     Phenomena : Scale-out indication, drift and calibration error occurred to analyzer
     Check : Disassemble the cell to assure that the inside is clean.
  2) Error mode : Crack in cell window
     Phenomena : No change in indication, slow response, calibration error, and indication fluctuation
     Check : Perform a visual check of the cell window.
- Measures : Cell : Clean the inside of the cell (refer to the instruction manual for details). Replace If the inside is exposed to excessive contamination or corrosion.
  Cell window : Clean the cell window. Replace if the inside is exposed to excessive contamination.
- Adjustment after clean and replacement :
  Check of optical balance (adjust if significantly deviated) and calibration of zero/span points and response.

(5) Detector (except for O_2 sensor)

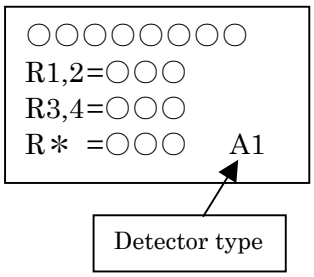
- Recommended period of replacement : 5 years
  1) Error mode : Damage to mass-flow detector
     Phenomena : Scale-out indication of analyzer , calibration error occurs.
     Check : Turn OFF the power of the analyzer and disconnect the connector connected from the detector to PC board. Measure each resistance between GND and S1 on the PC board of detector and between GND and S2. The measure values must be between 25Ω and 60Ω. If the resistance value is beyond the specified range, the detector element may be damaged.



Note) For resistance measurement, avoid using a measuring device such as analog tester that flows a current of 2 mA or more. If used, the detection element may be damaged.

  2) Error mode : Sensitivity deterioration due to sealed gas leak
     Phenomena : Calibration error, fluctuation in indication and poor stability of analyzer's measured value
     Check : After making sure the light source is normal and the cell is clean, check moisture sensitivity. (For the method of fault judgment and sensitivity check, refer to "5(3) Troubleshooting of detectors" in "5. TROUBLESHOOTING AND DATA COLLECTION.")
- Measures : Replace detector.

- Replacement :
  Turn off power supply to the analyzer, remove the bolts which fix the detector and remove the detector. Mount a new detector and tighten the bolts.
  The type of detector varies with the gas component to be measured. So before mounting, check the symbol marked on the detector label.
- Adjustment after replacement :
  Optical balance adjustment, moisture interference adjustment and zero/span calibration



(6) Built-in O_2 sensor

- Recommended period of replacement : 10 years
- Error mode : Breakage of O_2 sensor
- Phenomenon : Zero is read on the O_2 meter and the reading remains unchanged even for the span gas.
- Check : Confirmation of O_2 input voltage --- Measure the voltage between check terminals TP4 and SC on the main PC board using a digital voltmeter, and make sure the voltage is about 0 V for zero gas and 0.5 to 1 V for span gas. If the voltage does not change between the zero and span gases, the O_2 sensor is damaged.
- Measures : Replacement of O_2 sensor
- Replacement : Turn OFF the analyzer main unit
  Unplug the O_2 sensor connector. Then, remove the screws which fasten the O_2 sensor mounting plate to the main frame and separate the O_2 sensor together with the mounting plate. The O_2 sensor is fixed by screws from the rear side of the mounting plate. So remove the screws to detach the O_2 sensor. A new sensor is mountable by reversing the above procedure.
- Adjustment after replacement :
  Zero and span calibration

(7) Printed circuit board (see printed circuit diagram at the back of the manual)

1) Main printed circuit board (main board)

Note) The main board is set according to the specifications of each analyzer. When placing an order for a replacement PC board, notify the serial number of your analyzer in advance so that the new board will have suitable parameters in it.

- Check : Check of circuit voltage

Check terminal	Adjusting VR	Regulated voltage	Contents
GND1-Vcc	-	+5±0.2V	Digital 5 V
VG1-P15	-	+15±0.5V	Analog 15 V
VG1-N15	-	−15±0.5V	Analog −15 V
GND1-3.3V	-	+3.3±0.1V	Digital 3.3 V
GND2-TP10	VR4	About +26 V	LCD drive voltage, contrast adjustment

- Precautions on replacement:

- The cable (connector CN2) from LCD is connected to the main printed circuit board.
  Do not unplug or plug the connector from or into the board with the analyzer power ON, or the electronic parts and indication block may be damaged.
  Before replacement, be sure to turn OFF the analyzer.
- The cable (connector CN5) from the membrane key is connected to the main printed circuit board. Since a stopper is provided on the CN5 connector, the flexible cable should not be pulled forcibly. Forcible pulling may result in poor contact. For disconnecting the flexible cable, slide the stopper lightly toward you by holding both sides of CN5 with fingers. And for reconnecting the flexible cable, insert it fully down to the bottom and attach the stopper. (The flexible cable should be inserted with its contact face directed toward the printed circuit board.)
  - Adjustment after replacement

    The above-mentioned voltage check/adjustment and contrast adjustment (VR4). Contrast should be adjusted so as to be easy to see indications at the height of your eyes.
    In factory mode, zero offset adjustment, zirconia adjustment (when equipped with zirconia O_2 meter) and output adjustment (For adjustments in factory mode, refer to “factory mode” in this manual.)
    Moisture interference adjustment and zero/span calibration

2) Amplifier printed circuit board (amplifier board)) One board provided for each optical block (the following check items are for one board)

- Check : Check of circuit voltage

	Check terminal	Regulated voltage	Contents
a	SG-P15	+15±0.5V	+15 V power supply
b	SG-N15	−15±0.5V	−15 V power supply
c	N15-DV1	+17.5±0.5V	1st component detector power supply (used in common for Main and Compo.)
d	N15-DV2	+17.5±0.5V	2nd component detector power supply (used in common for Main and Compo.)
e	SG-TP5	+2.5±0.1V	Reference voltage for A/D conversion

Check of signal processing block:

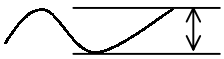
Unplug all connectors of the cables from the detector.

Display the screen for "12. A/D Data" in Factory Mode.

In the A/D Data screen, numbers 0 to 3 stand for signals from the amplifier board for the 1st optical block and numbers 4 to 7 stand for signals from the amplifier board for the 2nd optical block.

Check if the count value in each number lies within a range of 15000 ± 1000.

Detector signal check (check by flowing the following gases)

Check terminal	Under zero gas flow	Under span gas flow	Under 2°C-wet zero gas
SG-TP1		1.0 to 2.0Vp-p	TP1 and TP2 at almost the same magnitude
SG-TP2		-	
ST-TP3	8.33 Hz, 0.2 Vp-p max. in AC signal width	1.0 to 2.0Vp-p	TP3 and TP4 at almost the same magnitude
SG-TP4		-	

* TP2 and TP4 signals are 0 V when the lower end of measuring range is 0 to 10% or more.

- Precautions on check:

  The amplifier board is connected to the mother board by connector.

  If the connector is not plugged in adequately, the above check may not bring about a normal result. Before check, make sure the connector is plugged in correctly.

- Precautions on replacement:

  A cable from the detector is connected to the amplifier board. If the connector is unplugged or plugged in with the analyzer power ON, the detector may be damaged. Before replacement, be sure to turn off the power supply.

- Adjustment after replacement:

  Verification of the contents of the above checks, adjustment as per "4. Zero Offset" in Factory Mode and zero/span calibration

3) Mother printed circuit board (mother board)

- Adjustment after replacement:
  Output adjustment (Refer to “10. Output Adj.” in Factory Mode.)

4) I/O terminal printed circuit board (I/O terminal board)

- Adjustment after replacement :
  Output check (Adjust if output is offset. Refer to “10. Output Adj.” in Factory Mode.)

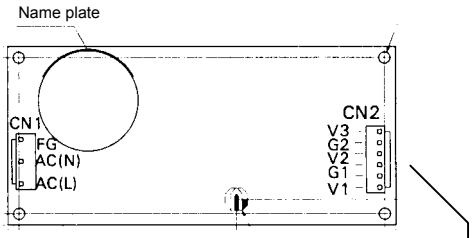
(8) Liquid crystal display (LCD)

- Service life of parts : 5 years
- Error mode : Deterioration
- Phenomena : LCD is not displayed, or the display is dim or flickers.
- Check : Check LCD drive voltage on the main board. (See “Check for printed circuit board”)
  Check connection to the main board.
- Countermeasures against error : Replace LCD.
- Replacement : Turn OFF the power. Disconnect the connector from the main printed circuit board and replace it with a new one.
- Adjustment after replacement :
  Check the drive voltage and adjust the contrast

(9) Power supply

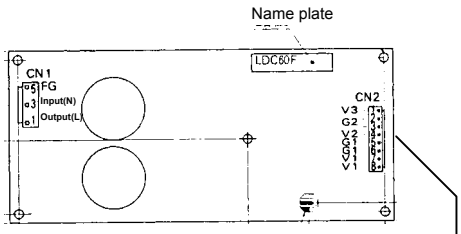
- Recommended period of replacement : 5 years
- Error mode : Power-down
- Phenomena : No display and no output
- Check : Check if short circuit occurs.
  Disconnect the secondary SW power connector. Turn ON the power and check the voltage at the connector. If no voltage is applied to it, replace.
- Measures : Replace the S.W. power supply
- Replacement : Turn OFF the instrument power. Disconnect the connector from the motherboard and replace it with a new one.
- Check after replacement :
  Check the power supply voltage on the main printed circuit board.

LDC30F-2



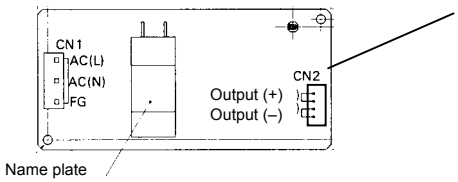
Pin	Symbol	Voltage
1	V3	–15V
2	G2	
3	G2	
4	V2	+15V
5	G1	
6	V1	+5V

LDC60F-2

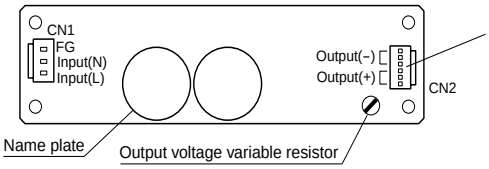


Pin	Symbol	Voltage
1	V3	–15V
2	G2	
3	G2	
4	V2	+15V
5	G1	
6	G1	
7	V1	+5V
8	V1	+5V

LDA10F



Pin	Symbol	Voltage
1	–V	
2	–V	
3	+V	+5V
4	+V	+5V



Pin	Symbol	Voltage
1 to 3	–V	
4 to 6	+V	+19.8V

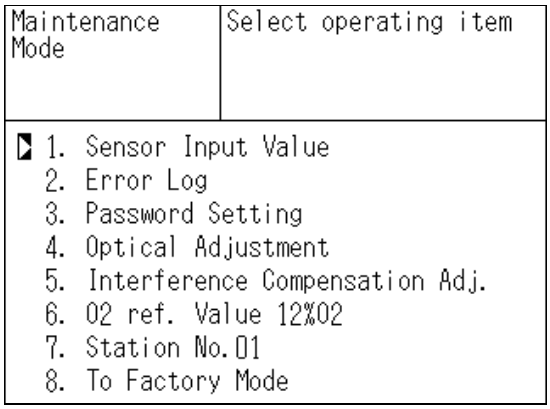
(10) Membrane key

- Error mode : Key contacts are worn.
- Phenomena : It prevents the switch from being operated.
- Check : Check for the contacts with main printed circuit board
- Measures : Replace the membrane key.
- Replacement : Turn OFF the power. Disconnect the connector from the main print circuit board. Remove soldered portion of the power switch and remove the power switch from the main instrument. Strip off membrane key and adhesives are wiped off completely. Then, replace it with a new one.
  Remove the power switch and install it in the reverse procedure as removal. Connect the key cable to the connector of the main print circuit board.
- Check after replacement :
  Check key-in operation.

3. FACTORY MODE

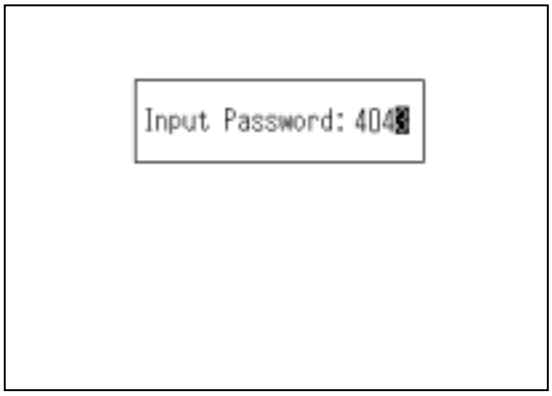
(1) How to go to factory mode

Point the cursor to “8. To Factory Mode” by using the ▲ or ▼ key on the Maintenance Mode screen and enter the ENT key. Then, the password input screen appears.



ENT

Enter the password.
To select setting items, set “4 0 4 3”.
(“8. O2 Adj.,” “10. Output Adj.” and “13. Others.” are settable with “4043.” Items 1, 2, 3, 5, 6, 7, 9, 12, 13, 14, 15, 16 and 17 can be viewed.)
Select digits by the ▶ key.
Change numerical values by using ▲ or ▼ key.

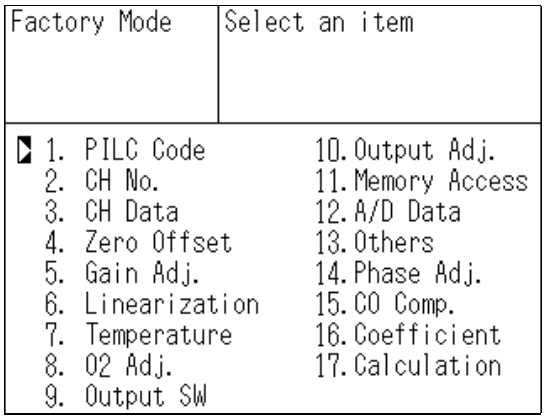


After password entry has been completed, press the ENT key, and the Factory Mode initial screen appears

ENT

How to select setting item from Factory Mode screen

On the Factory Mode screen that appears, point the cursor to the item you want by using the ▶, ▲ or ▼ key.
To get access to each setting screen, press the ENT key.



To return from each setting screen to the initial screen, press the ESC key.
When escaping from the Factory Mode screen to the Maintenance Mode screen, press the ESC key.

ESC ESC

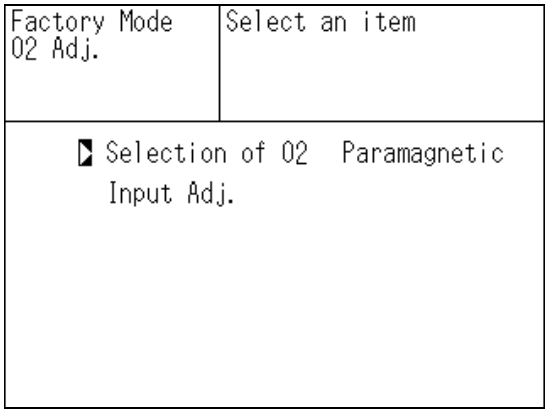
Into each parameter screen

(2) Setting

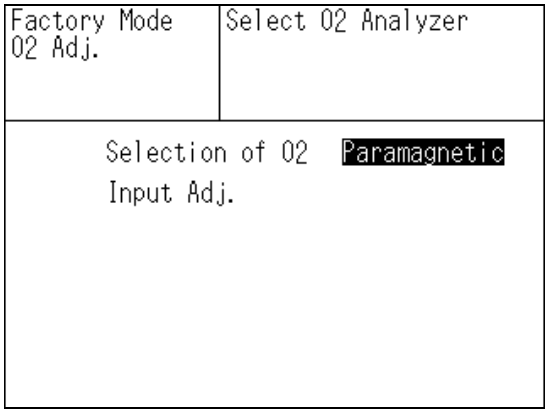
1) O_2 adjustment

- Function : Paramagnetic, External O_2 or Zirconia sensor is selectable. Necessary adjustment can be carried out for each oxygen measurement.
- Operation : The setting screen where O_2 adjustment is performed is as follows.

Factory mode initial screen
The cursor is in 8



Selection of O_2 sensor
Match the cursor with Selection of O_2 and press the ENT key. Indication of this setting item will be inverted



Setting item can be changed by pressing ▲ and ▼ keys and its selection can be determined by the ENT key.

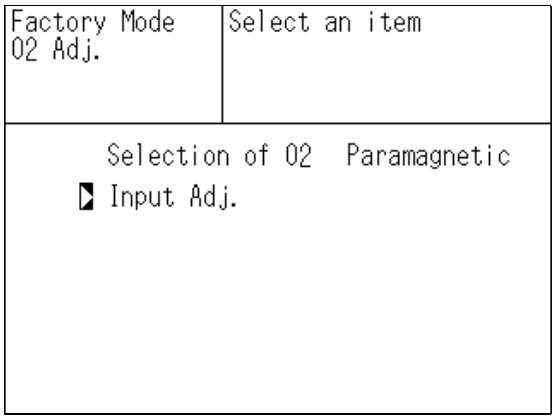
When "Paramagnetic" and "External O_2" are selected, "O_2 offset" is displayed in the setting item. When "Zirconia" is selected, "Zirconia adjustment screen" is displayed in the setting item.
After "Selection of O_2," O_2 offset adjustment or zirconia adjustment can be carried out.

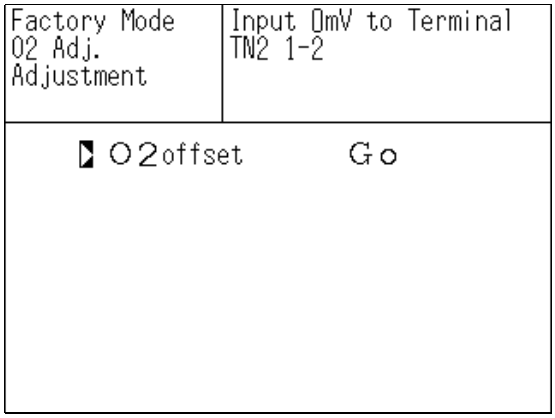
In case of O_2 offset adjustment

O_2 offset adjustment allows you to store electrical offset required for measurement by using a paramagnetic sensor and external O_2 meter.

(Note) For using the built-in O_2 sensor, unplug the O_2 sensor connector before adjustment. Unless unplugged, the O_2 sensor may become faulty.

- Operation : The O_2 offset adjustment screen is shown at the right.
  For this adjustment, input 0 V to or shot-circuit the O_2 input terminal of ZKJ-2.



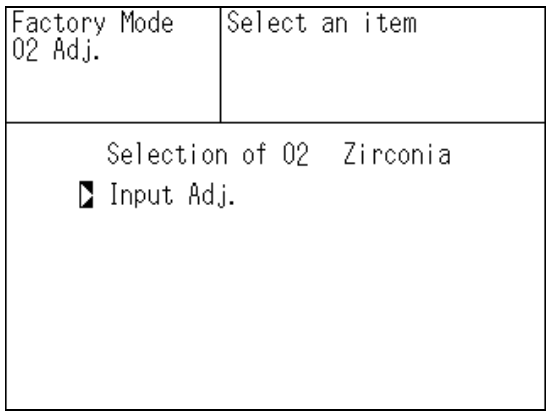


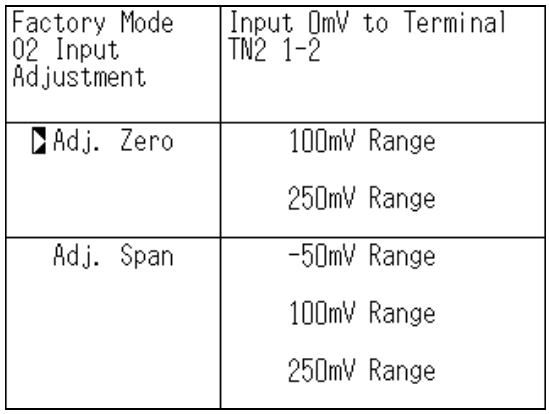
1) Add 0 mV (short) to the O_2 input.
2) With the cursor placed next to "Input Adj." (O_2 offset adjustment), the "O_2 Offset" screen is displayed by pressing the ENT key.
3) Press the ENT key on the "O_2 offset" screen, and the message appears, prompting you to verify that you want to offset the O_2 sensor.
4) After confirming that the O_2 input is completed, press the ENT key to save the offset values. Each gain is automatically exchanged to save the offset values. About 15 seconds will be required for saving. When "Go" is selected, the "Now offsetting" message appears. After offset, the screen returns to the one shown in right.

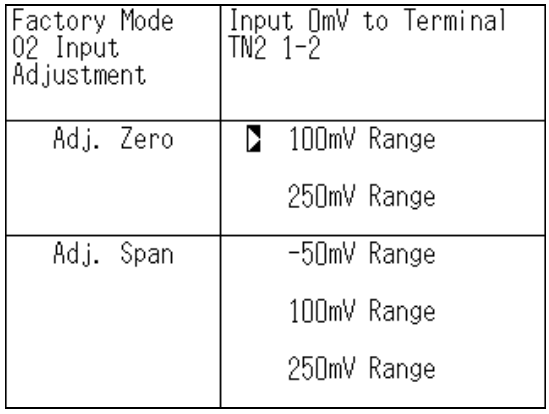
In case of zirconia adjustment

When measuring the O_2 concentration, the data can be stored for converting A/D counter values into voltage values.

- Operation : Zirconia adjustment screen is shown at right.
  For this adjustment, disconnect the cable from the O_2 sensor to input terminal of ZKJ, connect a reference voltage generator to the input terminal and perform zirconia adjustment while applying each voltage (simulative input) to the terminal.







1) Apply 0 mV to the O_2 input terminal.
2) With the cursor placed next to Adj. Zero, press the (ENT) key to move the cursor to a position next to "100mV Range".
3) Press the (ENT) key after about 10 seconds have passed, the voltage value is saved and the cursor moves to the "250mV Range".
4) Press the (ENT) key in about 10 seconds, the voltage value is saved and the cursor returns to "100mV Range".
5) Press the (ESC) key and escape from "Adj. Zero".
6) Move the cursor to "Adj. Span" and press the (ENT) key. The cursor move to "–50mV Range". Enter –50 mV and press the (ENT) key in about 10 seconds. The cursor will move to "100mV Range".
7) With the cursor placed on "100mV Range", apply 100 mV and press the (ENT) key in about 10 seconds. The cursor will move to "250mV Range".
8) With the cursor placed to "250mV Range", apply 250 mV and press the (ENT) key in about 10 seconds. The cursor will return to "–50mV Range".
9) Press the (ESC) key, and adjustment is completed.

* After adjustment has been completed, check that the indication value is within the range of ±0.2 mV with respect to the input value when 0, 50 and 150 mV is applied to the O_2 input terminal according to "1. Sensor Input Value" in the Maintenance mode. If the indication is beyond the range, repeat steps 1) to 9).

2) Output adjustment

- Function : Adjust the zero point and span point of the analog output to 4 to 20 mA or 0 to 1 V.
- Operation : The Analog Output Adjustment screen is as shown in right.

Factory mode initial screen
The cursor is in 10

Select any of the output terminals (OUT 1 to 12) to be adjusted by using the ▲ or ▼ key and connect a digital multi-meter to the output terminal.
* Correspondence of the OUT number to output terminal
OUT 1 to 12 corresponds to CH1 to CH12.
Set value is inverted by pressing the ENT key.

Factory Mode Output Adj. | Adjust OUTPUT ZERO and SPAN

OUT	ZERO	SPAN	OUT	ZERO	SPAN
1	01900	12500	7	01900	12500
2	01900	12500	8	01900	12500
3	01900	12500	9	01900	12500
4	01900	12500	10	01900	12500
5	01900	12500	11	01900	12500
6	01900	12500	12	01900	12500

Use the ▲ or ▼ key and adjust the indication so that the digital multi-meter reads 4 mA or 0 V for zero-point adjustment and 20 mA or 1 V in case of span-point adjustment.
* The indication can be increased or decreased by using the ▲ or ▼ key. If the values are larger than expected, change the upper-significant digit by using the ▶ key.
Adjustment is established by pressing the ENT key.
If you don't want to establish adjustment, press the ESC key.

Factory Mode Output Adj. | Adjust OUTPUT ZERO and SPAN

OUT	ZERO	SPAN	OUT	ZERO	SPAN
1	0190	12500	7	01900	12500
2	01900	12500	8	01900	12500
3	01900	12500	9	01900	12500
4	01900	12500	10	01900	12500
5	01900	12500	11	01900	12500
6	01900	12500	12	01900	12500

- Contents of setting values :
  The output number (OUT 1 to 12) corresponds to CH1 to CH12.
  The set values are converted into the digital values to transfer to the D/A converter.

- Adjustment value:

Voltage output:	0 V	Within 0V ±0.002 V (Adjust so that error is minimized.)
	1 V	Within 1V ±0.002 V (Adjust so that error is minimized.)
Current output:	4 mA	Within 4mA ±0.05 mA (Adjust so that error is minimized.)
	20 mA	Within 20mA ±0.05 mA (Adjust so that error is minimized.)

3) A/D data

- Function : Measures the counter readings immediately after A/D conversion.
- Operation : To measure the counter readings, press the (ENT) key on the "Factory Mode" initial screen.

Factory mode initial screen
The cursor is in 12

Factory Mode
A/D Data

Ainp NO	Count	Ainp NO	Count
0	13913	8	20001
1	11851	9	15900
2	15544	10	11163
3	19978	11	11161
4	17836	12	59742
5	15812	13	60258
6	12032	14	60186
7	14241	15	59855

Ainp No.	Type	Ainp No.	Type
0	Optical block 1-1, Main	8	Oxygen input
1	Optical block 1-1, Compo.	9	Temperature
2	Optical block 1-2, Main	10	-
3	Optical block 1-2, Compo.	11	-
4	Optical block 2-1, Main -	12	Optical block 1 motor pulse +
5	Optical block 2-1, Compo.	13	Optical block 1 motor pulse -
6	Optical block 2-2, Main	14	Optical block 2 motor pulse +
7	Optical block 2-2, Compo.	15	Optical block 2 motor pulse -

When supplying zero gas (dry);

No. 0 to 7 (infrared component) : No problem within 10000 to 22000 (However, ignore the values where no detector is available.)

No. 8 (oxygen sensor input) : No problem within 10000 to 18000 (However, if an oxygen meter is not provided, ignore this input.)

No. 9 (temperature sensor input) : No problem within 5000 to 18000.

No. 12 to 15 : No problem within 58000 to 61000 (If the 2nd optical block is not provided, ignore Nos. 14 and 15.)

4) Other parameters

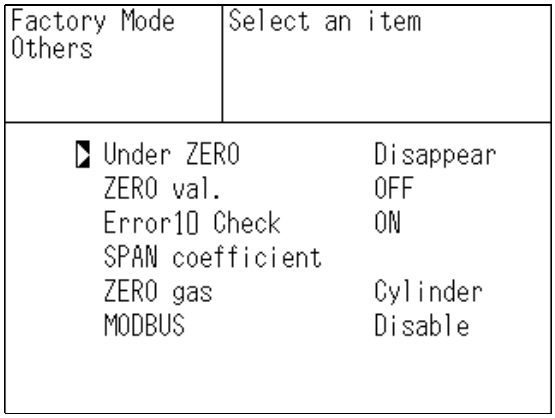
- Selection of minus indication:

Function : Minus-side indication (below zero) of measured concentration values can be selected or avoided.

Operation : Minus indication selecting screen is shown at right.

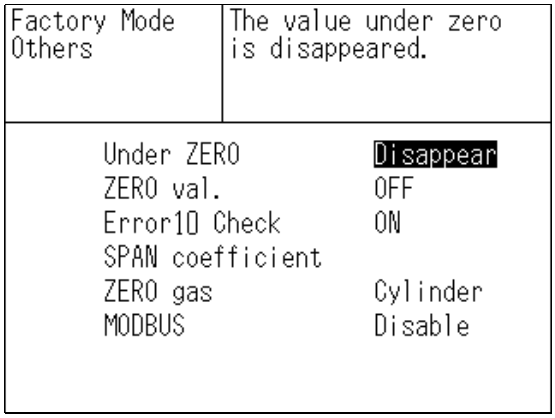
Factory mode initial screen
The cursor is in 13

Invert indication of the setting item by the (ENT) key.



Select Disappear/Appear by (▲) and (▼)keys.

Press the (ENT) key for determining your setting, or the (ESC) key for avoiding it.



Contents of setting:

Yes; Indicates and outputs the minus side.

No: Avoids indication and output of the minus side.

Initial value : Disappear

*** This mode is used for checking the indication in adjustment.**
When "Appear" is set for Minus Indication prior to adjustment, be sure to set "Disappear" after adjustment.

- Calibration concentration zero variable

Function : Turn ON this setting when calibration to a value other than 0 is desired in zero calibration, and a calibration concentration at zero point will become settable.

Operation : Invert the relevant setting as in the selection of minus indication and select ON or OFF as desired.

Contents of setting :

OFF; Fixes the calibration value at zero point to 0.

ON; Makes the calibration value at zero point variable.

Initial value : OFF

- Error 10 judgment

  Function : It is settable whether to judge an error (Error 10) which occurs if the connection to the input/output terminal is abnormal.

  Operation : ON/OFF selection as in the above item

  Contents of setting:

  ON; Selects Error 10 judgment.

  OFF; Avoids Error 10 judgment.

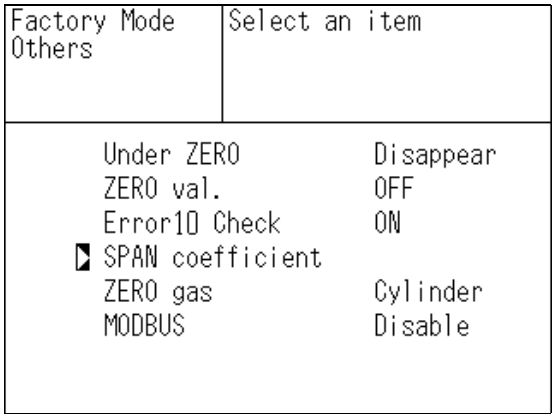
  Initial value : ON

- Range link calibration coefficient

  Function : The calibration coefficient to be used for calibration can be checked and initialized when range-linked calibration is set in user-mode calibration setting and calibration range action.

  Operation : Operation and screen are described below.

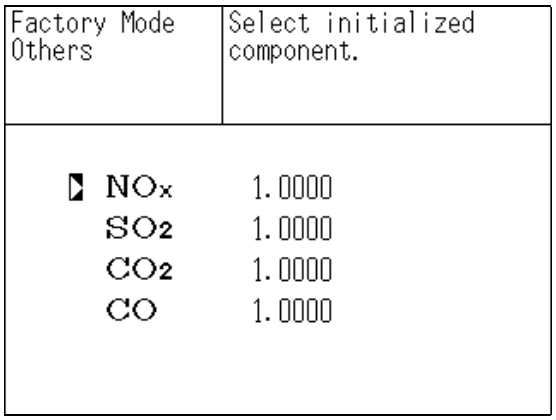
  Press the (ESC) key for entry into the coefficient check and clearing screen.



  Select a gas component by the (▲) and (▼) keys.

  Pressing the (ENT) key clears the factor to 1.0000.

  Pressing the (ESC) key returns display to the previous screen.



- Zero gas action

  Function : The gas to be used for zero calibration is selectable between cylinder gas and atmospheric air. In calibration, the calibration contact according to your selection is operated.

  Operation : While the indication of the relevant setting is inverted, select Cylinder or Air as in the selection of minus indication.

Contents of setting:

Cylinder ; Cylinder air or N_2 gas is used as the gas for zero calibration.

Air ; Atmospheric air is used as the gas for zero calibration.

Initial value : Cylinder

- MODBUS

Function : In communication with the serial communication port, it is settable whether to use the MODBUS protocol or not.

Operation : Simple selection of Used or Unused status as described above

Contents of setting:

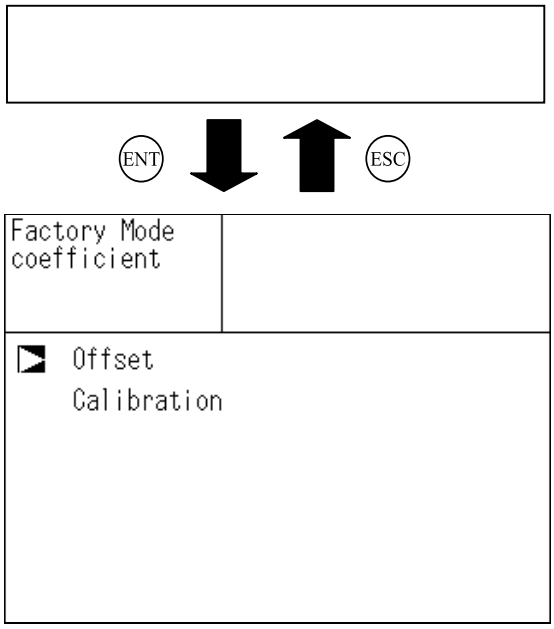
Disable ; The MODBUS communication protocol is unused.

Enable ; The MODBUS communication protocol is used.

Initial value : Disable

5) Coefficient

- Function : Displays zero offset and calibration coefficient.
- Operation : The coefficient initial screen is as shown at right.



Select any item by using the ▲ or ▼key.

Press the ENT key, and each display screen appears.

In case of moisture interference or offset selection:

- Display contents: Displayed for each CH
  - Offset ···· Offsets detector or O_2 sensor.
  - H_2O ····· Moisture interference compensation coefficient

Factory Mode
coefficient

	offsetM	offsetC	H2O
CH1	16128	16128	1.0000
CH2	16128	16128	1.0000
CH3	16128	16128	1.0000
CH4	16128	16128	1.0000
CH5	11139		

In case of calibration coefficient:

- Display contents:
  - Displayed in range of each CH
  - Zero ····· Zero calibration coefficient
  - Span ····· Span calibration coefficient

Factory Mode
Calibration

CH	RANGE	ZERO	SPAN
CH1	0-100ppm	+00000	01.0000
NOx	0-2000ppm	+00000	01.0000
CH2	0-100ppm	+00000	01.0000
SO2	0-2000ppm	+00000	01.0000
CH3	0-5vol%	+00000	01.0000
CO2	0-20vol%	+00000	01.0000
CH4	0-100ppm	+00000	01.0000
CO	0-2000ppm	+00000	01.0000
CH5	0-25vol%	+00000	01.0000
O2			

6) Calculation

- Function : Displays a screen in which the values under the internal calculation of analyzer can be checked for each gas component.
- Operation : As described below.

Select an item by the ▲and ▼ keys.

Press the ENT key for entry into each indication screen.

Select a gas component by the ▲ and ▼ keys.

Press the ENT key for entry into the calculation check screen.

When further pressing the ENT key, change of the values will stop. The previous status can be restored by pressing the ESC key.

Factory mode initial screen
The cursor is in 17

ENT ESC

Factory Mode Calculation	Select component.

▶ NOx
SO2
CO2
CO
O2

ENT ESC

Factory Mode Calculation NOx	ZERO:Zero gas SPAN:Span gas ENT: Freeze

X	13905	Y	11841
X1	-02223	Y1	-04287
X2	-02223	Y2	-04287
X3	-02224	Y3	-04288
X4	-02224	Y4	-04288
X5	-02224	Y5	-04288
X6	02064		
X7	02064	X9	02064
X8	02064	X10	02064

Contents of indication
(In selection of infrared component)
(X: Main, Y: Compo.)

X, Y = A/D conversion input values
X, Y1 = After offset
X, Y2 = Scale conversion
X, Y3 = Filter
X, Y4 = Zero calibration (for each of Main and Compo.)
X, Y5 = Span temperature compensation
X6 = Interference compensation
X7 = Zero temperature compensation
X8 = Zero calibration
X9 = Span calibration
X10 = Linearization

(In selection of paramagnetic or external oxygen meter)

X = A/D conversion input value
X1 = After offset
X2 = Scale conversion
X3 = Filter
X4 = Zero point temperature compensation
X5 = Zero calibration
X6 = Span temperature compensation
X7 = Span calibration
X8 = Linearization

(In selection of zirconia oxygen meter)

X = A/D conversion input value
X1 = mV conversion value

Action : When pressing the zero key, the zero valve turns on, and it turns off when pressing the key again. When pressing the span key, the span valve turns on, and it turns off when pressing the key again.

4. ERROR JUDGEMENT CRITERIA FOR ERROR CODES

* This section covers the error judgement criteria for error codes.
For the contents of errors, refer to Instruction Manual.

Error No.	Contents	Criteria
Error 1	Motor rotation detector signal is faulty.	Detector signals generated due to motor chopping are converted into rectangular waves and rectangular waves are monitored. If waves are not generated or irregular, an error occurs. A/D conversion value (count) can be checked on the A/D data indication screen in the factory mode. 59000 ≦ Ainp No. 12, 13, 14, 15 ≦ 61000
Error 4	Zero calibration is not within the allowable range	If the following ranges are not met in zero calibration, an error occurs. Infrared component: 5000 ≤ A/D conversion value in zero calibration ≤ 25000 Paramagnetic oxygen: −3000 ≤ zero calibration coefficient ≤ 3000 Zirconia oxygen: Zero calibration concentration after mV conversion ± 5 mV
Error 5	An amount of zero calibration is over 50% of full scale.	This error occurs in the following condition. 50% of FS < (Zero calibration concentration set value) – (current display)
Error 6	Span calibration is not within the allowable range.	When span calibration coefficient is not within the following range, error occurs. Infrared component: 0.05 ≦ span calibration coefficient ≦ 5 Paramagnetic oxygen: 0.5 ≦ span calibration coefficient ≦ 16 Zirconia oxygen: Span calibration concentration after mV conversion ± 10 mV
Error 7	An amount of span calibration is over 50% of full scale.	This error occurs in the following condition. 50% of FS < (Span calibration concentration set value) – (current display)
Error 8	Measured values fluctuate to much during zero and span calibration	If A/D conversion value fluctuates beyond each range specified below in calibration, an error occurs. Infrared component, paramagnetic oxygen meter: A/D input value ± 100 Zirconia oxygen: Oxygen concentration after mV conversion ± 0.2 mV
Error 9	Calibration is abnormal during auto calibration	Error corresponding to No. 4 to No.7 occurs during auto calibration
Error 10	Output cable connection is improper.	Error occurs if no response is made from the output IC

Main portions to be checked during error

Error No.	Main portions to be checked
Error 1	Sector motor rotation, mother and amplifier printed circuit board synchronization signal, rectangular waves between GND and MPD3 on main printed circuit board (8.33 Hz, 5 Vp-p)
Error 4	See service manual “5. (1) No zero calibration can be performed”.
Error 5	
Error 6	See service manual “5. (1) No span calibration can be performed”.
Error 7	
Error 8	See service manual “5. (1) Zero calibration and span calibration can not be performed”.
Error 9	
Error 10	Contact portions of main printed circuit board and motherboard printed circuit board (plug-in connector). Contact portions of mother printed circuit board and output printed circuit board (cable).

5. TROUBLESHOOTING AND DATA COLLECTION

(1) Countermeasures against trouble

1) No zero calibration can be performed (ERROR No. 4, 5 or 8 has occurred.)

1) Check that a specified flow rate of zero gas is supplied to the analyzer main unit
   ⇒ Locate a gas leaked portion and remedy.
2) Check optical balance. (Refer to "optical balance adjustment" in instruction manual.)
   ⇒ Adjust optical balance.
3) Check the A/D data against the display. (Refer to "Sensor Input Value" in Maintenance Mode.)
4) If this trouble has occurred on the zirconia O_2 measurement, check the sensor output voltage.
5) If ERROR No. 5 has occurred, carry out zero calibration forcibly and check the result.
   ⇒ If ERROR No. 4 occurs, return to above.

2) No span calibration can be performed (ERROR No. 6, 7 or 8 has occurred.)

1) Check that specified flow rate of span gas is supplied to the analyzer main unit.
   ⇒ Locate a gas leaked portion and remedy.
2) Check that zero calibration can be properly performed.
   ⇒ If zero calibration cannot be performed, repeat the procedure in "No zero calibration can be performed" described above.
3) Check the A/D data against the display. (Refer to "Sensor Input Value" in Maintenance Mode.)
   ⇒ Check for change from when flowing the zero gas.
4) Check the amplifier PC board. (Refer to "amplifier printed circuit board" in this manual.)
5) If this trouble has occurred on the zirconia O_2 meter, check the sensor output voltage.
6) If ERROR No. 7 has occurred, carry out span calibration forcibly and check the result.
   ⇒ If ERROR No. 6 occurs, return to above.

3) Error occurs in automatic calibration. (ERROR No. 9 has occurred.)

Depending on whether the error has occurred in zero calibration or span calibration, the relevant measure described above should be taken.

4) Drift

1) Check that specified flow rate of measured gas is supplied to the analyzer main unit.
   ⇒ Locate a gas leaked portion and remedy.
2) Check that the cell window, O-ring, detector window and cell inside are not contaminated.
   ⇒ Clean the cell and window. Replace parts.

5) Readings are high or low too much.

1) Check for influence by moisture interference.
   ⇒ Carry out moisture interference adjustment.
2) Check if the concentration of interference component in measured gas is too high.
   ⇒ Moisture should be below 2°C saturation.
   Check for other interference components. (Ask the user what components are contained in measured gas.)

6) Readings are not increased

1) Check that specified flow rate of measured gases are supplied to the analyzer main unit.
   ⇒ Locate a gas leaked portion and remedy.
2) Check that zero and span calibration can be performed.
   ⇒ If possible, check for sampling system (related to measured gas) and take remedies.
   ⇒ If not possible, check the item **1)** and **2)**.

(2) Data sampling at trouble

When trouble occurs, be sure to sample the following data.
In the case of the trouble in connection with the characteristic, please sample data (please surely sample data to a factory at the time of an inquiry).
Supply the gas given in Table and sample the measured value of measurement screen, sensor input values in maintenance mode.
On the measured component that caused a trouble, supply the gas given in the following table, and write down the measured value of measurement screen and "Sensor Input Value" in Maintenance Mode.

Measurement component and range	Component	Range 1	Range 2

Supply gas	Calibration concentration set value		Measurement display value		Sensor input value in maintenance mode (Main)	Sensor input value in maintenance mode (Compo.)
Zero gas	Range 1					
	Range 2					
Span gas	Range 1					
	Range 2					
2°C-wet zero gas			Range 1			
			Range 2			
Sample gas			Range 1			
			Range 2			

- If there is no Range 2, the part of a Range 2 is entry needlessness.
- If trouble occurs to other components, sample data for each component.
- If trouble occurs on the O_2 meter, there is no sensor input value for Compo.

Check each coefficient by "Coefficient" in the factory mode.

Channel No.	Offset	Moisture interference	Zero coefficient		Span coefficient
CH1			Range 1		
			Range 2		

- Sampling system diagram
  If sampling system diagram is prepared, report the diagram number.
  If sampling system diagram is not prepared, report the sketch.

For other troubles, sample various data about necessary setting items.

(3) Troubleshooting of detectors

1) Trouble judgment

a. Check that the sampling line is not abnormal and that the dehumidifying line/filter status and sample gas properties do not have a problem.

b. Check that other units and functions of the analyzer are not abnormal.
Make sure the light source, sample cell and synchronization signal circuit do not have a problem.

c. Examine each correlation with the ambient temperature and plant operating conditions (such as gas and heat radiation).

2) A/D data

a. Calculate sensitivity against steam from the A/D data. For generation of 2°C-wet zero gas, use a reliable bubbler and electronic cooler.
Check the A/D data of each detector on the optical balance screen when flowing each gas listed in the following table.

	Measurement detector (Main)	Interference compensation detector (Compo.)
Dry zero gas	Zm	Zc
Dry span gas	Sm	Sc
2°C-wet zero gas	Wm	Wc
Span gas concentration (ppm)	P	-

Steam sensitivity H = P × (Wm - Zm)/(Sm - Zm) ppm, concentration of measured component

- SO_2 meter When H > 70 ppm SO_2 equivalent, the detector may be faulty.
- NO meter When H > 180 ppm NO equivalent, the detector may be faulty.

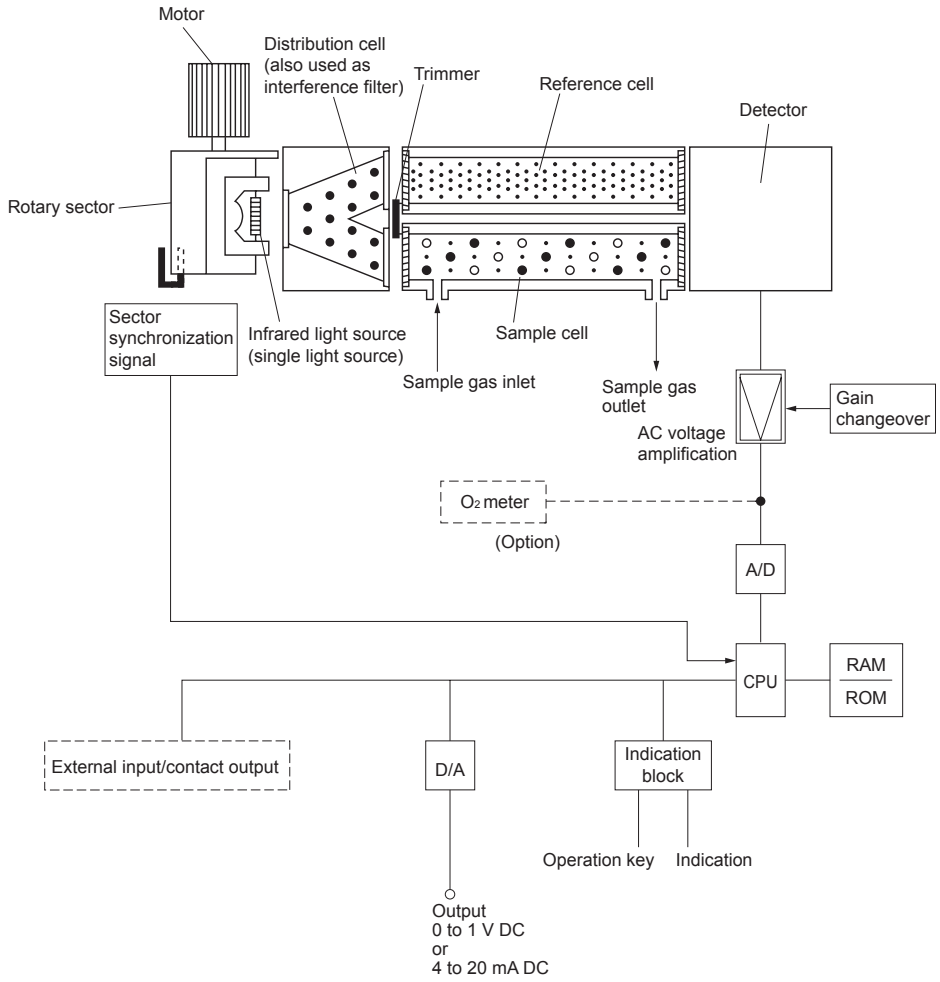
b. Span A/D data
This data varies with range ratio. It is therefore unreliable to judge whether the detector is normal or not according to this data alone. If steam sensitivity is abnormal in 1), compare the span A/D data with that at shipment from the factory and judge the detector also using the result in 1).

(4) Range-linked calibration

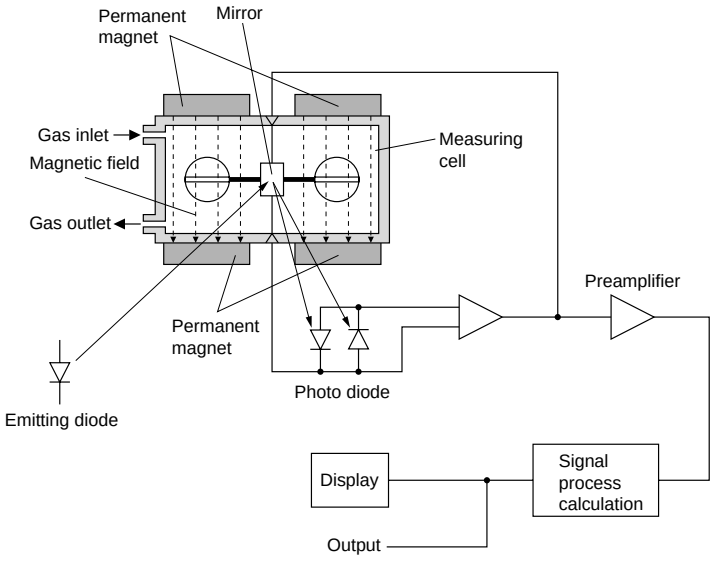
When this analyzer has 2 measuring ranges, range-linked calibration is settable in setting of calibration range. (Refer to the instruction manual.)
The range-linked calibration function works normally on condition that each range is calibrated correctly. (This is because the range-linked calibration is carried out so that compensation amount is always the same between the ranges.)
If a significant indication error occurs between the ranges, set calibration range in each range (“current”) and carry out zero/span calibration in each range. Then, set calibration range to the “both” mode again.

APPENDIX 1. MEASURING PRINCIPLE DIAGRAM

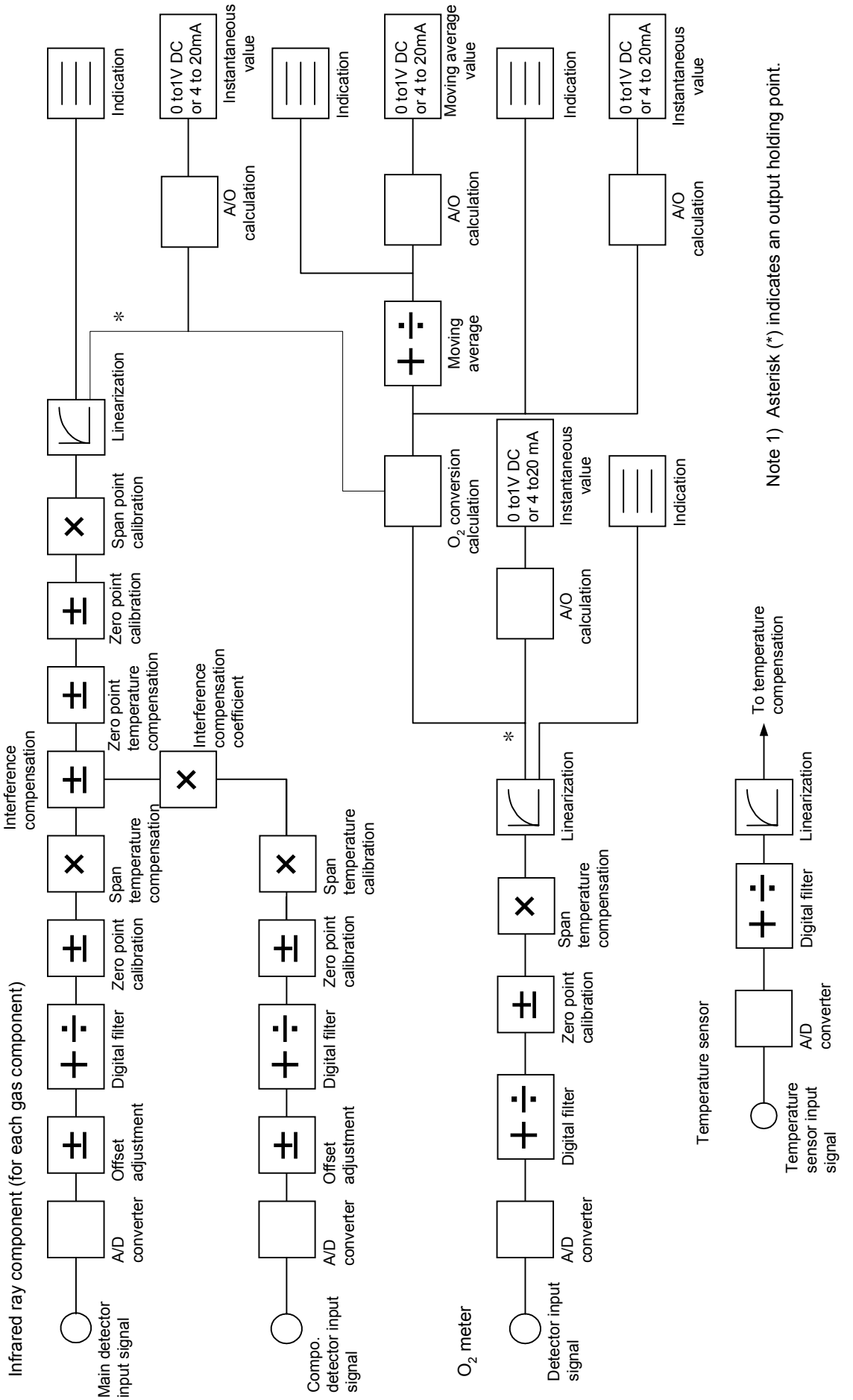
Infrared ray type (NO, SO_2, CO_2, CO, and CH_4)



Paramagnetic type (O_2)

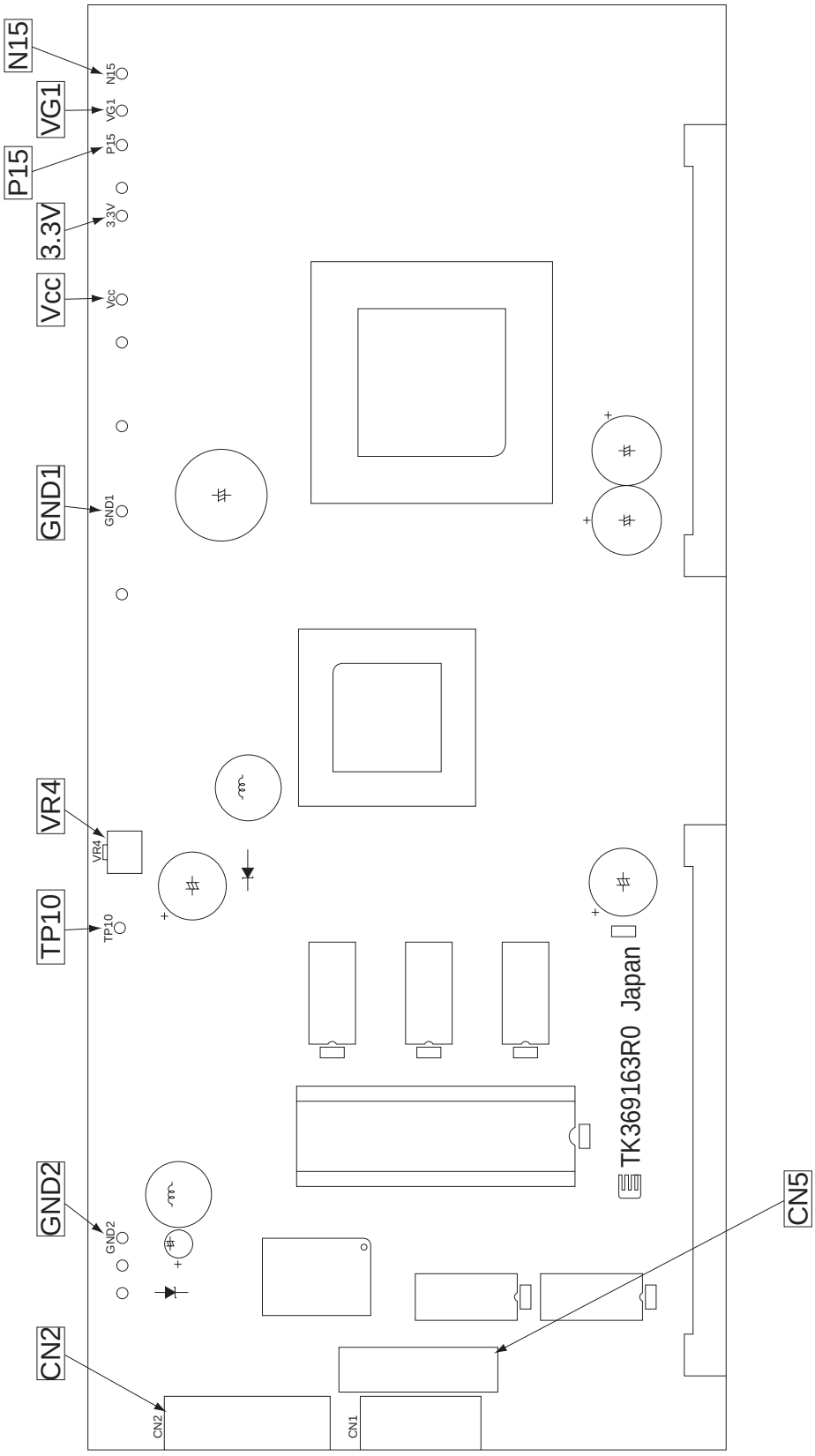


APPENDIX 2. SOFT FLOW DIAGRAM



APPENDIX 3. PRINTED CIRCUIT BOARD DIAGRAM

Main PC board



Amplifier PC board