Service Manual

INFRARED GAS ANALYZER

TYPE: ZRJ-5

Fuji Electric Co., Ltd.

INZ-TN513433a-E

PREFACE

This service manual describes the infrared gas analyzer (Type: ZRJ-5).
This service manual is intended for use with the instruction manual to help you in understanding maintenance and inspection for the infrared gas analyzer (ZRJ). 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 (ZRJ) 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.

Delivered Items

Name	Quantity	Remark
Analyzer main unit	1	_____
Power cable	1	_____
Fuse	2	(250V AC / 0.5A delay type)
Instruction Manual	1	_____
Test result	1	_____

Manufacturer: Fuji Electric 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

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Request

- It is prohibited to transfer part or all of this manual without Fuji Electric's permission in written format.
- Description in this manual will be changed without prior notice for further improvement.

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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 3 levels, "DANGER", "CAUTION" and "PROHIBITION".

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.
PROHIBITION	Items which must not be done are noted.

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	• For installation, observe the rule on it given in the instruction manual and select a place where the weight of gas analyzer can be endured. Installation at an unsuited place may cause turnover or fall and there is a risk of injury. • For lifting the gas analyzer, be sure to wear protective gloves. Bare hands may invite an injury. • Before transport, fix the casing so that it will not open. Otherwise, the casing may be separated and fall to cause an injury. • During installation work, care should be taken to keep the unit free from cable chips or other foreign objects. Otherwise, it may cause fire, trouble or malfunction of the unit.

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	• Wiring work must be performed with the main power set to OFF to prevent electric shocks. • Enforce construction of class-3 grounding wire by all means. If the specified grounding construction is neglected, a shock hazard or fault may be caused. • 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. • Be sure to use a power supply of correct rating. Connection of power supply of incorrect rating may cause fire.

Caution on use	
⚠ DANGER	• For correct handling of calibration gas or other reference gases, carefully read their instruction manuals beforehand. Otherwise, carbon monoxide or other hazardous gases may cause an intoxication particularly.
⚠ CAUTION	• Before leaving unused for a long time or restarting after left at such a status for an extended length of time, follow the directions of each instruction manual because they are different from normal starting or shutdown. Otherwise, the performance may be poor and accidents or injuries may be caused. • Do not operate the analyzer for a long time with its door left open. Otherwise, dust, foreign matter, etc. may stick on internal walls, thereby causing faults.

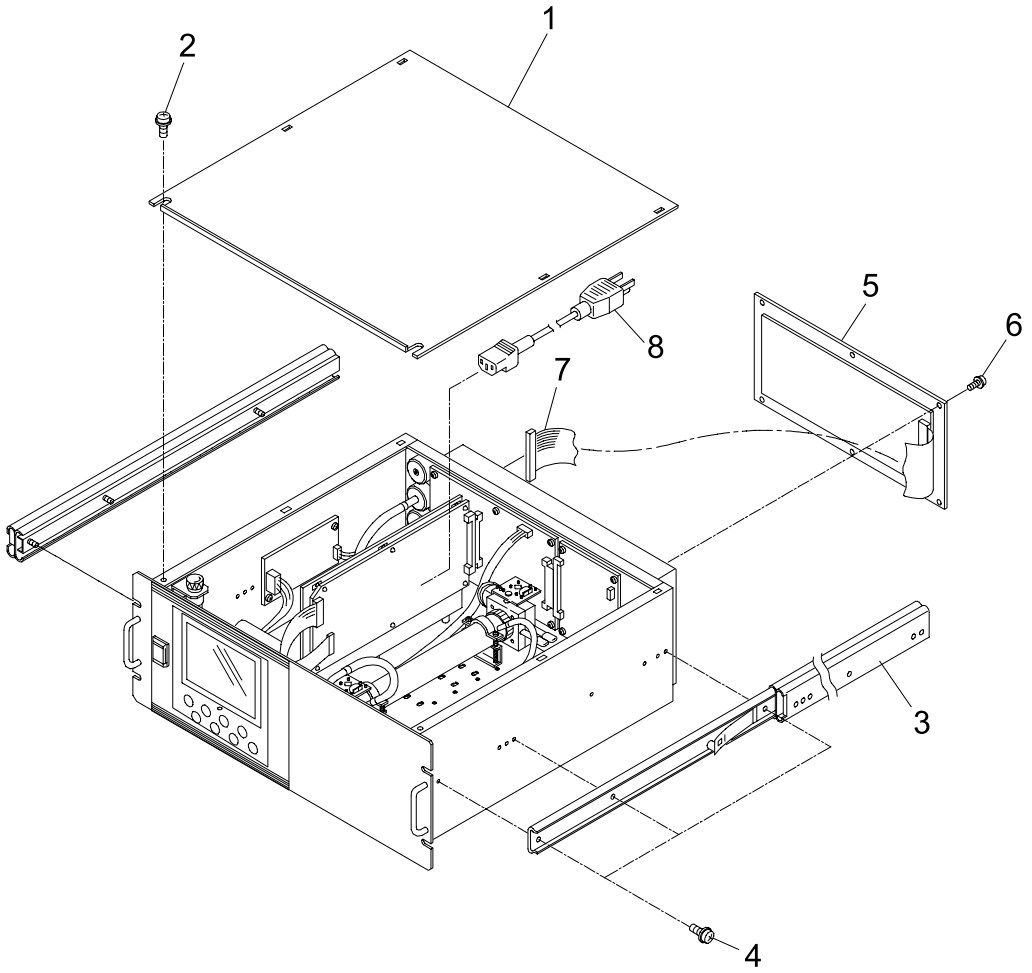
Caution on use	
PROHIBITION	• Do not allow metal, finger or others to touch the input/output terminals in the instrument. Otherwise, shock hazard or injury may occur. • Do not smoke nor use a flame near the gas analyzer. Otherwise, a fire may be caused. • Do not allow water to go into the gas analyzer. Otherwise, hazard shock or fire in the instrument may be caused.

Caution on maintenance and check	
DANGER	• When doors are open during maintenance or inspection, be sure to purge sufficiently the inside of the gas analyzer as well as the measuring gas line with nitrogen or air, in order to prevent poisoning, fire or explosion due to gas leak.
CAUTION	**Be sure to observe the following for safe operation avoiding the shock hazard and injury.** • Remove the watch and other metallic objects before work. • Do not touch the instrument wet-handed. • If the fuse is blown, eliminate the cause, and then replace it with the one of the same capacity and type as before. Otherwise, shock hazard or fault may be caused. • Do not use a replacement part other than specified by the instrument maker. Otherwise, adequate performance will not be provided. Besides, an accident or fault may be caused. • Replacement parts such as a maintenance part should be disposed of as incombustibles.

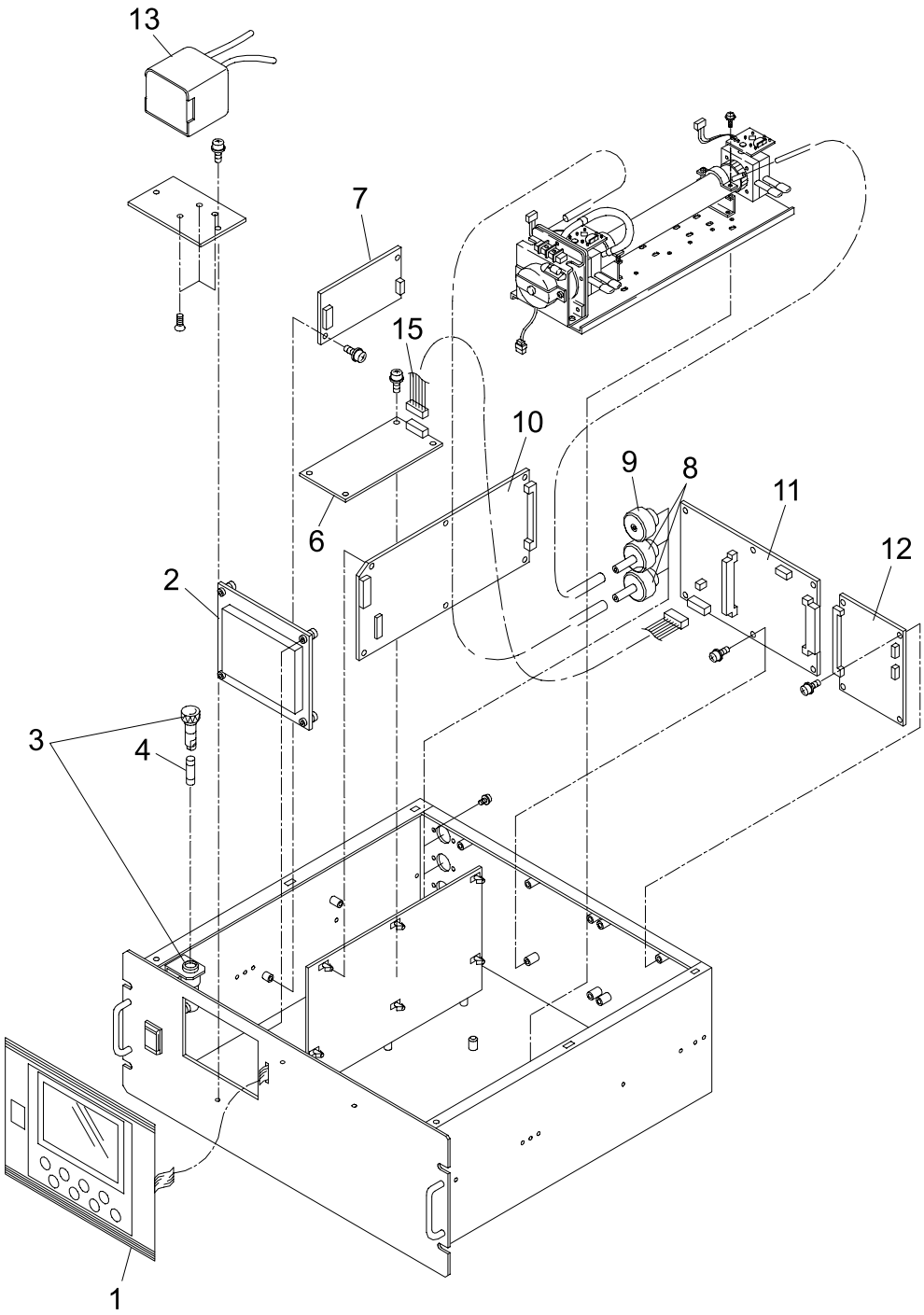
Others	
CAUTION	• If the cause of any fault cannot be determined despite reference to the instruction manual, be sure to contact your dealer or Fuji Electric's technician in charge of adjustment. If the instrument is disassembled carelessly, you may have a shock hazard or injury.

1. STRUCTURE OF ANALYZER AND NAMES OF PARTS

(1) Analyzer main unit

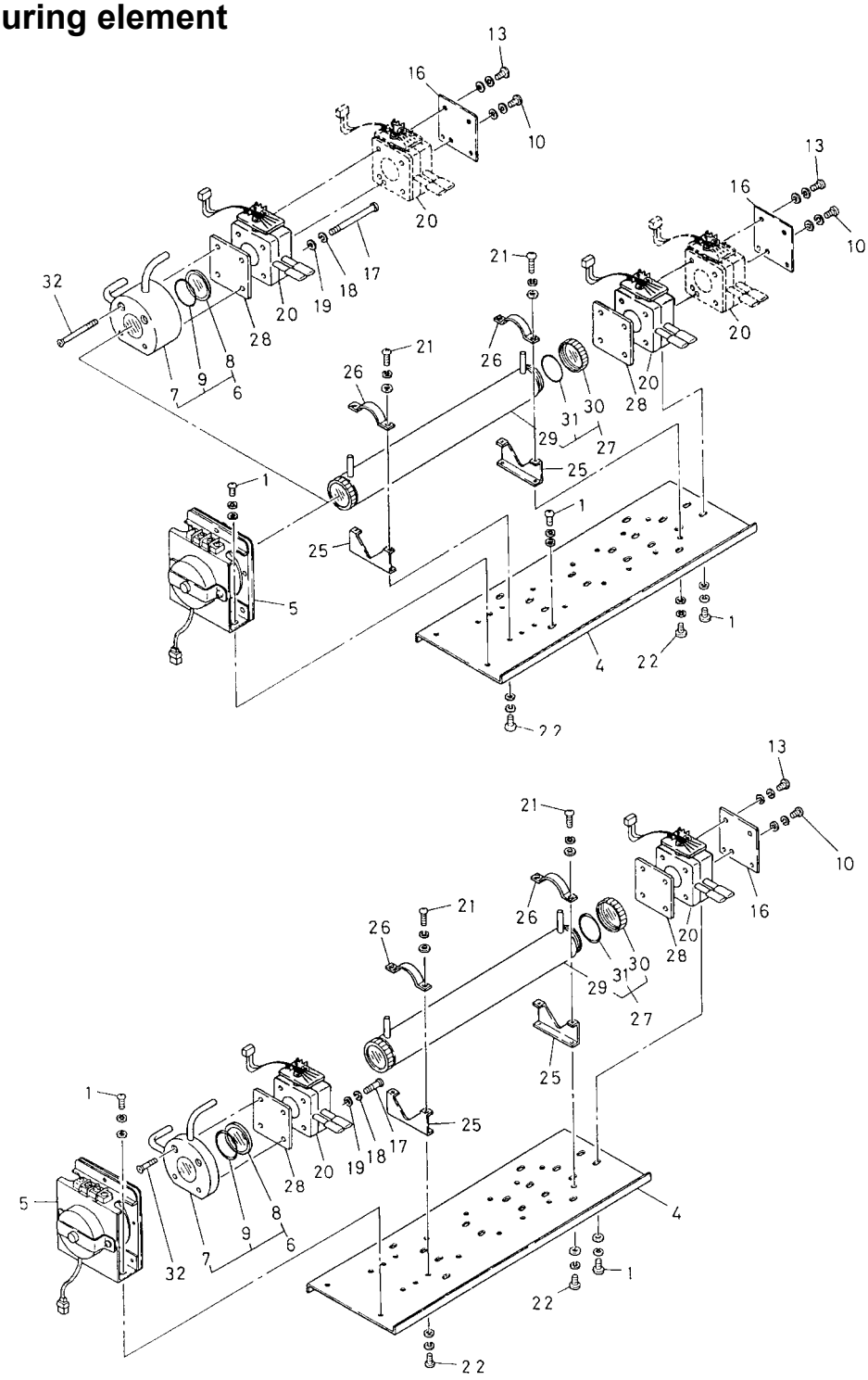


Parts No.	Part name
1	Cover
2, 4, 6	Screw
3	Rail
5	Terminal ass'y
7	Terminal cable
8	Power supply cable



Parts No.	Part name	Parts No.	Part name
1	Membrane key	9	Purge gas inlet fittings
2	LCD unit	10	Main P.C.B
3	Fuse holder	11	Mother P.C.B
4	Fuse	12	Amplifier P.C.B
6	Power supply	13	O_2 sensor
7	Power supply		
8	Gas inlet/outlet fittings		

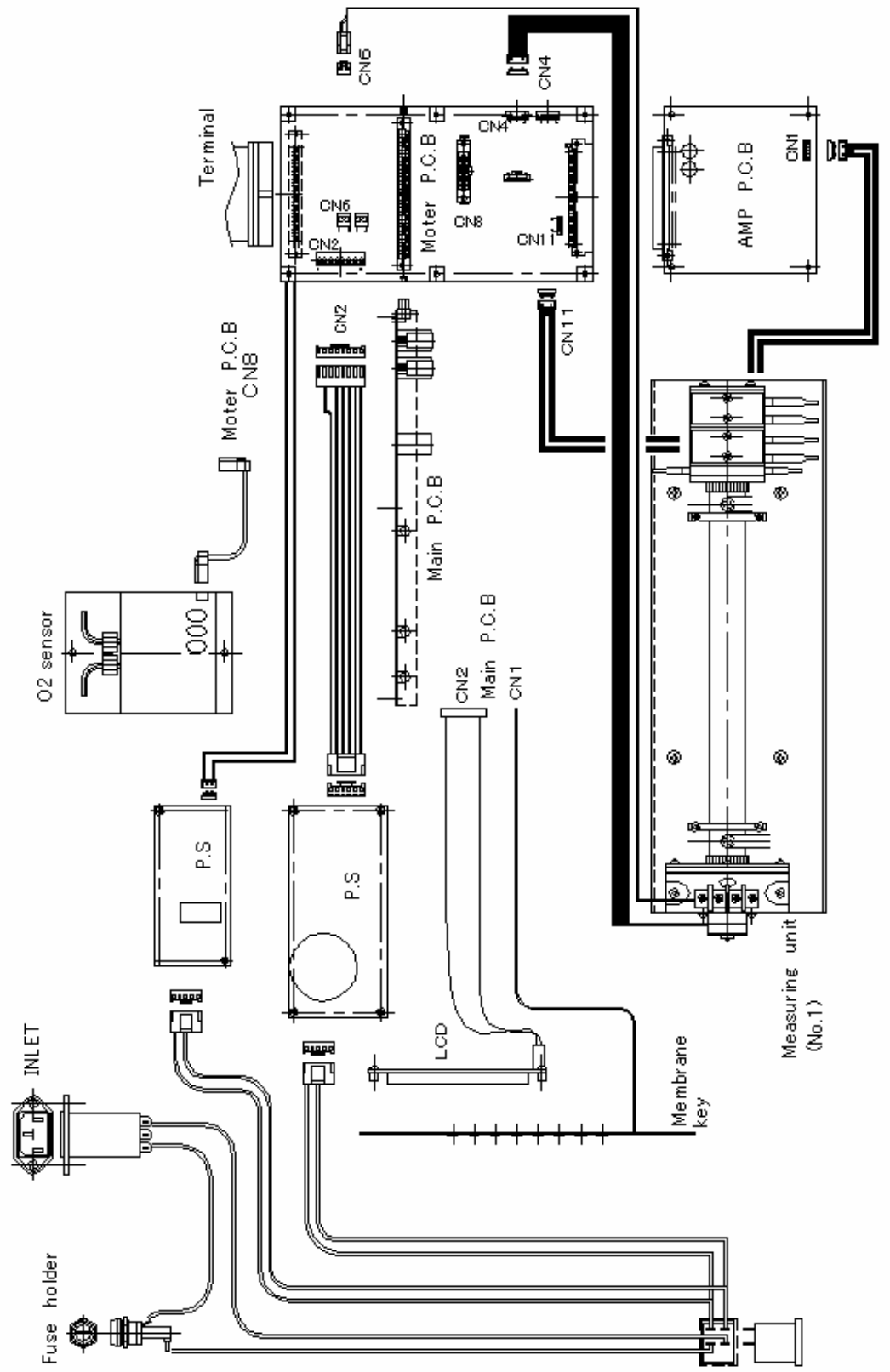
(2) Measuring element



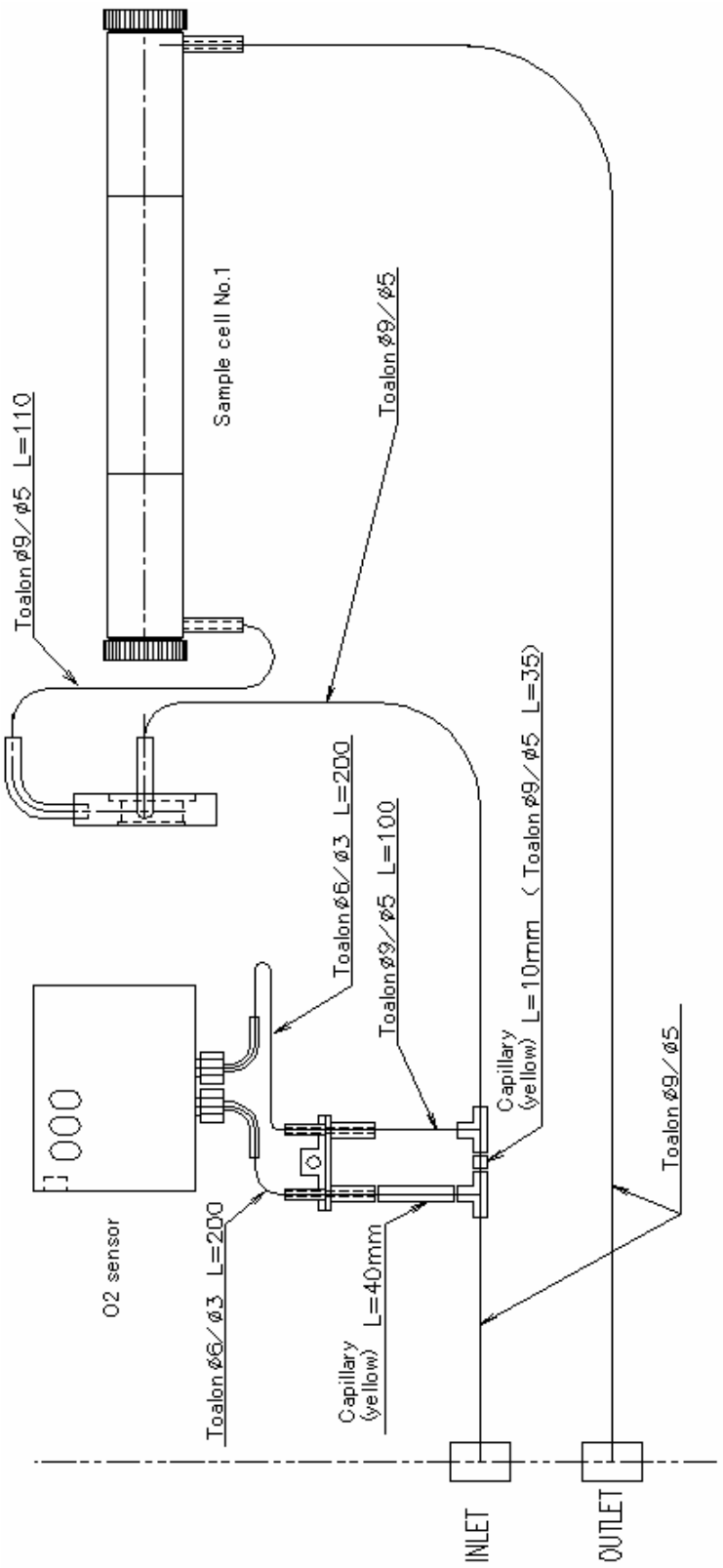
Parts No.	Part name	Parts No.	Part name	Parts No.	Part name
4	Base board	16	Cover	29	Pipe cell
5	IR source unit	20	Detector unit	30	Window for pipe cell
7	Block cell	25	Support	31	O-ring for pipe cell
8	Window for block cell	26	Pushing		
9	O-ring for block cell	28	Filter		

(3) Connection of parts

- **Connection diagram**



- **Piping diagram**

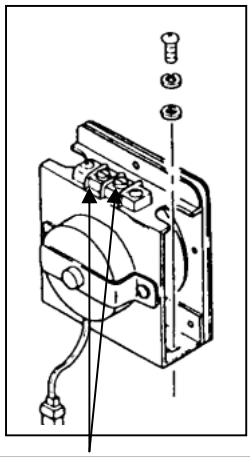


2. MAINTENANCE AND INSPECTION, AND REPAIR AND ADJUSTMENT AT REPLACEMENT OF MEASURING UNITS

(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 , Error-1 occurs.
  Check : Turn OFF the power of the analyzer and remove the power cable connected to the light source. (Pull out connectors CN6 and CN7 on the motherboard). Measure resistance between 2-pin terminals at the light source, and the resistance value must be 37Ω ±2Ω. If resistance values are infinite, the light source may be broken. As the resistance value is decreased, the indication will be drifted in the minus direction.

<Motor unit for light source>



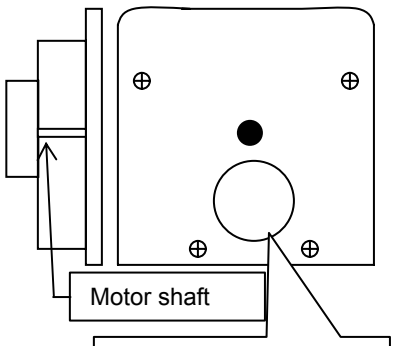
Measure the resistance between terminals with cables disconnected.

- 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.
- Measures : If the light source is found defective, replace the light source motor unit.
- Replacement : To replace the motor unit, remove the cable between 2-pin terminals and motor connector. Loosen 2 screws that fasten the light source motor unit to the optical base plate .
- Adjustment after replacement : Adjust amp gain and perform zero point and span point calibration.

(2) Sector motor and sector

- Recommended period of replacement : 5 years
- 1) Error mode : Motor rotation stop
  Phenomena : Scale-out indication of analyzer , Error- 1 occurs.
  Check : With the analyzer power ON, check that the shaft is normally rotating as viewed from the motor.
- 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. If no noise is heard, remove the light source motor unit. Turn ON the power of the analyzer and check the rotation of motor shaft and sector
- Measures : If the sector motor is found defective, replace the light source motor unit.

Light source motor unit as viewed from cell side



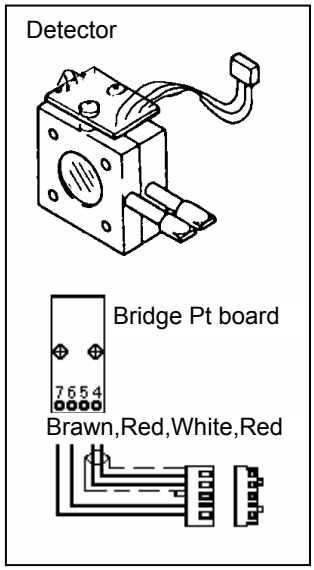
Check sector rotation from here.

- Replacement : To replace the motor unit, remove the cable between 2-pin terminals and motor connector. Loosen 2 screws that fasten the light source motor unit to the optical base plate.
- Adjustment after replacement:
  Adjust amp gain and perform zero point and span point calibration.

(3) 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.
- Replacement : For replacement, refer to the instruction manual.
- Adjustment after clean and replacement :
  Adjust amp gain, and check zero point and span point calibration and response.

(4) Detector (except for O_2 sensor)



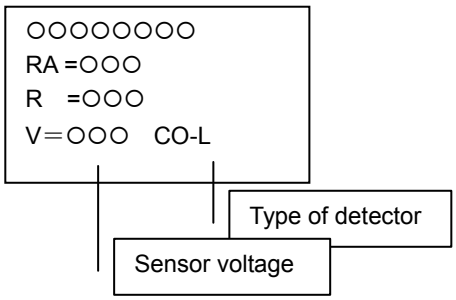
- Recommended period of replacement : 5 years
- 1) Error mode : Damage to mass-flow detector
  Phenomena : Scale-out indication of analyzer , Error- 1 occurs
  Check : Turn OFF the power of the analyzer and disconnect the connector connected from the detector to PC board. Measure resistance between 4 – 7 and 5 – 7 of the bridge printed circuit board on the detector. The measure values must be between 25Ω and 60Ω. If the resistance value is fluctuated beyond the specified range, the detector element may be damaged.
  Note : Do not use measurement instrument that allows a current of 2 mA or more to be supplied when measuring resistance, otherwise the element can be damaged.
- 2) Error mode : Sensitivity deterioration due to sealed gas leak
  Phenomena : Calibration error and fluctuation in indication
  Check : Check indication value at zero point
  Check the indication value for each component on the “Sensor Input Value” screen in the “Maintenance” mode. If the light source is in normal condition and the cell is free of contamination, the counter value indicates 38000 to 42000 when zero gas is supplied. If the counter value is below the range, sensitivity can be degraded.
- Measures : Replace detector.

- Replacement :
  - When a cell is a block cell, remove the light source motor unit. The light source motor unit and block cell are screwed to the detector. Unscrew the detector and then the light source motor unit and block cell can be separated from the detector. After that, unscrew the block cell side, the block cell can be separated from the detector. Install a new detector in reverse procedure of removal.
  - When a cell is a pipe cell, the detector is screwed to the rear of the optical base plate. First, remove the base plate and then unscrew the detector. Install a new detector in reverse procedure of removal.
- Adjustment after replacement :

  Voltage regulation of detector : Regulate the detector voltage to the voltage specified on the label.

  Note : Adjust the detector voltage on the printed circuit board and plug the connector into the detector. Do not insert the connector before voltage regulation, or the element may be damaged.

  Adjustment of amp gain, and zero/span point calibration



(5) Built-in O_2 detector

- Error mode : Damage to O_2 detector
- Phenomena : O_2 detector indication is at 0 and O_2 detector will not even respond to span gas.
- Check : Check of O_2 input voltage

  Apply a digital voltage meter between the check terminal TP4 and SC on the main printed circuit board and check that it reads about 0 V with zero gas and 0.5V to 1V with span gas. If no change in voltage is made with zero and span gases, O_2 detector can be damaged.
- Measures : Replace O_2 detector
- Replacement : Turn OFF the analyzer main unit

  Since the O_2 detector case is common to the 0V line, be careful when installing it avoid contacting the analyzer main unit case and O_2 detector case. Generally, an insulation mounting plate is supplied.
- Adjustment after replacement : Zero and span calibration

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

1) Mother printed circuit board (see Appendix 3)

- Check : Voltage check (regulation)

Check terminal	Regulation VR	Regulation voltage
SC-DV1	VR2	1st component detector voltage ±0.1 V

* Perform a voltage check of the main printed circuit board in addition to the above.

: Sensor signal check

Flow zero gas and check to assure that a digital voltmeter indicates 1.8 V to 2.6 V between TP2 and SC. If specified voltage cannot be obtained, regulate the voltage by using a VR1.

- Adjustment after replacement :

Perform the following procedures in sequence after replacement. Failure to follow the sequence may result in damage to the detector.

① Sensor voltage regulation

Turn ON the power with the detector signal cable (CN11) disconnected. Use VR2 and adjust the voltage to be within ±0.1 V of the 1st component detector display voltage between SC and DV1.

② Adjustment of amplifier circuit

Turn OFF the main unit once. Connect the detector signal cable and turn ON the power again. Wait for about 30 minutes until the instrument is warmed up. Then, supply zero gas. Adjust the VR1 so that a voltmeter indicates 2.0 ±0.2V between TP2 and SC.

③ Perform zero point and span point calibration by supplying the specified standard gas.

④ Perform an output adjustment. (See factory mode 9. “Output adjustment”.)

2) Amplifier printed circuit board (see Appendix 3) (Used when measuring components are 2 or more excluding O_2)

- Check : Voltage check (regulation)

Check terminal	Regulation VR	Regulation voltage
GND-DV1	VR2	2nd component detector voltage ±0.1 V
GND-DV2	VR4	3rd component detector voltage ±0.1 V

: Sensor signal check

Supply zero gas and check to assure that a voltmeter indicates 1.8 V to 2.6 V between TP2 and SG1 for 2nd component, TP6 and SG2 for 3rd component. If specified voltage cannot be obtained, regulate the voltage by using a VR1 for 2nd component, VR3 for 3rd component.

- Adjustment after replacement :

Perform the following procedures in sequence after replacement. Failure to follow the sequence may result in damage to the detector.

① Sensor voltage regulation

Turn ON the power with the detector signal cable {CN1(CN2)} disconnected. Use VR2 (VR4) and adjust the voltage to be ±0.1 V of the 2nd (3rd) component detector display voltage between GND and DV1 (GND and DV2).

② Adjustment of amplifier circuit
Turn OFF the main unit once. Connect the detector signal cable and then turn ON the power again. Wait for about 30 minutes until the instrument is warmed up. Then, supply zero gas. Adjust the VR1 (VR3) so that a voltmeter indicate 2.0 ±0.2V between TP2 and SG1 (TP6 and SG2). (VR3),(TP6 and SG2) are for the 3rd component.

③ Perform zero point and span point calibration by supplying the specified standard gas.

3) Main printed circuit board (see Appendix 3)

Note) The main board is set according to the specifications of each analyzer. When ordering, notify instrument serial number. So the main P.C.B has suitable parameter in it.

- Check : Voltage check

Check terminal	Adjusting VR	Regulated voltage	Contents
GND-Vcc	-	+5 ±0.2 V	Digital 5 V
VG-P15	-	+15 ±0.5 V	Analog 15 V
VG-N15	-	–15 ±0.5 V	Analog –15 V
VG-VD	-	+5 ±0.1 V	Analog 5 V
VG-N12	-	–12 ±0.3 V	Analog –12 V
SC-TP5	-	+2.5 ±0.1 V	A/D conversion reference voltage
GND-TP6	VR4	Displayed Clearly	LCD drive voltage

- Precautions on replacement:
  - The cable (connector CN2) from LCD is connected to the main printed circuit board. Do not remove or plug the connector from or into the board with the power ON, or electronic parts may be damaged. Before replacement, be sure to turn OFF the instrument.
  - The cable (connector CN1) from the membrane key is connected to the main printed circuit board. Since a stopper is provided on the CN1 connector, do not pull the flexible cable forcedly. Poor contact to membrane key may result. When removing the stopper, slide it lightly toward you by holding both sides of CN1 with fingers. When attaching the stopper, insert the flexible cable fully into the depth and attach the stopper. The flexible cable should be installed with its contact surface facing toward the printed circuit board.
- Adjustment after replacement :
  After replacement, perform a voltage check:
  Use VR4 and perform contrast adjustment while viewing the LCD. Determine an easy-to-see height and adjust contrast.
  Press the switch to check that all keys are normally operated.

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

- Adjustment after replacement :
  Output check (Adjust if output is offset. See factory mode: output adjustment.)

(7) Liquid crystal display (LCD)

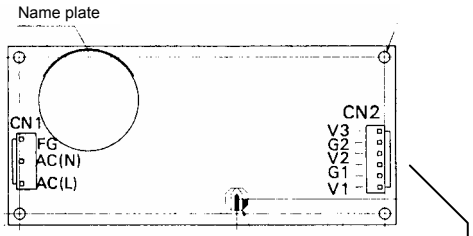
- Service life of parts : 5 years
- Error mode : Deterioration
- Phenomena : LCD is not displayed, or the display is dim or flickers.
- Check : Check LCD drive voltage on the main board. (See “Check for printed circuit board”) Adjust contrast (main board VR3). Check connection to the main board.
- Countermeasures 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 (See “Adjustment after replacement of main PC board”).

(8) Power supply

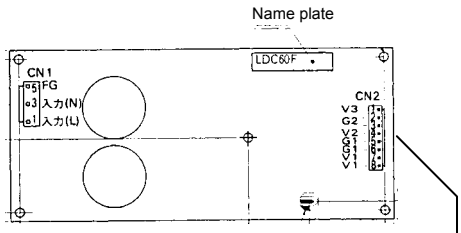
- Recommended period of replacement : 5 years
- Error mode : Power-down
- Phenomena : No display and no output
- Check : Check if short circuit occurs.
  Disconnect the secondary SW power connector. Turn ON the power and check the voltage at the connector. If no voltage is applied to it, replace.
- Measures : 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



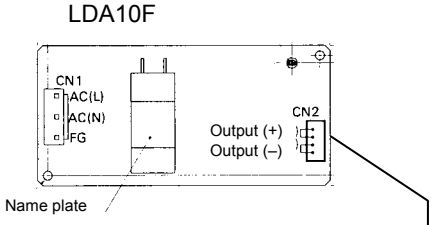
Pin	Symbol	Voltage
1	V3	–15V
2	G2	
3	G2	
4	V2	+15V
5	G1	
6	V1	+5V

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

(9) 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.
- Precautions on replacement :

  To the main printed circuit board is connected the cable (connector CN1) from the key. Since a stopper is provided on the CN1 connector, do not pull the flexible cable forcedly. Poor contact may result in the key. When removing the stopper, slide it lightly toward you by holding both sides of CN1 with fingers. When attaching the stopper, insert the flexible cable fully into the depth and attach the stopper. The flexible cable should be installed with its contact surface facing toward the printed circuit board.
- 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.

(10) Amplifier gain and adjustment of detector voltage

See "(6), Printed circuit board, 1) mother printed circuit board and 2) amplifier printed circuit board".
After replacing measuring parts, adjust the amplifier gain.
After replacing a detector, perform a voltage adjustment of the detector.
For check terminals and controls, see Table as given below. (No adjustment is required for the O_2 meter).

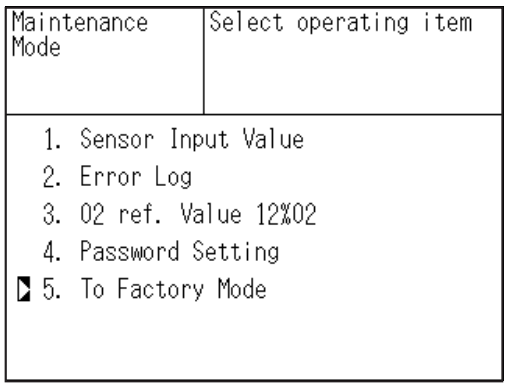
	Detector voltage		Amplifier gain	
	Portions to be checked	Controls	Portions to be checked	Controls
1st component	Mother printed circuit board SC - DV1	Mother printed circuit board VR2	Mother printed circuit board SC – TP2	Mother printed circuit board VR1
2nd component	Amplifier printed circuit board GND – DV1	Amplifier printed circuit board VR2	Amplifier printed circuit board SG1 – TP2	Amplifier printed circuit board VR 1
3rd component	Amplifier printed circuit board GND – DV2	Amplifier printed circuit board VR4	Amplifier printed circuit board SG2 – TP6	Amplifier printed circuit board VR 3

Adjust the detector voltage to voltage ±0.1 V specified on the detector label. Adjust the amplifier gain to 2.0V±0.2V when supply zero gas.

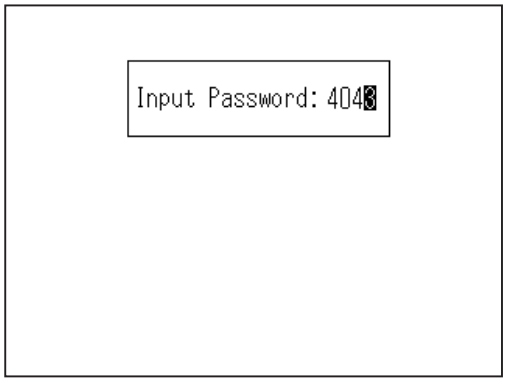
3. FACTORY MODE

(1) How to go to factory mode

Point the cursor to “5. To Factory Mode” by using the ▲ or ▼ key on the Maintenance Mode screen and enter the ENT key. Then, the password input screen appears.



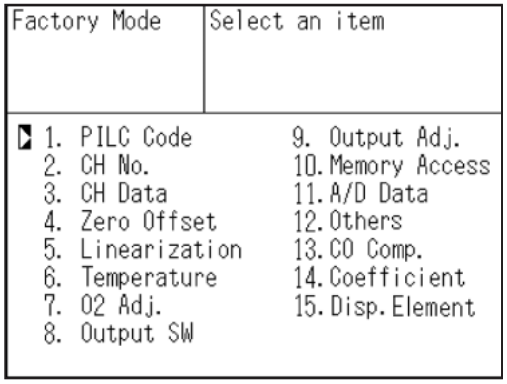
Enter the password.
To select setting items, set “4 0 4 3”. (“7. O_2 adjustment”, “9. Output adjustment”, “12. Disappear under Zero” are settable with “4 0 4 3”. Items 1, 2, 3, 5, 6, 7, 8, 9, 11, 12, 13 and 14 can be viewed).
Select digits by the ▶ key.
Change numerical values by using ▲ or ▼ key.



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

• 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.

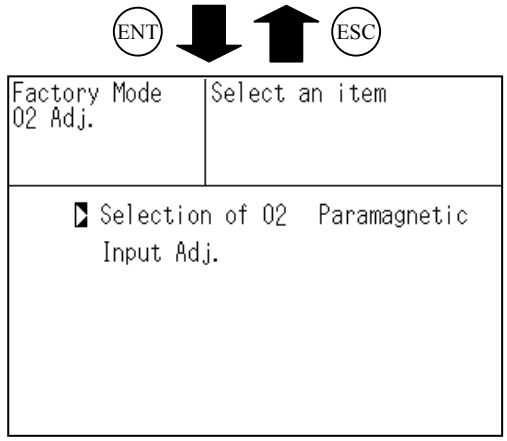
Into each parameter screen

(2) Setting

1) O_2 adjustment

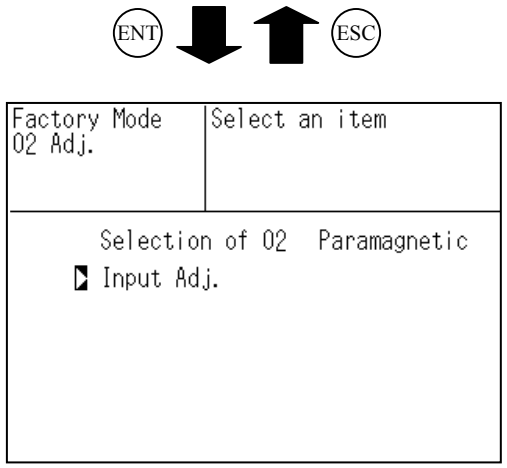
- Function : Necessary adjustment is carried out for each oxygen sensor.
- Operation : The setting screen where O_2 adjustment is performed is as follows.

Factory mode initial screen□
The cursor is in 7.



Selection of O_2 sensor
No change will be required for the O_2 sensor because it is factory-set for best performance before shipment.

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.
Move the cursor to any adjustment item by using the up-arrow key (▲) or down-arrow key (▼) and press the ENT key. Then, the adjustment screen appears.

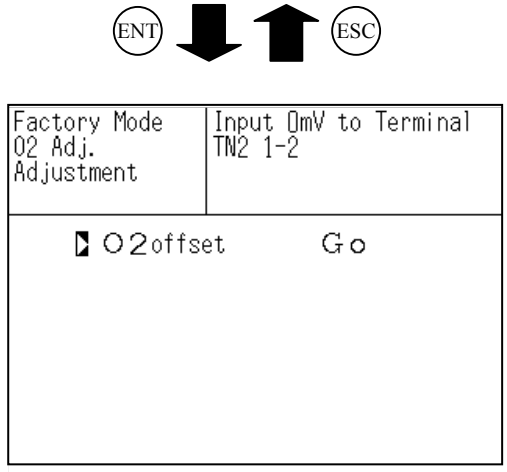


In case of O_2 offset adjustment

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

- Operation : When performing O_2 offset adjustment by the built-in O_2 sensor, disconnect the motherboard CN8 connector and input 0 V or short-circuit at the O_2 input terminal.

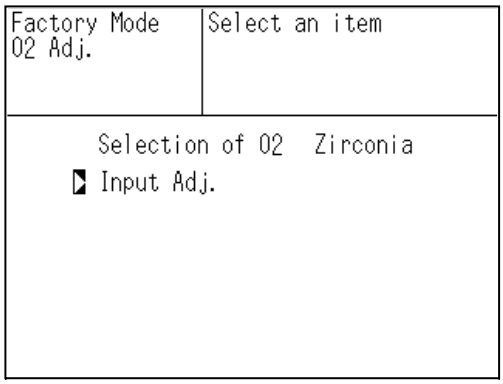
① Add 0 mV (short) to the O_2 input.
② With the cursor placed next to "Input Adj." (O_2 offset adjustment), the "O_2 Offset" screen is displayed by pressing the ENT key.
③ Press the ENT key on the "O_2 offset" screen, and the message appears, prompting you to verify that you want to offset the O_2 sensor.
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 that appears shown in right.
  Connect a standard voltage generator to the O_2 input terminal of ZRJ and perform zirconia adjustment while applying each voltage (mimic input) to the terminal.



Factory Mode O2 Input Adjustment	Input 0mV to Terminal TN2 1-2
Adj. Zero	100mV Range 250mV Range
Adj. Span	-50mV Range 100mV Range 250mV Range

Factory Mode O2 Input Adjustment	Input 0mV to Terminal TN2 1-2
Adj. Zero	100mV Range 250mV Range
Adj. Span	-50mV Range 100mV Range 250mV Range

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 9.

(ENT) (ESC)

Factory Mode Output Adj.			Adjust OUTPUT ZERO and SPAN		
OUT	ZERO	SPAN	OUT	ZERO	SPAN
1	-1340	1740	7	-1340	1740
2	-1340	1740	8	-1340	1740
3	-1340	1740			
4	-1340	1740			
5	-1340	1740			
6	-1340	1740			

Select any of the output terminals (OUT 1 to 8) 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 8 corresponds to CH1 to CH8.

Set value is inverted by pressing the (ENT) key.

(ENT) (ENT) (ESC)

Factory Mode Output Adj.			Adjust OUTPUT ZERO and SPAN		
OUT	ZERO	SPAN	OUT	ZERO	SPAN
1	-134	1740	7	-1340	1740
2	-1340	1740	8	-1340	1740
3	-1340	1740			
4	-1340	1740			
5	-1340	1740			
6	-1340	1740			

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.

- Contents of setting values :
  The output number (OUT 1 to 8) corresponds to CH1 to CH8.
  The set values are converted into the digital values to transfer to the D/A converter.

- Initial value: OUT 1 to 8
  At current output: Zero = –1340
  Span = 1740
  At voltage output: Zero = 0000
  Span = 1760

- 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.

Ainp No	Type	Ainp No	Type
0	Infrared ray component 2	8	Temperature
1	Infrared ray component 3	9	Infrared ray component 1
2	-	10	-
3	-	11	-
4	-	12	Oxygen input
5	-	13	-
6	-	14	-
7	-	15	Reference voltage

Factory mode initial screen
The cursor is in 11.

Factory Mode
A/D Data

Ainp NO	Count	Ainp NO	Count
0	20468	8	17634
1	20465	9	33894
2	20464	10	20466
3	20464	11	20464
4	20464	12	20726
5	20464	13	17634
6	20464	14	20464
7	20464	15	45594

When supplying zero gas (dry);

No. 9 (Infrared ray component 1)	38000 to 42000
No. 0 (Infrared ray component 2)	38000 to 42000
No. 1 (Infrared ray component 3)	38000 to 42000
No. 12 (Oxygen input)	18000 to 22000
No. 8 (Temperature)	15000 to 25000

If A/D data are within the range, there is no problem. If infrared ray composition 2, infrared ray composition 3 and oxygen do not exist, ignore Nos. 0, 1 and 12.

4) Disappear under Zero

- Function: Switches measured concentration values below zero to either display or no display mode.
- Operation: The “Disappear under zero” screen is as shown in right.

Set values are inverted by pressing the (ENT) key, when the cursor is aligned with the “disappear under zero”.

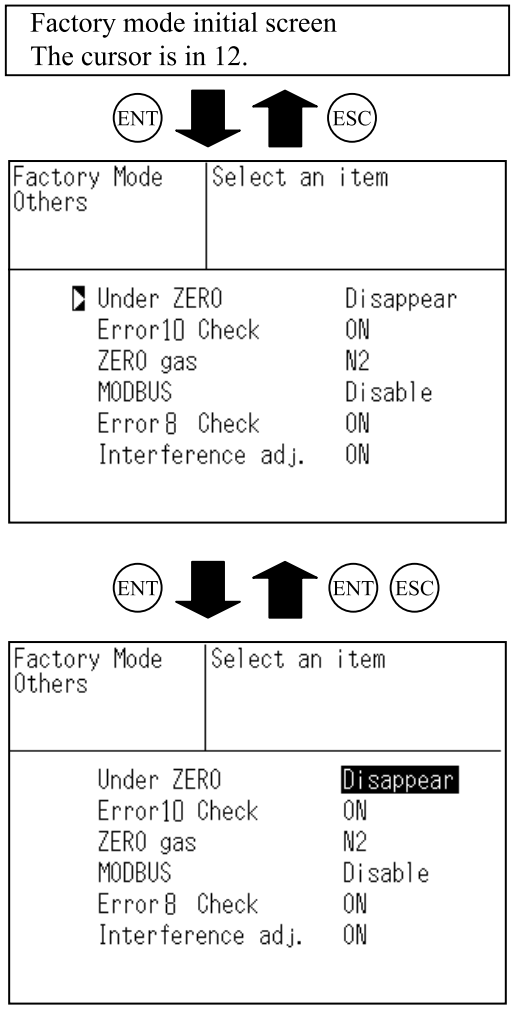
Switching between Appear and Disappear by the (▲) or (▼) key.

Establish the setting contents by pressing the (ENT) key.

If you don’t want to establish the contents, press the (ESC) key.

- Setting contents:
  Disappear: does not display and output values below zero
  Appear: displays and outputs values below zero.
- Initial value: Disappear (default: Disappear)

*** This mode is used at the time of adjustment in order to check a display. If the minus display (disappear under Zero) is set to Appear, be sure to return the lock to Disappear after adjustment.**



5) Coefficient

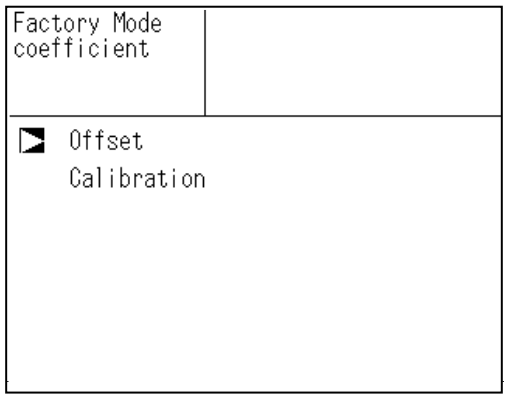
Function: Displays zero offset and calibration coefficient.

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.

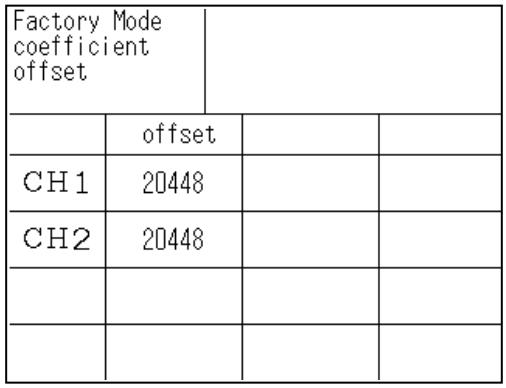
Factory mode initial screen
The cursor is in 14.



In case of offset selection:

- Display contents:
  - Displayed for each CH
  - Offset ·· ··Offsets detector or O_2 meter.
  - Calibration coefficient

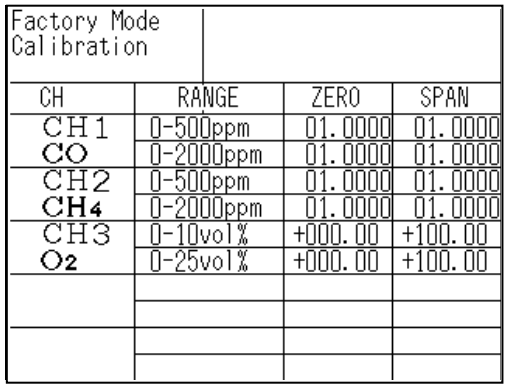
In case of selection of "Offset"



In case of calibration coefficient:

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

In case of selection of "Calibration coefficient"



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.
Error 3	A/D conversion signal is faulty.	Monitor A/D conversion reference voltage (main printed circuit board). When the reference voltage is outside the following range after A/D conversion, error occurs. A/D conversion values (counter values) can be checked by the counter indication when the Factory mode screen is displayed. 44288 ≦ Ainp No. 15 ≦ 46336
Error 4	Zero calibration is not within the allowable range.	Infrared component: 0.7 ≦ zero calibration coefficient ≦ 4.0 Paramagnetic oxygen: -3000 ≦ zero calibration coefficient ≦ 3000 Zirconia oxygen: -5mV ≦ input voltage ≦ 5 mV
Error 5	A 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: 0.5 ≦ span calibration coefficient ≦ 6 Paramagnetic oxygen: 0.5 ≦ span calibration coefficient ≦ 10 Zirconia oxygen: -10 mV ≦ input voltage ≦ 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	Check if measured values fluctuate excessively during calibration. Infrared component, paramagnetic oxygen: If measured values are not stabilized in 60 seconds (a change of more than 100 counts is continued) Zirconia oxygen: If measured values are not stabilized in 60 seconds (a change of input voltage is continued by more than 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, light source, motherboard, and detector signal on amplifier printed circuit board. Rectangular waves between GND and MPD3 on main printed circuit board (10Hz, 5Vp-p)
Error 3	Ainp No. 15 of A/D data in factory mode Voltage between SC-TP5 on main printed circuit board
Error 4	See service manual “5. (1) No zero calibration can be performed”.
Error 5	See service manual “5. (1) No zero calibration can be performed”.
Error 6	See service manual “5. (1) No span calibration can be performed”.
Error 7	See service manual “5. (1) No span calibration can be performed”.
Error 8	
Error 9	See service manual “5. (1) Zero calibration and span calibration can not be performed”.
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

- Check that a specified amount of zero gas is supplied to the analyzer main unit
  ⇒ Locate a gas leaked portion and remedy.
- Check if detector signal is as specified (based on result of detector signal checked on motherboard printed circuit board and amplifier printed circuit board).
  ⇒ Adjust detector signals. If a check cannot be made on signals, check the detector.
  Record voltage when zero gas is supplied and check the detector voltage.
- Check the A/D data against the display (see Factory mode and A/D data).
  ⇒ Check voltage at the main printed circuit board. Check the switching power supply. Record the A/D data when zero gas is supplied.

2) No span calibration can be performed

- Check that span gas concentration and span concentration settings are the same.
- Check that specified amount of span gas is supplied to the analyzer main unit.
  ⇒ Locate a gas leaked portion and remedy.
- Check that zero calibration can be properly performed.
  ⇒ If zero calibration can not be performed, repeat the procedure “1) No zero calibration can be performed”,
- Check if detector signal is as specified (based on result of detector signal checked on motherboard printed circuit board and amplifier printed circuit board).
  ⇒ Record voltage when span gas is supplied (to compare with the voltage when zero gas is supplied).
  Check the detector and detector voltage.
- Check the A/D data against the display (see Factory mode and A/D data).
  ⇒ Check voltage at the main printed circuit board. Check the switching power supply. Record the A/D data when span gas is supplied.

3) Drift

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

4) Readings are high or low too much.

- Check that a large quantity of interference components (moisture and CO_2) is not contained in sampling gas.
  ⇒ Check the components contained in measured gases (Ask the user what components are contained in measured gas.

5) Readings are not increased

- Check that specified amount of measured gases are supplied to the analyzer main unit.
  ⇒ Locate a gas leaked portion and remedy.
- Check that zero and span calibration can be performed.
  ⇒ If possible, check for sampling gas (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.

Supply gas	Gas concentration, composition		Span calibration concentration set value	Measurement display		Sensor input value in maintenance mode
Zero gas	Range 1					
	Range 2					
Span 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 to O_2 sensor, sample zero calibration concentration set values together with span calibration concentration set value.

Check each coefficient by “Coefficient” in the factory mode.

Coefficient	Component	Offset value	Range value		Zero coefficient	Span coefficient
CH1			Range 1			
			Range 2			
CH2			Range 1			
			Range 2			
CH3			Range 1			
			Range 2			

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

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

6. ADJUSTMENT IN HEAT TREATMENT FURNACE

What is the adjustment in heat treatment furnaces?

If, in plant gases to be measured actually, a large amount of other lower-molecular-weigh gases than nitrogen (N_2) such as hydrogen (H_2), or a large amount of other higher-molecular-weight gases than nitrogen (N_2) such as argon (Ar) are contained, including the measuring components, it is known that the calibration curve (output performance to gas concentration) of gas analyzers will be affected (pressure broadening).

In such a case, analyzer is adjusted with gases similar to plant gas compositions in manufacturing (adjustment by scale gas). After this adjustment, the analyzer is checked the calibration curve with N_2 balance gas (calibration curve by check gas). Graphs with these calibration curves drawn are attached to products to be supplied.
Since measurement in a heat treatment furnace has much gas of such composition, it is considering as the adjustment for heat treatment furnaces.

In order to perform exact measurement, there are two methods in span calibration:
Composition of the standard gas for span calibration used for each method and its method are explained using an example:
For the standard gas for zero calibration, use dry N_2 in any case so that zero point will not be affected.

<Example>
Assume that a 0 – 1% CO_2 meter of the infrared ray gas analyzer measures CO_2 contained in plant gases.
When plant gases are composed of 0.5% CO_2, 23% CO, 30% H_2, 0.2% CH_4 and 46.3% N_2, either of the following is used as the span calibration standard gas.

	Standard gas type	Composition of standard gas	Method for span adjustment
1	Standard gas with the same composition as plant gases (scale gas)	0.9% to 1% CO_2 23% CO, 30% H_2, remainder is N_2 *	Perform span calibration directly.
2	Check gas	0.9% to 1% CO remainder is N_2	Perform span calibration indirectly

* A small amount of gas like 0.2% CH_4 with little effect on span calibration may be excluded from the standard gas.

(1) Method for span calibration by standard gas with the same composition as plant gas

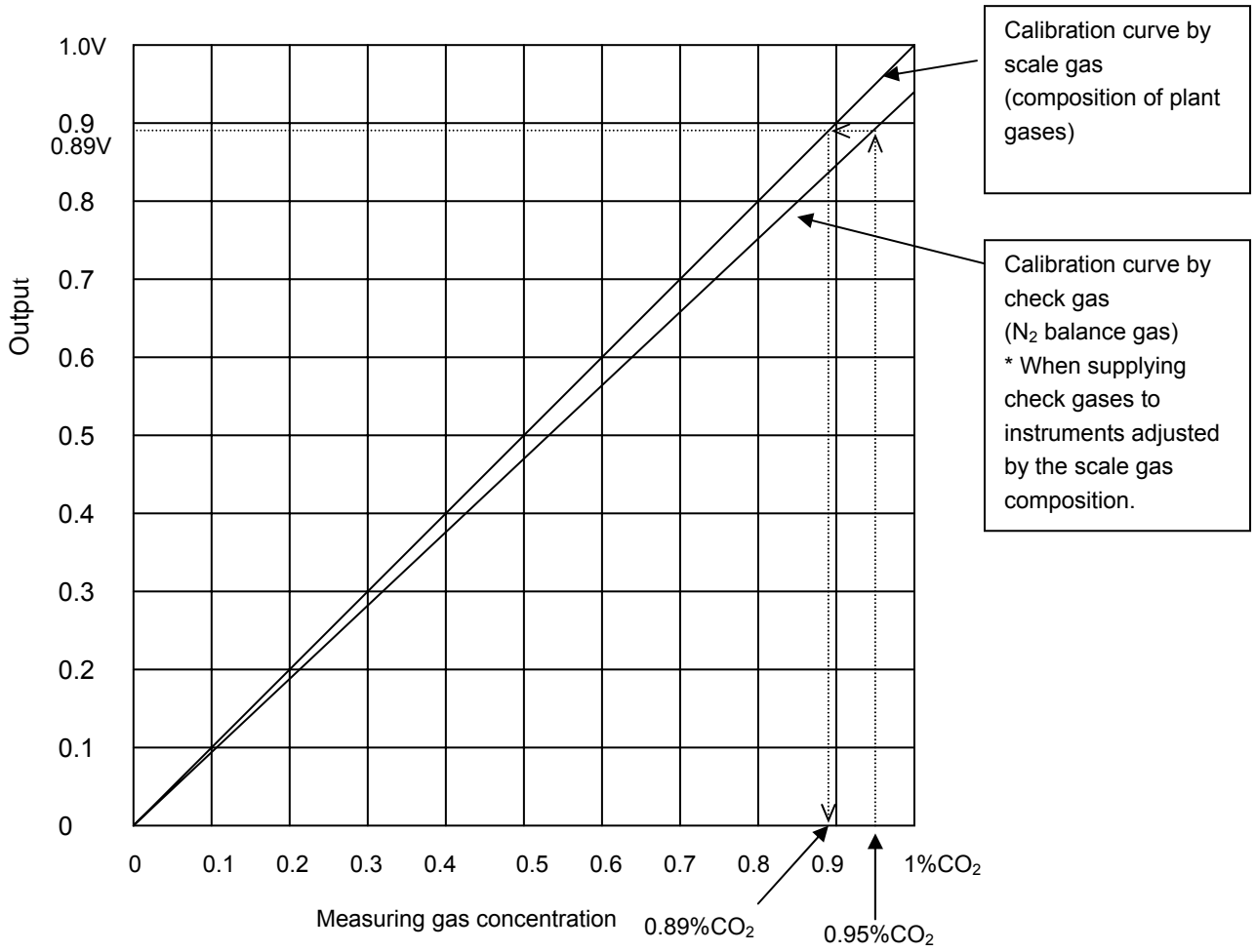
When using the standard gas with the same composition as plant gases given in 1, calibration can be performed without correction, as an error in calibration curve does not occur.

1) Set CO_2 concentration to span calibration concentration set value.
2) Perform span calibration by using the operation key.

(2) Method for span calibration by check gas

The method for span calibration by use of check gas (give in 2) is explained based on the example.
(Since span calibration has an error of calibration curve, preset a calibration indication on the calibration curve graph attached to this analyzer for indirect calibration.)

1) The following calibration curve graph is attached to the test results for the product. In graph, the calibration curve by the scale gas (that is similar to plant gas and determines scales of this analyzer) and the calibration curve by the check gas that is adjusted by the scale gas (gas of simple composition of N_2 balance gas to facilitate the analyzer check) are drawn.



Calibration curve graph attached to the product

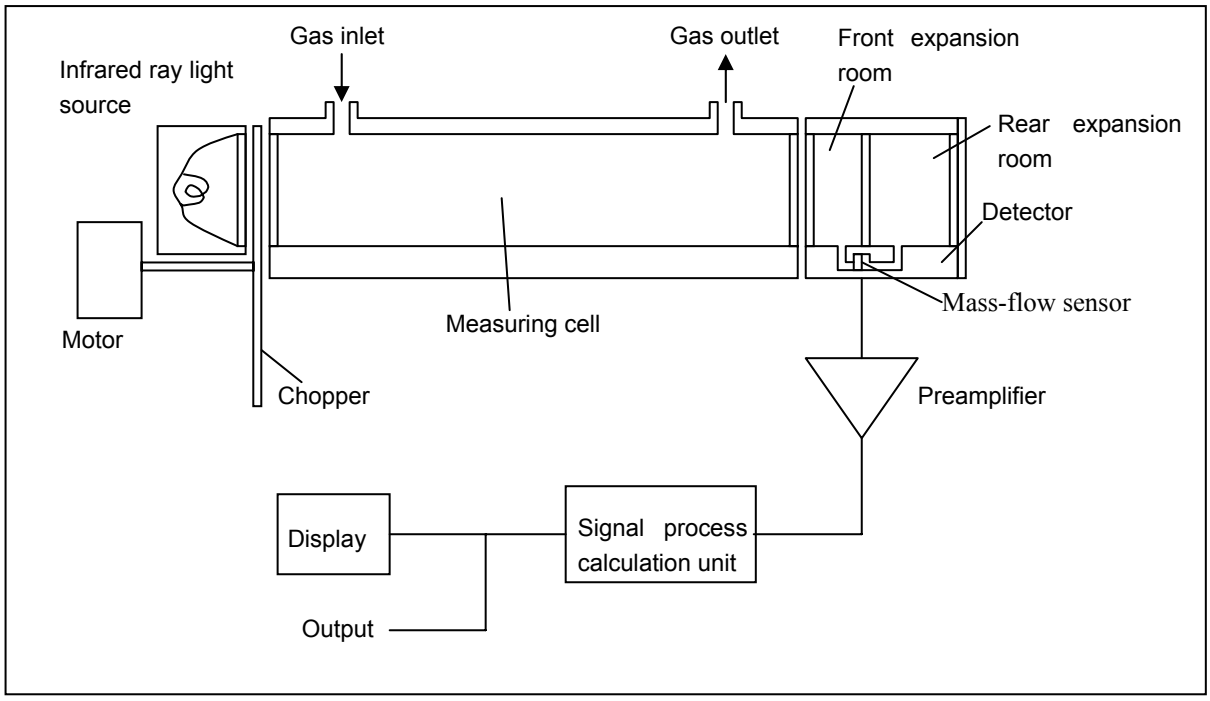
2) When using 0.95% CO_2 and remainder N_2 (check gas) as calibration gas,
In graph, a point of 0.95% on X-axis should be stretched to upward, draw a line toward Y-axis from the cross point with the check gas calibration curve. From the cross point with calibration curve on the scale gas composition, 0.89% or equivalent values can be obtained.

3) Set this point (0.89%) to the span calibration concentration of the calibration concentration set value.

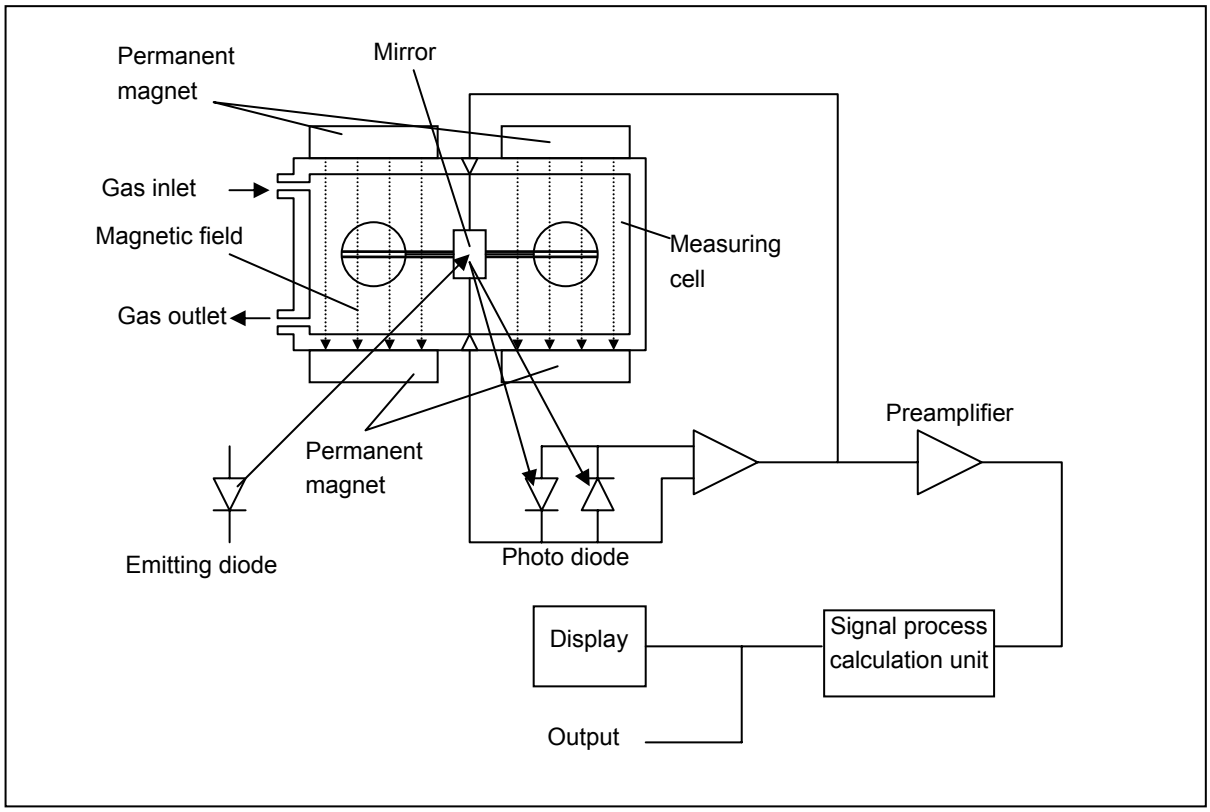
4) Supply 0.95% check gas to perform span calibration. Then, the concentration value is corrected to 0.89%. Measurement suited to actual plants can be performed by this error correction of calibration curve.

APPENDIX 1. MEASURING PRINCIPLE DIAGRAM

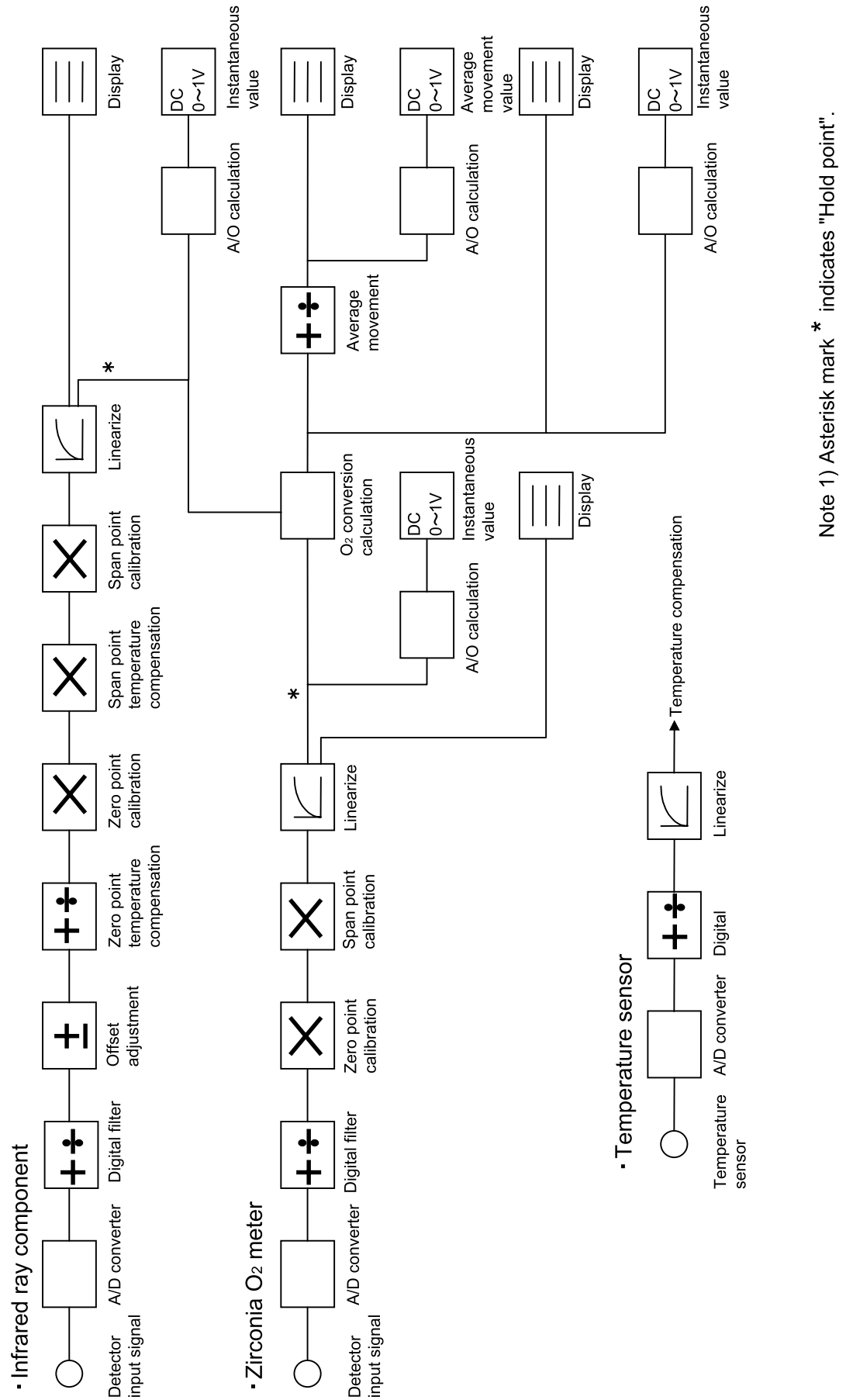
Infrared ray type (SO_2, CO_2, CO, and CH_4)



Paramagnetic type (O_2)

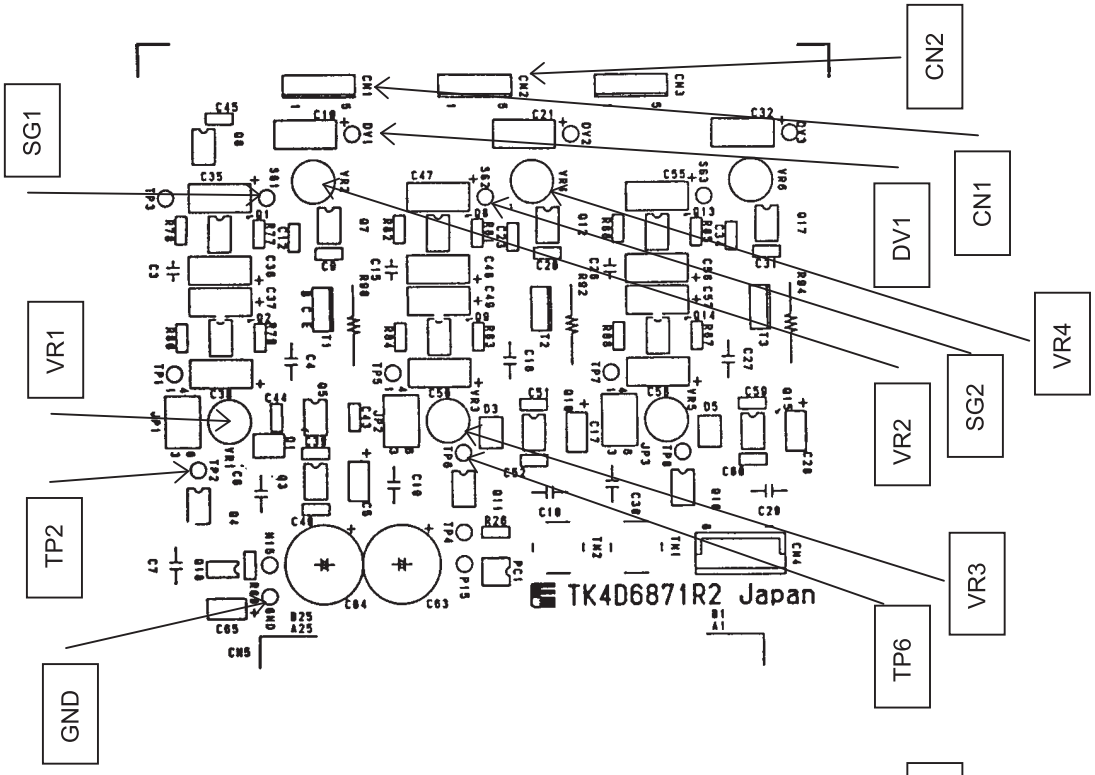


APPENDIX 2. SOFT FLOW DIAGRAM

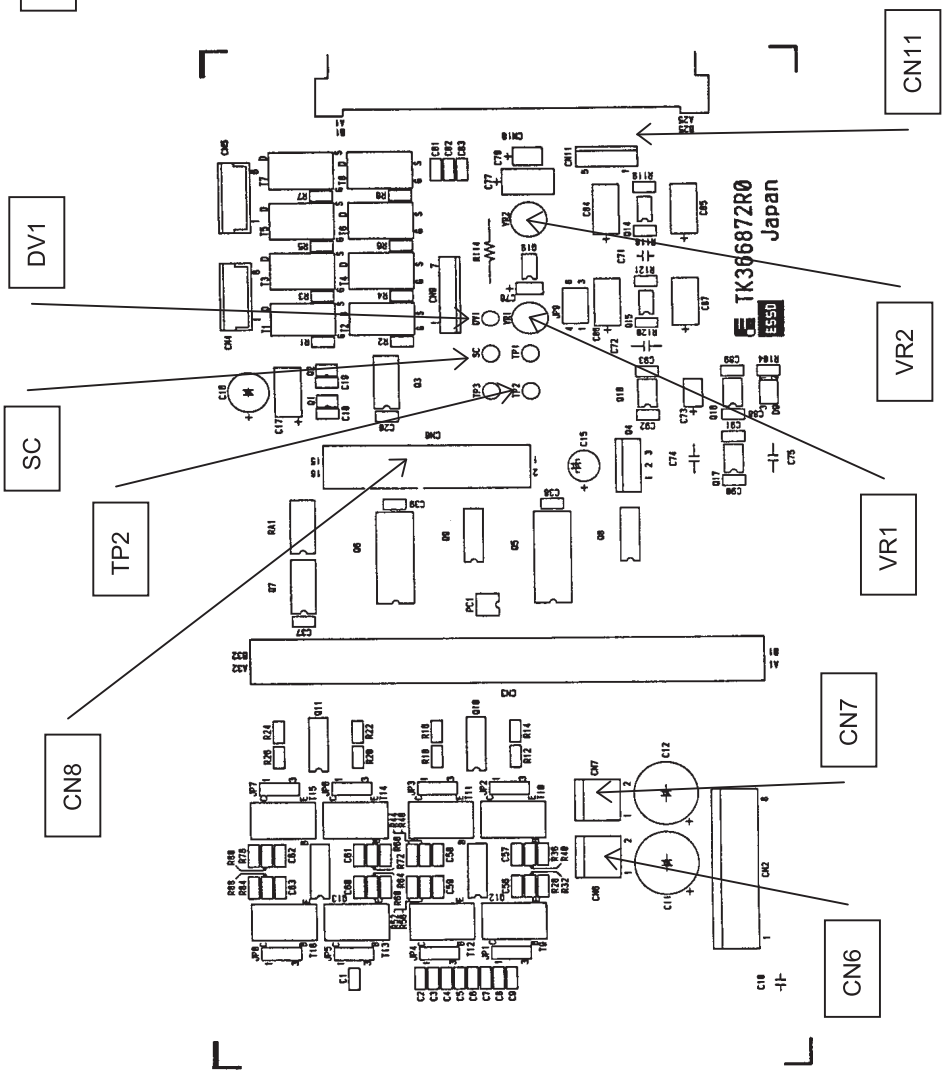


APPENDIX 3. PRINTED CIRCUIT BOARD DIAGRAM

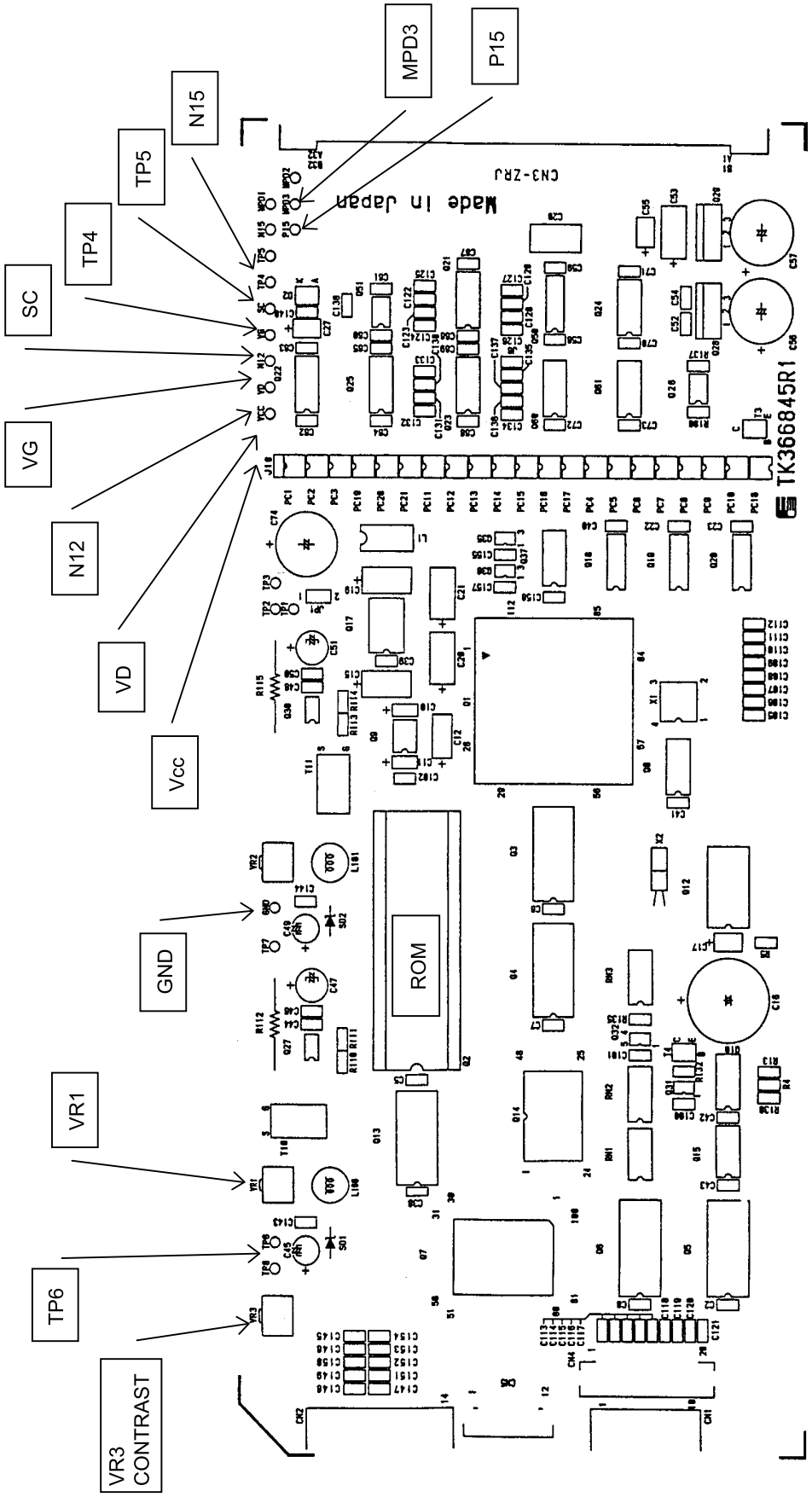
- **Amplifier printed circuit board**



- **Mother printed circuit board**



- **Main printed circuit board**



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