MANUAL No.3019E R3

Model TF Zirconia Type O_2 Analyzer

Model DTF-101 Receiver

Instruction Manual

(KX-621034)

The person who operates the product must read through this instruction manual.

ENERGY SUPPORT CORPORATION

1. For safe use of product

For safe use of the product, warning labels are provided on the instrument to increase caution, and cautionary messages are described in the instruction manual by the following method. After understanding the message content, use the product safely.

1-1 Cautionary message

	85 or 132 VAC is applied to the power terminal block. Since an electric shock may occur during check of wiring, turn off the external main power supply.

1-2 Warning

CAUTION	* Even if the power switch at the bottom right of this equipment is turned off, the source power is supplied to the terminal block. • Be sure to turn the external power supply off when working.

WARNING ELECTRIC SHOCK	* Touching power supply terminal block, switches and other electric devices may result in electric shock. • Be sure to turn the power off when inspecting. Handling with wet hands will cause danger.

● The notice terms mean the following:

WARNING It is a latent danger. Unless it is avoided, it may cause a death or serious injuries.

CAUTION It is a latent danger. Unless it is avoided, it may cause light or medium damage. It is also used as a warning for an operation which is not safe.

2. General items

2-1 Preface

"Model TF Zirconia Type O_2 Analyzer " is a unique oxygen analyzer emerged out of the state-of-art fine ceramics technology. Down-sizing, minimal power consumption were attained with the integration of zirconia sensor and the ceramic heater. This Instruction Manual described the installation, operation and inspection procedures of Model DTF-101 Receiver for Model TF Zirconia Type O_2 Analyzer. We hope that this unit is operated after reading this Operating Manual carefully prior to using it understanding the details of it thoroughly. Please be advised that this Instruction Manual contains the descriptions on multiple number of units of partially different specifications, therefore, there are some descriptions not applicable to your unit.

2-2 Product Warranty

(1) Term: Described in the final document.
Unless it is provided, the warranty term will last for one year after acceptance.

(2) Conditions: In the assumption that the product is properly stored and installed till the test operation and adjustment after acceptance at the customer's site, the delivered product shall be replaced or repaired without charge if any trouble or abnormality attributed to the poor design, manufacture or material which our company is responsible for occurs though the product is properly used during the above warranty term. Here, the proper operation method is as follows:

① The operational conditions and installation conditions described in the specifications and instruction manual shall be satisfied.

② Any excessive mechanical shock or vibration shall not be applied to the probe transmitter.

③ Calibration of the analyzer and replacement of the consumable parts shall be periodically carried out.

④ The operational state of the analyzer shall be checked and maintained.

(Note) The consumable and similar parts shall be outside the warranty range.

(3) Application: The warranty shall be limited only to those article delivered by us. Warranty shall not be applicable to the losses incurred following to the failure of our delivered articles(the losses or lost profits and others incurred out of the controls or records by using the articles delivered from us, the losses or lost profit and others of the equipment on which the articles delivered from us are installed).

2-3 Contents

2-4 Cautionary points as to operation

Use "Model DTF-101 Receiver" for Model TF Zirconia Type O_2 Analyzer in the following environments.

- Area not exposed to the direct sunlight as much as possible
- Area with a surrounding temperature of -10 to 50℃ with minimal variation of temperature (+/-10℃ or less/day)
- Area with minimal moisture and dust
- Area with minimal mechanical vibration
- Area with minimal electromagnetic influence
- Area with minimal corrosive gases
- Any corrosive materials must not be present in the discharge gas or sampled gas.
- Keep in mind that an error may result in the measured oxygen concentration if any combustible gas is present in the discharge gas or sampled gas.

2-5 Outline of product

"Model DTF-101 Receiver" for Model TF Zirconia Type O_2 analyzer is a gas analyzer used to monitor and control the atmosphere in an oven by measuring oxygen in the gas discharged from the boiler, heating oven, etc..

The following excellent functions and performance are featured:

- Automatic calibration and automatic purge function setting are possible.
- Setting of the content is possible for input/output points.
- The function and abnormality content are displayed on the LCD and LED.
- The value of the sensor signal can be indicated.
- - O_2 (converted into the butane gas) measurement inside the reducing atmosphere can be made with zirconia 2 cell pump type O_2 meter.
- Low sensor power consumption(normally approx. 20W) with low running cost.
- Short warm-up time(approx. 3 min.) with good operability.
- Easier maintenance with a small size and light-weight.

Principle of Zirconia 2 cell Pump Type Oxygen Analyzer

1. Construction and functions (Refer to figure at right)

①Heater : Sensing element is heated to approx. 800℃

②Sensing Cell : (1) Set the oxygen concentration of reference oxygen chamber to approx. 100%

(2) Measure the oxygen concentration of gas detection chamber.

(Refer to the following for detailed theory of operation.)

③Pumping Cell : Set the oxygen concentration of gas detection chamber to 0%.

(Refer to the following for detailed theory of operation.)

④Gas Detection Chamber : Gather the exhaust gas through the gas diffusion holes.

⑤Reference Oxygen Chamber : The oxygen concentration is at approx.100% with the reference oxygen electrical Micro current.

2. Characteristics of the detection section when heated to a high temperature

①An electromotive force (EMF) is generated with an induced oxygen ion conduction when gases of different oxygen concentration are placed between the electrodes.

(Oxygen Battery by Concentration Principle)

②By flowing an electrical current are transferred in the opposite direction to the electrical current.

(Oxygen Pumping Effect)

The sensing cell utilizes principles ① and ② , while the pumping cell utilizes principle ②.

3.Principle of the sensing cell

①A minute electrical current flow is applied between the electrodes of the sensing cell.

By flowing electrical current through the electrodes , oxygen in the gas detection chamber is transferred to the reference oxygen chamber and the oxygen concentration of reference oxygen chamber becomes approximately

100%.

NOTE:As the amount of oxygen transferred from gas detection chamber to the reference oxygen chamber is extremely small , the oxygen concentration in the gas detection chamber is not affected.

②An electromotive force determined by the equation shown below is generated between the electrodes of the sensing cell owing to the difference in oxygen concentrations between gas detection and reference oxygen chambers.

This electromotive force is measured in the sensing cell section and sends a signal to the pumping cell so that this electromotive force will become 350mV

(oxygen concentration in the gas detection chamber is 0%).

$$EMF = About - 53.2 \times \log_{10} \frac{\text{Oxygen Concentration in Gas Detection Chamber}}{\text{Oxygen Concentration in Reference Oxygen Chamber (100)}}$$

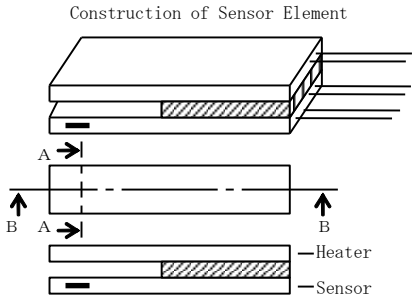
$$450 = -53.2 \times \log_{10} \frac{X}{100}$$

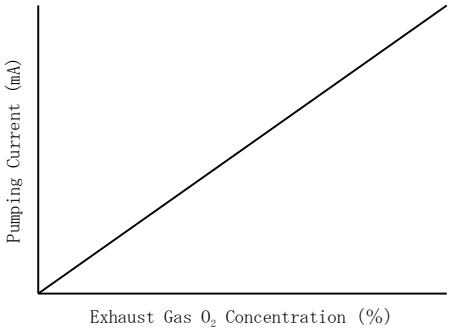
$$X = 0.00348\text{ppm} \fallingdotseq 0\%$$

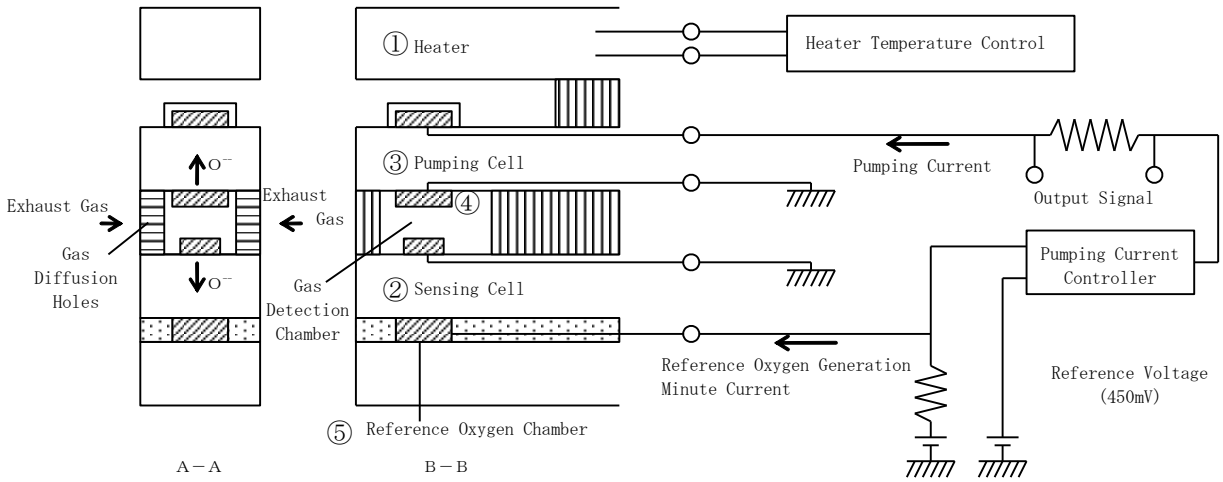
4.Principle of the pumping cell

An electrical current is applied between the electrodes of the pumping cell so that the oxygen concentration of the gas detection chamber becomes 0% by receiving a signal from the sensing cell.

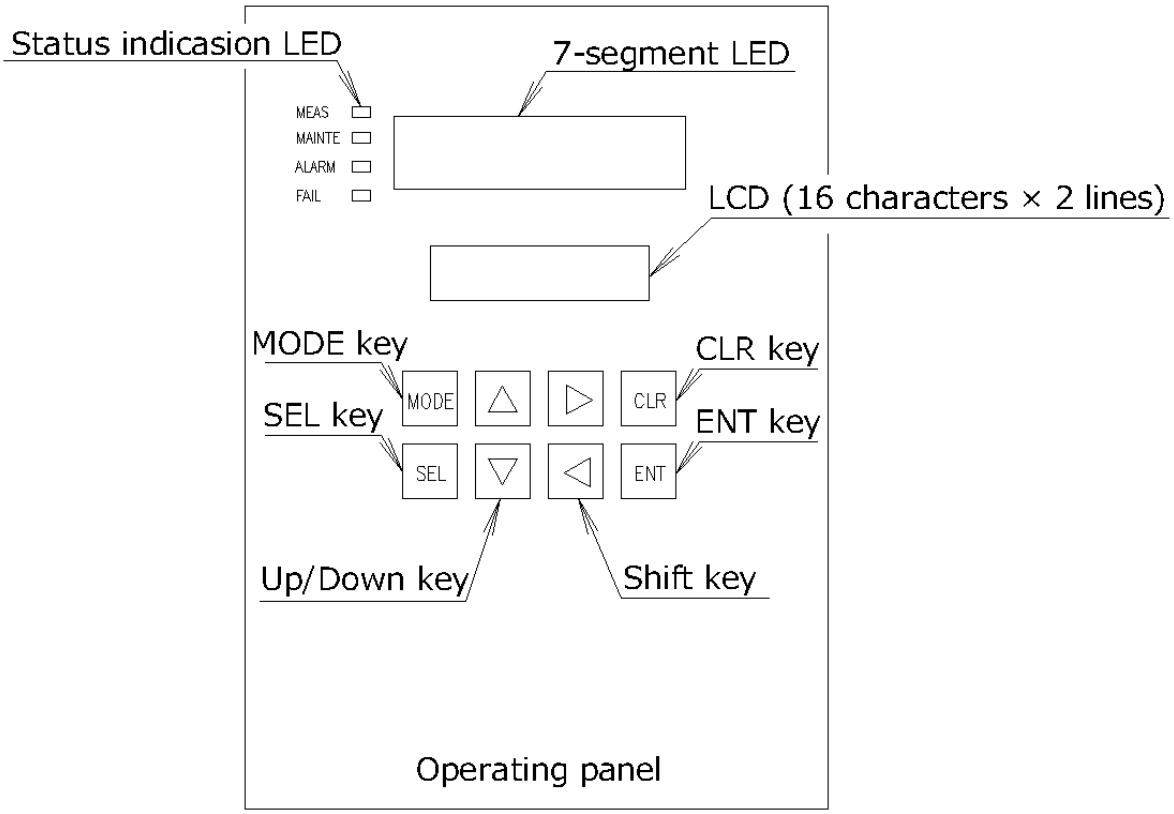
Because the oxygen concentration in the exhaust gas is proportional to the electrical current that flowed , the oxygen concentration in the exhaust gas can be measured by measuring the electrical current.







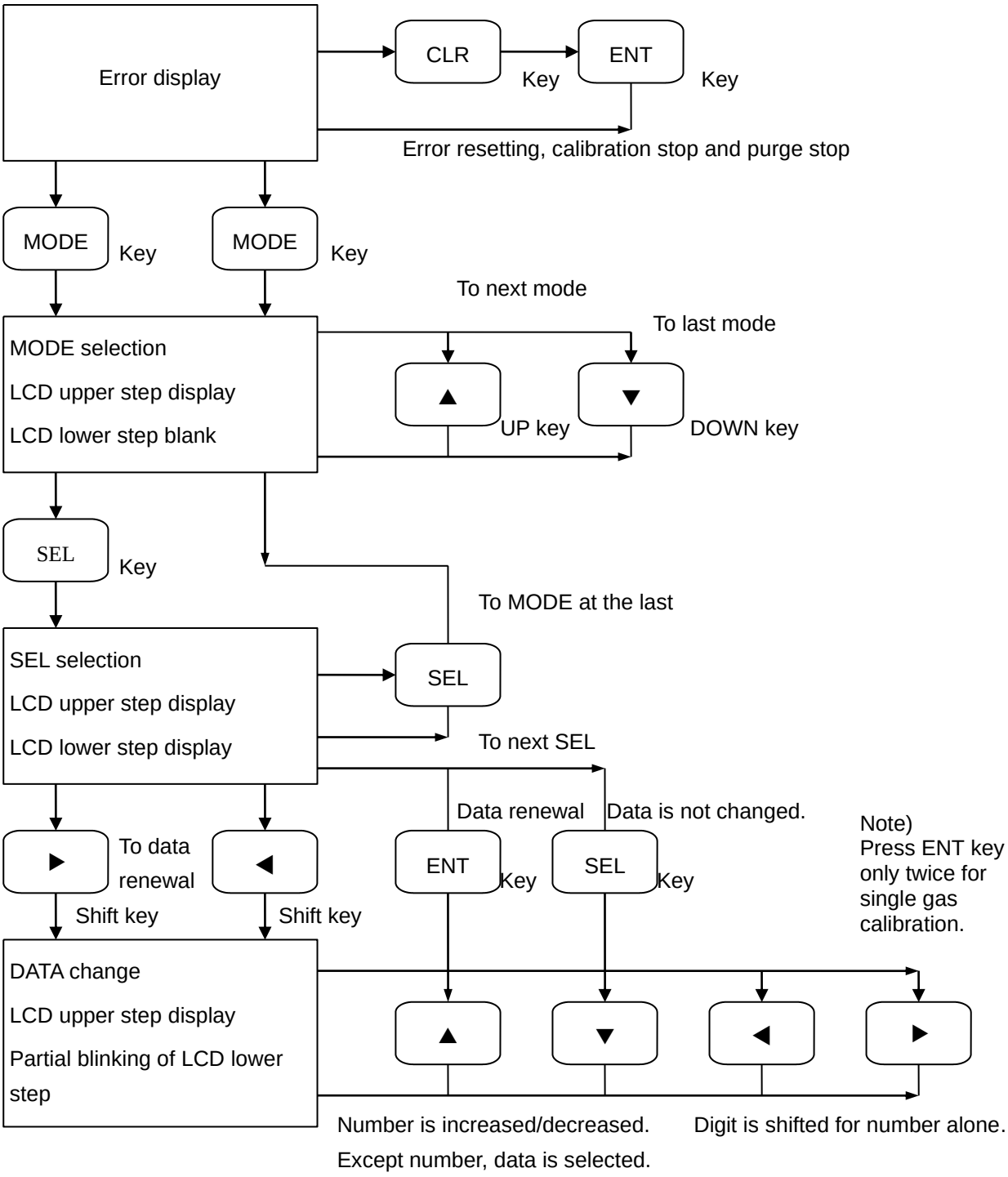
(3) Appearance of operation panel, and names and functions of components



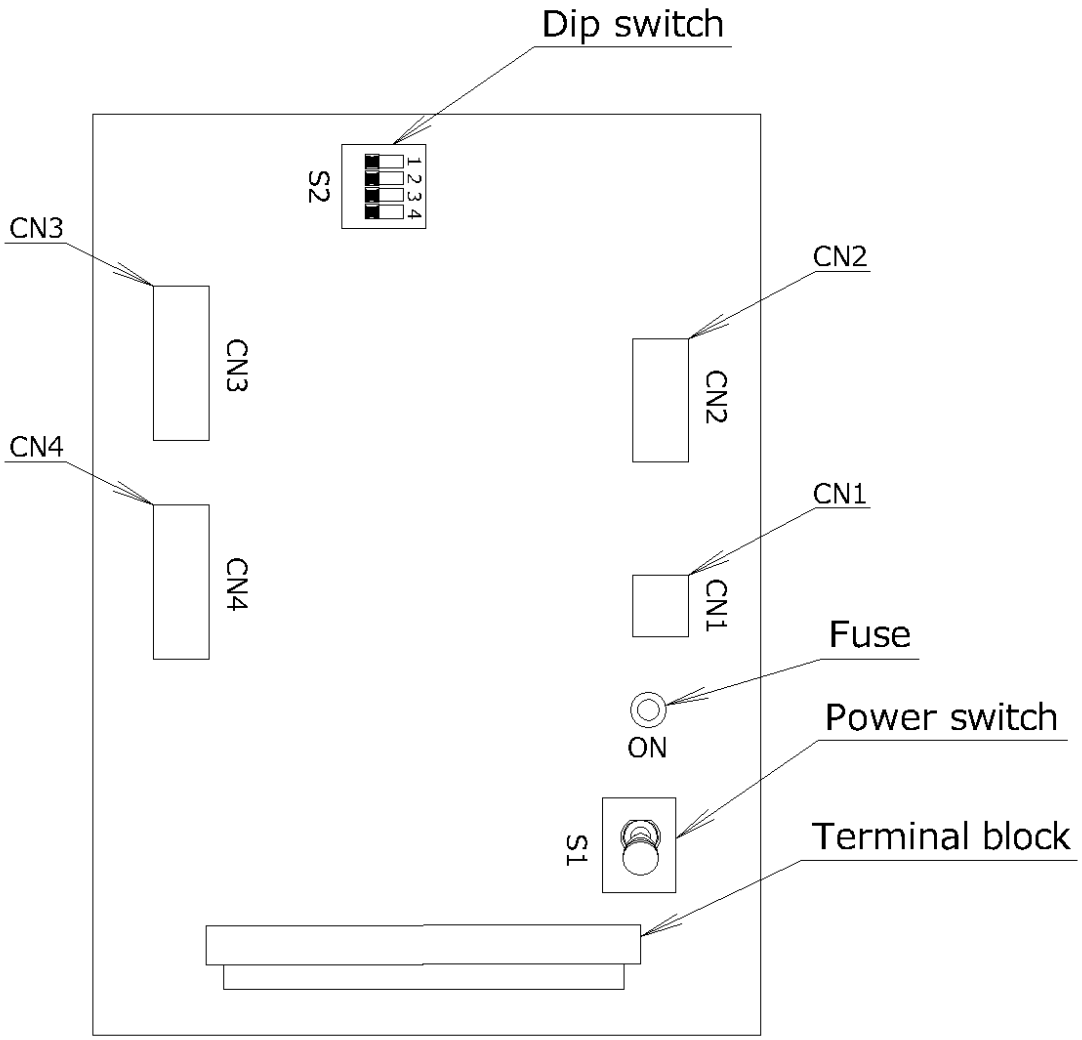
Name	Function
7-segment LED (Display unit 1)	Temperature rising time: The warm-up time is counted down. Measurement time: Oxygen concentration is displayed. Displayed content can be selected. (Refer to Page 22.) Abnormal time: Error code is displayed. (Refer to Page 55.)
16×2 characters LCD (Display unit 2)	Upper display : Mode is displayed. (Refer to Page 21.) Lower display : Message is displayed. (Refer to Pages 21 through 40.)
Status display LED	MEAS: Lit for normal measurement. MAINTE: Lit for temperature rise, calibration, purging, holding, MFT input and data setting ALARM: Lit when the alarm results from the upper or lower limit of the oxygen concentration. FAIL: Lit for occurrence of E-10 through E-20 errors
MODE key	MODE selection: LCD upper step MODE display selection / ordinary display (RANGE)
SEL key	SEL selection: LCD lower step display selection
UP/DOWN key	MODE switch : Used to select MODE (except RANGE). MODE can be selected. LCD lower step: Numeral data is increased/decreased. Other data except numeral data can be selected and changed.
Shift key	Data change : Digits of numeral value displayed at the lower step of LCD is shifted.
CLR key	Error reset: Error display is reset. ENT key returns it to the measurement mode. Calibration stop: Calibration is stopped. ENT key returns it to the measurement mode. Purge stop: Purging is stopped. ENT key returns it to the measurement mode.
ENT key	Data renewal: Measured data is registered.

Flow chart of key operation

The concept diagram of key operation is shown. For details of operation and setting content, refer to "5-2 Key operation method".



(4) Appearance of CPU board, and names and functions of components



Name	Function
Terminal block	External connection terminal block (Refer to p15.)
Power switch	Power switch for receiver ✎ Even if the main power switch is turned off, the voltage is still supplied to the terminal block of the power supply.
Power fuse	Glass tube fuse (ϕ 5.2×20mm×2A) JIS-MF-51NR 2A
Heater fuse	Glass tube fuse (ϕ 5.2×20mm×5A) JIS-MF-51NR5A
Dip switch	Only used to check the function of receiver. ✎ Don't turn on the switch. (Otherwise, the ordinary function of the receiver will turn off.)
CN1	Power connector
CN2	Transformer assembly connector
CN3	LED board connector
CN4	KEY board connector

2-7 Temporary storage of product

When temporarily storing the product, take care for the following:

- It is desirable to protect the product with styrene or similar in the box for storage.
- Store it at the place not directly exposed to sunlight.
- Store it at the surrounding temperature of -10 to 50℃ with the minimal temperature variation.
- Store it at the place with minimal moisture and dust.
- Store it at the place not exposed to rain water.
- Store it at the place with minimal mechanical vibration.
- Store it at the place free of corrosive and dangerous gases.

3. Installation

3-1 Installation conditions

In order to safely and properly operate the product, take care of the following points when determining the installation place since the analyzer is a precise instrument. Select a place which satisfies the best possible conditions.

- Place with minimal vibration (0.1G or less)
- Place free of corrosive gases (SO_2, H_2S, etc.)
- Place not exposed to radiation of hot heat.
- Place with minimal influence of electromagnetic field
- Place with minimal moisture and dust
- Voltage minimal fluctuations.
- Fluctuation of frequency of power supply is minimal.
- Place at the surrounding temperature of -10 to 50℃ (not exposed to direct sunlight)

3-2 Installation method

Cautionary points as to installation

① Since the analyzer is a precise instrument, take care to prevent applying excessive shock or load during installation.

② Since it is easily damaged, take care not to hit the instrument during installation.

3-3 Wiring method

Connect the wiring at the terminal block. Route the cables through the wiring hole at the bottom of the case.

Moreover, apply a dust-tight and drip-proof seal to the wiring during installation.

(1) Terminal block

M4 screws are all used on the terminal block.

> Since an electric shock may occur during check of wiring at the terminal block, turn off the external main power supply.

Arrangement on the terminal block

IN1	IN2	IN3	VS +	IP +	H +	S +	OUT	RY1	RY2	RY3	RY4	RY5	POW -ER	POW -ER
COM	IN4	IN5	VS −	IP −	H −	S −	OUT	RY1	RY2	RY3	RY4	RY5	E	

① POWER: Power terminal, supply power: 100 ±10V(115,200 VAC are optional)

> If any voltage above 110 VAC is applied to the power supply terminal block, it may cause trouble or a fire.

② COM-IN1 through 5 : Contact input terminal No-voltage contact max. 5 points
(Approx. 12 VDC, 6 mA is applied.)

③ VS +/VS- : Transmitter signal input sensing cell output voltage

④ IP+/IP- : Transmitter signal input pumping cell output current

⑤ H +/H- : Transmitter signal input heater applied voltage

⑥ S+/S- : Transmitter signal input heater applied voltage

} 4- terminal wiring

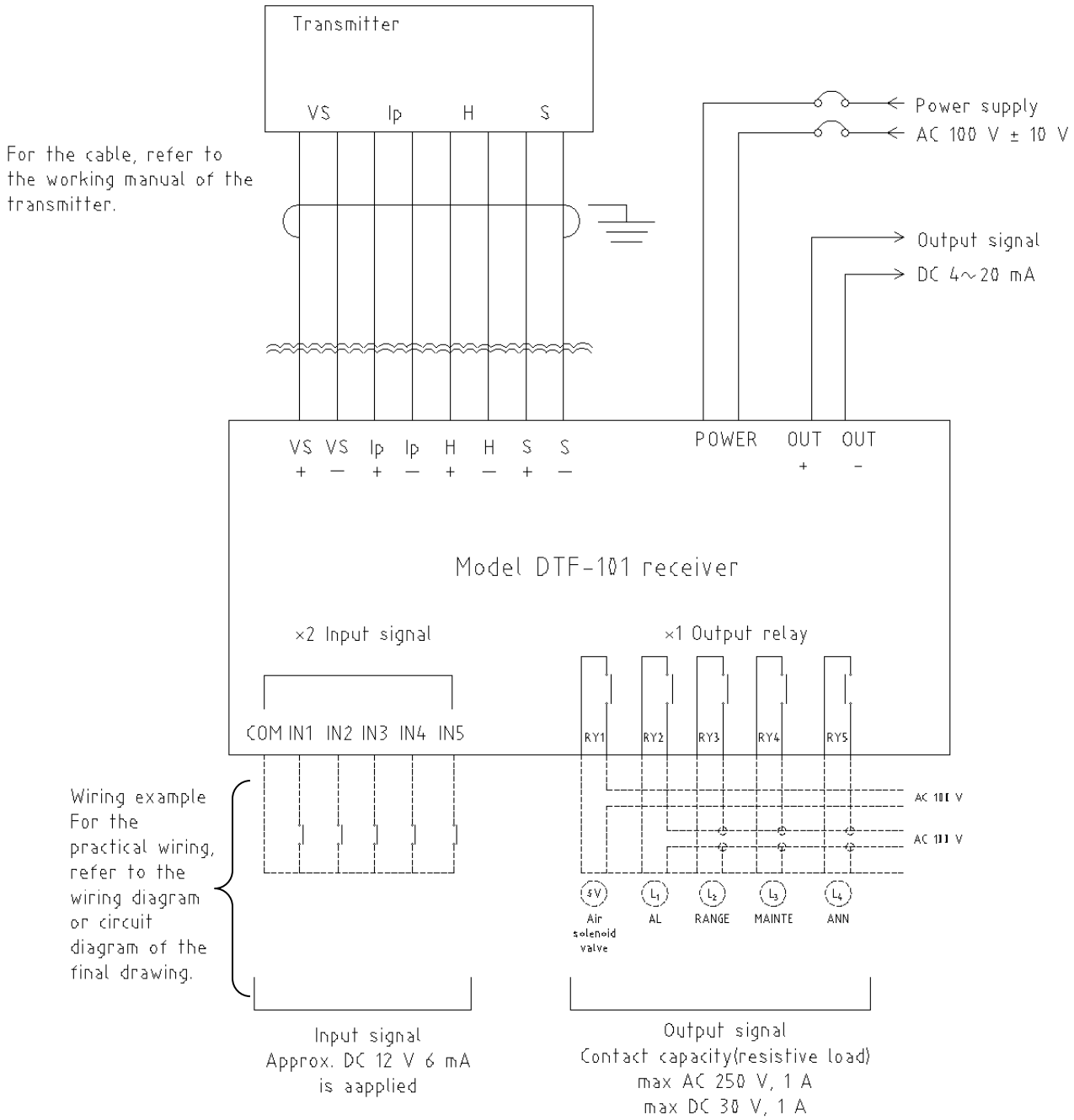
⑦ OUT+/OUT- : Output signal DC 4 to 20mA(load 600 ohms max.)

⑧ RY1 to RY4 : Contact output terminals, no-voltage contact, max. 4 points
(Contact capacity: AC 250V, 1A, DC 30V, 1A resistive load)

⑨ RY5 : Power OFF warning or instrument error
(ON: when power source OFF or in error)

⑩ E : Ground terminal (work must be conducted by referring to the Type 3 Grounding requirements.)

(2) Wiring



*1 The function of the output relay is input by we according to the specifications. (Refer to P43.)

*2 The function with the input signals is input by we according to the specifications. (Refer to P44.)

3-4 Inspection after installation

> Proper wiring from the transmitter of Model TF Zirconia type O_2 analyzer to the receiver of Model DTF-101 receiver. If power is supplied to the wrong wiring, it will cause a sensor breakage or other serious trouble.

In order to prevent trouble which results from wrong wiring, check the wiring by the following procedure with the air selected as the measured gas when turning on the power supply for the first time for test operation and adjustment.

After verifying that the power supply of the receiver is off, check the following.

(1) Heater wiring check (H+),(H-),(S+),(S-)

Check the followings after confirmed the receiver power is OFF.

- Resistance is measured at terminal block of the receiver between (H+), (H-) and between (S+),(S-).

Standard value: Wiring cable resistance(1 ohm/100 meter for 2 sq.)

- Resistance is measured at terminal block of the receiver between (H+), (H-), and between (S+), (S-).

Standard Value: Wiring cable resistance (1 ohms/100 meter for 2 sq.)

(2) Signal Load Wiring Check(Vs+),(Vs-),(Ip+),(Ip-)

Turn the electrical power to ON by disconnecting the lead wires of (Ip+),(Ip-) at receiver terminal block. Warm-up of transmitter is complete in about 3 minutes, so the followings are measured at the lead wires disconnected at the receiver terminal board.

> Take sufficient care to prevent the disconnected line from being short-circuited or grounded.

The EMF between (Vs+) and (Vs-) is measured.

Standard value: 0 to 150mV (Approx. 50mV)

The EMF between (Ip+) and (Ip-) is measured.

Standatd value: 0 to 100mV(Approx. omV)

(3) Heater polarity check

Followings are measured at terminal block of the receiver.

Voltage between (H-) and (H+) Standard value: 5 to 13V(approx. 10V)

Voltage between (S-) and (S+) Standard value: 5 to 13V(approx. 10V)

Potential of (H+) and (S+) must be the same.

Potential of (H-) and (H+) must be the same.

(4) Signal wiring polarity check

Turn the electrical power to OFF and connect the lead wires(Ip+) and (Ip-) disconnectin in paragraph(2) on the receiver side

Then turn the electrical power to ON and the followings are measured at transmitter side after elapsed 3 minutes.

Voltage between (Vs-) and (Vs+): Standard value: 100 to 600mV(approx. 450mV)

Voltage between (Ip-) and (Ip+): Standard value: 0.5 to 1.5V(approx. 1V)

(5) Maintenance inspections and wiring checks during the sensor replacements will be easier when the cable marking bands are attached on the transmitter and receiver cables at this time after completed the wiring checks.

Note: The standard values indicated in paragraph(1) through(4) above are those when the sensor is at an initial condition. Because that value may change with the use, therefore, the wiring checks must be made using the sensor in an initial condition.

Check Sheet during initial installation(Refer to paragrapg (1) to (4) on the previous pages for details of the checks.)

	Check items		Standard value	Check 1 ( )	Check 2 ( )
(1)	Heater + Heater Wiring resistance	H+/H-	2.5- 9Ω		
		S+/S-	2.5- 9Ω		
	Heater wiring Resistance	H+/S+	5Ω or less		
		H-/S-	5Ω or less		
(2)	Sensor signal	Vs-/Vs+	Approx. 50mV		
		Ip-/Ip+	Approx. 50mV		
(3)	Heater wiring Polarity	H+/H-	Approx. 10V		
		S+/S-	Approx. 10V		
		H+/H-	Approx. 10V		
		H-/H+	Approx. 10V		
(4)	Sensor signal Wiring polarity	Vs-/Vs+	Approx. 450mV		
		Ip-/Ip+	Approx. 1V		

This column is reserved for a convenient use during checks.

4. Function list of receiver

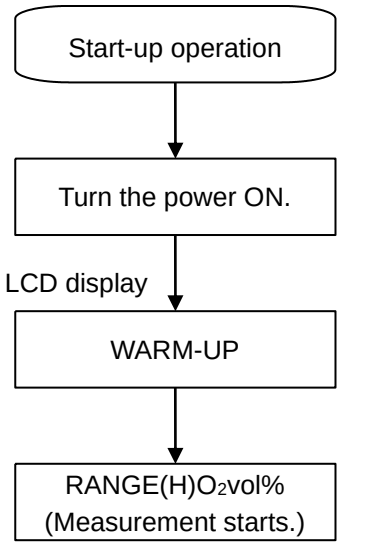
<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>Automatic calibration function</td><td>The solenoid valve is automatically opened and closed every preset time to apply the air, zero and span calibrations.
Note 1) There are two methods: automatic calibration is started every time preset by the timer and at a desired time by key operation.
Note 2) The calibration types of one-point calibration with the air and three-point calibration with air, zero and span can be selected.</td></tr>
<tr><td>Primary delay calculation function</td><td>The primary delay calculation in the range of 0 through 60 seconds is possible. (63% response Here, 90% response conversion is multiplied 2.3 times.)</td></tr>
<tr><td>O_2 upper/lower limit alarm function</td><td>The alarm contact is output by setting the upper and lower limit values of O_2.
Note) The alarm contact is automatically reset.</td></tr>
<tr><td>Output holding function</td><td>The output value can be held when the sensor is abnormal or during maintenance. PHM1 and PHM2 can be held at any set value within the range of 0 to 100%FS.
Hold operation by setting
<table>
<tr><th rowspan="2">Status</th><th colspan="4">HOLD SET setting</th></tr>
<tr><th>STD</th><th>OFF</th><th>PHM1</th><th>PHM2</th></tr>
<tr><td>Abnormal occurrence</td><td rowspan="5">Hold to previous value 5 seconds</td><td>Hold to previous value 5 seconds</td><td rowspan="5">Hold to set value</td><td rowspan="5">Hold to set value</td></tr>
<tr><td>During calibration</td><td rowspan="3">Not hold</td></tr>
<tr><td>Purging</td></tr>
<tr><td>Hold input</td></tr>
<tr><td>MFT input</td><td>Hold to previous value 5 seconds</td></tr>
</table></td></tr>
<tr><td>Self-diagnosis function</td><td>The abnormal places of the sensor and receiver are automatically detected with the self-diagnosis, and the error indication and alarm contact are output.</td></tr>
<tr><td>Monitor function</td><td>The O_2 value, cell electromotive force, thermocouple electromotive force and other data can be monitored.</td></tr>
<tr><td>Output value check/adjustment function</td><td>The output value of 4 to 20 mA can be checked and adjusted with the key operation.</td></tr>
<tr><td>Programmable range function</td><td>A desired value can be set for the SPAN point and ZERO point of the measured range.
Note 1) Two kinds of the Hi/Lo ranges can be set.
Note 2) The range of min. 5%O_2 to max. 25%O_2 is applied. The width of the range which does not include 0% is set at 10%O_2 or more.</td></tr>
</table>

Remote range switch function	Two kinds of the ranges can be switched from the external by turning on and off the no-voltage contact input of the terminal.
Remote calibration start function	The automatic calibration can be started by turning on the no-voltage contact input of the terminal.
MFT signal input process function	The heater control of the detector is turned off by the main fuel trip (MFT) signal (the error is not output), and the purge relay is turned on. After MFT is reset, it is started at the temperature rise.

5. Operation

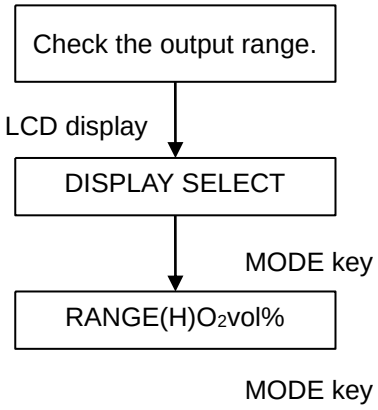
5-1 Start-up Operation

The basic operation procedure for starting the oxygen analyzer is shown below.



① Turn the power ON.

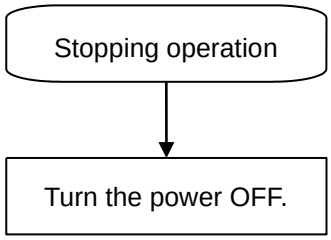
After the external power switch and the power switch inside the receiver are turned on, the receiver starts the count-down timer for warming the sensor (WARM-UP shown on LCD). After the set temperature has been reached, the measurement mode starts.



② Check the range (H/L) using the MODE key.

Operating the key on the receiver, check the output signal range. To change the range, refer to page 23.

5-2 Stopping Operation



Before turning the receiver off, check that the inside of the transmitter and the sensor are in the air environment. Otherwise sensor deterioration will result.

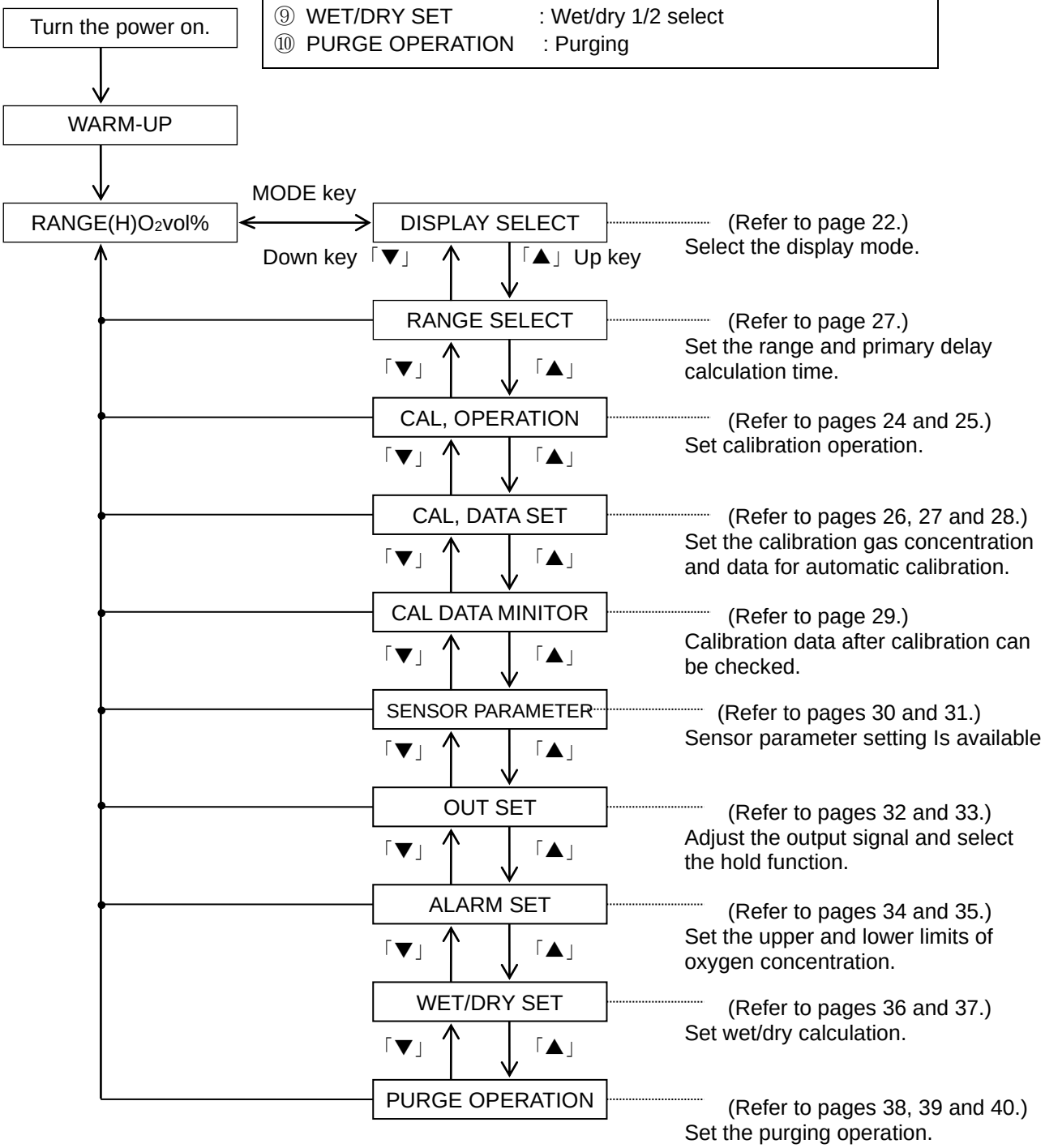
Turn the power switch of the receiver off.

When inspecting the terminals of the analyzer or receiver or performing maintenance work accompanying disconnection of wiring, turn the external power switch (source power switch) off.

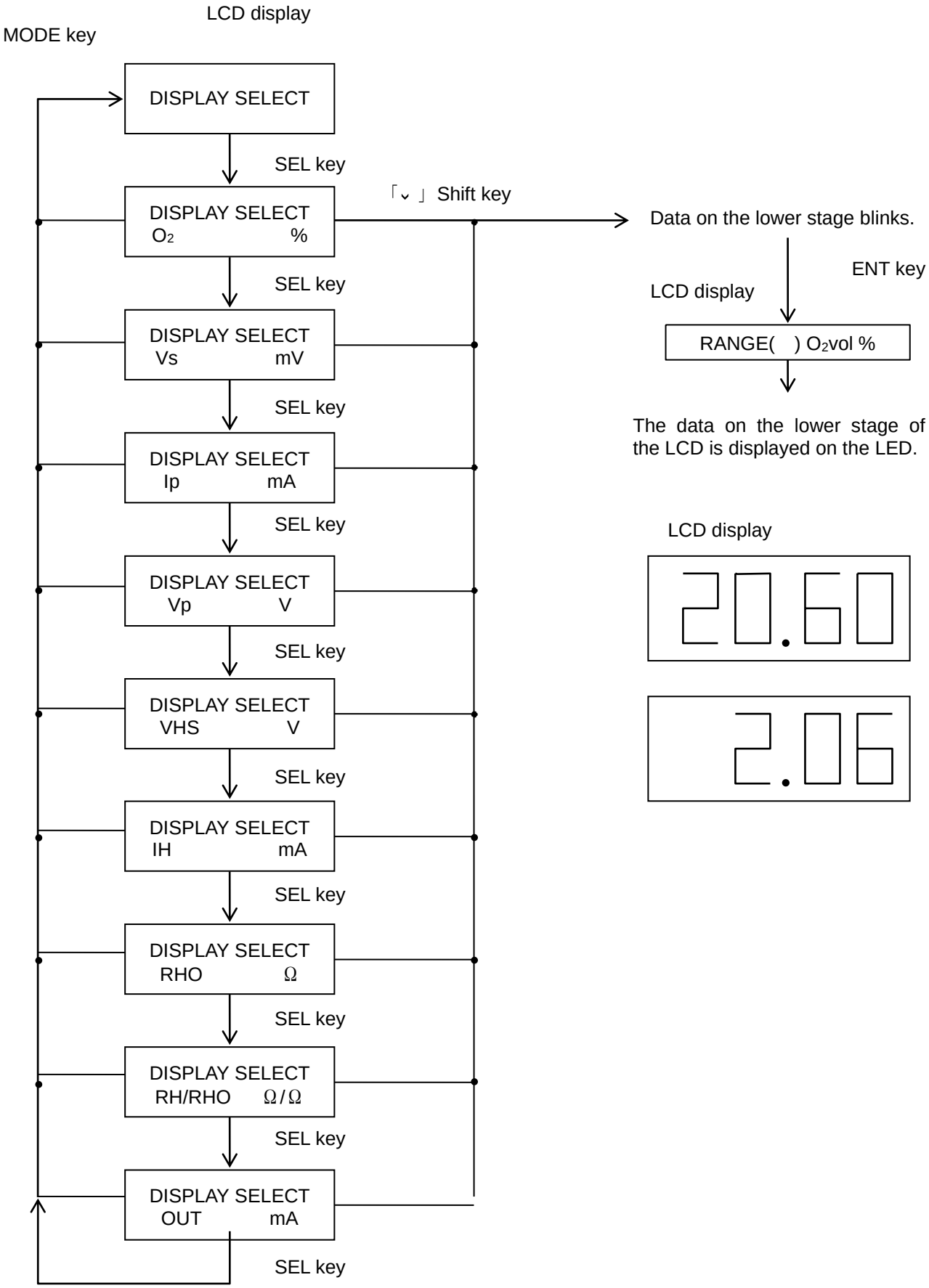
5-3 Key Operation Method

The following 10 functions are available using key operation.

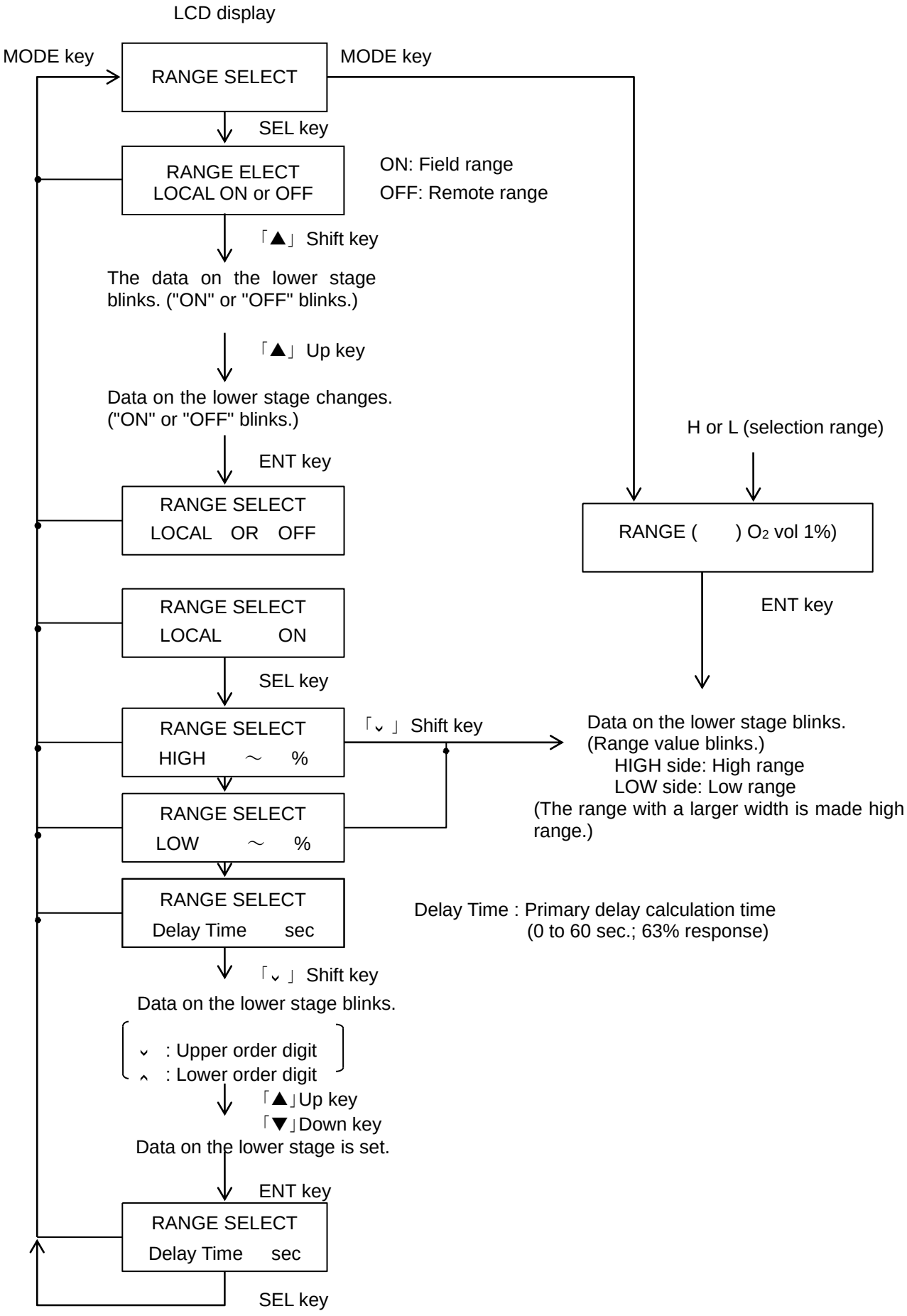
CLD display (upper stage)	
① DISPLAY SELECT	: Display select
② RANGE CHANGE	: Range changeover
③ CAL, OPERATION	: Calibration
④ CAL, DATA SET	: Calibration data setting
⑤ CAL, DATA MONITOR	: Calibration data confirmation
⑥ SENSOR PARAMETER	: Sensor parameter setting
⑦ OUT SET	: Output signal setting
⑧ ALARM SET	: Oxygen concentration alarm setting
⑨ WET/DRY SET	: Wet/dry 1/2 select
⑩ PURGE OPERATION	: Purging



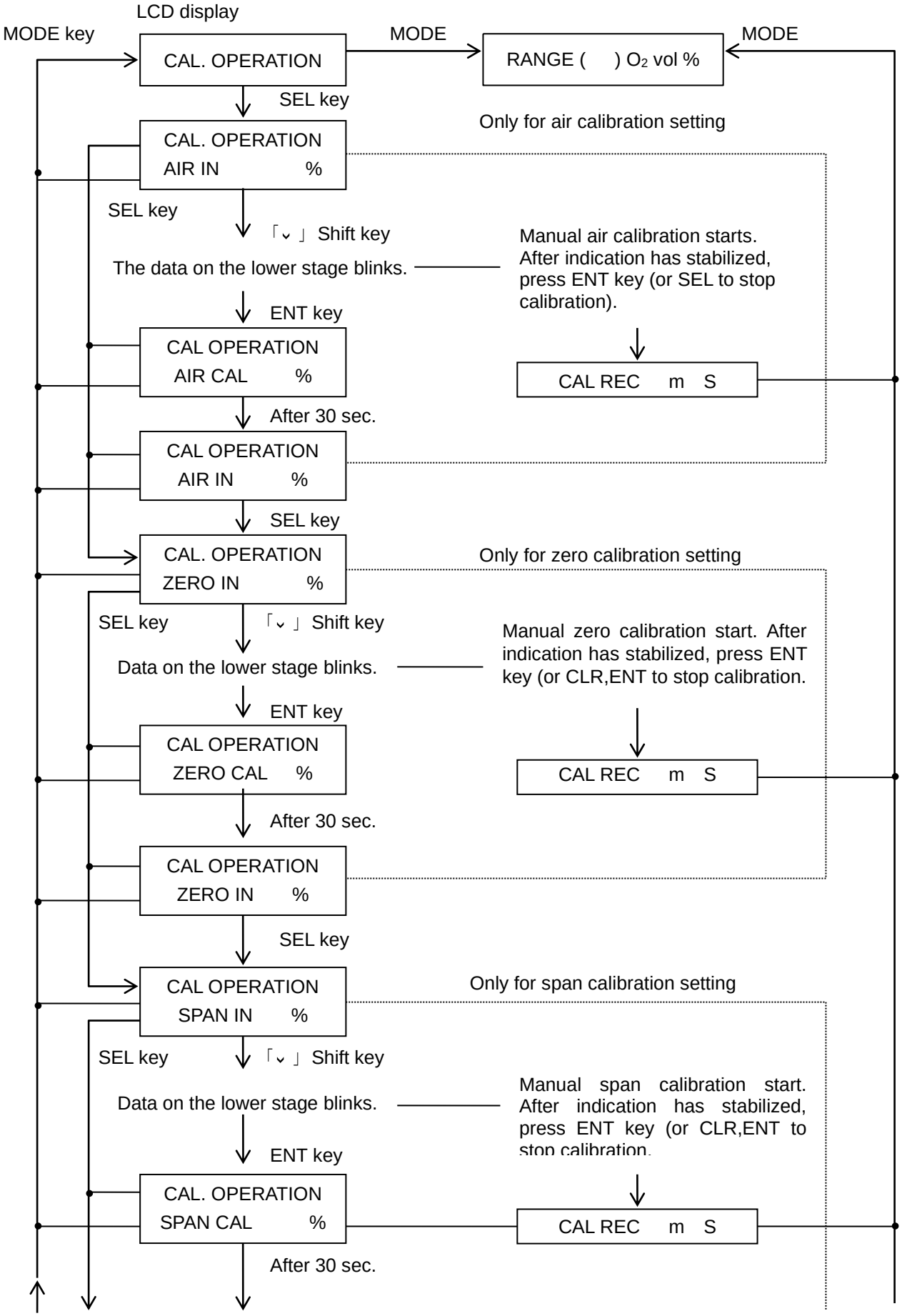
① Display select

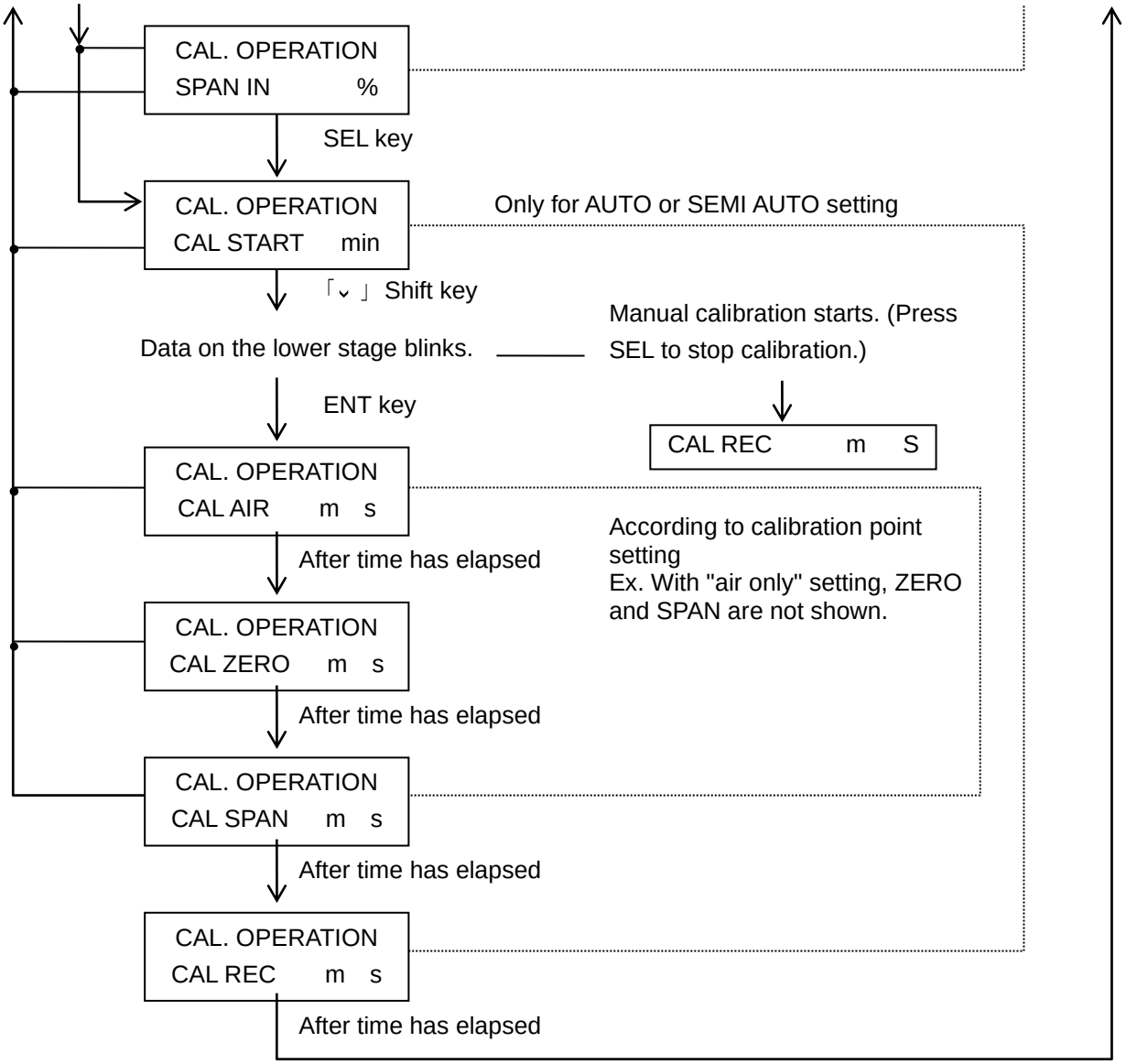


② RANGE CHANGE (Range change)

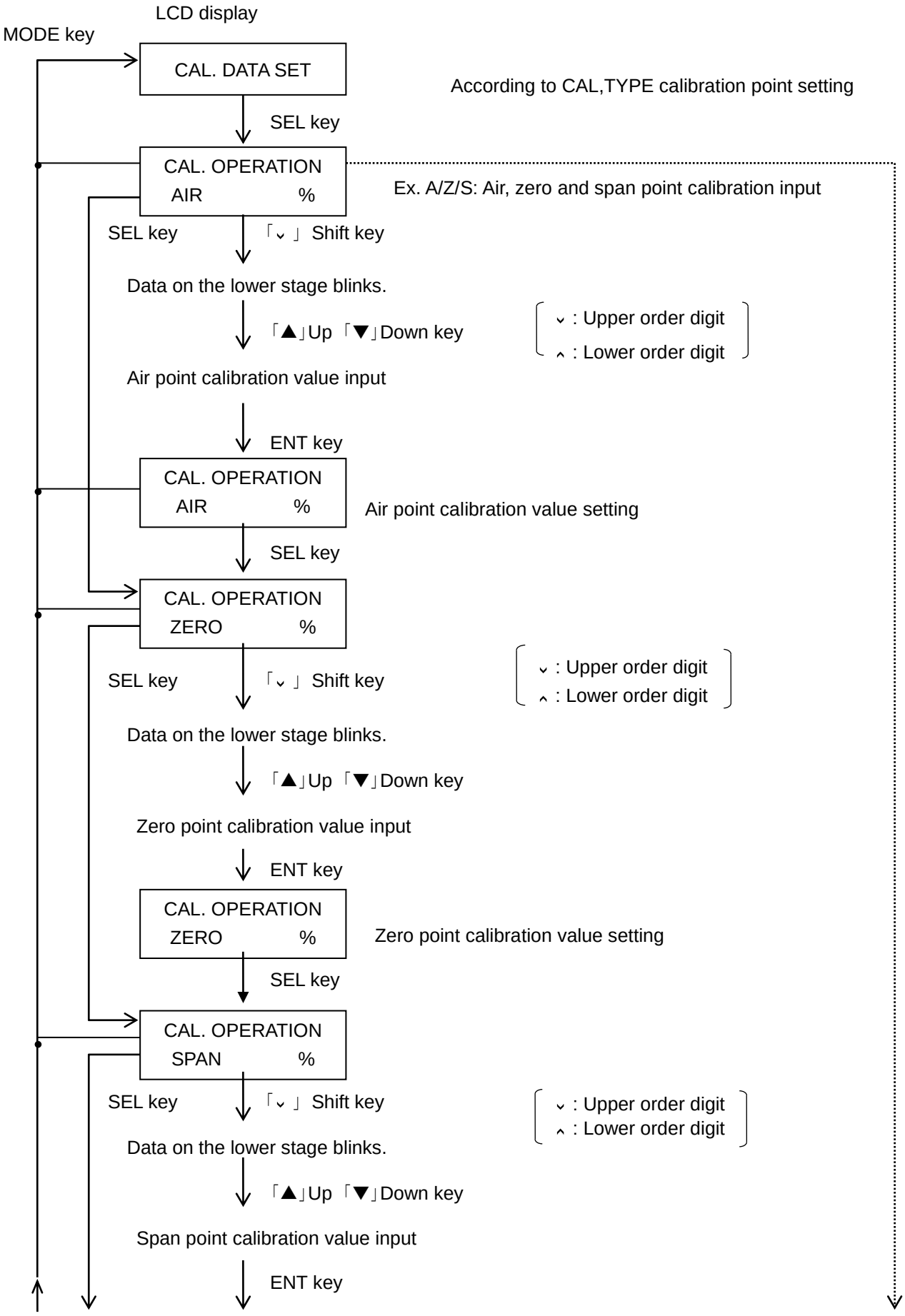


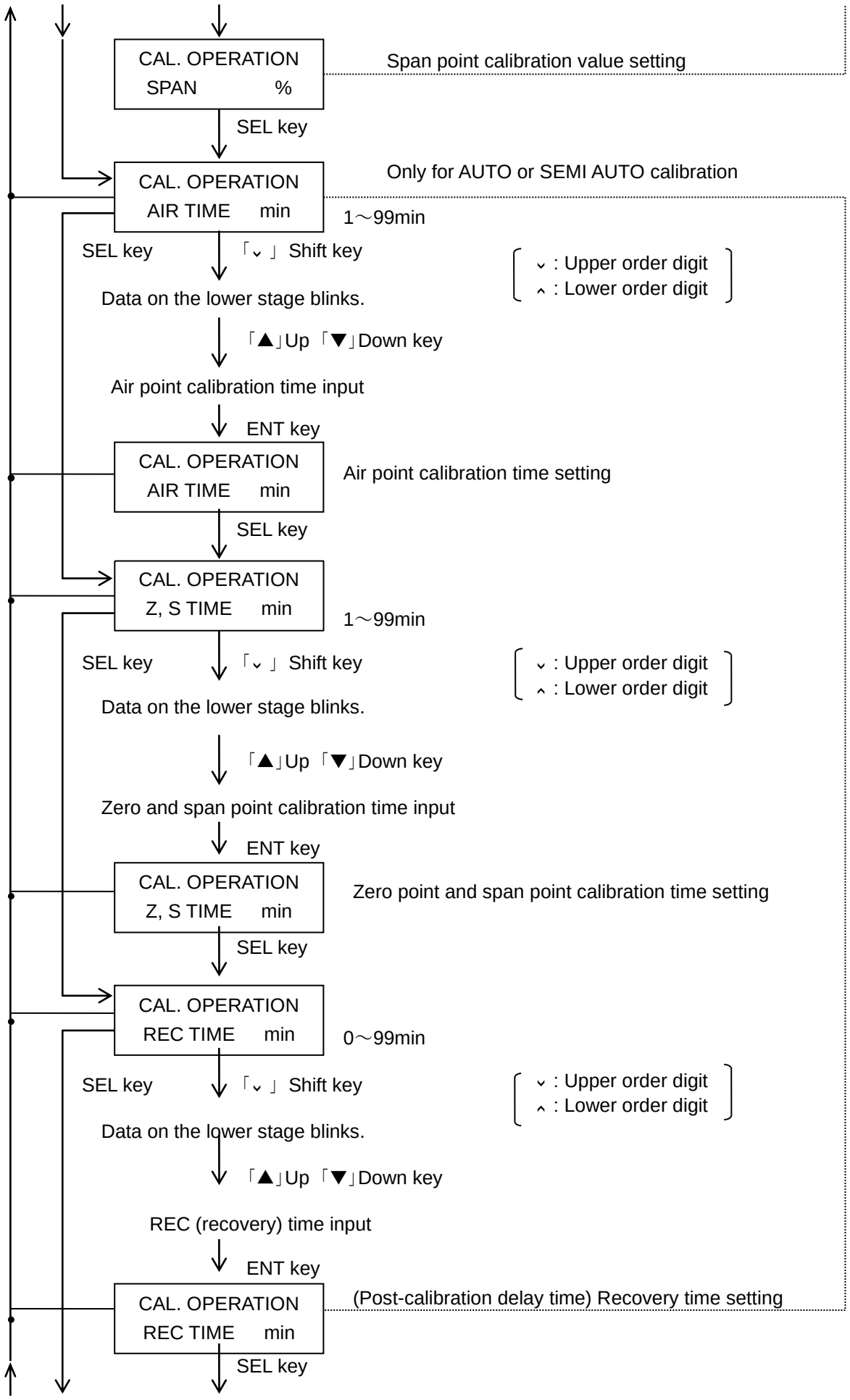
③ CAL. OPERATION (Calibration)

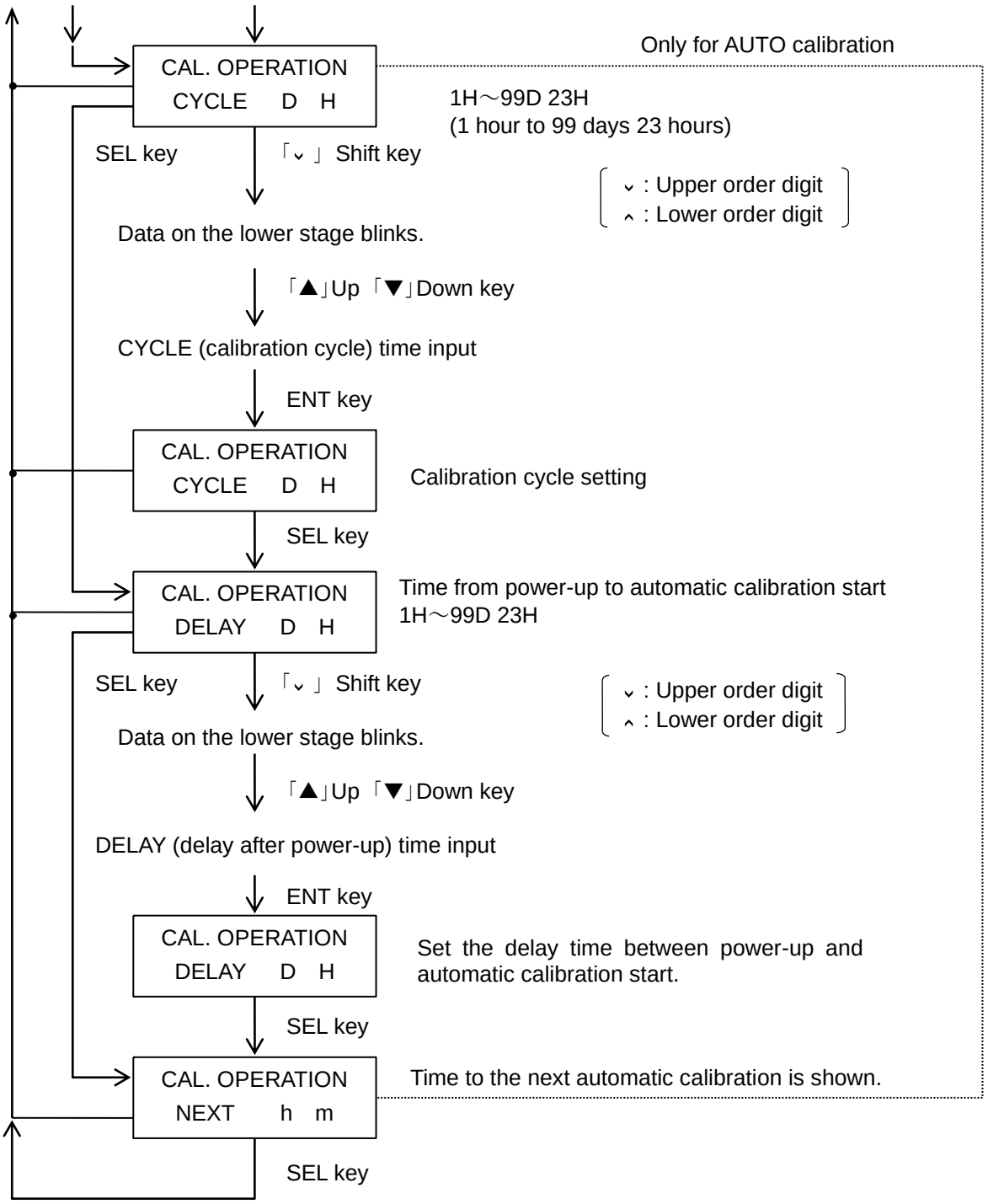



CAL. OPERATION
SPAN IN %
SEL key
CAL. OPERATION
CAL START min
Only for AUTO or SEMI AUTO setting
「˅」Shift key
Data on the lower stage blinks.
Manual calibration starts. (Press SEL to stop calibration.)
ENT key
CAL REC m S
CAL. OPERATION
CAL AIR m s
After time has elapsed
According to calibration point setting
Ex. With "air only" setting, ZERO and SPAN are not shown.
CAL. OPERATION
CAL ZERO m s
After time has elapsed
CAL. OPERATION
CAL SPAN m s
After time has elapsed
CAL. OPERATION
CAL REC m s
After time has elapsed

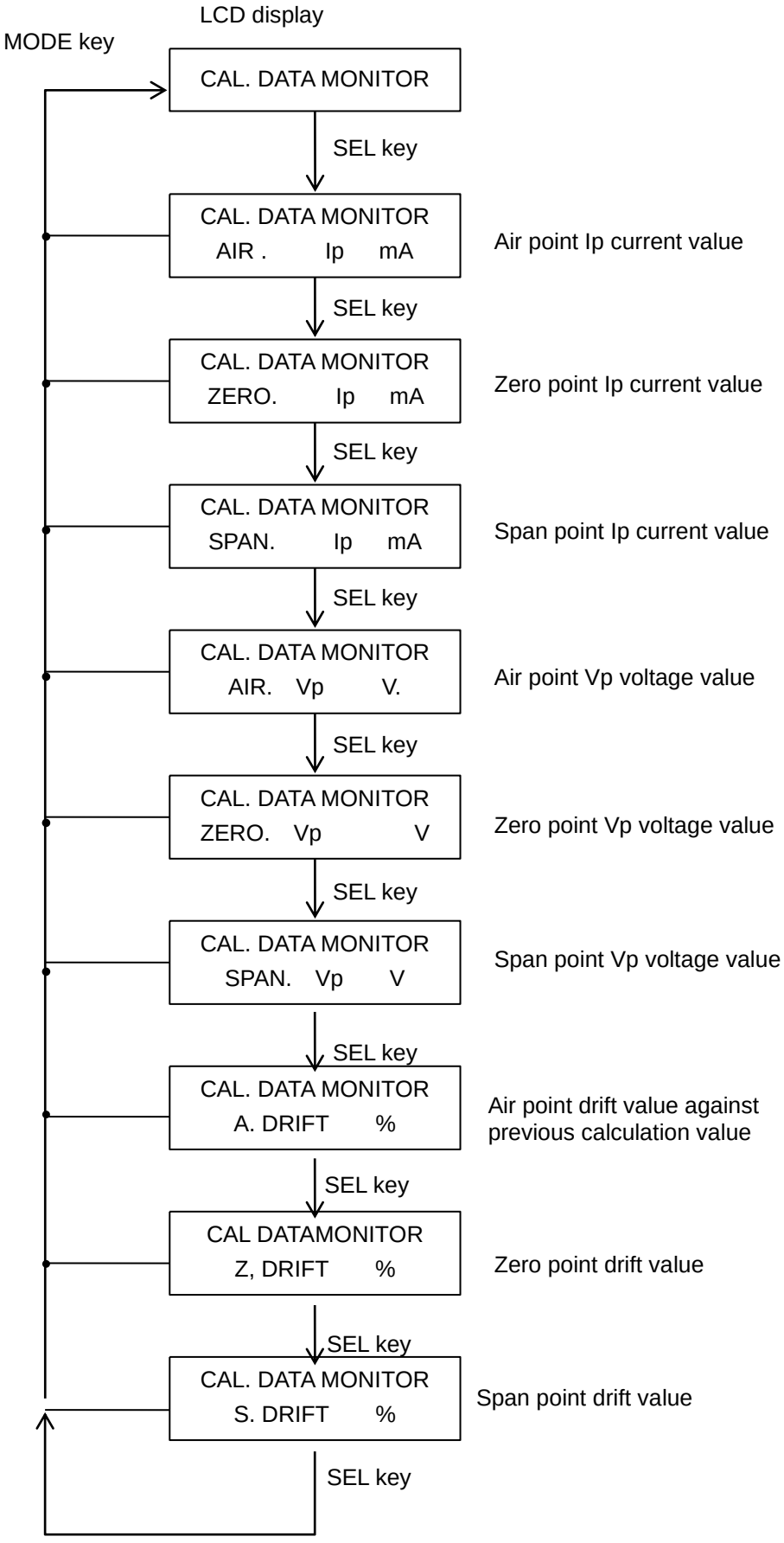
④ CAL DATA SET (Calibration data setting)



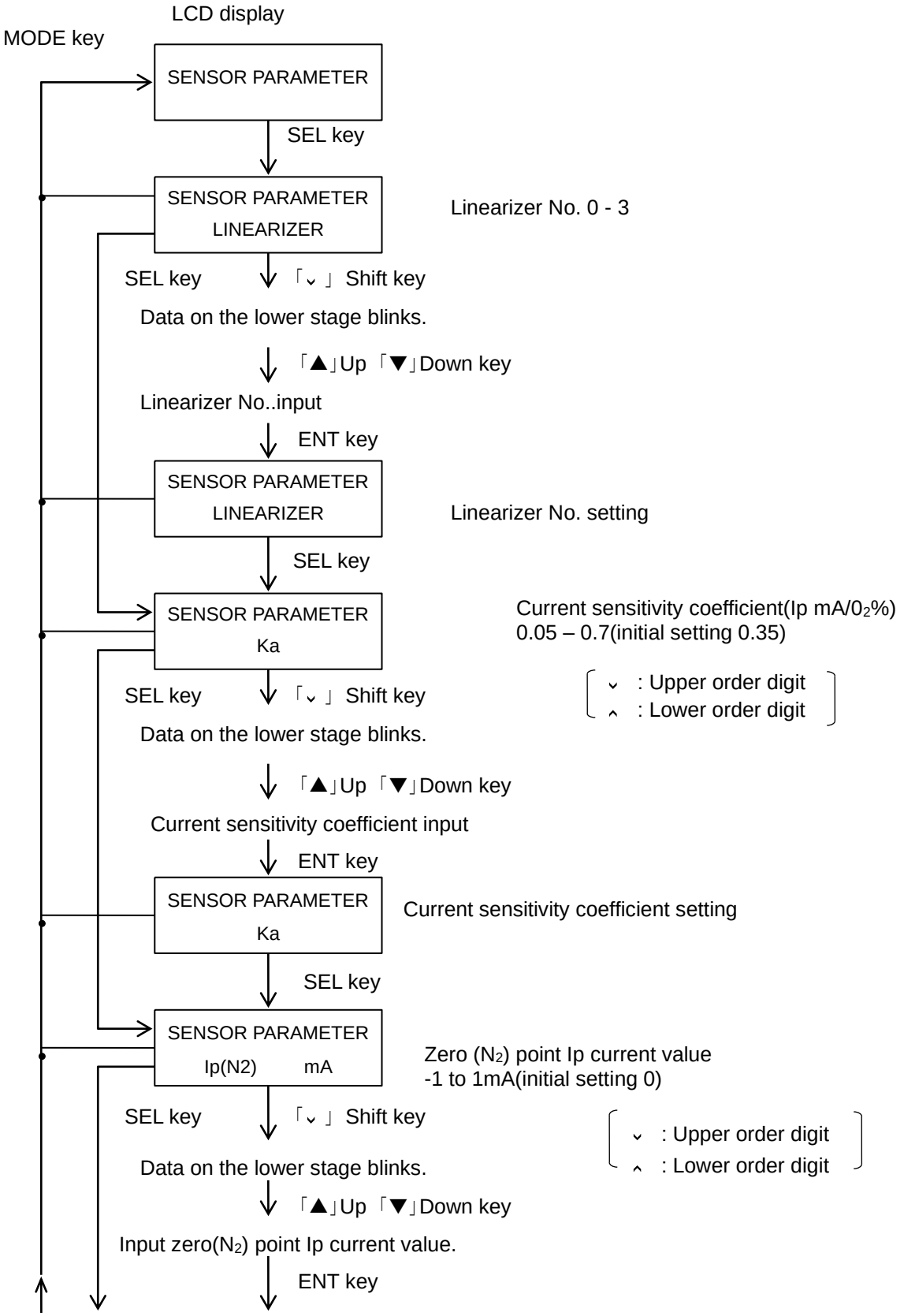

CAL. OPERATION
SPAN %
Span point calibration value setting
SEL key
CAL. OPERATION
AIR TIME min
Only for AUTO or SEMI AUTO calibration
1～99min
SEL key
「˅」Shift key
˅ : Upper order digit
˄ : Lower order digit
Data on the lower stage blinks.
「▲」Up 「▼」Down key
Air point calibration time input
ENT key
CAL. OPERATION
AIR TIME min
Air point calibration time setting
SEL key
CAL. OPERATION
Z, S TIME min
1～99min
SEL key
「˅」Shift key
˅ : Upper order digit
˄ : Lower order digit
Data on the lower stage blinks.
「▲」Up 「▼」Down key
Zero and span point calibration time input
ENT key
CAL. OPERATION
Z, S TIME min
Zero point and span point calibration time setting
SEL key
CAL. OPERATION
REC TIME min
0～99min
SEL key
「˅」Shift key
˅ : Upper order digit
˄ : Lower order digit
Data on the lower stage blinks.
「▲」Up 「▼」Down key
REC (recovery) time input
ENT key
CAL. OPERATION
REC TIME min
(Post-calibration delay time) Recovery time setting
SEL key

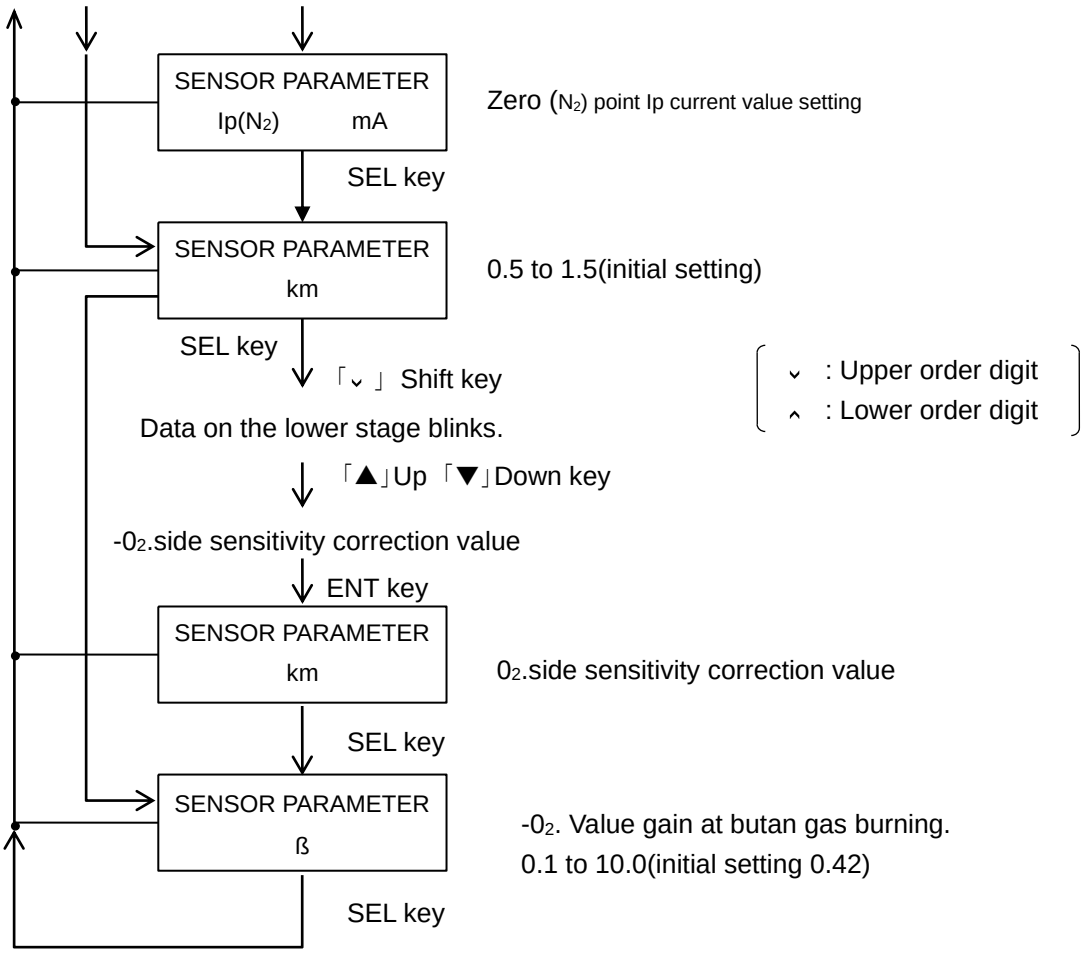

Only for AUTO calibration
CAL. OPERATION
CYCLE D H
1H～99D 23H
(1 hour to 99 days 23 hours)
SEL key
「˅」 Shift key
˅ : Upper order digit
˄ : Lower order digit
Data on the lower stage blinks.
「▲」Up 「▼」Down key
CYCLE (calibration cycle) time input
ENT key
CAL. OPERATION
CYCLE D H
Calibration cycle setting
SEL key
CAL. OPERATION
DELAY D H
Time from power-up to automatic calibration start
1H～99D 23H
SEL key
「˅」 Shift key
˅ : Upper order digit
˄ : Lower order digit
Data on the lower stage blinks.
「▲」Up 「▼」Down key
DELAY (delay after power-up) time input
ENT key
CAL. OPERATION
DELAY D H
Set the delay time between power-up and automatic calibration start.
SEL key
CAL. OPERATION
NEXT h m
Time to the next automatic calibration is shown.
SEL key

⑤ CAL DATA MONITOR (Calibration data display)

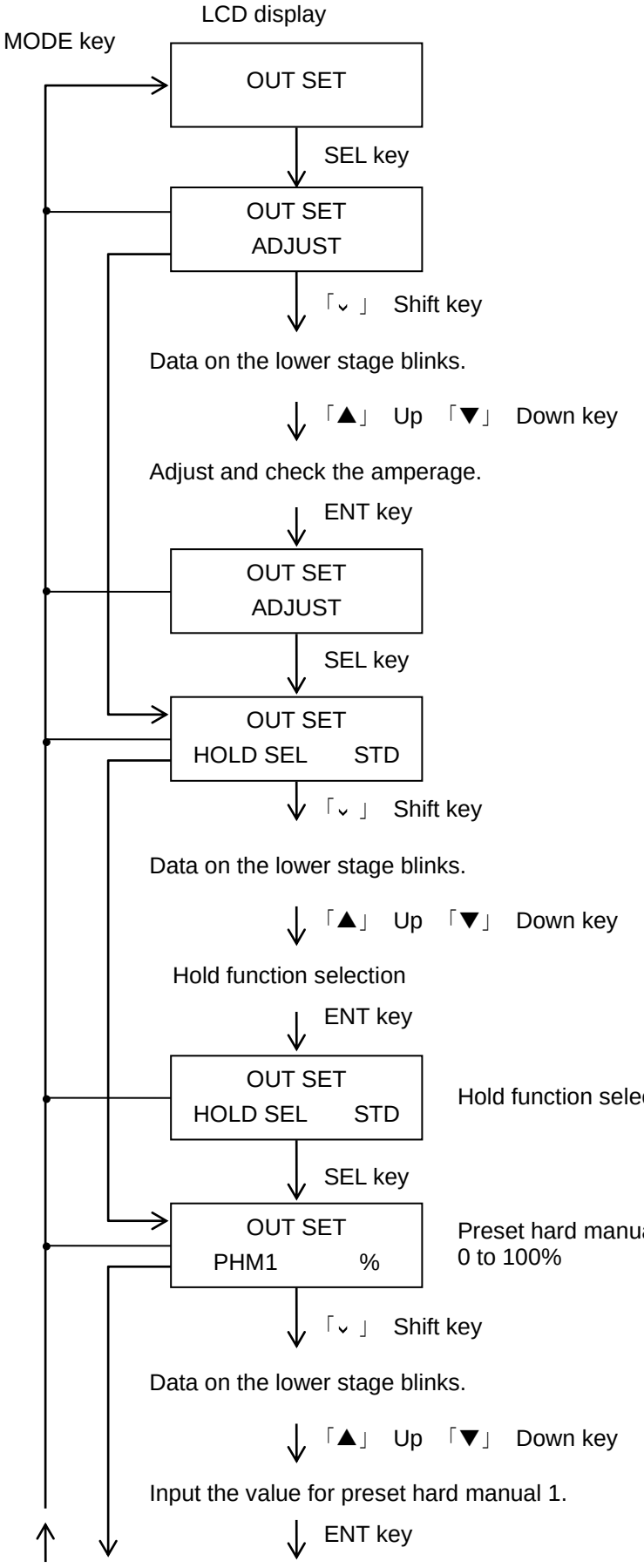


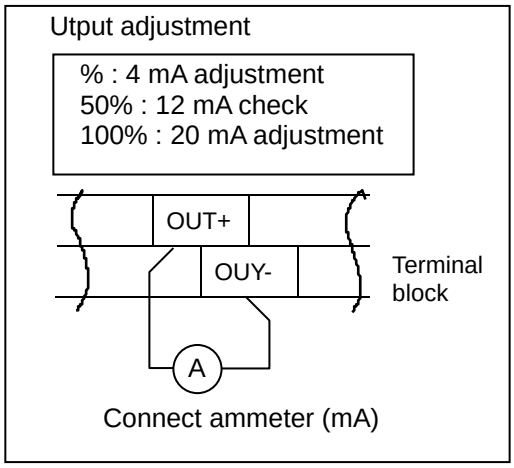
⑥ OUT SET (Output signal setting)




SENSOR PARAMETER
Ip(N2) mA
Zero (N2) point Ip current value setting
SEL key
SENSOR PARAMETER
km
0.5 to 1.5(initial setting)
SEL key
「˅」 Shift key
˅ : Upper order digit
˄ : Lower order digit
Data on the lower stage blinks.
「▲」Up 「▼」Down key
-02.side sensitivity correction value
ENT key
SENSOR PARAMETER
km
02.side sensitivity correction value
SEL key
SENSOR PARAMETER
ß
-02. Value gain at butan gas burning.
0.1 to 10.0(initial setting 0.42)
SEL key

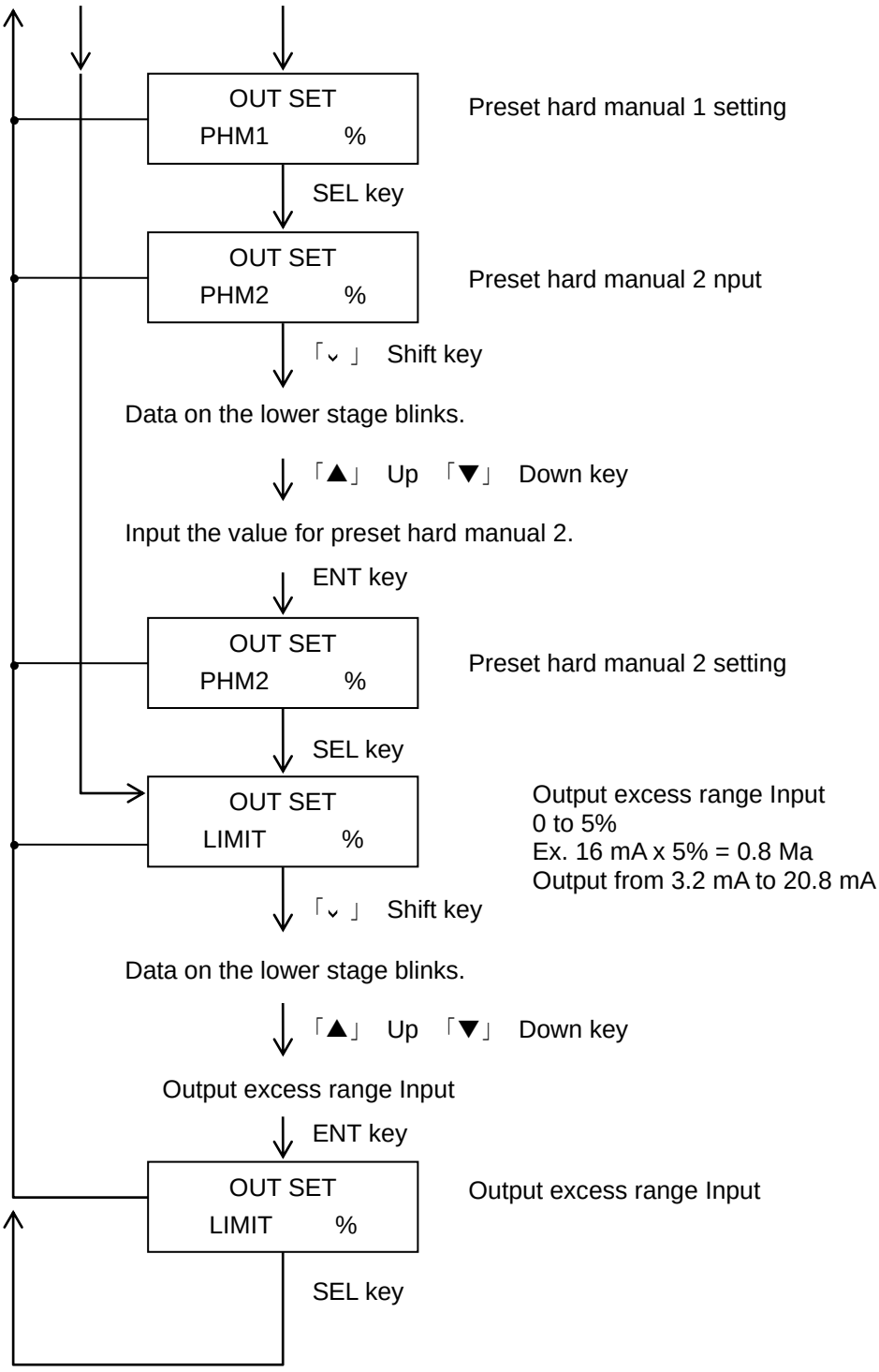
⑦ OUT SET (Output signal setting)



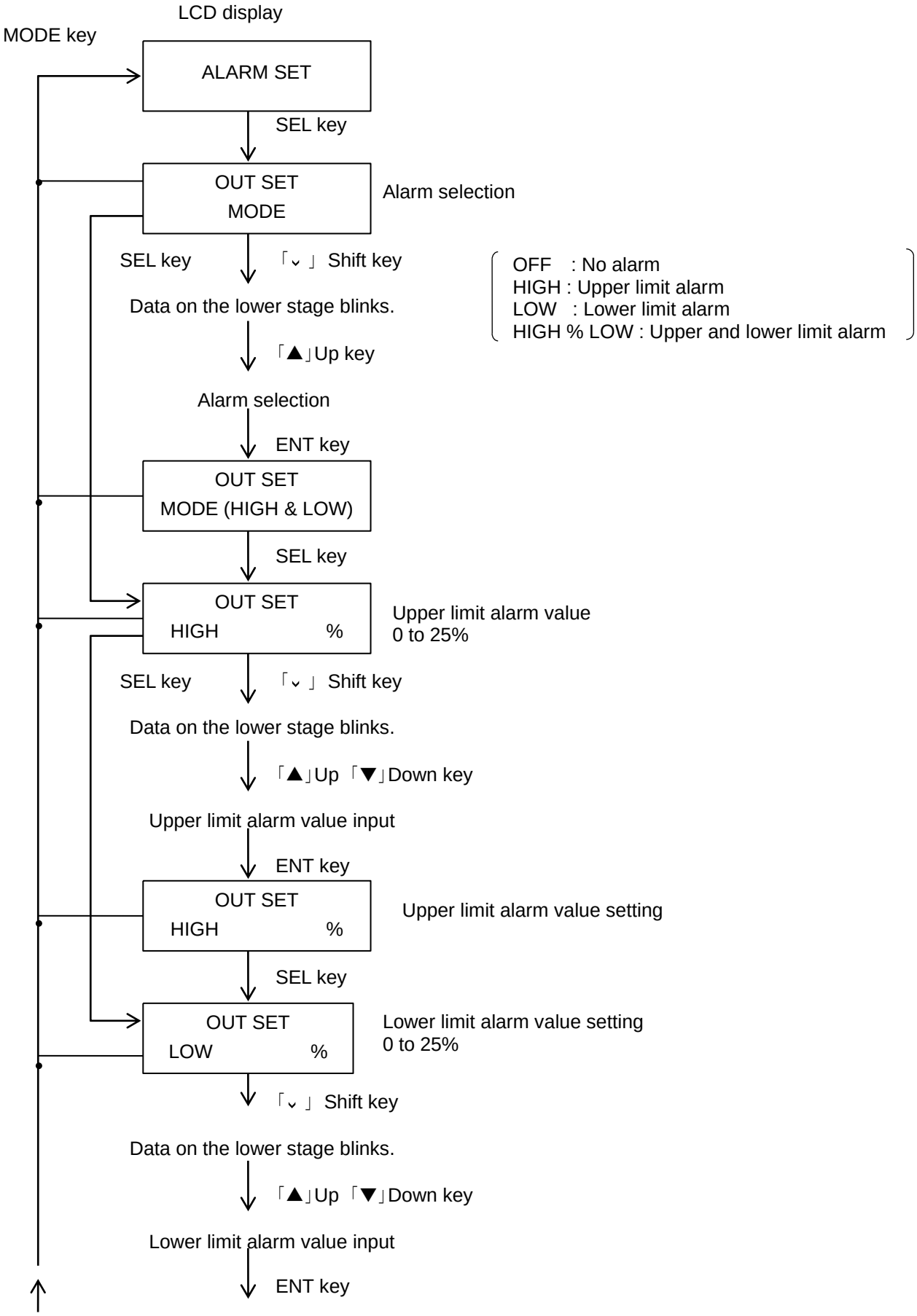


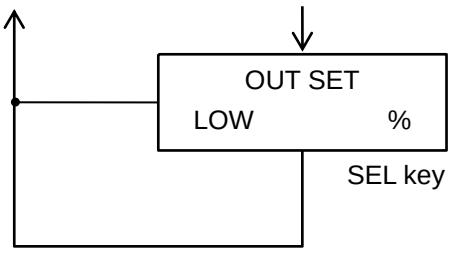
Hold operation by setting

Status	HOLD SET setting			
	STD	OFF	PHM1	PHM2
Abnormal occurrence	Hold to previous value 5 seconds	Hold to previous value 5 seconds	Hold to set value	Hold to set value
During calibration		Not hold		
Purging				
Hold input				
MFT input		Hold to previous value 5 seconds		


OUT SET
PHM1 %
Preset hard manual 1 setting
SEL key
OUT SET
PHM2 %
Preset hard manual 2 nput
「˅」 Shift key
Data on the lower stage blinks.
「▲」 Up 「▼」 Down key
Input the value for preset hard manual 2.
ENT key
OUT SET
PHM2 %
Preset hard manual 2 setting
SEL key
OUT SET
LIMIT %
Output excess range Input
0 to 5%
Ex. 16 mA x 5% = 0.8 Ma
Output from 3.2 mA to 20.8 mA
「˅」 Shift key
Data on the lower stage blinks.
「▲」 Up 「▼」 Down key
Output excess range Input
ENT key
OUT SET
LIMIT %
Output excess range Input
SEL key

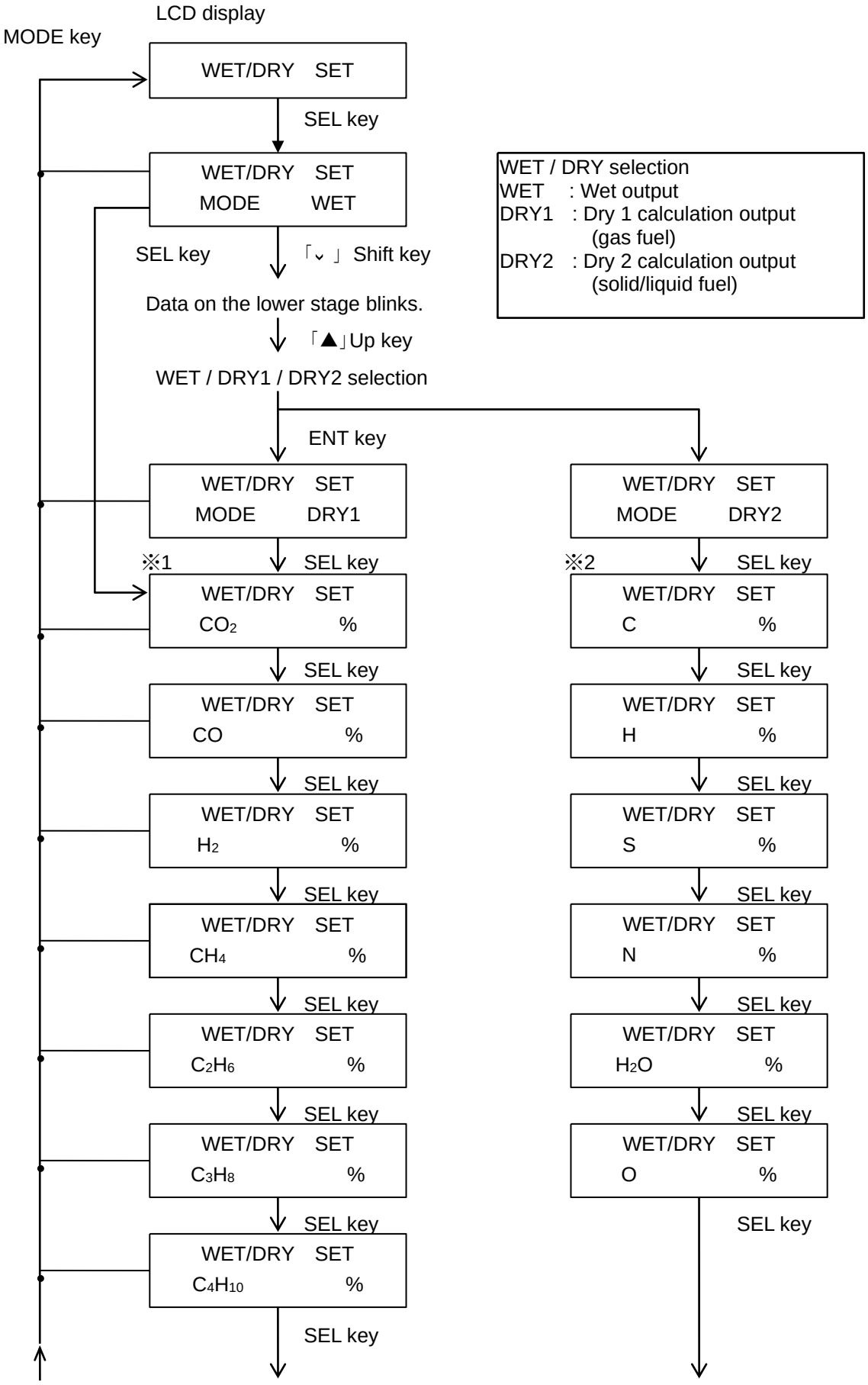
⑧ ALARM SET (Alarm setting)

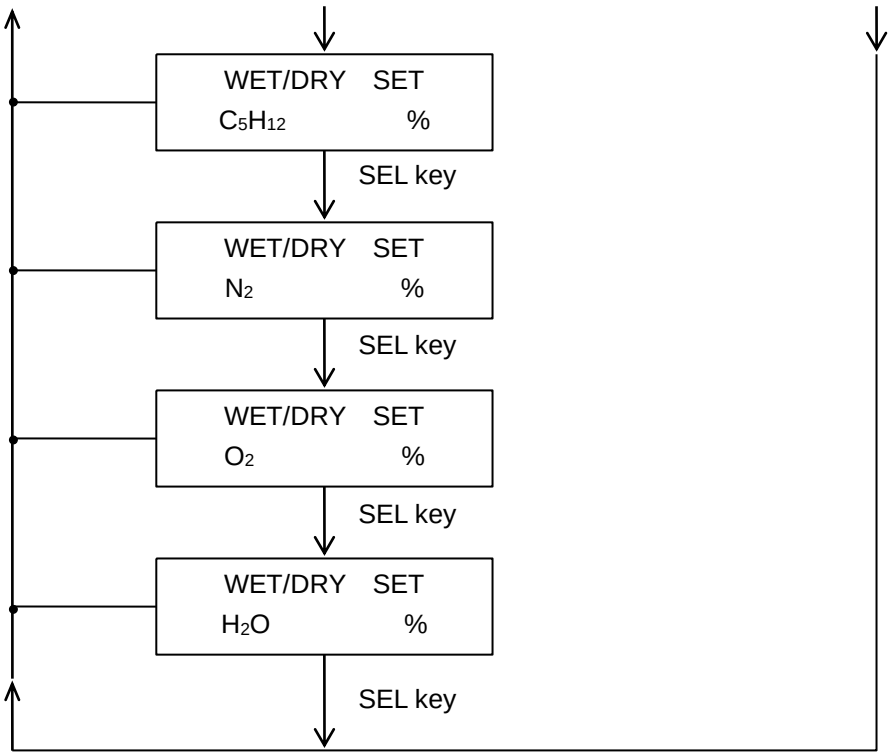




Lower limit alarm value setting

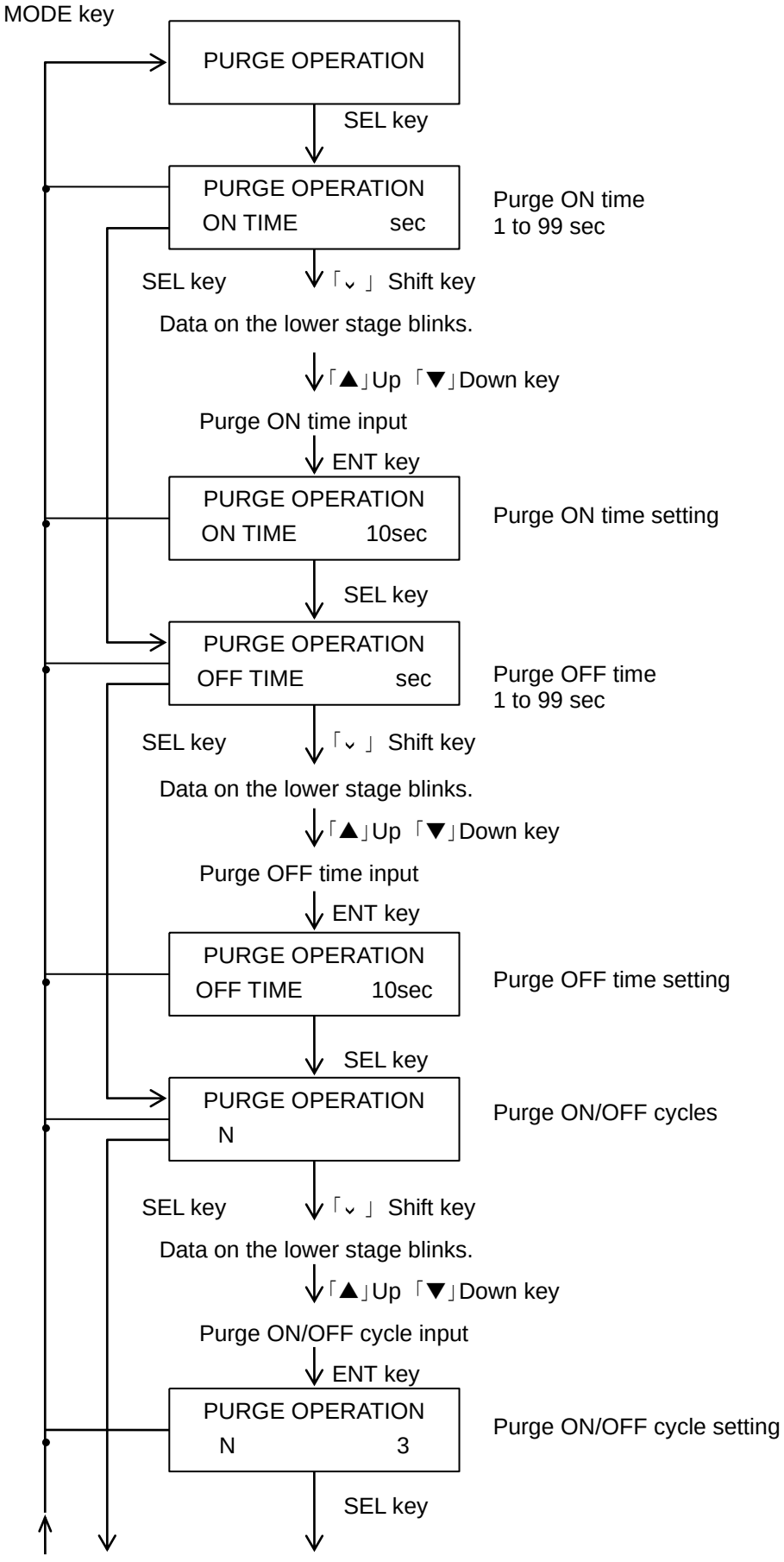
⑨ WET / DRY SET (Wet / dry setting)

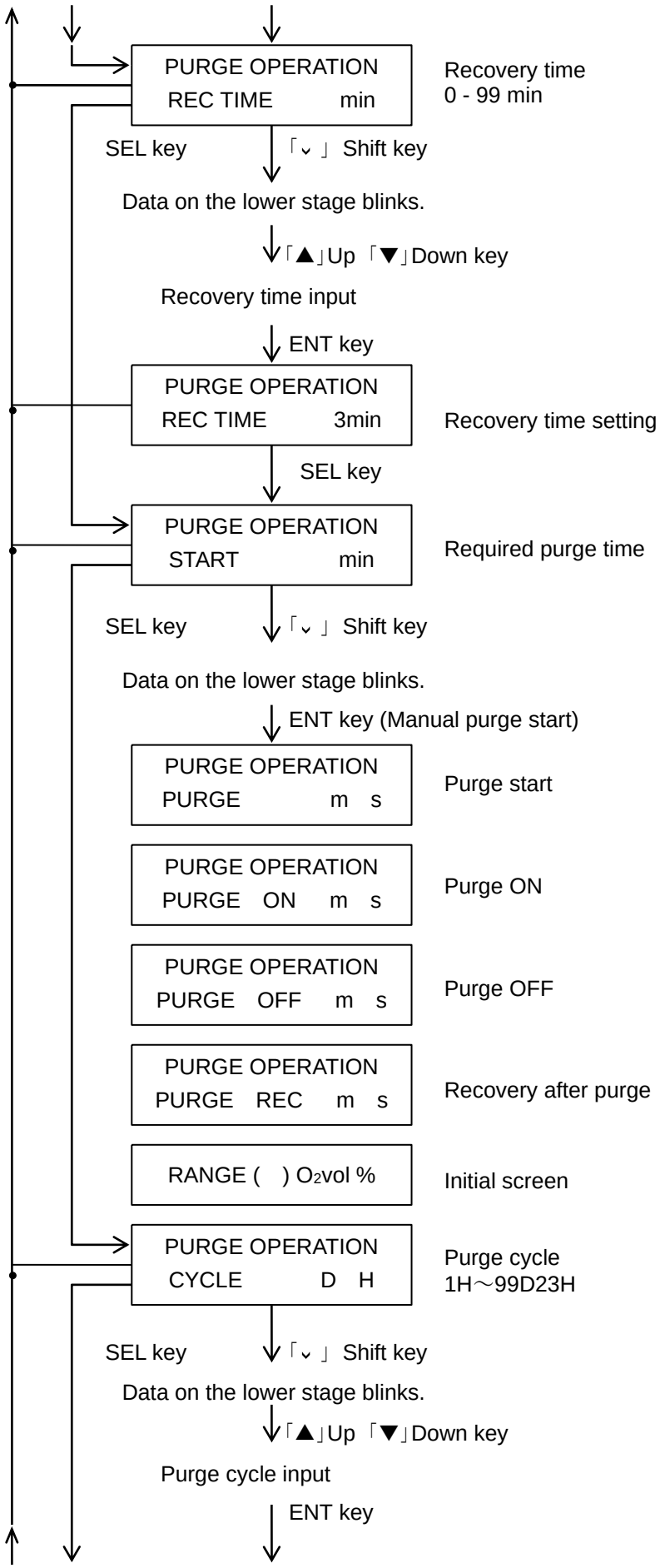


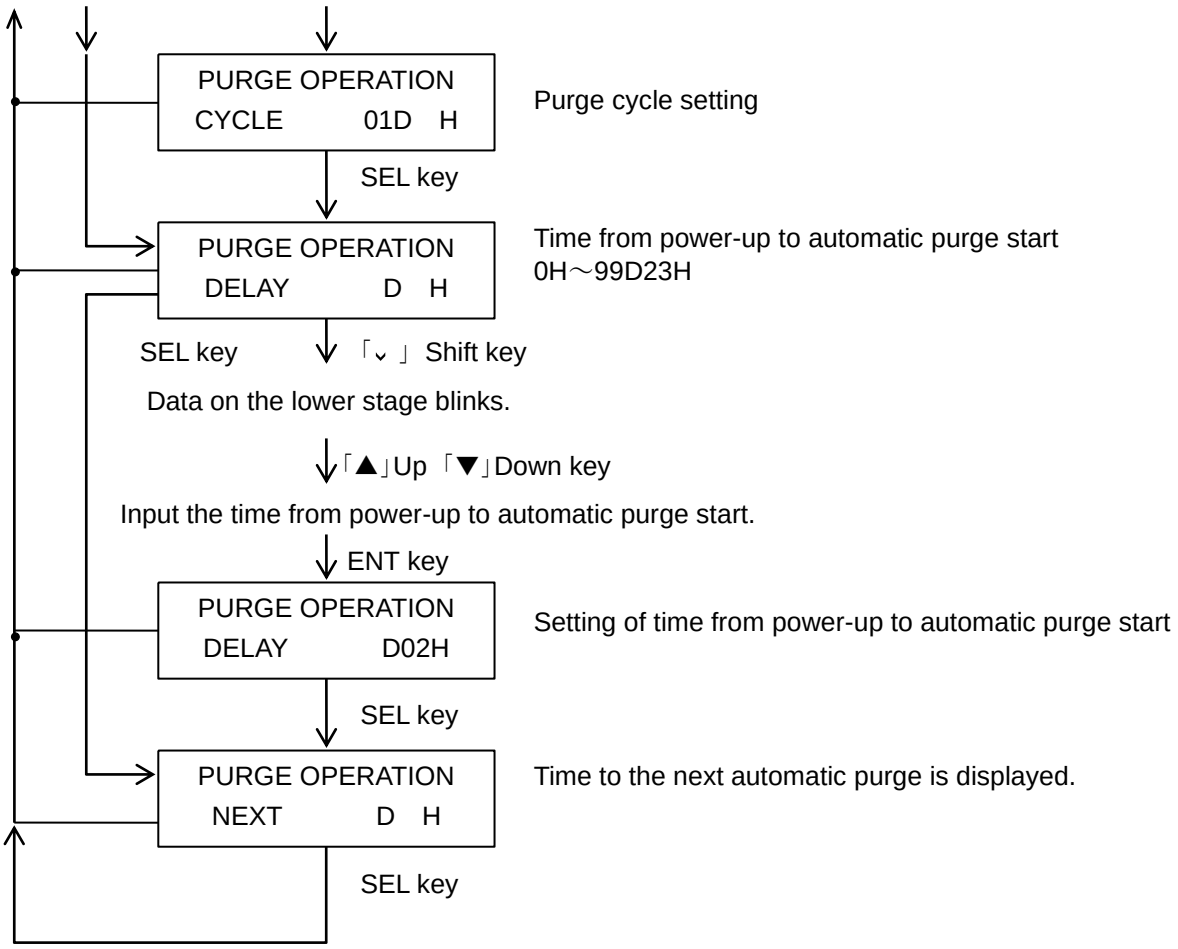


*1: Input the gas fuel content.
*2: Input the solid and liquid fuel contents.
Press the「˅」shift key to blink the data.
Press the「▲」up or「▼」down key to input data.
Press the ENT key to set the data.

⑩ PURGE OPERATION (Purge operation)




PURGE OPERATION
REC TIME min
Recovery time
0 - 99 min
SEL key
「⌄」 Shift key
Data on the lower stage blinks.
「▲」Up 「▼」Down key
Recovery time input
ENT key
PURGE OPERATION
REC TIME 3min
Recovery time setting
SEL key
PURGE OPERATION
START min
Required purge time
SEL key
「⌄」 Shift key
Data on the lower stage blinks.
ENT key (Manual purge start)
PURGE OPERATION
PURGE m s
Purge start
PURGE OPERATION
PURGE ON m s
Purge ON
PURGE OPERATION
PURGE OFF m s
Purge OFF
PURGE OPERATION
PURGE REC m s
Recovery after purge
RANGE ( ) O2vol %
Initial screen
PURGE OPERATION
CYCLE D H
Purge cycle
1H～99D23H
SEL key
「⌄」 Shift key
Data on the lower stage blinks.
「▲」Up 「▼」Down key
Purge cycle input
ENT key


PURGE OPERATION
CYCLE 01D H
Purge cycle setting
SEL key
PURGE OPERATION
DELAY D H
Time from power-up to automatic purge start
0H～99D23H
SEL key
「˅」 Shift key
Data on the lower stage blinks.
「▲」Up 「▼」Down key
Input the time from power-up to automatic purge start.
ENT key
PURGE OPERATION
DELAY D02H
Setting of time from power-up to automatic purge start
SEL key
PURGE OPERATION
NEXT D H
Time to the next automatic purge is displayed.
SEL key

5-4 User key input value (Set by we according to specifications in delivered product)

No.	Block name	Setting item	Set value	Content
①	DISPLAY SELECT	———	O_2%	LED display
②	RANGE CHANGE	LOCAL	OFF	Range select field
		HIGH	(High range)	High range selection
		LOW	(Low range)	Low range selection
		Delay Time	0 sec	Primary delay calculation time
④	CAL. DATA SET	AIR	(Air calib. value)	Air O_2 concentration
		ZERO	(Zero gas calib. value)	Zero gas concentration
		SPAN	(Span gas calib. value)	Span gas concentration
		AIR TIME	5 min	Air calibration time
		Z, S TIME	5 min	Zero and span calibration time
		RECTIME	3 min	Recovery time
		CYCLE	30D00H	Calibration cycle
		DELAY	00D07H	Calibration delay
⑥	SENSOR PARAMETER	LINEARIZER	(1, 2, 3)	According to lineareyer No. Inspection data
		Ka	0.35	Currant seusitivity coefficient
		IP (N_2)	0.00	Zero point Ip eurrent
		Km	1.00	-O_2 sensitivityn correction coefficient
		β	0.42	Butan fuel -O_2 gain
⑦	OUT SET	ADJUST	0 %	Output signal adjustment
		HOLD SET	OFF	Output signal hold
		PHM1	0 %	Output setting 1
		PHM2	0 %	Output setting 2
		LIMIT	0 %	Output over range
⑧	ALARM SET	MODE	OFF	Alarm selection
		HIGH	25 %	O_2 upper limit
		LOW	0 %	O_2 lower limit
⑨	WET/DRY SET	MODE	WET	Wet / dry selection
		CO_2-H_2O	All 0%	Dry 1 / Dry 2 data setting
⑩	PURGE OPERATION	ON TIME	10 sec	Purge ON time
		OFF TIME	10 sec	Purge OFF time
		N	5	ON / OFF cycles
		RECTIME	3 min	Recovery time
		START	All time display	Purge time
		CYCLE	01d00h	Purge cycle
		DELAY	00d02h	Purge delay

↑ Key operation method, item No.

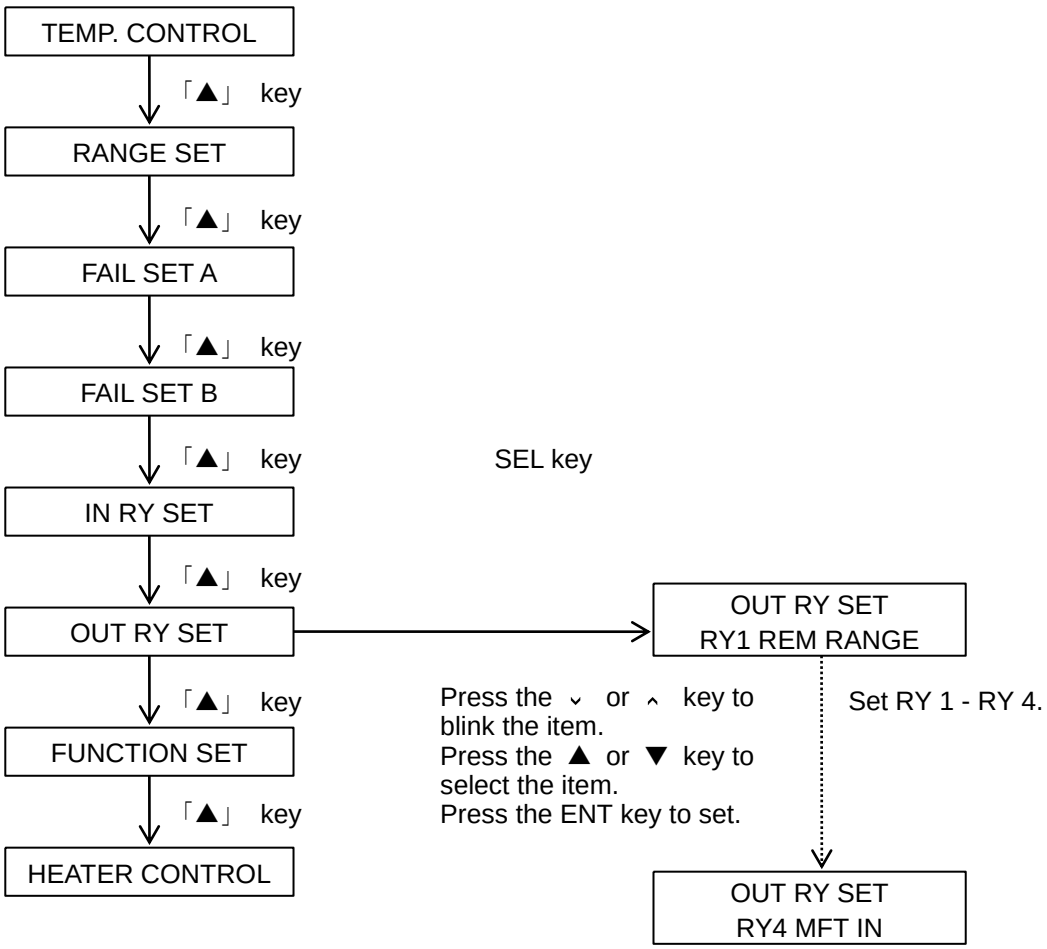
↑ Description in parentheses ( ) in the table is input according to instruction document (drawing, etc.)

5-5 System key input value (Set by we according to specifications in delivered product)

Block name	Setting item	Set value	Content
HEATER CONTROL	Warm up	3 min	Warm-up time
	VHS	10.50 V	Heater voltage
	RH/RHO	2.700	Target resistant ratio
	P	100 %	Proportional band
	I	100 sec	Integration time
	D	1 sec	Differentiation time
RANGE SET	H. ZERO	Input the range from drawings, etc.	H range setting -15 - 25%
	H. SPAN		
	L. ZERO		
	L. SPAN		
FAIL SET A	Ka H.	0.500	Current sensitivity high
	Ka L.	0.100	Current sensitivity low
	KM H.	1.30	-O_2 Current sensitivity high
	KM L.	0.70	-O_2 Current sensitivity low
FAIL SET A	Ip N_2	±0.50 mA	Zero calibration error
	Ip H.	10.00 mA	Ip Current high
	Ip L.	-10.00 mA	Ip Current low
	Vp H.	2.30 V	Vp Voltage high
	Vp L.	-2.30 V	Vp Voltage low
FAIL SET B	Vs H.	600 mA	Vs Voltage high
	Vs L.	100 mA	Vs Voltage low
	IH H.	1600 mA	IH Current high
	IH L.	500 mA	IH Current low
	VHS H.	13.00 V	VHS Voltage high
	VHS L.	5.00 V	VHS Voltage low
FUNCTION SET	O_2 MODE	+O_2, -O_2	O_2 mode
	CAL MODE	OFF, MANUAL, SEMIAUTO, AUTO	Calibration mode
	CAL TYPE	A, A/Z, A/S, A/Z/S, S, Z/S	Calibration gas
	PUG MODE	OFF, SEMIAUTO, AUTO	Purge mode
	MONI SW	Set to OFF (A/D MONITOR)	A / D monitor
	WARNING	Set to ON	Setting error display

(1) Contact output (Set by we according to specifications)

Contact outputs RY 1 through RY 5 are provided, among which RY 5 is a "b" contact only for error output (turned on upon an error) and RY 1 through RY 4 are "a" contacts to which the function in the table below can be assigned. The contact capacity is 250 VAC 1A or 30 VDC 1A.



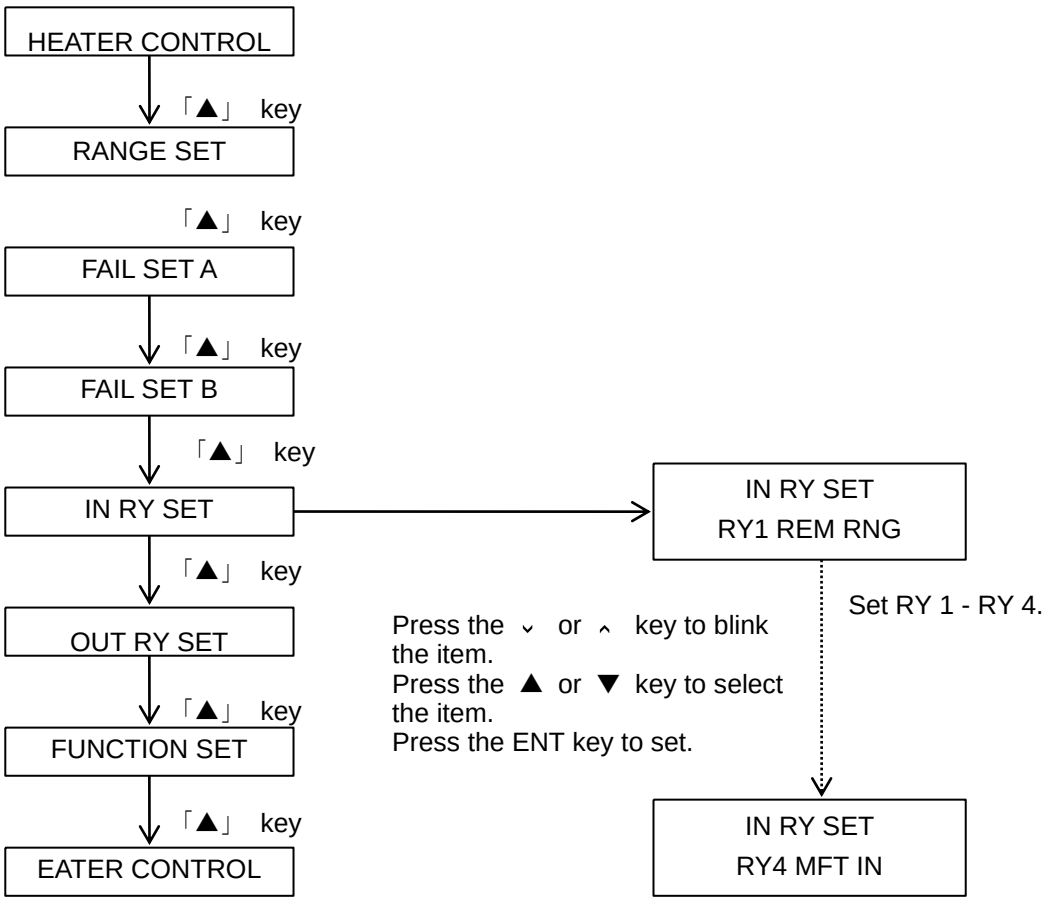
Functions assigned to contact output

Setting	Description
OFF	This contact is not used.
RANGE H	Turned on when the high range is selected.
RANGE L	Turned on when the low range is selected.
CAL AIR	Turned on when the air gas is supplied during automatic calibration.
CAL ZERO	Turned on when the zero gas is supplied during automatic calibration.
CAL SPAN	Turned on when the span gas is supplied during automatic calibration.
PURGE	Turned on during purging and MFT.
MAINTE	During temperature rise, during purging, during calibration, during hold signal input, during MFT signal input, during system data setting (when DIP switch S2-1 on the CPU board is turned on)
ALARM H	The oxygen concentration is higher than the upper limit setting. (Refer to the paragraph for alarm for details.)
ALARM L	The oxygen concentration is lower than the lower limit setting. (Refer to the paragraph for alarm for details.)
ALM H&L	ALARM H or ALARM L is turned on.

Note) Either RANGE H or RANGE L is always turned on.

(2) Contact input (Set by we according to specifications.)

Contact inputs IN 1 through IN 5 are provided, and each of them can be set. The terminal voltage when the contact is open is about 10 to 12 V, and the current when the contact is shorted is about 5 to 6 mA.



Functions assigned to contact input

Setting	Description
OFF	This contact is not used.
REM RNG	Opening this terminal selects the high range and shorting selects the low range in the RANGE CHANGE / LOCAL OFF mode.
OUT HOLD	When this terminal is shorted, the current output is held at the previous value. The 7-segment LED display is not held.
REM CAL	Shorting this terminal in the measurement mode with the CAL MODE set at SEMI AUTO or AUTO starts automatic calibration.
REM PUG	Shorting this terminal with the PUG MODE set at SEMI AUTO or AUTO starts purging.
MFT IN	Shorting this terminal holds the current output and shows "-----" at the 7-segment LED. Heater control is disabled and the cell error or low temperature error is not detected. Setting the purge relay turns on the input. After the input is reset, the process starts at temperature rise.
RESET	Shorting this terminal restarts the timer for timer calibration and timer purge. The next timer calibration is after the set calibration cycle (CAL, DATA, SET, CYCLE), and the next purge is after the set purge cycle (PURGE, OPERATION, CYCLE).

If the same function is set for two or more terminals, an input to any of the terminals activates the function.

5-6 Gas calibration method

> Be sure to perform gas calibration to maintain the measurement accuracy.
> (About once every month)

• Calibration method

Type	Calibration method	Description
MANUAL	Manual calibration	Supply calibration gas and perform calibration key operation manually.
SEMI AUTO	Manual calibration start	Supply of calibration gas and calibration operation are performed automatically by solenoid valves and other components. To start calibration, perform key operation manually or remotely.
AUTO	Automatic calibration	Supply of calibration gas and calibration operation are automatically performed by solenoid valves and other components. Calibration is started by the internal timer or remote operation.

(System key input; set by we)

Preliminary contact input assignment is necessary for remote operation (REM, CAL).

• Calibration types

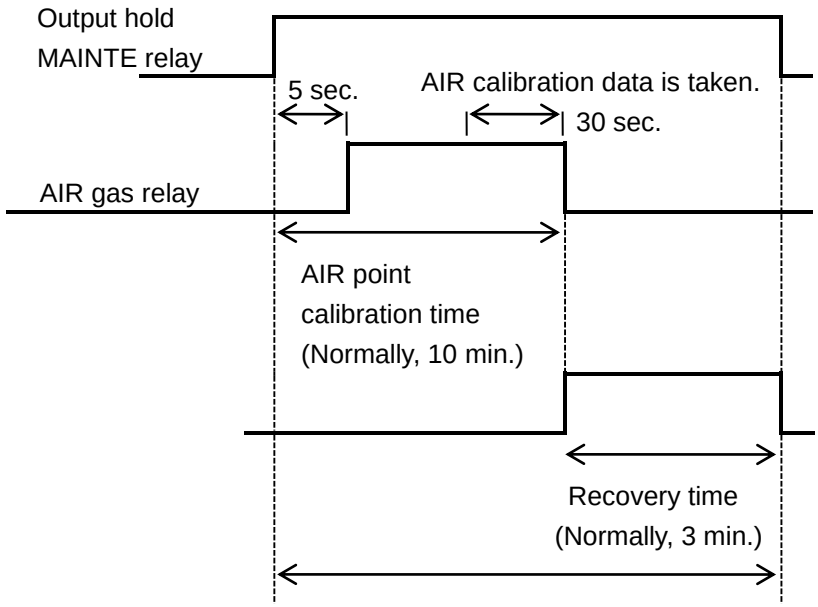
Type	Calibration method	Description
A	AIR	High range 1 point calibration
A/Z	AIR, ZERO	High range two-point calibration
A/S	AIR, SPAN	One each at high range and low range calibrations or the SPAN point Is used for calibration at -O_2 side.
A/Z/S	AIR, ZERO, SPAN	High range three-point calibration However, the SPAN point Is matched to the low range. Alternatively, the SPAN point Is used for calibration at -O_2 side.
S	SPAN	One low range calibrations or used for calibration at -O_2 side.
Z/S	ZERO, SPAN	Low range two-point calibration

(System key input; set by we)

※ Calibration of -O_2 side Is set at SPAN point.

The calibration gas at -O_2 side Is used after bubbling through water of CO : 9%, H_2 : 7%, CO2 : Bal. calibration values become as -8% O_2.

• Calibration timing



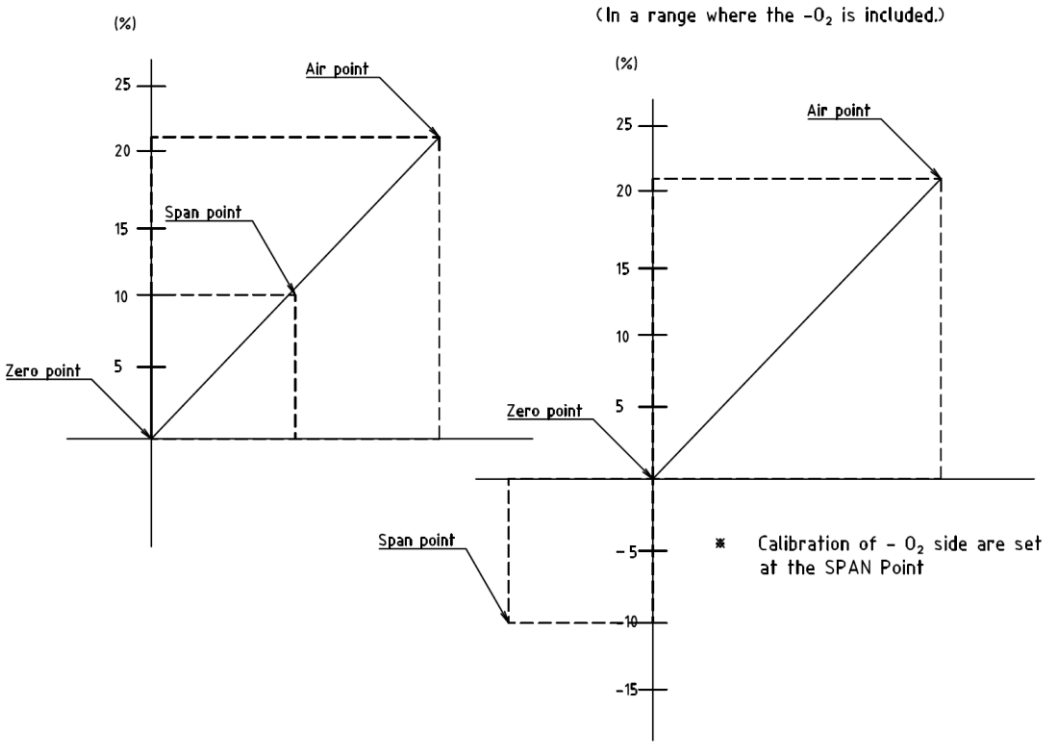
This time is displayed on the LCD when performing the calibration with key operations.

LCD display

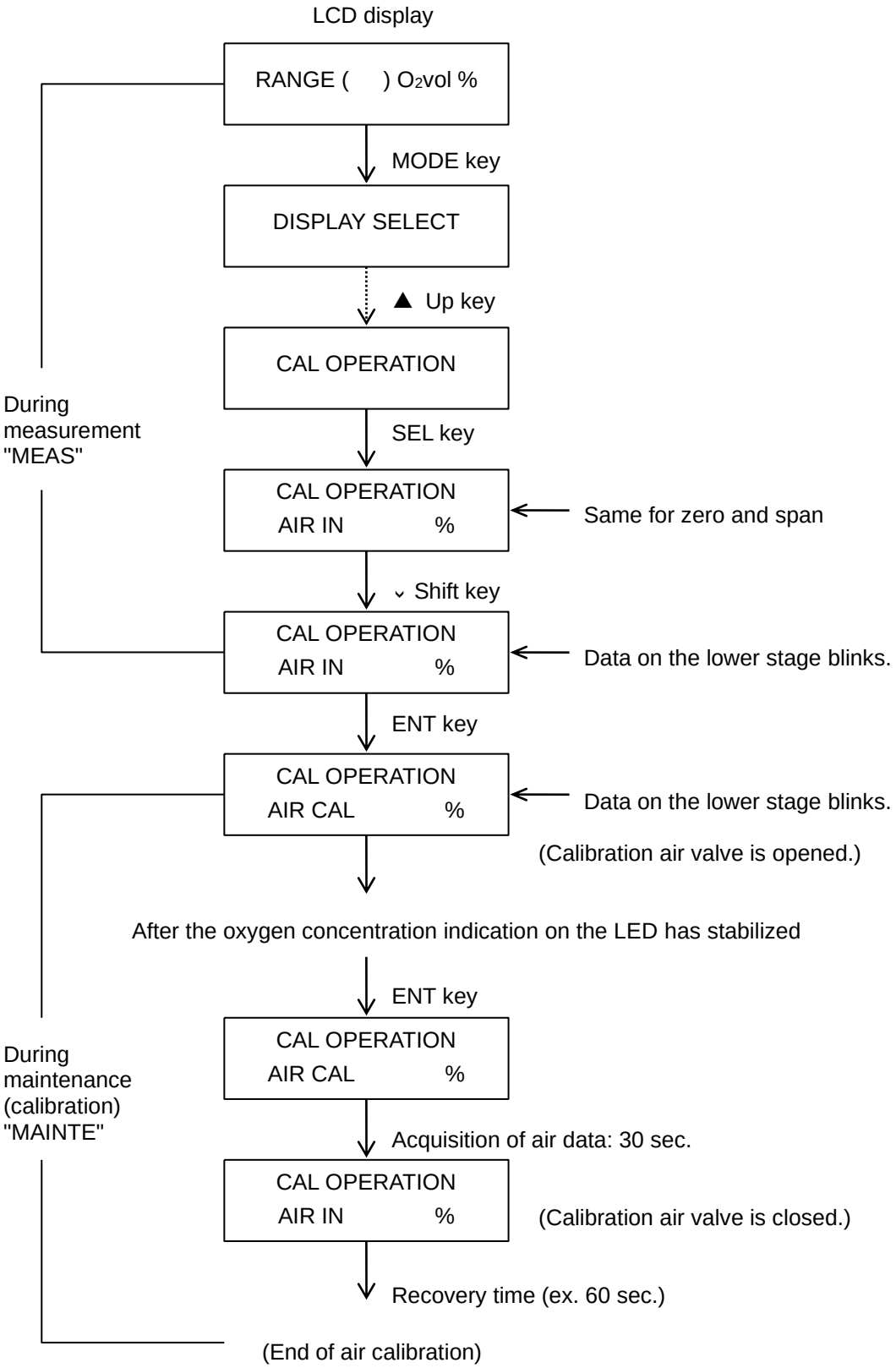
CAL. OPERATION
CAL. START min

• Calibration curve

Two point calibration with air and zero gas is regular choice but you can select three point calibration with air, zero gas and span gas for more accurate measurement.

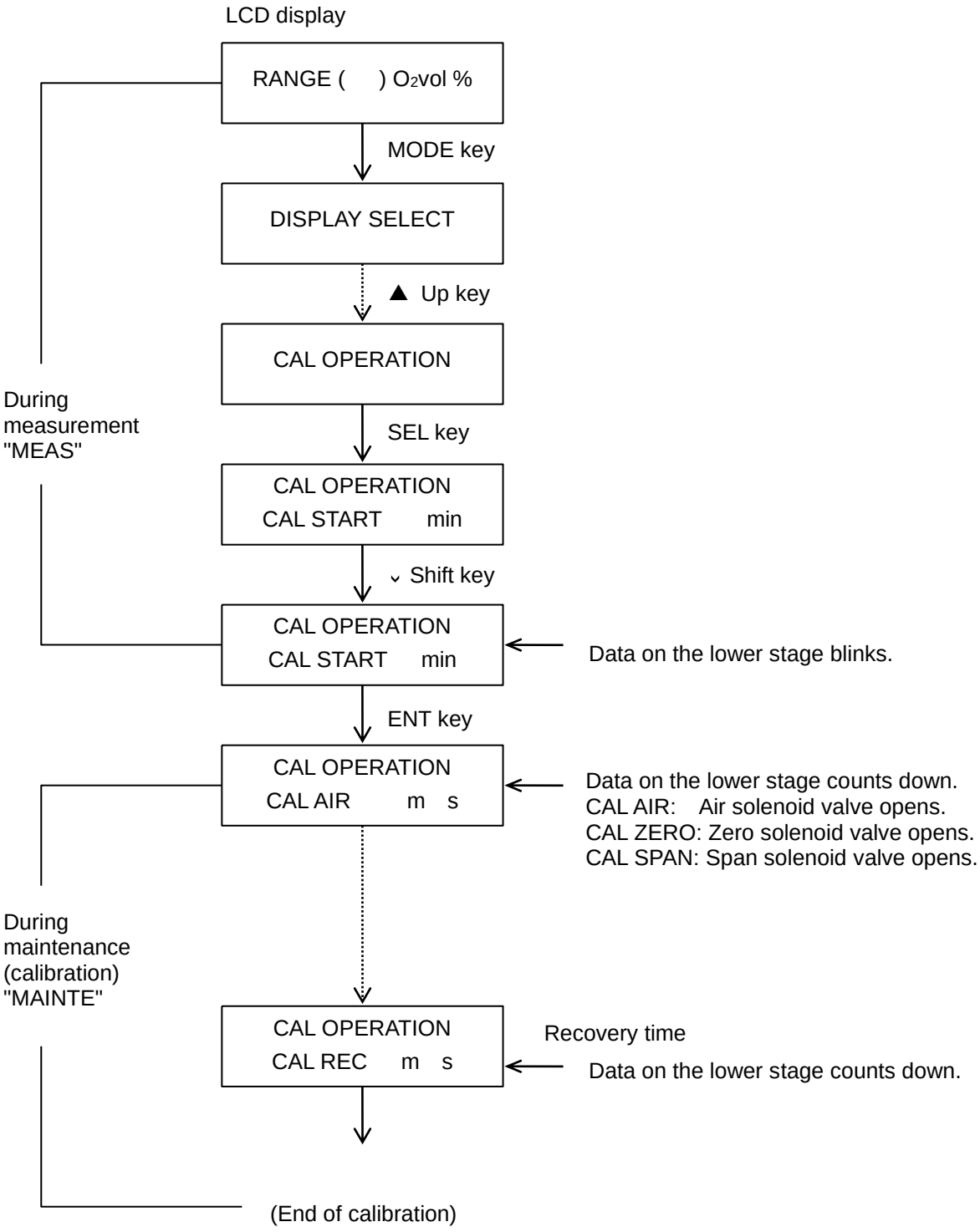


• Manual calibration method



• Semi auto (manual start) calibration method

Start automatic calibration manually.



5-7 Purging method

In a purging process, compressed air is blown to inside the probe transmitter. Periodically perform according to necessity.

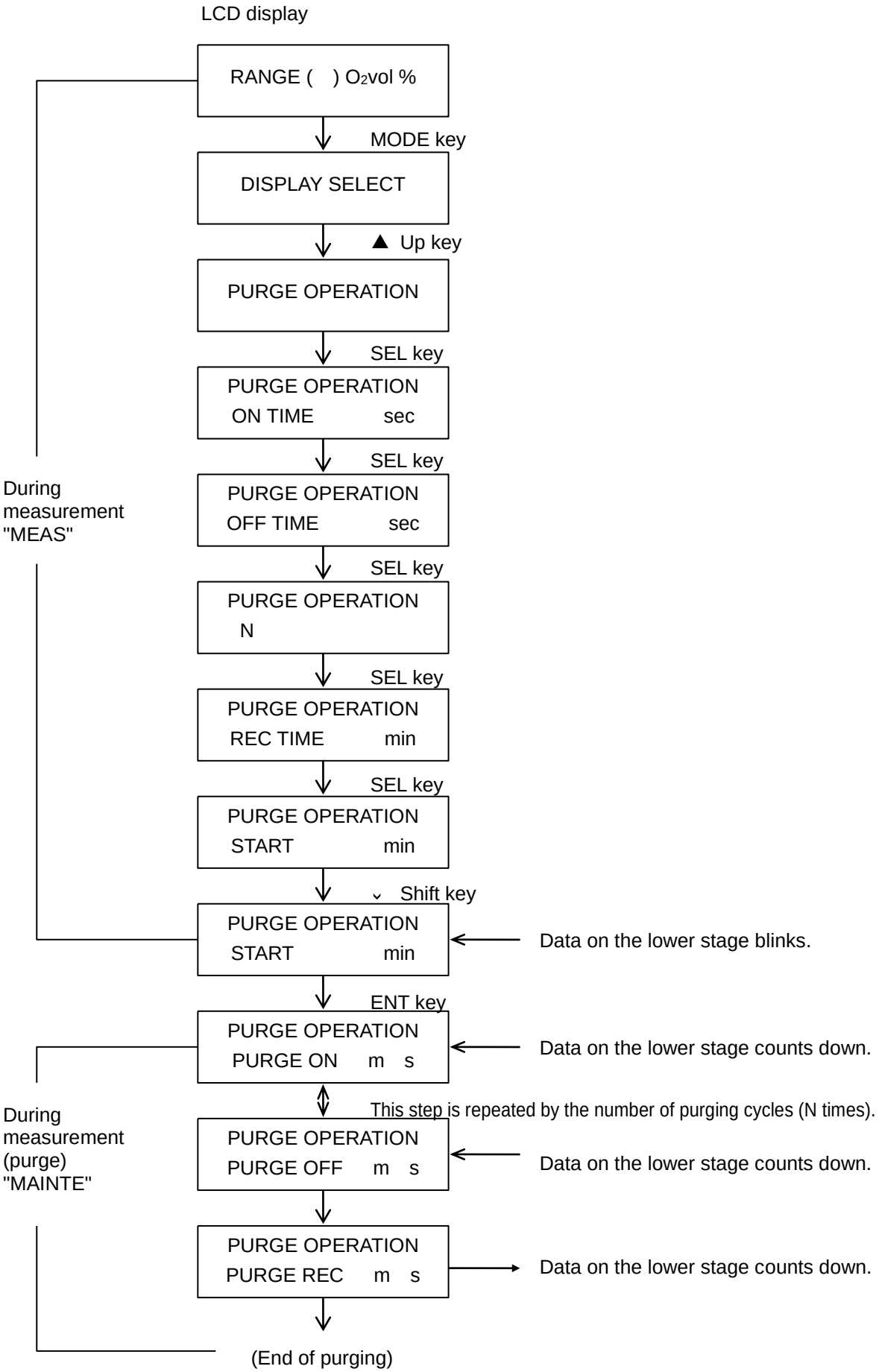
Purging method

Type	Purging method	Description
OFF	No purging function	
SEMI AUTO	Manual purge start	Perform key operation manually or perform remote operation to output the purge contact.
AUTO	Automatic purge	The purge contact is output by the internal timer or remote operation.

Preliminary contact output assignment is necessary for purging.
Preliminary contact input assignment is necessary for remote operation (REM PURGE).
The purging timing is shown in the figure below.

1/ Output hold, MAINTE relay
2/ Purge relay
3/ Purge ON time (normally 10 to 20 sec.)
4/ 5 sec.
5/ First time Second time Third time
6/ No. of purging cycle (normally 3 to 5 times)
7/ Recovery time
8/ Purge OFF time (normally 10 to 20 sec.)
9/ This time is shown on the LCD during purging by key operation.

• Semi auto (manual start) purging method



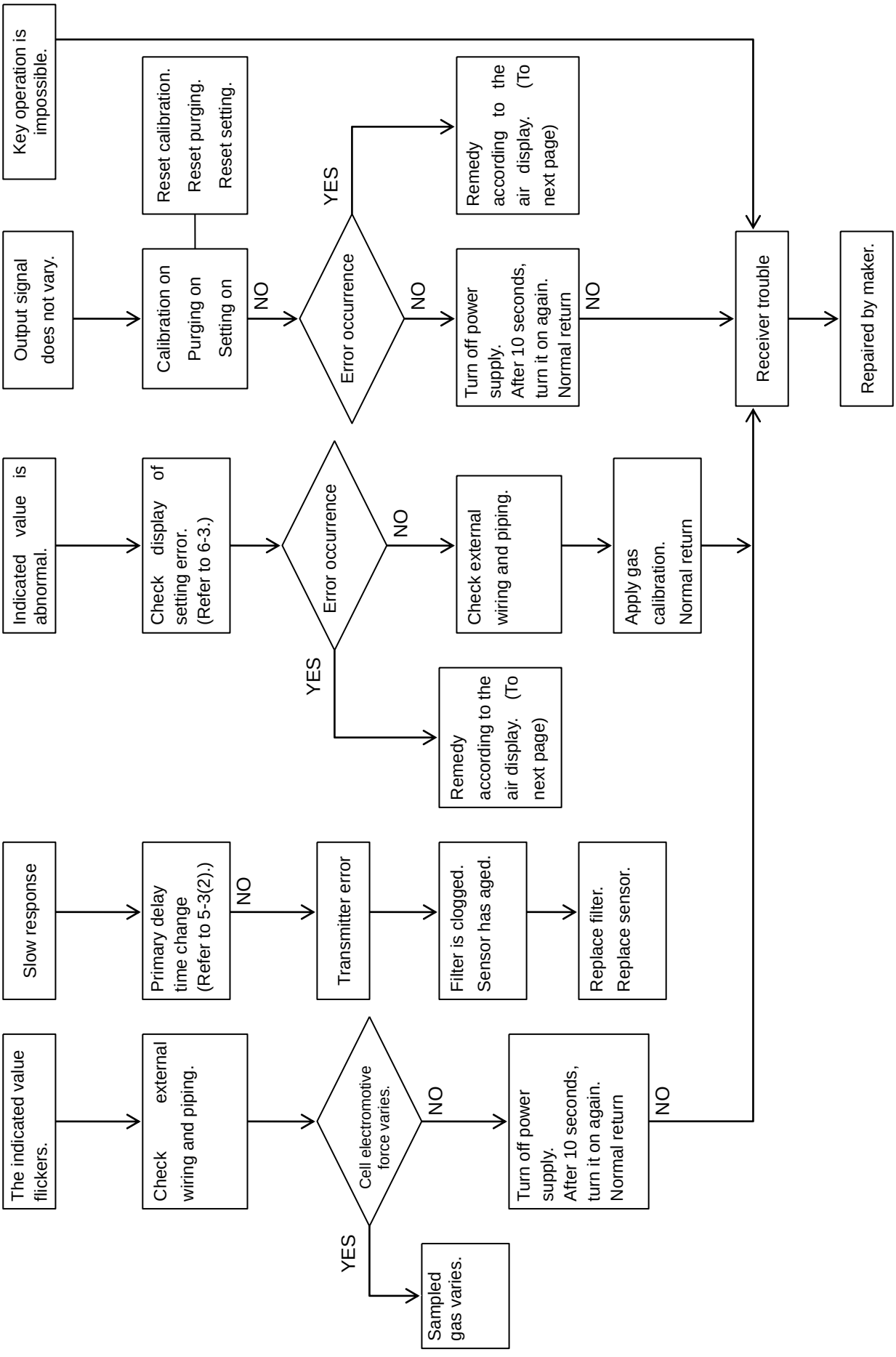
6. Maintenance

The daily/periodic inspections are important to maintain the proper functions for accurate measurement. After understanding the contents of the item and method, be sure to apply the inspection.

6-1 Daily/ periodic inspection

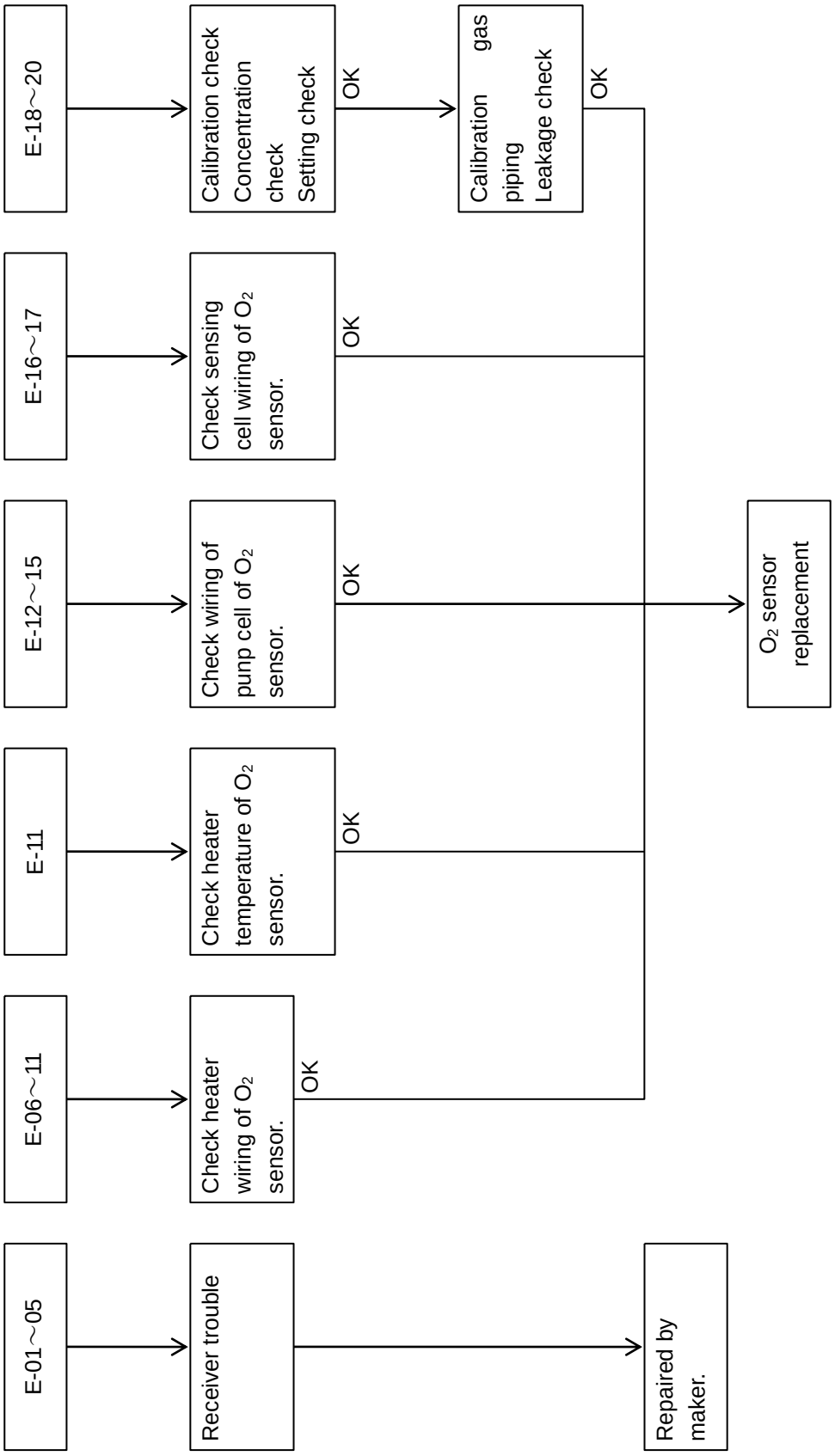
Gas calibration	Interval	One month
	Method	According to Item 5-6, apply the gas calibration. (According to Item 5-3(4), set the calibration method and so on.)
Sensor inspection	Interval	One month
	Method	After the gas calibration is completed, check the drift value against the previously calibrated value. (CAL, DATA MONITOR) Though it is normally +/-2% F.S./month or less, the sensor may be liable to age if the value is exceeded.
	Interval	1 to 6 months (Check if any abnormality is found during gas calibration.)
	Method	The electromotive force at air point is verified (DISPLAY SELECT) A voltage of about 50mV while in normal operation becomes to those exceeding 100mV when in error. When such is the case, then the sensor is considered started to degrade due to the poisoning gas being absorbed at the sensing cell electrode.
Sensor inspection	Interval	Inferred to be more than 2 years (varies according to the properties of sampled gas)
	Method	When the sensor need be replaced refer to the Instruction Manual for Model TF Transmitter (Refer to para. 6-2 Troubleshooting).

6-2 Troubleshooting



Troubleshooting

(Refer to the error display in P49.)



6-3 Display of setting error

LCD (lower step) display	Description
(01) AIR ZERO ?	Air calibration gas is excessively near zero calibration gas.
(02) AIR SPAN ?	Air calibration gas is excessively near span calibration gas.
(03) ZERO SPAN ?	Zero calibration gas is excessively near span calibration gas.
(04) SPAN <0?	Concentration of SPAN calibration Is minus at +O_2 mode.
(05) CAL CYCLE ?	The frequency of automatic calibration is shorter than calibration time.
(06) ALARM H&L ?	At the alarm, the width is excessively narrow or H is smaller than L.
(07) ALARM H<0?	Alarm H Is minus In +O_2 mode.
(08) ALARM L<0?	Alarm L Is minus In +O_2 mode.
(09) DRY1>100% ?	Sum of the gas fuel composition exceeded 100%.
(10) DRY2>100% ?	Sum of the gas liquid, soiled fuel composition exceeded 100%.
(11) PURGE CYCLE ?	The period Is shorter than the purge time In automatic purge.
(12) RANG H ZERO ?	Difference between ZERO and SPAN of H range Is less than 5%.
(13) RANG L ZERO ?	Difference between ZERO and SPAN of L range Is less than 5%.
(14) RANGE L>H ?	L range Is larger than H range.
(15) RANGE HZ<0?	H range ZERO Is minus In +O_2 mode.
(16) RANGE HS<0?	H range SPAN Is minus In +O_2 mode.
(17) RANGE LZ<0?	L range ZERO Is minus In +O_2 mode.
(18) RANGE LS<0?	Span relay Is not set during automatic calibration.
(19) Ka H&1 ?	Difference Is less than 0.1.
(20) Km H&L ?	Difference Is less than 0.1.
(21) Vs H&L ?	Difference Is less than 0.1.
(22) IH H&L ?	Difference Is less than 100mV.
(23) VH H&L ?	Difference Is less than 1V.
(24) No AIR RY ?	AIR relay is not set during automatic calibration.
(25) No ZERO RY ?	ZERO relay is not set during automatic calibration.
(26) No SPAN RY ?	SPAN relay is not set during automatic calibration.
(27) No PURGE RY ?	Purge relay is not set during automatic purging.

6-4 Error display

If any error occurs, the error number will be displayed on the 7-segment LED to display the cause of the error. At this time, the function to calculate the concentration is stopped for interruption. During heater control, it is automatically continued or stopped depending on the content of the error.

LED	LCD	Description	Resetting	Operation
E-01	———	Sum error does not match.	Turn on the power again.	Measurement stop
E-02	———	RAM operation error	Turn on the power again.	Measurement stop
E-03	EEROM ERROR (xx)	EEROM operation error	CLR-ENT	Measurement stop
E-04	LCD ERROR	LCD operation error	CLR-ENT	Measurement stop
E-05	A/D ERROR	A/D converter error	CLR-ENT	Measurement stop
E-06	HEATER Volt (HI)	Heater voltage Is too high	CLR-ENT	Measurement stop
E-07	HEATER Volt (LO)	Heater voltage Is too high	CLR-ENT	Measurement stop
E-08	HEATER curr (HI)	Heater current Is excessive	CLR-ENT	Measurement stop
E-09	HEATER curr (LO)	Heater current Is Insufficient	CLR-ENT	Measurement stop
E-10	HEATER (CABLEΩ)	Heater wire resistance too high	CLR-ENT	Measurement stop
E-11	RH/RHO ERROR	Resistance ratio Is too high	CLR-ENT	Measurement stop
E-12	IP (HIGH)	IP current Is too large	CLR-ENT	Temperature control continuation
E-13	IP (LOW)	IP current Is too small	CLR-ENT	Temperature control continuation
E-14	Vp (HIGH)	Pumping cell voltage Is too high	CLR-ENT	Temperature control continuation
E-15	Vp (LOW)	Pumping cell voltage Is too low	CLR-ENT	Temperature control continuation
E-16	Vs (HIGH)	Sensing cell voltage Is too high	CLR-ENT	Temperature control continuation
E-17	Vs (LOW)	Sensing cell voltage Is too low	CLR-ENT	Temperature control continuation
E-18	CAL AIR FAILED	Failure of air calibration	CLR-ENT	Temperature control continuation
E-19	CAL ZERO FAILED	Failure of zero calibration	CLR-ENT	Temperature control continuation
E-20	CAL SPAN FAILED	Failure of span calibration	CLR-ENT	Temperature control continuation

E-01 and E-02 do not blink in the LED display. Others blink in the 7-segment LED displays.

* For EEROM error, the error channel No. is displayed on LCD. (Position of xx in the list)
* Temperature control continuation: Oxygen concentration calculation is stopped but heater control is continued.
* Measurement stop: Oxygen concentration calculation and heater control are stopped.

LED	Reference
E-05	Converted ZERO Is less than 12,500 or larger than 25,000
E-06	When heater voltage (VH) Increased higher than 13V.
E-07	When heater voltage (VH) Increased higher than 5V.
E-08	When heater current (IH) Increased higher than 1600mA.
E-09	When heater current (IH) Increased lower than 500mA.
E-10	Heater voltage Is smaller than (heater PWM value/800)
E-11	Heater resisting ratio Is more than 5 or less than 2 (detected from 75 sec. After started temperature)
E-12	When Ip current Is larger than 10mA.
E-13	When Ip current Is less than -10mA.
E-14	When Vp voltage Is higher than 2.3V.
E-15	When Vp voltage Is less than -2.3V.
E-16	When Vs voltage Is higher than 600mV.
E-17	When Vp voltage Is less than 100mV.
E-18	When current sensitivity deviated from 0.1 to 0.5 as a result calculated Ka.
E-19	When Ip (N2) deviated ±0.5mA.
E-20	When minus current sensitivity deviated from 0.7 to 1.3 as a result calculated km.

E-05 through E-07 Is not recognized as an error unless it continues for 1 second (4 times).

* Mark Indicates than the temperature raising 75 seconds may be adjusted according to the time.

6-5 DTF – 101 Malfunction Displays and Operations

Malfunctions \ Displays and Operations			LED Display	LCD Display	Output Relay RY5	Output Signal	Release Method	Analyzer Operation	Descriptions
Normal		Power OFF	–	–	ON	0mA	–	Stop	
		Power ON (Warming-up)	–	WARM-UP	OFF	4mA	–	Warm-up	Normally the warm-up time is 3 minutes.
		Power ON (Measuring)	Measured value	RANGE 02 vol %	OFF	Measured value		Measurement	
Abnormal Power		Power lost	–	–	ON	0mA	Power reapplied	Stop	
		Low power voltage (−40%)	–	WARM-UP	ON	4mA	Power source voltage corrected	Warm-up	Not recover even becomes to WARM-UP warm condition at about −40%
		High power voltage (+20%)	Measured value	RANGE 02 vol %	OFF	4mA	Power source voltage corrected	Measurement	Necessary correct at ± 10% of the reference voltage
Abnormal Input Circuit	Broken lead wire	Vs+	E-13/16/17	Vs/Ip (HIGH/LOW)	ON	4mA	CLR-ENT after repaired	Calculation stop	Blinks alternatively between E-13/E-16/E-17
		Vs−	Measured value	RANGE 02 vol %	OFF	Measured value	Repair	Measurement	Measurement decreased (becomes to 0% 02/4mA within a few minutes)
		Ip+	E-15/17	Vs/Vp (HIGH/LOW)	ON	4mA	CLR-ENT after repaired	Calculation stop	Blinks alternatively between E-15/E-17
		Ip−	E-14/17	Vs/Vp (HIGH/LOW)	ON	4mA	CLR-ENT after repaired	Calculation stop	Blinks alternatively between E-14/E-17
		H+	E-07/09/10/11	HEATER Volt (LOW) etc.	ON	4mA	CLR-ENT after repaired	Calculation interrupted	Blinks alternatively between E-07/E-09/E-10/E-11 (start from warm-up when entered CLR-ENT)
		H−	E-07/09/10/11	HEATER Volt (LOW) etc.	ON	4mA	CLR-ENT after repaired	Calculation interrupted	Blinks alternatively between E-07/E-09/E-10/E-11 (start from warm-up when entered CLR-ENT)
		S+	E-07/10/11	HEATER Volt (LOW) etc.	ON	4mA	CLR-ENT after repaired	Calculation interrupted	Blinks alternatively between E-07/E-10/E-11 (start from warm-up when entered CLR-ENT)
		S−	E-11	RH/RHO ERROR	ON	4mA	CLR-ENT after repaired	Calculation stop	E-11 blinks
	Shorted lead wire	Vs+/Vs−	E-17	Vs (LOW)	ON	4mA	CLR-ENT after repaired	Calculation stop	E-17 blinks
		Vs+/Ip+	Measured value	RANGE 02 vol %	OFF	Measured value	Repair	Measurement	Higher value than true is measured temporarily
		Vs+/Ip−	E-12/17	Vs/Ip (LOW/HIGH)	ON	4mA	CLR-ENT after repaired	Calculation stop	Blinks alternatively between E-12/E-17
		Vs+/h+ (s+)	E-16/17	Vs (HIGH/LOW)	ON	4mA	CLR-ENT after repaired	Calculation stop	Blinks alternatively between E-16/E-17 (sensor is replaced when E-17 comes to OFF after entered CLR-ENT)
		Vs+/H− (S−)	E-12/17	Vs/Ip (LOW/HIGH)	ON	4mA	CLR-ENT after repaired	Calculation interrupted	Blinks alternatively between E-12/E-17
		Vs−/Ip+	E-17	Vs (LOW)	ON	4mA	CLR-ENT after repaired	Calculation interrupted	E-17 blinks
		Vs−/Ip−	Measured value	RANGE 02 vol %	OFF	Measured value	Repair	Measurement	Measurement not changed
		Vs−/H+ (S+)	E-07/08/10/11	HEATER Volt (LOW) etc.	ON	4mA	CLR-ENT after repaired	Calculation stop	Blinks alternatively between E-07/E-08/E-10/E-11 (start from warm-up when entered CLR-ENT)
		Vs−/H− (S−)	Measured value	RANGE 02 vol %	OFF	Measured value	Repair	Measurement	Measurement not changed
		Ip+/Ip−	E-17	Vs (LOW)	ON	4mA	CLR-ENT after repaired	Calculation stop	E-17 blinks
		Ip+/H+ (S+)	E-14/16	Vs/Vp (HIGH)	ON	4mA	CLR-ENT after repaired	Calculation stop	Blinks alternatively between E-14/E-16
		Ip+/H− (S−)	E-17	Vs (LOW)	ON	4mA	CLR-ENT after repaired	Calculation stop	E-17 blinks
		Ip−/H+ (S+)	E-07/08/10/11	HEATER Volt (LOW) etc.	ON	4mA	CLR-ENT after repaired	Calculation interrupted	Blinks alternatively between E-07/E-08/E-10/E-11 (start from warm-up when entered CLR-ENT)
		Ip−/H− (S−)	Measured value	RANGE 02 vol %	OFF	Measured value	Repair	Measurement	Measurement not changed
		H+ (S+) /H− (S−)	E-07/08/10/11	HEATER Volt (LOW) etc.	ON	4mA	CLR-ENT after repaired	Calculation interrupted	Blinks alternatively between E-07/E-08/E-10/E-11 (start from warm-up when entered CLR-ENT)
Abnormal Output Circuit	4-20mA output circuit	Broken output wiring	Measured value	RANGE 02 vol %	OFF	0mA	Repair	Measurement	
		Shorted output wiring	Measured value	RANGE 02 vol %	OFF	0mA	Repair	Measurement	
	Output relay circuit	RY1 function stopped	Measured value	RANGE 02 vol %	OFF	Measured value	Part replaced	Measurement	Unable output the range H, range L, maintenance, alarm H, alarm L, purge, Calibration 17, Calibration Zero, Calibration span
		RY2 function stopped	Measured value	RANGE 02 vol %	OFF	Measured value	Part replaced	Measurement	Unable output the range H, range L, maintenance, alarm H, alarm L, purge, Calibration 17, Calibration Zero, Calibration span
		RY3 function stopped	Measured value	RANGE 02 vol %	OFF	Measured value	Part replaced	Measurement	Unable output the range H, range L, maintenance, alarm H, alarm L, purge, Calibration 17, Calibration Zero, Calibration span
		RY4 function stopped	Measured value	RANGE 02 vol %	OFF	Measured value	Part replaced	Measurement	Unable output the range H, range L, maintenance, alarm H, alarm L, purge, Calibration 17, Calibration Zero, Calibration span
		RY5 function stopped	Measured value	RANGE 02 vol %	OFF	Measured value	Part replaced	Measurement	Unable output the instrument malfunction, power off warning
Abnormal CPU		IC12/13 check	E-01	–	ON		Power reapplied	Calculation stop	O2 concentration calculation and heater control stopped (matching error between EEPROM and RAM)
		IC13 function stopped	E-02	–	ON		Power reapplied	Calculation stop	O2 concentration calculation and heater control stopped (RAM malfunctioning)
		IC12 function stopped	E-03	EEPROM ERROR	ON		CLR-ENT	Calculation stop	O2 concentration calculation and heater control stopped (EEPROM malfunctioning)
		LCD display	E-04	LCD ERROR	ON		CLR-ENT	Calculation stop	O2 concentration calculation and heater control stopped (LCD malfunctioning)
		IC9 (A/D)	E-05	A/D ERROR	ON		CLR-ENT	Calculation stop	O2 concentration calculation and heater control stopped (A/D converter malfunctioning)
		IC10 (A/D)	E-05	A/D ERROR	ON		CLR-ENT	Calculation stop	O2 concentration calculation and heater control stopped (A/D converter malfunctioning)

The contents of this manual are subject to change without notice for improvement.

ENERGY SUPPORT

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ENERGY SUPPORT CORPORATION
1, Aza Kamikobarii, Inuyama, Aichi 484-8505 Japan