

SS09-9B002


Applicable lots:  
9612 lot -

Prepared in Dec., 1996

No. 005

## TERUFUSION SYRINGE PUMP

## TE-311/312 SERVICE MANUAL

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TERUMO CORPORATION

## CONTENTS

1. General
2. Specifications
3. Special Jigs and Measuring Instruments Needed
4. Various Modes
  - 4.1 Aging mode
  - 4.2 Syringe-maker setting mode
  - 4.3 Diagnosis mode
  - 4.4 Special function setting mode
  - 4.5 Adjustment mode
  - 4.6 Computer interface condition setting mode
  - 4.7 Initialization of E<sup>2</sup> PROM
  - 4.8 Flow rate max limit setting mode
5. Principle of Operation
  - 5.1 Block diagram
  - 5.2. Electric and software system
    - 5.2.1 Structure
    - 5.2.2 Description of operation
      - 5.2.2.1 Power supply circuit
      - 5.2.2.2 Recharging circuit
      - 5.2.2.3 Low battery detection circuit
      - 5.2.2.4 CPU peripheral circuit, reset circuit, reference voltage supply circuit, E<sup>2</sup>PROM circuit
      - 5.2.2.5 Fail-safe circuit
      - 5.2.2.6 Motor driving circuit
      - 5.2.2.7 Power switch circuit
      - 5.2.2.8 LED display circuit
      - 5.2.2.9 Buzzer driving circuit
      - 5.2.2.10 Motor rotation detection circuit
      - 5.2.2.11 Occlusion detection circuit
      - 5.2.2.12 Syringe and nearly empty detection circuit
      - 5.2.2.13 Setting dial and switch circuits
      - 5.2.2.14 Computer interface and nurse-call circuits
      - 5.2.2.15 Liquid crystal display circuit

- 5.2.2.16 Plunger/clutch disengagement detection circuit
- 5.3 Mechanism systems
  - 5.3.1 Structure
  - 5.3.2 Description of operation
    - 5.3.2.1 Driving unit
    - 5.3.2.2 Slider
    - 5.3.2.3 Clutch
    - 5.3.2.4 Clamp
    - 5.3.2.5 Syringe detector
- 6. Service Parts List and Development Elevation
  - 6.1 Service parts list
  - 6.2 Development elevation
- 7. Disassembly, Reassembly, and Adjustment
  - 7.1 Disassembly procedure
  - 7.2 Reassembly procedure
  - 7.3 Adjustment procedure
- 8. Troubleshooting
  - 8.1 Troubleshooting
  - 8.2 Alarms and error messages
- 9. Maintenance and Cleaning
  - 9.1 Precautions for maintenance
  - 9.2 Inspection items, methods and intervals
  - 9.3 Cleaning
- 10. Circuit Diagrams and Silk-screen Diagram
  - 10.1 Main board
  - 10.2 Power-supply board
  - 10.3 Motor rotation detection board
  - 10.4 Occlusion detection board
  - 10.5 Setting dial board
  - 10.6 Computer interface board
  - 10.7 7-segment LED board
  - 10.8 Nurse-call board

## 1. GENERAL

This Service Manual has been prepared for BME maintenance service of the TERUFUSION Syringe pump (TE-311/312).

When informed of a pump unit malfunction from a doctor/nurse, please troubleshoot according to the following procedures.

- (1) If any fault is found to be caused by improper operation by the doctor/nurse, correct the cause of the problem and instruct the user how to operate the equipment properly so that recurrence of the fault can be prevented.
- (2) Before starting of actual repair of the equipment, be sure to confirm the fault that the doctor/nurse has brought to your attention. After assessing the actual state of the fault, only then should you start any repair work.
- (3) If the equipment is found to malfunction even when it is operated properly, use the troubleshooting procedure in this manual to diagnose the faulty pump.
- (4) If you are unable to correct the fault by using this manual, please contact your local TERUMO distributor or TERUMO Corporation for corrective action and repair.
- (5) Disinfect the items contaminated by patient's body fluids before returning to TERUMO distributor or TERUMO Corporation. Please include all items that have been removed from the equipment during preliminary checks upon return of equipment. If it is necessary to send back those items that have not been disinfected, seal them completely and attach a memorandum indicating that the contents are unsanitary and to be handled with care.

(General precaution)

- (1) Don't detach connectors or printed-circuit boards while the equipment is supplied with power.

- (2) First visually check the malfunction equipment for open circuits, short circuits, loose connectors and damaged parts. Also, check for abnormal sounds or foul smells (caused by burned resistor, etc.).
- (3) After completion of repair work, check that all switches are set in the respective original settings. Clean the equipment and its periphery and, then, report the result of repair work to the BME manager.
- (4) When handling semiconductors, especially MOS-IC, take special care not to cause electrostatic breakage, etc.

Keep your body and your soldering iron in constant connection with a ground point through a  $1M\Omega$  resistor. (A statically insulated type of soldering iron does not require grounding, but it must be used only after being checked for completeness of insulation.)

When carrying ICs and printed-circuit boards, be sure to keep them in electrically conductive containers or wrap them in metal sheets (such as aluminum foil).

(Never use plastic containers or sheets for this purpose.)

- (5) If you find that an abnormality disappears when a printed-circuit board is replaced, try to remount the original board to ascertain that the previous abnormality still recurs. If there is no recurrence, poor contact or another fault could be suspected; continue troubleshooting.

This Service Manual is expressed in the following "SI" units (Système International d'Unités):

Quantity	SI unit		
	Name	Symbol	Remarks
Force	Newton	N	1Kgf = 9.80665 N
Pressure	Pascal	Pa	1Kgf/cm <sup>2</sup> = 98066.5 Pa

**2. SPECIFICATIONS**

[Common to TE-311/312]

Name: TERUFUSION syringe pump

Model: TE-311/312

Name	TERUFUSION syringe pump TE-311				TERUFUSION syringe pump TE-312			
Model	TE-311				TE-312			
Code No.	Syringe used	Body weight mode function	Computer interface / Nurse call		Syringe used	Body weight mode function	Computer interface / Nurse call	
TE-311N	Specified brands	Without	Without	-	-	-	-	-
TE-311C	Specified brands	Without	With	TE-312C	Specified brands	With	With	

Syringe used: 10, 20, 30, 50 mL of Terumo &amp; specified brands

Flow rate setting range:

When 10, 20 or 30 mL syringe is used: 0.1 - 300.0 mL/h (0.1 mL/h step)

When 50 mL syringe is used: 0.1 - 1200 mL/h

(0.1 - 999.9 mL/h: 0.1 mL/h step)

(1000 - 1200 mL/h: 1 mL/h step)

Display range of volume delivered:

0.1 - 999.9 mL (0.1 mL step)

Accuracy of flow rate: Mechanical accuracy: within  $\pm 1\%$ (Nominal valve) accuracy incl. syringe: within  $\pm 3\%$  (when measured over 1 hour after start of infusion using TERUMO syringe and, thereafter, every hour at a flow rate of 1.0 mL/h or more)

Occlusion detection pressure: Selective setup in three stages

Setting ranges with TERUMO syringe used

[H]:  $800 \pm 200$  mmHg ( $106.7 \pm 26.7$  kPa,  $1.09 \pm 0.27$  kgf/cm<sup>2</sup>)

[M]:  $500 \pm 100$  mmHg ( $66.7 \pm 13.3$  kPa,  $0.68 \pm 0.14$  kgf/cm<sup>2</sup>)

[L]:  $300 \pm 100$  mmHg ( $40.0 \pm 13.3$  kPa,  $0.41 \pm 0.14$  kgf/cm<sup>2</sup>)

Purge flow rate: Approx. 1200 mL/h (with 50 mL syringe used)

Approx. 500 mL/h (with 30 mL syringe used)

Approx. 400 mL/h (with 20 mL syringe used)

Approx. 300 mL/h (with 10 mL syringe used)

Alarming function: Occlusion, nearly empty, low battery, syringe dislocated, plunger/clutch disengaged

Special function: • Possible selective functions with internal selector switch are:

(1) Setting of delivery limit: 0.1 - 999.9 mL (0.1 mL step)

[when Delivery limit is specified.]

- Infusion completion alarm
- Keep-vein-open function (to continue infusion at rate of 0.1 mL/h after completion of infusion)

(2) Repeat alarm function (This function will come into action if alarm is not released within 2 minutes after alarm buzzer stops sounding.)

(3) Start reminder alarming function (This function will come into action if operable state continues 2 minutes or more.)

(4) Flow rate max limit setting function

(5) Remote computer-interface function

- Clear volume delivered button (Display of volume delivered counter is reset to "0" when the button is pushed for 1.5 seconds.)

Computer interface function: RS-232C or RS-485 (TE-311C, TE-312C, only)

## Nurse-call alarm:

Relay contact point for alarm output (applicable to nurse call)

Contact-point capacity 1A, 12 VDC (TE-311C, TE-312C, only)

Operating conditions: Ambient temperature: 5 - 40°C, Relative humidity: 30 - 90%

Storage conditions: Ambient temperature: -20 - 45°C, Relative humidity: 10 - 95% (no condensation)

Power supply: 110 V/120 V/220 V/230 V/240 V AC, 50/60 Hz

12 VDC (by exclusive use of power supply)

Built-in battery keeps continuous use for about 2 hours. (when computer interface function is used: approx. 1 hour 45 minutes.)

(provided that a new battery is charged up for at least 24 hours at ambient temperature 25°C, with power off, and is used under the condition of 5 mL/h flow rate and occlusion-pressure set value "M" )

Power consumption: 12 VA (when AC power is used) or 8.4 W (when DC power is used)

Electric shock protection class & type:

Class I and internal power-supply device CF type IPX 4

External dimensions: 322(W) × 114(H) × 115(D) mm

Weight: Approx. 2.3 kg (TE-311)



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Body weight mode setting range:

Dose rate: 0.00 - 50.00  $\mu\text{g}/\text{kg}/\text{min}$  (0.01  $\mu\text{g}/\text{kg}/\text{min}$  step)

Body weight: 0.0 - 300.0 kg (0.1 kg step)



















Drug volume: 0.0 - 300.0 mg (0.1 mg step)

Solution volume: 0.0 - 300.0 mL (0.1 mL step)

Weight: Approx. 2.4 kg

Specification and design are subject to change for improvement without notice.  
Computer interface and Nurse call connectors are available on the specified product.

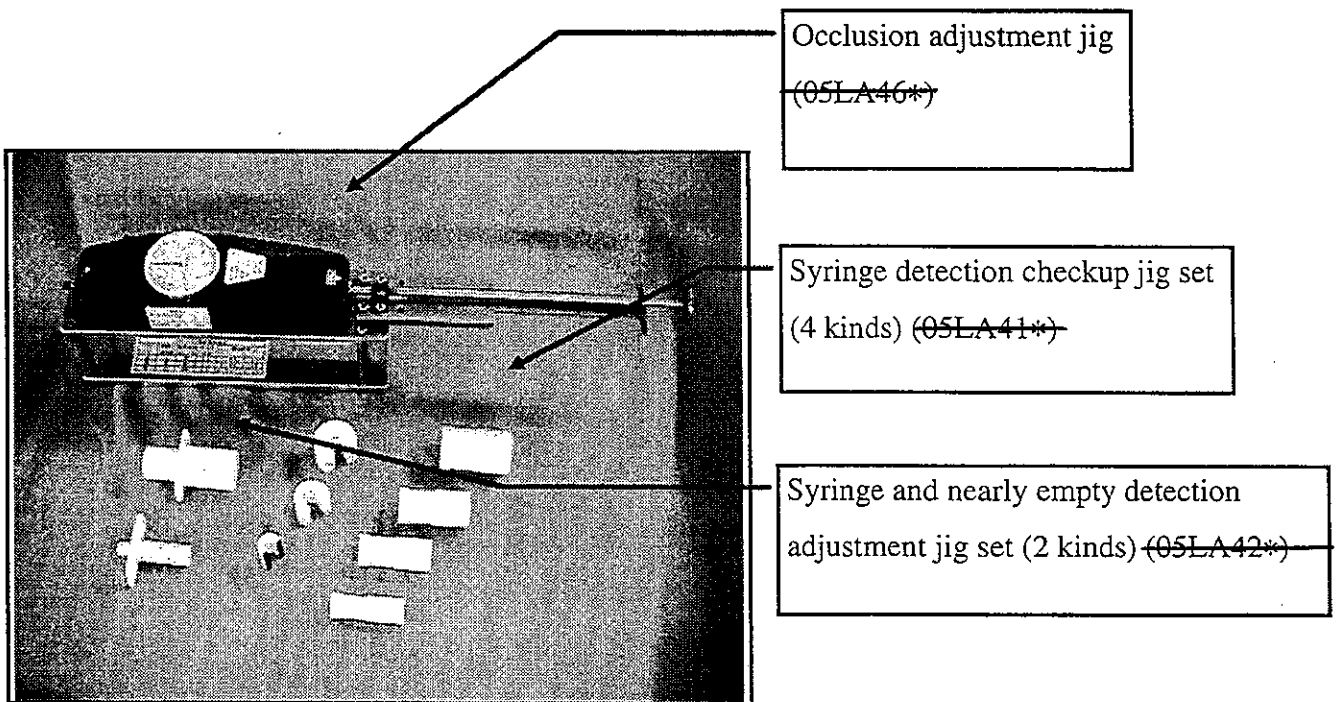
## Units Available:

Reorder number	Voltage	Plug type	Socket type	Body weight mode	Computer interface / Nurse call connector
TE*311NB1	110V	American type		-	-
TE*311ND1	120V	American type		-	-
TE*311NG2	220V	UK type		-	-
TE*311NG3	220V	European type		-	-
TE*311NH2	230V	UK type		-	-
TE*311NH3	230V	European type		-	-
TE*311NH3*	230V	European type		-	-
TE*311NI3	240V	European type		-	-
TE*311CH2	230V	UK type		-	yes
TE*311CH3*	230V	European type		-	yes
TE*312CB1	110V	American type		yes	yes
TE*312CD1	120V	American type		yes	yes
TE*312CG2	220V	UK type		yes	yes
TE*312CG3	220V	European type		yes	yes
TE*312CH2	230V	UK type		yes	yes
TE*312CH3	230V	European type		yes	yes
TE*312CH3*	230V	European type		yes	yes
TE*312CI3	240V	European type		yes	yes

**NOTE: Separate set - up procedures are required for products with voltage - plug combination other than listed above.**

**3. SPECIAL JIGS AND MEASURING INSTRUMENTS NEEDED**

No.	Special jigs and measuring instruments
1	Digital voltmeter
2	Synchroscope
3	Pressure gage (0 - 30 Kpa; 0 - 3 Kgf/cm <sup>2</sup> )
4	Occlusion adjustment jig <del>(05LA46*)</del>
5	Syringe and nearly empty detection adjustment jig set (2 kinds of jigs) <del>(05LA42*)</del>
6	Syringe detection checkup jig set (4 kinds of jigs) <del>(05LA41*)</del>
7	Measuring cylinder
8	Cross-point screwdriver set (large & small), plain screwdriver (small), thread lock, cable tie, nipper, tweezers, and long-nose plier
9	Plunger / Clutch disengagement detection adjusting jig <del>(05LA47*)</del>



#### 4. VARIOUS MODES

Various kinds of modes can be set up with the rotary switch inside the equipment body.  
Specification for internal switch is as follows:

[Internal switches specification]

Switch spec.	Mode	Description
[0]	Aging mode	For warming up the product in the early stage of production or after parts replacement during maintenance
[1 - A]	Normal mode	-
[B]	Diagnosis mode	For diagnosing switches, lamps, buzzers, and sensors individually
[C]	Special-function setting mode	For setting "Delivery limit" mode, "Repeat alarm" mode, and "Start reminder alarm" mode
[D]	Adjustment mode	For adjusting the syringe detection, nearly empty detection, and occlusion detection
[E]	Computer interface environment and ID number setting mode	For setting the computer interface speed, stop bit, etc.
[F]	E <sup>2</sup> PROM initialization	For initializing E <sup>2</sup> PROM in early stage of production

\* The internal switch is of the rotary switch type.

When resetting the internal switch, remove the battery cover from the bottom of equipment body and take out the battery from the inside of body, and the internal switch can be reset through the window at the depth of battery housing. Take care not to unplug the battery connector.

**Note: Put the rotary switch (S1) back to its original position "1", after the operation of each modes.**

#### 4.1 Aging Mode

##### (1) Operating method

- 1) With the power switched off, set the rotary switch to "0".
- 2) With "STOP" switch button kept pressed, turn "POWER" switch ON, and the states 1) to 3) of aging action (2) will occur, indicating that the aging mode comes into effect.

\* If "POWER" switch is turned ON without pressing "STOP" button, "Er96" will appear on the "Flow rate / Delivery limit / Volume delivered" display (7-segment LED).

##### (2) Aging action

- 1) The motor runs. (Movement of slider: approx. 9 mm/h)
- 2) All of indicative elements connected blink at 1 Hz/50% duty.
- 3) During running of motor, a minimum level of purge sound is heard.
  - During aging operation, it is possible to stop the motor with "STOP" switch and start it again with "START" switch.
  - During aging operation, the motor can be stopped by occlusion detection (approx. 4.7 kgf).

(3) When "POWER" switch is turned OFF, aging mode ceases.

#### 4.2 Syringe-brand Setting Mode

- (1) Set the rotary switch (S1) on the main board to "1" (original setting position), and turn [POWER] switch to ON. Now, setting of a desired one of the previously-stored syringe brands becomes possible. The display shows "11" or "12" (corresponding to TERUMO syringes) which has been preset before shipment from the factory.

[Setting - Syringe brand]

Display	Syringe Brand	Syringe accepted
11	TERUMO JAPAN made	10,20, 30, 50 mL
12	TERUMO EUROPE made	10,20, 30, 50 mL (30mL TERUMO JAPAN made)
13	TERUMO USA made	10,20, 30, 50 [60] mL
14	B-D A combination	10, 20 mL (SIN), 30, 50 [60] mL (PLASTIPAK®/USA)
15	B-D B combination	10, 20, 30, 50 [60] mL (PLASTIPAK®/USA)
16	Dong Bang	10,20, 30, 50 mL
17	Nipro	10,20 mL (Thailand) 30, 50 mL (Japan)
18	Boin	10, -, 30, 50 mL
19	Dae-Ah	10,20, 30, 50 mL
20	Sherwood MONOJECT®	10,20, 30, 50 [60] mL
21	B. Braun OMNIFIX®	10,20, 30, 50 [60] mL
22	JMS(Japan)	10,20, 30, 50 mL

(2) Setting procedure

**Note: When making setting, be sure to enter the setting number which properly represents the desired syringe brand to be used.**

- 1) The power is now turned off , and rotary switch (S1) position is "1"(initial setting).With both the [STOP] and [DISPLAY SELECT] buttons kept pushed turn [POWER] switch to ON for a few seconds, and an indication "SEt" will appear on the [RATE/D.LIMIT/ $\Sigma$  mL] display and the syringe-brand setting mode come into effect.
- 2) Then, an indication "nn" (n: optional number) will appear on the [RATE/D.LIMIT/ $\Sigma$  mL] display. Make sure that the [10 mL] lamp is lit.
- 3) The syringe - brand setting number advances by one each time the [STOP] button is pushed. (Set on appropriate number corresponding to the syringe brand. The number doesn't go down.)
- 4) Once a setting number is entered, push the [START] button and keep it pushed for approx. 1.5 seconds to store the entry.  
As this process is completed with a beep, an indication "good" will appear on the [RATE/D.LIMIT/ $\Sigma$  mL] display (for approx. 2 seconds.) In case of abnormality, "bAd" will be displayed.

**Note: Whenever any change of setting is made, be sure to store the changed matter.**

- 5) The syringe-brand setting mode can be terminated by turning power supply to OFF.

**Note: Turn [POWER] switch to ON again, check for proper indication of a number representing the syringe brand selected, and then stick the new syringe-brand label in place of existing one.**

(3) Special mention

- 1) Soon after indication of "good" or "bAd," the display will return to the initial indication.
- 2) If power supply is cut off during setting procedure, a failure to store the entry will result.

### 4.3 Diagnosis Mode

#### 4.3.1 Operating method

- 1) With the power switched off, set the rotary switch to "B".
- 2) With "STOP" switch button kept pressed, turn "POWER" switch ON, and "dIAG" will appear on the "Flow rate / Delivery limit / Volume delivered" display, indicating the start of diagnosis mode. If "POWER" switch is turned ON without pressing "STOP" button in this case, "Er91" will appear on the "Flow rate / Delivery limit / Volume delivered" display.

Also, be sure to release "STOP" switch button as soon as the power is switched on; otherwise, "Er 8" will be indicated.

\* [dIAG stands for Diagnosis.]

- 3) When "POWER" switch is turned OFF, diagnosis mode ceases.

- \* Succeeding to start of diagnosis mode, execution of diagnosis actions, checking for proper action, and indication of status can be made as described below.
- \* Pushing "PURGE" switch button while diagnosis item (1) being indicated causes the diagnosis item to skip.

Diagnosis item	Description
(1)	Display of software-version numbers.
(2)	Diagnosis of indicative elements
(3)	Diagnosis of "operational" switches
(4)	Diagnosis of buzzer
(5)	Diagnosis of preset dial
(6)	Diagnosis of clutch sensor
(7)	Diagnosis of motor rotation and rotation-detection sensor
(8)	Diagnosis of syringe nearly empty detection sensor
(9)	Diagnosis of syringe detection sensor
(10)	Diagnosis of occlusion detection sensor
(11)	Diagnosis of power-supply voltage and status of AC/DC power supplies
(12)	Diagnosis of nurse-call function

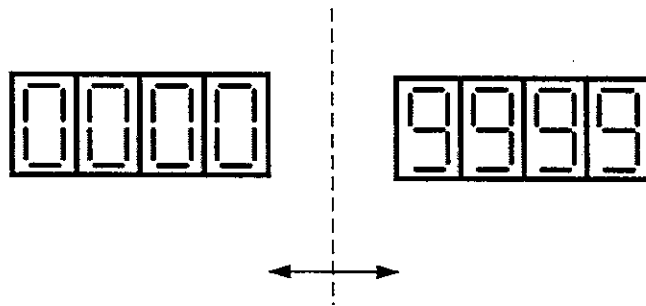


## (1) Display of software-version numbers

When "STOP" switch button is released immediately after start of diagnosis mode, the software (CPU program) version number is indicated on the "Flow rate/ Delivery limit/ Volume delivered" display.

- The 4 digits from the first indicates the software version number (0000 - 9999).

"Flow rate/ Delivery limit/ Volume delivered" display



Software version number:

0000 - 9999

## (2) Diagnosis of indicative elements

1) Each time "STOP" button is pushed, the indicative elements are switched over one after another automatically in the following sequence to diagnose them:

- "Syringe mL" lamps (4 lamps) light up simultaneously.
- Operational indicator red lamps (4 lamps) light up simultaneously and green lamp revolves.
- "Occlusion limit" indicator (H,M,L) light up simultaneously.
- "Alarm indicator" lamps (3 lamps) light up simultaneously.
- "Flow rate/ Delivery limit/ Volume delivered" display (7 segments) and a lamp light up simultaneously.
- "AC/DC" lamp and "Battery" lamps (3 lamps) light up simultaneously.

However, three "Battery" lamps are lighted up when power is switched on as far as the battery is fully charged.

2) In the case of TE-312

- All of LCD indicator and backlight are turned on.

(3) Diagnosis of "operational" switches

1) Pushing "STOP" button after the indicative elements have been diagnosed causes progress to the diagnosis of "operational" switches. In this case, the "Flow rate/ Delivery limit/ Volume delivered" display indicates "H□1.1" (□ means blank).

2) Diagnosis of "START" switch

While "H□1.1" being indicated, turning "START" switch ON/OFF causes indication "L□1.1"/"H□1.1" appear alternately on the display.

That is, "L" and "H" correspond to ON and OFF respectively as far as "START" switch is in the normal condition.

Push "STOP" switch to proceed to diagnosis of "PURGE" switch.

3) Diagnosis of "PURGE" switch

While "H□2.1" being indicated, turning "PURGE" switch ON/OFF causes indication "L□2.1"/"H□2.1" appear alternately on the display.

That is, "L" and "H" correspond to ON and OFF respectively as far as "PURGE" switch is in the normal condition.

Push "STOP" switch to proceed to diagnosis of "DISPLAY SELECT" switch.

4) Diagnosis of "DISPLAY SELECT" switch

While "H□3.1" being indicated, turning "DISPLAY SELECT" switch ON/OFF causes indication "L□3.1"/"H□3.1" appear alternately on the display.

That is, "L" and "H" correspond to ON and OFF respectively as far as "DISPLAY SELECT" switch is in the normal condition.

Push "STOP" switch to proceed to diagnosis of "C ΣmL" switch.

5) Diagnosis of "C ΣmL" switch

While "H□4.1" being indicated, turning "C ΣmL" switch ON/OFF causes indication "L□4.1"/"H□4.1" appear alternately on the display.

That is, "L" and "H" correspond to ON and OFF respectively as far as "CLEAR (C ΣmL)" switch is in the normal condition.

In the case of TE-311, push "STOP" switch to proceed to diagnosis of the buzzer.

In the case of TE-312, perform diagnosis of "DISPLAY ON/OFF" switch.

6) Diagnosis of "DISPLAY ON/OFF" switch

While "H□5.1" being indicated, turning "DISPLAY ON/OFF" switch ON/OFF causes indication "L□5.1"/"H□5.1" appear alternately on the display.

That is, "L" and "H" correspond to ON and OFF respectively as far as "DISPLAY ON/OFF" switch is in the normal condition.

Push "STOP" switch to proceed to diagnosis of "ITEM SELECT" switch.

7) Diagnosis of "ITEM SELECT" switch

While "H□6.1" being indicated, turning "ITEM SELECT" switch ON/OFF causes indication "L□6.1"/"H□6.1" appear alternately on the display.

That is, "L" and "H" correspond to ON and OFF respectively as far as "ITEM SELECT" switch is in the normal condition.

8) Push "STOP" switch, and it will cause indication of "□□1.2" and proceed to the diagnosis of the buzzer.

(4) Diagnosis of buzzer

1) As far as "START" button is kept pressed, the buzzer sounds warning.

- While "□□1.2" being indicated, the buzzer makes sound at low volume.

Releasing "START" button causes proceed to the next-stage of volume.

- While "□□2.2" being indicated, the buzzer makes sound at medium volume.

Releasing "START" button causes proceed to the next-stage of volume.

- While "□□3.2" being indicated, the buzzer makes sound at high volume.

Releasing "START" button causes proceed to the next-stage of volume.

- While "□□4.2" being indicated, the buzzer makes sound at top volume using the fail-safe function, and at the same time "Alarm" lamps (4 lamps) light up.

Releasing "START" button causes return to the initial level of sound volume.

- \* Each change of sound volume is transient and no recording to E<sup>2</sup>PROM is made.
- 2) Press "STOP" button, and it will cause indication of "n □ □3" (n= 0 - 9) and proceed to the diagnosis of the preset dial.

(5) Diagnosis of preset dial

- 1) Turn the preset dial clockwise (increase) or counterclockwise (decrease). The preset dial is regarded as functioning normally if "n" of "n □ □3" appearing on the "Flow rate/ Delivery limit/ Volume delivered" display counts up or down (0 - 9).
- 2) Push "STOP" button, and it will cause indication of "L □ □4" and proceed to the diagnosis of the clutch sensor.

(6) Diagnosis of clutch sensor (excepting domestic specification)

- 1) Manually place the clutch in lock/unlock position and check for proper state of the clutch sensor port.
- 2) Each time the display must indicate "L □ □4" for lock or "H □ □4" for unlock.
- 3) Push "STOP" button, and it will cause indication of "□ □ 5" and proceed to the diagnosis of motor drive and rotation-detection sensor.

(7) Diagnosis of motor drive and rotation-detection sensor.

- 1) While "□ □ 5" being indicated, pushing "START" button will cause the motor to run by only one rotation and that rotation will be detected by the sensor.
- 2) The result of diagnosis is indicated on the display as "g □ □5" (good) or "b □ □5" (bad).
- 3) Push "STOP" button, and it will cause indication of "nnn.6" (n= 0 - 9) and proceed to the diagnosis of the nearly empty detection sensor.

(8) Diagnosis of nearly empty detection sensor

- 1) With the clutch disconnected, move the slider toward the extremely pushed position, and the value of A/D will vary with slider position.
- 2) Indication is made in the form of "nnn.6" in which "nnn" represents A/D value given in decimal.

- 3) Push "STOP" button, and it will cause indication of "nnn.7" and proceed to the diagnosis of the syringe detection sensor.

(9) Diagnosis of syringe detection sensor

- 1) The 10 cc syringe lamp lights and an A/D value is indicated.
- 2) Indication is made in the form of "nnn.7" in which "nnn" represents A/D value given in decimal.
- 3) Push "STOP" button, and it will cause indication of "□□□.8" and proceed to the diagnosis of the occlusion detection sensor.

(10) Diagnosis of occlusion detection sensor

- 1) Indication "□□□.8" remains until the "START" button or "STOP" button is pushed.
- 2) Pushing "START" button will cause the motor to drive at 300 pps and indication to change to "nnn.8" in which "nnn" represents A/D value given in decimal.
- 3) A/D value is dependent on load applied to the slider.
- 4) When "STOP" button is pushed, the motor will come to stop, making a stop sound, and the state will proceed to the next diagnosis of the power-supply voltage and status of AC/DC power supplies.

- \* If the slider approaches near the nearly empty limit position, the motor will automatically come to a stop, making a stop sound (to prevent the slider from reaching the extreme-end of stroke.)

(11) Diagnosis of power-supply voltage and status of AC/DC power supplies

- 1) The A/D value of the voltage detection sensor is indicated in the form of "nnn.9".
- 2) In the case of battery drive, the "AC/DC" lamp goes off and an A/D value lower than that of AC drive will be indicated.
- 3) In the case of AC drive, the "AC/DC" lamp lights and an A/D value higher than that of battery drive will be indicated.
- 4) If ripple exists in the AC/battery boundary, the indication will become unsteady (because of absence of hysteresis).

- 5) Push "STOP" button, and it will cause indication of "□ □ □A" and proceed to the diagnosis of the nurse-call (relay) function.

(12) Diagnosis of nurse-call function

- 1) While "□ □ □A" is indicated, pushing "START" button will cause a change of indication to "L□ □A" and a trip (conduction) of the nurse-call relay.
- 2) Pushing "START" button again will cause indication to change to "H□ □A" and the relay to be cut off.

Each time "START" button is pushed, the relay turns to ON and OFF alternately.

- 3) Push "STOP" button to ceases all items of diagnosis, and indication on the display will return to "dIAG" showing the state of equipment being standing by for the next keying.

#### 4.4 Special Function Setting Mode

- (1) The selective special functions are shown below:

Description
Setting of delivery limit mode
Setting of silenced repeat alarm mode
Setting of silenced start reminder alarming mode
Setting of remote computer-interface mode
Setting of flow rate max limit mode

- (2) Setting method

- 1) With power supply cut OFF, set the rotary switch to "C".
- 2) With "STOP" switch kept pressed, turning "POWER" switch to ON will cause indication of "SPEC" in the "Flow rate / Delivery limit / Volume delivered" display (7-segment display), making selection of special functions possible.

Then, "10 mL" lamp will light and a binary number of four figures will appear in the numeral display zone.

Each figure of 4-figure binary number corresponds to a related setting item. At each figure, "0" and "1" corresponding to "valid" and "invalid", respectively, alternate each time "STOP" button is pushed.

\* [SPEC stands for Special.]

\* If "POWER" switch is turned ON without pushing "STOP" button, an error indication "Er92" will appear on the 7-segment LED.

- 3) Each time "PURGE" button is pushed, a binary number of four figures will blink in the sequence of "tenth's place" → "unit place" → "tenth place" → "hundred place" one after another, allowing you to set "0" or "1" in a blinking place.
- 4) Each time "DISPLAY SELECT" button is pushed, the four lamps (10, 20, 30, 50 mL lamps) will light one after another to indicate four different set conditions of a binary number of four figures corresponding to the lamp going on.
- 5) After completion of setting, keeping "START" button pressed for about 1.5 seconds will cause the preset data to be stored in E<sup>2</sup>PROM and the buzzer to make a bleep.  
Data related to all of 16 items are stored, irrespective of going on or off of four lamps.  
At the end of processing, the buzzer makes a bleep and the 7-segment LED indicates "good" (for about 2 seconds) or "bAd" .

**Note: Whenever any modification to data is made, be sure to update the stored data.**

6) The Special function setting mode is terminated by switching power supply OFF.

Function	Lamp going ON	Blinking place	Setting possible	
	Selected with "DISPLAY SELECT" switch	Selected with "PURGE" switch	Selected with "STOP" switch	
Setting of delivery limit max mode	10 mL		0: Standard mode	1: Delivery limit mode
	10 mL			1: Standard mode
	10 mL		0: Standard mode	
Setting of silenced repeat alarm mode	10 mL		0: Standard mode	
	20 mL		0: Silenced mode	1: Standard mode
	20 mL			1: Standard mode
Setting of silenced start reminder alarming mode	20 mL		0: Silenced mode	1: Standard mode
	20 mL			1: Standard mode
	30 mL			1: Standard mode
Setting of silenced computer-interface mode	30 mL		0: Standard mode	1: Entry enable mode
	30 mL		0: Standard mode	
	30 mL			1: Standard mode

\* enclosure is initialization setting.



Function	Lamp going ON	Blinking place	Setting possible	
	Selected with "DISPLAY SELECT" switch	Selected with "PURGE" switch Entry enable mode	Selected with "STOP" switch	
	50 mL		1: Standard mode	
Setting of flow rate max limit mode	50 mL		0: Standard mode	1: Variable mode
	50 mL		0: Standard mode	
	50 mL		0: Standard mode	
	10 mL, 20 mL		0: Standard mode	
	10 mL, 20 mL		0: Standard mode	
	10 mL, 20 mL		0: Standard mode	
	10 mL, 20 mL		0: Standard mode	
	10 mL, 30 mL		0: Standard mode	
	10 mL, 30 mL		0: Standard mode	
	10 mL, 30 mL		0: Standard mode	
	10 mL, 30 mL		0: Standard mode	

\* enclosure is initialization setting.

**Note: Absolutely avoid changing any setting other than Delivery limit mode, Silenced repeat alarm mode, Silenced start reminder alarming mode, Setting of computer-interface mode and Setting of flow rate max limit mode. After setting, make sure the set mode functions normally.**

(3) Special mention

- 1) After data is stored by pushing the "START" switch, the "10 mL" lamp will light and the initially set state of indication is recovered.
- 2) If power supply is cut off before data storing action is made with the "START" switch, no storage of data will be made.
- 3) Operation of "PURGE", "START", "STOP" or "DISPLAY SELECT" switch is made invalid if two or more of them are actuated together. Operation of any other switch is also made invalid.

#### 4.5 Adjustment mode

For the adjustment mode, see 7.3 Adjustment procedure in section 7. Disassembly, Reassembly, and Adjustment.

#### 4.6 Computer interface condition setting mode

(1) Items possible to set are as follows:

Item	Setting
Baud rate:	4800, 9600, 19200 bps
Stop bit:	1, 2 bits
ID number:	8 digits

\* To set the entry enable mode in which changing the flow rate, etc. is possible through computer interface, refer to section 4.4 "Special function setting mode."

## (2) Setting method

- 1) With the power switched OFF, set the rotary switch to "E".
- 2) With "STOP" switch button kept pressed, turn "POWER" switch to ON, and "bAUd" will appear on the "Flow rate / Delivery limit Volume delivered" display, indicating the start of computer interface condition setting mode.
  - \* If "POWER" switch is turned ON without pressing "STOP" button in this case, error message "Er94" will appear on the 7-segment LED.
- 3) The "Flow rate" lamp among "Flow rate / Delivery limit / Volume delivered" lamps goes on and the [RATE/D.LIMIT/ $\Sigma$  mL] display indicates a number.

Each figure of the number corresponds to a related setting item. At each figure, a digit indicated corresponds to the state of setting.

Each time "DISPLAY SELECT" button is pushed, lighting of lamps is switched over in sequence of "Flow rate" lamp  $\rightarrow$  "Volume delivered" lamp  $\rightarrow$  Both "Flow rate" and "Volume delivered" lamps to indicate three different set conditions of the number corresponding to the lamp (or lamps) going on.

- 4) Each time "STOP" button is pushed, digit is switched over progressively at the designated figure of the number.
- 5) Each time "PURGE" button is pushed, the digits of a number indicated by 7-segment LED will blink in the sequence of "tenth's place"  $\rightarrow$  "unit place"  $\rightarrow$  "tenth place"  $\rightarrow$  "hundred place" one after another, allowing you to set a new digit in a blinking place.

Functions of setting and conditions of setting possible are shown in the table below.





- 6) After completion of setting, keeping "START" button pressed for about 1.5 seconds will cause the preset data to be stored in E<sup>2</sup>PROM and the buzzer to make a bleep.

Data related to all of 3 items are stored, irrespective of going on or off of lamps.

At the end of processing, the buzzer makes a bleep and the 7-segment LED indicates "good"(for about 2 seconds) or "bAd" .

**Note: Whenever any modification to data is made, be sure to update the stored data.**

- 7) The Computer interface condition setting mode is terminated by switching power supply OFF.

Function	Lamp going ON Selected with "DISPLAY SELECT" switch	Blinking place Selected with "PURGE" switch	Setting possible Selected with "STOP" switch
Setting of baud rate	"Flow rate" lamp		0:4800bps <span style="border: 1px dashed black; padding: 2px;">1:9600bps</span> 2:19200bps
Setting of stop bit	"Flow rate" lamp		0: 1 bit <span style="border: 1px dashed black; padding: 2px;">1: 2 bits</span>
Setting of 4 figures of lower half of ID number	"Volume delivered" lamp		Each figure <span style="border: 1px dashed black; padding: 2px;">0</span> - 9
Setting of 4 figures of upper half of ID number	"Flow rate" & "Volume delivered" lamps		Each figure <span style="border: 1px dashed black; padding: 2px;">0</span> - 9

\*    enclosure is initialization setting.

### (3) Special mention

- 1) Operation of any switch other than "PURGE," "START," "STOP" and "DISPLAY SELECT" switches is made invalid.
- 2) After data is stored by pushing the "START" switch, the "Flow rate" lamp will light and the initially set state of indication is recovered.
- 3) If power supply is cut off during setting operation, no storage of data will be made.

### 4.7 Initialization of E<sup>2</sup>PROM

- (1) After data is erased, E<sup>2</sup>PROM can be refreshed by ROM data (initial data at the time of shipping).

**Note: This operation causes all of set values stored to be subject to change; readjustment of them is necessary.**

(2) Operating method

- 1) With power supply switched OFF, set the rotary switch to "F".
- 2) With "STOP" switch button kept pressed, turn "POWER" switch to ON, and the 7-segment LED will indicate "CLEA" and initialization of E<sup>2</sup>PROM becomes possible.
  - \* If "POWER" switch is turned to ON without pressing "STOP" button in this case, error message "Er95" will appear on the 7-segment LED.
- 3) Keep "PURGE" button depressed for about 1.5 seconds, and initialization of E<sup>2</sup>PROM will be made.

At the end of processing, the buzzer makes a bleep and the 7-segment LED indicates "good"(for about 2 seconds) or "bAd" .
- 4) The E<sup>2</sup>PROM initialization mode is terminated by switching power supply to OFF.

(3) Special mention

- 1) Indication of "good" or "bAd" is succeeded by return to the initial display.
- 2) Operation of "PURGE" switch is made invalid if it is actuated together with another switch. Operation of any other switch is also made invalid.

#### **4.8 Flow rate max limit setting mode**

##### (1) Setting method

- 1) With both the [STOP] and [DISPLAY SELECT] buttons kept pushed while power is OFF, turn [POWER] switch to ON, and an indication "SEt" will appear on the [RATE/D.LIMIT/ $\Sigma$  mL] display and the flow rate max limit setting mode come into effect.
- 2) Then, an indication "nn" (n: optional number) will appear on the [RATE/D.LIMIT/ $\Sigma$  mL] display. Push [PURGE] button and make sure that "nnnn" appears on the [RATE/D.LIMIT/ $\Sigma$  mL] indicator and the [20 mL] lamp is lit.

\* To make the flow rate max limit setting mode effective, refer to section 4.4 "Special function setting mode."

- 3) Set the flow rate max limit to a desired value of 1 to 1200 mL/h with the setting dial.
- 4) Once a setting value is entered, push the [START] button and keep it pushed for approx. 1.5 seconds to store the entry.

As this process is completed with a beep, an indication "good" will appear on the [RATE/D.LIMIT/ $\Sigma$  mL] display (for approx. 2 seconds.) In case of abnormality, "bAd" will be displayed.

**Note: Whenever any change of settings is made, be sure to store the altered adjustments.**

- 5) The flow rate max limit setting mode can be terminated by turning power supply to OFF.

##### (2) Special mention

- 1) Soon after indication of "good" or "bAd," the display will return to the initial indication.
- 2) If power supply is cut off during setting procedure, a failure to store the entry will result.
- 3) In the case where any flow rate exceeding 300 mL/h is set, the maximum flow rate of 10, 20, 30 mL syringe is limited to 300 mL/h.

**Date:** 10/26/98  
**Sender:** Eugene Yeo  
**To:** Dennis Valsamis  
**Priority:** Normal  
**Subject:** [Information] Silence Alarm for Purging on TE-311/312

---

Dear Dennis

Attached are the steps necessary to silent the purge alarm. Do  
test it in-house before advising users.

Any question - feel free to call me back.

Regards  
Eugene

---

Forward Header

---

**Subject:** [Information] Silence Alarm for Purging on TE-311/312  
**Author:** Toshiya Iwami at TERUMO-HONSHA01  
**Date:** 10/22/98 11:21 AM

Dear Eugene-san,

Hope your Vietnam live would be successful.

By the way, I would like to inform you of the procedure as below  
mentioned and kindly refer it and try to confirm it before you  
explain it to customer.

1. Dip Switch: Change its position to be " C " from "1"
2. Holding "Stop" button and press "Power" button together.  
Note: Holding both buttons more than 3 seconds.  
Otherwise, the error message will be shown.
3. Press " Rate/Limit " button till syringe size "20ml"  
is flashing.
4. Press " Purge " button till the below position is  
flashing and press " Stop " button to set the figure  
to be " 0 " Zero.

Display: 1 1 1 1  
Flashing " Press " Stop "

Display: 1 1 0 1

5. Press "Start" button in order to memorize silence condition.  
And then "good " will be shown on the display.  
Then turn off the power.

Display: g o o d

6. Change the dip switch to be "1". Confirm that  
number shown on the display is " 0" during self check.  
Also, confirm silence for purging.

Please try to do it yourself first and kindly contact me if you have  
any questions.

6) The Special function setting mode is terminated by switching power supply OFF.

Function	Lamp going ON	Blinking place	Setting possible	
	Selected with "DISPLAY SELECT" switch	Selected with "PURGE" switch	Selected with "STOP" switch	
Setting of delivery limit max mode	10 mL		0: Standard mode	1: Delivery limit mode
Nurse Call Mode Activation	10 mL		0: Not Activated	1: Standard mode
Memory Mode Activation	10 mL		0: Standard mode	1: Mode 'ON'
Battery Saving Mode	10 mL		0: Standard mode	1: Mode 'ON'
Setting of silenced repeat alarm mode	20 mL		0: Silenced mode	1: Standard mode
Purge Sound Activation	20 mL		0: Silenced Mode.	1: Standard mode
Key Sound Activation	20 mL		0: Silenced Mode	1: Standard mode
Setting of silenced start reminder alarming mode	20 mL		0: Silenced mode	1: Standard mode
NOT USED	30 mL			1: Standard mode
Clutch Disengage Alarm	30 mL		0: Standard mode	1: Not Activated
Low Battery Alarm Timing	30 mL		0: 20 minutes	1: Standard mode 30 mins
Setting of computer-interface mode	30 mL		0: Standard mode	1: Entry enable mode

\* enclosure is initialization setting.



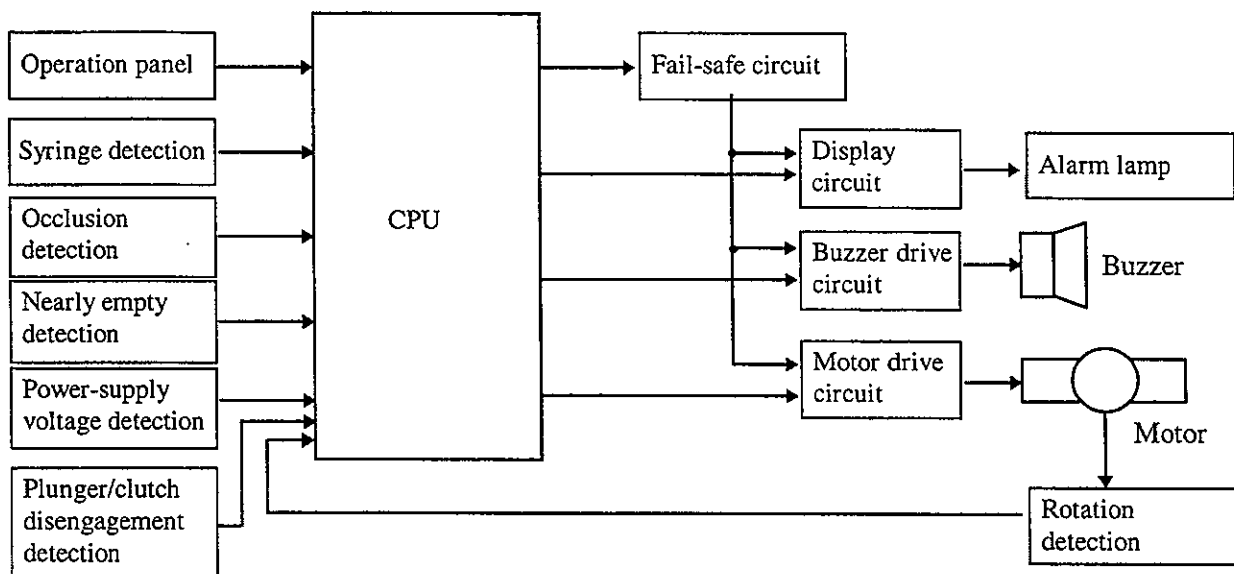
Function	Lamp going ON	Blinking place	Setting possible	
	Selected with "DISPLAY SELECT" switch	Selected with "PURGE" switch Entry enable mode	Selected with "STOP" switch	
	50 mL		<input type="checkbox"/> 1: Standard mode	
Setting of flow rate max limit mode	50 mL		<input type="checkbox"/> 0: Standard mode	<input type="checkbox"/> 1: Variable mode
	50 mL		<input type="checkbox"/> 0: Standard mode	
Dial Half Turn Beep Sound	50 mL		<input type="checkbox"/> 0: Standard mode	<input type="checkbox"/> 1: Not Activated.
	10 mL, 20 mL		<input type="checkbox"/> 0: Standard mode	
	10 mL, 20 mL		<input type="checkbox"/> 0: Standard mode	
	10 mL, 20 mL		<input type="checkbox"/> 0: Standard mode	
	10 mL, 20 mL		<input type="checkbox"/> 0: Standard mode	
	10 mL, 30 mL		<input type="checkbox"/> 0: Standard mode	
	10 mL, 30 mL		<input type="checkbox"/> 0: Standard mode	
	10 mL, 30 mL		<input type="checkbox"/> 0: Standard mode	
	10 mL, 30 mL		<input type="checkbox"/> 0: Standard mode	

\*  enclosure is initialization setting.

## 5. PRINCIPLE OF OPERATION

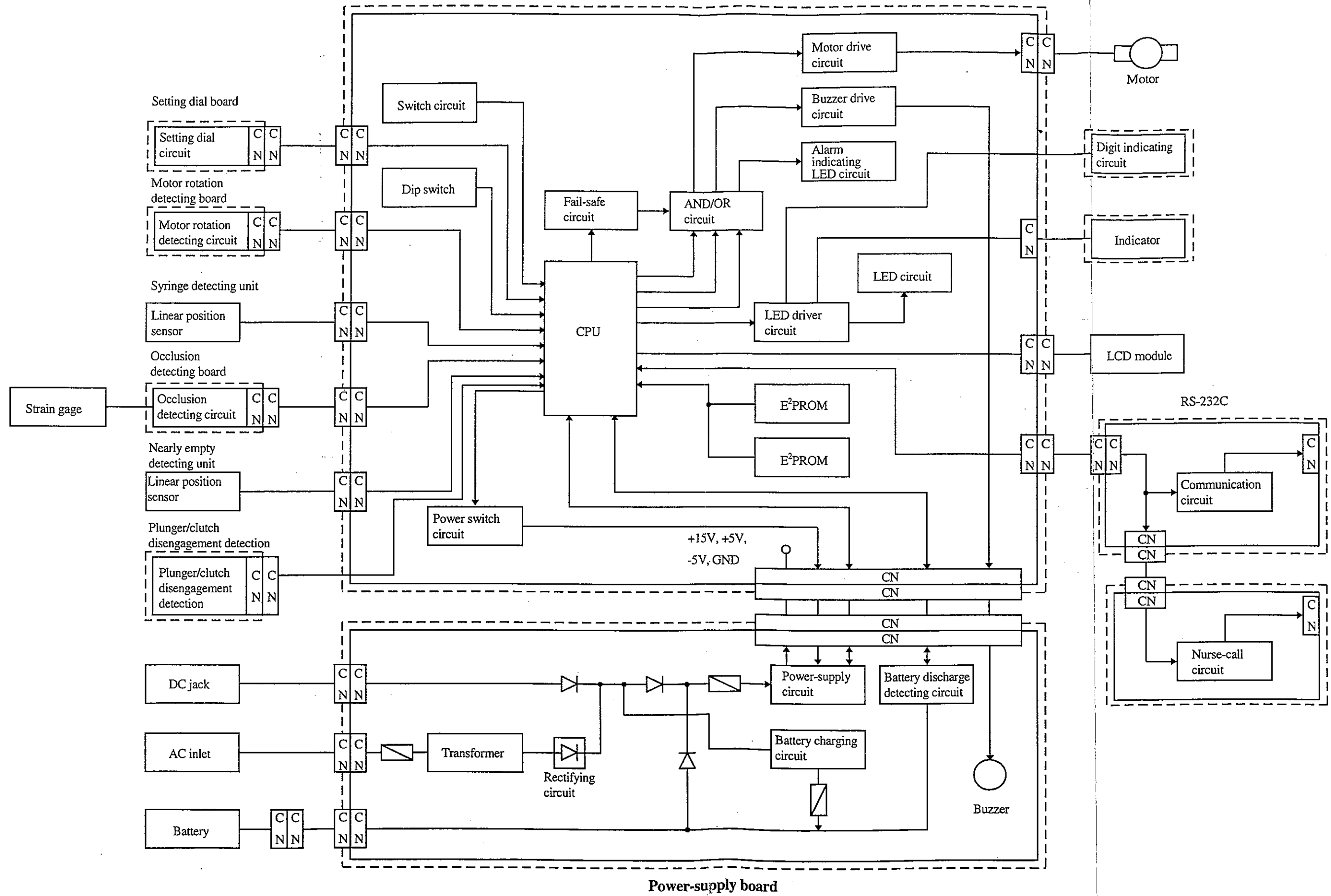
All functions related to operation, display, buzzer and motor control, and detections are under control of the microcomputer (CPU).

In case of erroneous operation of the CPU, the fail-safe circuit outside the CPU will force the motor to stop and, at the same time, will cause the indication of an alarm and a bleep of buzzer.



5.1 Block Diagram

Main board



Power-supply board

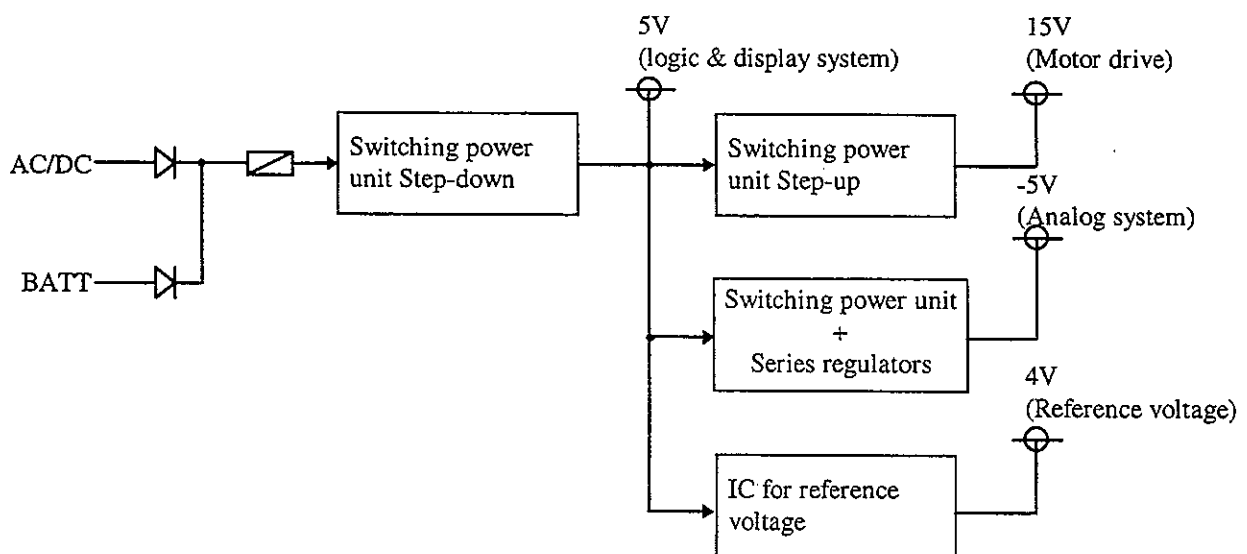


## 5.2.2 Description of operation

### 5.2.2.1 Power-supply circuit

To cope with a wide input-voltage range of approx. 8V to 20V, which is dependent on the use of AC, DC or battery for power supply, a step-down switching power unit (5V) is provided in the first stage.

Through this 5V power unit, power is supplied to meet the needs of 15V for the motor drive, -5V for the occlusion detection amplifier, and 4V for the A/D conversion reference voltage for CPU. Since all switching power supplies have the "short-circuit detecting" functions which cut off power supply in case of occurrence of an excessive overload current.

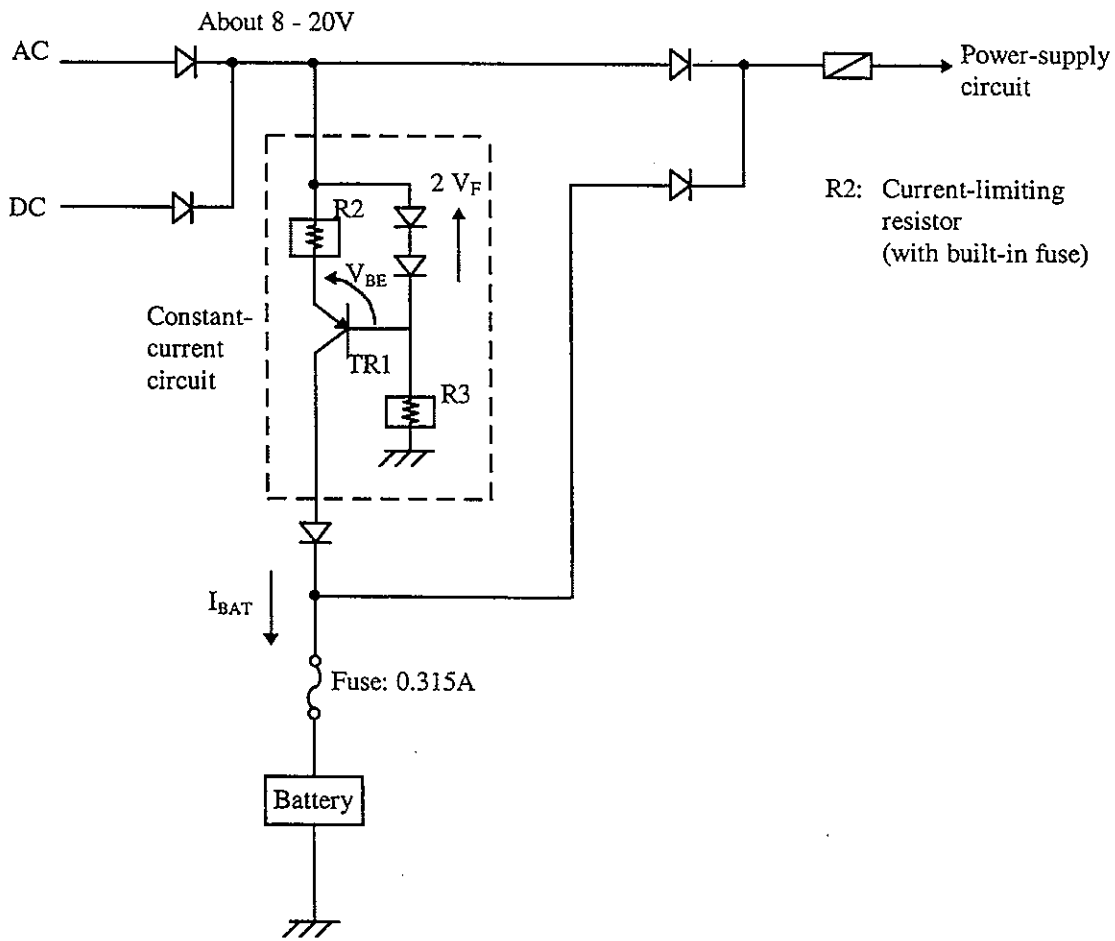


**5.2.2.2 Recharging circuit**

The battery is recharged by trickle-charge of a constant-current circuit. Charging current  $I_{BAT}$  is calculated by the following equation:

$$I_{BAT} = (2V_F - V_{BE})/R_2$$

(where,  $V_F$ : Forward voltage of diode,  $V_{BE}$ : Base-emitter voltage of transistor)



### 5.2.2.3 Low battery detection circuit

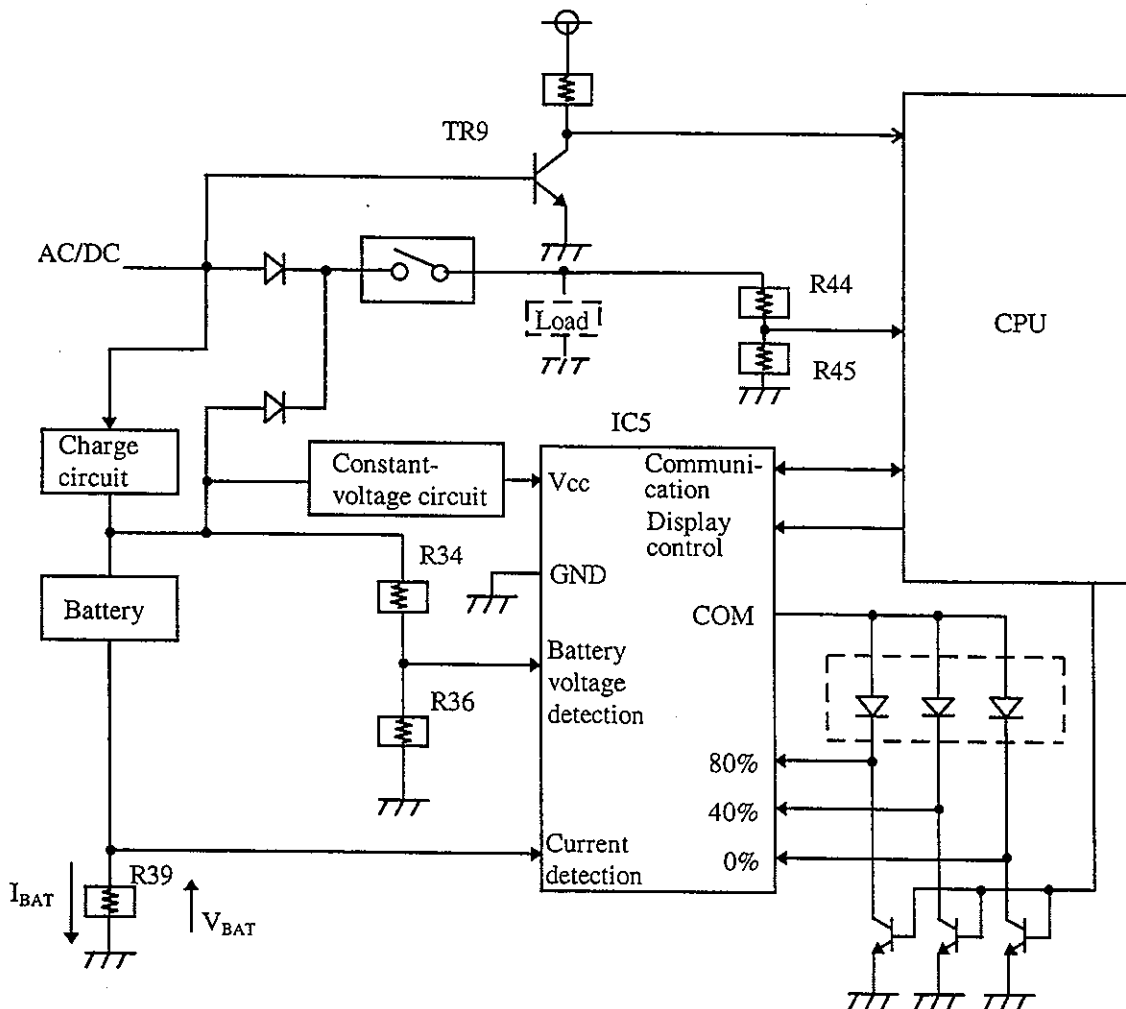
An IC5 is used for detecting the low battery and recharging current.

The internal memory of IC5 always needs supplying power and, therefore, a battery is kept connected to the IC5 even when the power switch is OFF.

**Note: Data stored in the IC5 would be cleared if the battery is disconnected from IC5 for replacement of the battery or if the battery is left unattended for a long time until it loses output voltage (self-discharge).**

**In such a case, it is necessary to check for accurate indication of low battery by using the checking method given in the instruction manual.**

The battery voltage is detected at a point at which battery output resistance is divided into two (R34 and R36). Battery discharge/recharge current ( $I_{BAT}$ ) is derived from voltage being generated across resistance R39.



The IC5 has a function of learning how much capacity the battery involved holds actually and, accordingly, if the battery capacity has decreased due to deterioration, three indicator lamps in the low battery detection circuit may fail to light even if the battery is charged fully. Since lighting of the indicator lamps is based on the "nominal value" of battery capacity, whenever the battery is disconnected from and reconnected to IC5 for replacement of the battery, it is necessary to check for accurate indication of low battery by using the checking method given in the instruction manual.

The CPU being in computer interface with IC5 performs the following functions:

(1) Detecting battery abnormality: If any of the following abnormal conditions is detected, the CPU will cause the three "Battery" lamps to blink simultaneously:

- Open to circuit of battery changing line.
- Short circuit of cells
- Expiry of battery life

(2) Detection of low battery charge:

If low battery charge reduces to 20% (approx.) or if the CPU detects a low sustainable battery voltage of 1.05V (1.00 - 1.10V) (approx.) for each cell, the CPU will cause the battery-charge alarm to generate.

(3) Shutdown alarm:

If the CPU detect a reduction of voltage to approx. 0.95V (0.90 - 1.00V) per battery, the CPU will cause the shutdown alarm to generate.

*Tone & Shut Display*



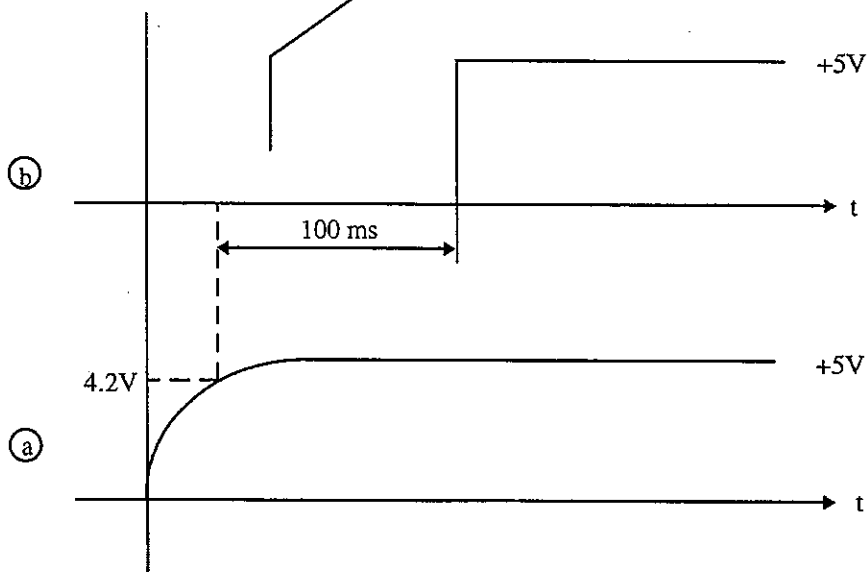
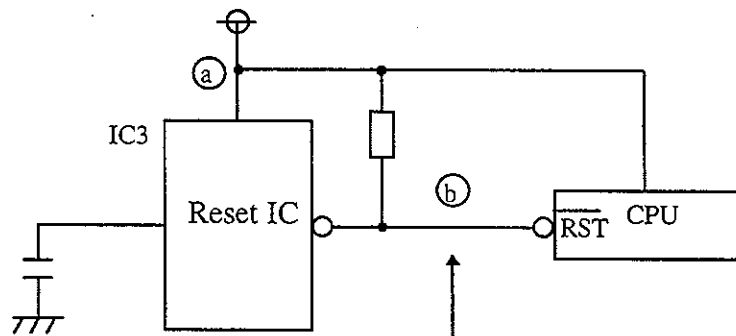
**5.2.2.4 CPU peripheral circuit**

The CPU comprises the following terminals:

Terminal (Port)	Function
P00 - P03	Input of state of dip switch.
P04	Input of AC/DC/BATT select signal.
P05 - P07	Control of LCD state (with/without, back-light ON/OFF, tip select).
P10 - P12	Output of data signal to LED driver.
P13, P15	Output of data from E <sup>2</sup> PROM and output of clock.
P20	Output of signal for lighting low battery LED.
P21	Input of data signal for setting dial (side B).
P22	Output of display-permit signal for low battery LED.
P24 - P27	Output of alarm-lamp lighting signal.
P30	Output of nurse-call alarm.
P31 - P33	Output of data signal for buzzer volume (L, M, H).
P41 - P47	Input of key data signal.
P52	Output of buzzer driving pulse.
P54	Output of motor driving signal.
P51, P55	Output of motor controlling signal.
P56	Output of shutdown signal.
P60, P61	Input of rotation detecting signal.
P62	Input of signal from external fail-safe circuit (on the software, unused).
P63	Input of data signal for setting dial (side A).
P64, P66	Input / output of serial data for low battery LED.
P65	Output of pulse to external fail-safe circuit.
P67, P40	Input of clutch disengagement detection signal.
P70	Input of occlusion detection signal.
P71	Input of nearly empty detection signal.
P72	Input of syringe detection signal.
P73	Input of analog value of power-supply voltage.

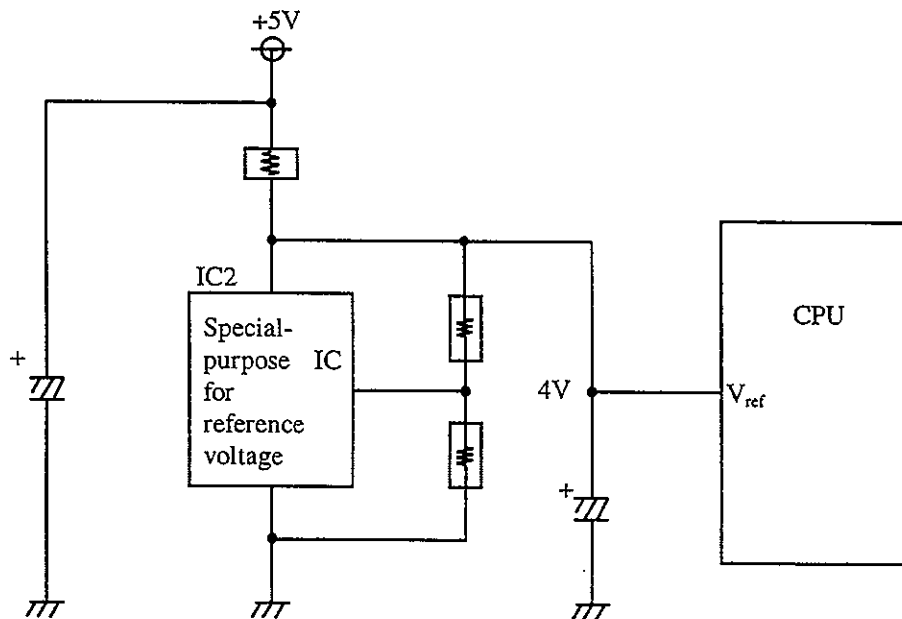
(1) Reset circuit

When "POWER" button of the equipment has been pushed, the reset circuit actuates the CPU approx. 100 ms after the 5V-system power supply nearly rises up.



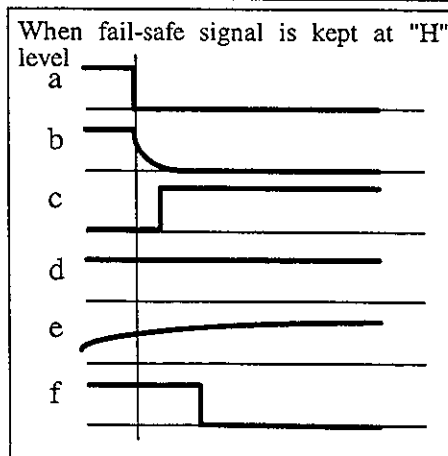
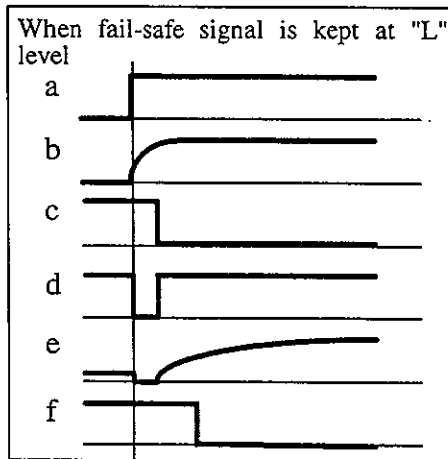
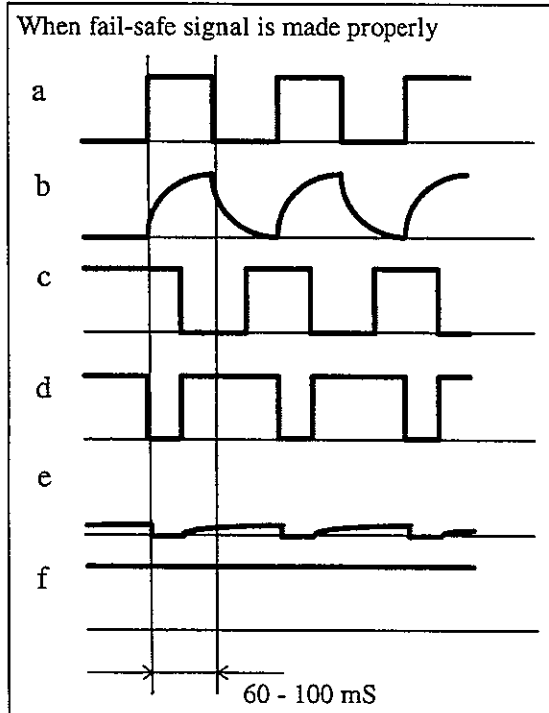
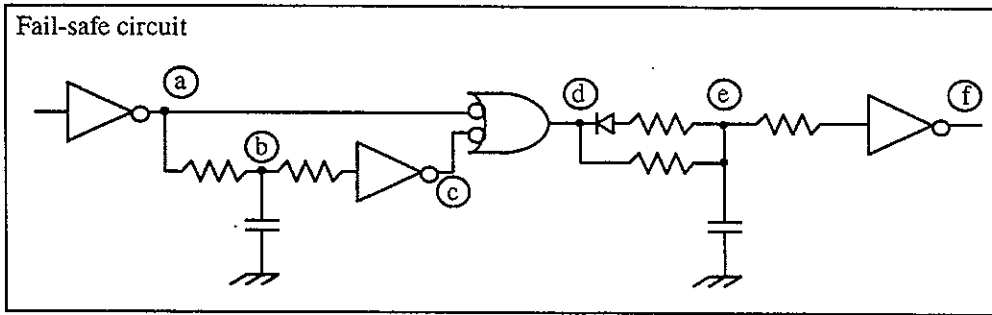
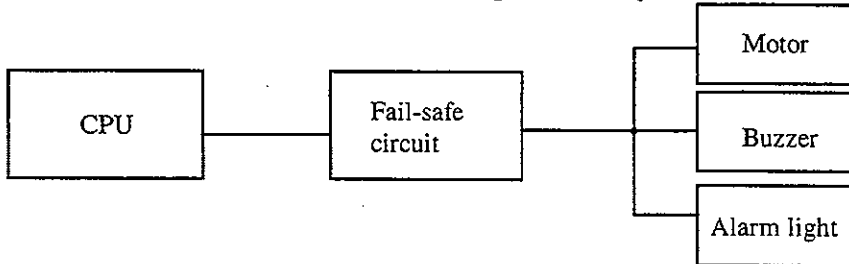
## (2) Reference voltage supply circuit

A special-purpose IC is prepared for generating 4V power supply which is used as a reference voltage for A/D conversion in the CPU when detecting presence of the syringe, occlusion of the syringe, nearly empty, and power-supply voltage.



**5.2.2.5 Fail-safe circuit**

In case of erroneous operation of the CPU, a fail-safe circuit outside the CPU causes braking force to stop the motor and, at the same time, alarming is made by both the buzzer and alarm light.

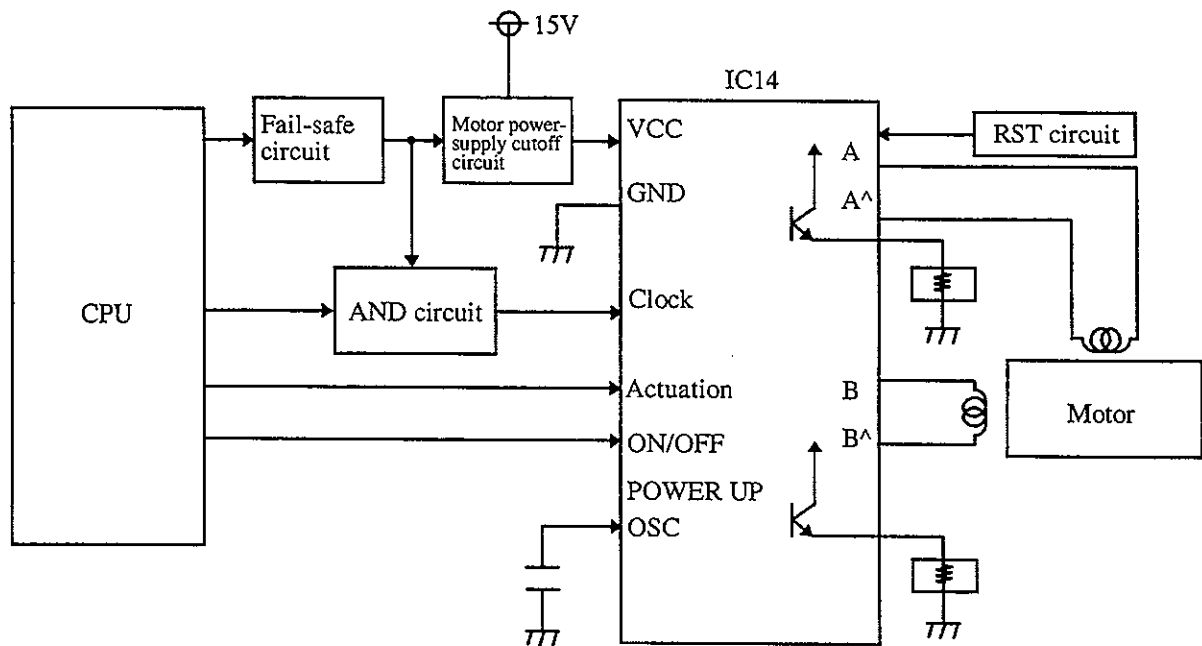


### 5.2.2.6 Motor driving circuit

When a drive signal from the CPU enters the motor driver IC (IC14-7), output signals from IC output pins actuates the respective motor phases one after another to drive the motor.

Also, the motor power control signal from the CPU enters the same IC, so that an "L" level signal, for instance, acts on the motor to decrease its power.

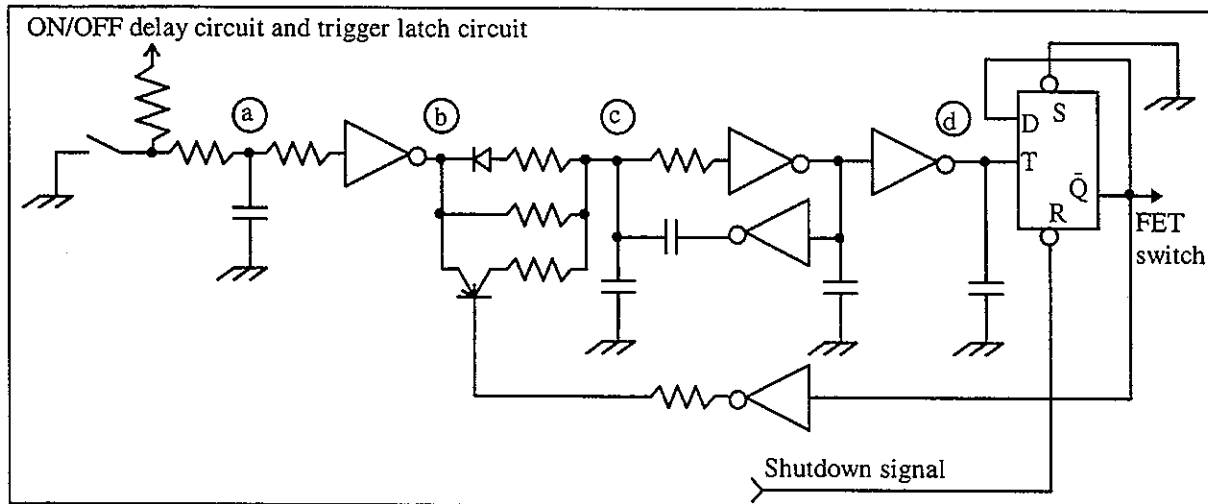
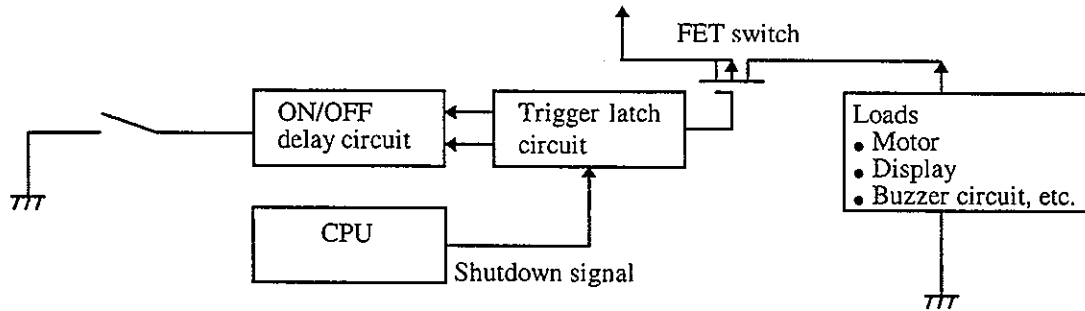
In case of erroneous operation of the CPU, a fail-safe circuit outside the CPU causes braking force to stop the motor.



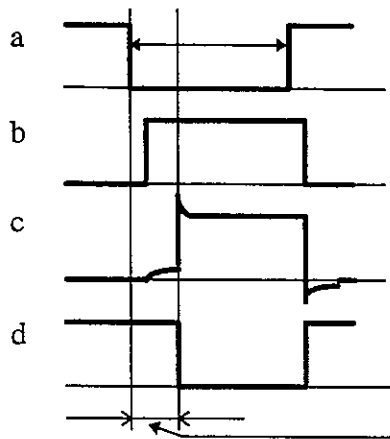
**5.2.2.7 Power switch circuit**

This circuit prevents the power switch from chattering. It is also provided with an ON/OFF delay circuit giving a delay time of approx. 0.5 second when power is turned ON and approx. 2 seconds of delay when turned OFF.

Power supply is cut off also by a low-voltage shutdown signal from the CPU.



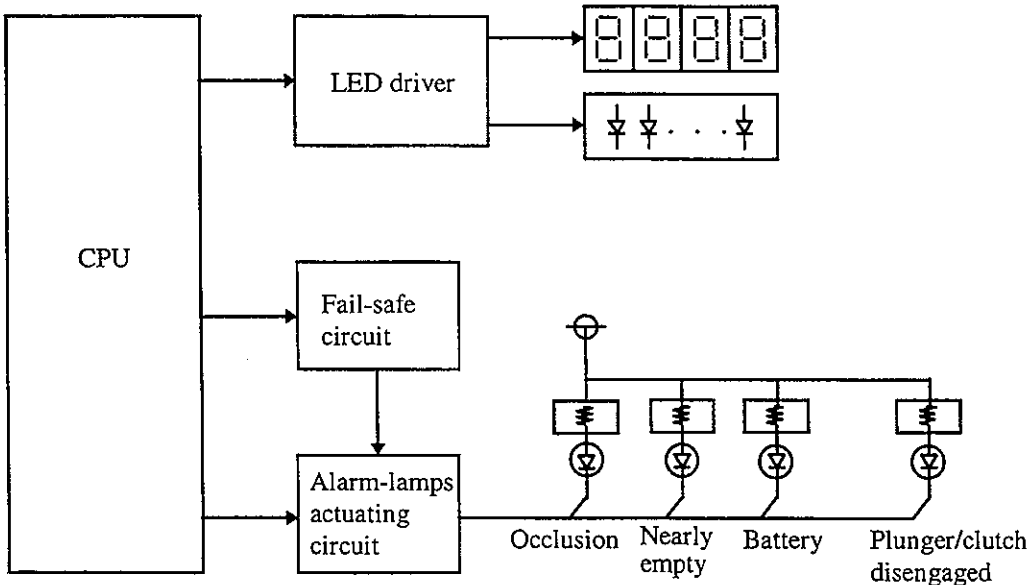
When power switch is pushed



When power ON:  
approx. 0.5 sec.  
When power OFF:  
approx. 2 sec.

**5.2.2.8 LED display circuit**

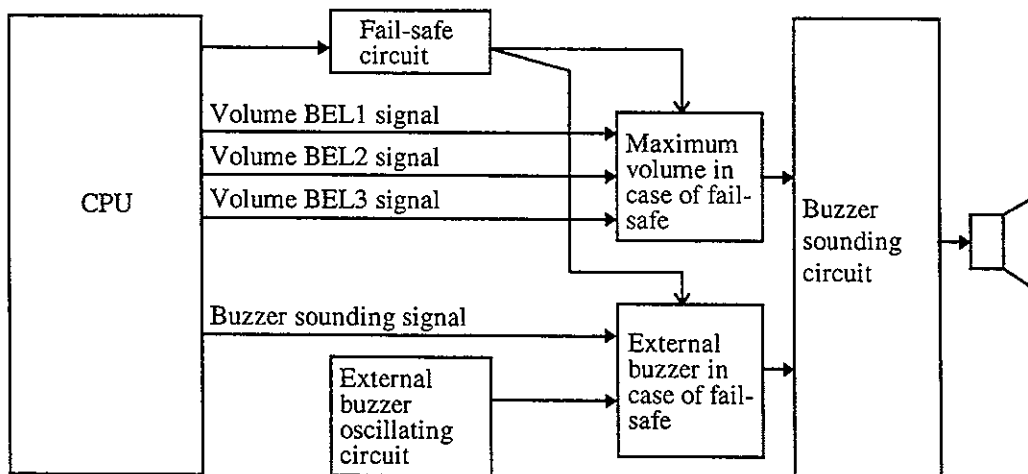
Output data signal from the CPU to the LED driver causes the LED display lamps to light. In case of erroneous operation of the CPU, a fail-safe circuit outside the CPU causes the warning red lamps (occlusion, nearly empty, low battery, and plunger/clutch disengaged) to light.



### 5.2.2.9 Buzzer driving circuit

Buzzer driving signal and volume signal are sent to the buzzer from the CPU.

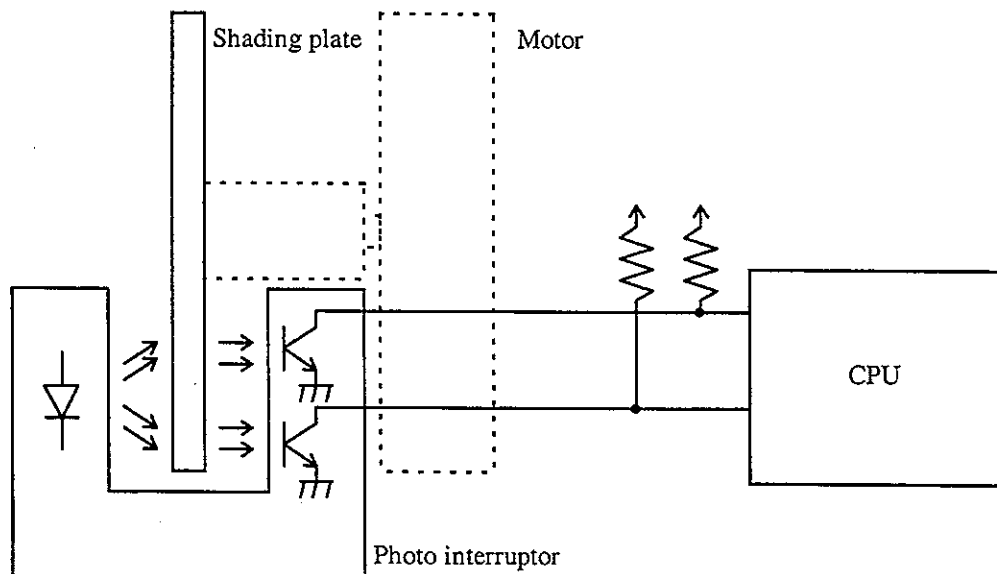
In case of erroneous operation of the CPU, a fail-safe circuit outside the CPU causes the buzzer to sound at the maximum volume, regardless of setting of buzzer volume.





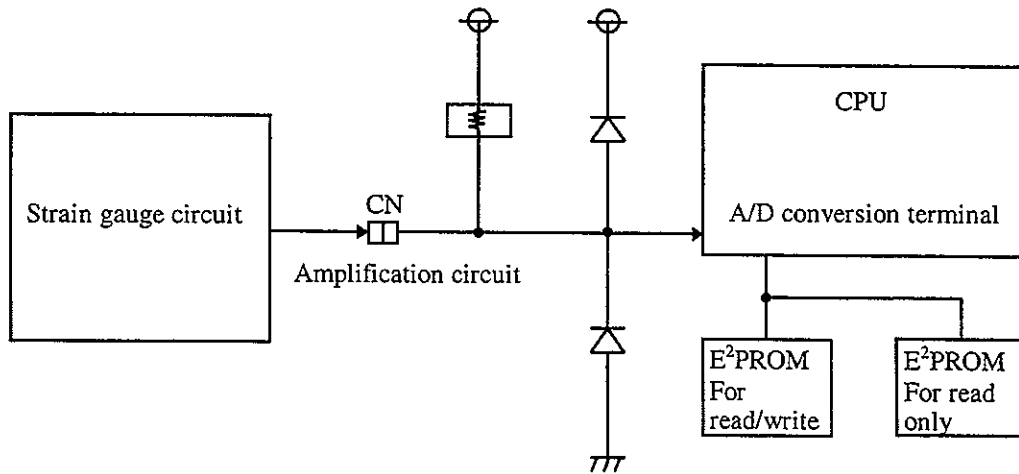
### 5.2.2.10 Motor rotation detection circuit

Rotation of the motor is detected by a shading plate attached to the motor and a photo interrupter on the rotation detecting board.

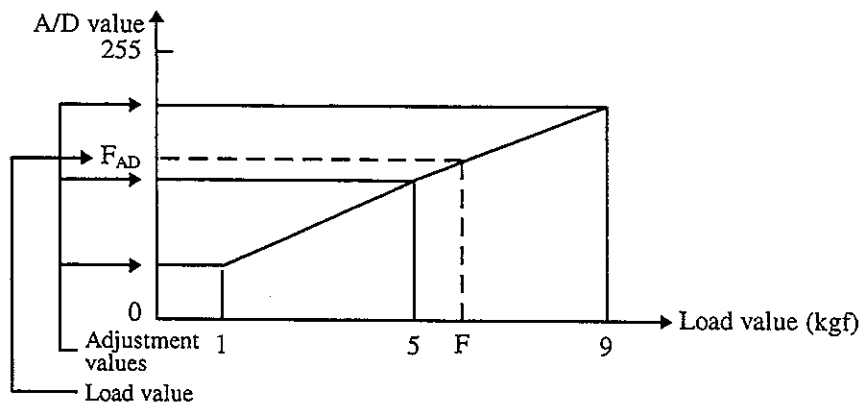


**5.2.2.11 Occlusion detection circuit**

For occlusion detection, an increase in syringe inner pressure is detected as a load imposed on the slider.



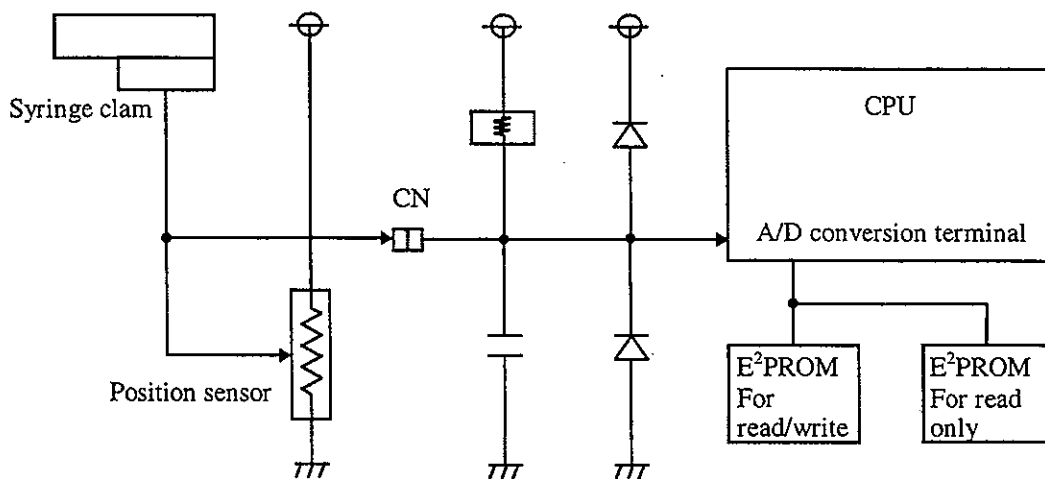
The diagram below shows the state of data found inside the CPU at four different values of load imposed on the slider: Adjustment values (1, 5, 9 kgf) and value F.



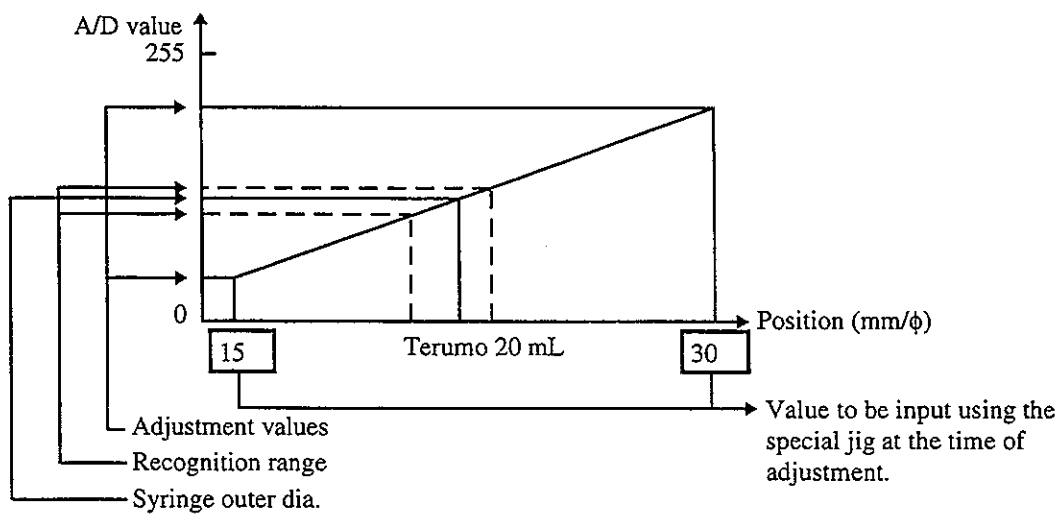
**5.2.2.12 Syringe and nearly empty detection circuit**

Syringe and nearly empty are detected with the voltage divider of a potentiometer and the resulting data (a ratio of voltages proportional to the ratio of resistance) enters the CPU at A/D port.

- \* The nearly empty alarm is made when nearly empty decreases to approx. 0.5 mL for 10 mL syringe and to approx. 1 mL for other syringes.



The diagram below shows the state of data processing at three different values: Adjustment values (15, 30 mm/φ) and Terumo 20 mL syringe recognition range.

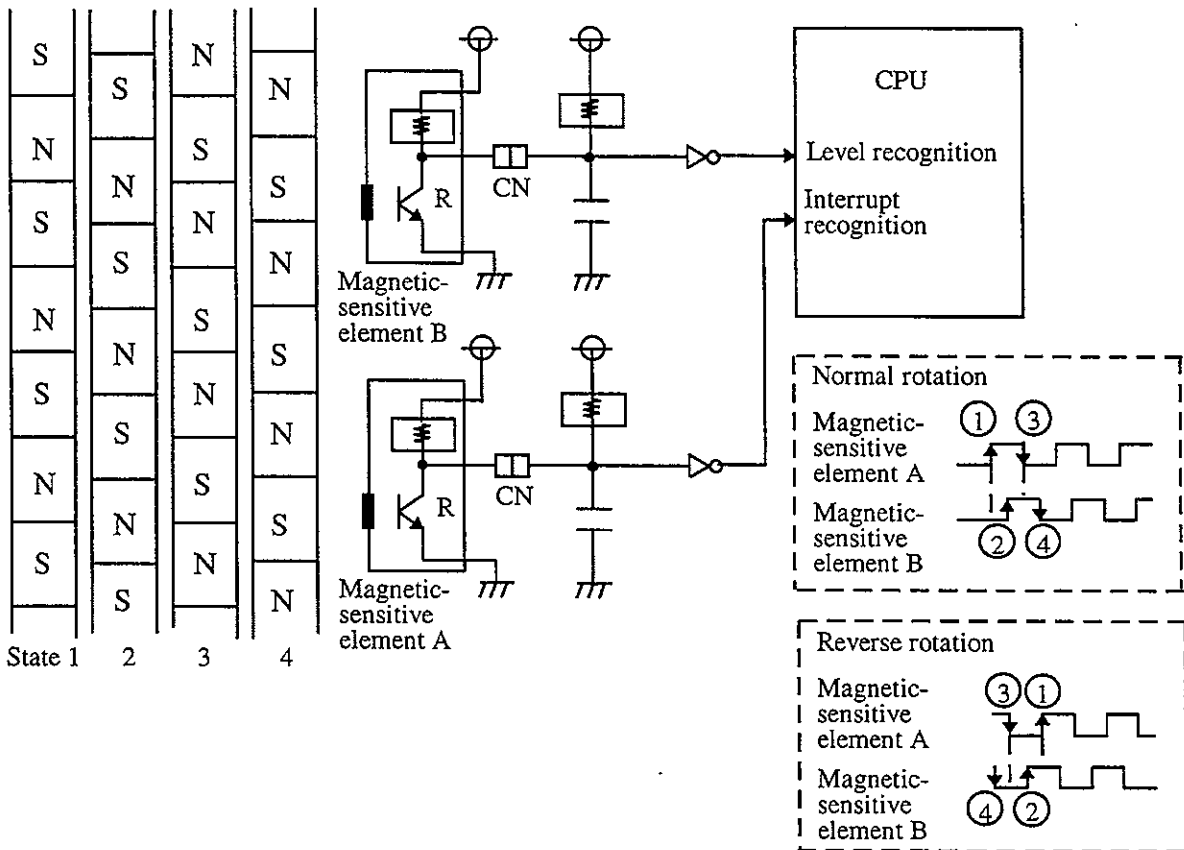


**5.2.2.13 Setting dial and switch circuits**

**(1) Setting dial circuit**

Rotation of the setting dial is detected, and the set value is increased or decreased as necessary, by the magnets inside the setting dial and two magnetic-sensitive elements (phase difference 90°) on the setting-dial board.

To prevent erroneous operation, the set value is kept unvaried in the range of approx. 180° after start of rotation by an insensitive zone.



**(2) Switch circuit**

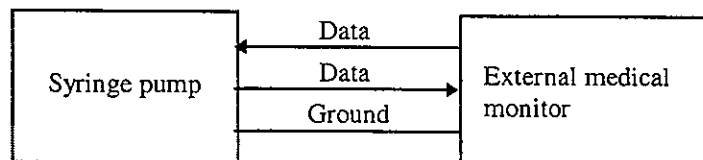
When a switch button is pushed on the main board (SS09-1EA01), switch data output enters the CPU and the switch circuit detects which button is pushed.

Each port of the CPU is usually at "H" level as far as the switch button corresponding to the port is not pushed. Pushing a button causes the relative port to turn to "L" level, allowing the CPU to discriminate the button pushed from others.

### 5.2.2.14 Computer interface and nurse-call circuits

#### (1) Computer interface circuit

- \* For details, refer to the specification for the external computer interface function.
- Using the external computer interface (RS-232C or RS-485), you are able to confirm the syringe size, acting state, various alarming state, preset dose mode, and Body weight mode.
- The pump is connected to an external medical monitor with a line composed of three wires: two data wires and a ground wire. No control signal is exchanged.



- The pump does not transmit data unless it receives an order from the external. (There is no possibility of so called "spontaneous effluence.")
- For reliability and safety of data, data check per bit is made by nibble reverse method." (nibble = 4 bits.)
- Even if two or more pumps are used or if there is mixing with other devices, each pump can be discriminated from others by setting ID numbers (2-digit unit number and 8-digit product number).
- In case where proper connecting cables are not available in the market, it is necessary to have them made to order by the cable maker or the medical monitor maker.

When it is necessary to change the flow rate, etc. externally for purposes of pump inspection and so on, make enable the entry of computer-interface mode setting by referring to section 4.4 "Special function setting mode." For necessary commands, see the table below.

### Communication Protocol

For details, refer to "Computer interface protocol" packed in the unit box.

1) Change the variables of the main unit.

\* No change is allowed after starting.

◆ Command	02H	
◆ Auxiliary commands	00H 01H 02H 03H 04H 05H	Change of flow rate Change of dose rate Change of body weight Change of drug volume Change of solution volume Change of delivery limit
◆ Data	0000H	2 bytes Dose rate: 100 times as large as the specified value Others: 10 times as large as the specified value Transmission should occur from lower to upper bytes

2) Change the status of the main unit.

◆ Command	02H	
◆ Auxiliary commands	20H	Status is changed
◆ Data	00H	1 byte 01H: START, 05H: STOP/SILENCE

If the request is accepted in either case of (1) and (2), the response "0" will be returned, and if not accepted, the response "1" will be returned.

C (2) Nurse-call circuit

In case of alarm, the contact point of the relay inside the pump will close for about 5 seconds to generate a nurse-call.

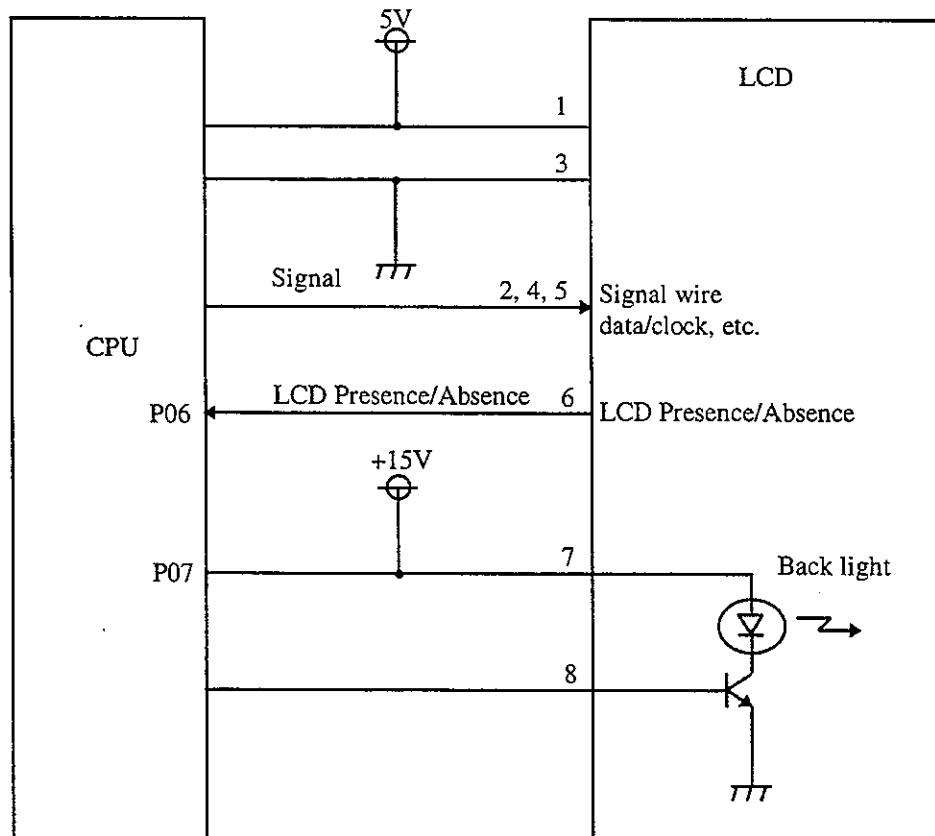
Note: Use a capacity not exceeding 1A (12VDC).

### 5.2.2.15 Liquid crystal display (LCD) circuit

Presence or absence of LCD is detected at CPU port: P06.

When the connector is coupled, since this terminal is connected to the ground inside the LCD module, the level is turned to "L" and the LCD (presence) is detected.

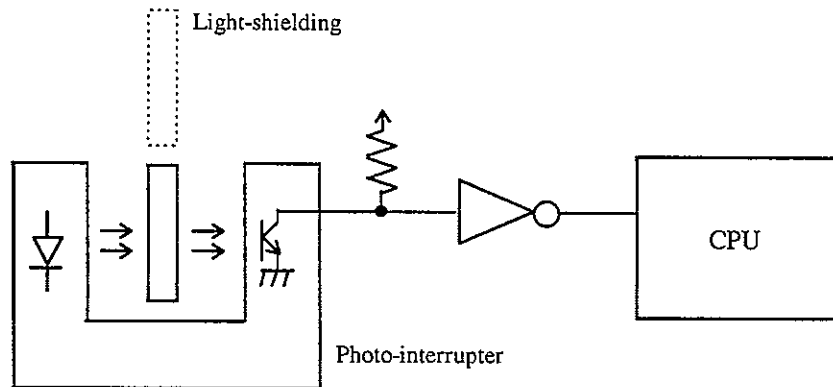
At port: P07, ON/OFF signal is output to the back light of LCD.





### 5.2.2.16 Plunger/clutch disengagement detection circuit

A light-shielding plate next to the feed nut, which is actuated by clutch operation, and photo interrupter on plunger / clutch disengagement board, detects the plunger / clutch disengagement.



5.3 Mechanism systems5.3.1 Structure

Name	Components	Typical function
Driving unit	Driving system unit ( <del>06LA543*</del> ) <Other parts included> <ul style="list-style-type: none"> <li>• Driver (<del>06LA514*</del>)</li> <li>• Motor unit (<del>05LA15*</del>)</li> <li>• Rotation detection board (<del>05LA16*</del>)</li> <li>• Occlusion detection unit (<del>05LA17*</del>)</li> <li>• Nearly empty detection unit (<del>05LA18*</del>)</li> <li>• Plunger/clutch disengagement detection unit (<del>05LA49*</del>)</li> </ul>	<ul style="list-style-type: none"> <li>• Power transmission</li> <li>• Motor</li> <li>• Motor rotation detection</li> <li>• Occlusion pressure detection</li> <li>• Nearly empty position detection</li> </ul>
Slider/ Clutch	Slider unit ( <del>06LA510*</del> ) Slider cover ( <del>06LA511*</del> )	<ul style="list-style-type: none"> <li>• Syringe plunger Holding/Pushing</li> <li>• Feed screw &amp; feed nut Connection/Release</li> </ul>
Clamp	Clamp unit ( <del>06LA503*</del> )	<ul style="list-style-type: none"> <li>• Syringe holding</li> </ul>
Syringe detector	Syringe detection unit ( <del>05LA05*</del> )	<ul style="list-style-type: none"> <li>• Syringe size detection</li> </ul>

## 5.3.2 Description of operation

### 5.3.2.1 Driving system unit

The driving unit is composed of the motor unit, gearing, feed screw, feed nut, pipe shaft, rotation detection board, occlusion detection unit, and nearly empty detection unit.

#### (1) Driver and motor unit

Rotation of the motor causes the motor-attached gearing and feed screw to turn. The feed nut in mesh with the feed screw causes linear movement of the slider.

#### (2) Rotation detection board

Rotation of the motor is detected by the combination of a shading plate attached to the motor and a photo interrupter for rotation detection.

Since the shading plate is perforated, light beam to the photo interrupter passes the shading plate intermittently with turning of the shading plate as far as the motor is in normal rotation.

In case where an error occurs in rotation of the motor, however, light beam fails to pass the shading plate at regular intervals, making an alarm and causing a the pump to stop.

#### (3) Occlusion detection unit

If the Infusion line is occluded, a pressure will be transmitted to the feed screw which delivers that pressure as a load to the strain gauge attached to the screw end.

The strain gauge usually keeps an equilibrium. Once a occlusion state occurs, however, the equilibrium is lost and the occlusion is detected.

#### (4) Nearly empty detection unit

A projection locating close to the feed nut moves the linear position sensor of the nearly empty detection unit to detect the nearly empty in the syringe.

(5) Plunger/clutch disengagement detection unit

A light-shielding plate next to the feed nut, which is actuated by the photo-interrupter for plunger/clutch disengagement detection, detects the plunger/clutch disengaged.

**5.3.2.2 Slider and clutch**

- Slider

With the plunger set in the syringe pump, solution is infused by operating the plunger.

- Clutch

With the clutch held, the feed screw and nut can be disengaged from each other to move the slider freely. Releasing the clutch causes the feed screw to mesh with the nut.

**5.3.2.3 Clamp**

The clamp holds the syringe plunger set in the syringe pump.

**5.3.2.4 Syringe size detector**

The detector in the clamp, moves the linear position sensor of the syringe detecting unit to detect the syringe size.

Applicable lots:  
9612 lot-

Prepared in Jun.,2001

**6.2 Service parts List**

A list of service parts comprising TE-311/312 is shown below. This list and the development elevation in paragraph 6.1 will be useful for performing the maintenance work.

- \* The numbers in the list correspond to those in 6.1.
- Parts for TE-311 (including a part of TE-312)

No.	Name	Service parts revision history		Q'ty(@)	Remarks
		Revision	Order No.		
1	Upper case unit TE-311	3	06LA501□	1	□=A: TE*311N B: TE*311C MDD(2800324) MDD(2800178)
			06LA501□		
2	Panel sheet TE-311	-	06LA502	1	
3	Clamp unit	-	06LA503	1	
4	Dial unit	-	05LA04	1	
5	Syringe detection unit	-	05LA051	1	
6	Main board (TE-311*/312*)	3	06LA5062		(B No.2579)
			06LA5064		MDD(2800324) MDD (B No.2579-A No.2655)
8	Indicator unit	-	05LA08	1	
9	Setting dial board	-	05LA09	1	
10	Slider unit	-	06LA510	1	
11	Slider cover	-	06LA511	1	
12	Boot	1	05LA121	1	(A No.2507)
13	Boot holder plate	-	05LA13	1	
14	Driver	-	06LA514	1	
15	Motor unit	-	05LA15	1	
16	Rotation detection board	-	05LA16	1	
17	Occlusion detection unit	-	05LA17	1	

@:Q'ty in one unit(pouch).  
NOTE: Segment (E) in the Applicable lot are applicable to TE\*311NH\*,TE\*311CH\*,TE\*312CH\*, and segment (A) are applicable to the others.  
NOTE: (\*) is included in the concerned spare parts.

Applicable lots:  
9612 lot-

Prepared in Jun.,2001

No.	Name	Service parts revision history		Applicable lot	Other parts included	Q'ty(@)	Remarks
		Revision	Order No.				
18	Nearly empty detection unit	-	05LA181	9612		1	
19	Lower-case unit, type C (TE*311C) (TE*312C)	1	06LA5191□	9612-	Rubber foot.(05LT17) Battery caution label	1	□=A: TE*311CH. B: TE*312CB. D: TE*312CD. G: TE*312CG. H: TE*312CH. I: TE*312CL. AE: TE*311CH*. HE: TE*312CH*.
20	Lower-case unit, type N (TE*311N)	1	06LA5201□	9612-	Rubber foot.(05LT17) Battery caution label	1	□=B: TE*311NB. D: TE*311ND. G: TE*311NG. H: TE*311NH. I: TE*311NI. HE: TE*311NH*.
21	Battery	2	06LA521 (for Asia)	9612-	600mAh	1	
			06LA521R (for Europe)	9702-			
			06LA550 (for Asia)	9612-	1100mAh	1	NOTE)Allowed to use for only the pump which corresponds with the specification for three hours battery. (No.2800291)
22	Battery cover	-	05LA22	9612-		1	
23	Battery case O-ring	-	05LA23	9612-		1	

@:Q'ty in one unit(pouch).  
NOTE: Segment (E) in the Applicable lot are applicable to TE\*311NH\*TE\*311CH\*TE\*312CH\* and segment (A) are applicable to the others.  
NOTE: (\*) is included in the concerned spare parts.

Applicable lots:  
9612 lot-

Prepared in Jun.,2001

No.	Name	Service parts revision history		Other parts included	Q'ty(@)	Remarks
		Revision	Order No.			
24	DC jack unit	3	05LA241	9612-0103(A) 9702-9712(E) 0104- (A) 9801- (E)	1	MDD(2800324) MDD(2800178)
		-	06LA524E			
		-	06LA525□	Fuse: Glass tube. (05LA26) Fuse: Actual board package (05LA35) Buzzer unit: (05LA50)		
		-	05LA26	9612- 10 Pieces		
26	Fuse	-	05LA26	9612-	1	
		-	05LA271	9612-		
27	Nurse-call board and RS232C board	-	05LA28	9612-	1	
		-	05LA29	9612-		
28	Case seal rubber	-	05LA28	9612-	1	100 Pieces
		-	05LA29	9612-		
29	Packing for screw	-	05LA28	9612-0103(A) 9702-9712(E)	1	
		-	05LA30			
30	Packing for AC inlet	3	05LA30	9612-0103(A) 9702-9712(E) 0104- (A) 9801- (E)	1	MDD(2800324) MDD(2800178)
		-	06LA530E			
		-	05LA31	9612-		
		-	06LA532□	9612-		
31	Pole clamp with tray	-	05LA31	9612-	1	□=A: American type B: U.K. type C: European type
32	Power cord	-	06LA532□	9612-	1	
33	AC inlet	3	05LA331	9612-0103(A) 9702-9712(E) 0104- (A) 9801- (E)	1	MDD(2800324) (B No.2630)
		-	06LA533IE			
		-	06LA534I	9612- 10 Pieces		
		-	05LA35	9612- 10 Pieces		
34	W/H unit	1	06LA534I	9612-	1	MDD(2800178)
35	Fuse (for board solder)	-	05LA35	9612-	1	

@:Q'ty in one unit(pouch).  
 NOTE: Segment (E) in the Applicable lot are applicable to TE\*311NH\*TE\*311CH\*TE\*312CH\* and segment (A) are applicable to the others.  
 NOTE: (\*) is included in the concerned spare parts.

Applicable lots:  
9612 lot-

Prepared in Jun.,2001

No.	Name	Service parts revision history		Applicable lot	Other parts included	Q'ty(@)	Remarks
		Revision	Order No.				
36	E <sup>2</sup> PROM	3	06LA536	9612-0103(A)	E <sup>2</sup> PROM(Ver3.1) ----- E <sup>2</sup> PROM(Ver3.2)	1	MDD(2800324) MDD(2800178) 10 Pieces •TE*311NB,•TE*311ND •TE*311NG,•TE*311NH •TE*311NI,•TE*311CH •TE*312CB,•TE*312CD •TE*312CG,•TE*312CH •TE*312CI •TE*311NH*, •TE*311CH*, •TE*312CH*
			06LA5361	9702-9712(E) 0104- (A) 9801- (E)			
			06LA538	9612-			
			06LA539A (Label for Asia)	9612-			
38	Syringe size label		06LA539E (Label for Europe)	9702-			
39	Cord No. label		05LA40	9612-		1	10 Pieces
40	Upper case setting dial sheet.		06LA549	9612-		1	
41	Plunger/clutch disengagement detection unit		05LA50	9612-		1	
42	Buzzer unit		06LA543	9612-		1	
	Driving system unit				Driver. (06LA514) Motor unit. (05LA15) Rotation detection board. (05LA16) Occlusion detection unit. (05LA17) Nearly empty detection unit. (05LA181) Plunger/clutch disengagement detection unit. (05LA549)	1	
-	MEMO.		05LA44	9612-		1	
-	Nurse call cable		06LA548	9612-		1	
-	DC cable		05LN51	9612-		1	
-	Slider hook unit		05LA51	9612-		1	4 Pieces

@:Q'ty in one unit(pouch).  
NOTE: Segment (E) in the Applicable lot are applicable to TE\*311NH\*,TE\*311CH\*,TE\*312CH\* and segment (A) are applicable to the others.  
NOTE: (\*) is included in the concerned spare parts.



Applicable lots:  
9612 lot-

Prepared in Jun.,2001

• Parts exclusive for TE-312 use

No.	Name	Service parts revision history		Applicable lot	Other parts included	Q'ty(@)	Remarks
		Revision	Order No.				
1	Upper case unit. TE-312	3	06LB501	9612-0103(A) 9702-9712(E)	Panel sheet. (05LB502) Syringe size label. (05LA538) Upper-case setting dial sheet. (05LA40)	1	MDD(2800324) MDD(2800178)
			06LB501	0104- (A) 9801- (E)			
			06LB502	9612-			
2	Panel sheet. TE-312	-	06LB503	9612-		1	
3B	LCD. TE-312	-	06LB503	9612-		1	

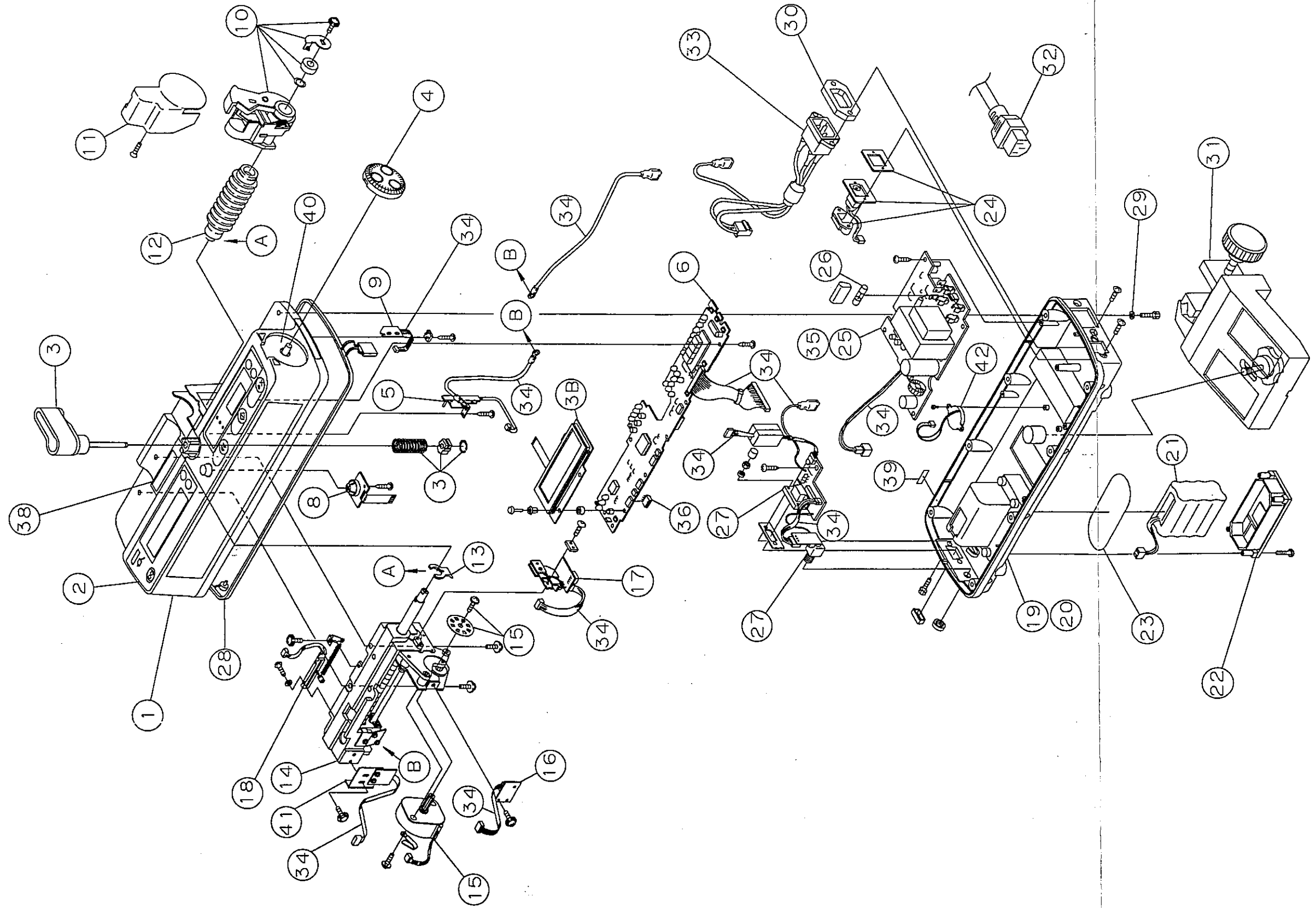
• Special jigs

No.	Name	Service parts revision history		Applicable lot	Other parts included	Q'ty(@)	Remarks
		Revision	Order No.				
-	Syringe detection checking jig	-	05LA41	9612-		1	
-	Syringe and Nearly empty detection adjustment jig	-	05LA42	9612-		1	
-	Occlusion adjustment jig	2	05LA461	9612-		1	(B No.2683)
-	Plunger/clutch disengagement detection adjusting jig	-	05LA47	9612-		1	

@:Q'ty in one unit(pouch).  
NOTE: Segment (E) in the Applicable lot are applicable to TE\*311NH\*TE\*311CH\*TE\*312CH\* and segment (A) are applicable to the others.  
NOTE: (\*) is included in the concerned spare parts.

6.2 Development elevation

SS09-9B002  
Applicable lots:  
9612 lots-  
Prepared in Dec., 1996



**7. DISASSEMBLY, REASSEMBLY, AND ADJUSTMENT**

[List of checks and adjustments accompanying disassembly, assembly and replacement]

- \* Whenever disassembly, assembly, or replacement is made, perform checks and adjustments shown in the table below. Also, be sure to perform periodic inspection after working. (See Para. 9. Maintenance and Cleaning.)

Check & adjust		Syringe detection See Para. 7.3.1 & 7.3.4.	Nearly empty detection See Para. 7.3.1 & 7.3.4.	Occlusion detection See Para. 7.3.3 & 7.3.4.	Others:
Working					
Dial unit	Remove Replace				
Battery	Remove Replace				↓
Upper/lower case unit	Remove Replace (upper) Replace (lower)	Adjust	Adjust	Adjust	
Power-supply board	Remove Replace				Aging
AC inlet	Remove Replace				
DC jack unit	Remove Replace				
Fuse	Remove Replace				Aging
Nurse-call board/ RS232C board	Remove Replace				Aging
Main board	Remove Replace	Check Adjust	Check Adjust	Check Adjust	Aging
Indicator unit	Remove Replace				

Check & adjust		Syringe detection See Para. 7.3.1 & 7.3.4.	Nearly empty detection See Para. 7.3.1 & 7.3.4.	Occlusion detection See Para. 7.3.3 & 7.3.4.	Others:
Working					
LCD	Remove Replace				Aging
Slider unit	Remove Replace		Check Check	Check Check	
Boot	Remove Replace				
Drive unit	Remove Replace		Adjust Adjust	Check Adjust	Aging
Rotation detection board	Remove Replace				Aging
Nearly empty detection unit	Remove Replace		Adjust Adjust		Aging
Motor unit	Remove Replace				Aging
Occlusion detecting unit	Remove Replace			Adjust Adjust	Aging
Plunger/clutch disengagement detection unit	Remove Replace				Aging
Syringe detection unit	Remove Replace	Adjust Adjust			Aging
Clamp unit	Remove Replace	Adjust Adjust			
Setting dial board	Remove Replace				Aging

## 7.1 Disassembly Procedure

The procedure for disassembling the TE-311/312 is described below. When performing disassembly, follow the sequence flow chart.

When handling the parts of appearance-important, such as the upper and lower cases, lay them on soft material such as rags and perform disassembly work carefully not to deteriorate the quality of surface by scratching, etc.

[Disassembling flow chart]

### Pump body

— Take off dial unit	7.1.1
— Dismount the battery	7.1.2
— Detaching the upper and lower case units	7.1.3
(Disassembling the lower case unit)	7.1.4
— Removing the power-supply board	7.1.4.1
— Removing the AC inlet	7.1.4.2
— Removing the DC jack unit	7.1.4.3
— Removing the fuse	7.1.4.4
— Removing the buzzer	7.1.4.5
— Removing the nurse-call board and RS232C board	7.1.4.6
(Disassembling the upper case unit)	7.1.5
— Removing the main board	7.1.5.1
— Removing the indicator unit	7.1.5.2
— Removing the LCD	7.1.5.3
— Removing the boot and slider unit	7.1.5.4
— Removing the drive unit	7.1.5.5
— Removing the rotation detection board	7.1.5.6
— Removing the nearly empty detection unit	7.1.5.7
— Removing the motor unit	7.1.5.8
— Removing the occlusion detection unit	7.1.5.9
— Removing the plunger/clutch disengagement detection unit	7.1.5.10
— Removing the syringe detection unit	7.1.5.11
— Removing the clamp unit	7.1.5.12
— Removing the setting dial board	7.1.5.13

For identification and location of parts, refer to Section 6. Service Parts List and Development Elevation. In the elevation, the number succeeding part name represents service part code.

### 7.1.1 Taking off the dial unit

The dial unit (1) is attached to the pump body with magnet. To take it off, position the dial unit with its groove up, put the thumb at the groove and pull the dial with fingers, shaking it right and left.



Fig. 7.1.1(1)

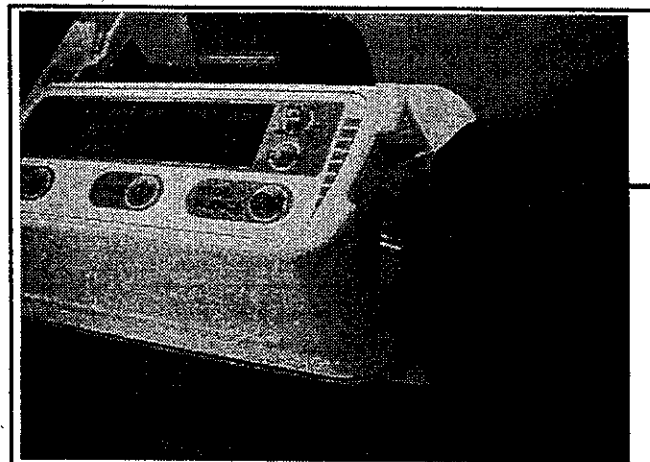


Fig. 7.1.1(2)

Dial unit  
(05LA04\*)

**7.1.2 Dismounting the battery**

- (1) Withdraw 4 screws (pan-head, M3×16) fastening the battery cover to the bottom of pump body, and remove the battery cover.

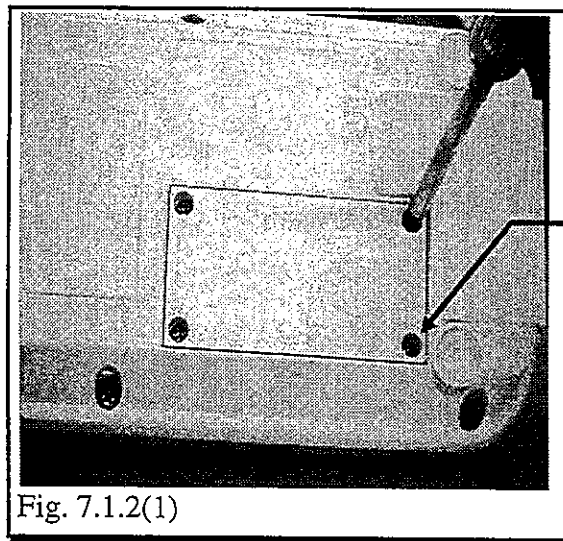


Fig. 7.1.2(1)

- (2) Dismount the battery and disconnect the battery connector.  
If the battery-case O-ring has been deteriorated, remove also the O-ring from the groove.

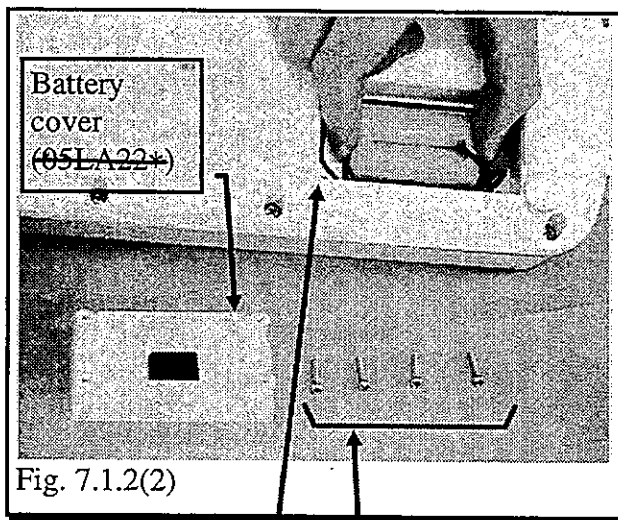


Fig. 7.1.2(2)

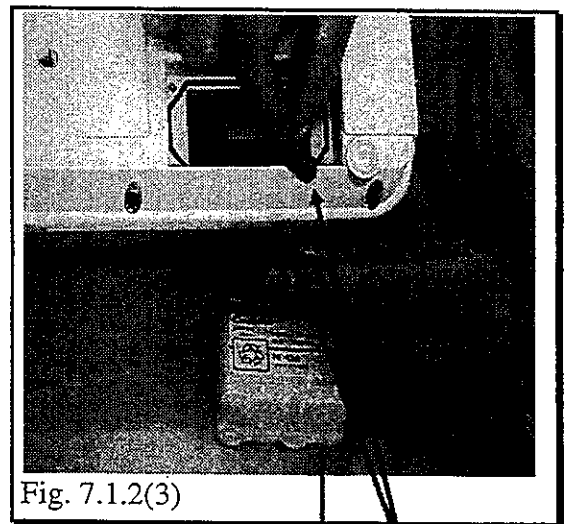


Fig. 7.1.2(3)

Battery-case  
O-ring  
(05LA23\*)

Pan-head  
4-M3×16

Battery  
~~06LA521\*~~ (for Asia)  
~~06LA521R\*~~ (for Europe)

Battery  
connector

**7.1.3 Detaching the upper and lower case units**

- (1) Withdraw 8 screws (pan-head, M4×10) together with packings.

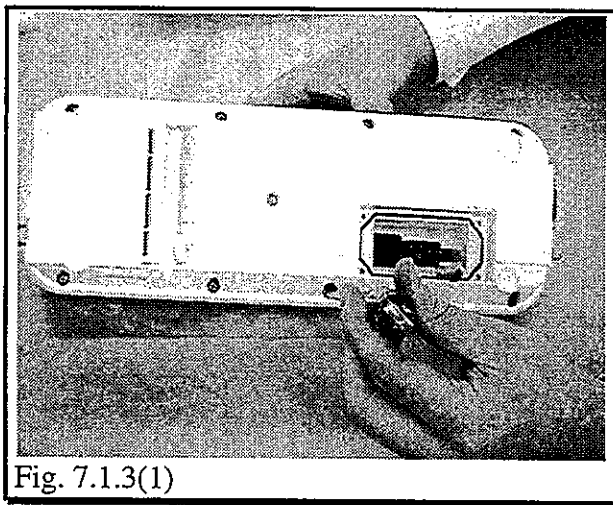
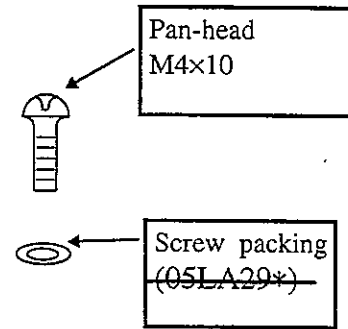


Fig. 7.1.3(1)



- (2) Detaching the upper and lower case units together by pulling the lower case unit so that it makes an arc of swing.

\* During removal, take care not to apply excessive tension to the cables inside the pump body.

Lower-case unit,  
TE\*311N(06LA520E\*)  
or  
TE\*311C(06LA519A\*)  
TE\*312C(06LA519E\*)

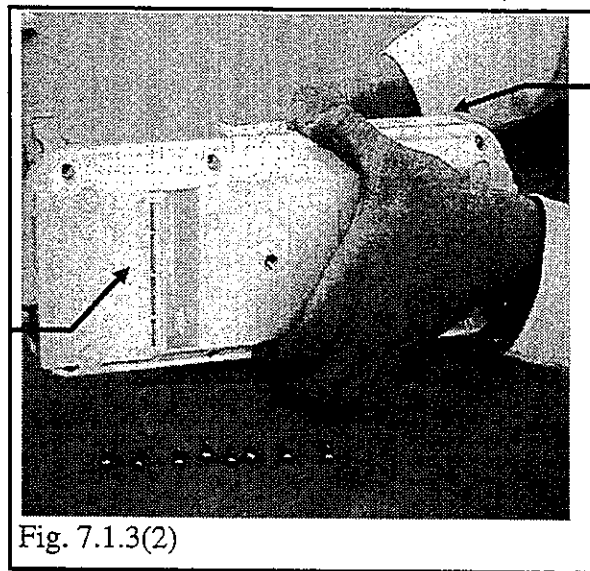


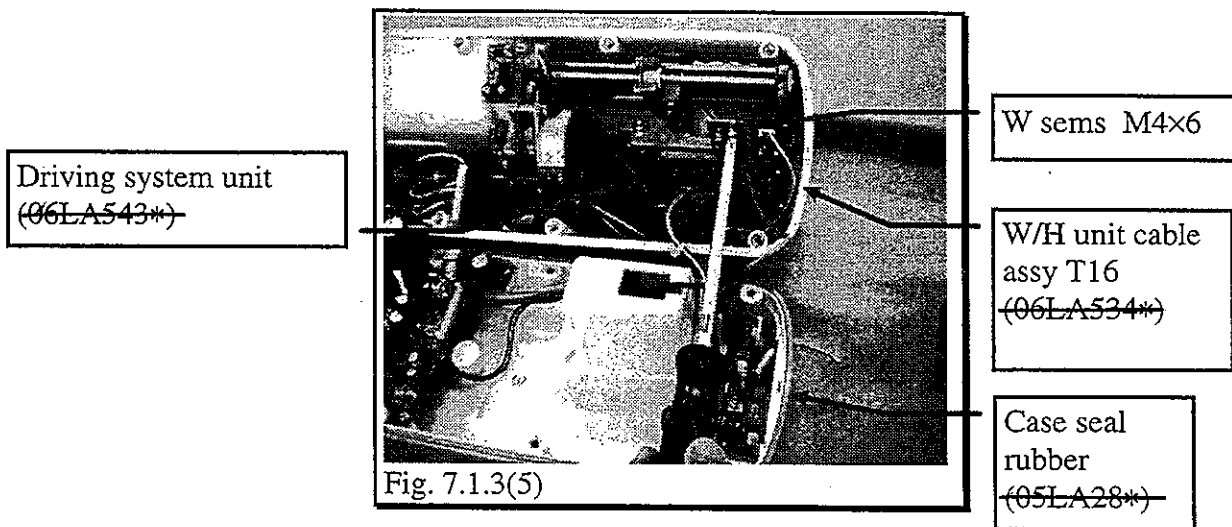
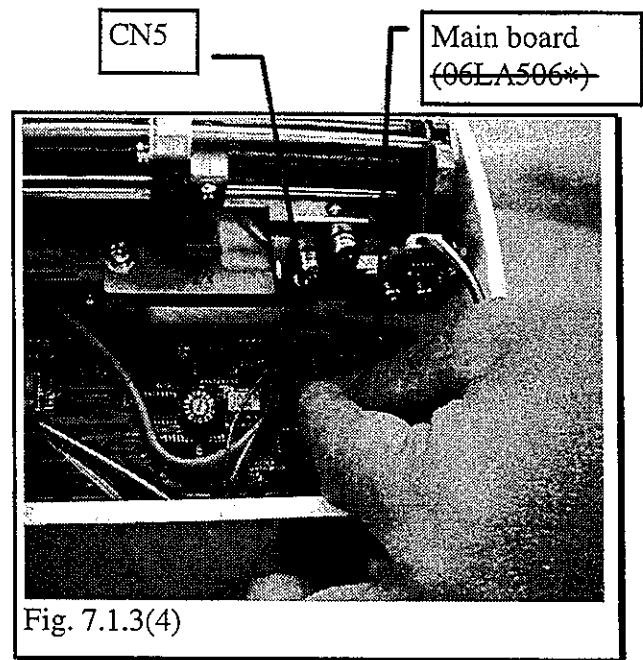
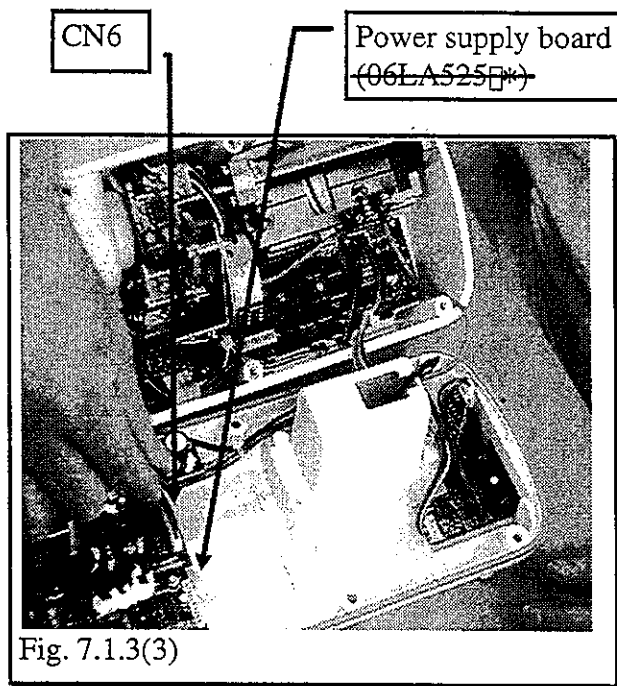
Fig. 7.1.3(2)

Upper-case unit, exclusive  
for  
TE\*311N(06LA501A\*)  
TE\*311C(06LA501B\*)  
or  
TE\*312C(06LB501\*)



- (3) Remove the ground-wire attaching screws (W sems M4×6) from CN6 on the power supply board and CN5 on the main board, and from the driving unit. Separate the upper-case and lower-case units from each other and remove the case-seal rubber.

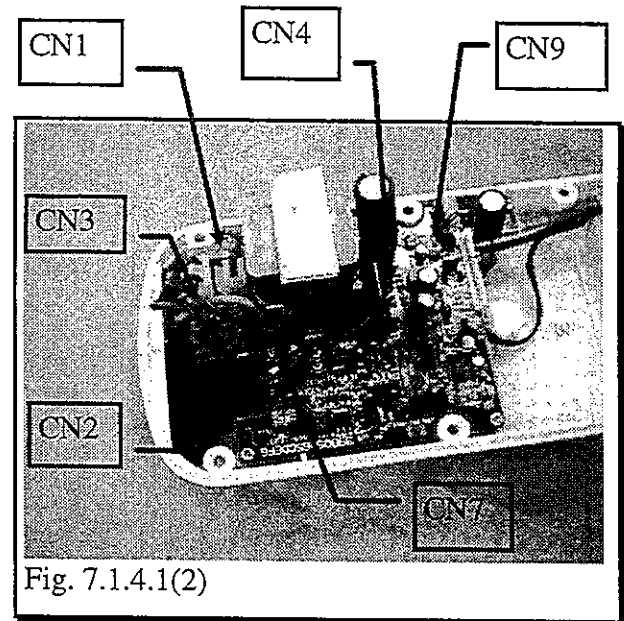
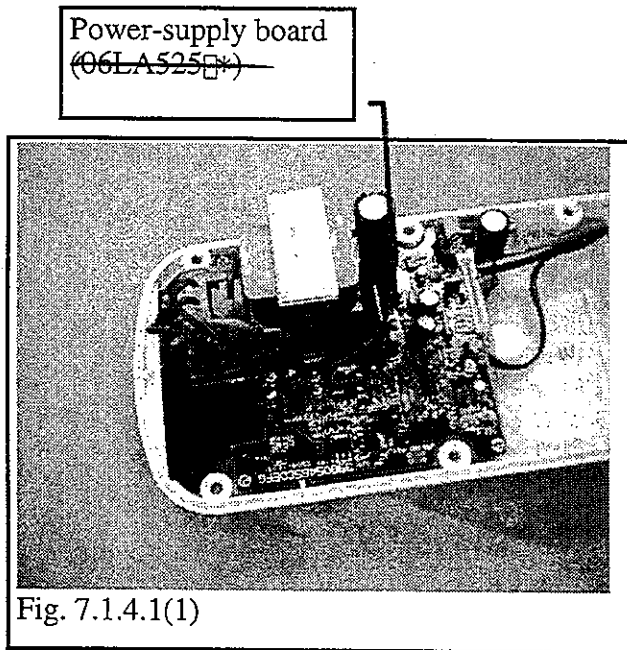
**Note: An occlusion detection unit is in the opening of the upper-case unit. Absolutely avoid to place the upper-case unit with its opening side down.**



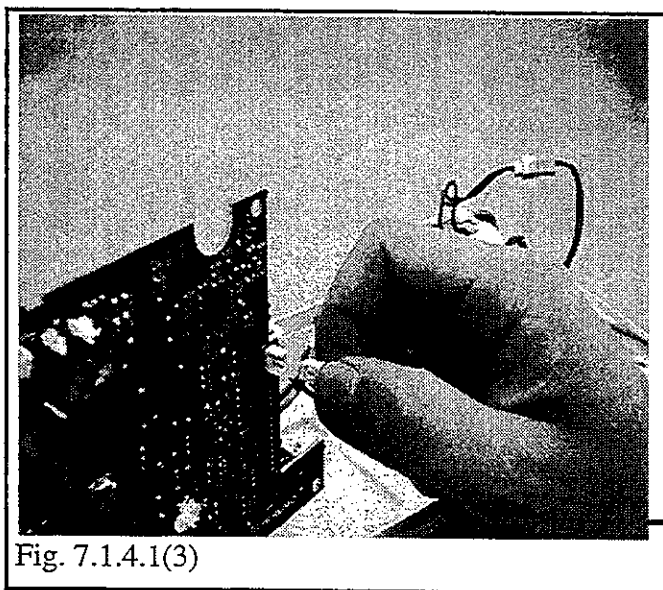
**7.1.4 Disassembling the lower case unit**

**7.1.4.1 Removing the power-supply board**

- (1) Disconnect the connectors CN1, CN2, CN3, CN4 and CN7 CN9 from the power-supply board.



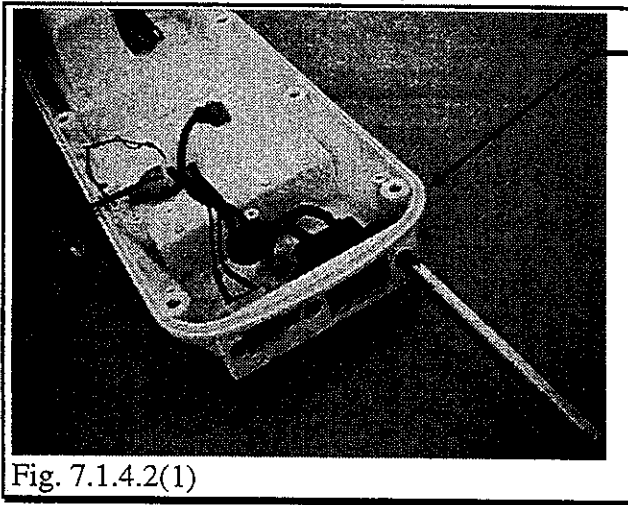
- (2) Remove 6 screws (tapping screw, M3×10) fastening the power-supply board, cut the tie, and disconnect the connector CN5. Detach the power-supply board from the lower case.



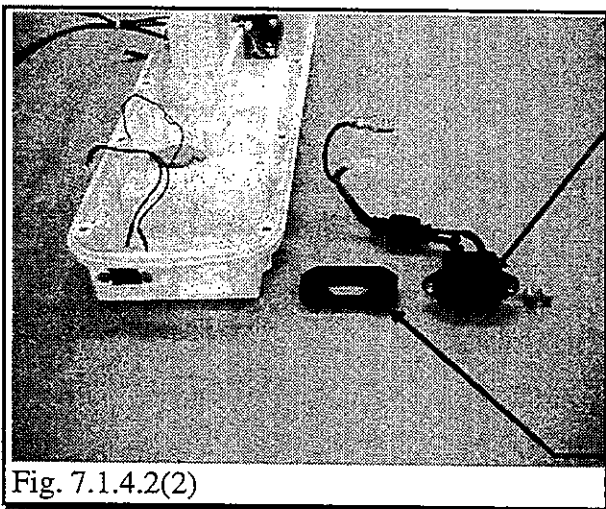
Note: Capacitor C3 on the power-supply board may be left charged with electricity; discharge C3 for 2 to 5 seconds by short-circuiting it through a resistor of approx. 2 kΩ put across C3. Using a circuit tester, check for completion of discharge.

7.1.4.2 Removing the AC inlet

- (1) Remove 2 screws (Bind screw, M3×10) fastening the AC inlet and push the AC inlet into the case inside. Separate the AC inlet from its packing.



Bind 2-M3x10

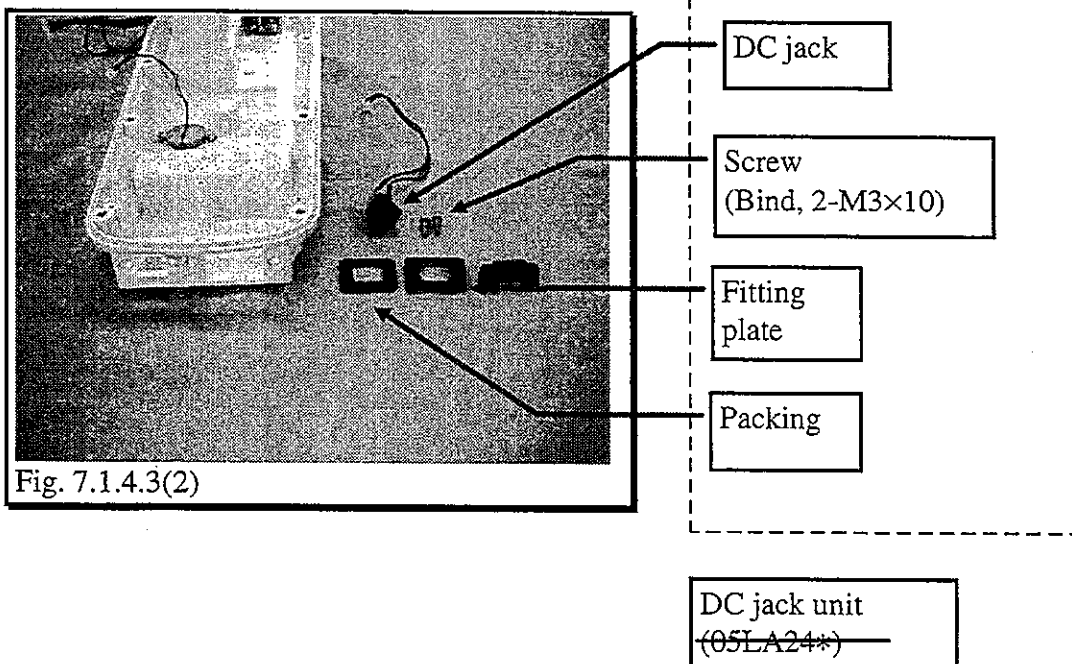
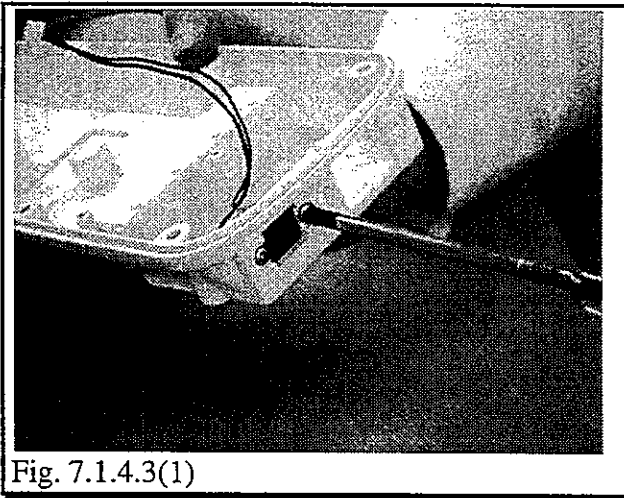


AC inlet  
(05LA33\*)

Packing for AC  
inlet  
(05LA30\*)

### 7.1.4.3 Removing the DC jack unit

- (1) Remove 2 screws (Bind screw, M3×10) fastening the DC jack unit and push the unit upward. Separate the DC jack unit from its packing.



7.1.4.4 Removing the fuse

- (1) Take off the fuse cover and remove the fuses (FS1, FS2).

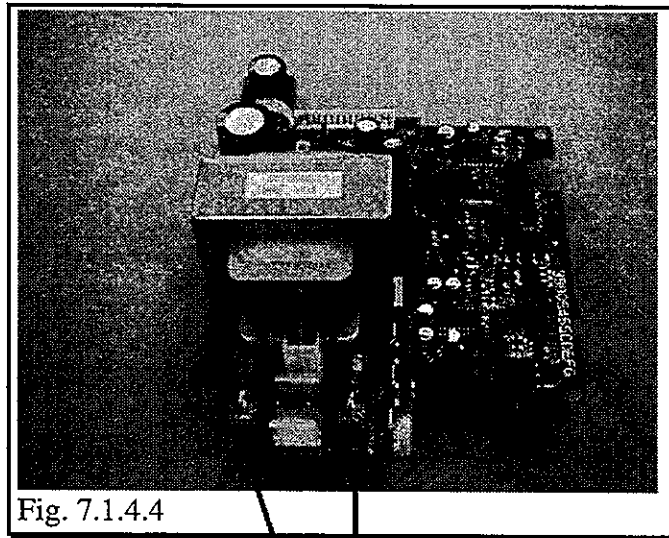


Fig. 7.1.4.4

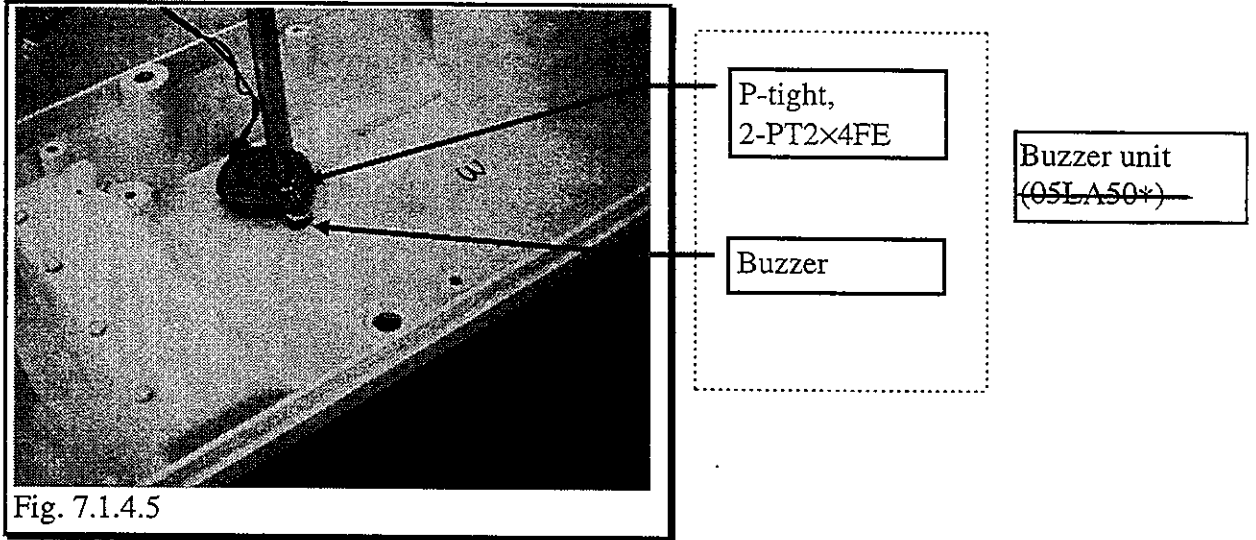
FS1

FS2

Fuse (315 mA)  
(05LA26\*)

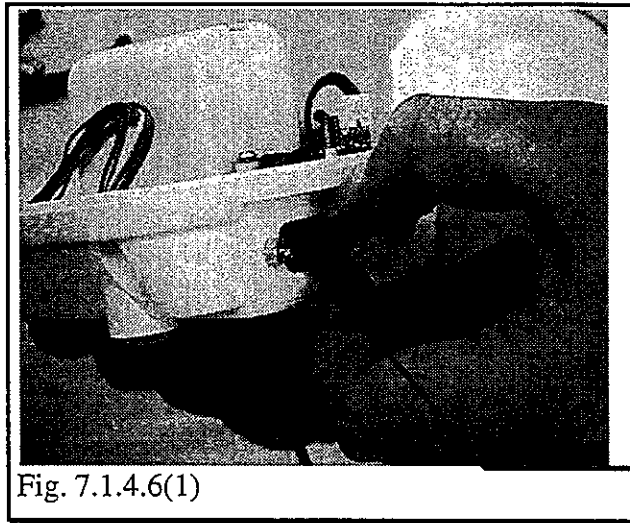
**7.1.4.5 Removing the buzzer**

- (1) Remove mounting screws (P-tight, 2-PT2×4FE) and detach the buzzer unit from the lower case.



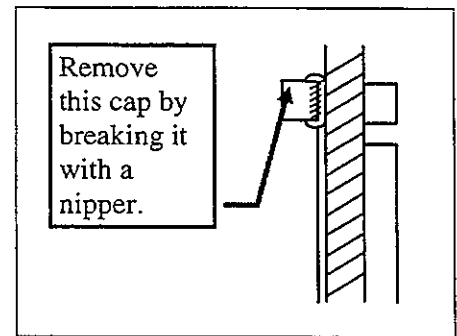
**7.1.4.6 Removing the nurse-call board and RS232C board**

- (1) Take off the computer interface connector dust cover.



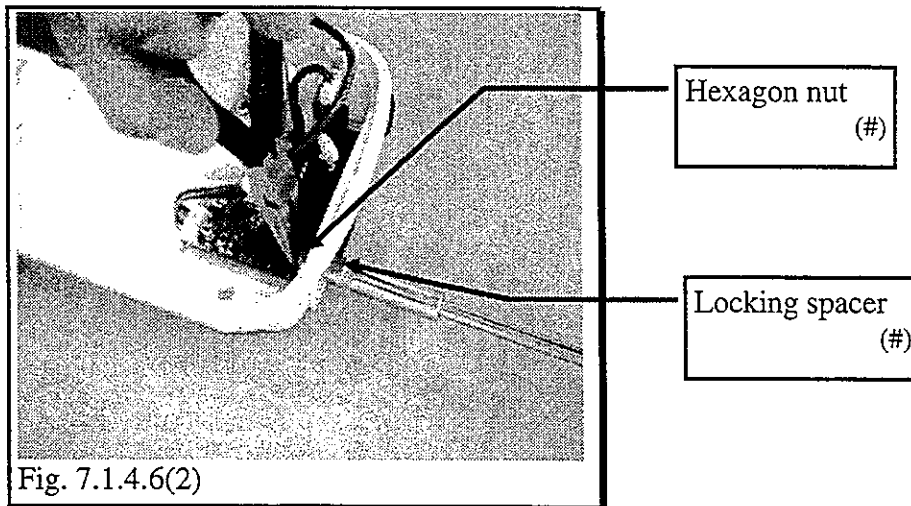
- (2) Remove the cap covering the nut.

\* The cap bonded to the nut with silicone adhesive needs breaking to remove it. The broken cap cannot be re-used and, therefore must be replaced with new one.

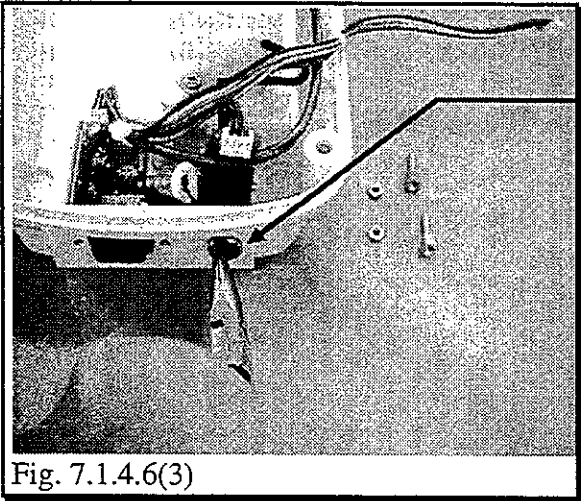


- (3) Remove 2 hexagon nuts and 2 locking spacers.

**Note: Locking spacers are liable to break off. Be sure to remove them only after loosening the nuts.**



- (4) Unscrew the nurse-call locking nut, disconnect the connector CN15 and CN21 on the computer interface board, and detach the nurse-call board.



Nurse-call locking nut (#)

Fig. 7.1.4.6(3)

- (5) Remove tapping screw M3×6 fastening the computer interface board, and detach the computer interface board.

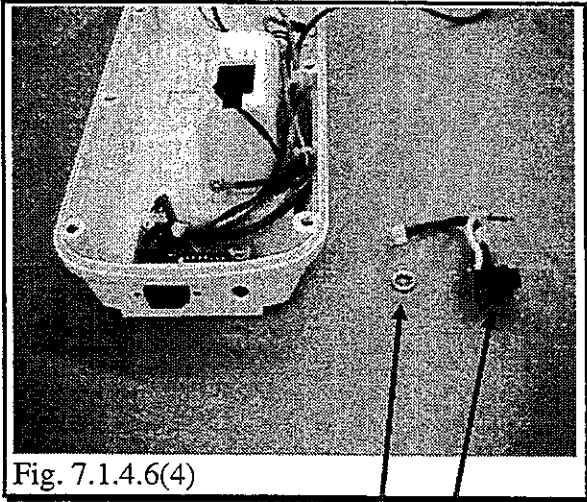


Fig. 7.1.4.6(4)

Nurse-call locking nut (#)

Nurse-call board (#)

#: Nurse-call board•RS232C board (05LA27\*)

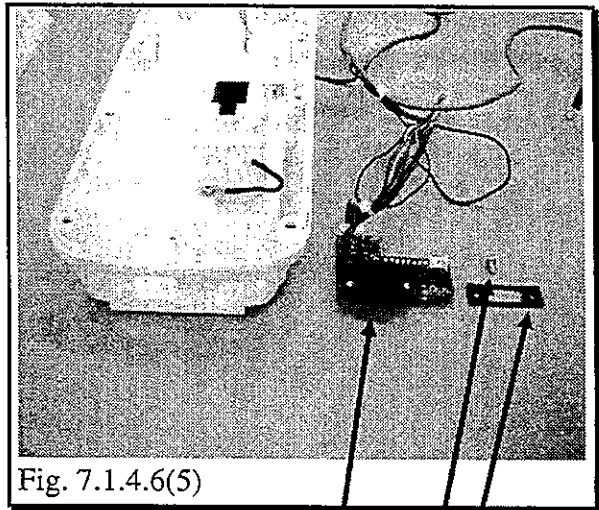


Fig. 7.1.4.6(5)

Computer interface board (#)

Tapping screw screw M3×6 (#)

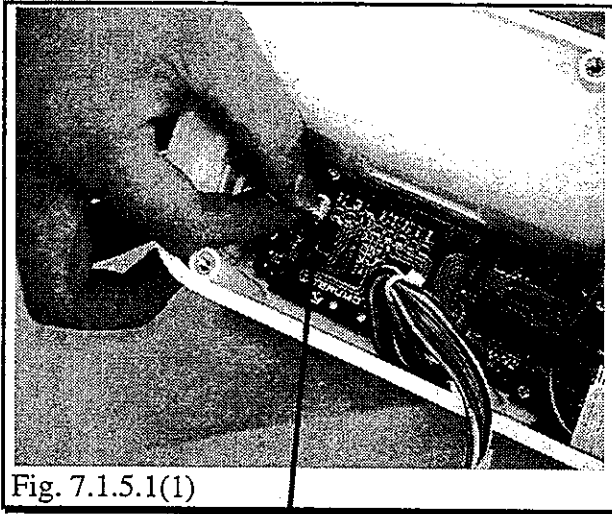
Connector plate (#)



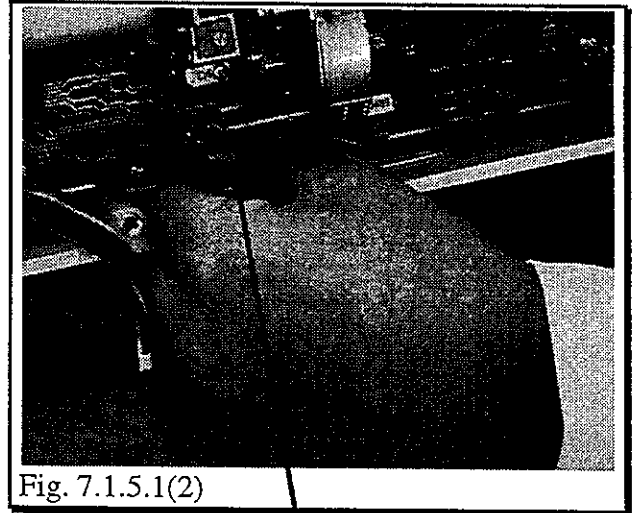
**7.1.5 Disassembling the upper case unit**

**7.1.5.1 Removing the main board**

- (1) Disconnect the connectors CN3 and CN11 from the main board.

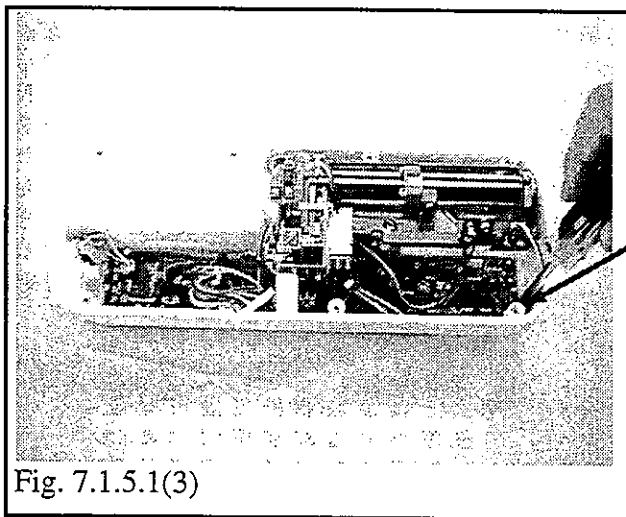


CN3



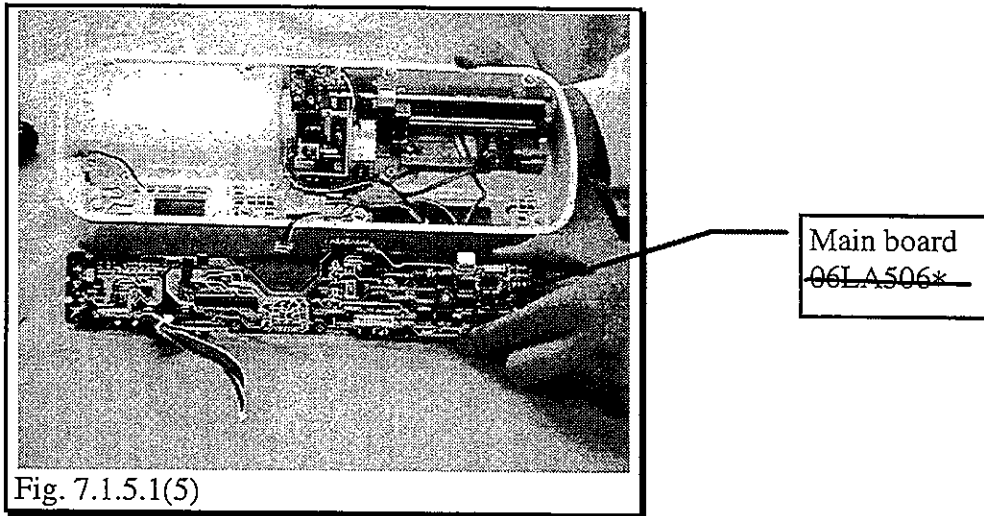
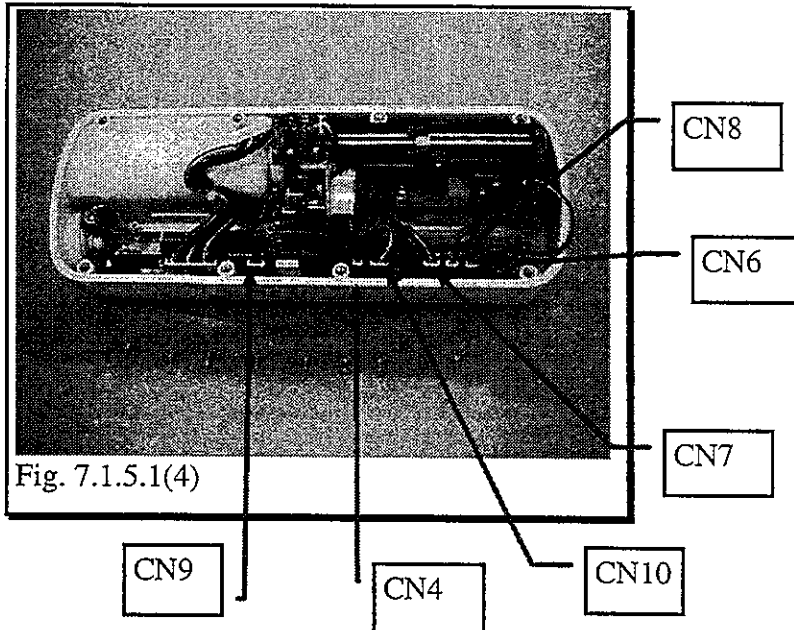
CN11

- (2) Remove 9 screws (tapping screw, M3×8) fastening the main board.



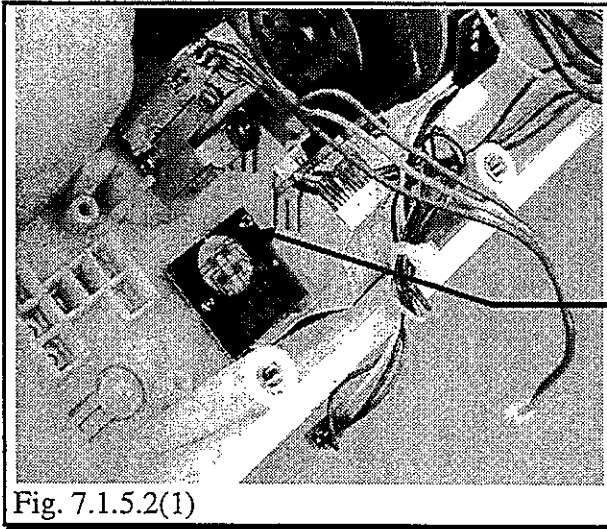
Tapping screw  
9-M3×8

- (3) Tilting the main board toward you and gradually raising it, disconnect the connector, CN4, CN6, CN7, CN8, CN9, and CN10, and detach the main board from the upper case.

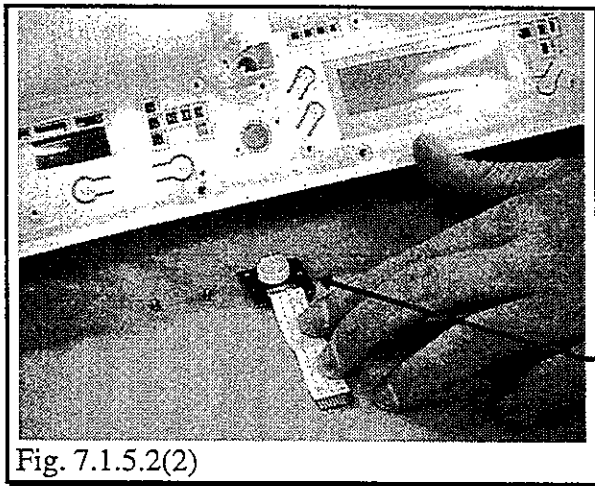


### 7.1.5.2 Removing the indicator unit

- (1) Remove 2 screws (tapping screw, M2×4) and detach the indicator unit from the upper case.



Tapping screw  
2-M2×4



Indicator unit  
(05LA08\*)

**7.1.5.3 Removing the LCD (TE-312 only)**

- (1) Disconnect the flexible cable from connector CN1 on the main board.

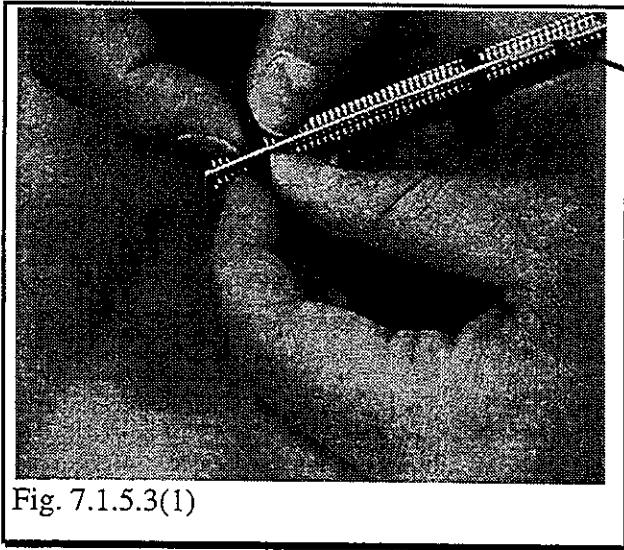
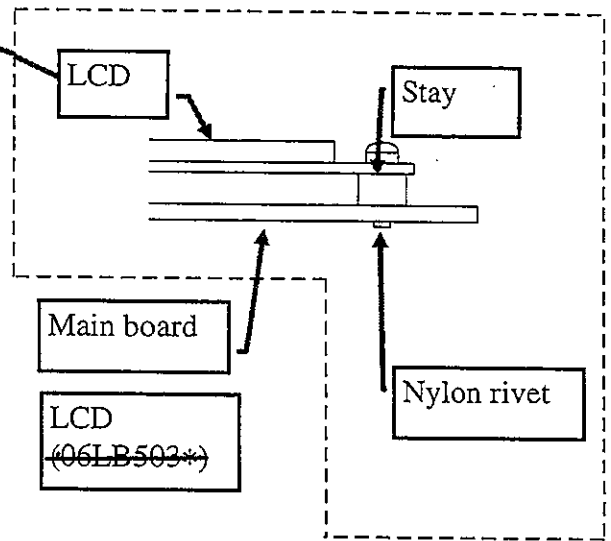


Fig. 7.1.5.3(1)



- (2) Push the nylon rivet (inside) from the reverse side of main board to separate the LCD from the main board.

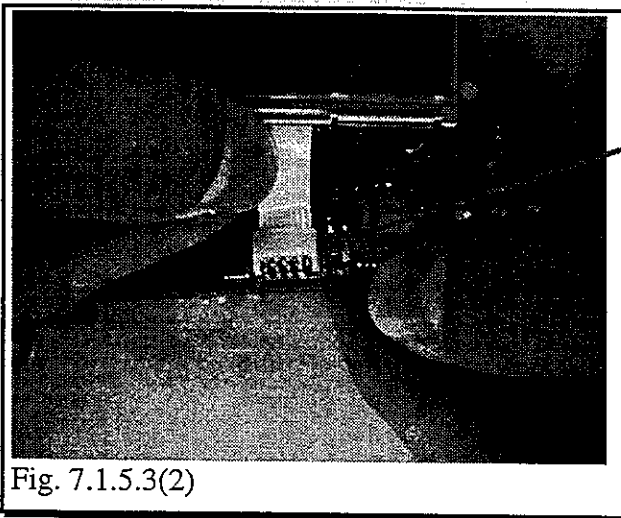
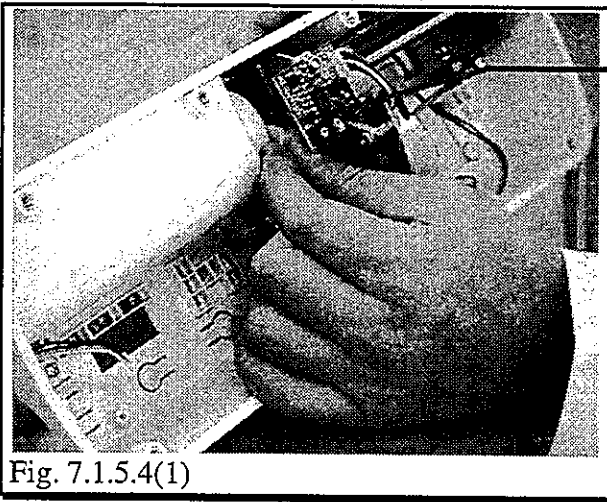


Fig. 7.1.5.3(2)

**7.1.5.4 Removing the boot and slider unit**

- (1) Take off the boot holder plate from the upper case inside.



Boot holder plate  
(05LA13\*)

Fig. 7.1.5.4(1)

- (2) Before removing the slider cover, put back the lower case unit (which has been separated from the upper one in **Para. 7.1.3**) onto the upper case unit. Grasp and press the clutch to open the clamp lever, and remove the slider cover fixing screws (flat-head, M2.5×5).

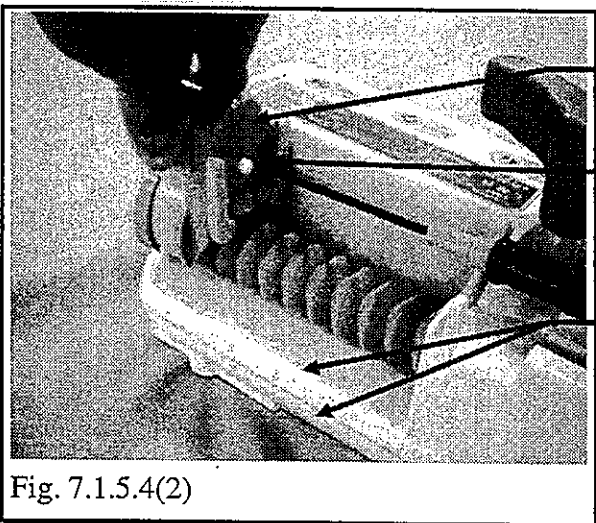


Fig. 7.1.5.4(2)

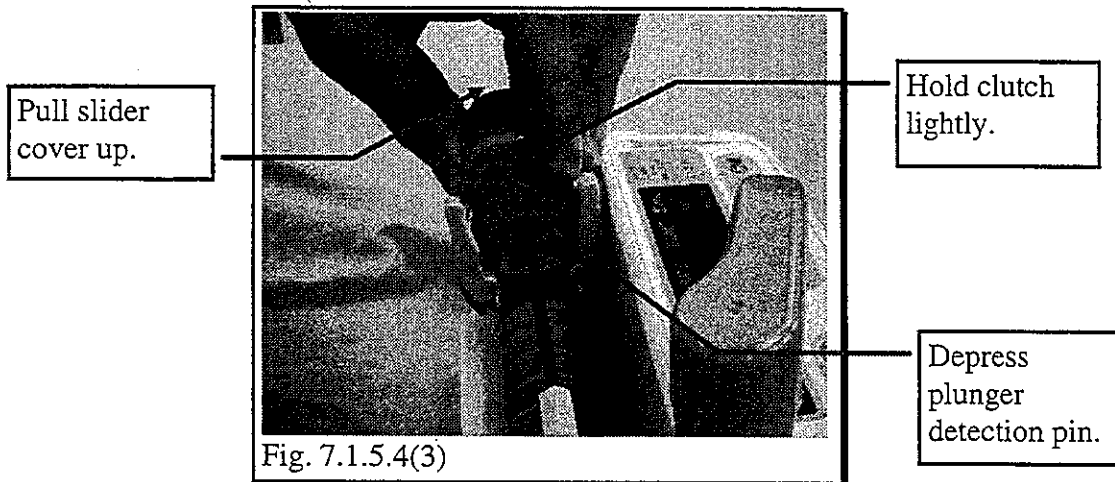
Slider cover

Flat-head,  
M2.5×5

Slider cover  
(06LA511\*)

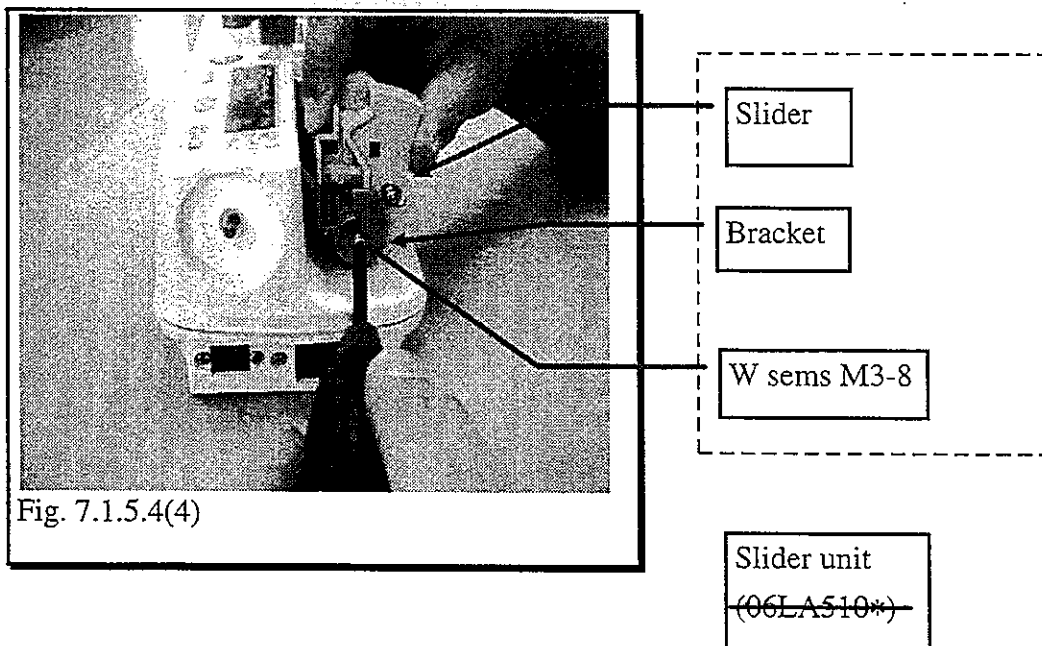
**Note: When removing the slider unit, the lower case unit should be put back on the upper case unit temporarily to protect the occlusion detection unit from being damaged.**

- (3) With the clutch hold lightly and the plunger detection pin depressed, pull the slider cover up to remove it.



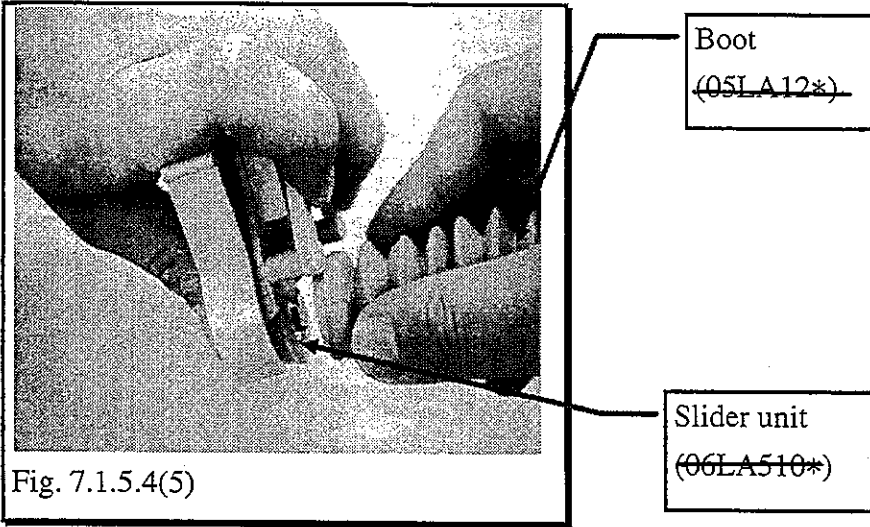
- (4) Remove the screw (W sems, M3×8) and bracket. Push the slider unit out with thumb.

**Note: Take special care not to scratch the boot when removing the slider.**



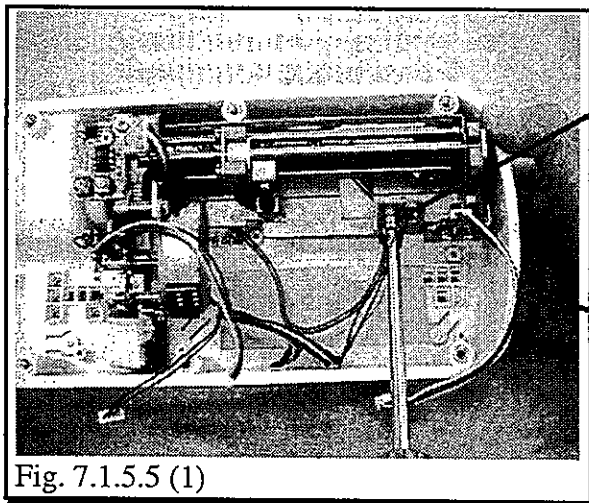
(5) Remove the boot from the slider.

**Note: Take special care not to scratch the boot when removing it.**



**7.1.5.5 Removing the drive unit**

- (1) From the drive unit, disconnect the grounding wire (cable assy T10) leading to the syringe detecting unit.

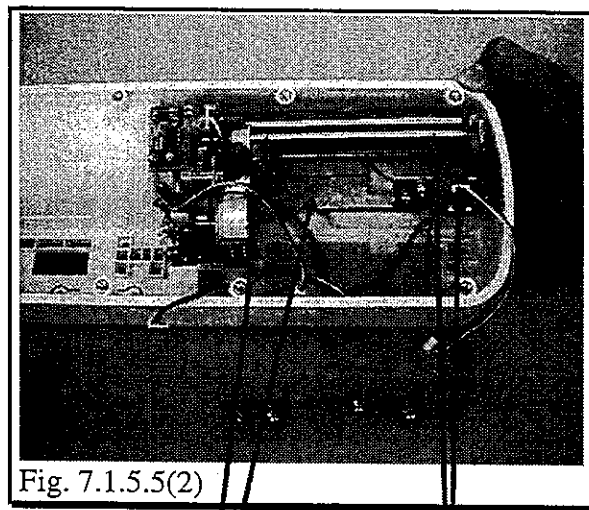


W sems M4×6

W/H unit  
CABLE ASSY T10  
~~(06LA534\*)~~

Fig. 7.1.5.5 (1)

- (2) Remove 4 screws fastening the drive unit to the upper case (W sems, 2-M4×8, 2-M4×10) and detach the unit.

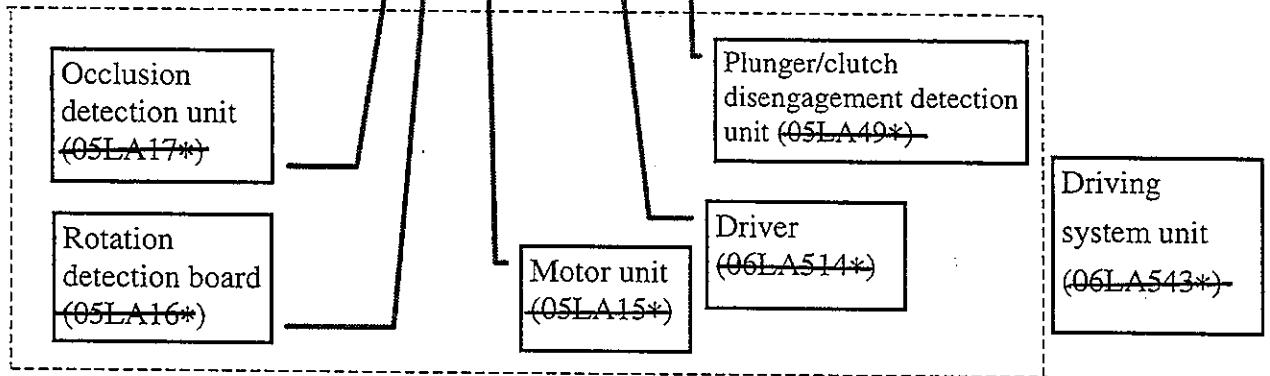
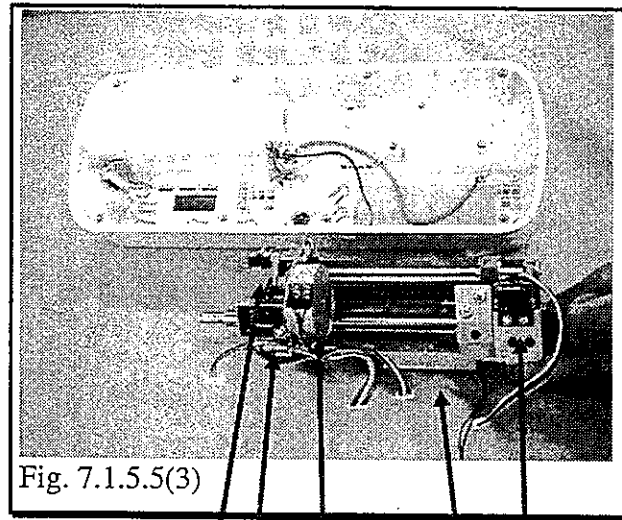


Longer screw  
2-M4×10

Shorter  
screw  
2-M4×8

Fig. 7.1.5.5(2)





**Note: When placing the drive unit on the workbench, be careful not to let the occlusion detect unit and rotation detect board face down.**

### 7.1.5.6 Removing the rotation detection board

- (1) Cut the cable tie to loosen the cables. (Please take care when carrying out this procedure.)

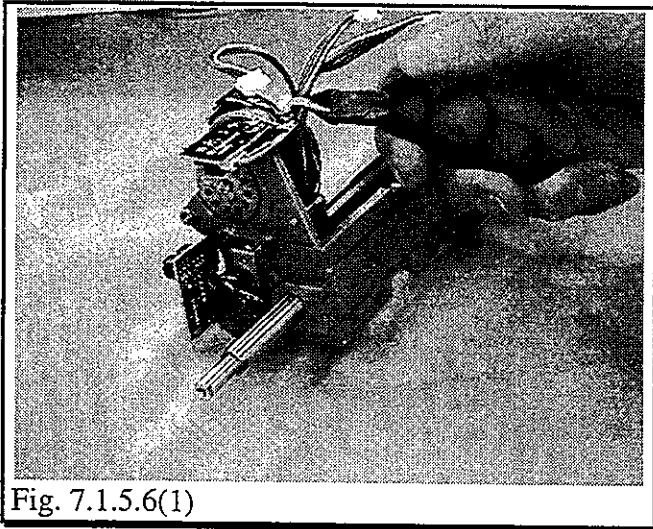


Fig. 7.1.5.6(1)

- (2) Remove screw (W sems, M3×6) fastening the rotation detection board to the driver and detach the board.

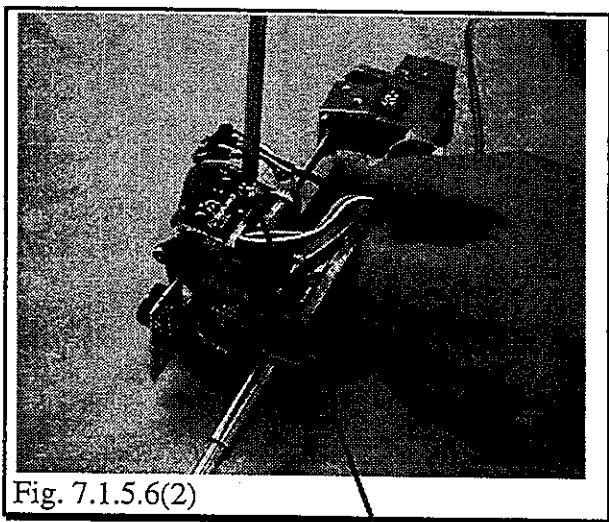


Fig. 7.1.5.6(2)

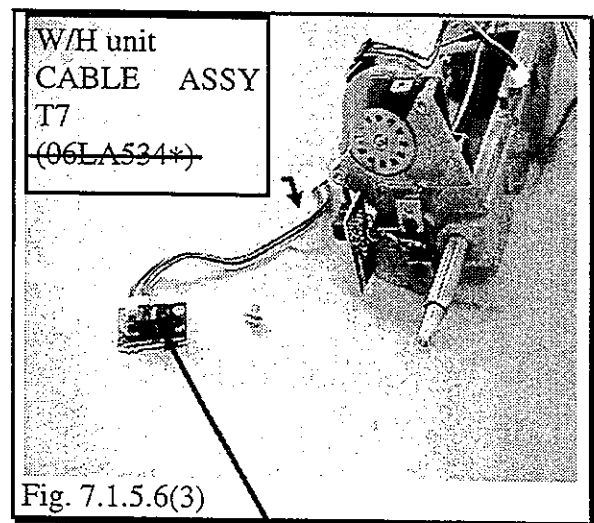


Fig. 7.1.5.6(3)

Rotation detection board  
(05LA16\*)

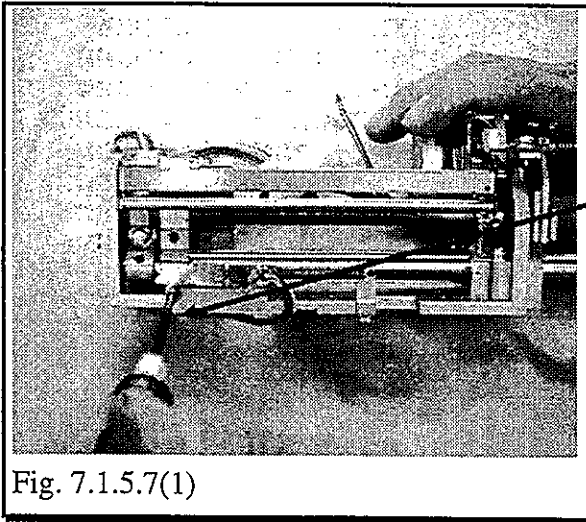
W sems M3×6

Rotation detection board

**7.1.5.7 Removing the nearly empty detection unit**

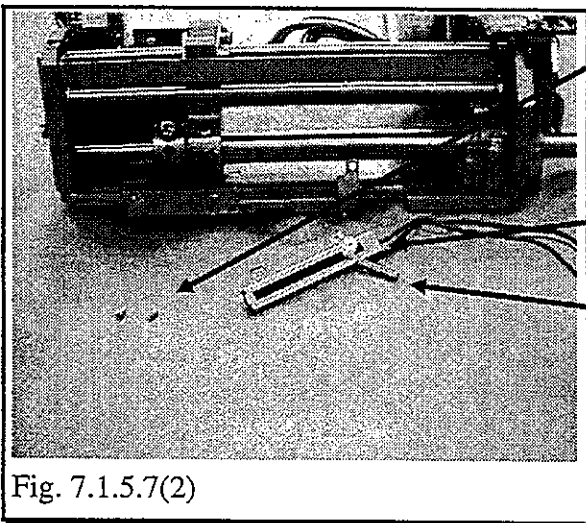
- (1) Remove screws (Pan-head, 2-M1.6×3) and spring washers (2-M1.7) fastening the nearly empty detection unit to the driver and detach the unit.

**Note: When taking off the linear position sensor, be careful neither to apply excessive tension to the spring nor to apply undue stress to the cable soldered part and slide pin.**



Pan-head screw: 2-M1.6  
Spring washer: 2-M1.7

Fig. 7.1.5.7(1)



Pan-head screw:  
2-M1.6×3  
Spring washer:  
2-M1.7

Linear position  
sensor

Spring

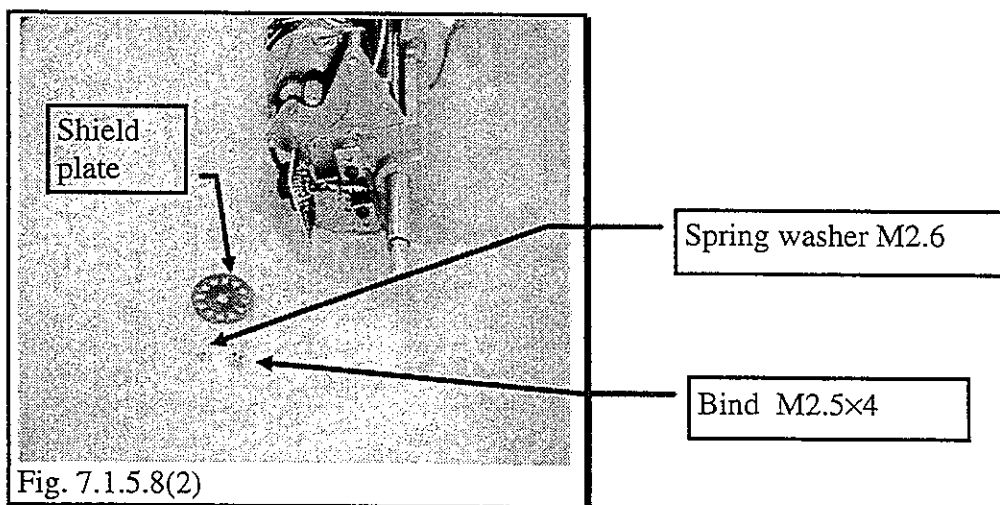
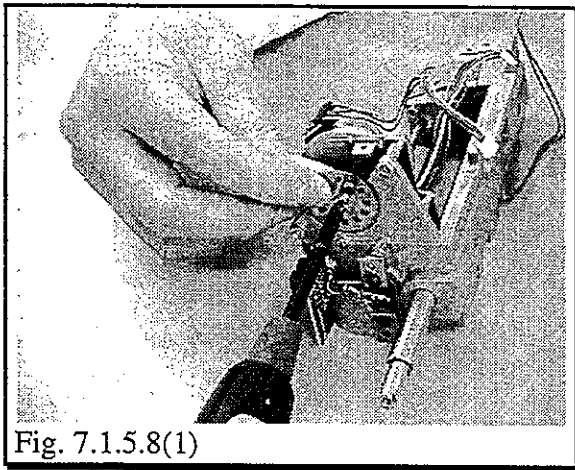
Nearly empty  
detection unit  
(05LA18\*)

Fig. 7.1.5.7(2)

### 7.1.5.8 Removing the motor unit

Note: The disassembly work described in this paragraph should be performed only by a person qualified by a special training.

- (1) Secure shield plate with fingers, remove the screw (bind, M2.5×4 and spring washer M2.6), taking care not to bend the shield plate. Detach the shield plate from the motor.



- (2) Remove the screws (Sems, 2-M3×18) fastening the motor and detach the motor from the driver.

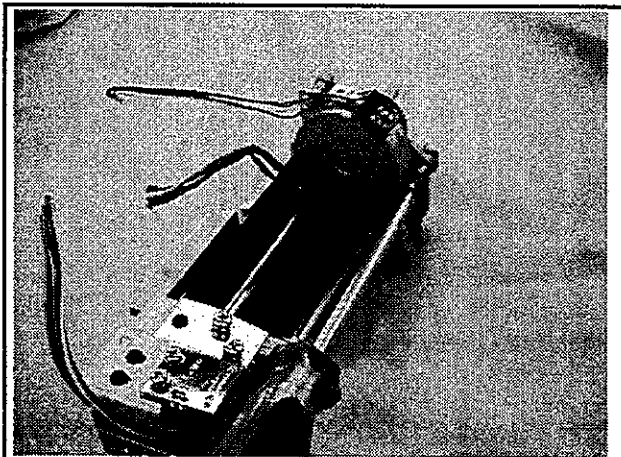


Fig. 7.1.5.8(3)

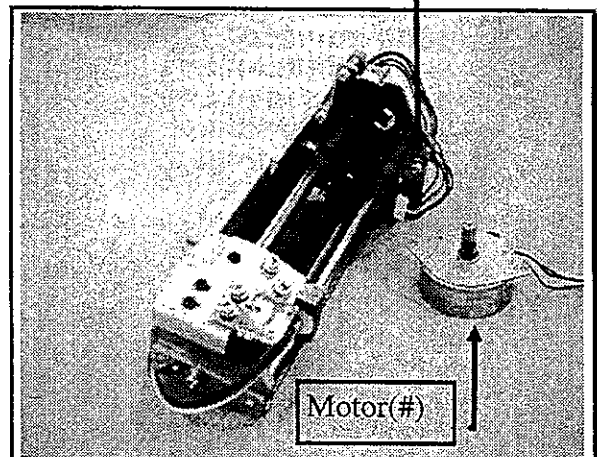


Fig. 7.1.5.8(4)

#: Motor unit (05LA15\*)

Note: If the motor attaching screws (Sems 2-M3×18) are left removed, the gear head would fall apart.

After the motor has been removed, be sure to put back the screws to the driver.

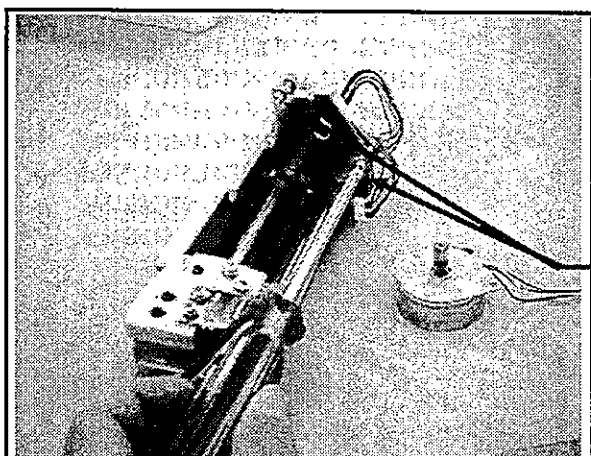


Fig. 7.1.5.8(5)

Sems  
2-M3×18

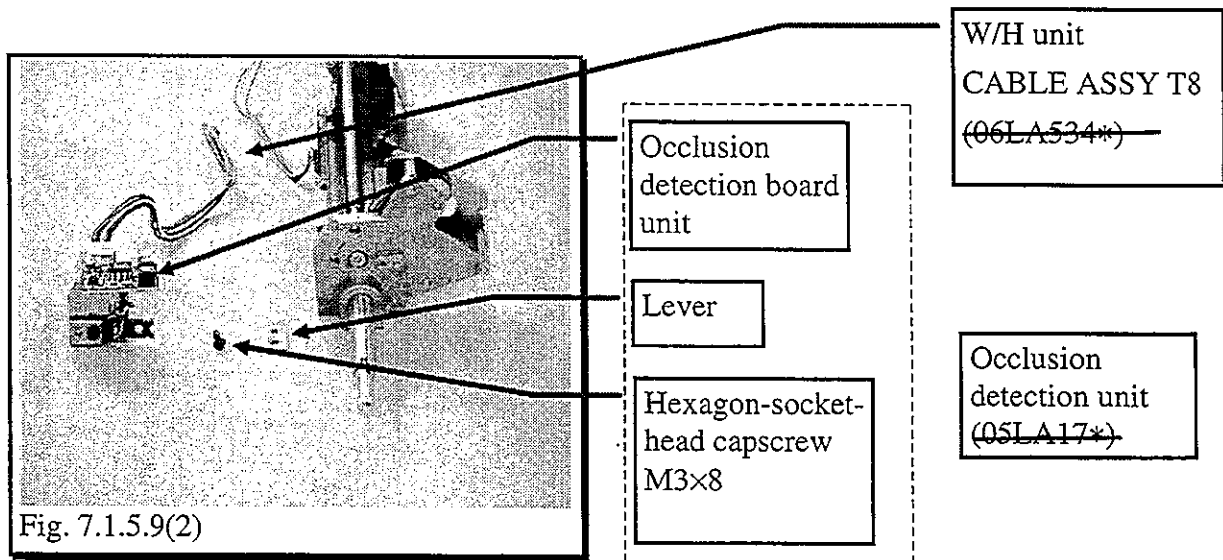
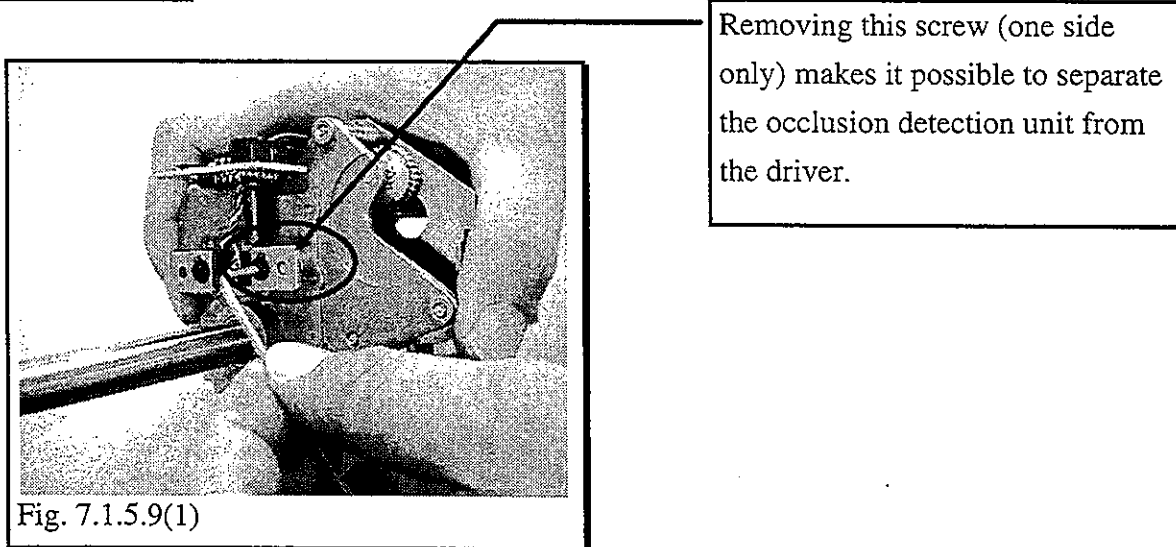
### 7.1.5.9 Removing the occlusion detection unit

Note: The disassembly work described in this paragraph should be performed only by a person that has been qualified competent by special training.

Important: Never tamper with the volume on the occlusion detection board which has been properly adjusted in the factory. The service parts are also adjusted before shipment.

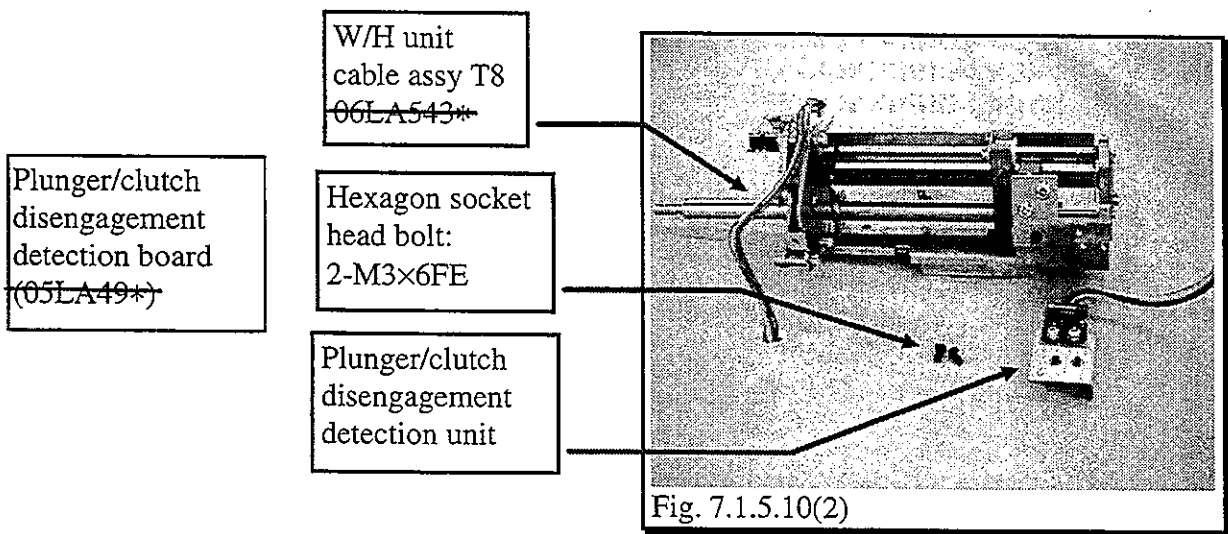
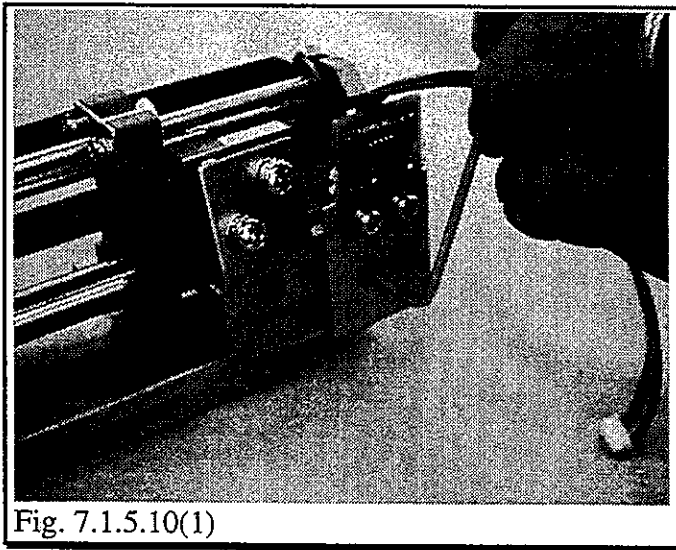
- (1) Remove the screws (hexagon-socket-head capscrew, M3×8) fastening the occlusion detection unit and detach the unit from the driver.

Note: Take special care not to apply stress to any cable between the strain gauge and occlusion detection board.



**7.1.5.10 Removing the plunger/clutch disengagement detection unit**

- (1) Remove screws (hexagon socket head bolt: 2-M3×6FE) fastening the plunger/clutch disengagement detection unit and detach the unit from the driving system unit.



**7.1.5.11 Removing the syringe detection unit**

- (1) Remove the screws (tapping screw, M3×8) fastening the syringe detection unit. Sliding the syringe detection unit sideward, draw the slide pin out of the joint meter.

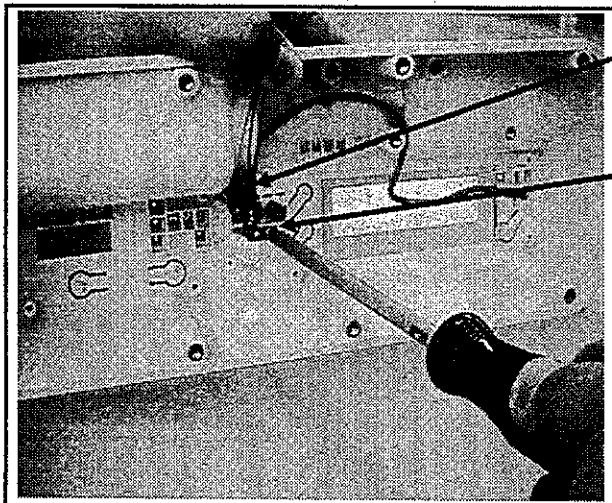


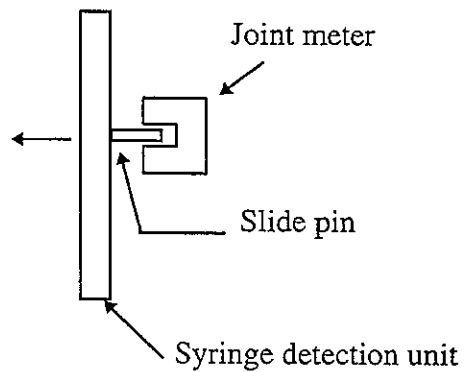
Fig. 7.1.5.11

Linear position sensor

Tapping screw, M3×8

Syringe detection unit  
(05LA05\*)

Slide the unit sideward to remove.





**7.1.5.12 Removing the clamp unit**

- (1) Remove the E-ring and detach the joint meter and spring.

**Note: When removing the E-ring, please hold down joint meter with fingers, so as to prevent parts from being scattered by strong spring force.**

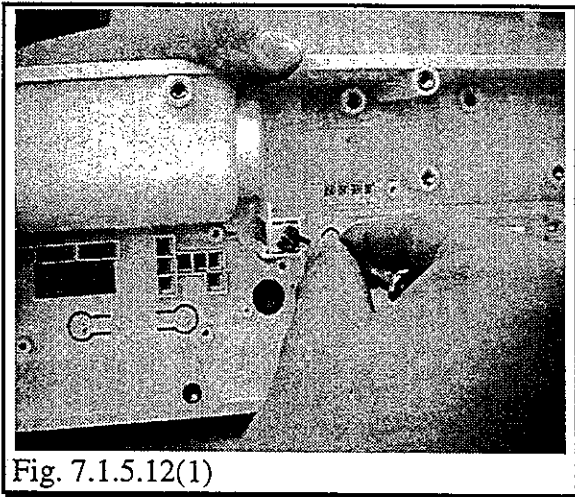


Fig. 7.1.5.12(1)

- (2) Draw off the clamp from the upper case.

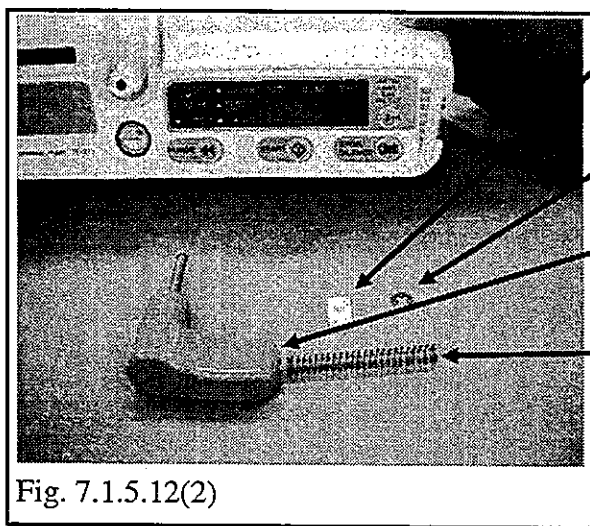
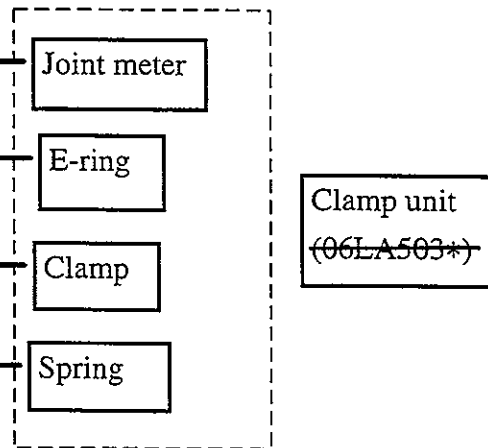


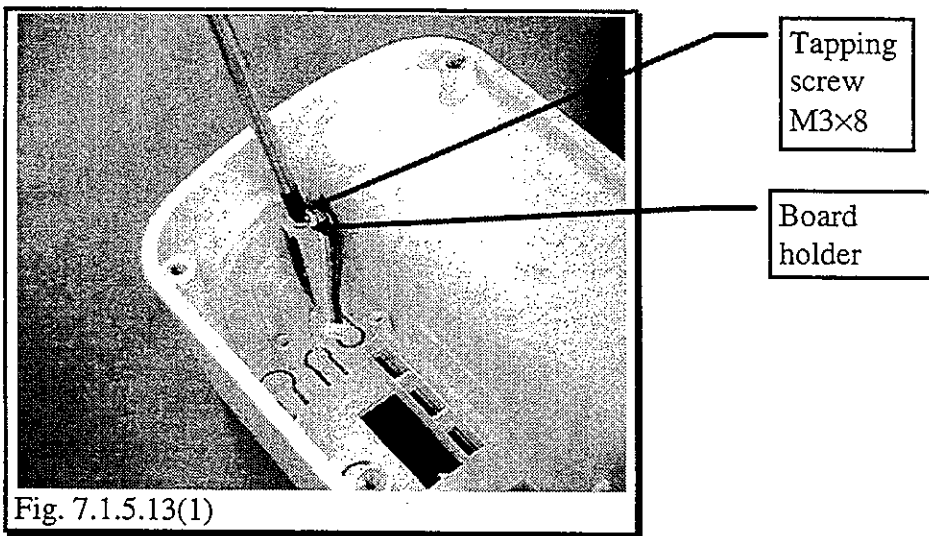
Fig. 7.1.5.12(2)



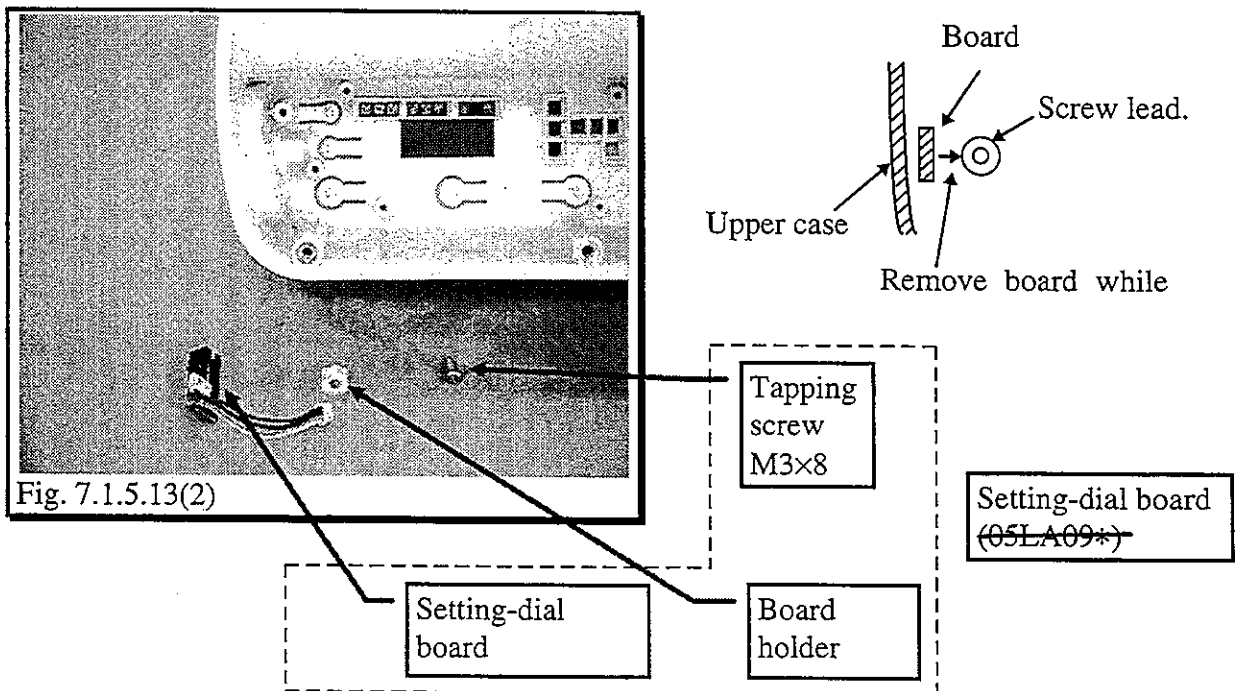
**7.1.5.13 Removing the setting dial board**

(1) Remove the setting dial board mounting screw\* (tapping screw, M3×8) and the board holder.

\* In the case of a setting dial board bonded to the upper case with adhesive (e.g. KE-45), first remove the adhesive.



(2) Remove the setting-dial board while pushing it against the board mounting screw lead on the upper case.



## 7.2 Reassembling procedure

The procedure for reassembling the TE-311/312 is described below. When performing reassembly, follow the sequence of the reassembling flow chart.

When handling the parts of appearance-important, such as the upper and lower cases, lay them on soft material such as polishing cloth and perform reassembly work carefully not to deteriorate the quality of surface caused by scratching, etc.

[Reassembling flow chart]

(Reassembling of upper case unit)	7.2.1
Installing the setting dial board	7.2.1.1
└─ Installing the clamp unit	7.2.1.2
Installing the syringe detection unit	7.2.1.3
└─ Installing the plunger/clutch disengagement detection unit	7.2.1.4
└─ Installing the occlusion detection unit	7.2.1.5
└─ Installing the motor unit	7.2.1.6
└─ Installing the nearly empty detection unit	7.2.1.7
└─ Installing the rotation detection board	7.2.1.8
└─ Installing the drive unit	7.2.1.9
Installing the boot and slider unit	7.2.1.10
└─ Installing the LCD	7.2.1.11
└─ Installing the indicator unit	7.2.1.12
Installing the main board	7.2.1.13
(Reassembling the lower case unit)	7.2.2
└─ Installing the nurse-call board and RS232C board	7.2.2.1
└─ Installing the buzzer	7.2.2.2
└─ Installing or replacing the fuse	7.2.2.3
└─ Installing the DC jack unit	7.2.2.4
└─ Installing the AC inlet	7.2.2.5
Installing the power-supply board	7.2.2.6
Uniting the upper and lower cases	7.2.3
Adjusting the plunger disengagement position	7.2.4
Mounting the battery	7.2.5
Fitting the dial unit	7.2.6
Pump body	

**7.2.1 Reassembling of upper case unit**

**7.2.1.1 Installing the setting dial board**

- (1) Install the setting dial board with its connector side up. With the board pushed against the upper case, fasten the board holder with screw (tapping screw, M3×8).

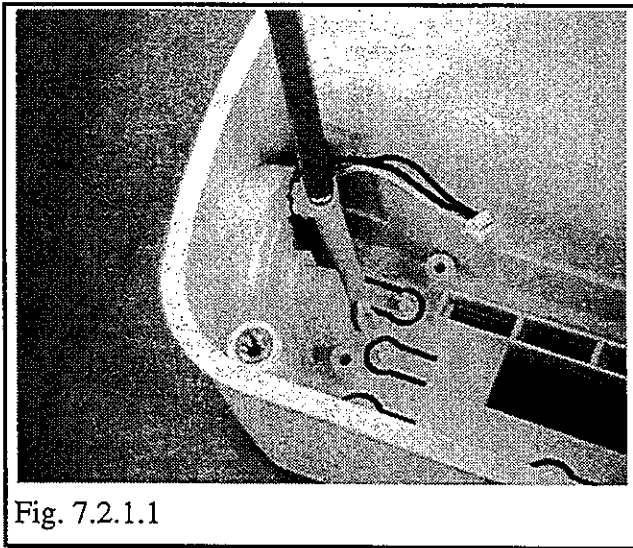
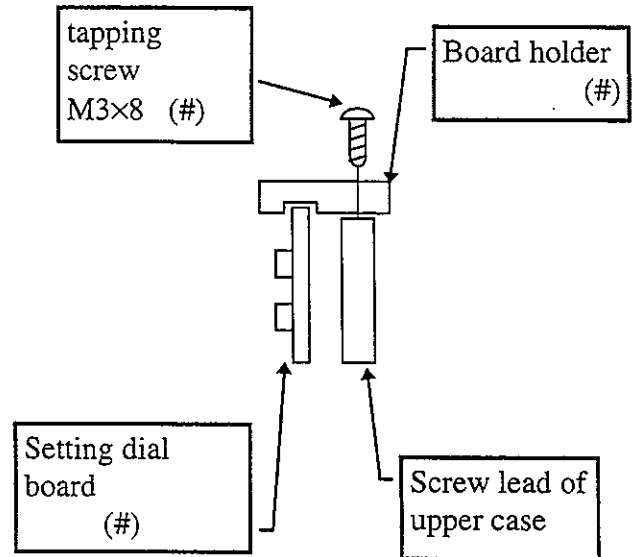


Fig. 7.2.1.1



#: Setting dial board (05LA09\*)

**7.2.1.2 Installing the clamp unit**

- (1) Put the clamp into the upper case.
- (2) Put in the spring and joint meter. Fix them with an E-ring, taking care to hold down joint meter to prevent it from springing out.

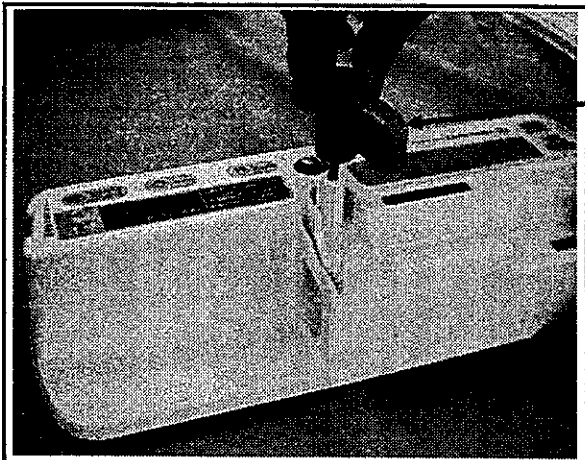


Fig. 7.2.1.2(1)

Clamp  
(#)

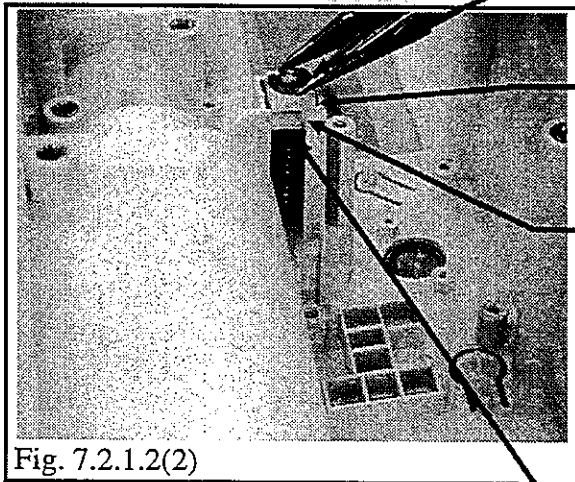
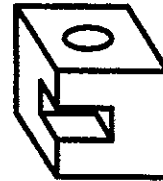


Fig. 7.2.1.2(2)

E-ring  
(#)

Joint meter  
(#)

Note: Let the joint meter face as illustrated below.



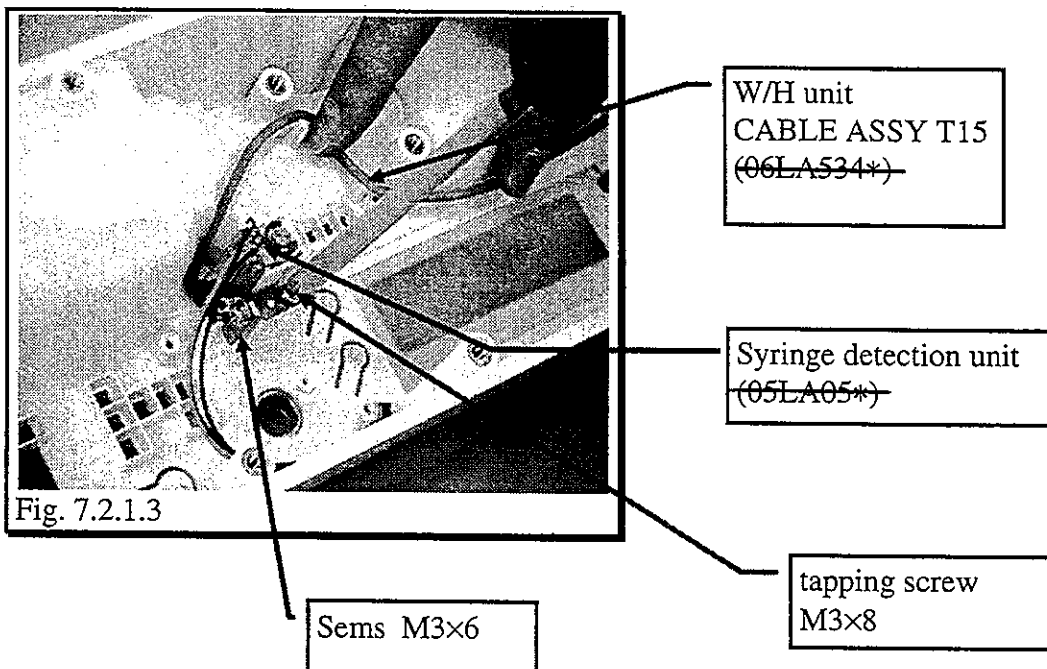
Spring  
(#)

#: Clamp unit(06LA503\*)

### 7.2.1.3 Installing the syringe detection unit

- (1) Attach the grounding wire (CABLE ASSY T15) to the syringe detection unit mounting bracket with screw (Sems, M3×6). Put the linear position sensor slide pin into the groove in the joint meter and fit the syringe detection unit to the upper case with screw (tapping screw, M3×8). After installation, fix the screw with thread lock cement / loctite adhesive.

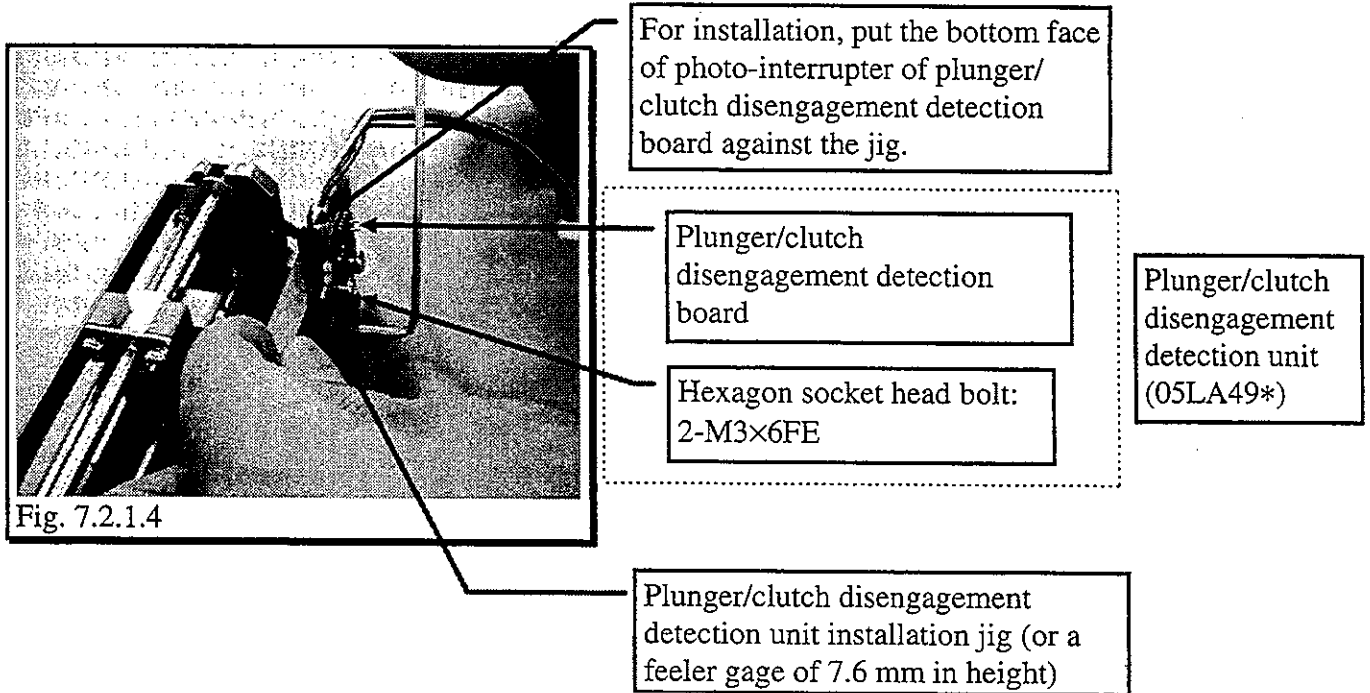
**Note: There is a possibility of damage to the linear position sensor if the joint meter is oriented wrong or fitted improperly. Perform installation work with special care.**



**7.2.1.4 Installing the plunger/clutch disengagement detection unit**

- (1) Install the plunger/clutch disengagement detection unit to the driving system unit with screws (hexagon socket head bolt: 2-M3×6FE) as illustrated below, with the help of the detection unit mounting jig. Then, fix the screws with thread lock cement / loctite adhesive.

**Note: Be sure to remove the jig after installation.**



**7.2.1.5 Installing the occlusion detection unit**

**Note: The reassembly work described in this paragraph should be performed only by a person that has been qualified competently by special training.**

- (1) Attach the occlusion detection unit with screw (hexagon-socket-head capscrew, M3×8) so that the projection on the feed screw side pressure plate aligns with the recession in the occlusion detection unit.

**Note: Take special care not to exert stress on the cable between the strain gauge and occlusion detection board.**

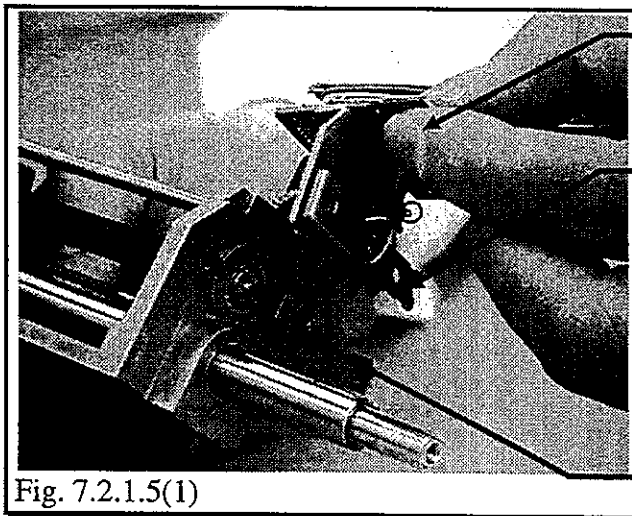


Fig. 7.2.1.5(1)

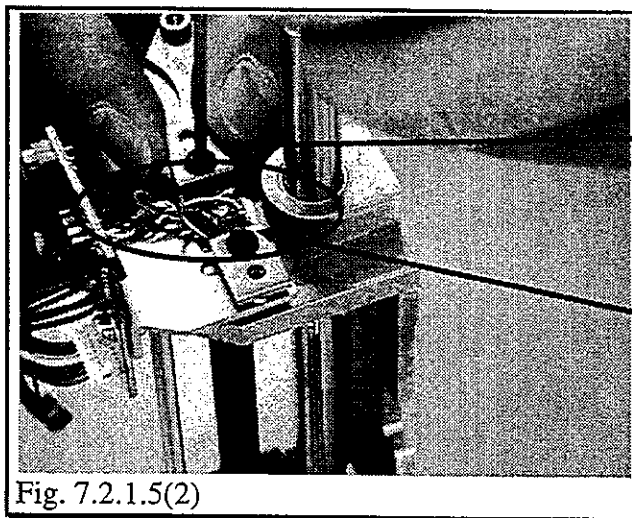
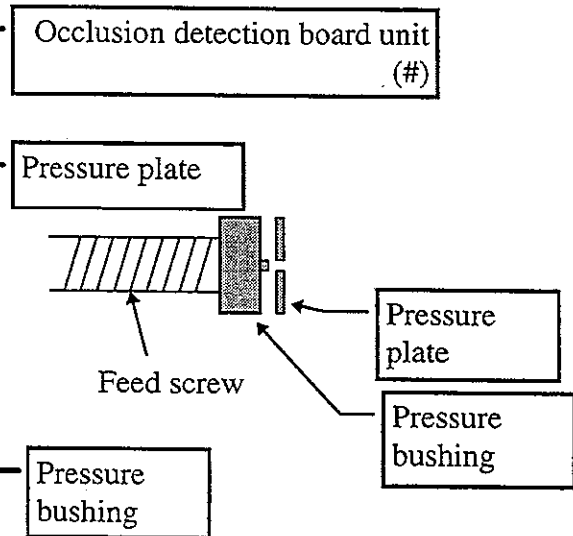


Fig. 7.2.1.5(2)

Lever  
(#)

**Note: Take care to keep this cable free from stress.**

#: Occlusion detection unit  
(05LA17\*)

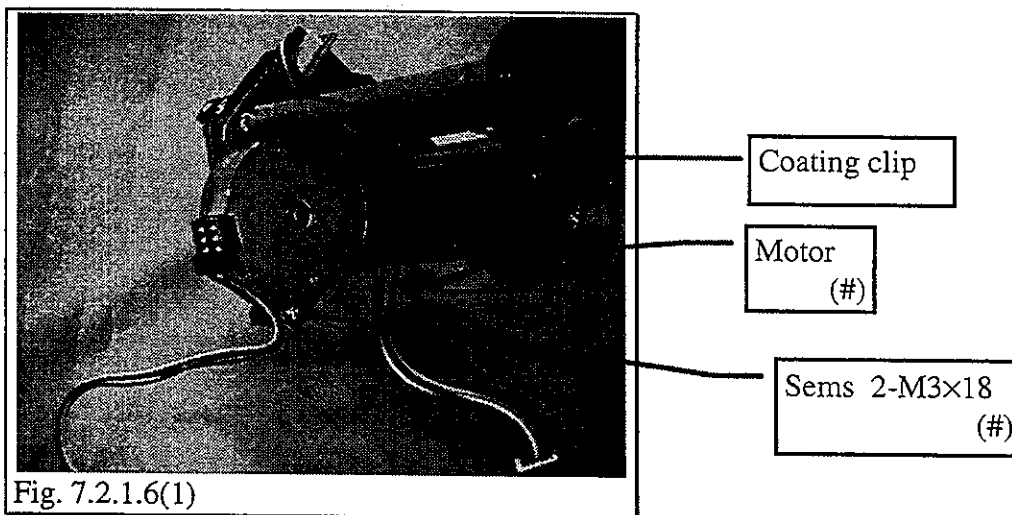


### 7.2.1.6 Installing the motor unit

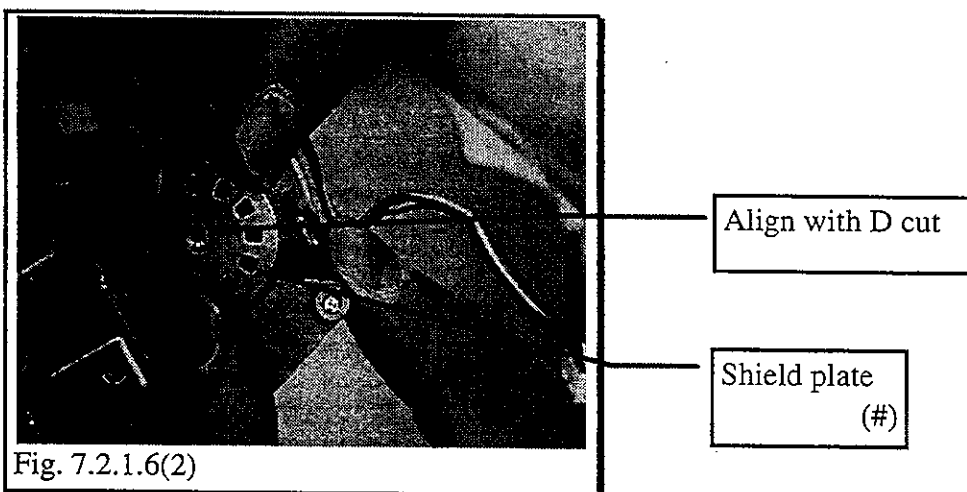
**Note:** The resassembly work described in this paragraph should be performed only by a person that has been qualified competently by special training.

- (1) Mount the motor unit with screws (Sems, 2-M3×18) so that the cable is located to the left side of the motor.

\* Be sure to install the coating clip without fail.



- (2) Align the D cut of the gear head with the shield plate and set the shield plate with screw (Bind, M2.5×4 and spring washer M2.6). After installation, fix the the screw with thread lock cement / loctite adhesive.



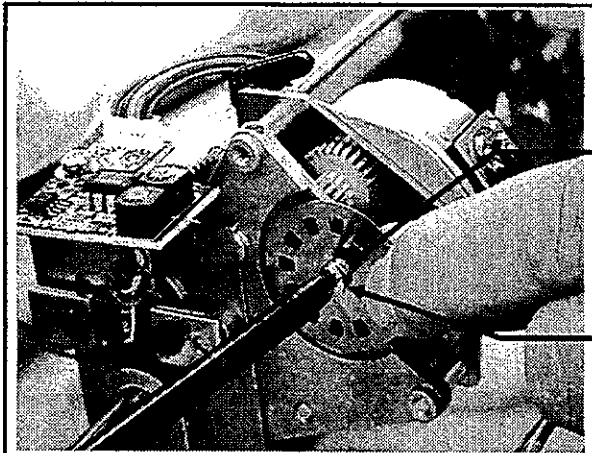


Fig. 7.2.1.6(3)

Spring washer M2.6  
(#)

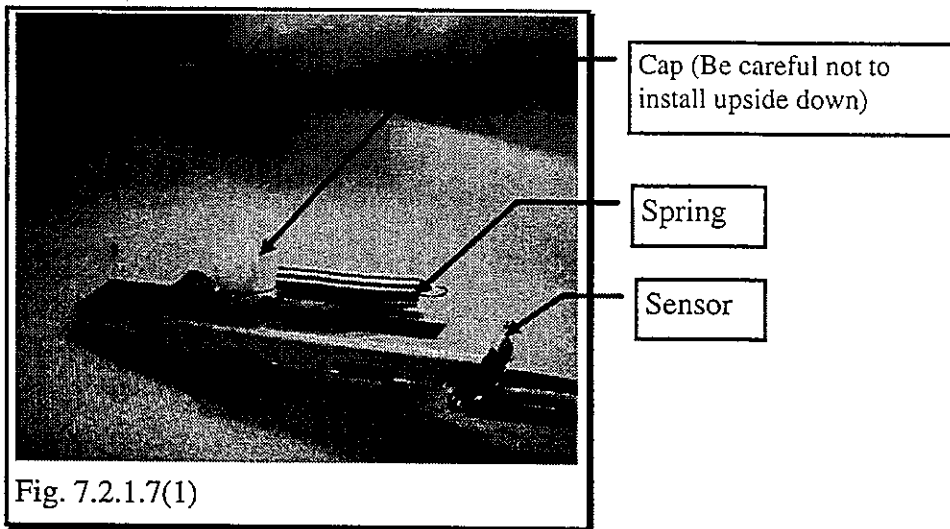
Bind M2.5×4  
(#)

#: Motor unit (~~05LA15\*~~)

**7.2.1.7 Installing the nearly empty detection unit**

- (1) Put on the cap to the linear position sensor slide pin and then install the spring.

**Note: When fixing the linear position sensor, take care not to over stretch the spring, and not to over stress on the soldered cable part and/or slide pin.**



(2) Set the spring at the spring hook on the driver. Gradually pulling the linear position sensor against spring force, locate the linear position sensor in place with screws (pan-head, 2-M1.6×3) and spring washers (2-M1.7). After installation, fix the screws with thread lock cement.

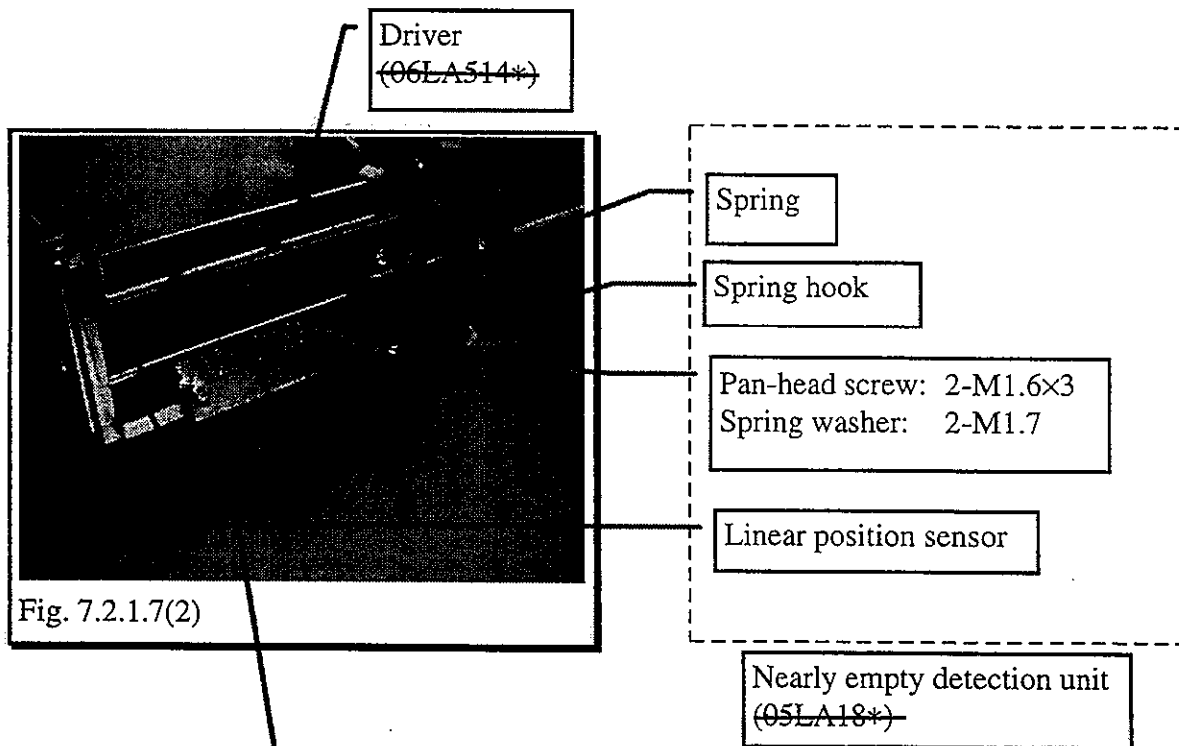


Fig. 7.2.1.7(2)

**Note: This part must be located at the position shown in the figure to prevent the linear position sensor slide pin from breaking off.**

**7.2.1.8 Installing the rotation detection board**

- (1) Install the rotation detection board with screw (W sems, M3×8) so that the shield plate is centered with the photo interruptor. After installation, fix the screws with thread lock cement / loctite adhesive.

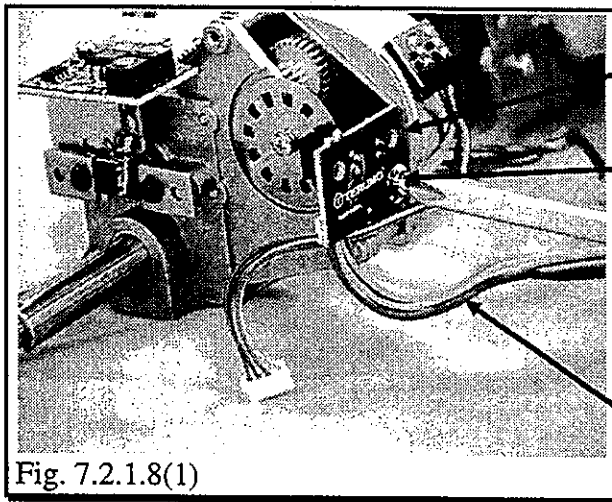


Fig. 7.2.1.8(1)

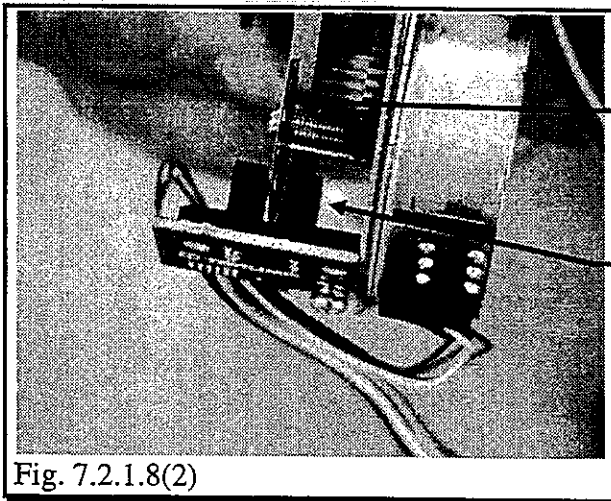
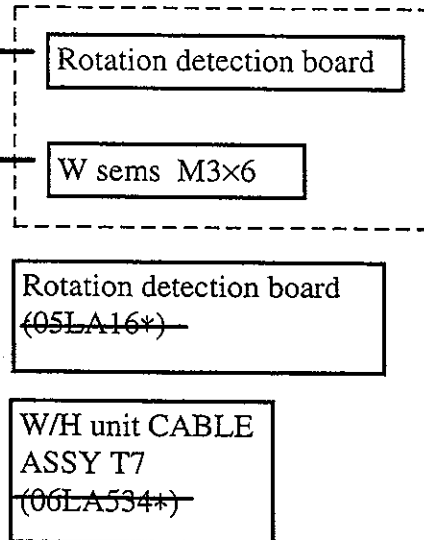
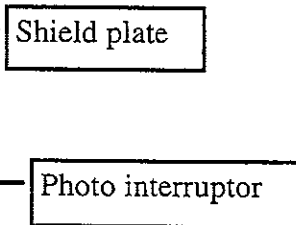
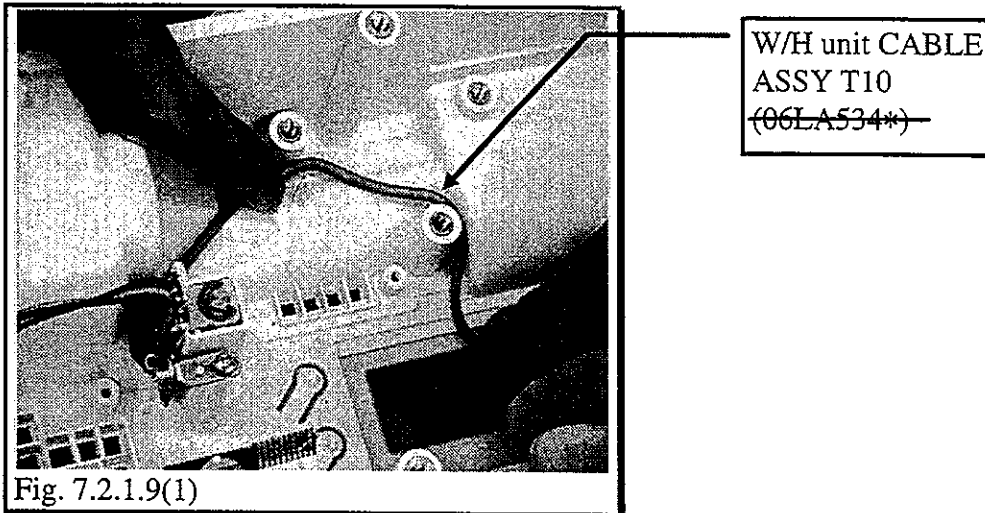


Fig. 7.2.1.8(2)



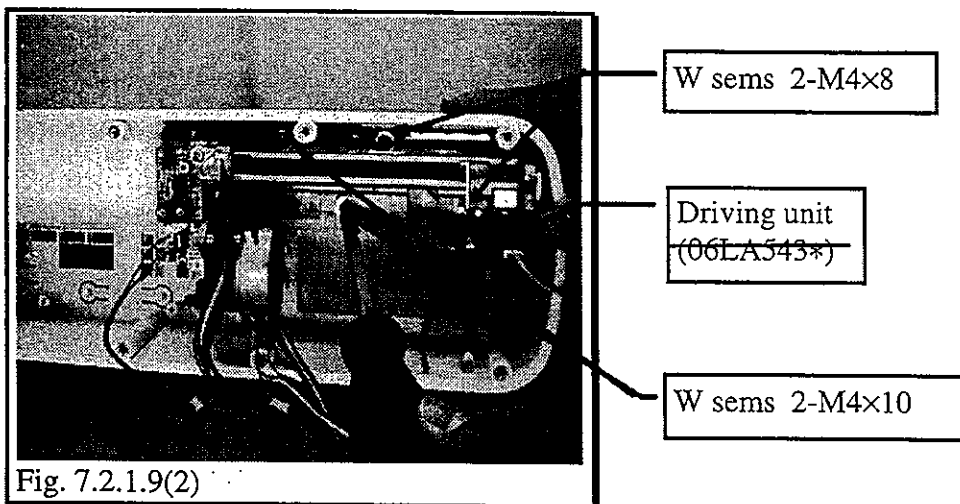
### 7.2.1.9 Installing the drive unit

- (1) Extend the grounding wire (CABLE ASSY T10), from the syringe detection unit, on the upper case as shown in 7.2.1.9(1).

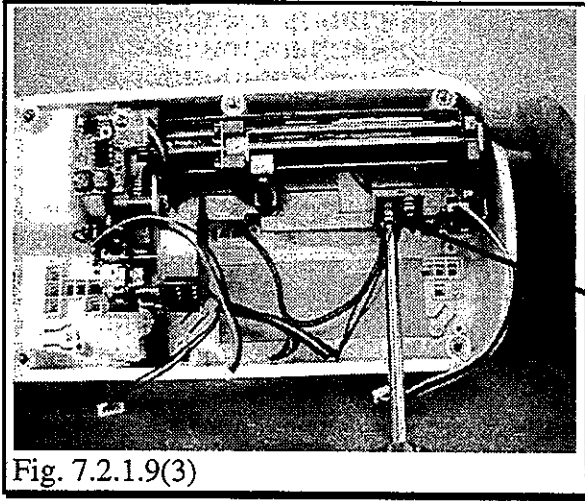


- (2) Then, extend the cable coming from the nearly empty detection unit, taking care not to jam it between the upper case and driving unit.

Install the driving unit in the upper case with screws (W sems, 2-M4×8, 2-M4×10) and fix the screws with thread lock cement / loctite adhesion.



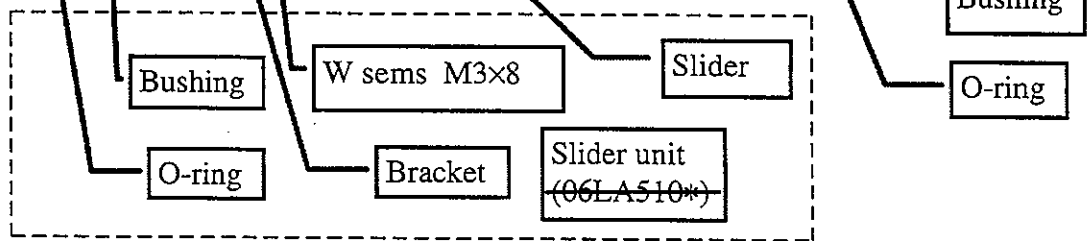
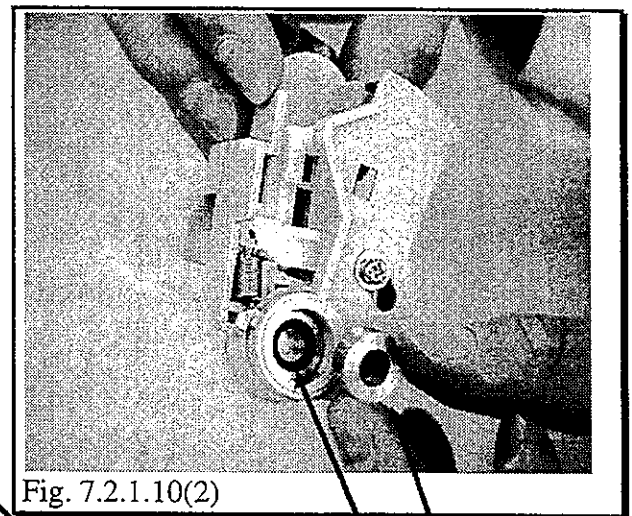
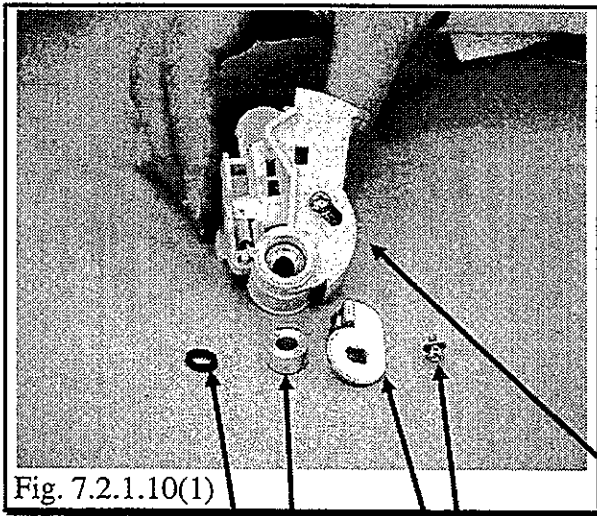
- (3) Connect the grounding wire coming from the syringe detection unit to the driving unit with screw (W sems, M4×6) and fix the screws with thread lock cement / loctite adhering.



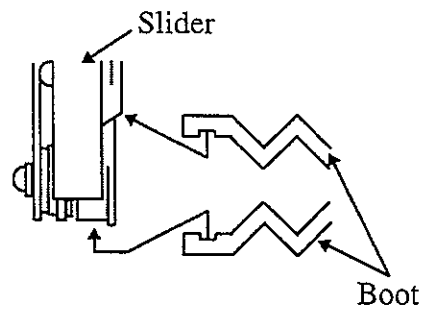
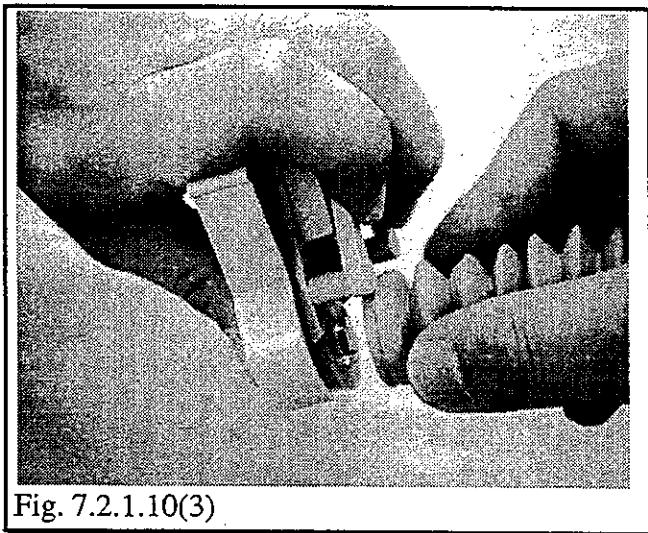
W sems M4×6

**7.2.1.10 Installing the boot and slider unit**

- (1) Set the O-ring and bushing in the slider unit.



- (2) Then, cover the slider unit with the boot.

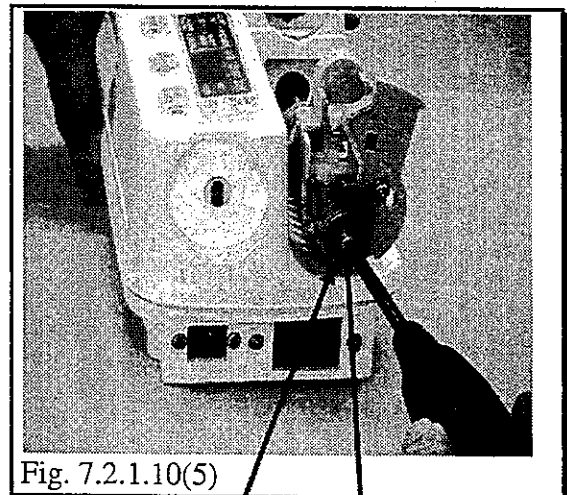
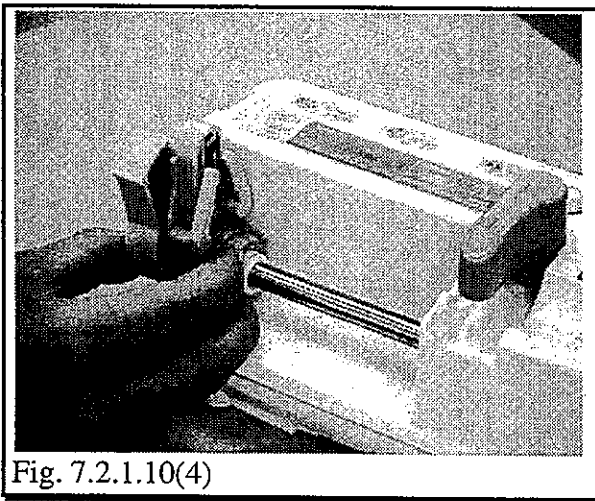




- (3) With the boot shrunk, put the slider unit onto the pipe shaft and fit the bracket with screw (W sems, M3×8).

**Note: Be careful not to place the upper case with its opening down on the workbench to prevent damage to the occlusion detection unit and rotation detection unit.**

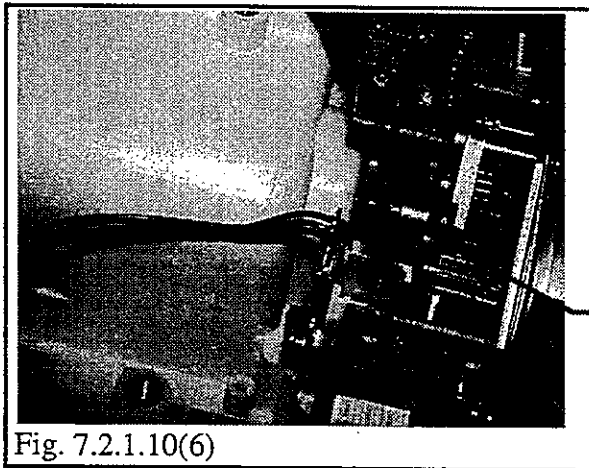
- \* When installing the slider, keep the upper and lower cases put together as shown in the figure below.



Bracket

W sems M3×8

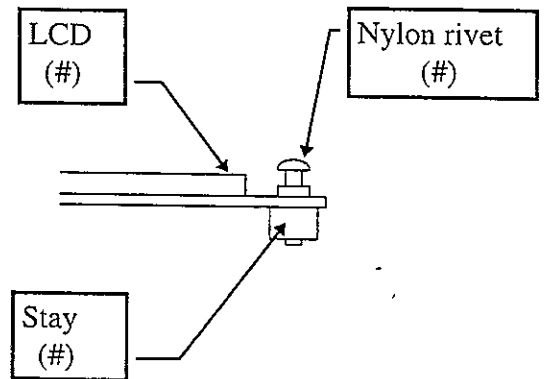
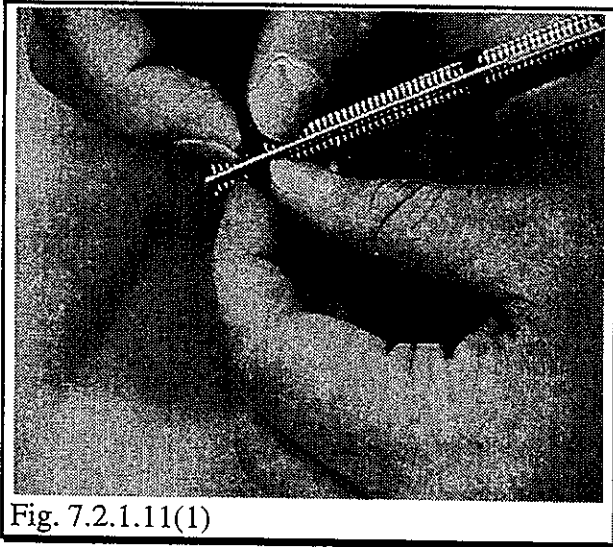
- (4) Fix the boot to the boot holder plate inside the upper case.



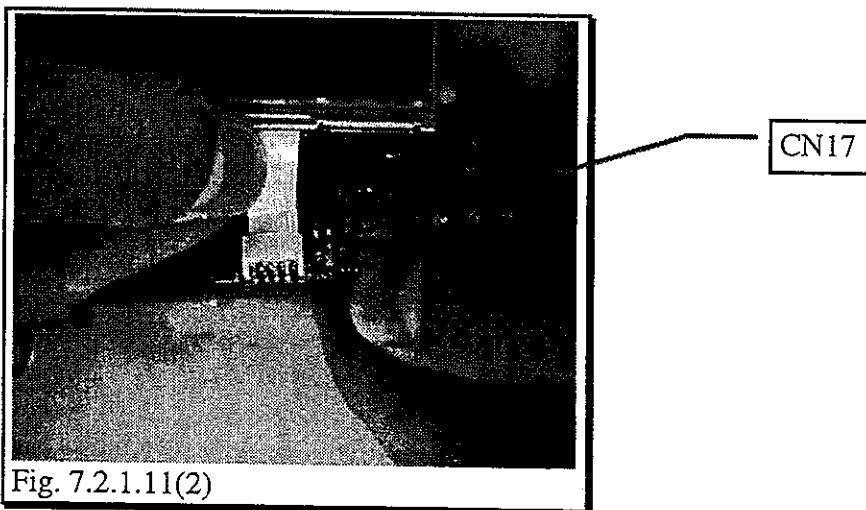
Boot holder plate  
(05LA13\*)

**7.2.1.11 Installing the LCD(Only for TE-312)**

- (1) Put in the nylon rivets into three rivet holes from the LCD side. Leave the stays (4 mm×3) set temporarily.



- (2) Plug in the flexible cable coming from the LCD to the connector CN17 on the main board.



- (3) Then, push the LCD onto the head of each nylon rivet to mount the LCD to the main board.

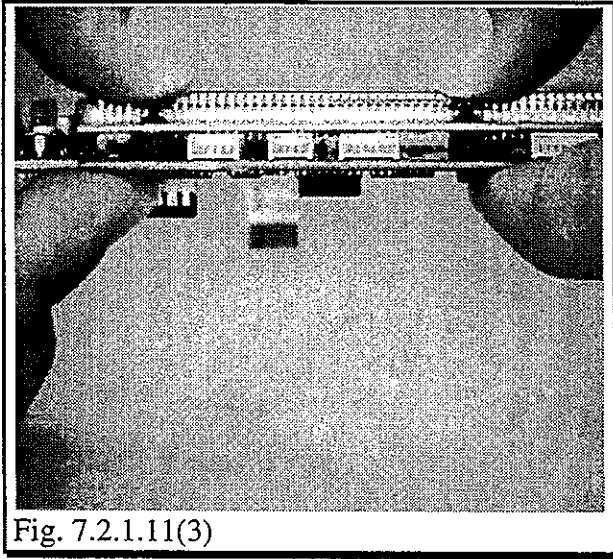
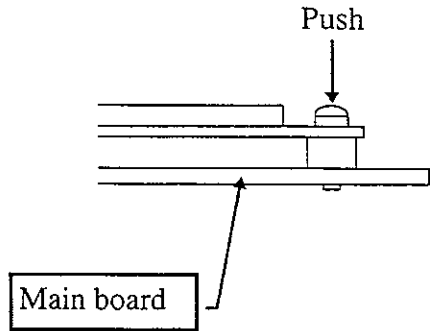


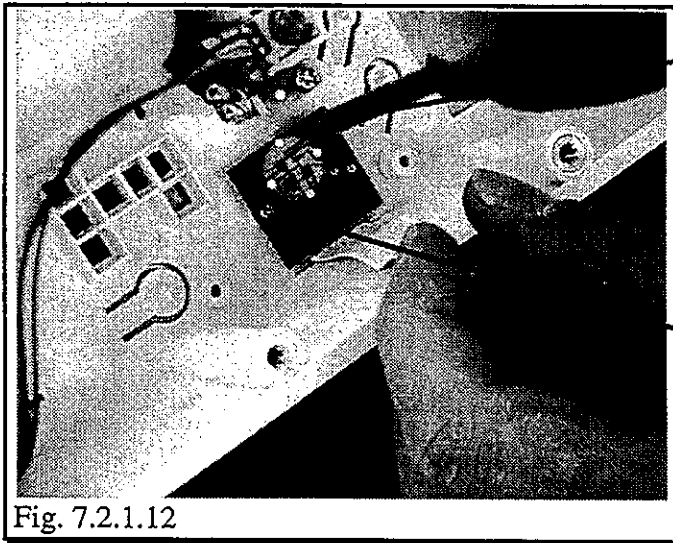
Fig. 7.2.1.11(3)



#: LCD(06LB503\*)

**7.2.1.12 Installing the indicator unit**

- (1) Install the indicator unit to the inside of the upper case with screws (tapping screw, 2-M2×4). After installation, fix the screws with thread lock cement / loctite adhesing.

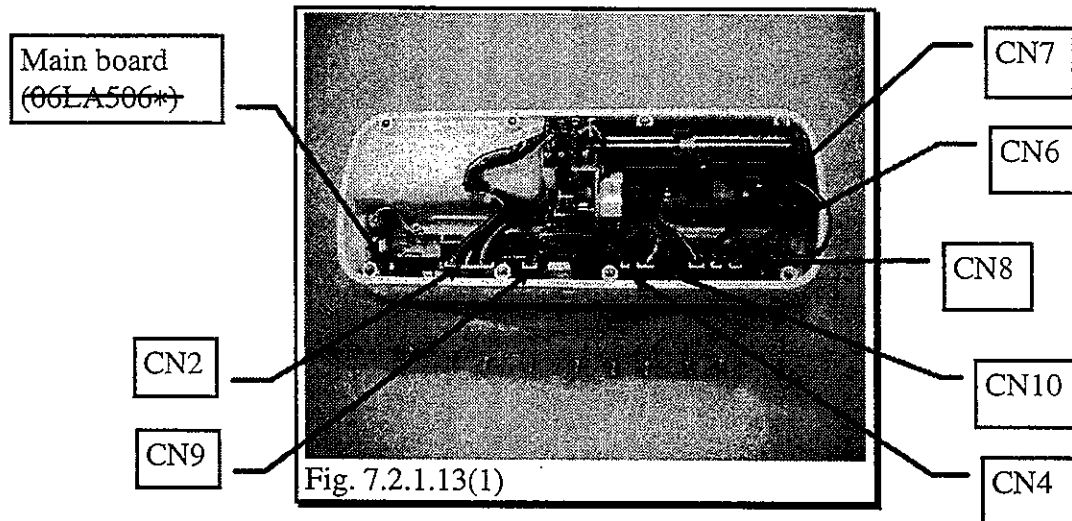


Tapping screw  
2-M2×4

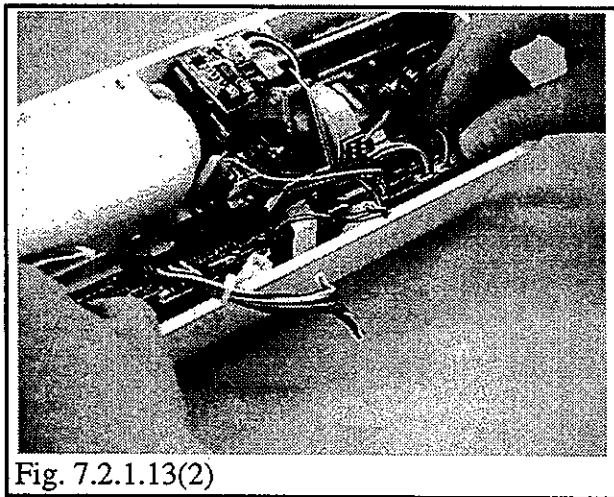
Indicator unit  
(05LA08\*)

### 7.2.1.13 Installing the main board

- (1) Place the main board against the upper case inside such as illustrated below connect the cables to connectors CN2, CN4, CN6, CN7, CN8, CN9, and CN10.



- (2) Set the main board in place, taking care to prevent the 7-segment LED, etc. from getting out of place, and install it with screw (tapping screw, 9-M3×8). After installation, fix the screws with thread lock cement.



- (3) Tie the cables leading to the syringe detecting unit, motor unit, occlusion detecting unit, and nearly empty detecting unit together with tie bands.

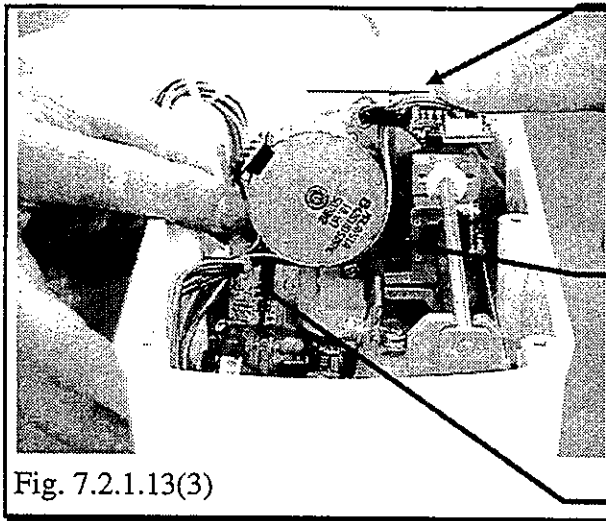


Fig. 7.2.1.13(3)

**Note: Make tied-up cables flat here. Swelling if any may cause interference with the lower case, thus preventing proper occlusion detecting function.**

**Note: Make the cables running on the motor periphery flat here. Swelling if any may cause interference with the driving part, inviting a possibility of breakage to cables.**

Tie band

- (4) Connect the connectors CN3 and CN11 to each other.

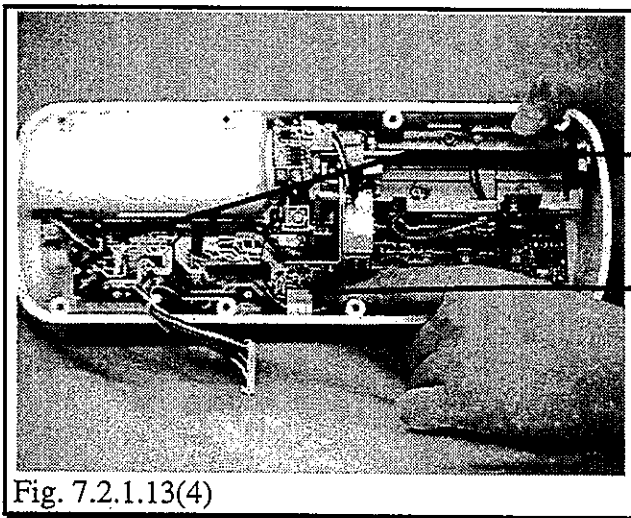


Fig. 7.2.1.13(4)

CN3

CN11

**7.2.2 Reassembling the lower case unit**

**7.2.2.1 Installing the nurse-call board and RS232C board**

- (1) Connect the cables to the connectors CN15 on the RS232C board and CN15 on the nurse-call board. Also, connect the grounding wire from the nurse-call board to CN21 on the communication board. For the RS232C board, attach the connector and connector keep plate with lock spacers, insert the spacers, and fasten the nuts.
- (2) Charge the caps with silicone (KE-348) and put each cap onto the nut and lock spacer thoroughly.

**Note: Never wipe off silicone overflowing the caps.**

Then, install the RS232C board with screw (P-tight, M3×6) and fix the screw with thread lock cement.

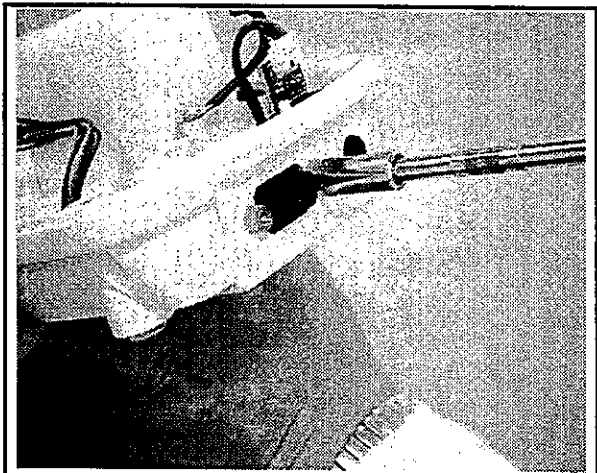


Fig. 7.2.2.1(1)

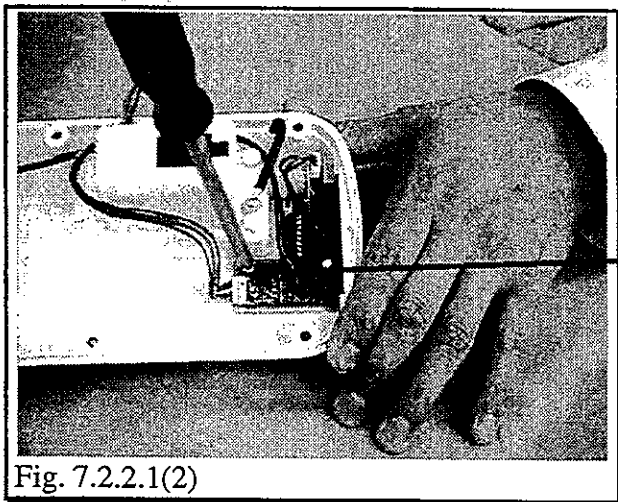
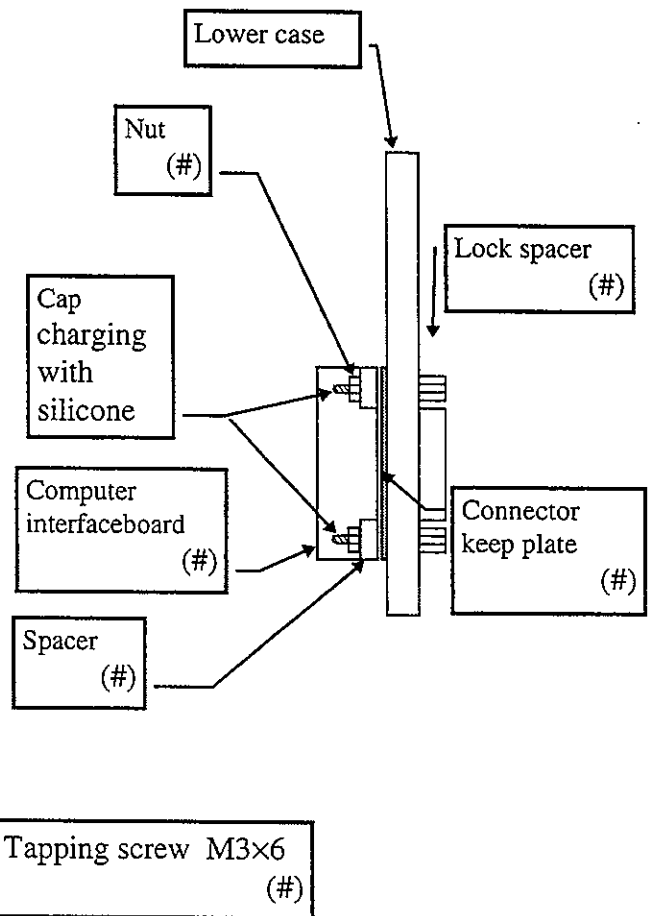
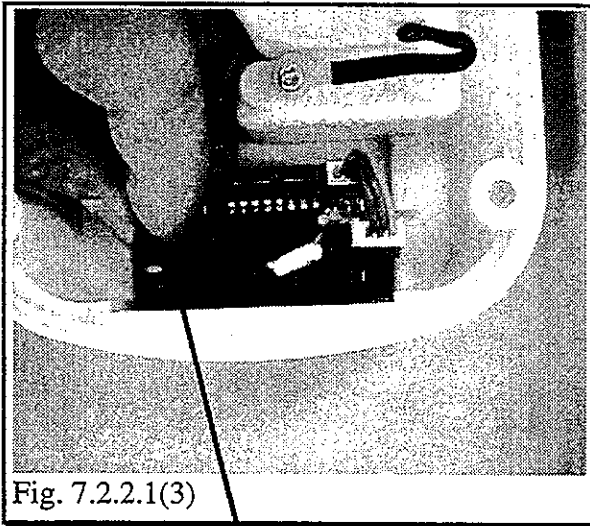
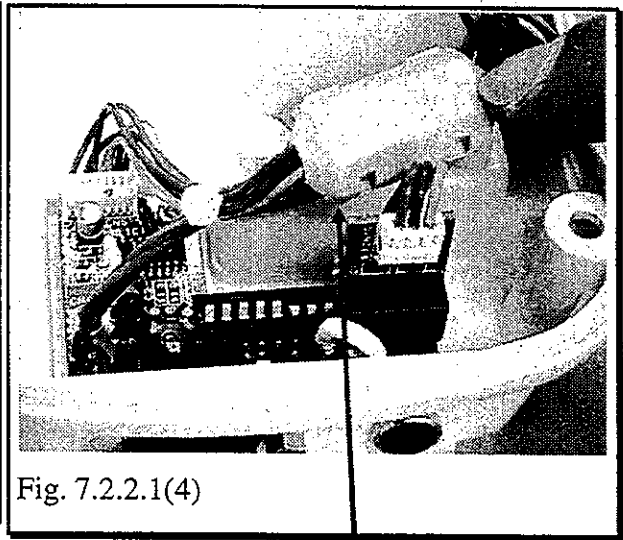


Fig. 7.2.2.1(2)



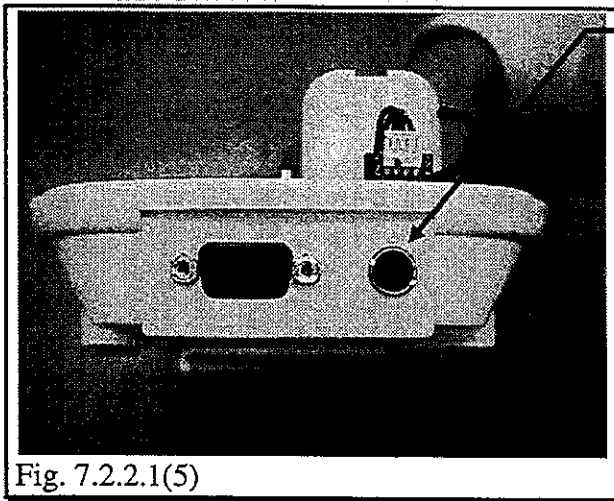


Never wipe off  
overflowing silicone



Ferrite core

(2) Install the nurse-call board with the nurse-call locknut.



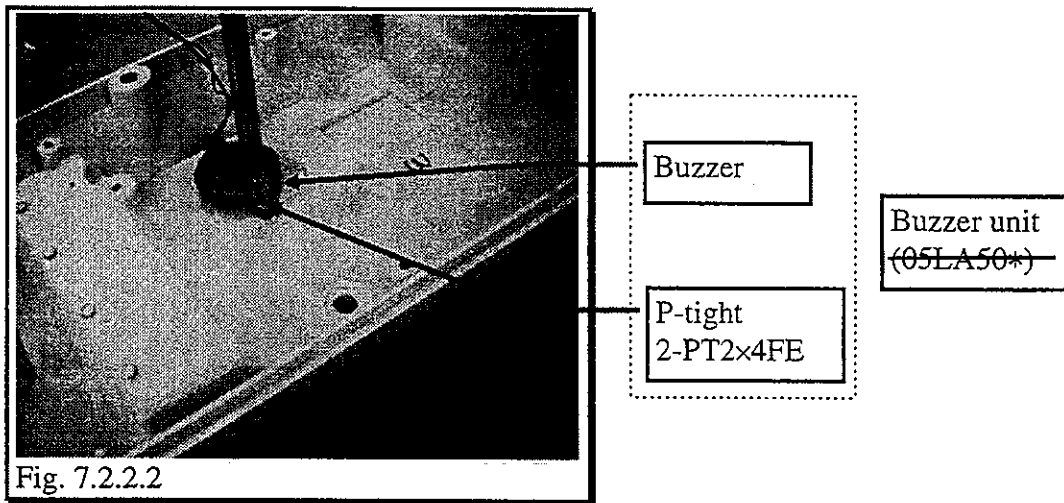
Nurse-call locknut  
(#)

#: Nurse-call board and RS232C board  
(05LA27\*)



**7.2.2.2 Installing the buzzer**

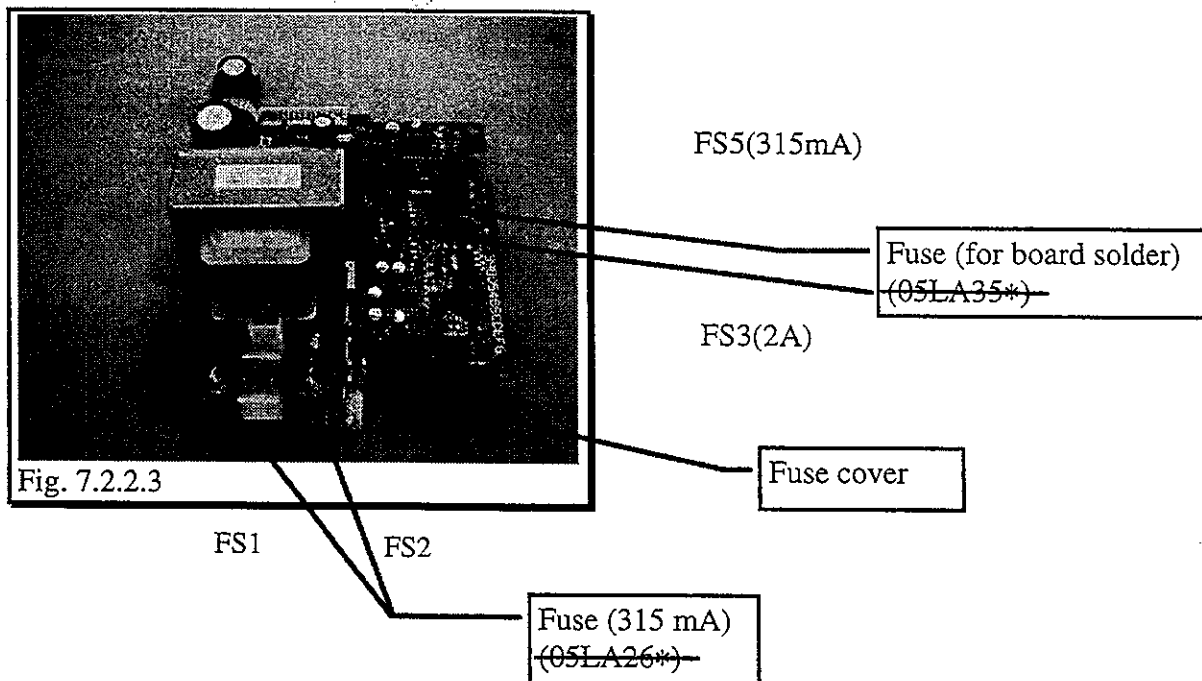
- (1) Install the buzzer unit (05LA50\*) to the lower case as illustrated below with screws (P-tight 2-PT2×4FE). Fix the screws with thread lock cement.



**7.2.2.3 Installing or replacing the fuse**

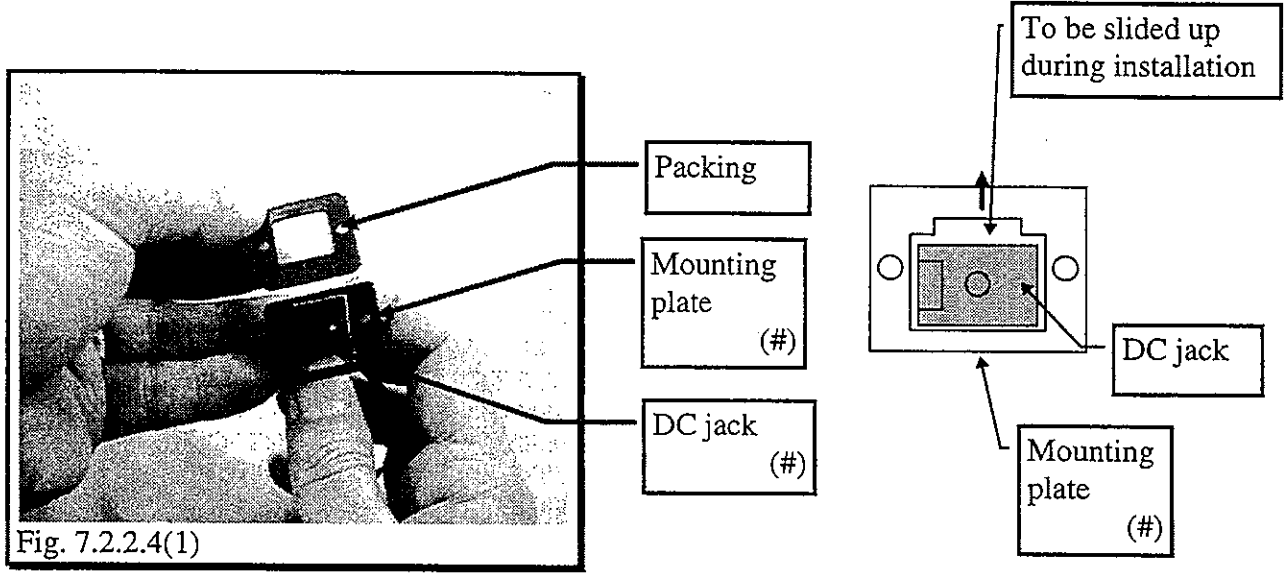
- (1) Check the fuse for blowing out before installation (FS1 and FS2: visual inspection; FS3 and FS5: continuity test). If not blown out, install the fuse and then the fuse cover.

**\* FS3 and FS5 melt down easily by heat. Take care not to heat them excessively during soldering.**

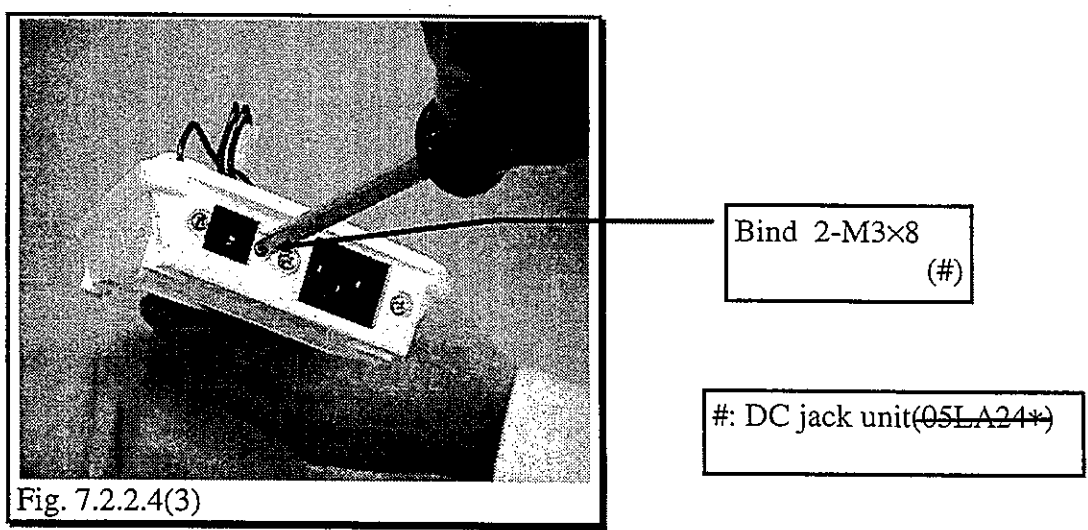


### 7.2.2.4 Installing the DC jack unit

- (1) Attach the DC jack to the mounting plate.

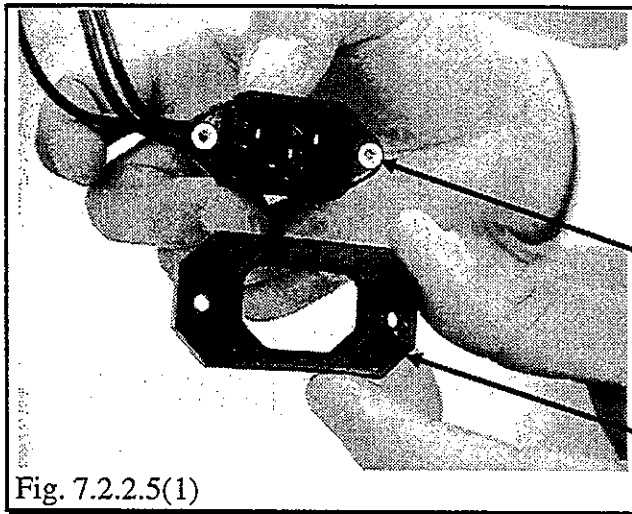


- (2) Fit the mounting plate and packing together to the lower case with screws (bind, 2-M3×8). After installation, fix the screws with thread lock cement (inside).



### 7.2.2.5 Installing the AC inlet

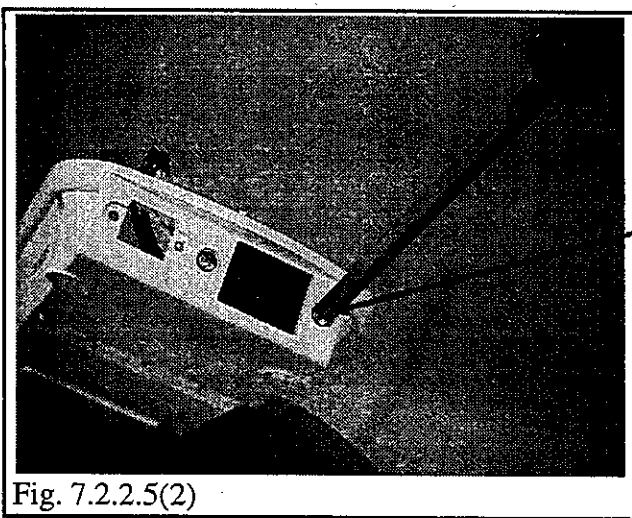
- (1) Put the packing on the AC inlet.



AC inlet  
(05LA33\*)

Packing for AC inlet  
(05LA30\*)

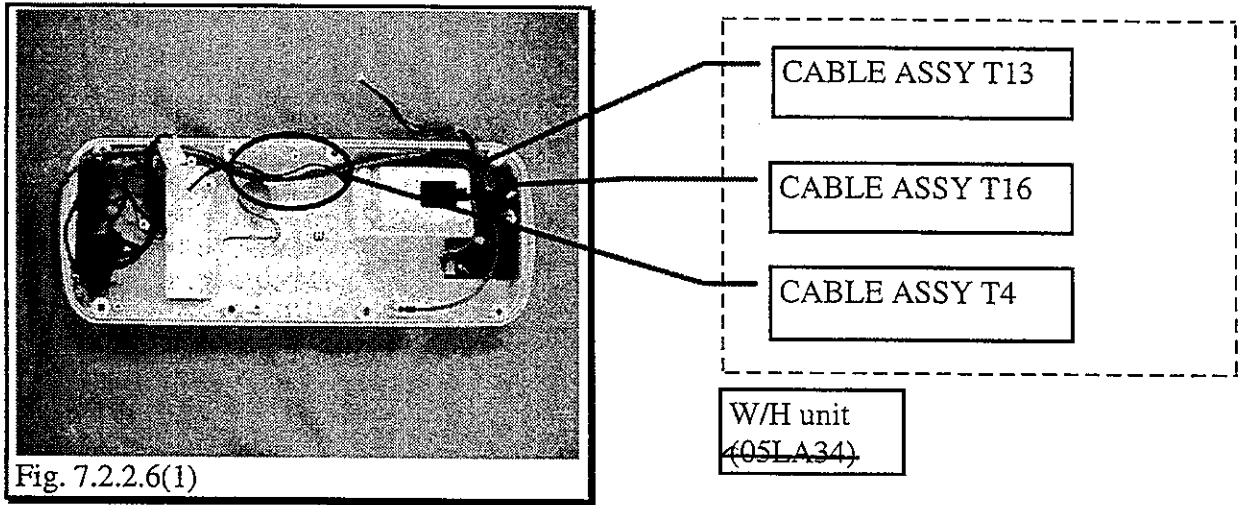
- (2) Fit the AC inlet with its ground terminal down to the inside of lower case and fix it with screws (bind, 2-M3×10) from the outside. After installation, fix the screws with thread lock cement (inside).



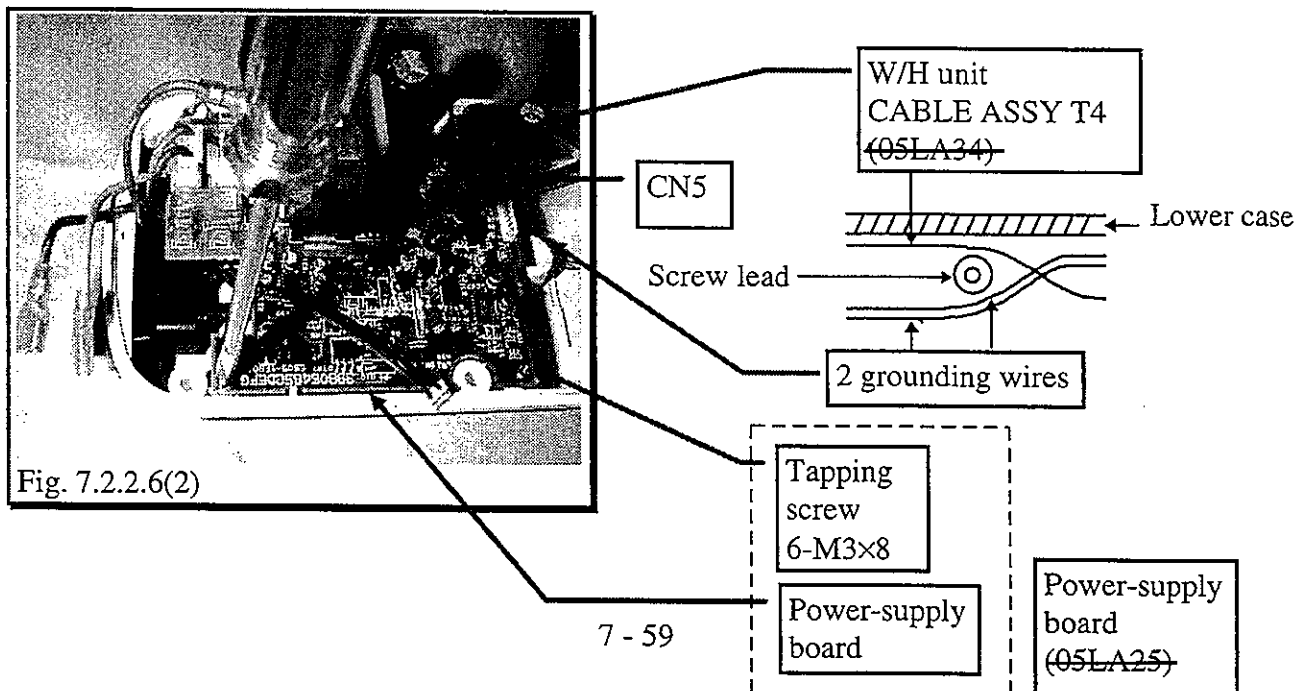
Bind 2-M3×10

**7.2.2.6 Installing the power-supply board**

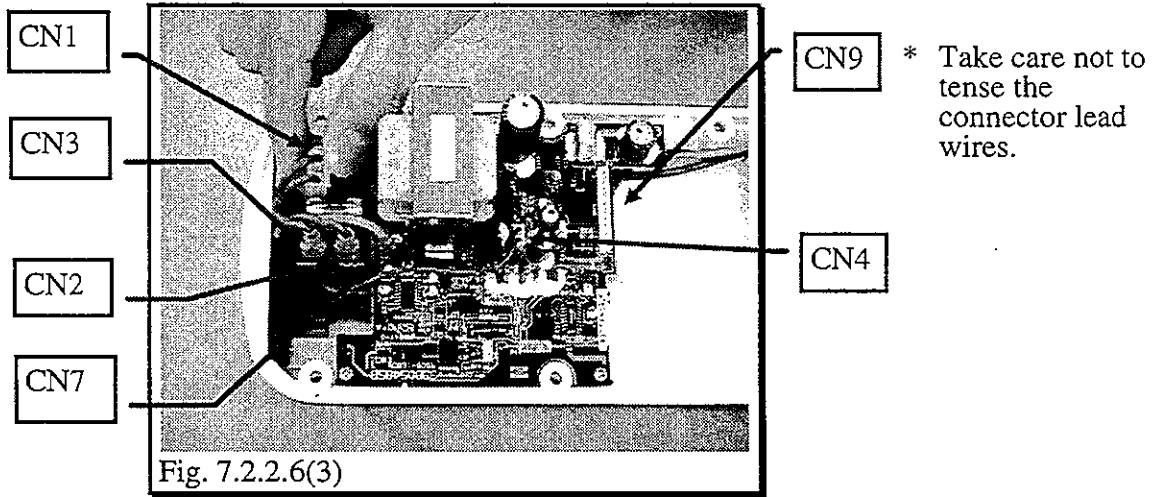
- (1) Extend the battery cable and grounding wires (from the RS232C board and the driving part) (L=520 mm) neatly on the lower case and leave the end of them put together as shown in figure below.



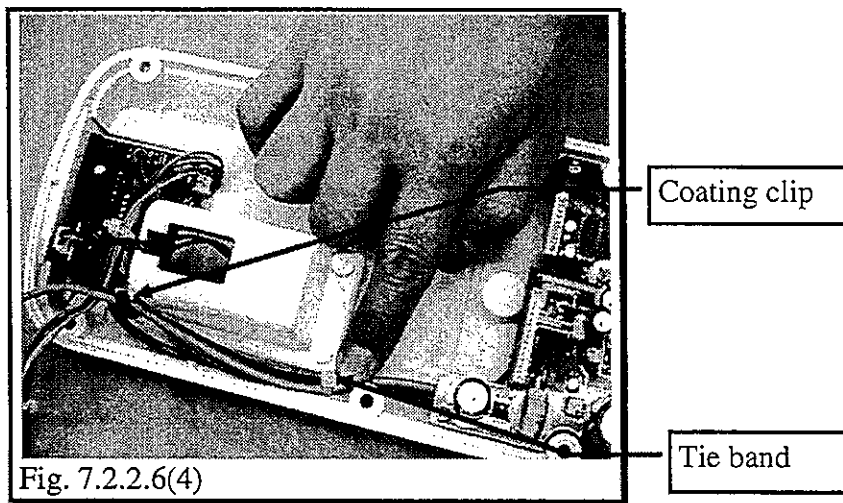
- (2) Pass two grounding wires through in front of and the battery cable at the back of the power-supply board fastening screw lead. After connecting the battery cable to connector CN5, install the power-supply board with screws (tapping screw, 6-M3×8), taking care not to jam the cables. After installation, fix the screws with thread lock cement.



- (3) Connect the connectors CN1, CN2, CN3, CN4 and CN7, CN9.



- (4) After fixing the power-supply board, tie two grounding wires and the battery cable together with tie band and fix the tied-up cables with coating clip. As to the battery cable connector, leave it put into the battery housing until it is connected to the battery later on.



**7.2.3 Uniting the upper and lower cases**

- (1) Connect the grounding wire from the lower case unit to the drive unit with screw (Sems, M4×6).

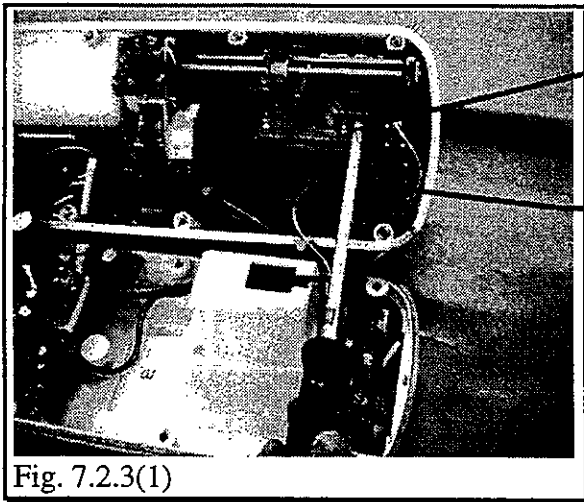


Fig. 7.2.3(1)

- (2) Placing the upper-case unit and lower-case unit as shown in figure below, engage the projection of case seal rubber with the recess of lower case on both right and left sides, and connect the main board cable connector (CN2) to the power-supply board connector (CN6).

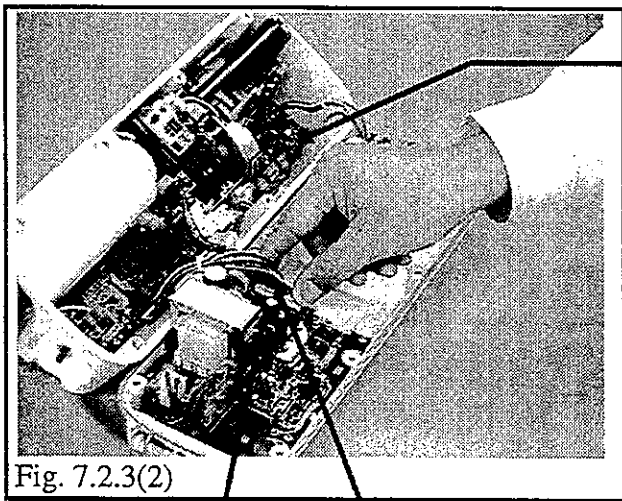


Fig. 7.2.3(2)

CN6

W/H unit  
CABLE ASSY T5  
(06LA534\*)

Upper case unit  
exclusive for  
TE\*311N(06LA501A\*)  
TE\*311C(06LA501B\*)  
or  
TE\*312C (06LB501\*)

Case seal  
rubber  
(05LA28\*)

Lower case unit  
TE\*311N(06LA520\*)  
or  
TE\*311C(06LA519A\*)  
TE\*312C(06LA519\*)

- (3) Connect the RS232C board cable to the connector CN5.

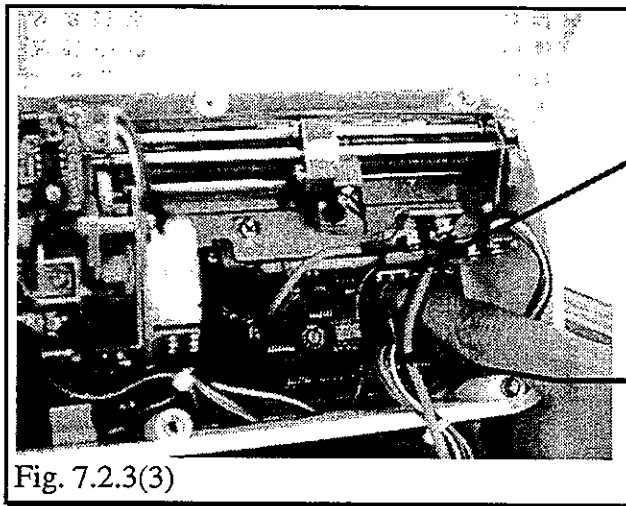


Fig. 7.2.3(3)

CN5

W/H unit  
CABLE ASSY T12  
(06LA534\*)

- (3) Join the upper and lower cases together, taking care to prevent cables from being jammed between the upper and lower case units or in the mounted parts, and fasten the case unit with screws (pan-head, 8-M4×10) and screw packings.
- \* First tighten 4 inside screws in the diagonal order and, then, tighten 4 remaining screws in the diagonal order.

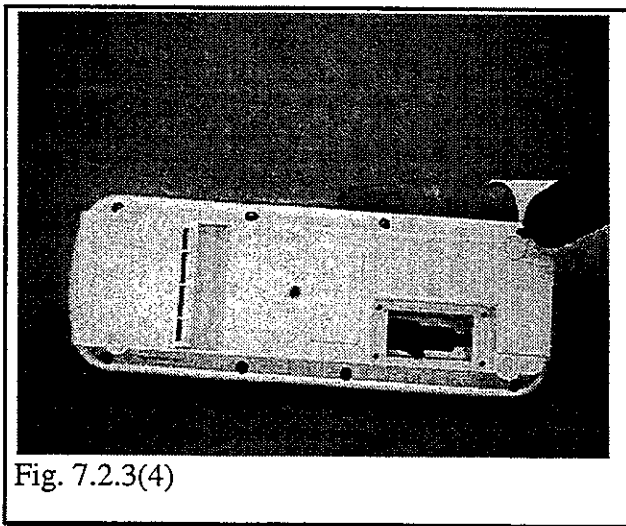


Fig. 7.2.3(4)

Pan-head  
M4×10

Packing for screw  
(05LA29\*)



### 7.2.4 Adjusting the plunger disengagement position

- (1) Remove the slider cover , and grasp the clutch to project the plunger / clutch disengagement detection pin as below figure.

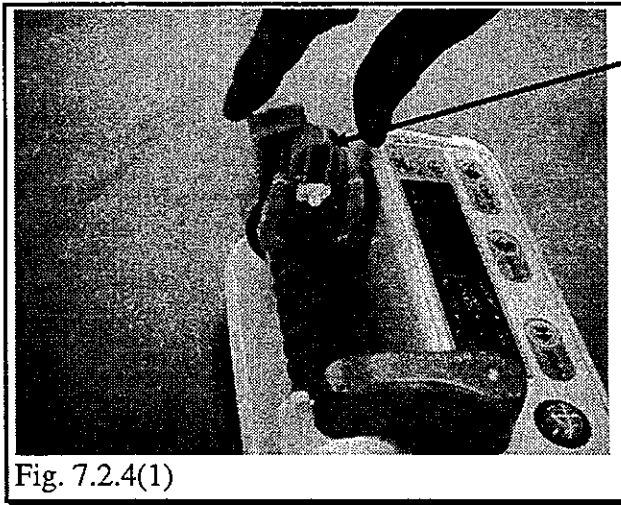


Fig. 7.2.4(1)

Pinch the clutch to project the plunger disengagement detection pin.

- (2) By adjusting the set screw , align the lowest part of the sensor arm and the lowest end of the photo-interrupter of the plunger / clutch disengagement detection.

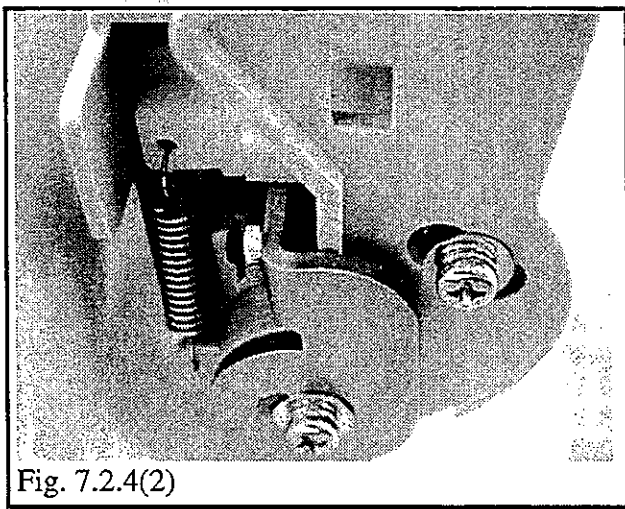
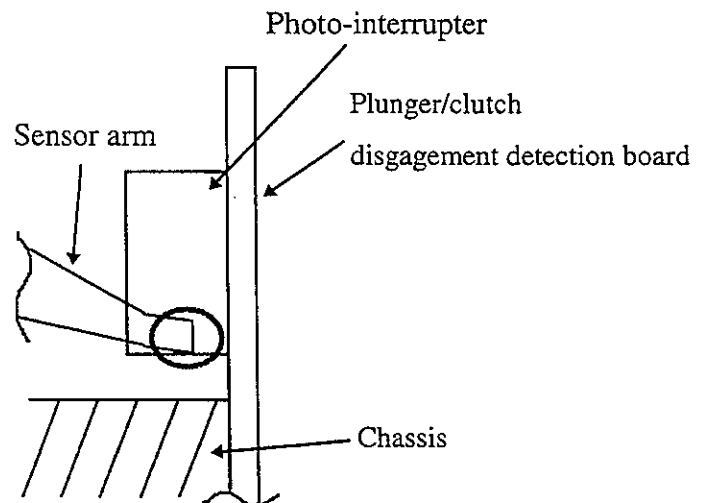


Fig. 7.2.4(2)



- (3) Turn on the power switch and check that the plunger/clutch disengagement lamp blinks under the state mentioned above and that the lamp goes off when the plunger disengagement detection pin is pushed back.

If any abnormality is found, readjust the installed condition referring to the section "Installing the plunger/clutch disengagement detection unit."

- (4) Grasp the clutch to open the clamp lever. Make sure that the clamp lever does not interfere with the upper case

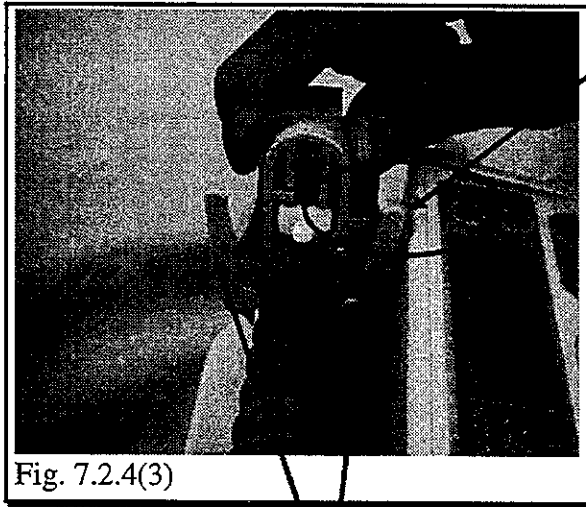


Fig. 7.2.4(3)

Grasp the clutch to open the clamp lever and check for interference with the upper case.

Clamp levers

- (5) Put the slider cover onto the slider while opening the clamp lever. Fix the slide cover with screw (pan-head, M2.5x5).

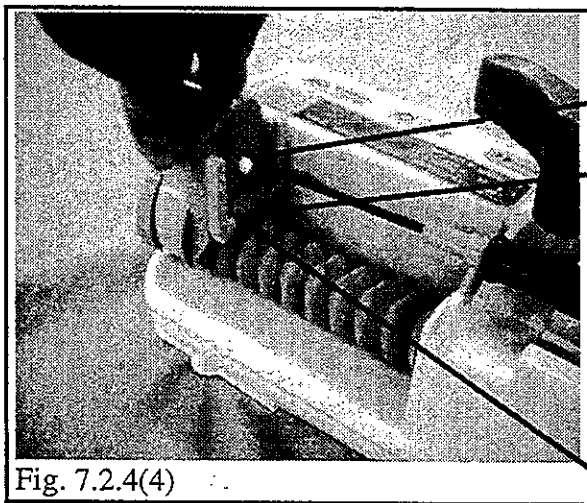


Fig. 7.2.4(4)

Slider cover

Pan-head  
M2.5x5

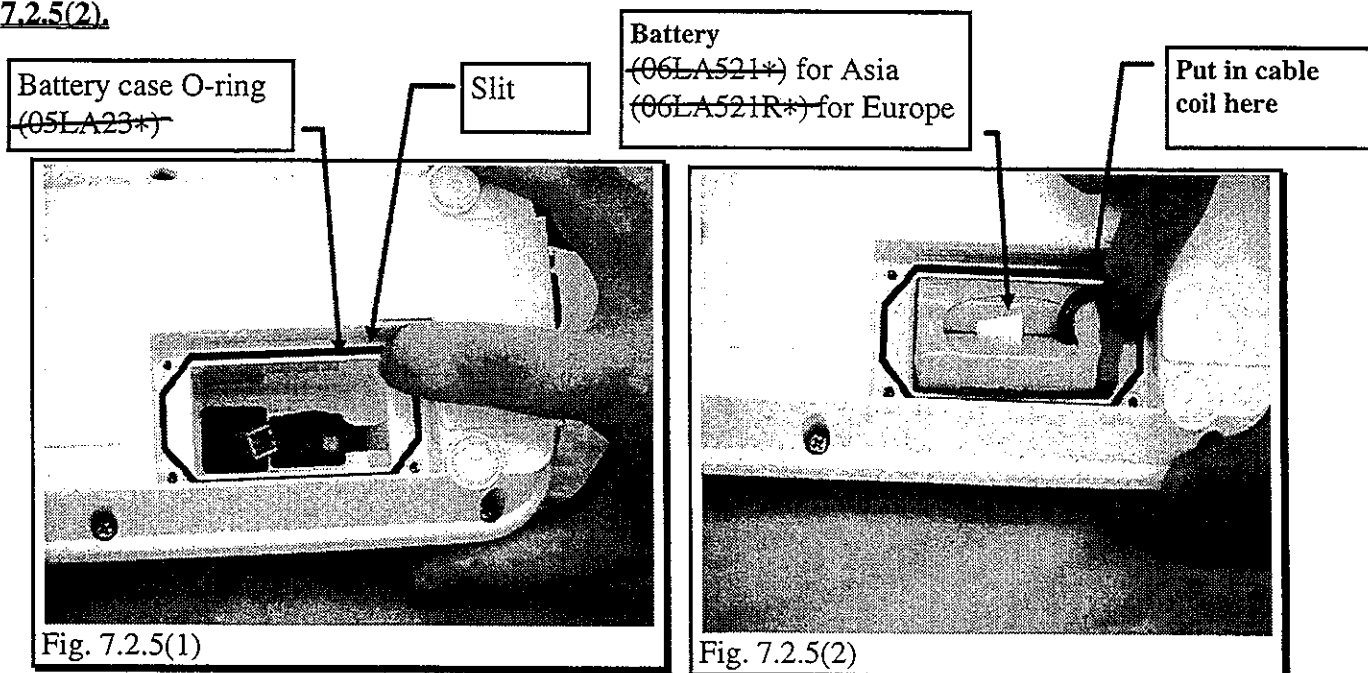
Slider cover  
(06LA511\*)

Plunger  
disengagement  
detection pin

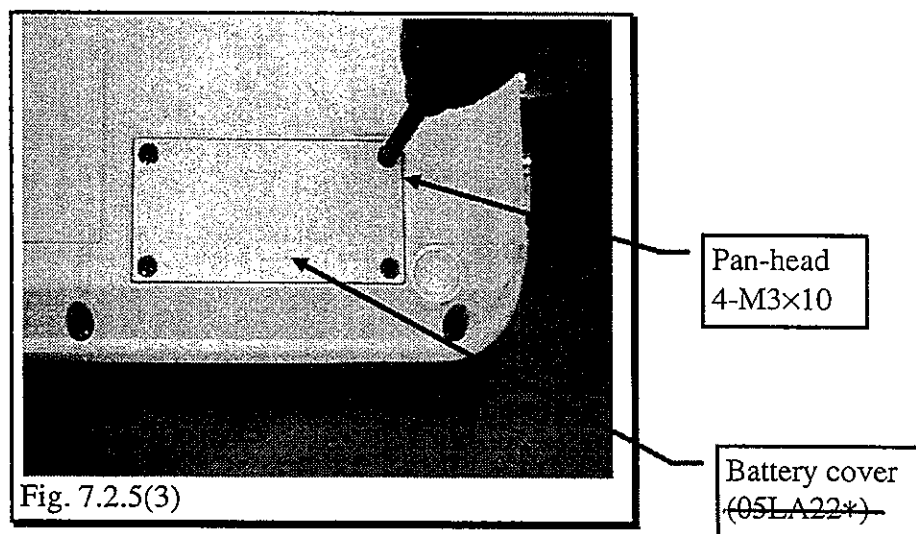
### 7.2.5 Mounting the battery

- (1) Set the battery-case O-ring in the battery case at the bottom of the pump body.
- (2) Connect the battery connector and mount the battery in place as shown in figure 7.2.5(2).

**Note:** Coil the rest of cable and put it into space left in the battery case as shown in figure 7.2.5(2).

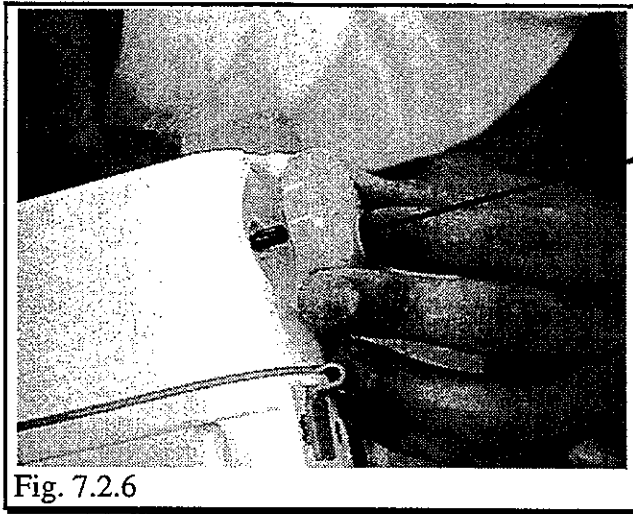


- (3) After confirming that the battery-case O-ring is placed in the slit, install the battery cover, taking care not to jam any cable in the cover. Fasten the cover with screws (pan-head, 4-M3×16).



**7.2.6 Fitting the dial unit**

- (1) Fit the dial unit to the pump body. After installation, check for smooth rotation of the dial unit.



Dial unit  
(05LA04\*)

### 7.3 Adjustment Procedure

Whenever the syringe pump TE-311/312 has been disassembled or reassembled, be sure to perform adjustment according to the procedure shown in the List of checks and adjustments accompanying disassembly, assembly and replacement of 7. Disassembly, reassembly, and adjustment.

If the necessary adjustments are neglected, it will be hard to ensure normal operation of various kinds of alarming functions and the battery charge monitor.

**Note: Once the "START" button is pushed, all data stored are lost. When skipping the adjustment items from one to another, push the "STOP" button several times repeatedly.**

### 7.3.1 Adjusting the syringe detection function

- (1) Remove the battery cover from the syringe-pump body bottom. Without disconnecting the connector, take out the battery. Now, the rotary switch (S1) on the main board becomes accessible through the window at the depth of vacancy from which the battery removed. Turn the rotary switch to set it to "D".

Note: When turning the rotary switch, keep the current pump setting condition in record and be sure to restore the original set condition after adjustment.

Also, whenever the battery connector is disconnected, be sure to take the necessary measures, referring to "Periodical inspection and replacement of battery" given in the instruction manual.

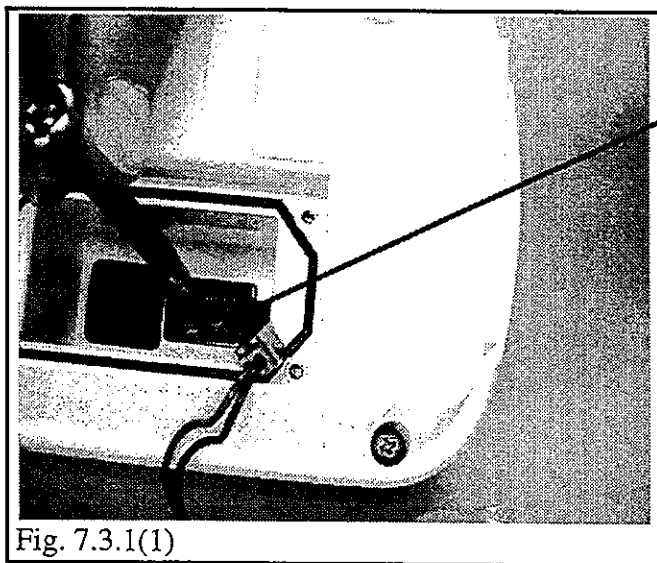
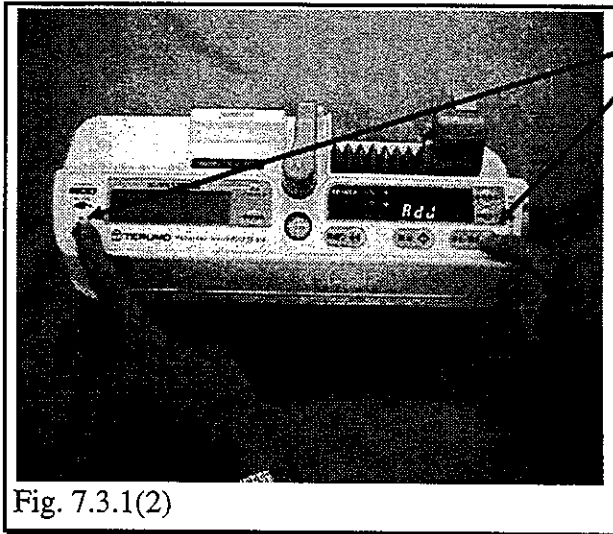


Fig. 7.3.1(1)

- (2) With the "STOP/SILENCE" button kept pressed, turning the power switch ON, will cause the "Flow rate/ delivery limit/ Volume delivered" display to indicate "Adj. " and the "Syringe mL" lamp to light at "10".



With "STOP" button pressed, switch on the power. After confirming that "Adj" appears on the display, release the switch buttons.

Fig. 7.3.1(2)

- (3) Pull the clamp up, set the smaller one of a set of jigs for syringe-position & nearly empty detection adjustment (05LA42\*), and gradually lower the clamp. Push "START" button to write the adjustment value obtained.

**Note: Lower the clamp gradually; lowering in haste would cause an error of adjustment.**

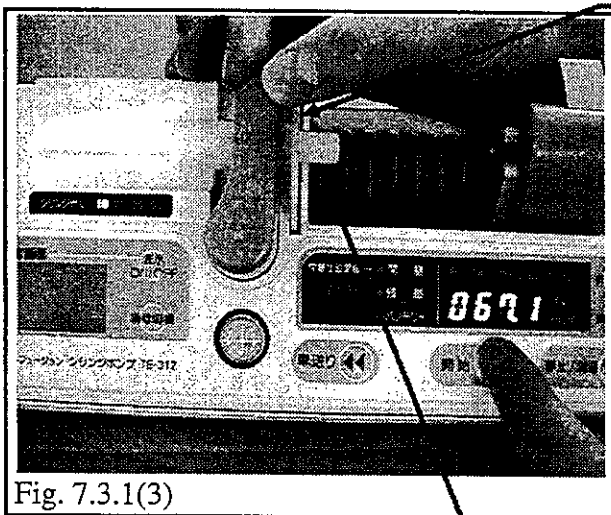
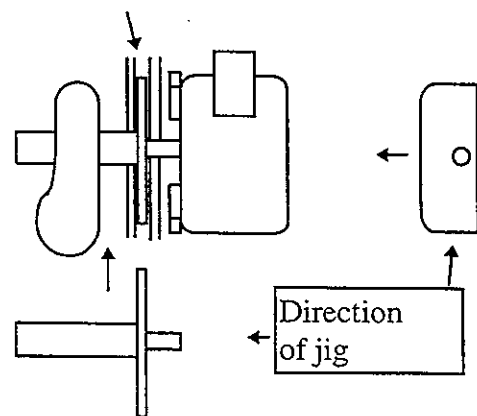


Fig. 7.3.1(3)

**Note: With the thin side of the jig put on the slider side, set the flange accurately.**



Syringe/nearly empty detection adjustment jig (small)  
(05LA42\*)

- (4) Push "START" button, write adjustment value obtained, and indication of the "Syringe mL" lamp will automatically change to "20".

After the indication is changed, similarly write the adjustment value obtained by using the larger one of the jig set (05LA42\*). As the adjustment value is written by pushing the "START" button, adjustment is complete.

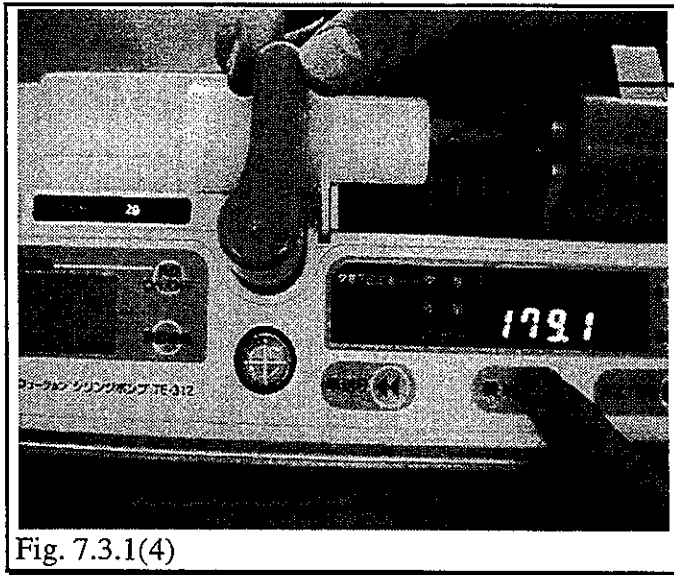


Fig. 7.3.1(4)



**7.3.2 Adjusting the nearly empty detection function**

- (1) As syringe detection has been adjusted, the nearly empty detection adjustment mode comes into effect.

Check that the "Flow rate" lamp is lit.

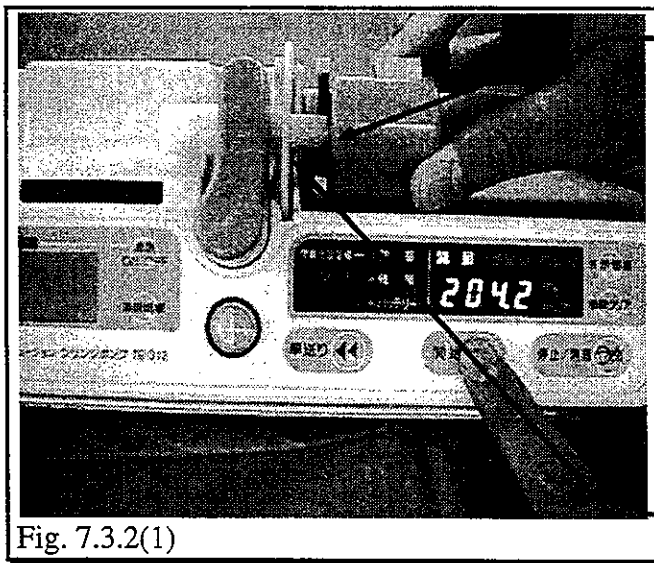
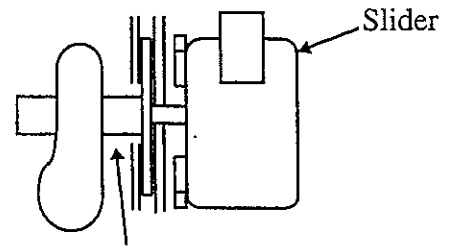


Fig. 7.3.2(1)

Grasp the clutch and move the slider until it comes into contact with the jig.



Syringe/nearly empty detection adjustment jig

Syringe/nearly empty detection adjustment jig (small)  
(05LA42\*)

- (2) Pull the clamp up to set the smaller one of a set of jigs for syringe position & nearly empty detection adjustment (05LA42\*). Then, grasp the clutch and move the slider until it comes into contact with the jig.

Push "START" button to write the adjustment value obtained.

- (3) As the adjustment value is written, "Volume delivered" lamp is lit.

Making sure that the "Volume delivered" lamp is going on, similarly write the adjustment value obtained by using the larger one of the jig set (~~05LA42\*~~).

As the adjustment value is written by pushing the "START" button, adjustment is complete.

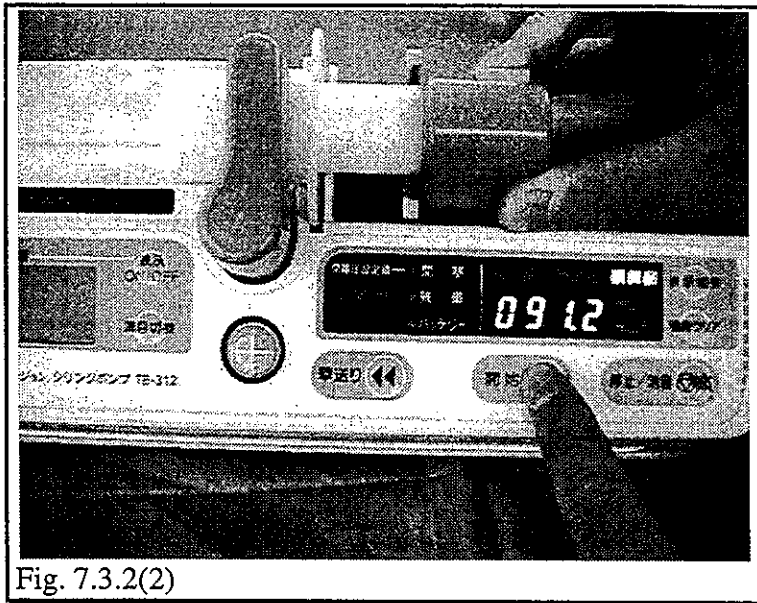
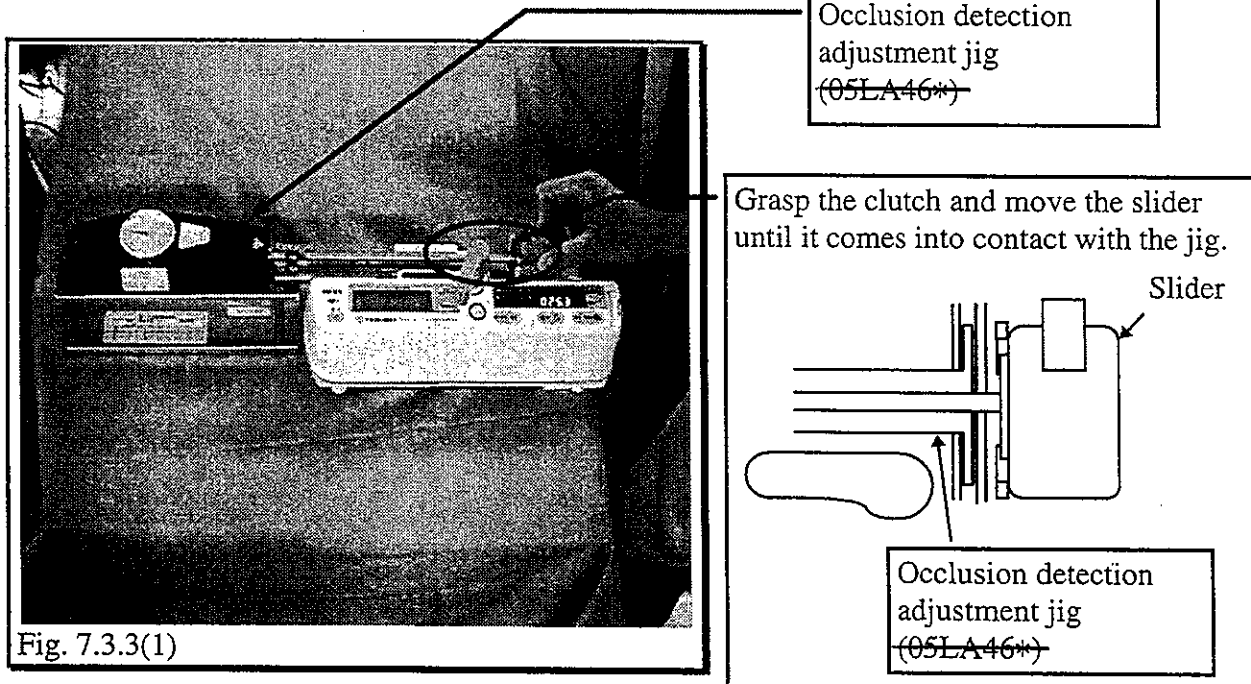


Fig. 7.3.2(2)

### 7.3.3 Adjusting the occlusion detection function

- (1) As nearly empty detection has been adjusted, the occlusion detection adjustment mode comes into effect.

Check that the "Occlusion pressure set value" lamp is lit in "L".



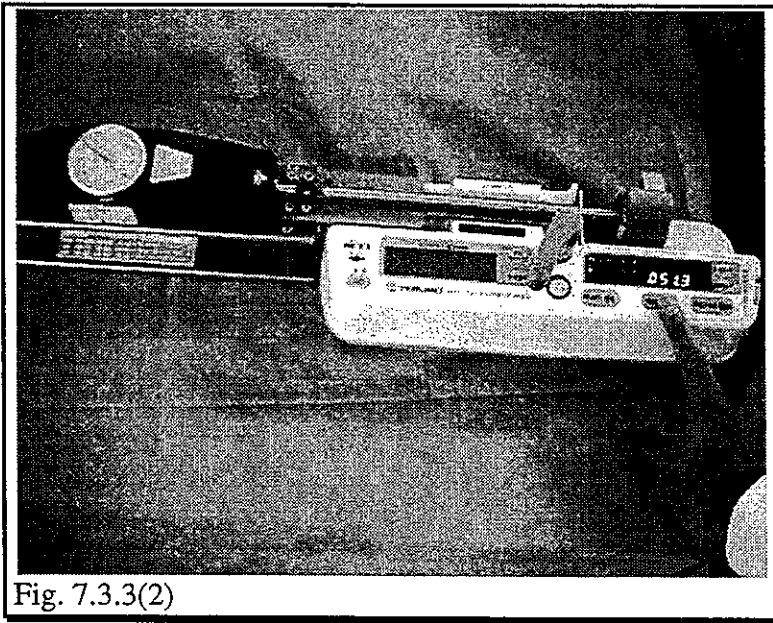
- (2) After making sure of lighting of the mode lamp, pull the clamp up to set the occlusion adjust jig (05LA46\*). Grasp the clutch and move the slider until it comes into contact with the jig.

**Important: Never tamper with the volume on the occlusion detection board which has been properly adjusted in the factory. The service parts are also adjusted before shipment.**

**Important: Align the push-pull shaft with the pump shaft.**

- (3) Push "PURGE" button one time to move the slider. As the value of 9.81N (1 Kgf) is obtained with the jig, push the "PURGE" button again to stop the slider. Then, push "START" button to write the adjustment value obtained.

\* The "PURGE" button serves as the motor start/stop switch in this mode.



- (4) After the adjustment value is written, lighting of the "Occlusion pressure set value" lamp automatically changes to "M".

In the same manner as before, push "PURGE" button one time to move the slider.

As the value of 49.0N (5 Kgf) is obtained with the jig, push the "PURGE" button again to stop the slider. Then, push "START" button to write the adjustment value obtained.

- (5) After the adjustment value is written, lighting of the "Occlusion pressure set value" lamp automatically changes to "H".

In the same manner as before, push "PURGE" button one time to move the slider.

As the value of 88.3N (9 Kgf) is obtained with the jig, push the "PURGE" button again to stop the slider. Then, push "START" button to write the adjustment value obtained.

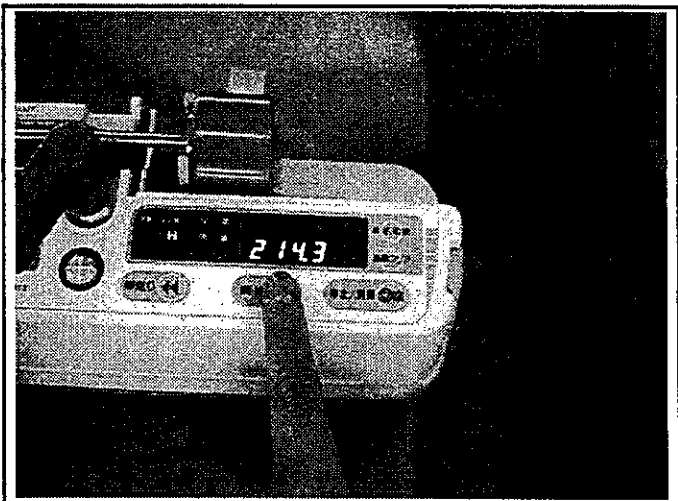


Fig. 7.3.3(3)

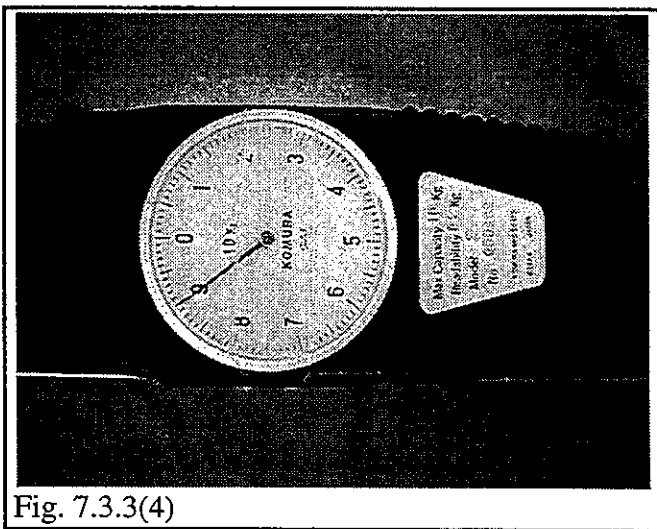
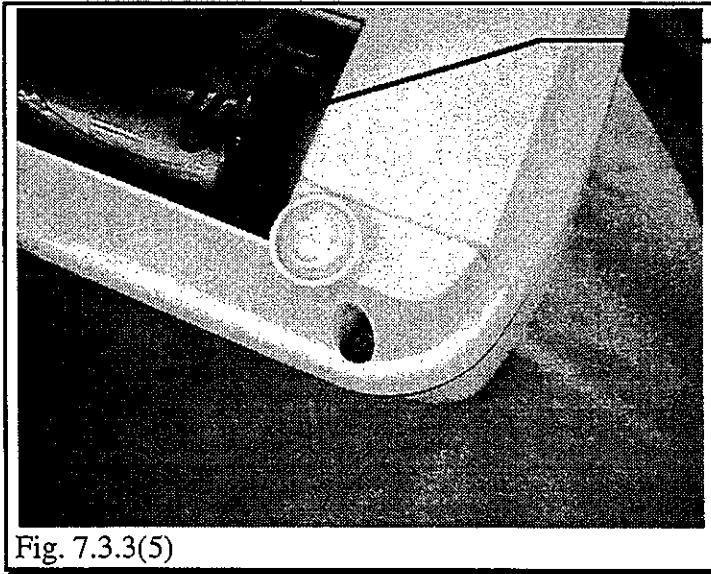


Fig. 7.3.3(4)

- (6) Now all necessary adjustments have been completed. Turn the power switch to OFF and set the rotary switch in the original position. Mount the battery in the battery housing and put the battery cover back.

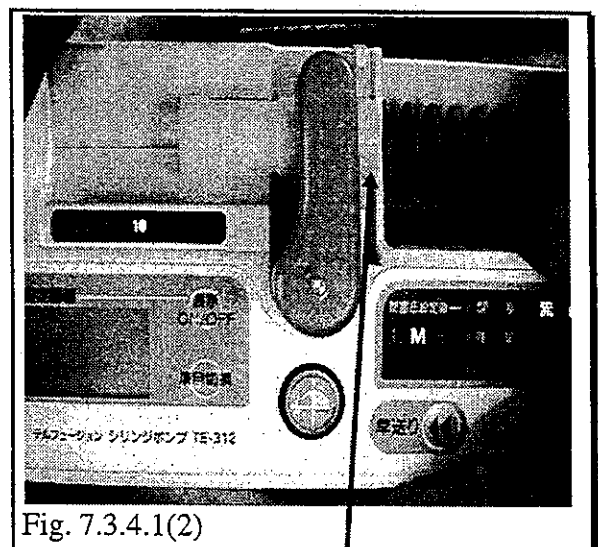
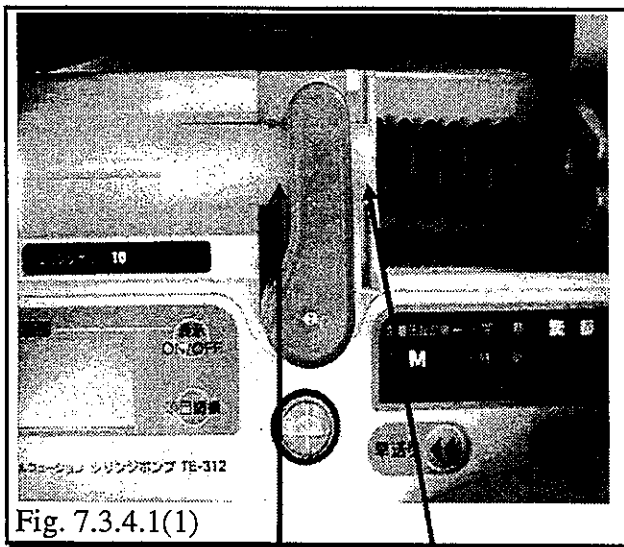


**Note: For proper installation of the battery cable, refer to 7.2.5 Installing the battery.**

**7.3.4 Checking for proper adjustments**

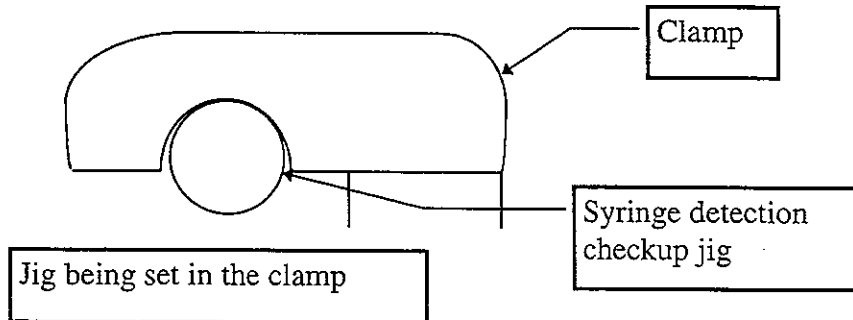
**7.3.4.1 Checking for syringe size detection function**

- \* Set the "Syringe maker" selection to Terumo. 12
  - \* Since the sensor output is in linear proportion to syringe diameter as shown by the operational principle in 5.2.2.12, syringe detection function should be checked up by setting the "Syringe maker" to Terumo. 12
- (1) Turn the power switch to ON. Set the syringe size detection checkup jig (05LA41\*) (for 10 mL) to the clamp. Make sure that the [10 mL] lamp lights up, regardless of which side of the jig faces the slider; the thin side or thick side.



Syringe detection checkup jig (05LA41\*)

Note: When setting the jig, take care not to allow it to override here.



- (2) Similarly, set the other syringe detection checkup jigs (~~05LA41\*~~) (for 20 mL, 30 mL and 50 mL) to the clamp, one after another, and make sure that the corresponding lamps light up properly.

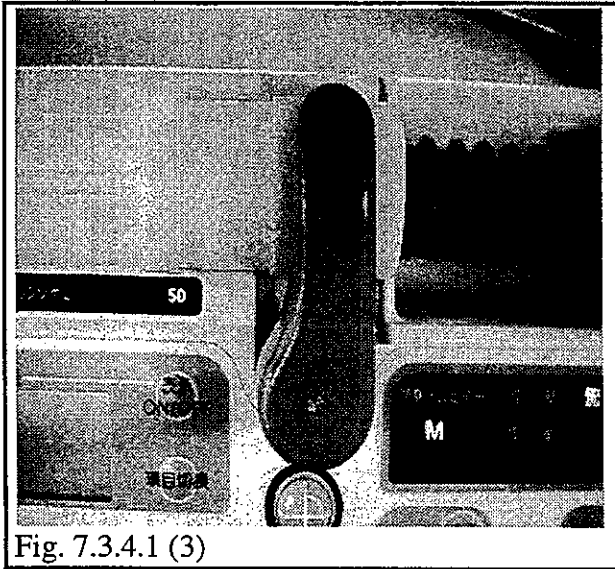


Fig. 7.3.4.1 (3)

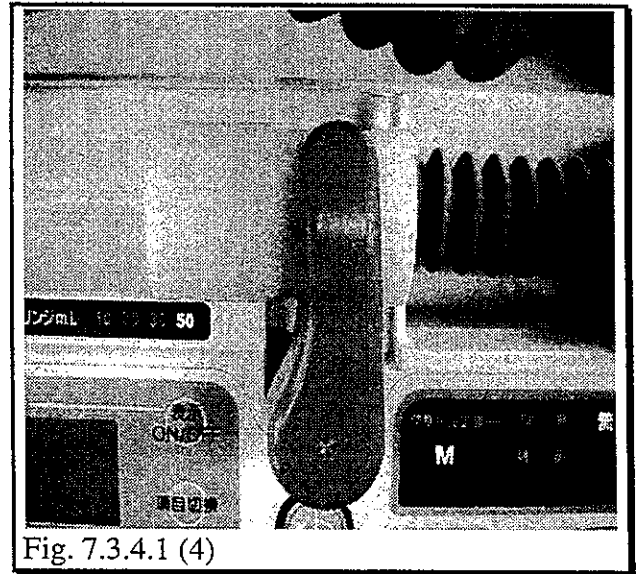
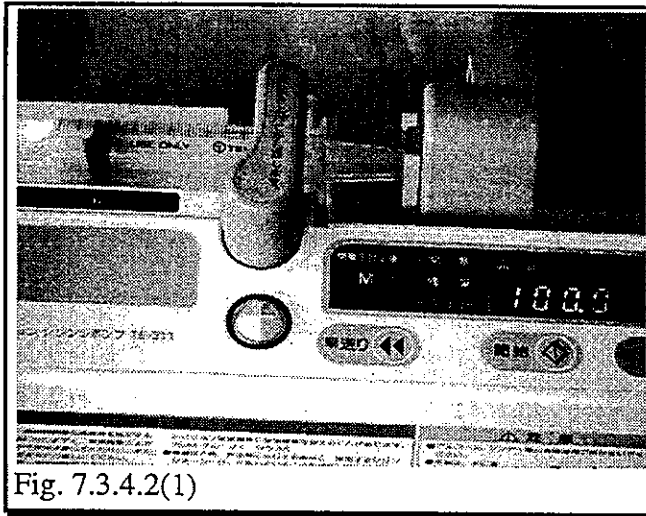


Fig. 7.3.4.1 (4)

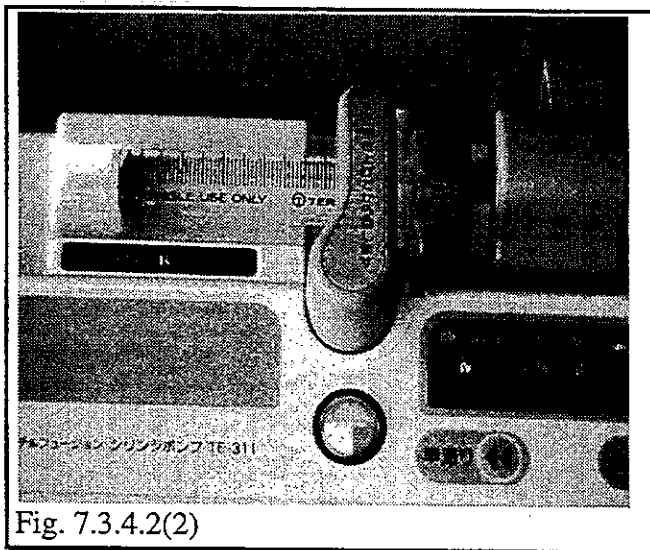


### 7.3.4.2 Checking for nearly empty detection function

- (1) With the plunger of a 10 mL syringe drawn to near the 5 mL position, set the syringe in the clamp. Grasp the clutch and advance the slider until it touches the plunger.



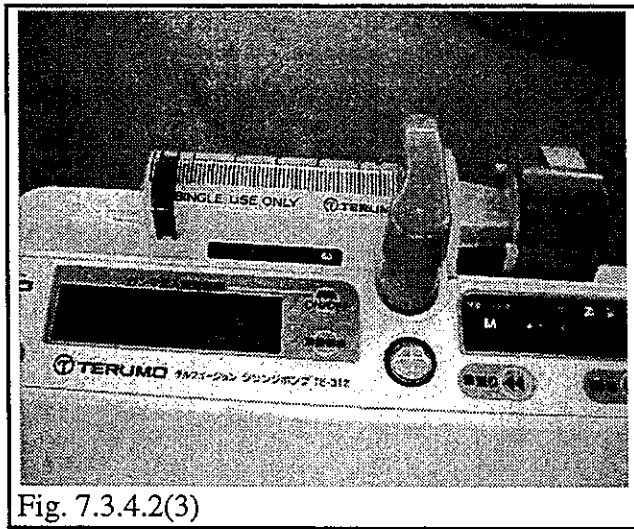
- (2) As the slider comes into contact with the plunger, start the pump at a flow rate of 50 - 100 mL/h until the nearly empty alarm occurs. Visually check the syringe position at which alarm is made.



\* The nearly empty alarm position is dependent on syringe size:

Syringe size	Nearly empty alarm position
10	0.5mL (by the graduation on the syringe)
20, 30, 50	1.0 mL

- (3) Similarly, set the other sizes of syringes (20 mL, 30 mL and 50 mL) to the clamp, one after another, and make sure that nearly empty alarm is made properly for each syringe size.



**7.3.4.3 Checking for occlusion detection function**

- (1) When using the occlusion adjustment jig for checkup
  - \* Set the "Syringe maker" selection to TERUMO. 12.
  - \* Since the sensor output is in linear proportion to slider load as shown by the operational principle in 5.2.2.11, occlusion detection function should be checked up at about three points using a load of 1 - 9 Kgf.
- 1) Set the occlusion adjustment jig (05LA46\*) in the pump body. Grasp the clutch and move the slider until it touches the jig.

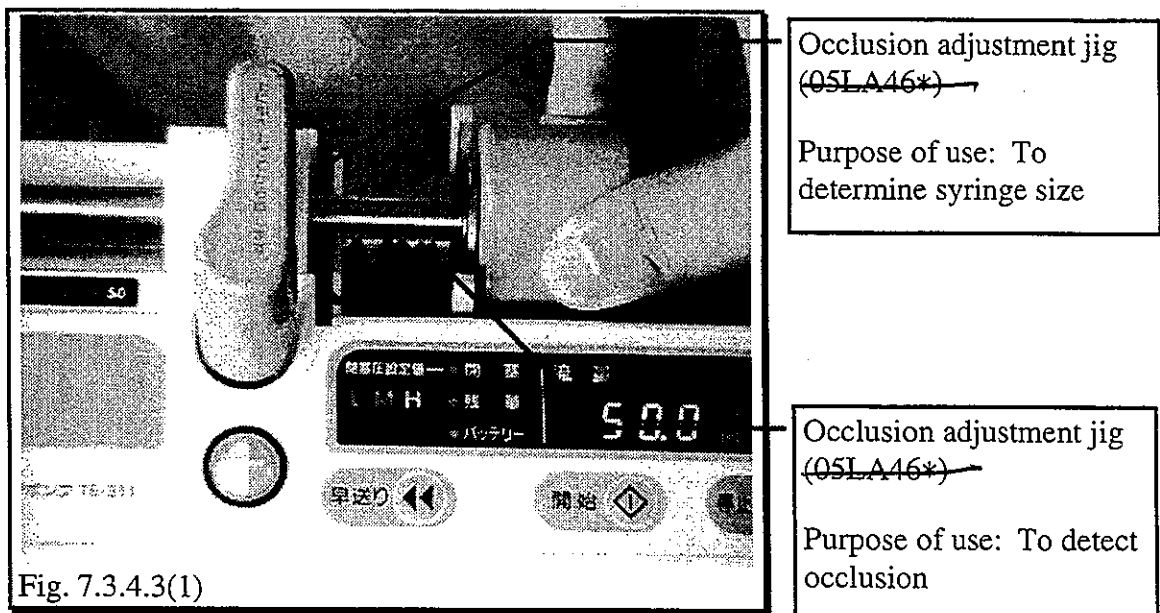


Fig. 7.3.4.3(1)

- 2) Set the occlusion pressure and flow rate to the values shown in table below and perform Purging to the target values shown. Push the [START] button to check for proper action of occlusion alarm.

Syringe size [mL]	Occlusion pressure set value	Flow rate set value [mL/h]	Target of fast feed [N] ([Kgf])
10	L	30	4.90 (0.5)
30	M	30	19.6 - 24.5 (2.0 - 2.5)
50	H	50	24.5 - 63.7 (6.0 - 6.5)

\* Occlusion pressure set value cannot be changed while an alarm is made. Release the alarm state before making a change.

- 3) Make sure that the value of load at which an occlusion alarm occurs is within the specified range.

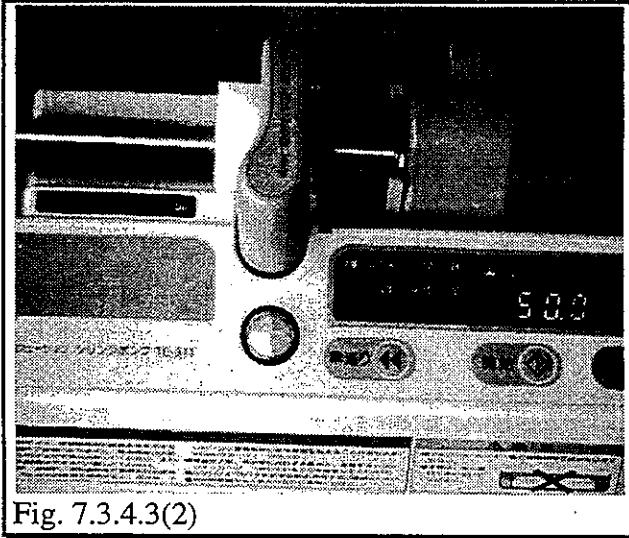


Fig. 7.3.4.3(2)

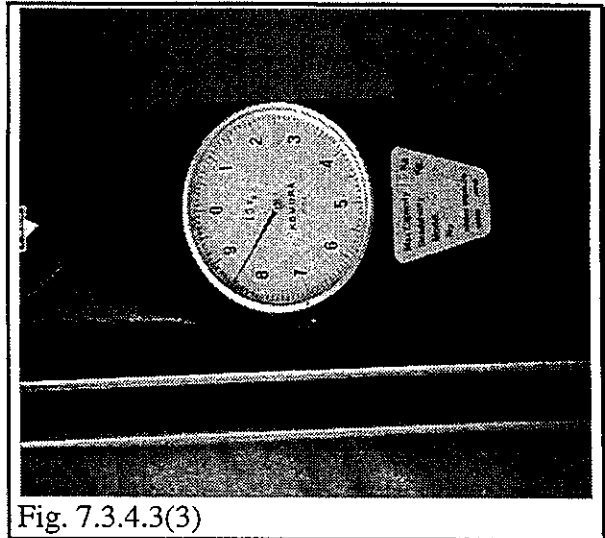


Fig. 7.3.4.3(3)

Syringe size [mL]	Occlusion detection load [N] ([Kgf])
10	10.1 - 15.2 (1.03 - 1.55)
30	28.6 - 40.0 (2.92 - 4.08)
50	64.6 - 100.3 (6.59 - 10.23)

If any out-of-range occlusion load is found, perform readjustment according to the procedure given in **7.3.3 Adjusting the occlusion detection function.**

(2) When using the pressure gauge for confirmation of settings.

- 1) Connect a 50 mL syringe (filled with 20 - 30 mL of water) and a pressure gauge to each other with a tube (approx. 50 cm). Set the syringe in the clamp. Grasp the clutch and move the slider until it touches the plunger.

Note: For this confirmation of setting procedure, be sure to use only a new syringe. (Used syringes are not suitable for this purpose because it may bring about inaccurate detection of occlusion testing.)

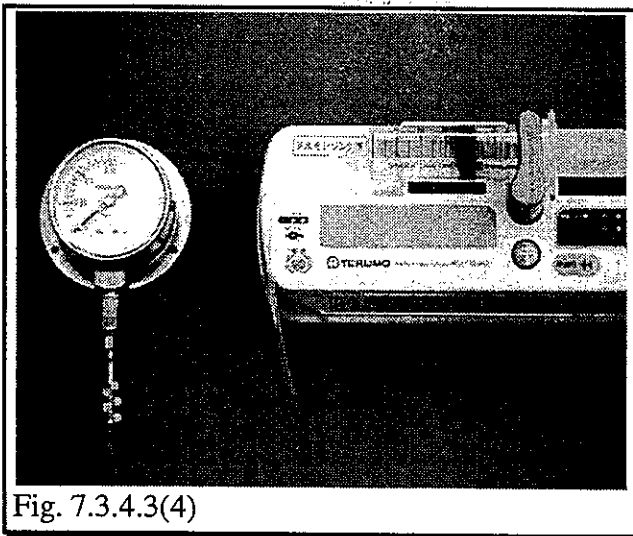


Fig. 7.3.4.3(4)

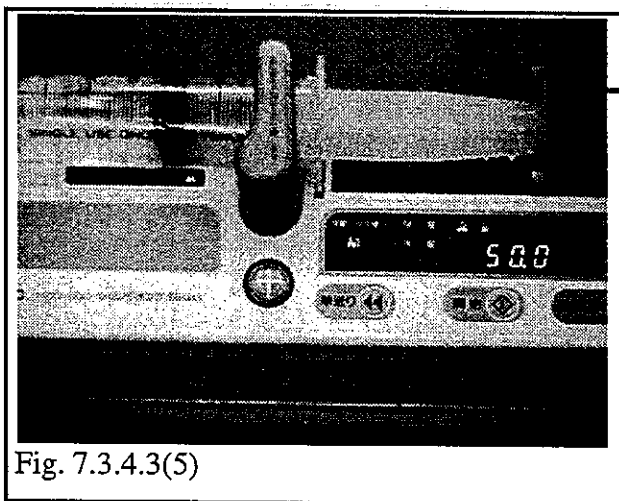


Fig. 7.3.4.3(5)

\* Move the slider until it comes into contact with the syringe.

- (2) Set the occlusion pressure and flow rate to the values shown in table below and start the pump until an alarm occurs.

Syringe size [mL]	Occlusion pressure set value	Flow rate set value [mL/h]	Occlusion detection pressure [KPa] ( [Kgf/cm <sup>2</sup> ] )
50	M	50	53.4 - 80.0 (0.54 - 0.82)

- (3) Make sure that the value of pressure at which a occlusion alarm occurs is within the specified range.

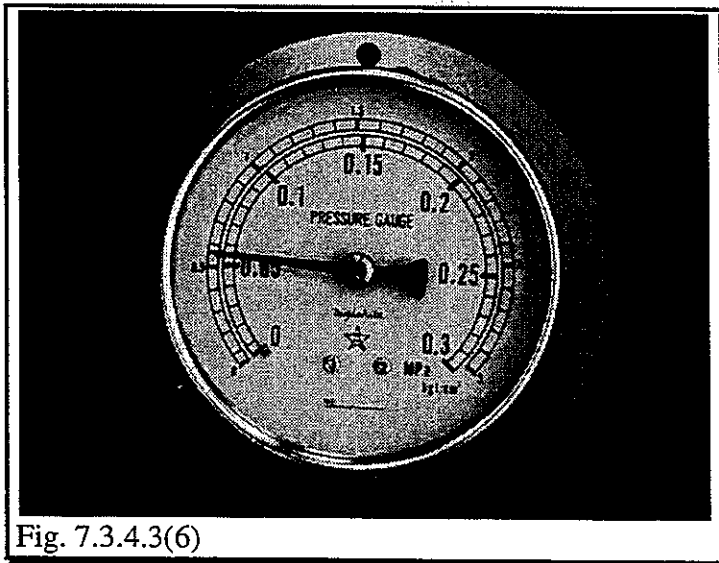


Fig. 7.3.4.3(6)

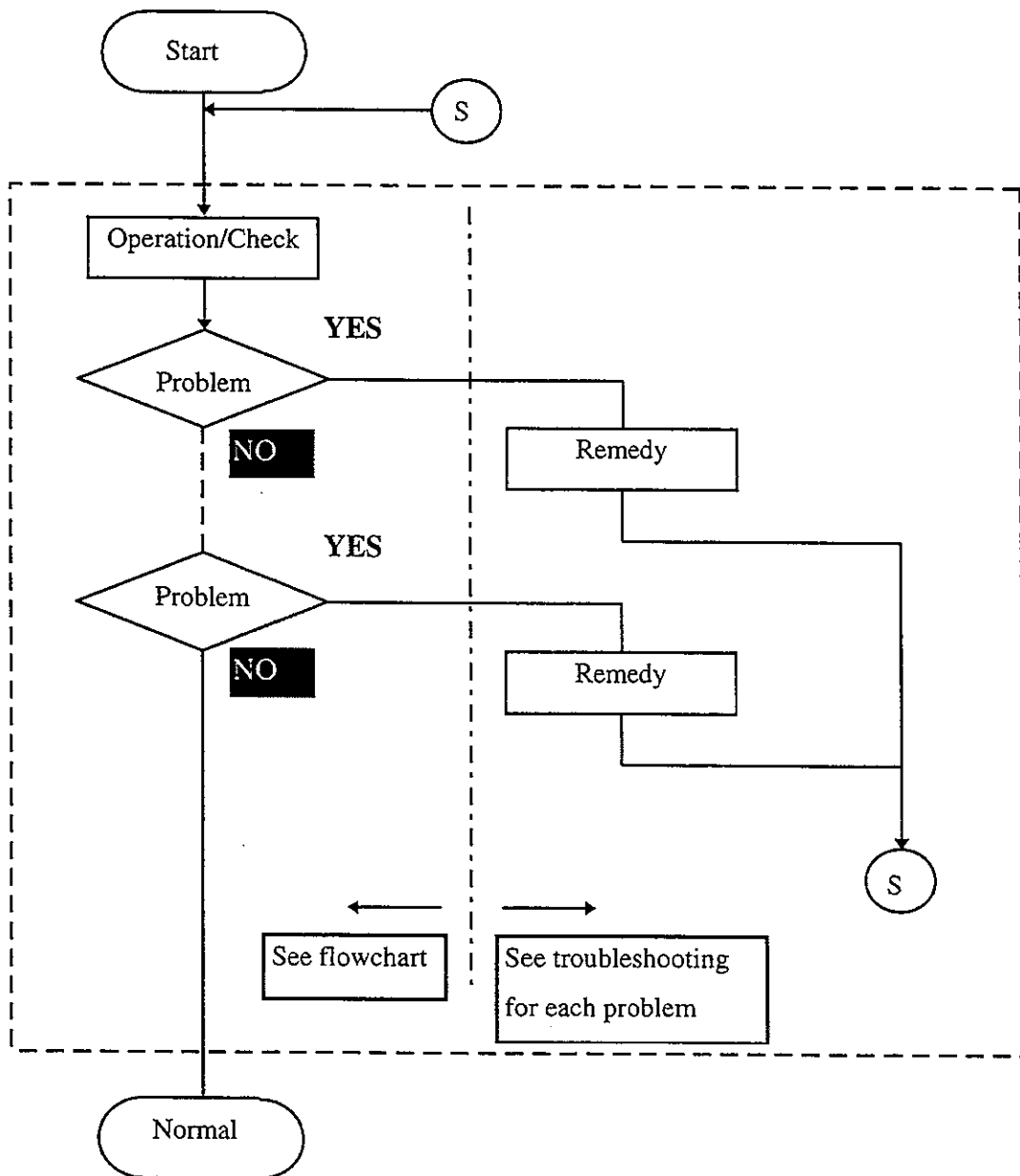
If any out-of-range occlusion pressure is found, perform readjustment according to the procedure given in 7.3.3 Adjusting the occlusion detection function.

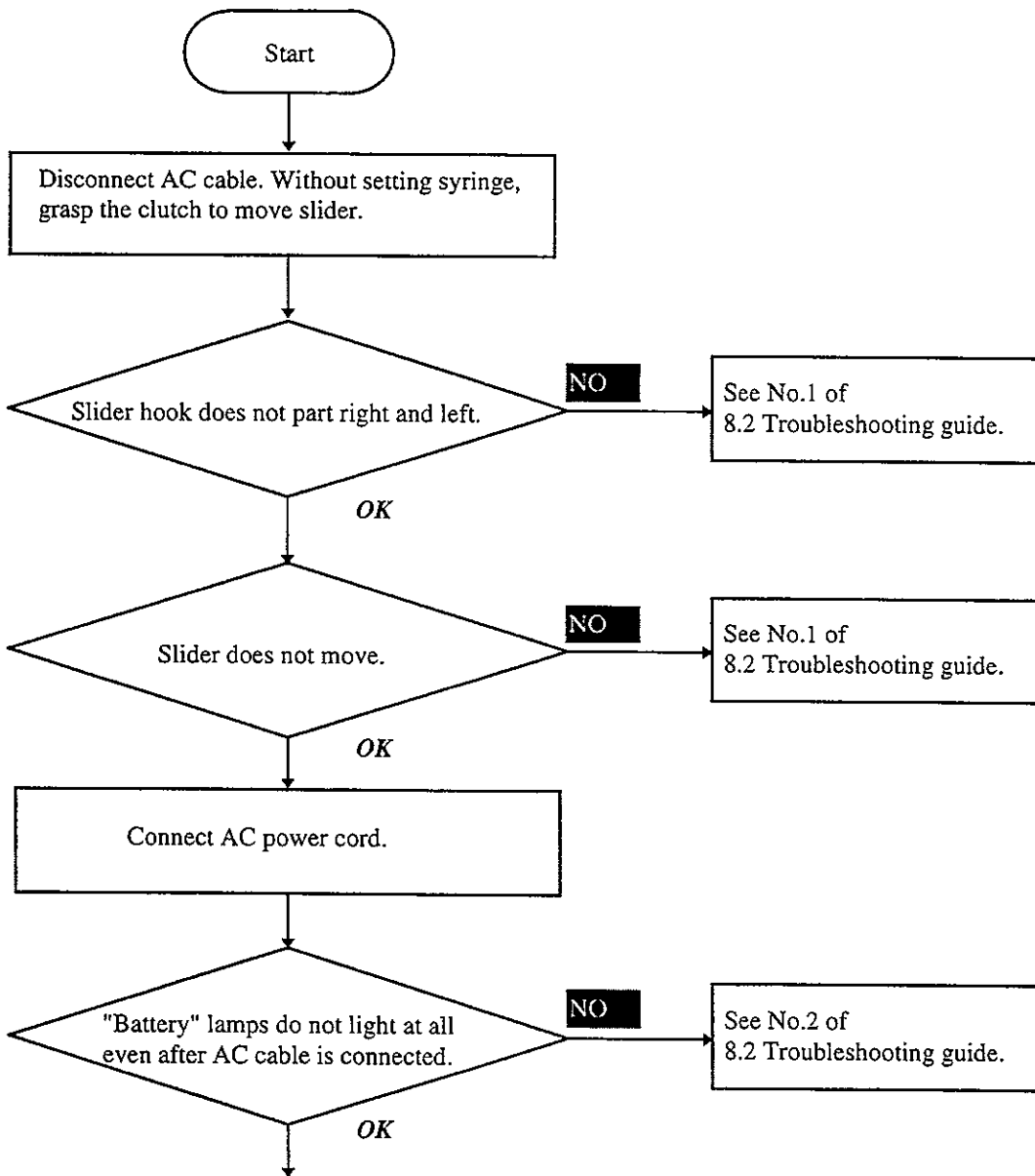
**8. TROUBLESHOOTING**

The troubleshooting flowchart and fault-finding chart below will be helpful for you to cope with troubles which may occur in the product.

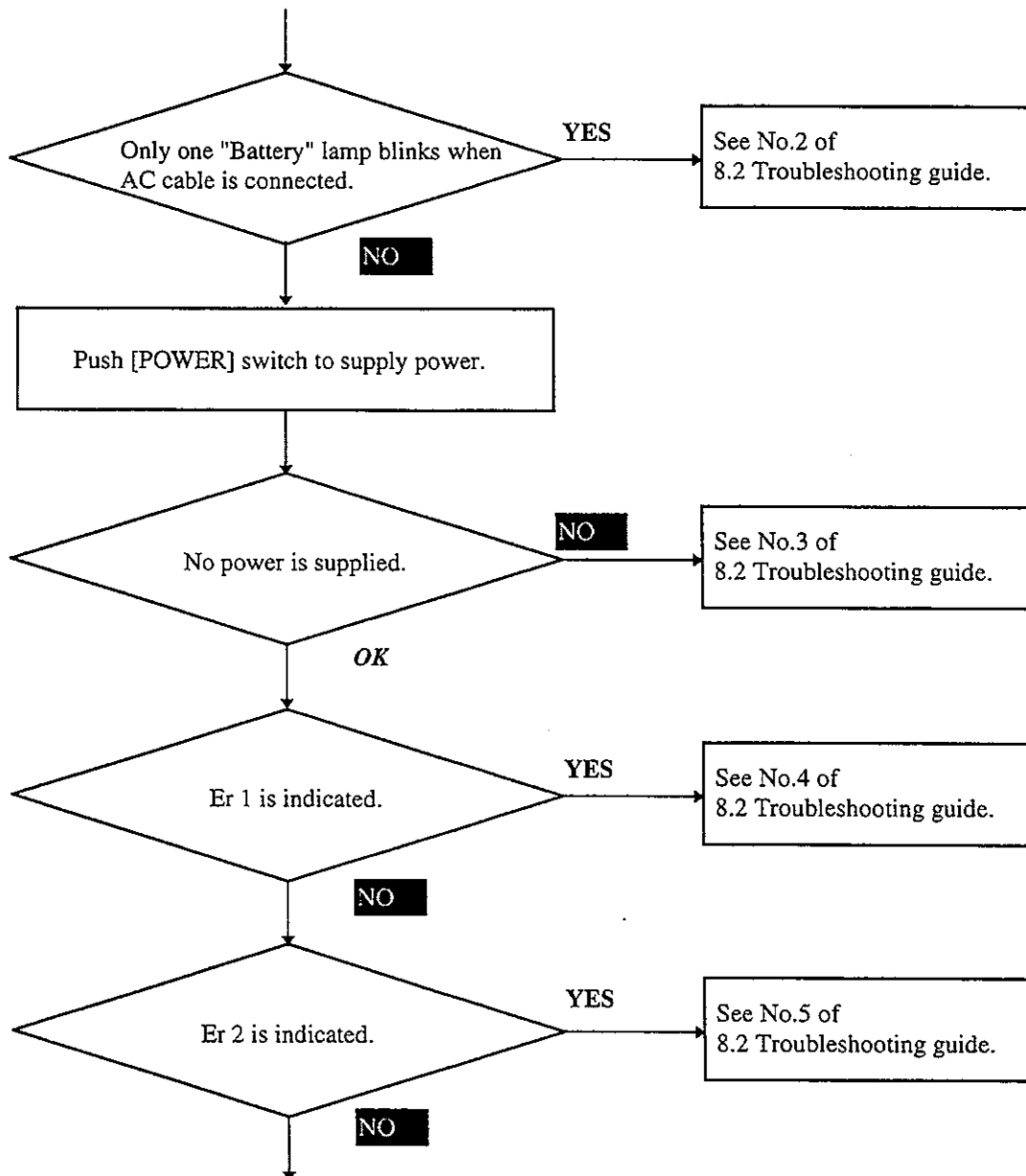
If you find any problem not covered by the following charts, contact TERUMO.

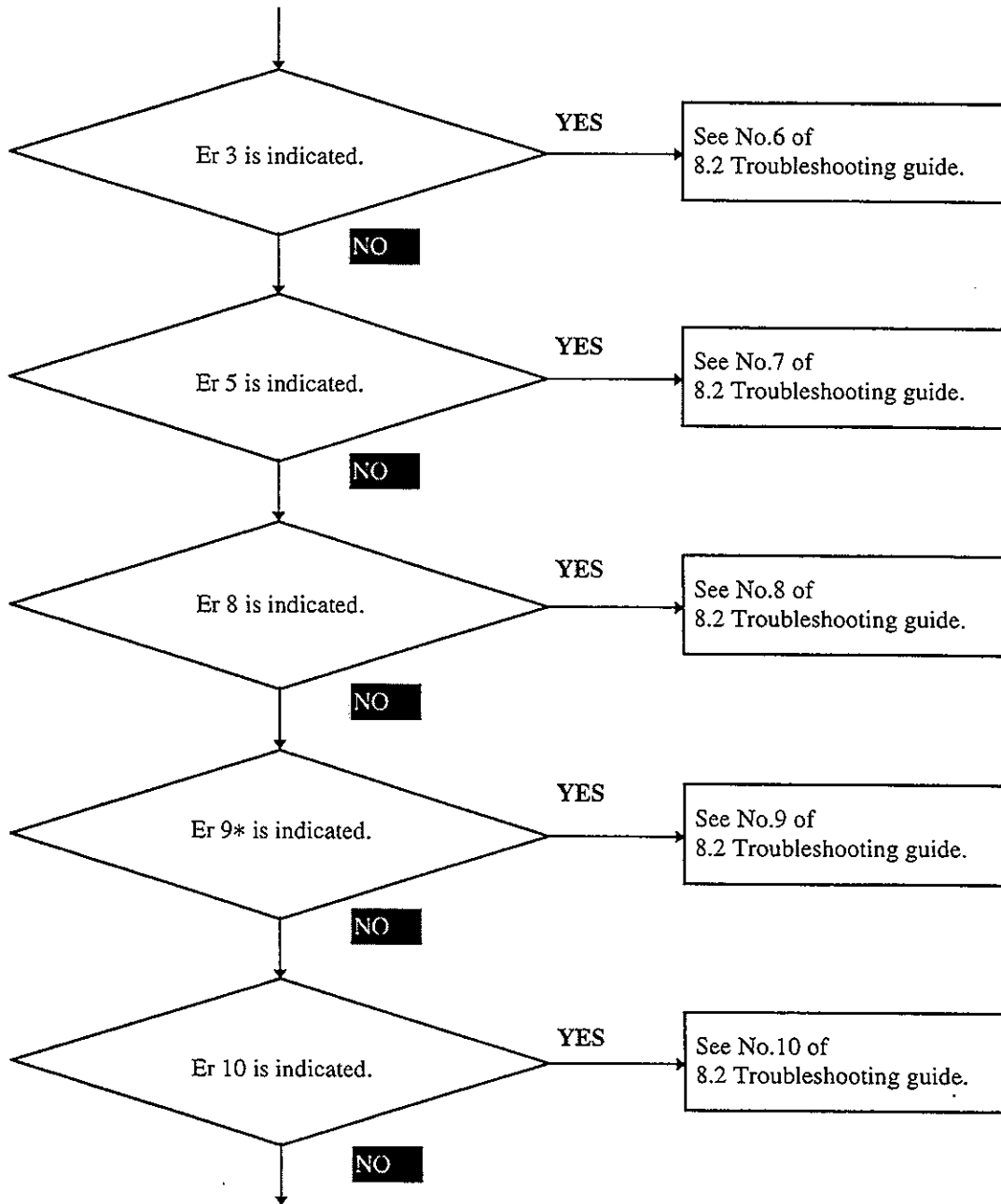
**8.1 Troubleshooting flowchart**

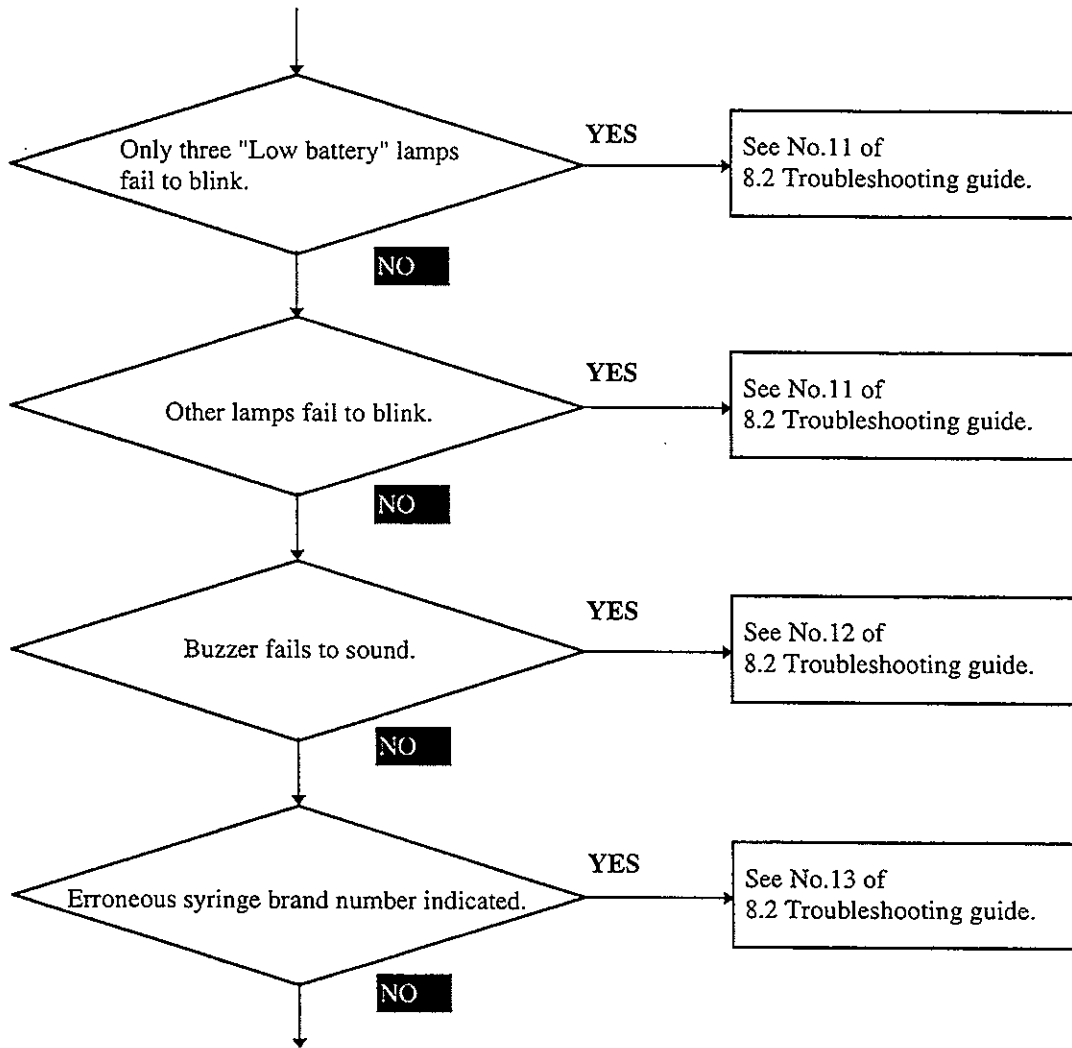


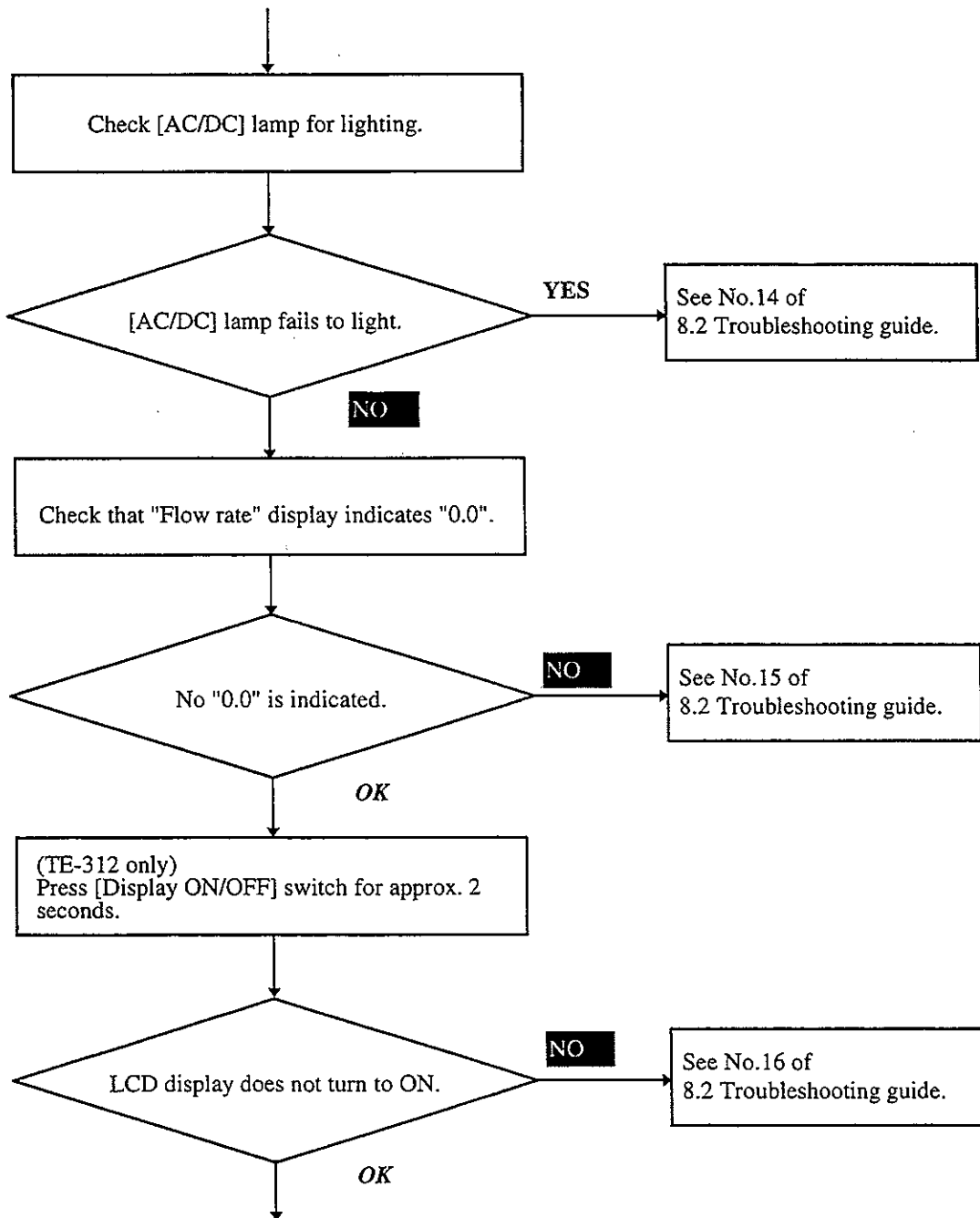


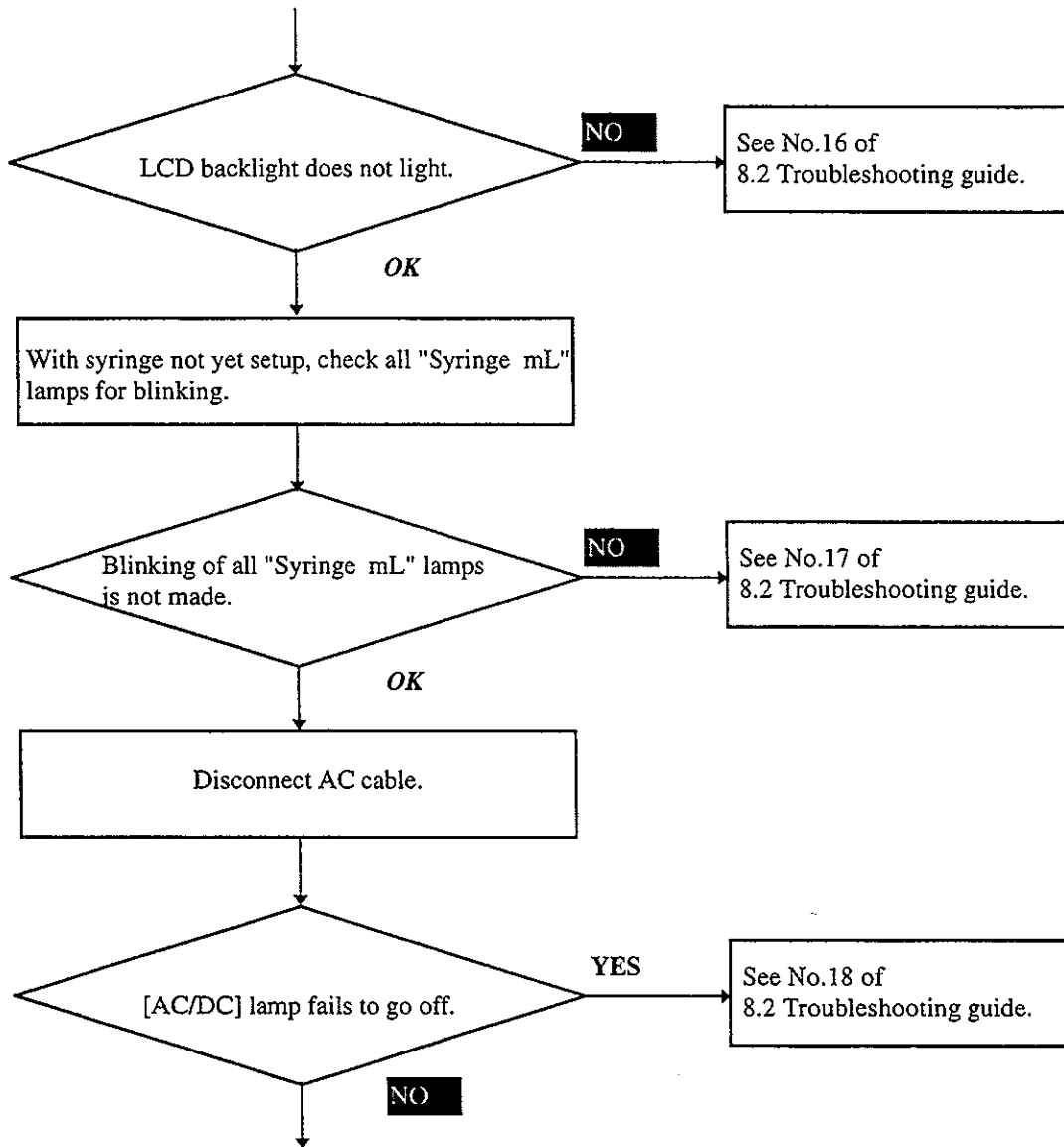


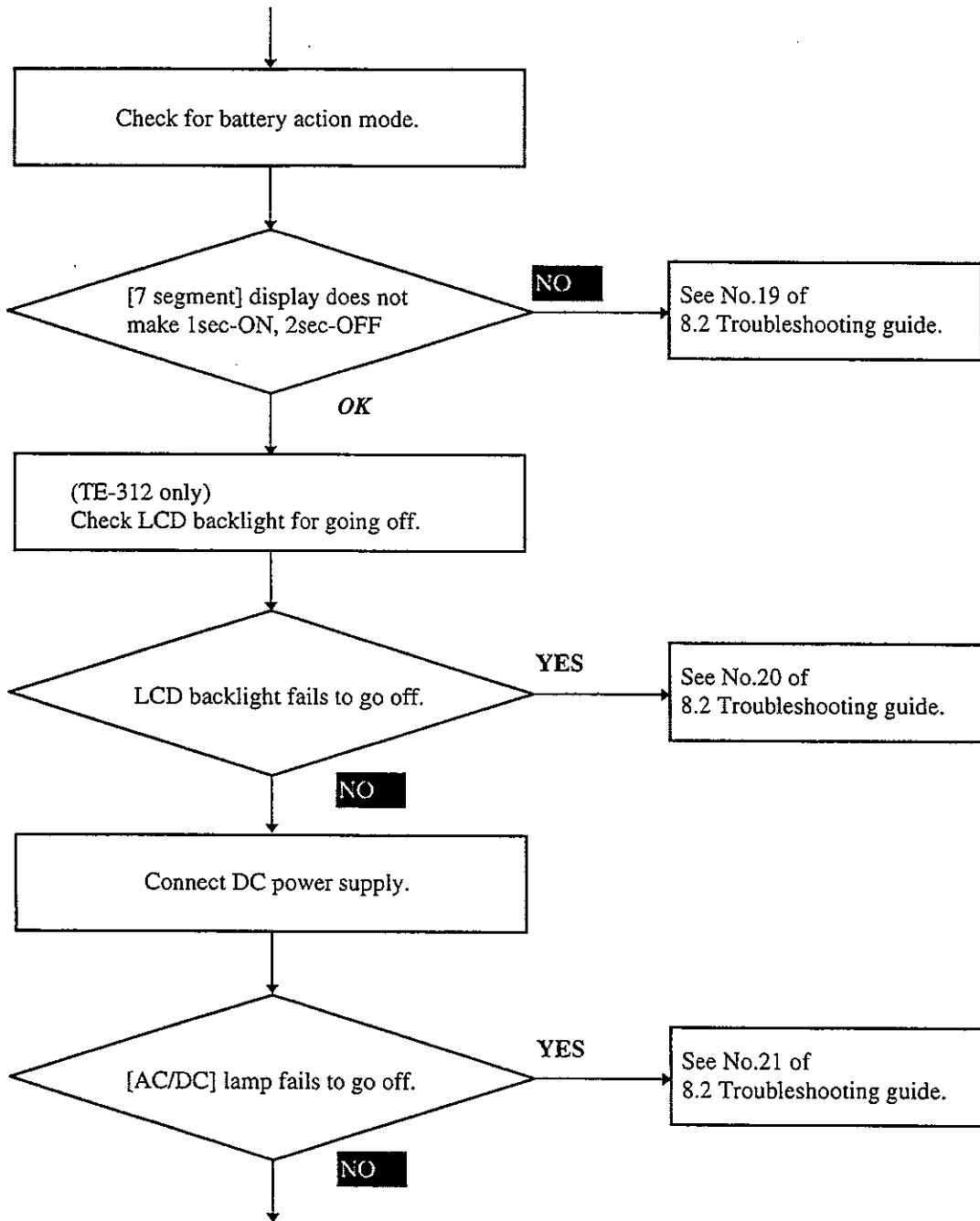


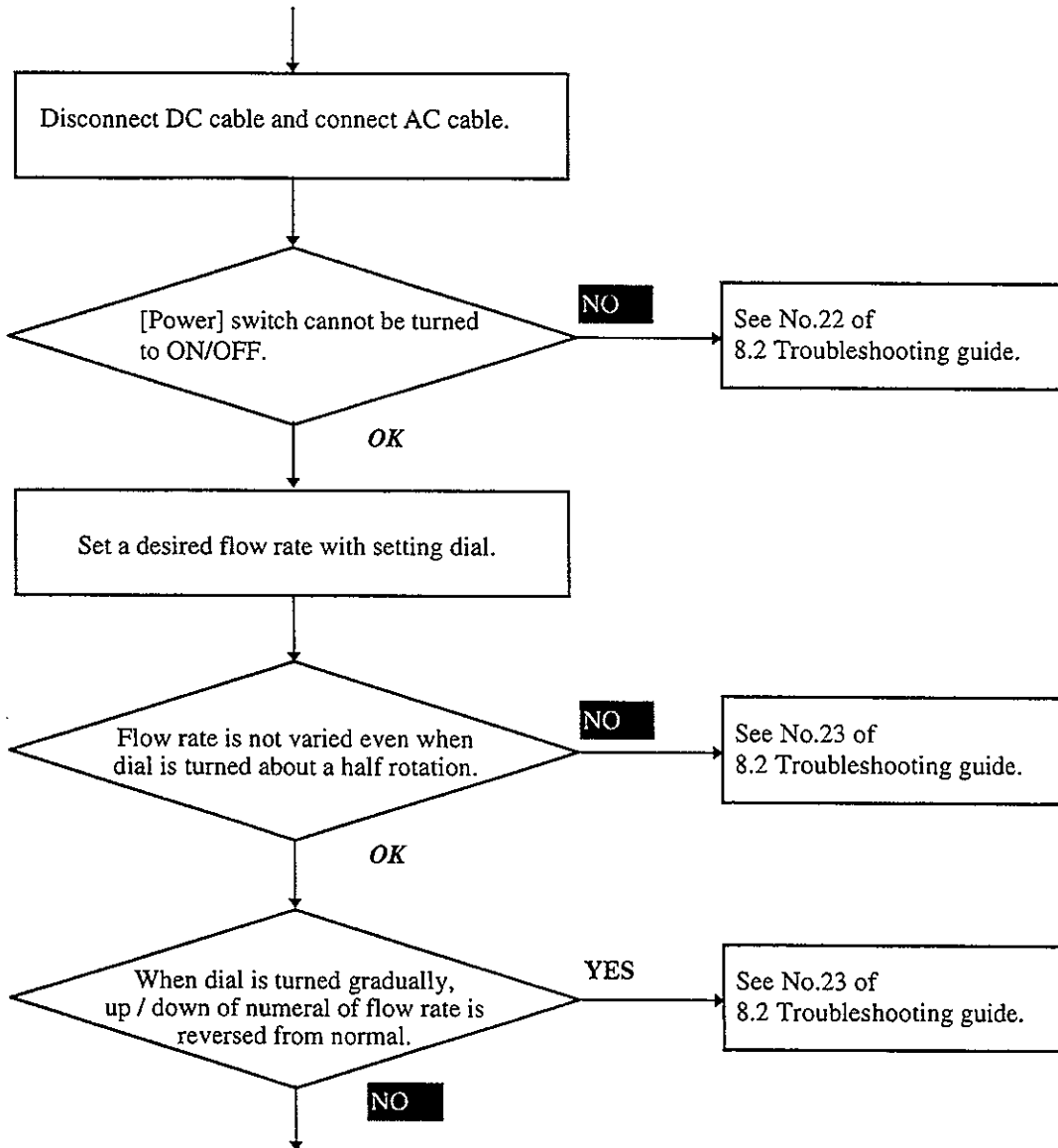


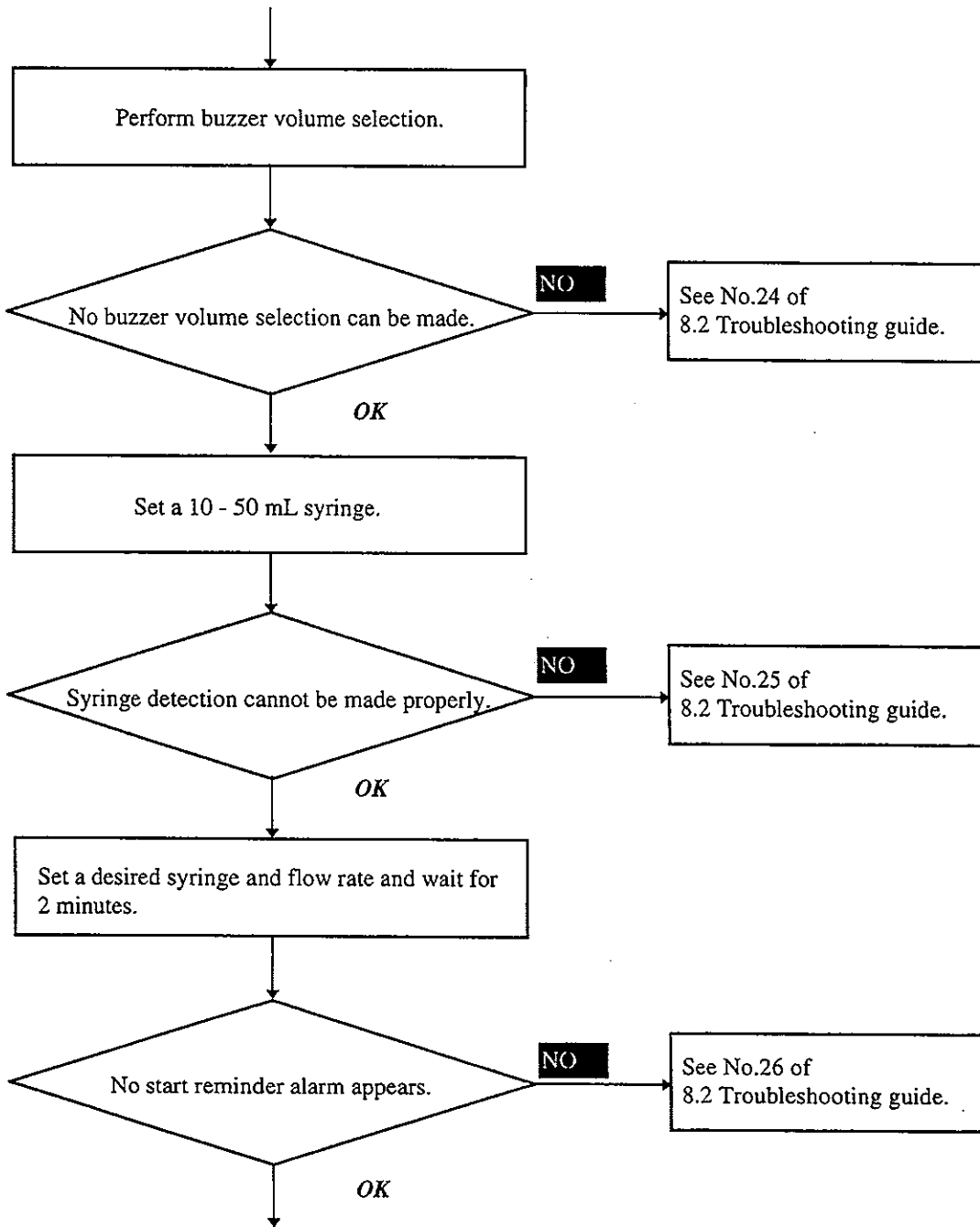




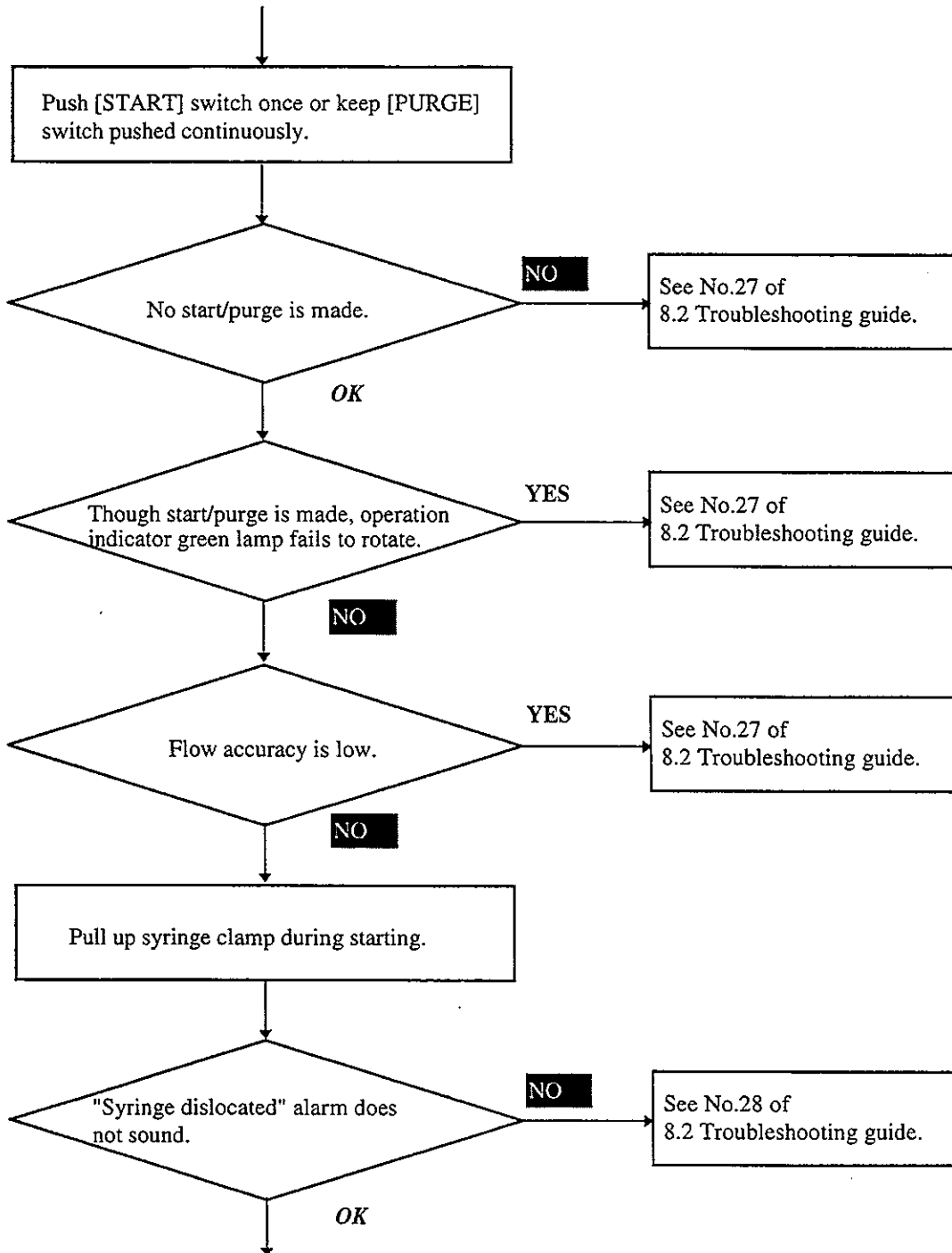


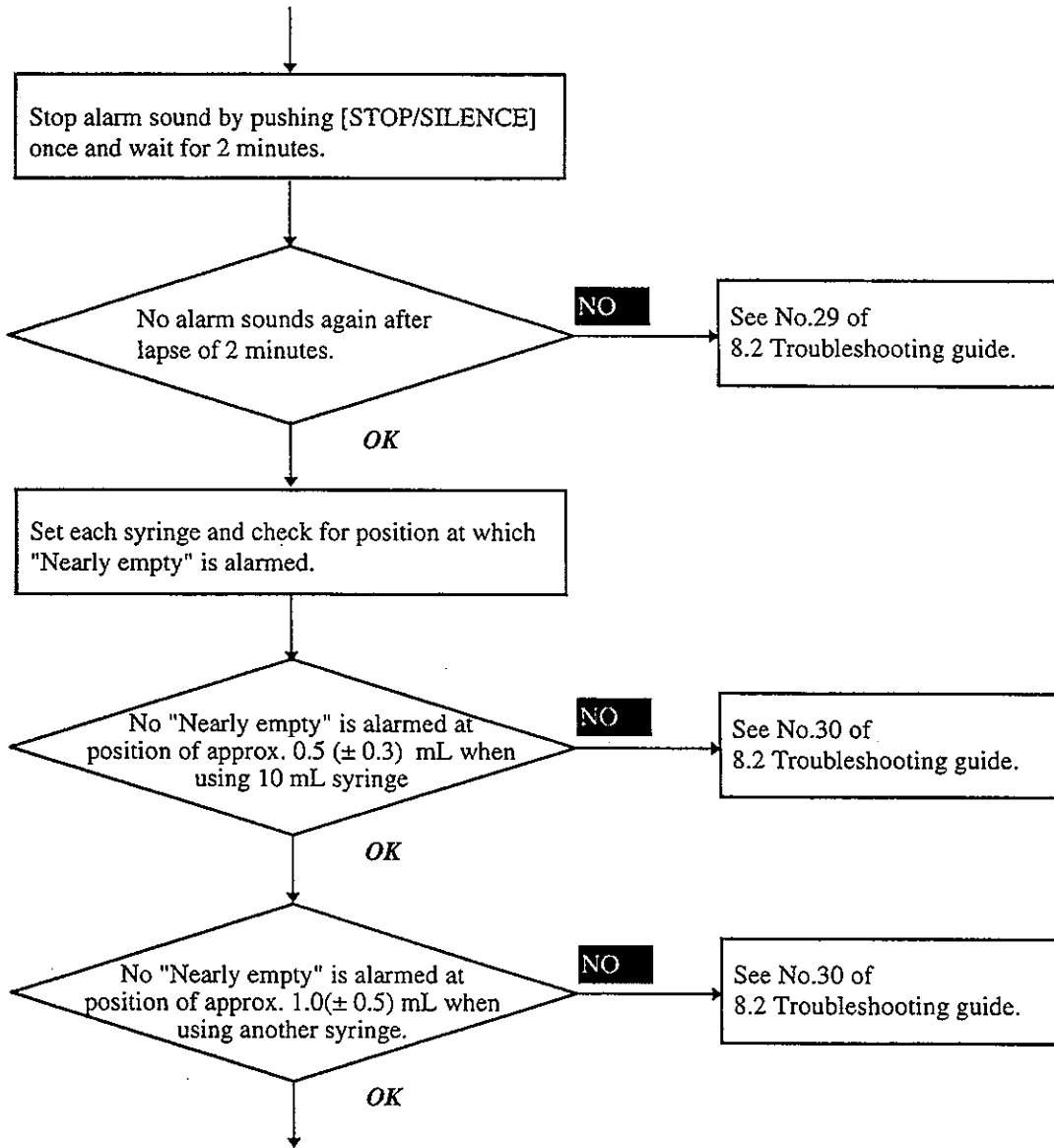


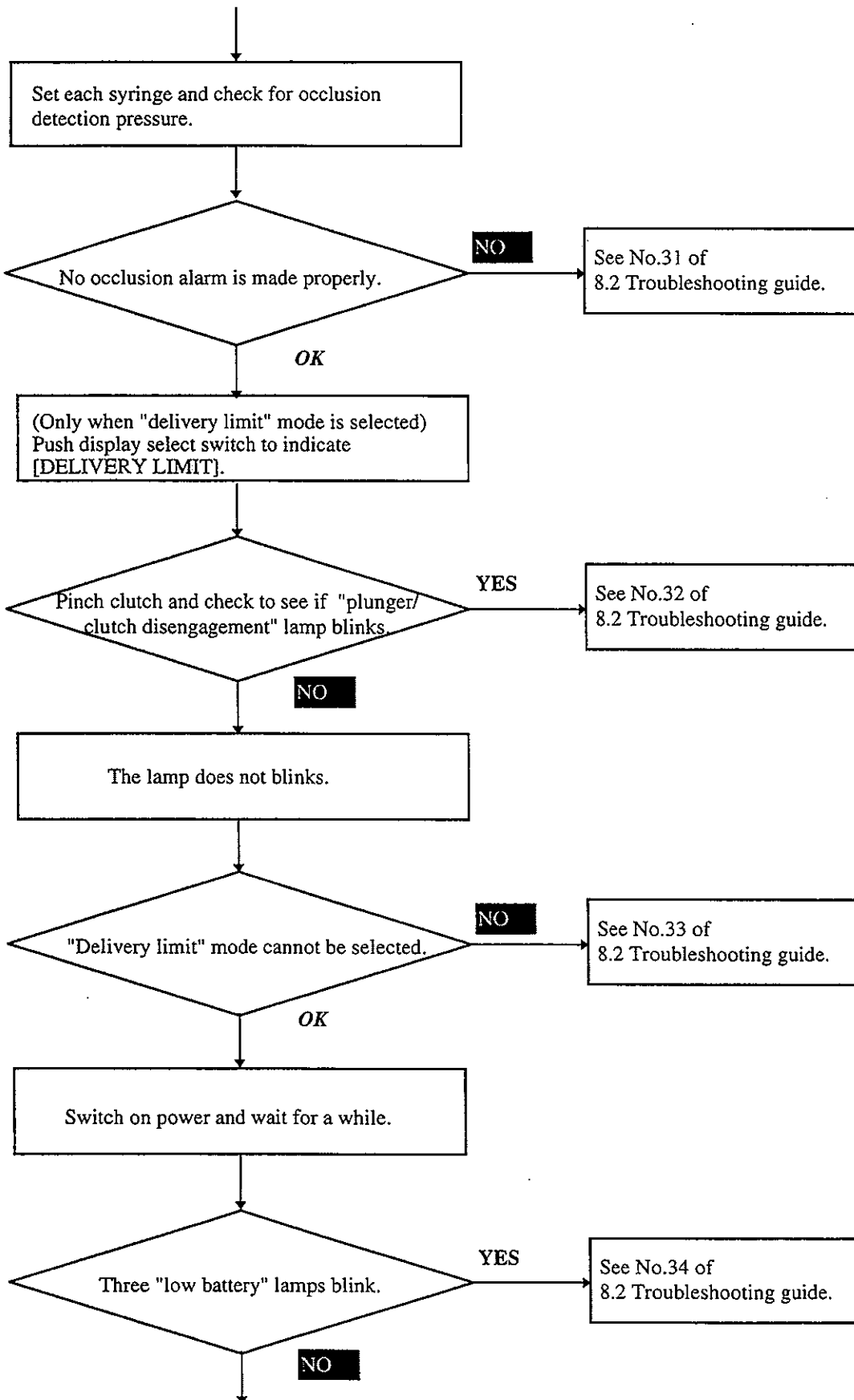


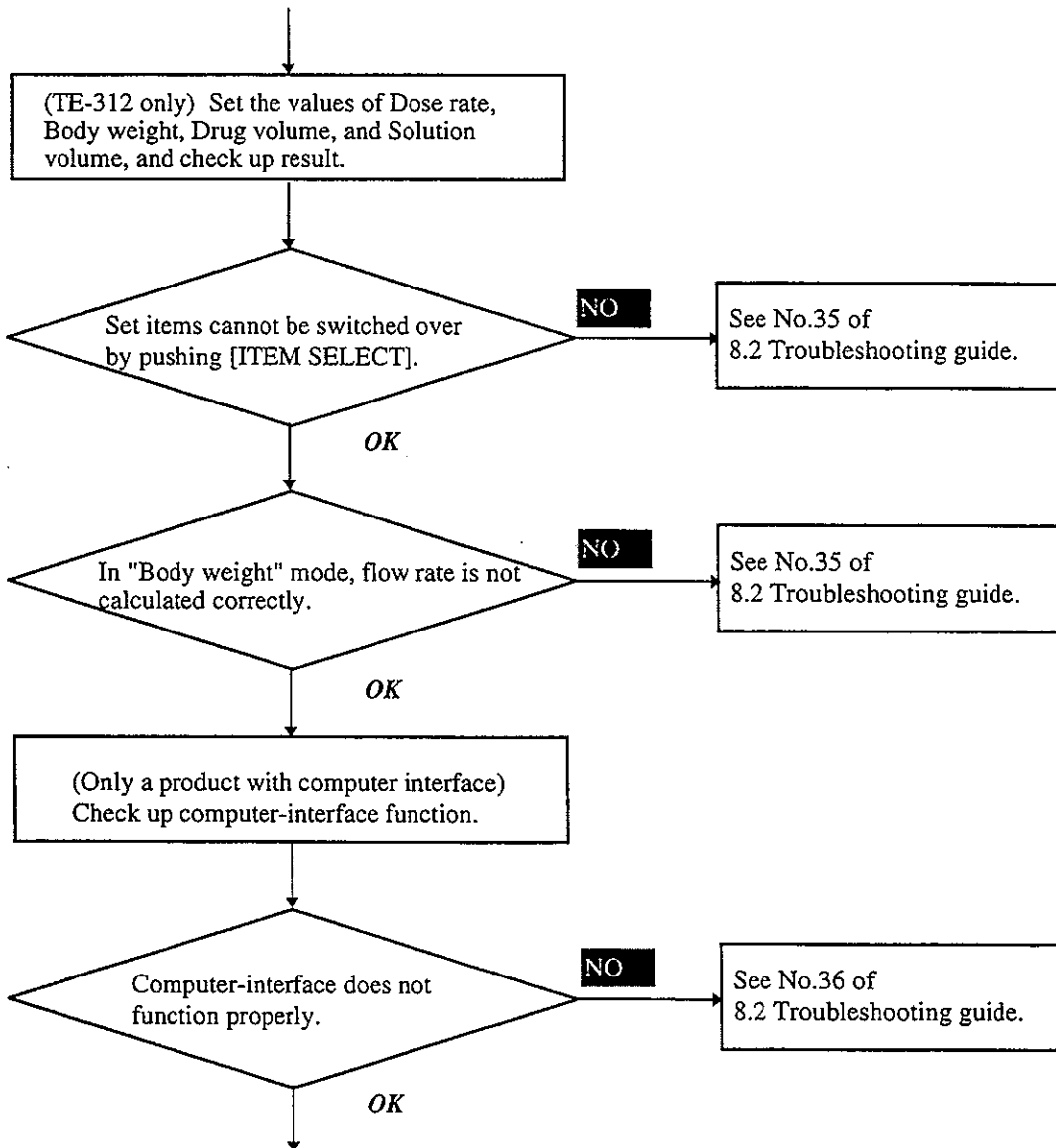


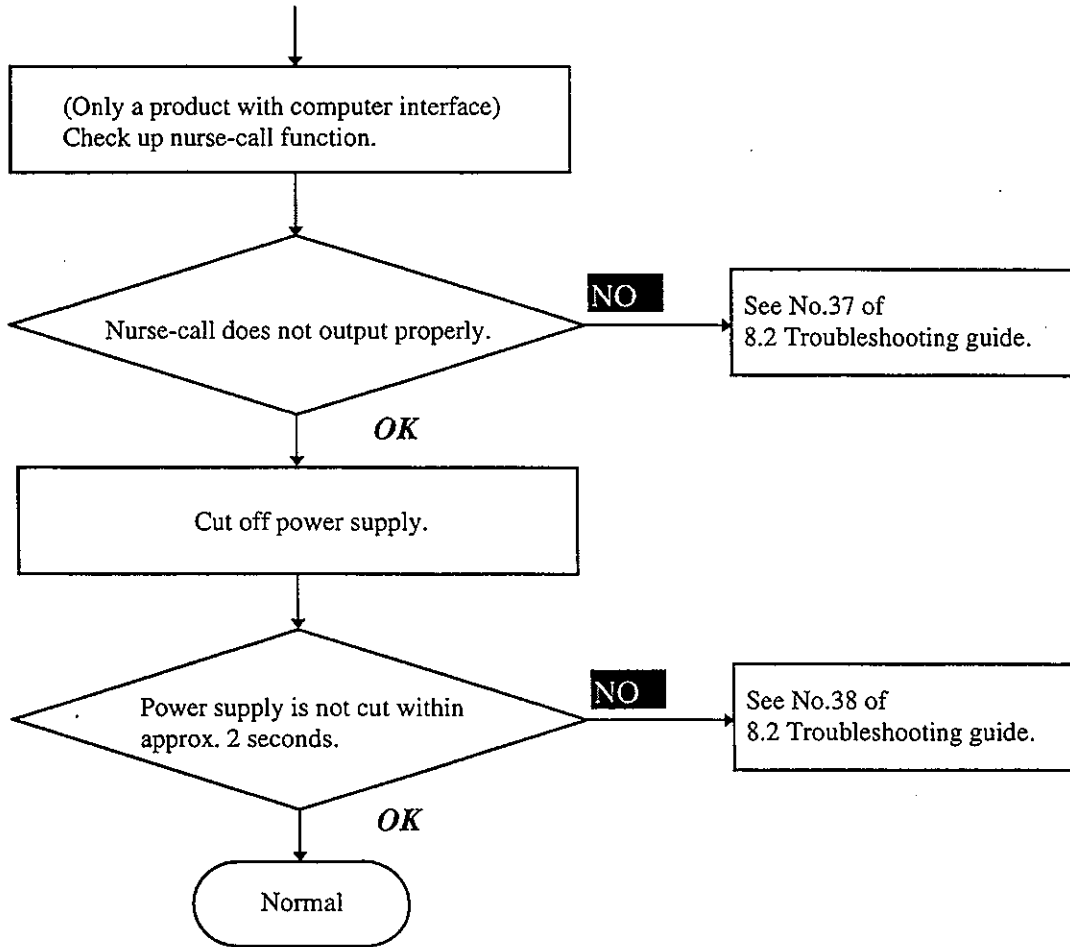












SS09-9B002

Applicable lots:  
9612 lot -

Prepared in Dec., 1996

**8.2 Fault finding chart**

No.	Operation/Check	Problem	Cause	Judgment	Remedy
1	Disconnect AC power cord. Without setting syringe, move slider.	<ul style="list-style-type: none"> <li>Grasping clutch does not cause slider hook to open.</li> <li>Grasping clutch does not cause slider to move.</li> </ul>	<ul style="list-style-type: none"> <li>Slider unit failure.</li> <li>Slider unit failure.</li> </ul>	<ul style="list-style-type: none"> <li>Abnormality is found by visual inspection.</li> <li>Abnormality is found by visual inspection.</li> </ul>	<ul style="list-style-type: none"> <li>Reassemble. (See 7.2.)</li> <li>Replace slider unit. <del>(06LA510*)</del></li> <li>Reassemble. (See 7.2)</li> <li>Replace slider unit. <del>(06LA510*)</del></li> </ul>
2	Connect AC power cord	<ul style="list-style-type: none"> <li>"Battery" lamps do not light at all or only one lamp blinks.</li> </ul>	<ul style="list-style-type: none"> <li>Low battery charge</li> <li>AC cable disconnected.</li> <li>Connector contacting poorly (Power-supply boards CN1, CN5, CN6)</li> <li>Fuse blown off (FS1, FS2, FS3, FS5)</li> </ul>	<ul style="list-style-type: none"> <li>Number of lamps light up does not exceed one when AC cable is connected for about 10 minutes.</li> <li>AC cable is found abnormal in appearance and/or conductance.</li> <li>Abnormality is found by visual inspection. (Try to connect and disconnect connector several times repeatedly.)</li> <li>Abnormality is found by visual inspection.</li> <li>Abnormal in appearance and/or conductance. (Disconnect AC power cord to assure safety.)</li> </ul>	<ul style="list-style-type: none"> <li>Replace battery. (06LA521*/06LA521R*)</li> <li>Replace power cord. <del>(06LA532E*)</del></li> <li>Wipe dirt clean.</li> <li>Replace broken cable. <del>(06LA534*)</del></li> <li>Replace fuse FS1 and/or 2. <del>(05LA26*)</del></li> <li>Replace fuse FS3 and/or 5. <del>(05LA35*)</del></li> </ul>

SS09-9B002

Applicable lots:  
9612 lot -

Prepared in Dec., 1996

No.	Operation/Check	Problem	Cause	Judgment	Remedy
2	Connect AC power cord	<ul style="list-style-type: none"> <li>"Battery" lamps do not light at all or only one lamp blinks.</li> </ul>	<ul style="list-style-type: none"> <li>Transformer failure.</li> <li>Power-supply IC5 and peripheral circuit failure</li> <li>Main board failure in case none of above are applicable to.</li> </ul>	<ul style="list-style-type: none"> <li>Secondary voltage of transformer is lower than approx. 20V<sub>r-p</sub>AC.</li> <li>Approx. 6V is not impressed on Vcc (#16 pin) of IC5.</li> <li>Interface with CPU (#13 pin) is abnormal.</li> </ul>	<ul style="list-style-type: none"> <li>Replace power-supply board. <del>(06LA525□)</del></li> <li>Replace power-supply board. <del>(06LA525□)</del></li> <li>Replace power-supply board. <del>(06LA525□)</del></li> <li>Replace main board. <del>(06LA506*)</del></li> </ul>
3	Power ON with power switch.	<ul style="list-style-type: none"> <li>Pushing [POWER] button for 0.5 sec does not cause power to on.</li> </ul>	<ul style="list-style-type: none"> <li>Connector contacting poorly. (Between power-supply board and main board).</li> <li>Fuse blown off. (FS3)</li> <li>Power-supply board TR2 failure.</li> </ul>	<ul style="list-style-type: none"> <li>Abnormality is found by visual inspection. (Try to connect and disconnect connector several times repeatedly.)</li> <li>Appearance / conductivity is abnormal.</li> <li>Check for TR2 gate ON/OFF signal (1) With ON/OFF. (2) Without ON/OFF</li> </ul>	<ul style="list-style-type: none"> <li>Wipe dirt clean.</li> <li>Replace broken cable. <del>(06LA534*)</del></li> <li>Replace fuse FS3 and/or 5. <del>(05LA35*)</del></li> <li>Replace power-supply board. <del>(06LA525□)</del></li> <li>Replace main board. <del>(06LA506*)</del></li> </ul>

SS09-9B002

Applicable lots:  
9612 lot -

Prepared in Dec., 1996

No.	Operation/Check	Problem	Cause	Judgment	Remedy
3	Power ON with power switch.	<ul style="list-style-type: none"> <li>Pushing [POWER] button for 0.5 sec does not cause power to on.</li> </ul>	<ul style="list-style-type: none"> <li>Power-supply failure.</li> <li>Main board failure in case none of above are applicable to.</li> </ul>	<ul style="list-style-type: none"> <li>Approx. 10V is not impressed on CN6 (#2 pin) of power-supply board.</li> </ul>	<ul style="list-style-type: none"> <li>Replace power-supply board. <del>(06LA525F*)</del></li> <li>Replace main board. <del>(06LA506*)</del></li> </ul>
4	Self-check (Hardware troubleshooting: Main board)	<ul style="list-style-type: none"> <li>Er 1 is displayed.</li> </ul>	<ul style="list-style-type: none"> <li>RAM/register of CPU faulty.</li> </ul>	-	<ul style="list-style-type: none"> <li>Replace main board. <del>(06LA506*)</del></li> </ul>
5	Self-check (Hardware troubleshooting: Main board)	<ul style="list-style-type: none"> <li>Er 2 is displayed.</li> </ul>	<ul style="list-style-type: none"> <li>ROM of CPU faulty.</li> </ul>	-	<ul style="list-style-type: none"> <li>Replace main board. <del>(06LA506*)</del></li> </ul>
6	Self-check (Hardware troubleshooting: Motor rotation)	<ul style="list-style-type: none"> <li>Er 3 is displayed.</li> </ul>	<ul style="list-style-type: none"> <li>Rotation-detection board failure.</li> <li>Connector contacting poorly (Between main board and rotation-detection board).</li> <li>Faulty installation of shield board on motor.</li> <li>Foreign matter in gear unit.</li> </ul>	<ul style="list-style-type: none"> <li>No signal is at CN7 (No. 2, 3 pins)</li> <li>Abnormality is found by visual inspection.(Try to connect and disconnect connector several times repeatedly.)</li> <li>Abnormality is found by visual inspection.( Loose screw, D-cut surfaces not flush with each other, etc.)</li> <li>Abnormality is found by visual inspection.</li> </ul>	<ul style="list-style-type: none"> <li>Replace rotation detect board. <del>(05LA16*)</del></li> <li>Wipe dirt clean.</li> <li>Replace broken cable. <del>(06LA534*)</del></li> <li>Reassemble. (See 7.2)</li> <li>Remove foreign matter.</li> </ul>



SS09-9B002

Applicable lots:  
9612 lot -

Prepared in Dec., 1996

No.	Operation/Check	Problem	Cause	Judgment	Remedy
6	Self-check (Hardware troubleshooting: Motor rotation)	• Er 3 is displayed.	• Main board failure in case none of above are applicable to.	• Abnormal rotation is found by visual inspection.	• Replace driving System unit <del>(06LA543*)</del> . (Have motor unit replaced in factory, as necessary.) • Replace main board. <del>(06LA506*)</del>
7	Self-check (Hardware troubleshooting: E <sup>2</sup> PROM)	• Er 5 is displayed.	• Poorly mounted IC5 of main board. • Faulty IC5 (E <sup>2</sup> PROM) of main board. • Main board failure in case none of above are applicable to.	• Abnormality is found by visual inspection. • Signal exists at IC5 (#5, 6 pins) of main board and voltage is impressed on V <sub>cc</sub> (#8 pin).	• Remount. • Replace E <sup>2</sup> PROM. <del>(06LA536*)</del> • Replace main board. <del>(06LA506*)</del>
8	Self-check (Hardware troubleshooting: Switch)	• Er 8 is displayed.	• [POWER] switch is pushed while another switch is kept depressed. • Main board failure if the above is not applicable to.	• Erroneous operation.	• Repeat operation from first. • Replace main board. <del>(06LA506*)</del>
9	Self-check (Hardware troubleshooting: Mode setup)	• Er 9• is displayed. (*: 0 - 6)	• Switch (S1) on main board is set at any position other than 1 - A. • Main board failure if the above is not applicable to.	• Abnormality is found by visual inspection.	• Reset. • Replace main board <del>(06LA506*)</del>

SS09-9B002

Applicable lots:  
9612 lot -

Prepared in Dec., 1996

No.	Operation/Check	Problem	Cause	Judgment	Remedy
10	Self-check (Hardware troubleshooting: Battery monitor)	<ul style="list-style-type: none"> <li>Er 10 is displayed.</li> </ul>	<ul style="list-style-type: none"> <li>Connector contacting poorly (Between main board and power-supply board).</li> <li>Lacking in battery charge</li> <li>No voltage is impressed on IC5 of power-supply board.</li> <li>Faulty IC5 on power-supply board.</li> <li>Main board failure in case none of above are applicable to.</li> </ul>	<ul style="list-style-type: none"> <li>Abnormality is found by visual inspection. (Try to connect and disconnect connector several times repeatedly.)</li> <li>Recharge for about 5 minutes. Check to see if Er10 recurs when power switch is turned on again.</li> <li>Approx. 6V is not impressed on IC5 (#6 pin: V<sub>cc</sub>) of power-supply board.</li> <li>No voltage is imposed on IC5 (#13 pin) of power-supply board.</li> </ul>	<ul style="list-style-type: none"> <li>Wipe dirt clean.</li> <li>Replace broken cable. <del>(06LA534*)</del></li> <li>Replace battery. <del>06LA521*</del> (for Asia) <del>06LA52HR*</del> (for Europe)</li> <li>Replace power-supply board. <del>(06LA525E*)</del></li> <li>Replace power-supply board. <del>(06LA525E*)</del></li> <li>Replace main board <del>(06LA506*)</del></li> </ul>
11	Self-check (Hardware troubleshooting: Lamp)	<ul style="list-style-type: none"> <li>Only three "Low battery" lamps fail to blink.</li> </ul>	<ul style="list-style-type: none"> <li>Connector contacting poorly (Between main board and power-supply board).</li> <li>Power-supply board fuse (FS5) blown out.</li> <li>Charge current limit resistor (R5) broken.</li> </ul>	<ul style="list-style-type: none"> <li>Abnormality is found by visual inspection. (Try to connect and disconnect connector several times repeatedly.)</li> <li>Appearance / conductivity is abnormal.</li> <li>Appearance / conductivity is abnormal.</li> </ul>	<ul style="list-style-type: none"> <li>Wipe dirt clean.</li> <li>Replace broken cable. <del>(06LA534*)</del></li> <li>Replace fuse. <del>(05LA25*)</del></li> <li>Replace power-supply board. <del>(06LA525E*)</del></li> </ul>

SS09-9B002

Applicable lots:  
9612 lot -

Prepared in Dec., 1996

No.	Operation/Check	Problem	Cause	Judgment	Remedy
11	Self-check (Hardware troubleshooting: Lamp)	<ul style="list-style-type: none"> <li>Only three "Low battery" lamps fail to blink.</li> </ul>	<ul style="list-style-type: none"> <li>Battery defective.</li> <li>Power-supply board IC5 defective.</li> <li>Main board failure in case none of above are applicable to.</li> </ul>	<ul style="list-style-type: none"> <li>Approx. 4 - 6V is not impressed on #1 pin of IC5.</li> </ul>	<ul style="list-style-type: none"> <li>Replace battery. <del>06LA521*</del> (for Asia) 06LA521R* (for Europe)</li> <li>Replace power-supply board. <del>(06LA525□*)</del></li> <li>Replace main board. <del>(06LA506*)</del></li> </ul>
12	Self-check (Hardware troubleshooting: Buzzer)	<ul style="list-style-type: none"> <li>Buzzer fails to sound.</li> </ul>	<ul style="list-style-type: none"> <li>Connector contacting poorly (Between main board and power-supply board).</li> <li>Buzzer failure.</li> <li>Main board failure in case none of above are applicable to.</li> </ul>	<ul style="list-style-type: none"> <li>Abnormality is found by visual inspection. (Try to connect and disconnect connector several times repeatedly.)</li> <li>Signal is abnormal.</li> </ul>	<ul style="list-style-type: none"> <li>Wipe dirt clean.</li> <li>Replace broken cable. <del>(06LA534*)</del></li> <li>Replace power-supply board. <del>(06LA525□*)</del></li> <li>Replace main board. <del>(06LA506*)</del></li> </ul>
13	Self-check (Hardware troubleshooting: Syringe maker)	<ul style="list-style-type: none"> <li>Erroneous syringe maker number indicated.</li> </ul>	<ul style="list-style-type: none"> <li>Mis-setting of main-board switch (S1).</li> <li>Erroneous setting of syringe brand.</li> <li>Main board failure if the above is not applicable to.</li> </ul>	<ul style="list-style-type: none"> <li>Abnormality is found by visual inspection.</li> </ul>	<ul style="list-style-type: none"> <li>Reset.</li> <li>Reset. (See section 4.2.)</li> <li>Replace main board. <del>(06LA506*)</del></li> </ul>

SS09-9B002

Applicable lots:  
9612 lot -

Prepared in Dec., 1996

No.	Operation/Check	Problem	Cause	Judgment	Remedy
14	<ul style="list-style-type: none"> <li>Check [AC/DC] lamp for lighting.</li> </ul>	<ul style="list-style-type: none"> <li>[AC/DC] lamp fails to light.</li> </ul>	<ul style="list-style-type: none"> <li>AC cable disconnected.</li> <li>Connector contacting poorly (CN1, CN6)</li> <li>Power-supply board fuse blown off (FS1, FS2).</li> <li>Transformer failure.</li> <li>TR9 on power-supply board defective.</li> <li>Main board failure in case none of above are applicable to.</li> </ul>	<ul style="list-style-type: none"> <li>AC cable is found abnormal in appearance and/or conductance.</li> <li>Abnormality is found by visual inspection. (Try to connect and disconnect connector several times repeatedly.)</li> <li>Abnormal in appearance and/or conductance. (Disconnect AC power cord to assure safety.)</li> <li>Secondary voltage of transformer is lower than approx. 20V<sub>P-P</sub>AC.</li> <li>TR9 (collector) on power-supply board does not change from 5V to 0V when AC inlet is disconnected.</li> </ul>	<ul style="list-style-type: none"> <li>Replace power cord. <del>(06LA532□*)</del></li> <li>Wipe dirt clean.</li> <li>Replace broken cable. <del>(06LA534*)</del></li> <li>Replace fuse FS1 and/or 2. <del>(05LA26*)</del></li> <li>Replace power-supply board. <del>(06LA525□*)</del></li> <li>Replace power-supply board. <del>(06LA525□*)</del></li> <li>Replace main board <del>(06LA506*)</del></li> </ul>
15	<ul style="list-style-type: none"> <li>Check that "Flow rate" display indicates "0.0".</li> </ul>	<ul style="list-style-type: none"> <li>No "0.0" is indicated.</li> </ul>	<ul style="list-style-type: none"> <li>Setting according to 14.4 Special function setting mode is not made properly.</li> <li>Main board failure if the above is not applicable to.</li> </ul>	<ul style="list-style-type: none"> <li>See 4.4 Special function setting mode.</li> </ul>	<ul style="list-style-type: none"> <li>Select mode correctly.</li> <li>Replace main board <del>(06LA506*)</del></li> </ul>

SS09-9B002

Applicable lots:  
9612 lot -

Prepared in Dec., 1996

No.	Operation/Check	Problem	Cause	Judgment	Remedy
16	<p>(TE-312 only) Press Display ON/OFF for approx. 2 seconds.</p>	<ul style="list-style-type: none"> <li>LCD display does not turn to ON.</li> <li>LCD backlight does not light.</li> </ul>	<ul style="list-style-type: none"> <li>Connector contacting poorly (Between LCD and main board).</li> <li>LCD failure.</li> <li>Connector contacting poorly (Between LCD and main board).</li> <li>LCD failure.</li> <li>Main board failure in case none of above are applicable to.</li> </ul>	<ul style="list-style-type: none"> <li>Abnormality is found by visual inspection.(Try to connect and disconnect connector several times repeatedly.)</li> <li>Abnormality is found by visual inspection.(Try to connect and disconnect connector several times repeatedly.)</li> <li>Backlight does not light when 0V is impressed on #8 pin of LCD.</li> </ul>	<ul style="list-style-type: none"> <li>Wipe dirt clean.</li> <li>Replace LCD <del>(06LB503*)</del></li> <li>Wipe dirt clean.</li> <li>Replace LCD. <del>(06LB503*)</del></li> <li>Replace main board. <del>(06LA506*)</del></li> </ul>
17	<p>With syringe not yet setup, check all "Syringe mL" lamps for blinking.</p>	<ul style="list-style-type: none"> <li>Blinking of all "Syringe mL" lamps is not made.</li> </ul>	<ul style="list-style-type: none"> <li>Syringe detection unit adjustment error.</li> <li>Syringe detection unit malfunctioning.</li> <li>Main board failure in case none of above are applicable to.</li> </ul>	<ul style="list-style-type: none"> <li>Refer to 7.3 Adjustment procedure.</li> <li>No readjustment is made.</li> </ul>	<ul style="list-style-type: none"> <li>Readjust.</li> <li>Replace syringe detection unit. <del>(05LA05*)</del></li> <li>Replace main board. <del>(06LA506*)</del></li> </ul>

SS09-9B002

Applicable lots:  
9612 lot -

Prepared in Dec., 1996

No.	Operation/Check	Problem	Cause	Judgment	Remedy
18	Disconnect AC power cord.	<ul style="list-style-type: none"> <li>[AC/DC] lamp fails to go off.</li> </ul>	<ul style="list-style-type: none"> <li>TR9 on power-supply board defective.</li> <li>Main board failure if the above is not applicable to.</li> </ul>	<ul style="list-style-type: none"> <li>TR9 (collector) on power-supply board does not change from 5V to 0V when AC power cord is disconnected.</li> </ul>	<ul style="list-style-type: none"> <li>Replace power-supply board. <del>(06LA525[**])</del></li> <li>Replace main board. <del>(06LA506*)</del></li> </ul>
19	<ul style="list-style-type: none"> <li>Check for battery action mode.</li> </ul>	<ul style="list-style-type: none"> <li>[7 Segment] display does not make 1 sec-ON, 2 sec-OFF action.</li> </ul>	<ul style="list-style-type: none"> <li>Setting according to 14.4 Special function setting mode is not made properly.</li> <li>Main board failure if the above is not applicable to.</li> </ul>	<ul style="list-style-type: none"> <li>See 4.4 Special function setting mode.</li> </ul>	<ul style="list-style-type: none"> <li>Select mode correctly.</li> <li>Replace main board. <del>(06LA506*)</del></li> </ul>
20	(TE-312 only) Check LCD backlight for going off.	<ul style="list-style-type: none"> <li>LCD backlight fails to go off.</li> </ul>	<ul style="list-style-type: none"> <li>Setting according to 14.4 Special function setting mode is not made properly.</li> <li>Connector contacting poorly (Between LCD and main board).</li> <li>LCD failure.</li> <li>Main board failure in case none of above are applicable to.</li> </ul>	<ul style="list-style-type: none"> <li>See 4.4 Special function setting mode.</li> <li>Abnormality is found by visual inspection.(Try to connect and disconnect connector several times repeatedly.)</li> <li>Backlight does not go off when approx. 5V is impressed on #8 pin of LCD.</li> </ul>	<ul style="list-style-type: none"> <li>Perform mode selection correctly.</li> <li>Wipe dirt clean.</li> <li>Replace LCD. <del>(06LB503**)</del></li> <li>Replace main board. <del>(06LA506*)</del></li> </ul>

SS09-9B002

Applicable lots:  
9612 lot -

Prepared in Dec., 1996

No.	Operation/Check	Problem	Cause	Judgment	Remedy
21	Connect DC power supply for special use.	• [AC/DC] lamp fails to go off.	<ul style="list-style-type: none"> <li>• DC cable disconnected.</li> <li>• Connector contacting poorly (Between DC connector and Power-supply board).</li> <li>• Main board failure in case none of above are applicable to.</li> </ul>	<ul style="list-style-type: none"> <li>• DC cable is found abnormal in appearance and/or conductance.</li> <li>• Abnormality is found by visual inspection. (Try to connect and disconnect connector several times repeatedly.)</li> </ul>	<ul style="list-style-type: none"> <li>• Replace DC cable. <del>(05LA51*)</del></li> <li>• Wipe dirt clean.</li> <li>• Replace broken cable. <del>(06LA534*)</del></li> <li>• Replace main board. <del>(06LA506*)</del></li> </ul>
22	Disconnect DC cable and connect AC power cord.	• [Power] switch cannot be turned to ON/OFF.	<ul style="list-style-type: none"> <li>• Main board faulty. (<math>\Sigma</math> mL cannot be cleared during alarming.)</li> </ul>	-	<ul style="list-style-type: none"> <li>• Replace main board. <del>(06LA506*)</del></li> </ul>

SS09-9B002

Applicable lots:  
9612 lot -

Prepared in Dec., 1996

No.	Operation/Check	Problem	Cause	Judgment	Remedy
23	Set a desired flow rate with dial.	<ul style="list-style-type: none"> <li>Flow rate is not varied even when dial is turned about a half rotation.</li> <li>When dial is turned gradually, up / down of numeral of flow rate is reversed from normal.</li> </ul>	<ul style="list-style-type: none"> <li>Connector contacting poorly (Between set-up dial board and main board)</li> <li>Setting dial faulty.</li> <li>Dial board faulty.</li> <li>Main board failure in case none of above are applicable to.</li> <li>Main board faulty.</li> </ul>	<ul style="list-style-type: none"> <li>Abnormality is found by visual inspection.(Try to connect and disconnect connector several times repeatedly.)</li> <li>Abnormality is found by visual inspection.</li> <li>Normal action is restored with another dial.</li> <li>Turning setting dial does not cause any signal to be impressed on CN3 (#2, 3 pins) of main board.</li> </ul>	<ul style="list-style-type: none"> <li>Wipe dirt clean.</li> <li>Replace broken cable. <del>(06LA534**)</del></li> <li>Replace dial unit. <del>(05LA04**)</del></li> <li>Replace setting dial board. <del>(05LA09**)</del></li> <li>Replace main board. <del>(06LA506**)</del></li> </ul>
24	Perform buzzer volume selection.	<ul style="list-style-type: none"> <li>No buzzer volume selection can be made.</li> </ul>	<ul style="list-style-type: none"> <li>Main board faulty.</li> </ul>	-	<ul style="list-style-type: none"> <li>Replace main board. <del>(06LA506**)</del></li> </ul>
25	Set a 10 - 50 mL syringe.	<ul style="list-style-type: none"> <li>Syringe detection cannot be made properly.</li> </ul>	<ul style="list-style-type: none"> <li>Erroneously set maker number.</li> <li>Adjustment error.</li> </ul>	<ul style="list-style-type: none"> <li>Maker of syringe being used does not coincide with syringe maker number which is indicated after power ON.</li> <li>See 7.3 Adjustment procedure.</li> </ul>	<ul style="list-style-type: none"> <li>Resetting of syringe brand.</li> <li>Readjust.</li> </ul>



SS09-9B002

Applicable lots:  
9612 lot -

Prepared in Dec., 1996

No.	Operation/Check	Problem	Cause	Judgment	Remedy
25			<ul style="list-style-type: none"> <li>Connector contacting poorly (Between syringe detection board and main board)</li> <li>Syringe detection unit malfunction.</li> <li>Clamp unit faulty.</li> <li>Main board failure in case none of above are applicable to.</li> </ul>	<ul style="list-style-type: none"> <li>Abnormality is found by visual inspection. (Try to connect and disconnect connector several times repeatedly.)</li> <li>Abnormality is found by visual inspection. (Poorly soldered parts, broken slide shaft, etc.)</li> <li>Abnormality is found by visual inspection.</li> </ul>	<ul style="list-style-type: none"> <li>Wipe dirt clean.</li> <li>Replace syringe detection unit (<del>05LA05*</del>) if its cable has been broken..</li> <li>Replace syringe detection unit. (<del>05LA05*</del>)</li> <li>Replace clamp unit. (<del>06LA503**</del>)</li> <li>Replace main board. (<del>06LA506**</del>)</li> </ul>
26	Set a desired syringe and flow rate and wait for 2 minutes.	<ul style="list-style-type: none"> <li>No start reminder appears.</li> </ul>	<ul style="list-style-type: none"> <li>Start reminder mode is canceled with software switch.</li> <li>Main board failure if the above is not applicable to.</li> </ul>	<ul style="list-style-type: none"> <li>See 4.4 Special function setting mode.</li> </ul>	<ul style="list-style-type: none"> <li>Select mode correctly.</li> </ul>
27	<ul style="list-style-type: none"> <li>Push start switch once.</li> <li>Keep Purge switch pushed continuously.</li> </ul>	<ul style="list-style-type: none"> <li>No start / purge is made.</li> </ul>	<ul style="list-style-type: none"> <li>Syringe set and/or flow rate is not made correctly. (Incl. preset flow in the case of preset flow mode)</li> <li>Main board failure if the above is not applicable to.</li> </ul>	<ul style="list-style-type: none"> <li>-</li> <li>-</li> <li>-</li> </ul>	<ul style="list-style-type: none"> <li>Replace main board. (<del>06LA506**</del>)</li> <li>Correct setting.</li> <li>Replace main board. (<del>06LA506**</del>)</li> </ul>

SS09-9B002

Applicable lots:  
9612 lot -

Prepared in Dec., 1996

No.	Operation/Check	Problem	Cause	Judgment	Remedy
27	<ul style="list-style-type: none"> <li>• Push start switch once.</li> <li>• Keep Purge switch pushed continuously.</li> </ul>	<ul style="list-style-type: none"> <li>• Though start / purge is made, (1) Operation indicator green lamp fails to rotate.</li> </ul>	<ul style="list-style-type: none"> <li>• Connector contacting poorly (Between indicator unit and main board)</li> <li>• Main board failure if the above is not applicable to.</li> <li>• Syringe used is set improperly.</li> </ul>	<ul style="list-style-type: none"> <li>• Abnormality is found by visual inspection. (Try to connect and disconnect connector several times repeatedly.)</li> </ul>	<ul style="list-style-type: none"> <li>• Wipe dirt clean.</li> <li>• Replace main board.</li> </ul>
		<ul style="list-style-type: none"> <li>(2) Flow accuracy is low.</li> </ul>		<ul style="list-style-type: none"> <li>• <del>(06LA506*)</del> Resetting of syringe brand.</li> </ul>	
			<ul style="list-style-type: none"> <li>• Syringe does not coincide with syringe maker number which is indicated after power ON.</li> <li>• Syringe sliding resistance is high.</li> <li>• Driving system unit is assembled improperly.</li> <li>• Main board failure in case none of above are applicable to.</li> </ul>	<ul style="list-style-type: none"> <li>• Maker of syringe being used does not coincide with syringe maker number which is indicated after power ON.</li> <li>• Abnormality is found by visual inspection. (New syringe is not used.)</li> <li>• Abnormality is found by visual inspection.</li> </ul>	<ul style="list-style-type: none"> <li>• Use new syringe.</li> <li>• Reassemble (See Para. 7.2.)</li> <li>• Replace driving system unit.</li> <li>• Replace main board.</li> </ul>
				<ul style="list-style-type: none"> <li>• <del>(06LA543*)</del></li> </ul>	
				<ul style="list-style-type: none"> <li>• <del>(06LA506*)</del></li> </ul>	

SS09-9B002

Applicable lots:  
9612 lot -

Prepared in Dec., 1996

No.	Operation/Check	Problem	Cause	Judgment	Remedy
28	Pull up syringe clamp during starting.	<ul style="list-style-type: none"> <li>"Syringe dislocated" alarm does not appear.</li> </ul>	<ul style="list-style-type: none"> <li>Syringe used is set improperly.</li> <li>Adjustment error.</li> <li>Syringe detection unit failure.</li> <li>Main board failure in case none of above are applicable to.</li> </ul>	<ul style="list-style-type: none"> <li>Maker of syringe being used does not coincide with syringe maker number which is indicated after power ON.</li> <li>See 7.3 Adjustment procedure.</li> <li>Abnormality is found by visual inspection. (Poor soldering, slide shaft broken, loosening, etc.)</li> </ul>	<ul style="list-style-type: none"> <li>Resetting of syringe brand.</li> <li>Readjust.</li> <li>Reassemble. (See Para. 7.2.)</li> <li>Replace syringe detection unit. <del>(05LA05*)</del></li> <li>Replace clamp unit. <del>(06LA503*)</del></li> <li>Replace main board. <del>(06LA506*)</del></li> </ul>
29	Stop alarm by pushing [STOP/SILENCE] once and wait for 2 minutes.	<ul style="list-style-type: none"> <li>No alarm sounds again after lapse of 2 minutes.</li> </ul>	<ul style="list-style-type: none"> <li>Re-alarm is programmed ineffectively.</li> <li>Main board failure if the above is not applicable to.</li> </ul>	<ul style="list-style-type: none"> <li>See 4.4 Special function setting mode.</li> </ul>	<ul style="list-style-type: none"> <li>Select mode properly.</li> <li>Replace main board. <del>(06LA506*)</del></li> </ul>

SS09-9B002

Applicable lots:  
9612 lot -

Prepared in Dec., 1996

No.	Operation/Check	Problem	Cause	Judgment	Remedy
30	Set each syringe and check for position at which "nearly empty" is alarmed.	<ul style="list-style-type: none"> <li>No "nearly empty" is alarmed at position of approx. 0.5 (±0.3) mL when using 10 mL syringe or approx. 1.0(±0.5) mL when using another syringe.</li> </ul>	<ul style="list-style-type: none"> <li>Adjustment error.</li> <li>Connector contacting poorly (Between nearly empty detect unit and main board).</li> <li>Nearly empty detect unit improperly assembled.</li> <li>Nearly empty detect unit malfunction.</li> <li>Main board failure in case none of above are applicable to.</li> </ul>	<ul style="list-style-type: none"> <li>See 7.3 Adjustment procedure.</li> <li>Abnormality is found by visual inspection.(Try to connect and disconnect connector several times repeatedly.)</li> <li>Abnormality is found by visual inspection. (Spring getting out of place, cap slipped off, etc.)</li> <li>Abnormality by visual inspection. (Poorly soldered parts, broken slide shaft, etc.)</li> </ul>	<ul style="list-style-type: none"> <li>Readjust.</li> <li>Wipe dirt clean.</li> <li>Replace nearly empty detection unit (<del>05LA18*</del>) if its cable has been broken.</li> <li>Replace nearly empty detection unit (<del>05LA18*</del>).</li> <li>Replace nearly empty detection unit (<del>05LA18*</del>).</li> <li>Replace main board. (<del>05LA506*</del>)</li> </ul>
31	Set each syringe and check for occlusion detection pressure.	<ul style="list-style-type: none"> <li>No occlusion alarm is made properly.</li> </ul>	<ul style="list-style-type: none"> <li>Adjustment error.</li> <li>Connector contacting poorly (Between occlusion detect unit and main board).</li> </ul>	<ul style="list-style-type: none"> <li>See 7.3 Adjustment procedure.</li> <li>Abnormality is found by visual inspection.(Try to connect and disconnect connector several times repeatedly.)</li> </ul>	<ul style="list-style-type: none"> <li>Readjust.</li> <li>Wipe dirt clean.</li> <li>Replace cable (<del>06LA534*</del>) if it has been broken.</li> </ul>

SS09-9B002

Applicable lots:

9612 lot -

Prepared in Dec., 1996

No.	Operation/Check	Problem	Cause	Judgment	Remedy
31	Set each syringe and check for occlusion detection pressure.	<ul style="list-style-type: none"> <li>No occlusion alarm is made properly.</li> </ul>	<ul style="list-style-type: none"> <li>Occlusion detection unit malfunction.</li> <li>Main board failure in case none of above are applicable to.</li> </ul>	<ul style="list-style-type: none"> <li>With an A/D value indicated in adjustment mode, no variation in A/D value is found when load is applied to slider.</li> </ul>	<ul style="list-style-type: none"> <li>Replace driving system unit. <del>(06LA543*)</del></li> <li>Have Occlusion detection unit replaced in factory, as necessary.)</li> <li>Replace main board. <del>(06LA506*)</del></li> </ul>
32	Pinch clutch and check to see if "plunger/clutch disengagement" lamp blinks.	<ul style="list-style-type: none"> <li>The lamp does not blink.</li> </ul>	<ul style="list-style-type: none"> <li>Adjustment error.</li> <li>Connector contacting poorly.</li> <li>Plunger/clutch disengagement detection unit failure.</li> <li>Main board failure if the above is not applicable to.</li> </ul>	<ul style="list-style-type: none"> <li>See 7.2.1.4</li> <li>Abnormality is found by visual inspection. (Try to connect and disconnect connector several times repeatedly.)</li> </ul>	<ul style="list-style-type: none"> <li>Readjust</li> <li>Replace cable <del>(06LA534*)</del> if it has been broken.</li> <li>Replace Plunger / Clutch detection unit. <del>(05LA49*)</del></li> <li>Replace main board. <del>(06LA506*)</del></li> </ul>
33	(Only when "delivery limit" mode is selected) Push display select switch indicate [DELIVERY LIMIT].	<ul style="list-style-type: none"> <li>"Delivery limit" mode cannot be selected.</li> </ul>	<ul style="list-style-type: none"> <li>Delivery limit" mode is programmed ineffectively.</li> <li>Main board failure if the above is not applicable to.</li> </ul>	<ul style="list-style-type: none"> <li>See 4.4 Special function setting mode.</li> </ul>	<ul style="list-style-type: none"> <li>Perform mode selection correctly.</li> <li>Replace main board. <del>(06LA506*)</del></li> </ul>

SS09-9B002

Applicable lots:  
9612 lot -

Prepared in Dec., 1996

No.	Operation/Check	Problem	Cause	Judgment	Remedy
34	Switch on power and wait for a while.	<ul style="list-style-type: none"> <li>Three " low battery " lamps blink.</li> </ul>	<ul style="list-style-type: none"> <li>Battery is discharged.</li> </ul>	<ul style="list-style-type: none"> <li>Low battery recharging voltage (ex. 10V or less) or low battery discharging voltage (ex. 8.4V or less).</li> </ul>	<ul style="list-style-type: none"> <li>Replace battery.</li> </ul>
			<ul style="list-style-type: none"> <li>Connector contacting poorly (between power-supply board and battery) and (between power-supply board and main board).</li> </ul>	<ul style="list-style-type: none"> <li>Time to the end of battery charge is as short as half or less of that of a new battery.</li> </ul>	<ul style="list-style-type: none"> <li><del>06LA521*</del> (for Asia)</li> <li><del>06LA521R*</del> (for Europe)</li> <li>(Important: Whenever battery connector has been disconnected and reconnected, be sure to perform inspection according to "Periodic check-up / Replacement of battery" in the Instruction Manual.</li> </ul>
			<ul style="list-style-type: none"> <li>Charge-line fuse (FS5) is blown.</li> </ul>	<ul style="list-style-type: none"> <li>Abnormality is found by visual inspection.(Try to connect and disconnect connector several times repeatedly.)</li> <li>Abnormal appearance / conductivity is found. (Disconnect AC/DC power cord to assure safety.)</li> </ul>	<ul style="list-style-type: none"> <li>Wipe dirt clean.</li> <li>Replace cable <del>(06LA534*)</del> if it has been broken.</li> </ul>
				<ul style="list-style-type: none"> <li>Abnormal appearance / conductivity is found. (Disconnect AC/DC power cord to assure safety.)</li> </ul>	<ul style="list-style-type: none"> <li>Replace fuse. <del>(05LA35*)</del></li> </ul>

SS09-9B002

Applicable lots:  
9612 lot -

Prepared in Dec., 1996

No.	Operation/Check	Problem	Cause	Judgment	Remedy
34	Switch on power and wait for a while.	<ul style="list-style-type: none"> <li>Three " low battery " lamps blink.</li> </ul>	<ul style="list-style-type: none"> <li>Charge-current limiting resistor (R2) damaged.</li> <li>Main board failure in case none of above are applicable to.</li> </ul>	<ul style="list-style-type: none"> <li>Abnormal appearance / conductivity is found. (Disconnect AC/DC power cord to assure safety.)</li> <li>Abnormal appearance / conductivity is found. (Disconnect AC/DC power cord to assure safety.)</li> </ul>	<ul style="list-style-type: none"> <li>Replace power-supply board. <del>(06LA525H*)</del></li> <li>Replace main board. <del>(06LA506*)</del></li> </ul>
35	(TE-312 only) Set the values of Dose rate, Body weight, Drug volume, and Solution volume, and check up result.	<ul style="list-style-type: none"> <li>Set items cannot be switched over.</li> <li>In "Body weight" mode, flow rate is not calculated correctly.</li> </ul>	<ul style="list-style-type: none"> <li>Main board failure.</li> <li>Poor value display of LCD.</li> <li>Main board failure in case none of above are applicable to.</li> </ul>	<ul style="list-style-type: none"> <li>When dial is turned, LCD indicates correct value but some missing in segments.</li> </ul>	<ul style="list-style-type: none"> <li>Replace main board. <del>(06LA506*)</del></li> <li>Replace LCD. <del>(06LB503*)</del></li> <li>Replace main board. <del>(06LA506*)</del></li> </ul>
36	(Only products with computer interface) Check up computer interface.	<ul style="list-style-type: none"> <li>Computer interface does not function properly.</li> </ul>	<ul style="list-style-type: none"> <li>ID number of external medical monitor does not coincide with that of syringe pump.</li> <li>Connector contacting poorly (Between computer interface and main board).</li> </ul>	<ul style="list-style-type: none"> <li>See "Computer interface protocol."</li> <li>Abnormality is found by visual inspection. (Try to connect and disconnect connector several times repeatedly.)</li> </ul>	<ul style="list-style-type: none"> <li>Correct setting.</li> <li>Wipe dirt clean.</li> <li>Replace cable <del>(06LA534*)</del> if it has been broken.</li> </ul>

SS09-9B002

Applicable lots:  
9612 lot -

Prepared in Dec., 1996

No.	Operation/Check	Problem	Cause	Judgment	Remedy
36	(Only products with computer interface) Check up computer interface.	<ul style="list-style-type: none"> <li>• Computer interface does not function properly.</li> </ul>	<ul style="list-style-type: none"> <li>• Cable to external medical monitor is defective.</li> <li>• RS232C/485 set improperly.</li> <li>• Communication board failure.</li> <li>• Main board failure in case none of above are applicable to.</li> </ul>	<ul style="list-style-type: none"> <li>• Wiring is not made properly according to cable connection diagram given in protocol.</li> <li>• Setting of "RS-232C and RS-485" is not made properly according to protocol and/or setting of pump body is erroneous.</li> <li>• Output signal from communication board is erroneous.</li> </ul>	<ul style="list-style-type: none"> <li>• Correct wiring or replace cable.</li> <li>• Correct setting.</li> <li>• Replace nurse-call board and RS232C board. <del>(05LA27*)</del></li> <li>• Replace main board. <del>(06LA506*)</del></li> </ul>
37	(Only products with computer interface) Check up nurse-call.	<ul style="list-style-type: none"> <li>• Nurse-call does not output properly.</li> </ul>	<ul style="list-style-type: none"> <li>• Connector contacting poorly (Between nurse-call board and communication board).</li> <li>• Setting is not made properly according to 14.4 Special function setting mode.</li> <li>• Nurse-call board / Communication board failure.</li> <li>• Main board failure in case none of above are applicable to.</li> </ul>	<ul style="list-style-type: none"> <li>• Abnormality is found by visual inspection. (Try to connect and disconnect connector several times repeatedly.)</li> <li>• See 4.4 Special function setting mode.</li> <li>• Output signal from nurse-call board / communication board is erroneous.</li> </ul>	<ul style="list-style-type: none"> <li>• Wipe dirt clean.</li> <li>• Replace cable <del>(06LA534*)</del> if it has been broken.</li> <li>• Correct mode selection.</li> <li>• Replace nurse-call board and RS232C board. <del>(05LA27*)</del></li> <li>• Replace main board. <del>(06LA506*)</del></li> </ul>



SS09-9B002

Applicable lots:  
9612 lot -

Prepared in Dec., 1996

No.	Operation/Check	Problem	Cause	Judgment	Remedy
38	Push [POWER] switch.	<ul style="list-style-type: none"> <li>Power supply is not cut within approx. 2 seconds.</li> </ul>	<ul style="list-style-type: none"> <li>Connector contacting poorly (Between main board and power-supply board).</li> <li>TR2 on power-supply board is faulty.</li> <li>Main board failure in case none of above are applicable to.</li> </ul>	<ul style="list-style-type: none"> <li>Abnormality is found by visual inspection. (Try to connect and disconnect connector several times repeatedly.)</li> <li>Pushing [POWER] switch, check for ON/OFF action of TR2 (gate) on power-supply board.</li> <li>(1) ON/OFF action is made.</li> <li>(2) No ON/OFF action is made.</li> </ul>	<ul style="list-style-type: none"> <li>Wipe dirt clean.</li> <li>Replace cable <del>(06LA534*)</del> if it has been broken.</li> <li>Replace power-supply board. <del>(06LA525*)</del></li> <li>Replace main board. <del>(06LA506*)</del></li> <li>Replace main board. <del>(06LA506*)</del></li> </ul>

### 8.3 Alarms and Error Messages

Alarms and error messages are detailed below.

If any abnormal state such as shown in the following is found, take necessary action, referring to the Instruction manual, Computer interface protocol, and "8. Troubleshooting."

#### 8.3.1 Alarms and cautions

Alarm or caution	Description
Syringe dislocated alarm	Occurs if the syringe gets out of place during syringe pump operation.
Occlusion alarm	Occurs if the slider is subjected to overload due to occlusion in the infusion line.
"Nearly empty" alarm	Occurs if the solution in the syringe has been exhausted to a limit.
Low Battery alarm	Occurs if the syringe pump built-in battery has discharged to a limit.
Start-reminder caution	Occurs when standby state continues for 2 minutes or more until "Start" switch is pushed.
Re-alarm	Occurs if the alarm involved is not reset within 2 minutes after the "Stop/Silence" switch is pushed to stop the buzzer.
Delivery-end caution	Occurs when the preset delivery limit is reached.
Plunger/clutch disengagement alarm	Occurs if the syringe plunger is not set properly or if the clutch is disengaged during operation.

**8.3.2 Error messages**

Error No.	Error
1	CPU(RAM/Register) error
2	CPU (ROM) error
3	Motor rotation error
5	E <sup>2</sup> PROM error
8	Switch error
9*	Rotary switch error (*: optional)
10	Communication port error (communication with battery-supervisory IC) (*1)

**• Contents of Er 9\***

Error No.	Error
Er 91	The STOP switch is not kept pressed when the POWER switch is pushed to select the troubleshooting mode.
Er 92	The STOP switch is not kept pressed when the POWER switch is pushed to select the special function setting mode.
Er 93	The STOP switch is not kept pressed when the POWER switch is pushed to select the adjustment mode.
Er 94	The STOP switch is not kept pressed when the POWER switch is pushed to select the computer interface and ID No. setting mode.
Er 95	The STOP switch is not kept pressed when the POWER switch is pushed to select the initialization of E <sup>2</sup> PROM.
Er 96	The STOP switch is not kept pressed when the POWER switch is pushed to select the aging mode.

\*1: Even if AC/DC is kept in connection, Er10 may appear because of lacking in battery charge when power switch is turned on after the pump has not been used for a long time. Recharging the battery for about 5 minutes will be effective to prevent Er10 from recurring.

Recharging the battery without fail, referring to the "Periodic check-up and replacement of battery" section in the instruction manual.

S.M.T.

## 9. MAINTENANCE AND CLEANING INSTRUCTIONS

### 9.1 Precautions for Maintenance

#### 9.1.1 Syringe to be used for maintenance service

**IMPORTANT: Be sure to use only a syringe type corresponding to the syringe number selected from the syringe brand list in the instruction manual and set up on the pump as instructed.**

- \* For the selected syringe maker (one of makers listed on the label at the back of the pump body), its ID number is indicated for 3 seconds at the end of self-diagnosis. For the method of changing of maker ID number, see 4.2 Syringe maker setting mode.

**IMPORTANT: To prevent danger of infection, use only the disposable type of sterilized syringe and I.V. catheter. Avoid using any used syringes. Reuse of a syringes will affect the accuracy of measurement.**

#### 9.1.2 In case of pump experiencing shock.

**IMPORTANT: If the pump has been dropped from a height or subjected to a hard knock, avoid using it even though its appearance and action do not show any remarkable deterioration.**

**9.1.3 Periodical replacement parts**

The parts listed below deteriorate and wear out gradually with pump operation and, therefore, need replacing periodically to keep proper accuracy and performance of the products.

Replace those parts at proper intervals.

Product code	Part name	Interval	Symptom of deterioration
<del>06LA521*</del> (for Asia) <del>06LA521R*</del> (for Europe)	Battery (built-in type)	1.5 - 2 years	Charge of the battery does not last long, causing the [Battery] lamp to blink and the alarm buzzer to sound.
<del>05LA31*</del>	Pole clamp with tray	2 - 3 years	The clamp is damaged by solution or worn down. It becomes hard to grasp the pole.
<del>05LT17*</del>	Rubber foot (4 pcs.)	5 - 6 years	Foot worn and tear remarkably, making the pump body hard to rest stable on a level surface.
(TE-311) <del>06LA501A*</del> (TE*311N) <del>06LA501B*</del> (TE*311C)  (TE-312) <del>06LB501*</del> (TE*312C)	Upper case unit (operation panel)	1.5 - 2 years	<ul style="list-style-type: none"> <li>• The panel is perforated.</li> <li>• Entry with push buttons is rather hard.</li> </ul>
<del>05LA15*</del>	Motor unit	2 - 3 years	Flow rate becomes irregular and abnormal sound is heard during operation.

**Note: Appropriate intervals of replacing each unit depend on the frequency of using the pump and the environmental conditions.**

## 9.2 Inspection items, methods and intervals

### 9.2.1 Checking before operation (every time)

Before every time use of the pump, check up the followings:

- 1) Check that the outside of pump body and the pole clamp are free from damage.
- 2) Check that the battery is enable to drive the pump.
- 3) Check that, when the pump is switched on, the following self-diagnosis function is carried out normally:
  1. All lamps blink three times repeatedly, the buzzer sounds warning, and the motor rotates slightly. (The operation indicator lamp lights red and green, alternately.)
  2. Subsequently, the [RATE / D.LIMIT /  $\Sigma$ ml] display (7-segment LED) indicates for 3 seconds a number representing the maker of syringe used.
- 4) Check that the [BATTERY] lamp lights up as soon as the AC power cable is connected to the pump but power is not yet supplied. (\*See note.)
- 5) Check that both the [BATTERY] lamp and [AC/DC] lamp light up when AC power is supplied. (\*See note.)
- 6) Check that the [SYRINGE SIZE] indicator detects each syringe when 10, 20, 30 and 50 mL syringes made by a maker whose ID number has been preset are set in the pump.
- 7) Check that the [D. LIMIT] lamp blinks when the slider is pushed all the way of its stroke without any syringe set in the pump.
- 8) Check that pushing the [STOP/SILENCE] switch during pump operation cause the pump to stop operating.

\* The [BATTERY] lamp may fail to light because the battery has discharged; in such a case, the lamp will go on after about 10-minute recharging by AC power.

**9.2.2 Checking for occlusion detection accuracy (Every 2 months)**

\* You are advised to carry out checking using the occlusion adjustment jig to get highly precise measurement, though the more simple but rather less accuracy checking method using a pressure gauge is described latter.

**(1) When using the occlusion adjustment jig**

Every 2 months, check for occlusion detection function using the following procedure:

- 1) Set the occlusion adjustment jig (05LA46\*) in the syringe pump. Lower the clamp to light the [50 mL] lamp in the [SYRINGE mL] display.
- 2) Grasp the clutch to move the slider until it comes into contact with the occlusion adjust jig.
- 3) Turn on the power switch. Set the flow rate and occlusion pressure to the values shown in table below.  
(For the method of changing occlusion pressure set value, refer to para. 25 of Instruction Manual.)
- 4) Push the [START] switch to allow the pump to operate until the pump comes to a stop with occurrence of a occlusion alarm.
- 5) As the pump comes to a stop, record the detected occlusion pressure and make sure that it is within the allowable range.
- 6) If the measurement exceeds the allowable range, readjust according to 7.3 Adjustment procedure. Then, repeat steps 1) to 6) to check the result again.

Syringe size	Occlusion detect pressure	Test flow rate	Allowable range of pressure [N] ([Kgf])
50	M	50	35.7 - 53.6 (3.64 - 5.47)

Occlusion adjustment jig (05LA46\*)

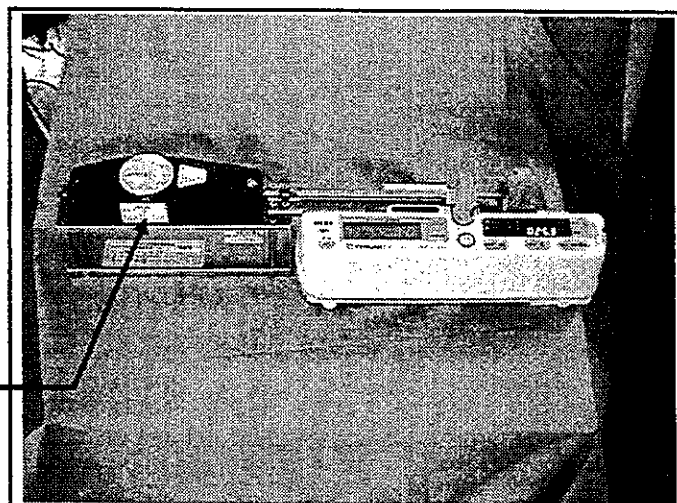


Fig.9.2.2 (1)

## (2) When using a pressure gauge

Every 2 months, check for occlusion detection function using the following procedure:

- 1) Connect a pressure gauge with a tube to a new 50 cc. syringe filled with water of 20 - 30 cc. Set the syringe in the pump.
- 2) Grasp the clutch to move the slider until it comes into contact with the syringe plunger.
- 3) Turn on the power switch. Set the flow rate and occlusion pressure to the values shown in table below.

(For the method of changing occlusion pressure set value, refer to para. 25 of Instruction Manual.)

- 4) Push the [START] switch to allow the pump to operate until the pump comes to a stop with occurrence of a occlusion alarm.
- 5) As the pump comes to a stop, record the detected occlusion pressure and make sure that it is within the allowable range.
- 6) If the measurement exceeds the allowable range, readjust according to 7.3 Adjustment procedure. Then, repeat steps 1) to 6) to check the result again.

Syringe size	Occlusion detect pressure	Test flow rate	Allowable range of pressure [KPa] ([Kgf/cm <sup>2</sup> ])
50	M	50	53.4 - 80.0 (0.54 - 0.82)

Pressure gauge

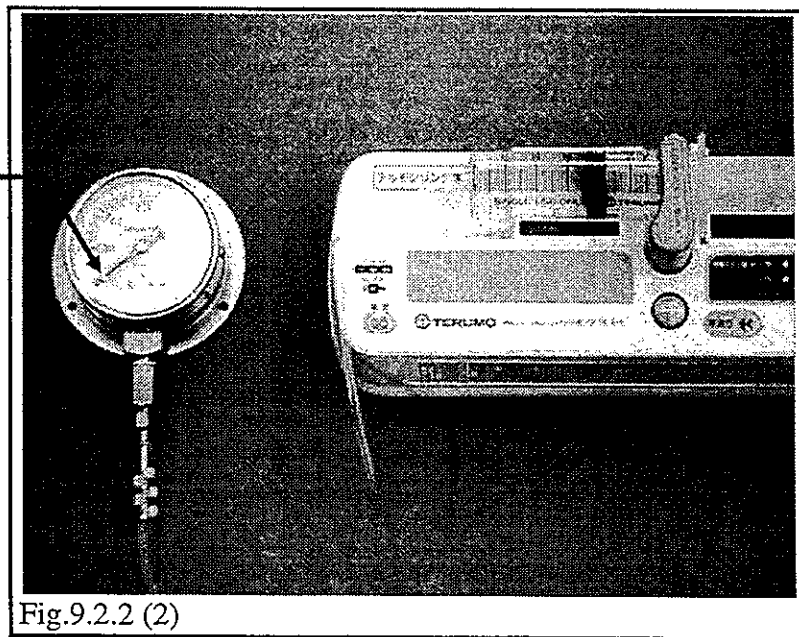


Fig.9.2.2 (2)

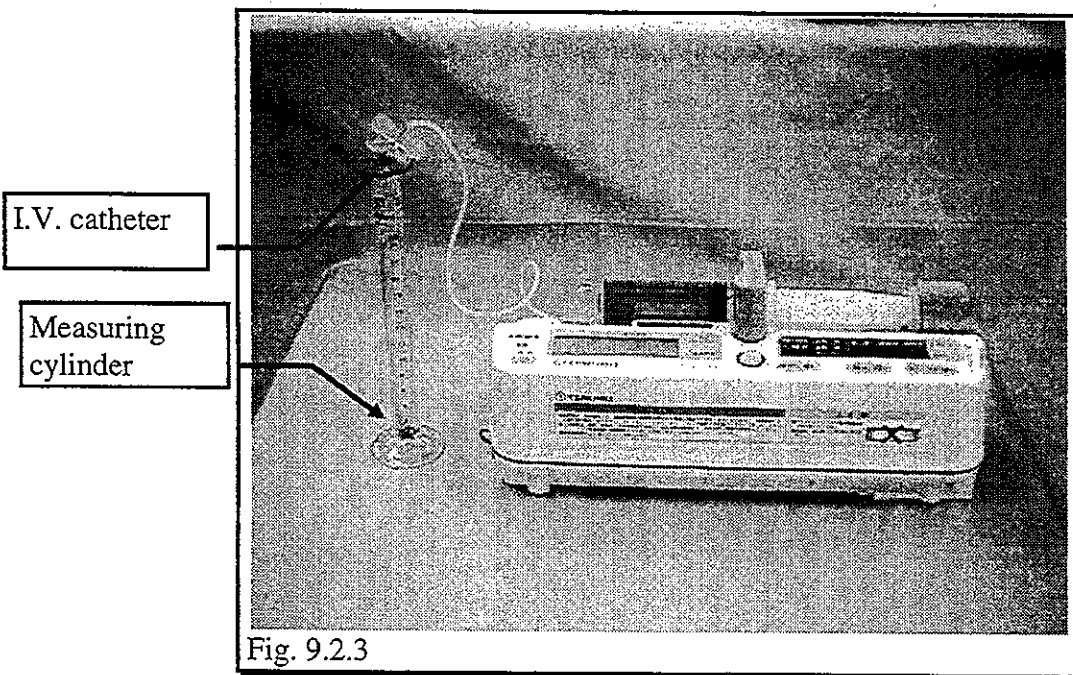


**9.2.3 Checking for flow-rate measurement accuracy(Every 2 months)**

Every 2 months, check for flow-rate measurement accuracy using the following procedure:

- 1) Set a 50 mL syringe filled with water in the pump. Attach an I.V. catheter to the syringe.
- 2) Grasp the clutch to move the slider until it comes into contact with the syringe plunger.
- 3) Turn on the power switch. Push the [PURGE] switch to send water to the tip of catheter, filling up the catheter with water.
- 4) Push the [CLEAR (C ΣmL)] switch to reset the volume delivered to 0.
- 5) Immerse the needle of I.V. catheter into a measuring cylinder and set the flow rate to 70 mL/h.
- 6) Push the [START] switch and, at the same time, start to count the time with a stopwatch. After operating the pump for 30 minutes, stop it by pushing the [STOP/SILENCE] switch.
- 7) Push the [DISPLAY SELECT] switch to select indication of the volume delivered. Confirm that water collected in the measuring cylinder and the indicated the volume delivered value are within the standard range shown in the table below.

Flow rate set value	Test time	Display of volume delivered	Standard range
70 mL/h	30 min.	35 mL	34 - 36 mL



**IMPORTANT:** If the result of testing shows that the amount of collected water does not fall within the standard range, stop to use the syringe pump. Take a measure to correct abnormality, referring to 8. Troubleshooting.

### 9.2.4 Checking for battery (Every month)

The syringe pump has a built-in battery which serves as a backup power source.

The built-in battery gradually deteriorates with time, regardless of use of it. Therefore, the battery needs inspecting periodically and replacing as necessary.

Appropriate battery replacement interval depends on the working environment and the frequency of use of the syringe pump.

- 1) With the power switch kept OFF, connect the AC power cord to the pump to recharge the battery for 24 hours or more.
- 2) Turn the power switch to ON. Fill a 50 mL syringe (with an I.V. catheter) with water and set it in the pump. Start the pump to operate at flow rate set to 5 mL/h. Set the occlusion pressure to "M". (Refer to PP.25 - 31 of Instruction Manual.)
- 3) Disconnect the AC power cord and make sure that the battery is able to sustain pump operation for at least 60 minutes. Thereafter, continue to operate the pump until the discharged battery is no more able to supply power. Then, connect the AC power cord to the pump again and recharge the battery for 24 hours or more.

### 9.2.5 Periodical inspection ✱

To ensure safe and long use of the syringe pump, perform periodical inspection once a year, as a rule, using the following procedure:

#### (1) Visual inspection

- 1) Check the external surfaces of housing, label, etc. for scratches, dirt and deformation.
- 2) Grasp the clutch and check the slider for any dragging movement.

#### (2) Functional inspection

##### 1) Self-check

Connect the AC power cord and turn on the power switch. Check that all indicator lamps blink three times, a syringe maker number appears on the [FLOW RATE / DELIVERY LIMIT / VOLUME DELIVERY] display, and the buzzer sounds warning. (For TE-312, check that also the backlight and letters flicker on the LCD.)

Then, check that the syringe maker number on the [FLOW RATE/DELIVERY LIMIT/VOLUME DELIVERY] display is superseded by "0.0" and not any error No.

2) Dial

Gradually turn the setting dial clockwise. Make sure that the value displayed does not vary until the dial turns about a half rotation and, thereafter, the value increases about 16 counts when the dial completes one rotation. Contrariwise, gradually turn the dial counterclockwise and make sure that the value displayed decreases 16 counts when the dial makes one complete rotation.

3) CLEAR (C ΣmL) switch

With the pump stopped, check that the volume delivered value displayed can be cleared by keeping the [CLEAR (C ΣmL)] switch pushed for about 1.5 seconds.

4) Buzzer volume

With the [STOP/SILENCE] switch pressed, push the [CLEAR (C ΣmL)] switch, and "bEL.\*" will appear on the [FLOW RATE / DELIVERY LIMIT / VOLUME DELIVERY] display to indicate the setting mode. Leaving the [STOP/SILENCE] switch pressed, temporarily release the [CLEAR (C ΣmL)] switch and then try to push it repeatedly. Each time, the buzzer sounds, varying the level of sound sequentially, and at the same time respective buzzer volumes are indicated on the said display.

- Buzzer volume "Small"( bEL.1) ; "Middle"( bEL.2); "Large"(bEL.3)

\* After testing, finally set the volume to "bEL.2."

5) Computer interface connector

Check the computer interface connector for normal function. For details, refer to "Computer interface protocol."

6) Nurse-call connector

With the syringe pump switched on, raise the syringe clamp to test generation of a syringe alarm. Make sure that output signal from the nurse-call connector continues for about 5 seconds.

7) Power ON/OFF

Check that power is supplied about 1 second after the switch is turned ON and is cut off about 2 seconds after the switch is turned OFF.

## 8) Body weight mode (TE-312 only)

Check that keeping the [DISPLAY ON/OFF] switch pressed for about 2 seconds causes the body weight mode screen to light on. Check that each time the [ITEM SELECT] switch is pushed, the dose rate, body weight, drug volume and solution volume items flash in sequence on the screen, allowing you to set the respective values with the setting dial.

## 3. Performance test

- 1) Checkup of syringe detection function: See 7.3.4.1.
- 2) Checkup of nearly empty detection function: See 7.3.4.2.
- 3) Checkup of occlusion detection function: See 7.3.4.3.

**9.2.6 Inspection record**

Fill the result of foregoing periodical inspection work in a record form such as shown below and keep it for the purpose of reference in the future.

## TE0311/312 INSPECTION RECORD

Model	Serial No.	Classification	Date	Checked by	Remarks
TE-31		Before operation / Accuracy			

Item	Check point	Result
------	-------------	--------

## • Inspection before operation (Each time)

Visual inspection	1	Check pump body and pole clamp for damage, etc.	OK • NG
Battery power	2	Check that syringe pump can be operated by battery power.	OK • NG
Diagnosis	3	Check that diagnosis is made normally when power is switched on.	OK • NG
AC power	4	Check that [BATTERY] lamp lights on when AC inlet cable is connected.	OK • NG
AC power	5	Check that [AC/DC] / [BATTERY] lamp lights on as far as pump is operated by AC power.	OK • NG
Syringe detection	6	Check that 10, 20, 30, 50 mL syringes can be detected normally.	OK • NG
Nearly-empty alarm	7	Check that [NEARLY EMPTY] lamp blinks when slider without syringe is moved.	OK • NG
Stop switch	8	Check that pump in operation can be stopped by pushing [STOP/SILENCE] switched.	OK • NG

## • Checking for operational accuracy (Every 1 - 2 months as a rule)

Occlusion detection; every 2 months	1	Check that occurrence of [OCCLUSION] alarm is within specification. 50 mL syringe: 35.7 - 53.6N (3.64 - 5.47 kgf) at flow rate 100 mL/h and occlusion set pressure M. (or, 50 mL syringe: 53.4 - 80.0 KPa (0.54 - 0.82 kgf/cm <sup>2</sup> ) at flow rate 50 mL and occlusion set pressure M: ).	N (kgf) KPa (kgf/cm <sup>2</sup> )
Flow rate accuracy; every 2 months	2	Check that accuracy of flow rate is within specification. 50 mL syringe: 34 - 36 mL by 30-min. testing at 70 mL/h of flow rate.	mL
Battery power; every month	3	Check that battery is able to support pump operation at least 60 minutes. Test 50 mL syringe at flow rate 5 mL/h and occlusion set pressure M.	Minutes

## TE0311/312 INSPECTION RECORD

Model	Serial No.	Classification	Date	Checked by	Remarks
TE-31		Periodical			

Item	Check point	Result
------	-------------	--------

## • Periodical inspection (Once a year as a rule)

Electrical safety test	1	One-minute, voltage-resistant test. Check for 3000VAC* voltage resistance between AC inlet (N and L) of body and metal part (pole clamp mounting screw) of body casing. * over 50 - 150V = 3000VAC, over 150 - 250V = 4000VAC	OK • NG
	2	Casing leak current test. Check for leak current at AC inlet (N and L) of body and metal part (pole clamp mounting screw) of body casing, under both normal and simple-failure conditions.	Normal condition 0.1 mA or less
			Single fault condition 0.5 mA or less
	3	Ground leak current test. Check for leak current from AC inlet (N and L) of body to grounding terminal, under both normal and simple-failure conditions.	Normal condition 0.5 mA or less
Single fault condition 1.0 mA or less			
Visual inspection	1	Flaw/dirt/damage on or to product, label, etc. Smoothly movement of slider.	OK • NG
Functional inspection	1	Self-diagnosis - Problems indicated by indicator lamp and/or alarm.	OK • NG
	2	Dial - Switching of up/down of counts by reversing direction of turning of dial.	OK • NG
	3	Clear ΣmL - Successful clear of ΣmL with Clear (C ΣmL) switch.	OK • NG
	4	Buzzer volume - Successful setting at three levels.	OK • NG
	5	Computer interface - Normal function.	OK • NG
	6	Nurse call - One-shot output from connector.	OK • NG
	7	Power on/off - Proper switch function (1 sec - ON, 2 sec - OFF).	OK • NG
	8	Body weight mode - Correct working of mode. (TE-312 only)	OK • NG
Performance inspection	1	Syringe size detection (10, 20, 30 and 50 mL) - Normal function.	OK • NG
	2	Nearly empty alarm - 0.5 mL for 10 mL syringe and 1 mL for other syringes.	OK • NG
	3	Check that occurrence of [OCCLUSION] alarm is within specification.	
		10 mL syringe, occlusion set pressure L: 10.1 - 15.2N (1.03 - 1.55 kgf).	N (kgf)
30 mL syringe, occlusion set pressure M: 28.6 - 40.0N (2.92 - 4.08 kgf).		N (kgf)	
	50 mL syringe, occlusion set pressure H: 64.6 - 100.3N (6.59 - 10.23 kgf).	N (kgf)	
	4	Flow rate accuracy 50 mL syringe: 34 - 36 mL by 30-min. testing at 70 mL/h of flow rate.	mL
	5	Check that pump is able to operate more than 60 min. on battery. 50 mL syringe, flow rate 5 mL/h, and occlusion set M.	Minutes

### 9.3 Cleaning

#### 9.3.1 Cleaning of syringe pump

If the syringe pump is fouled with the solution or dirt, immediately wipe the pump with the gauze moistened with cold or tepid water. Don't use alcohol, thinner or any other organic solvent.

**Caution: Before cleaning the pump, be sure to turn off the power switch and disconnect the AC inlet cable.**

#### 9.3.2 Disinfection of syringe pump

To prevent infections, disinfect the pump periodically.

Softly wipe the pump with gauze which is moistened with disinfectant solution, such as listed below, and wrung lightly. Follow the direction, such as about the ratio of dilution, of the disinfectant solution used.

Thereafter, wipe off such disinfectant solution with gauze moistened with tepid water and wrung lightly.

**IMPORTANT: To prevent the syringe pump from being deteriorated in performance and material, never use a dryer to dry the pump or use any alcohol-based disinfectant.**

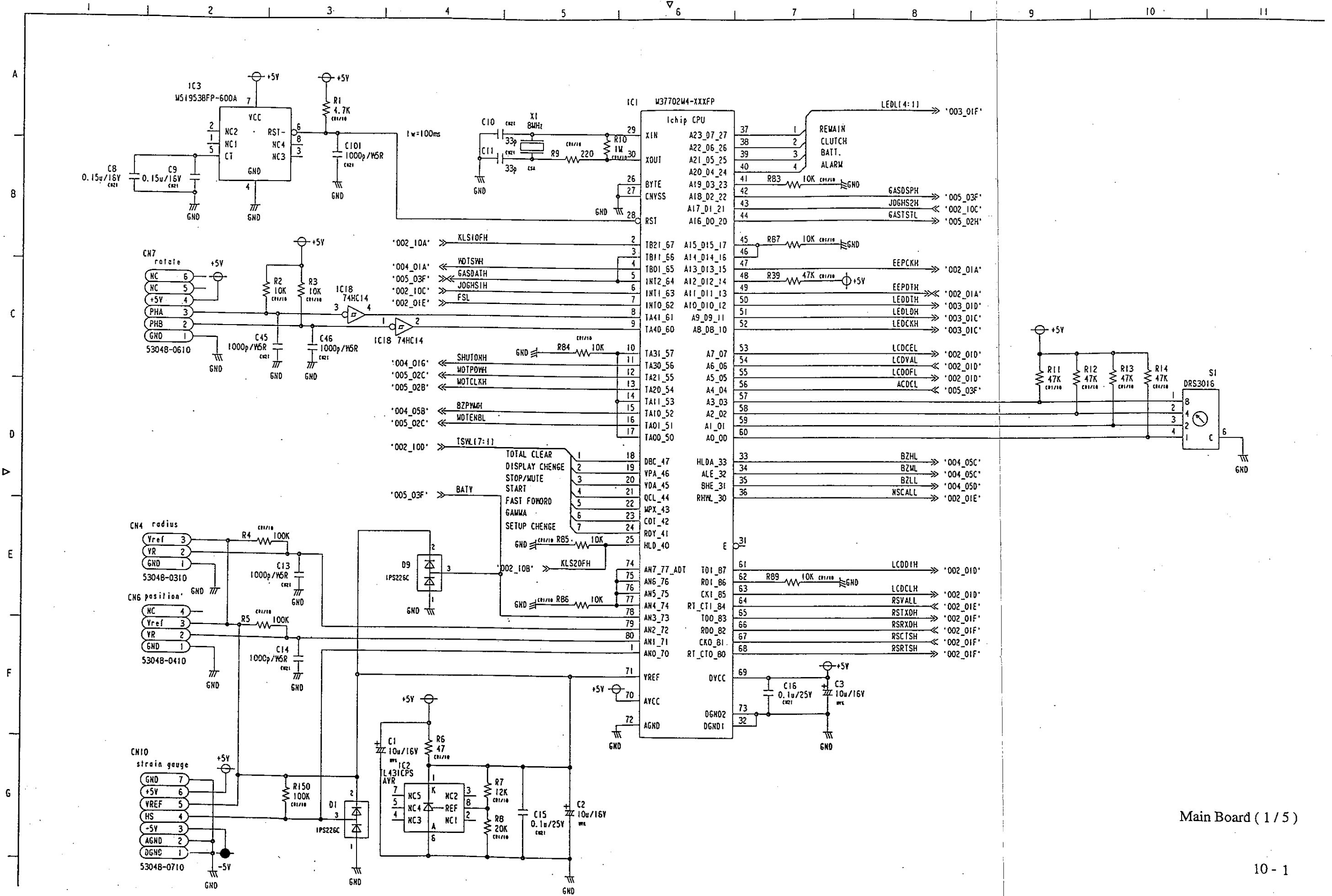
Name of disinfectant solution		Manufacturer
Cidex	2.25%*1	Johnson & Johnson
Sterihyde	20%*1	Maruishi Pharmaceutical Co., Ltd.
Sterihyde L	20%*1	Maruishi Pharmaceutical Co., Ltd.
Hibitane	5%*2	Zeneca
Maskin	5%*2	Maruishi Pharmaceutical Co., Ltd.
Osvan solution	10%*3	Nihon Pharmaceutical Co., Ltd.

\*1 Glutaral (Glutaraldehyde) \*2 Chlorhexidine gluconate \*3 Benzalkonium chloride

10. CIRCUIT DIAGRAM

SS09-9B002  
 Applicable lots:  
 9612 lot -  
 Prepared in Dec., 1996

10.1 Main Board. (SS09 - 1EA01 - 1)

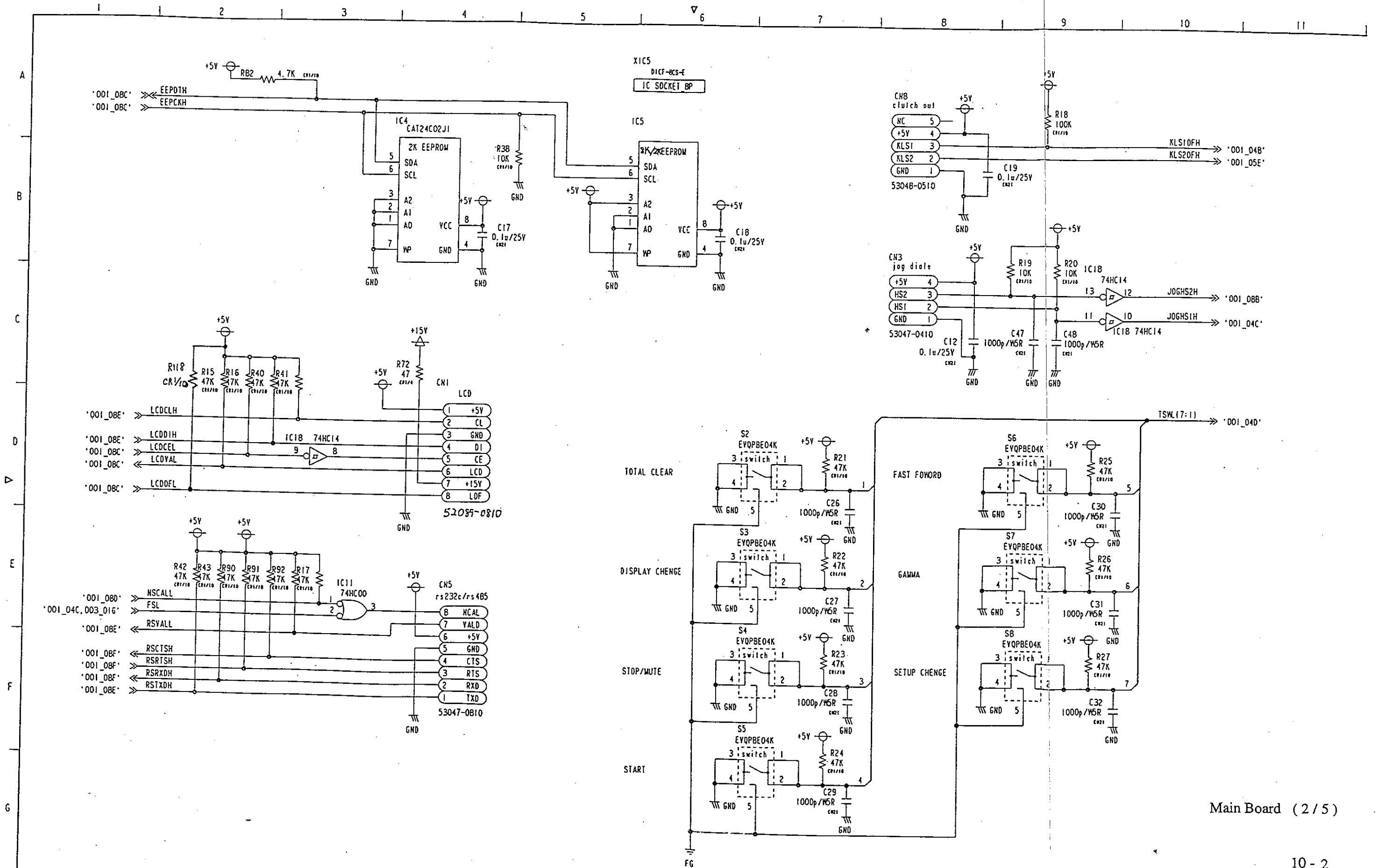


Main Board (1/5)



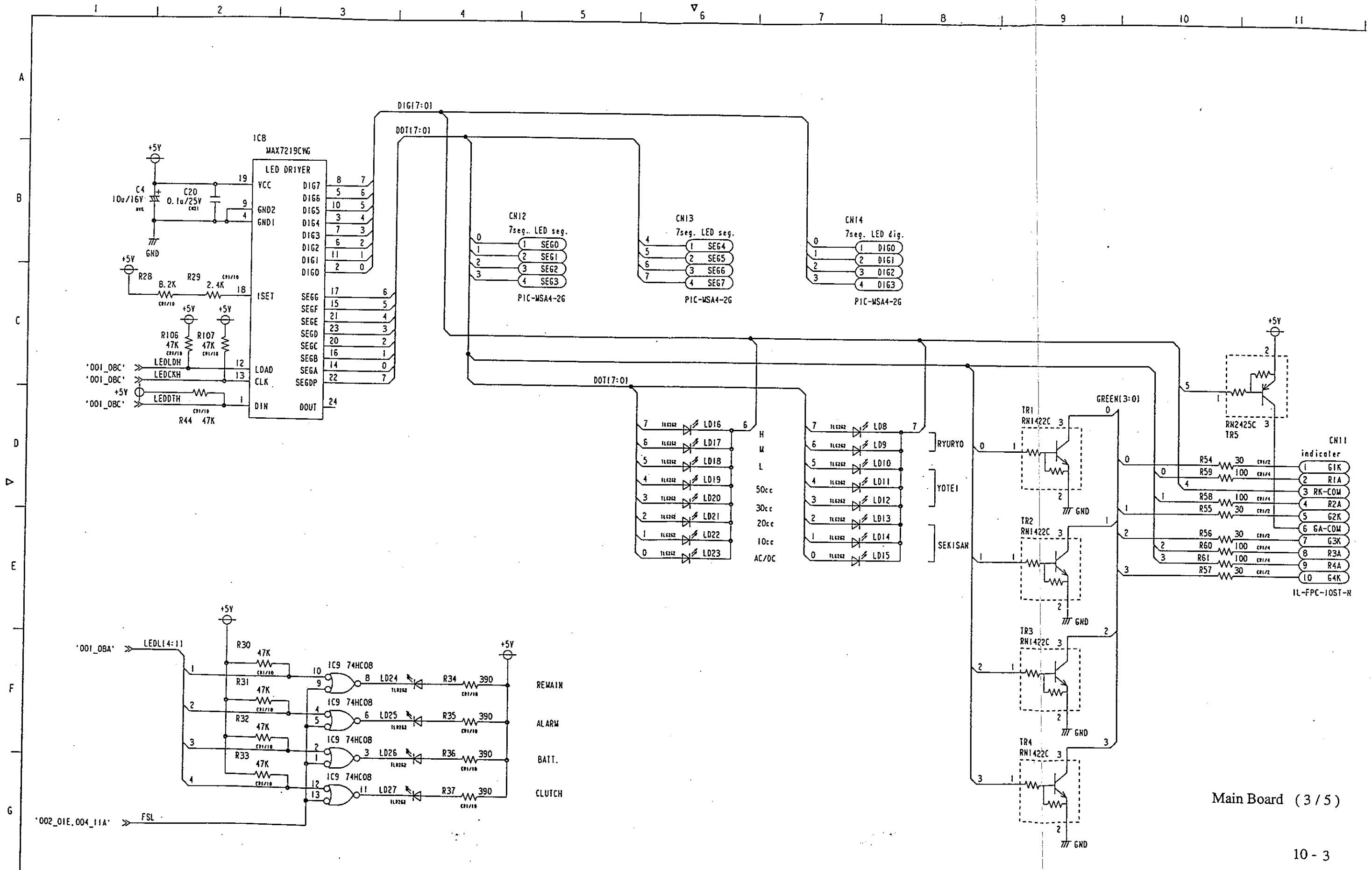
10.1 Main Board. (SS09 - 1EA01 - 1)

SS09-9B002  
 Applicable lots:  
 9612 lot -  
 Prepared in Dec., 1996

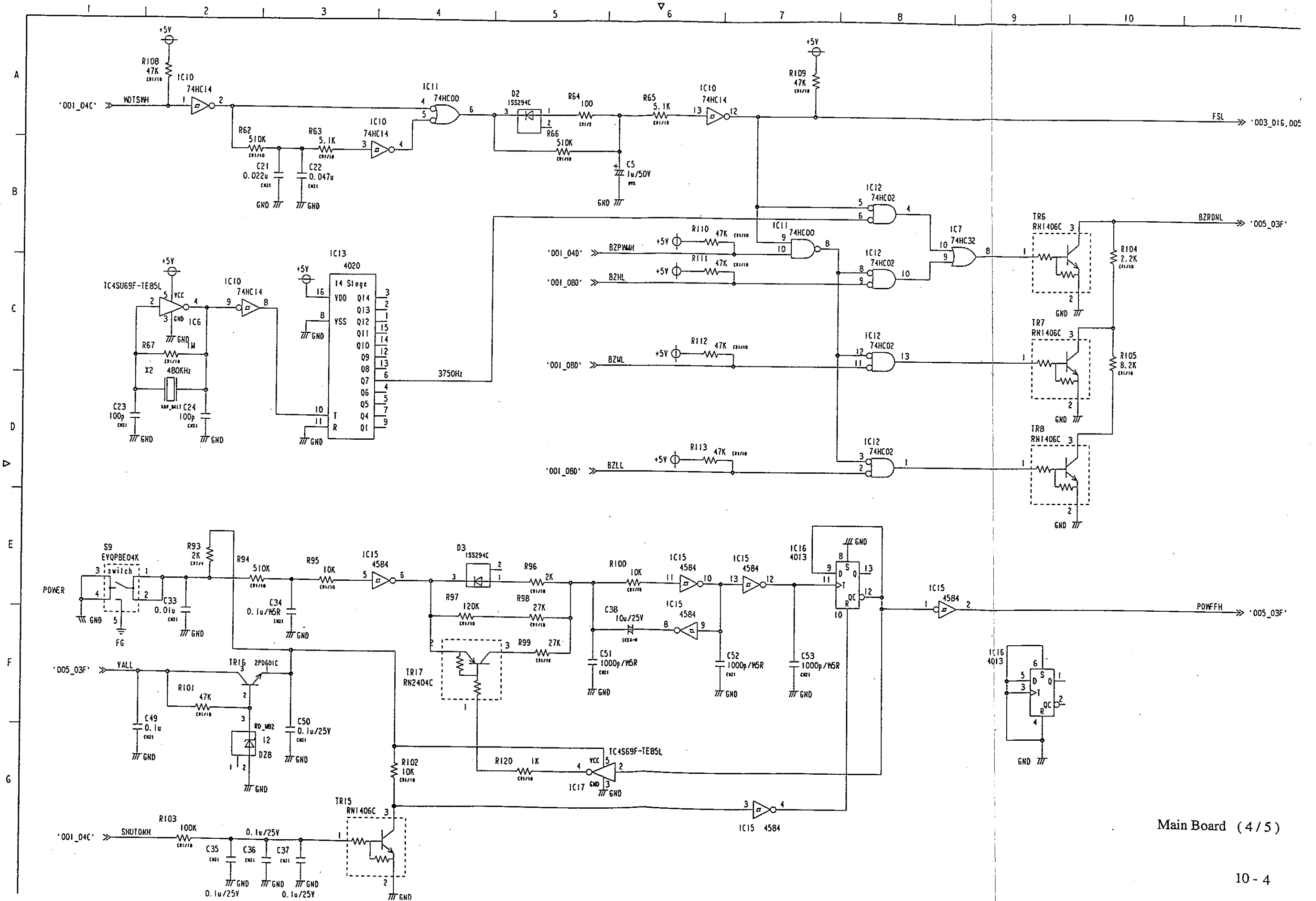


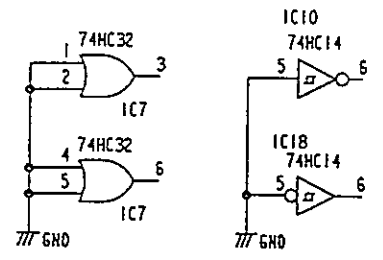
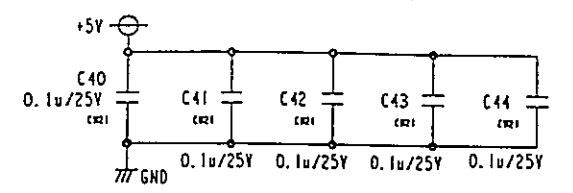
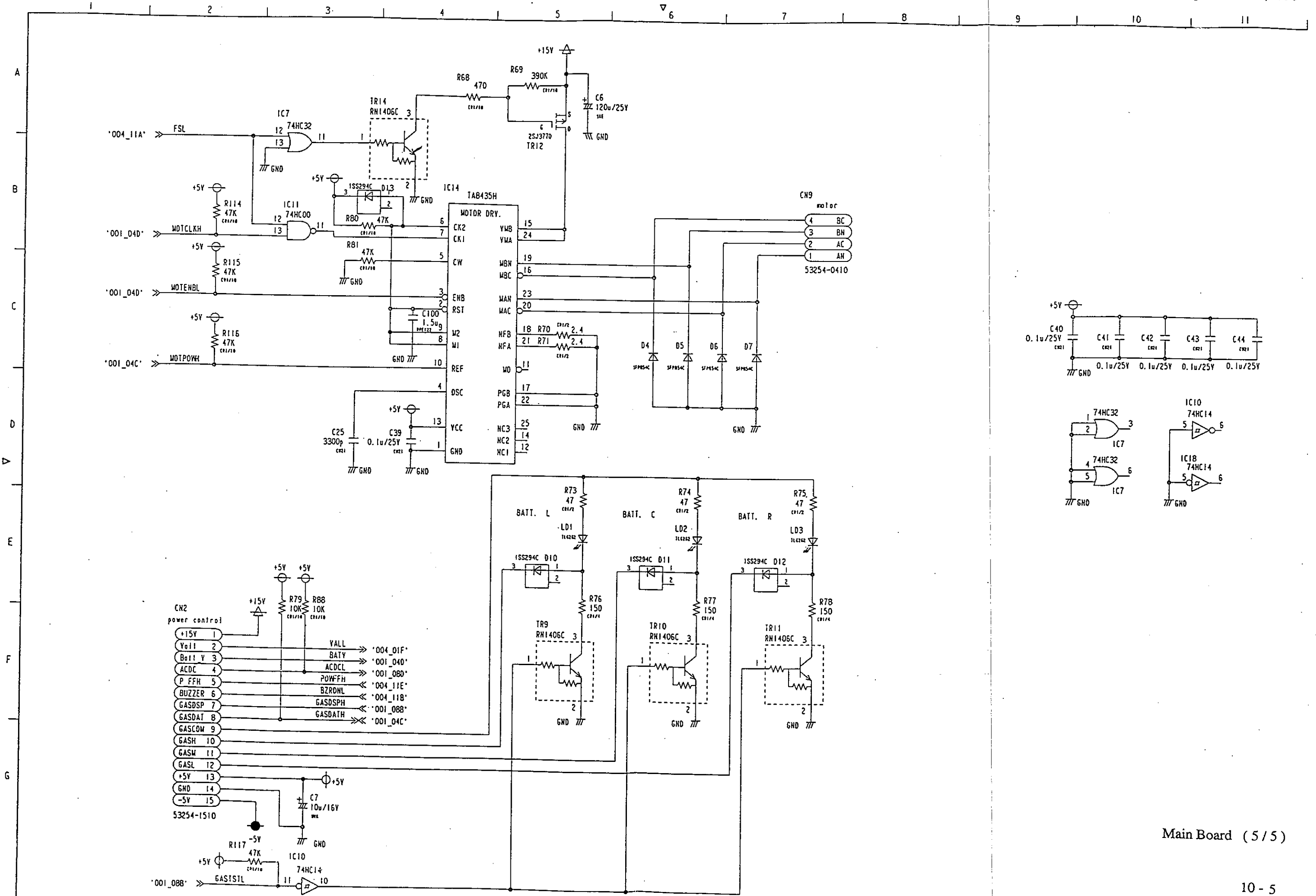
10.1 Main Board. (SS09 - 1EA01 - 1)

SS09-9B002  
 Applicable lots:  
 9612 lot -  
 Prepared in Dec., 1996



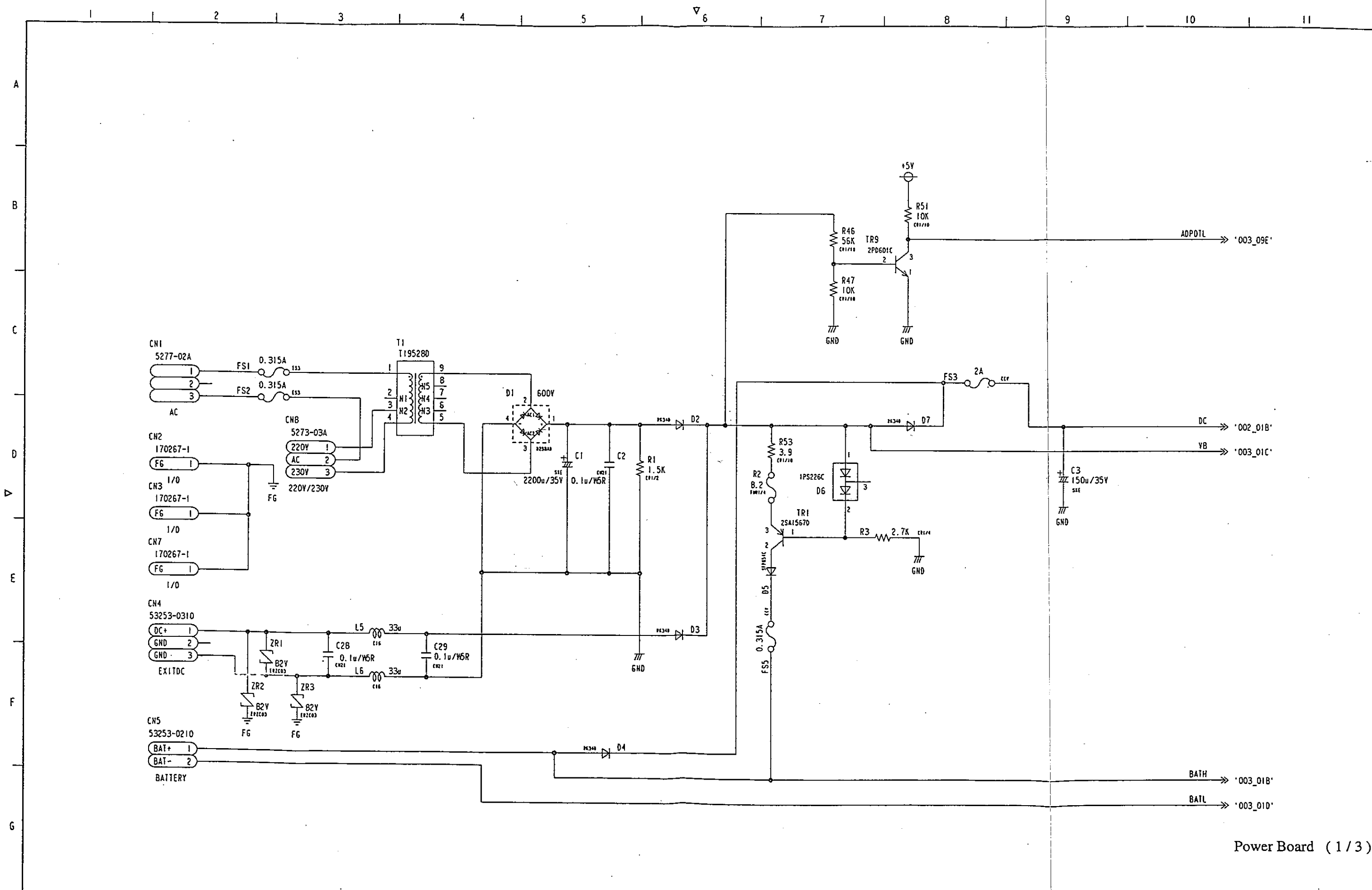
Main Board (3/5)





10.2. Power Board. (SS09 - 1EB01 - 1)

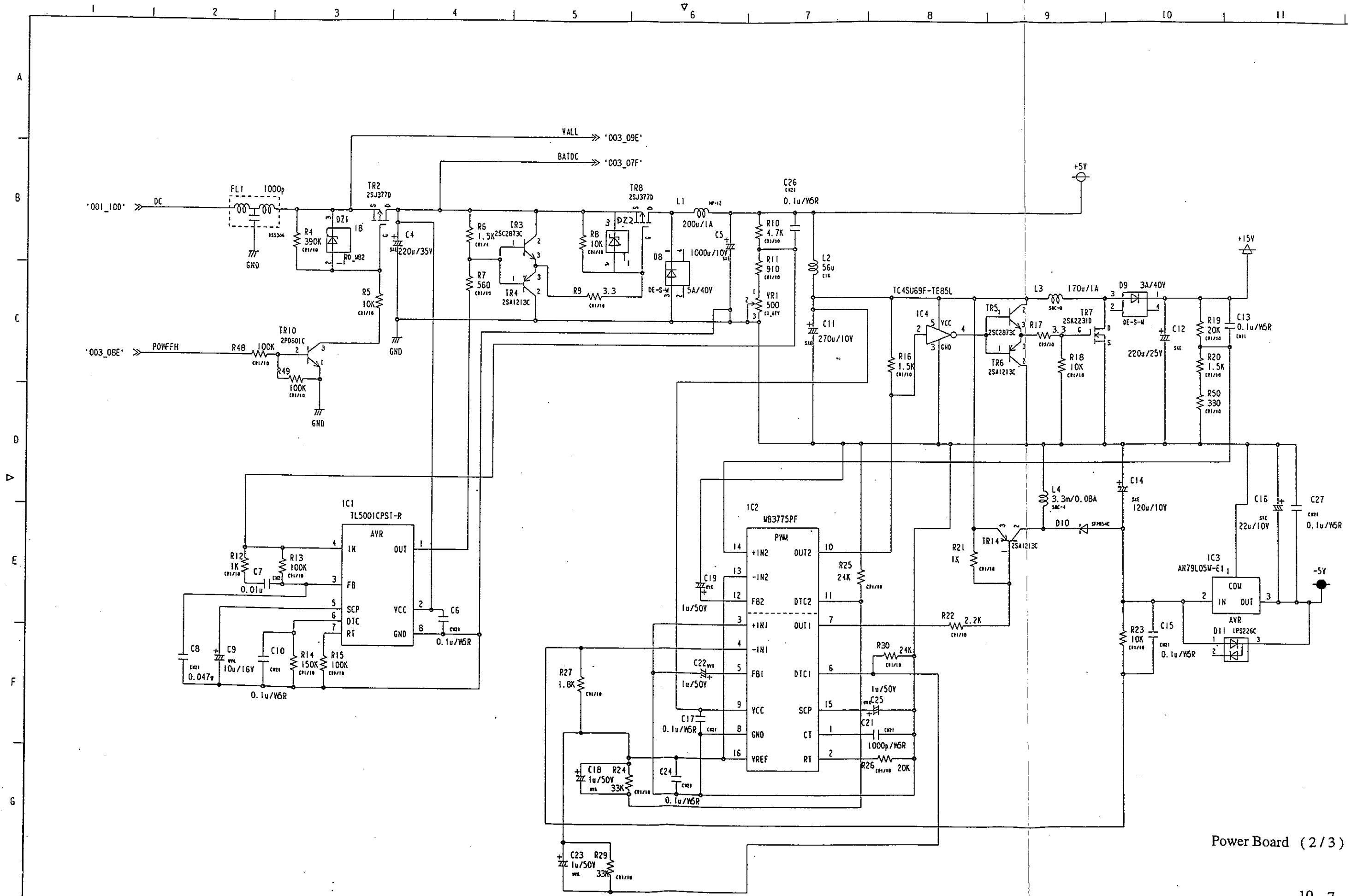
SS09-9B002  
 Applicable lots:  
 9612 lot -  
 Prepared in Dec., 1996



Power Board (1/3)

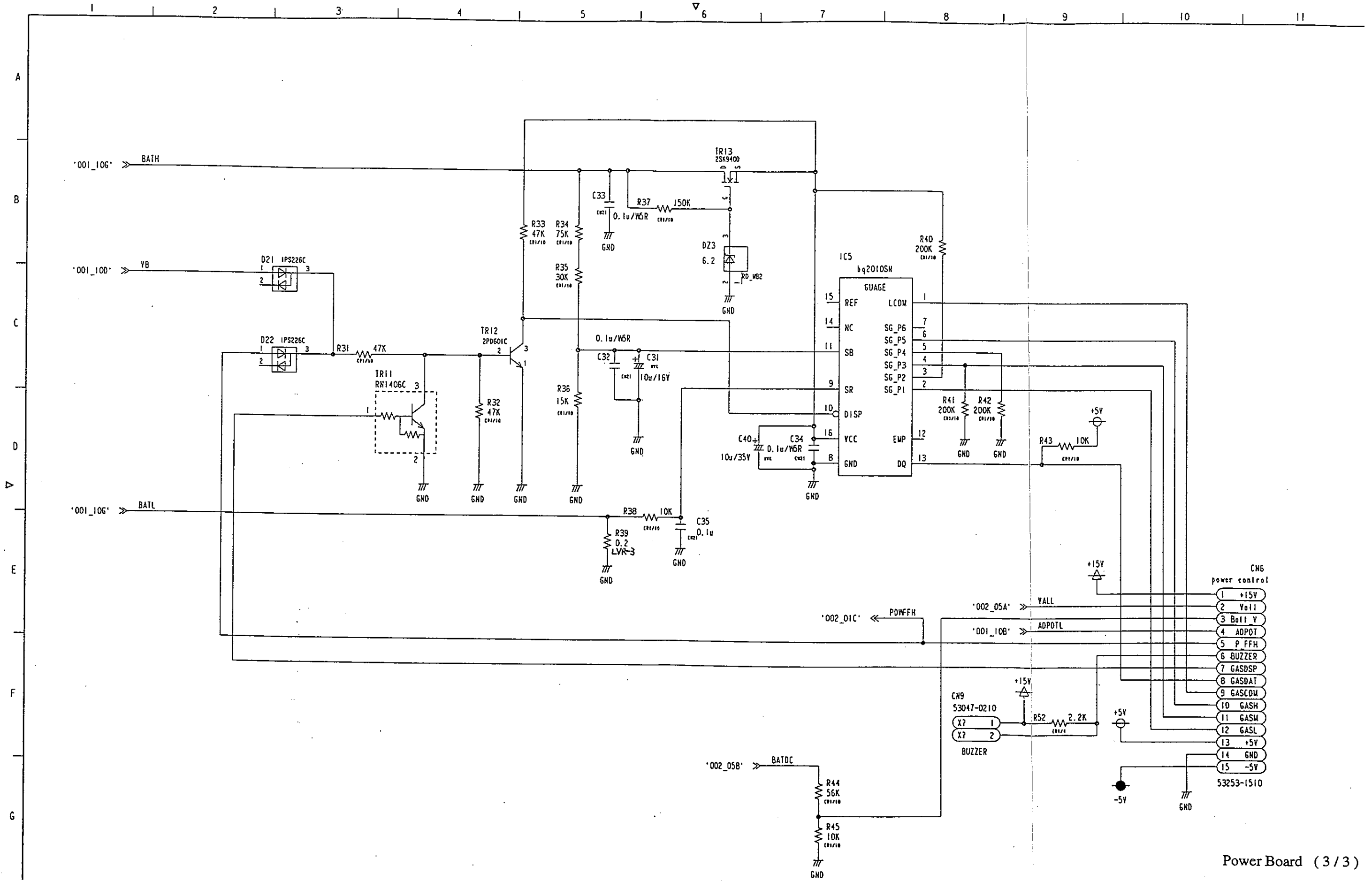
10.2. Power Board. (SS09 - 1EB01 - 1)

SS09-9B002  
 Applicable lots:  
 9612 lot -  
 Prepared in Dec., 1996



Power Board (2/3)

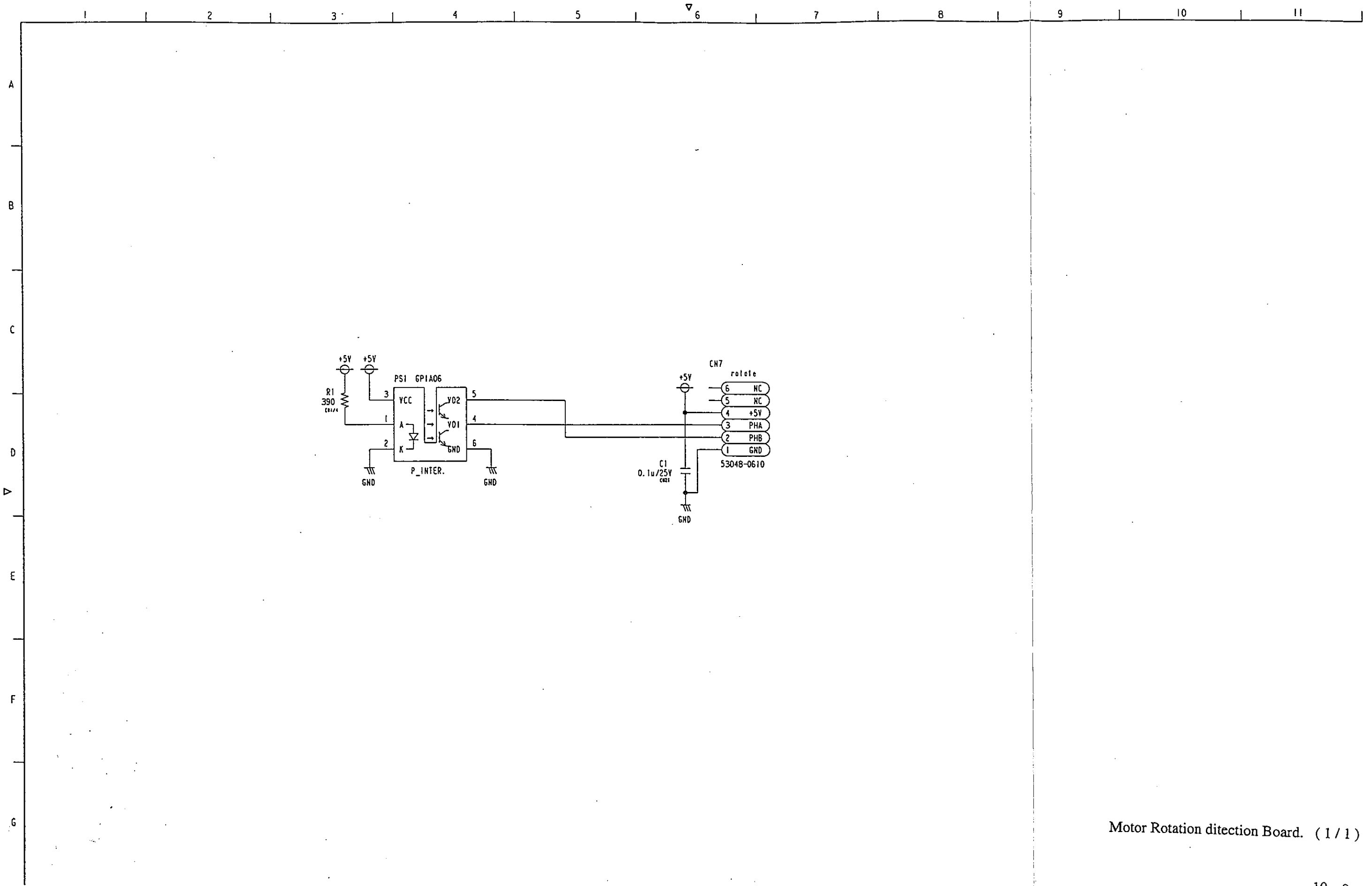
10.2. Power Board. (SS09 - 1EB01 - 1)



Power Board (3/3)

10.3. Motor Rotation detection Board. (SS09 - 1EC01 - 1)

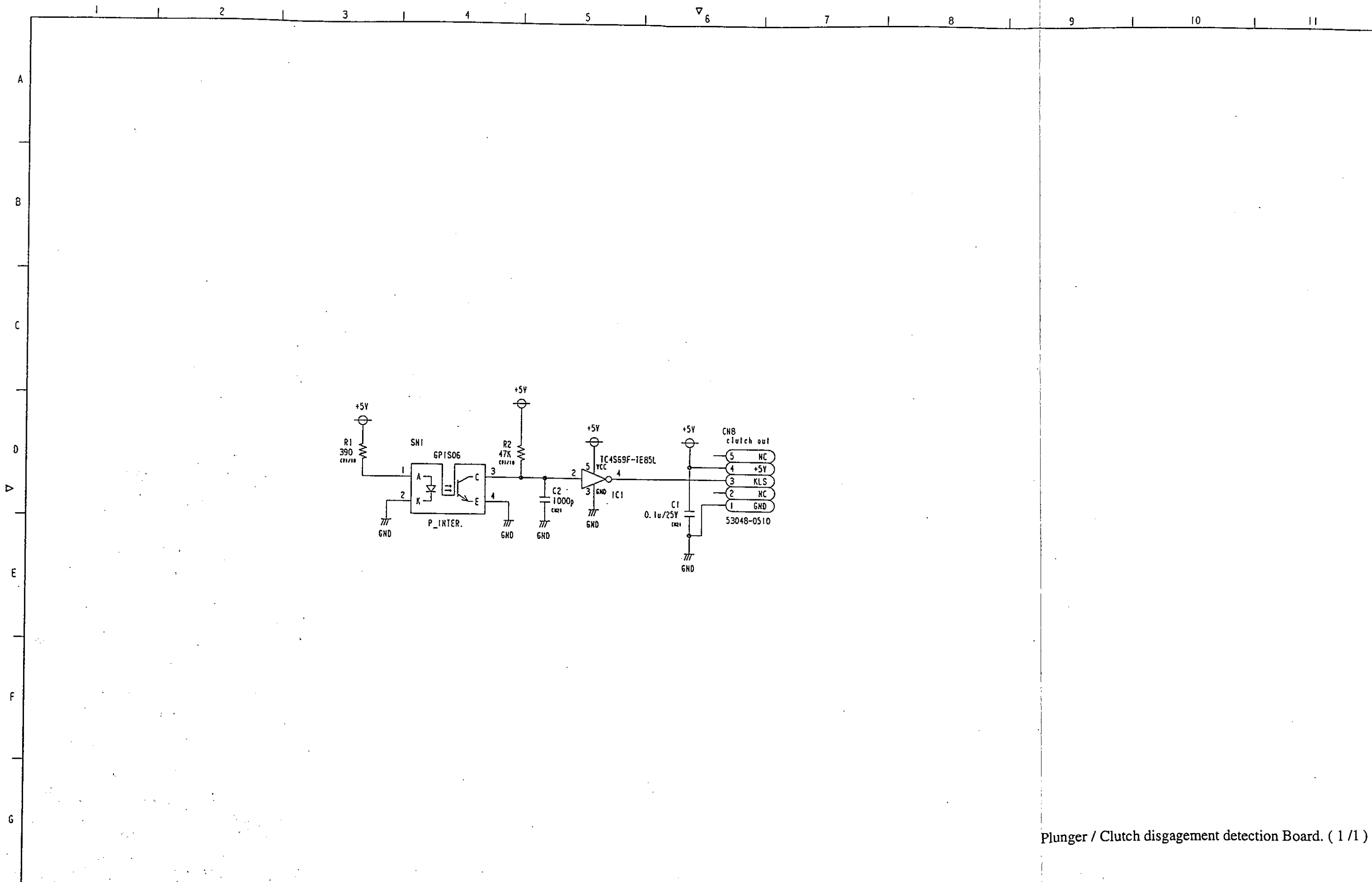
SS09-9B002  
Applicable lots:  
9612 lot -  
Prepared in Dec., 1996



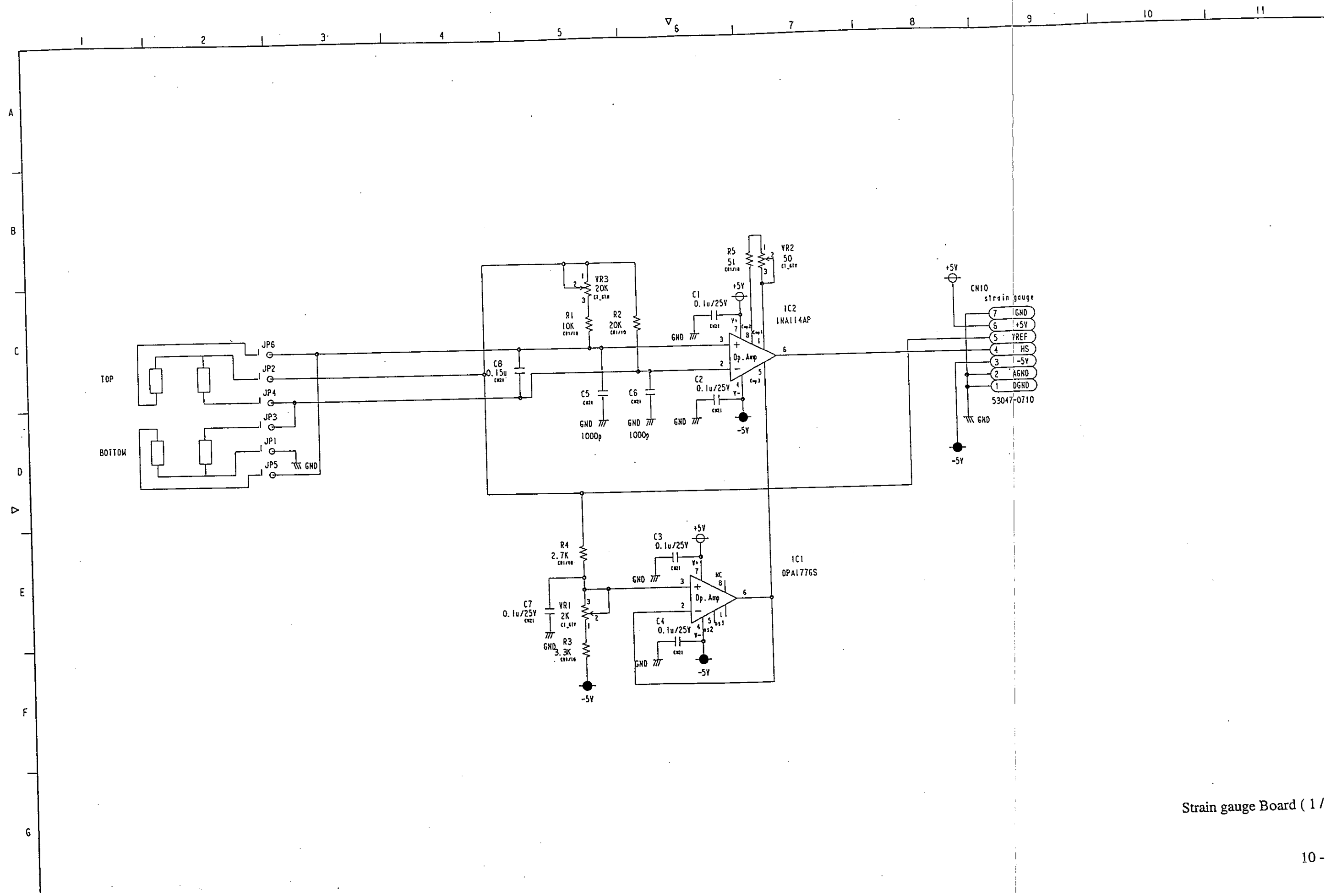
Motor Rotation detection Board. (1/1)



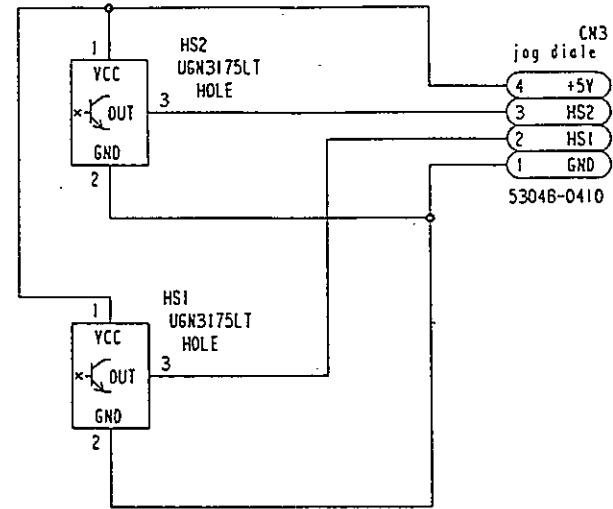
10.4. Plunger / Clutch disengagement detection Board. (SS09 - 1EE01 - 1)



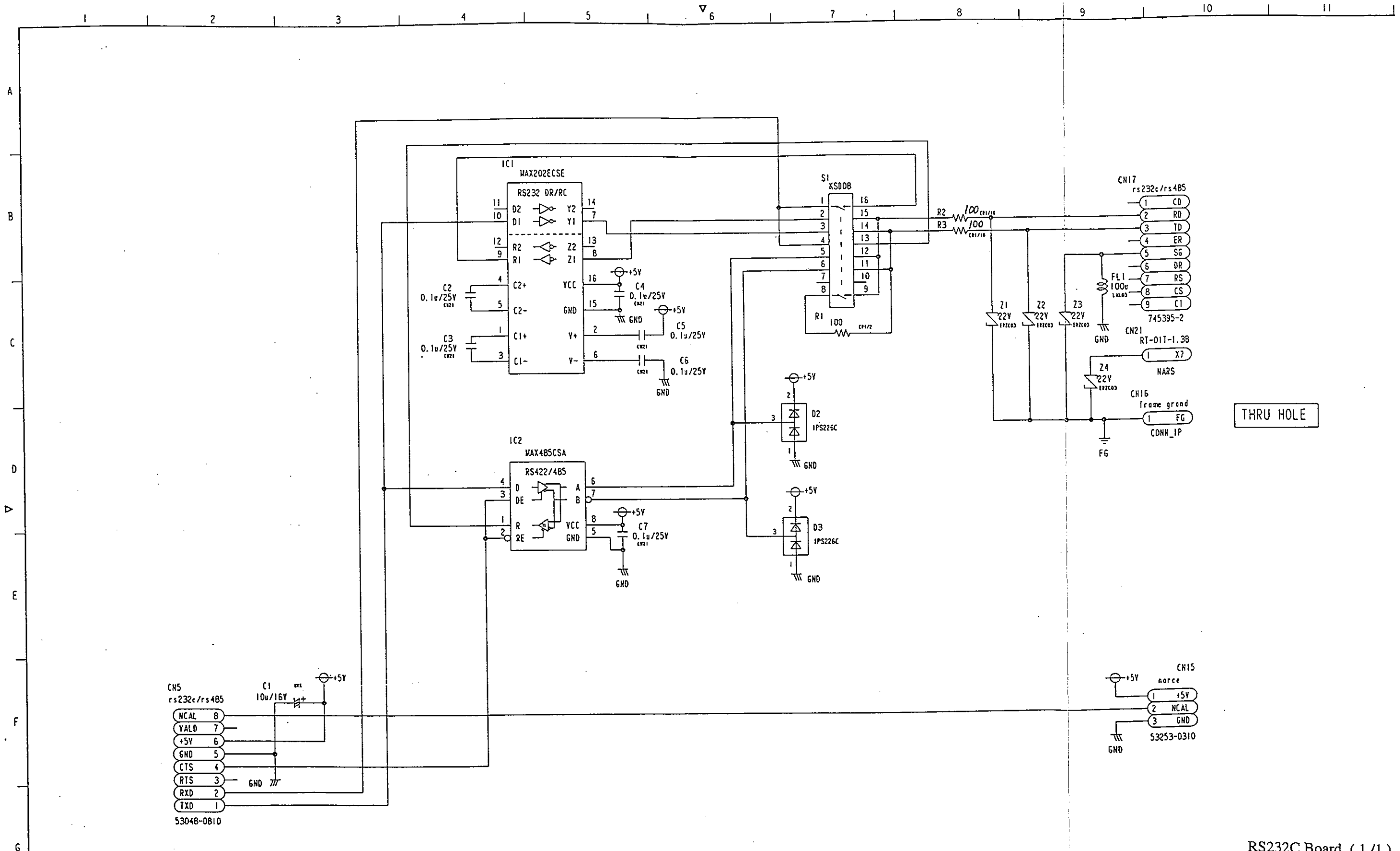
10.5. Straingauge Board. (SS09 - 1EF01 - 1)



10.6. Setting dial Borad. (SS09 - 1EG01 - 1)

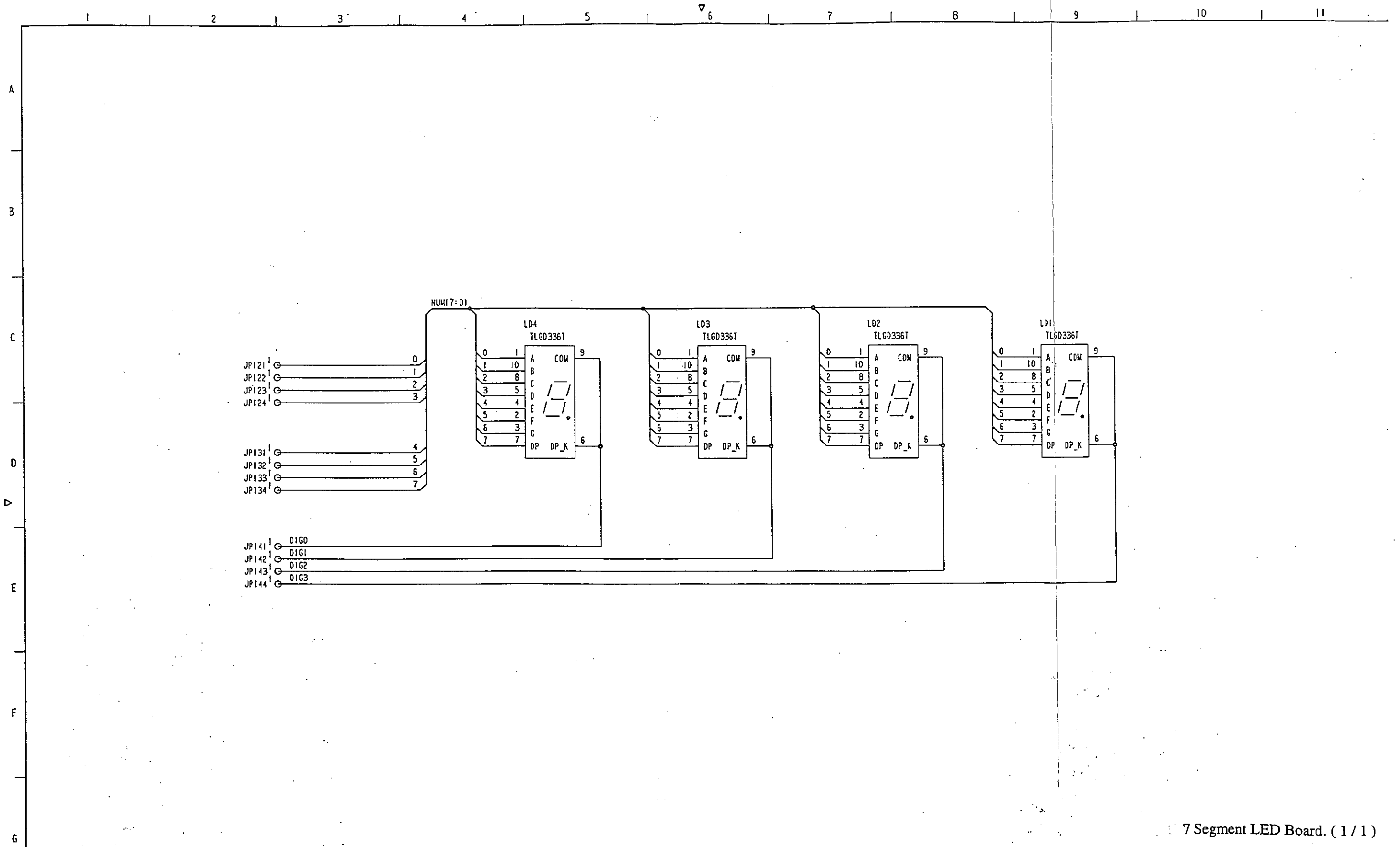


10.7. RS232C Board. (SS09-1EH01-1)



THRU HOLE

10 . 8. 7 Segment LED Board. ( SS09 - 1EI01 - 1 )



10.9. Nurse-call Board. (SS09 - 1EJ01 - 1)

SS09-9B002  
 Applicable lots:  
 9612 lot -  
 Prepared in Dec., 1996

