NIDEK

AR-600/ARK-700 SERIES

SERVICE MANUAL

FOR AR-600 ARK-700
AR-600A ARK-700A
AR-660A ARK-760A

NIDEK CO., LTD.

MAR10*RTZ001C/E
Total Page: 164
2003. 12

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§1 INTRODUCTION

- This manual provides information on after-sales servicing procedures of NIDEK AUTO REFRACTOMETER AR-600 series and AUTO REF/KERATOMETER ARK-700 series.

- For correct after-sales service, it is necessary to understand this manual thoroughly before service.

- If the instrument cannot be repaired by following the procedures described in this manual, contact NIDEK or your authorized distributor and let us know the serial number and details of the symptom. If it is possible to obtain measurements in the condition, also send us the data obtained by measuring with the model eye (-10D, 0D, +10D) and steel balls (5.95mm, 7.94mm and 9.13mm).

§2 TROUBLESHOOTING

- For correct after-sales service, follow the procedures described in “2.1 Check flows and items to be checked” of this manual. For operating procedure, refer to “Operator’s Manual” for each instrument.

- If you encounter any abnormal condition, track down the failure’s source as described in “3 TROUBLESHOOTING” and then immediately turn OFF the Power Switch of the instrument.

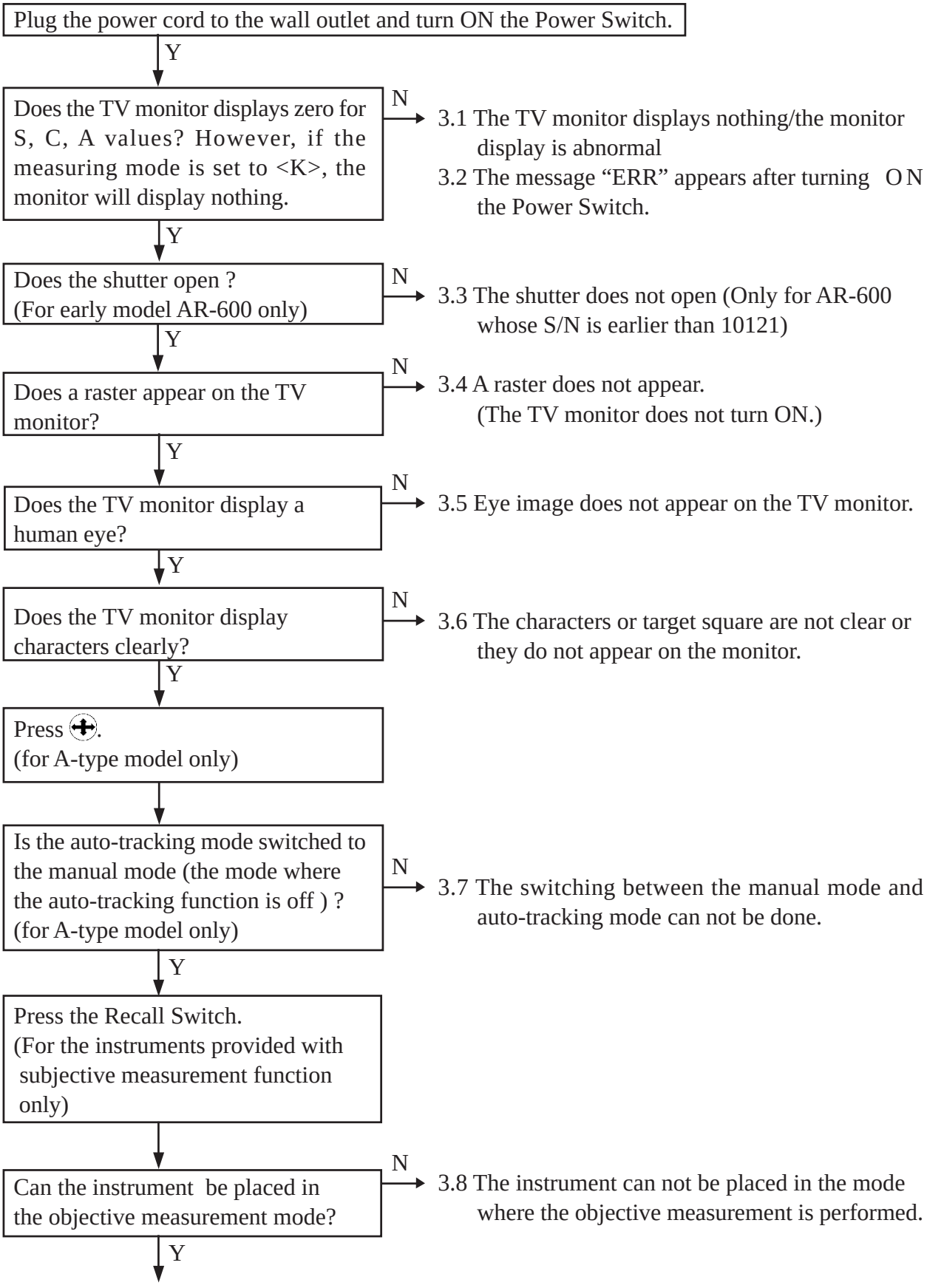
- Before disassembling the instrument, be sure to turn OFF the Power Switch and disconnect the power cord from the wall outlet.

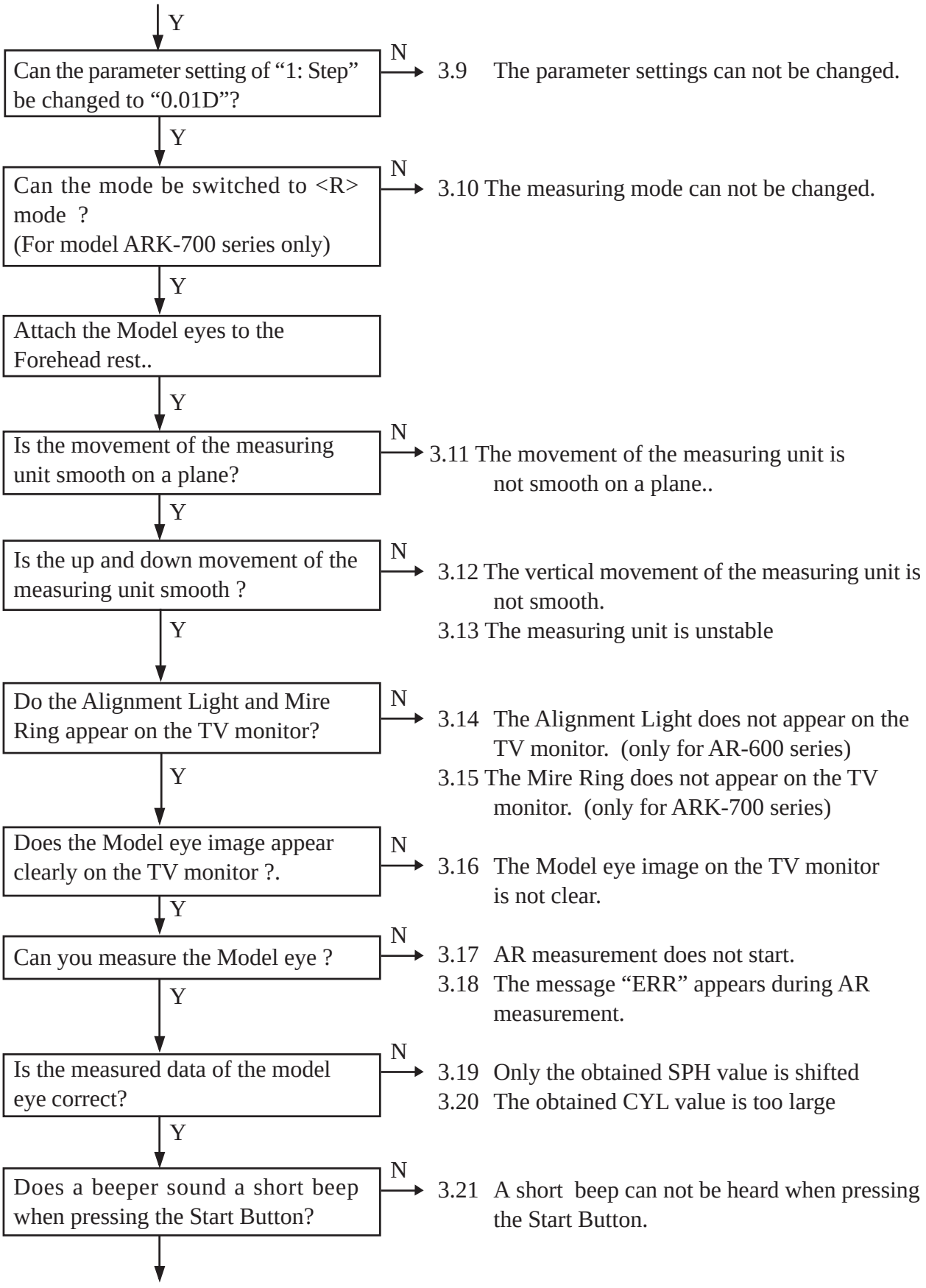
- In “3 TROUBLESHOOTING”, check the following for cables, referring to the attached WIRING DIAGRAM and CONNECTOR TABLE.
  ① All the connectors are connected or crimped securely.
  ② There is no contact failure of connectors.
  (Check by connecting or disconnecting them.)
  ③ The cable has no break.
  Take care not to strain the cable.

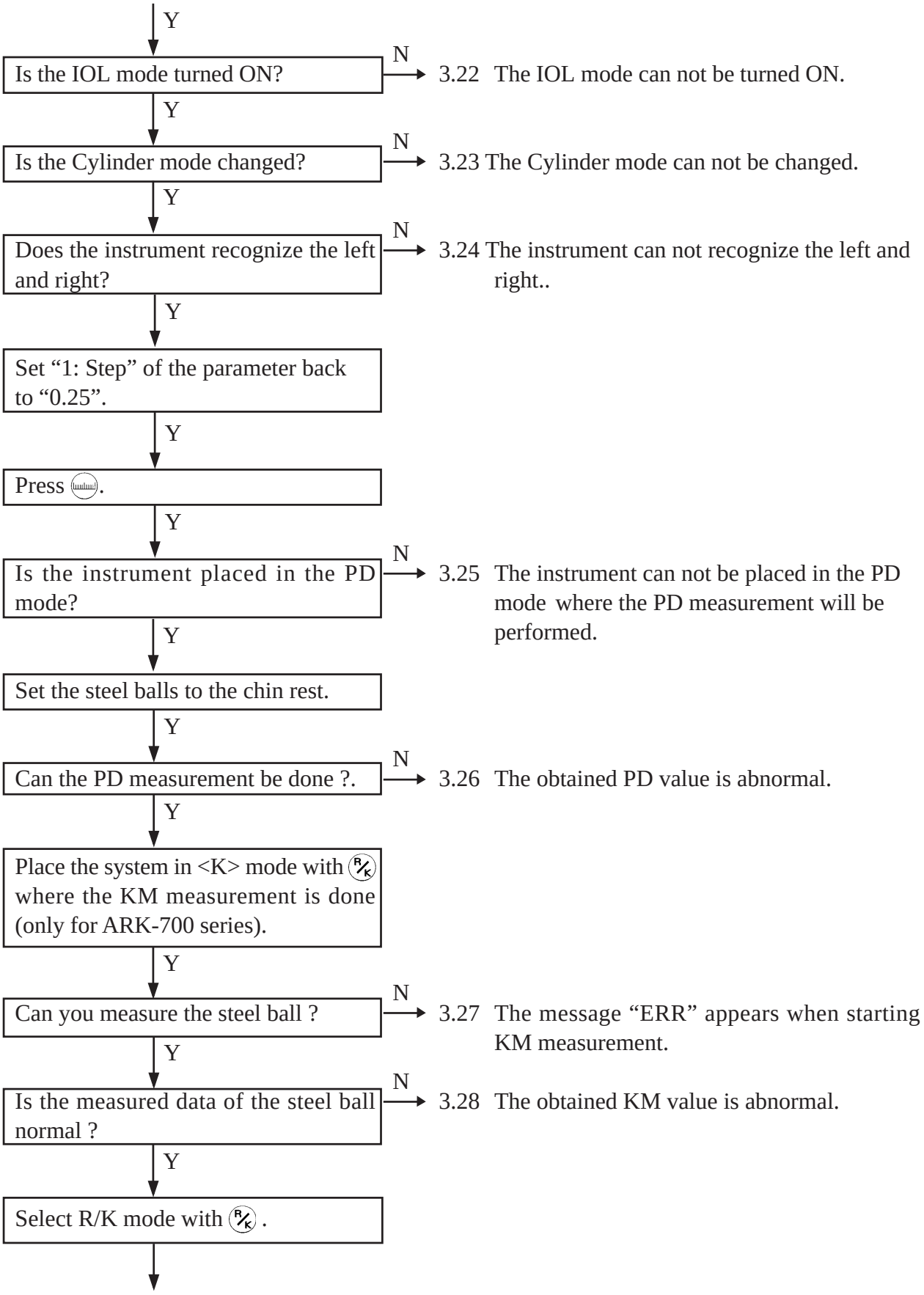
- Take care not to lose the removed screws or parts, or not to drop them inside the instrument.

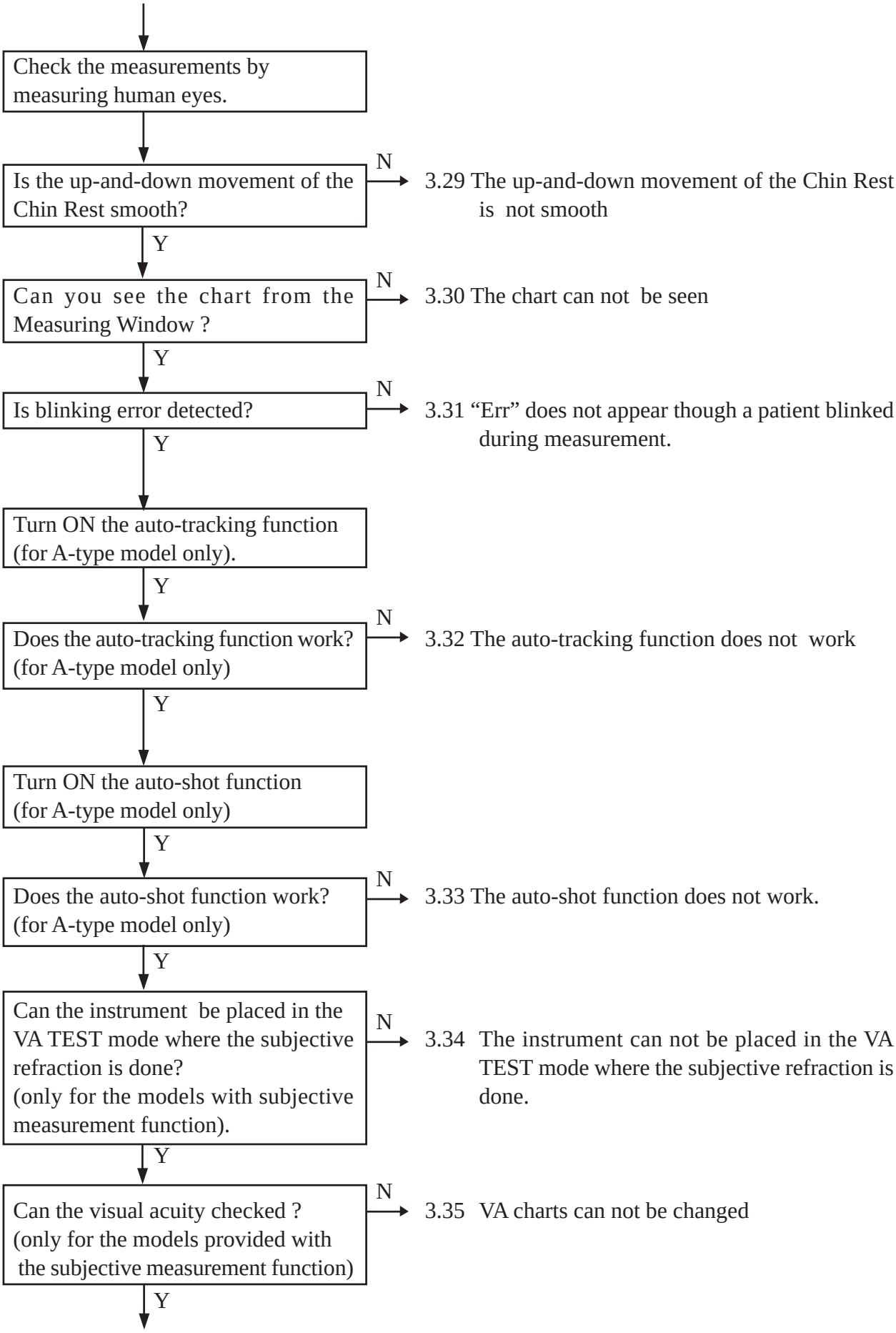
- Be sure to apply Locktight to the fixed screws.

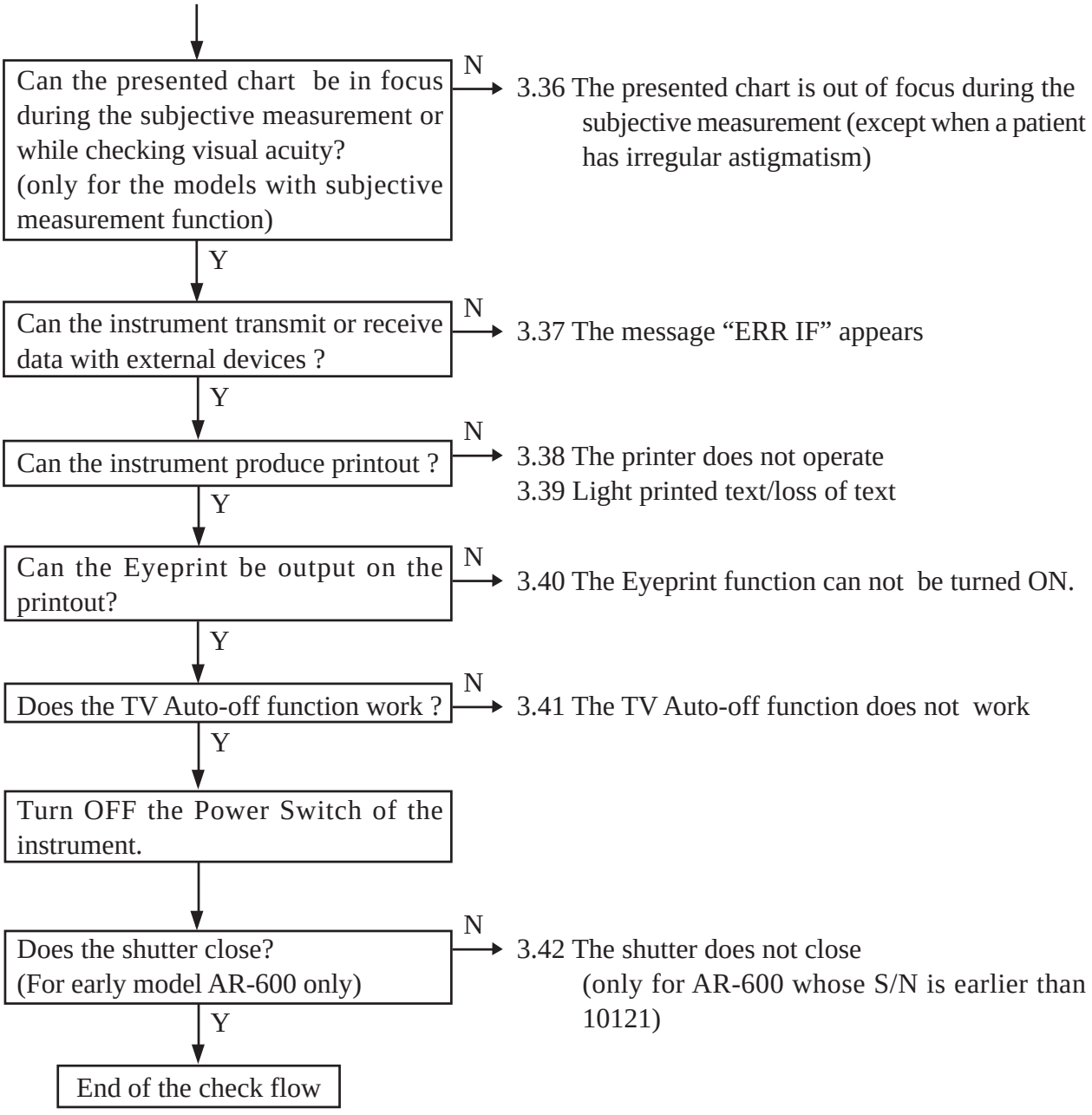
2.1 Check flow and items to be checked



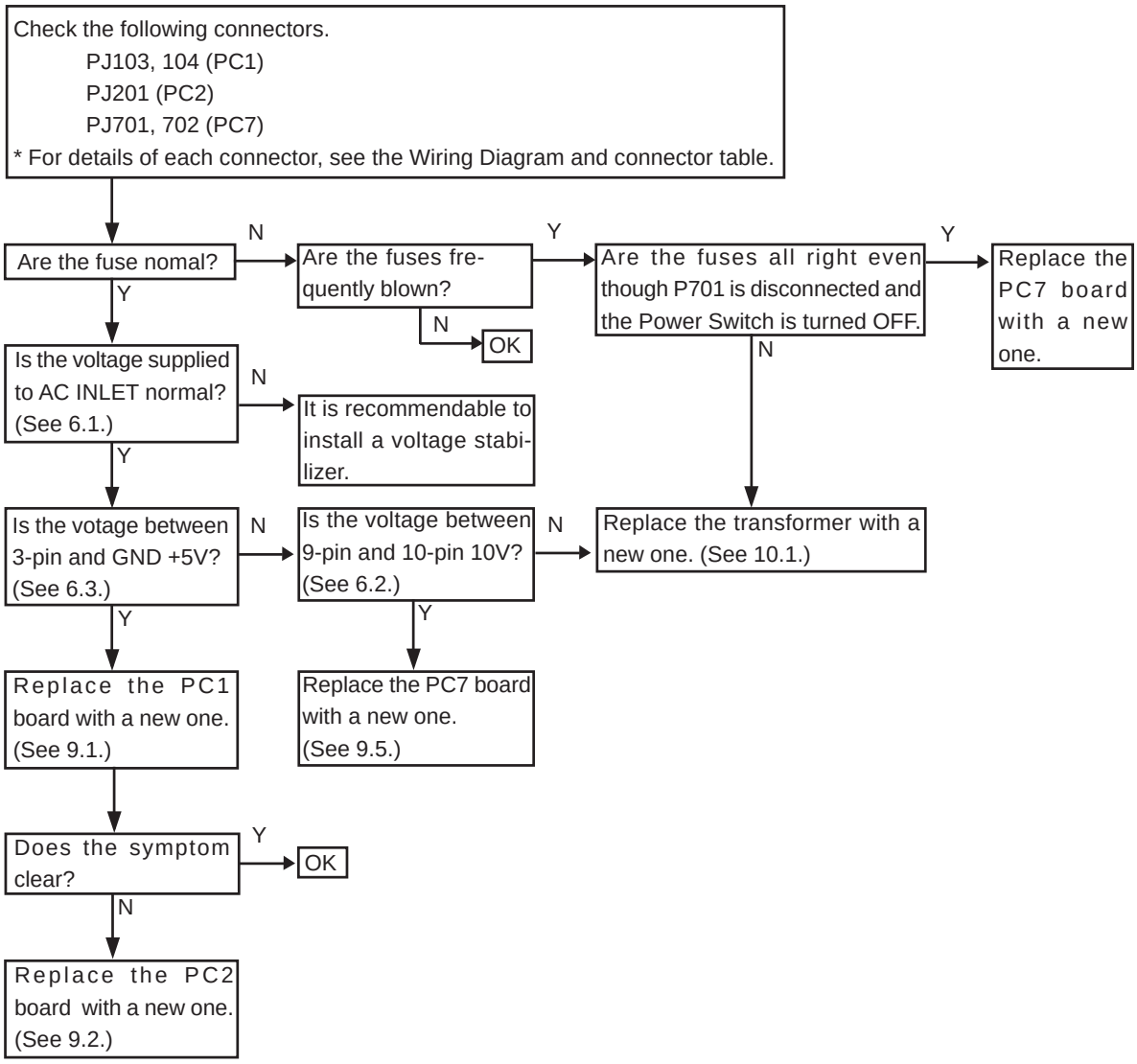

Y
Can the parameter setting of “1: Step” be changed to “0.01D”?
N
3.9 The parameter settings can not be changed.
Y
Can the mode be switched to <R> mode ?
(For model ARK-700 series only)
N
3.10 The measuring mode can not be changed.
Y
Attach the Model eyes to the Forehead rest..
Y
Is the movement of the measuring unit smooth on a plane?
N
3.11 The movement of the measuring unit is not smooth on a plane..
Y
Is the up and down movement of the measuring unit smooth ?
N
3.12 The vertical movement of the measuring unit is not smooth.
3.13 The measuring unit is unstable
Y
Do the Alignment Light and Mire Ring appear on the TV monitor?
N
3.14 The Alignment Light does not appear on the TV monitor. (only for AR-600 series)
3.15 The Mire Ring does not appear on the TV monitor. (only for ARK-700 series)
Y
Does the Model eye image appear clearly on the TV monitor ?.
N
3.16 The Model eye image on the TV monitor is not clear.
Y
Can you measure the Model eye ?
N
3.17 AR measurement does not start.
3.18 The message “ERR” appears during AR measurement.
Y
Is the measured data of the model eye correct?
N
3.19 Only the obtained SPH value is shifted
3.20 The obtained CYL value is too large
Y
Does a beeper sound a short beep when pressing the Start Button?
N
3.21 A short beep can not be heard when pressing the Start Button.


Y
Is the IOL mode turned ON?
N
3.22 The IOL mode can not be turned ON.
Y
Is the Cylinder mode changed?
N
3.23 The Cylinder mode can not be changed.
Y
Does the instrument recognize the left and right?
N
3.24 The instrument can not recognize the left and right..
Y
Set "1: Step" of the parameter back to "0.25".
Y
Press .
Y
Is the instrument placed in the PD mode?
N
3.25 The instrument can not be placed in the PD mode where the PD measurement will be performed.
Y
Set the steel balls to the chin rest.
Y
Can the PD measurement be done ?.
N
3.26 The obtained PD value is abnormal.
Y
Place the system in <K> mode with R/K where the KM measurement is done (only for ARK-700 series).
Y
Can you measure the steel ball ?
N
3.27 The message "ERR" appears when starting KM measurement.
Y
Is the measured data of the steel ball normal ?
N
3.28 The obtained KM value is abnormal.
Y
Select R/K mode with R/K .


Check the measurements by measuring human eyes.
Is the up-and-down movement of the Chin Rest smooth?
N
3.29 The up-and-down movement of the Chin Rest is not smooth
Y
Can you see the chart from the Measuring Window ?
N
3.30 The chart can not be seen
Y
Is blinking error detected?
N
3.31 "Err" does not appear though a patient blinked during measurement.
Y
Turn ON the auto-tracking function (for A-type model only).
Y
Does the auto-tracking function work? (for A-type model only)
N
3.32 The auto-tracking function does not work
Y
Turn ON the auto-shot function (for A-type model only)
Y
Does the auto-shot function work? (for A-type model only)
N
3.33 The auto-shot function does not work.
Y
Can the instrument be placed in the VA TEST mode where the subjective refraction is done? (only for the models with subjective measurement function).
N
3.34 The instrument can not be placed in the VA TEST mode where the subjective refraction is done.
Y
Can the visual acuity checked ? (only for the models provided with the subjective measurement function)
N
3.35 VA charts can not be changed
Y


Can the presented chart be in focus during the subjective measurement or while checking visual acuity?
(only for the models with subjective measurement function)
N
3.36 The presented chart is out of focus during the subjective measurement (except when a patient has irregular astigmatism)
Y
Can the instrument transmit or receive data with external devices ?
N
3.37 The message “ERR IF” appears
Y
Can the instrument produce printout ?
N
3.38 The printer does not operate
3.39 Light printed text/loss of text
Y
Can the Eyeprint be output on the printout?
N
3.40 The Eyeprint function can not be turned ON.
Y
Does the TV Auto-off function work ?
N
3.41 The TV Auto-off function does not work
Y
Turn OFF the Power Switch of the instrument.
Does the shutter close?
(For early model AR-600 only)
N
3.42 The shutter does not close
(only for AR-600 whose S/N is earlier than 10121)
Y
End of the check flow

3.1 The TV monitor displays nothing/the monitor display is abnormal

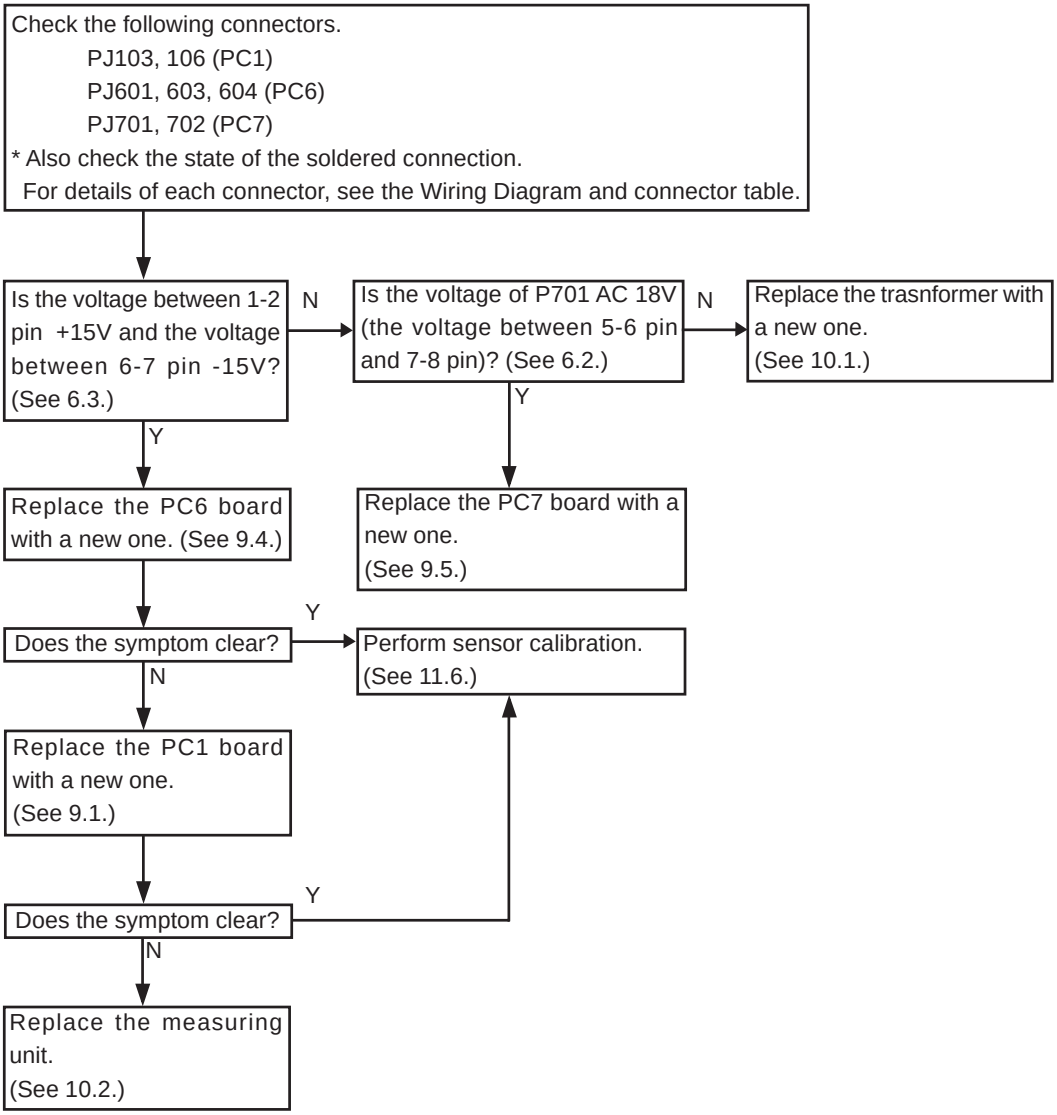


3.2 The message “Err” appears after turning ON the Power Switch

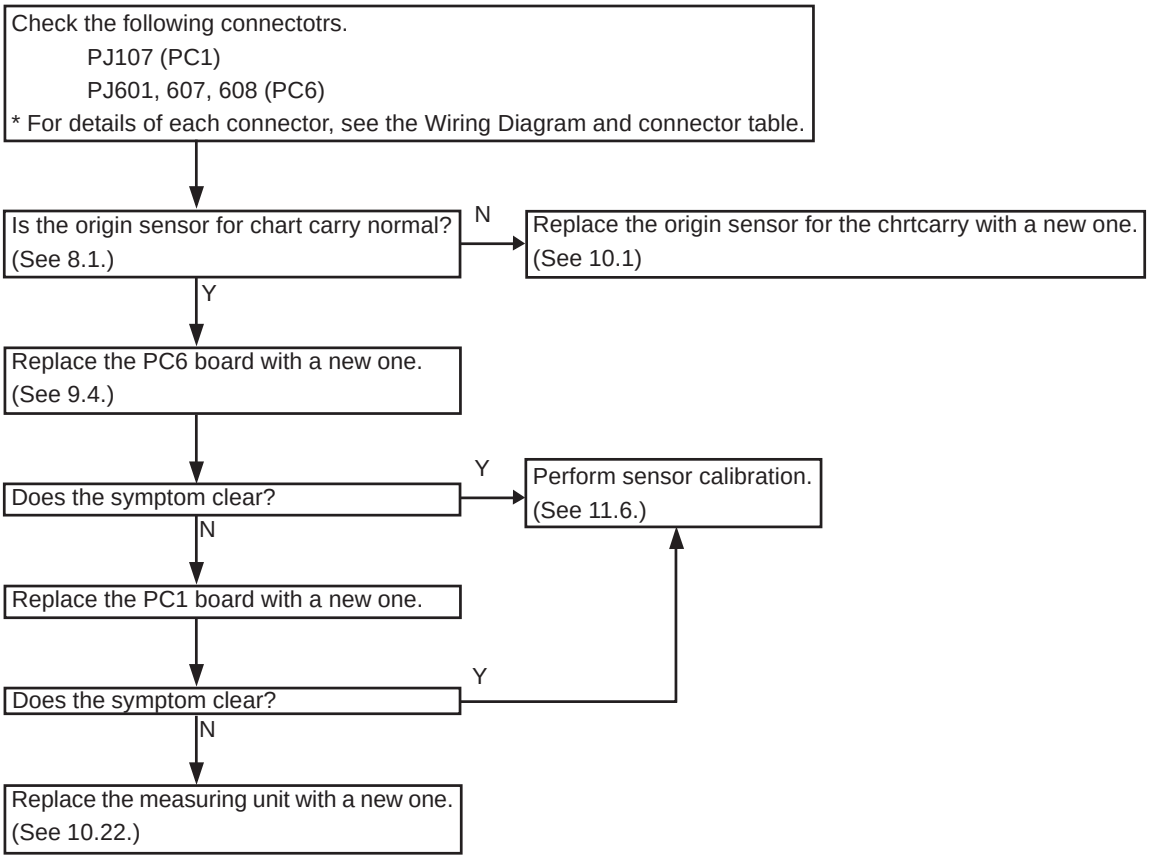
* If the message “Err” appears after turning ON the Power Switch, set the following parameter to “YES”, following the instructions in Operator’s Manual.

For AR-600 series (PARAMETERS 33: Err Code YES)
For ARK-700 series (PARAMETERS 37: Err Code YES)

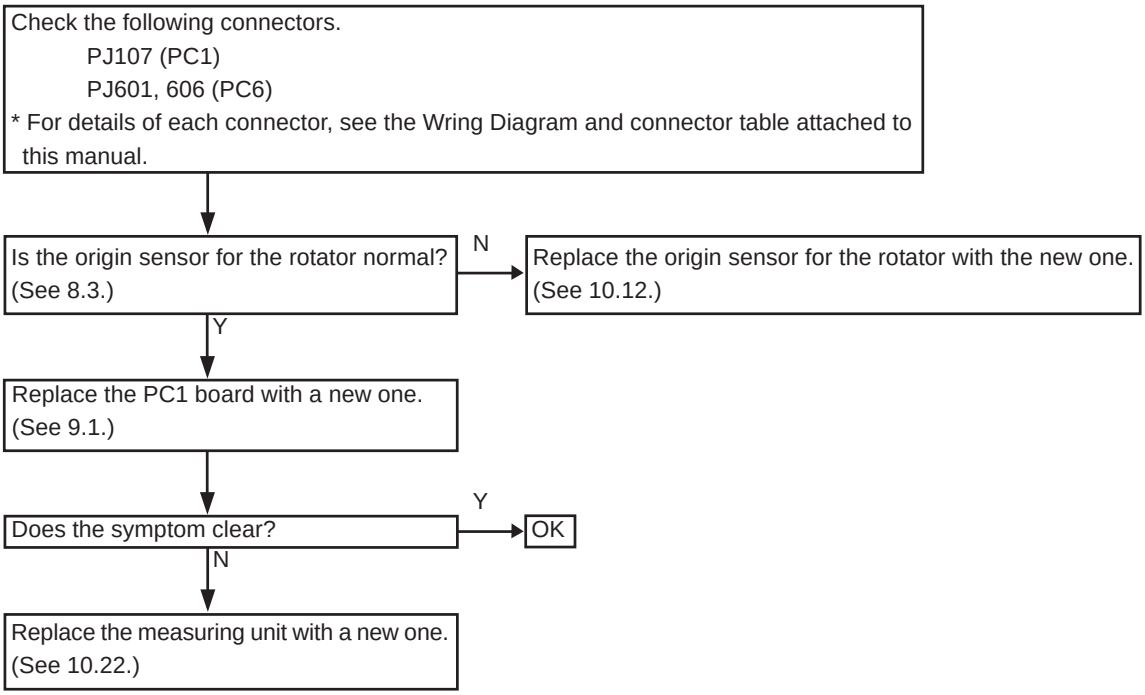
3.2.1 “Err 1” (Sensor carry error) appears.



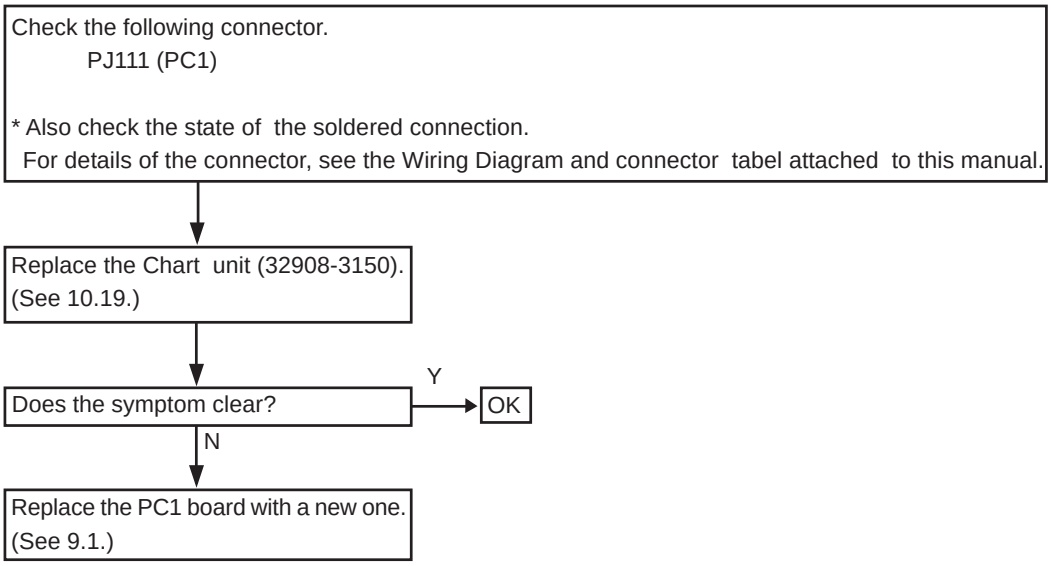
3.2.2 “Err2” (Chart carry error) appears.



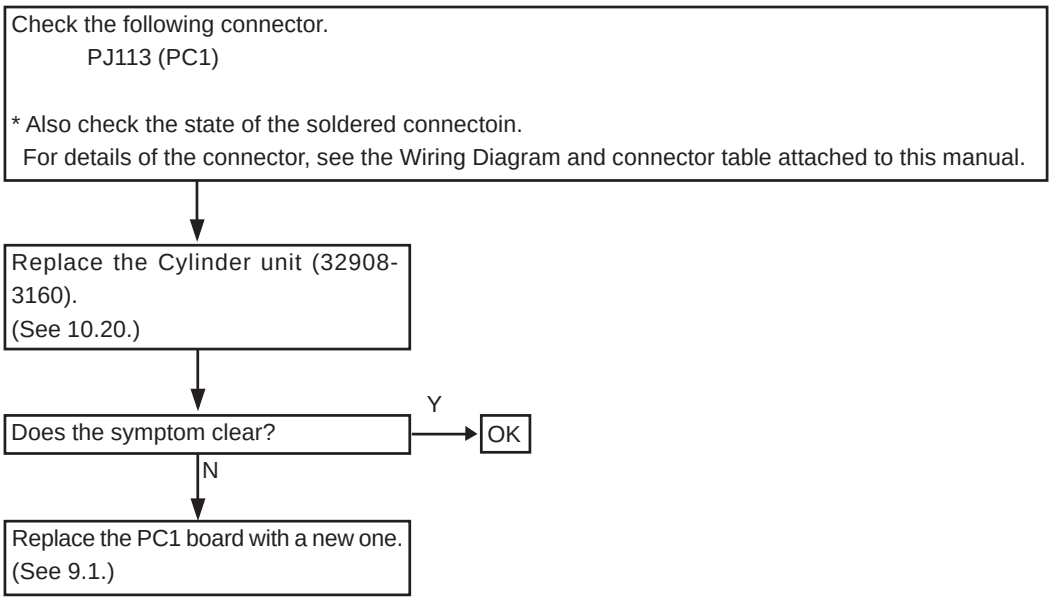
3.2.3 “Errr 3” (Rotator error) appears.



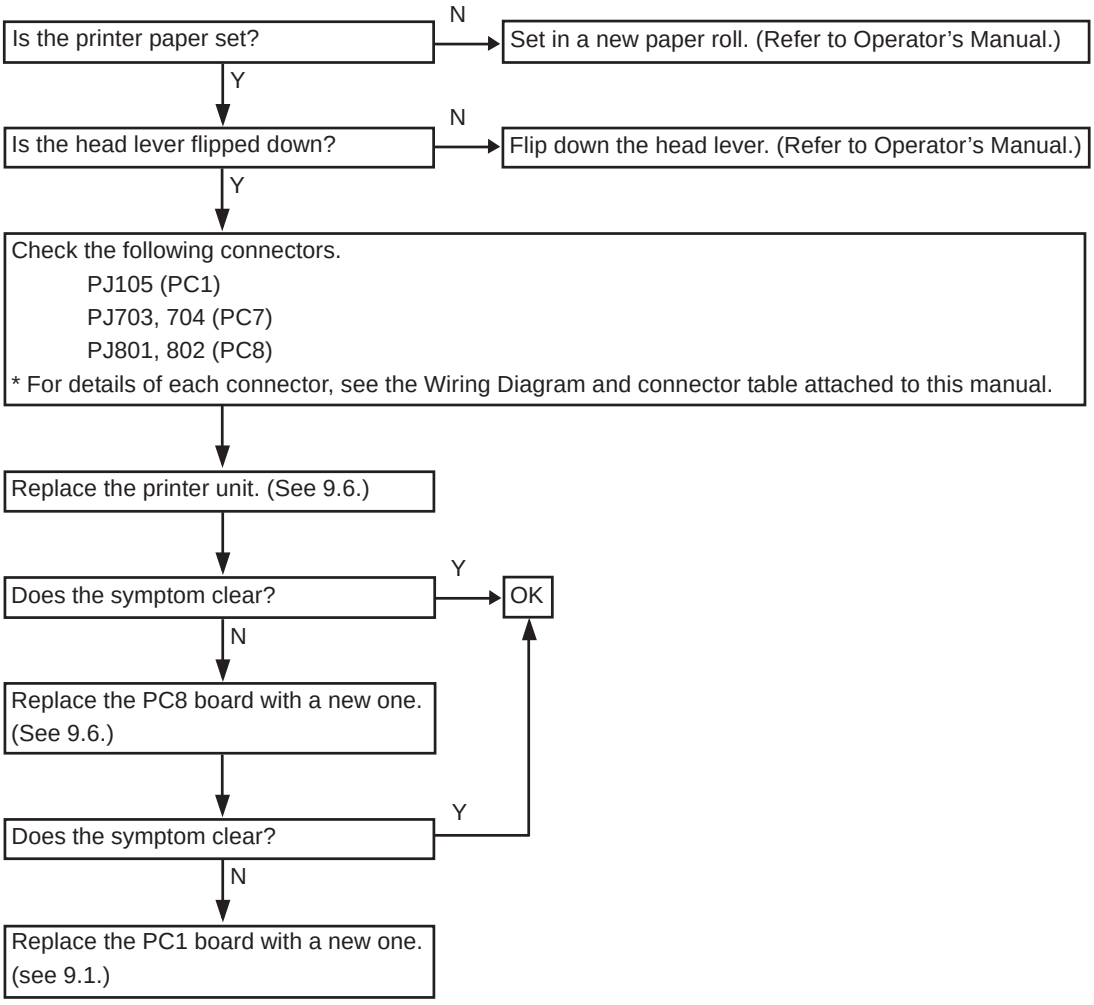
3.2.4 “Err 4” (Chart error) appears.



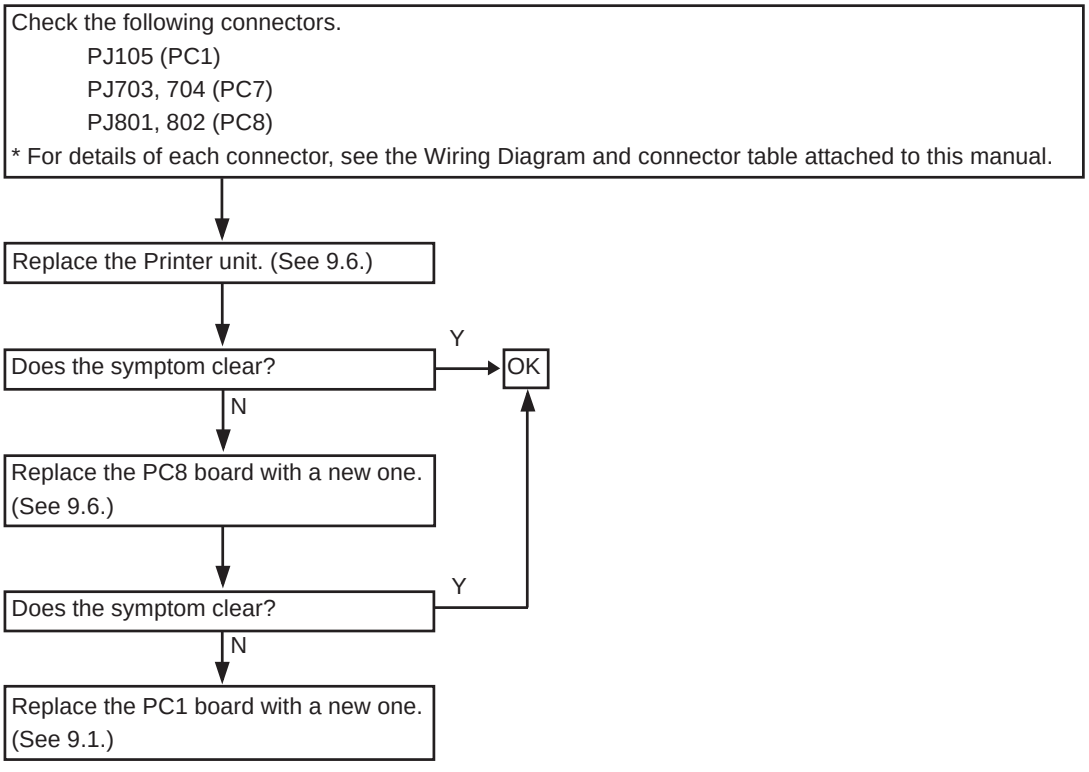
3.2.5 “Err 5” (CL1 error) or “Err 6” (CL2 error) appears.



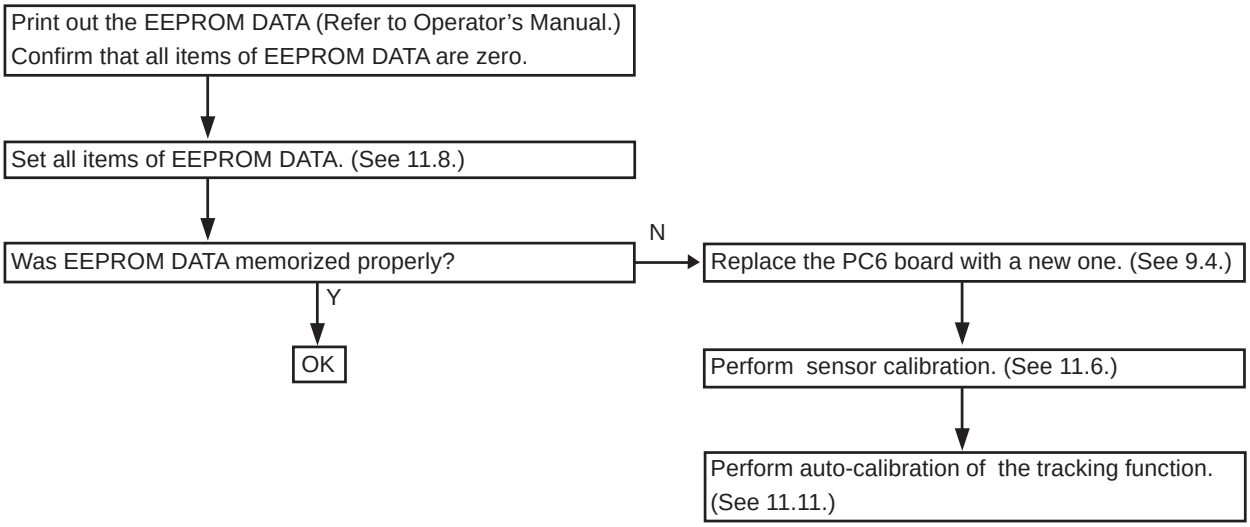
3.2.6 “Err 7” ([line] printer error) appears.



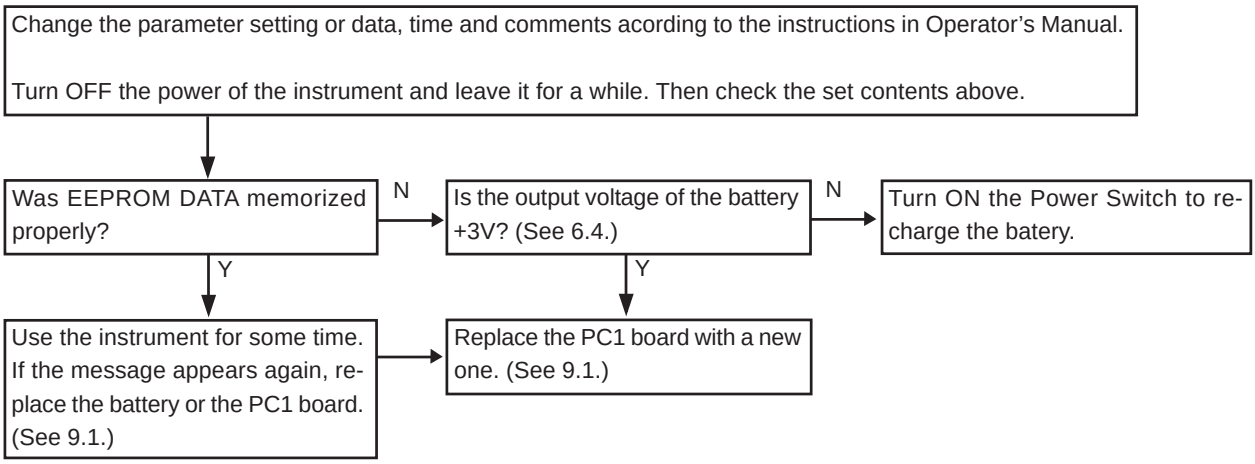
3.2.7 “Err 8” ([serial] printer error) appears.



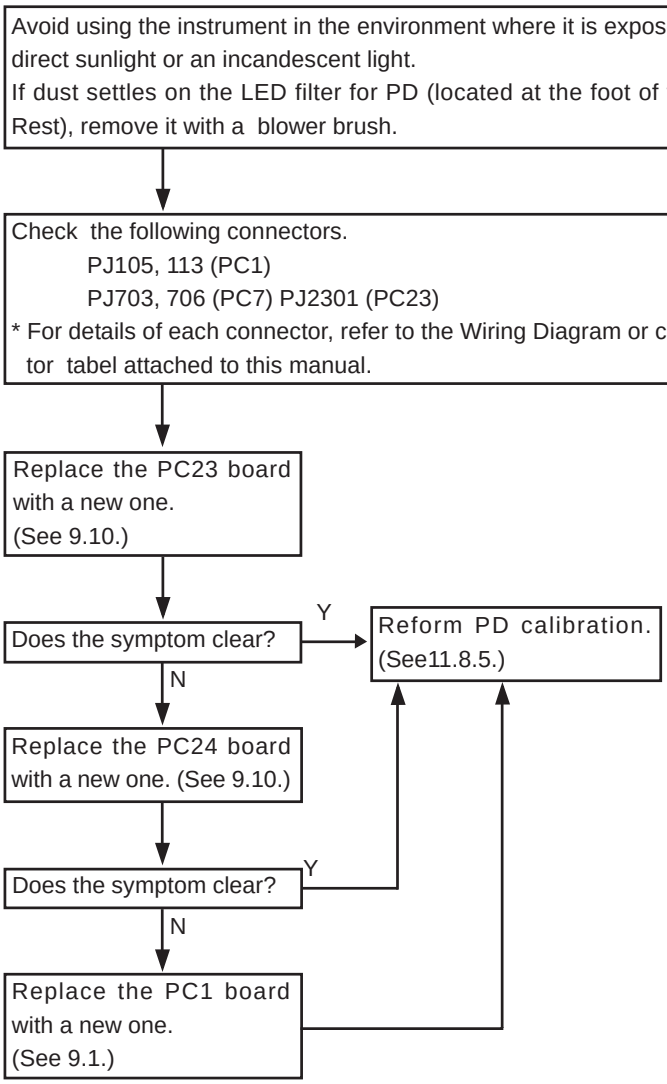
3.2.8 “Err 9” (MEMORY FAILURE ON EEPROM) appears.



3.2.9 “Err A” (MEMORY FAILURE ON RAM) appears.



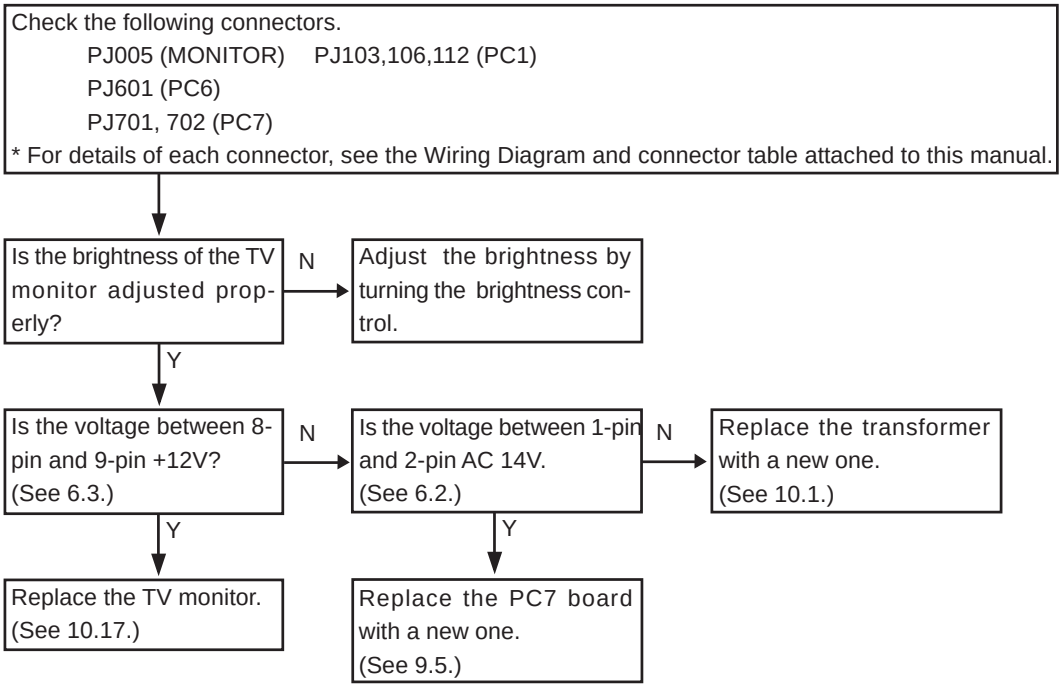
3.2.10 “PD ERR” appears.



3.3 The shutter does not open (only for AR-600 whose S/N is earlier than 10121)

Remove the shutter unit.
(See 10.8.)

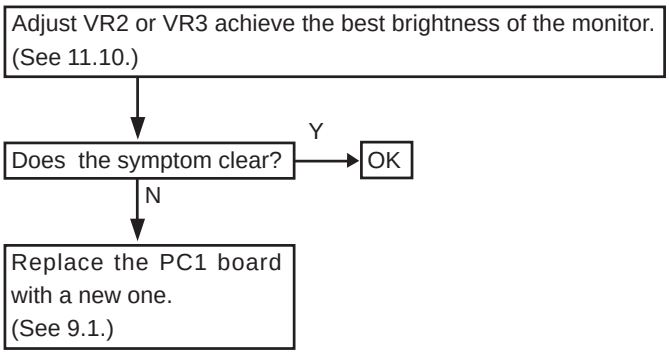
3.4 A raster does not appear (The TV monitor does not light well.)



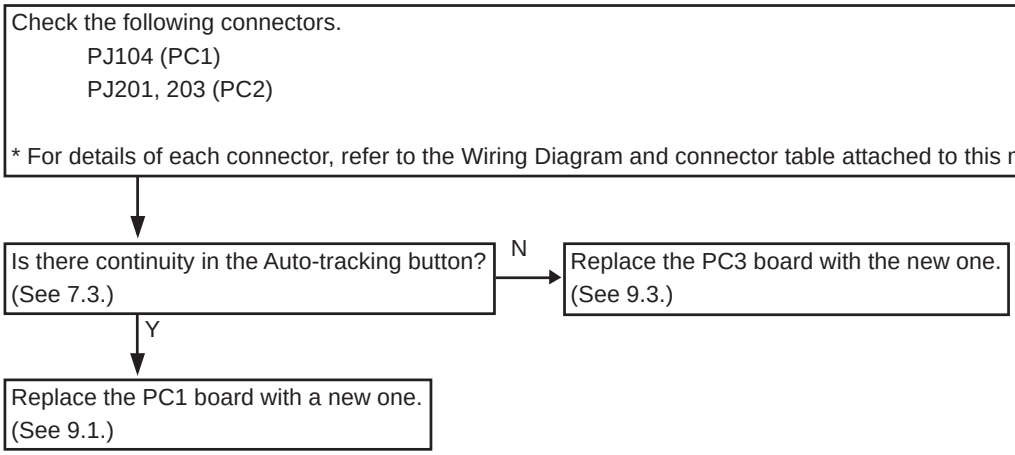
3.5 Eye image does not appear on the TV monitor

Replace the CCD camera unit with a new one.
(See 10.18.)

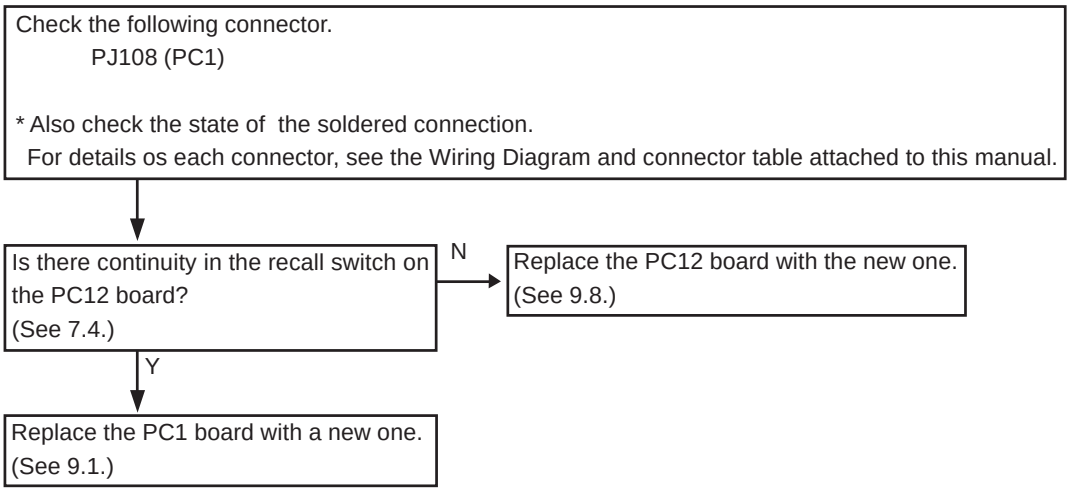
3.6 The characters or target are not clear or they do not appear on the TV monitor



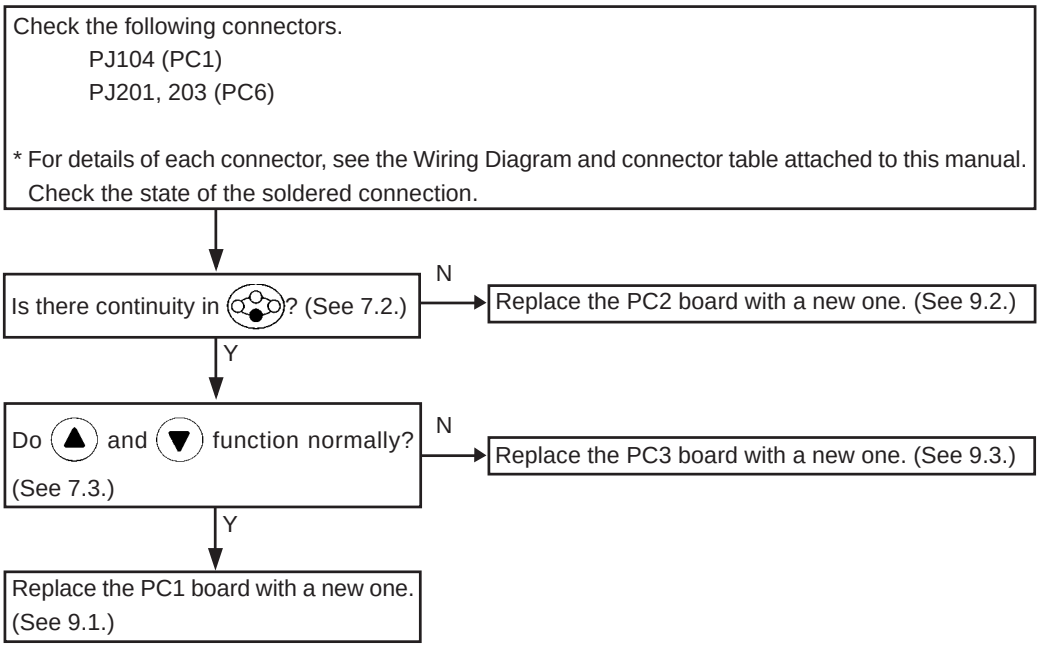
3.7 The switching between the manual mode and auto-tracking mode can not be done



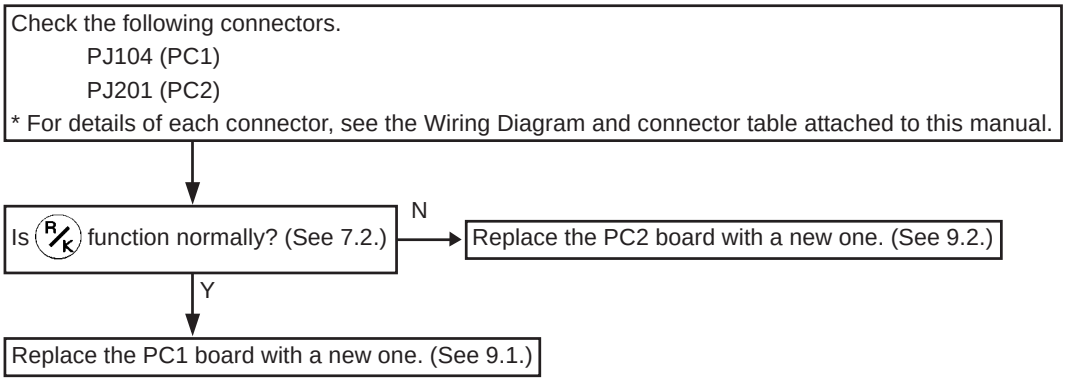
3.8 The instrument can not be placed into the mode where the objective measurement is performed.



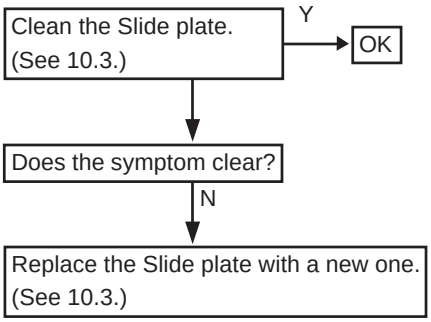
3.9 The parameter settings can not be changed



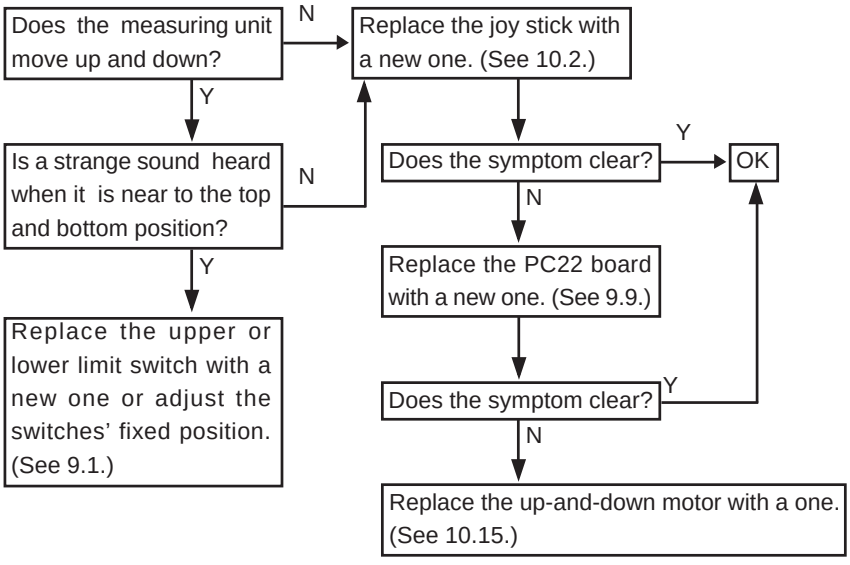
3.10 The measuring mode can not be changed



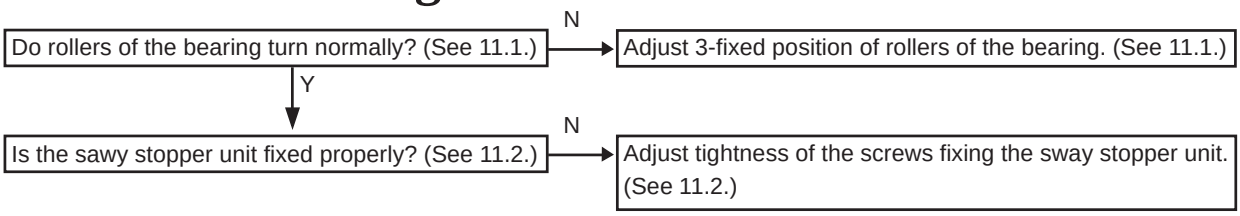
3.11 The movement of the measuring unit is not smooth on a plane.



3.12 The vertical movement of the measuring unit is not smooth

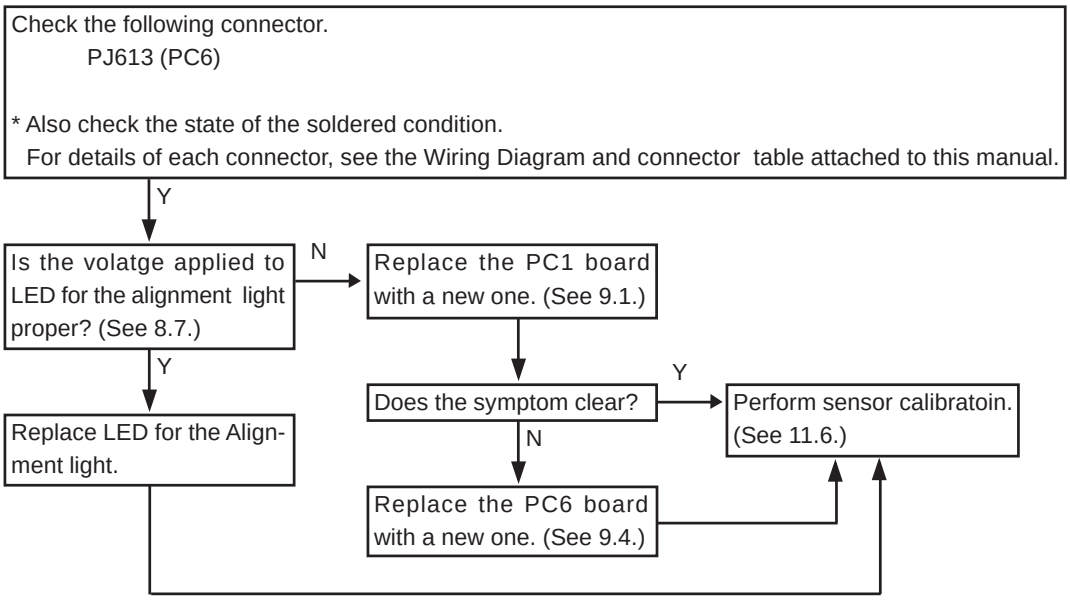


3.13 The measuring unit is unstable



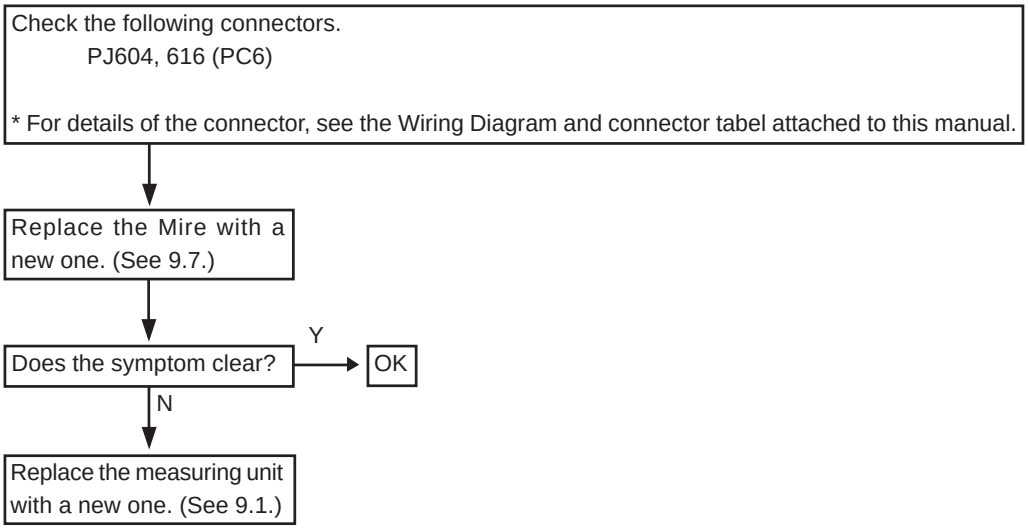
3.14 The alignment light does not appear

(only for AR- 600 series)

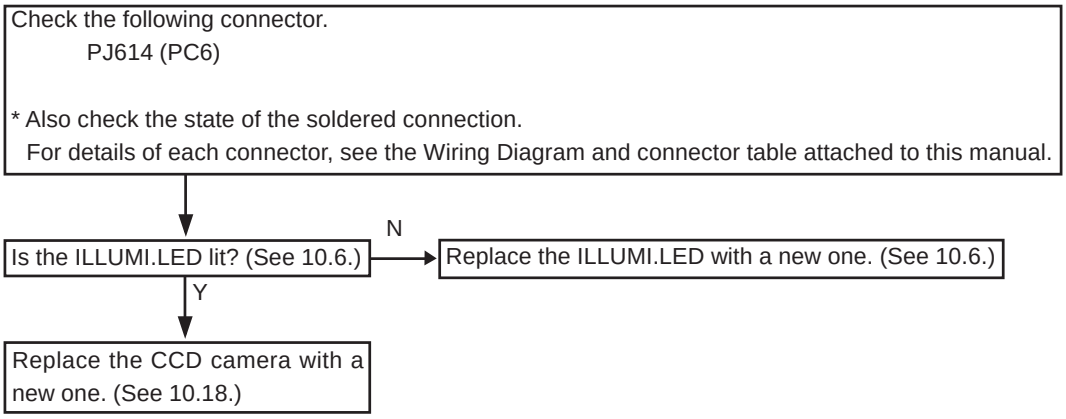


3.15 The Mire Ring does not appear

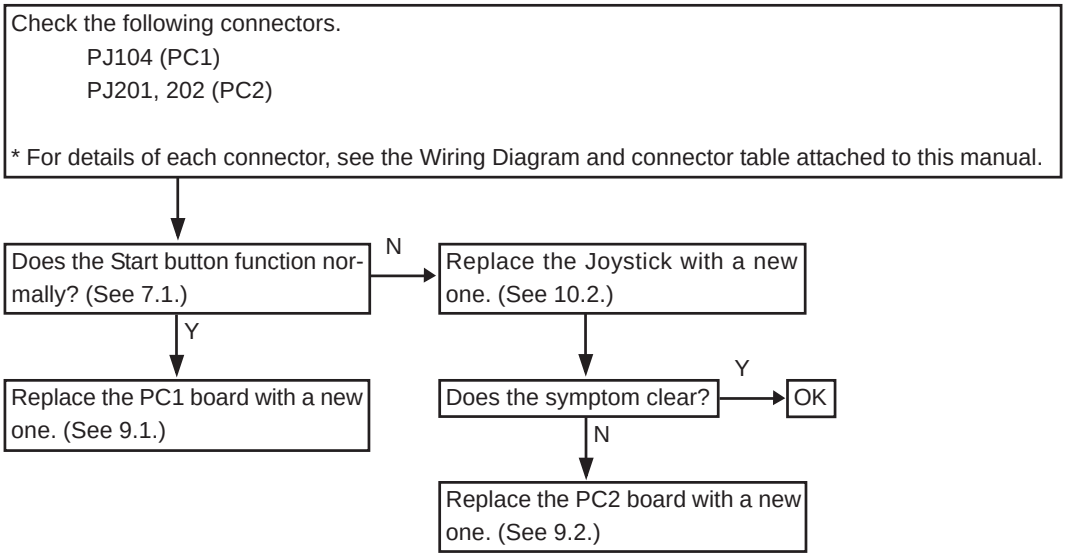
(only for ARK-700 series)



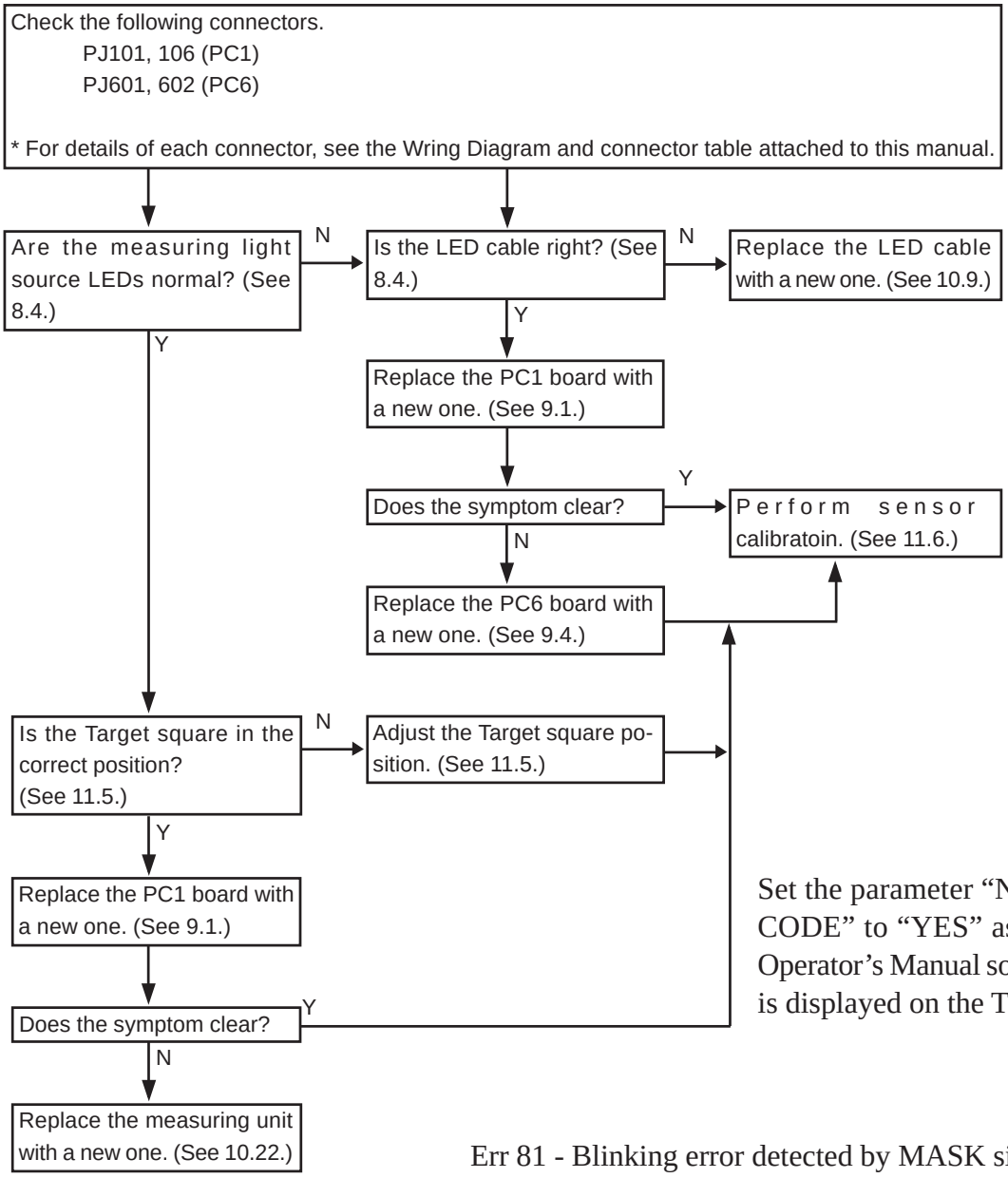
3.16 The model eye image is not clear



3.17 AR measurement does not start



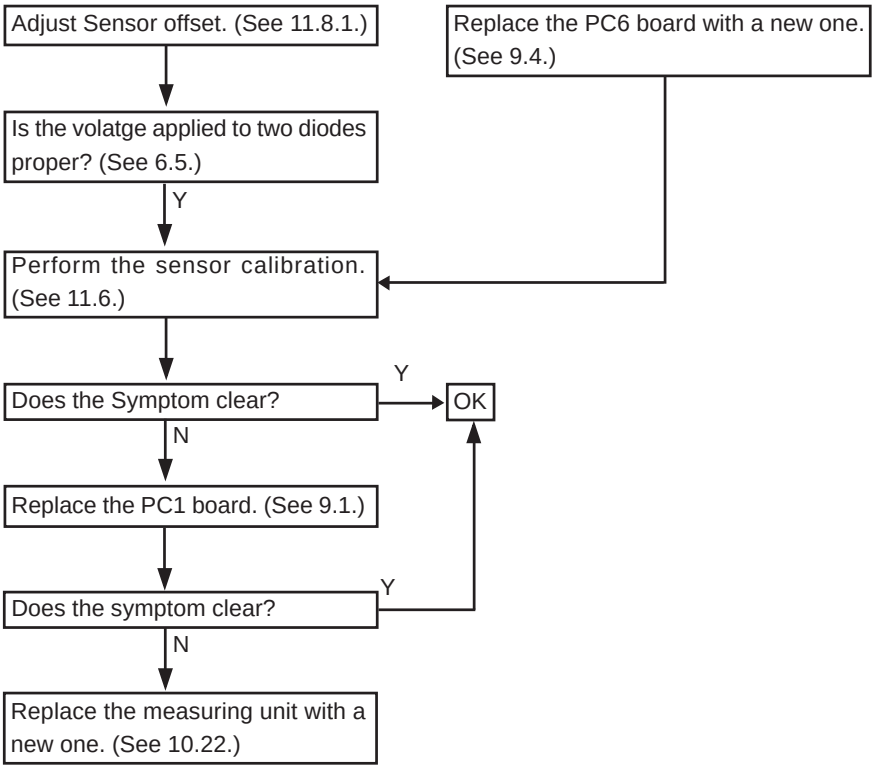
3.18 The message “Err” appears during AR measurements



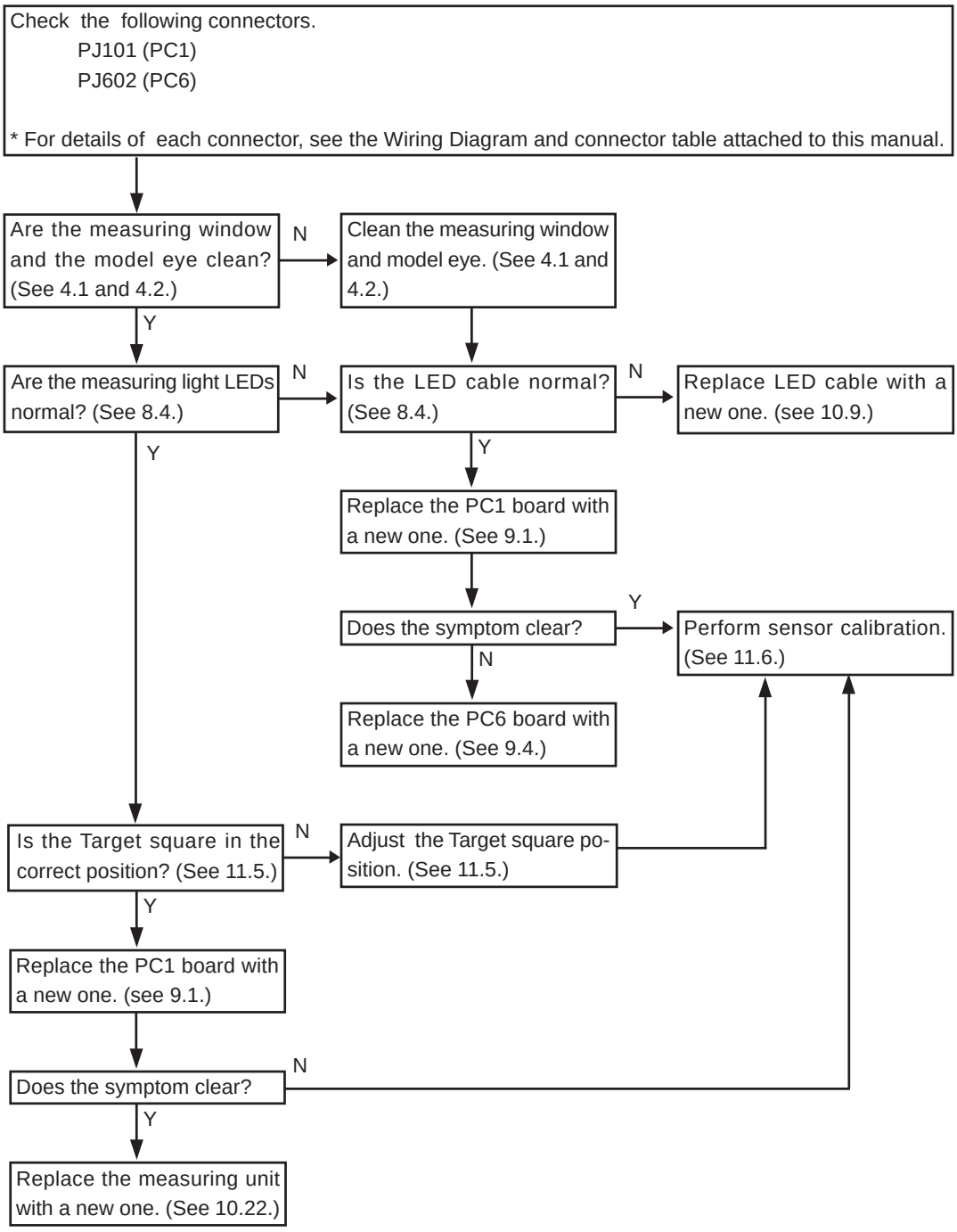
Set the parameter “No. 18 ERROR CODE” to “YES” as instructed on Operator’s Manual so that error code is displayed on the TV monitor.

Err 81 - Blinking error detected by MASK signal
Err 82 - Blinking error due to the amount of S-DIV change
Err 83 - Error due to gradient coefficient
Err 91 - SPH + over error caused when SPH value is + 23D or more (VD12mm)
Err 92 - SPH - over error caused when SPH is-18D or less (VD12mm)
Err 93 - CYL - over error caused when CYL is 8D or more (VD12mm)
Err 94 - CONF error caused by the desparity between the measuring value and the rough approximation of a sine wave.

3.19 Only the obtained SPH value is shifted



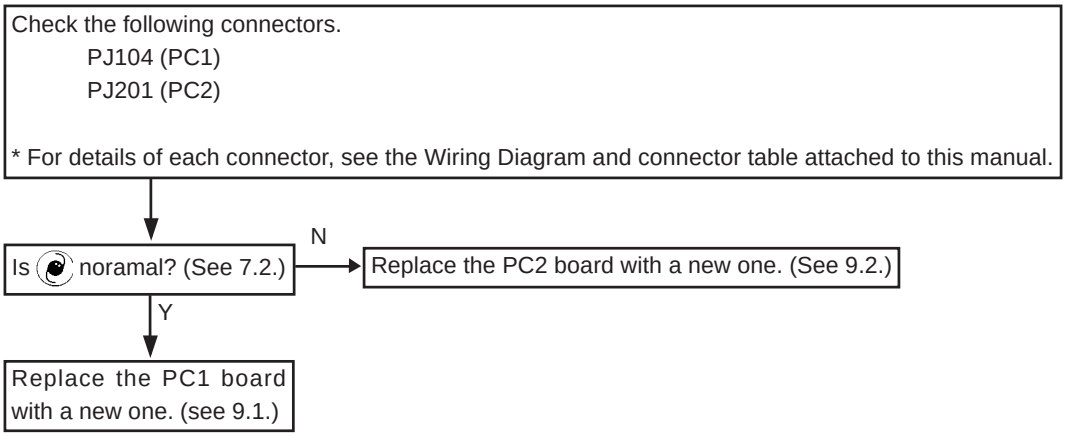
3.20 The obtained CYL value is too large



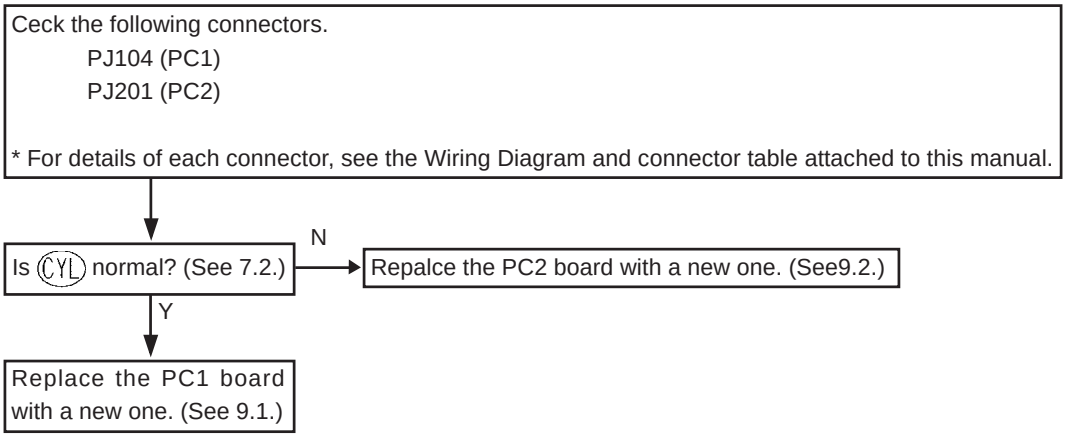
3.21 A short beep can not be heard when pressing the Start button

Replace the PC1 board with a new one.
(see 9.1.)

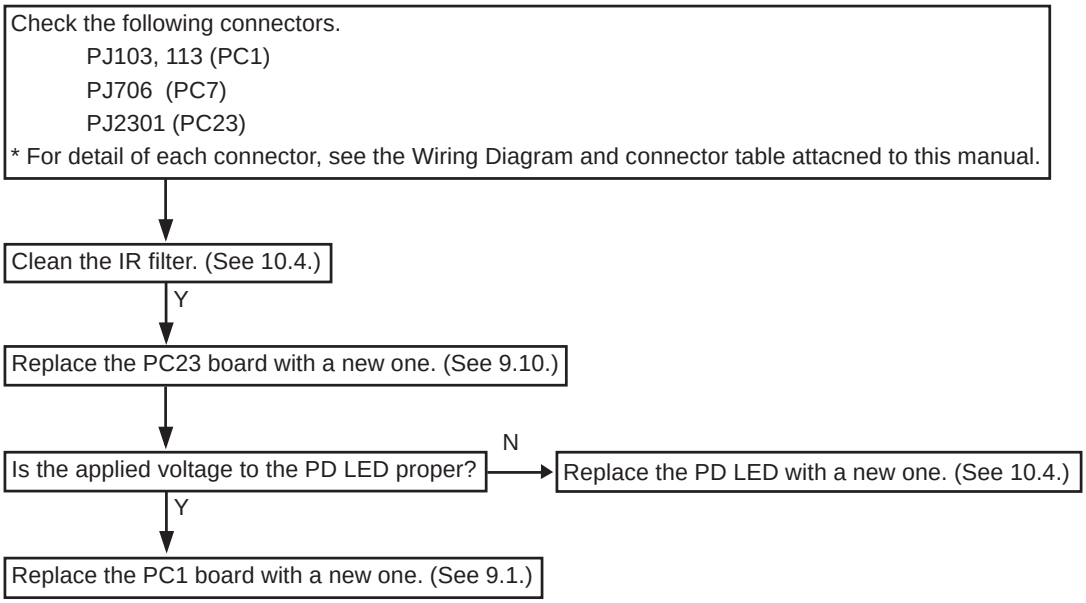
3.22 The IOL mode can not be turned ON



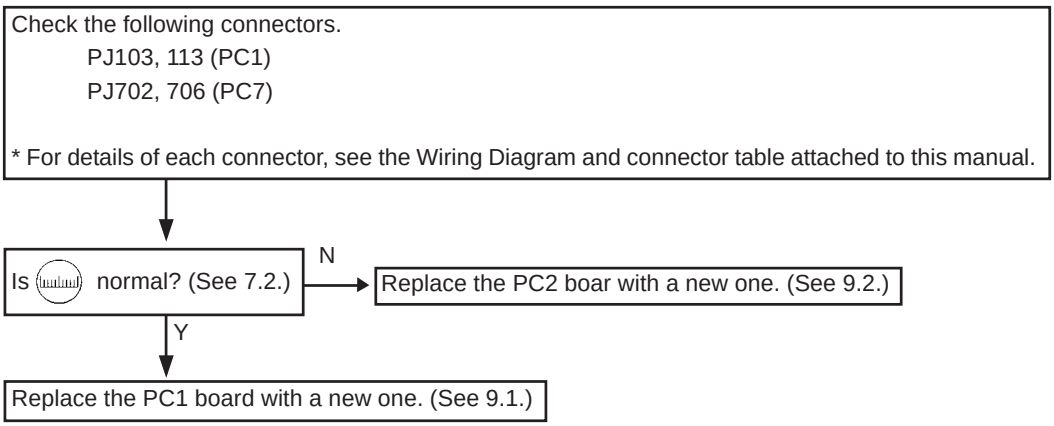
3.23 The Cylinder mode can not be changed



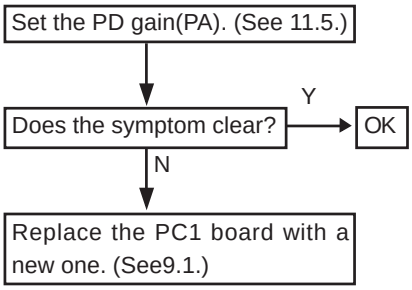
3.24 The instrument can not recognize the left and right



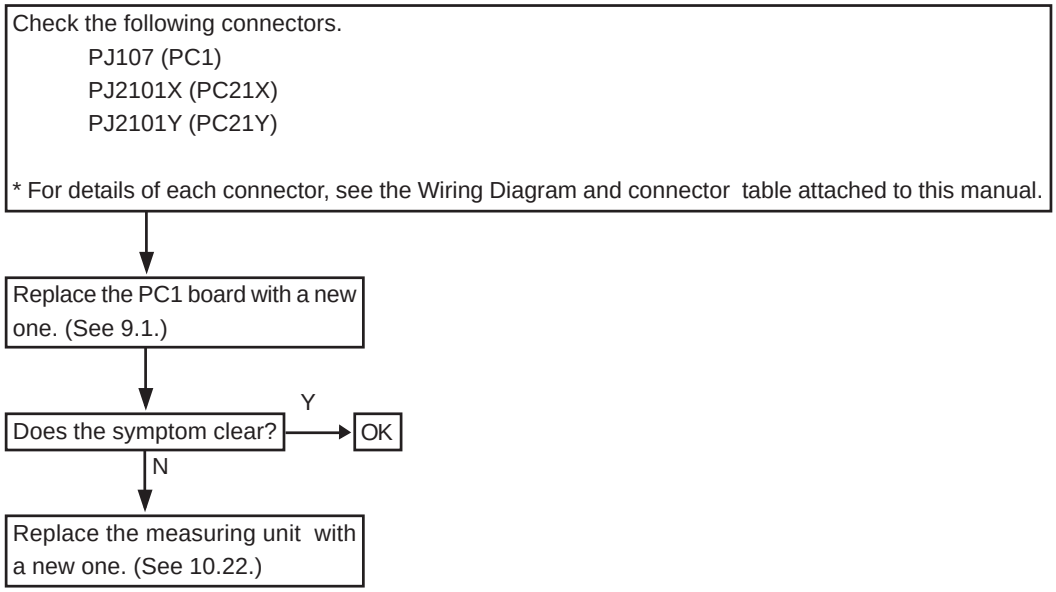
3.25 The instrument can not be placed in the PD mode



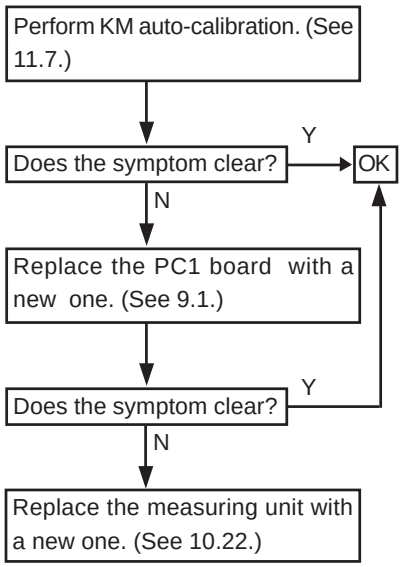
3.26 The obtained PD value is abnormal



3.27 The message “Err” appears during KM measurement



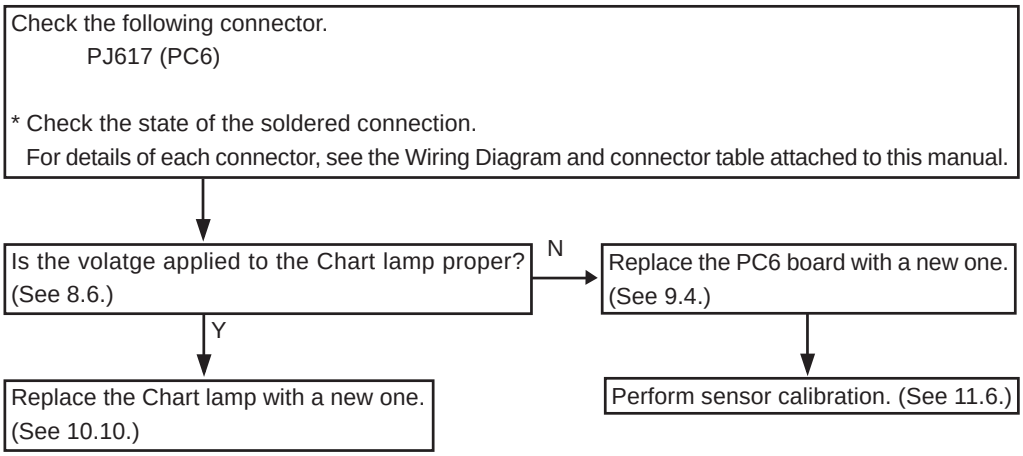
3.28 The obtained KM value is abnormal



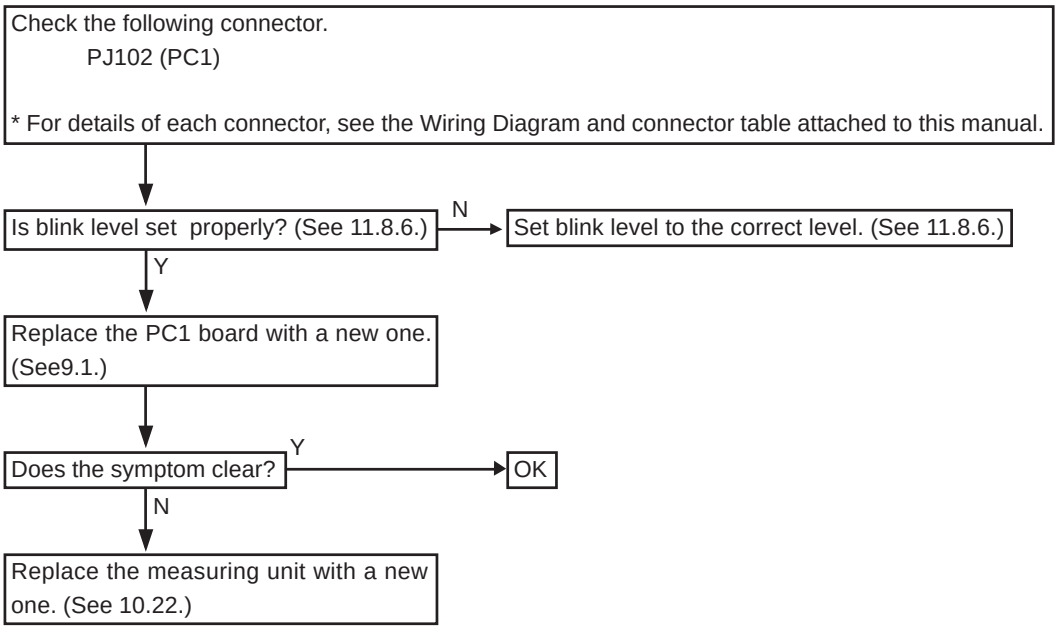
3.29 The up-and-down movement of the Chin rest is not smooth

Adjust the up-and-down movement of the Chin rest. (See11.3.)

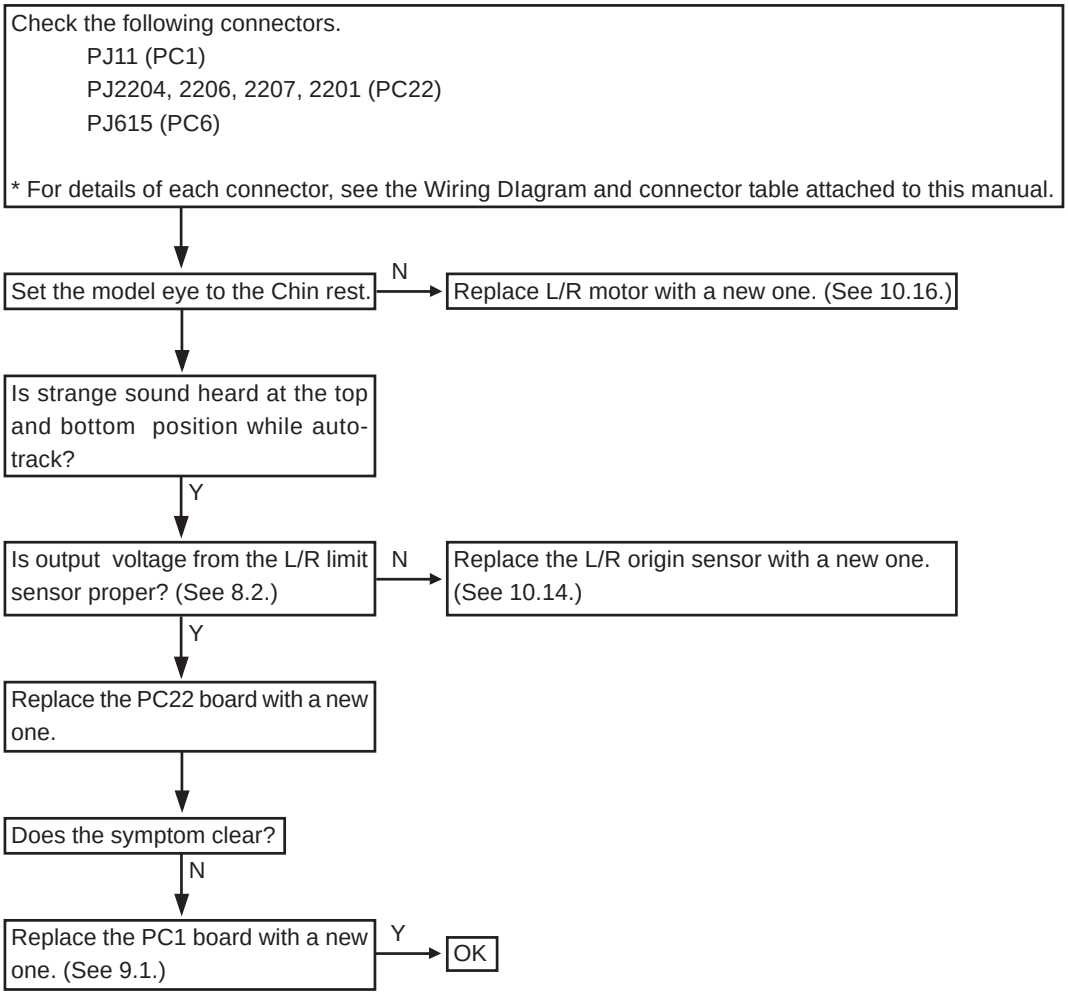
3.30 The chart can not be seen



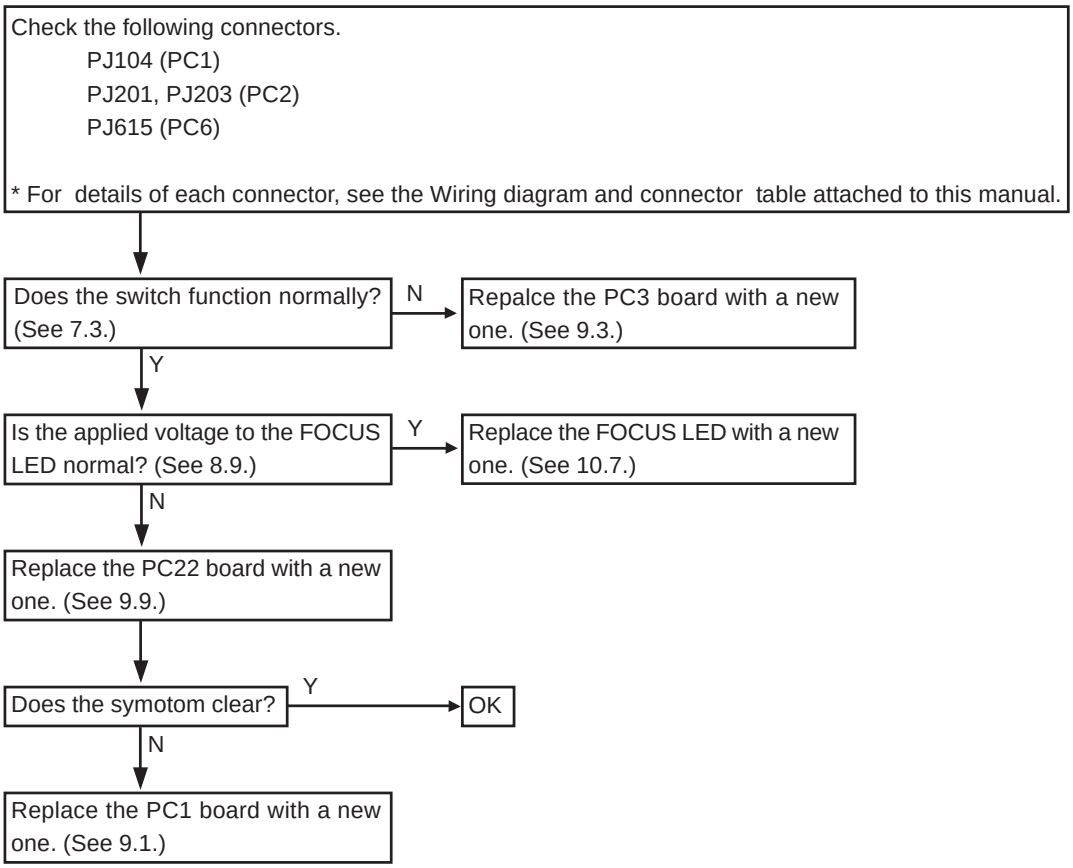
3.31 “Err” does not appear though the patient blinked during measurement



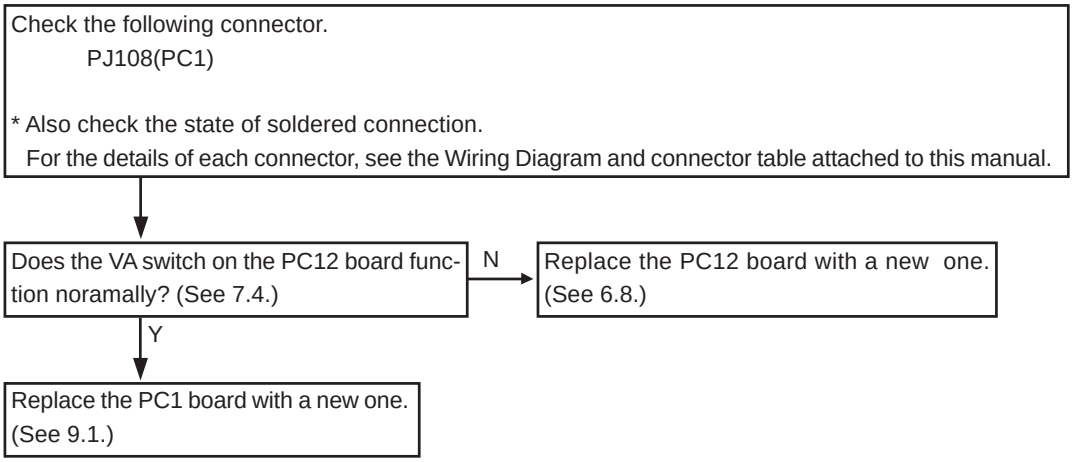
3.32 The auto-tracking function does not work



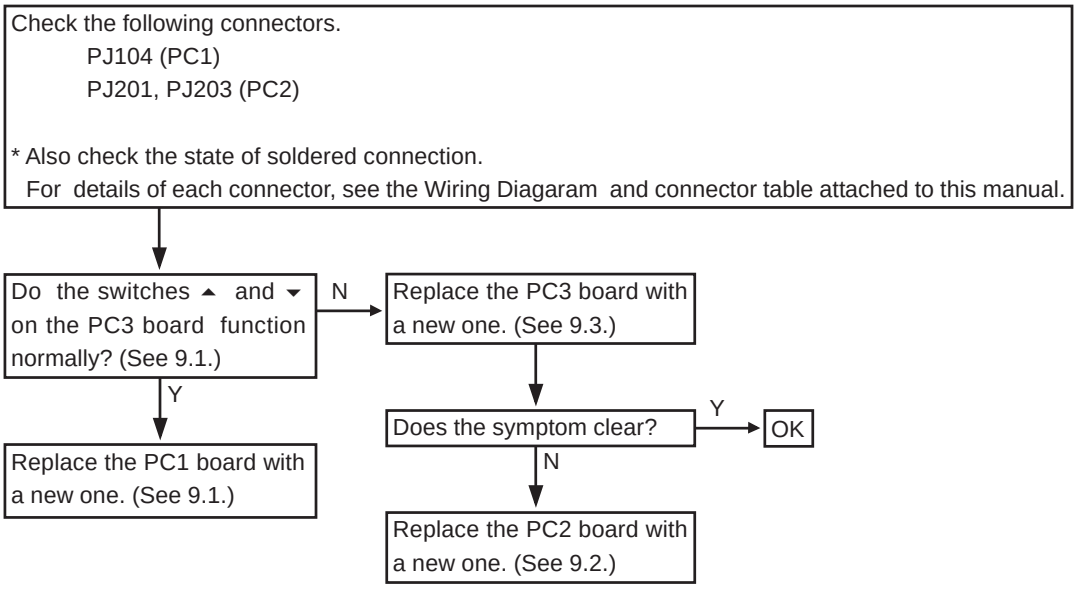
3.33 The auto-shot function does not work



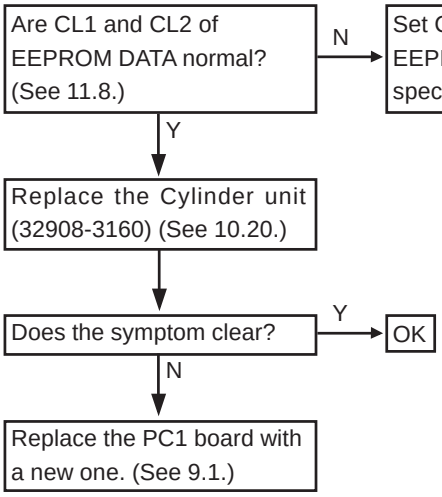
3.34 The instrument can not be placed in the VA TEST mode



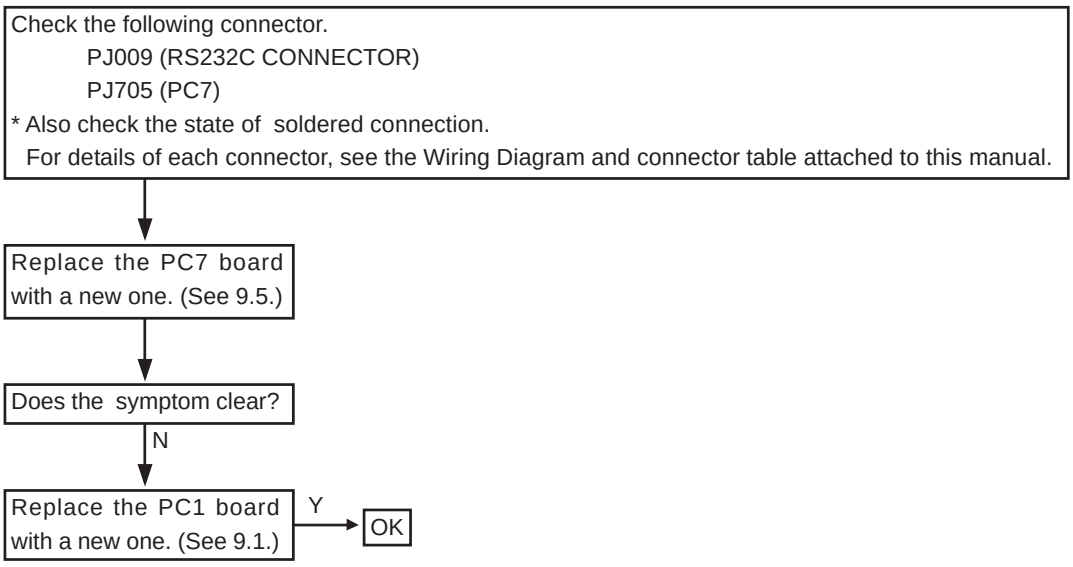
3.35 VA Charts can not be changed



3.36 The presented chart is out of focus during the subjective measurement (except when a patient has irregular astigmatism)



3.37 The message “Err IF” (Interface Error) appears



NOTE)
If the error message “Err IF” appears, set the parameter “ERROR CODE” to “YES” as instructed on Operator’s Manual so that the particular error code will appear to indicate the corresponding error state. The following describes ten error codes and the corresponding contents. It will be helpful when searching for errors.

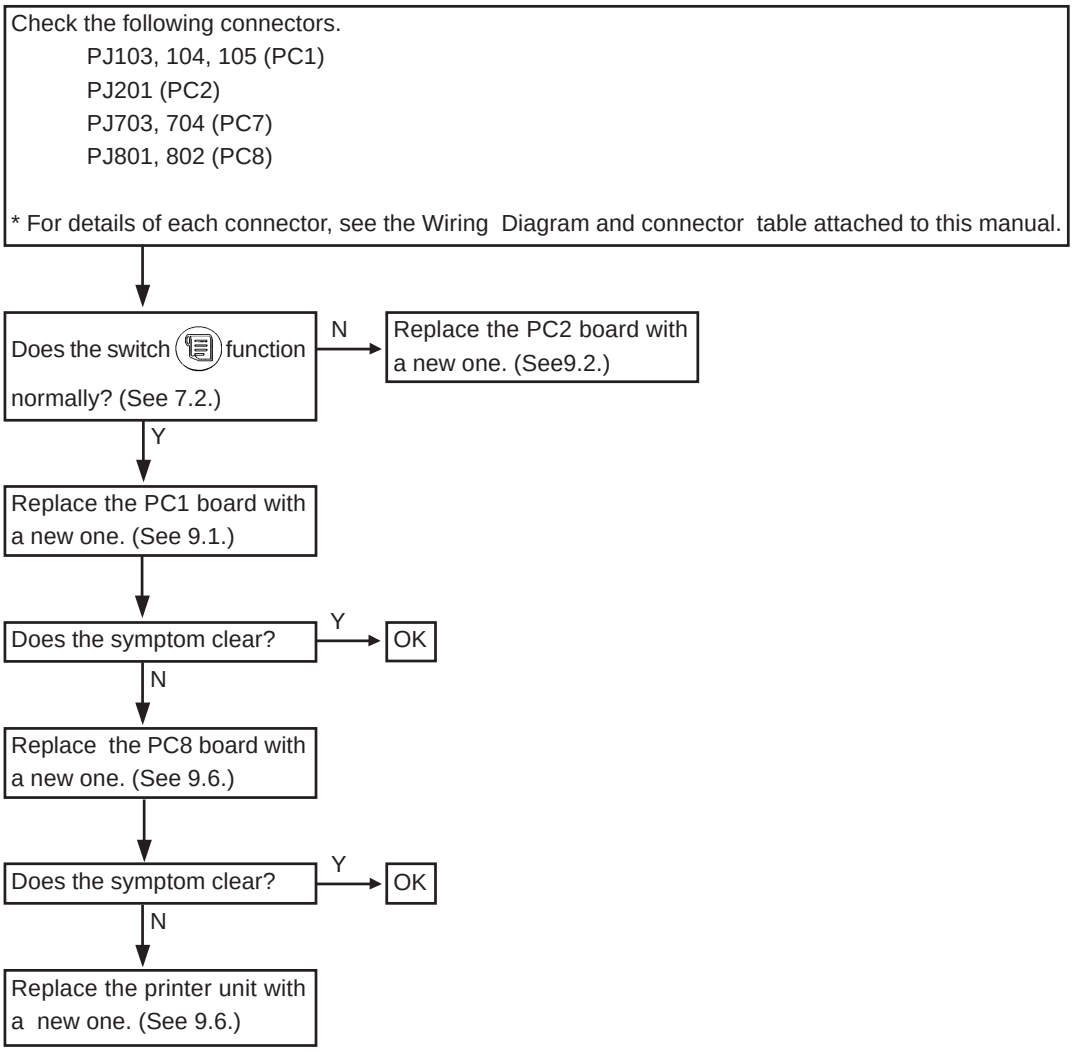
I/F CONNECTOR communication error

Err 11- DSR is flagged when SD command is received.
Err 12 - DSR is flagged when data is transmitted.
Err 13 - No input data comes
Err 14 - The reception buffer is full.
Err 15 - Illegible commands are received.

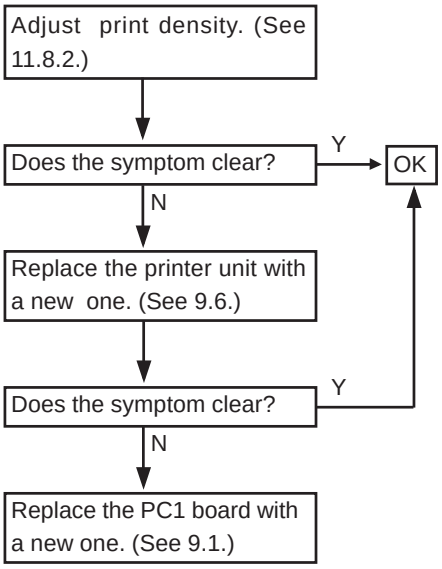
IC CARD R/W communication error

Err 18- DSR is flagged when SD command is received.
Err 19 - DSR is flagged when data is transmitted.
Err 20 - No input data comes
Err 21 - The reception buffer is full.
Err 22 - Illegible commands are received.

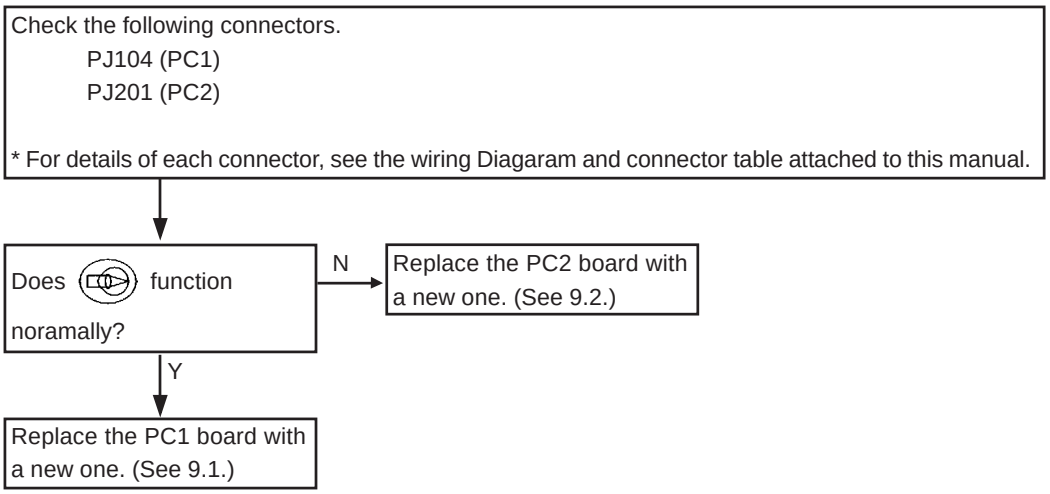
3.38 The printer does not operate



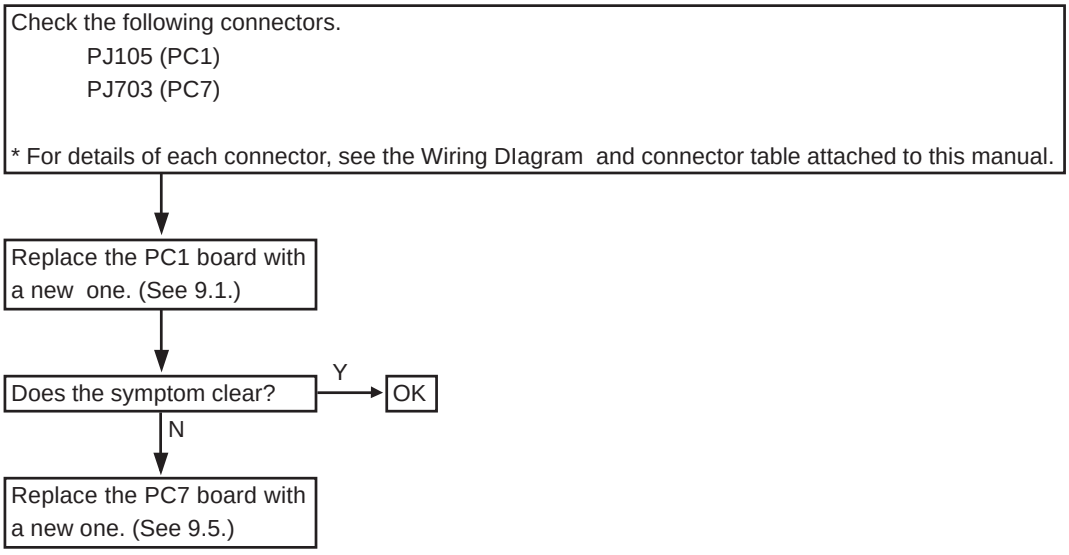
3.39 Light printed text/loss of text



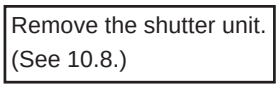
3.40 The Eyeprint function can not be turned on



3.41 The TV auto-OFF function does not work



3.42 The shutter does not close (only for the AR-600 whose S/N is earlier than 10121)



§4 Checking the obtained data with Model eyes

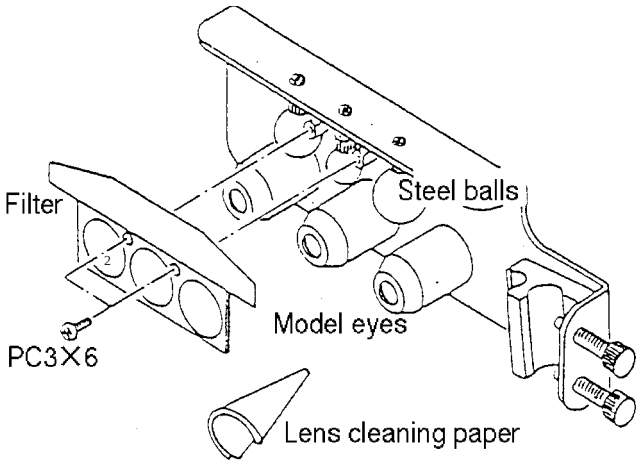
Obtaining the measurements with the model eyes (＋ 10D, 0D and － 10D) and the Steel balls (5.95mm, 7.94mm and 9.13mm) is important for checking if the instrument operates normally or not. The service persons should be trained to obtain the reliable data correctly. If they adjusts the electrical, optical, or mechanical parts of the instrument according to the incorrect data, the instrument may be out of working order.
The following describes the notes and procedures for obtaining the correct data with Model eyes and Steel balls.

4.1 Cleaning the Model eyes and Steel balls

1. **Remove the filter.**

2. **Blow out dust with a blower.**

3. **Fold lens cleaning paper with acetone as shown in the right figure. Wipe the model eyes and steel balls with it.**



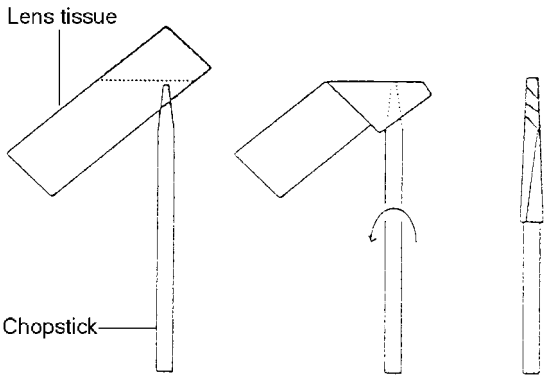
4. **Check to see that the model eyes and steel balls are clean. If not replace the paper with a new one and repeat the cleaning.**

4.2 Cleaning the measuring window

1. **Turn ON the Power switch to open the shutter (only for the early model AR-600).**

2. **Blow out dust with a blower.**

3. **Wrap lens tissue (Japanese special paper : Ganpi-shi) around the tool (for example, chopstick) as shown in the figure. Then dip it into acetone and wipe the measuring window with it.**



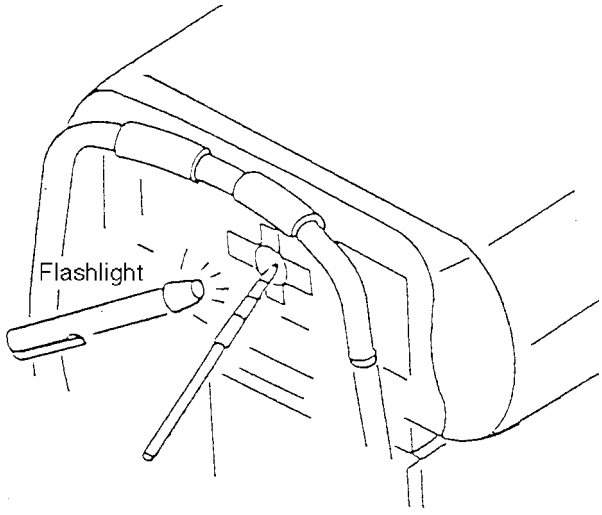
   * Pay attention not to dip it into too much acetone. Otherwise, acetone remains on the measuring window.

   For lens tissue, use Japanese special paper : Ganpi-shi.
   For the Chopstick, use the sticks which are unlikely to scratch glass.

   * Wipe the window as if drawing a circle from the center to the outside.

4. **Check to see that the measuring window is clean by using a flashlight. If not, replace the tissue with a new one and repeat the cleaning.**

   * If acetone deposits the covers of the instrument, it may result in decoloration. Pay attention not to spot the covers with acetone. If the cover changes in color, replace it with a new one.



4.3 Measuring the Model eyes

1. **Attach the Model eyes (ARKJ-4) to the Forehead rest.**
   * Do not tighten the screws too much. The Forehead rest may be scratched.

2. **Turn the Power switch ON.**

3. **Set the parameter 1: STEP to 0.01D.**

4. **Perform alignment and focusing correctly as instructed on Operator's Manual, and start measurement.**

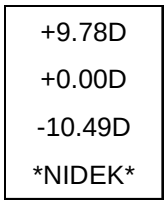
   * In case of measuring the Model eye of 10D, the range that you detect focusing is within ± 1.0D. This can cause an error in measurement.
   Therefore, every time, move the Joystick to the same direction in order to perform a precise alignment.

4.4 Tolerance on AR measurement error

See the table on the right.

* The labels on the Model eyes tell SPH power of each eye.
Compare the obtained SPH with the correct SPH stuck to the Model eyes and check if the error is within tolerance.

	TOLERANCE	
	SPHERE	CYLINDER
+10D	±0.25D	±0.25D
0D	±0.25D	±0.25D
-10D	±0.25D	±0.25D



4.5 Measuring the Steel balls

1. **Attach the Model eye (ARKJ-4) to the Forehead rest.**

2. **Turn the Power switch ON.**
   Pressing R/K , the instrument will be placed in the <K> (KM measurement) mode.

3. **Perform fine alignment and focusing and start measurement.**

   * When measuring the steel balls, the range that you detect focusing is ±0.1D. This can cause an error in measurement. Therefore, every time, move Joystick to the same direction in order to perform a precise alignment.

4.6 Tolerance on KM measurement error

See the table on the right.

	TOLERANCE	
	AVE	R1-R2
R5.95	±0.02	±0.04
R7.94	±0.02	±0.04
R9.13	±0.02	±0.04

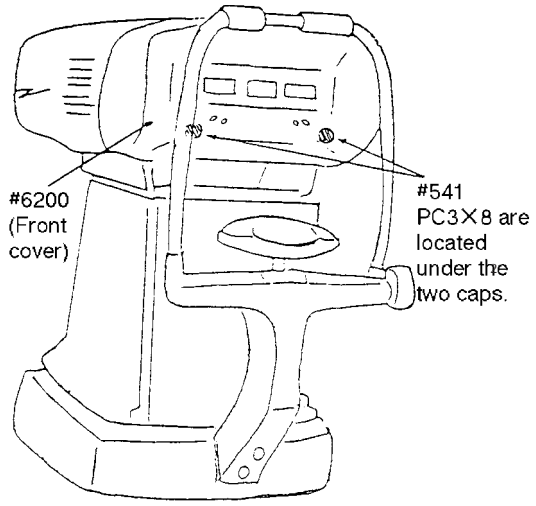
5.1 Removing the Front, Left and Right covers

1. Remove two caps (#541) on the front cover.

Remove them with a screwdriver so as not to scratch the caps.

2. Unscrew PC3 × 8 (n=2).

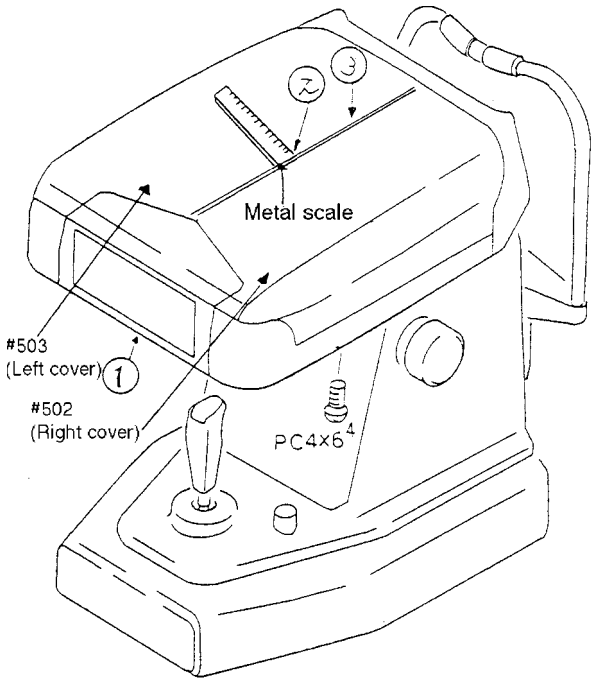
* It is not possible to remove the Front cover yet.

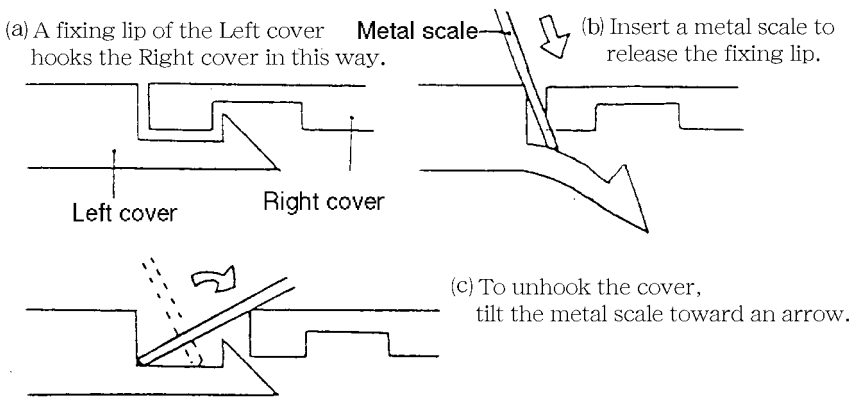


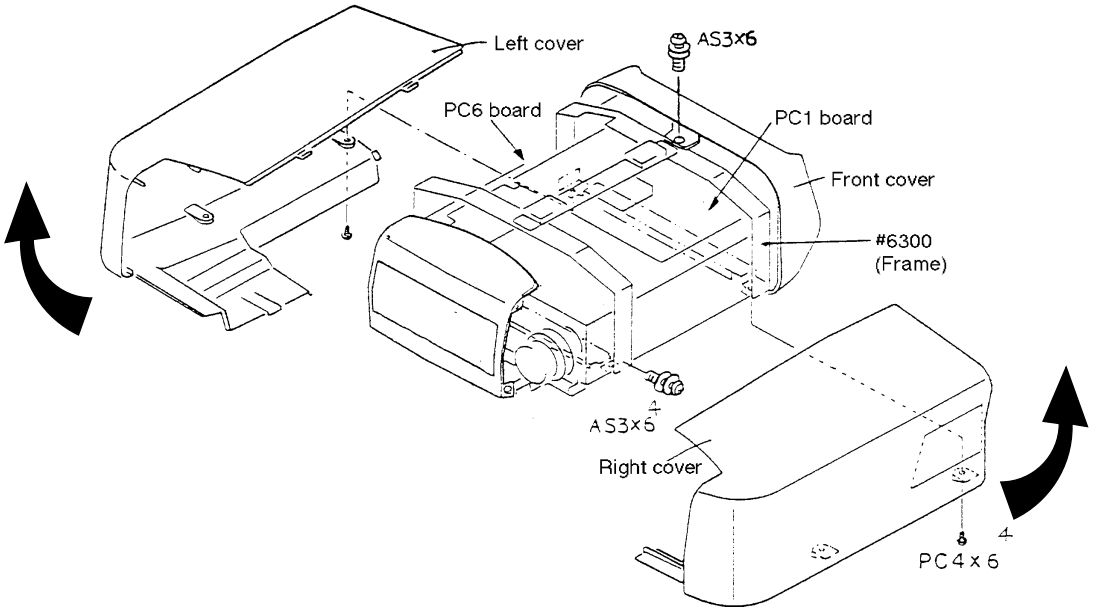
3. Unscrew PC4 × 6 (n=4) fixing the Left and Right covers at the bottom of them.

4. Insert a metal scale or an equivalent in a clearance between the left and right covers and release the fixing lip to remove the covers.

* The left and right covers are combined with three fixing lips ①,② and ③ as shown in the figure.







5. **Remove the Left and Right covers.**
   * When removing or assembling the Left and right covers, hold both the covers with your both right and left hands and open them to the arrow direction as above.
   When fitting the cover, fasten the fixing lips of the Front cover in advance.

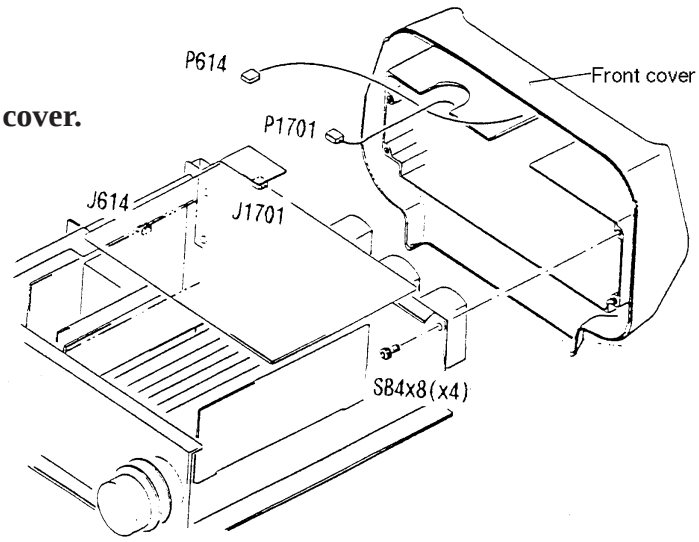
6. **Unscrew AS3 × 6 fixing the front cover.**

7. **Unscrew AS3 × 6 (n=4) fixing the frame to remove the frame #6300.**

8. **Disconnect J13 (flat cable) on the PC1 board, J19 (white, black) and J14 (red, black) on the PC6 board from connectors.**

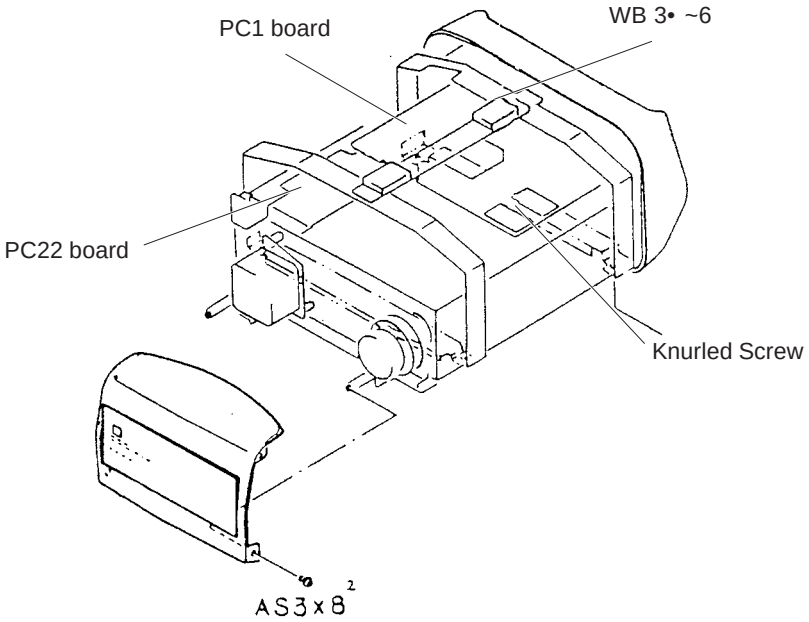
9. **Release the mask cable (gray flat cable) and alignment LED cable (orange, black) from the metal clamps on front cover.**
   * When fitting the Front cover, these cables should be located as before.
   It is necessary to remember their original position.

10. **Remove the front cover.**



5.2 Removing the Rear cover of the measuring unit

1. **Unscrew AS3 × 8 (n=2) to remove the Rear cover.**

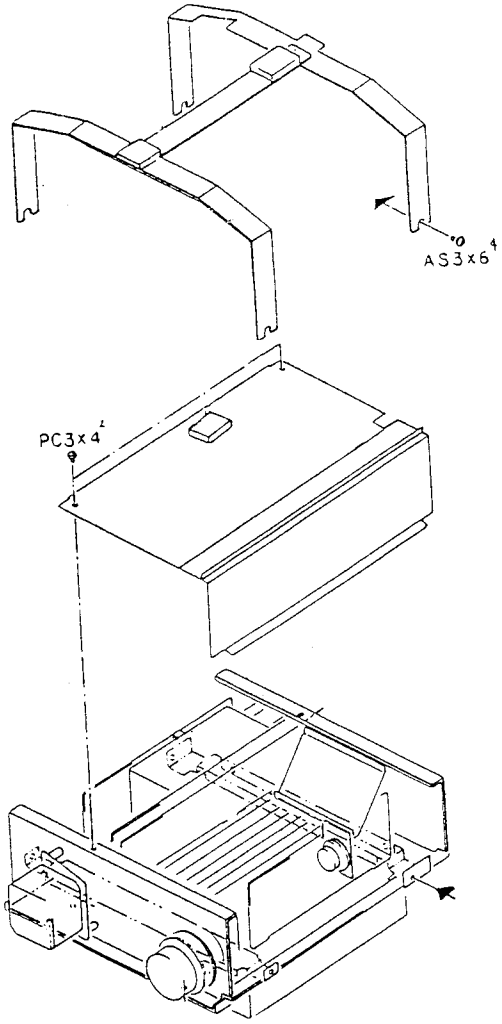


5.3 Removing the Inner cover

1. **Loosen AS3 × 8 (n=4) to remove the frame.**

2. **Loosen WB3 × 6 and the knurled screw to stand the PC1 and PC22 board.**

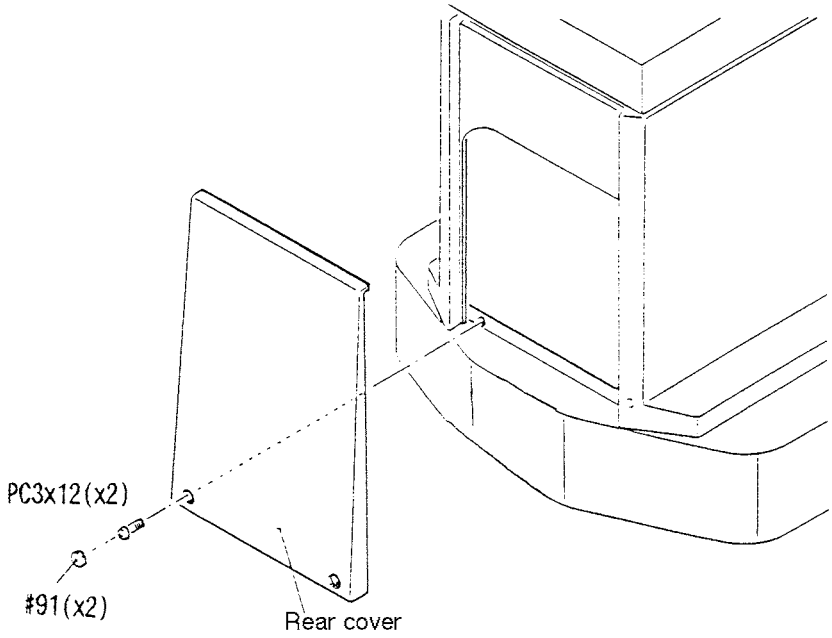
3. **Unscrew PC3 × 4 (n=2) to remove the Inner cover.**



5.4 Removing the Rear cover

1. **Remove #91 with a precision driver.**

2. **Unscrew PC3 × 12 to remove the Rear cover.**



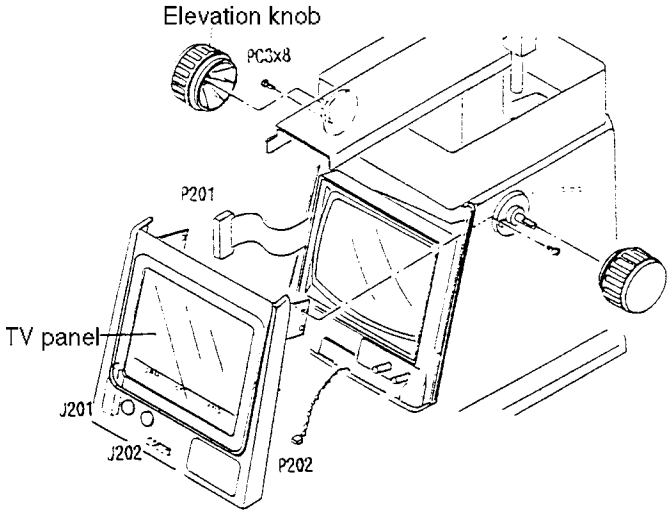
5.5 Removing the TV panel

(For AR-600)

1. Pull out the elevation knob.

2. Unscrew PC3 × 8 and disconnect the connectors (J201 and J202) to remove the TV panel.

* In removing the TV panel, first lift it to release the fixing lips of the panel, and then pull the panel forward from the bottom side.

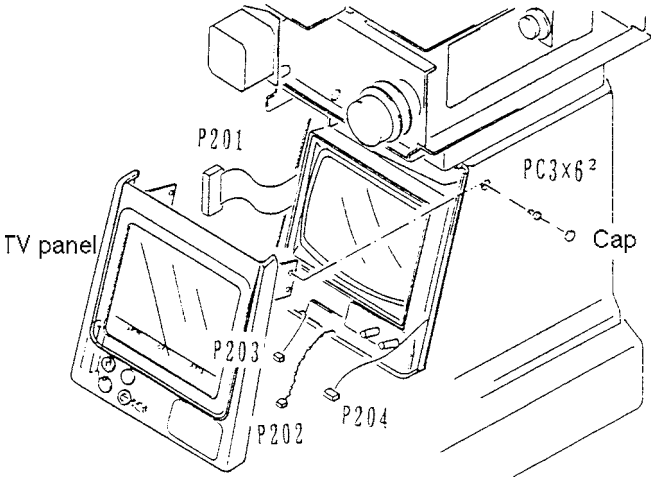


(For AR-600/AR-700 series except AR-600)

1. Remove #91 with a precision driver.

2. Unscrew PC3 × 8 and disconnect the connectors (J201, J202, J203 and J204) to remove the TV panel. (J203 and J204 are for the instrument provided with subjective measurement function.)

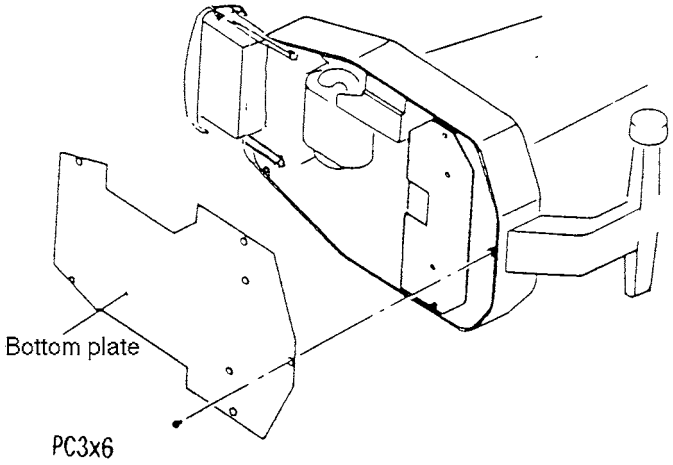
* In removing the TV panel, first lift it to release the fixing lips of the panel, and then pull the panel forward from the bottom side.



5.6 Removing the bottom plate of the instrument

1. **Fix the main body to the base with Locking hnob and gently lay down the instrument.**

2. **Unscrew PC3 × 6 and draw the printer unit to remove the bottom plate.**



§6 Checking the mains supply condition

6.1 Checking the supply voltage to AC INLET

1. **Check AC voltage in the wall outlet and between terminals on the table tap with a multimeter. Confirm that the voltages are within ± 10% of the specified voltage. If the obtained voltages are out of ± 10% due to poor electrical environment, it is recommended to use a voltage stabilizer.**

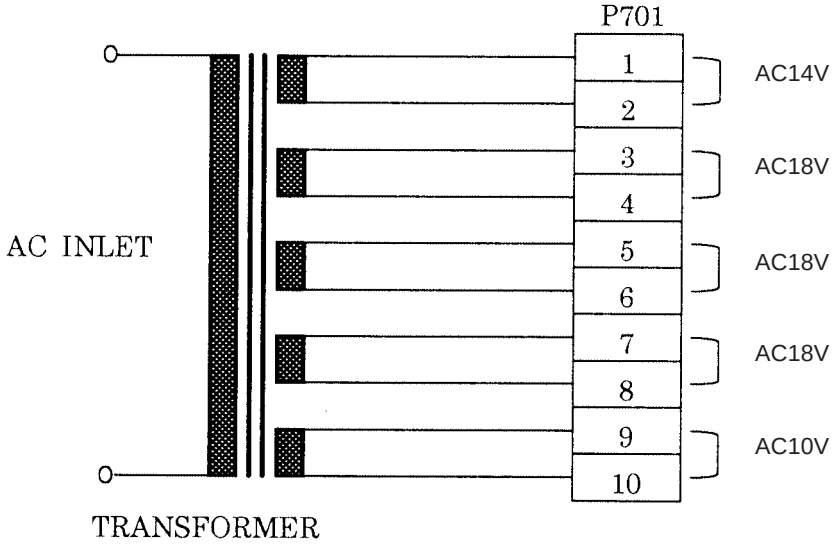
   * Take care not to touch the metal part of the multimeter probe.

6.2 Checking the secondary voltage of the transformer

1. **Lay the instrument down and remove the bottom plate. (See 5.6)**

2. **Unscrew PC4 × 8, lift the PC7 board and disconnect the connector (P701). (See 9.5)**

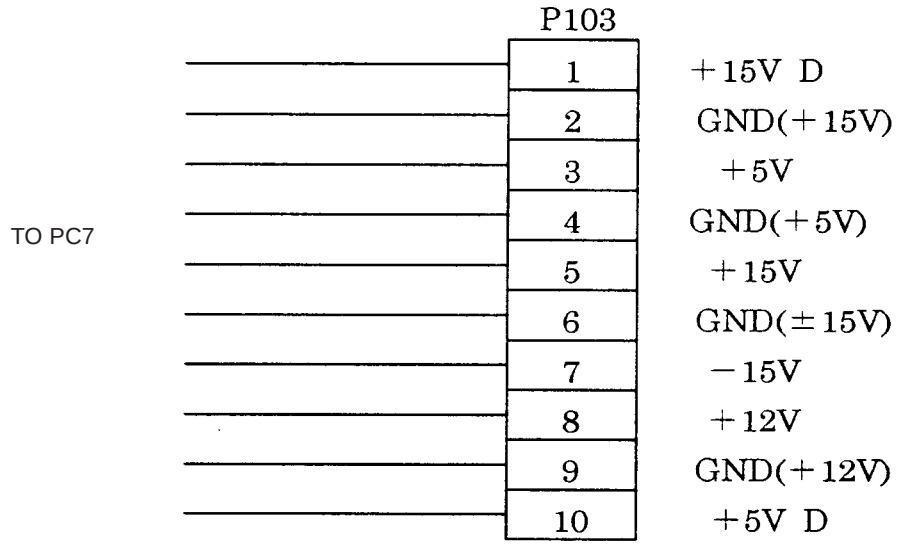
3. **Turn ON the Power switch and check the AC voltage between the following terminals respectively. Confirm that each voltages are within ± 10% of the specified level.**



6.3 Checking output voltage on PC7 board

1. Remove the Left and Right covers. (See 5.1)

2. Disconnect the connector P103 on PC1 board and turn ON the Power switch. Check the output voltage between the following pins. Confirm that each voltage are within ± 5% of the specified level.



* Observe the correct polarity for multimeter's probes.
GND pins on PC7 board and the ones of P103 connector are common pins.

6.4 Checking output voltage from backup battery

1. Remove the Left and Right covers. (See 5.1)

2. Remove the frame.

3. Check the output voltage from the BT1 on the PC1 board. Confirm that it is within 3V ± 5%.

* Observe the correct polarity for multimeter's probes.

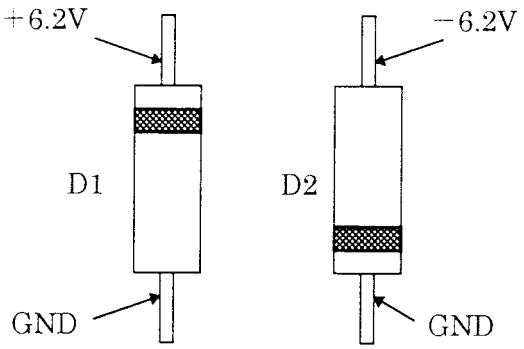
6.5 Checking voltage in D1 and D2 on the PC6 board

1. **Remove the Left and Right covers. (See 5.1)**

2. **Remove the frame.**

3. **Turn ON the Power switch. Check the voltage between the leads of two zener diodes. Confirm that it is within ± 5% of the specified voltage.**

   * Observe the correct polarity for multimeter's probes.

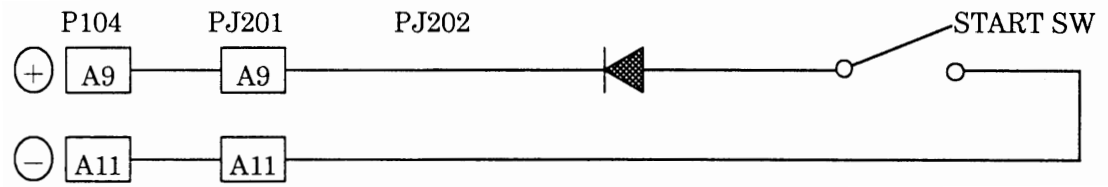


§7 Checking continuity of switches

Remove the Left and Right covers and frame, and then disconnect the connector P104 to check each switch. As there are a diode for static protection on the circuit, pay attention to polarity of multimeter's probe. Following figures tell plus or minus of multimeter's probe which is connected to each pin.

7.1 START SW

Check the continuity between the following pins of P104 to confirm the switch's correct operation.

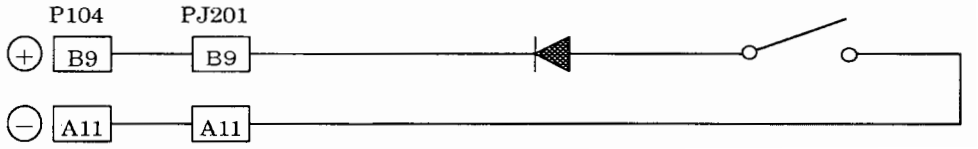


* It is possible that the cables in the Joystick have a break. Confirm that there is no break in the cables while operating the Joystick.

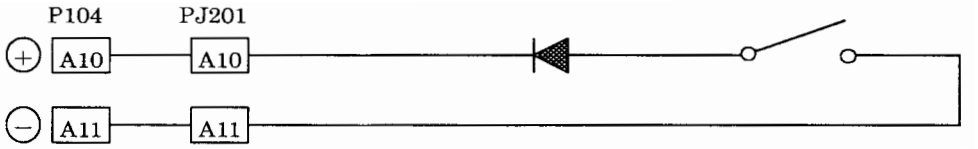
7.2 Switches on the PC2 board

Check the continuity between the following pins of P104 to confirm the switches' correct operation.

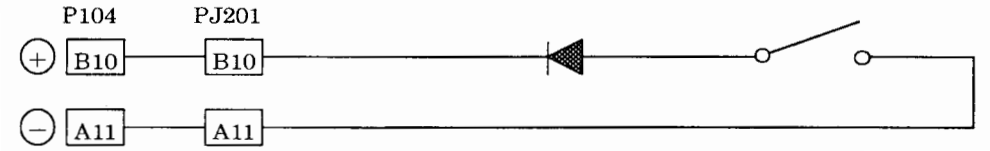
<PRINT SW>



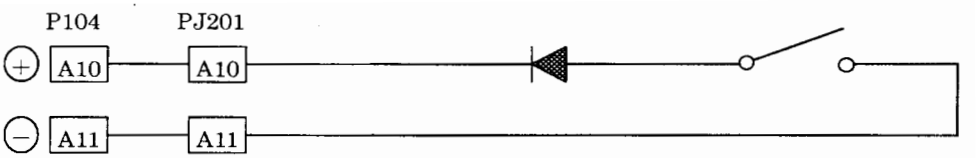
<IOL SW>/For AR-600 series



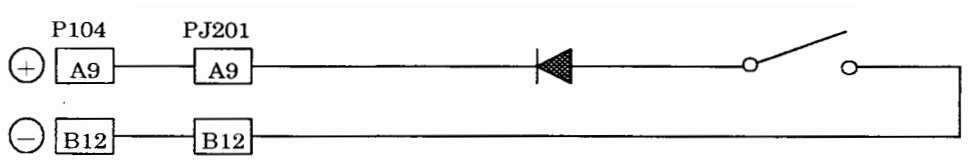
<IOL SW>/For AR-700 series



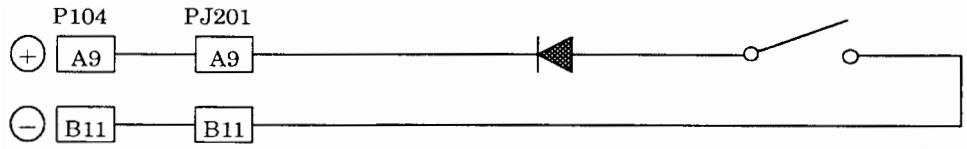
<R/K SW>/Only for AR-700 series



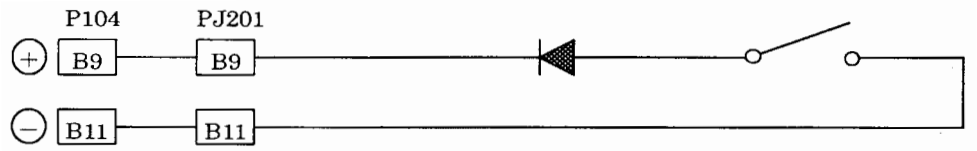
<SCALE SW>



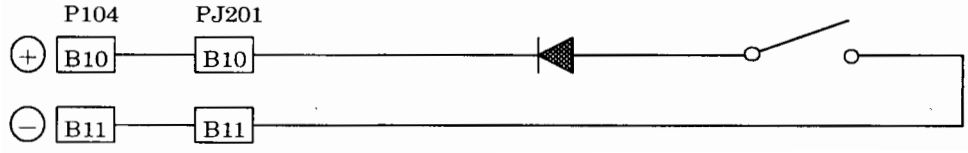
<CYL SW>



<EYE PRINT SW>

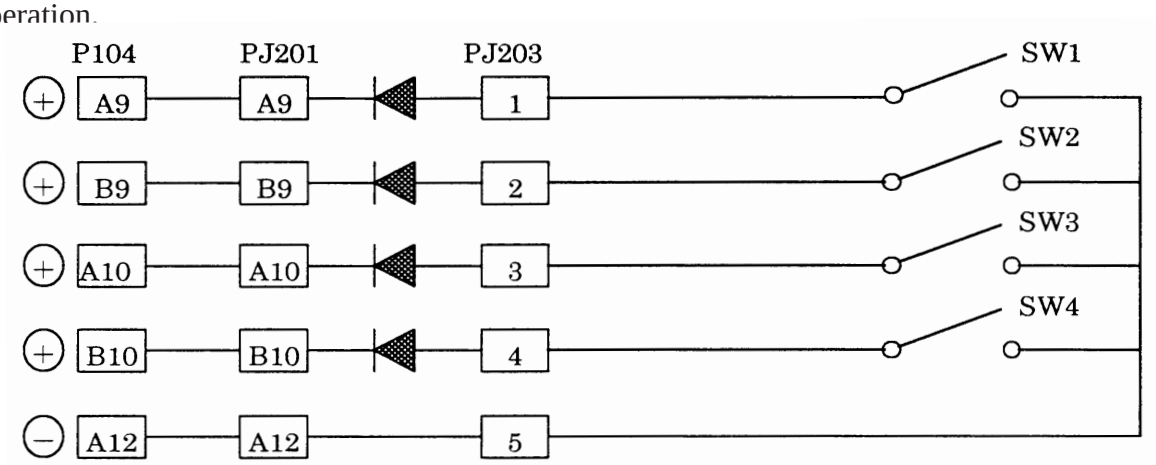


<SET SW>



7.3 Switches on the PC3 board (except AR-600)

Check the continuity between the following pins of P104 to confirm the switches' correct operation.

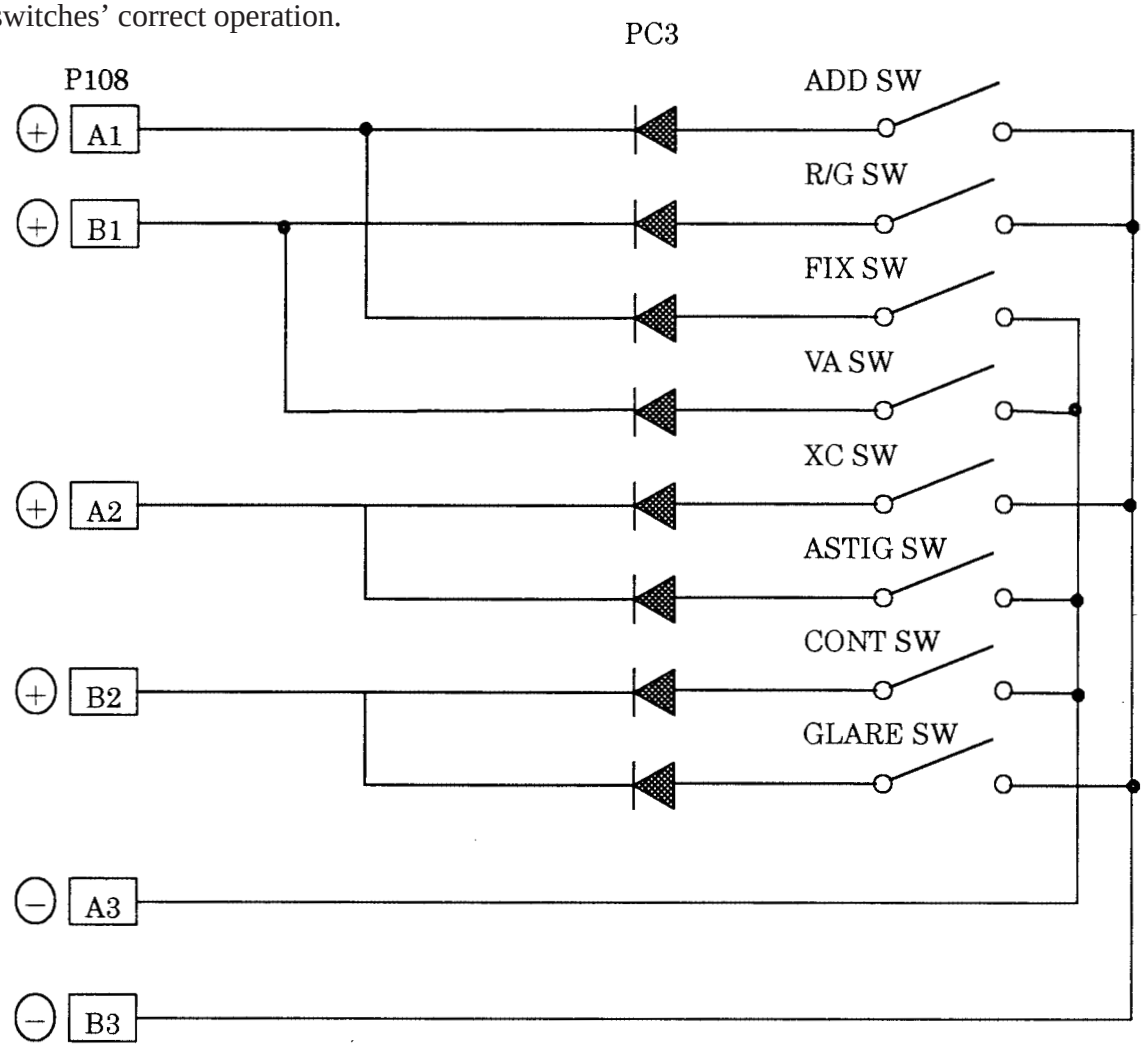


	AR-600A	AR-660A	ARK-700	ARK-700A	ARK-760A
SW1	⇕	▼	▼	▼	▼
SW2	A	▲	▲	▲	▲
SW3		⇕		⇕	⇕
SW4		A		A	A

Switches' positions and numbers differ according to each model.
See the above table.

7.4 Switches on the PC12 board (only for AR-660A and ARK-760A)

Check the continuity between the following pins of P108 to confirm the CHART SELECT switches' correct operation.

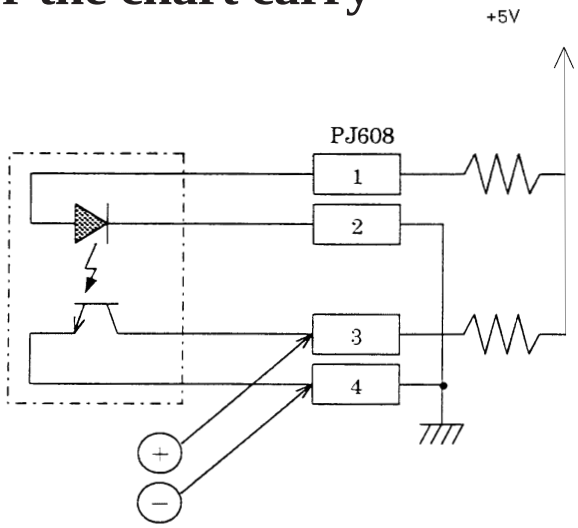


8.1 Checking origin sensor for the chart carry

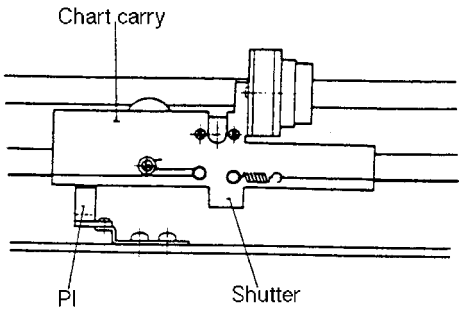
1. **Remove the Left, Right and Inner covers and turn ON the Power switch. (See §5.)**

2. **Slide the Chart carry manually and check the output voltage between 3-pin and 4-pin of PJ608 with a multimeter oncewhile the shutter blocks P1 (photointerrupter), and at the next with no block.**

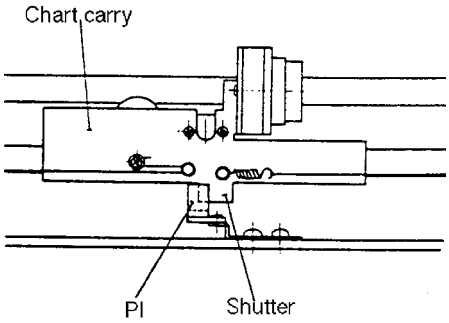
   * Observe the correct polarityshown in the figure for multimeter's probes.



- The output voltage is "LOW (0V)" when the shutter does not block the P1.



- The output voltage is "HIGH (+5V)" while the shutter blocks the P1.



8.2 Checking L/R origin sensor (except AR-600 & ARK-700)

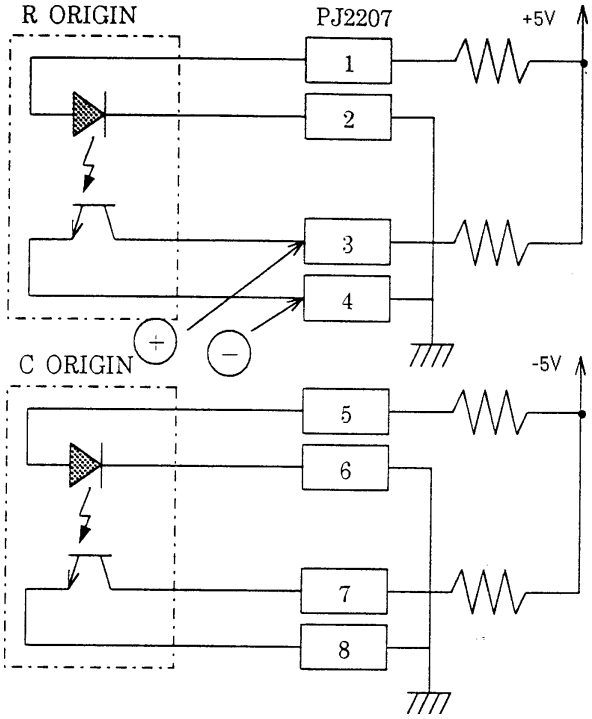
1. **Remove the Left, right covers and Rear cover of the measuring unit and turn ON the Power switch.**
   (See §5.)

2. **Attach the Model eye (ARKJ-4) to the Forehead rest.**

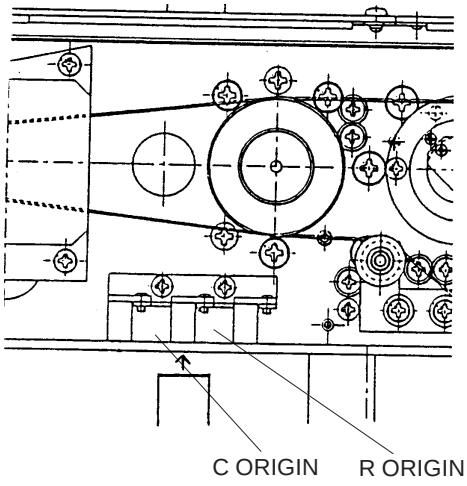
3. **Turn ON the Auto-tracking button.**

4. **Check the output voltage between 3 - 4 pin, and 7 - 8 pin of J2207 with a multimeter once while a sort of Kent paper blocks the P1 (photo-interrupter), and at the next with no block.**

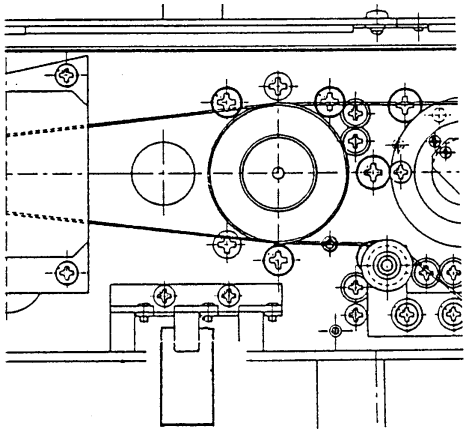
   * Observe the correct polarity shown in the figure for multimeter's probes.



- The output voltage is "LOW (0V)" when a Kent paper does not block the P1.



- The output voltage is "HIGH (+5V)" when a Kent paper does not block the P1.

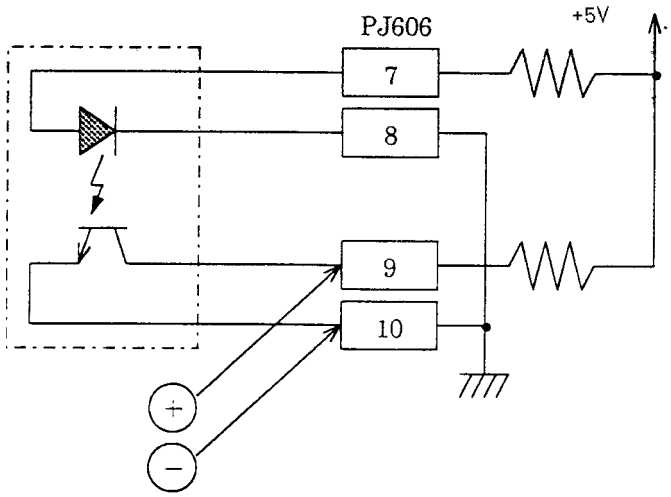


L ORIGIN sensor is provided for the early models but it is not used.

8.3 Checking the Origin sensor for the Rotator

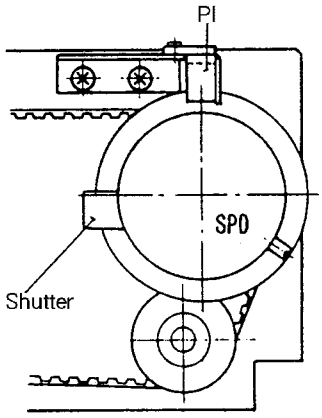
1. **Remove the Left, Right covers and Rear cover of the measuring unit and turn ON the Power switch. (See § 5.)**

2. **Rotate the SPD clockwise and Check the output voltage between 9-pin and 10 - pin of PJ606 with a multimeter while a shutter blocks the P1 (photo-interrupter) and while it does not block the P1.**

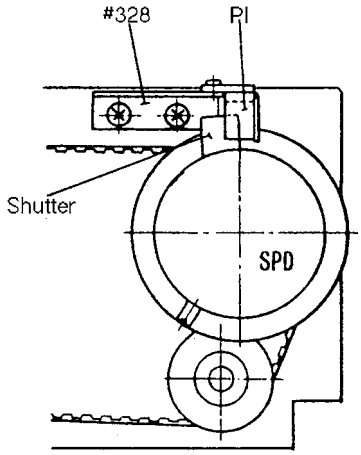


* Observe the correct polarity shown in the figure for multimeter's probes.

- The output voltage is "LOW (0V)" when the shutter does not block the P1.



- The output voltage is "HIGH (+5V)" while the shutter blocks the P1.

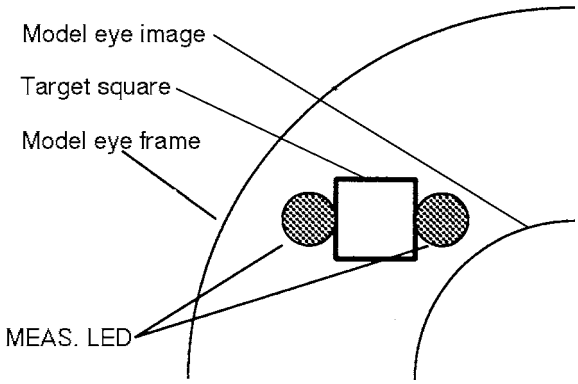


8.4 AR measurement LED and LED cable

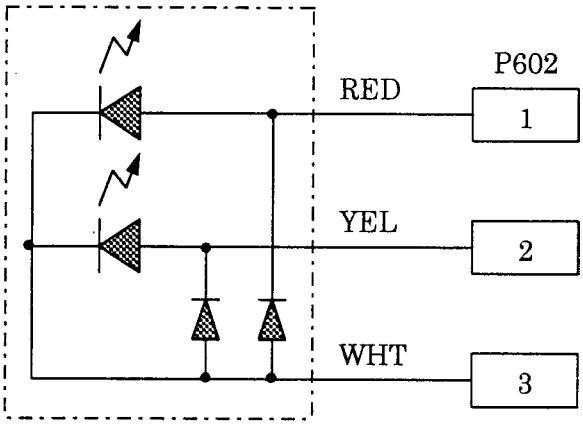
1. **Remove the Left and Right covers and turn ON the Power switch. (See 5.1.)**

2. **Attach the Model eye (ARKJ-4) to the Forehead rest.**

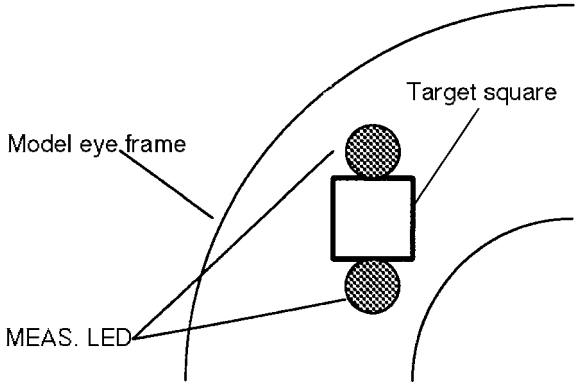
3. **Set Switch 4 of switchpack SW1 on the PC1 board to the ON position. Press the Start button once to place the instrument to the "mode 1". (See § 12.)**



4. **Put the target square within the model eye frame. Two lights of light source LED for AR measurement LED appears by moving the Main body back and force.**
   At that point, move the LED cable and check to see that the lights do not blink. The blinking lights show signs of breaking LED cable.
   If the LED is not lit, check the continuity between 1-3 pin and 2-3 pin with a multimeter.
   Since the LED is included in the circuit, a multimeter will not read 0Ω.
   But if the LED cable has a break, a multimeter will show no indication.
   The polarity of probes of multimeter does not matter.



5. **Rotate SPD clockwise and check to see that the target square is tangent to two lights of LED.**



8.5 Checking the ILLUMI. LED voltage

1. **Remove the Left , Right covers and frame. Then disconnect the connector P614. Turn on the Power Switch. (See § 5.)**

2. **Check the voltage between 1-pin and 2-pin of J614 with a multimeter. Confirm that it reads around + 5V.**

* Multimeter's probe (+) 1 pin
(-) 2 pin

8.6 Checking the Chart lamp voltage

1. **Remove the Left, Right covers and frame. Then disconnect the connector P617. Turn on the Power Switch. (See § 5.)**

2. **Check the voltage between 1-pin and 2-pin of J617 with a multimeter. Conform that it reads around + 5V.**

* Multimeter's probe (+) 1 pin
(-) 2 pin

8.7 Checking the alignment light LED voltage

1. **Remove the Left, Right covers and frame. Then disconnect the connector P613. Turn on the Power Switch. (See § 5.)**

2. **Check the voltage between 1-pin and 2-pin of J613 with a multimeter. + 12V with pulse having a period of 0.5sec. is applied to J613 on the circuit. Since the multimeter measures the stable voltage, its needle moves slowly. If the meter indicates slightly upscale, the voltage is normal.**

* Multimeter's probe (+) 1 pin
(-) 2 pin

8.8 Checking the PD LED voltage

1. **Remove the bottom plate and disconnect the connector P706. Turn ON the Power Switch. (See 5.6.)**

2. **Check the voltage between 1-pin and 2-pin of J706 with a multimeter. Confirm that it reads around + 5V.**

* Multimeter's probe (+) 1 pin
(-) 2 pin

8.9 Checking the FOCUS LED voltage (only for AR-600A, AR-660A)

1. **Remove the Left and Right covers. Then disconnect the connector P615. Turn ON the Power Switch. (See 5.1.)**

2. **Check the voltage between 1-2-pin and 7-8 pin of J615 with a multimeter. Confirm that it reads around + 5V.**

   * Multimeter's probe (+) 1 , 7 pin
     (-) 2, 8 pin

8.10 Checking the AKM LED voltage (only for AR-700 series)

1. **Remove the Left and Right covers. Then disconnect the connector P615. Turn ON the Power Switch. (See 5.1.)**

2. **Check the voltage between 1-2 pin, 3-4 pin, 5-6 pin and 7-8 pin of J615 with a multimeter. Confirm that it reads around + 5V.**

   * Multimeter's probe (+) 1 , 3, 5, 7 pin
     (-) 2, 4, 6, 8 pin

8.11 Checking the AKM LED voltage (except AR-600)

1. **Remove the Left and Right covers. Then disconnect the connector P616. Turn ON the Power Switch. (See 5.1.)**

2. **Check the voltage between 1-3 pin and 2-3 pin of J616 with a multimeter. Confirm that it reads around + 12V.**

   * Multimeter's probe (+) 1, 2 pin
     (-) 3 pin

§9 *Replacing circuit boards*

9.1 Replacing PC1 (MAIN) board

Replacement parts: 32906-BA01/ ROM (IC2 and IC3) is not included in the P.C.B.

1. **Remove the Left, Right covers and frame. (See § 5.)**

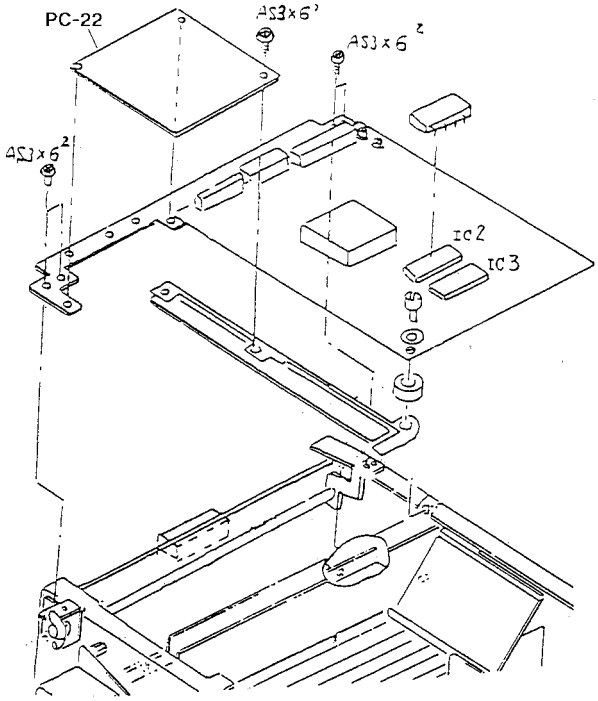
2. **Remove all the connectors from the board.**

3. **Take out the PC22 board by screwing AS3 × 6. (See 9.9)**
   * The PC22 board is not used in AR-600 and ARK-700.

4. **Unscrew AS3 × 6 and take out the PC1 board (with heat radiating plate).**

5. **Unscrew the knurled screw and the screws fixing the PC1 board and attach them on the new PC1 board.**

6. **Extract ROM and mount it onto the new board.**



7. **Set SW1 and SW2 according to "§ 14 List of SW1 and SW2 functions on the PC1 board".**
   * The PC1 board including ROM can be commonly used in the AR-600 and ARK-700 series. However, the setting of SW1 and SW2 differs according to the model and destination.

8. **Set the parameter, date and time and input comments, referring to Operator's manual. Then check the instrument for proper operation.**

9.2 Replacing PC2 (DISPLAY) board

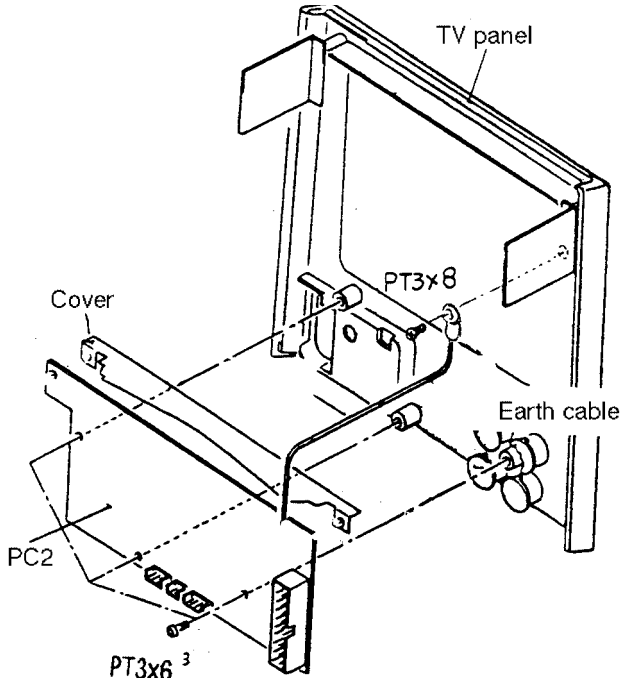
Replacement parts: 32906-BA02

1. **Remove the TV panel. (See § 5.)**

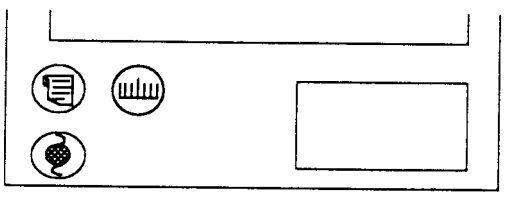
2. **Unscrew PT3 × 8 and PT3 × 6 (n=3) to take the PC2 out.**

3. **Take off the Cover from the PC2 board and attach it to the new P.C.B with an adhesive tape.**

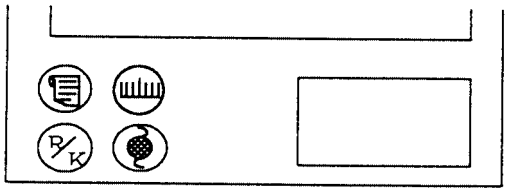
   * If a button is off, return it to the original position, following the figures below.
   Note that the buttons position differs according to the model. After replacing the board with a new one, check the buttons for correct operation.



FOR AR-600 SERIES

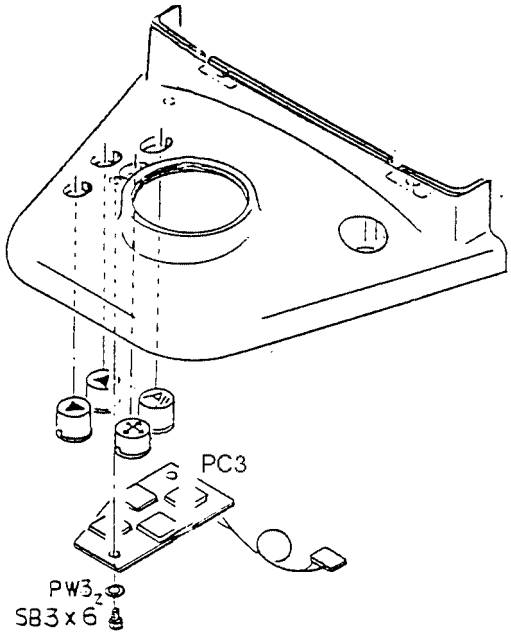


FOR AR-700 SERIES



9.3 Replacing PC3 (INC.DEC SW) board (except AR-600)

Replacement parts: 32907-EA03

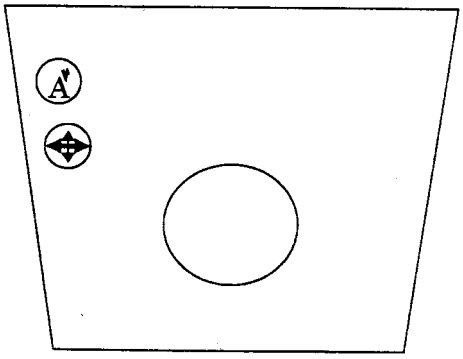


1. **Remove the Rear cover and TV panel. (See § 5.)**

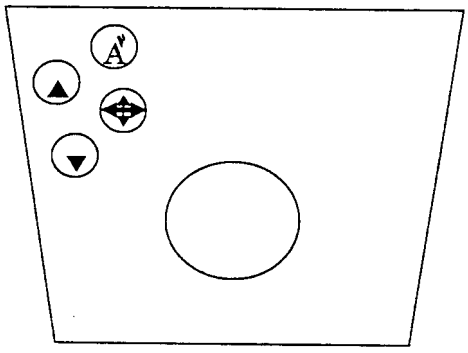
2. **Remove the Joystick (See 10.2).**
   * It is possible to take out the PC3 board without disconnecting the wiring of the Joy stick.

3. **Unscrew SB3 × 6 (n=2) to replace PC3 with a new one.**
   * If a button is off, return it to the origina position, following the figures below. Note that the buttons position differs according to the model. After replacing the board with a new one, check the buttons for correct operation.

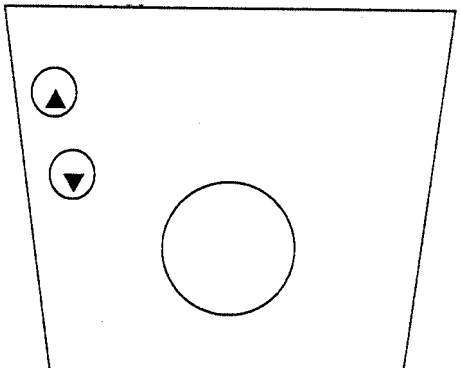
For AR-600A



For AR-660A, ARK-700A and ARK-760A

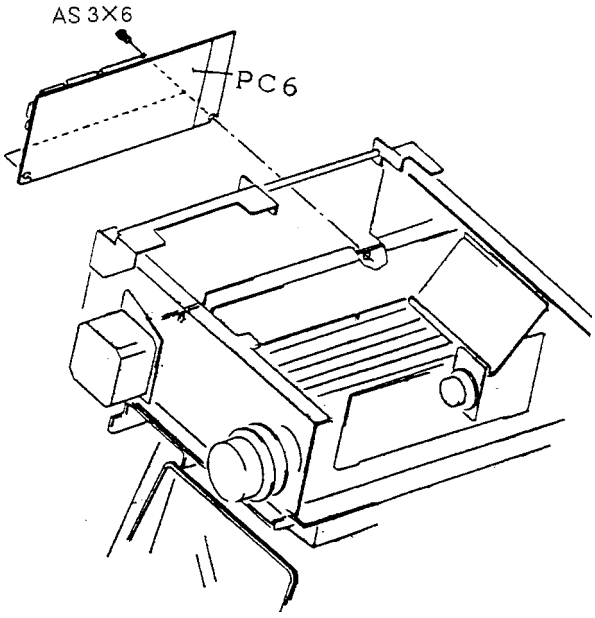


For ARK-700



9.4 Replacing PC6 (ADJUST) board

Replacement parts: 32906-BA06



1. Remove the Left, Right covers and frame. (See § 5.)

2. Remove all the connectors from the board.

3. Unscrew AS3 × 6 (n=2) and replace the PC6 board with a new one.

* The connectors on the P.C.B is quite alike. When mounting the connectors on the new P.C.B, pay attention to the connector No. For details of each connector, see the WIRING DIAGRAM attached to this manual.

4. Mount the IC2 (E2PROM) on the former PC6 board to the new P.C.B. except when "Err9" (MEMORY FAILURE ON E2PROM) appears.

* If "Err9 (MEMORY FAILURE ON E2PROM" arises, follow the troubleshooting on 3.2.8.

5. Set the volume of VRs on the new PC6 as before. Note that VR9 should not be turned to CW over 3:00 position.

6. Set the parameter, date and time and input comments, referring to Operator's manual.

7. Perform sensor calibration. (See 11.6.)

8. When replacing the IC2 (E2PROM), perform tracking calibration and KM auto-calibration. (See 11.11.)

9. Check the instrument for proper operation.

Functions of VRs

VR1: S. GAIN
VR2: S. ZERO
VR3: AR LED R
VR4: AR LED L
VR5: KM LED 1
VR6: KM LED 2
VR7: KM LED 3
VR8: KM LED 4
VR9: MIRE LED
VR10: ALIGN. LED
VR11: ILLUMI LED

9.5 Replacing PC7 (POWER SUPPLY) board

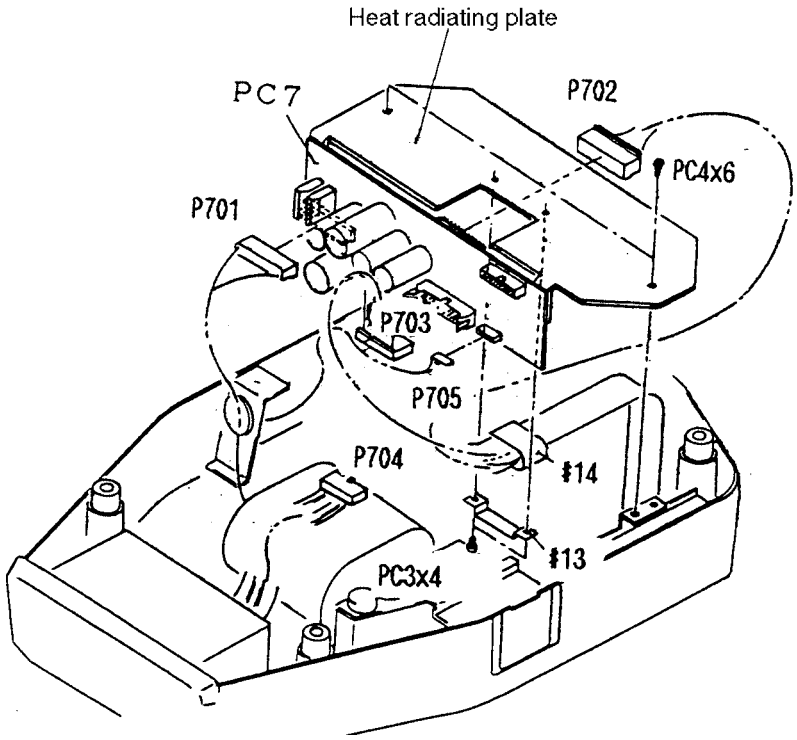
Replacement parts: 32906-BA07

1. **Fix the Main body to the Base with Locking knob, gently lay down the instrument. Then remove the bottom plate of the main body.**

2. **Unscrew PC4 × 6.**

3. **Remove PC3 × 4, #13, #14 and replace the PC7 board with a new one.**

   * Apply heat sinker to the whole heat radiating plate of the PC7 board. Arrange the cables so that they do not interfere with taking-in and out of the printer.



9.6 Replacing PC8 (PRINTER) board and printer

(For AR-600 and ARK-700)
Replacement parts (PC8) : 32903-E5008
(PRINTER) : 806-06-00007 line printer

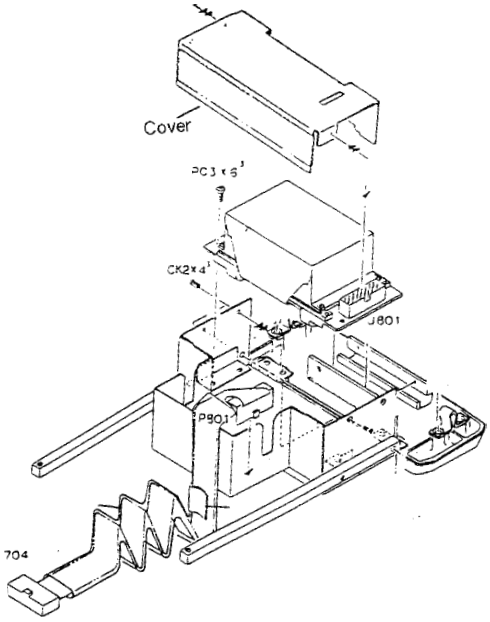
1. **Draw out the printer, turn the gear seen on the cover backward to take out the used paper roll.**

2. **Unscrew CK2 × 4 (n=3) to take off the Cover.**

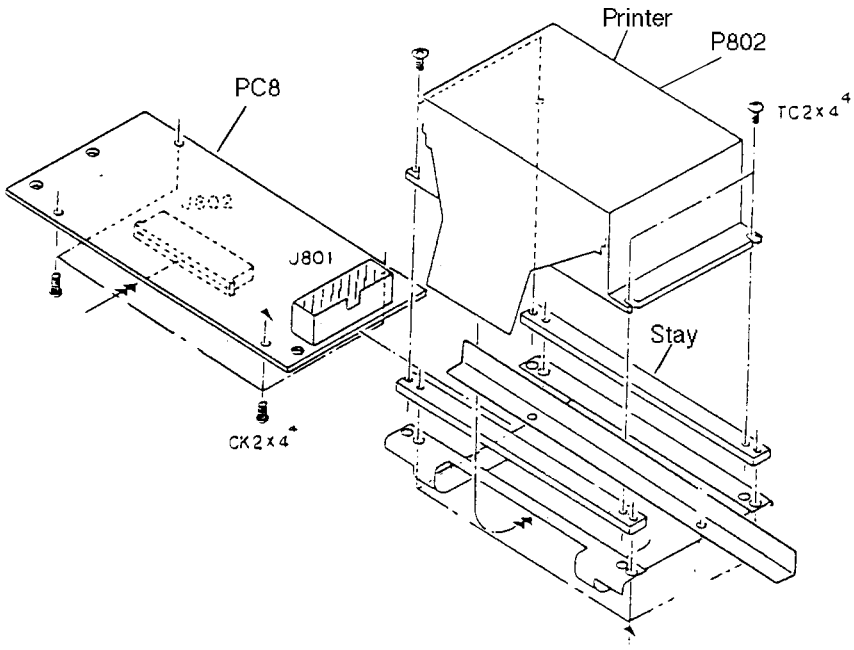
3. **Unscrew PC3 × 6 (n=3), a connector to take off the Printer and the PC8 board.**

4. **Unscrew TC2 × 4 and the connector P802 to replace the printer with a new one.**

   * Do not touch the cable contact of the connector P802 directly with hands. If it gets dirty, wipe it with acetone. Also note that the cable contact may be damaged by connecting and disconnecting the connector five or six times.

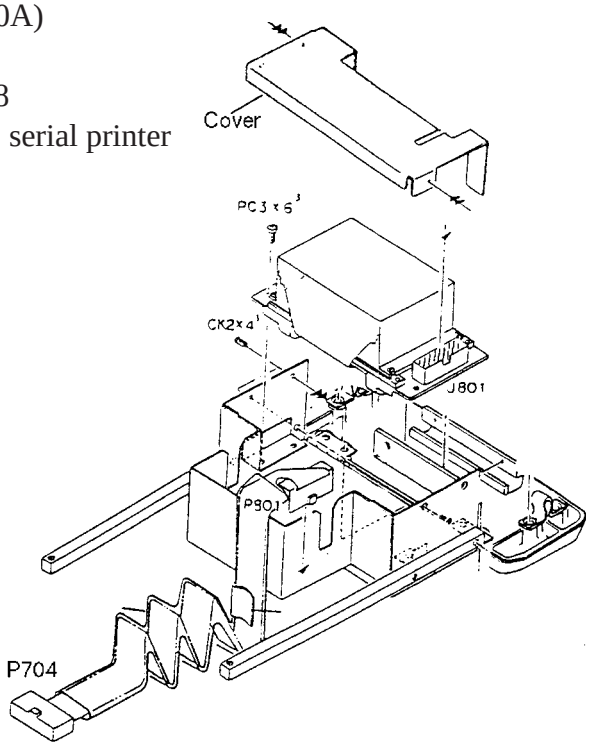


5. **Remove CK2 × 4 (n=4) and the Stay to replace the PC8 board.**



(For AR-600A, AR-660A, ARK-700A and ARK-760A)

Replacement parts (PC8) : 32907-BA08
(PRINTER) : 32907-E022 serial printer



1. **Draw out the printer, turn the gear on the cover backward to take out the used paper roll.**

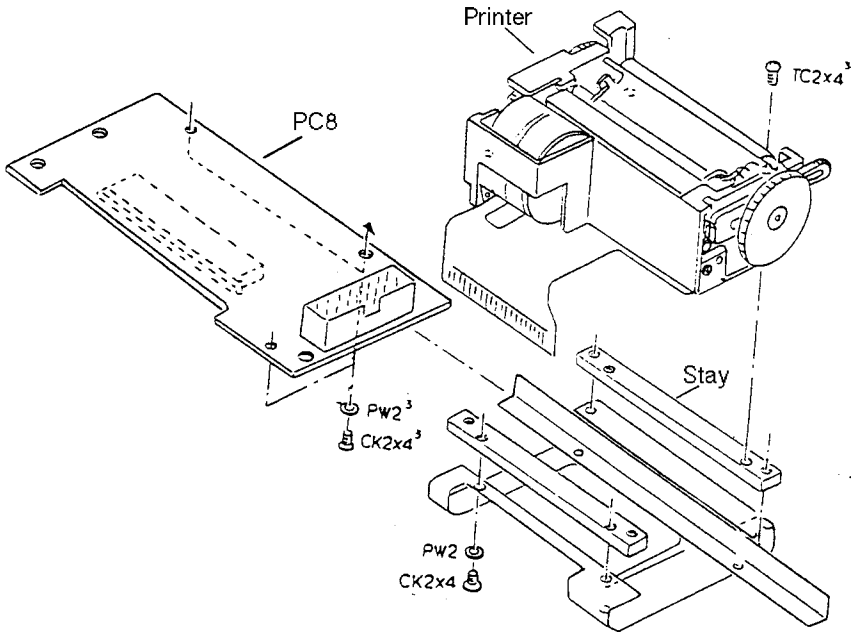
2. **Unscrew CK2 × 4 (n=3) to take off the Cover.**

3. **Remove PC3 × 6(n=3), a connector to take off the Printer and the PC8 board.**

4. **Remove TC2 × 4 (n=2) and the connector J802 to replace the printer with a new one.**

   * Do not touch the cable contact of the connector J802 directly with hands. If it gets dirty, wipe it with acetone. Also note that the cable contact may be damaged by connecting and disconnecting the connector five or six times.

5. **Unscrew CK2 × 4 (n=3) and to replace the PC8 board.**



9.7 Replacing PC10 (MIRE) board

(For ARK-700 series)

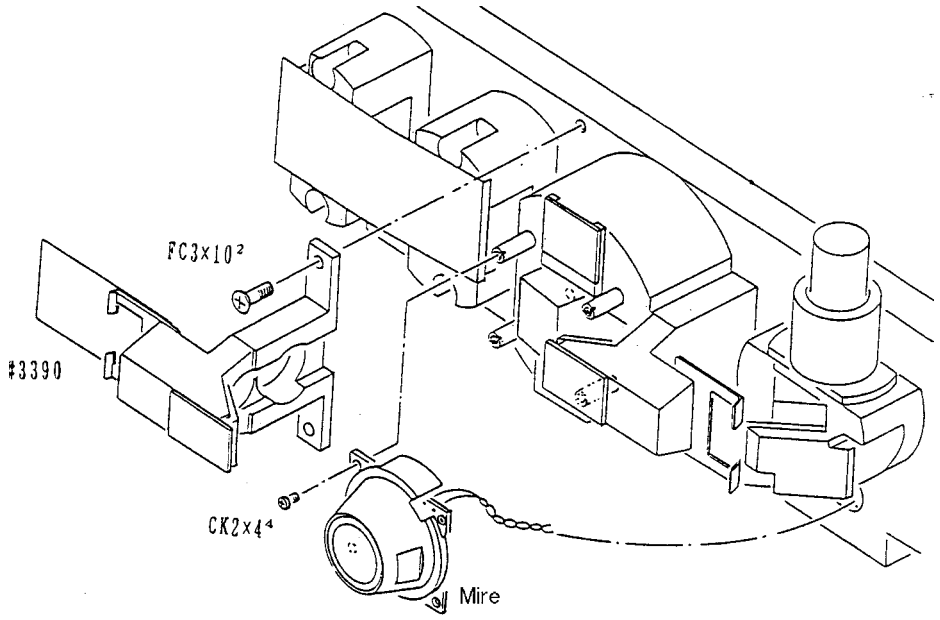
Replacement parts: 32158-3380
: 80423-10002 (tie wrap)

1. Remove the Left, Right and Front covers. (See § 5.)

2. Unscrew FC3 × 10 (n=2) and to take the #3390 off.

3. Unscrew CK2 × 4 (n=4), replace the MIRE and tie the cables together as before.

4. Perform auto-tracking and auto-shot calibrations and KM auto-calibration. (see 11.11.)



(For AR-600A, AR-660A)

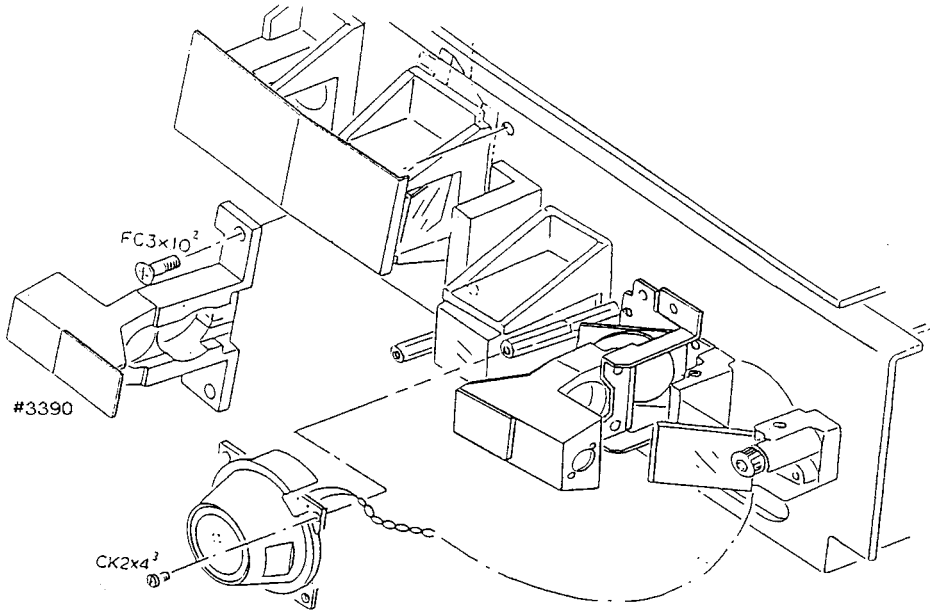
Replacement parts: 32907-3380
: 80423-10002 (tie wrap)

1. Remove the Left, Right and Front covers. (See § 5.)

2. Unscrew FC3 × 10 (n=2) to take the #3390 off.

3. Unscrew CK2 × 4, replace the MIRE and tie the cables together as before.

4. Perform auto-tracking and auto-shot calibration. (See 11.11.)



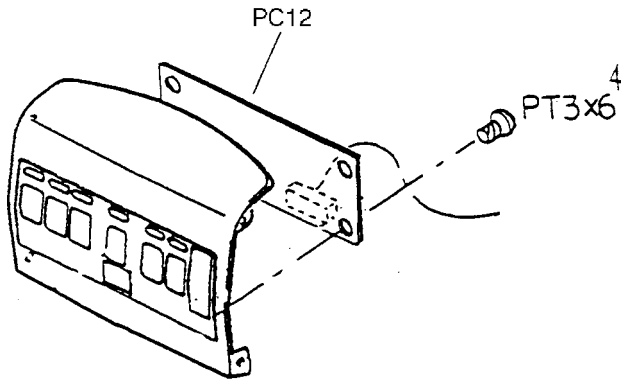
9.8 Replacing PC12 (CHART SELECT SW) board

(For AR-660A, ARK-760A)

Replacement parts: 32908-EA12

1. Remove the Left, Right and Rear covers. (See § 5.)

2. UnscrewPT3 × 6 (n=4) and then replace the PC12 board with a new one.

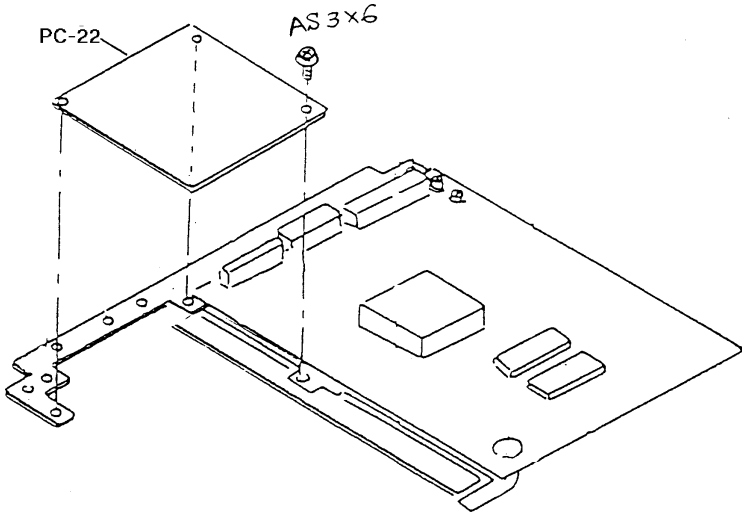


9.9 Replacing the PC22 (TRACKING) board

(For AR-660A, AR-660A, ARK-700A, ARK-760A)

Replacement parts: 32907-BA22

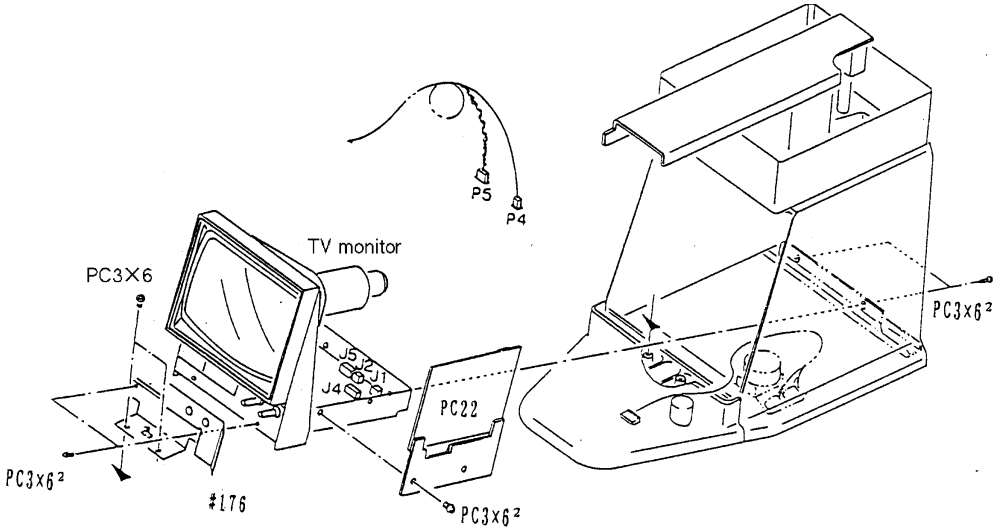
1. **Unscrew AS3 × 6 (n=3) and disconnect J1 from the PC1 board, and J2201 from the PC22 board.**



(For ARK-700)

Replacement parts: 32156-BA22

1. **Take the TV monitor off. (See 10.17.)**
2. **Unscrew AS3 × 6 (n=3) and replace the PC22 board with a new one.**



9.10 Replacing the PC23 (PD CCD) board

Replacement parts PC23: 32906-BA23
Shading paper: 32906-M528

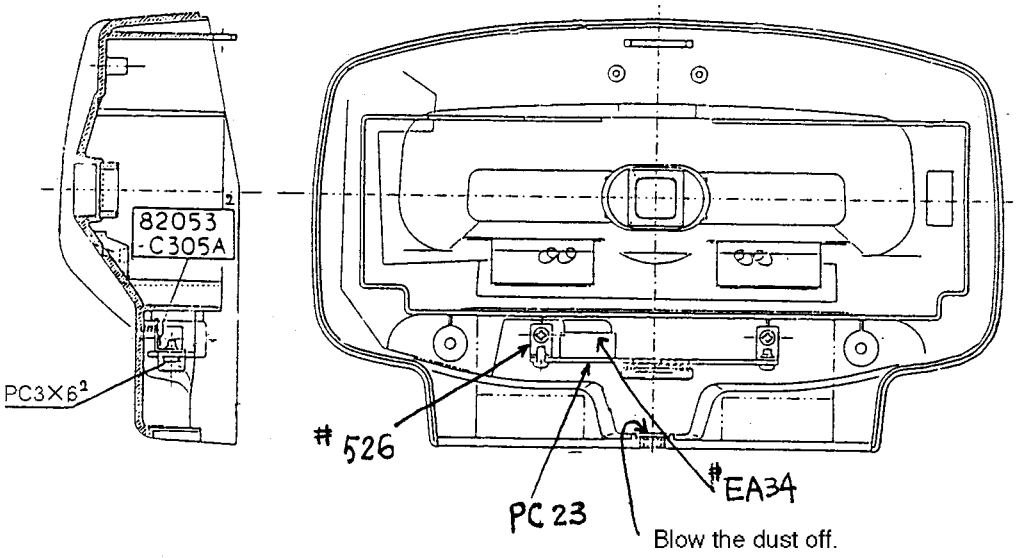
1. **Remove the Left, Right and Front covers. (See § 5.)**

2. **Remove the #528 (shading paper).**

3. **Remove #82053-C305A(n=2), #526, the PC23 board and #EA34.**

4. **Remove PC3 × (n=2), #526 and then replace the PC23 board to the new one.**
   * Do not touch the photoreceptor CCD.
   Note that CCD is easily damaged by static electricity.

5. **Affix the new #528 (shading paper).**
   * If the dust settles on the filter, blow the dust off with a blower.

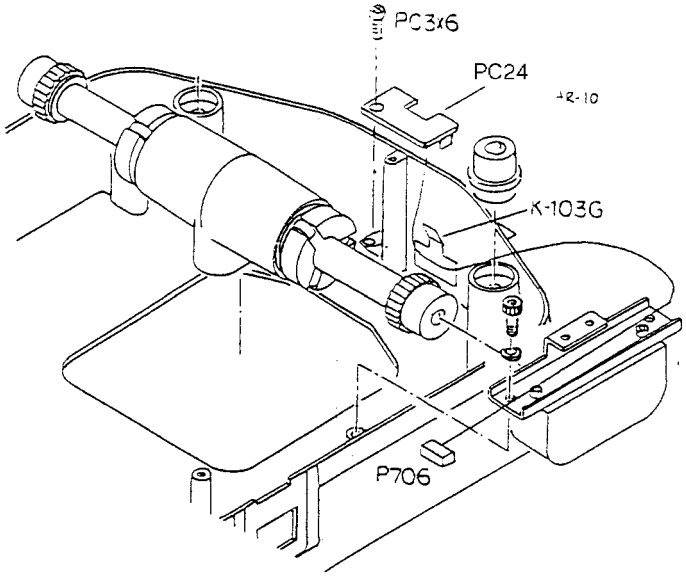


9.11 Replacing the PC24 (PD LED) board

Replacement parts PC24: 32906-EA24

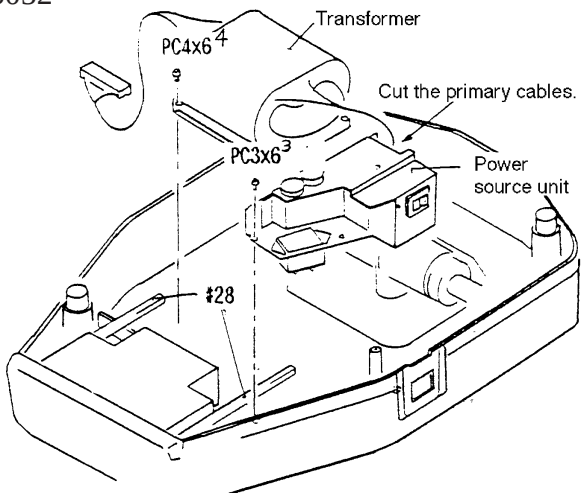
1. Take off the Bottom plate. (See 5.6.)

2. Replace the PC24 board with a new one.
* Check to see that the LED stands straight.



10.1 Replacing the transformer

Replacement parts (100V series) : 32903-E5051
(200V series) : 32903-E5052



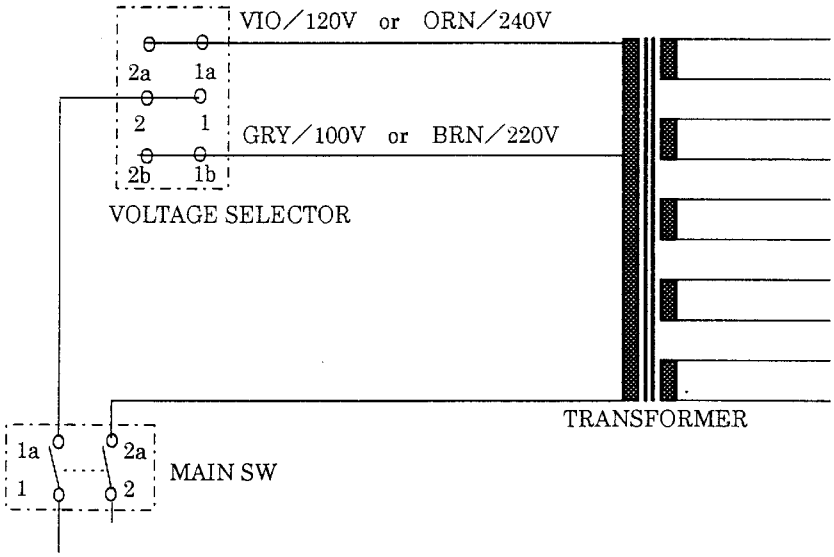
1. **Remove the bottom plate. (See 5.6.)**

2. **Take out the PC7 board. (See 9.5.)**

3. **Unscrew PC4 × 6 (n=4) and PC3 × 6 (n=3) and then take the power source unit out.**

4. **Cut off three primary cables of the Power source unit, take away the transformer from the power source unit.**

5. **Desolder the above cables from the transformer and replace it with a new one.**
   * Route the wires following the wiring diagram below. Insulate the soldered sections with heat shrink tubes. Arrange the cables so that they do not interfere with #28 when taking in and out the printer.



10.2 Replacing the Joystick

Replacement parts:

AR-600	ARK-700	AR series except AR-600 And ARK-700
32906-2080	32158-2090	32907-2080

1. Remove the TV panel. (See 5.5.)

2. Take out the Rear cover. (See 5.4.)
* For ARK-700, remove the connectors on the PC22 board which is on the side of the monitor.

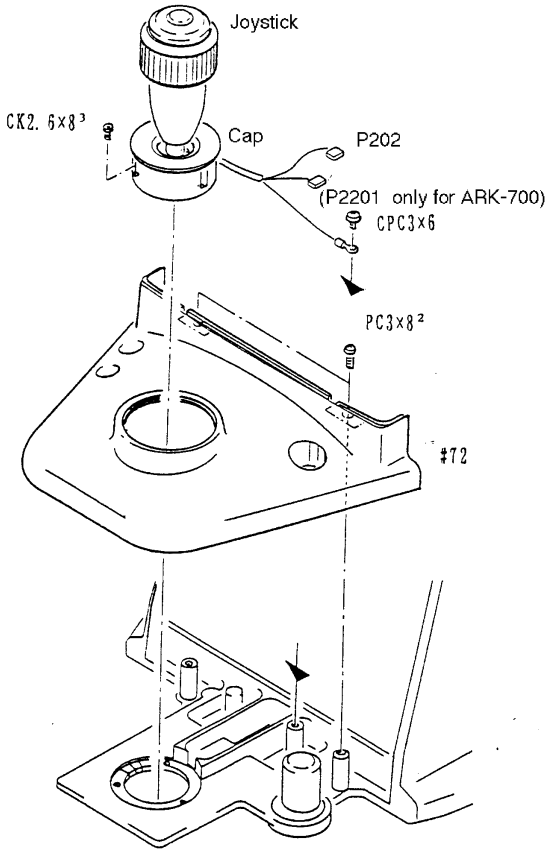
3. Remove the Cap.
* Be careful not to scratch #72. Also be careful not to crack the hooks on the cap.

4. Unscrew CK2.6 × 8 (n=3).

5. Remove PC3 × 8 (n=2) and #72.

6. Unscrew CPC3 × 6 to release the ground cable.

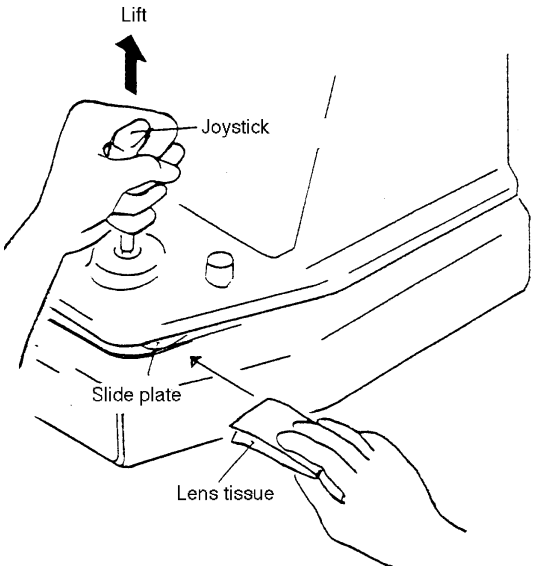
7. Disconnect the connector P202 and replace the Joystick with a new one.
* When assembling the removed parts, pay attention to the arrangement of the cables.



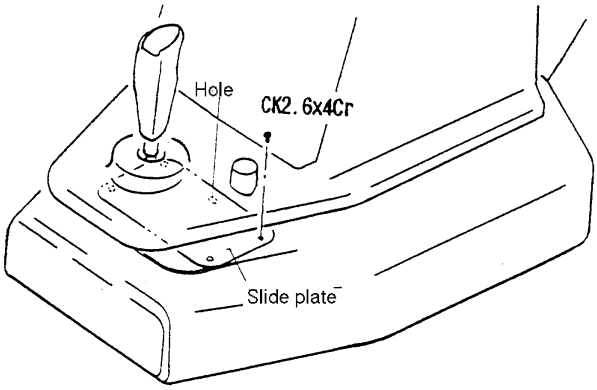
10.3 Cleaning and replacing the Slide plate

Replacement part: 32906-M004

1. **If the slide plate gets dirty, the movement of the main body on a plane becomes worse. In such cases, grip and lift the Joystick and insert a lens tissue with acetone between the base and the main body and wipe the slide plate, sliding the main body.**



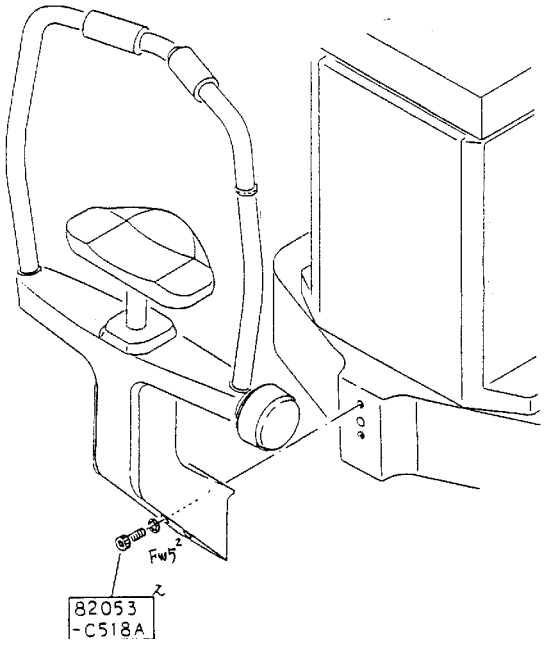
2. **If the slide plate gets scratched, the movement may not be improved. In such cases, unscrew CK2.6 × 4 (n=4) and replace the slide plate with a new one.**
   * Pay attention to the fixed orientation of the plate.



10.4 Replacing LED and cleaning IR filter

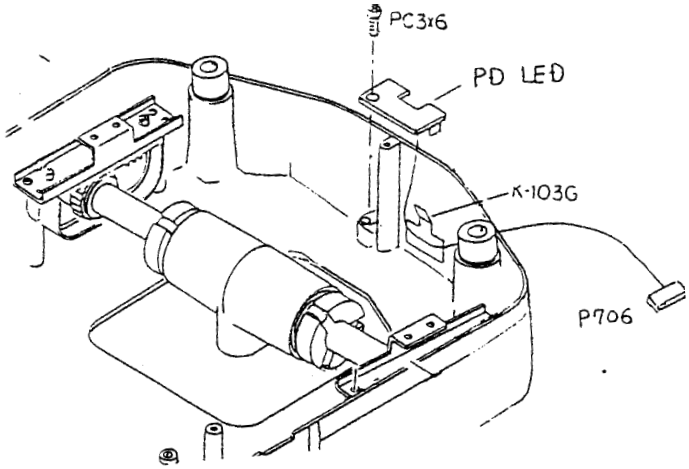
Replacement part: 32906-EA24

1. **When "PD ERR" occurs, first clean the IR filter at the foot of the Head rest.**
   * Cleaning is easily done by removing the Chin rest. To finish the cleaning, use the acetone.



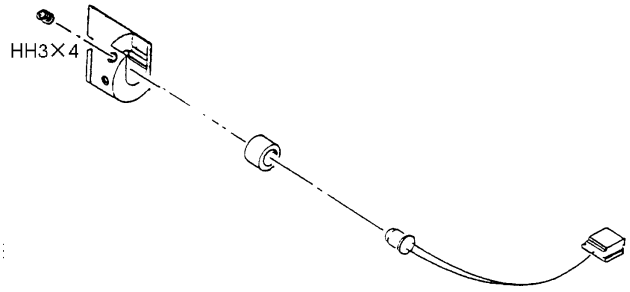
2. **Remove the Bottom plate. (See 5.6.)**

3. **Unscrew PC3 × 6 and replace the PD LED with a new one.**
   * Make sure that the LED stands straight for the P.C.B.



10.5 Replacing LED and cleaning of the G29

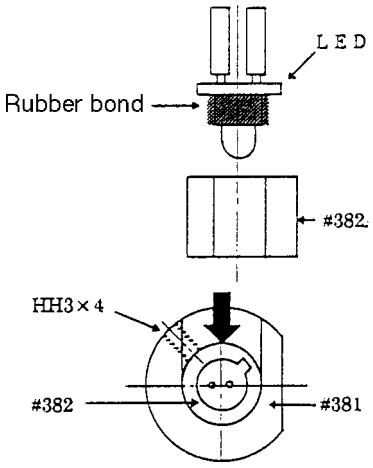
Replacement part: 32906-EA40



<Replacing the LED for the Alignment>

1. **Remove the Left, Right and Inner covers and the frame. (See § 5.)**

2. **Loosen HH3 × 4 and replace the LED for the Alignment.**
   * Fit the LED into #382 with a rubber bond. Take care not to tighten the screw (HH3 × 4) too much. If not, the LED may be damaged.

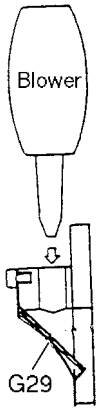


<Blowing the dust on G29 off>

When replacing the LED, G29 may get dirty. Check the G29 for dusts and clean it if necessary, following the procedure below.

1. **Turn ON the Power switch and look at the chart through the measuring window. If the dirt is seen within the field of view, blow the dust off the G29.**

   * The optical system was designed so that a person whose sphere powers are around - 2D can see the surface of G29 in focus. If one can not see the surface of the G29 clearly, wear correction lenses.



10.6 Replacing the Front cover

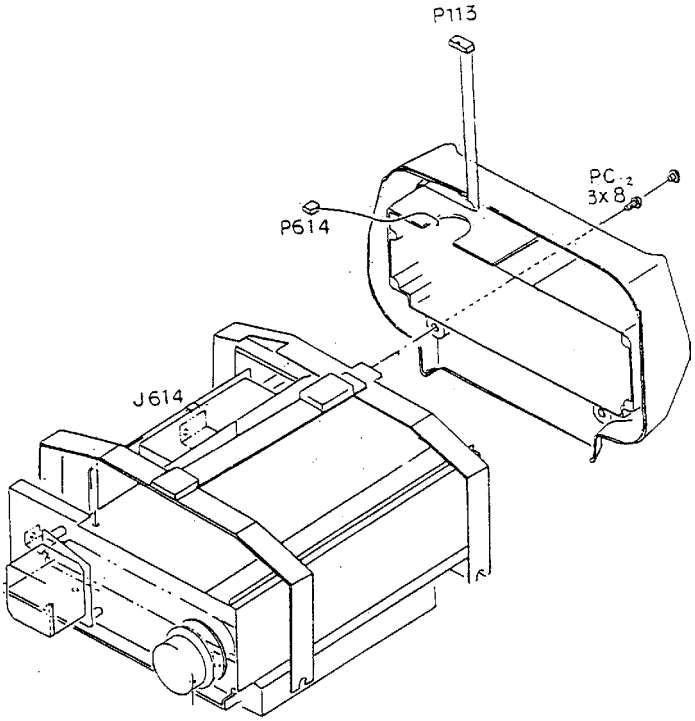
Replace the Front cover if the anterior segment lamp is faulty.

Replacement parts:

AR-600	AR series except AR-600
32906-6200	32907-6200

1. **Remove the Left, Right and Front covers. (See 5.1.)**

2. **Replace the Front cover with a new one.**



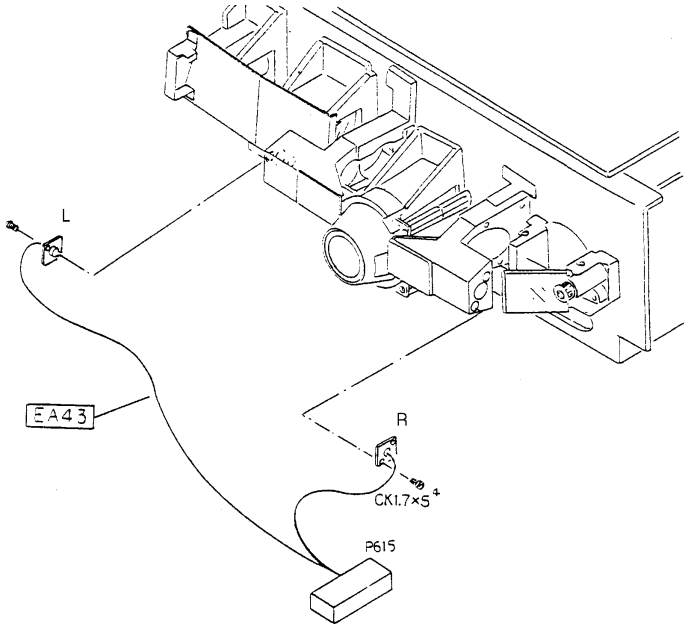
10.7 Replacing the FOCUS LED

Replacement part: 32907-EA43

1. **Remove the Left, Right and Front covers . (See 5.1.)**

2. **Unscrew CK1.7 × 5 (n=4) and replace the FOCUS LED with a new one.**

3. **Perform the auto-tracking and auto-shot calibrations.**
   * Return the cables to their original positions and arrange them so that they will not interfere with optical parts.

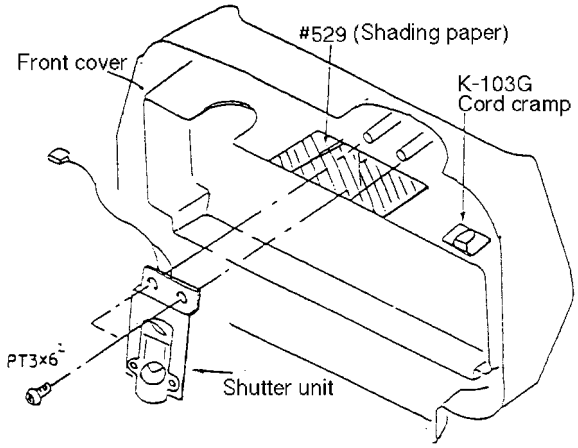


10.8 Replacing the Shutter

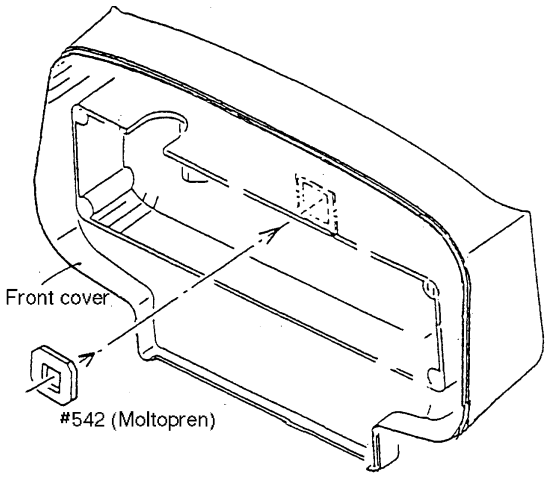
Replacement part: 32906-M542 (Moltopren)

1. Remove the Left, Right and Front covers. (See 5.1.)

2. Remove a shading paper (#529) from the Front cover.
* A shading paper is cemented to the front cover with a double-sided tape.
Pay attention not to tear it as it will be used again.

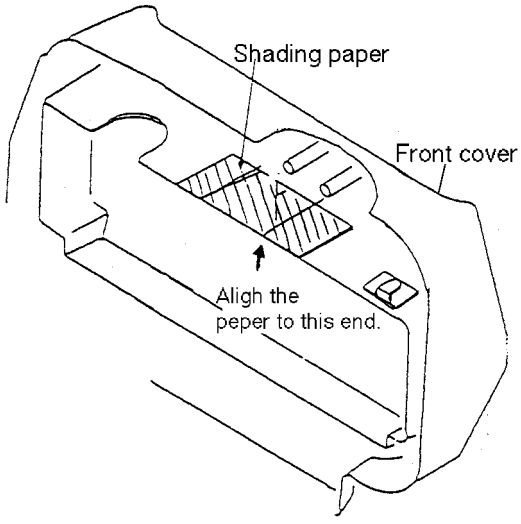


3. Unscrew 3 × 6 (n=2). Take the shutter unit away from the front cover.



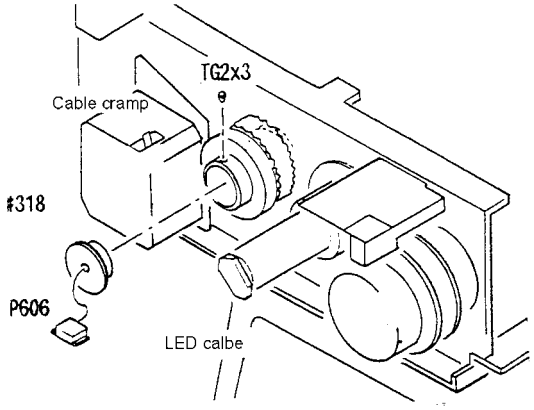
4. Stick the #542 on the inside the measuring window.
* Check to see that the whole Moltopren is not shifted from the frame of the window.

5. Affix the shading paper to its original position with a double-sided adhesive tape.

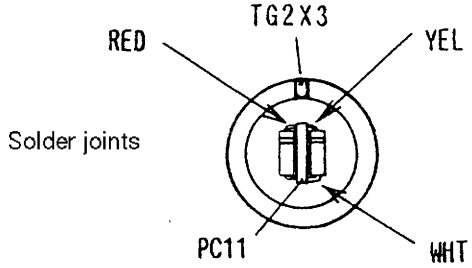


10.9 Replacing the LED cable

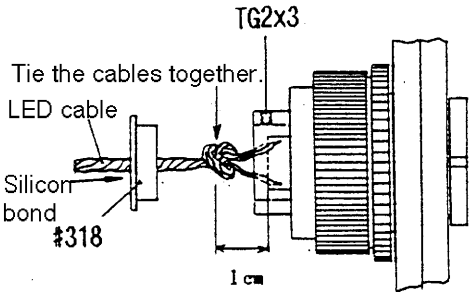
Replacement part : 32903-E5033



1. **Remove the Left, Right covers and Rear cover of the measuring unit. (See § 5.)**
2. **Disconnect the connector P606 and release the tied cables. (See 9.5.)**
3. **Loosen the screw (TG2 × 3), pull out #318 and cut the cables off.**



4. **Unsolder the cut-off cables on the PC11.**



5. **Pass the new cables through #318 and solder each cable to the PC11 board as shown in the figure.**
6. **Knot three cables inside #318 so that a force is not directly applied to the soldered joints.**
7. **Apply a drop of the silicone bond to the cable for the protection from breakage.**
   * Leave the cable for one half day or more until the bond becomes stiff. Confirm that the cable does not allow a slight movement even though the rotator is turned.
8. **Clamp the cable with a cable clamp so that it will not catch the moving rotator.**

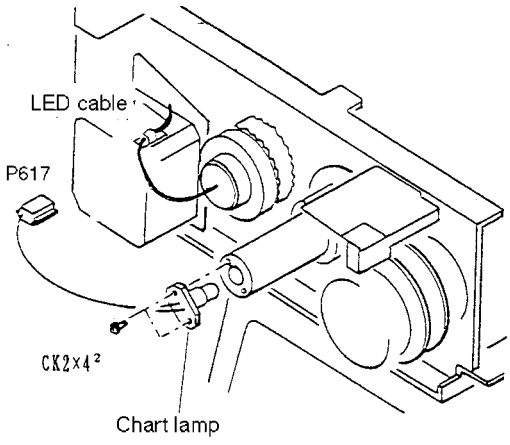
10.10 Replacing the Chart lamp

Replacement parts: 32906-EA14

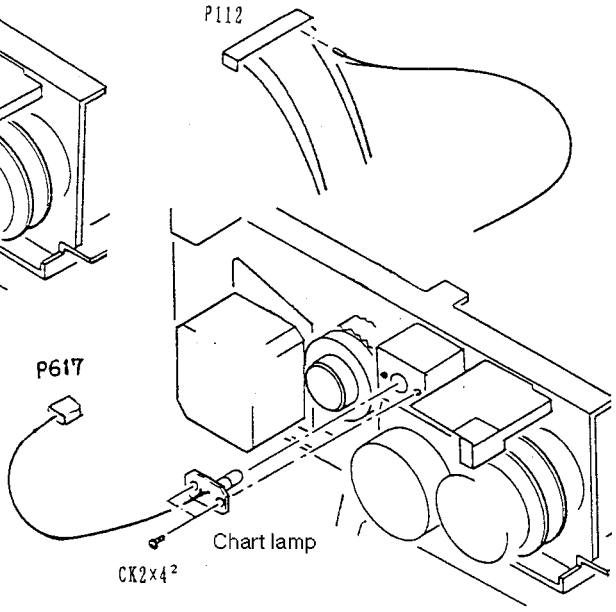
1. **Remove the Left, Right covers and Rear cover of the measuring unit. (See § 5.)**

2. **Unscrew CK2 × 4 (n=2) and replace the Chart lamp with a new one.**
   * Arrange the Chart cable so that it will not interfere with the LED cable.

<AR-600, AR-600A, ARK-700, ARK-700A>



<AR-660A, ARK-760A>



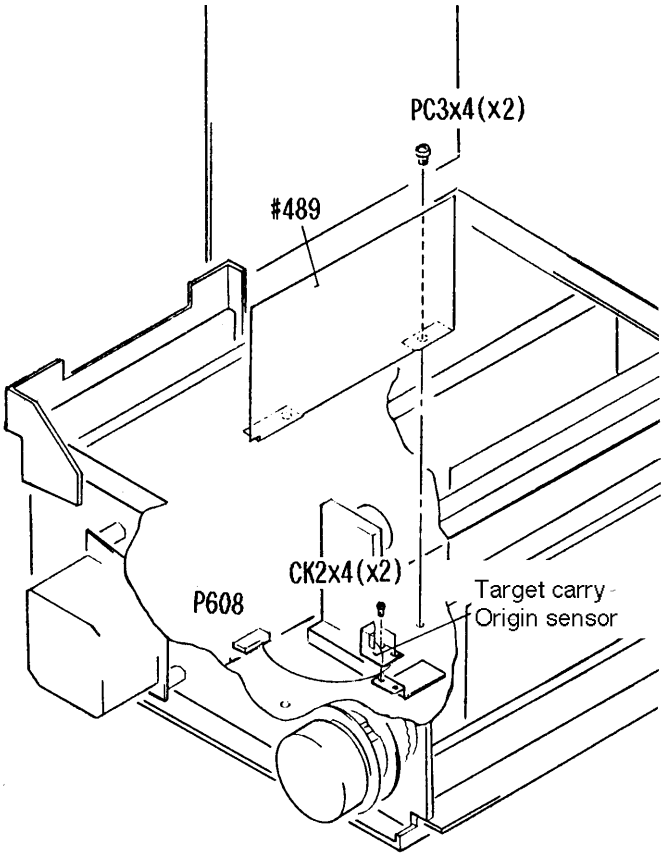
10.11 Replacing the Chart carry origin sensor

Replacement parts: 32906-EA36

1. **Remove the Left cover, Rear cover of the measuring unit and Inner cover. (See § 5.)**

2. **Remove the screw (PC3 × 4) and #489.**

3. **Unscrew CK2 × 4 and replace the Chart carry Origin sensor with a new one.**
   * Fix the sensor so that it will not interfere with the shutter of the Chart carry unit. Pay attention to cable arrangement. They should not interfere with the Carry unit and pulley.



10.12 Replacing the Rotator unit origin sensor

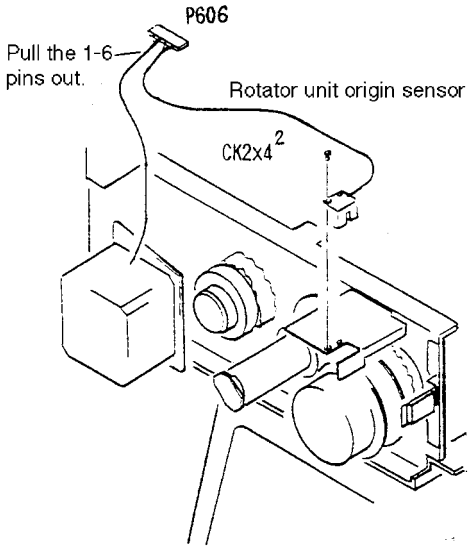
Replacement parts: 32903-E5045

1. Remove the Left and Right covers. (See § 5.1.)

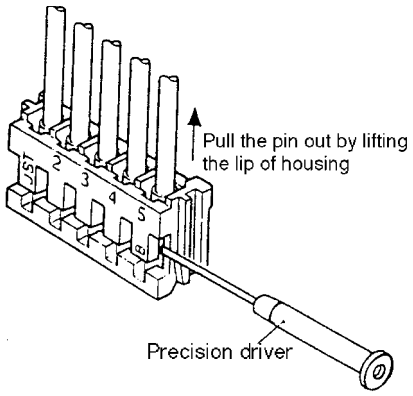
2. Disconnect the connector (P606) and then pull the contact pin (1 - 6 pins) from the connector housing of the connector, and release the tie of the cables.

3. Unscrew PC2 × 4 (n=2) and replace the Rotator unit origin sensor with a new one.

* See the following for the pins' position of the connector P606. Be careful not to return the pin to a wrong position.



1	YELLOW	Rotator P.M.
2	WHITE	
3	BLACK	
4	RED	
5	GREEN	
6	BLUE	
7	BROWN	Rotator origin
8	RED	
9	ORANGE	
10	YELLOW	



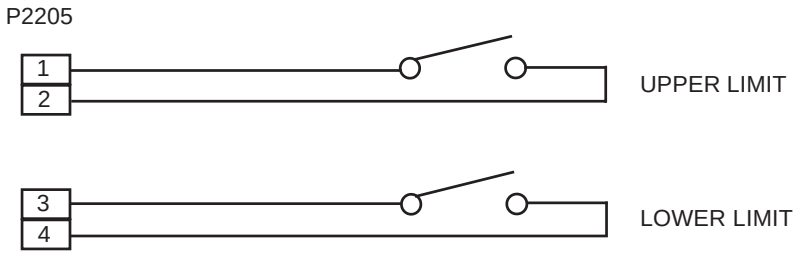
* Note that the cable from the Rotator unit origin sensor should not interfere with the LED cable.

10.13 Replacing U/D limit switches

<Checking the operation of U/D limit switch>

1. **Remove the Left, Right, Inner covers and rear cover of the measuring unit. (See § 5.)**

2. **Check the upper and lower limit switches for proper operation.**
   Disconnect the connector (P2205) and check the continuity in the switches with a multimeter.



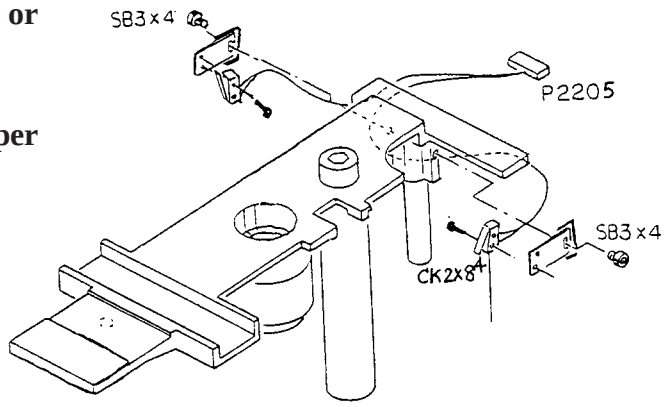
* Press an actuator with a screwdriver. The above shows the position of the Upper and Lower limit switches.

<Replacing U/D limit switches>

Replacement parts: 32097-EA47

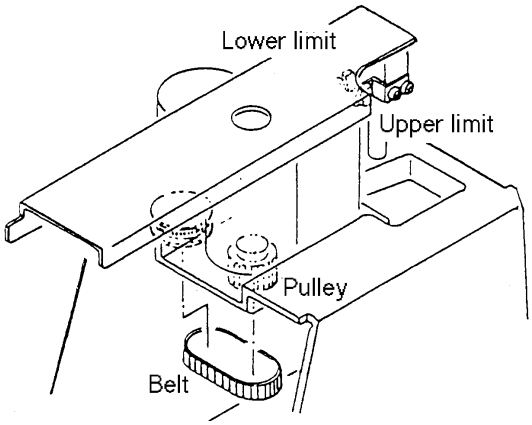
1. **Unscrew SB3 × 4 and take off the Upper or Lower limit switch.**

2. **Unscrew CK2 × 8 (n=4) to replace the Upper or Lower limit switch with new ones.**



<Positioning Upper and Lower limit switches>

1. **Remove the TV panel, Rear cover and Monitor. (See § 5 and 10. 17.)**
   * Keep the Pulleys in a state where they can be moved easily and directly by hand. To achieve the state, it is recommended to remove the belt.



2. **While moving up and down the measuring unit, loosen the screw (SB3 × 4) and position the Upper limit switch so that it conducts at the position where the pulley is returned one and a half turn from its mechanical limit with hands.**

3. **While moving up and down the measuring unit, loosen the screw (SB3 × 4) and position the Lower limit switch so that it conducts at the position where the pulley is returned a half-turn from its mechanical limit.**

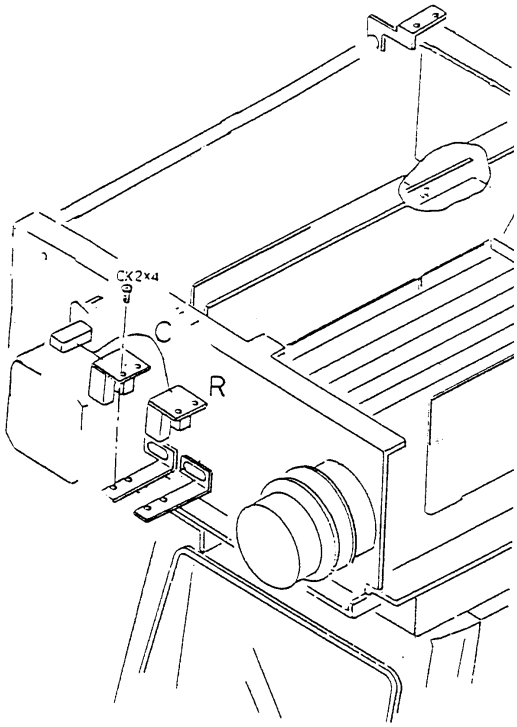
10.14 Replacing the Left and Right limit sensor unit (except for AR-600 and ARK-700)

Replacement parts: 32907-EA49

1. **Remove the Left, Right covers, Frame and the Rear cover of the measuring unit. (See § 5.)**

2. **Remove the connector and screw (CK2 × 4). Then replace the Left and Right limit sensor unit with a new one.**
   * Three sensors are included in the early models as the Left and Right limit sensor unit, but one of the sensors attached on the left is not activated.

   * The sensor R - Connected to 1-4 pin of P2207
     The sensor C - Connected to 5-8 pin of P2207



<Checking if the horizontal travel of the Main body is 6mm>

1. **Set Switch 4 of switchpack to the ON position.**

2. **Press and place the instrument in the "TRC ADJUST MODE 31".**

3. **Press and move the measuring unit to the right or left.**

4. **Verify that the horizontal travel between the left limit and the right limit of the measuring unit is 6 ± 1mm. (Draw lines of the right and the left limit position measured with the shading plate on the measuring base.**
   If it is not 6 ± 1mm, adjust the fixed positions of sensors.

5. **Press . The measuring unit will moves to its center. (Draw lines of the center position measured with the shading plate. Remember to draw lines of both the center measured from the left limit and the one measured from the right limit.)**

6. **Take a measurement of the distance between the lines. Then verify that the distance between the center position and each limit is 2mm or more.**
   * A displacement between the center positions measured in step 5 should be within 1mm.

10.15 Replacing the U/D Motor (for moving the measurement unit up and down) (Except AR-600)

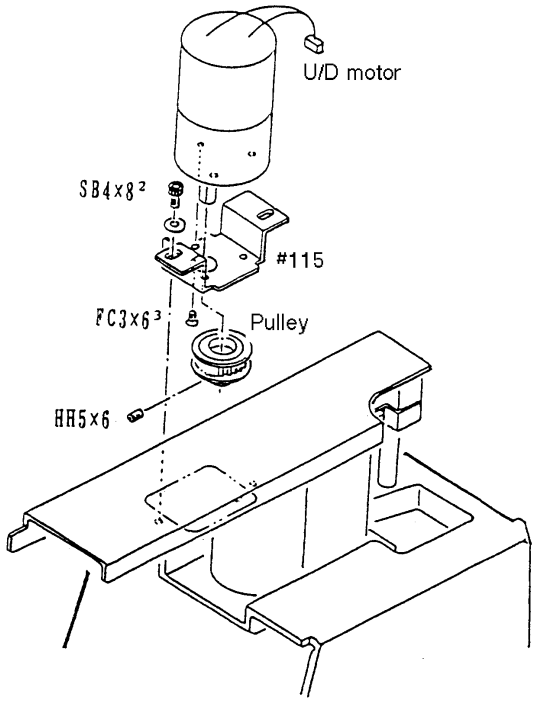
Replacement parts: For ARK-700 32156-EA05 For ARK-600A, ARK-700A, AR-660A, ARK-760A 39047-EA46

1. **Remove the Left, Right and Front covers, Rear covers of the measuring unit, Inner cover and TV panel. (See § 5.)**

2. **Remove the Monitor and measuring unit. (See 10.17 and 10.23.)**

3. **Unscrew SB4 × 8 and take the U/D motor away.**

4. **Remove the screw (HH5 × 6), Pulley, three screws (FC3× 6) and #115 and then replace the U/D motor with a new one.**
   * Adjust the belt tension so that it sags 4- 5mm when it is pressed down lightly with hands.



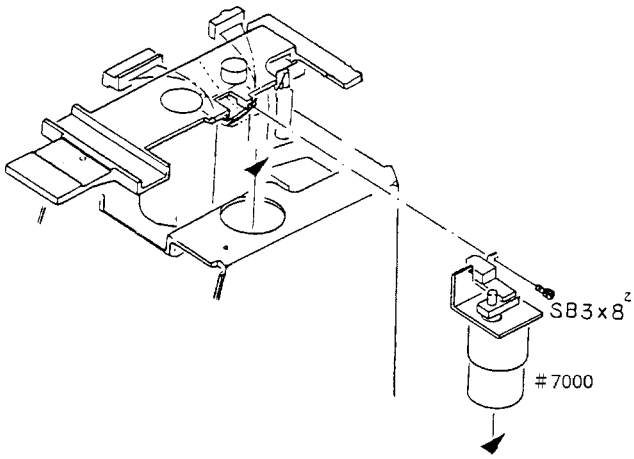
10.16 Replacing the R/L motor (For moving the instrument to the right or left) (Except AR- 600 and ARK-700)

Replacement part : 32907-EA48

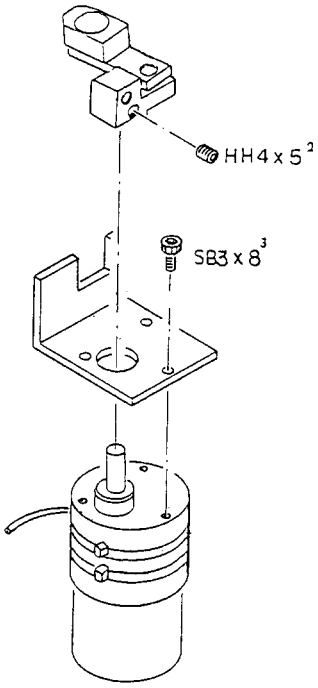
1. **Remove the Left, Right and Front covers, Rear cover of the measuring unit, Inner cover and TV panel. (See § 5.)**

2. **Remove the Monitor and measuring unit. (See 10.17 and 10.23.)**

3. **Unscrew SB3 × 8 (n=2) and take off #7000.**



4. **Unscrew HH4 × 5 (n=2) and SB3 × 8) and replace the motor with a new one.**



10.17 Replacing the TV Monitor

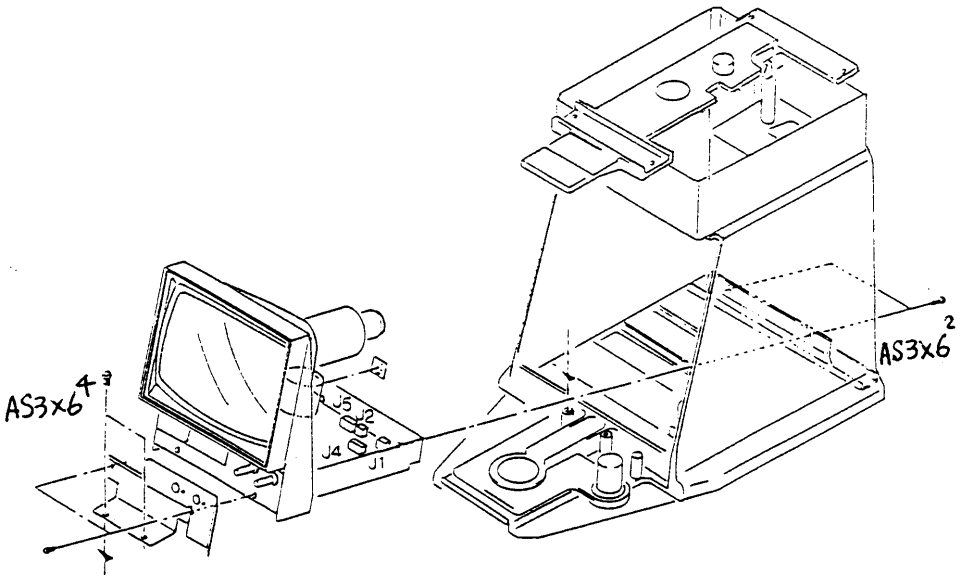
Replacement parts: 32903-E001B

1. **Remove the Rear cover and TV panel.**
   (See § 5.)

2. **Disconnect the connectors.**

3. **Remove the screws (AS3 × 6) and #176 and replace the TV monitor with a new one.**
   * The Joystick may obstruct the replacement work. It is possible to bring the TV monitor toward the Joystick by removing the bottom cover.

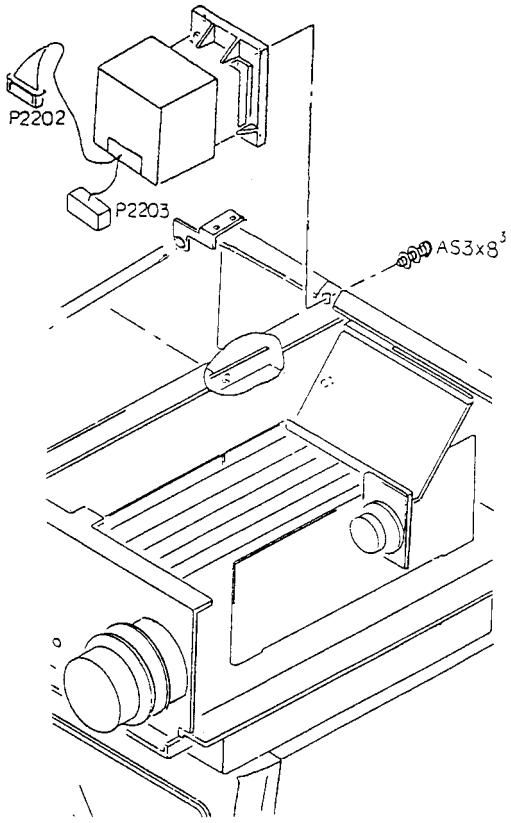
   * Image centering may be slightly shifted. The shift can be corrected with H.V volume. If it can not be corrected completely, it is necessary to perform image centering. (See 11.9.)



4. **Fit the parts in reverse order.**
   * P004 can be connected to either J1 (VIDEO IN) or J2 (VIDEO OUT).

10.18 Replacing the CCD camera

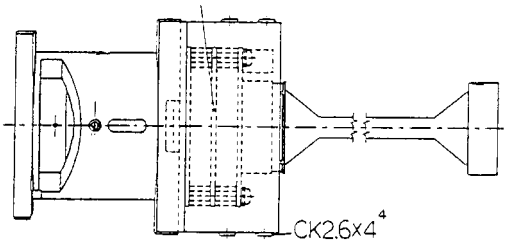
Replacement parts: 32903-E001A



1. **Remove the Left, Right covers, Rear cover of the measuring unit and Inner cover. (See § 5.)**

2. **Disconnect the connectors.**
   * For AR-600, disconnect P004 only.

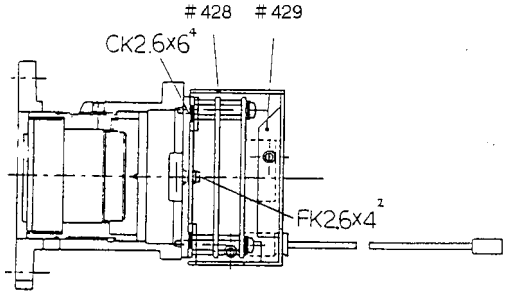
3. **Unscrew AS3 × 8 (n=3) and replace the CCD camera with a new one.**



4. **Unscrew CK2.6 × 4 (n=4) and then remove CCD camera, #428 and #429.**

5. **Unscrew FC 2.6 × 4 and replace CCD camera with a new one.**

6. **Turn ON the Power switch and verify hat the target square is in focus. If it is out of focus, adjust the lens focus of the CCD camera.**
   * The image centering may be slightly shifted. If the centering cannot be achieved perfectly by adjusting the variable resistor on PC6 board, adjust the focus of the CCD camera lens. (See 11.9.)



10.19 Replacing the Chart unit

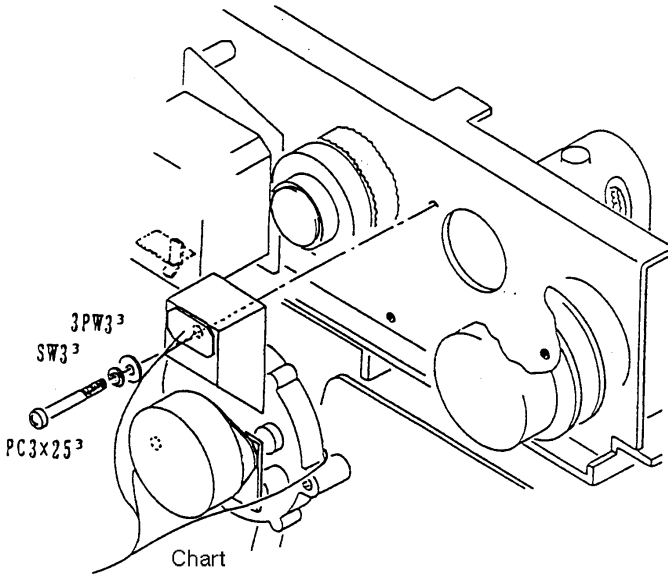
Replacement parts: 32908-3150

1. Remove the Left and Right covers and the Rear cover of the measuring unit (See § 5.)

2. Disconnect the connectors.

3. Unscrew PC3 × 25 (n=3) and replace the chart unit with a new one.

* Though the replacement part is stored in a plastic bag to keep dust out, check to see that no dust settles on the part before attaching it.
Attach the unit temporally, then turn ON the Power. Adjust the inclination of the chart unit so that the chart can be seen on a perfectly-horizontal plane.



10.20 Replacing CYL unit (Only for AR-660A and ARK-760A)

Replacement parts: 32908-3160

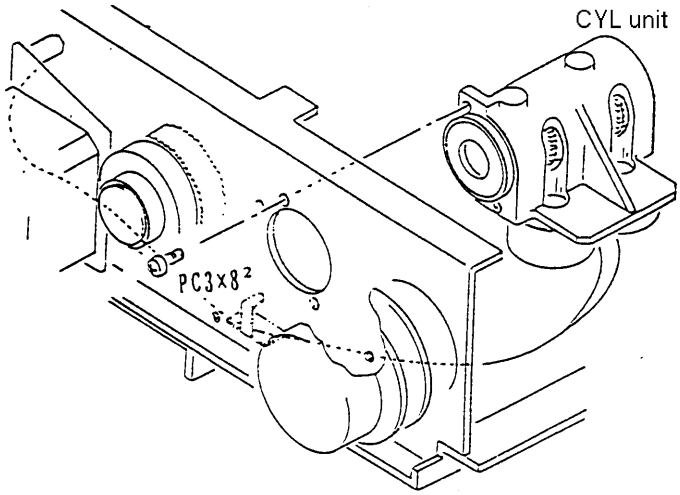
1. **Remove the Left and Right covers and Rear cover of the measuring unit, and Inner cover. (See § 5.)**

2. **Take the shading plate out.**

3. **Remove the Chart unit.**
   * Do not remove the connectors but remove the screws and position the chart unit so that it will not obstacle the replacement work for CYL unit. Check to see that no dust settles on the part before attaching it. Pay attention not to touch the unit when routing the cables.

4. **Remove the connectors P610 and P611.**

5. **Unscrew PC3 × 8 (n=2) and replace the CYL unit with a new one.**
   * Though the replacement part is stored in a plastic bag to keep dust out, check to see that no dust settles on the part before attaching it.
   Pay attention to the arrangement of the cables.



6. **Set CYL zero (C1) and CYL axis (C2) to the specified values. (See 11.8.10.)**
   * Set them to the component values specified on the note which is attached to the replacement part.

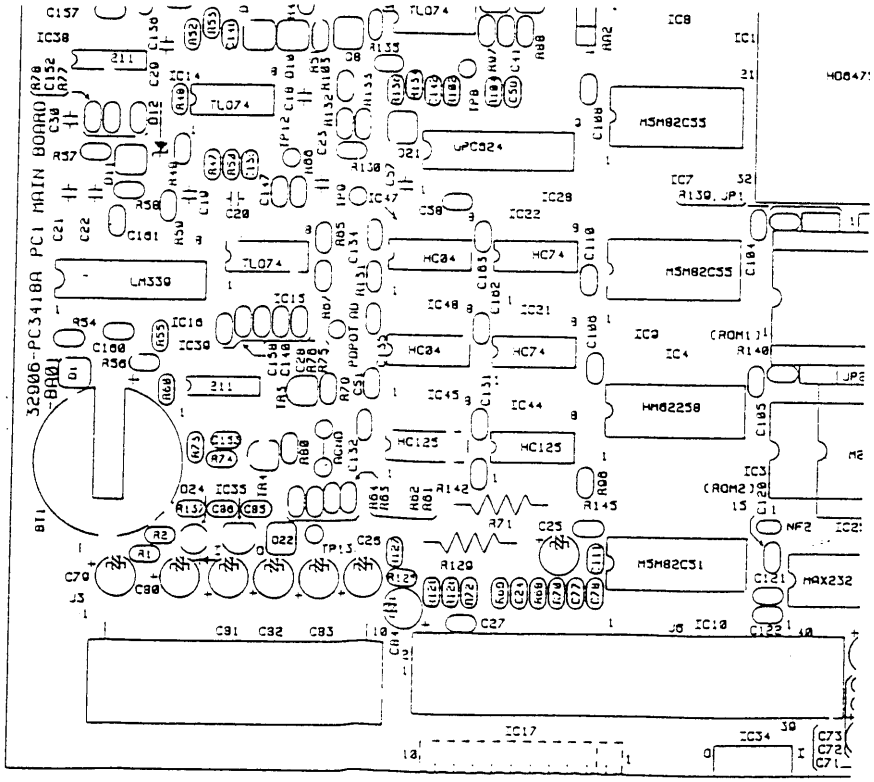
10.21 Replacing the Battery

Replacement parts: 32906-E651

1. **Remove the Left and Right covers and Rear cover of the measuring unit, and Inner cover. (See § 5.)**

2. **Stand the PC1 board.**

3. **Replace the battery with a new one.**
   * Observe the correct polarity for BT1.



10.22 Replacing the Measuring unit

<For AR-600 and ARK-700>

	AR-600	AR-700
Replacement parts:	32906-9000	32158-9000

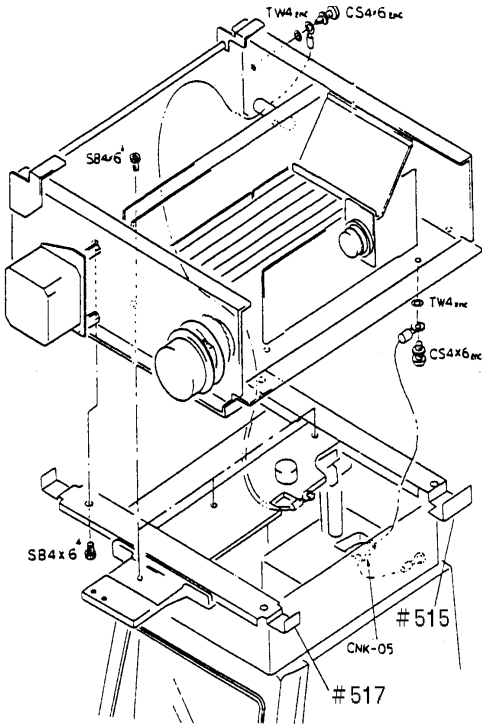
1. Remove the Left, Right covers, the Rear cover of the measuring unit and Inner cover. (See § 5.)

2. Disconnect the connectors on PC1 board.

3. Remove the screws (CS4 × 6[2]) and grounding wires.

4. Remove the screws (SB4 × 6[4]), #515 and #517, and replace the measuring unit with a new one.

* The measuring unit should be transported with its covers attached for keeping dust out. Therefore, for returning the unit for service and etc, be sure to pack the measuring unit with its covers attached.
* For the early models, replace #515 and #517 together with the measuring unit. This is because that the holes' positions for #515 and #517 differs from the ones for the other models.



5. Set the parameters according to parameter tables on Operator's Manual.

<For AR-600A, AR-660A, ARK-700A and ARK-760A>

Replacement parts:	For AR-600A	For ARK-660A	ARK-700A	ARK-760A
	32907-9000	32908-9000	32159-9000	32160-9000

1. Remove the Left, Right and Front, Rear covers of the measuring unit, Inner cover and TV panel. (See § 5.)

2. Disconnect the connectors.

3. Unscrew CS4 × 6 (n=2) and take off grounding wires.

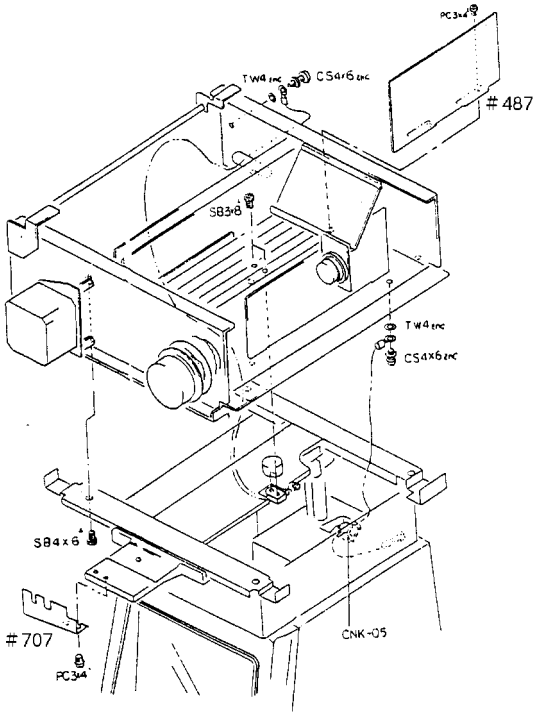
4. Unscrew PC3 × 4 (n=3) and take off #107.

5. Unscrew PC3 × 4 (n=3) and take off #487.

6. Unscrew SB3 × 8 (n=3) and SB4 × 6 (n=4) and replace the measuring unit with a new one.

* The measuring unit should be transported with its covers attached for keeping dust out. Therefore, to return the unit for service and etc, be sure to pack the measuring unit with its covers attached.

* For the early models, replace #515 and #517 together with the measuring unit. This is because that the holes' positions for #515 and #517 differs from the ones for the other models.

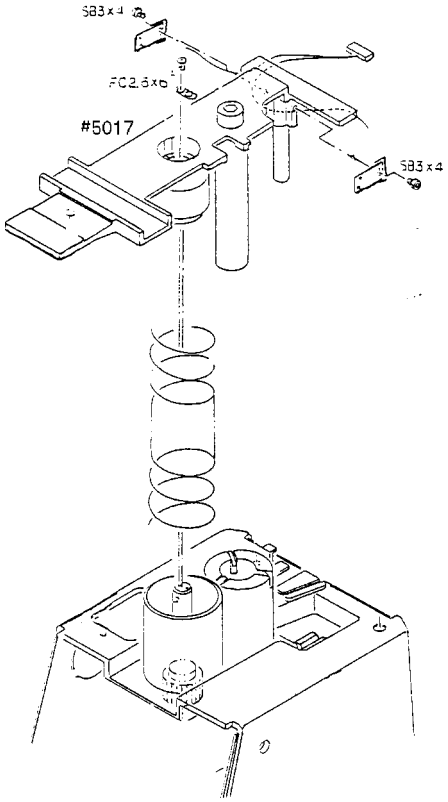


7. Set the parameters according to parameter tables on Operator's Manual.

11.1 Adjusting the pressure of roller bearing (#67) for up-and-down shaft

If the roller bearings become loose due to shock delivered during transportation and the measuring unit becomes unstable, adjust the pressure of the bearings, following the procedure below.

Replacement parts (Shaft) : 34322-M066
(Eccentric shaft) : 34322-M067
(Roller bearings) : 82011-0410A



1. **Turn ON the Power switch and verify that all three bearings are turning when moving up and down the measuring unit. If not, follow the steps below.**

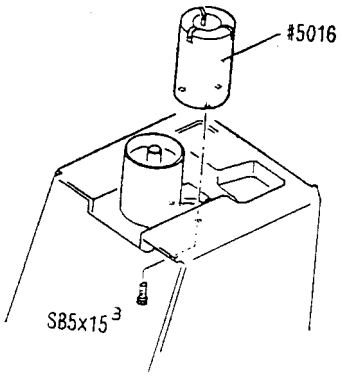
2. **Take the measuring unit off. (See 10.22.)**

3. **Remove the screws (PC4 × 6) and #84.**

4. **Unscrew FC2.6 × 5, take off #76 and #5017.**
   * Take off #5017 by turning the Joystick while holding down #5017.
   Pay attention not to spring #5017 away as it is pressed upward by the spring.

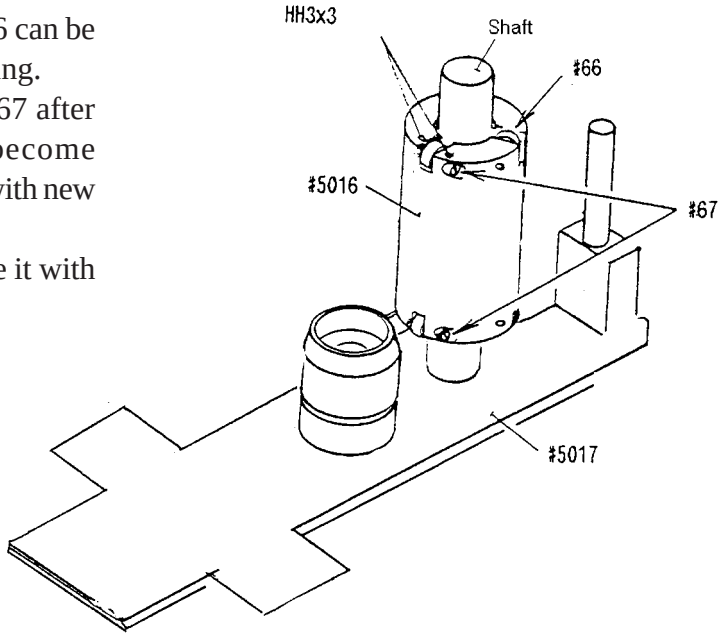
5. **Take off the TV monitor. (See 10.18.)**

6. Unscrew SB5 × 15 and then take off #5016.



7. Fit #5016 on the Shaft of #5017, loosen HH3 × 3 and adjust #66 so that the Shaft moves up and down smoothly and it is stable.

* Since #67 has a slot on its head, #66 can be turned with a screwdriver for adjusting.
* If there is still a too much play in #67 after adjusting it, #66 and #67 may become warped. In such cases, replace them with new ones.
* If the bearing has cracks in it, replace it with a new one.



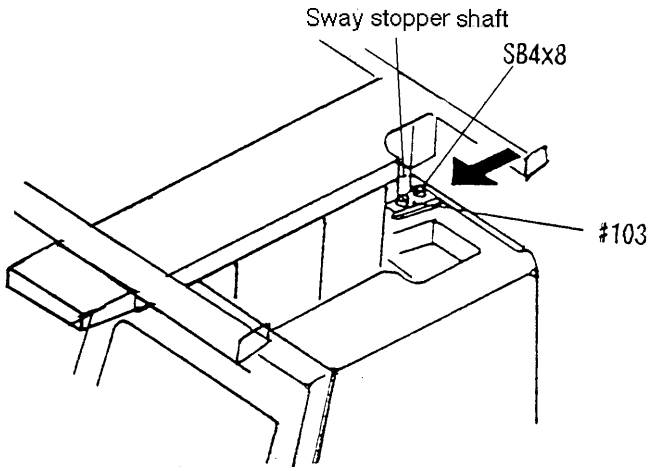
11.2 Adjusting the Sway stopper unit

If there is too much play in the Sway stopper unit due to shock delivered during transportation, and the measuring unit sways when laterally-turned, adjust the sway stopper unit, following the procedure below.

1. **Lock the main body and take the measuring unit off. (See 10.22.)**
   * It is not necessary to remove the PC1 board, CCD camera and Front cover.

2. **Take off #84. (See 11.1.)**

3. **Loosen the screw (SB4 × 8) and position #103 until there is no play in the Sway stopper unit.**
   * Take care not to tighten the screws (SB4 × 8) too much. The measuring unit may not be moved up and down.
   * If the applied grease dried out, the lateral movement of the measuring unit become worse. In such cases, apply the grease to the Sway stopper shaft.

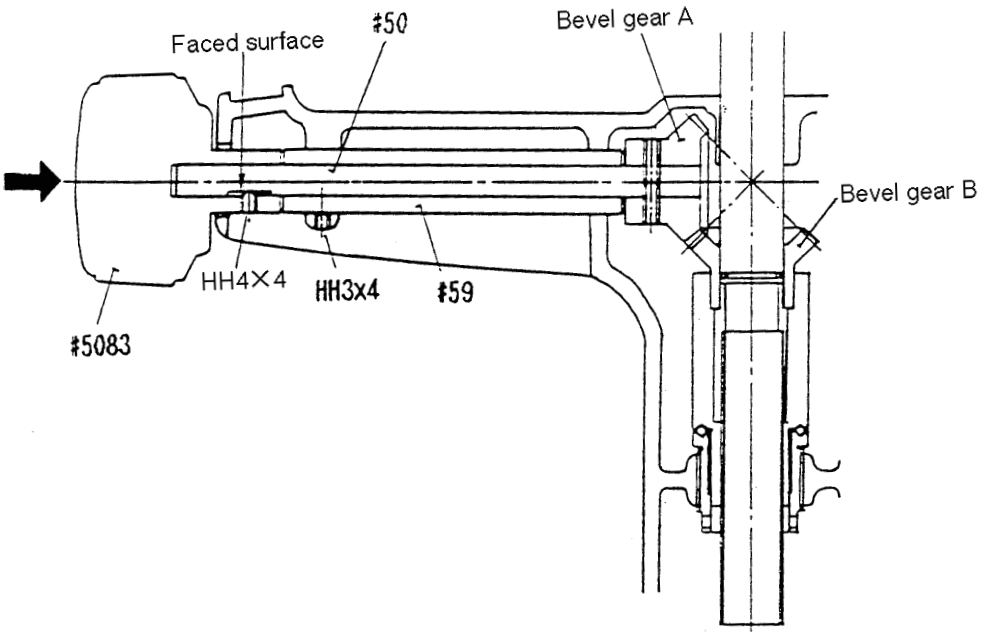


11.3 Adjusting the up-and-down movement of the Chin rest

If the Chin rest knob become loose, it may drop with chin's weight when placing chin on the rest. In such cases, adjust the Chin rest knob, following the procedure below.

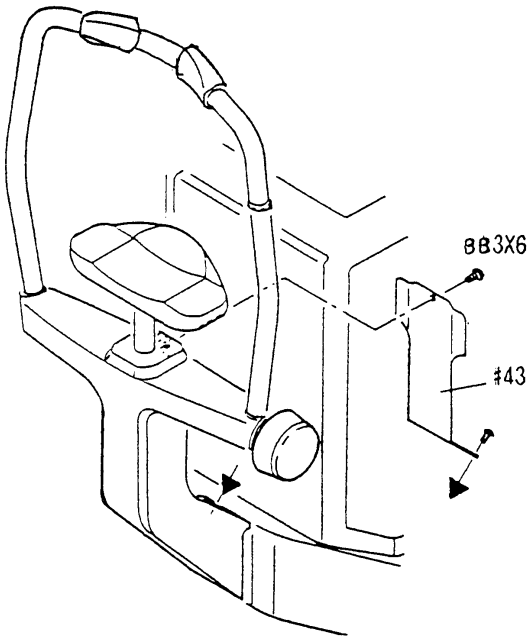
1. **Loosen HH3 × 4 fixing #59 and HH4 × 4 fixing #5083.**
   Then tighten the screw (HH4 × 4) while pressing the Chin rest knob toward the arrow direction.
   * Tighten HH4 × 4 so that it touches the faced surface of #50.

2. **Adjust the Chin rest knob properly. Insure proper fit between the Bevel gear A and B. Then tighten HH3 × 4 to fix #59.**



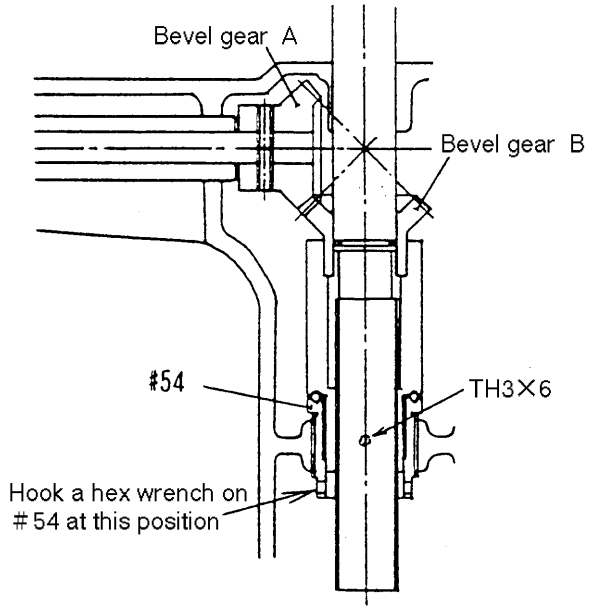
If the proper movement of the Chin rest cannot be achieved by adjusting the Knob, it is necessary to adjust the height of the Bevel gear B. In such cases, follow the procedures below.

3. Unscrew BB3 × 6 and take #43 off.



4. Loosen TH3 × 6 and turn #54. Adjust the height of the Bevel gear B and a fit between the Bevel gears A and B.

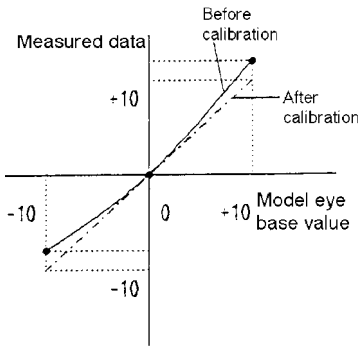
* Hook the hex wrench on #54 and turn it with the wrench.



11.4 Calibrating by adjusting the focus of CCD camera lens

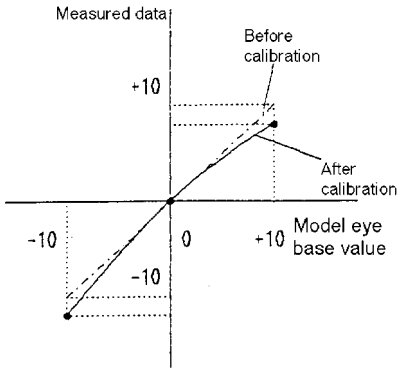
When calibration can not be achieved properly by adjusting the variable resistors on the PC6 board, it is necessary to perform calibration by adjusting the focus of CCD camera lens.

1. **Measure the Model eye of 0D and verify that the obtained data equals to the model eye base value. If not, adjust VR2 (S.ZERO) on the PC6 board. (See 11.7.1.)**



2. **Measure the model eyes of − 10D and + 10D. Check the difference between the obtained data and Model eye base value.**

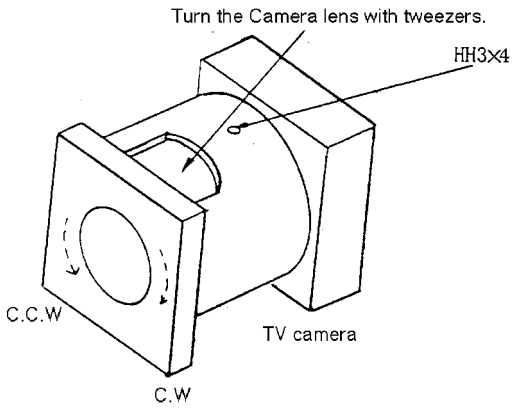
3. **If all the data obtained by measuring model eyes of any diopter is higher than the calibration value as shown on the right graph, turn the CCD camera lens clockwise.**



4. **If all the data obtained by measuring model eye of any diopter is lower than the calibration value as shown on the right graph, turn the CCD camera lens counterclockwise.**

5. **Adjust the TV camera lens properly so that the data distribution forms a straight line on the graph. Adjust GAIN (gradient) on VR1 (S. GAIN) on the PC6 board. (See 11.6.)**

6. **Tighten the screw (HH3 × 4) after the adjustment work of camera lens.**



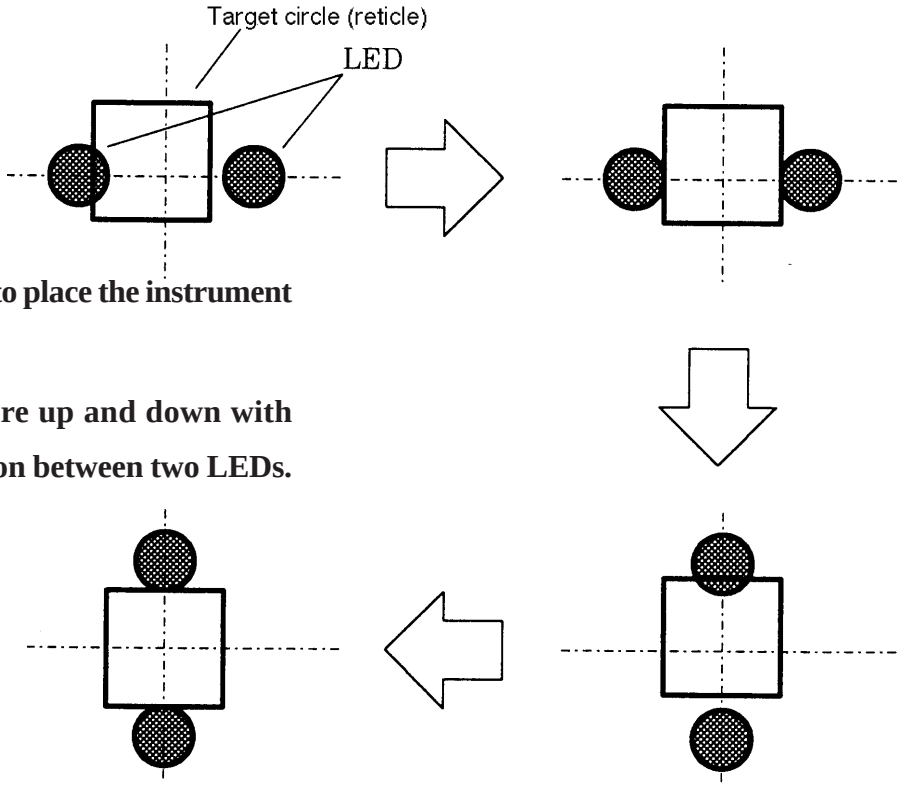
11.5 Positioning the target

1. **Set Switch 4 of the switchpack to the ON position.**

2. **Press and place the instrument in the OTHER ADJUST MODE 10-0.**

3. **Align the frame of the model eyes to the measuring point and adjust the focus of two measurement light LEDs.**

4. **Move the target square to the right and left with and to position it between two LEDs.**



5. **Turn the Rotator 90º.**

6. **Press the Start button to place the instrument in the MODE 10-2.**

7. **Move the target square up and down with ▲ and ▼ to position between two LEDs.**

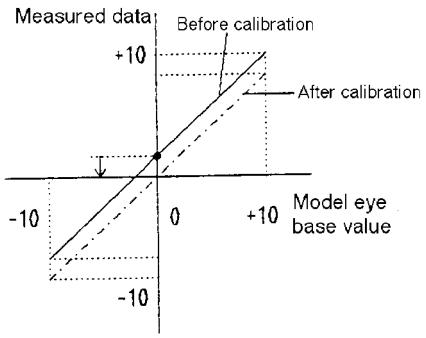
11.6 Sensor calibration (adjusting VR1 and VR2 on the PC6 board)

If only the obtained SPH data is abnormal after replacing the PC6 board, perform sensor calibration by adjusting VR1 and VR2 on the PC6 board. However, the calibration work should be performed only in conditions where sensor OFFSET is normal and the focus of the camera lens are achieved properly.
If CYL data is too high and SPH data is abnormal due to other reasons, correct the erroneous state first. If not, the measured data may be unreliable instead.

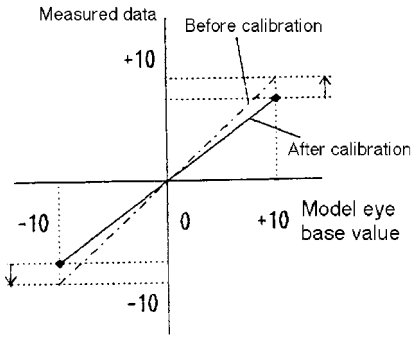
1. **Remove the Left and Right covers (See 5.1.)**

2. **Attach the Model eyes (three steel balls) to the Forehead rest and turn ON the Power Switch (See 4.3).**

3. **Adjust the VR2 (S.ZERO) on the PC6 board so that the measured data of 0D model eye (the center one) equals to its base value.**



4. **Adjust the VR1 (S.GAIN) on the PC6 board so that the measured data of ＋ and － 10D model eyes (the left and right ones) equal to their base value.**



<Adjusting SPH correction range>

1. Set Switch 4 of the switchpack to the ON position.

2. Press and place the instrument into the AR ADJUST MODE 0.

Procedure for correcting - SPH range
<For AR-600 series>

1. Press while holding down CYL. → SPH power decreases.

2. Press while holding down CYL. → SPH power increases.

Procedure for correcting + SPH range
<For AR-600 series>

1. Press while holding down . → SPH power decreases.

2. Press while holding down . → SPH power increases.

Procedure for correcting - SPH range
<For ARK-700 series>

1. Press while holding down . → SPH power decreases.

2. Press while holding down . → SPH power increases.

Procedure for correcting + SPH range
<For AR-700 series>

1. Press while holding down CYL. → SPH power decreases.

2. Press while holding down CYL. → SPH power increases.

11.7 KM auto-calibration (only for ARK-700 series)

1. **Set the Model eyes to the Forehead Rest.**
   Clean the steel balls and measuring window before calibration.

2. **Turn the Power switch ON.**

3. **Set Switch 4 of the switchpack to the ON position. Press (R/K) to place the instrument in the KM calibration mode.**

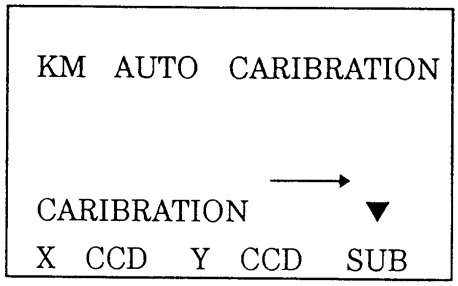
4. **Press (▼). The display as shown on the right figure appears.**

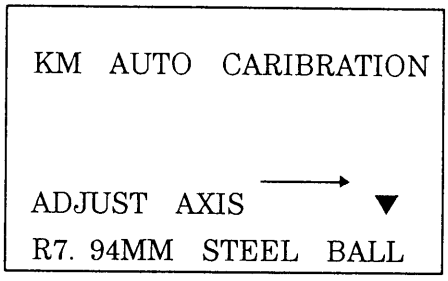
5. **Align the steel ball of R7.94mm to the center of the TV monitor and then press the Start button. KM measurement will take place 10 times in a row automatically. The display on the right figure appears.**

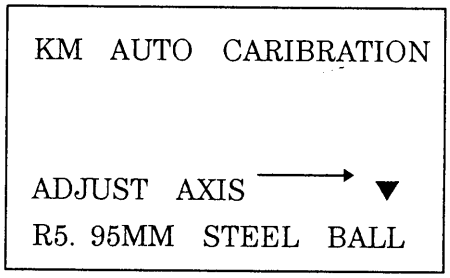
6. **Align the steel ball of R5.95mm to the center of the TV monitor and then press the Start button. KM measurement will take place 10 times in a row automati cally. The display on the right figure appears.**

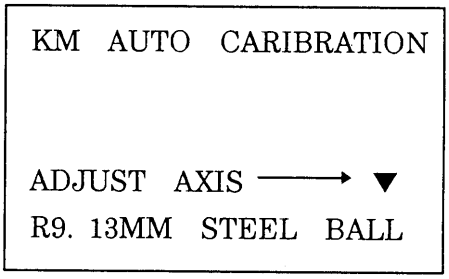
7. **Align the steel ball of R9.13mm to the center of the TV monitor and then press the Start button. KM measurement will take place 10 times in a row automatically. The display on the right figure appears.**

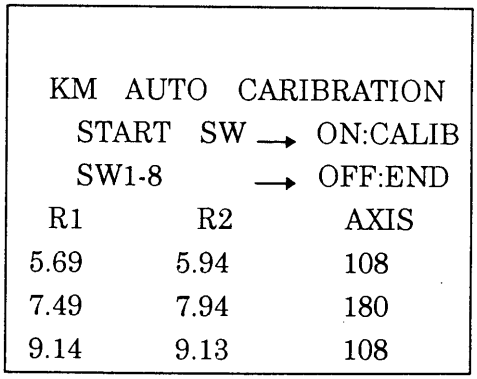
8. **Verify that the measurement results are within the following tolerances.**
   R1 →± 0.02mm
   R2 →± 0.02mm







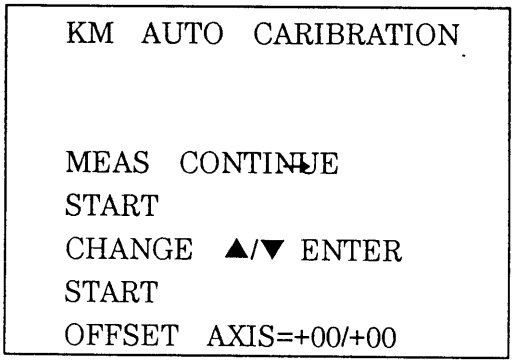




9. **If the measurement results are out of the tolerances, check to see that the steel ball is aligned precisely to the center of the TV monitor and perform auto-calibration again.**

10. **If the desired results cannot be obtained by repeating the calibration several times, it is necessary to adjust the optical axis for KM measurement again.**

11. **Set Switch 4 of the switchpack to the OFF position.**



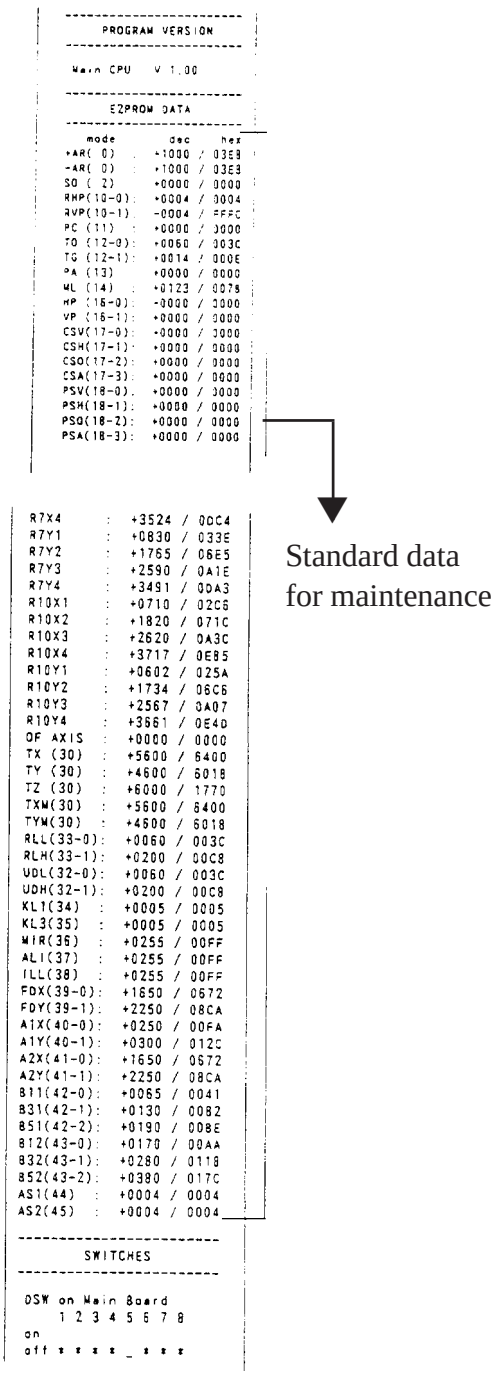
11.8 Setting EEPROM DATA

If EEPROM DATA is cleared, inquire of NIDEK or your authorized distributor about DATA and set EEPROM DATA following the procedure below.

* Regardless of no erroneous condition on the circuit, there are cases where EEPROM DATA is cleared and only “MEMORY FAILURE ON EEPROM” is printed out one time instead of EEPROM DATA (due to noises). In such cases the message will not be printed out any further.
  If the message is printed out, it is certainthat EEPROM DATA will be cleared. To checkif the DATA is cleared, turn ON and the Power switch. If the DATA is cleared, all the items in the DATA will become zero.

* There are variations in the values of EEPROM DATA from instrument to instrument.

  All the items in the DATA will be memorized by setting SW3 of switchpack 1 on the PC1 board to the OFF position. Print out the DATA once to check it.
* The DATA will be stored in any MODE (MODE 10-20) by setting Switch 3 to the OFF position.



Standard data for maintenance

11.8.1 Setting Sensor Offset (SO)

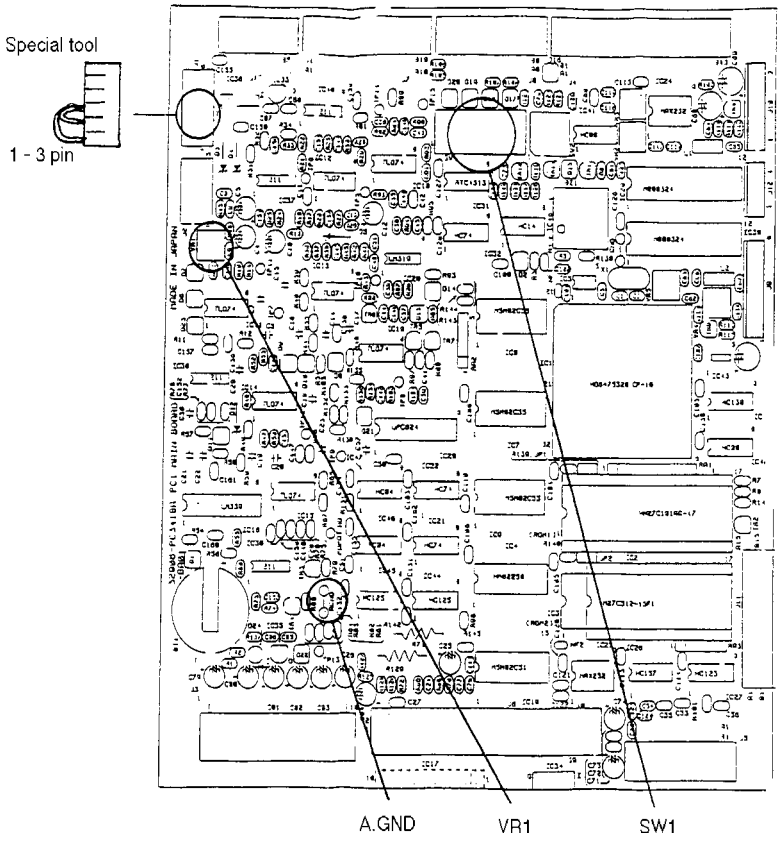
1. **Disconnect the P101 connector. Connect the special tool between 1 and 3 pins, 2 and 3 pins to short-circuit the 1, 2, and 3 pins of the J1 connector on the PC1 board. Then turn the Power switch ON.**

2. **Set Switch 4 of the switchpack1 to the ON position and press the start button twice to place the instrument in "MODE 2" (See § 12.)**

3. **Connect a digital multimeter between TP12 and A. GND on the PC1 board and verify that the reading is 0V. If not, adjust VR1 on the PC1 board.**

4. **Press both and PD button simultaneously.**

5. **Set Switch 4 of the switchpack 1 to the OFF position. The sensor offset data will be stored.**
   * Since the stored SO data is operated by CPU, it is not always equal to the factory-shipped data.

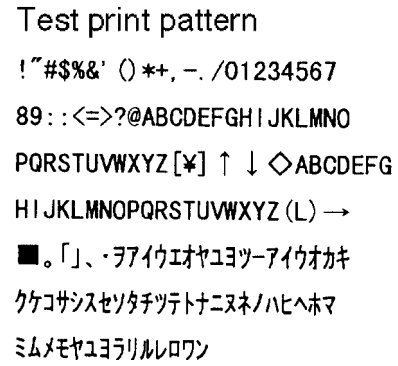


11.8.2 Setting Print Density (PC)

1. **Turn ON the Power switch.**

2. **Set Switch 3 of the switchpack 1 on the PC1 board to the ON position. The instrument will be placed in "MODE 10".**

3. **Change the value with ▲ and ▼ (the value changes in －1.00 - ＋1.00 range in 1 increments) and print out the data with R/K to check the printout for density.**

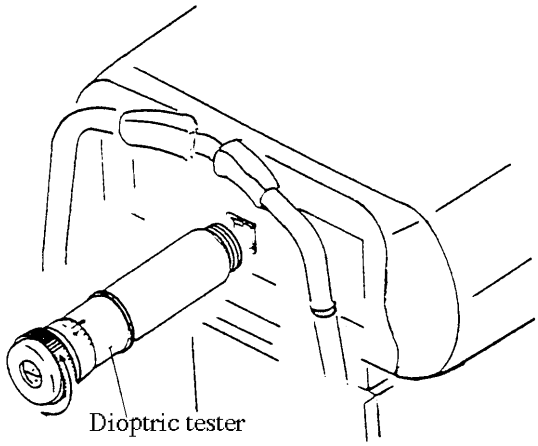


   * Normally set the data to "000". Setting a positive value will slow down the printing speed and increase the print density. Setting the value higher than needed may affect life of the printer head.

4. **Change the mode to "MODE11" for the next adjustment. Hold down the Start button for three sec. and release it. The mode will change to "MODE 11".**

11.8.3 Setting Target Offset (TO)

1. **Set the value as you inquired with PD button or in "MODE 11".**
   * The deterioration of the dial string may cause the 0D to be shifted. If you have a dioptric tester, look at the chart through a dioptric tester and check to see that the chart is in correct focus (Be sure to adjust the dioptric tester to your visibility). If the chart is out of focus, adjust the focus properly. In such cases, the focus should be the point when the sharp focus is obtained first while changing the value from positive side.



2. **Change the mode to "MODE12" for the next adjustment. Press the Start button. The mode will change to "MODE 12".**

11.8.4 Setting Target Gain (TG)

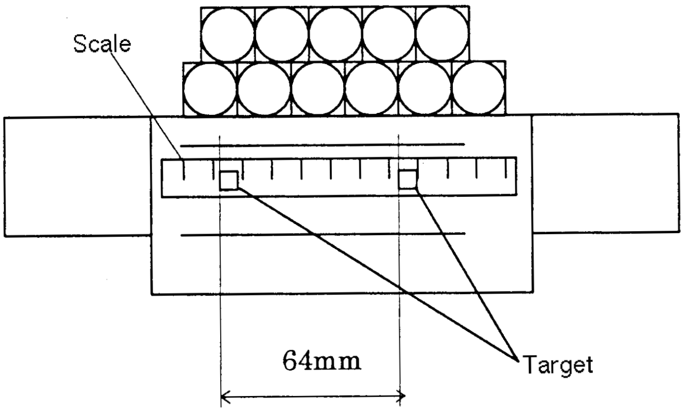
1. **Set the value as you inquired with PD button or in "MODE 12".**
   * Most instruments have their values (indication value) set to "1.03".
     The printed data will be "(DEC) + 0015".

2. **Change the mode to "MODE14" for the next adjustment. The mode will change to "MODE14" by additionally pressing the start button for three sec. and releasing it.**
   * The target gain does not change as it is controlled by a pulse motor. The target calibration can be checked in "MODE 13", which is only subordinate function.

11.8.5 Setting PD Gain (PA)

1. Press the Start button to place the instrument in "MODE 13".

2. Stick a scale on the Model eye with a plastic tape and calibrate the PD value to 64mm.



3. Align the target to the standard line of the scale.

4. Slide the main body by 64mm to the right, align the target to the scale and then press (button).

5. Check that "64" appears. If not, adjust the value to 64 with ▲ and ▼.

6. Change the mode to "MODE 15" for the next adjustment.

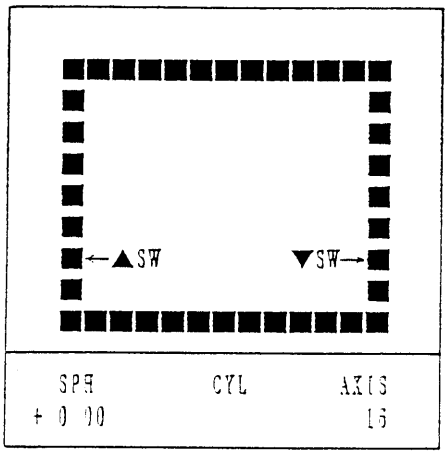
11.8.6 Setting Mask Blink Level (ML)

1. Set the value to ＋123 (1.8V) with ▲ and ▼ in "MODE 15".

11.8.7 Setting Horizontal Position (HP) of display

1. **Place the instrument in "MODE 16-0" with the Start button.**

2. **Adjust the horizontal position of the display with (▲) and (▼).**

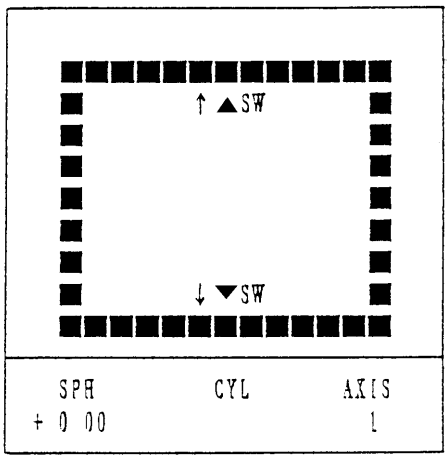


11.8.8 Setting Vertical Position (VP) of display

1. **Place the instrument in "MODE 16-0" with the Start button.**

2. **Adjust the vertical position of the display.**

3. **Revert the system to MODE 16-0 with (CYL).**
   * Check to see that the display is positioned as shown in the right figure.



11.8.9 Adjusting scale for CS (Corneal Size) measurement (only for ARK-700 series)

1. **Place the instrument in “MODE 17-0” with the Start button.**

2. **Adjust the vertical position of the fiducial line and guide line with and (▼).**

3. **Change the mode to “MODE 17-1” with the Start button.**

4. **Adjust the vertical position of the fiducial line and guide line with and (▼).**

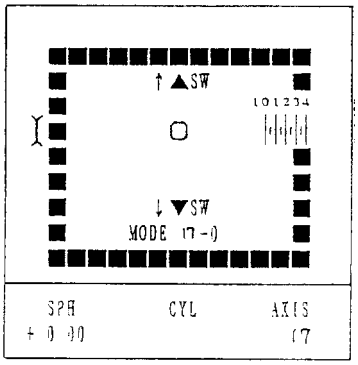
5. **Change the mode to “MODE 17-2” with the Start button.**

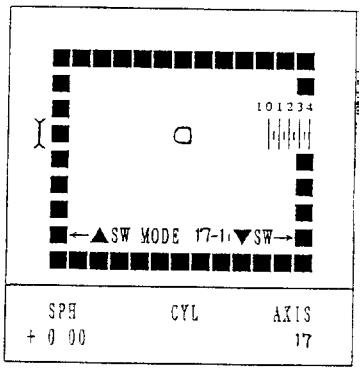
6. **Move the guide line to the left or right with (▲) and (▼), and position it 12mm to the fiducial line right so that the 12mm of the guide line is aligned with 12mm of the guide line eye.**

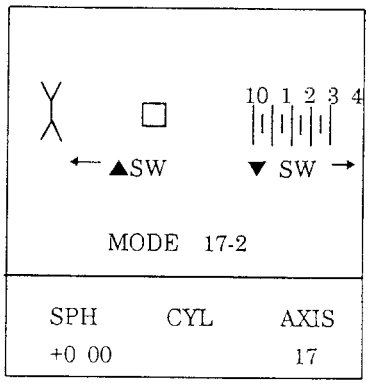
7. **Change the mode to “MODE 17-3” with the Start button.**

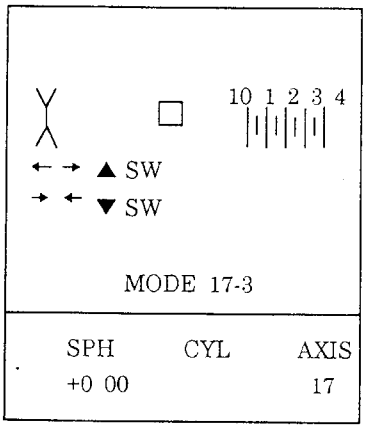
8. **Change spacings between scales of the guide line with (▲) and (▼), and align the 10 - 14mm scales with the ones of the model eye scale.**

9. **Return the mode to “MODE 17-0” with (CYL).**









<Adjusting CS>

1. **Place the instrument in "MODE 18-0" with the Start button.**

2. **Adjust the vertical position of the fiducial line and guide line with ▲ and ▼.**

3. **Change the mode to "MODE 18-1" with the Start button.**

4. **Adjust the vertical position of the fiducial line and guide line with ▲ and ▼.**

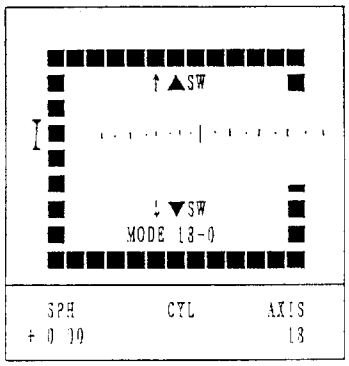
5. **Change the mode to "MODE 18-2" with the Start button.**

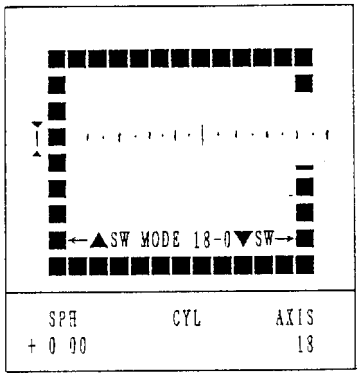
6. **Move the guide line to the left or right with ▲ and ▼, and position it 5mm to the fiducial line right so that the 5mm scale of the guide line is aligned with the one of the model eye scale.**

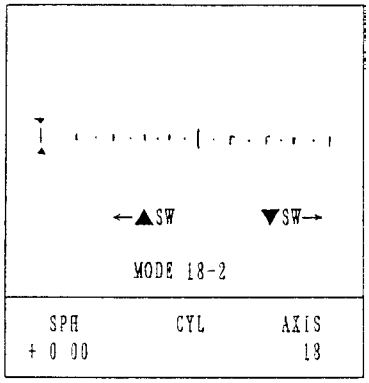
7. **Change the mode to "MODE 18-3" with the Start button.**

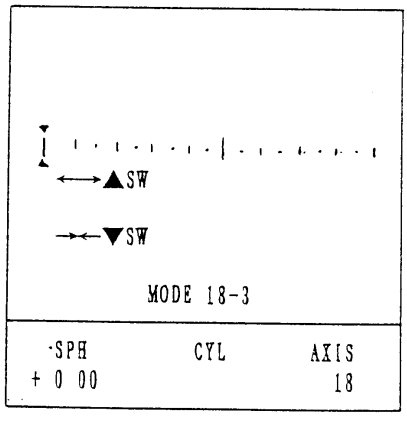
8. **Change spacings between scales of the guide line with ▲ and ▼, and align the 1 - 10mm scales with the ones of the model eye scale.**

9. **Return the mode to "MODE 18-0" with CYL.**









11. 8. 10 Setting CYL zero (C1) and CYL axis (C2) (Only for AR-660A and ARK-760)

1. **Set Switch 4 of the switchpack 1 on the PC1 board to the ON position and press to place the instrument in the CYL lens mode.**

2. **Set the CYL axis (C2) value to the specified one in "MODE 61".**

3. **Set the CYL zero (C1) value to the specified one in "MODE 60".**

4. **Set Switch 4 of the switchpack 1 to the OFF position.**

   * The value changes in 10 increments with ▲ or ▼ while pressing ✥.

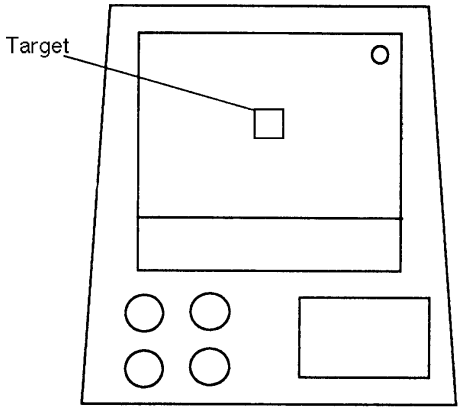
   The presented chart can be switched with ▭ and ☯.

   Axis can be changed in 90° increments with A.

11.9 Adjusting image centering

When replacing CCD camera or TV monitor with new ones, the image centering may be slightly shifted. It is possible to adjust it with H.V. volume. However, if it can not be adjusted properly, follow the procedures below to perform the centering.

1. **Position the target on the center of the display with H.V. volume to adjust the image centering.**



11.10 Adjusting Brightness and Sharpness of display

1. **Connect the connector P602 of the LED to J2 on the PC6 board.**

2. **Connect the oscilloscope as follows.**

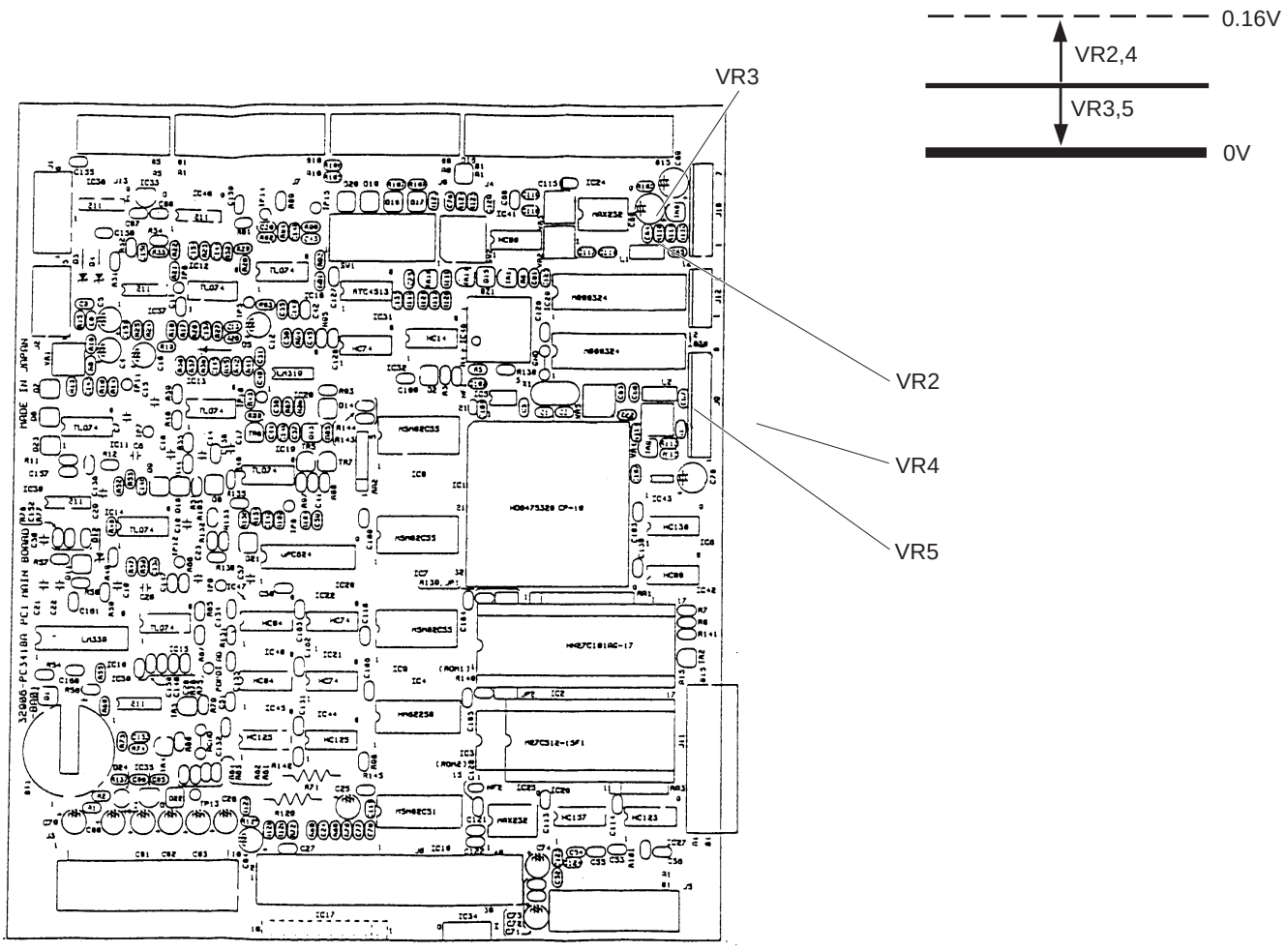
CH1	Probe	to soldered surface of J12 on the PC1 board
CH1	alligator clip	to ANALOG GND on the PC1 board
TIME	5 μs/DIV	
VOLTS	0.1V/DIV AC	

3. **Turn ON the Power switch while holding down (A). For AR-600 and ARK-700, set Switch 7 to the ON position and then turn ON the Power switch.**

4. **Adjust each value as follows.**

For adjusting letters VR2 (Brightness): 0.16V VR3 (Sharpness): 0V

For adjusting the target VR2 (Brightness): 0.16V VR5 (Sharpness): 0V



11.11 Tracking auto-calibration (except AR-600 and ARK-700)

1. **Set Switch 4 to the ON position. Or press the Power switch while holding down (CYL) and to place the instrument in TRC ADJUST MODE.**

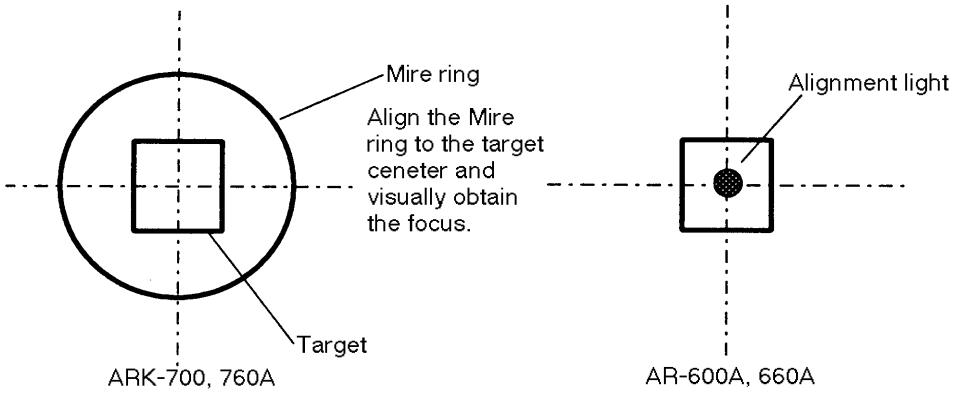
2. **Set Switch 6 to the ON position.**

3. **Set the Model eye to the Forehead rest.**

4. **Place the instrument in "MODE 30".**

5. **Press (+) to make "30" appear at the left end of the Display panel.**

6. **For ARK-700A and ARK-760A, align the Mire ring to the center of the target and adjust the focus properly. For AR-600A and AR-660A, align the Alignment light to the center of the target and adjust the focus properly. Then press (A).**



8. **Press the Start button once and place the instrument in "MODE 31".**
   * Hereafter the MODE No. will be switched to another No. with every press of the Start button.

9. **Press and check to see that th measuring unit will move to the right limit.**

10. **Press and check to see that the measuring unit will move to the left limit.**

11. **Press and check to see that the measuring unit will move to the center limit.**
    * After checking that the measuring unit will stop at each limit properly, leave it at the center limit.

※

12. **Place the instrument in "MODE 32-0" and set the value to "55" with ▲ or ▼.**
    * Hereafter change the value with ▲ or ▼.

13. **Place the instrument in "MODE 32-1" and set the value to "170" with ▲ or ▼.**

14. **Place the instrument in "MODE 33-0" and set the value to "55" with ▲ or ▼.**

15. **Place the instrument in "MODE 33-1" and set the value to "170" with ▲ or ▼.**

16. **Place the instrument in "MODE 44" and set the value to " + 8" with ▲ or ▼.**

17. **Place the instrument in "MODE 45" and set the value to " + 2" with ▲ or ▼.**

18. **Revert the instrument to "MODE 31" and repeat the steps ※ to check the measuring unit for correct operation again.**
    * If the movement of the instrument is not smooth, fine-adjust the slide rail.

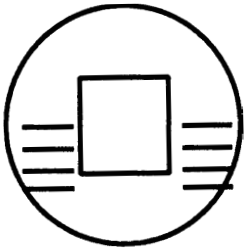
19. **Set Switch 4 to the OFF position.**
    Or press both CYL and simultaneously.

20. Press . will appear on the display.

21. Align the 0D model eye position to the measuring point.

22. Bring the Main body forward and then gradually adjust the focus.

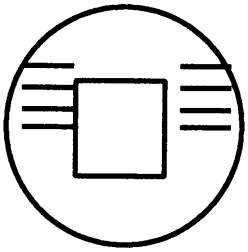
23. Check to see that the instrument starts measurement automatically when the number of bars which are on both sides of the target decreases to one.



(Measurement will take place.)

24. If bars blink, it is possible that the light of the Mire ring (for ARK-700 series) or tracking light (For AR-600 series) may be coming out.
In such cases, block it with black lacquer.

25. Bring the Main body backward and gradually adjust the focus.



26. Check the number of bars when measurement automatically starts as in the step 24.

27. Perform the steps 23 - 27 with the + 22D and + 17D model eye to check the correct operation of the instrument.

§12 Program for adjustment

To the system into the adjustmnet mode, turn ON DS4 or press PON, (CYL) and ( ). Writing EEPROM data is possible while DSW4 is OFF. Or use (CYL) + ( ) combinations to writing the data.

・AR ADJUST ( )

MODE No.	Function	Remarks
0	AR adjustment: LED Off: Servo Off	"Prt" : Rotate TEST
	Correcting the compensation range (plus side)	"CL select" + "▲" : Addition of Compensation coefficient "CL select" + "▼" : Subtraction of Compensation coefficient
	Correcting the compensation range (minus side)	"CL select" + "▲" : Addition of Compensation coefficient "CL select" + "▼" : Subtraction of Compensation coefficient
1	AR adjustment: LED ON :Servo Off	"Prt" : Parameter setting (Japan)
		"Change" : Parameter setting (N. INC)
		"ILO" : Parameter setting (Overseas)
		"CL select" : Moving sensor carry unit forcefully(0V)
2	AR adjustment: LED ON :Servo On	"Prt" & "Change" : SDIV adjust
		"ILO" : Switching between SPD and DUMMY (The mode can be checked by the Print LED)

Common operations: Start button...The mode will be changed to the next mode.
( ).....The instrument revert to the Menu mode.

・OTHER ADJUST ( ) (AR models do not have adjustment mode 17 and 18.)

MODE No.	Function	Remarks
10	Mode 0: Target Horizontal adjustment	Change the horizontal position with "▲" or "▼".
	Mode 1: Target vertical adjustment	Change the vertical position with "▲" or "▼". Revert to "MODE 0" with (CYL) .
	Print density adjustment	Change the print density with "▲" or "▼".
12	Mode 0: Chart offset adjustment	Change offset value with "▲" or "▼".
	Mode 1: Chart gain adjustment	Change gain with "▲" or "▼".
	Mode 2: Chart position check	Switch the chart positions between 0D, -12D and +12D with( ) . The illumination will be turned ON and OFF with ( ) . Revert to "MODE 0" with (CYL) .
13	Mode 0: PD center offset adjustment	Change offset value with "▲" or "▼". Obtain the offset value from the preset position (center) with ( ).
	Mode 1: PD gain adjustment	Measure a distance between two desired points with ( ) and set the indicated value to the obtained one with"▲" or "▼". Revert to "MODE 0" with (CYL) .
14	Mask Blink Level adjustment	Change the blink level "▲" or "▼".
15	Mask-LED Position check	Change the Rotator angle to 90° with ( ). Change the Rotator angle to 0° or 180° with "▲" or "▼". Change the Rotator angle to 45° or 135° with "▲" or "▼".
16	Mode 0: Display Horizontal adjustment	Change the horizontal position with "▲" or "▼".
	Mode 1:Display Vertical adjustment	Change the vertical position with "▲" or "▼". Revert to "MODE 0" with (CYL) .
17	Mode 0: CS screen Vertical adjustment	Change the vertical position with "▲" or "▼".
	Mode 1: CS screen Horizontal adjustment	Change the horizontal position with "▲" or "▼". Adjust the standard position.
	Mode 2: CS Scale 14mm adjustment	Adjust the CS Scale 14mm position with "▲" or "▼".
	Mode 3: CS Scale 10mm adjustment	Adjust the CS Scale 10mm position with "▲" or "▼". Revert to "MODE 0" with (CYL) .
18	Mode 0: PS screen Vertical adjustment	Change the vertical position with "▲" or "▼".
	Mode 1: PS screen Horizontal adjustment	Change the horizontal position with "▲" or "▼". Adjust the standard position.
	Mode 2: PS Scale 14mm adjustment	Adjust the PS Scale 14mm position with "▲" or "▼".
	Mode 3: PS Scale 10mm adjustment	Change the PS Scale 10mm position with "▲" or "▼". Revert to "MODE 0" with (CYL) .

・TRC ADJUST (⊕) (only for A-type models)

MODE No.	Function	Remarks
30	Auto-tracking position adjustment	Set the Auto-tracking position with Ⓐ.
31	R/L Center Limit adjustment	Information about each limit will be displayed on the TV monitor.
32	Mode 0: The smallest value at fine-run of R/L motor.	Change the minimum value with "▲" or "▼". Switch between static image and line drawing with Ⓓ.
	Mode 1: The largest value at fine-run of R/L motor	Change the maximum value with "▲" or "▼". Switch between static image and line drawing with Ⓓ. Revert to "MODE 0" with ⓒYL.
33	Mode 0: The smallest value at fine-run of U/D motor.	Change the minimum value with "▲" or "▼".
	Mode 1: The largest value at fine-run of U/D motor.	Change the maximum value with "▲" or "▼". Revert to "MODE 0" with ⓒYL.
34	KM1 LED (Left side) Level adjustment	Change the value with "▲" or "▼".
35	KM3 LED (Right side) Level adjustment	Change the value with "▲" or "▼".
36	MIRE LED Level adjustment	Change the value with "▲" or "▼".
37	ALIGN LED Level adjustment	Change the value with "▲" or "▼".
38	ILLUMI LED Level adjustment	Change the value with "▲" or "▼".
39	MODE 0: X axis focus indicator width	Change the value with "▲" or "▼".
	MODE 1: Y axis focus indicator width	Change the value with "▲" or "▼". Revert to "MODE 0" with ⓒYL.
40	MODE 0: X axis focus auto-shot range (for the first measurement)	Change the value with "▲" or "▼".
	MODE 2: Y axis focus auto-shot range (for the first measurement)	Change the value with "▲" or "▼". Revert to "MODE 0" with ⓒYL.
41	MODE 0: X axis auto-shot range (for the second measurement or later)	Change the value with "▲" or "▼".
	MODE 1: Y axis focus auto-shot range (for the second measurement of later)	Change the value with "▲" or "▼". Revert to "MODE 0" with ⓒYL.
42	MODE 0: The range in which one focus bar is indicated (for the first measurement)	Change the value with "▲" or "▼".
	MODE 1: The range in which three focus bars are indicated (for the first measurement)	Change the value with "▲" or "▼".
	MODE 2: The range in which five focus bars are indicated (for the first measurement)	Change the value with "▲" or "▼". Revert to "MODE 0" with ⓒYL.
43	MODE 0: The range in which one focus bar is indicated (For the second measurement or later)	Change the value with "▲" or "▼".
	MODE 1: The range in which three focus bars indicated (for the second measurement or later)	Change the value with "▲" or "▼".
	MODE 2: The range in which five focus bars are indicated (for the second measurement or later)	Change the value with "▲" or "▼". Revert to "MODE 0" with ⓒYL.
44	Auto-shot start counter (for the first measurement)	Change the value with "▲" or "▼".
45	Auto-shot start counter (for the second measurement or later)	Change the value with "▲" or "▼".
46	MODE 0: Auto-tracking stop range X	Change the value with "▲" or "▼".
	MODE 0: Auto-tracking stop range Y	Change the value with "▲" or "▼". Revert to "MODE 0" with ⓒYL.
47	Auto-shot: Time-out at serial measurement	Change the value with "▲" or "▼".

・SAGITTAL MODEL (▼) (only for ARK-700 series and SW6 is set to the ON position)

Mode No.	Function	Remarks
50	Sagittal model select This should be set before shipment	Change the setting with "▲" or "▼". 0: Destined for overseas 1: Destined for OCULUS

Common operations: Start button The mode will be switched to the next mode.

Ⓓ..... The setting will be printed out.

Ⓜ.....The instrument revert to the Menu mode.

§13 Replacing ROM (Program)

R&D division releases Technical Bulletin every time the ROM version changes. If the program is not proper for your instrument, replace ROM with a correct one.
Remember that all types of instrument has IC2 commonly installed. However, the earlier program version is not corresponding with AR-660A and ARK-760A.

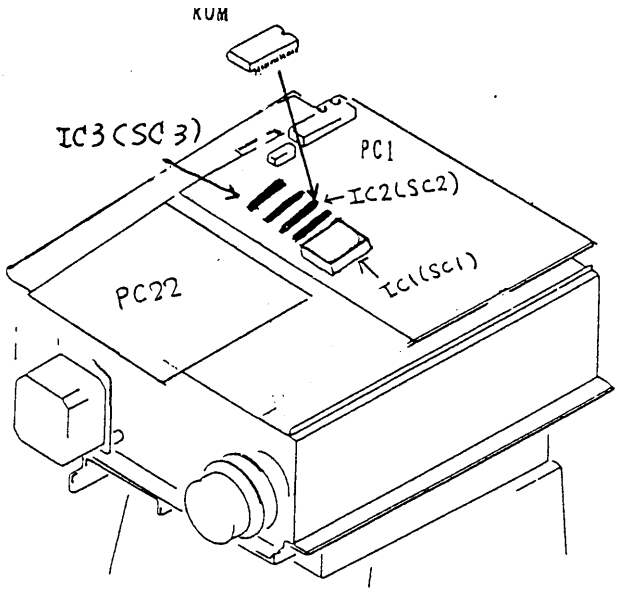
Replacement parts: 32906-E174/IC2

1. **Remove the Left, Right covers and frame.**
   (See § 5.)

2. **Extract ROM (IC2 and IC3).**
   Use a special CPU extractor if possible. If the tool is not available, use two screwdrivers instead. Insert the screwdriver blades to both sides of ROM and lift it off.

3. **Install the new ROM, paying attention to its fixed orientation.**
   Mount it in a horizontal position.
   * Take care not to touch the contact surface of ROM. The corrosion may cause contact failure.

4. **Set parameters, date and time and comment according to the instructions on Operator's Manual.**



§14 List of SW1 and SW2 operations

Functions of DIP SW (SW1)

Functions of AR-10 (A)/RK-4 (A) DIP SW

• Functions of DIP SW

SW No.	Function	OFF	ON
1	RESERVE	Factory setting: OFF	————
2	RESERVE	Factory setting: OFF	————
3	RESERVE	Factory setting: OFF	————
4	Adjustment mode (AR, KM, OTHER)	Normal mode	Adjustment mode
5	Dimming ON/OFF	Dimming ON	Dimming OFF
6	Sagittal setting (KM model)	Without sagittal	With sagittal
7	Printer setting (line printer/serial printer)	Line printer	Serial printer
8	Import (valid/invalid)	Valid (LM)	IC card

Functions of AR-10 TYPE Ⅱ DIP SW

• Functions of DIP SW (for V4.00)

SW No.	Function	OFF	ON
1	RESERVE	Factory setting: OFF	————
2	Printer setting (SW No.7: valid/new line printer)	————	Line printer
3	RESERVE	Factory setting: OFF	————
4	Adjustment mode	Normal mode	Adjustment mode
5	Dimming ON/OFF	Dimming ON	Dimming OFF
6	RESERVE	Factory setting: OFF	————
7	RESERVE	Factory setting: OFF	————
8	Import (valid/invalid)	Valid (LM)	Invalid (IC card)

Functions of AR-10B/RK-4B DIP SW

• Functions of DIP SW

SW No.	Function	OFF	ON
1	RESERVE	Factory setting: OFF	————
2	RESERVE	Factory setting: OFF	————
3	Domestic/overseas index setting	Domestic index	Overseas index
4	Adjustment mode (AR, KM, OTHER)	Normal mode	Adjustment mode
5	Dimming ON/OFF	Dimming ON	Dimming OFF
6	Sagittal setting (KM model)	Without sagittal	With sagittal
7	Printer setting (line printer/serial printer)	Line printer	————
8	Import (valid/invalid)	Valid	Invalid (IC card)

Functions of ROTARY SW (SW2)

Function of ROTARY SW (Except AR-10 TYPE Ⅱ)

• Functions of ROTARY SW

No.	Model Code	Model
0	AR-10	AR-600
1	AR-10A	AR-600A
2	AR-10B	AR-660A
3	NOT USED	NOT USED
4	NOT USED	NOT USED
5	RK-4	ARK-700
6	RK-4A	ARK-700A
7	RK-4B	ARK-760A
8	NOT USED	NOT USED
9	NOT USED	NOT USED

Function of ROTARY SW (AR-10 TYPE Ⅱ)

• Functions of ROTARY SW

No.	Model code	Model
0	NOT USED	NOT USED
1	NOT USED	NOT USED
2	NOT USED	NOT USED
3	AR-10	AR-600 type Ⅱ
4	NOT USED	NOT USED
5	NOT USED	NOT USED
6	NOT USED	NOT USED
7	NOT USED	NOT USED
8	NOT USED	NOT USED
9	NOT USED	NOT USED

Program functions are set with the ROTARY SW. (Refer to the comparative chart of model and functions.)

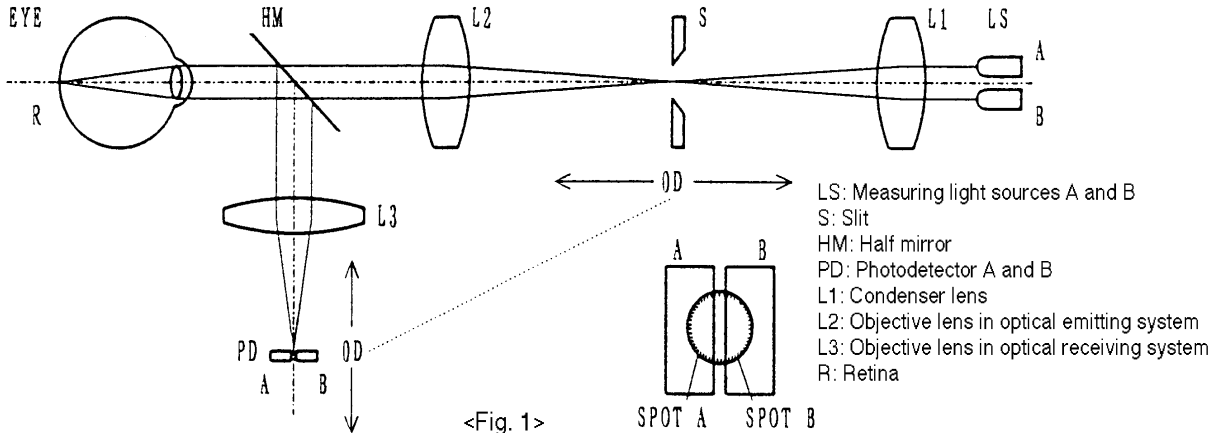
§15 Principle of Measurement

1. Outline of AR measurement principle

AR-600 and ARK-700 series uses invisible infrared rays as the light source for measurement. The infrared rays are projected thorough the slit on the patient's retina, and the image formation on the Patient's retina is detected by the photodetector and transmit it to the mechanism that determine the refractive power.
NIDEK Auto Refractometer derives the patient's refractive power from a slit travel by servo mechanism and from calculation by microcomputer.

2. Description of AR measurement principle

The Figure 1 illustrates the optical system; the slit images (S) are projected on the retina (R) by the light sources (LS) and the refracted light from the retina reaches the photodetector (PD). The light sources are located at A and B as shown in the figure.
The slit with a round aperture moves in accordance with the photodetector. The slit images projected by the light sources pass through the objective lens in optical emitting system (L2) and they are focused on retina through the patient's crystalline lens.
The slit images formed on the retina are refracted by the half mirror (HM) again through the objective lens in optical receiving system (L3) and finally the images are formed on the photodetector.



<Fig. 1>

Fig.1 illustrates the optical system when measuring emmetropia. The slit is located at the focal distance of the objective lens in optical emitting system. The slit images are properly projected on the retina through the objective lens in optical emitting system and the patient's crystalline lens. The figure shows that the slit images thrown by the light sources A and B coincide SPOT A and SPOT B on the photodetectors A and B. Assuming that the slit position for emmetropia is at 0D, it moves according to the refractive power of myopia or hyperopia.

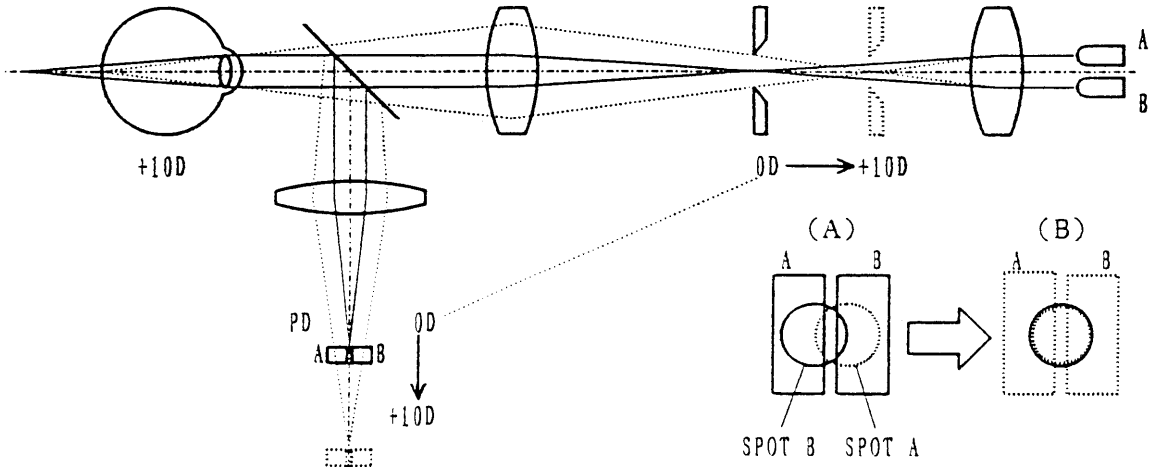
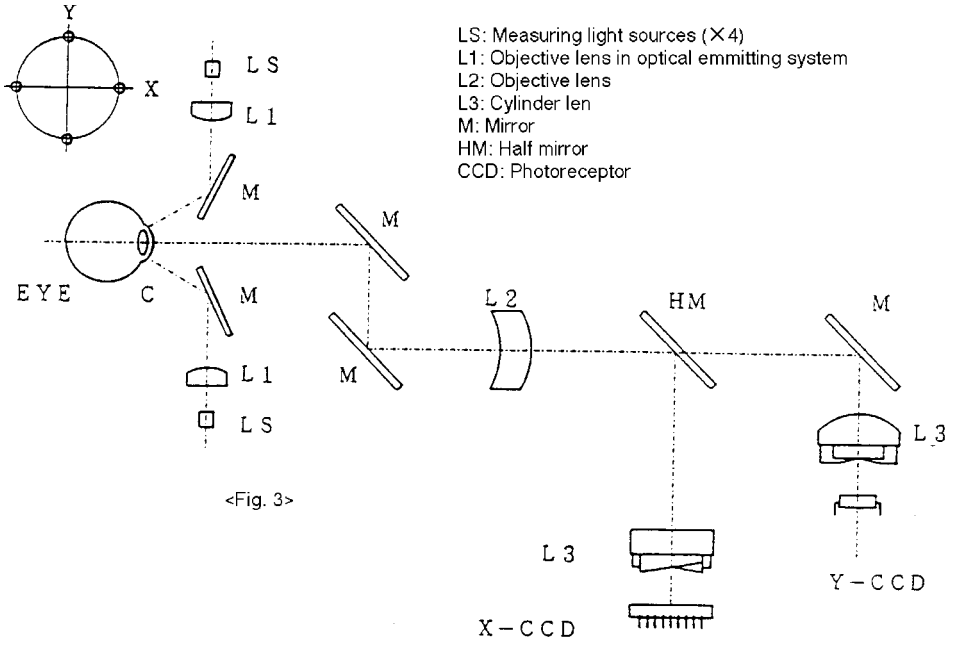


Fig. 2 illustrates the optical system when measuring hyperopia. If the slit is located at the focal distance of the objective lens in optical emitting system, the slit images do not coincide with each other on the retina; the photodetector A receives light mainly from SPOT B. On the other hand, the photodetector B receives light mainly from SPOT A. The slit moves in the positive direction until the image formation on the photodetectors achieves the (B) state in the figure.

In the case of myopia, the slit moves in the negative direction.

The SPH, CYL and AXIS values are given by the microcomputer after obtaining the refractive power of each meridian.

3. Outline of KM measurement principle



<Fig. 3>

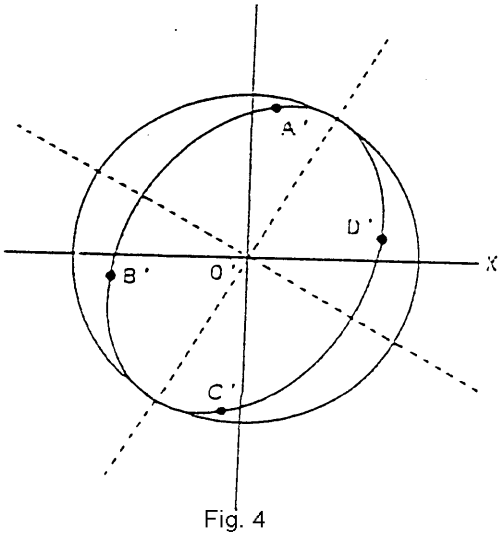


Fig. 4

Fig 3 illustrates the optical system in which the light sources are projected on the cornea and the refracted light from the cornea reaches the photoreceptors. The figure shows that there are two measuring lights arranged in horizontal direction and the other two lights in vertical direction.

Fig. 4 illustrates the position of refracted image (virtual image) on the cornea when four measuring lights are projected on the cornea.

Corneal radius on both 1st and 2nd principle meridians and cylinder axis on the patient's cornea are calculated in the measurement.
They are derived by computing the placement of at least three lights images projected on the cornea, rather than computing positions of each light. This is because that the refracted images are focused on the photoreceptors (CCD).

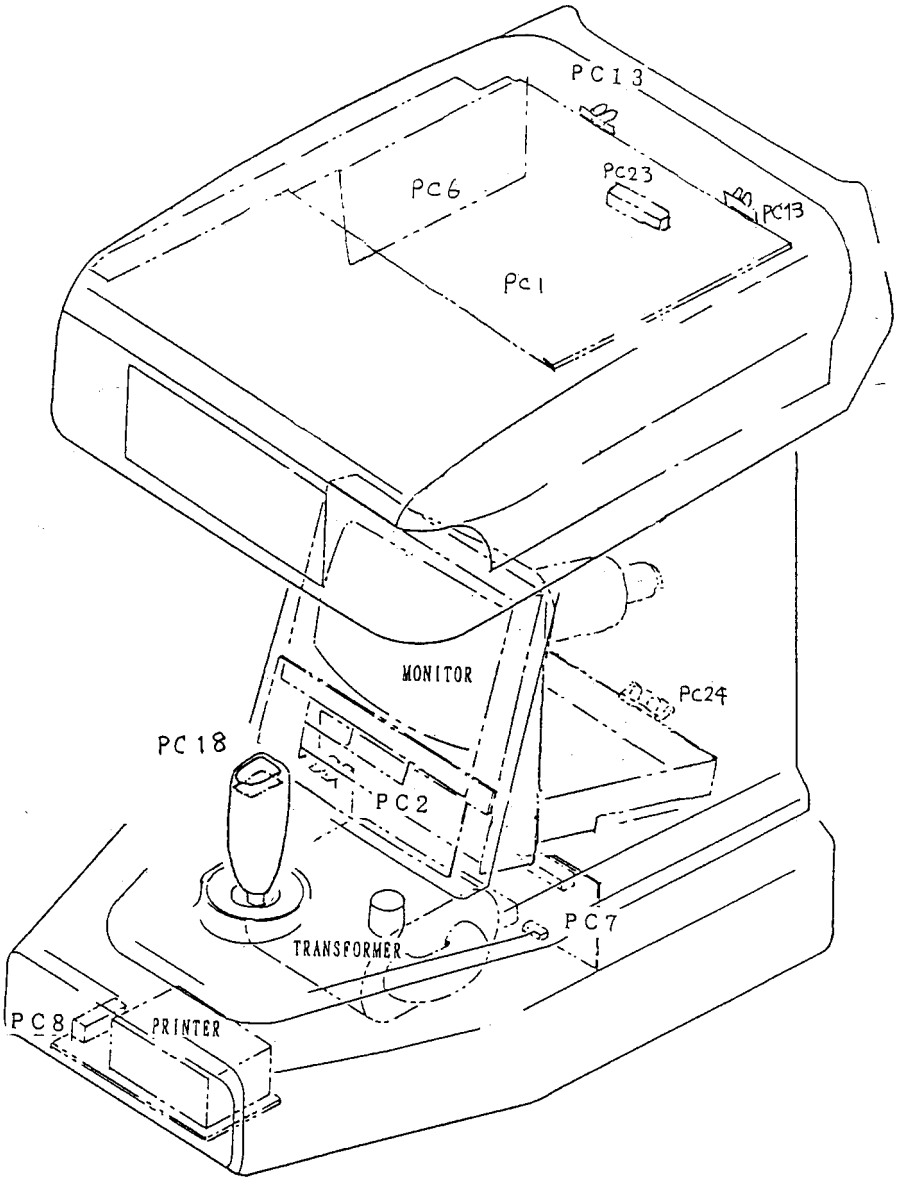
CCD lenear image sensor

The CCD linear image sensor on which micro-photodiodes are in line detect relative spacings between imcoming rays.

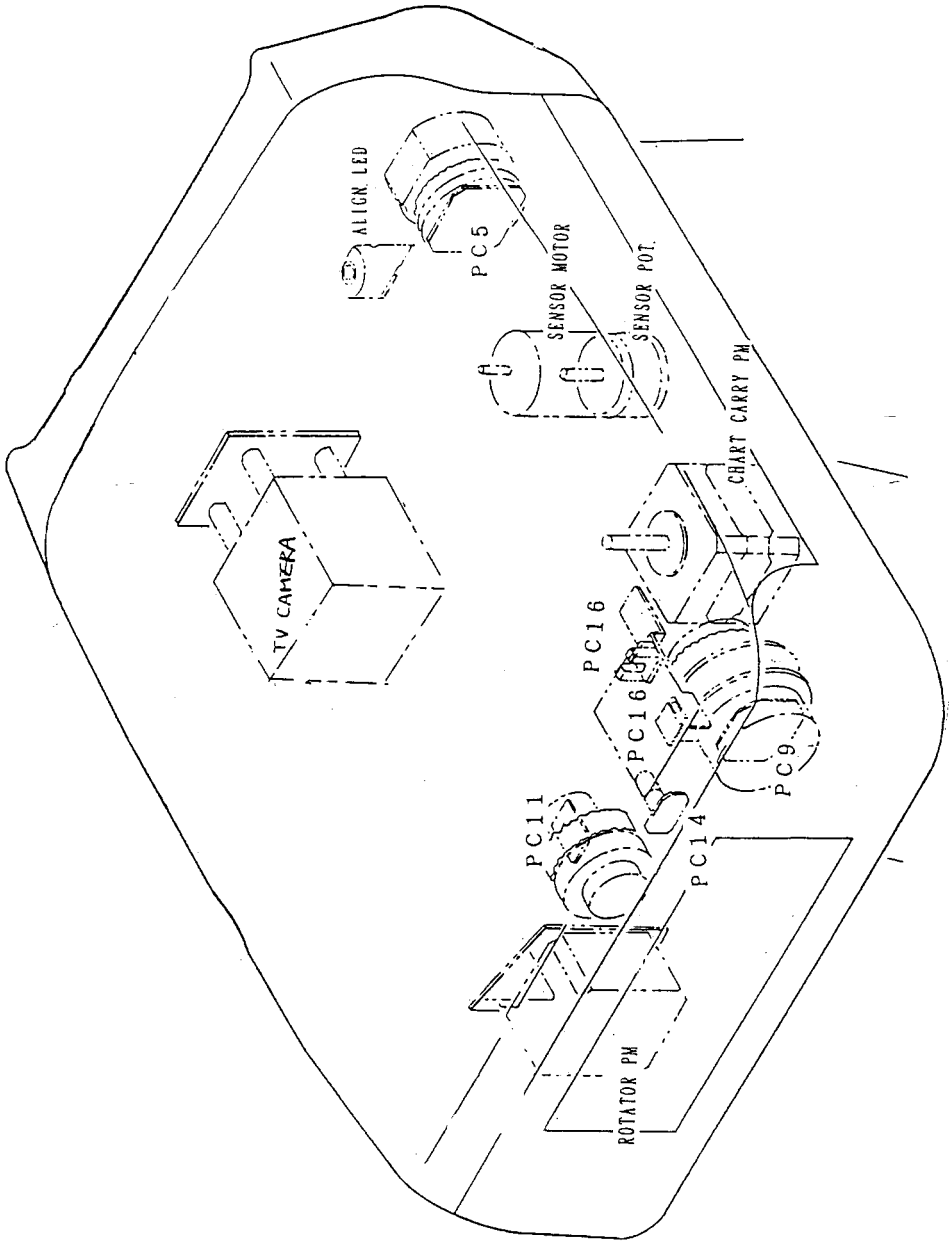
The bit number of the spacing between A and B spotlights can be obtained by measuring $t_{A\ -\ B}$ with a certain unit of clock signal. The spacing can be detected since one bit of photoreceptor is known.

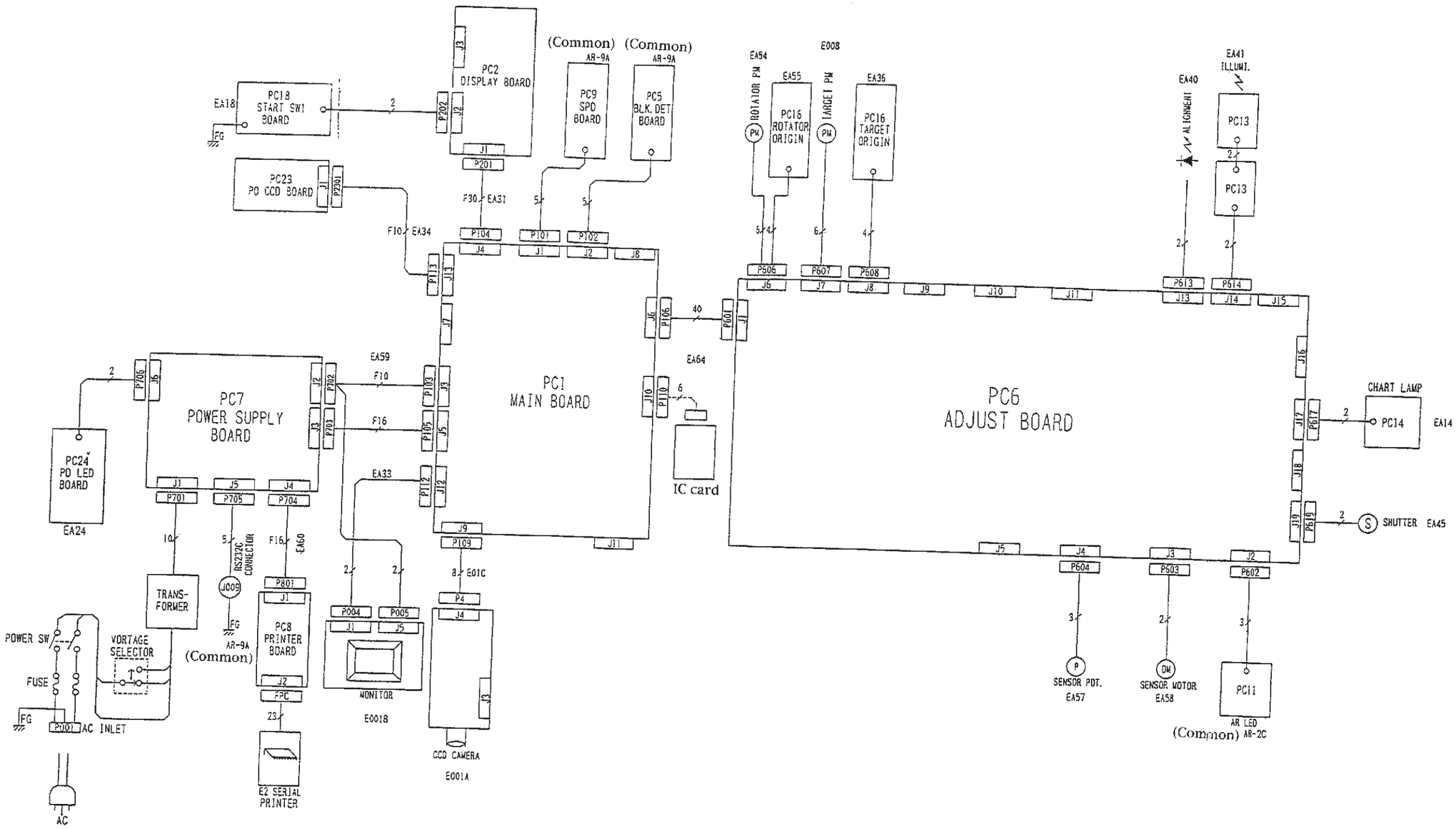
Since CCD has an extremely-narrow spacing, the virtual image is deviated from the photoreceptor and it cannot be detected. Therefore, cylinder lens is placed in front of the photoreceptors (CCD) to lengthen each image to the direction in which each image crosses the axis at right angles.

• **AR-600 CONSTRUCTION DRAWING**



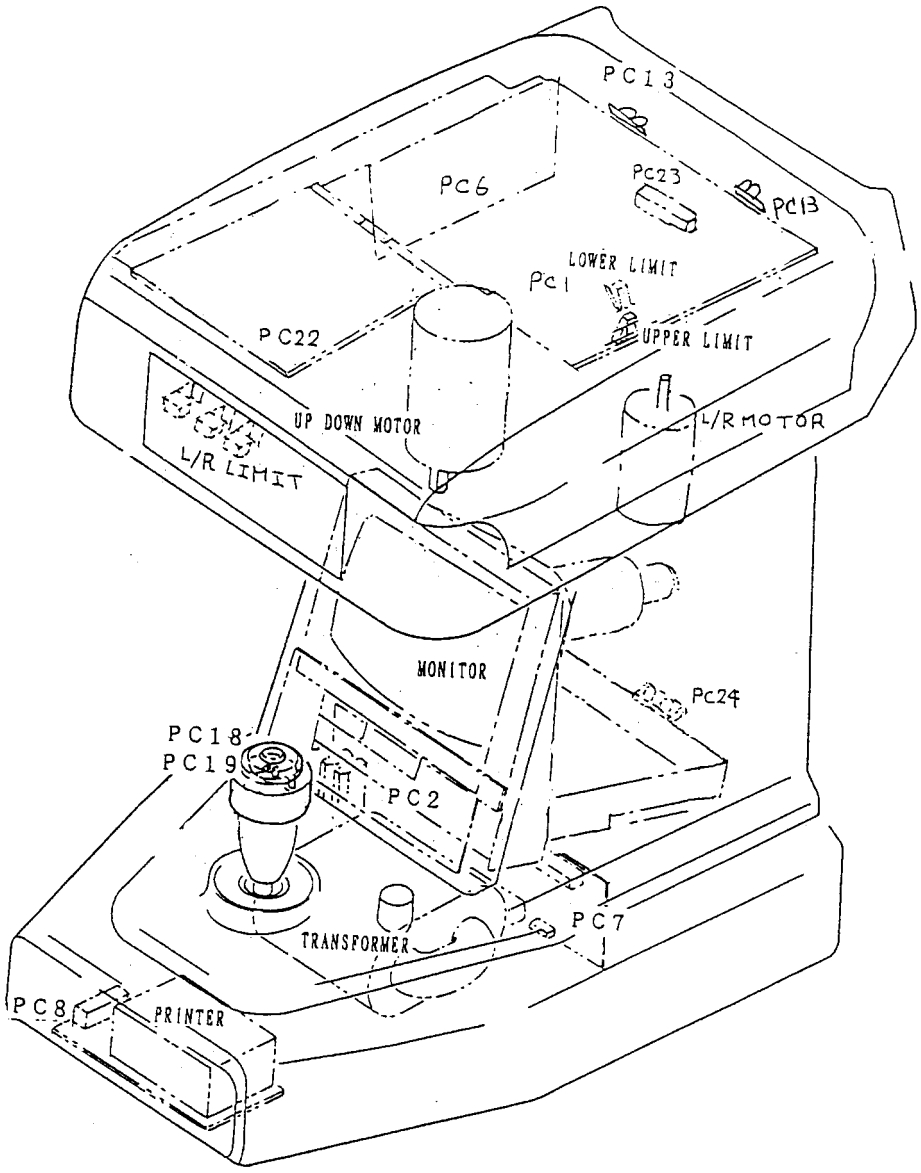
• **AR-600 CONSTRUCTION DRAWING**



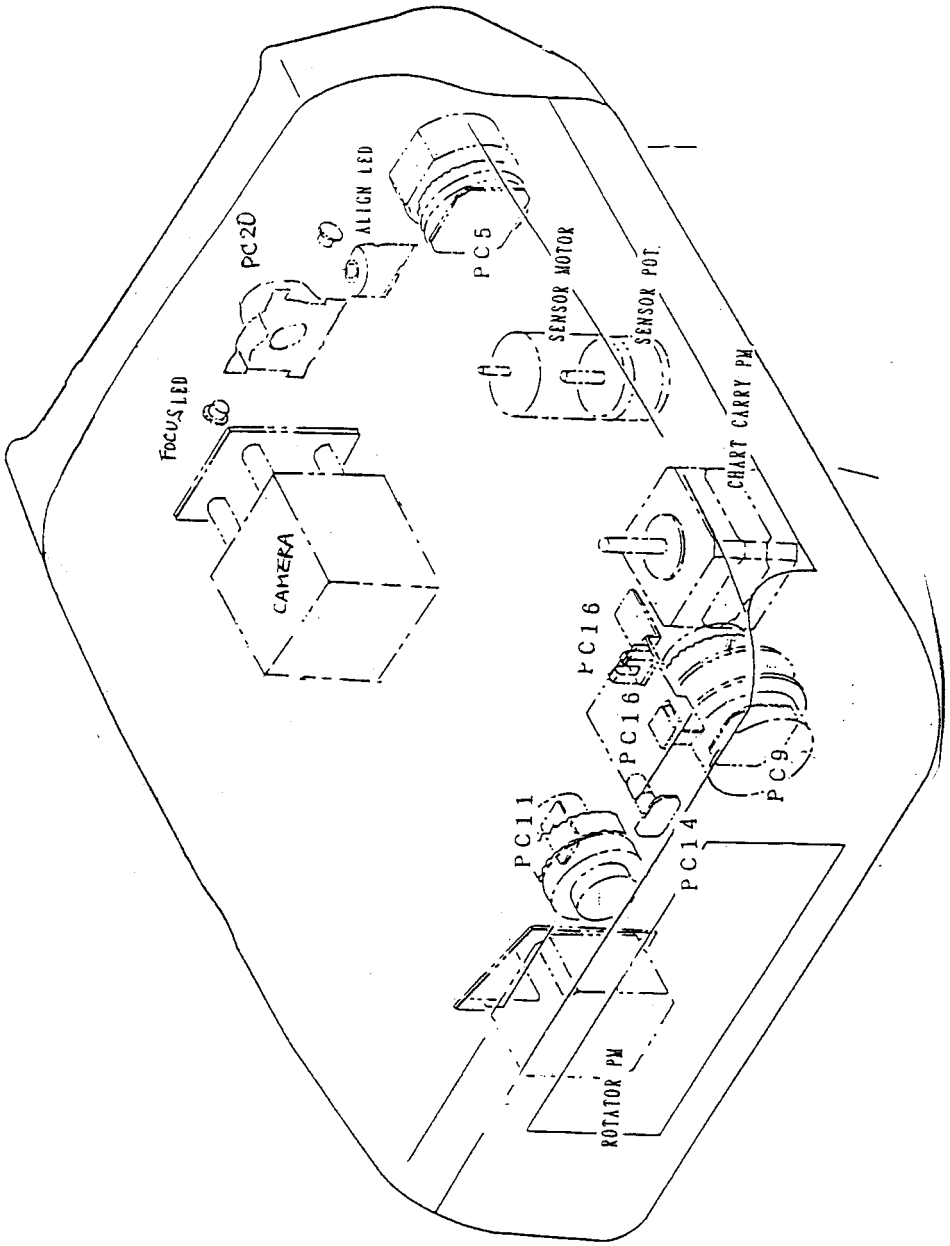


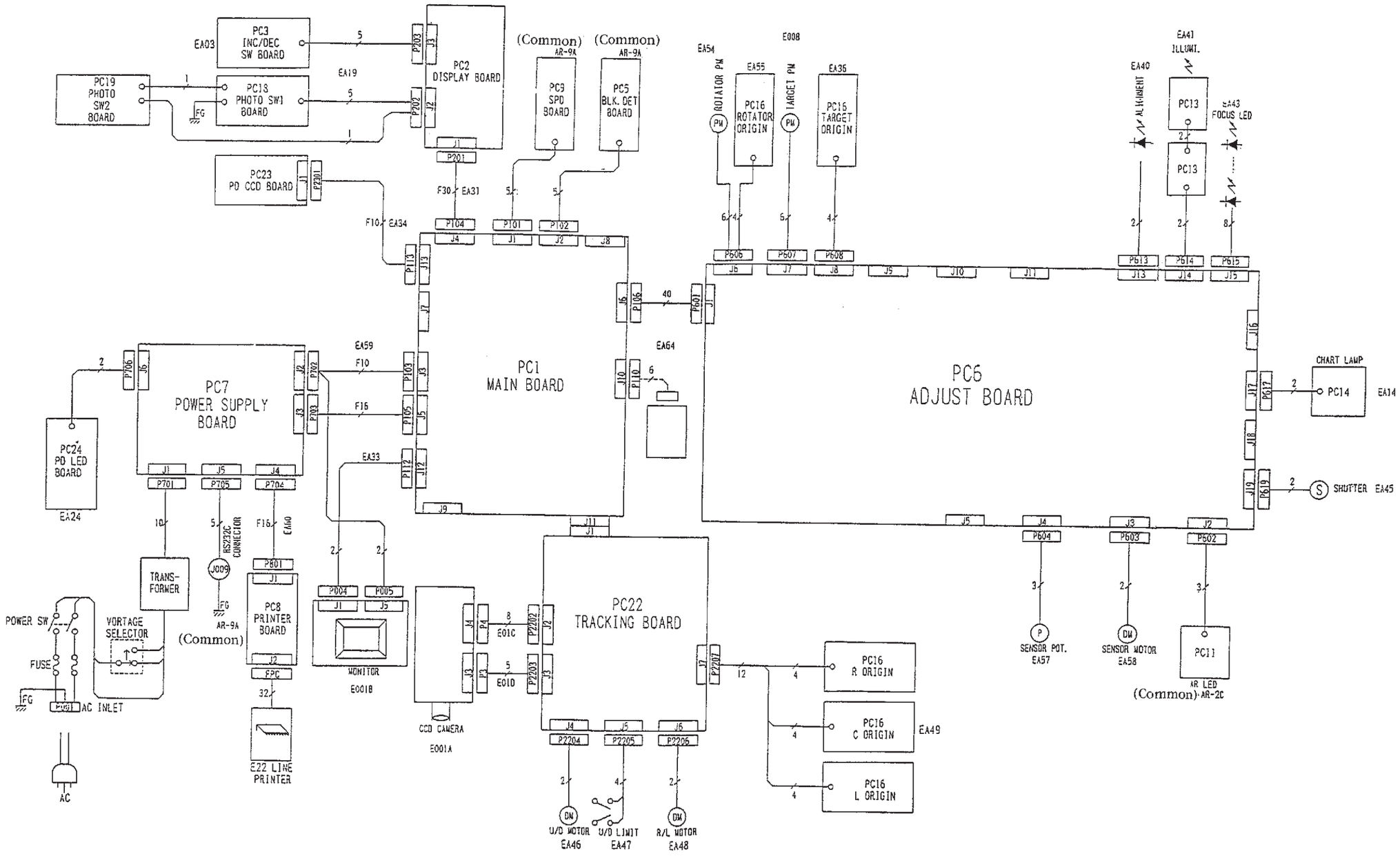
● AR-600 WIRING DIAGRAM

• **AR-600 CONSTRUCTION DRAWING**



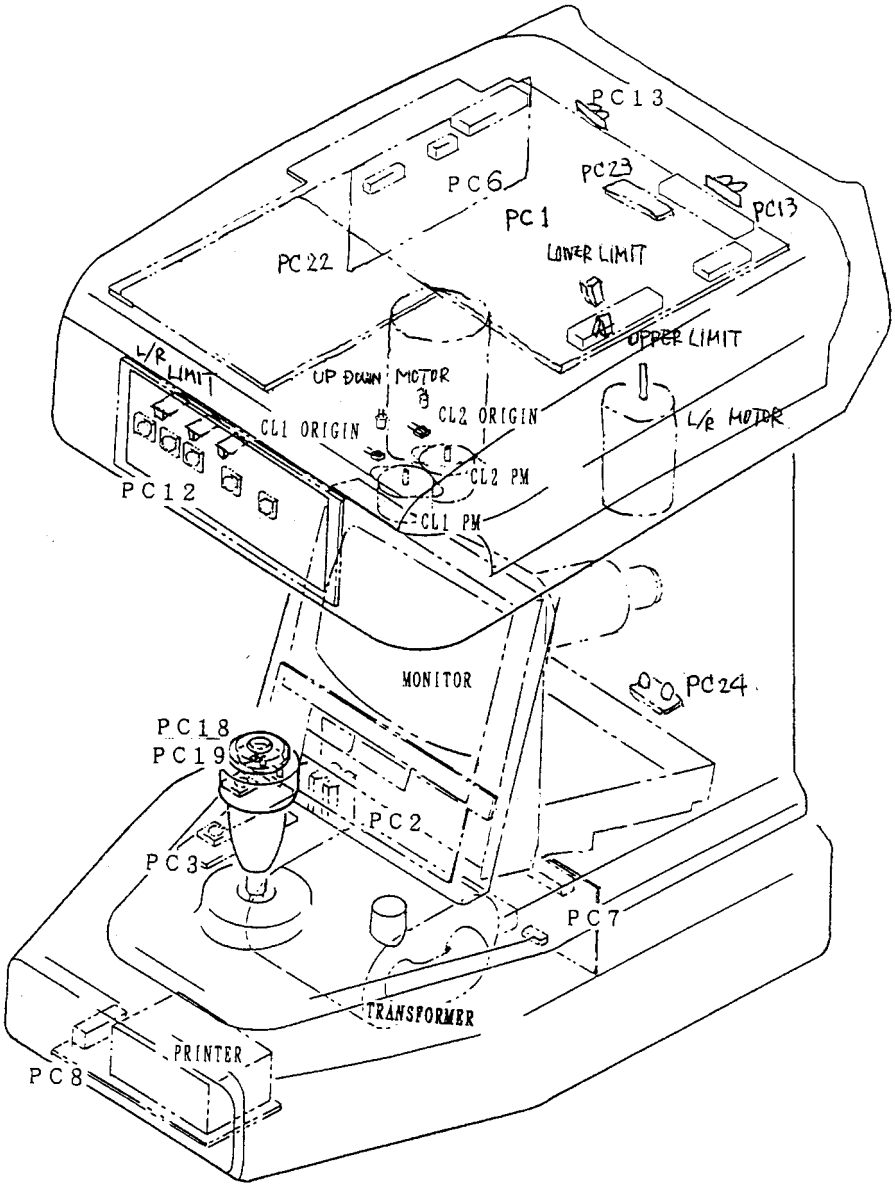
• **AR-600A CONSTRUCTION DRAWING**



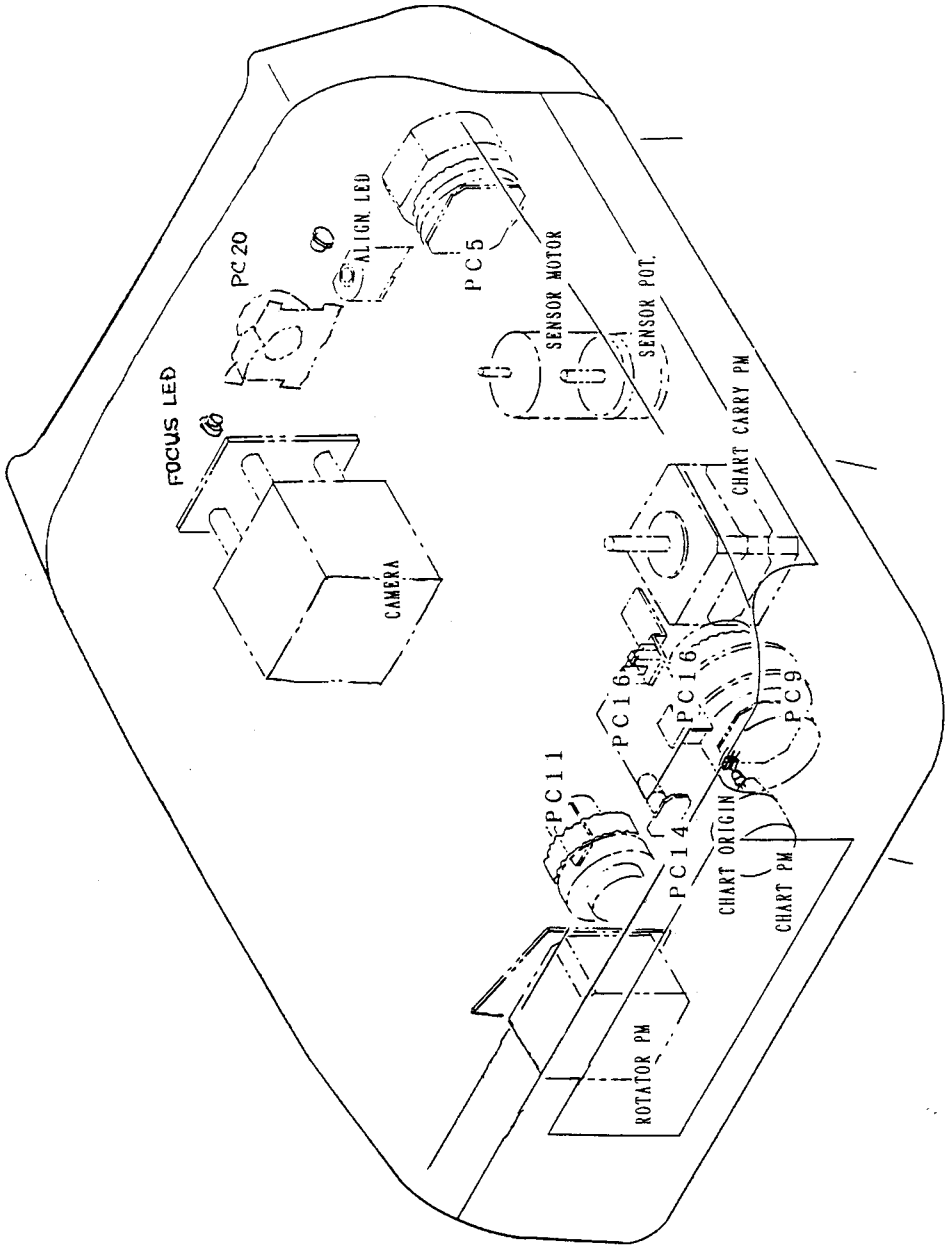


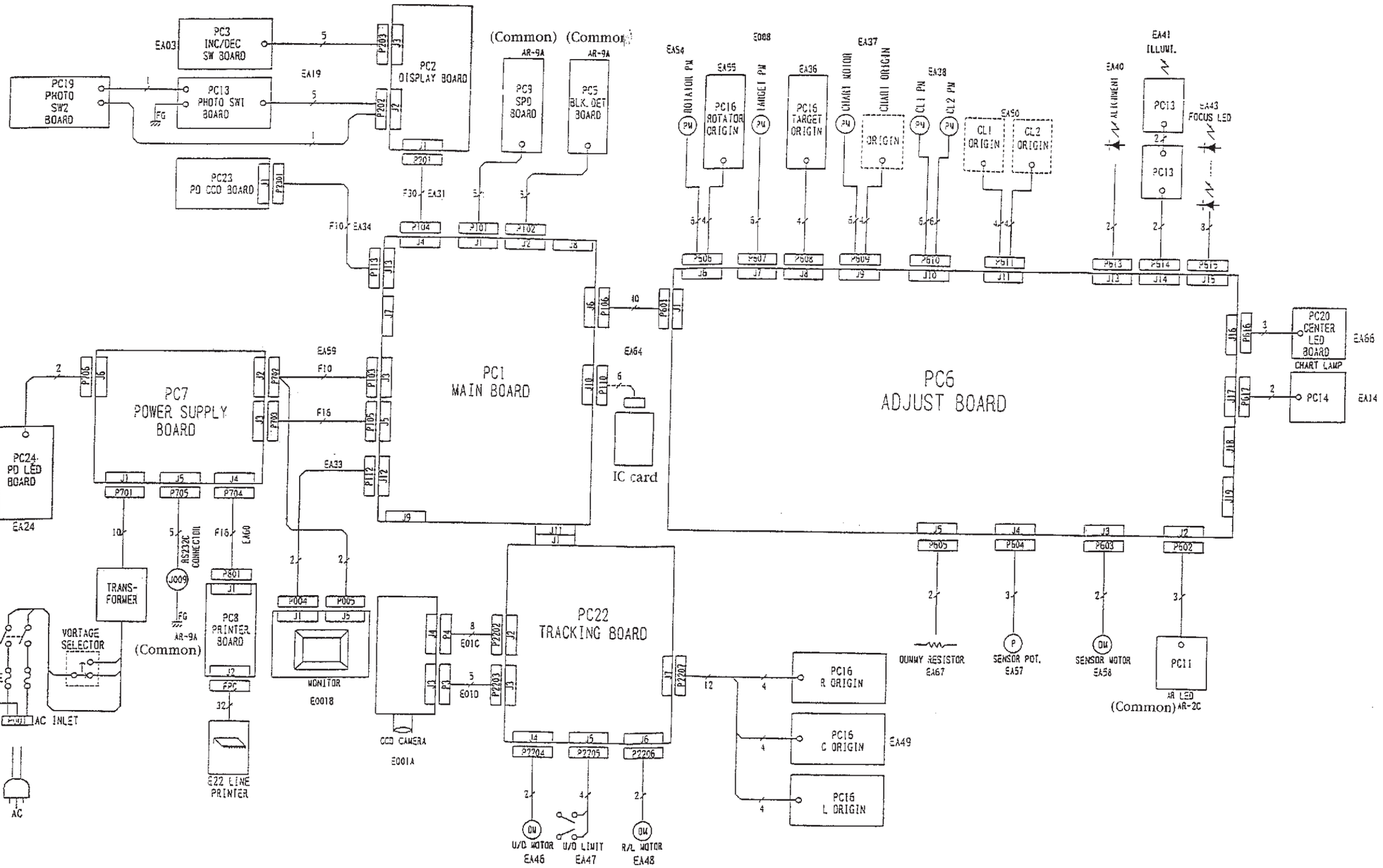
● AR-600A WIRING DIAGRAM

• **AR-660A CONSTRUCTION DRAWING**



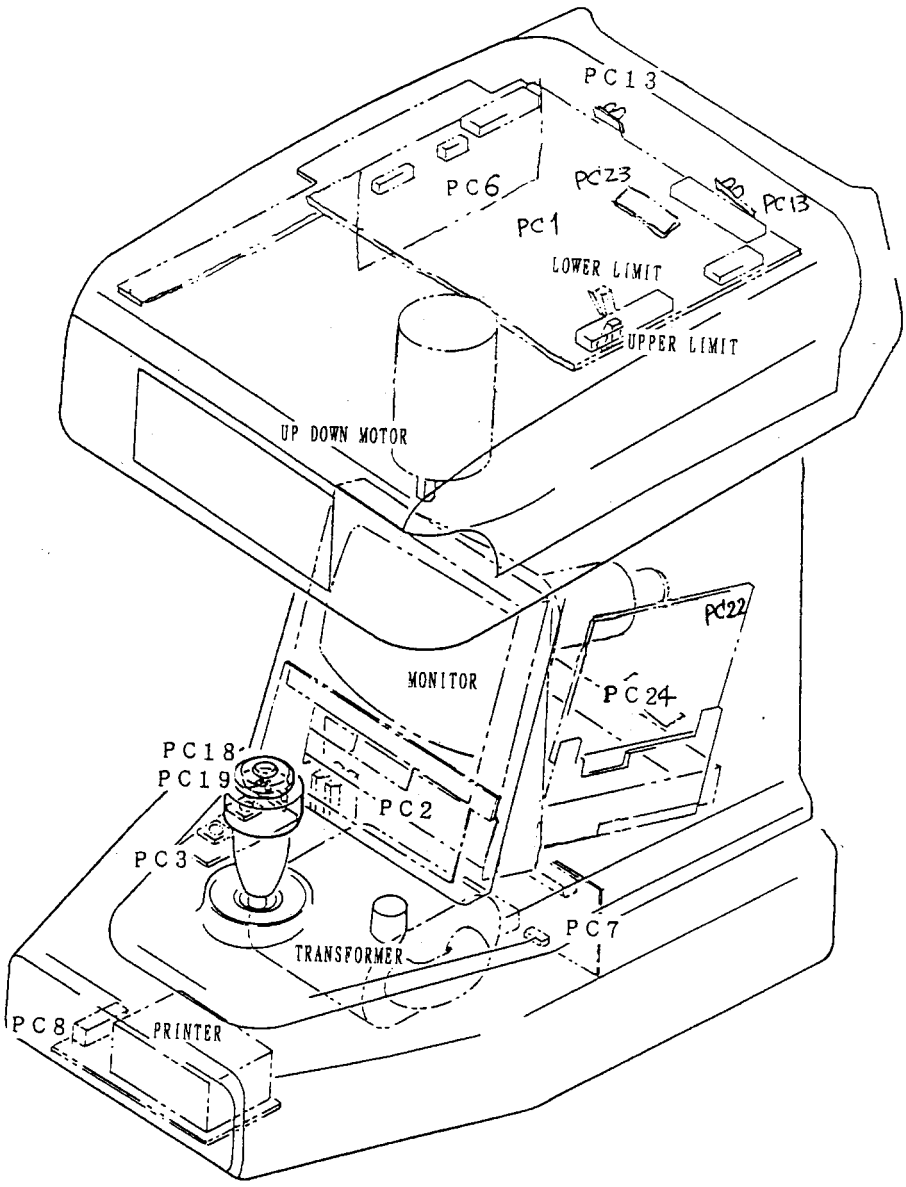
• **AR-660A CONSTRUCTION DRAWING**



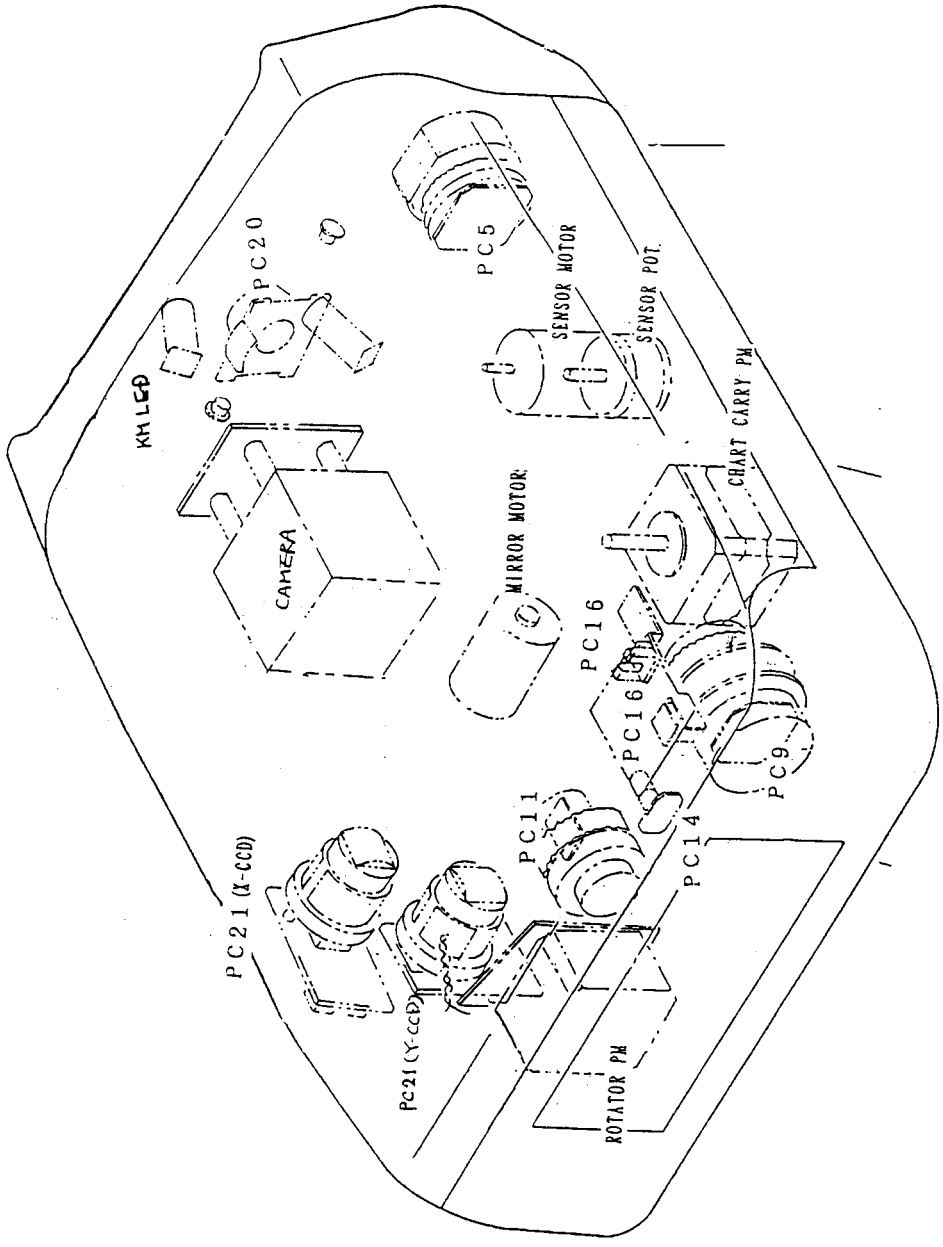


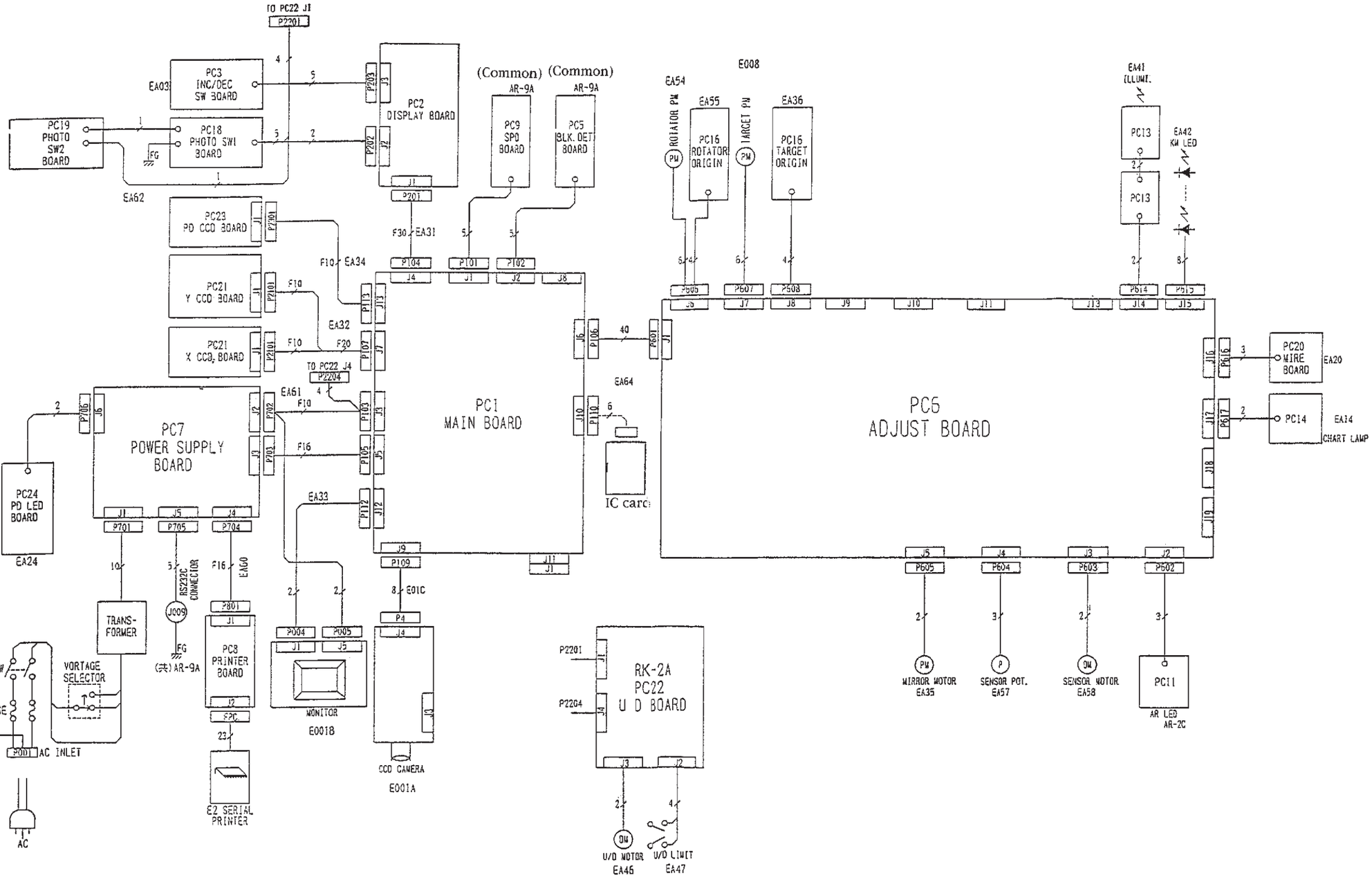
● AR-660A WIRING DIAGRAM

• **ARK-700 CONSTRUCTION DRAWING**



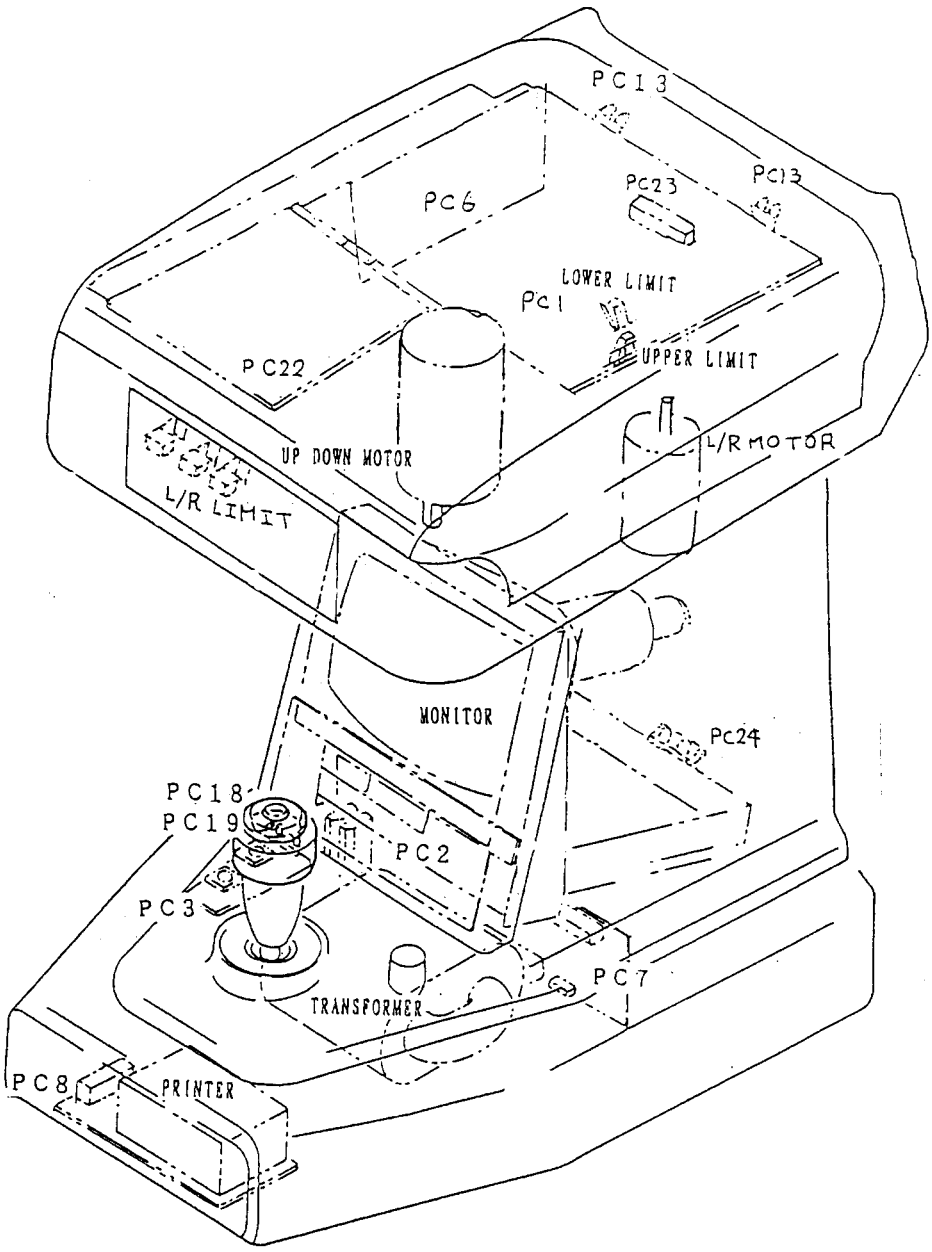
• **ARK-700 CONSTRUCTION DRAWING**



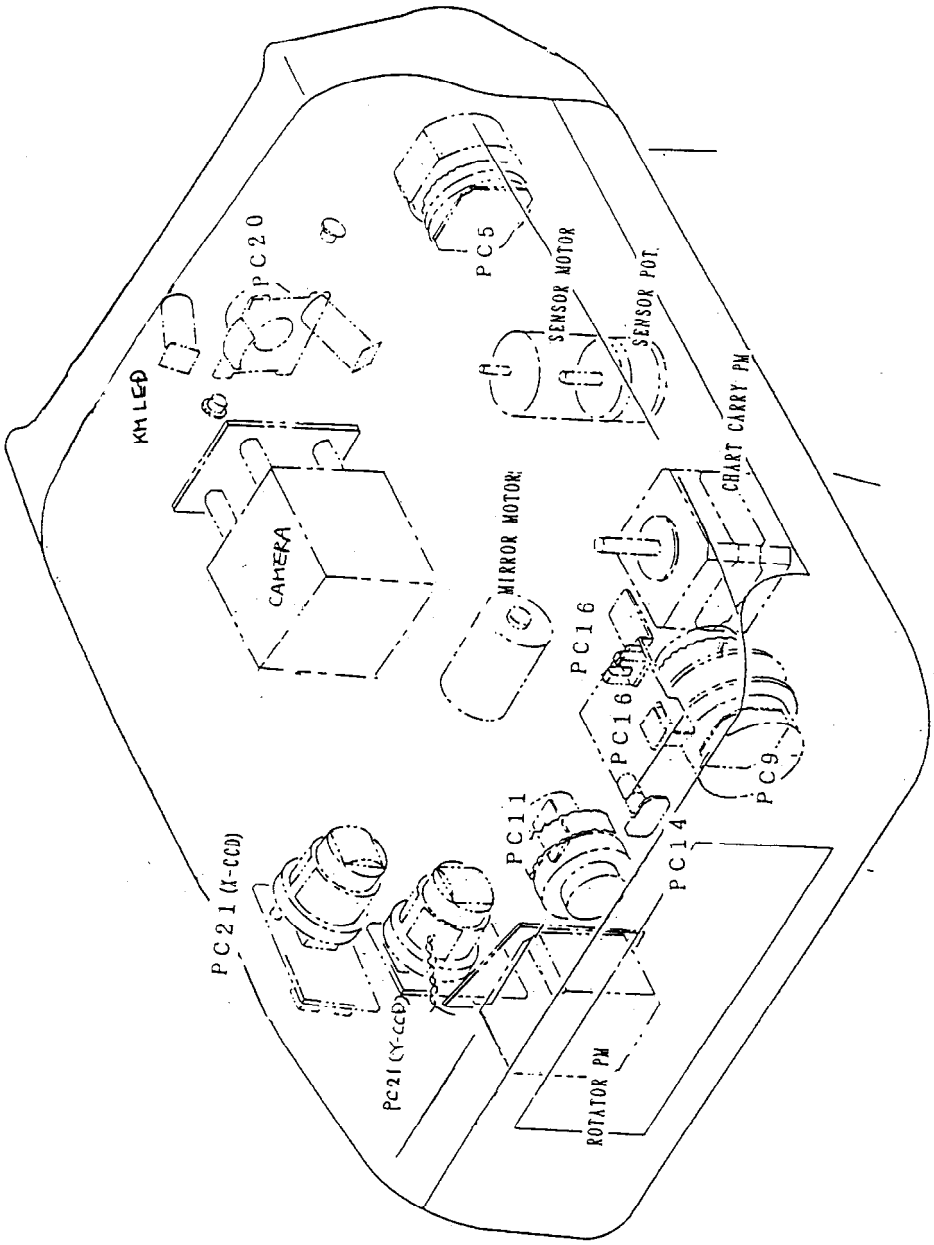


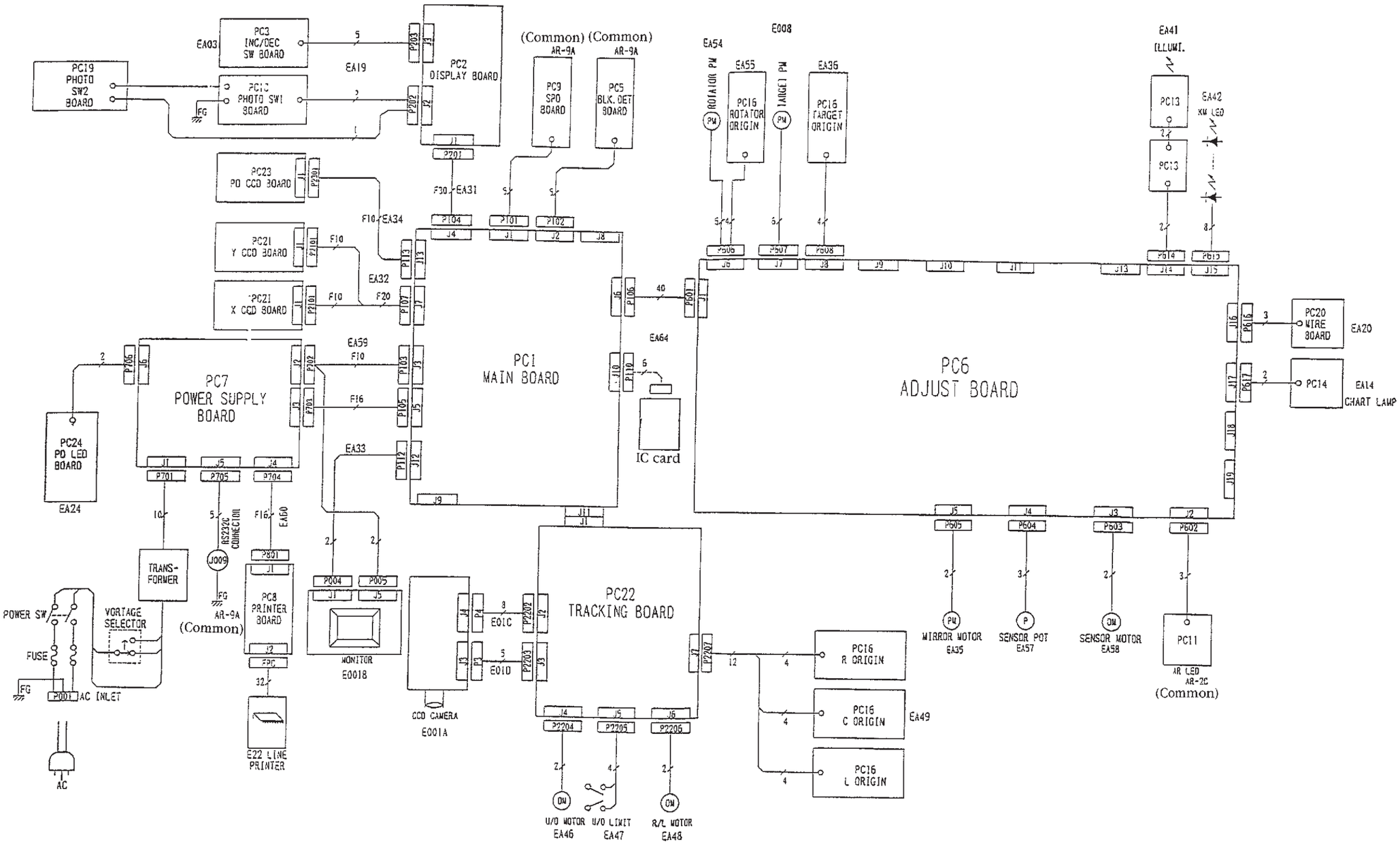
● ARK-700 WIRING DIAGRAM

• **AR-700A CONSTRUCTION DRAWING**



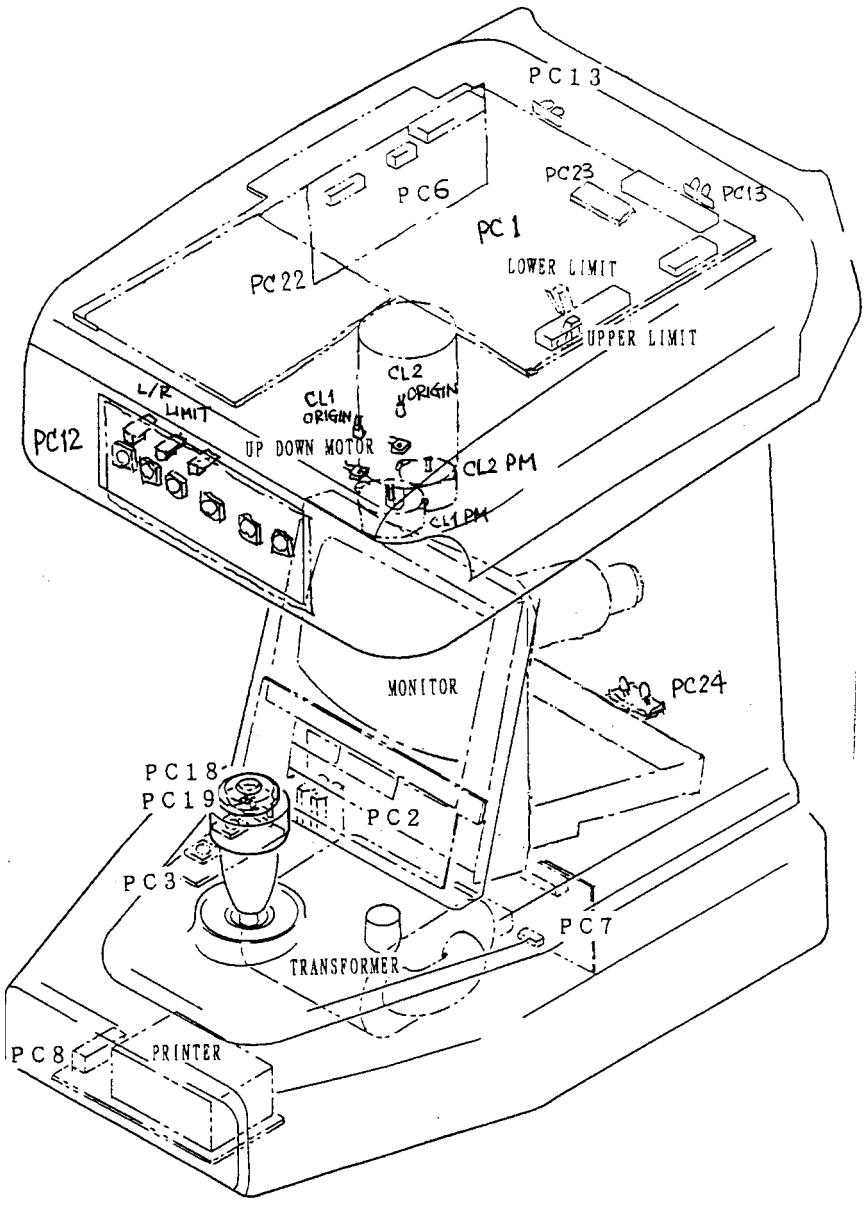
• **AR-700A CONSTRUCTION DRAWING**



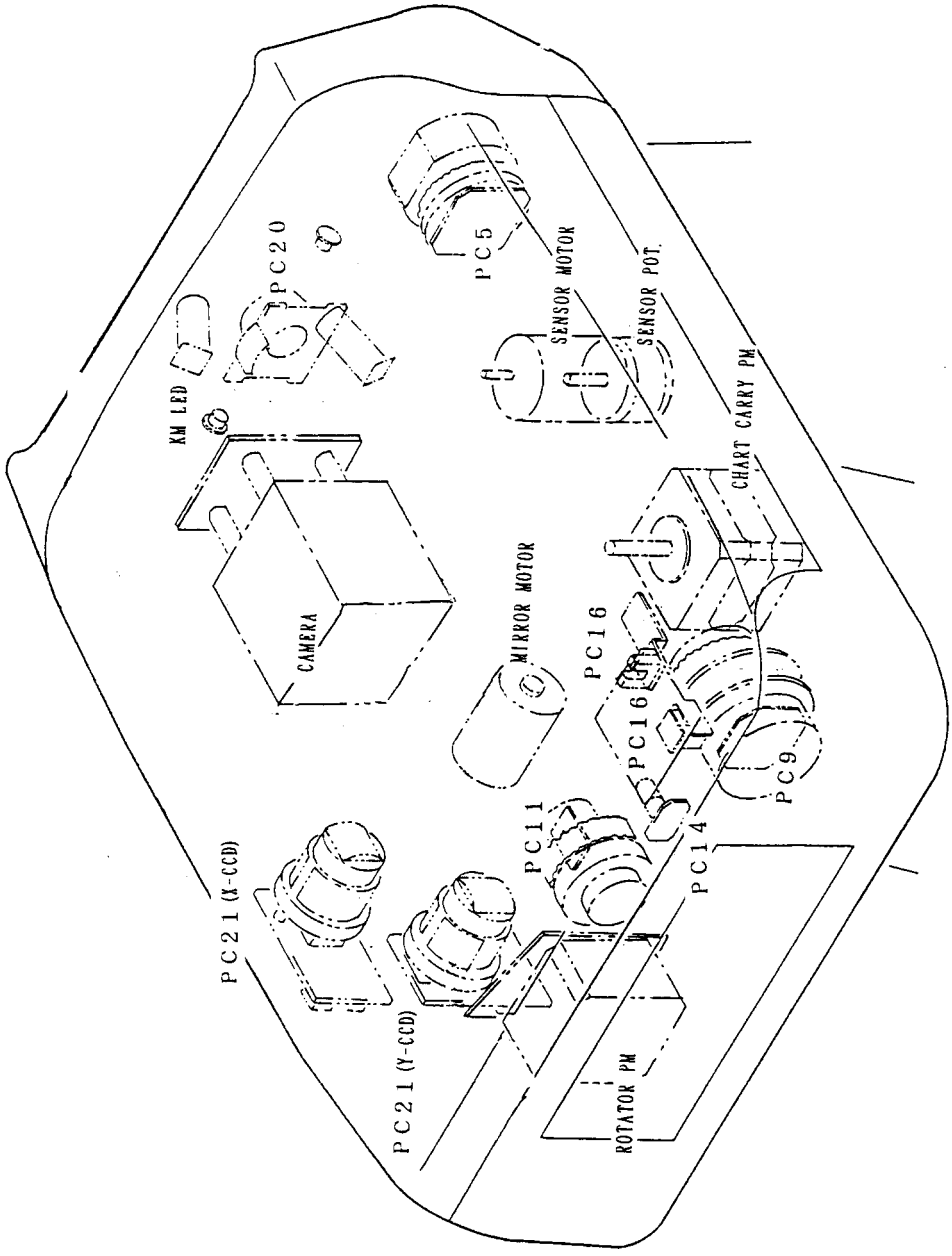


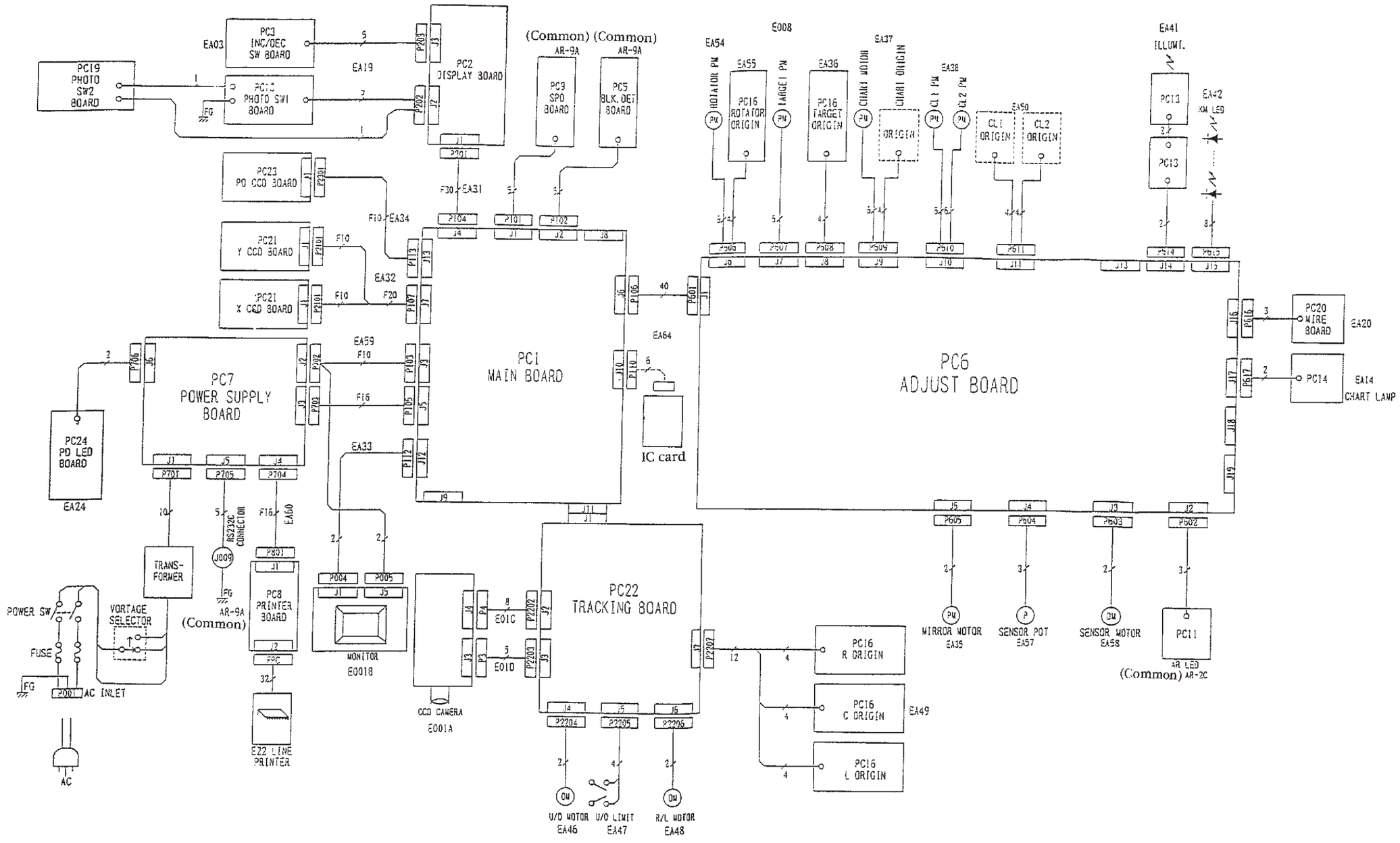
- ARK-700A WIRING DIAGRAM

- **AR-760A CONSTRUCTION DRAWING**

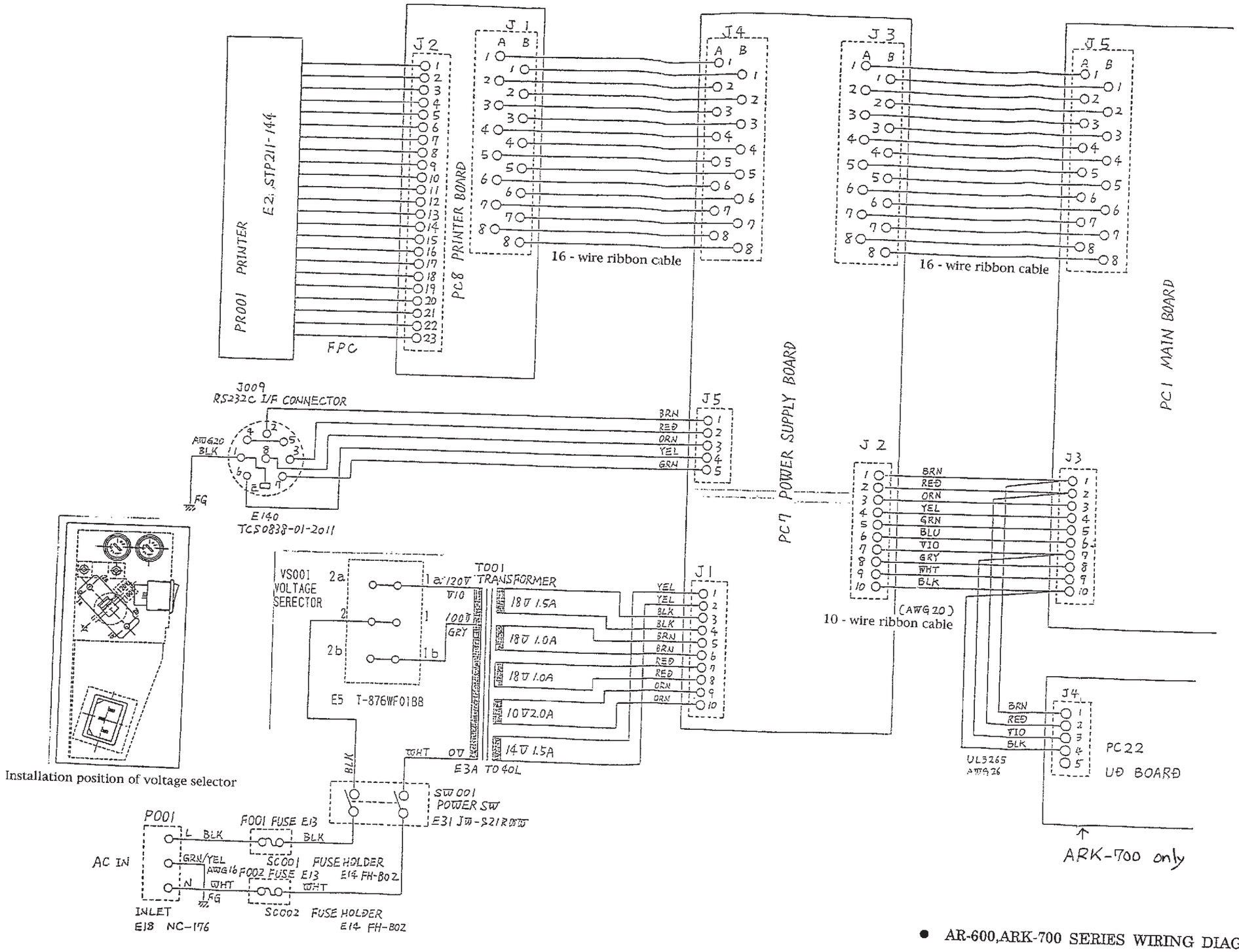


• **AR-760A CONSTRUCTION DRAWING**

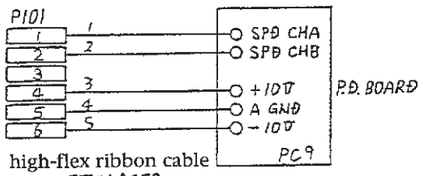




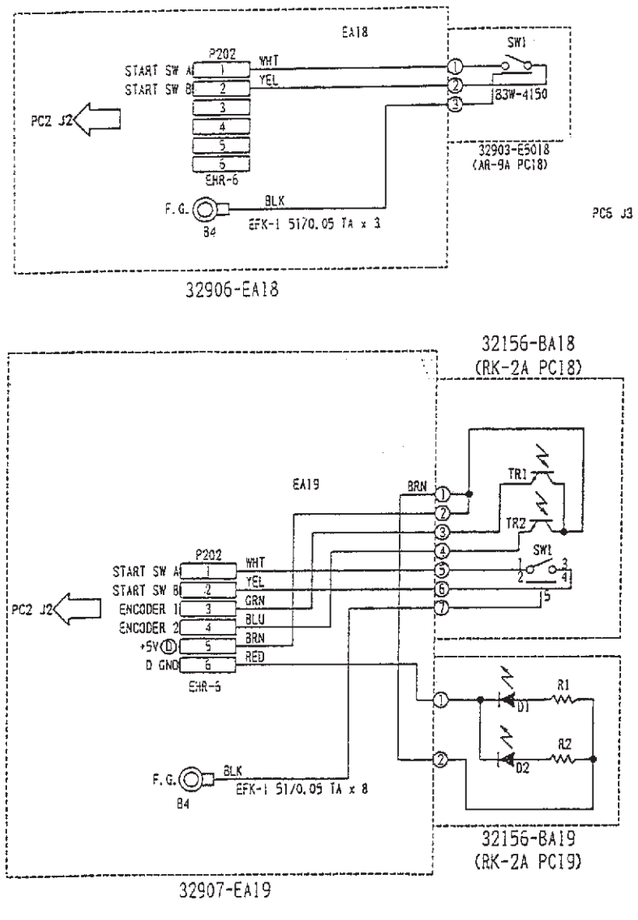
● ARK-760A WIRING DIAGRAM

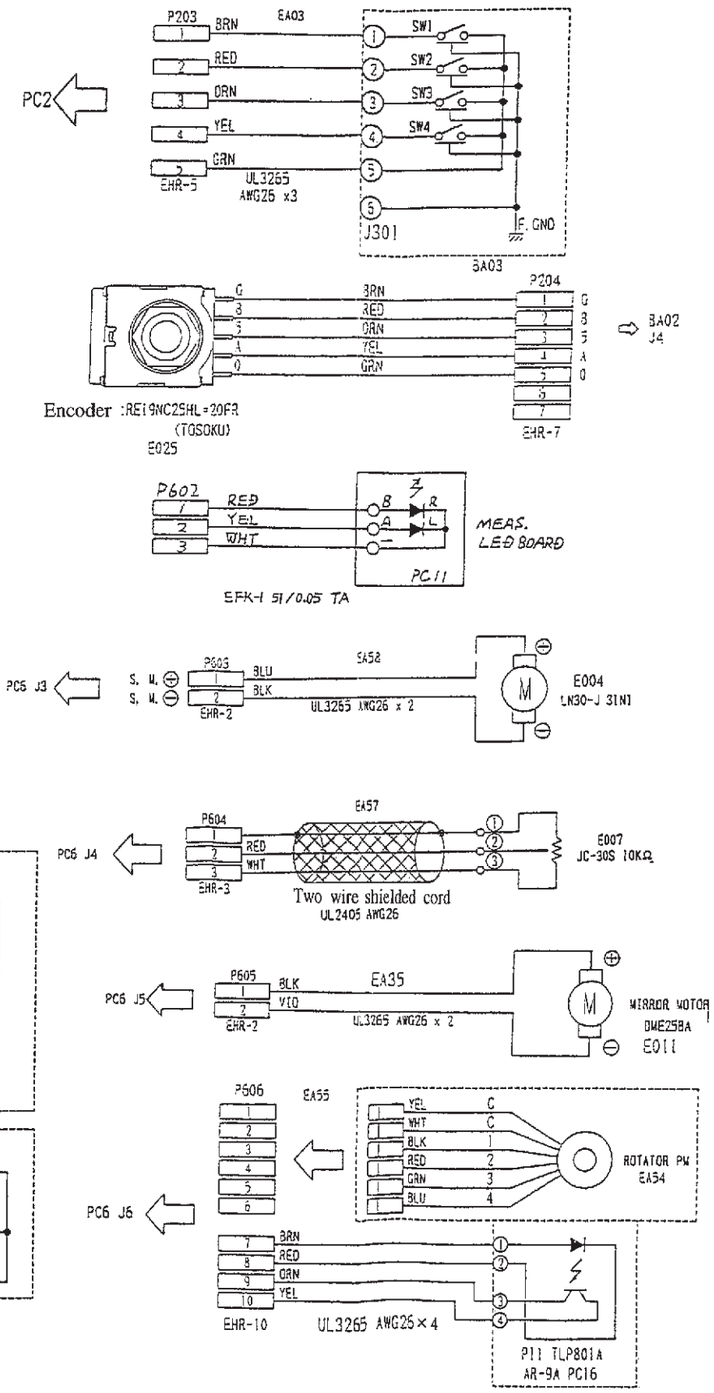


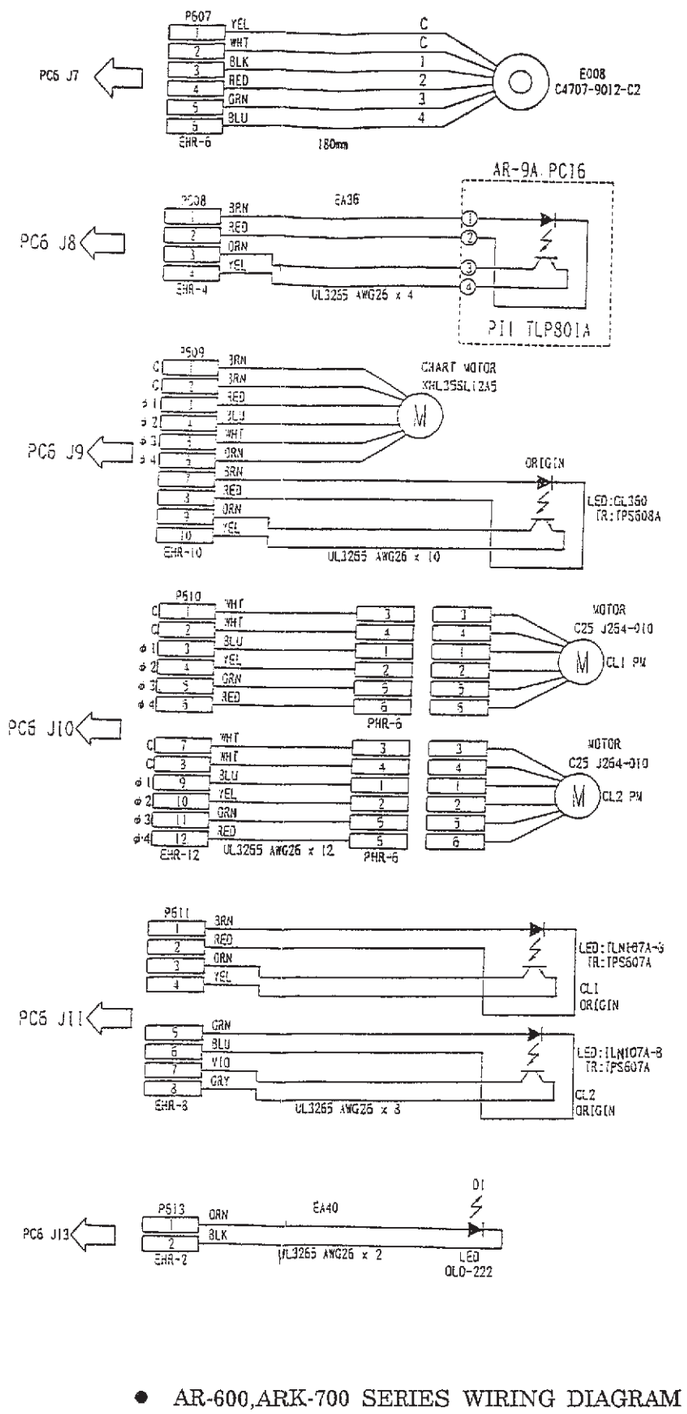
- AR-600,ARK-700 SERIES WIRING DIAGRAM

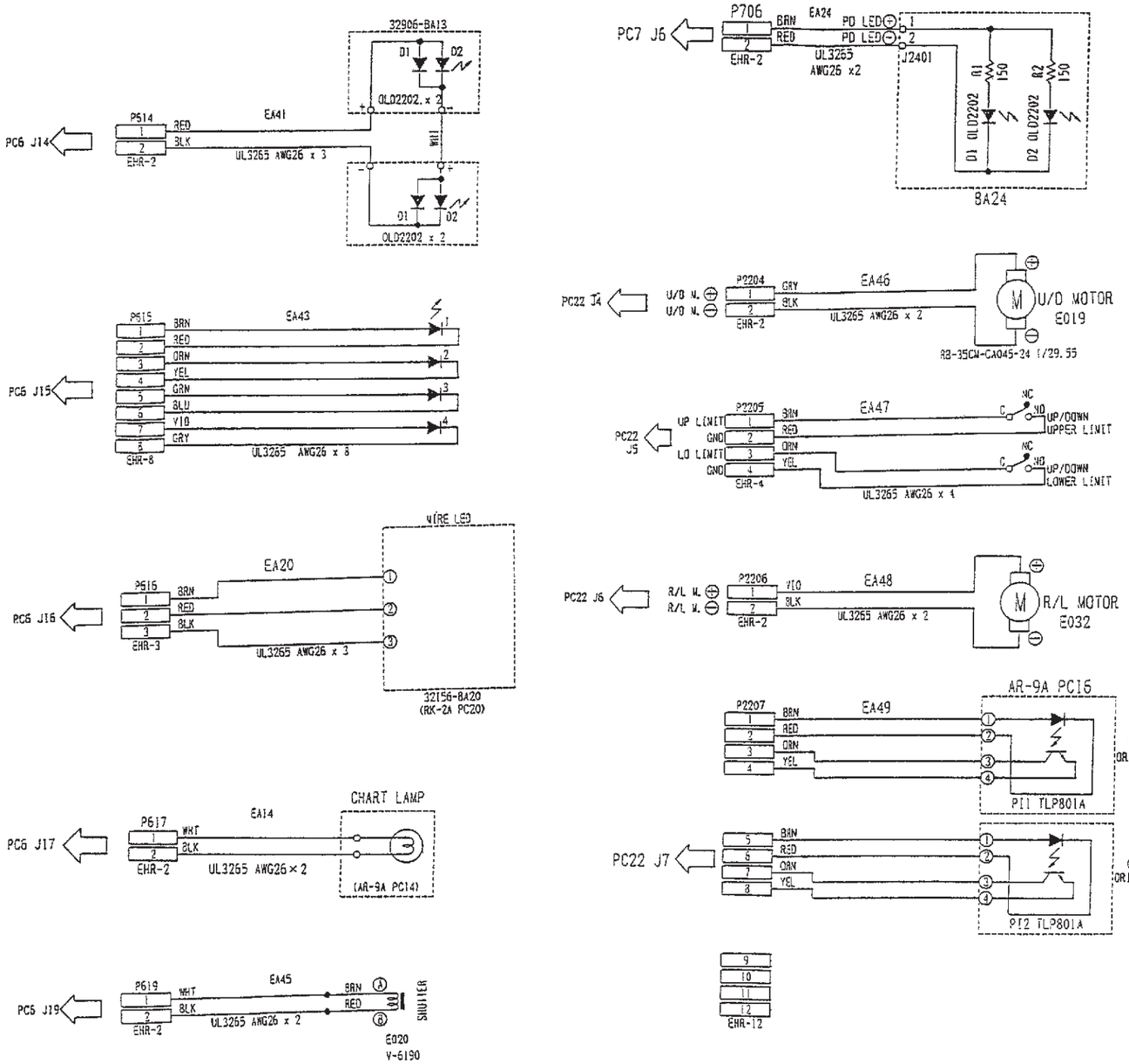

P101
SPD CHA
SPD CHB
+10V
A GND
-10V
P.D. BOARD
PC9
high-flex ribbon cable
FD06A050
No. on each wire corresponds to the wire No.
P102
MASK CHA
MASK CHB
+10V
A GND
-10V
BLK. DET BOARD
PC5
high-flex ribbon cable
FD06A050
No. on each wire corresponds to the wire No.

EA18
P202
START SW A
START SW B
WHT
YEL
SW1
83W-4150
PC2 J2
EHR-6
F.G.
BLK
B4
EFK-1 5170.05 TA x 3
32903-E5018
(AR-9A PC18)
32906-EA18


32156-BA18
(RK-2A PC18)
EA19
BRN
TR1
TR2
SW1
P202
START SW A
START SW B
ENCODER 1
ENCODER 2
+5V
D GND
WHT
YEL
GRN
BLU
BRN
RED
PC2 J2
EHR-6
R1
D1
R2
D2
F.G.
BLK
B4
EFK-1 5170.05 TA x 8
32156-BA19
(RK-2A PC19)
32907-EA19


P203
EA03
BRN
RED
ORN
YEL
GRN
SW1
SW2
SW3
SW4
PC2
EHR-5
UL3265
AWG25 x3
J301
F. GND
BA03
Encoder :RE19NC25HL-20FR
(TOSOKU)
E025
P204
BA02
J4
EHR-7
P602
RED
YEL
WHT
MEAS.
LED BOARD
PC11
EFK-1 5170.05 TA
PC6 J3
P603
EA58
BLU
BLK
S. M.
S. M.
EHR-2
UL3265 AWG26 x 2
E004
LN30-J 31N1
PC6 J4
P604
EA57
RED
WHT
EHR-3
E007
JC-30S 10KΩ
Two wire shielded cord
UL2405 AWG26
PC6 J5
P605
EA35
BLK
VIO
EHR-2
UL3265 AWG26 x 2
MIRROR MOTOR
DME258A
E011
PC6 J6
P506
EA55
BRN
RED
ORN
YEL
EHR-10
UL3265 AWG26×4
ROTATOR PW
EA54
P11 TLP801A
AR-9A PC16


PC6 J7
P507
YEL
WHT
BLK
RED
ORN
BLU
EHR-6
180mm
E008
C4707-9012-C2
AR-9A PC16
PC6 J8
P508
EA36
BRN
RED
ORN
YEL
EHR-4
UL3265 AWG26 x 4
P11 TLP801A
PC6 J9
P509
EA37
CHART MOTOR
XHL35SL12A5
BRN
RED
BLU
WHT
ORN
ORIGIN
LED:GL360
TR:TPS608A
EHR-10
UL3265 AWG26 x 10
PC6 J10
P510
EA38
MOTOR
C25 J264-010
CL1 PW
CL2 PW
PHR-6
EHR-12
UL3265 AWG26 x 12
PC6 J11
P511
EA39
LED:TLN107A-G
TR:TPS607A
CL1
ORIGIN
LED:TLN107A-B
CL2
ORIGIN
EHR-8
UL3265 AWG26 x 8
PC6 J13
P513
EA40
ORN
BLK
EHR-2
UL3265 AWG26 x 2
LED
OLD-222


32806-BA13
D1
D2
OLD2202. x 2
P514
RED
BLK
EA41
PC6 J14
EHR-2
UL3265 AWG26 x 3
WHT
OLD2202 x 2
P515
BRN
RED
ORN
YEL
GRN
BLU
YLW
GRY
EA43
PC6 J15
EHR-8
UL3265 AWG26 x 8
WIRE LED
EA20
P516
BRN
RED
BLK
PC6 J16
EHR-3
UL3265 AWG26 x 3
32156-BA20
(RK-2A PC20)
CHART LAMP
EA14
P617
WHT
BLK
PC6 J17
EHR-2
UL3265 AWG26×2
(AR-9A PC14)
EA45
P619
WHT
BLK
BRN
RED
PC6 J19
EHR-2
UL3265 AWG26 x 2
SHUTTER
E020
V-6190
P706
BRN
RED
EA24
PD LED⊕
PD LED⊖
PC7 J6
EHR-2
UL3265
AWG26 x2
J2401
R1
150
R2
150
D1 OLD2202
D2 OLD2202
BA24
P2204
GRY
BLK
EA46
U/D M.⊕
U/D M.⊖
PC22 J4
EHR-2
UL3265 AWG26 x 2
U/D MOTOR
E019
RB-35CW-CA045-24 1/29.55
P2205
BRN
RED
ORN
YEL
EA47
UP LIMIT
GND
LO LIMIT
GND
PC22
J5
EHR-4
UL3265 AWG26 x 4
NC
NO
UP/DOWN
UPPER LIMIT
UP/DOWN
LOWER LIMIT
P2206
YEL
BLK
EA48
R/L M.⊕
R/L M.⊖
PC22 J6
EHR-2
UL3265 AWG26 x 2
R/L MOTOR
E032
AR-9A PC16
P2207
BRN
RED
ORN
YEL
EA49
R
ORIGIN
PI1 TLP801A
PC22 J7
C
ORIGIN
PI2 TLP801A
EHR-12

• AR-600, AR-700 SERIES CONNECTOR TABLE

PJ101	1	SPD CHA	BLUE LINE
	2	SPD CHB	
	3	(DUMMY)	(OPEN)
	4	+10V	FLAT CABLE
	5	A GND	
	6	-10V	

PJ102	1	MASK CHA	BLUE LINE
	2	MASK CHB	
	3	+10V	
	4	A GND	FLAT CABLE
	5	-10V	

PJ103	1	+15V D	BRN
PJ702	2	+15V D GND	RED
	3	VCC/+5V	ORN
	4	+5V GND	YEL
	5	+15V	GRN
	6	A GND	BLU
	7	-15V	VIO
	8	+12V	GRY
	9	+12V GND	WHT
	10	+5V D	BLK

		A	B
PJ104	1	D GND	D GND
PJ201	2	+5V D	+5V D
	3	D0	D1
FLAT	4	D2	D3
RIBBON	5	D4	D5
	6	D6	D7
	7	WR0	WR1
	8	DISP MODE	B
	9	DISP SW1	SW2
	10	SW3	SW4
	11	SCAN0	SCAN1
	12	SCAN2	SCAN3
	13	EC1	EC2
	14	+5V D	+5V D
	15	A	D GND

		A	B
PJ105	1	PRINT PROG	P20
PJ703	2	P21	P22
	3	P23	PRSTATUS
FLAT	4	+12V REMOTE	TH-EN
RIBBON	5	EXT TXD	EXT-RXD
	6	EXT DTR	EXT-DSR
	7	Voc	Voc
	8	GND	GND

		A	B
PJ106	1	+15V	SDUMPER
PJ601	2	SPOT	-15V
	3	A GND	+5V D
FLAT	4	+5V D	+15V D
RIBBON	5	+15V D	+15V D
	6	S.M.	AR LED R
	7	AR LED L	D GND
	8	D GND	D GND
	9	MIR.MOTOR	LED L TMG
	10	LED R TMG	Voc
	11	Voc	GND
	12	GND	SOUT EN
	13	SOUT SCK	SOUT DATA
	14	SOUT LATCH	E2PROM CS
	15	SK	DI
	16	DO	RT.ORIGIN
	17	TG.ORIGIN	CH.ORIGIN
	18	CL1 ORIGIN	CL2 ORIGIN
	19	LED EN PW3	LED SCK
	20	LED SO	LED LATCH

		A	B
PJ107	1	ø M1	ø CCD1
	2	ø SH1	VIDEO1
CCD1	3	+5V A	+12V
	4	GND	A GND
	5		
	6	ø M2	ø CCD2
CCD2	7	ø SH2	VIDEO2
	8	+5V A	+12V
	9	GND	A GND
	10		

		A	B
PJ108	1	SW1	SW2
J1201	2	SW3	SW4
	3	SCAN5	SCAN6
FLAT	4	LOAD	DATA
RIBBON	5	CLOCK	
	6	GND	GND
	7	Voc	Voc
	8		

PJ109	1	VIDEO IN	
	2	GND	
	3	+12V	
	4	GND	
	5	HD	
	6	VD	
	7	GND	
	8	+5V(C)	

PJ110	1	CARD DTR	BRN
PJ011	2	CARD TXD	RED
	3	CARD DSR	ORN
	4	CARD RXD	YEL
	5	D GND	GRN
	6	+5V D	BLU
	7		VIO

		A	B
J111	1	+15V D	D GND
J2201	2	+15V D	D GND
	3	+15V D	D GND
	4	LED LATCH	LED SCK
FLAT	5	LED SO	TXD
RIBBON	6	DSR	SCK
	7	DTR	RXD
	8	ROTR/L	EC1EC2
	9	VCC	HD
	10	VCC	VD
	11	VD	VCC
	12	+15V	GND
	13	+5V(C)	+5V(C)
	14	GND	GND
	15	VIDEO	GND

PJ112	1	VIDEO OUT	WHT
P004	2	GND	SHIELD

(J001) MONITOR

		A	B
PJ113	1	ø M3	ø CCD3
PJ2301	2	ø SH3	VIDEO3
	3	+5V A	+12V
FLAT	4	GND	A GND
RIBBON	5		

PJ202	1	START SW A	BRN
	2	START SW B	GRN
	3	ENCODER 1	BLU
	4	ENCODER 2	WHT
	5	+5V D	YEL
	6	D GND	RED

PJ203	1	SW1	BRN
	2	SW2	RED
	3	SW3	ORN
	4	SW4	YEL
	5	SCAN2	GRN

S.C.A. ENCODER

PJ204	1	G	BRN
	2	B	RED
	3	5	ORN
	4	A	YEL
	5	O	GRN
	6		
	7		

PJ602	1	AR LED R	RED
	2	AR LED L	YEL
	3	D GND	WHT

PJ603	1	S.M.+	BLU
	2	S.M.-	BLK

PJ604	1	-6.2V	SHIELD
	2	S.POT	RED
	3	+6.2V	WHT

PJ605	1	MIR.MOTOR +	VIO
	2	MIR.MOTOR -	BLK

PJ606	1	R.PM COM	YEL
	2	R.PM COM	WHT
	3	ø 1	BLK
	4	ø 2	RED
	5	ø 3	GRN
	6	ø 4	BLU
	7	P.I.A	BRN
	8	P.I.K	RED
	9	R.ORIGIN	ORN
	10	GND	YEL

PJ607	1	T.PM.COM	YEL
	2	T.PM.COM	WHT
	3	ø 1	BLK
	4	ø 2	RED
	5	ø 3	GRN
	6	ø 4	BLU

PJ608	1	P.I.A	BRN
	2	P.I.K	RED
	3	T.ORIGIN	ORD
	4	GND	YEL

PJ609	1	CH.PM COM	BRN
	2	CH.PM COM	BRN
	3	ø 1	RED
	4	ø 2	BLU
	5	ø 3	WHT
	6	ø 4	ORN
	7	P.I.A	BRN
	8	P.I.K	RED
	9	CH.ORIGIN	ORN
	10	GND	YEL

PJ610	1	CL1 PM COM	WHT
	2	CL1 PM COM	WHT
	3	ø 1	BLU
	4	ø 2	YEL
	5	ø 3	GRN
	6	ø 4	RED
	7	CL2 PM COM	WHT
	8	CL2 PM COM	WHT
	9	ø 1	BLU
	10	ø 2	YEL
	11	ø 3	GRN
	12	ø 4	RED

PJ611	1	CL1 LED A	BRN
	2	CL1 LED K	RED
	3	CL1 ORIGIN	ORN
	4	GND	YEL
	5	CL2 LED A	GRN
	6	CL2 LED K	BLU
	7	CL2 ORIGIN	VIO
	8	GND	GRY

PJ613	1	ALIGN.LED A	ORN
	2	ALIGN.LED K	BLK

PJ614	1	ILLUMI.LED A	RED
	2	D GND	BLK

PJ615	1	LED1 A (R)	BRN
	2	LED1 K	RED
	3	LED2 A (U)	ORN
	4	LED2 K	YEL
	5	LED3 A (L)	GRN
	6	LED3 K	BLU
	7	KED4 A (D)	VIO
	8	LED4 K	GRY

PJ616	1	MIRE LED A	BRN
	2	MIRE LED A	RED
	3	MIRE LED K	BLK

PJ617	1	VCC	WHT
	2	CHART LAMP	BLK

PJ18	1	+5V D
	2	GLARE LAMP
	3	+5V D
	4	GLARE LAMP

PJ619	1	+5V D	WHT
	2	SHUTTER	BLK

PJ701	1	AC14V	YEL
	2	AC14V	YEL
	3	AC18V	BLK
	4	AC18V	BLK
	5	AC18V	BRN
	6	AC18V	BRN
	7	AC18V	RED
	8	AC18V	RED
	9	AC10V	ORN
	10	AC10V	ORN

		A	B
PJ704	1	PR.PROG.	P20
	2	P21	P22
	3	P23	HOME SW/PRSTATUS
FLAT	4	TH.TRIG.	TH.EN.
RIBBON	5	+5V (PM)	+5V(PM)
	6	+5V	+5V
	7	GND	GND
	8		

PJ705	1	TXD	BRN
	2	RXD	RED
	3	DTR	ORN
	4	DSR	YEL
	5	S.GND	GRN

PJ706	1	PD LED +	RED
	2	PD LED -	BLD

		SER.PRINTER	LIN PRINTER
PJ802	1	GND	③ P.I.C
	2	HOME SW	② P.I.E.K
	3	H.PM COM	① SW.P.I.A
	4	H.PM COM	SW
	5	H.PM ø 1	VH
	6	ø 2	VH
	7	ø 3	DATA IN
	8	ø 4	B.E.O.
	9	TH1	LATCH
FLEX	10	TH2	CLOCK
WIRE	11	TH3	STB6
	12	TH4	STB5
	13	TH5	STB4
	14	TH6	STB3
	15	TH7	STB2
	16	TH8	STB1
	17	TH COM.	GND_H
	18	P.PM COM.	GND_H
	19	P.PM COM.	GND_H
	20	P.PM ø 1	GND_H
	21	ø 2	GND_L
	22	ø 3	V_{DD}
	23	ø 4	T2
	24		T1
	25		THERMISTOR
	26		THERMISTOR
	27		B
	28		B
	29		A
	30		A
	31		V_H
	32		V_H

PJ2202	1	VIDEO IN	WHT
PJ004	2	VIDEO GND	SHIELD
CAMERA	3	NC	WHT
	4	GND	WHT
	5	HD	WHT
	6	VD	WHT
	7	GND	WHT
	8	+5V(C)	WHT

PJ2203	1	DC	WHT
	2	DC GND	WHT
	3	FI	WHT
	4	C.SYNC	WHT
	5	GND	WHT

PJ2204	1	U/D M. +	GRY
	2	U/D M. -	BLK

PJ2205	1	UPLIMIT	BRN
	2	GND	RED
	3	DOWN LIMIT	ORN
	4	GND	YEL

PJ2206	1	R/L M. +	VIO
	2	R/L M. -	BLK

PJ2207	1	P.I.A	BRN
	2	P.I.K	RED
	3	R LIMIT ORIGIN	ORN
	4	GND	YEL
	5	P.I.A	BRN
	6	P.I.K	RED
	7	C LIMIT ORIGIN	ORN
	8	GND	YEL
	9		
	10		
	11		
	12		

		A	B
PJ2301	1	ø M	ø CCD
	2	ø SH	VIDEO OUT
FLAT	3	+5V A	+12V
RIBBON	4	GND	A GND
	5		

PJ005	1	+12V	GRY
MONITOR	2		
	3		
	4	GND	WHT

Error Code	Indication		Contents	Details
	With code	Without code		
1	Err	Err 1	Sensor error	The distance the sensor moves is abnormal.
2	Err	Err 2	Target error	The target limit SW does not work.
3	Err	Err 3	Rotator error	The rotator limit SW does not work.
4	Err	Err 4	Chart error	The chart sensor does not work.
5	Err	Err 5	CL1 error	The cylinder lens 1 sensor does not work.
6	Err	Err 6	CL2 error	The cylinder lens 2 sensor does not work.
7	Err	Err 7	Printer error	Paper is lack or the paperweight is lift up. (When the line printer is used.)
8	Err	Err 8	Printer error	The HOME SW does not work. (When the serial printer is used.)
9	Err	Err 9	E2PROM error	E2PROM data is broken.
A	Err	Err a	RAM error	RAM backup data is broken.
B	Err	Err b	TV camera error	Synchronized signal does not appear.
C	Err	Err c	PC22 communication error	Cannot communicate with PC22 board.
D	Err	Err d	Clock error	Clock data is abnormal.
11	Err IF	Err 11	DSR error (OUT)	Data is not set ready when SD command is received.
12	Err IF	Err 12	DSR error (OUT)	Data is not set ready when data is sent.
13	Err IF	Err 13	Data error (OUT)	Data cannot be received.
14	Err IF	Err 14	Overflow (OUT)	The receive buffer is full.
15	Err IF	Err 15	Command error (OUT)	An illegible command is input.
16	Err IF	Err 16	Data emptiness (OUT)	There is no data to send.
18	Err IF	Err 18	DSR error (IN)	Data is not set ready when SD command is received.
19	Err IF	Err 19	DSR error (IN)	Data is not set ready when data is sent.
1A	Err IF	Err 1a	Data error (IN)	Data cannot be received.
1B	Err IF	Err 1b	Overflow (IN)	The receive buffer is full.
1C	Err IF	Err 1c	Command error (IN)	An illegible data is input.
81	Err	Err 81	Blink error	Mask signal blink error
82	Err	Err 82	Blink error	Mask signal blink error 2
83	Err	Err 83	Blink error	SGRAD corrugation blink error
84	Err	Err 84	SGRAD error	Slope coefficient error
85	Err	Err 85	Blink error	Mask signal blink error in the real measurement
86	Err	Err 86	Blink error	Measuring corrugation blink error in the real measurement
87	Err	Err 87	Blink error	The go-and-return measurement blink error
88	Err	Err 88	Alignment error	The alignment is out of position after AR measurement.
91	Err +0	Err 91	SPH + over	+23 D or more (VD=12mm)
92	Err -0	Err 92	SPH – over	–18 D or more (VD=12mm)
93	Err co	Err 93	CYL over	8 D or less (VD=12mm)
94	Err	Err 94	Confident coefficient error	
A1	ERROR	ERROR A1	CCD light-lack error	Measuring light does not enter CCD.
A2	ERROR	ERROR A2	CCD edge-lack error	The number of X or Y CCD measuring light is 2 or less.
A3	ERROR	ERROR A3	CCD edge-overmuch error	The number of X or Y CCD measuring light is 5 or more.
A4	ERROR	ERROR A4	CCD corrugation error	The width of the measuring light is too wide.
A6	ERROR	ERROR A6	CCD edge number error	The numbers of X and of Y CCD measuring light are different.
B1	ERROR	ERROR B1	R (corneal curvature) + over	10.06 mm or more
B2	ERROR	ERROR B2	R (corneal curvature) - over	4.94 mm or less
B3	ERROR	ERROR B3	CYL (cornea) over	10.00 D or more
C1	ERROR	ERROR C1	Sagittal number lack error	The number of sagittal value to calculate the eccentricity is lack.

※ Error code 9 and A are also printed out.

9: Memory Failure on E2PROM

A: Memory Failure on RAM

* Specifications are subject to change without notice for improvement.

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