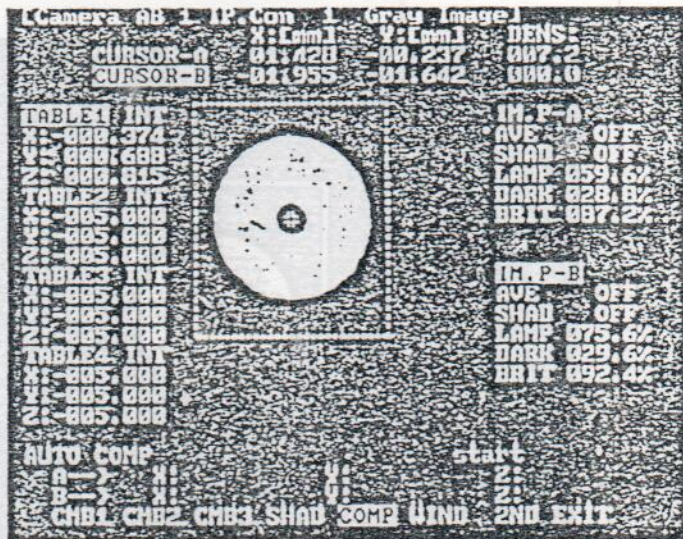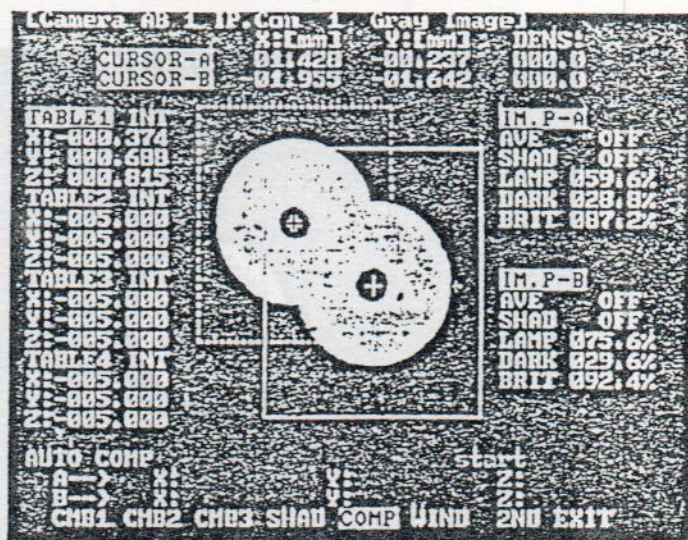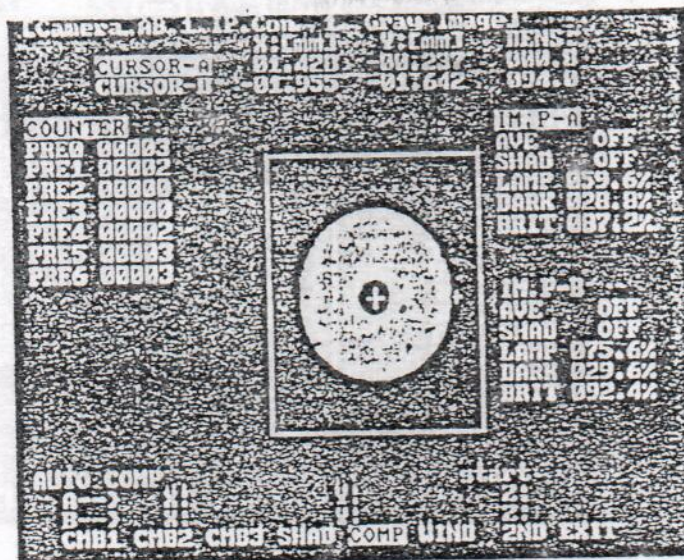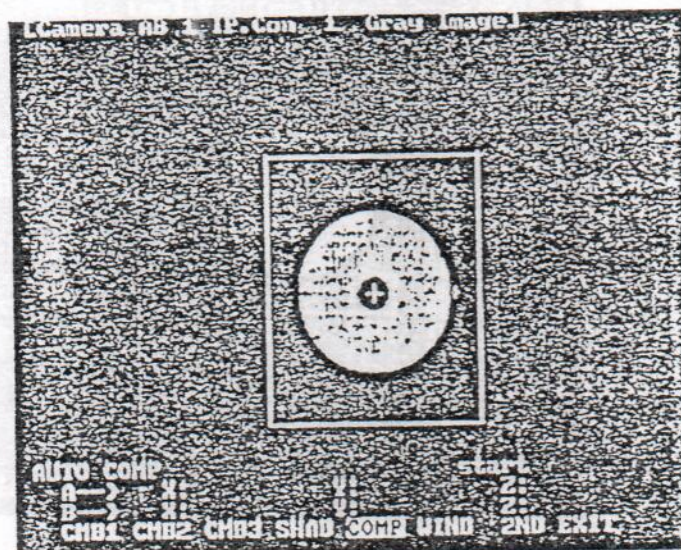Page 1 Channel A

Page 1 Channel B
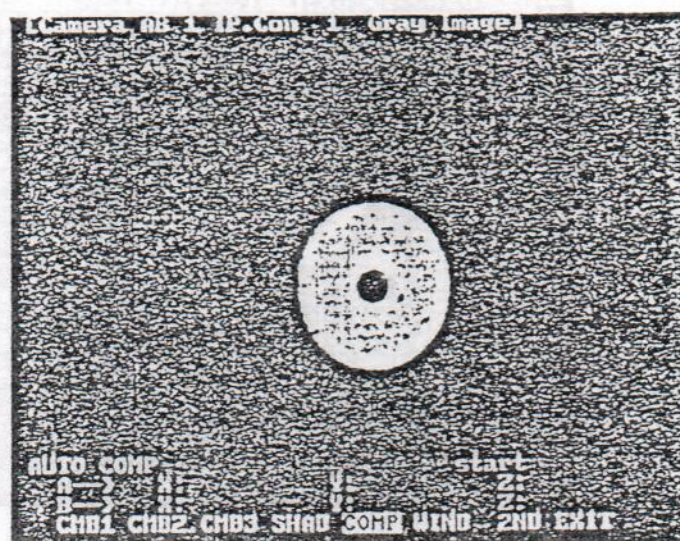

Page 1 Channel A and B Superimposed

Page 2

Page 3

Page 4

5.2.2   BINARY IMAGE

The binary image and image processing conditions, measurement data, and other necessary data for channels A and B of the selected camera are displayed together. The amount of data displayed can be switched through four levels by pressing the BINARY IMAGE switch of the DISPLAY group of switches.
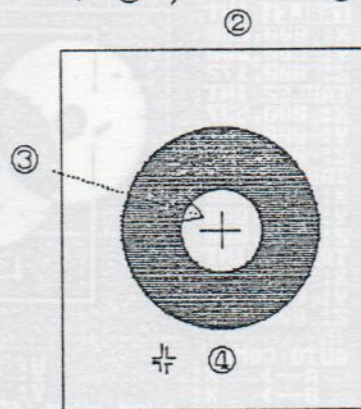
Channel A and B screens can be displayed together by setting the CAMERA CH switch to the AB condition (when both upper and lower LEDs light).

The following items are displayed.

- Binary image

- Windows   Full line for channel A and broken line for channel B

- Alignment point   + for channel A, − for channel B

- Cursor   + for both channels A and B

- Mark center coordinates in mm

- Mark area in mm²

- Mark diameter   Calculated assuming mark to be a circle.

- Binary image processing conditions   Segmentation
                                           Filtering
                                           Grading
                                           Threshold value

- Stage position data   3 × 4, total 12 axes, units: mm

- Counter values   7 channels, channel 0 to channel 6
                                           Incrementing by sequencer

```
[Camera AB  1  IP.Con  1    Binary Image]
              X[mm]     Y[mm]     D[mm]     A[mm2]
     DATA-A   0.000     0.001     1.931     02.931
     DATA-B   0.000     0.004     1.910     02.866
                      <─ ⑤ ─>      ⑦          ⑥

TABLE1 INT                ②           IM.P-A
X: 000.000                            SEGM   BMD1
Y: 000.000                            FILT   OBJ7
Z: 000.172                            OGRY   WHIT     ⑧
TABLE2 INT      ③                     BGRY   BLAK
X: 000.000                            SL 1   057.2%
Y: 000.000                            SL 2   054.0%
Z: 000.172
TABLE3 INT                            IM.P-B
X: 000.000                            SEGM   BMD1
Y: 000.000                            FILT   OFF
Z: 000.172           ┿ ④             OGRY   WHIT      ⑧
TABLE4 INT                            BGRY   BLAK
X: 000.000                            SL 1   071.6%
Y: 000.000                            SL 2   033.2%
Z: 000.172
```

■ Screen Examples

Page 1 Channel A

Page 1 Channel B

Page 1 Channel A and B Superimposed

[Camera.AB][IP.Con][Binary.Image]

	X[mm]	Y[mm]	D[mm]	A[mm2]
DATA-A	0.001	0.002	1.930	02.928
DATA-B	0.000	0.005	1.910	02.865

```
COUNTER                          IM.P-A
PRE0 00000               SEGM  BMD1
PRE1 00000               FILT  OBJ7
PRE2 00000               OGRY  WHIT
PRE3 00000               BGRY  BLAK
PRE4 00000               SL.1 057.2%
PRE5 00000               SL.2 054.0%
PRE6 00000
                         IM.P-B
                         SEGM  BMD1
                         FILT   OFF
                         OGRY  WHIT
                         BGRY  BLAK
                         SL.1 071.6%
                         SL.2 033.2%

AUTO COMP                          start
A-> X:                Y:         Z:
B-> X:                Y:         Z:
CHB1 CHB2 CHB3 SHAD COMP WIND 2ND EXIT
```
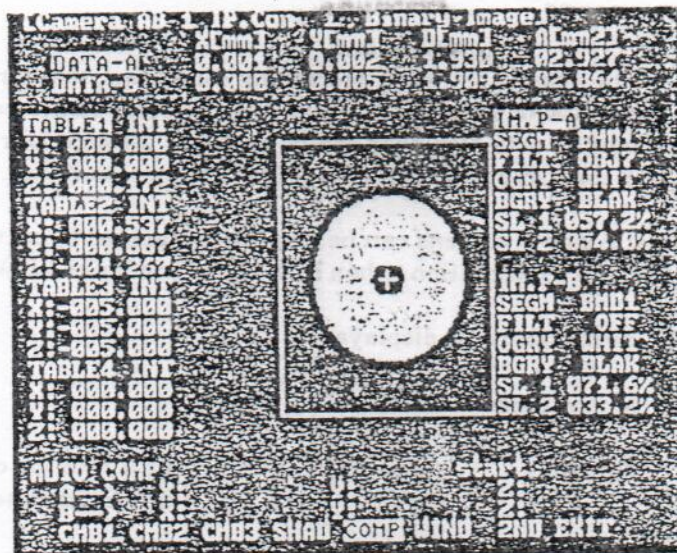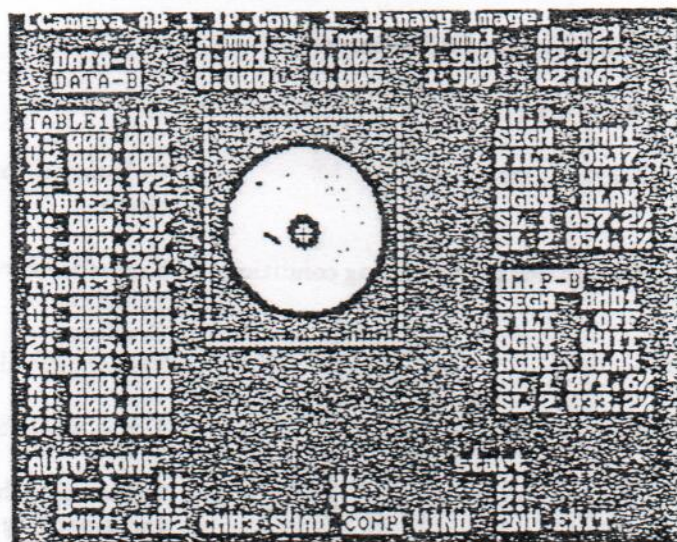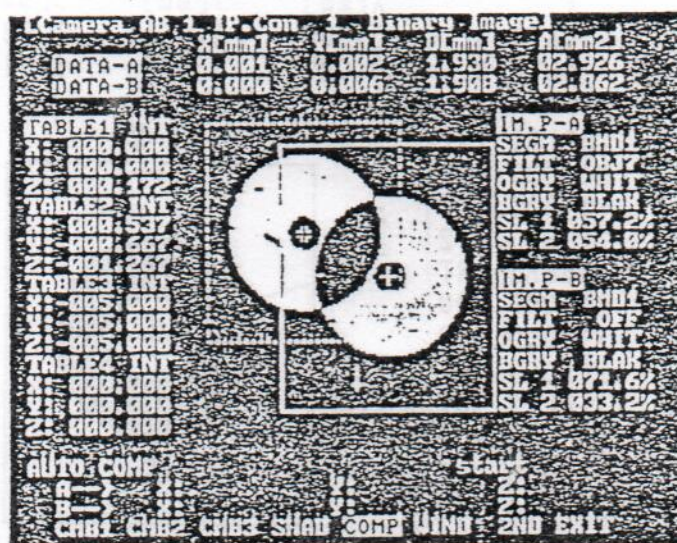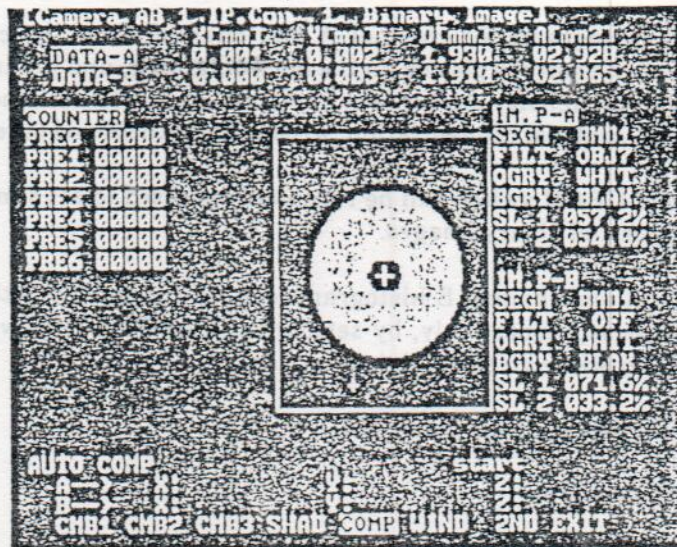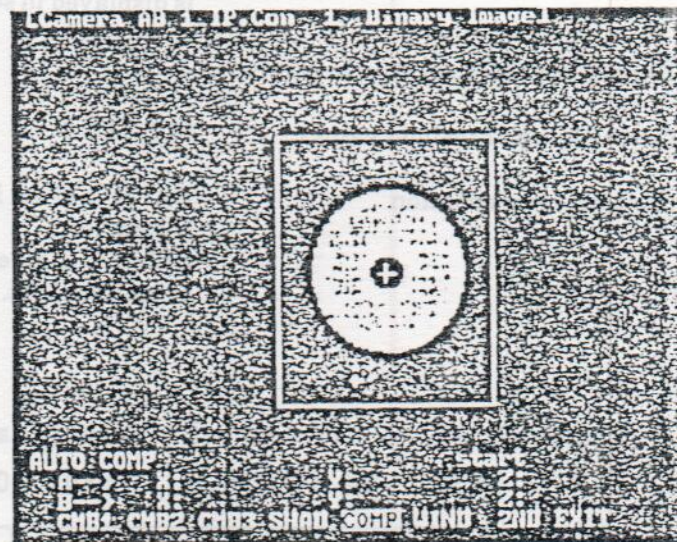
Page 2

```
[Camera.AB ][IP.Con ][Binary.Image]




AUTO COMP                          start
A-> X:                Y:         Z:
B-> X:                Y:         Z:
CHB1 CHB2 CHB3 SHAD COMP WIND 2ND EXIT
```

Page 3

```
[Camera.AB ][IP.Con ][Binary.Image]




AUTO COMP                          start
A-> X:                Y:         Z:
B-> X:                Y:         Z:
CHB1 CHB2 CHB3 SHAD COMP WIND 2ND EXIT
```
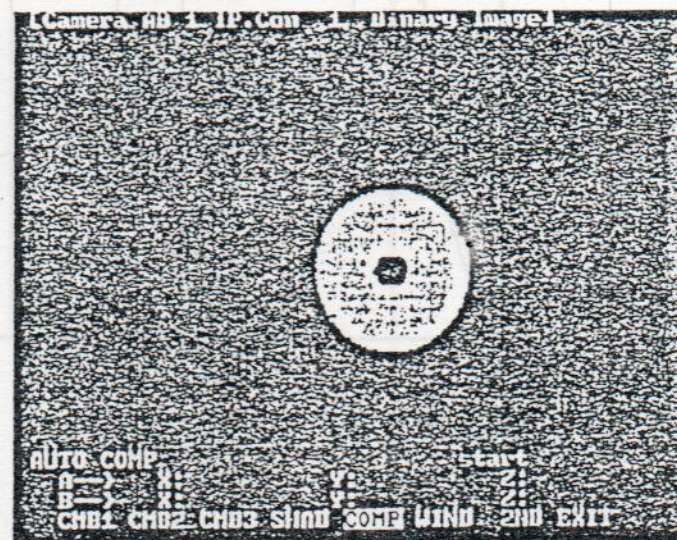
Page 4

5.2.3   HIST GRAM

Density histograms for channel A and channel B of the camera selected are displayed. Density is plotted on the horizontal axis, and luminance on the vertical axis for the density histogram the data of which is used to determine the threshold, contrast compensation, writing brightness and other values.

The HIST GRAM switch can be repeatedly pressed to set simultaneous display of multivalue and binary images.

Channel A and channel B histograms can be displayed together in the upper and lower screens, respectively, by setting the CAMERA CH switch to AB condition (both LEDs above an below light).

The following items are displayed.

- Histogram

- Cursor

- Density at cursor position   Value before contrast compensation
                                                 is displayed in square brackets

- Density at cursor position in pixels

- Currently set threshold values   SL1, SL2

- Contrast compensation   DARK is given in square brackets at
                                                 bottom left.
                                                 BRIGHT is given in square brackets
                                                 at bottom right.

```
 [Camera AB  1  IP.Con 1    Histgram]
      DENS: 088.8%[089.6]  FREQ: 00181
CH-A
```

```
    0           50              100
 [021.6]                     [098.4]
    ⑥                           ⑥
```
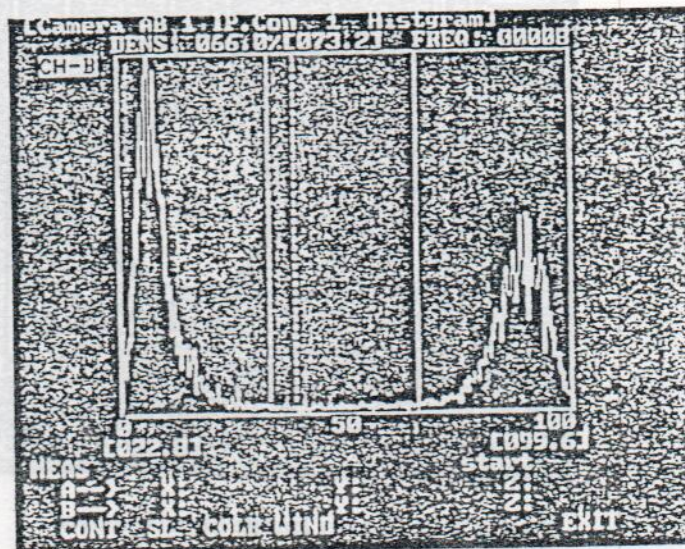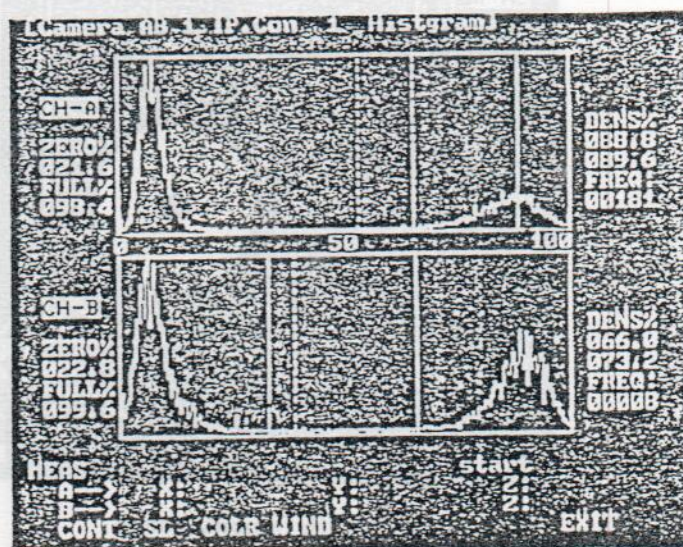
-21-
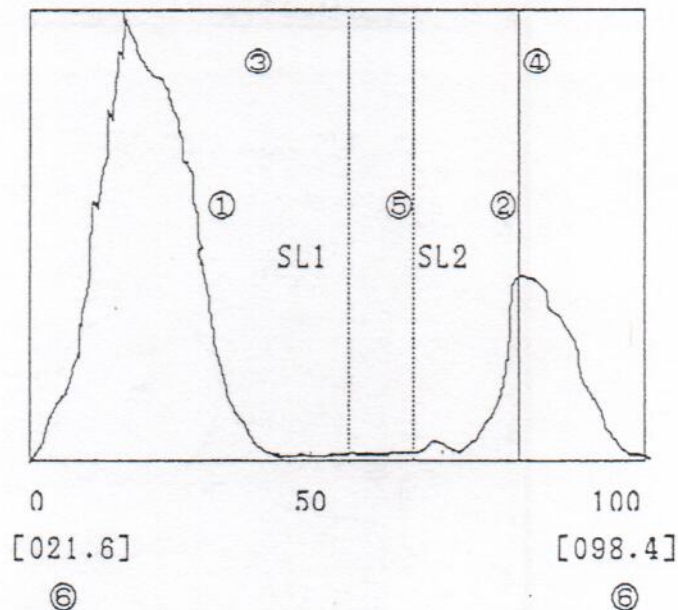
■ Screen Examples
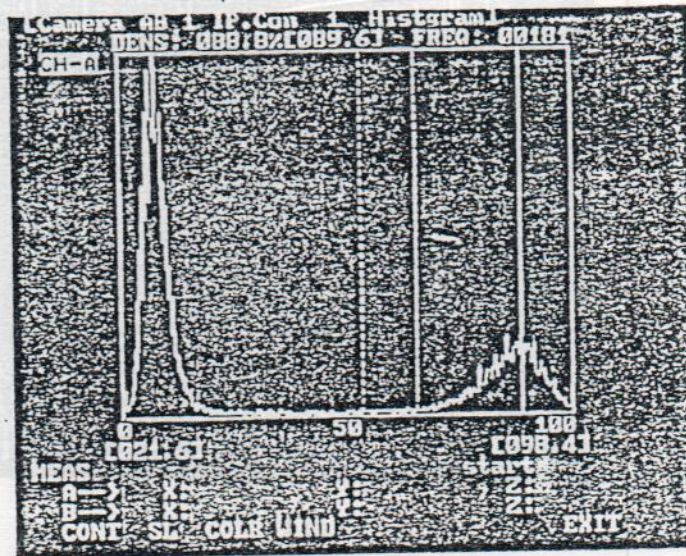
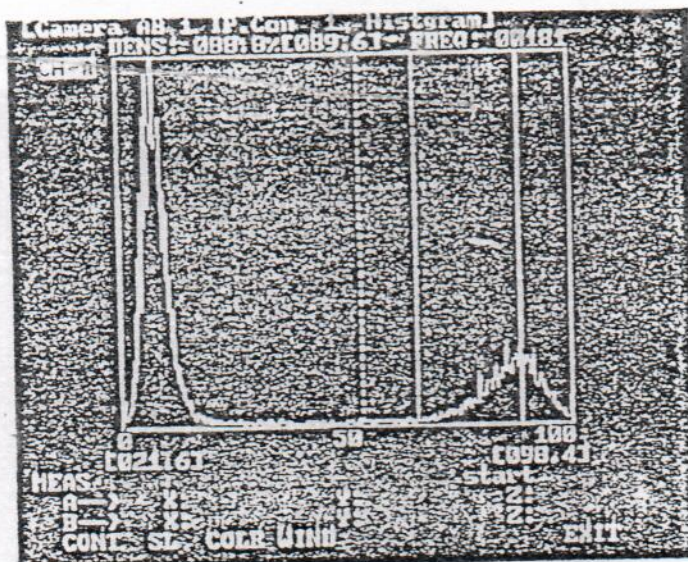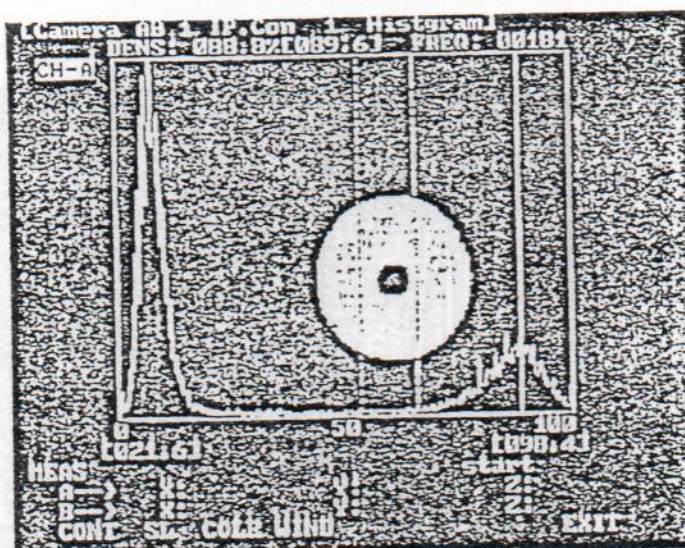Channel A Histogram

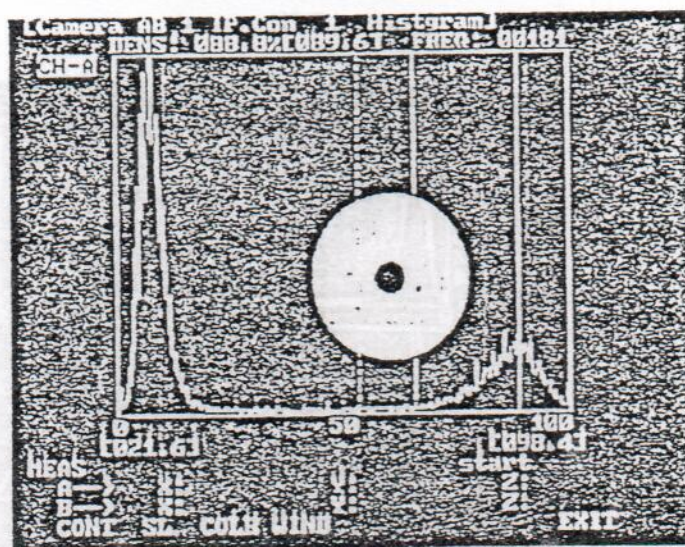Channel B Histogram

Channel A and Channel B Histograms

Page 1

Page 2 With Binary Image Superimposed

Page 3 With Density Image

5.2.4 SET DATA

Alignment, image processing, and sensor condition data for the selected camera channel and image processing conditions are displayed together with the setting data for the four stages.

The SET DATA switch can be pressed to switch between Set Data and Table Condition display on page 5.

■ Display Example

```
[Camera AB 1 IP Con 1 Set Data]
** Positioning **                      CH-A   CH-B
                         ERROR  [mm]    0.010  0.010
   MODE    MOD2          AREA   [mm2]   02.826 02.768
   STEP    1             LIMI MAX [%]   200    200
   TABLE   TBL1               MIN [%]   006    006
                         POSP  X:[mm]   00.600 -00.500
                               Y:[mm]  -00.095 00.445

** Image Processing **                 CH-A   CH-B
         CH-A   CH-B     LAMP [%]       061.2  075.6
   SEGM  BMD1   BMD1     DARK [%]       021.6  022.8
   COLR  WHIT   WHIT     BRIT [%]       098.4  099.6
   FILT  OBJ7   OFF      SL 1 [%]       053.2  038.8
   SHAD  ON     OFF      SL 2 [%]       065.6  033.2
   AVE   4      4
** Sensor **             SHAD          CH-A   CH-B
         CH-A   CH-B     POT1 [%]       063.2  100.0
   MAG   0.990  0.990    POT2 [%]       100.0  100.0
   ANG  -025.4 -025.8    POT3 [%]       063.6  100.0
   CPOS                  POT4 [%]       059.6  100.0
      X: -078.2 -179.5   POT5 [%]       100.0  100.0
      Y:  065.8  083.6   POT6 [%]       058.0  100.0
MEAS                                start
   A--> X:           Y:              Z:
   B--> X:           Y:              Z:
   CONT  SL  COLR WIND                    EXIT
```

```
[Table Condition]
*TABLE1*
TYPE  XYZ       ARM[mm] 250.000     DRIV  INT
                *AXIS X*   *AXIS Y*   *AXIS Z*
   PULR [um/p]  002.50     002.50     002.50
   FMIN [Hz]    00300      00300      00300
   FMAX [Hz]    02000      02000      02000
   TIME [msec]  00100      00100      00100
   LCAT 2ND[mm] 001.750    003.255    003.505
        P1 [mm] 006.000    006.000    006.000
        P2 [mm] 004.000    004.000    004.000
        P3 [mm] 008.000    008.000    008.000
        P4 [mm] 009.000    009.000    009.000
        P5 [mm] 001.000    001.000    001.000
   CONS D1[mm] -002.300    104.204    098.961
        D1[mm]  000.200    000.200    000.200
        D1[mm]  000.300    000.300    000.300
        D1[mm] -000.255   -000.255   -000.255
        D1[mm] -000.155   -000.155   -000.155
        D1[mm] -000.055   -000.055   -000.055
        D1[mm]  000.044    000.044    000.044
   CURRENT [mm] 001.750    003.255    003.677
MEAS                                start
   A--> X:           Y:              Z:
   B--> X:           Y:              Z:
   CONT  SL  COLR WIND                    EXIT
```

MANUAL, AUTO, and COPY SET switches form the MODE group of switches, and TABLE, MEAS and POSI, the group of OPERATION switches.

MANUAL AUTO   COPY TABLE   MEAS   POSI

☐   ☐   ☐   ☐   ☐   ☐

The mode selection can only be made after the display selection has been made.

All mode operations are performed in the same way as display operations, by selecting the camera channel and image processing conditions.

Each mode has its own tree structure and the necessary parameters are selected using the function keys. The assignments of the function keys are displayed over the keys on the bottom line of the CRT screen.

The immediately previous tree-structure position is saved for each mode, so the previous position is automatically selected when control is switched back to that mode. The first level of each tree structure is displayed by pressing the respective mode key twice.

5.4   Manual Setting

All parameters required for measurement control are set manually in this mode.

Press the MANUAL switch of the SET group of MODE switches to display the following functions.

```
MANU ①                                    f_key
   A-->   X:           Y:           Z:
   B-->   X:           Y:           Z:
   POSI  GIMP  BIMP  CAME  TABL  COUN  setP  exeP


   1 □   2 □   3 □   4 □   5 □   6 □   7 □   8 □
```

Fig. 5-4-1

```
┌──   ①  P O S I   ──────
│     ②  G I M P   ──────
│     ③  B I M P   ──────
│     ④  C A M E   ──────
├──   ⑤  T A B L   ──────
│     ⑥  C O U N   ──────
│     ⑦  s e t P   ──────
└──   ⑧  e x e P   ──────
```

Fig. 5-4-2

These are the first-level functions of the manual-mode tree structure. The parameters are grouped into the six large blocks for POSI, GIMP, BIMP, CAME, TABL, and COUN. Select the required parameter group using function keys 1 to 8 and make the settings.

Entry, table, cursor, and f__key setting modes are available for setting values for the different parameters.

5.4.1 POSItioning

This is the block of alignment parameters and it has the following tree structure.

Fig. 5-4-3

- e indicates that values are set in the entry mode, e/c that they can be set in either the entry or cursor modes (valid in multivalue or binary image display)., and if neither of these appear, values are set in the f__key mode.

- ☆ indicates that channel A or channel B has to be selected with the CAMERA CH keys of the SELECT group of keys. (Both channels can also be selected together.)

- △ indicates that the X- or Y-axis has to be selected with the AXIS keys. (Both axes can also be selected together.)

①   PMOD (Positioning MOde)

Use the function keys to select MOD1, MOD2, or MOD3 for the alignment completion condition.

- MOD1

If the alignment accuracy falls below the stage movement resolution (PURL), alignment is terminated even if the specified number of repetitions (STEP) has not been reached.

- MOD2

If the alignment accuracy falls below the allowable error (ERR), alignment terminates in the same way as for MOD 1.

- MOD3

Alignment is terminated after one alignment operation no matter what the value of STEP is. No accuracy decision is made after termination, so use MOD3 if the alignment point is set outside the field of view of the camera (mark coordinates are not measured after alignment terminates).

②   STEP

The maximum number of alignment repetitions is selected in the range 1 to 64 in powers of 2 using the function keys. Set the value of STEP to 2 or more if the there are factors which may cause errors, such as stage backlash, or if the marks do not fall completely within the window.

③   ERR (ERRor)

Set the allowable error for the alignment accuracy decision as a numerical value using the jog dial. The units are millimeters. Depending on the size of the allowable error for channel A and channel B, the alignment will be symmetrical about the center (A = B), channel A will be the standard (A < B), or channel B will be the standard (A > B)

④   AREA

Set the area decision criterion as a numerical value using the jog dial. The units are square millimeters.

⑤   LIMI (LIMIt)

Set the upper and lower limits for the area decision as a percentage using the jog dial. The upper limit is AREA × MAX, and the lower limit is AREA × MINI.

⑥   POSP (POSitioning Point)

Set the alignment points in millimeters for each mark in rectangular coordinates with the center of the camera's field of view as the origin using the jog dial in the entry or cursor mode.

⑦   TABL (TABLe)

Use the function keys to select the channel of the stage being used for alignment from TBL1, TBL2, TBL3, or TBL4.

5.4.2   Gray IMage Processing

This the block of parameters for multivalue image processing and it has the following tree structure.

```
                                                    ① 1
                                                    ② 2
                                                    ③ 4
               ① A V E r a g e ───────────────     ④ 8
                                                    ⑤ 1 6
                                                    ⑥ 3 2
                                                    ⑦ 6 4

                                                    ① M o v e P O S ☆
               ② W I N D o w ─────────────────     ② C E N T e r   c☆
                                                    ③ P o i n t 1   c☆
 ② G I M P ─┤                                       ④ P o i n t 2   c☆

                                                    ① O N           ☆
               ③ S H A D i n g ───────────────     ② O F F         ☆
               ④ L A M P  e ☆

                                                    ① D A R K  e/c ☆
               ⑤ C O N T r a s t ─────────────     ② B R I g h T e/c ☆
                                                    ③ I N I T i a l ☆
```
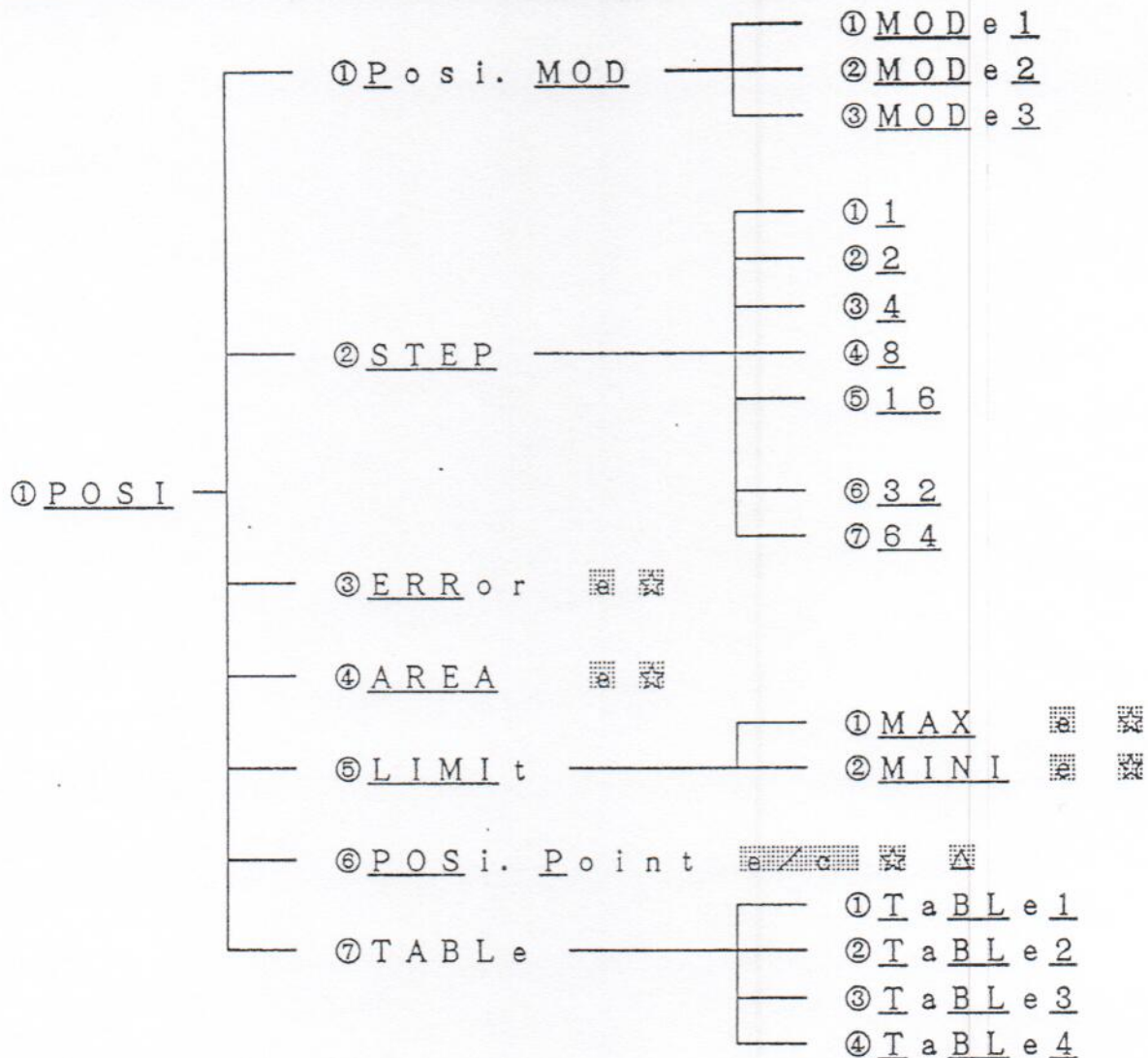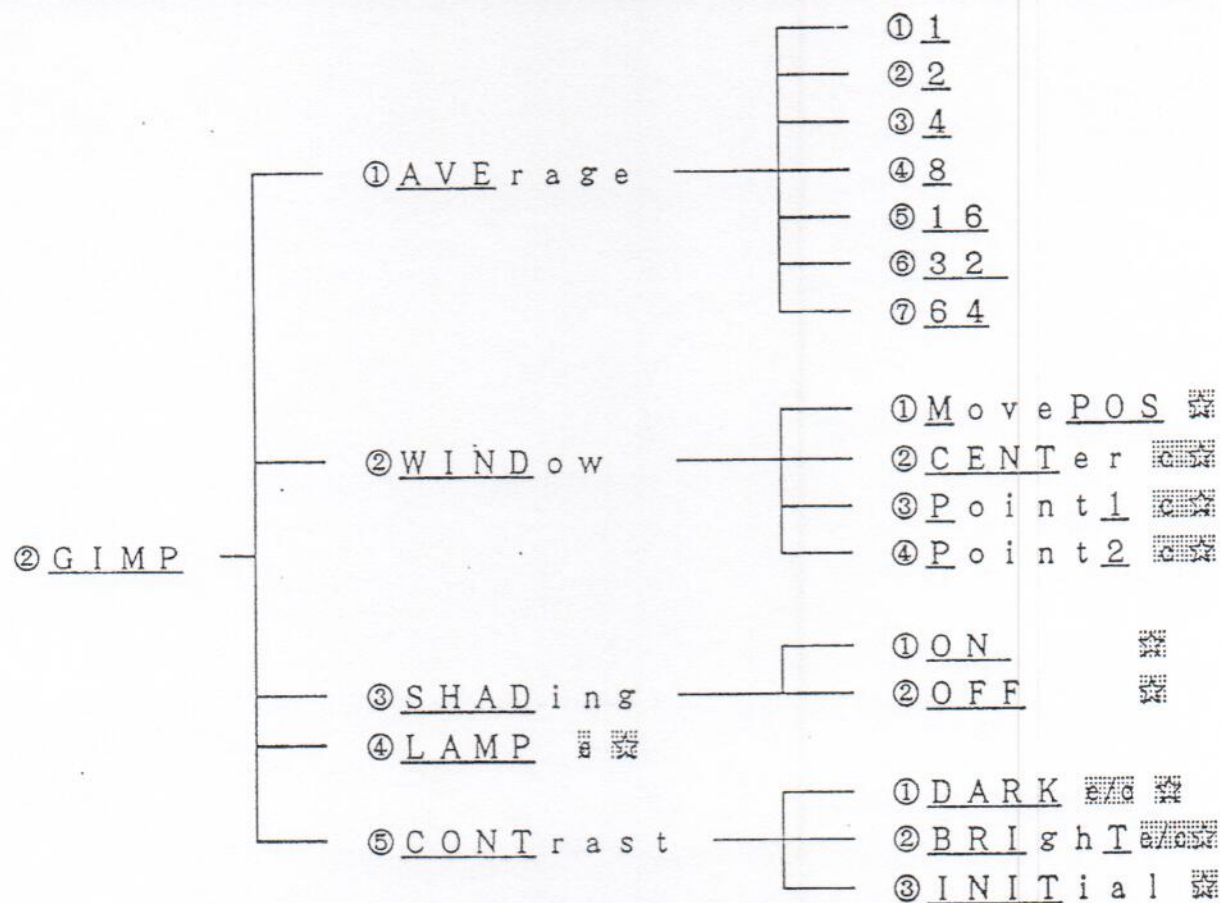
Fig. 5-4-4

- e indicates that settings are made in the entry mode, c in the cursor mode, e/c in either (valid in multivalue or binary image display), and if none of these appear, values are set in the f__key mode.

- ☆ indicates that channel A or channel B has to be selected with the CAMERA CH keys of the SELECT group of keys. (Both channels can also be selected together.)

① AVE (AVErage)

Select the number of summation averages of the image being used for measurement using the function keys as 1, 2, 4, 8, 16, 32, or 64. The time for one measurement (one frame) is approximately 1/30 s.

② WIND (WINDow)

Set the measurement range at the top of the screen using the jog dial in the cursor mode. This can only be set when the display mode is either dense-image or binary-image display.

There are three ways to set the values, so use the function keys to select the setting method.

- MPOS

  The window size is not changed and the center is moved to the alignment point.

- CENT

  The window size is not changed and the center is moved to the cursor position.

- P1, P2

  Set the window diagonal in the cursor mode.

③ SHAD (SHADing)

Select whether to perform shading compensation or not using the function keys.

④ LAMP

Set the brightness of the illumination as a percentage using the jog dial in the entry mode.

⑤ CONT (CONTrast)

Select the screen contrast compensation value as DARK or BRIT using the function keys and set the value using the jog dial in the entry or cursor mode.

- DARK

  Contrast compensation is performed to make the density of the pixels 0%.

- BRIT

  Contrast compensation is performed to make the density of the pixels 100%.

- INIT

  Contrast compensation is turned off, that is DARK is set to 0% and BRIT to 100%.

This is the block of parameters for binary image processing and it has the following tree structure.

```
                                                        ┌─── ① BiMoDal1    ☒
                                                        ├─── ② BiMoDal2    ☒
                                    ① SEGMent ──────────┤
                                                        ├─── ③ TriMoDal1   ☒
                                                        └─── ④ TriMoDal2   ☒

                                    ② SLice1    e/c  ☒
                                    ③ SLice2    e/c  ☒

                                                        ┌─── ① BLAcK       ☒
③ BIMP ───────┬──────────────────── ④ Object           │
              │                        GRaYting ────────┼─── ② GRAY        ☒
              │                                          └─── ③ WHITe       ☒
              │
              │                                          ┌─── ① BLAcK       ☒
              │                     ⑤ Back               │
              │                        GRaYting ─────────┼─── ② GRAY        ☒
              │                                          └─── ③ WHITe       ☒
              │
              │                                          ┌─── ① OFF         ☒
              │                                          ├─── ② OBJect3     ☒
              │                                          ├─── ③ OBJect5     ☒
              │                     ⑥ FILTer ────────────┼─── ④ OBJect7     ☒
              └──────────────────────                    ├─── ⑤ BAcK3       ☒
                                                         ├─── ⑥ BAcK5       ☒
                                                         └─── ⑦ BAcK7       ☒
```
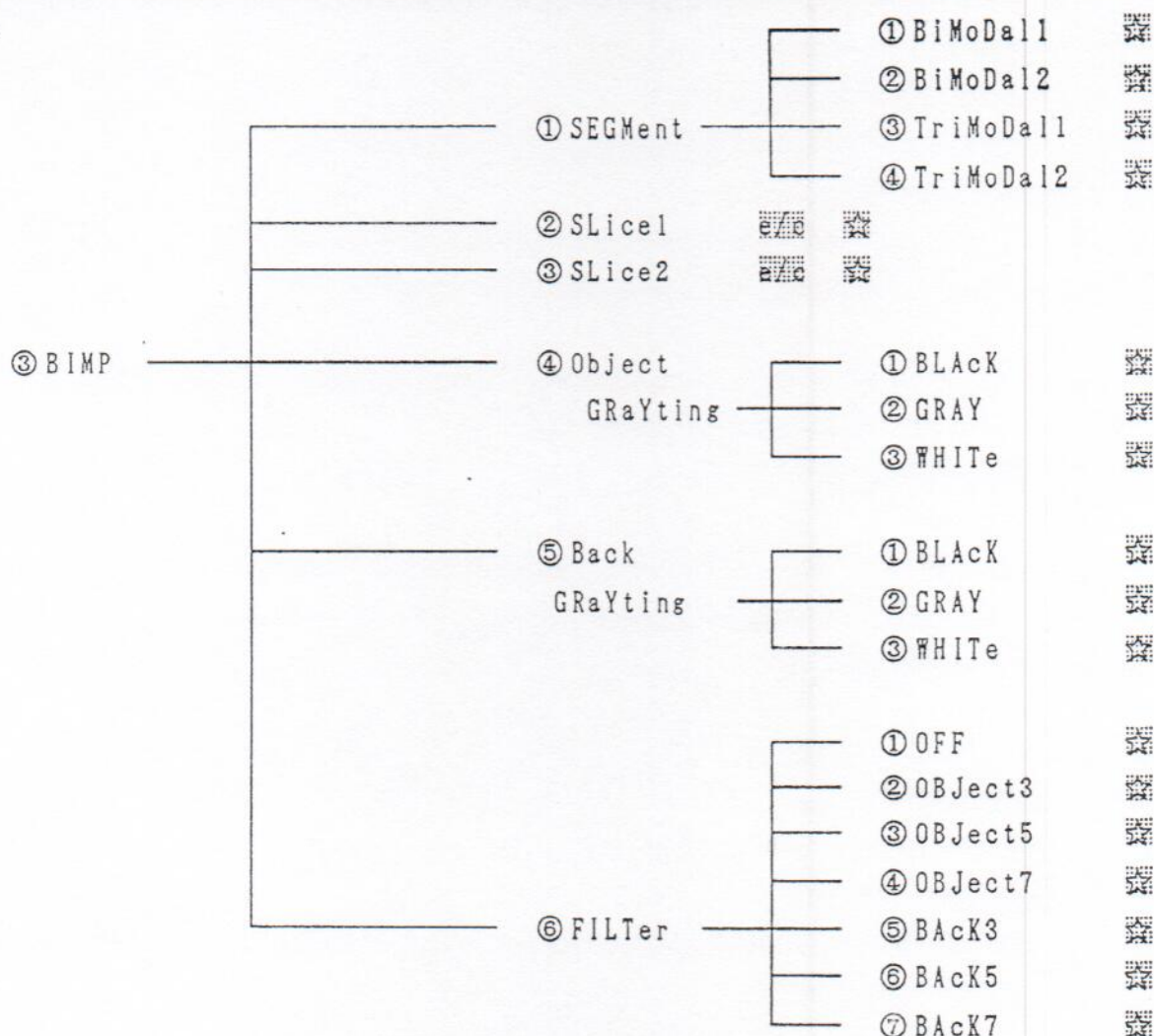
Fig. 5-4-6

- e/c indicates that the values can be set in either the entry or cursor modes.

- ☆ indicates that channel A or channel B has to be selected with the CAMERA CH keys of the SELECT group of keys. (Both channels can also be selected together.)

①   SEG (SEGMent)

Conditions for segment division (conversion to binary) can be set using the function keys in any of the four modes.

- BMD1 (BiMoDal1)

  Selecting SL1 converts an image with bimodal density distribution (two peaks appear in histogram) to binary.

- BMD2 (BiMoDal2)

  Selecting SL2 converts an image with bimodal density distribution (two peaks appear in histogram) to binary.