VRA53501-R.3521.A

社外秘

作成承認印	配布許可印
ニコンイメージングシステムズ CS推進部 GM	サービス計画課 M

Nikon

SUPER COOLSCAN 4000 ED VRA53501

REPAIR MANUAL

Nikon | NIKON CORPORATION
Tokyo, Japan

Recycled paper
再生紙を使用しています

Printed in Japan Mar 2001

Specifications of Contents

Specifications

1. General

1. 1 Model name Nikon Film Scanner LS-4000 ED

1. 2 Intended use

This scanner maintains and enhances Cool Scan system performance for general users and individual users who demand high image quality.

This scanner will enter the market as a high image quality, high speed, and high throughput film scanner for simple office applications.

The scanner interface uses the IEEE1394 serial interface.

A film loading section has introduced an adapter system so that the scanner can read various formats of 135 and IX-240 film and can produce preview and thumbnail scans. Also, this scanner is compatible with roller film, and the scanner shares a similar design to the LS-40 ED which can load film winding sections for reducing costs.

1. 3 Configuration This scanner consists of the following parts.

- Mechanical unit: This image scanning unit shines light on the film, moves the image-forming mechanism on the linear sensor in the film optical axis direction to bring the image into focus, and then scans this image in the secondary scanning direction.
- Power supply,
- Main board assembly,
- Case

2. Major Specifications

2. 1 General

2.1.1 Model name Nikon Film Scanner LS-4000 ED

2.1.2 Scanner type Film scanner

2.1.3 Sensor Black-and-white CCD

2.1.4 Maximum film size Pixel size: 6.377 u mm

2.1.4.1 Scanning range/number of scanning pixels (at maximum resolution):

(1) MA-20(S), FH-3, FH-G1, SF-200 25.17 x 36.87 mm/3946 x 5782 pixels

The center of the scanning range when using the FH-3 is at a 1 mm depth.

(2) IA-20(S) 18.6 x 28.4 mm/2916 x 4453 pixels

(3) SA-21, SA-30 25.17 x 38 mm/3946 x 5959 pixels

The center of the secondary scanning range is at a 1.3 mm depth from (1).

2.1.4.2 Aperture size and number of scanning pixels for each adapter

(1) MA-20(S), SF-200 22.5 x 34.3 mm/3529 x 5379 pixels

(Slide mount aperture size)

(When using the FH-3): Based on the FH-3 specifications.

(When using the FH-G1): Based on the FH-G1 specifications.

(2) IA-20(S) 16.1 x 27.4 mm/2525 x 4297 pixels

(3) SA-21, SA-30 23.4 x 36 mm/3670 x 5646 pixels

The firmware is used to detect the frame starting position, and then this is used to find the secondary scanning start position and size.

2.1.4.3 Effective scanning size/number of scanning pixels with respect to the aperture size

(1) MA-20(S), SF-200

Main scanning: 100%, secondary scanning: 100% (eclipsing can occur due to the mount shape)

(2) IA-20(S)

Main scanning: 100%, secondary scanning: 98% min.

16.1 x 26.9 mm min./2525 x 4219 pixels

(3) SA-21, SA-30

Main scanning: 99.5% min., secondary scanning: 100%

23.3 x 36 mm min./3654 x 5646 pixels

2.1.5 Optical resolution (maximum)

3981 dots/25.4 mm (approx. 4000 dpi)

2.1.6 Interface

2.1.6.1 Format Compliant with IEEE1394, SBP-2

Note: This scanner only supports operation as a target. Therefore, operations requiring initiator functions, such as direct printing, are not supported.

2.1.6.2 Connector

IEEE1394: 6-pin connector x 1

2. 2 Scanning

2.2.1 Scanning time (typ. value: 135 film, standard film, at maximum optical resolution)

The display time is assumed to be 7 s. The display time is the time at the host after the Start button is pressed until the image is fully displayed. (Conditions: The computer used is a Windows-based computer in the description below.)

If SDC processing is used, the maximum time is the time shown below plus 228 seconds. Any reduction in the scanning speed due to conversion to 2-byte data is contained in the SDC processing executed in parallel.

Positive film, not including display: Approx. 44 seconds

Positive film, including display: Approx. 51 seconds

Negative film, not including display: Approx. 45 seconds

Negative film, including display: Approx. 52 seconds

* Computer

Any Windows-based computer can use the latest version of NikonDriver.

However, the Windows-based computer described below should be used for speed evaluation and other performance-sensitive items.

Nikon Scan 3 provides identical performance.

Windows: DELL DIMENSION XPS T700, SDRAM: 256 MB, 1024 x 768 pixels, 16-bit color, OS: Windows 2000

IEEE1394 host adapter: IEEE1394 interface board (for LS-4000 ED)

2.2.2 Scanning speed (fastest value under the conditions below)

No connection with host, lighting LEDs at standard brightness, standard positive film. Approx. 6.0 ms/line

2.2.3 A/D conversion bits 14 bits

2.2.4 Image scanning

2.2.4.1 Image sensor type

CCD (3964 pixels 8μm manufactured by Sony, black-and-white linear CCD) (Note: The number of effective scanning pixels as a scanner device is 3946 pixels.)

2.2.4.2 Projection lenses

(1) Configuration 7 asymmetrical glass lenses in 4 groups

(2) Focal distance 46.18 mm (e line)

(3) Magnification -1.254 fixed magnification

(4) OWD 169.33 mm

(5) Aperture ratio 1:5,74 (fixed effective value)

2.2.5 Lighting sourc

2.2.5.1 Light source I, R, G, B-LED array

2.2.5.2 System Distributing-type slit lighting using condenser lens and diffusion plate

2.2.5.3 Emission spectrometry characteristics

Peak wavelength I: 830 **nm**, R: **655 nm**, G: **528 nm**, B: **465 nm**

2.2.6 Color separation

I, R, G, B-LED light sources are switched and turned on for each line

2.2.7 Color sequence Single path

2.2.8 Dropout color R, G, B film conveyor path

2. 3 Output

2.3.1 Output mode

Full color, black and white (black-and-white output is processed and output by the driver software from the scanned R, G, B data)

2.3.2 Number of gradations 8/14 bit for each I, R, G, B

2.3.3 Color sequence Successively line by line

2.3.4 Data transmission speed

IEEE1394 Maximum:400 Mb/s,full size one-screen average:2 MB/s (500 ns/byte)

2.3.5 Output resolution

Main scanning direction: 1 to 1/44 (4000 to 90 dpi) Secondary scanning direction: 1 to 1/44 (4000 to 90 dpi)

(In this scanner, the range 1/(integer) is possible.)

2. 4 Additional functions

2.4.1 Other image quality adjustment functions (contrast, brightness, gamma correction, color compensation, etc.)

Based on the available commands in the driver software.

2.4.2 Miscellaneous

2.4.2.1 Trimming

In the maximum scanning range, a selected size can be cut out by designating the address from the driver software (X, Y) where X: main scanning, and Y: secondary scanning. (However, since trimming for the main scanning is performed by the driver software, data for the entire effective range that is compatible with the adapter and holder is sent from the scanner.)

2.4.2.2 Focusing

(1)Method Autofocus

(2)Focusing system

Contrast detection system using CCDs. The film is fixed. The optical system is driven by a fulcrum Oscillation system, and the relative position with the film is adjusted.

2.4.2.3 Status display

The following three statuses are displayed based on the display G-LED. Power supply on/Standby: LED is on

Busy: Slow flashing

2.4.2.4 Firmware update

The firmware update can be downloaded from the host computer.

2. 5 Film scanning

2.5.1 Film format 135 strip (up to six frames and up to 40 frames)/mount, IX240 film cartridge, preparation

2.5.2 Film loading

(1)The slide mount is installed either in the MA-20(S) or the SF-200. However, the mount should have a thickness of 1.0 to 3.2 mm and a size of 49 to 50.8 mm (diagonal).

(2)For preparation, the medical holder FH-G1 is used and loaded into the MA-20(S).

(3)The IX-240 film cartridge (15, 25, and 40 frames) is loaded into the IA-20(S).

(4)135 strip film with 1 to 6 frames uses the FH-3 and is loaded into the MA-20(S).

(5)135 strip film with 2 to 6 frames is loaded into the SA-21 and SA-30.

(6)135 strip film with 2 to 40 frames is loaded into the SA-30.

2. 6 Physical characteristics and power supply

2.6.1 Size 93(W) x 168.6(H) x 315(D) mm

The unit can be used in an upright position or on its side.
(Side position only when using the SF-200;
Upright position only when using the SA-30)

2.6.2 Weight	Approx. 3 kg
2.6.3 Supply input range	AC 85-264 V
2.6.4 Supply frequency range:	45-66 Hz
2.6.5 Power consumption	AC 100-240 V, 0.3-0.2 A (+10%) max.
2.6.6 Operating environment	+10 to +35℃, 20 to 60% RH(no condensation)

2. 7 EMC and Safety Standards

2.7.1 EMC

■CE marking ■VCCI (Class B) ■FCC15 (Class B) ■CSAC108.8
■AS/NZS3548, Radio Regulations1993 ■CNS13438 (Taiwan)
■Information and Communication Unit Notification 1996-78
(South Korea)・

2.7.2 Safety Standards

■EN60950 ■UL1950 ■CSA950 ■CCEE mark GB4943 (China)

2.7.3 Operating noises Not to exceed 55 dB at a distance of 1 m.

2. 8 Accessories and options

SA-20 is not supported. Data is sent to the host computer as a non-supported adapter.

2.8.1 Accessories

- Slide mount adapter MA-20(S)
- 135 strip film adapter SA-21
- 135 film holder FH-3 (Used by inserting into the MA-20(S).)

2.8.2 Options

- Slide feeder SF-200
- APS film adapter IA-20(S)
- Medical holder FH-G1 (Used by inserting into the MA-20(S).)
- 135 roller film adapter SA-30

Description of Mechanisms

1. Case

The case consists of a plastic front panel with a metallic coating and a front slide cover, right and left side covers made from colored steel and a steel-plate rear panel. The front slide cover of the front panel slides open to reveal the adapter slot for loading film.
The status is indicated on the front panel by LEDs.
The Power button is located on the front of the cover.
Rubber legs are secured in place on the right and left side covers.
An IEEE1394 interface connector is provided on the rear panel.
An integrated AC inlet is exposed on the rear panel for the power supply.
The rear panel is provided with screw holes for mounting an attachment for installing the winding unit in the scanner when using the SA-30.
The winding unit is secured to the screw holes by using the attachment.
The winding unit can be secured in place by tightening the knurled screws by hand.
Also, there is a slot for guiding the film to the winding unit, and a cover is attached to this slot in case the SA-30 is not used.
The inside of the case includes a steel-plate chassis, mechanical unit, main board, and power supply.

2. Mechanical unit

An optical scanning system is provided that consists of an optical lighting system, an optical projection system, and CCD assembly.
To perform AF, this system is moved in a circular motion that is almost straight and is nearly perpendicular to the film by the stepping motor known as the AF motor and by a cam with a gear using the motor shaft.
Also, secondary scanning is performed by moving the entire system Linearly by the stepping motor known as the scanning motor and by a gear using the motor shaft and connected to the lead screws.

3. Main board (Main board assembly)

The components of the main board can be classified by their functions: MCU, custom IC unit, interface unit, analog signal processing unit, lighting LED driving unit, and motor driving unit.

3. 1 MCU

The MCU consists of a 16-bit MCU, SS assembly (512 KB x 8-bit Flash Memory), 128 KB x 8-bit SRAM x 1 Reset IC, and other components. The MCU performs control of the entire system (including the adapters and feeders).

3. 2 Custom IC unit

The custom IC unit operates at a maximum operating frequency of 100 MHz, and the main functions include scanning of image data, control of lighting LEDs, DMA control with host interface, generation of CCD, A/D and other control signals, and input/output control with other peripheral circuits.

As coefficient memory and a line buffer, two units of 128 KB x 8-bit SRAM and two units of 32 KB x 8-bit SRAM are provided and connected externally.

3. 3 Interface unit

The interface unit consists of a IEEE1394 controller and IEEE1394 connector. No power supply function is available.

3. 4 Analog signal prbcessing unit

The CCD signal is processed by a bit-clamp circuit (CDS), gain circuit, and black level adjustment circuit, and then undergoes A/D conversion, and output to the custom IC.

- Gain circuit 2-level switch
- Black level adjustment circuit A coarse adjustment circuit and fine adjustment circuit with 8-bit D/A are used to adjust the potential of the black level.
- A/D conversion circuit Resolution: 14 bit Conversion frequency: 2.778 MHz

3. 5 Lighting LED driving unit

This unit consists of the transistor array, regulator, resistors, and other components. R, G, B, and I LED control is performed by turning the transistors on and off. The peak accuracy when passing straight through is 16383+0-192.

3. 6 Motor driving unit

The motor driving unit is provided with two circuits for the main unit, two circuits for the adapters, and a motor driving circuit.

· Main unit 15.5 V system 2-phase bipolar stepping motor circuit x 1
5 V system 2-phase bipolar stepping motor circuit x 1
· Adapter 15.5 system 4-phase unipolar stepping motor circuit x 1
5 V system DC motor circuit x 1

4. CCD board (CCD assembly)

The CCD board consists of the CCD board assembly, CCD, CCD mounting board and CCD insulation sheet. The CCD has 3964 effective pixels.

Using the black-and-white linear sensor, the output signals from the CCD pass through the emitter follower (buffer) and are output to the main board.

The main board is connected to the CCD by the CCD flexible cable.

5. Power supply unit

The open-frame type custom power supply meets all safety standards. It uses a plastic board, and includes an AC inlet and power supply switch in addition to a power supply circuit. Input is AC 85 to 264 V, and output is at 5 V, -12.2 V, and +15.5 V.

6. Connection of adapter and feeder to scanner

If an adapter(SA-20) not supported by this scanner is mounted, an undefined adapter error code is set, and the LEDs flash to indicate an error.

The FH-3, FH-A1, and FH-G1 are supported holders, and the scanner can identify which holder is mounted. If an unsupported holder is mounted in the MA-20(S), it is assumed to operate as a slide mount. If the film gate cover is closed, even if the SA-30 is installed, operation is identical to the SA-21, and up to six frames is supported.

6. 1 Mechanical connections

The adapter rails fit into the grooves in the scanner side. The adapter is pressed into the rails by springs from the top. When the adapter is inserted, the protruding section of the springs fits into the indented section of the adapter.

6. 2 Electrical connections

These consist of connector connections. However, the MA-20(S) does not have any electrical connections. Connections are possible when the scanner power is on (hot plug support).

6. 3 Connection identification

Connection identification is based on the sensor switches. For the MS-20(S), there is no identification for signals inside the connector.

7. Light exposure adjustment

The light exposure is adjusted by changing the exposure time and gain.

7. 1 Exposure time

The exposure time is controlled by the time that the LEDs are turned on. The time that the LEDs are on is controlled by the count value for the custom IC timer that is set by the MCU.

The control units are 10 ns, and the control range is 21 μs to 671.088 ms.

7. 2 Gain

Gain based on analog hardware can be set to one of two levels: 1.000 or 2.000 magnification(typ.).

8. Image quality adjustment

8. 1 Dark voltage correction

The dark signal non-uniformity (DSNU) is corrected digitally for each pixel using the custom IC. The dark signal voltage (VDRK) is corrected by using the two D/A of coarse adjustment and fine adjustment and adding offset to the CCD signal.

The correction coefficient is measured for each operation for the commands used when performing scanning operations from the CCD during initialization of the scanner and when instructions are issued from the driver software.

8. 2 Shading correction

Based on the 14-bit correction coefficient for each color, 0 to 49.98% CCD sensitivity and lighting non-uniformity undergo digital correction for each pixel by the custom IC according to the following equation.

Output =((Correction coefficient + 16384) x input)/16384

The correction coefficient is found by reverse calculation from the above equation so that the input is added up 16 times and the output is equal to the maximum value of all pixels.

An error occurs if the lighting non-uniformity exceeds 49.98% (correction coefficient=16383).

The correction coefficient is measured when film is discharged by the IA-20(S) and when the adapter is replaced in addition to when instructions are issued from the driver software and during initialization of the scanner.

8. 3 White balance

The exposure time is adjusted so that the average values for R, G, B, and I when passing straight through while shading correction is enabled are within 90% of the full-scale value ± tolerance error, that is, 14744±64. After convergence, increase the exposure time by 16383/14744.

A fatal error occurs if the average value is 16383 when the exposure time is the minimum value of the control range, or if the exposure time adjustment did not converge into the above range after being repeated 16 times. In addition to when instructions are issued from the driver software and during initialization of the scanner, the white balance is measured when film is discharged and when the adapter is replaced.

8. 4 Prescan

135 film

The target center of the scanning is same as of the final scanning, and the following range is scanned at a pitch of 14.

The range for positive film is 25.17 mm x 38.87 mm (main and secondary addresses: 0,0 to 3940,5782)

The range for negative film is 18.75 mm x 29.07 mm (main and secondary addresses: 504,613 to 3443,5162)

240 film

The target center of the scanning is same as of the final scanning, and the following range is scanned at a pitch of 14.

The range for positive film is 18.61 mm x 28.34 mm (main and secondary addresses: 0,0 to 2912,4452)

The range for negative film is 13.47 mm x 22,39 mm
(main and secondary addresses: 403,471 to 2502,3970)

(1) Main unit prescan

A histogram is created for each color from the image scanned using AV on, and the maximum and minimum values of each color are then calculated from these histograms. For the negative image, the exposure time and gain are set so that the maximum value for each RGB color is 16383, and the LUT shape is changed so that the minimum values become the white dots of the positive image. The minimum value should be 0.42%
of the number of pixels in the prescan range when counted from the minimum value side at the histogram.
For the positive image, the maximum value in the RGB colors is determined to be the largest value of a color, and a uniform multiplier is used for the RGB exposure time so that the maximum value of the color becomes 16383.
If the above maximum value is not from one half of the full range up to the full range after the prescan results, change the exposure conditions so that the results for the second prescan fit into the range. The scanner's d fault gamma (LUT) has one type of setting for negative images and one linear type for positive images.

(2) Host processing

The above processing and improvement processing is performed by the driver software. In this scanner, the exposure time
(LED turn-on time for each color) and LUT data are sent from the driver software, and data that is scanned under these conditions is sent to the host computer. The transferred data has 14 bits.

8. 5 Gamma correction

This is set when the host computer downloads to LUT. This does not include a gamma function for monitors.

8. 6 Averaging

Commands from the host computer allow the custom IC in the scanner to perform averaging in the main scanning direction only.
Pitch 1, 2: 2-pixel average; Pitch 3: 4-pixel average; Pitch 4

and higher:8-pixel average. This function shall be used only in the following cases.

- When scanning thumbnail images when using 240 film cartridges, SA-21, or SA-30.
- When prescanning · When scanning at pitch 2

8. 7 Negative and positive conversion

Conversion is performed using LUT. The negative image sets The black-and-white inversion and grayscale characteristics.
The grayscale characteristics of the negative are changed according to the prescan results.

9. AF

In the AF, the mechanical body is moved in 1-point 52-_m steps over the entire movement range for a total of 78 points while the contrast of each point is calculated, and then the mechanical body is moved to the point where the maximum contrast was obtained. To prevent focusing errors at the boundaries of the image, the average value for each point is found, and then the maximum and minimum values are checked using the following condition.
(Maximum value - minimum value) < 1920 (14-bit data)
The contrast is found by the sum of the differences of adjoining image data in the main scanning direction for the designated point±350 pixels.
The AF execution position can be selected as desired, and the specified range above is 700 pixels. A warning is indicated when there is an image with an extremely low contrast or when using nontransparent film. The AF is then set to the focus position (center position if the AF has not been executed yet) of the previous AF results.
The AF execution colors are 1.B, 2.I, 3.G, or R. If the contrast cannot be obtained, or when the border of the image does not satisfy the conditions above, a retry is made by performing secondary scanning movement.
If using a mount with MA-20(S), AF can be executed automatically at the scanner side when insertion of the mount is detected.

10. Preview

This scanner does not have a preview mode. To check the image beforehand, use the data obtained in the prescan operation or the final scan data.

Limits on the operation time and other performance is based on the prescan limits.

11. Thumbnail scan

Index images can be scanned when using the SA-21, SA-30, and IA-20(S).

In the SA-21 and SA-30, the scan block is fixed, and the film is fed by the motor in the SA main unit where it is scanned. In the IA-20(S), the adapter feeds one frame at a time, and scanning is performed by the mechanical unit.

12. Final scan

The LEDs turn on for each line, the CCD is driven, data is written to the buffer, data is transferred to the interface, and then the scan block is moved. Control of the LED, CCD, buffer, and interface is performed based on the settings for the custom IC and sending of the operation trigger.

Transfer of the image data is performed in parallel with other processes.

Movement of the scan block is performed during the time that the R, G, B, and I lighting LEDs are not turned on.

The scan data can be selected from 8 bit (1 byte) and 14 bit (2 byte) output.

13. Interface IEEE1394

Scanner static data, including adapter data, is sent to the host by Inquiry commands. Dynamic data including all of the error data is sent from the sense data.

14. Firmware download

The firmware can be updated from the host computer by the Write Buffer and the Set Parameter and Execute commands designated by Initialize.

15. Detection of film insertion/removal when using MA-20(S)

This function detects whether film loaded in the MA-20(S) has been removed or inserted at one-second intervals using a green light and CCD.

16. Transport lock

Transport lock screws are not required. To prevent damage due to shocks or jolts, the scan mechanism and AF mechanism are secured to the transport lock position during transport.

To set the mechanisms to the transport lock status, you can remove the adapter while the power is still on, or complete initialization with the power on and the adapter not inserted, and then turn off the power.

17. D-ICE (Digital Image Correction Enhancement)

D-ICE detects damage, dust, fingerprints, and other imperfections on the film and uses software processing (software at the driver side) to recover the image data that was lost.

When scanning film, the R, G, and B visible light and I (infrared) light are projected on the film as light sources, and the I beam is used to measure the size (level) of the defect from the attenuation and the positional coordinates of the defect.

From the attenuation level obtained by the I beam, the R, G, and B visible beams attenuated by the defect at the same position on the film are restored to the R, G, and B visible level that they should have (if there were no defec).

The processing software is manufactured by ASF Corporation.

18. D-ROC/GEM (Restoration of Color/Grain Equalization and Management)

The processing in the driver software allows faded colors in the image to be restored to their original colors or set to selected colors (ROC). There are also functions for making the granularity less noticeable (GEM)

The processing software is manufactured by ASF Corporation.

19. Light reduction detection

The white balance time at scanner initialization, after an adapter is replaced, or measured when a shading measurement command is issued from the driver software is compared to the default white balance time stored in the Flash Memory. If the light is reduced by more than 40%, an error is detected as, "the signal is too small during measurement of white balance"

20. Multi-Sample Scanning

In the final scan, the same line is scanned multiple times, and a high-quality image is obtained by eliminating random noise. The number of times is based on the command from the host computer. However, the maximum is 16 times.

Disassembly and Re-assembly

Notes:
<1> During disassembly, make a note of how the cords are routed and connected and which screws are installed, their types, etc.
<2> Electrical parts must always be grounded since they are easily damaged by static.

Contents

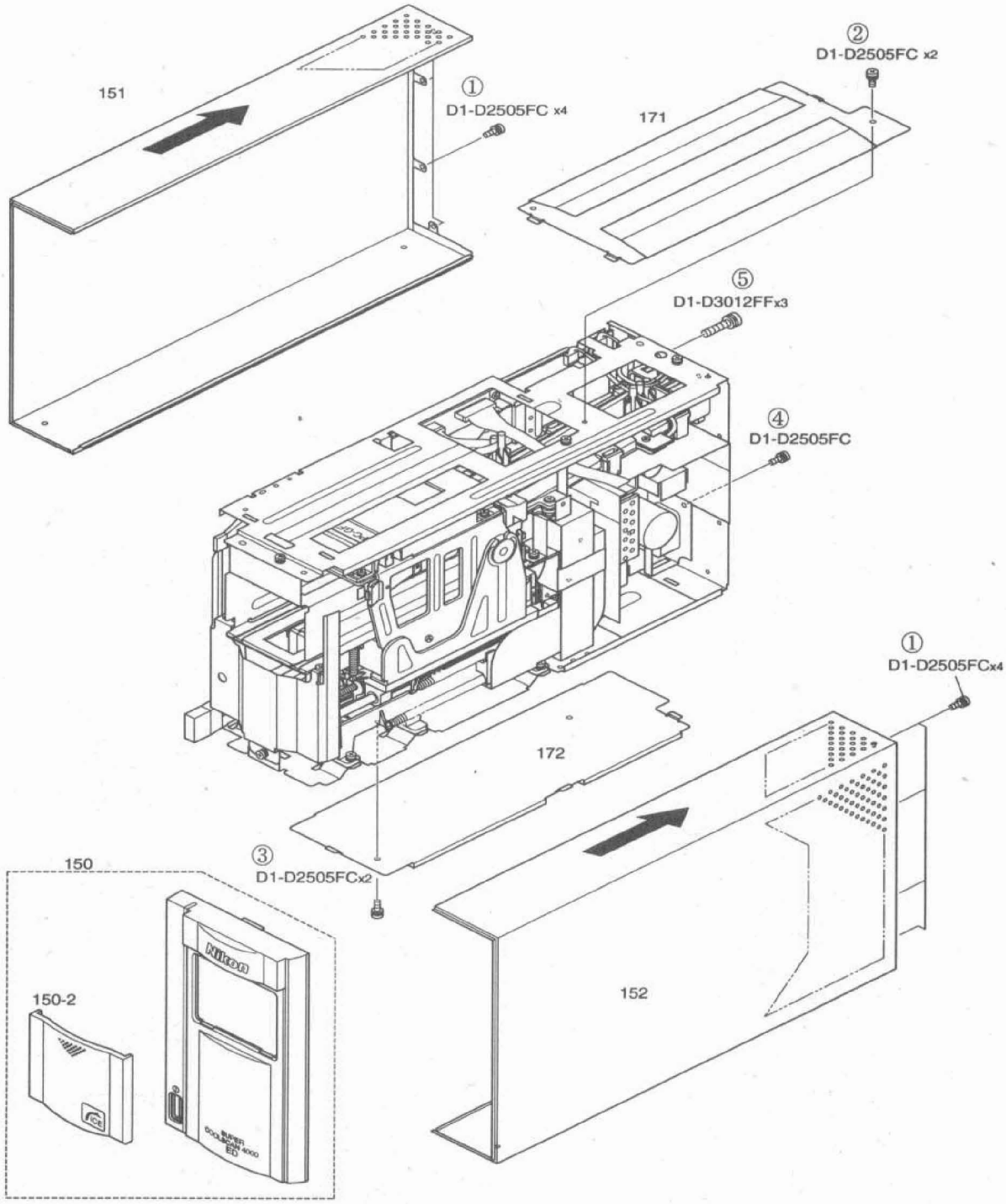
1. Exterior covers

[Disassembly]

- Remove the eight screws ①(D1-D2505FC), and remove the L side cover assembly #151 and right side cover assembly #152.
- Remove the two screws ②(D1-D2505FC), and remove the top shield panel #171.
- Remove the two screws ③(D1-D2505FC), and remove the bottom shield panel #172.
- Remove the front panel assembly #150.
- Remove the screw ④(D1-D2505FC) and three screws ⑤(D1-D3012FF).

[Re-assembly]

Follow the disassembly procedure in reverse.



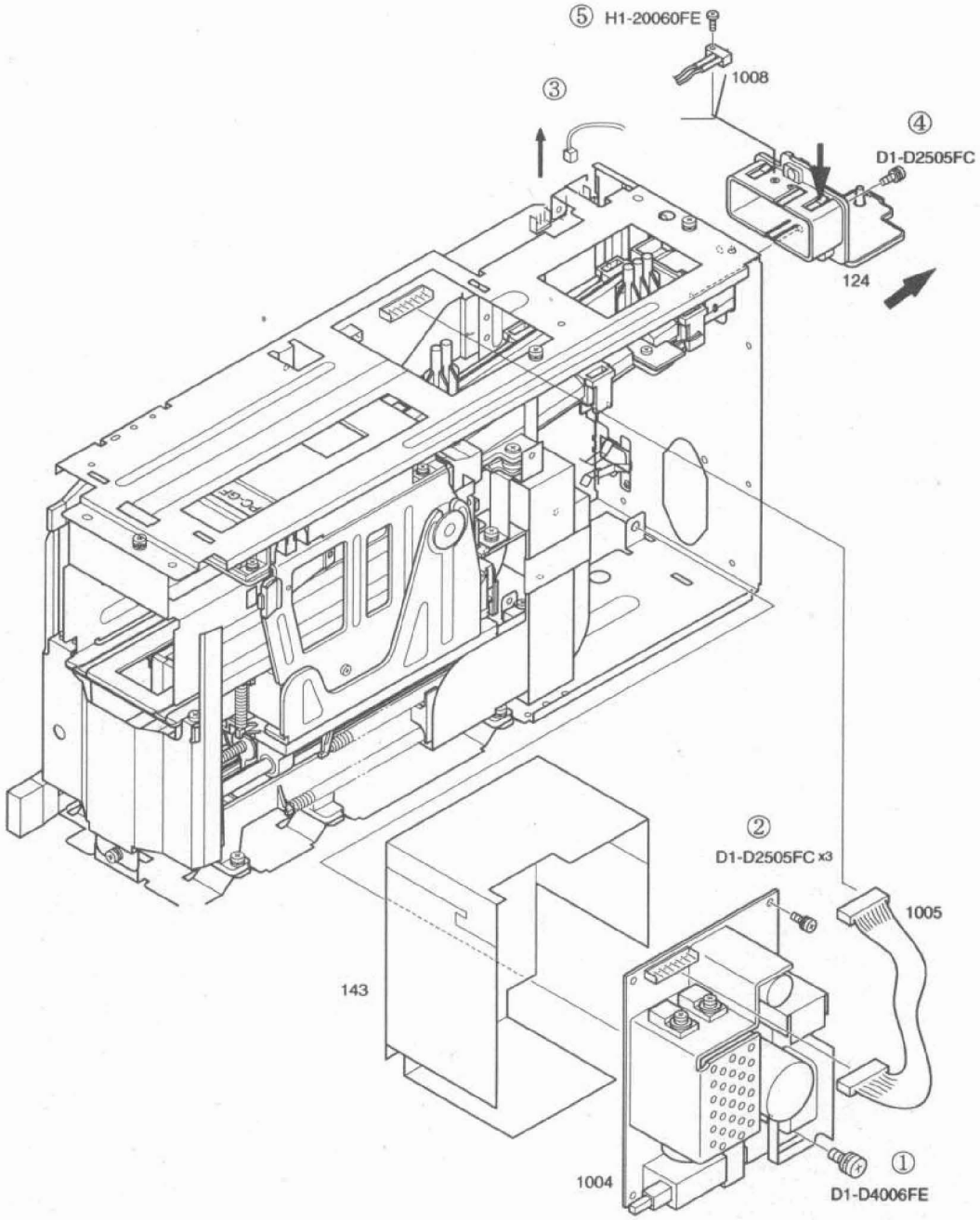
2. Power supply block and film gate assembly

[Disassembly]

- Disconnect the connector (on the main board assembly side) of the power supply harness #1005.
- Remove the screw ①(D1-D4006FC) and three screws ②(D1-D2505FC), and remove the power supply assembly #1004.
- Remove the PS insulating sheet #143.
- Remove the connector ③(on the main board assembly side) of the cover open/close switch harness.
- Remove the screw ④(D1-D2505FC), and press the film gate #124 in the directions of the two arrows to remove it.
- Remove the screw ⑤, and remove the cover open/close switch harness #1008.

[Re-assembly]

Follow the disassembly procedure in reverse.



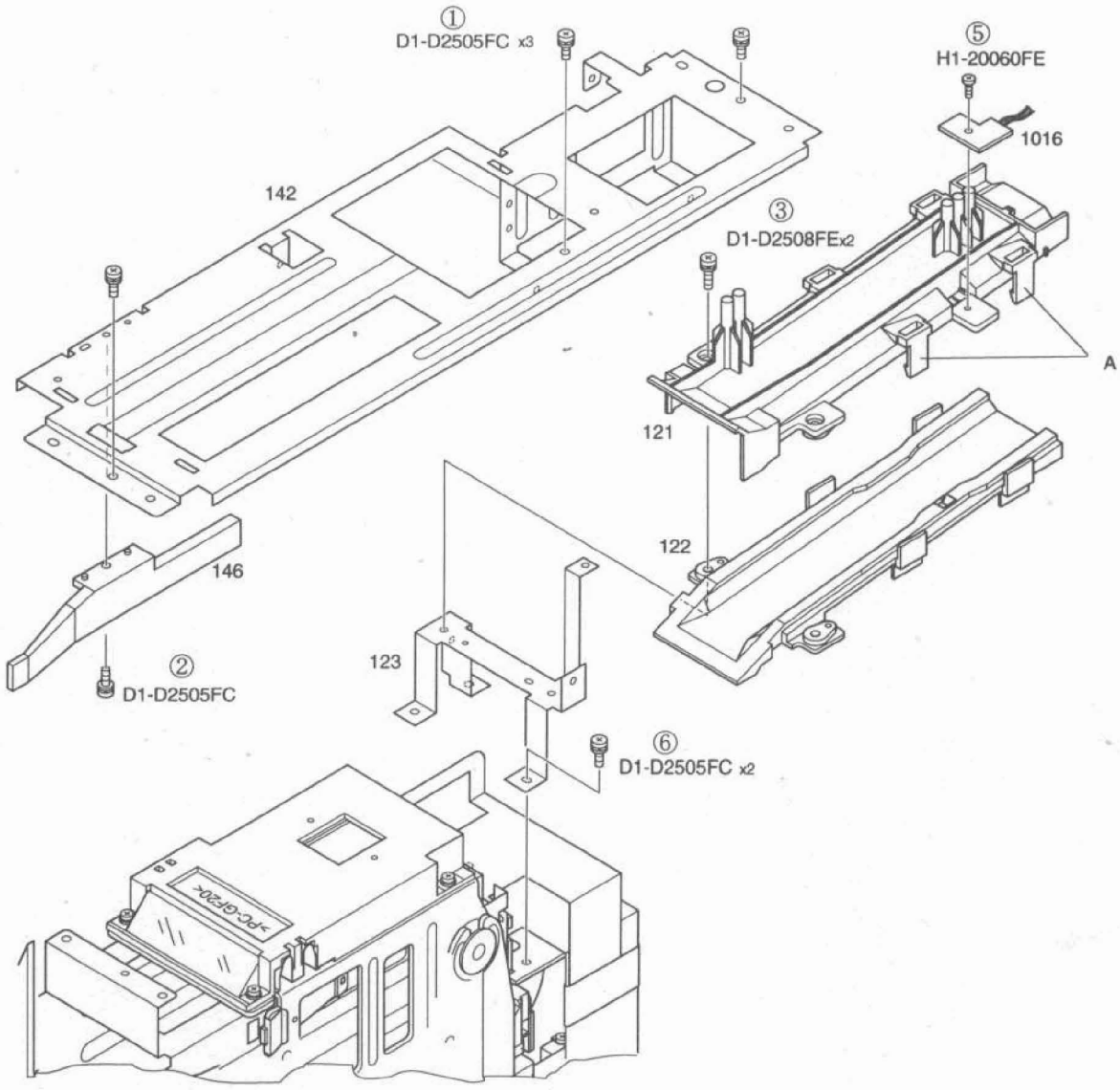
4. Top chassis unit and film rail unit

[Disassembly]

- Remove the three screws ① (D1-D2505FC), and remove top chassis #142.
- Remove the screw ② (D1-D2505FC), and remove the light guide #146.
- Remove the two screws ③ (D1-D2508FE) to disengage the film rail unit (#121, #122 and rail perforation sensor #1016).
- Disengage the four tabs (A) of the film rail top #121 from the film rail bottom to separate the parts.
- Remove the screw ⑤ (H1-20060FE), and remove the rail perforation sensor #1016.
- Remove the two screws ⑥ (D1-D2505FC), and remove #123.

[Re-assembly]

Follow the disassembly procedure in reverse.



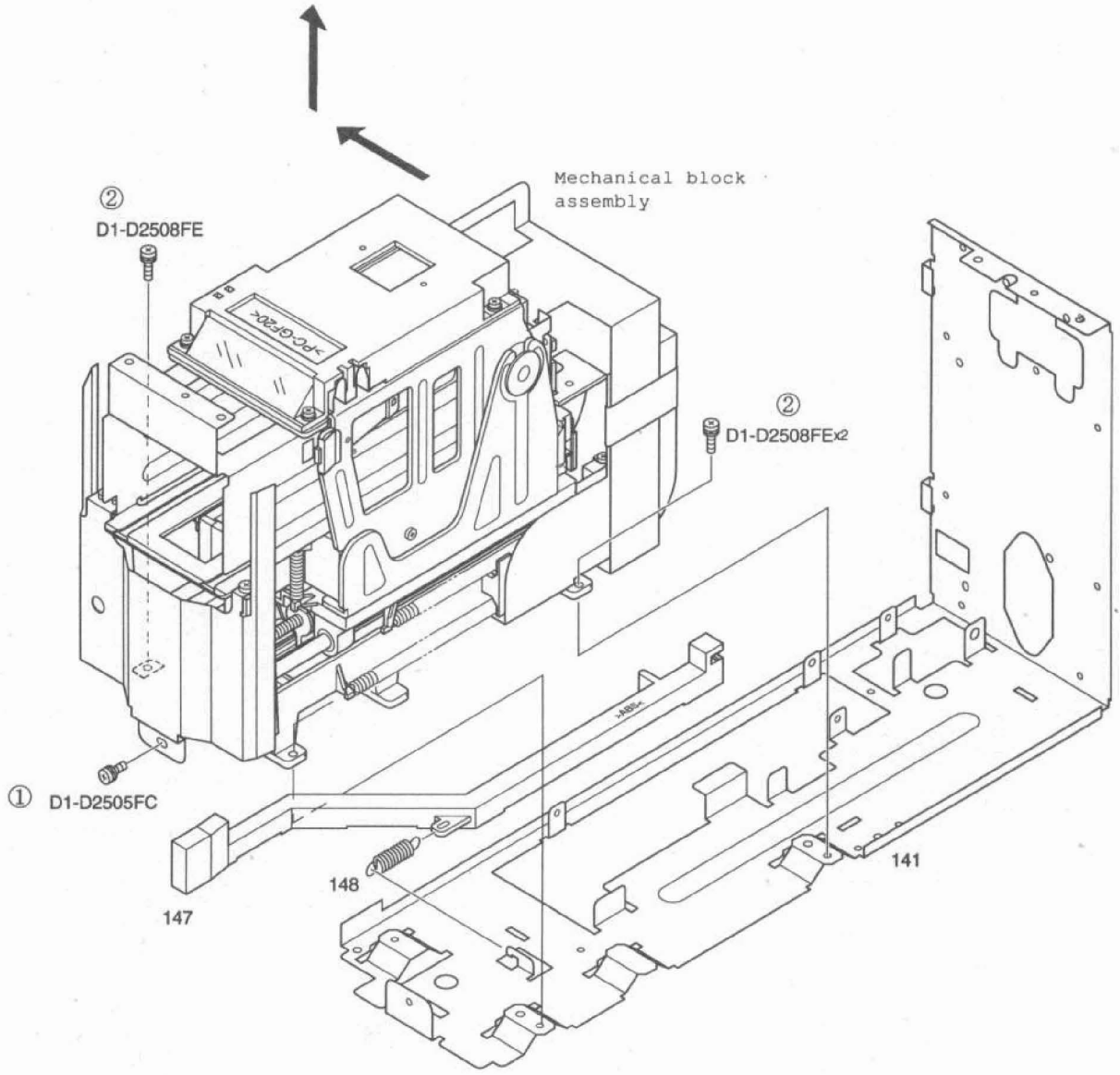
5. Main chassis unit

[Disassembly]

- Remove the screw ① (D1-D2505FC), and remove the three screws ② (D1-D2508FC).
- Move the mechanical block assembly in the direction of the arrow, and disengage it from the main chassis #141.
- Remove the power switch spring from the holder in the main chassis #141, and remove the power switch bar assembly #147.

[Re-assembly]

Follow the disassembly procedure in reverse.



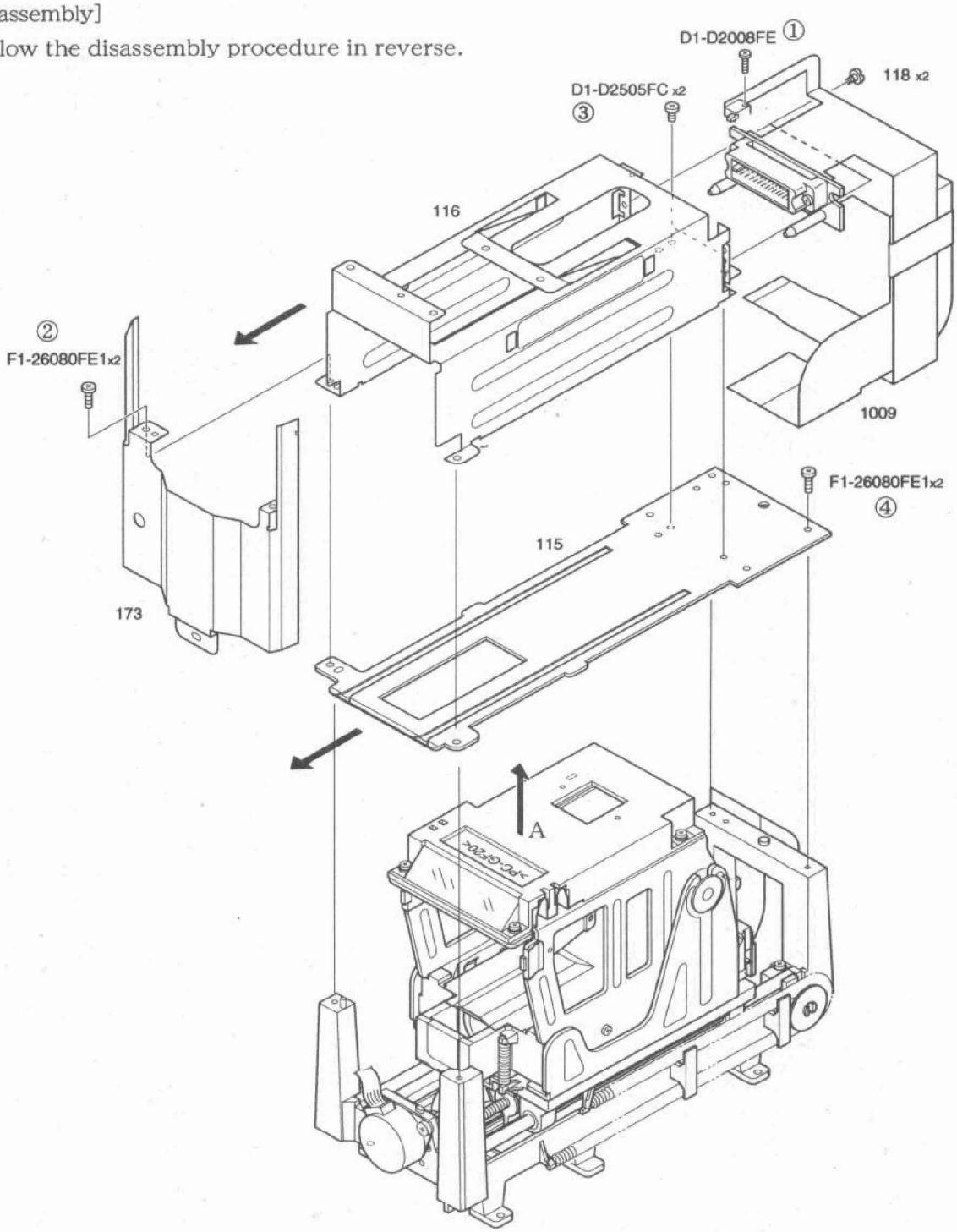
6. AD flexible cable, clamp panel and mounting panel assemblies

[Disassembly]

- Remove the screw ① (D1-D2008FE) and two float screws #118, and remove the AD flexible cable assembly #1009.
- Remove the two screws ② (F1-26080FE1), and remove the front shield panel #173.
- Remove the two screws ③ (D1-D2505FC) and, while simultaneously holding up section A in the direction of the arrow, remove the AD clamp panel assembly #116. Then remove the front shield panel #173.
- Remove the two screws ④ (F1-26080FE1), and remove the AD mounting panel assembly #115 in the direction of the arrow.

[Re-assembly]

Follow the disassembly procedure in reverse.



7. Mechanical base assembly

[Disassembly]

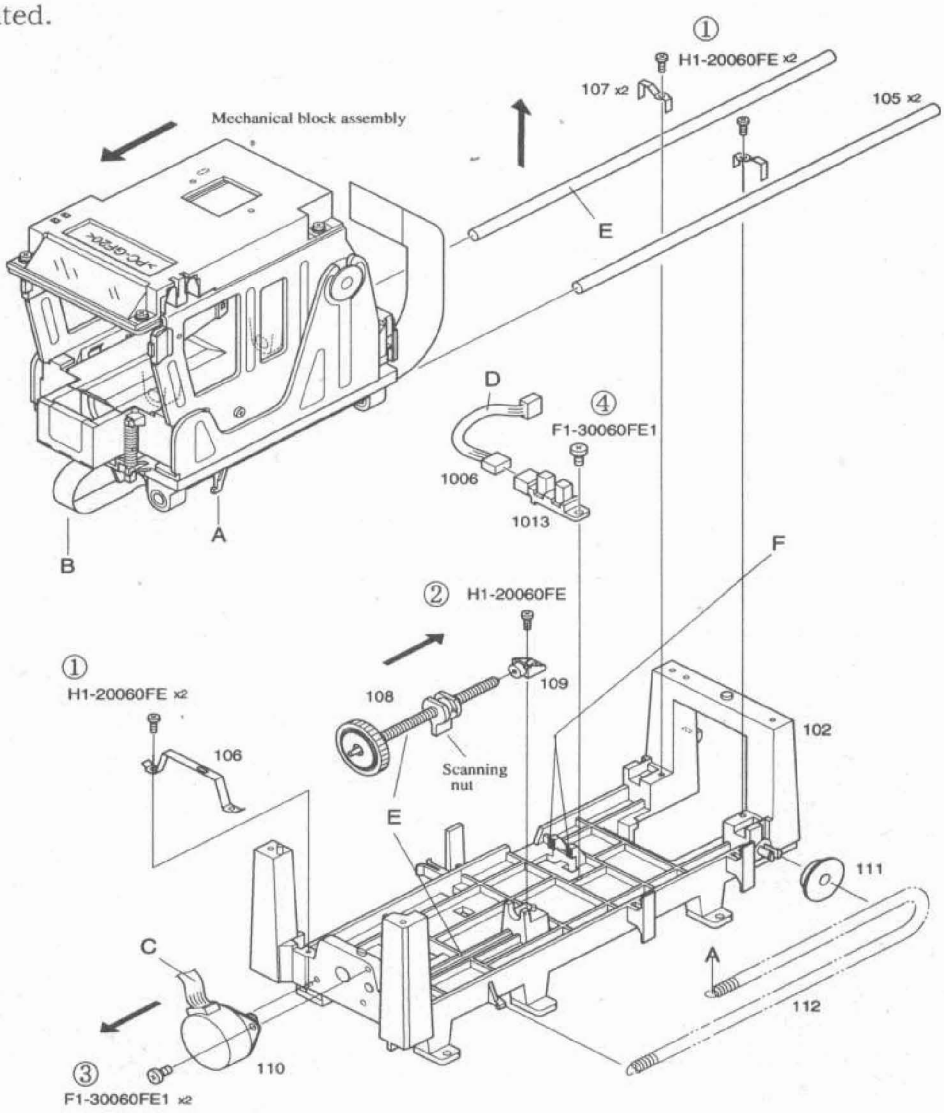
- Remove the scanning spring #112.
- Disengage the AF flexible cable B, scanning motor harness C and photo-interrupter harness #1006 from the tabs on the (rear and side panels of) the mechanical base #102.
- Remove the four screws ①(H1-20060FE), and remove the guide bar clamps #106 (x1) and #107(x2).
- Remove the mechanical block assembly from the mechanical base #102, and remove the two guide bars #105.
- Remove the screw ②(H1-20060FE), and remove the lead screw fitting #109.
  Remove the lead screw assembly #108 in the direction of the arrow.
- Remove the two screws ③(F1-30060FE1), and remove the scanning motor assembly #110.
- Remove the screw ④(F1-30060FE1), and remove the photo-interrupter #1013.

[Re-assembly]

Follow the disassembly procedure in reverse.

Notes:

- Push the photo-interrupter #1013 against the F part of the mechanical base #102.
- The scanning nut is installed 25 to 30 mm from the tip of the lead screw for re-assembly.
- The E part (lead screw, slider and guide bar board side only) is to be lubricated.



8. Mechanical block assembly

[Disassembly]

Note: When the lighting base assembly is to be removed, marks must be made on the part A chassis and lighting base assembly without fail.

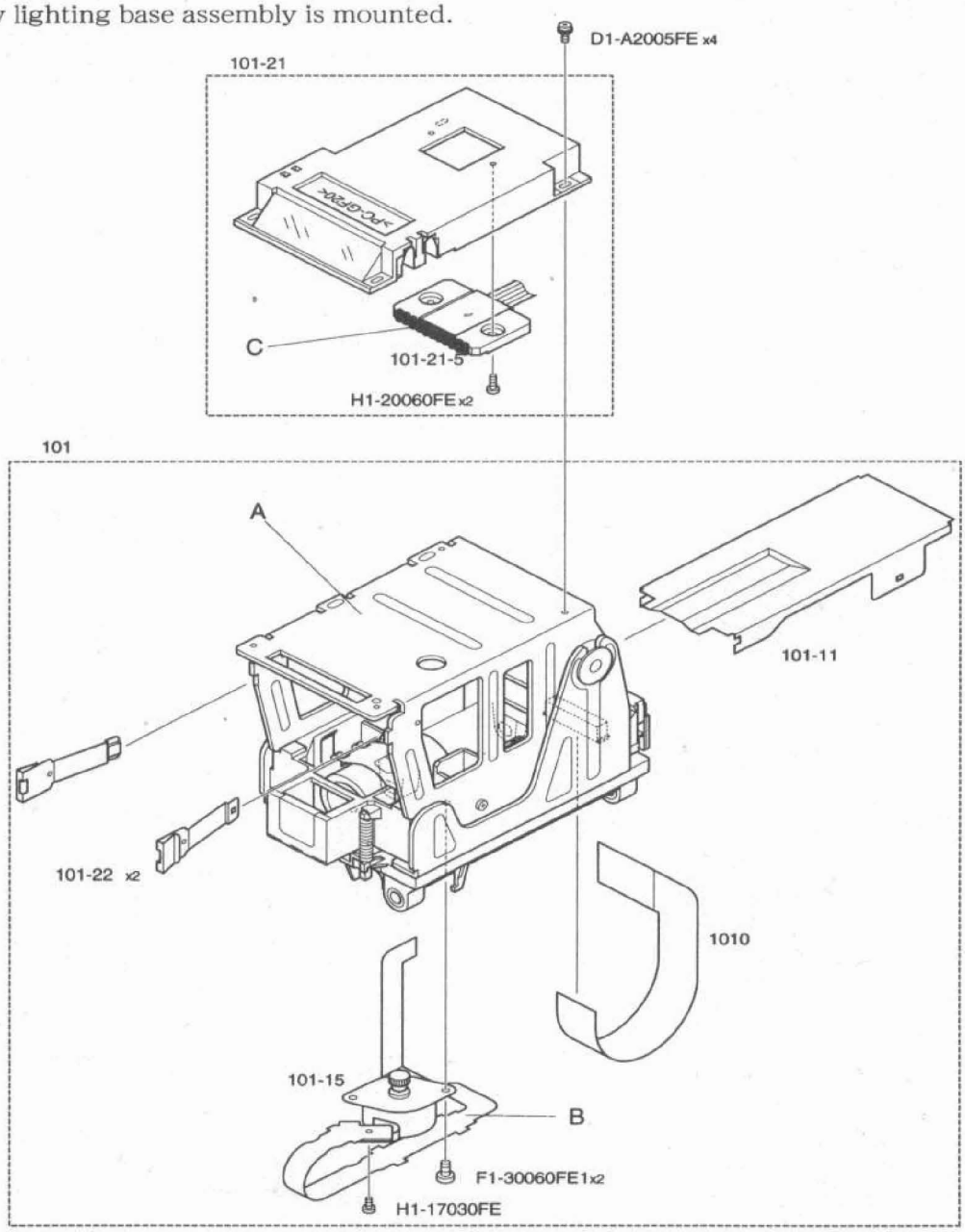
- Remove the four screws ① (D1-A2005FE), and remove the lighting base assembly #101-21.
- Remove the screw ② (H1-20060FE), and remove the LED block assembly #101-21-5.
- Remove the vibration-damping spring assembly #101-22.
- Remove the screw ③ (H1-17030FE) and two screws ④ (F1-30060FE1), and remove AF assembly #101-1. Remove the CCD flexible cable #1010 and the projection cover #101-11.

[Re-assembly]

Follow the disassembly procedure in reverse.

Notes:

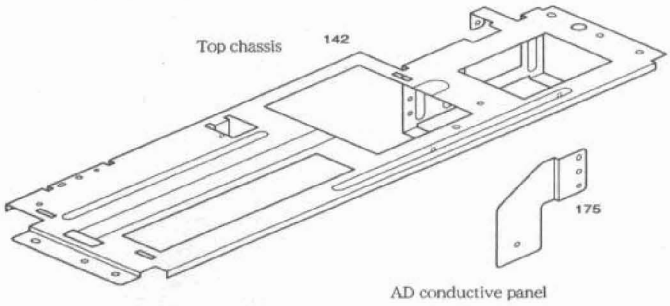
- When installing the LED block assembly #101-21-5, press it against the part C.
- When mounting the lighting base assembly, the marks on the part A chassis and lighting base assembly must be aligned without fail. The unevenness in the lighting must be adjusted when a new lighting base assembly is mounted.

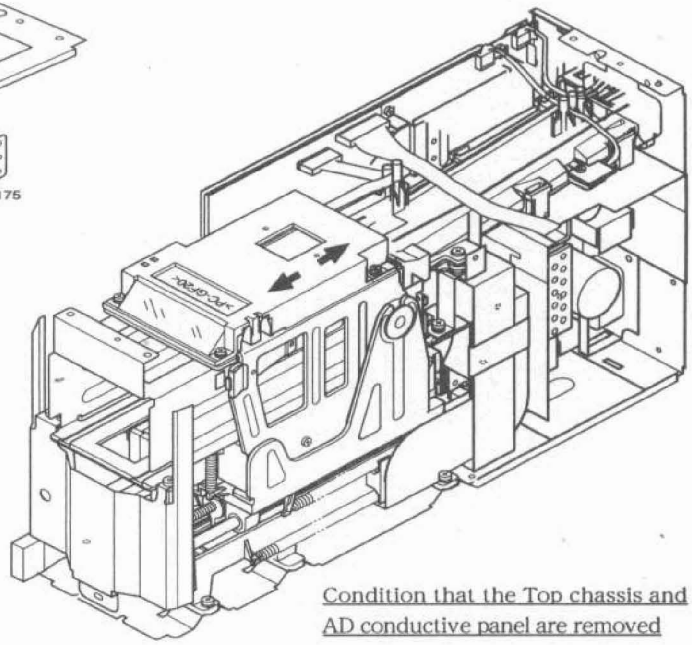


9. Adjustment of Lighting base assembly and LED Block assembly

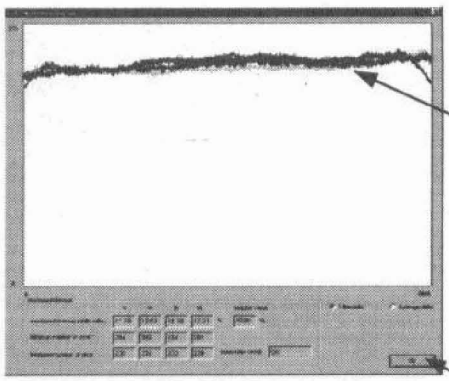
[Adjustment]

1) Remove the Top chassis #142 and the AD conductive panel #175 from the body.
2) Connect the scanner to the computer to show the Illumination irregularity of the inspection software. (Refer to "How to use the inspection software".
3) Slide the Lighting base assembly in an arrow direction to maximize the waveforms of Illumination irregularity.
4) When the waveforms of Illumination irregularity becomes maximum, fix the Lighting base assembly temporarily.
5) Click OK to finish the Illumination irregularity
6) Repeat 2)-5) and when the waveforms becomes maximum, fix the Lighting base assembly by the screws.





Condition that the Top chassis and AD conductive panel are removed



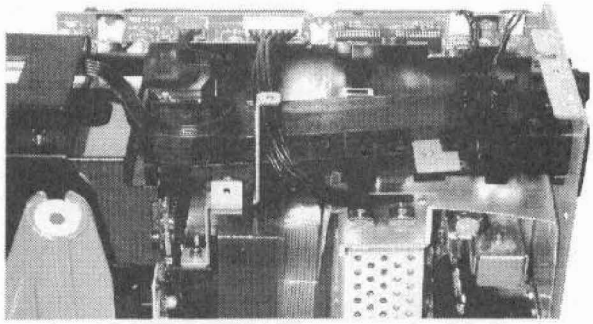
Adjust it so that the waveform would be maximum.

The waveforms of Illumination irregularity

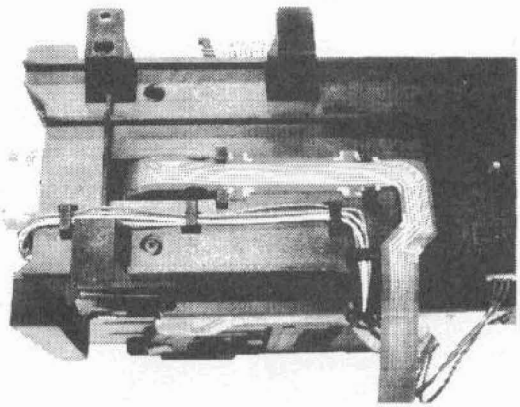
OK

9. Arrange of FPC , Lead wire

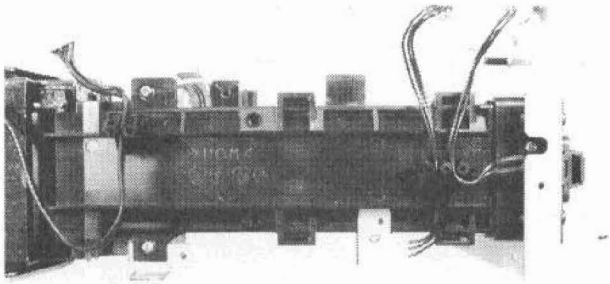
Upper part of Main PCB



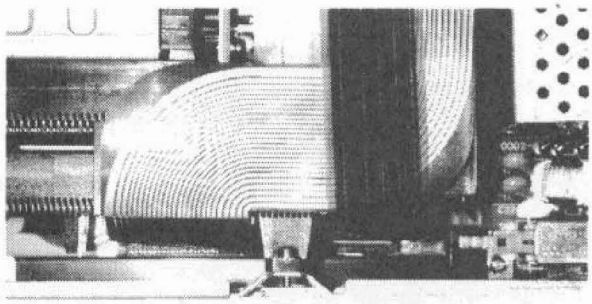
Bottom part of Mecha



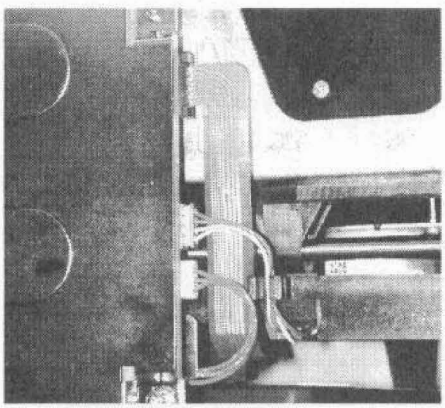
Upper part of Film rail unit



AD Flexible



AF Flexible cable, Scanning motor harness,
Photo-interrupter harness



How To Use The Inspection Software Program Contents

1. Objective

The purpose of this inspection software program is to perform illumination irregularity adjustments (when the illumination base assembly or LED block assembly needs to be replaced) and to perform inspections on the picture quality (resolution, CCD-related basic performance items, etc.) when users find them to be problematic, and such detailed inspections on the scanner main unit as color reproduction and color balance.

2. Preparations (equipment required, checks)

- Inspection chart (MA-20 + fixed setting of glass chart): J61187
- Positive film chart (positive): J61189
- Software program for servicing and inspections: J65037A (Japanese-language version), J65037B (English-language version)
- MA-20 or MA-21 adapter (for product conversion)

3. Inspection items

3-1. Initialization

・The firmware version is checked.

3-2. Illumination irregularity

・With shading OFF, the CCD raw data output is checked to verify that it comes within the standard.

3-3. Shading

・The CCD waveform data loaded with shading ON is checked to verify that it comes within the standard.

3-4. Log record

・The log numbers, number of times scanned, number of AF operations, number of thumbnails, number of initializations, number of adapter changes, adapter types, sense data and error contents are stored in the flash memory on the main circuit board.

The above data must be saved when the main circuit board assembly is replaced.

3-5. WB recording time

・As a means of countering dirt on the mirror, the shipment setting for the WB time is stored in the flash memory on the main circuit board. The WB time obtained by the WB measurement which is conducted during normal operation is compared with the WB time stored at the time of shipment, and an error is generated if it is higher by a percentage greater than the one prescribed.

The WB time must be rewritten when the LED-related parts are replaced.

3-6. Machine precision

• Scanning position precision

Deviation in the image scanning position (vignetting) is checked by obtaining the center positions (average values for x, y) of the four alignment marks and comparing them with their settings.

• Main/sub-scan perpendicularity

Collapse of the main scanning is checked by obtaining the angles (between main scanning and sub scanning) at three alignment mark positions (top left, top right and bottom right) and comparing them with their settings.

• Magnification

The optical system magnification is obtained from the distance between two alignment marks in the main scanning direction.

• Aspect ratio

The aspect ratio of the images is obtained from the distance between two alignment marks (top left to top right) in the main and sub scanning directions.

• Color registration

The color deviation on the images is checked.

• MTF

The resolution is checked from the contrast of the resolution pattern image.

• Flare

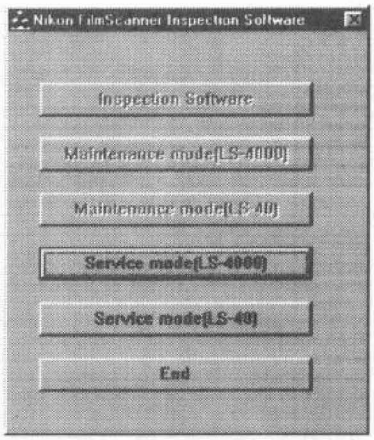
The optical system is checked for dirt.

3-7. Color reproduction (positive)

The Macbeth chart of the positive is scanned by the scanner, and the color reproducibility is checked for each color.

4. Inspection method

4-1. Start the service software program.



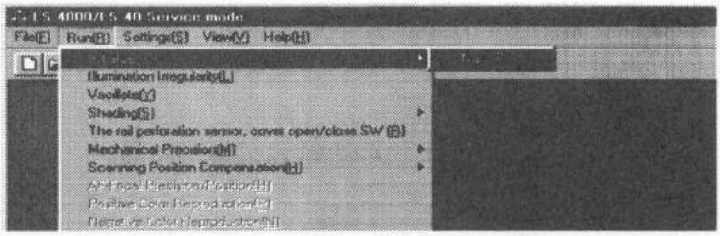
Select LS-4000ED or LS-40ED.

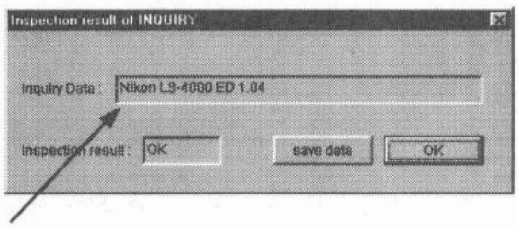
The service mode screen now appears.

4-2. Operating procedure for each inspection item

(1) Checking the firmware version

Check the firmware version by selecting [Run] on the main menu followed by [Initialize] and [INQUIRY]. Upon completion of the check, press [OK].



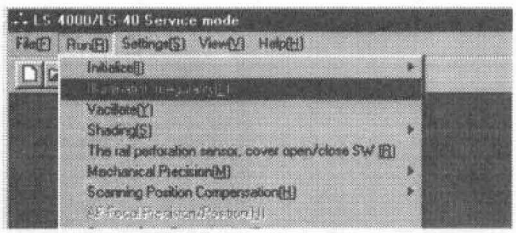


Firmware version

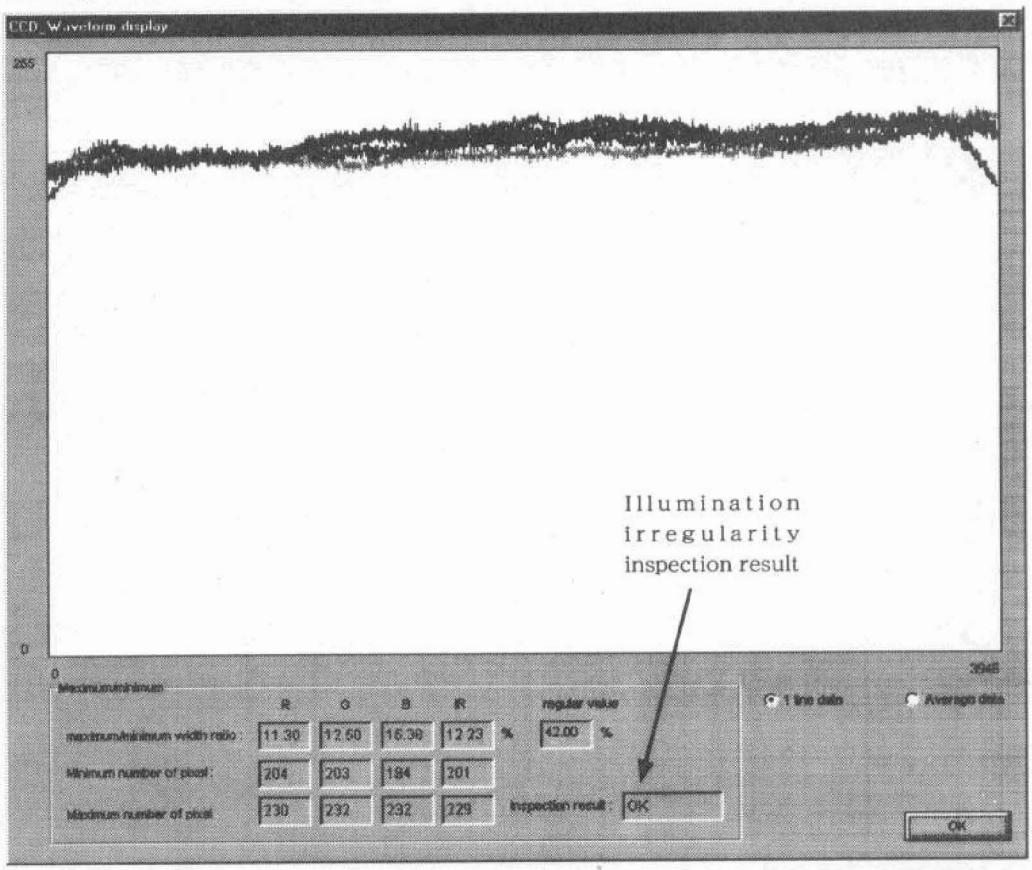
(2) Illumination irregularity

1) Install the MA-20 adapter on the scanner main unit.

2) Select [Run] on the main menu followed by [Illumination Irregularity].



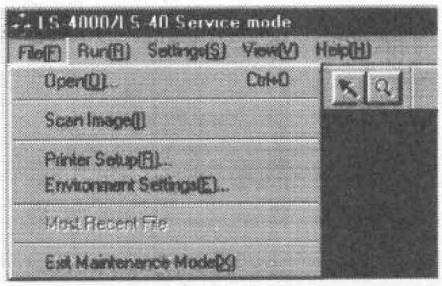
<3> Check that there is nothing wrong with the R, G, B and I waveforms.



On the screen shown above, the CCD sensor addresses 1 through 3946 have been allocated to the horizontal axis. If dirt or some other obstacle comes between the LED illumination and CCD sensor, the waveform at the position of the corresponding address will change significantly in the downward direction, enabling dirt and other obstacles to be detected visually. Illumination irregularity standard (less than 42%) If a NG result is yielded: Clean the optical system. (For details on the cleaning method, refer to the pages on the guidelines for repair.)

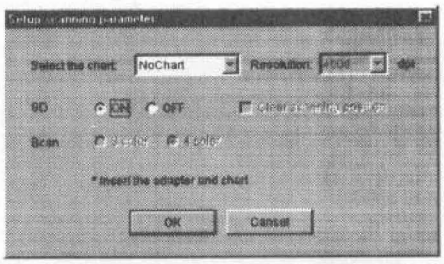
(3) Shading (shading ON data check)

· From [File], select [Scan Image] to display the parameter setting screen.



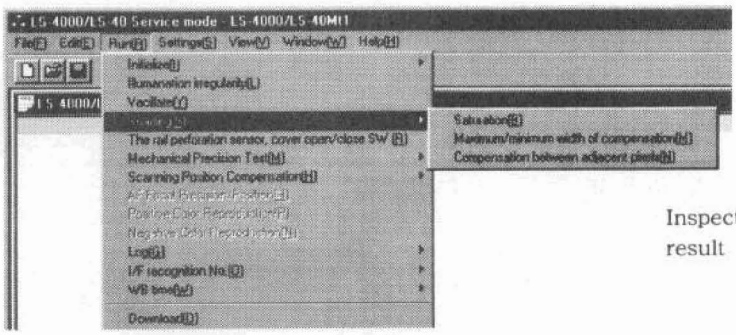
· Select the Chart: No Chart

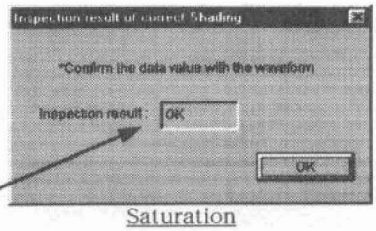
SD: Select ON, and click [OK].



·Scanning now starts automatically, and the shading ON data is displayed on the desktop.

• Select [Run] followed by [Shading] and [Saturation].

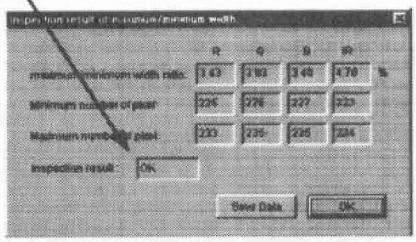




Inspection result

Saturation result

• Select [Run] followed by [Shading] and [Maximum/ minimum width of compensation].



Maximum/minimum width of compensation inspection result

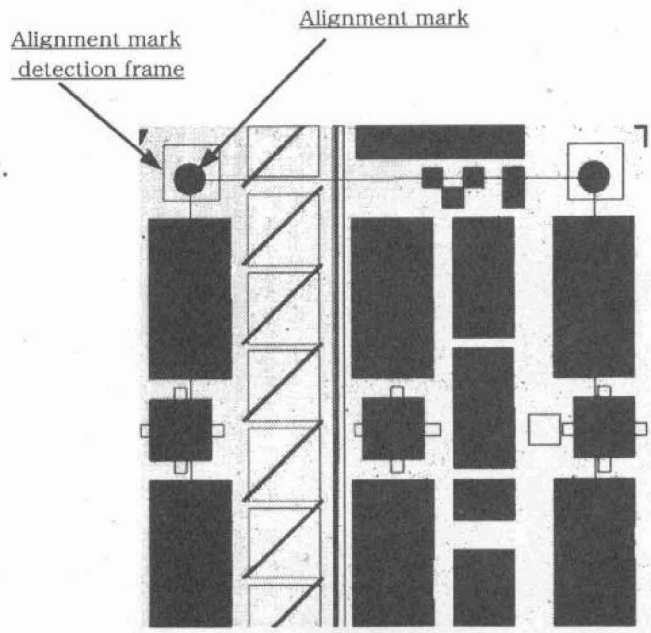
When a NG result is yielded:
The shading ON data is obtained by multiplying the reverse compensation data calculated on the basis of the illumination irregularity (shading OFF) data. If a NG result is yielded for this item, it may mean that the illumination irregularity precision is not within the rating or that there is something wrong with the shading compensation circuit on the main circuit board. In the former case, clean the optical system and check the illumination irregularity; in the latter case, replace the main circuit board.

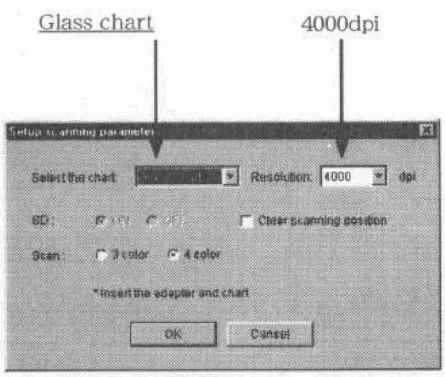
(4) Machine precision inspection

Insert the inspection chart (J61187) into the scanner main unit.

From [File], select [Scan Image] followed by [Glass Chart] and [4000 dpi (LS-4000ED)] or [2900 dpi (LS-40ED)] and click [OK] to start scanning.

When the scanned image of the chart appears on the monitor, use the mouse to drag the alignment detection frames (black square frames) to the alignment marks (black circles), and adjust their positions in such a way that the alignment marks are neatly housed inside. Once a position is adjusted, it is automatically saved in the initial file (se40.ini) so that there is no need for any subsequent adjustment provided that the film does not shift significantly from the mount and that there is no major change in the scanning position of the scanner.

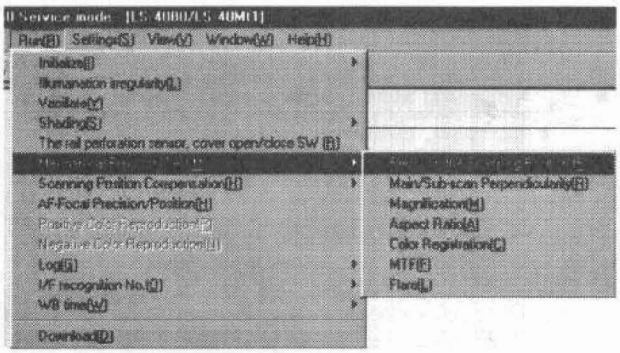




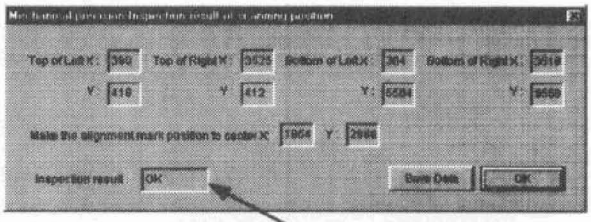
1) Scanning position precision

Select [Run] on the main menu followed by [Mechanical Precision Test] and [Precision the Scanning Position].

If a NG result is yielded, re-adjust the alignment mark.



Scanning position inspection result

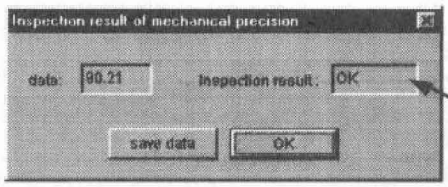


Inspection result

2) Main/sub-scan perpendicularity

Select [Run] on the main menu followed by [Mechanical Precision Test] and [Main/sub-scan Perpendicularity].

If a NG result is yielded, replace the optical block.



Inspection result

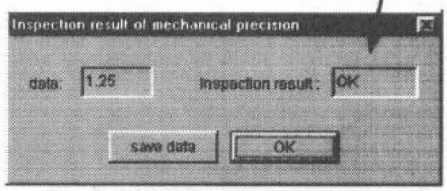
Main/sub-scan perpendicularity inspection result

3) Magnification

Select [Run] on the main menu followed by [Mechanical Precision Test] and [Magnification].

If a NG result is yielded, replace the optical block.

Inspection result

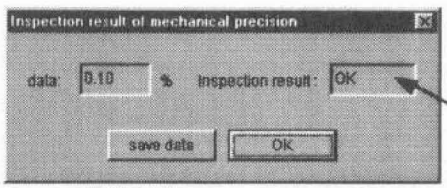


Magnification inspection result

4) Aspect ratio

Select [Run] on the main menu followed by [Mechanical Precision Test] and [Aspect Ratio].

If a NG result is yielded, replace the optical block.



Inspection result

Aspect ratio inspection result

5) Color registration

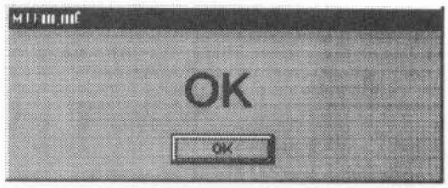
Select [Run] on the main menu followed by [Mechanical Precision Test] and [Color Registration].

If a NG result is yielded, clean the optical system, and either disassemble, clean and lubricate or replace the optical block.

6) MTF

Select [Run] on the main menu followed by [Mechanical Precision Test] and [MTF].

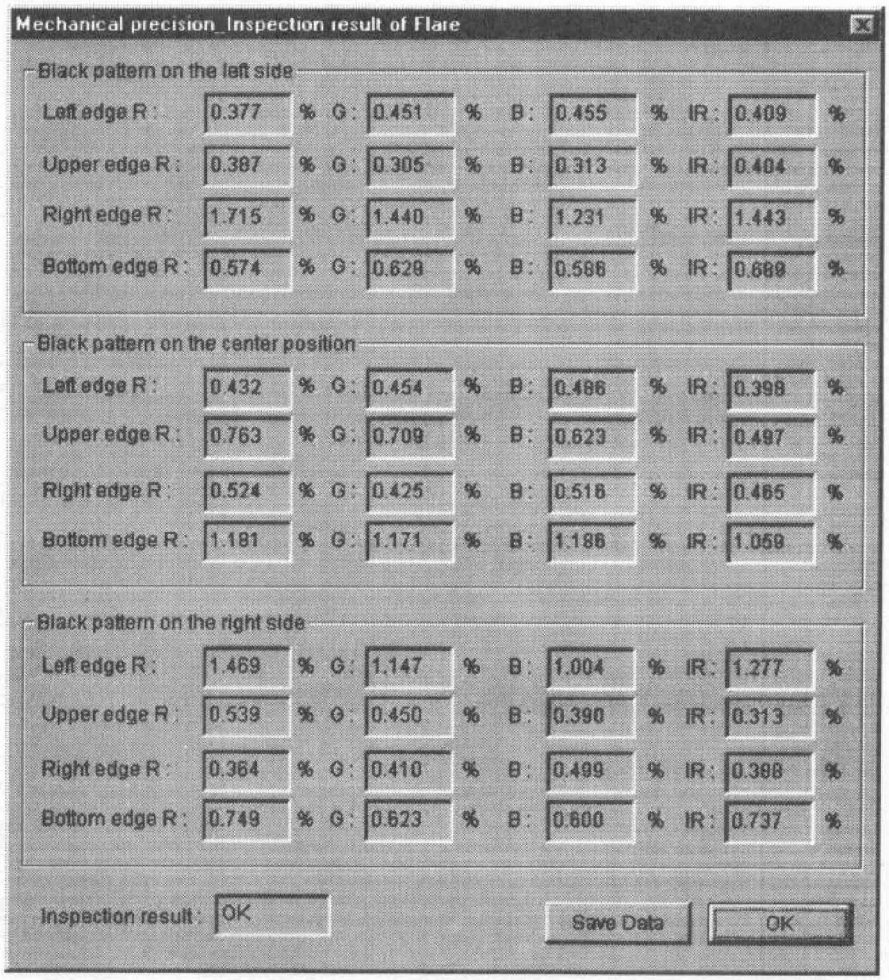
If a NG result is yielded, disassemble and clean the AF mechanism area, clean the optical system, and replace the optical block.



7) Flare

Select [Run] on the main menu followed by [Mechanical Precision Test] and [Flare].

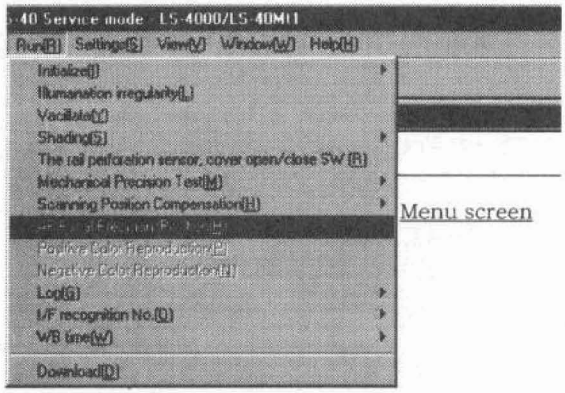
If a NG result is yielded, disassemble and clean the AF mechanism area, and clean the optical system.



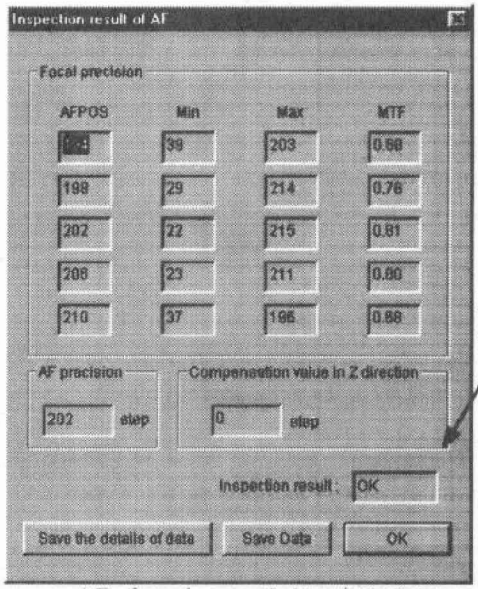
8) AF focal precision/position inspection

Select [Run] on the main menu followed by [AF-Focal Precision/Position]. The AF operation is now performed automatically.

If a NG result is yielded, disassemble and clean the AF mechanism area, and clean the optical system.



Menu screen



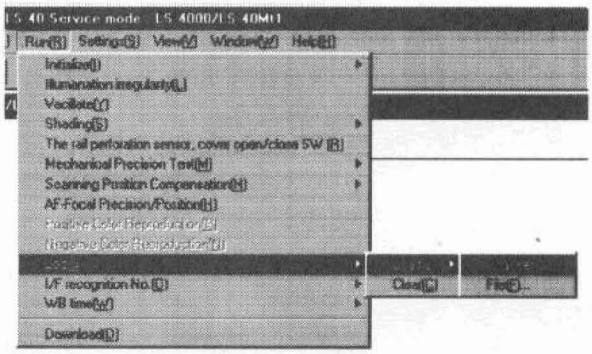
Inspection result

AF focal precision/position inspection result

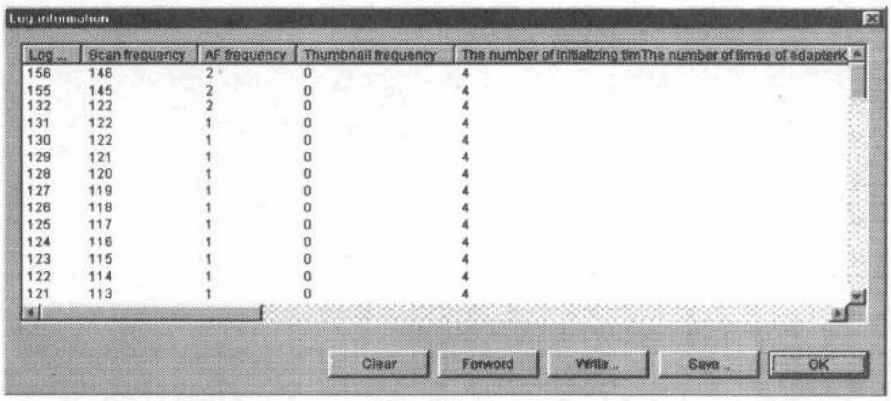
9) Logs

Select [Run] on the main menu followed by [Log], [Load] and [Scanner] in this order. The log data is now loaded automatically.

- When [Run] is selected followed by [Log], [Load] and [File] in this order, the log data which was saved will be recalled.
- When Log is selected followed by [Clear], the log data in the flash memory on the main circuit board will be cleared.



Menu screen



Log data screen

Clear: This is used to clear the log data from the flash memory on the main circuit board.

Write: This is used to write the saved log data into the flash memory.

Save: This is used to save the log data.

10) WB time

Select [Run] on the main menu followed by [WB time].

• Write WB time auto:

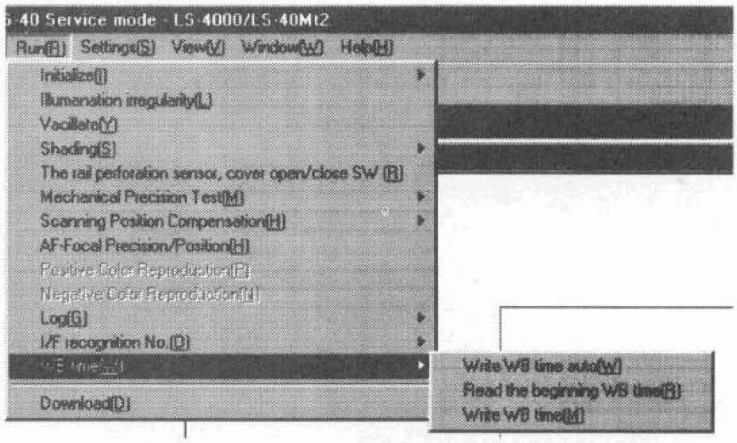
This is for writing the current WB data into the flash memory on the main circuit board. (This is useful when the LED-related parts are replaced or when the optical system is cleaned.)

• Read the beginning WB time:

This is for reading the WB data (during LED replacement or cleaning at the time of shipment or repair) which has been written in the flash memory.

• Write WB time:

This is for writing the WB data. Before the main circuit board assembly is replaced, the WB data must be copied, and then after it has been replaced, all the data must be written.

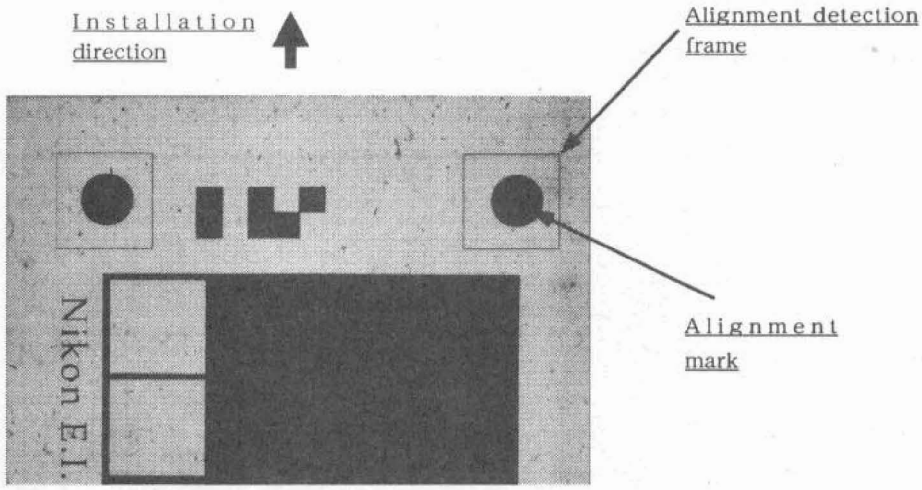


(5) Color reproduction (positive)

• Install the positive chart on the MA-20 in the direction shown by the arrow in the figure below.

•Select [File] followed by [Scan Image], [PosiChart] and [OK] in this order. Scanning is now performed automatically.

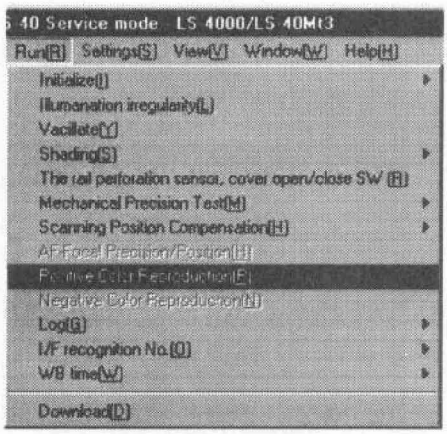
When the scanned image appears on the monitor, use the mouse to drag the alignment detection frames (black square frames) to the alignment marks (black circles), and adjust their positions in such a way that the alignment marks are neatly housed inside.



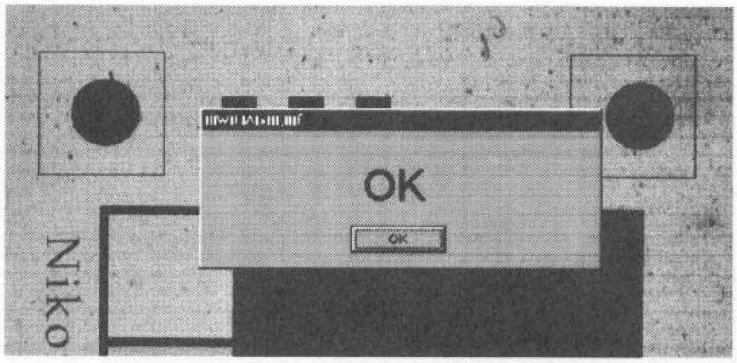
(6) Color reproduction (positive)

・Select [Run] on the main menu followed by [Positive Color Reproduction].

If a NG result is yielded, clean the color chart (positive), and replace the optical block.



Menu screen

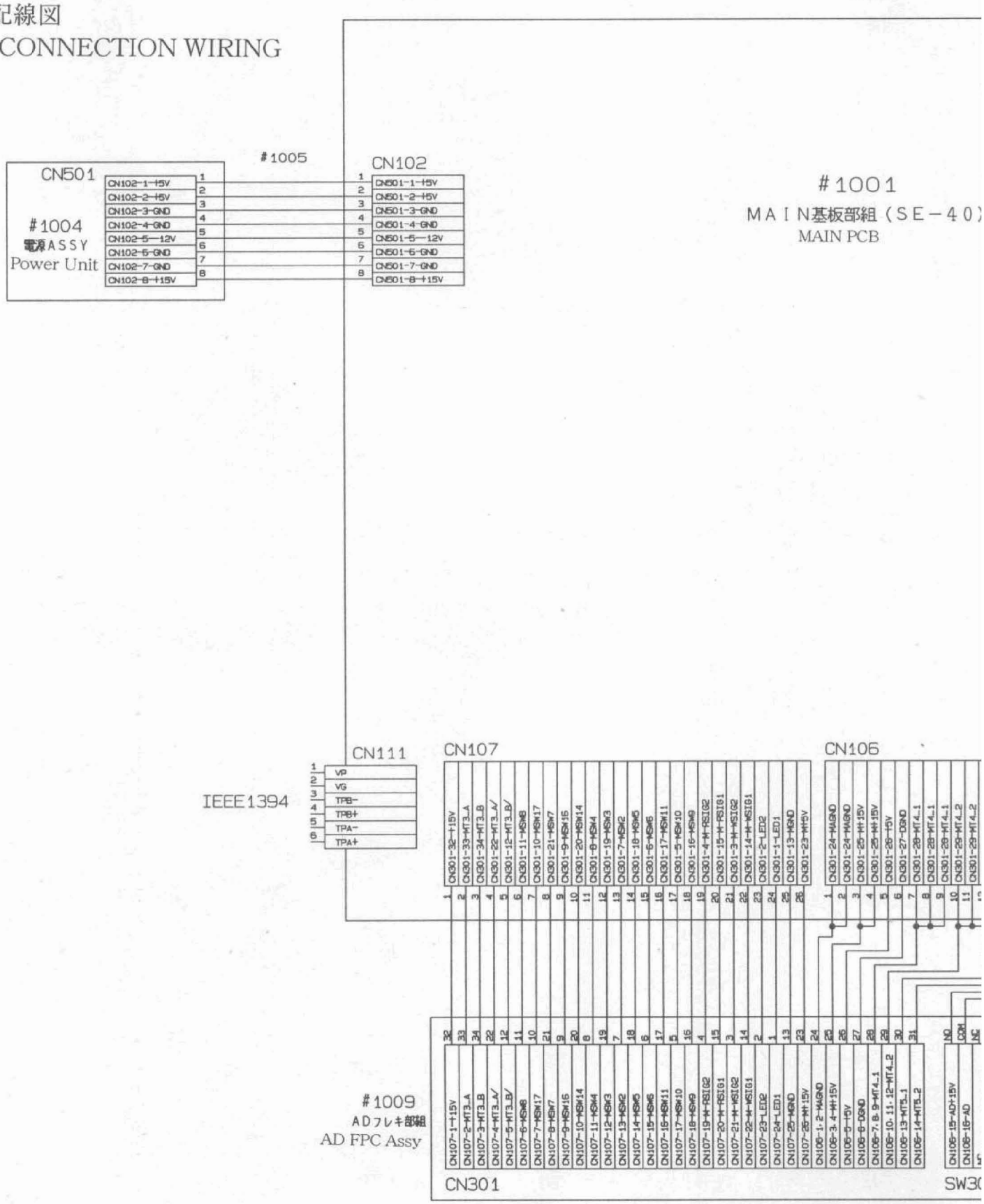


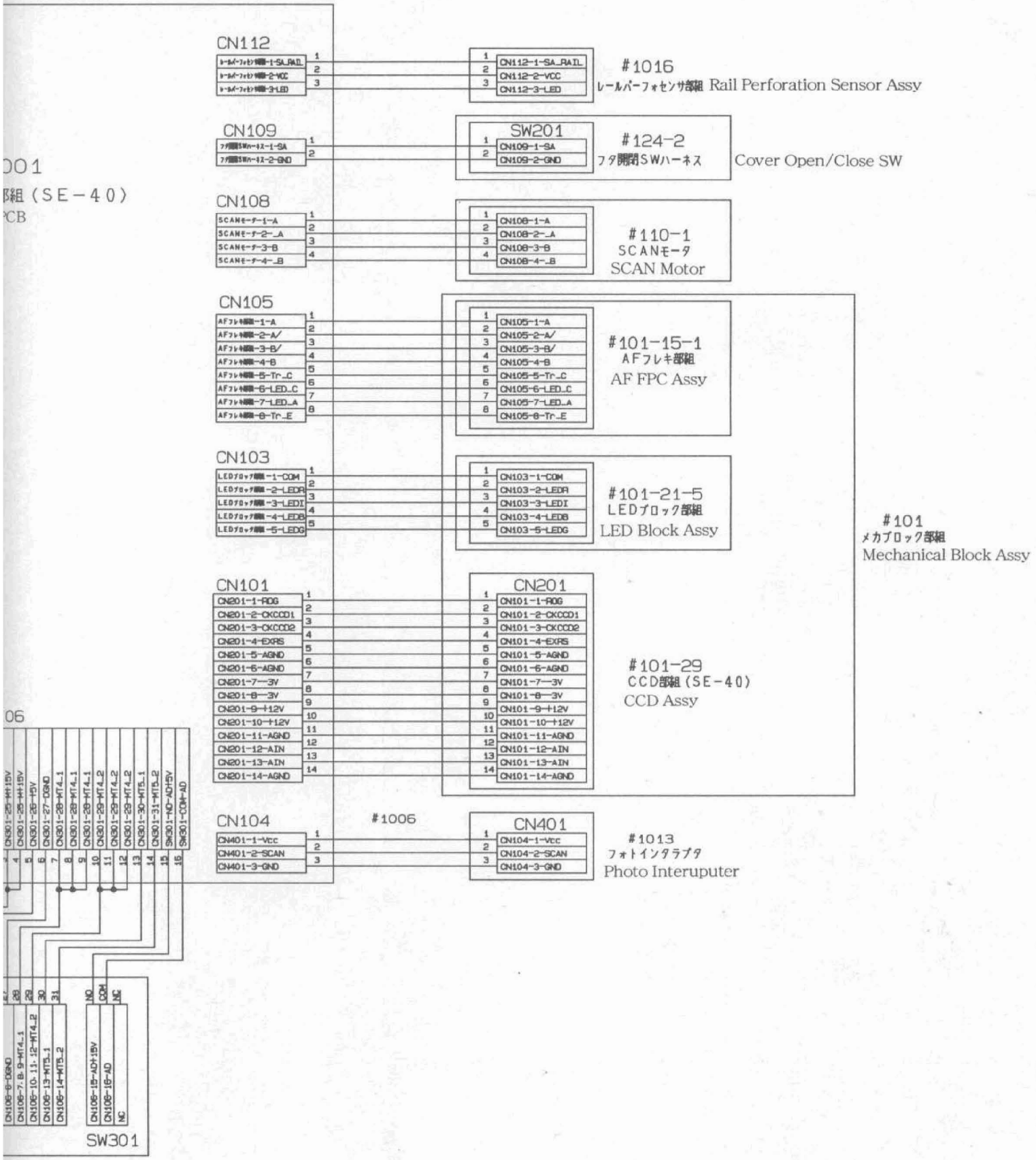
Color reproduction inspection result

ELECTRIC CIRCUIT

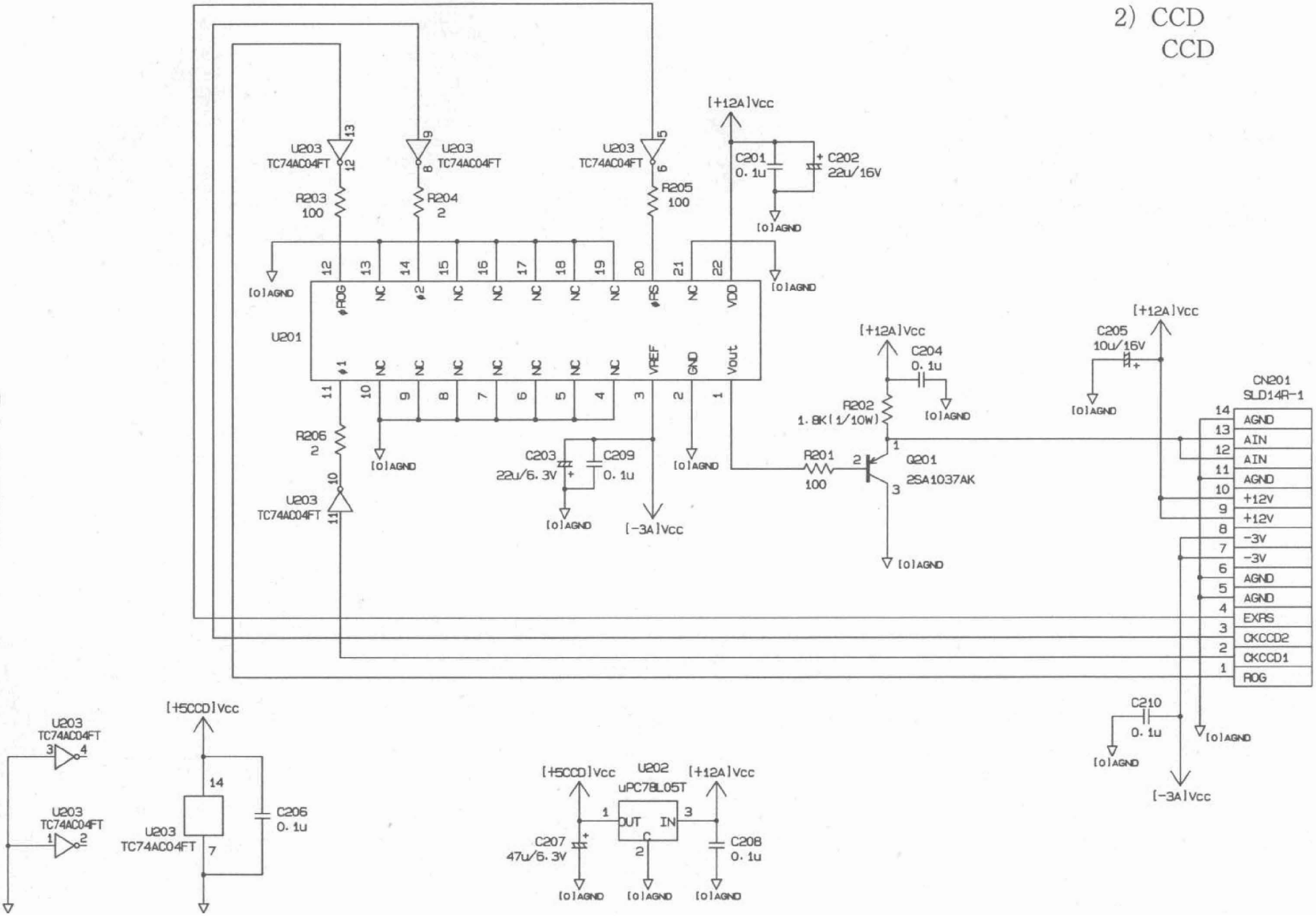
1）配線図

CONNECTION WIRING

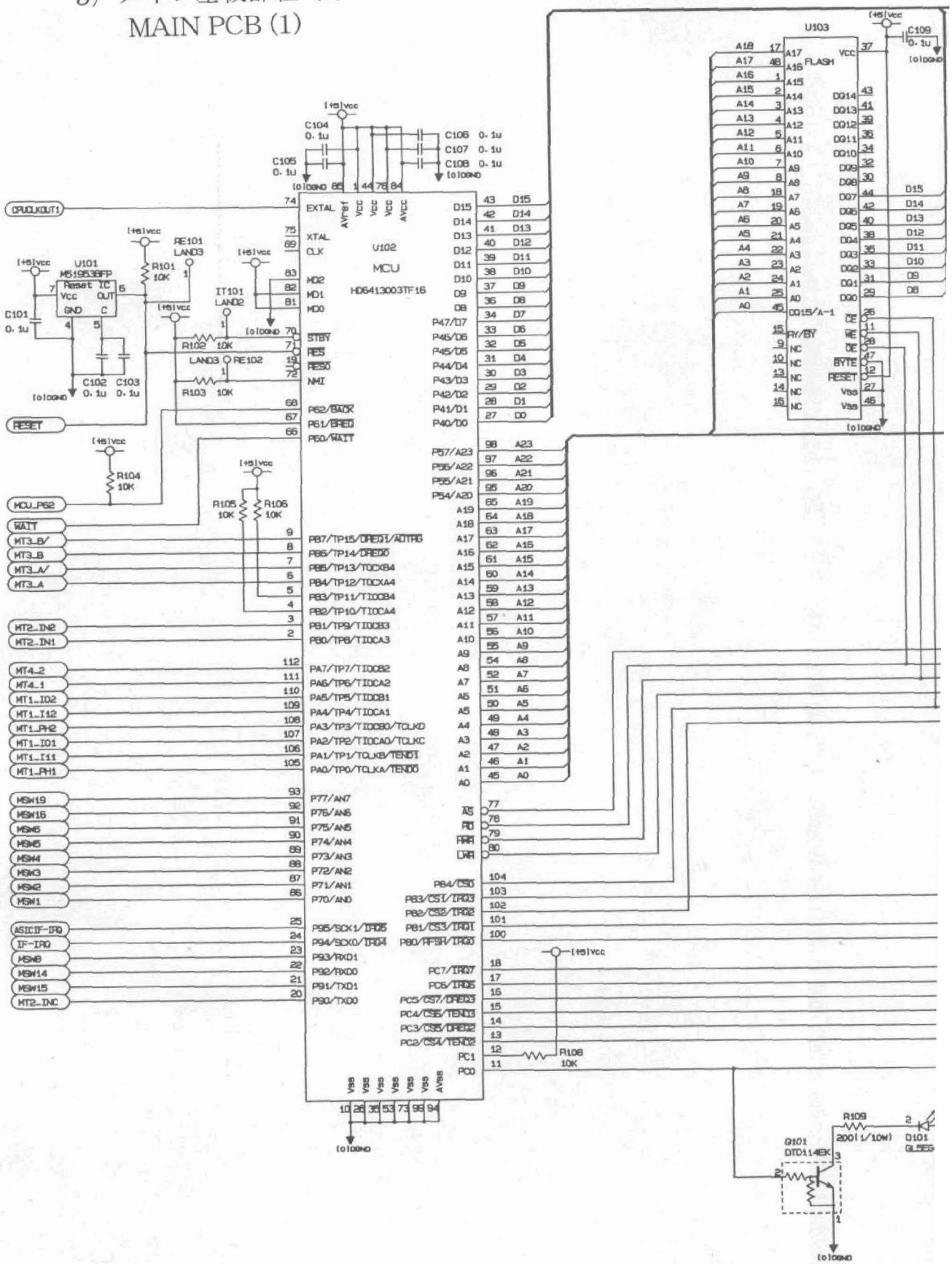


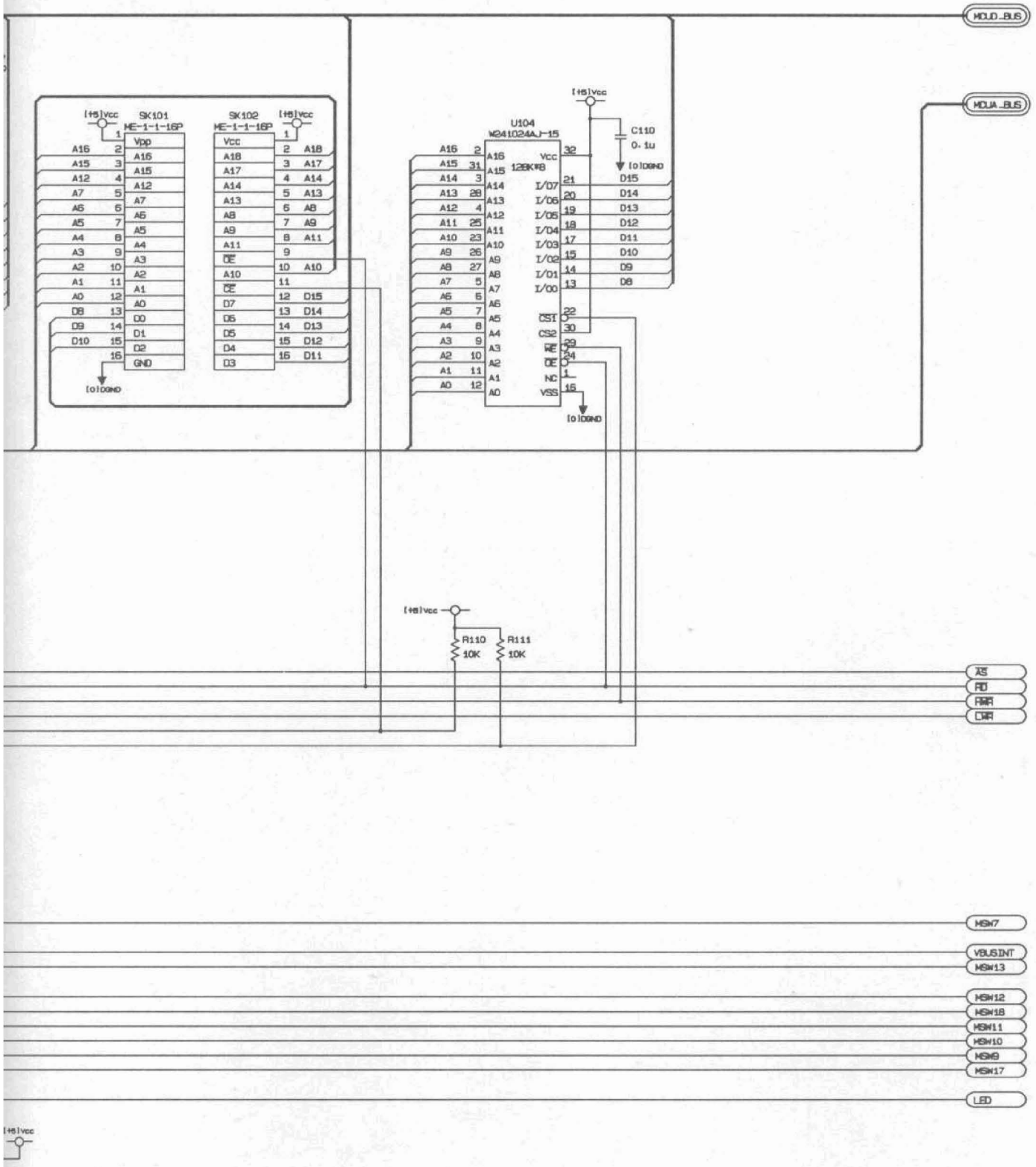

CN112
CN109
CN108
CN105
CN103
CN101
CN104
#1016
レールパーフォセンサ部組 Rail Perforation Sensor Assy
SW201
#124-2
フタ開閉SWハーネス
Cover Open/Close SW
#110-1
SCANモータ
SCAN Motor
#101-15-1
AFフレキ部組
AF FPC Assy
#101-21-5
LEDブロック部組
LED Block Assy
#101
メカブロック部組
Mechanical Block Assy
CN201
#101-29
CCD部組(SE-40)
CCD Assy
#1006
CN401
#1013
フォトインタラプタ
Photo Interuputer
SW301

2) CCD
CCD

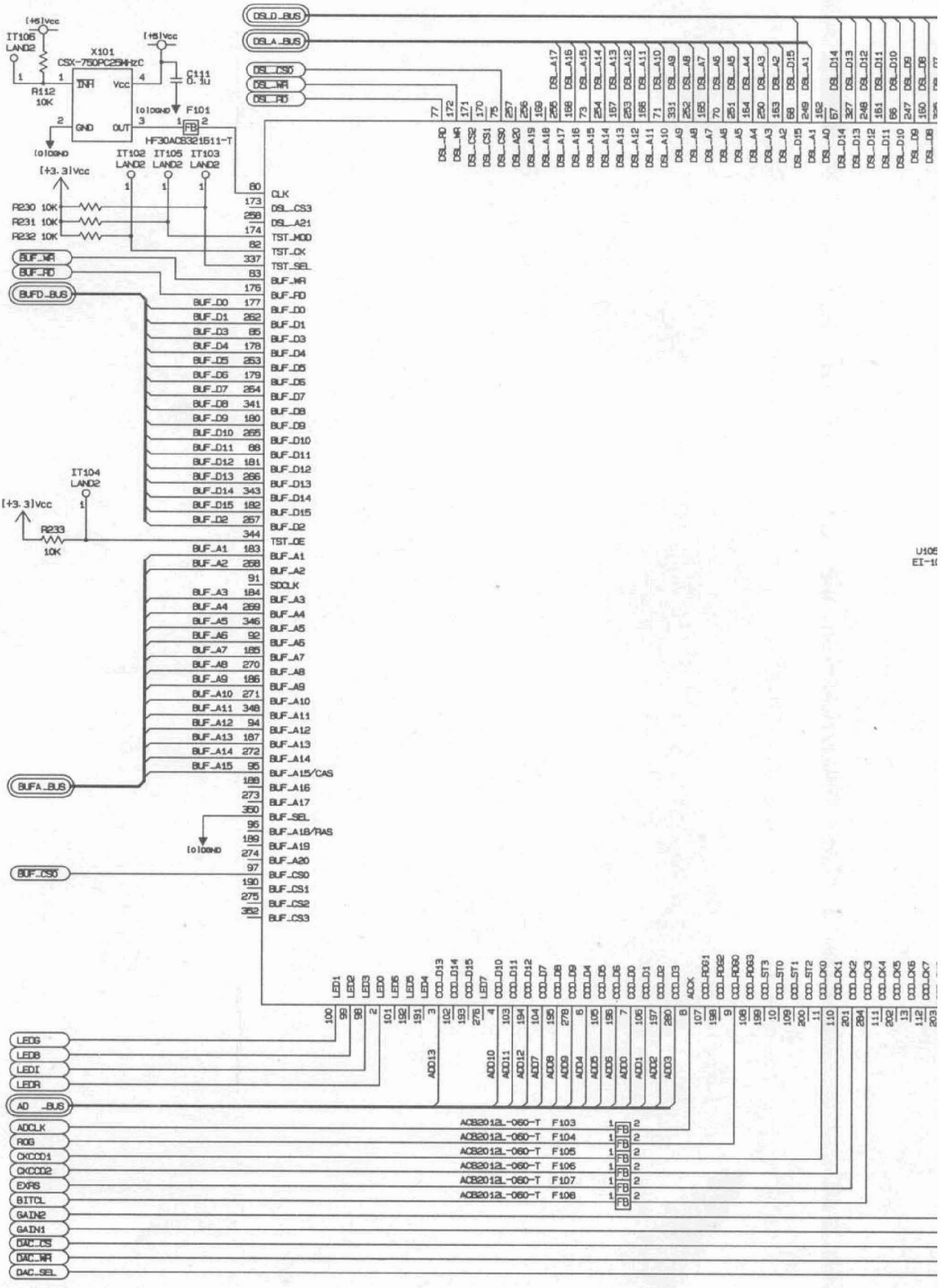

U203 TC74AC04FT
R203 100
R204 2
R205 100
[+12A]Vcc
C201 0.1u
C202 22u/16V
[o]AGND
U201
ΦROG
NC
Φ2
ΦRS
VDD
VREF
GND
Vout
C204 0.1u
C205 10u/16V
R202 1.8K(1/10W)
R201 100
Q201 2SA1037AK
C203 22u/6.3V
C209 0.1u
[-3A]Vcc
R206 2
CN201 SLD14R-1
AGND
AIN
+12V
-3V
EXPS
CKCCD2
CKCCD1
ROG
C210 0.1u
[+5CCD]Vcc
C206 0.1u
U202 μPC78L05T
OUT
IN
C207 47u/6.3V
C208 0.1u

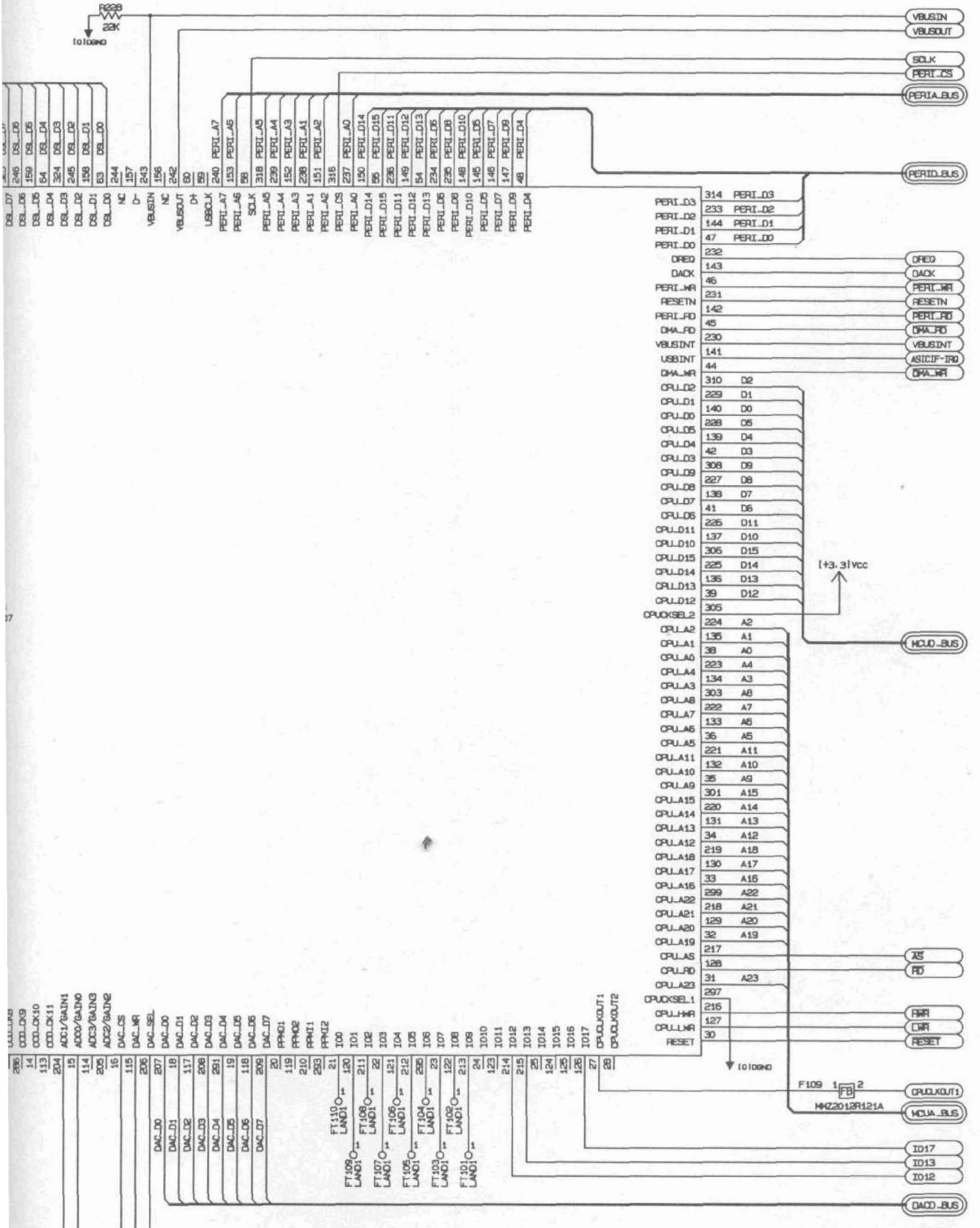
3) メイン基板部組 (1)
MAIN PCB (1)



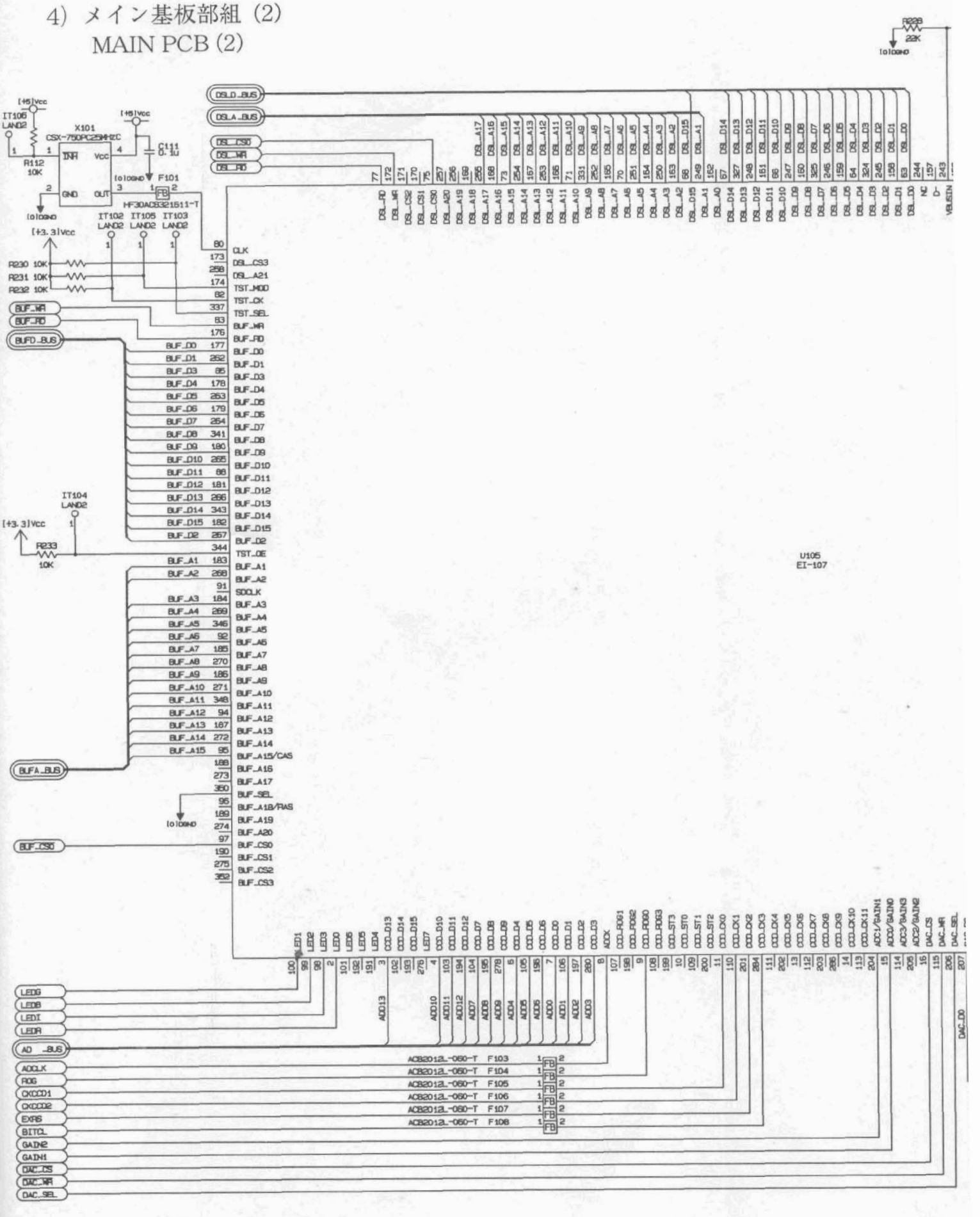

MCUD_BUS
MCUA_BUS
SK101
ME-1-1-16P
SK102
ME-1-1-16P
U104
W241024AJ-15
128K*8
C110
0.1u
R110
10K
R111
10K
AS
RD
PWR
DWR
MSW7
VBUSINT
MSW13
MSW12
MSW18
MSW11
MSW10
MSW9
MSW17
LED

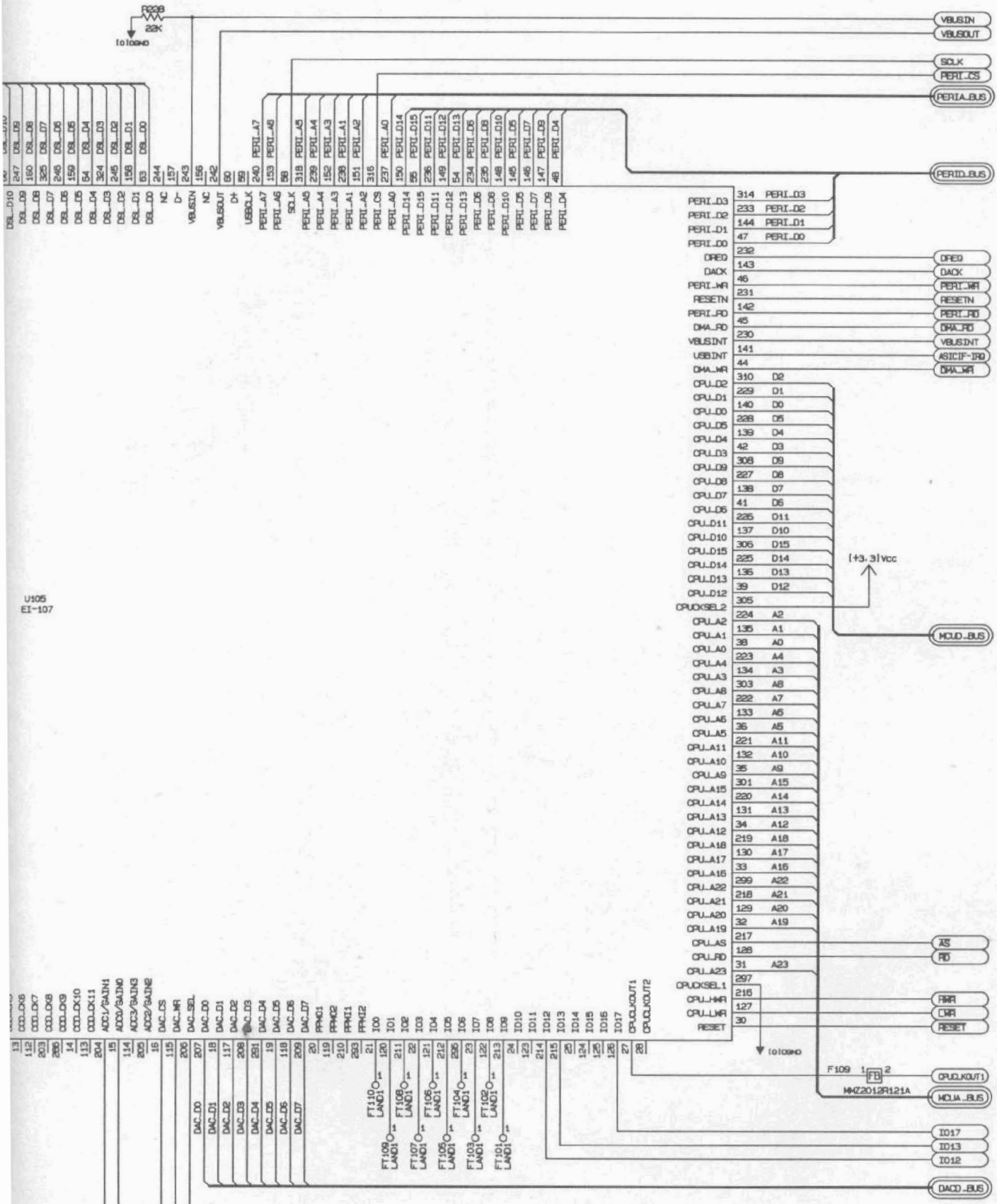
4) メイン基板部組 (2)
MAIN PCB (2)

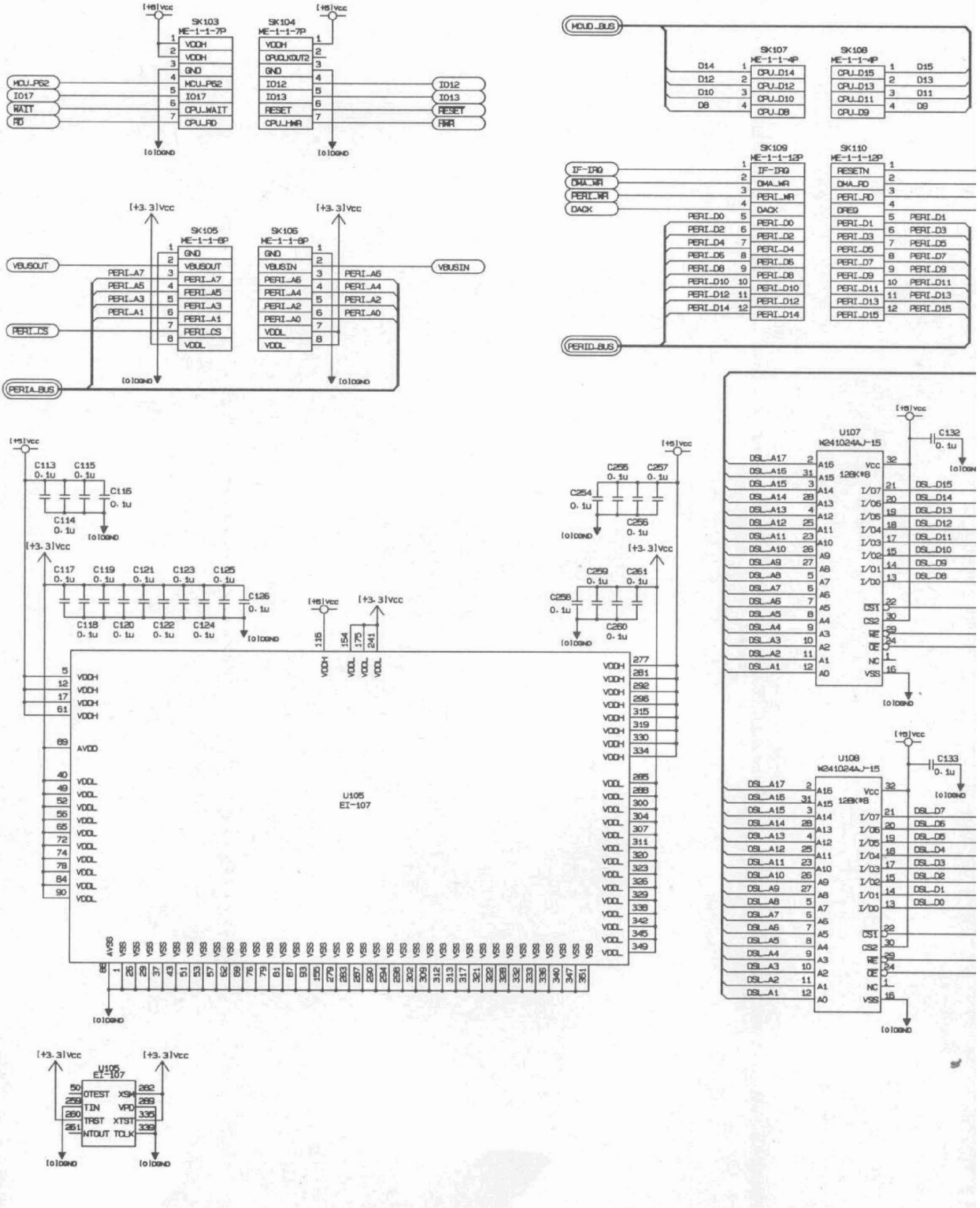



R228
22K
[o]GND
VBUSIN
VBUSOUT
SCLK
PERI_CS
PERIA_BUS
PERID_BUS
PERI_D3
PERI_D2
PERI_D1
PERI_D0
DREQ
DACK
PERI_WR
RESETN
PERI_RD
DMA_RD
VBUSINT
USBINT
DMA_WR
CPU_D2
CPU_D1
CPU_D0
CPU_D5
CPU_D4
CPU_D3
CPU_D9
CPU_D8
CPU_D7
CPU_D6
CPU_D11
CPU_D10
CPU_D15
CPU_D14
CPU_D13
CPU_D12
CPUCKSEL2
[+3.3]Vcc
CPU_A2
CPU_A1
CPU_A0
CPU_A4
CPU_A3
CPU_A8
CPU_A7
CPU_A6
CPU_A5
CPU_A11
CPU_A10
CPU_A9
CPU_A15
CPU_A14
CPU_A13
CPU_A12
CPU_A18
CPU_A17
CPU_A16
CPU_A22
CPU_A21
CPU_A20
CPU_A19
CPU_AS
CPU_RD
CPU_A23
CPUCKSEL1
CPU_HWR
CPU_LWR
RESET
CPUCKOUT1
CPUCKOUT2
MCUD_BUS
AS
RD
HWR
LWR
RESET
[o]GND
F109
FB
MHZ2012R121A
CPUCKOUT1
MCUA_BUS
IO17
IO13
IO12
DACD_BUS
PERI_A7
PERI_A6
PERI_A5
PERI_A4
PERI_A3
PERI_A1
PERI_A2
PERI_A0
PERI_D14
PERI_D15
PERI_D11
PERI_D12
PERI_D13
PERI_D6
PERI_D8
PERI_D10
PERI_D5
PERI_D7
PERI_D9
PERI_D4
USBCLK
SCLK
NC
D-
D+
VBUSIN
NC
VBUSOUT
DAC_D0
DAC_D1
DAC_D2
DAC_D3
DAC_D4
DAC_D5
DAC_D6
DAC_D7
DAC_CS
DAC_WR
DAC_SEL
ADC1/GAIN1
ADC0/GAIN0
ADC3/GAIN3
ADC2/GAIN2
PAN01
PAN02
PAN11
PAN12
FT110 LAND1
FT108 LAND1
FT106 LAND1
FT104 LAND1
FT102 LAND1
FT109 LAND1
FT107 LAND1
FT105 LAND1
FT103 LAND1
FT101 LAND1

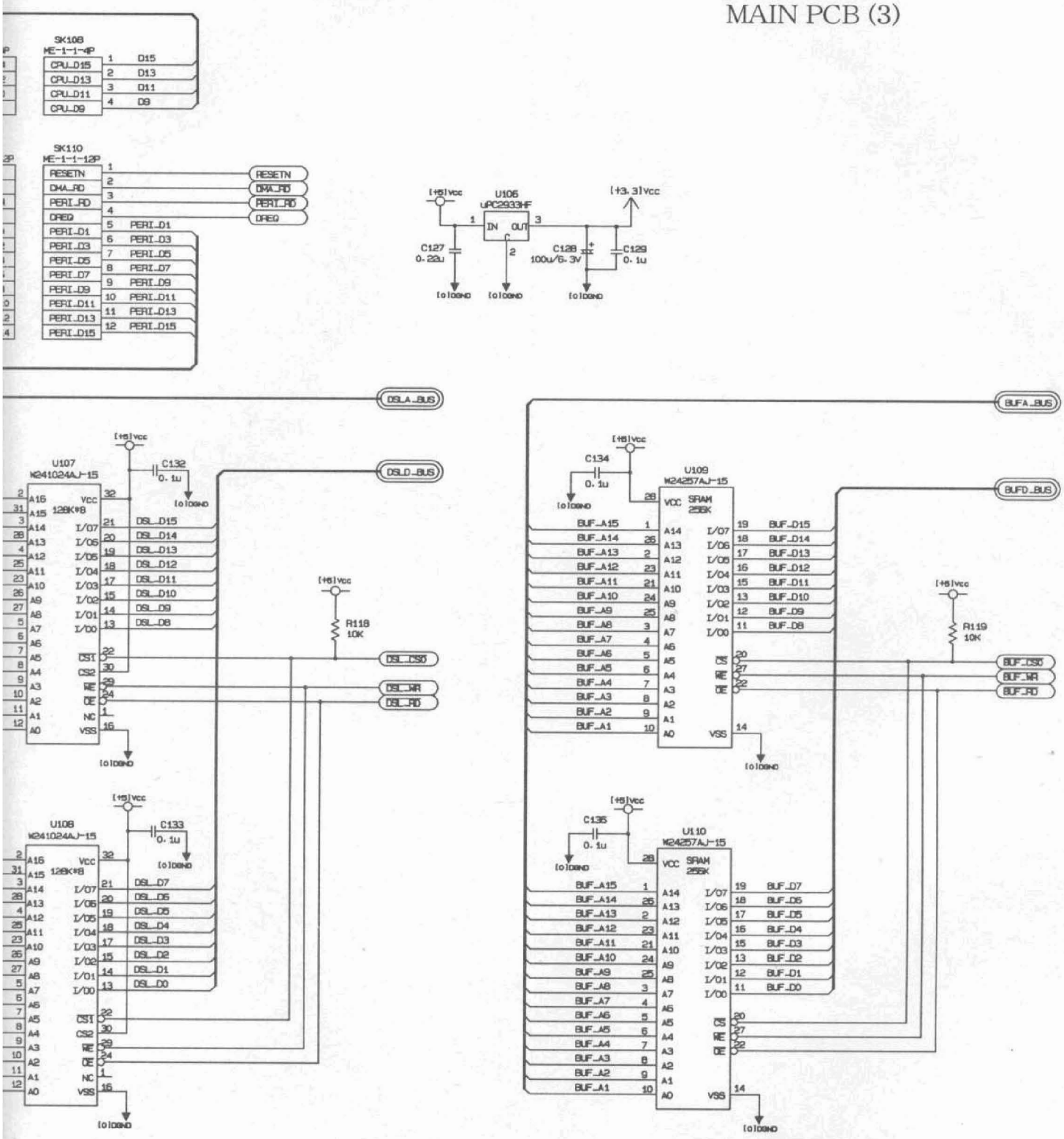
4) メイン基板部組 (2)
MAIN PCB (2)



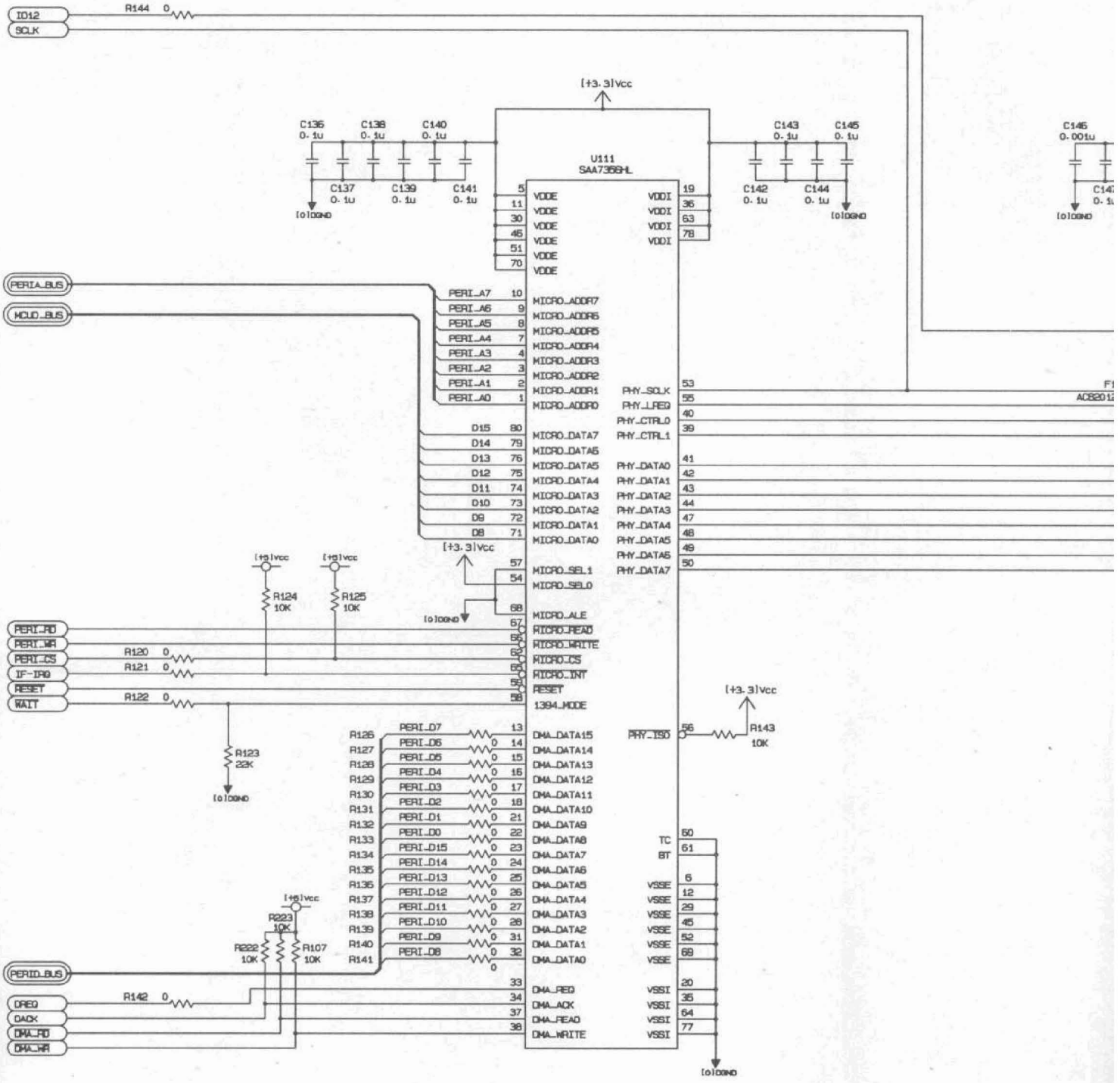

R228
22K
to GND
VBUSIN
VBUSOUT
SCLK
PERI_CS
PERIA_BUS
PERID_BUS
DREQ
DACK
PERI_WR
RESETN
PERI_RD
DMA_RD
VBUSINT
ASICIF-IRQ
USBINT
DMA_WR
+3.3Vcc
MCUD_BUS
U105
EI-107
AS
RD
RWR
LWR
RESET
CPUCLKOUT1
MCUA_BUS
F109
FB
MMZ2012R121A
ID17
ID13
ID12
DACD_BUS

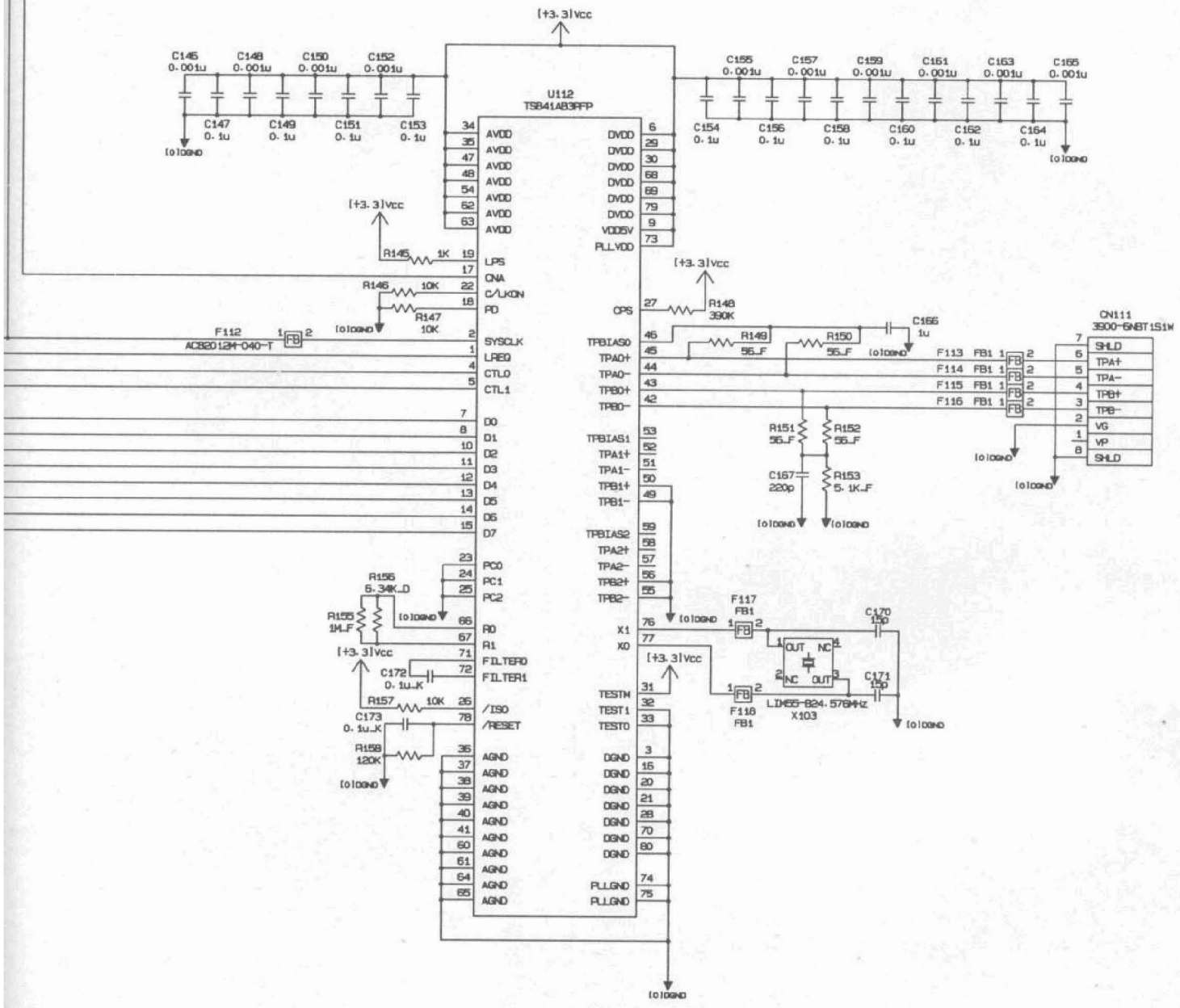

SK103
ME-1-1-7P
SK104
ME-1-1-7P
MCU_P62
IO17
WAIT
RD
IO12
IO13
RESET
RWR
SK107
ME-1-1-4P
SK108
ME-1-1-4P
MCUD_BUS
SK109
ME-1-1-12P
SK110
ME-1-1-12P
IF-IRQ
DMA_WR
PERI_WR
DACK
PERID_BUS
SK105
ME-1-1-8P
SK106
ME-1-1-8P
VBUSOUT
VBUSIN
PERI_CS
PERIA_BUS
U105
EI-107
U107
M241024AJ-15
U108
M241024AJ-15
128K*8
C132
C133
C113
C114
C115
C116
C117
C118
C119
C120
C121
C122
C123
C124
C125
C126
C254
C255
C256
C257
C258
C259
C260
C261
[+5]Vcc
[+3.3]Vcc
[0]GND

5) メイン基板部組 (3)
MAIN PCB (3)

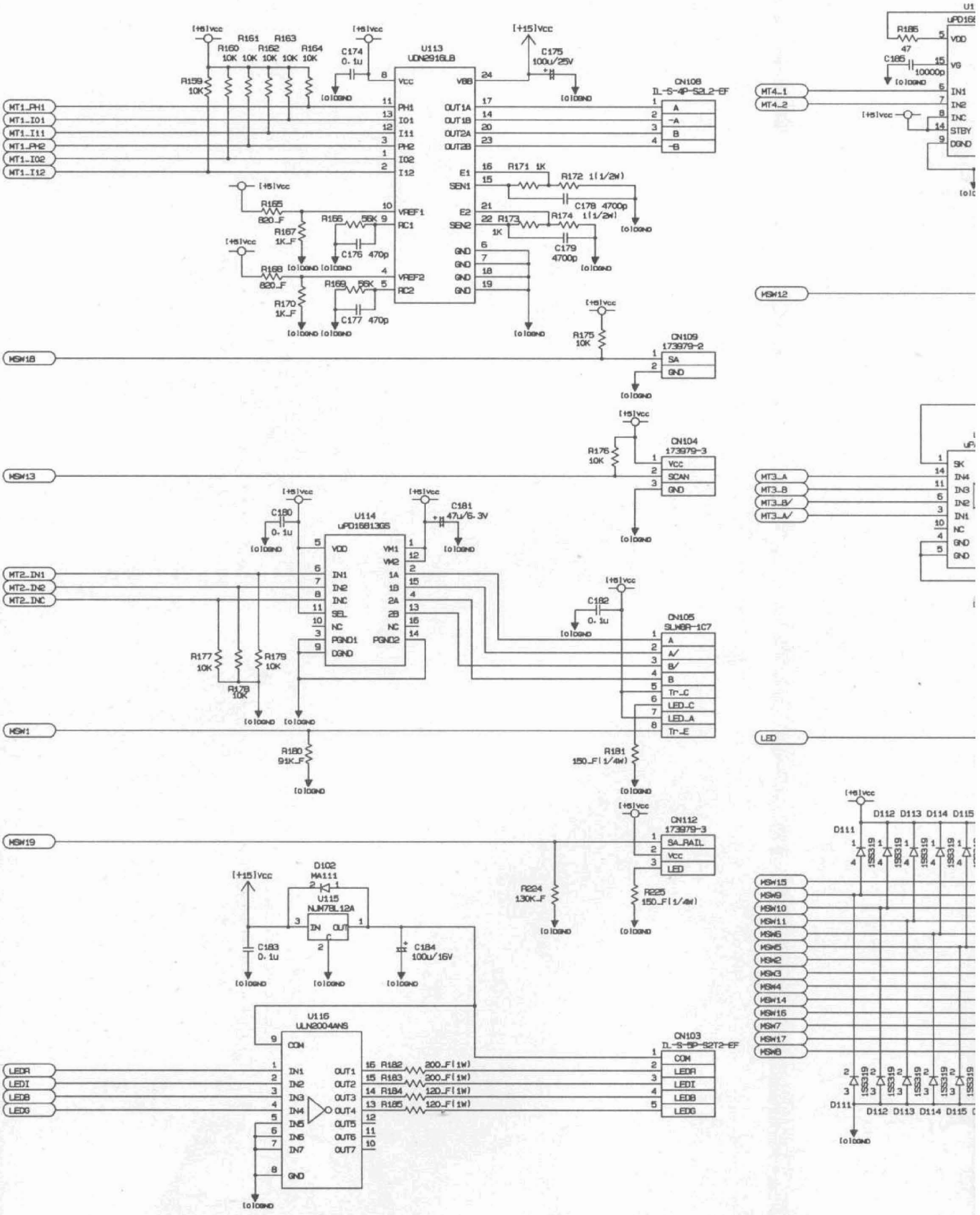


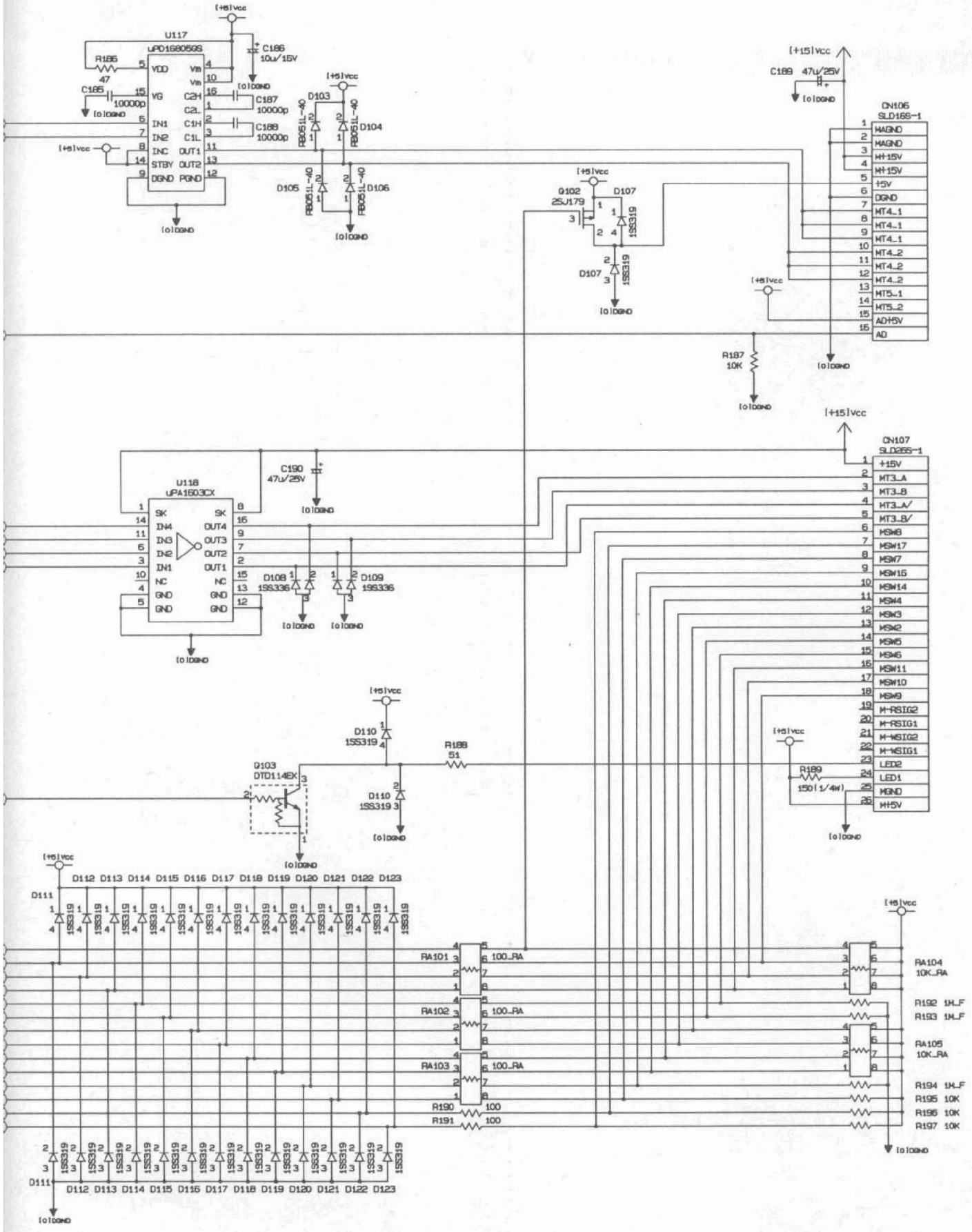
6) メイン基板部組 (4)
MAIN PCB (4)




[+3.3]Vcc
U112
TSB41AB3PFP
C145 0.001u
C148 0.001u
C150 0.001u
C152 0.001u
C147 0.1u
C149 0.1u
C151 0.1u
C153 0.1u
C155 0.001u
C157 0.001u
C159 0.001u
C161 0.001u
C163 0.001u
C165 0.001u
C154 0.1u
C156 0.1u
C158 0.1u
C160 0.1u
C162 0.1u
C164 0.1u
[o]DGND
AVDD
DVDD
VDD5V
PLLVDD
R145 1K
R146 10K
R147 10K
LPS
CNA
C/LKON
PD
F112 ACB2012M-040-T
SYSCLK
LREQ
CTL0
CTL1
D0
D1
D2
D3
D4
D5
D6
D7
CPS
R148 390K
R149 56_F
R150 56_F
C166 1u
TPBIAS0
TPA0+
TPA0-
TPB0+
TPB0-
F113 FB1
F114 FB1
F115 FB1
F116 FB1
CN111 3900-6NBT1S1W
SHLD
TPA+
TPA-
TPB+
TPB-
VG
VP
R151 56_F
R152 56_F
C167 220p
R153 5.1K_F
TPBIAS1
TPA1+
TPA1-
TPB1+
TPB1-
TPBIAS2
TPA2+
TPA2-
TPB2+
TPB2-
PC0
PC1
PC2
R156 6.34K_D
R155 1M_F
R0
R1
FILTER0
FILTER1
C172 0.1u_K
R157 10K
/ISO
/RESET
C173 0.1u_K
R158 120K
X1
X0
F117 FB1
F118 FB1
C170 15p
C171 15p
LIM65-B24.576MHz
X103
TESTM
TEST1
TEST0
AGND
DGND
PLLGND

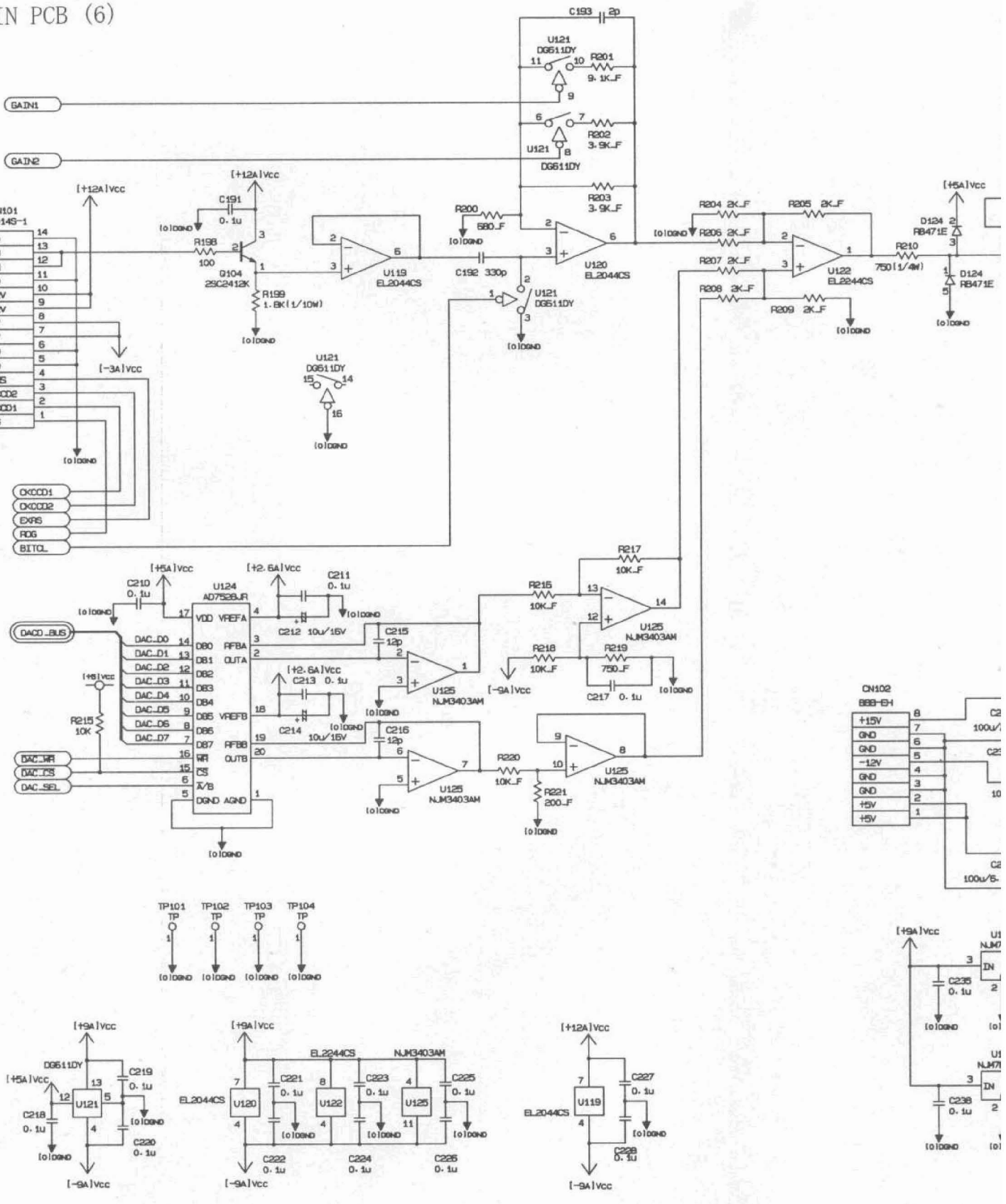
7) メイン基板部組 (5)
MAIN PCB (5)

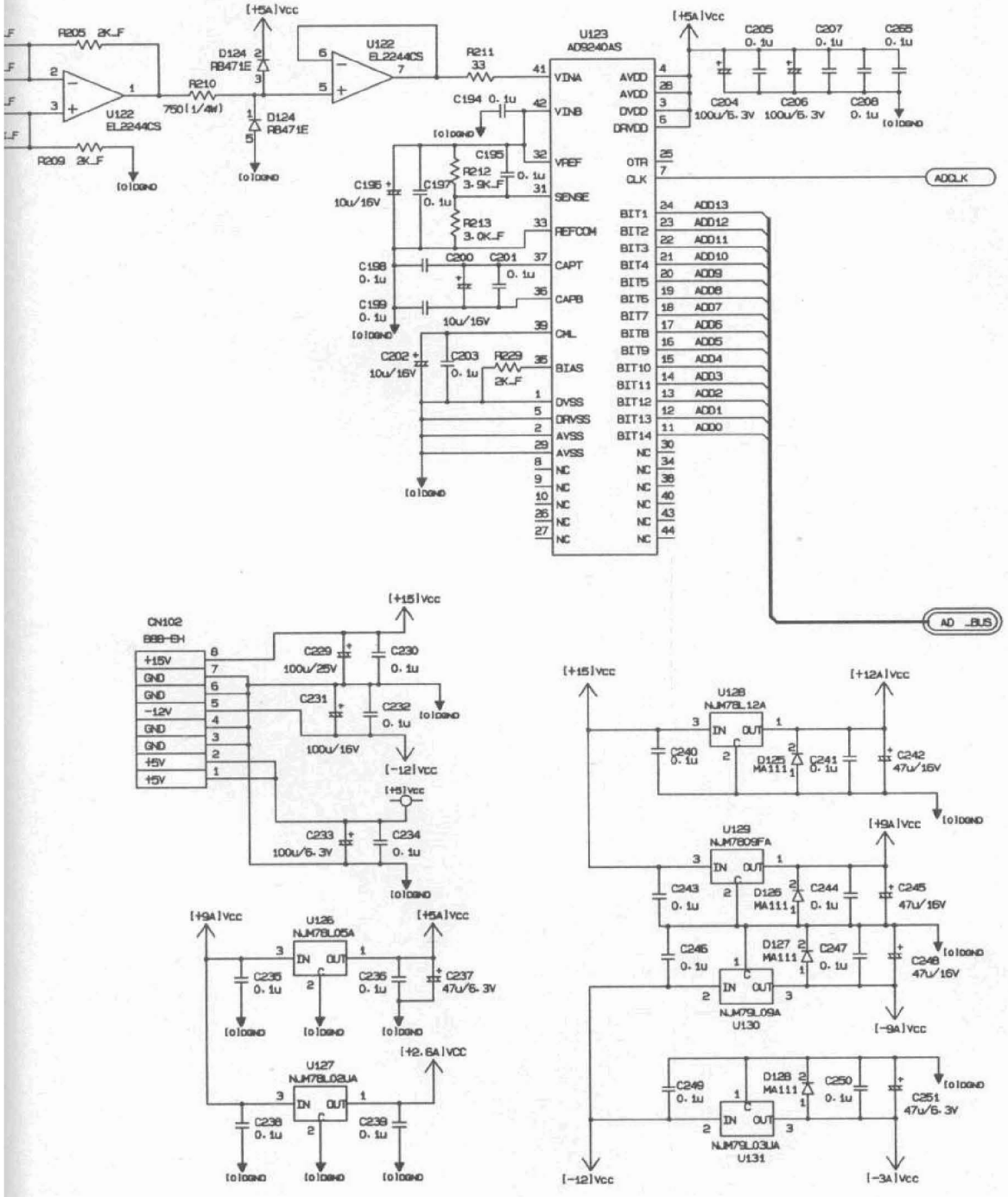



U117
uPD16805GS
R186 47
C185 10000p
C186 10u/15V
C187 10000p
C188 10000p
D103
D104
D105
D106
RB051L-40
Q102 2SJ179
D107 1SS319
C189 47u/25V
CN106 SLD16S-1
MAGND
MAGND
M+15V
M+15V
+5V
DGND
MT4_1
MT4_1
MT4_1
MT4_2
MT4_2
MT4_2
MT5_1
MT5_2
AD+5V
AD
R187 10K
U118
uPA1503CX
C190 47u/25V
D108 1SS336
D109 1SS336
CN107 SLD26S-1
+15V
MT3_A
MT3_B
MT3_A/
MT3_B/
MSW8
MSW17
MSW7
MSW15
MSW14
MSW4
MSW3
MSW2
MSW5
MSW6
MSW11
MSW10
MSW9
M-RSIG2
M-RSIG1
M-WSIG2
M-WSIG1
LED2
LED1
MGND
M+5V
D110 1SS319
R188 51
Q103 DTD114EK
R189 150[1/4W]
D111
D112 D113 D114 D115 D116 D117 D118 D119 D120 D121 D122 D123
RA101 100_RA
RA102 100_RA
RA103 100_RA
R190 100
R191 100
RA104 10K_RA
RA105 10K_RA
R192 1M_F
R193 1M_F
R194 1M_F
R195 10K
R196 10K
R197 10K
+5Vcc
+15Vcc
DGND

8) メイン基板部組 (6)

MAIN PCB (6)




U123
AD9240AS
VINA
VINB
VREF
SENSE
REFCOM
CAPT
CAPB
CML
BIAS
DVSS
DRVSS
AVSS
AVSS
NC
AVDD
AVDD
DVDD
DRVDD
OTR
CLK
BIT1
BIT2
BIT3
BIT4
BIT5
BIT6
BIT7
BIT8
BIT9
BIT10
BIT11
BIT12
BIT13
BIT14
ADCLK
AD_BUS
U122
EL2244CS
D124
RB471E
R205 2K_F
R209 2K_F
R210
750[1/4W]
R211
33
R212
3.9K_F
R213
3.0K_F
C194 0.1u
C195
C196
10u/16V
C197
0.1u
C198
0.1u
C199
0.1u
C200
C201
0.1u
10u/16V
C202
10u/16V
C203
0.1u
R229
2K_F
C205
0.1u
C207
0.1u
C265
0.1u
C204
100u/6.3V
C206
100u/6.3V
C208
0.1u
[+5A]Vcc
[0]GND
CN102
B8B-EH
+15V
GND
GND
-12V
GND
GND
+5V
+5V
C229
100u/25V
C230
0.1u
C231
100u/16V
C232
0.1u
[-12]Vcc
[+15]Vcc
C233
100u/6.3V
C234
0.1u
[+5]Vcc
[+9A]Vcc
U126
NJM78L05A
IN
OUT
C235
0.1u
C236
0.1u
C237
47u/6.3V
U127
NJM78L02UA
C238
0.1u
C239
0.1u
[+2.6A]Vcc
U128
NJM78L12A
C240
0.1u
D125
MA111
C241
0.1u
C242
47u/16V
[+12A]Vcc
U129
NJM7809FA
C243
0.1u
D126
MA111
C244
0.1u
C245
47u/16V
C246
0.1u
D127
MA111
C247
0.1u
C248
47u/16V
U130
NJM79L09A
[-9A]Vcc
C249
0.1u
D128
MA111
C250
0.1u
C251
47u/6.3V
U131
NJM79L03UA
[-3A]Vcc

Description of Circuits

1. Flow of Image Processing

1.1 CCD

The image signals (frequency: 2.778 MHz), which are produced by photo-electrically converting the optical information of the original documents, are passed through the emitter follower (buffer), and they are output to the CDS circuit of the main board which is connected by the CCD flexible cable.

1.2 CDS

In the CDS circuit, CDS processing is performed on the image signal that is input from the CCD by the bit clamp method (in which the precharge voltage is clamped at the reference voltage for each image), noise components are removed from the signal, and the resulting signal is output to the Gain circuit.

1.3 Gain

In the Gain circuit, the gain of the image signal that is input from the CDS circuit is boosted (to one of two levels, dependingon the brightness of the original), and the resulting signal is then output to the Black Level Compensation circuit.

1.4 Black Level Compensation

In the Black Level Compensation circuit, offset voltage is added to the image signal that is input from the Gain circuit by using two types of circuits, one for rough adjustment and one for fine adjustment, using 8-bit D/A conversion.

This offset voltage adjusts the black level voltage for an entire line; the resulting signal is then output to the A/D circuit.

1.5 A/D circuit

In the A/D circuit, the image signal that is input from the Black Level Compensation circuit is converted into a digital signal with a 14-bit (LS4000ED)/12-bit (LS-40ED) resolution and a conversion frequency of 2.778MHz.

The resulting signal is then output to the DSNU Compensation circuit.

1.6 DSNU Compensation (dark voltage compensation)

In the DSNU Compensation circuit, offset level compensation is applied for each pixel. The operation shown below is performed with the image signal that is input from the A/D circuit and the DSNU compensation signal. The signal resulting from this operation is output to the SD compensation circuit.

After compensation = image signal - DSNU compensation signal

1.7 SD Compensation (shading compensation)

In the SD Compensation circuit, compensation is applied for uneven illumination and uneven CCD sensitivity for each pixel. The operation shown below is performed with the image signal that is input from the DSNU compensation circuit and the SD compensation signal. The signal resulting from this operation is output to the Averaging circuit.

After compensation = (Image signals x compensation data/divisor) + image signals

(Divisor: LS-4000ED 16384, LS-40ED 4096)

1.8 Averaging Circuit

This circuit averages the image signal that is input from the SD compensation circuit for every 2, 4, 8, or 16 adjacent pixels in the main scanning direction, and then outputs the resulting signal to the LUT Converter circuit.

1.9 LUT

This circuit uses a 14-bit x 14-bit (LS-4000ED)/12-bit x 12-bit (LS-40ED) table to convert the image signal that is input from the Averaging circuit, and outputs the resulting signal to the Pitch Control circuit.

1.10 Pitch Control

This circuit extracts, as the effective data, those pixels in the main scanning direction prescribed according to the resolution specified by the host computer from the image signal that is input from the LUT Conversion circuit.

1.11 Buffer memory

This is memory that stores the image signal; this buffer actually consists of two buffers, an odd-numbered buffer and an even-numbered buffer. The image signal that is input from the Pitch Control circuit is temporarily stored in both of these buffers in alternation.

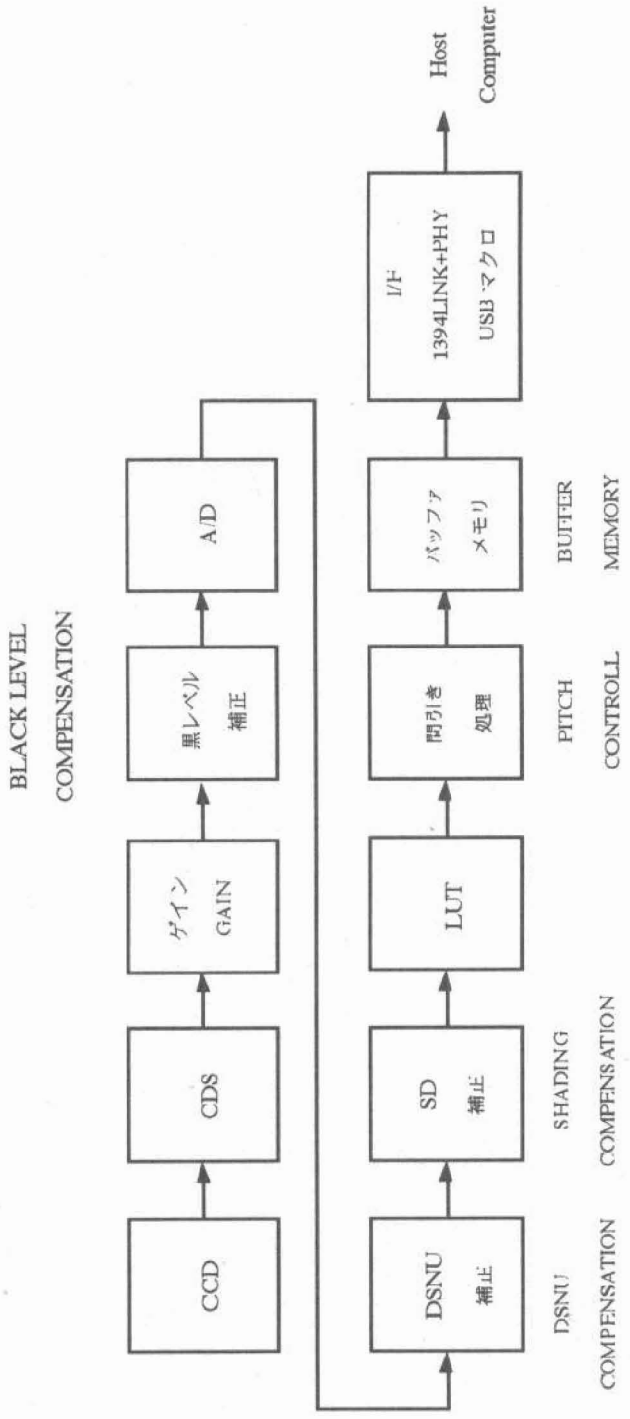
1.12 Interface controller

This sequentially transfers the image signals stored in the buffer memory to the host computer by means of the IEEE1394 LINK+PHY (LS-4000ED)/USB macro (LS-40ED).

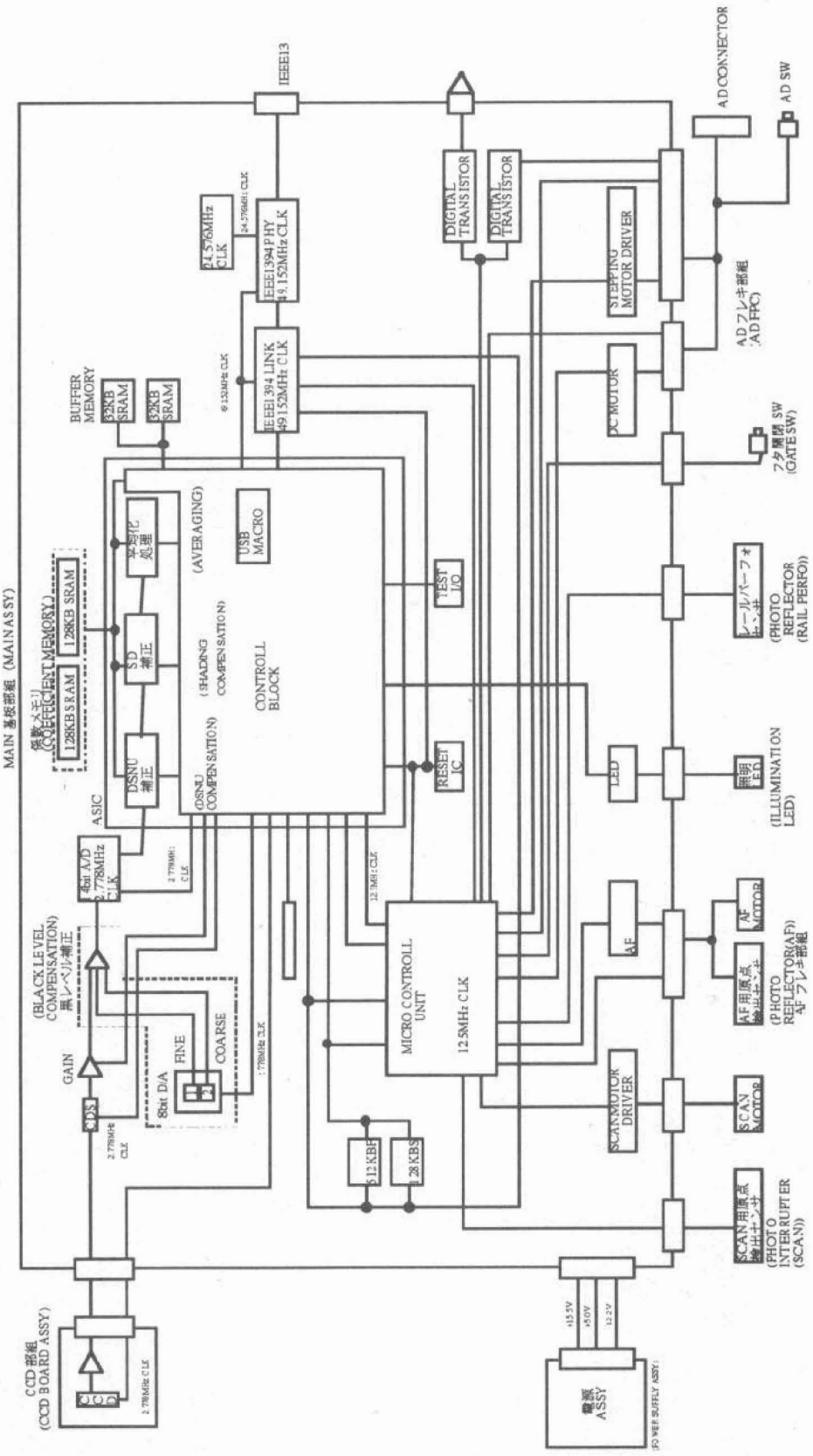
1.13 Host Computer

The image signals are input to the host computer, and the scanning resolution and other parameters are input and output by means of IEEE1394 (LS-4000ED)/USB (LS-40ED) communication with the interface controller.

Signal Flow (LS-4000ED/LS-40ED)



LS-4000ED Block Diagram



2. Image processing flow

2.1 Overview of Operations

During power-on processing, the indicator LED flashes slowly; after power-on processing is completed, the indicator LED remains lit while the unit is in the ready state. If an error occurs, the LED flashes rapidly.

2.1.1 Flow of power-on processing

The MCU and ASIC initial settings are performed.
At this point, the display LED starts lighting.

↓

A memory check (work RAM) is executed.

↓

The display LED starts flashing slowly.

↓

The status of the log recording area is identified.

↓

The settings (register settings, micro code downloading) of the peripheral IC (interface controller) are performed.

↓

A memory check (areas other than work RAM) is executed.
At this point, the interface interrupt is enabled.

↓

The connected adapter is identified.

↓

Log recording is initiated. (Initialization count +1, adapter types)

↓

The initialization operations of the adapters (but not the MA adapter) are performed.

↓

The auto focusing and scanning home points are detected.

↓

The mechanical block is moved to the designated measurement position.

↓

The WB, SD and various other measurements are performed.

↓

The adapters move to their standby positions.

↓

The standby mode is established.

2.2 Processing stages

- Initial setting of MCU/ASIC

The MCU registers and I/O ports are set in this step.

The initial setting of the ASIC registers is also performed in this step.

- Memory check

A read/write check is performed for the MCU work memory SRAM, coefficient memory, and buffer memory SRAM. If an error is discovered during the memory check, the display LED will continue to flash rapidly. In this case, the scanner suspends the processing performed when the power is switched on, and neither does it respond to the interface.

- Setting of peripheral IC

The initial settings of the interface controller are performed in this step.

- Adapter Initialization

When an adapter other than MA has been connected, the discharge operation of the original document is performed.

- Adapter identification

Which adapter has been connected is identified by sensing the combination of the AD SW setting and high/low statuses of the prescribed pins of the AD connector at the prescribed port of MCU. The port statuses and types of adapters supported are shown in the table below.

Adapter type	AD SW	ID pin 0	ID pin 1	ID pin 2
No adapter	OFF	*	*	*
For inspection purposes	ON	Lo	Lo	Lo
Not defined	ON	Hi	Lo	Lo
36SA	ON	Lo	Hi	Lo
6SA	ON	Hi	Hi	Lo
FD	ON	Lo	Lo	Hi
IA	ON	Hi	Lo	Hi
Not defined	ON	Lo	Hi	Hi
MA	ON	Hi	Hi	Hi

・Scanning home point detection (see Figs. 1-1, 1-2)

(Note: Y1 rotation: direction of movement to the front; Y2 rotation: direction of movement to the rear)

①SCheck whether the scanning home point detection sensor is shielded from the light.
If it is shielded, proceed to <6>; if it is not shielded, proceed to ②

↓

②Keep rotating the scanning motor in the Y2 direction until the scanning home point detection sensor is shielded.

↓

③Once the scanning home point detection sensor is shielded, start rotating the motor in the Y2 direction by an amount equivalent to Y_BCKRSH from this point, and then stop the rotation.

↓

④Keep rotating the scanning motor in the Y1 direction until the scanning home point detection sensor is no longer shielded.

↓

⑤Use the position where the shielding was cleared as the scanning home point position (Y_SENS).
This completes the procedure.

↓

⑥Keep rotating the scanning motor in the Y1 direction until the scanning home point detection sensor is no longer shielded.

↓

⑦Once the scanning home point detection sensor is no longer shielded, stop rotating the motor, then run the motor in the Y2 direction by an amount equivalent to Y_BCKRSH, and then stop the motor.

↓

⑧Keep rotating the scanning motor in the Y1 direction until the scanning home point detection sensor is no longer shielded.

↓

⑨Use the position where the shielding was cleared as the scanning home point position (Y_SENS).
This completes the procedure.

・AF home point detection (see Figs. 1-1, 1-2)

(Note: Z1 rotation: movement in upward direction; Z2 rotation: movement in downward direction)

①Check whether the AF home point detection sensor is set to the ON status. If it is at the OFF status, proceed to <2>; if it is at the ON status, proceed to ⑦.

↓

②Keep rotating the AF motor in the Z2 direction until the AF home point detection sensor is set to the ON status.

↓

③Once the AF home point detection sensor is set to the ON status, start rotating the motor in the Z2 direction by an amount equivalent to Z_BCKRSH + Z_SENS_SPACE from this point, and then stop the rotation.

↓

④Keep rotating the AF motor in the Z1 direction until the AF home point detection sensor is set from the OFF status to the ON status.

↓

⑤Keep rotating the AF motor in the Z1 direction until the AF home point detection sensor is set from the ON status to the OFF status.

↓

⑥Use the position where the OFF status was established as the AF home point position (Z_SENS). This completes the procedure.

↓

⑦Keep rotating the AF motor in the Z2 direction until the AF home point detection sensor is set to the OFF status.

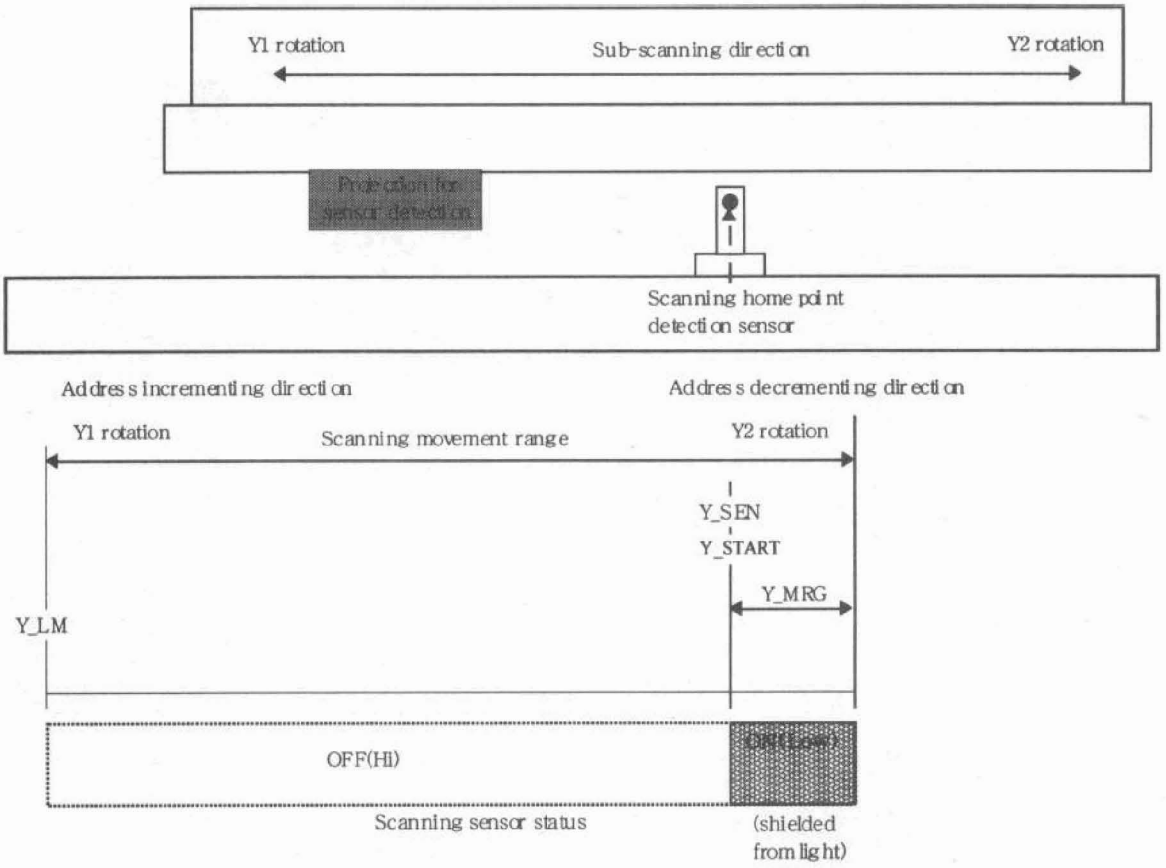

Y1 rotation
Sub-scanning direction
Y2 rotation
Protection for sensor detection
Scanning home point detection sensor
Address incrementing direction
Address decrementing direction
Y1 rotation
Scanning movement range
Y2 rotation
Y_SEN
Y_START
Y_MRG
Y_LM
OFF(Hi)
ON(Low)
Scanning sensor status
(shielded from light)

Fig. 1-1

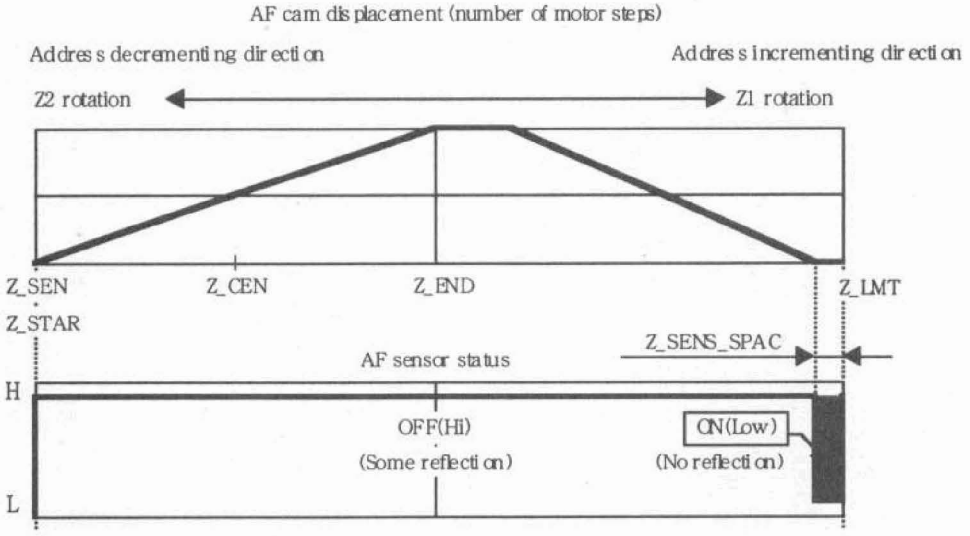

AF cam displacement (number of motor steps)
Address decrementing direction
Address incrementing direction
Z2 rotation
Z1 rotation
Z_SEN
Z_STAR
Z_CEN
Z_END
Z_LMT
Z_SENS_SPAC
AF sensor status
H
L
OFF(Hi)
(Some reflection)
ON(Low)
(No reflection)

Fig. 1-2

Quality and Tools

Conditions for inspection

1. Position for inspection : Possible to use in an upright position or on its side.
   (With SF-200, only in its side. With SA-30, only in an upright position)
2. Operating Environment : +10 +35C°, 20-60%RH (No dew condensation)
3. Power source : Input range : AC85-264V
   Frequency range : 45-66Hz
   Power Consumption : AC100-240V, 0.3-0.2A(+10%) max.

Quality

1. Overall quality of product (with accessories included)

1.1 Installation position

LS-4000ED/LS-40ED:Shall be positioned either perpendicularly or horizontally.

LS-4000ED: When the SF-200 is used, the main unit shall be positioned only horizontally; when the SA-30 is used, it shall be positionedonly perpendicularly.

1.2 PC used

Any PC supporting Windows and the latest version of NikonDriver shall be used.

However, the PCs supporting Windows which are specified below shall be used for speed evaluation and other tasks which are dependent upon the performance of the PC.

The Nikon Scan 3 shall also have the equivalent performance.

Mac:

When a 450 MHz PowerMacG3 with a 256MB memory and Nikon Scan are used, 200MB or more shall be allocated to Photoshop, and 1024 x 768 pixels, 32,000 colors and System8.6 shall be used.

Windows:

The Dell Dimension XPS T700 with a 256MB memory (SDRAM), 1024 x 768 pixels, 16-bit color and Windows 2000 shall be used.

IEEE1394 host adapter: IEEE1394 interface board (for LS-4000ED)

2. Scanning performance

2.1 Aspect ratio

(1) Ratio of frame width to frame height: 36.87 (sub)/25.17 (main) ± 2% or less

(2) Main scanning magnification: 1.254 times ± 1.83% or less

2.2 Main/sub perpendicularity: 90 deg. ± 0.35 deg.

2.3 Main feed precision

2.3.1 Transport parallelism

The straight line area on the chart parallel to the feed in the sub scanning direction is scanned, the straight line that compensates for the inclination of the straight line area from the transport is calculated, and the feed precision in relation to the compensatory straight line shall serve as the transport parallelism.

Compensatory straight line: The difference in the black and white density levels is set to 255, a search is performed in the main scanning direction on a line by line basis, and the coordinates of the 127 level are calculated by linear interpolation based on the density levels of the pixels, which are adjacent to those pixels with an intermediate density level of 127 and which exceed 127, and of the pixels which do not exceed 127.

Based on the coordinates of the 127 level of each line in the straight line area of the chart in the specification blocks below, the method of least squares is used to find the approximation curve which serves as the compensatory straight line.

- Total area : Less than 6 pixels in a movement distance range of 36.87 mm.
- Between adjacent pixels : Less than 1 pixel for any adjacent pixels in the sub scanning direction.
- Small area : Less than 4 pixels in a range of any 210 contiguous lines in the sub scanning direction.

2.3.2 Diagonal line feed precision

The straight line area forming a 45-degree angle with the feed in sub scanning direction is scanned, the compensatory straight line in the straight line area at 45 degrees to the transport as in (1) is obtained, and the feed precision in relation to the compensatory straight line shall serve as the diagonal line feed precision.

- Between adjacent pixels : Less than 1 pixel for any adjacent pixels in the sub scanning direction.
- Small area : Less than 4 pixels in a range of any 210 contiguous lines in the sub scanning direction.

2.3.3 Repeat accuracy

The amount of deviation resulting when the scanning and preview screens are repeated shall be less than 1 pixel.

2.4 AF range: More than 3.7 mm

2.5 AF performance

2.5.1 AF home point position precision: Less than ± 8 points (± 32 addresses)

2.5.2 AF repeat accuracy: Less than ± 1 point (when repeated at the same place on the same document)

2.5.3 AF execution position address

Details are shown in 8.1.

2.6 Scanning position deviation

The scanning position is compensated for in the sub scanning direction, and the compensation range shall be up to ± 0.6 mm. The compensation amount is converted into a number of lines and recorded in the flash memory, and compensation is provided by the firmware in accordance with the recorded value.

2.6.1 Position deviation (main unit only)

± 0.35 mm in main scanning direction

± 0.4 mm in sub scanning direction

2.6.2 Position deviation (when used with main unit)

	Main scanning direction	Sub scanning direction
MA-20(S):	± 0.7	± 0.5 (using 50 mm square mounts)
SF-200:	± 0.45	± 0.6 (using 50 mm square mounts) (LS4000ED only)
IA-20(S):	± 0.55	± 0.9
SA-21:	± 0.7	± 1.26
SA-30:	± 0.7	± 1.26 (LS4000ED only)

2.6.3 When trimming is specified

Within 1 pixel on the preview screen

2.6.4 Effective scanning size (%) for documents inside aperture

MA-20(S): 100% for main scanning, 100% for sub scanning

SF-200: 100% for main scanning, 100% for sub scanning (LS4000ED only)

IA-20(S): 100% for main scanning, over 98% for sub scanning

SA-21: Over 99.5% for main scanning, 100% for sub scanning by cutout using software

*With a mount whose size is at least 49.5 x 49.5 mm and whose aperture size is less than 23 x 34 mm for the SF-200

With a mount whose size is at least 49.9 x 49.9 mm and whose aperture size is less than 23 x 34.8 mm for the MA-20(S)

2.7 Pre-scanning and preview time

LS4000: Less than 25 sec. for main unit pre-scanning using a 135 film standard positive document

LS40: Less than 20 sec. for main unit pre-scanning using a 135 film standard positive document

2.8 Main scanning time

As subject to the following conditions for the time taken from the completion of data transfer to the completion of the display, the scanning times are listed below when it takes:

Less than 7 sec. for LS-4000 and less than 4 sec. for LS-40 when 3 colors are scanned,

Less than 7 sec. for LS-4000, less than 4 sec. less than 7 seconds for LS-40 when 4 colors are scanned,

data per color of each pixel is 1 byte for 3-color scanning

data per color of each pixel is 2 bytes for 4-color scanning

2.8.1 135 film

Time taken until display is completed for standard document over the total area consisting of 3946 x 5782 scanning pixels for LS-4000 or 2870 x 4203 scanning pixels for LS-40:

LS-4000	3-color scanning	4-color scanning
	Positive typ. value Less than 51 sec.	Less than 279 sec.
	Negative typ. value Less than 52 sec.	Less than 280 sec.
	Positive max. value Less than 51 sec.	Less than 279 sec.
	Negative max. value Less than 57 sec.	Less than 285 sec.
LS-40	3-color scanning	4-color scanning
	Positive typ. value Less than 67 sec.	Less than 187 sec.
	Negative typ. value Less than 67 sec.	Less than 187 sec.
	Positive max. value Less than 67 sec.	Less than 187 sec.
	Negative max. value Less than 67 sec.	Less than 187 sec.

2.8.2 240 film

Time taken until display is completed for standard document over the total area consisting of 2916 x 4453 scanning pixels for LS-4000 or 2120 x 3237 scanning pixels for LS-40:

LS-4000	3-color scanning	4-color scanning
	Positive typ. value Less than 36 sec.	Less than 165 sec.
	Negative typ. value Less than 39 sec.	Less than 168 sec.
	Positive max. value Less than 40 sec.	Less than 169 sec.
	Negative max. value Less than 45 sec.	Less than 174 sec.
LS-40	3-color scanning	4-color scanning
	Positive typ. value Less than 37 sec.	Less than 105 sec.
	Negative typ. value Less than 37 sec.	Less than 105 sec.
	Positive max. value Less than 43 sec.	Less than 111 sec.
	Negative max. value Less than 46 sec.	Less than 114 sec.

2.9 Shading

2.9.1 Illumination irregularity

The maximum/minimum width when no compensation is provided shall be less than 42% (at the time of shipment).

The maximum/minimum width when no compensation is provided shall be less than 49.98% (compensation enable range).

* Maximum/minimum width (%)= ((Max. - min.)/Max.) x 100

2.9.2 Between compensated adjacent pixels

Less than 5% for the result of the pixel average for 16 outputs after shading compensation in a storage time of 90% of the storage time during W/B.

* If "a" and "b" represent the adjacent data, and the relationship between them is defined as $a \leqq b$, then:Adjacent difference (%) = (1 - a/b) x 100

2.10 Total resolution

With positive, linear gamma and no averaging

RGB:

LS-4000ED: MTF in the 35 lines (LP)/mm area (on the document) of more than 20% for R, G and B

LS-40ED: MTF in the 25 lines (LP)/mm area (on the document) of more than 20% for R, G and B

I:

LS-4000ED: MTF in the 17.5 lines (LP)/mm area (on the document) of more than 20%

LS-40ED: MTF in the 12.5 lines (LP)/mm area (on the document) of more than 20%

* Definition of MTF: As per the following formula in which "a" represents the maximum value (white side) and "b" the minimum value (black side) at low frequencies while "c" represents the maximum value (white side) and "d" the minimum value (black side) at high frequencies:

MTF = (c-d)/(a-b) x 100 [%]

2.11 Color registration

Within 1 pixel between R, G and B, Within 4 pixels of deviation in I image from RGB image

2.12 Color reproduction

Color difference △ E from average of units L*, a* and b* for the image scanned under the conditions based on the exposure and gamma characteristics stipulated by the pre-scanning specifications of the main unit:

Positive: Average of less than 6, maximum of less than 12

Negative: Average of less than 8, maximum of less than 20 (Macbeth charts 1 through 18, 24) or less than 15 (Macbeth charts 19 through 23)

The target values on the units positive Macbeth charts are as shown below. The Macbeth numbers are arranged in sequence as per the following table. The "Nikon E.I.DIV.Q.A.SEC.9801P" charts are used.

Table Arrangement of Macbeth chart patch numbers

1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18
19	20	21	22	23	24

Table Macbeth chart target values

No.	L*	a*	b*
1	21.34653	33.42106	31.37387
2	66.82853	37.85244	37.85584
3	49.49329	-15.906	-22.2573
4	36.1294	-15.5316	21.24557
5	59.51188	2.998841	-17.7229
6	75.57874	-58.217	17.30139
7	61.02569	61.40651	76.01988
8	23.72244	-4.80503	-34.3783
9	48.22471	70.86314	58.84821
10	15.92354	27.11269	-6.0895
11	66.01666	-31.5169	64.58688
12	61.49955	58.53671	87.42304
13	13.71121	15.10393	-41.504
14	47.63316	-57.9111	30.1193
15	43.06006	69.02619	74.00269
16	70.30156	36.03295	89.13949
17	44.4374	67.20541	23.66225
18	48.28554	-30.6238	-35.1488
19	92.03587	-8.68148	0.226325
20	90.64162	-8.7773	0.512215
21	67.45644	-11.5541	-2.01993
22	46.62976	-11.9882	-2.44466
23	22.19595	-13.2356	-4.35974
24	1.048018	-0.41171	1.268268

2.13 Pre-scanning reproducibility

Color difference △ E between L*, a* and b* and each of their averages shall be less than 4 when pre-scanning is repeated 5 times with the same film under the same conditions.

2.14 Output image stability

(1) Drift

Color difference △ E of the scanned images on the same chart immediately after the power is turned on and after a 30-minute endurance operation shall be less than 5 on an average and less than 10 as the maximum. The shading standard shall also be satisfied.

(2) Streaking

Shall be less than 10/255 when a positive is scanned with linear.

2.15 Grain roughness

Shall not be conspicuously noticeable.

2.16 Ghost/flare

Ghost: Floating of data in the black areas shall be less than 10/255 when a pin-hole chart is scanned with positive and linear gamma.

Flare: Floating of data in the border areas between the white and black shall be less than 10/255 when a performance test chart is scanned with positive and linear gamma.

2.17 Uneven color

Color difference △ E between the average output of the whole screen and any positions shall be less than 5 when a transparence is scanned with positive linear.

2.18 Operating sounds

Shall be less than 55 dB (no matter which adapter and feeder are used) when measured at a distance of 1 meter from the unit.

2.19 Status displays

With BUSY: Flashing frequency of 0.635 Hz ± 1%

With ERROR: Flashing frequency of 5 Hz ± 1%

2.20 Adapter and feeding insertion/withdrawal force

2.20.1 Insertion force

At 500 g or more in each case:

MA-20(S): Less than 1.5 kg

SF-200, IA-20(S): Less than 5 kg

SA-21, SA-30: Less than 6 kg

2.20.2 Withdrawal force

At 500 g or more in each case:

MA-20(S): Less than 1.5 kg

SF-200, IA-20(S), SA-21, SA-30: Less than 5 kg

2.20.3 Front sliding cover operation

The cover shall move smoothly at both the perpendicular and horizontal positions. It shall be retained by the click-stop (perpendicular position).

Click-stop force: Less than 800 g for insertion or for release.

2.20.4 Film gate cover open/close operation (LS-4000 only)

The opening and closing forces of the cover where the film gate and 36 ex unit are joined shall be:

450 ± 200 g for the opening force

650 ± 300 g for the closing force

2.21 Durability

2.21.1 Scanner feed precision (when installed in a perpendicular or horizontal position)

After 16,200 times (where 1 time consists of 3 reciprocal movements over the maximum scanning range at pitch 5 and a 5-second standby):

(1) Transport parallelism

Under the same measurements as in 2.3.1

・Total area

Less than 7 pixels in a movement distance range of 36.87 mm.

・Between adjacent pixels

Less than 1.1 pixels for any adjacent pixels in the sub scanning direction.

・Small area

Less than 5 pixels in a range of any 210 contiguous lines in the sub scanning direction.

(2) Diagonal line feed precision

・Between adjacent pixels

Less than 1.1 pixels for any adjacent pixels in the sub scanning direction.

・Small area

Less than 5 pixels in a range of any 210 contiguous lines in the sub scanning direction.

(3) Repeat accuracy

The amount of deviation resulting when the scanning and preview screens are repeated shall be less than 1 pixel.

(4) Scanning position error

0.4 mm for main scanning, 0.45 mm for sub scanning

2.21.2 AF feed precision

After 15,000 times (where 1 time consists of 2 reciprocal movements and a 20-second standby):

(1) AF home point position precision: Less than ± 8 points (± 32 addresses)

(2) AF focal precision: Less than ± 1 point deviation between AF position and MTF peak position

(3) AF repeat accuracy: Less than ± 1 point (when repeated at the same place on the same document)

(4) AF time

LS-4000: Less than 4 sec. excluding sub scanning movement time (when AF was successful with 1 try); 120 sec. maximum duration for retries

LS-40: Less than 4 sec. excluding sub scanning movement time (when AF was successful with 1 try); 72 sec. maximum duration for retries

2.21.3 Amount of light from LED illumination

Number of lighting lines per sheet: One document is scanned with [pre-scanning (pitch 10) + preview (pitch 10) + main scanning (pitch 2)].

5782 (1/10 + 1/10+1/2) = 4047 yields 4,100 lightings per sheet.

The lighting cycle per line is: R lighting (800 μ s) → G lighting (1000 μ s) → B lighting (1700 μ s) → I lighting (1500 μ s)→ OFF (3200 μ s).

The lighting for one sheet is achieved after the above cycle has been repeated 4,100 times with a 5-sec. OFF time.

After lighting for the equivalent of 20,000 sheets ((15,000 sheets + IA-20(S) thumbnail lighting + mount/no mount detection):

(1) Changes in amount of light : Less than 10% for I, R, G and B

(2) Illumination irregularity : Less than 45%

2.21.4 Adapter mating

No abnormalities after adapter is mated and unmated 300 times.

2.21.5 Front slide cover opening/closing

No abnormalities after cover is opened and closed 300 times.

2.21.6 36 ex unit mounting/removal (LS-4000 only)

It shall be possible to use the unit problem-free after it is mounted and removal 200 times.

2.21.7 Back cover opening/closing force (LS-4000 only)

Specification in 4.2.22 shall be satisfied until the cover is opened and closed 200 times.

2.22 Reliability

2.22.1 Ambient temperature and humidity

No abnormalities in operation or damage shall occur in the following ranges:

Operation: +10 to +35 ℃/20 to 60% RH (no condensation)

Storage: -20 to +60 ℃/20 to 90% RH (no condensation)

Storage time = 24 hours at high temperature, 24 hours at low temperature and 20 hours at high temperature and high humidity

2.22.2 Standards

2.22.2.1 EMC standards

FCC Chapter 15 Class B (United States)

CE mark EN55022 Class B, EN55024 (EC member states)

VCCI Class B (Japan)

CSA C108.8 (Canada)

AS/NZS3548 (C-tick mark) (Australia)

Radio Regulations 1993 (New Zealand)

Notification No.1996-78 of Data Communications Ministry (South Korea)

CNS13438 (Taiwan)

2.22.2.2 Safety standards

UL1950 (United States)

CSA22.2 No.950 (Canada)

TUV GS mark EN60950 (EC member states)

CCEE mark (Great Wall mark) GB4943 (China)

2.23 Exterior

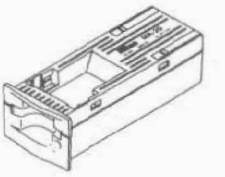
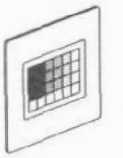
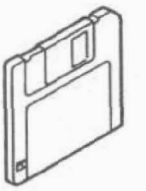
The front panel, front sliding cover, left and right side covers and rear panel shall be as follows:

(1) There must be no noticeable damage or marks in the form of lines or dots, dents, dirt, burrs or weld lines.

(2) There must be no uneven colors, missing characters or peeling of the printing on the front panel.

(3) There must be no uneven colors or peeling of the metallic paint (LS-4000 only).

工具一覧表　Tool List

工具番号 Tool No.	名　称 Name	略　図 Illustration	備　考 Remarks
J67033	グリース(180g) (スミテック３３１　No.1) Grease(180g) (SUMITEC ３３１)		
J61187	検査用チャート Chart for Inspection		
J61189	ポジフィルムチャート Chart for Inspection		
J65037A	サービス点検用ソフト Windows　(日本語版) Software for Inspection (Japanese)		
J65037B	サービス点検用ソフト Windows　(英語版) Software for Inspection (English)