COLOR BUBBLE-JET COPIER A1

SERVICE MANUAL

REVISION 3 SEPT.1991

Canon
FY8-1388-030

CANON COLOR BUBBLE-JET COPIER A1 REV. 3 SEPT. 1991 PRINTED IN JAPAN

BJ A1S MANUAL

SCANNER

SERVICE MANUAL

I. FEATURES

1. High resolution and image quality based on Canon's bubble jet technology.

With the digital color technology used in the copier, full-color documents can be copied with a resolution of 400 dpi. The documents may consist of fine lines and characters or may be diazo photos, and the copies will be made with each color and tone of the documents reproduced with high clarity.

In addition to the heads for cyan, magenta, and yellow, the copier is equipped with a BJ head for black. The extra head enables faithful reproduction of black areas of color documents expected of conventional mono color copiers.

2. Various intelligent features from digitalized mechanisms.

With color images converted into digital signals, the images may be processed and edited, removing limits so far imposed on production of creative color images.

Color manipulation	Reproduction ratio	Image manipulation	Shift	Area designation	Editing/ Others
Color conversion [of specified color / by painting / of single color] Color mode [7 mono colors / full color] Negative/Positive conversion	Zoom by 50% to 1200% Independent selection of length/width ratios Mode memory	Color balance specification Sharpness selection Photo mode	Center shift Corner shift Shift by specification	Trimming Masking Image segmentation	Image composition Multi-page enlargement Zoom program Fit reduction mode Recall mode Color registration Image repeat Character synthesis * Mosaic * Texture *

* Possible with addition of the digital interface memory PCB (option).

3. Easy to operate with user-friendly extra features (stick editor and touch panel display).

Set a document, and press the COPY START key. That is all it takes to obtain a full color copy attractive to anyone's standards. Fine adjusting the color tones does not require cumbersome key operations.

Area designation is also possible with the stick editor, which is a standard feature of the copier.

The liquid crystal touch panel display enables operation through dialogue with the copier. The copier responds to the touch of a finger, and the operator can make decisions while referring to the panel display for mode input, messages, and advice.

4. Accepts the Film Projector* for copies from 35mm film.

A common 35mm negative film set in the projector activates the negative/positive reversal mechanism to produce clear copies. Copies from positive film as well as transparent documents (4″× 5″ or 8″× 10″) are also possible.

* Option.

5. Zoom from 50% to 1200% and full range of basic features.

- Copy speed 6 minutes for a full color A1 document.
- Wide zoom from 50% to 1200%.
- Color copies in A4 to A1 sizes and on back print film in A1 and A2 sizes (BPF)*
- Cassette (100 sheets), manual feeding, and roll feeding.

* and or roll paper.

6. Compact in design, and power from regular commercial outlets (220V/240V, 15A).

The copier operates on 220V/240V, 15A just like any other PPCs.

II. SPECIFICATIONS

Type

Body	Desk top
Copyboard	Fixed
Light source	Halogen lamp (148 W)
Lens	Concave/Convex lens (Telecentrics)
Image read by	Charge coupled device (CCD)
Scanner unit image output	1-bit

Performance

Document type	Sheet, book, 3-D object (2 kg max.)
Document size	A1 max. (22" × 33" max.)
No. of areas specified (max.)	15 for trimming and masking 15 for color conversion and painting 15 for color mode and color balance
Image reproduction ratio	DIRECT: 1:1 (±0.5%) Stepless: 1:0.500 to 12.00 (1.0% increment)
Resolution	Main scanning direction: 400 dpi Sub scanning direction: 400 dpi
Continuous copying:	up to 99 copies
Options	Film Projector, Control Card IV, Digital Interface Memory

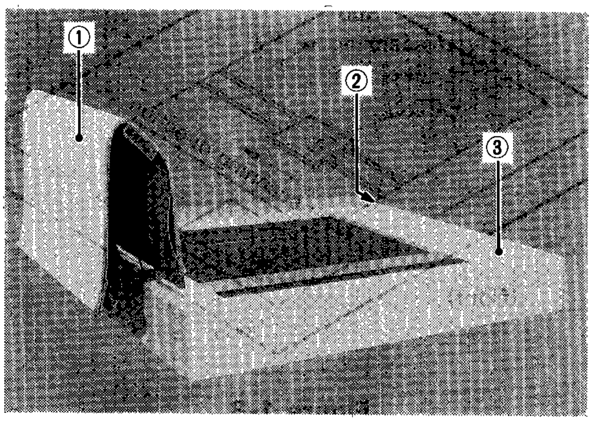
Others

Operating environment	Temperature: 15°C to 30°C (59°F - 86°F) Humidity: 10% to 80% RH Atmospheric pressure: 0.7 to 1 atm		
Power source (voltage fluction ± 10%)	Voltage / Frequency / Serial No. 115V 60 Hz CNU xxxx 220V 50 Hz DNU xxxx 240V 50 Hz ENU xxxx 240V (CA) 50 Hz FNU xxxx 220V (FRN) 50 Hz GNU xxxx 220V (GER) 50 Hz HNU xxxx 220V (AMS) 50 Hz KNU xxxx		
Power consumption	0.8 kW max. (approx.; scanner unit and printer unit) 1.5 kW max. (approx.; scanner, printer, and projector unit)		
Watthour	Stand by	0.19 kwh	Scanner and printer unit
	Copying	0.593 kwh	
Noise (1m away; scanner and printer units as one)	55 dB or less while document is exposed 50 dB or less while in standby		
Dimensions	Width: 1416 mm Depth: 1225 mm Height: 200 mm		
Weight	140 kg		

Specifications are subject to change for product improvement.

III. NAMES OF PARTS

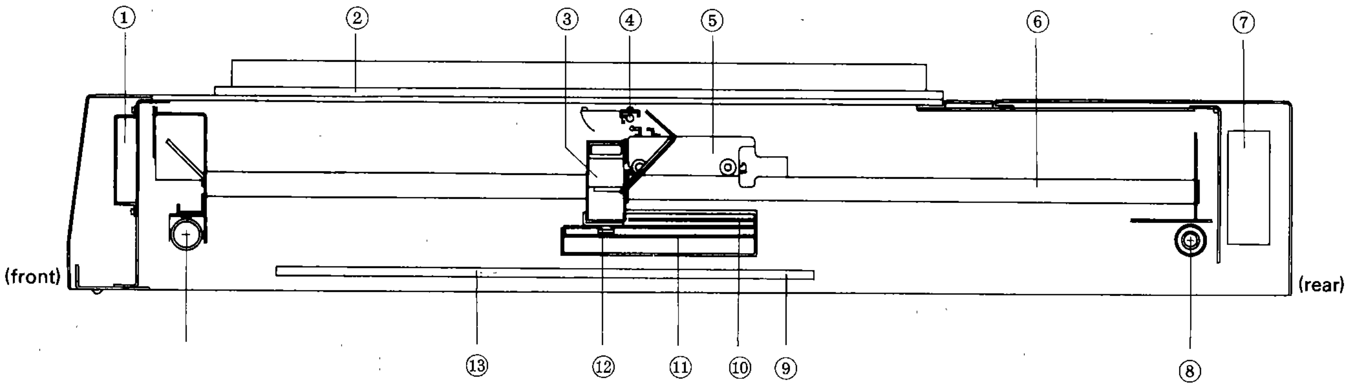
A. Exterior View



① Copyboard cover
② Power switch
③ Control panel

Figure 1-1

B. Cross-Sectional View



① Fan
② Copyboard cover
③ Lens
④ Scanning lamp
⑤ Main scanning carriage
⑥ Main scanning rail
⑦ DC power supply
⑧ Sub scanning rail (rear)
⑨ Auto head shading (AHS) PCB
Digital interface memory (IFM) PCB (option)
⑩ CCD driver PCB
⑪ CCD pre-amplifier PCB
⑫ Scanner video processor (SVP) PCB
Binary video processor (BVP) PCB
⑭ Sub scanning rail (front)

Figure 1-2

C. Scanning Direction

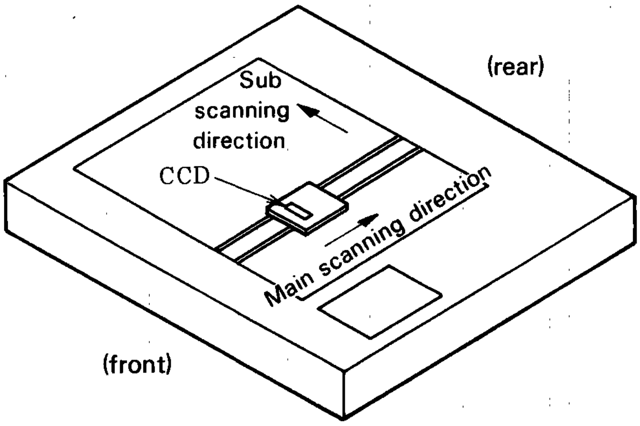


Figure 1-3

IV. POINTS TO NOTE

1. Effective Area of Input on Stick Editor

The movement of the main scanning carriage is limited so that it does not move any farther than about 730 mm in the X direction. Since the stick editor does not allow input of coordinates beyond the limit, the user should be advised to change the orientation of the document for copy operation.

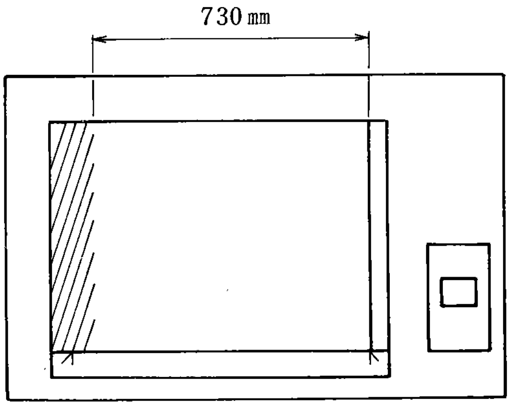


Figure 1-4 Scanner (top view)

2. Handling the Copyboard Cover

Force imposed from above on the copyboard cover can disorient the focus of the lens. Advise the user to leave the copyboard cover alone during copy operation.

The copyboard cover is made of rubber; and, if kept upright for a long time, it may deform across the center and, when closed, it may fail to come into contact with the copyboard glass. Advise the user to keep it closed when not in use.

3. Density Irregularity

Density irregularities can be corrected to a certain extent by executing 'HEAD SHADING' in the asterisk mode. Advise the user to consult the USER'S MANUAL for details.

I. BASIC OPERATIONS

A. Basic Construction

The scanner unit can be divided into three functional blocks; i.e., exposure system, control system, and image processing system.

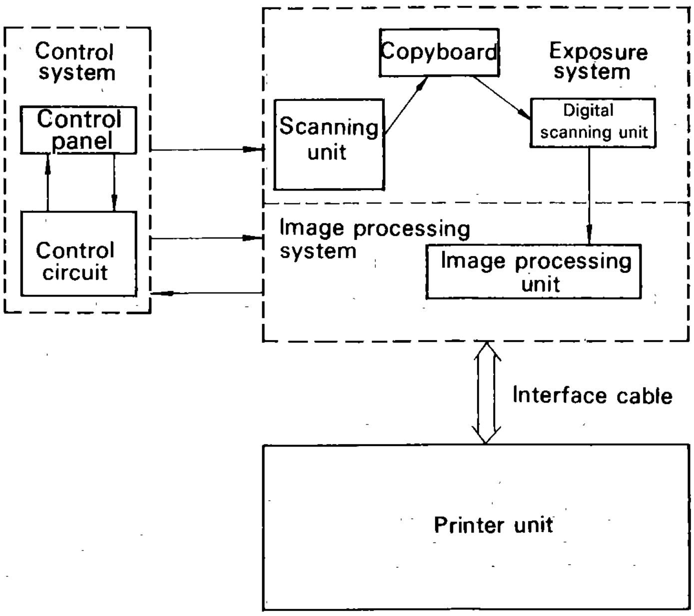


Figure 2-1

B. Outline of Electrical Circuitry

The sequential control of the major electrical mechanisms of the scanner unit is performed by the microprocessor on the scanner video processor (SVP) PCB.

Image processing is controlled by the scanner video processor (SVP) PCB and binary video processor (BVP) PCB.

The light reflected by the document is converted by the CCD into voltages. The voltages so converted are amplified and subjected to A/D conversion by the CCD pre-amplifier PCB. The SVP PCB and BVP PCB process the images and send them to the printer unit in the form of binary video signals.

Connection to the host computer requires an interface memory (IFM) PCB available as an option, and the interface mechanism is controlled by the auto head shading (AHS) PCB.

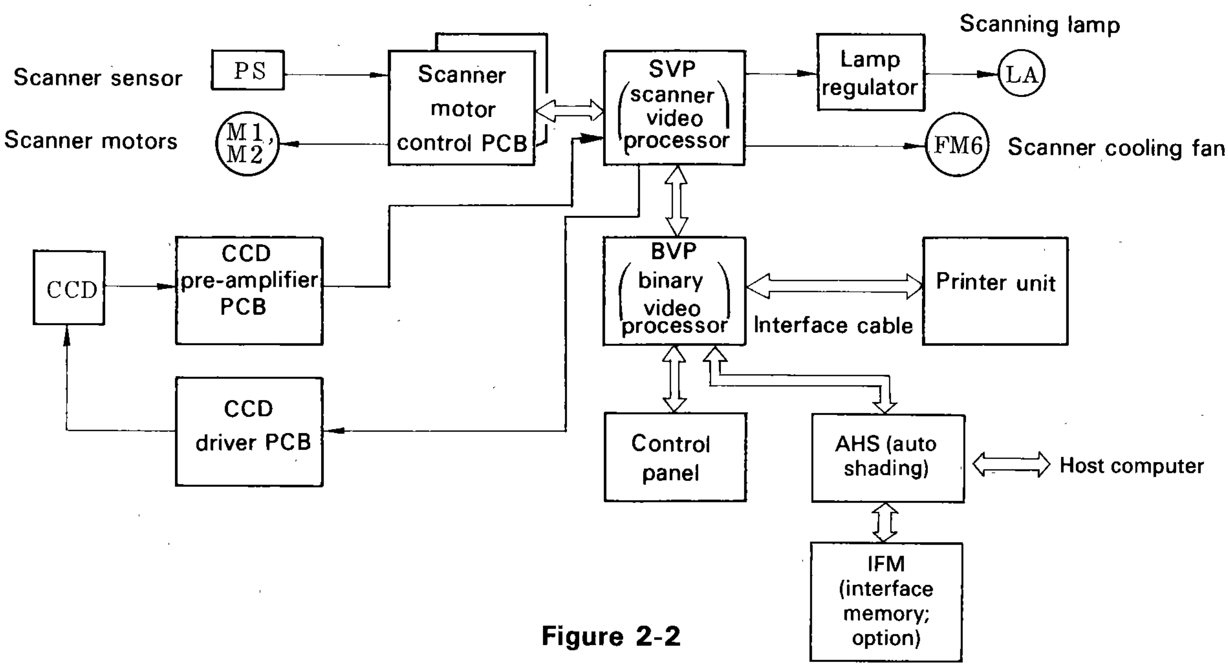


Figure 2-2

C. Scanner Video Processor (SVP) PCB Input/Output

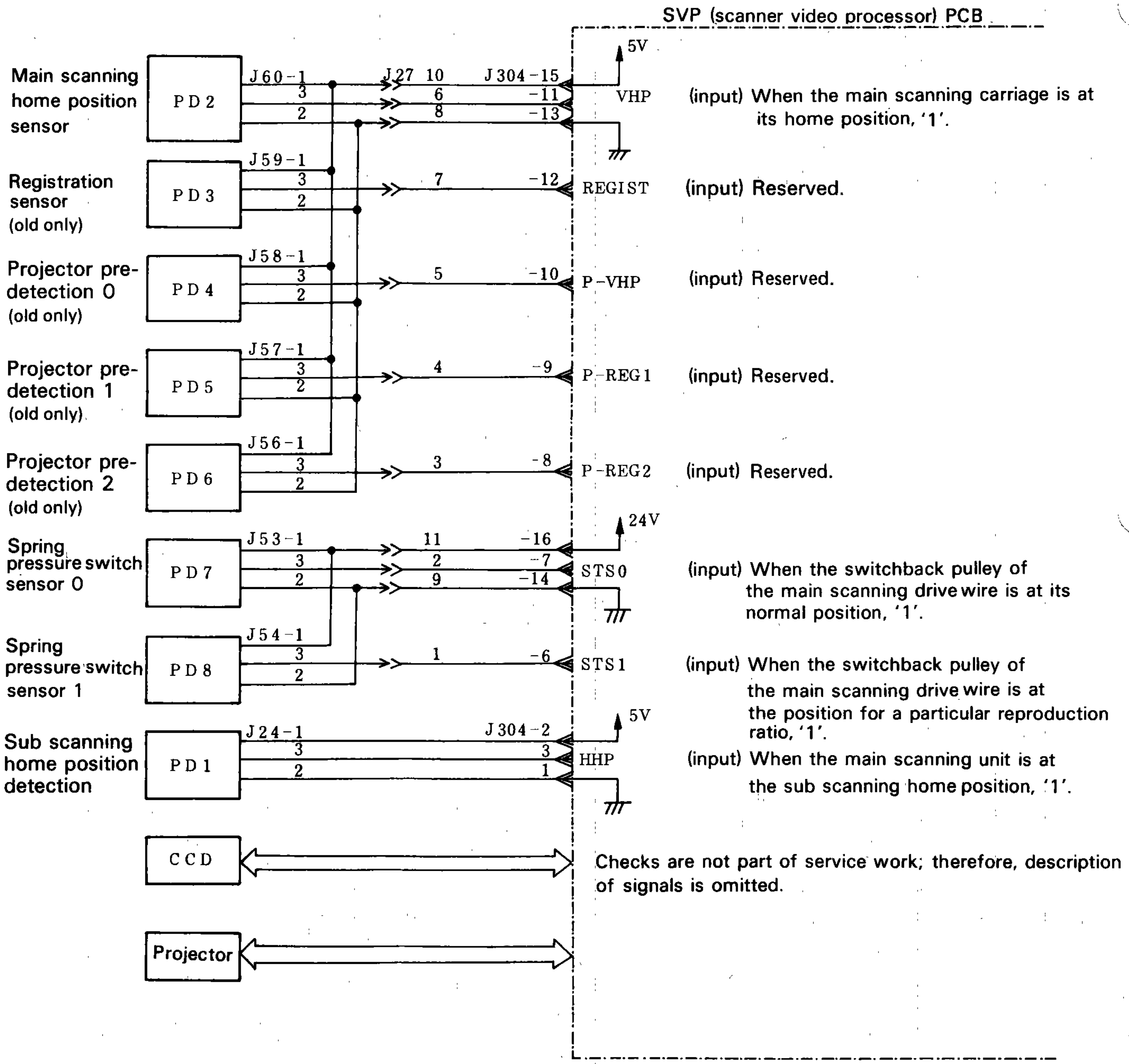


Figure 2-3

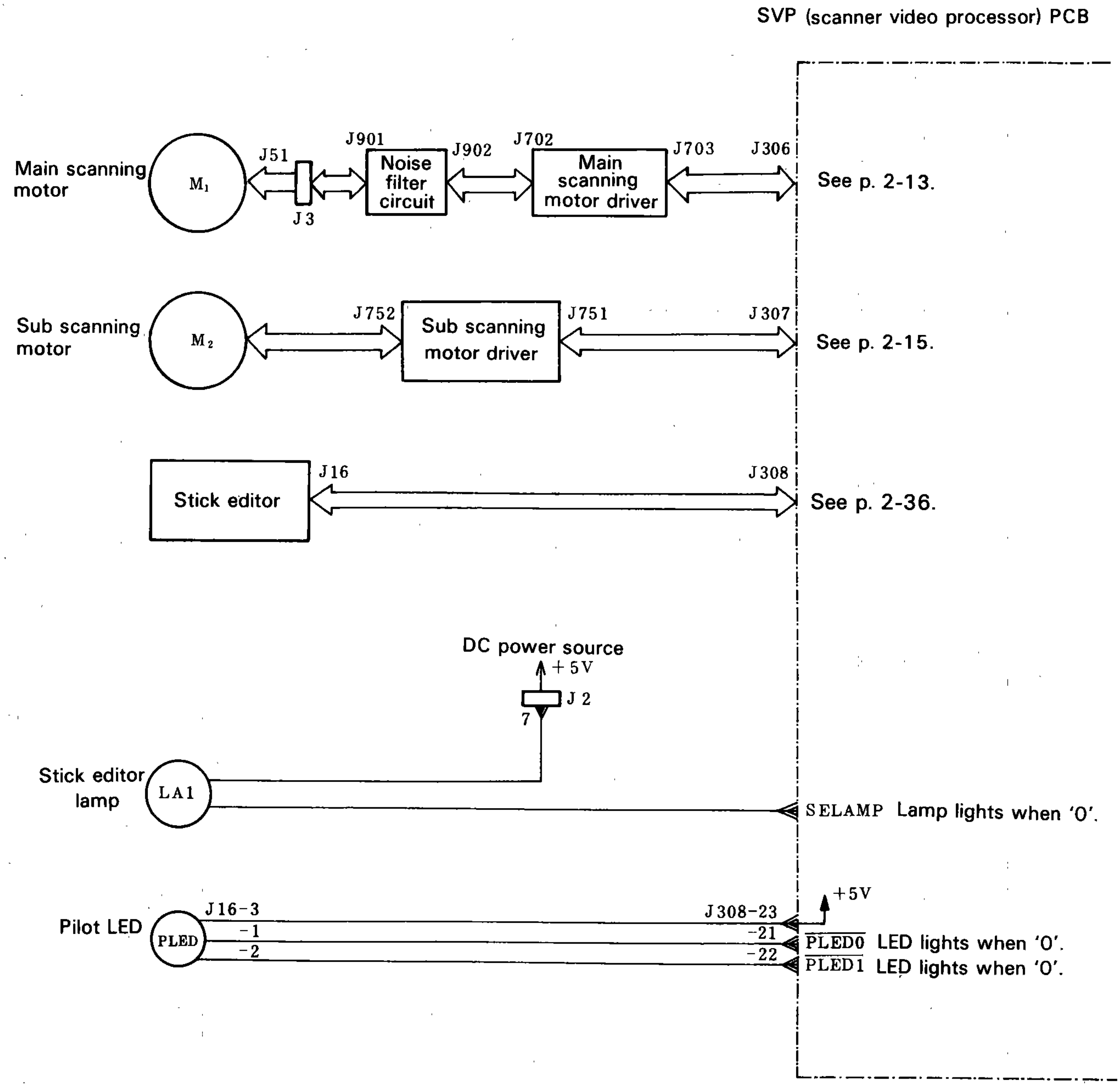

SVP (scanner video processor) PCB
Main scanning motor
M1
J51
J3
J901
Noise filter circuit
J902
J702
Main scanning motor driver
J703
J306
See p. 2-13.
Sub scanning motor
M2
J752
Sub scanning motor driver
J751
J307
See p. 2-15.
Stick editor
J16
J308
See p. 2-36.
DC power source
+5V
J2
7
Stick editor lamp
LA1
SELAMP Lamp lights when '0'.
Pilot LED
PLED
J16-3
-1
-2
J308-23
-21
-22
+5V
PLED0 LED lights when '0'.
PLED1 LED lights when '0'.

Figure 2-4

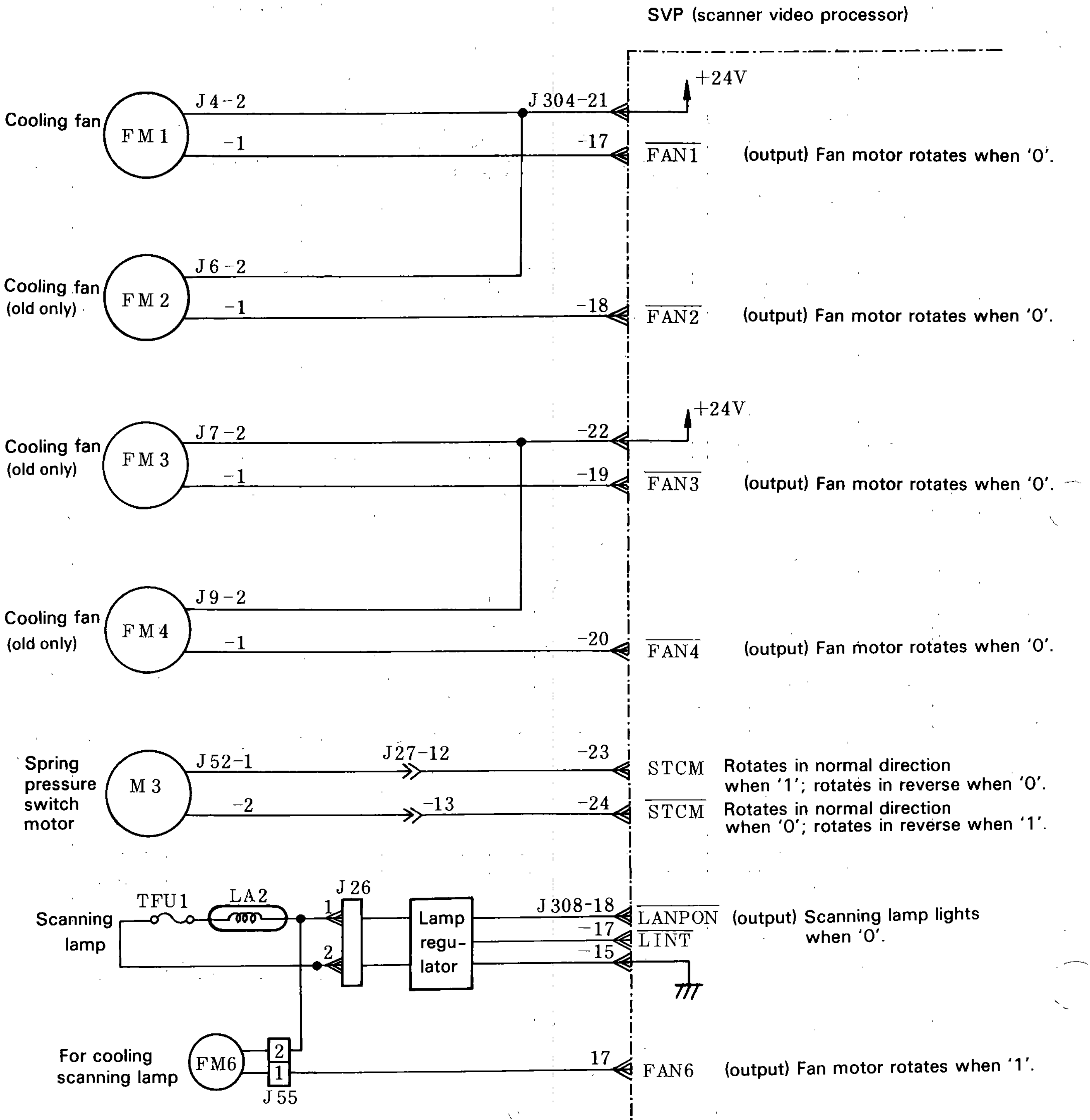

SVP (scanner video processor)
+24V
Cooling fan
FM1
J4-2
-1
J304-21
-17
FAN1
(output) Fan motor rotates when '0'.
Cooling fan
(old only)
FM2
J6-2
-1
-18
FAN2
(output) Fan motor rotates when '0'.
+24V
Cooling fan
(old only)
FM3
J7-2
-1
-22
-19
FAN3
(output) Fan motor rotates when '0'.
Cooling fan
(old only)
FM4
J9-2
-1
-20
FAN4
(output) Fan motor rotates when '0'.
Spring
pressure
switch
motor
M3
J52-1
-2
J27-12
-13
-23
-24
STCM
Rotates in normal direction
when '1'; rotates in reverse when '0'.
STCM
Rotates in normal direction
when '0'; rotates in reverse when '1'.
Scanning
lamp
TFU1
LA2
J26
1
2
Lamp
regu-
lator
J308-18
-17
-15
LANPON
LINT
(output) Scanning lamp lights
when '0'.
For cooling
scanning lamp
FM6
2
1
J55
17
FAN6
(output) Fan motor rotates when '1'.

Figure 2-5

D. Binary Video Processor (BVP) PCB Input/Output

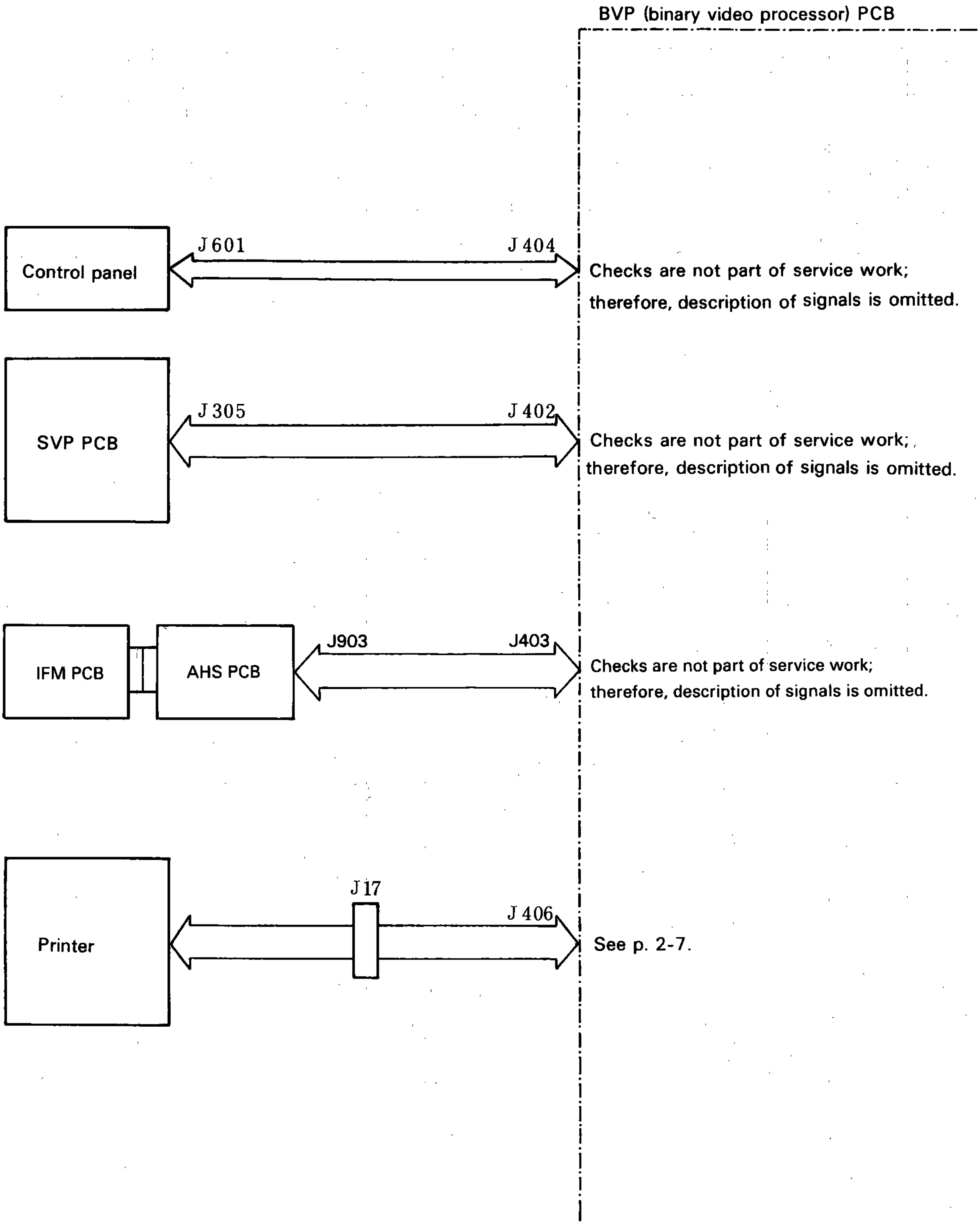


Figure 2-6

E. Basic Operations Sequence

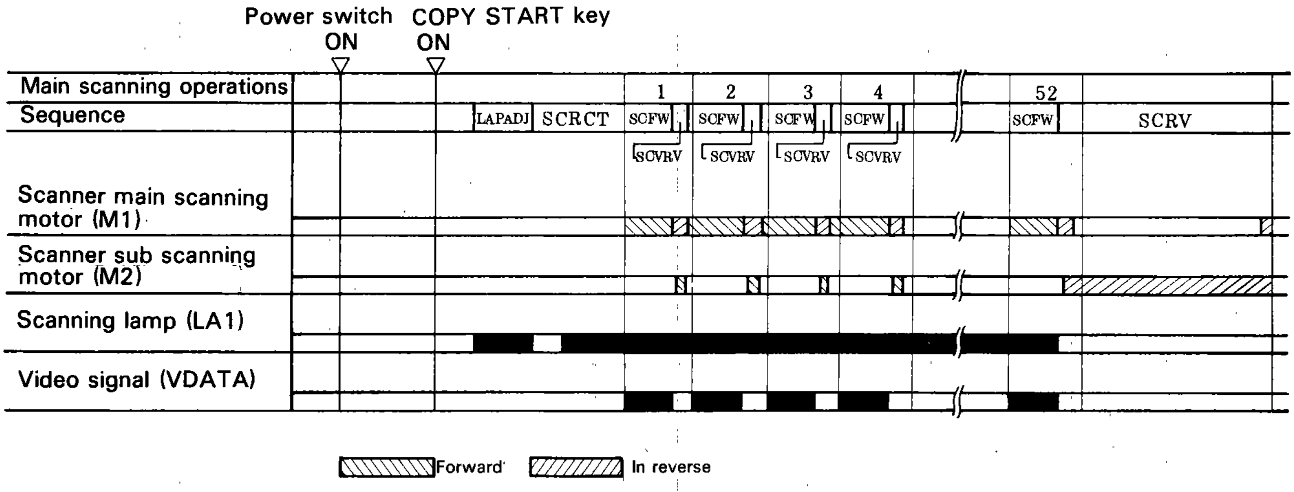


Figure 2-7 A1 (22" × 34"), Full Color, Single Copy

Period		Purpose	Remarks
LAPADJ (Lamp Adjustment)	While the scanning lamp is turned ON and OFF for adjustment of its intensity.	To adjust the intensity of the scanning lamp.	
SCRCT (Shading Correction)	From when the lamp intensity is adjusted for shading correction until the scanner starts to move forward.	To measure the density of the white plate for shading correction.	
SCFW (Scanner Forward)	While the scanner is moving forward in the main scanning direction for scanning the document.	To move the light from the scanning lamp reflected by the document onto the CCD.	
SCVRV (Scanner Reverse)	While the scanner is moving in reverse in the main scanning direction.	To return the scanner to its home position in the main scanning direction.	At the time, the scanner moves forward about 16 mm in the sub scanning direction.
SCRV (Scanner Reverse)	While the scanner is moving in reverse in the main and sub scanning directions.	To return the scanner to its home position in the sub scanning direction.	

Table 2-1

F. Interface Signals

Figure 2-8 shows the interface signals used for communication between the scanner unit and printer unit.

The scanner unit and printer unit exchange various information by means of these interface signals.

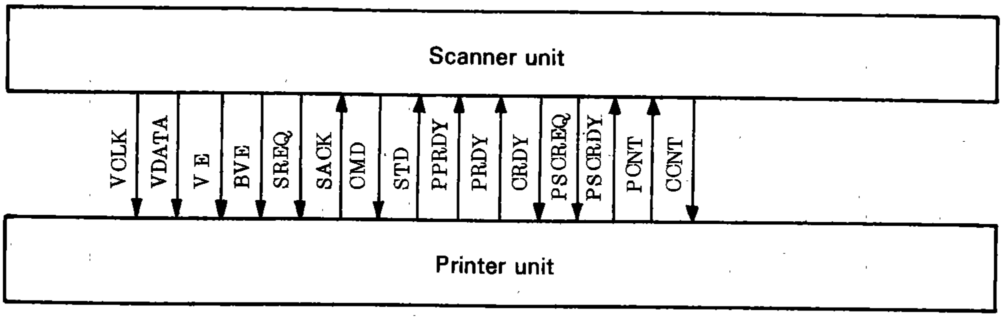


Figure 2-8

Abbreviation	Signal	Description
VCLK	Video Clock	When the scanner unit sends video (image) signals, it sends them synchronized with this signal.
VDATA	Video Data	These are video (image) signals from the scanner unit. They are serial color video signals that repeat C, M, Y, BK, C, M, Y, BK, and so forth for four colors.
VE	Video Enable	The signal indicates that image data equivalent to a single line from the CCD is sent. The signal is effective for 256 pixels × 4 colors = 1024 data units.
BVE	Block Video Enable	The signal indicates that effective video signals are sent by the scanner unit. The signal is effective while the main scanning carriage is scanning in the main scanning direction.
SREQ	Scanner Request	The signal is sent from the scanner unit to the printer unit when the scanner unit is about to send commands to the printer unit.
SACK	Status Acknowledge	This signal is sent by the printer unit to the scanner unit when the printer is ready to receive commands after receiving the SREQ signal.
CMD	Command Data	This is the line over which the scanner unit sends command data (8-bit) to the printer unit.
STD	Status Data	This is the line over which the printer unit sends status data (8-bit) to the scanner unit.
PPRDY	Printer Power Ready	This signal is effective when the microprocessor has finished initialization and is ready to communicate with the scanner unit.
PRDY	Printer Ready	This signal is effective when all print conditions are met in the printer unit.
CRDY	Controller Ready	This signal is effective when the microprocessor of the scanner is operating normally and is ready to communicate with the printer unit.
PSCREQ	Printer Scan Request	The signal is used by the scanner unit to instruct the printer unit to start a single scan in the main scanning direction.
PSCRDY	Printer Scan Ready	This signal is used by the printer unit to inform the scanner unit that it is ready to make a scan in the main scanning direction.
PCNT	Printer Connect	This signal informs the scanner unit that the connector between the scanner unit and the printer unit is connected.
CCNT	Controller Connect	This signal informs the printer that the connector between the scanner unit and the printer unit is connected.

Table 2-2

G. Timing for Output of Video Data

First, the scanner unit communicates with the printer unit in serial and, then, waits for the main scan ready signal (PSCRDY) from the printer.

When the main scan ready signal (PSCRDY) is enabled, the scanner unit in response sends the main scan request signal (PSCREQ) to the printer unit. The signal moves the scanner in the main scanning direction and, at the same time, the scanner unit sends video signals (VDATA) to the printer unit.

The scanner unit, in synchronization with the video clock signal (VCLK), sends video signals (VDATA), video enable signal (VE), and block video enable signal (BVE) to the printer unit.

Figure 2-9 shows the relationship between the document and the VE and BVE signals. Figures 2-10 and -11 show the timing for output of video data.

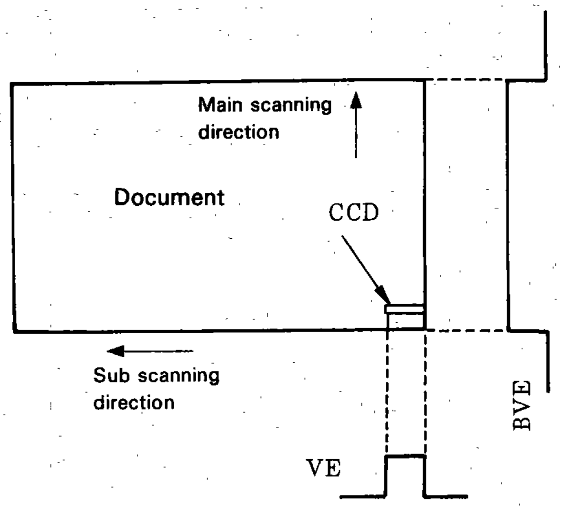


Figure 2-9

Video signals (VDATA) are enabled when both video enable signal (VE) and block video enable signal (BVE) are enabled.

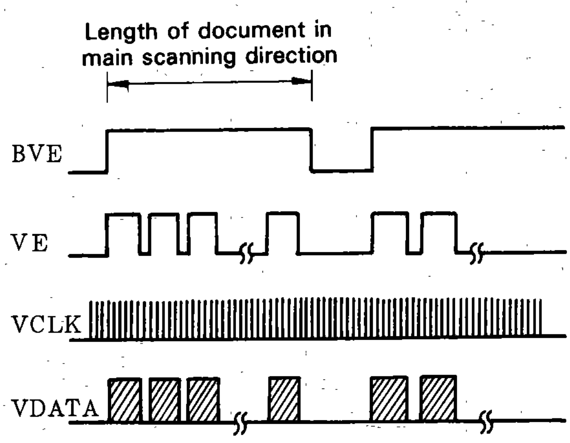


Figure 2-10

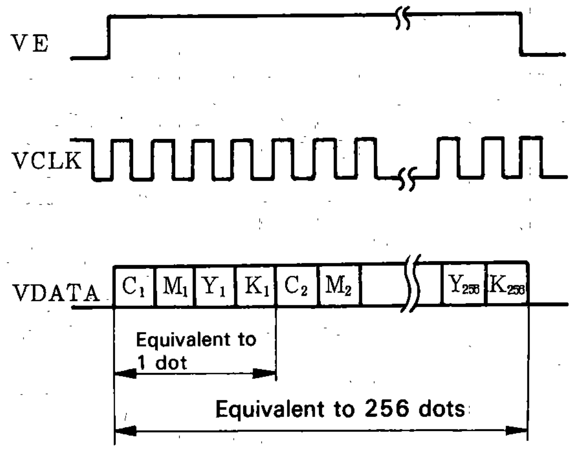


Figure 2-11

II. EXPOSURE SYSTEM

A. Outline

The scanner consists of the scanning lamp, CCD, CCD driver PCB, and CCD preamplifier PCB. In the DIRECT mode, the CCD reads the image at intervals of about 16 mm in the main scanning direction and, then, moves about 16 mm to the sub scanning direction to read the next image.

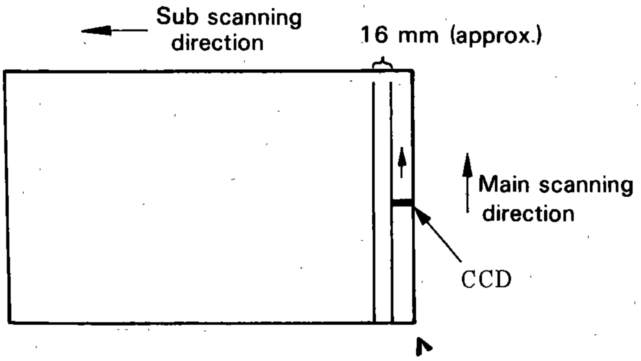


Figure 2-100

Each of these movements of the scanner is driven by the main scanning motor or sub scanning motor.

The pixels read by the CCD are of the DIRECT mode ($256 + \alpha$), α being pixels for correction.

The video enable signal (VE) sent to the printer unit is effective for 256 pixels regardless of the reproduction ratio in effect.

The number of pixels sent to the printer unit is 256 for both DIRECT and ENLARGEMENT modes and 128 in the REDUCTION mode.

In the REDUCTION mode, the remaining 128 pixels are masked on the BVP PCB. For this reason, the image formed in the printer unit is of no more than 128 pixels.

B. Varying the Reproduction Ratio

1. Main Scanning Direction

The reproduction ratio in the main scanning direction is varied by changing the speed of the scanner.

In the REDUCTION mode, the scanner is moved at a higher speed and, in the ENLARGEMENT mode, it is moved at a lower speed.

2. Sub Scanning Direction

The reproduction ratio in the sub scanning direction is varied by limiting the distance over which the scanner moves for both REDUCTION and ENLARGEMENT modes.

As the number of pixels sent to the printer unit is 128 for each color in the REDUCTION mode, the number of pixels read by the CCD (X_1) is (128/reduction ratio) + α.

The distance over which the scanner moves, therefore, can be obtained by the following equation:

$$\frac{16\text{ mm (approx.)}}{256\text{ pixels}} \times (X_1 - \alpha)$$

By the same token, as the number of pixels sent to the printer unit in the ENLARGEMENT mode is 256, the number of pixels read by the CCD (X_2) is (256/reproduction ratio) + α.

Consequently, the distance of movement in the sub scanning direction can be obtained by the following equation:

$$\frac{16\text{ mm (approx.)}}{256\text{ pixels}} \times (X_2 - \alpha)$$

See Table 2-101 (p. 2-10).

C. Mirror Image

Figure 2-101 shows the scanning direction of the scanner carriage in reading a mirror image.

The image data read by the CCD is the same as in the case of a normal image, but the image is reversed in the SVP PCB and sent to the BVP PCB.

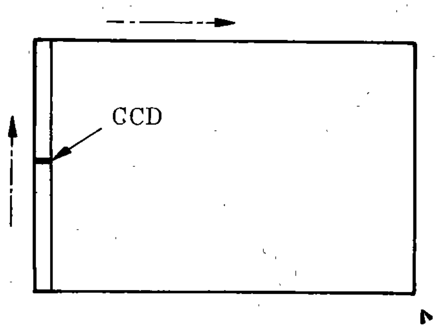


Figure 2-101

5. Pixels Used by CCD and Distance of Movement in Sub Scanning Direction

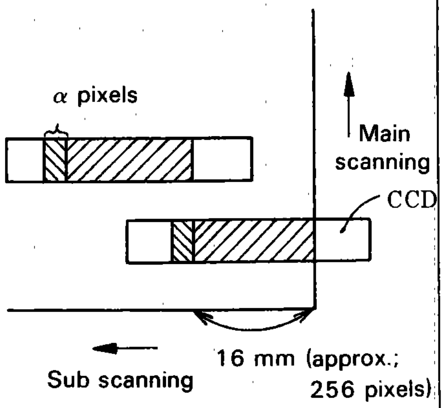
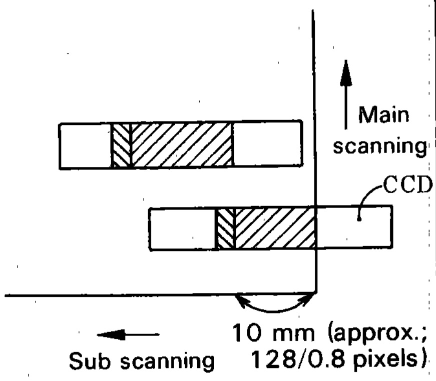
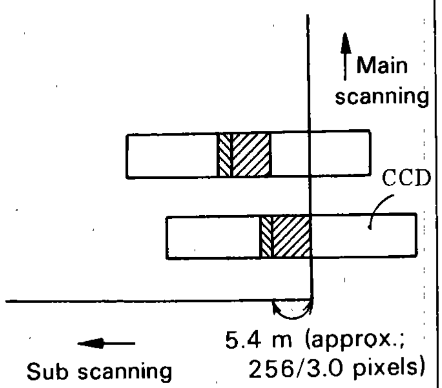
	Position of CCD and Pixels Used (pixels used by CCD shaded)	Distance over sub scanning direction	No. of pixels for data sent to printer unit
DIRECT		16 mm (approx.)	256 pixels/color
80% REDUCTION		10 mm (approx.)	128 pixels/color
300% ENLARGEMENT		5.4 mm (approx.)	256 pixels/color

Table 2-101

D. Scanner Drive System

1. Outline

The diagram shown in Figure 2-102 is a block diagram of the scanner drive system.

The scanner is moved vertically (from front to rear of copyboard) by the main scanning motor (M1).

The main scanning motor is controlled for the following:

- Direction of rotation
- Speed of rotation
- ON and OFF

The main scanning motor rotates in opposite directions to move the scanner forward or in reverse. As for its speed, the rotation is two or four times faster when moving the scanner in reverse depending on the reproduction ratio in effect.

The main scanning motor is a 5-phase stepping motor and, by controlling the pulses from the main scanning motor driver, its revolution and direction are varied.

The tension of the main scanning wire of the scanner is changed by the spring tension switch motor (M3).

The horizontal movement (from right to left of copyboard) of the scanner is driven by the sub scanning motor (M2).

The sub scanning motor is controlled for the following:

- Direction of rotation
- ON and OFF
- Period of rotation

The sub scanning motor is rotated and stopped so that the scanner, for each single scan in the main scanning direction, moves forward about 16 mm (DIRECT) into the sub scanning direction and stops.

The sub scanning motor also changes its direction in moving the scanner forward and in reverse.

In the case of the sub scanning motor, however, the speed of rotation is constant in moving the scanner both forward and in reverse.

The sub scanning motor is a 5-phase stepping motor and, by controlling the pulses sent to the motor, its direction and timing are varied.

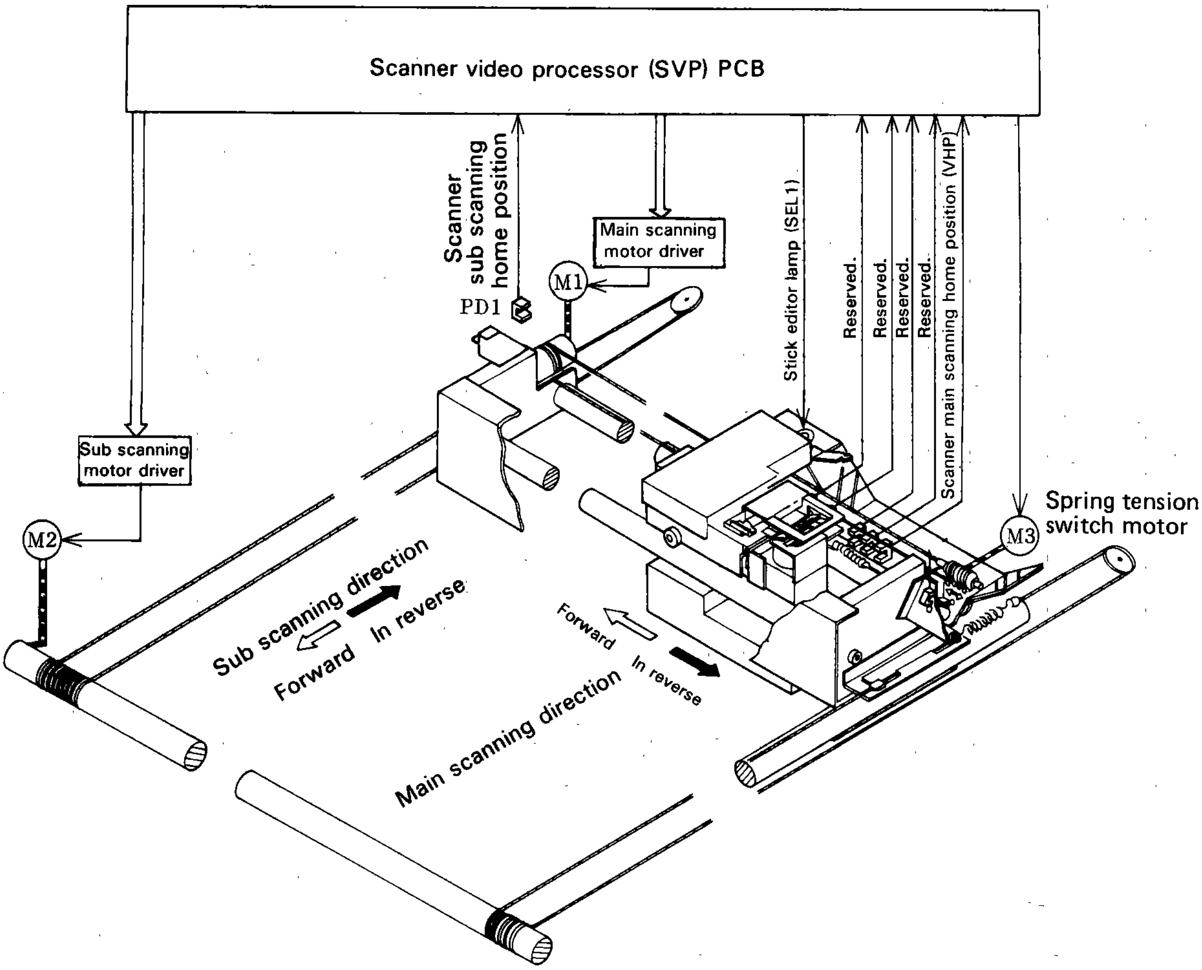


Figure 2-102

2. Relationship Between Photo Sensors and Signals

Photo sensor	Signal	CCD				Meaning
		Main scanning		Sub scanning		
		Forward	In reverse	Forward	In reverse	
PD1	HHP				↑	Scanner sub scanning home position
PD2	VHP		↑			Scanner main scanning home position
PD3	REGIST	↑				Reserved. (old only)
PD4	P-VHP	↑				Reserved. (old only)
PD5	P-REG1	↑				Reserved. (old only)
PD5	P-REG2	↑				Reserved. (old only)

Table 2-102

3. Basic Operations Sequence for Scanner

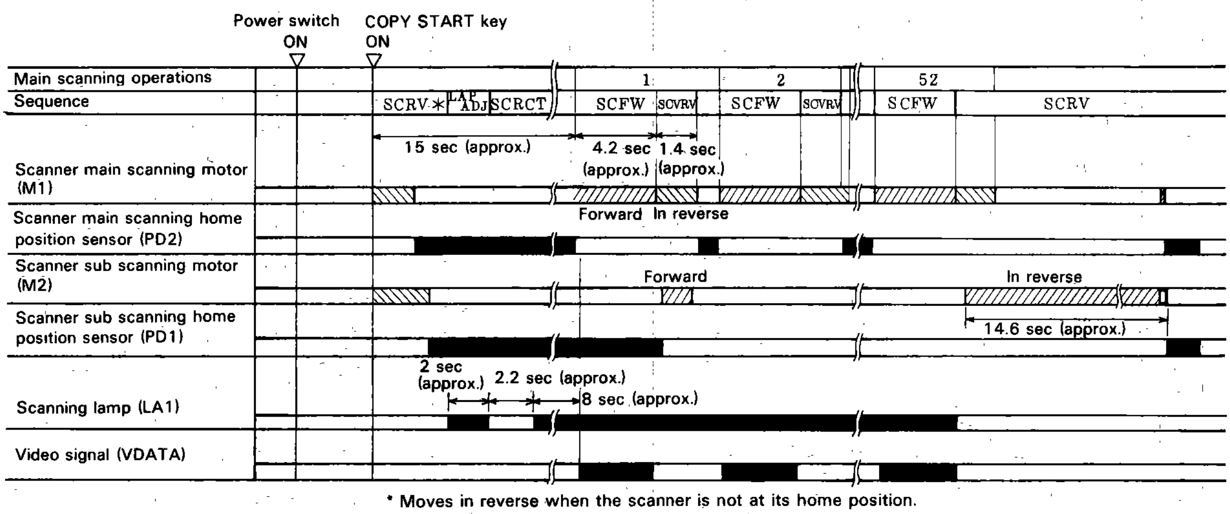


Figure 2-103 A1 (22" × 34"), Full Color, Single Copy, DIRECT

4. Controlling the Main Scanning Motor

a. Outline
Figure 2-104 is a block diagram of the main scanning motor control.
The main scanning motor is a 5-phase stepping motor.
The phase signal of the motor is sent to the motor from the SVP PCB through the main scanning motor driver PCB.

b. Motor Drive Signal
As shown in Figure 2-105, the main scanning motor rotates in normal direction by switching over from phase A through phase E in sequence to move the scanner carriage forward. In moving the carriage in reverse, the sequence of this phase switch-over is reversed as shown in Figure 2-107.

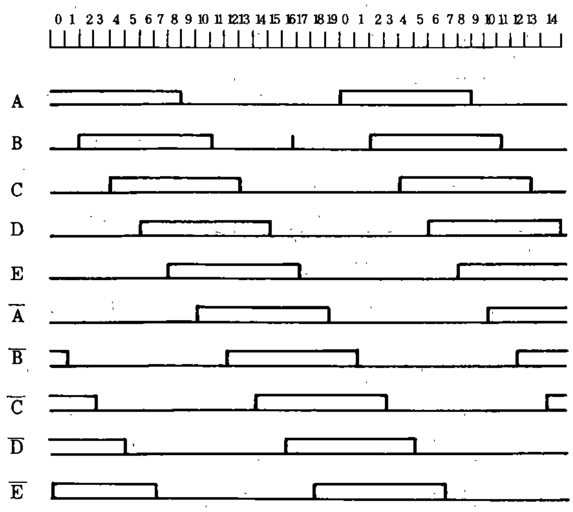


Figure 2-105

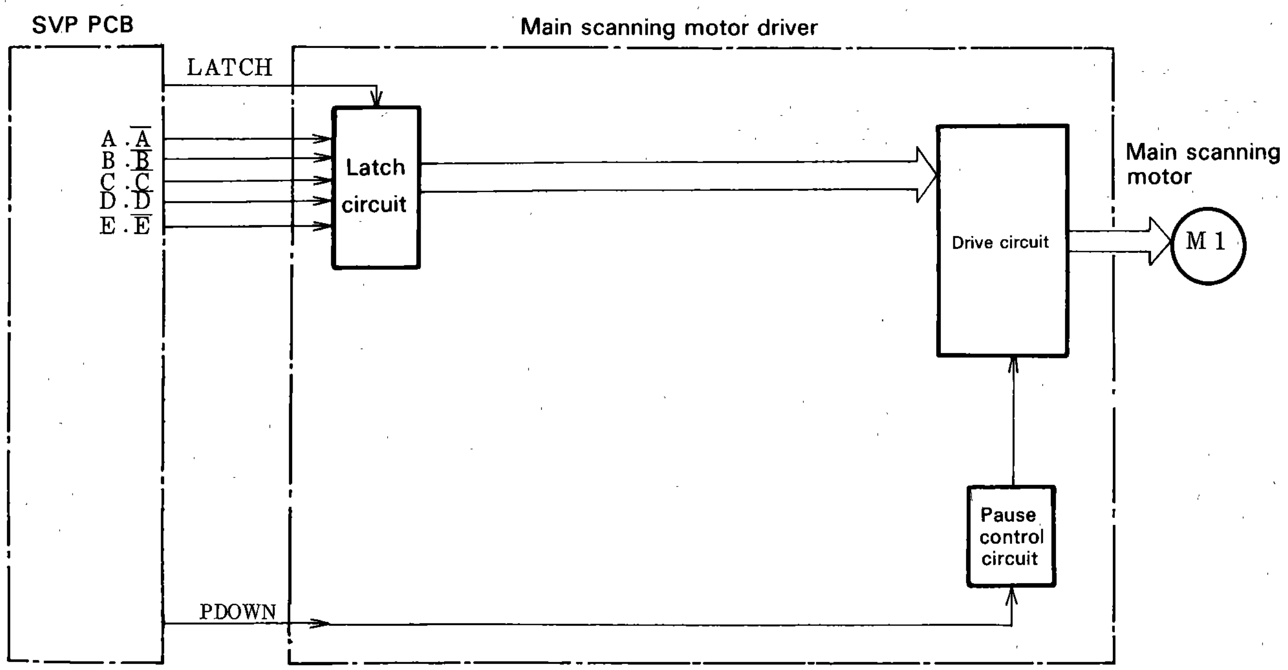


Figure 2-104

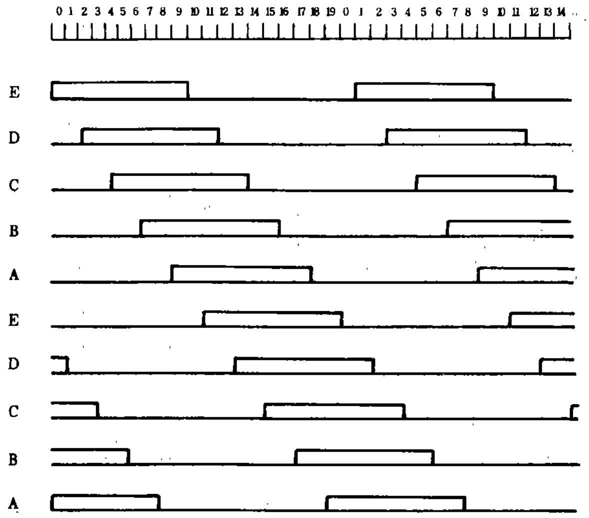


Figure 2-107

c. Motor on Hold
When the PDOWN signal is sent by the SVP PCB, the reference voltage (Vref) lowers to reduce the current to the motor, and the motor, in turn, is put on hold.

5. Control of Sub Scanning Motor

a. Outline

Figure 2-108 is a block diagram of the sub scanning motor control.

The sub scanning motor is a 5-phase stepping motor. The drive signal for the motor comes from the CPU of the SVP PCB and sent to the motor through sub scanning motor driver PCB.

The drive signal of the sub scanning motor is a pulse signal and, by changing its sequence of phases sent, the scanner is made to move forward or in reverse.

b. Motor Drive Signal

As shown in Figure 2-109, changing the phases from phase A through phase E in sequence causes the sub scanning motor to rotate in normal direction, and the scanner carriage in turn moves forward.

As shown in Figure 2-110, changing the phases from phase E through phase A in sequence causes the sub scanning motor to rotate in reverse direction, and the scanner carriage in turn moves in reverse.

c. Fault Detection Circuit

A large load imposed on the motor for some reason results in a current larger than normal flowing through the motor. When such a condition exists, the overcurrent detection circuit on the sub scanning motor driver PCB is activated to lower the output of the motor drive signal through the comparator and control circuit.

d. Motor on Hold

When the IDOWN signal is sent from the SVP PCB, the output voltage of the reference voltage generation circuit lowers.

The comparator relays the signal to the control circuit, and the motor drive current is reduced to put the motor on hold.

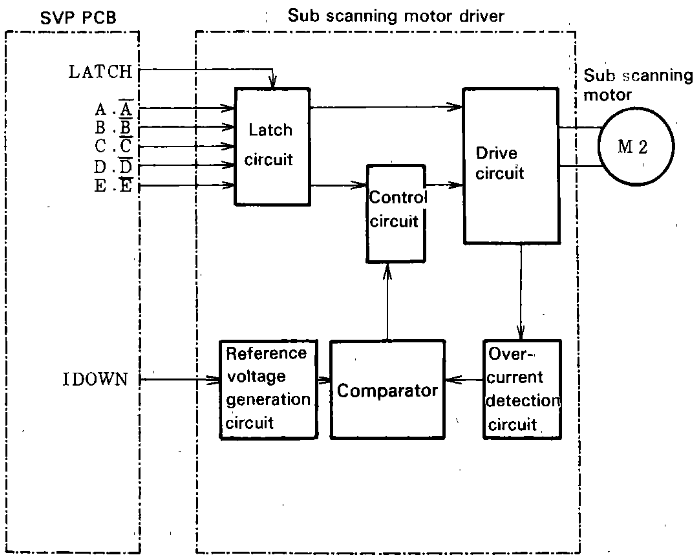


Figure 2-108

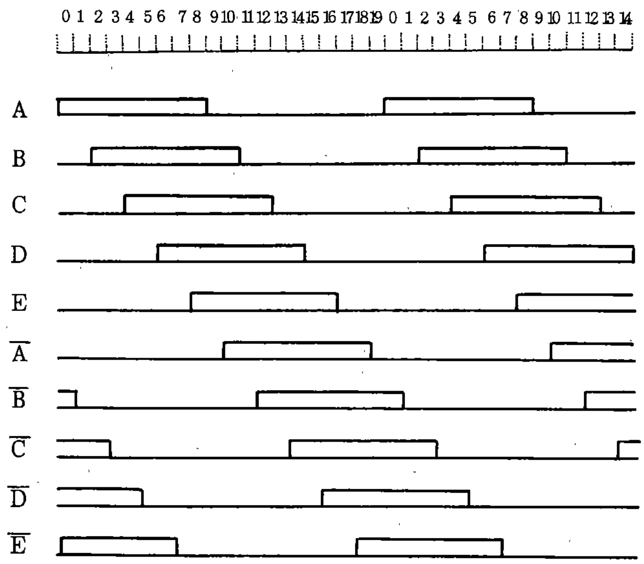


Figure 2-109

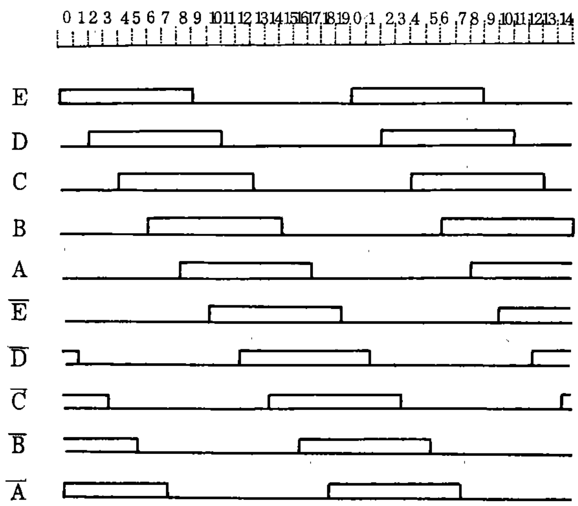


Figure 2-110

6. Spring Pressure Switch Motor Control

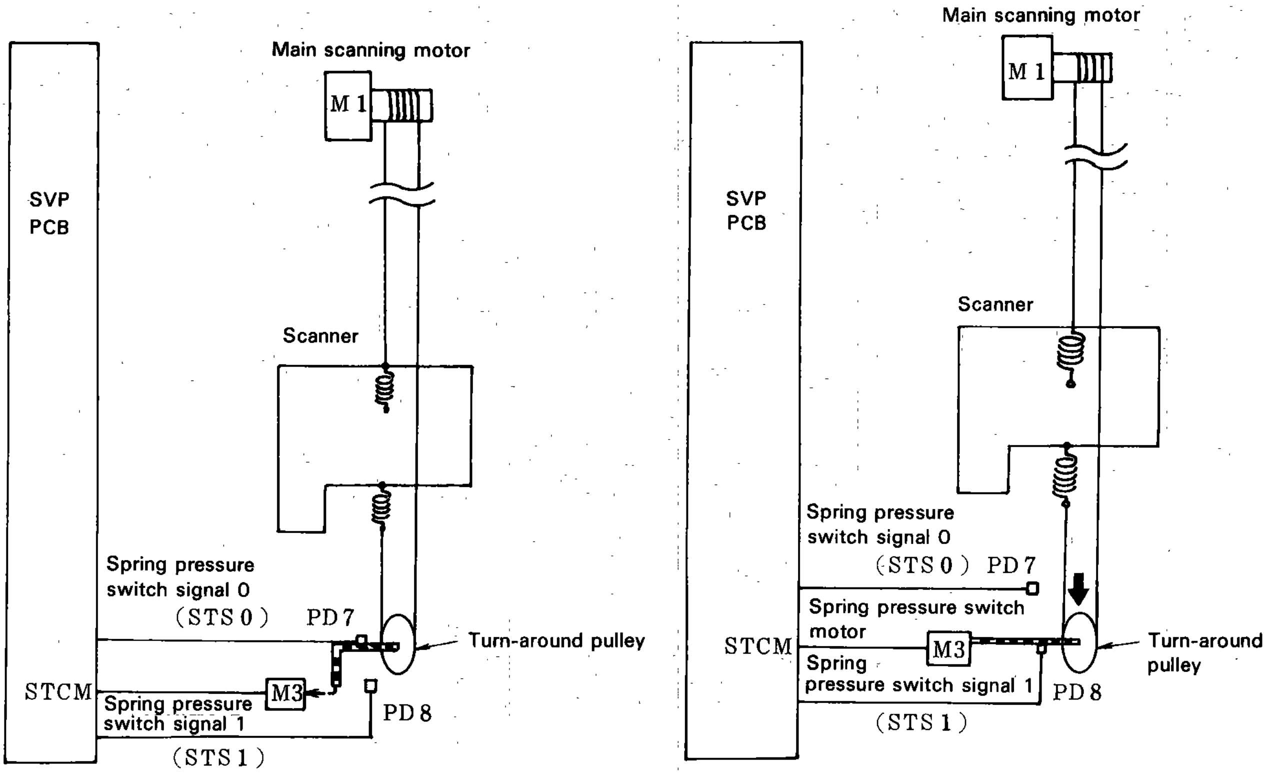
a. Outline

The speed at which the scanner moves in the main scanning direction is inversely proportional to the enlargement ratio, i.e., the larger the ratio, the lower the speed.

The vibration inherent to the scanner sometimes resonates with the vibration occurring when the scanner moves at a specific speed, and such resonance tends to produce copies with wavy images.

To eliminate the condition, the copier is designed to change the tension on the drive wire, which moves the scanner into the main scanning direction when enlargement ratios larger than a specified value are used. The tension of the drive wire is changed by changing the position of the turn-around pulley for the wire; the position, on the other hand, is changed by the spring pressure switch motor (M3) under control of the microprocessor of the SVP PCB.

Figure 2-111 shows the drive wire when in its normal state and at time of specific reproduction ratios.



(a) Drive wire in normal state

(b) Drive wire at time of specific reproduction ratios

Figure 2-111

Relationship Between Sensors and Signals

Sensor	Signal	Description
PD7	STS0	When the turn-around pulley of the main scanning wire is at its normal position.
PD8	STS1	When the turn-around pulley of the main scanning wire is at the position for specific reproduction ratios.

Table 2-103

E. Turning the Scanning Lamp ON and OFF

1. Operations

When $\overline{\text{LAMPON}}$ = 1, the lamp output of the lamp regulator is '0' and, being deprived of power, the scanning lamp (LA1) goes OFF.

When $\overline{\text{LAMPON}}$ = 0, the lamp output of the lamp regulator is '1' and, being supplied with power, the scanning lamp (LA1) goes ON.

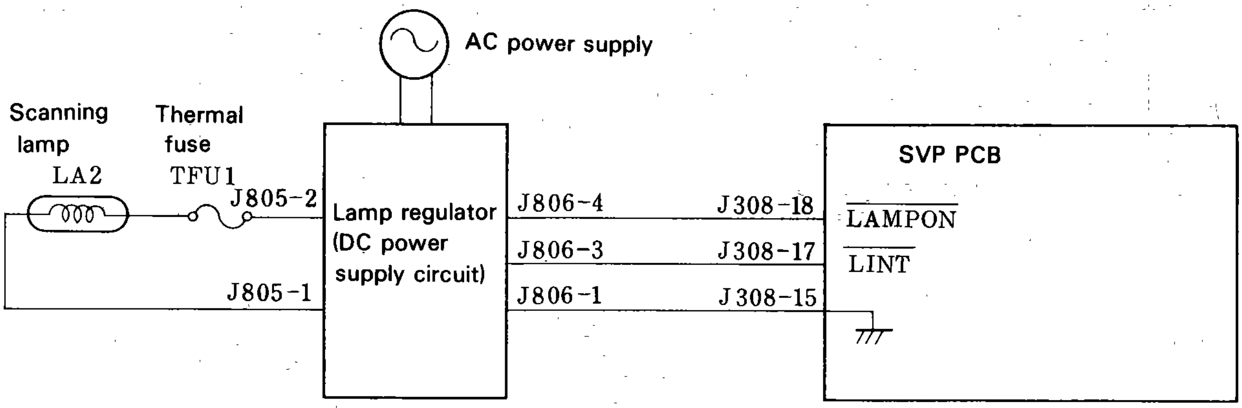


Figure 2-112

F. Adjusting the Intensity of the Scanning Lamp

The intensity of the scanning lamp is controlled by changing the supply voltage to the scanning lamp from the lamp regulator in response to the value of the LINT signal from the SVP PCB.

The LINT signal varies between 2.40V and 4.40V; and the variation of the signal is used to control the supply voltage to the scanning lamp between about 19.3V DC and 24V DC (20.8V DC and 25.8V DC at the output terminal of the lamp regulator).

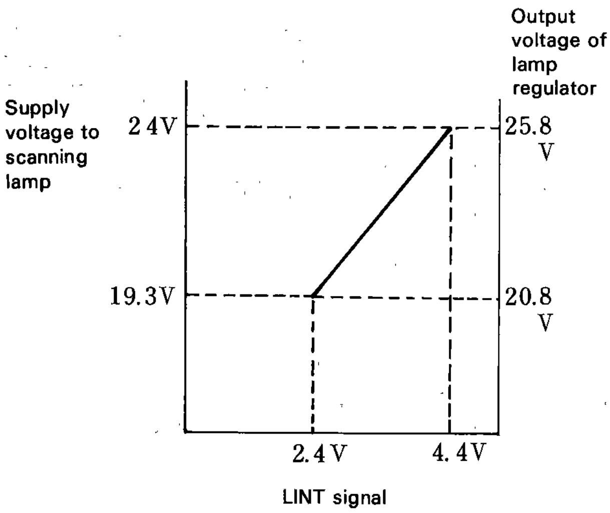


Figure 2-113

III. IMAGE PROCESSING SYSTEM

A. CCD and CCD Driver

1. Outline

The CCD (Charge Coupled Device) used in the scanner unit has about 1500 photocells arranged at intervals of about 21μm and consists of the filter and transfer and output units.

The photocells unit is constructed as a single entity with the B, G, and R filters; and, together with the three photocells (B, G, R), it reads a color image equivalent of a single pixel. As such, being a color CCD of about 500 pixels, the CCD is capable of reading an A1-size color document with a resolution of 400 dpi.

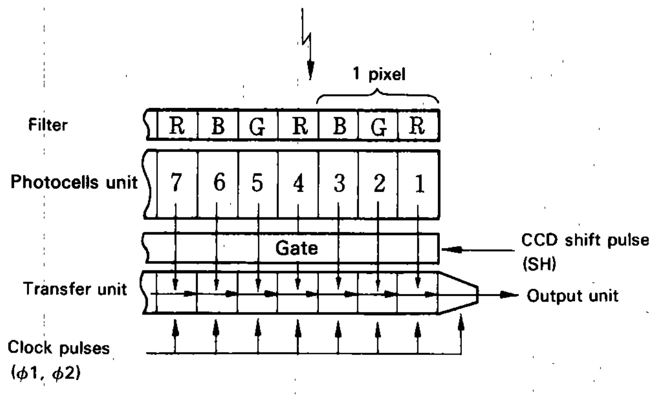


Figure 2-201

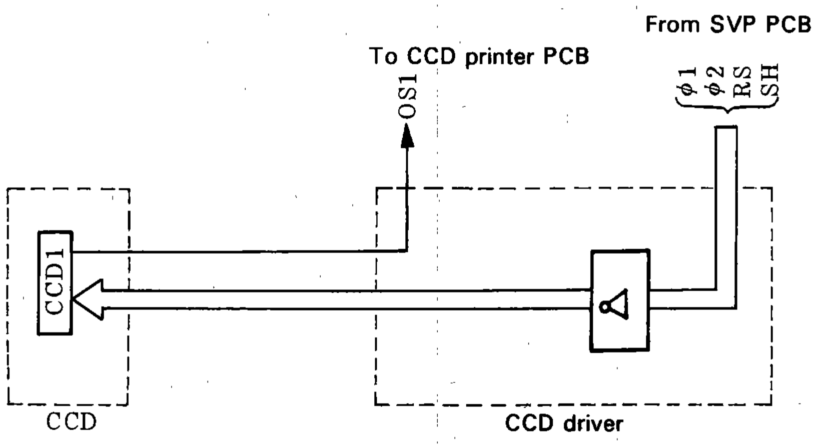


Figure 2-200

2. CCD Photocells Unit

The photocells unit converts optical signals into electrical signals (photoelectrical conversion) and is capable of storing the signals. The scanner unit uses photocells 46.3 × 12.17 μm in size and about 1500 in number.

The charge (Q) stored in the capacitor (C) of Figure 2-202 is directly proportional to the degree of exposure (L).

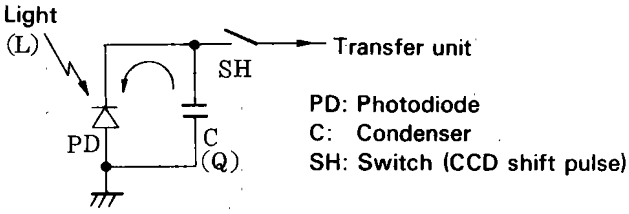


Figure 2-202

3. CCD Transfer Section

When the switch (SH) is ON, the charge stored until it is OFF again is relayed to the transfer section instantaneously. The charge is then transferred to the output section synchronization with clock pulses $\phi 1$ and $\Phi 2$ in sequence (analog shift register).

4. CCD Output Section

The charge signals from the transfer section are converted to voltage signals and sent in low impedance after amplification.

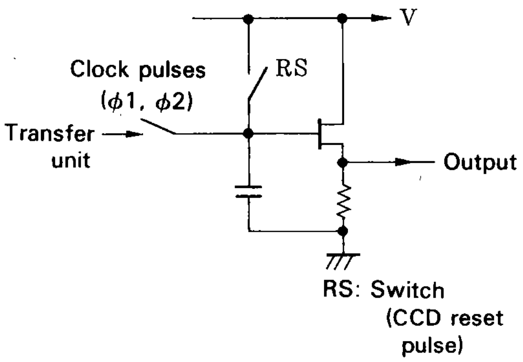


Figure 2-203

The switch (RS) is used to reset charge equivalent of the foregoing pixel for every single pixel (cell).

Figure 2-204 shows timing for clock pulses $\phi 1$ and $\phi 2$, reset pulse (RS), and CCD output.

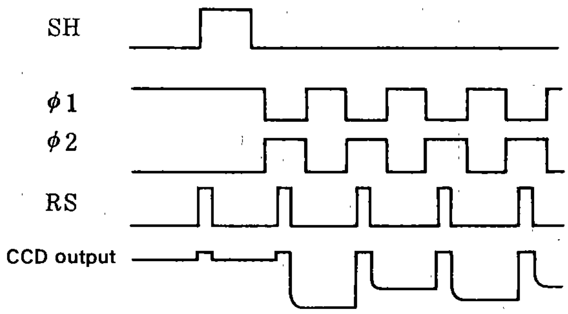


Figure 2-204

Each pulse, $\phi 1$, $\phi 2$, RS, and SH, comes from the CCD driver PCB.

Since the CCD reads on a single line basis, the CCD shift pulse (SH) is synchronized with the ← horizontal ← synchronization signal (SHSYNC) of the CCD driver.

B. Analog Image Processing Circuit

The CCD pre-amplifier PCB consists of the CCD pre-amplifier circuit and analog processor PCB and performs various analog processing over the output of the CCD.

a. CCD Pre-Amplifier Circuit

The CCD pre-amplifier circuit has two functions:

- DC component elimination
- Amplification

The voltage of the output of the CCD (OS1) is rid of its DC component and then amplified to a certain level.

b. Analog Processor Circuit

The analog processor circuit has two functions:

- BGR level matching
- A/D conversion

The video signals in three systems sent to the analog processor circuit are first processed for R, G, and B levels. This is to make up for the differing photoelectrical conversion ratios of the R, G, and B photocells in the CCD and is performed as follows:

The video signals of the three systems are generated on the CCD driver PCB.

The video signals are sample-held in the form of sample signals (R S/H, G S/H, B S/H), and each is separately amplified to match the level of R, G, and B. They are then adjusted so that the black areas of the document will be 0 V and A/D converted thereafter. On the A/D converter the video signals of the three systems are synthesized into one system with the help of the A/D conversion clock signals (R-AD, G-AD, B-AD).

The video signals of the three systems sent to the A/D converter are each converted into a digital signal of 8 bits and sent to the scanner video processor (SVP) PCB.

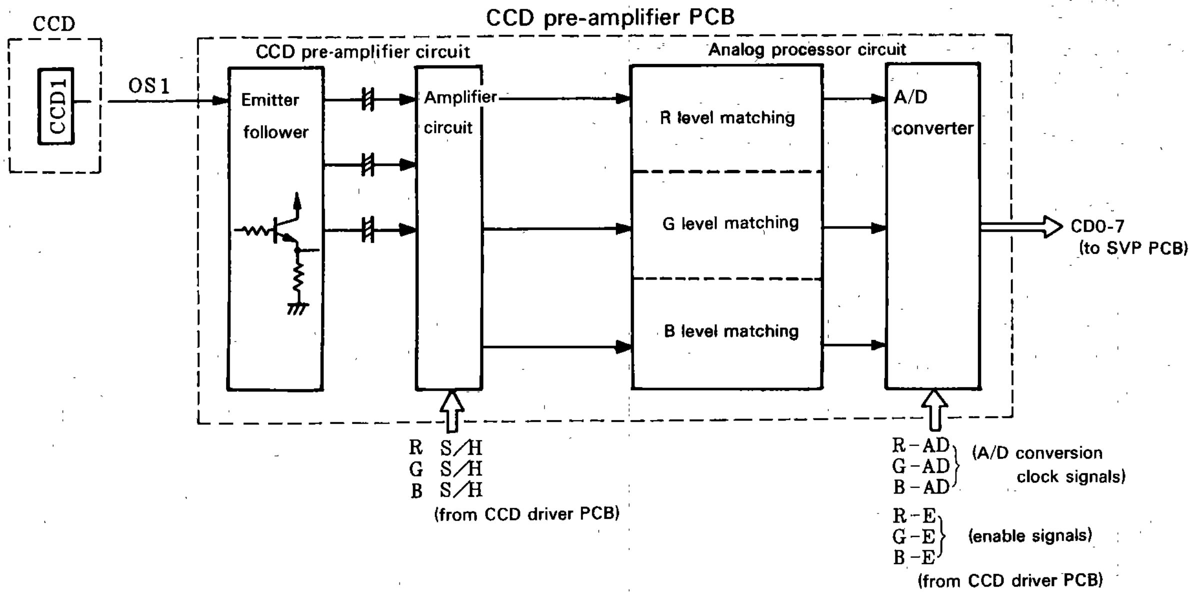


Figure 2-205

C. Digital Image Processing Unit

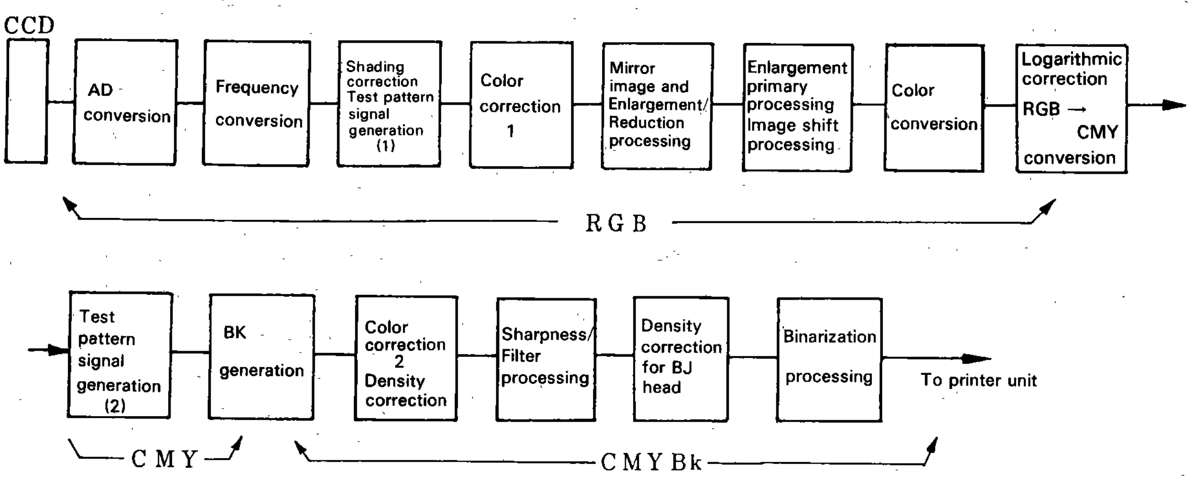


Figure 2-206

In the frequency conversion circuit, the frequency of the digital signals from the A/D converter is reduced to about 66%.

In the shading correction circuit, variations in the CCD, scanning lamp, and others are corrected. In the color correction 1 circuit, the transmission characteristic of each filter (B, G, R) is corrected.

In the mirror image and enlargement/reduction circuit, the sequence or timing of reading image data is changed if in the mirror image or ENLARGEMENT/REDUCTION mode. In the ENLARGEMENT primary processing circuit, image correction is performed for the ENLARGEMENT mode.

In the color conversion circuit, color conversion and painting processing are performed in response to the specifications made from the control panel.

In the logarithmic correction BGR → CMY conversion circuit, logarithmic correction is performed so as to maintain the gradation of print and, at the same time, the BGR signal is converted into ink YMC signals.

In the pattern signal generation circuit, image signals used in the service mode are generated.

In the BK generation circuit, black (BK) signals are generated from the three color signals (YMC).

In the color correction 2 circuit, the reflective characteristics of the four ink colors (YMCK) are corrected.

In the sharpness/filter processing circuit, images that suit the values of sharpness specified from the control panel are created.

In the density correction (for BJ head) circuit, irregularities in the copy density are corrected.

In the binarization circuit, digital signals of multiple values are converted into binary values to prepare binary image data for the printer unit; thereafter, trimming and masking processing is performed.

2. Frequency Conversion and Reduction Processing

Since the frequency at which the CCD reads the image data and the frequency following the shading correction circuit differ, the image data is subjected to frequency conversion.

Table 2-201 (p. 2-23) shows the method of processing the reproduction ratios used in the scanner unit.

3. Shading Correction

Even if the light reflected by the document and detected by the CCD is uniform throughout the scanning lines, CCD output does not necessarily produce constant values for corresponding pixels because of the following factors:

(1) The sensitivity of the CCD varies for each pixel;
(2) The degree of transmission of the lens varies;
(3) The intensity of the light from the scanning lamp differs between the center and both ends; and
(4) The scanning lamp may have deteriorated.

Shading correction is performed to make up for these factors.

The scanner is moved and positioned below the reference white plate, and the scanning lamp is turned ON. The CCD sends output of the light reflected by the reference white plate. Its difference from the target output value (255*) in relation to all photocells of the CCD is kept in memory.

* The target value can be varied in the service mode; DOC W-LEV.

Correction is performed for uniform output while scanning the document based on the correction value kept in memory.

Measurements for correction values are taken for each press on the COPY START key.

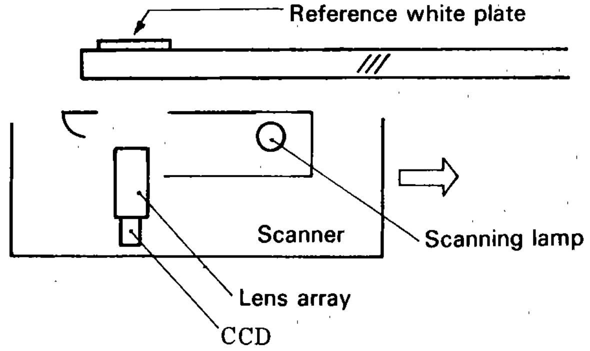


Figure 2-207

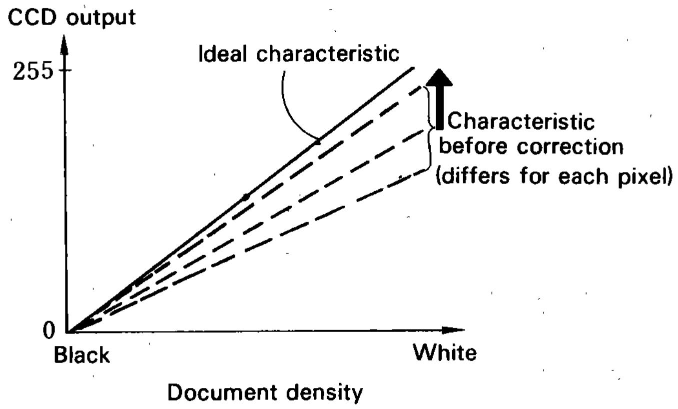


Figure 2-208 Shading Correction

4. Color Correction 1

The transmission characteristic of filters C, M, and Y in the CCD is corrected.

The correction is explained below with filter G as an example.

An "ideal" filter G transmits 100% of light with a wave length of 500 nm to 600 nm (green) and blocks out light with a wave length of less than 500 nm and more than 600 nm. In practice, however, areas designated as a, b, and c in Figure 2-209 exist, and the computation is performed based on equation 1.

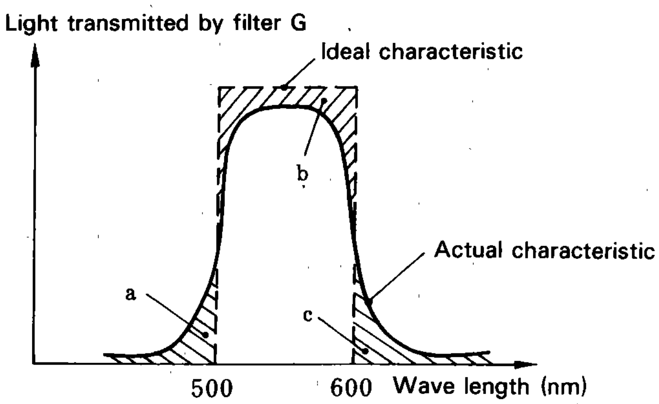


Figure 2-209

$$\begin{pmatrix} R \\ G \\ B \end{pmatrix} = \begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix} \begin{pmatrix} R \\ G \\ B \end{pmatrix} \cdots \text{Equation 1}$$

a_{11}, a_{12} ..... a_{33}: correction coefficient

5. Mirror Image and Enlargement/Reduction Processing

a. Mirror Image

The sequence of reading the image data from the memory is reversed in respect of normal images.

Figures 2-210 and -211 show the arrangement of data inside the memory and the operations of the CCD for normal and mirror images.

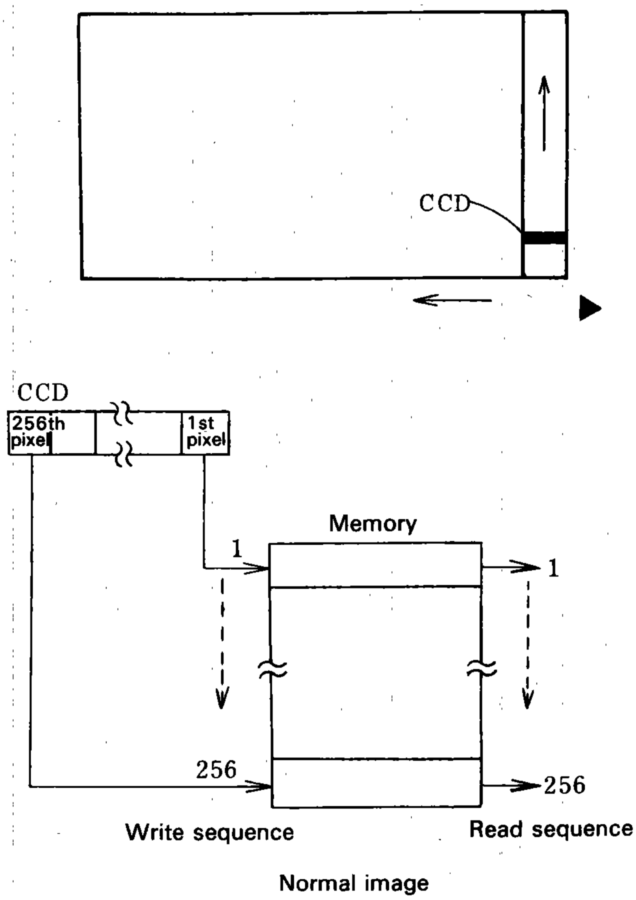


Figure 2-210

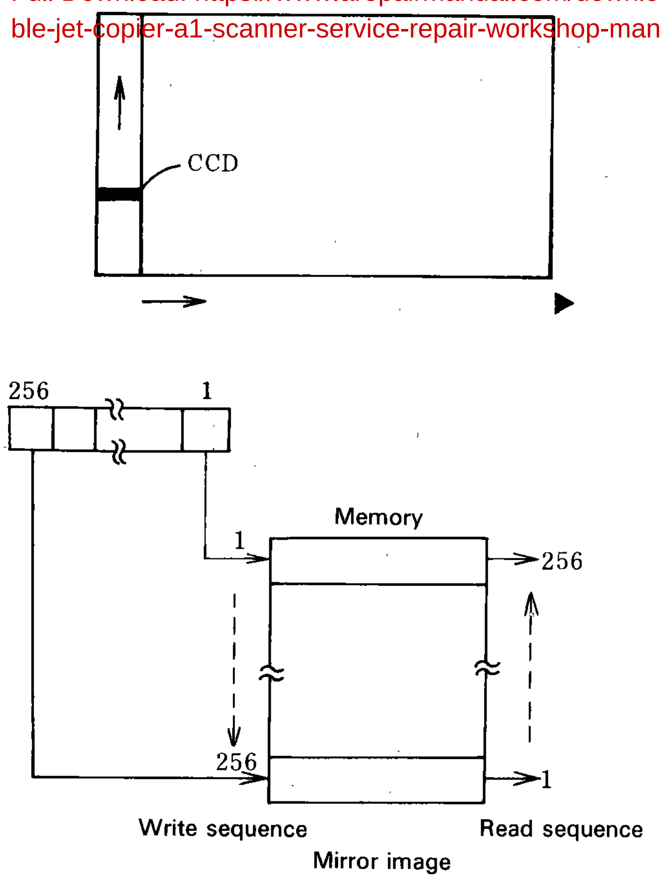


Figure 2-211

b. Enlargement Processing

(1) Vertical Reproduction Ratio (main scanning direction)

To vary the ratio, the speed of the scanner is changed (slowed down), thereby changing the scanning width over the document corresponding to a single pixel.

(2) Horizontal Reproduction Ratio (sub scanning direction)

In reading image data from the memory, the same data is read twice.

The area over which the CCD is used will be limited and, further, the interval in the sub scanning direction for each scan will also be limited.

Table 2-201 shows the method of processing the reproduction ratios used in the scanner unit.

c. Reduction Processing

(1) Vertical Reproduction Ratio (main scanning direction)

The speed of the scanner is changed (sped up) so as to change the scanning width over the document corresponding to a single pixel.

(2) Horizontal Reproduction Ratio (sub scanning direction)

In writing image data into the memory, the data from the CCD is skipped for reduction.

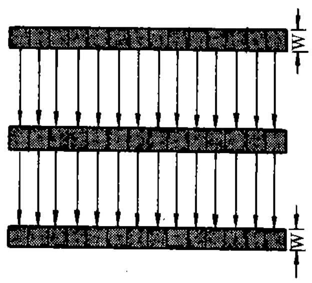
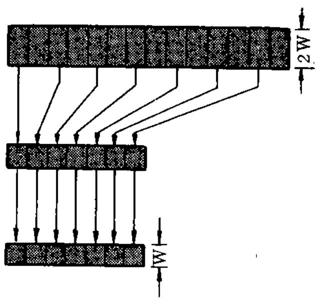
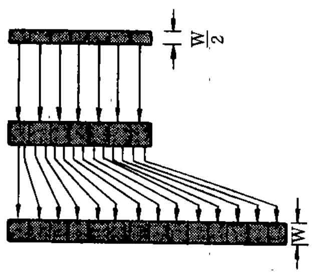
	DIRECT	REDUCTION	ENLARGEMENT
Document (image data) (write) Line memory (read) Copy			
Reproduction ratio in sub scanning direction	All data is written to the memory as is, read as is, and used.	For reduction by 1/2, every other data unit is written to the memory. The interval of the scanner movement is reduced depending on the reproduction ratio.	For enlargement by 2, all data is written to the memory as is but read twice. The interval of the scanner movement is reduced depending on the reproduction ratio.
Reproduction ratio in main scanning direction		The speed of the scanner (or copyboard) is increased to increase the scanning width over the document for each pixel.	The speed of the scanner movement is reduced to reduce the scanning width over the document for each pixel.

Table 2-201