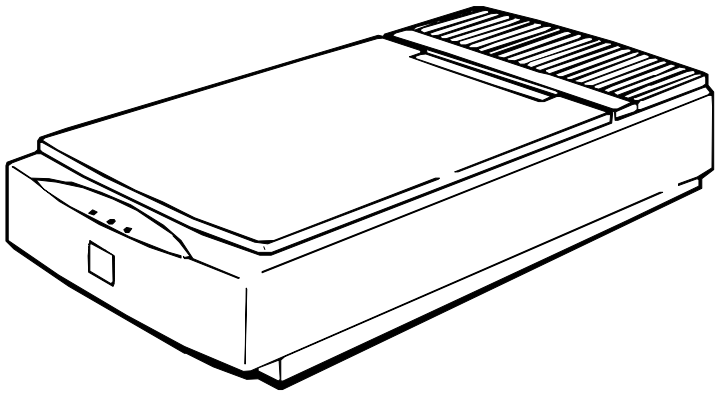
EPSON IMAGE SCANNER

GT-8500 / ES-1000C

SERVICE MANUAL



EPSON

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NOTICE

The contents of this manual are subjects to change without notice.

All efforts have been made to ensure the accuracy of the contents of this manual. However, should any errors be detected, SEIKO EPSON would greatly appreciate being informed of them.

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PRECAUTIONS

Precautionary notations throughout the text are categorized relative to 1) personal injury and 2) damage to equipment.

DANGER Signals a precaution which, if ignored, could result in serious or fatal personal injury. Great caution should be exercised in performing procedures preceded by DANGER Headings.

WARNING Signals a precaution which, if ignored, could result in damage to equipment.

The precautionary measures itemized below should always be observed when performing repair/ maintenance procedures.

DANGER

1. ALWAYS DISCONNECT THE PRODUCT FROM BOTH THE POWER SOURCE AND PERIPHERAL DEVICES PERFORMING ANY MAINTENANCE OR REPAIR PROCEDURE.

2. NO WORK SHOULD BE PERFORMED ON THE UNIT BY PERSONS UNFAMILIAR WITH BASIC SAFETY MEASURES AS DICTATED FOR ALL ELECTRONICS TECHNICIANS IN THEIR LINE OF WORK.

3. WHEN PERFORMING TESTING AS DICTATED WITHIN THIS MANUAL, DO NOT CONNECT THE UNIT TO A POWER SOURCE UNTIL INSTRUCTED TO DO SO. WHEN THE POWER SUPPLY CABLE MUST BE CONNECTED, USE EXTREME CAUTION IN WORKING ON POWER SUPPLY AND OTHER ELECTRONIC COMPONENTS.

WARNING

1. REPAIRS ON EPSON PRODUCT SHOULD BE PERFORMED ONLY BY AN EPSON CERTIFIED REPAIR TECHNICIAN.

2. MAKE CERTAIN THAT THE SOURCE VOLTAGE IS THE SAME AS THE RATED VOLTAGE, LISTED ON THE SERIAL NUMBER/RATING PLATE. IF THE EPSON PRODUCT HAS A PRIMARY AC RATING DIFFERENT FROM AVAILABLE POWER SOURCE, DO NOT CONNECT IT TO THE POWER SOURCE.

3. ALWAYS VERIFY THAT THE EPSON PRODUCT HAS BEEN DISCONNECTED FROM THE POWER SOURCE BEFORE REMOVING OR REPLACING PRINTED CIRCUIT BOARDS AND/OR INDIVIDUAL CHIPS.

4. IN ORDER TO PROTECT SENSITIVE MICROPROCESSORS AND CIRCUITRY, USE STATIC DISCHARGE EQUIPMENT, SUCH AS ANTI-STATIC WRIST STRAPS, WHEN ACCESSING INTERNAL COMPONENTS.

5. REPLACE MALFUNCTIONING COMPONENTS ONLY WITH THOSE COMPONENTS BY THE MANUFACTURE; INTRODUCTION OF SECOND-SOURCE ICs OR OTHER NONAPPROVED COMPONENTS MAY DAMAGE THE PRODUCT AND VOID ANY APPLICABLE EPSON WARRANTY.

REVISION SHEET

Revision	Issue Date	Revision Page
Rev. A	January 27, 1995	1st issue

TABLE OF CONTENTS

PREFACE

This manual describes functions, theory of electrical and mechanical operations, maintenance, and repair of GT-8500 / ES-1000C.
The instructions and procedures included herein are intended for the experience repair technician, and attention should be given to the precautions on the preceding page. The chapters are organized as follows:

CHAPTER 1. GENERAL DESCRIPTION

Provides a general product overview, lists specifications, and illustrates the main components of the printer.

CHAPTER 2. OPERATING PRINCIPLES

Describes the theory of printer operation.

CHAPTER 3. DISASSEMBLY AND ASSEMBLY

Includes a step-by-step guide for product disassembly and assembly.

CHAPTER 4. ADJUSTMENTS

Includes a step-by-step guide for adjustment.

CHAPTER 5. TROUBLESHOOTING

Provides Epson-approved techniques for adjustment.

CHAPTER 6. MAINTENANCE

Describes preventive maintenance techniques and lists lubricants and adhesives required to service the equipment.

APPENDIX

Describes connector pin assignments, circuit diagrams, circuit board component layout and exploded diagram.

The contents of this manual are subject to change without notice.

Chapter 1 Product Description

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1.1 FEATURES

The GT-8500 and ES-1000C are low-cost, high-resolution (400 dpi) color image scanners for A4 or letter-size sheets. Their main features are:

- ❑ High resolution: 400 dpi
- ❑ Full-color scanning: 24-bit color
  Capture at 10 bits/pixel images and convert to 8 bits
- ❑ High speed scanning: Approx. 18 msec/page (monochrome line art on A4 paper)
- ❑ Selectable resolution allows you to optimize scanning for output on various printers
- ❑ Resident bidirectional parallel and SCSI interfaces
- ❑ Equipped with multi I/F function (See Note 1)
- ❑ Available options: Automatic document feeder (ADF) and transparency unit
- ❑ TET (Text Enhanced Technology): Automatic background removal for text scanning by optimized threshold technology
- ❑ Halftone technology: Error diffusion and dither
- ❑ Software command level: ESC/I - B5
- ❑ GT-8000/ES-800C emulation (See Note 2)

Notes:
1. *SCSI and bidirectional parallel interfaces can be connected to two computers simultaneously, with the following exceptions:*
   *If the scanner receives the **ESC G** command from one I/F, it can't communicate with another I/F until it finishes capturing the image.*
   The Reset *button may be unusable when a computer connected using the bidirectional parallel interface is powered off.*
2. *The SCSI ID switch is set to 9, and in this mode, the SCSI ID is 2.*

Table 1-1 lists the optional units available. Figure 1-1 shows the scanner's external appearance.

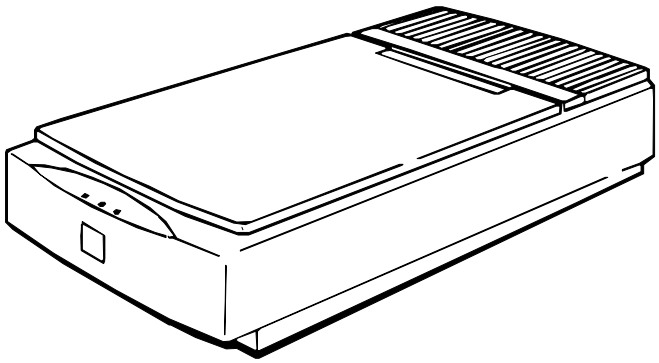

Figure 1-1. External View

Table 1-1. Optional Units

Model	Description
B813001	Automatic document feeder (for GT-8500)
B813011	Automatic document feeder (for ES-1000C)
B81302*	Transparency unit (5 x 5-inch size)
B81306*	Transparency unit (A4/letter size)
B80801*	Bidirectional parallel interface board (PC-compatible)
B860081	SCSI system cable (25-pin to 50-pin)
B860091	SCSI peripheral cable (50-pin to 50-pin)
B80618*	EPSON Scanning Safari for Macintosh (GT-8500)
B80619*	EPSON Scanning Safari for Windows (GT-8500)
B80620*	EPSON Scan! II for Macintosh (English)
B80625*	EPSON Scan! II for Windows (English)

The number represented by an asterisk (*) varies by country.

1.2 SPECIFICATIONS

This section provides specifications for the GT-8500 and ES-1000C.

1.2.1 Basic Specifications

Product type:	Flatbed color image scanner		
Sub-scanning method:	Reading head movement		
Photoelectric device:	CCD (charge coupled device) line sensor		
Size of original:	A4 or letter size — 216 × 297 mm (8.5 × 11.7 inches)		
Maximum effective picture elements:	3400 × 4680 pixels		
Scanning resolution:	Main scan:	400 dpi	
	Sub scan:	400 dpi	
Output resolutions:	50 dpi to 1600 dpi by 1 dpi per step		
Scanning speeds	Monochrome:	Approx. 4 msec/line	
	256 shades of gray:	Approx. 6 msec/line	
	Full color:	Approx. 18 msec/line	
Color separation:	By light source (green, red, blue)		
Reading sequence:	Color: Page sequence	3-time scanning (G, R, B)	
	Color: Line sequence	1-time scanning	
	Color: Byte sequence	1-time scanning	
	Monochrome:	1-time scanning	
	(dropout color selectable: G, R, or B)		
Software level:	ESC/I-B5		
Zooming:	50 % to 200 %, in 1 % steps		
Image data:	1-8 bits per pixel selectable for each color		
Gradiation:	Capture an image at 10 bits/pixel and convert to 8 bits/pixel		
Brightness:	7 levels		
Digital halftoning:	bi-level	Fixed threshold, TET	
		Halftone modes A, B, C	
		Dither (resident) 4 patterns	
		Dither (user-specified) 2 patterns	
	quad-level	Modes A, B, C	
Gamma correction:	CRT 1/linear; CRT2; Printer A, B, C; user defined		
Color correction:	Impact-dot, thermal, ink-jet printer, CRT display, user-defined		
Interfaces:	Bidirectional parallel		
	SCSI (two 50-pin connectors)		
Light source:	Noble gas fluorescent lights		
Safety regulations:	UL/CSA, TÜV		

1.2.2 Electrical Specifications

Rated voltage:	100 to 120 VAC 220 to 240 VAC
Input voltage:	90 to 132 VAC (100 - 120 V) 198 to 264 VAC (220 - 240 V)
Rated frequency range:	50 to 60 Hz
Input frequency range:	49.5 to 60.5 Hz
Power consumption:	25 W (with no optional unit) Max 50 W (with optional unit)
RFI noise:	FCC Class B, FTZ

1.2.3 Resistance to Electric Noise

Static electricity: Panel - 10 KV
Metal - 7 KV

1.2.4 Environmental Conditions

Temperature
Operating: 5 to 35° C (41 to 95° F)
Storage: –20 to 60° C (–13 to 140° F)

Humidity
Operating: 10 to 80 %, no condensation
Storage: 20 to 85 %, no condensation

1.2.5 Reliability

Main unit: MCBF 100,000 cycles

1.2.6 Operating Conditions

Dust: Ordinary office or home conditions.
Avoid placing in an extremely dusty environment.

Illumination: Avoid operation under direct sunlight or near a strong light source.

1.2.7 Documents

Refractive type: Documents with smooth surfaces, such as printing and photographs.

1.2.8 Size of Original for Scanning

Dimensions: 216 mm horizontal × 297 mm vertical
(8.64 inches horizontal × 11.88 inches vertical)

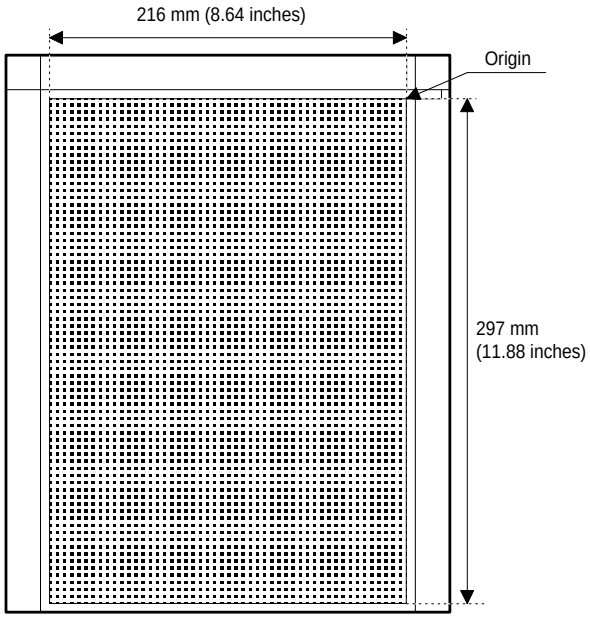

Figure 1-2. Maximum Size of Original for Scanning

1.2.9 Physical Dimensions and Weight

Dimensions (W × D × H): 368 mm × 577 mm × 161 mm (14.5 × 22.7 × 6.3 inches)
Weight: Approx. 8 kg (17.7 lb.)

1.3 INTERFACE SPECIFICATIONS

The GT-8500 and ES-1000C are equipped with the following external interfaces:

- Bidirectional parallel interface
- SCSI (Small Computer System Interface)

1.3.1 Bidirectional Parallel Interface

Interface type: Bidirectional parallel interface
Data format: 8-bit parallel
Synchronization: By STROBE pulse
Handshaking: By BUSY/ACKNLG pulse
Logic level: Input/output data and interface control signals are TTL-level compatible
Connector type: 36-pin 57-30360 (Amphenol) or equivalent

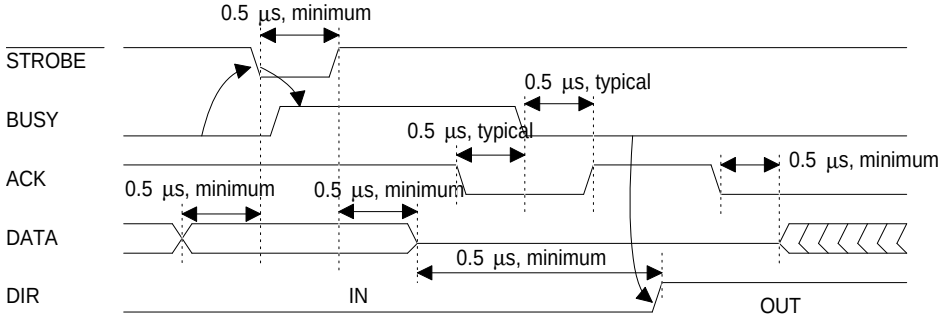

Figure 1-3. Data Transmission Timing (Host to Scanner)

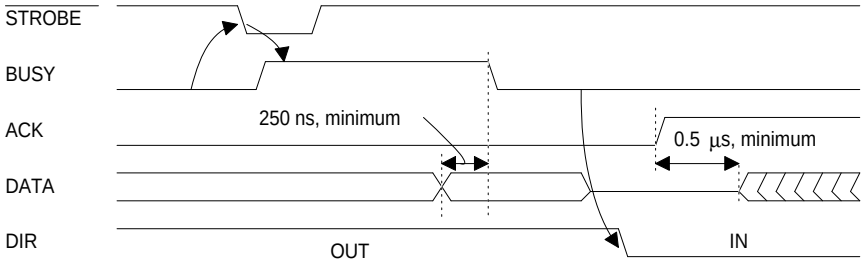

Figure 1-4. Data Transmission Timing (Scanner to Host)

Table 1-2. Pin Assignments for the Bidirectional Parallel Interface

Pin No.	Signal Name	I/O	Description
1	$\overline{\text{STROBE}}$	I	The $\overline{\text{STROBE}}$ pulse used to read in or send out data. Pulse width at the receiving terminal must exceed 0.5 μs.
2-9	DATA0-7	I/O	These signals convey the 1st to 8th bits of data. A HIGH level indicates a logical 1; a LOW level indicates a logical 0.
10	$\overline{\text{ACKNLG}}$	O	A pulse of approx. 12 μs. A LOW level indicates that data has been received and the scanner is ready to accept more data.
11	BUSY	O	When this signal is HIGH, the scanner cannot receive data. The signal becomes HIGH: 1. during data entry. 2. during scanning. 3. when the scanner is not ready. 4. when the scanner has an error.
12-15	NC	—	Not used.
16	GND	—	Logic ground level.
17	C_GND	—	Scanner chassis ground.
18	NC	—	Not used.
19-30	GND	—	Twisted-pair return signal ground level.
31	$\overline{\text{INIT}}$	I	When this signal level becomes LOW, the scanner is reset to its power on state. This level is usually HIGH. The pulse width at the receiving terminal must be greater than 50 μs.
32	NC	—	Not used.
33	GND	—	Twisted-pair return signal ground level.
34-35	NC	—	Not used.
36	DIR	I	A LOW indicates that the direction is input.

1.3.2 SCSI

This section describes the SCSI interface for the GT-8500/ES-1000C.

1.3.2.1 Basic Specifications

Any items not included in this service manual are in conformance with ANSI standard X3.131-1986.

Interface type: ANSI X3.131-1986

Functions: The following functions are included

1. Bus-free phase
2. Arbitration phase
3. Selection/reselection phase
4. Command phase

Note: *The LUN (Logical Unit Number) is fixed to 0 in this device. The Command Link Function is not supported.*

5. Data phase
   - Data in phase
   - Data out phase
6. Status phase
7. Message phase
   - Message in phase
   - Message out phase
8. Attention condition
9. Reset condition

Logic level: TTL-compatible

Electrical standard: ANSI standard X3.131-1986.

Terminator: Internal terminator turned on or off by the switch

ID settings: The SCSI ID is set with a rotary switch on the rear panel. The switch numbers correspond to the available addresses, and can be set from 0 to 7. Number 9 is for GT-8000 (ES-800C) emulation mode (used for self-test), and number 8 is reserved.

Connector type: Two 50-pin connectors

1.3.2.2 SCSI Commands

This device uses the following group “0" processor commands:

Table 1-3. Commands for SCSI Interface

Command	Code	Description
Test Unit Ready	00H	Confirm for operation
Request Sense	03H	Requires sense data (See Note 1)
Receive	08H	Data transmission from target to initiator
Send	0AH	Data transmission from initiator to target
Inquiry	12H	Requires information of SCSI device (See Note 2)

Notes:

1. Only the extension sense data format is supported for sense data returned by the sense request command.
2. Inquiry data is as follows:

   Peripheral device type: 03H (processor)
   RMB: 00H (non-removable media)
   Device type restriction: 00H
   ISO version: 00H
   ECMA version: 00H
   ANSI version: 01H (current version)
   Additional length: 23H
   Vendor-unique parameter bytes: [00H, 00H, 00H, ‘EPSON,’ 20H, ‘SCANNER,’ 20H, ‘GT-xxxx****,’ 00H, 00H, 00H, FFH]
   GT-xxxx : product name
   **** : ROM version

1.3.2.3 SCSI Status

Table 1-4. Status Bits for SCSI Interface

Status	Status Bits							
	7	6	5	4	3	2	1	0
Good	R	R	0	0	0	0	0	R
Check Condition	R	R	0	0	0	0	1	R
Busy	R	R	0	0	1	0	0	R

All other codes are reserved.
‘R’ means reserved bit.

1.3.2.4 SCSI Messages

Table 1-5. Messages for SCSI Interface

Message	Code	Direction	Completion of ATN
Command Complete	00H	In	—
Disconnect	04H	In	—
Bus Device Reset	06H	Out	Yes
Message Reject	07H	In/Out	Yes
Identify	80H-FFH	In/Out	No

1.3.2.5 SCSI Pin Assignments

Table 1-6. Pin Assignments for the SCSI

Pin No.	Signal Name	I/O	Description
1-12, 14-25, 35-37, 39, 40, 42	GND	—	Signal ground
13	NC	—	Not used
26-33	DB0-7	I/O	Data bus 0-7
34	DBP	I/O	Data bus parity
38	TERMPWR	—	Termination power (+5 V)
41	ATN	I	Attention
43	BSY	I/O	Busy
44	ACK	I	Acknowledge
45	RST	I	Reset
46	MSG	O	Message
47	SEL	I/O	Select
48	C/D	O	Control/Data
49	REQ	O	Request
50	I/O	O	Input/Output

1.4 BUTTONS AND INDICATORS

This scanner has two push buttons and three LED indicators for easy operation.

Buttons

OPERATE	Turns the scanner on and off. When power is turned on, the scanner is reset.
RESET	Initializes the scanner. Every value is reset to the default value.

Indicators

OPERATE (green LED)	Comes on when power is turned on.
READY (green LED)	Comes on when the scanner is ready to receive data.
ERROR (red LED)	Indicates that an error has occurred.

1.5 SELF-TEST

This scanner has a built-in self-test mode to check the functions of the following parts:

- Noble-gas fluorescent lamp
- Sensor mechanism

Procedure for color page sequence mode

1. Set the SCSI ID switch on the back of the scanner to 8.
2. Turn the scanner on while pressing the RESET button, and hold down the RESET button until the ERROR and OPERATE LEDs light. (It takes approximately 10 seconds.)
3. The scanner starts the color page sequence scanning operation when the RESET button is released.
4. After confirming the operation of the scanner, you can terminate the self-test either by pressing the RESET button or turning off the scanner.

Procedure for monochrome mode

1. Set the SCSI ID switch on the back of the scanner to 8.
2. Turn the scanner on while pressing the RESET button, and hold down the RESET button until all LEDs are lit. (It takes approximately 15 seconds.)
3. The scanner starts the monochrome page sequence scanning operation when the RESET switch is released.
4. After confirming the operation of the scanner, you can terminate the self-test either by pressing the RESET button or turning off the scanner.

1.6 ERRORS

When an error occurs, the scanner displays the corresponding error message using the LEDs.

Command Errors

Cause:	An unidentified command is detected.
Disposition:	The scanner ignores the command or parameter. (The current settings or the default values remain in effect.) The scanner sends a NACK and waits for the next command or parameter.
Indications:	READY LED comes ON ERROR LED comes ON
Remedy:	The error condition is cleared when the scanner receives a correct command.

Interface Errors

Cause:	A wrong procedure is detected during interface communications. With a SCSI interface, a transition is frozen more than 30 seconds, except in the BUS FREE phase.
Disposition:	The lamp goes OFF and the scanner stops operating.
Indications:	READY LED goes OFF. ERROR LED blinks.
Remedy:	Turn the scanner off and then back on. Press the RESET button. The INIT signal in the parallel interface turns active. The RESET signal in the SCSI interface turns active. Complete BUS DEVICE RESET message in SCSI.
Acceptable commands:	None

Fatal Errors

Cause:	The lamp is broken. Power was turned on and the transportation screw has not been removed. System breakdown. An error related to an option is detected, such as cover open, paper jamming, etc.
Disposition:	The lamp goes off and the scanner stops operating. Bit 7 of the status byte is set.
Indications:	READY LED blinks. ERROR LED blinks.
Remedy:	Turn the scanner off and then back on. Press the RESET button. Send **ESC @** codes to the scanner. The INIT signal in the parallel interface turns active. The RESET signal in the SCSI interface turns active. Complete BUS DEVICE RESET message in SCSI.
Acceptable commands:	**ESC F**, **ESC f**, **ESC @**

Option Error (Available only when an option is installed and enabled with ESC e)

Cause:	An error related to the option is detected, such as cover-open, paper empty, etc.
Disposition:	Bit 7 of the status byte is set. The responding bit is set in the extended status data.
Indications:	READY LED goes OFF. ERROR LED goes OFF.
Remedy:	This error is cleared when the cause of the error is removed.

1.7 DATA TRANSMISSION PROTOCOL

This section describes the data transmission protocol used by the scanner and host computer.

1.7.1 Handshaking Control Codes

This section describes the control codes for the handshaking procedure.

Control Codes without Parameters

Step 1 The host computer sends a control code.

Step 2 The scanner responds:
ACK (06H): Legal control code received.
(The scanner accepts the control code.)
NACK (15H): Illegal control code received.
(The scanner does not accept the control code.)

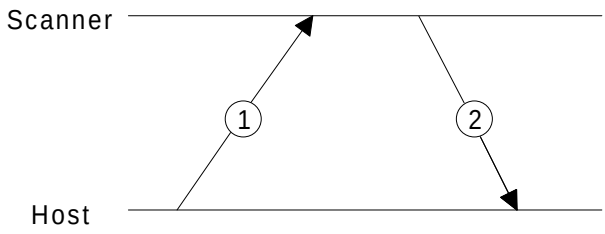

Figure 1-5. Control Code without Parameters

Control Codes with Parameters

Step 1 The host computer sends a control code.

Step 2 The scanner responds:
ACK (06H): Legal control code received.
(The scanner accepts the control code.)
NACK (15H): Illegal control code received.
(The scanner does not accept the control code.)

Step 3 If the host receives an ACK, it sends the parameters.

Step 4 The scanner responds:
ACK (06H): Legal parameters received.
(The scanner accepts the parameters.)
NACK (15H): Illegal parameters received.
(The scanner does not accept the parameters.)

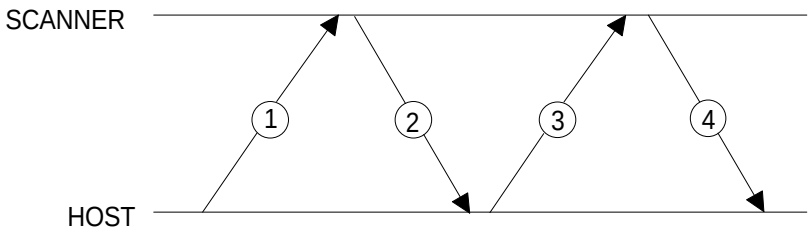

Figure 1-6. Control Code with Parameters

1.7.2 Data Block Handshaking Procedure

Monochrome or Color Line Sequence Reading in Block Data Transfer Mode

The following handshaking procedure is required to send the control code that requests the scanner send back data.

Step 1 The host computer sends a control code.

Step 2 The scanner sends a data block.

Step 3 The host computer responds:
ACK (06H): Continue, send more data.
CAN (18H): Abort.

Step 4 The scanner sends a final data block.

Note: *The host computer should not send back an ACK (06H) after receiving the final data block. The order of the image data is R, G, B in line-by-line mode.*

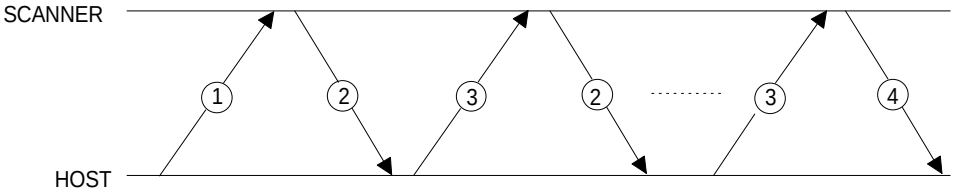

Figure 1-7. Scanner Data Request and Monochrome Reading

Page Sequence Mode Color Reading

Step 1 The host computer sends a control code.

Step 2 The scanner sends a data block.

Step 3 The host computer responds:
ACK (06H): Continue, send more data.
CAN (18H): Abort.

Step 4 The scanner sends a final data block.

Note: *The host should not send back an ACK (06H) after receiving the final data block.*

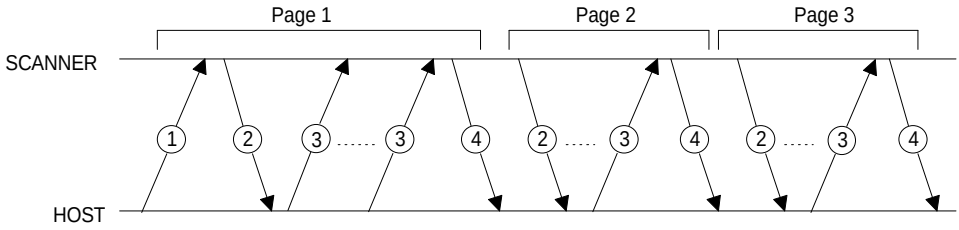

Figure 1-8. Color Reading (Page Sequence Mode)

Color Line Sequence Mode Reading

Step 1 The host computer sends a control code.

Step 2 The scanner sends a data block (green).

Step 3 The scanner sends another data block (red).

Step 4 The scanner sends a third data block (blue).

Step 5 The host computer responds:
ACK (06H): Continue, send more data.
CAN (18H): Abort.

Step 6 The scanner sends a final data block.

Note: *The host computer should not send back an ACK (06H) after receiving the final data block.*

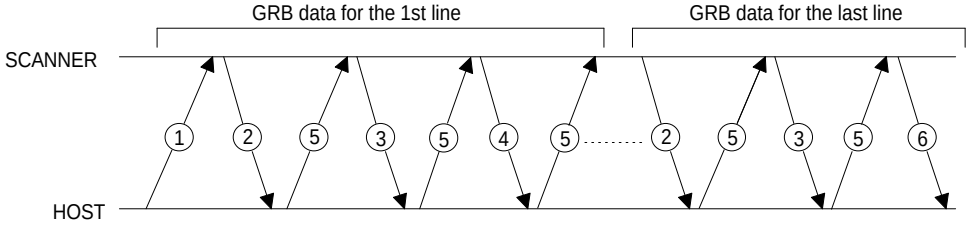

Figure 1-9. Color Reading (Line Sequence Mode)

Color Byte Sequence Mode Reading

Step 1 The host computer sends a control code.

Step 2 The scanner sends a 1 line data.

Step 3 The host computer responds:
ACK (06H): Continue, send more data.
CAN (18H): Abort.

Step 3 The scanner sends a final line data.

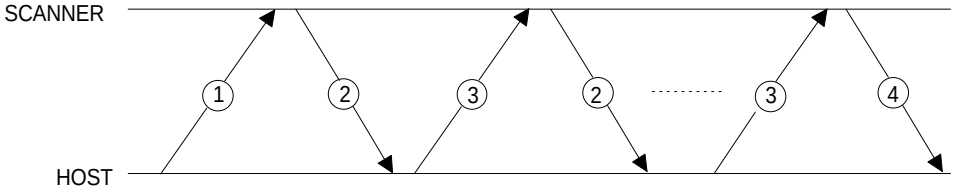

Figure 1-10. Color Reading (Color Byte Sequence Mode)

1.7.3 Data Block Formats

This section describes two data block formats.

Line data format — Consists of a 4-byte information block, or a 1-line image data block.

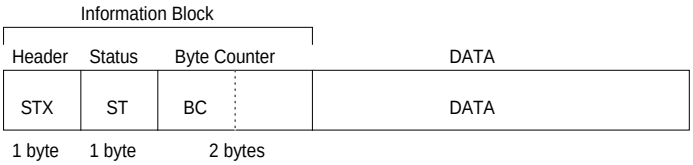

Figure 1-11. Line Data Format

Block data format — Consists of a 6-byte information block and *n* lines of image data. The parameter *n* indicates the value of the line counter in the information block.

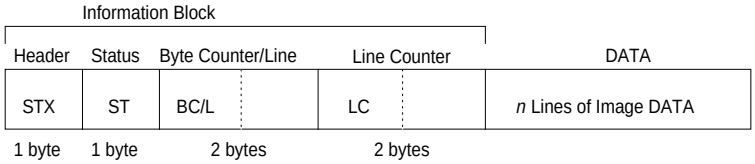

Figure 1-12. Block Data Format

Note : *If only the information block is to be sent to the host computer, the byte counter is set to 0000H.*

1.7.3.1 Line Data Format

Information Block

Header — STX code (02H)
The header indicates the beginning of a data block.

Status — Refer to Section 1.6.4.

Byte counter — The byte counter indicates the number of data bytes that follow the information block. The byte counter consists of 2 bytes, and the lower byte precedes the higher byte.

Data

Data is image data or information data, which corresponds to a command, such as **ESC I**, **ESC S**, and so on. It has the length indicated by the byte counter.

1.7.3.2 Block Data Format

Information Block

Header	STX code (02H) The header indicates the beginning of a data block.
Status	Refer to Section 1.6.4.
Byte counter/line	The byte counter/line indicates the number of bytes of image data per line in the main scanning direction.
Line counter	The line counter indicates the number of lines of image data per color.

Notes:

1. *Block data format is available when activating the 'set line counter' command.*
2. *For the color line sequence mode, image data is arranged in the order green, red, and blue. So, if 'n' lines of color data are included in a data block, the line counter indicates 3 x n.*
3. *The byte counter/line and the line counter consist of 2 bytes, and the lower byte precedes the higher byte.*
4. *The byte counter/line and the line counter should be checked before receiving data.*

Data

Data is an image data block.

1.7.4 Format of Status Byte

The status byte should have the format shown below.

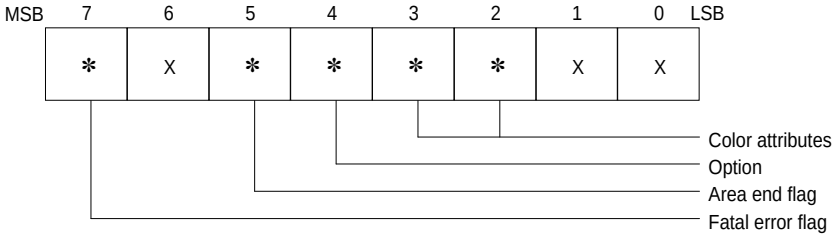

Figure 1-13. Status Byte

1. Status indicates the scanner's current condition and error status.
2. Status accompanies the information block of the data block.
3. Status is returned to the host computer when requested with the status request command **ESC F**.

The Meaning of Each Status Bit

Bit 7: Fatal error flag. Set when a system error occurs.

Bit 6: Reserved.

Bit 5: Area end flag.
For color reading, set to 1 for the last data block of a color page.
For monochrome reading, set to 1 for the last data block of the page.

Bit 4: Option flag. When optional equipment is installed, set this to 1.

Bit 3: Color attribute 1. See Table 1-7.

Bit 2: Color attribute 2. See Table 1-7.

Bit 1: Reserved (always 0).

Bit 0: Reserved (always 0).

Table 1-7. Color Attributes

Bit		3	2
Monochrome Mode (ESC C 0)		0	0
Color Mode (ESC C 1)	Green	0	1
	Red	1	0
	Blue	1	1

1.8 SCANNER FUNCTIONS

Table 1-8 summarizes the scanner's functions and settings. These functions, which are explained on the following pages, are all controlled by software commands.

Table 1-8. Scanner Functions

Function	Command	Available Settings
Data format	ESC D	1 to 8 bits per pixel for each color.
Output resolution	ESC R	29 settings, from 50 to 1200 dpi (main scan and sub scan resolutions can be set independently).
Zoom	ESC H	50% to 200%, by 1% step (main scan and sub scan zoom percentage can be set independently).
Reading area	ESC A	Offset and reading length.
Color mode	ESC C	Color line sequence, color page sequence, monochrome mode, selectable dropout color.
Digital halftoning	ESC B	1 disable for the digital halftoning mode, 3 halftoning modes, 4 dither patterns, 2 user download dither patterns.
Color correction	ESC M	4 settings for the output device (available only for color line sequence mode).
Brightness	ESC L	7 levels.
Sharpness	ESC Q	5 levels.
Gamma correction	ESC Z	6 settings for the output device.
Scanning mode	ESC g	Normal, high speed.

1.8.1 Data Format

The data format specifies the number of bits (from 1 to 8) used to represent the tone of each pixel. Larger values enable a greater variety of tones or colors.

In monochrome mode, a format setting of 1 bit/pixel (bi-level data) provides only two tones: black (0) and white (1). A setting of 2 bits/pixel (quad-level data) shows four tone levels (corresponding to binary values 00, 01, 10, and 11). Eight bits/pixel provides for 256 shades of gray, generating a result that has photographic quality.

When used with color mode, the data format defines the number of tones for each primary color (green, red, and blue). A setting of 1 bit/pixel allows for eight colors (2 x 2 x 2); 2 bits/pixel can represent 64 colors (4 x 4 x 4). Eight bits/pixel (providing a total of 24 bits for each pixel) can represent more than 16 million different colors.

Table 1-9. Data Format

Data Format	Monochrome	Color
1 bit/pixel	2 grays	8 colors
2 bits/pixel	4 grays	64 colors
3 bits/pixel	8 grays	512 colors
4 bits/pixel	16 grays	4,096 colors
5 bits/pixel	32 grays	32,768 colors
6 bits/pixel	64 grays	262,144 colors
7 bits/pixel	128 grays	2,097152 colors
8 bits/pixel	256 grays	16,772,216 colors

If you want to reproduce images using more than 2 bits/pixel, use an output device capable of supporting the resulting tonalities. Most microcomputer displays and printers cannot support such tonalities. To achieve optimal results with these devices, normally use a 1 bit/pixel format together with halftoning mode. The **ESC D** command sets the data format.

1.8.2 Output Resolution

The output resolution determines how many pixels, or dots, are used for reproducting an image. Resolution is measured in units of dpi (dots per inch). The output resolution can be set independently for the main scan and sub scan.

Normally, you should choose the setting that matches the resolution of the output device you use. To find a matching resolution, follow the guidelines below.

CRT displays: 72 to 80 dpi
9-pin dot matrix printers: 72, 90, 144 dpi
24-pin dot matrix printers: 90, 120, 160, 180, 320, 360 dpi
Page printers: 75, 150, 240, 300, 400, 600, 800, 900, 1200, 1600 dpi
Facsimile transmissions: 100, 200, 300, 400 dpi

1.8.3 Zoom

You can use the zoom function to reduce or enlarge the size of the output image. The reduction/enlargement ratio can be set to any value between 50 % and 200 %, in 1 % increments. Values for main scan and sub scan can be set independently.

The zoom values determine the vertical and horizontal lengths of the image. If the zoom is set to 100 % the image is scanned at actual size. If the zoom is set to 200 % for both main scan and sub scan, the image is magnified to four times the original size. If the zoom is set to 50 % for both main scan and sub scan, the image is reduced to one-fourth its original size.

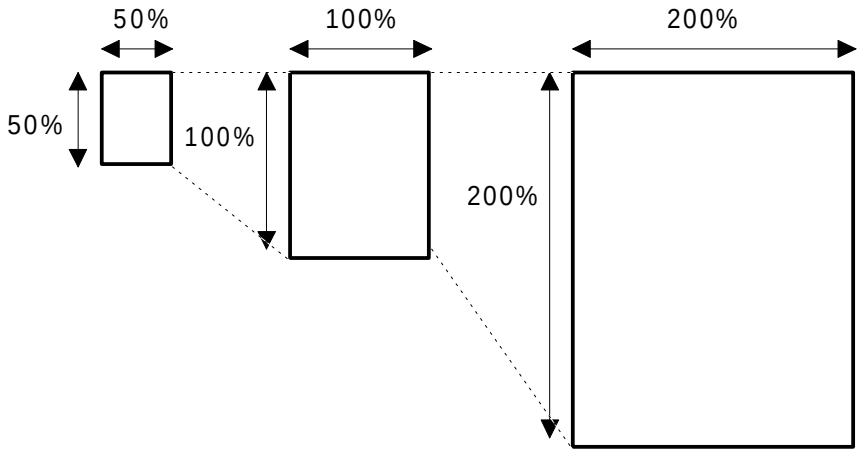

Figure 1-14. Zoom

The zoom function affects the number of scanning dots. An image scanned at 180 dpi at 200 % will have the same number of dots as the same image scanned at 360 dpi at 100 %. If the image scanned at 180 dpi at 200 % is the printed on a 180 dpi printer, the image will be enlarged 200 %.

Use the zoom function to perform the major part of the reduction/enlargement for use with application software. Use the application software only for fine adjustments. In particular, quality may deteriorate if you use an application to change an image size scanned in halftoning mode; this practice should therefore be avoided.

The zoom function is set by the **ESC H** command. The default setting is 100 % (for both the main scan and sub scan).

1.8.4 Reading Area

This function allows you to limit the scan to a specified portion of the document. Set the reading area by specifying the reading lengths, in units of dots, for both the main scan and the sub scan.

The maximum selectable reading area is determined by the resolution and zoom settings. To specify a smaller reading area, indicate the rectangular area and offset from the origin. The smaller area must lie within the maximum selectable area. The following figure shows the image as viewed from the scanner.

1.8.5 Color Mode

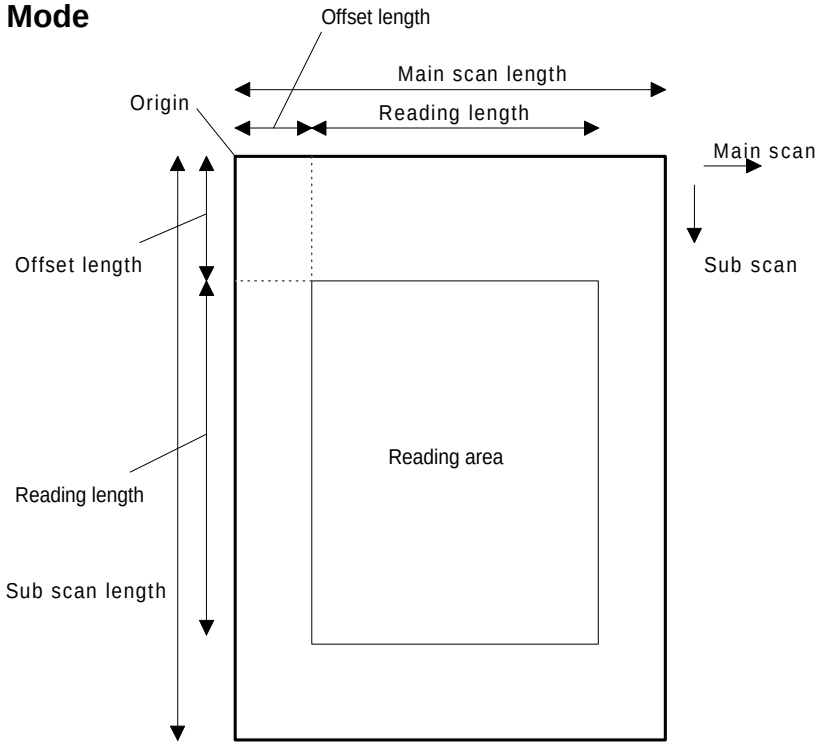

Figure 1-15. Reading Area

The color mode specifies color scanning or monochrome (black and white) scanning. In color scanning, you can choose either page sequence mode or line sequence mode. In monochrome scanning, you can also specify a dropout color.

Color page sequence mode
The scanner scans the document three times to scan green, red, and blue separately. Page sequence mode is faster than line sequence mode.

Color line sequence mode
The scanner scans the document once, scanning green, red, and blue simultaneously. This scanning method allows you to use the color correction function.

Monochrome mode
The scans the document once, and scans the image in monochrome. In standard monochrome scanning, all green, red, and blue lights are use to produce white light, and the undesirable dropout color is minimized.

Dropout color (monochrome scanning only)
The dropout color is the color that is not recognized by the scanner and can be used to erase an unwanted color. You can choose green, red, or blue.

1.8.6 Digital Halftoning

Generally speaking, 1 bit/pixel and 2 bits/pixel formats cannot express continuous image tones. The halftoning mode processes the scanned image data so that the data output in these formats simulates continuous tones when displayed or printed.

The halftoning mode is suitable for use with continuous tone images (such as photographs), and in conjunction with output devices that cannot handle multi-bus data for each pixel. Halftoning mode is not suitable for images requiring sharp definitions (line art, characters).

You can select whether or not to use halftoning. When halftoning is disabled, the data format determines which tones can be reprinted. Halftoning mode is not useful and cannot be selected for data formats of 3 or more bits per pixel.

If you decide to use halftoning, you may choose one from among three halftoning modes and four resident dither patterns. When you choose a halftoning mode, the scanner provides a scanned image with continuous tones, comparing the adjustment pixels. When you choose a dither mode, the scanner uses a regular pattern for the same purpose. Each mode is outlined below.

Halftoning Mode A

This is the standard halftoning procedure. The scanner converts the image into a hard-toned output which maintains image definition. This mode is suitable for most purposes.

Halftoning Mode B

The scanner converts the image to a soft-toned output. This mode is suited for images in which similar tones cover fairly large areas.

Halftoning Mode C

Image representation is similar to newspaper image printing (net screening). Tone gradations are represented by clusters of different numbers of dots.

Dither Mode A

The scanner processes the 1 bit/pixel image by using a 4×4 bayer pattern.

Dither Mode B

The scanner processes the 1 bit/pixel image by using 4×4 spiral pattern.

Dither Mode C

The scanner processes the 1 bit/pixel image by using 4×4 net screen pattern.

Dither Mode D

The scanner processes the 1 bit/pixel image by using 8×8 net screen pattern.

User Definition of Dither Modes A/B

In addition to the modes mentioned above, you can select two types of user-defined dither patterns to be downloaded.

Note: *When using halftoning mode, the image should be read at actual size, and then enlarged or reduced to the desired size by using the zoom function.*

This scanner also has the new function TET (Text Enhanced Technology), which allows the scanner auto-adjust the threshold level to enhance monochrome reading.

1.8.7 Color Correction

The color correction function can operate only when the scanner is in color line sequence mode, under which pixel color is determined immediately upon scanning. Four color-correction settings are provided. To disable color correction, select either color page sequence reading or monochrome reading.

This color-correction function processes image data to achieve optimal conformance with the characteristics of the color output device being used. CRTs, for example, create colors by combining the additive primary colors (green, red, and blue). In contrast, printers use subtractive primary colors (magenta, cyan, and yellow). Printers may also add an additional block to increase the definition. For printers, colors may also vary according to the printing method or ink type.

CRT Displays

This setting provides color compensation to match the characteristics of color CRT displays.

Impact Dot Matrix Printers

This setting provides color compensation to match the characteristics of impact dot-matrix color printers.

Thermal Transfer Printers

This setting provides color compensation to match the characteristics of thermal-transfer color printers.

Ink-Jet Printers

This setting provides color compensation to match the characteristics of ink-jet color printers.

1.8.8 Brightness

The scanner enables you to choose one of seven different brightness levels for scanning. The central setting is the normal one.

Darker settings are appropriate for line art and for faint original images; lighter settings should be used when the original image is dark. Brightness can be set independently of other functions.

The following graph shows the differences between brightness settings when the gamma correction is set to CRT display A.

1.8.9 Sharpness

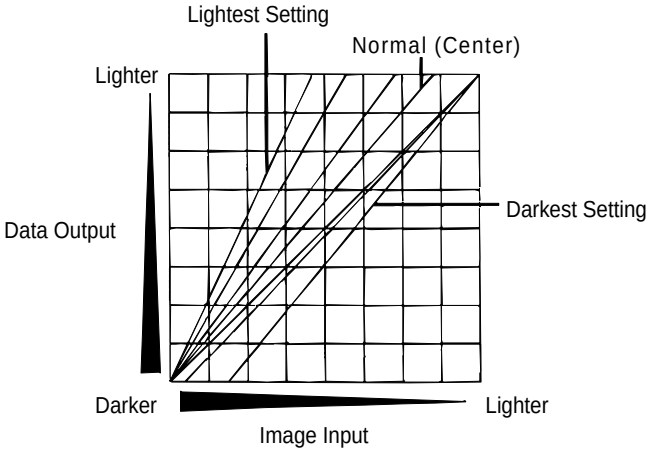

Figure 1-16. Brightness

This function allows you to adjust the sharpness of the image. You can choose normal level, two sharpness levels (strong and weak), and two defocusing levels (strong and weak).

1.8.10 Gamma Correction

This function adjusts the image input/output light-intensity ratio, so that tones can be preserved when the image is output to different types of devices. This ratio is called "gamma" (γ). See Figure 1-17 for a graphical representation of the five gamma correction settings.

Gamma correction is set independently of other scanner functions. This section provides an overview of the five gamma correction settings.

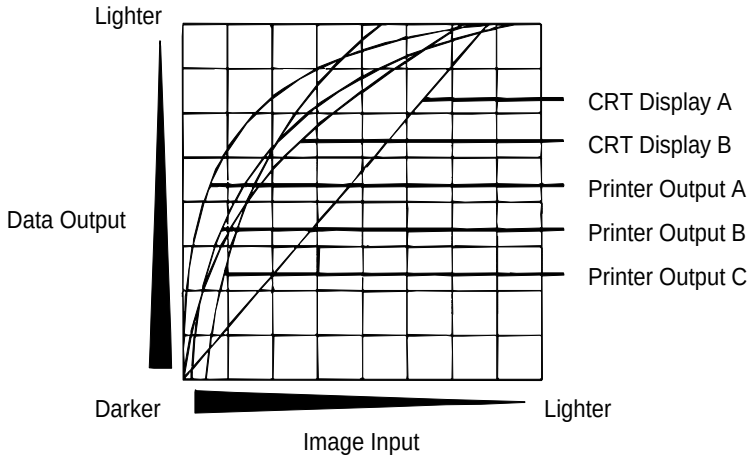

Figure 1-17. Gamma Correction

CRT Display A

The output data is directly proportional to the original image. This setting is generally suited to computer displays that show images in 1 bit/pixel/color format. The mode is also suited for images (such as line art) that lack continuous tones. For this mode, γ=1.

CRT Display B

This setting is suitable for analog-input CRTs. These CRTs display images using multiple tone levels (exceeding 1 bit/pixel/color). For this mode, γ=2.2.

Printer Output A

This setting is suitable for high-density (e.g., 24-dot) printers. The image is lightened to compensate for the higher (darker) density generated by these printers. If this mode is used to output the image to a CRT, the image will appear faint.

Printer Output B

This setting is suitable for low density, such as 8-dot (9-pin), printers and for page printers. The image is slightly darkened to compensate for the lower (lighter) density of these printers. If this mode is used to output the image to a CRT, the image will appear faint.

Printer Output C

This setting provides greater contrast and definition than printer outputs A and B. This setting is suitable for printing of high-contrast images containing both pictures and text. The dark sections of the original are further darkened, and the light sections on the original are further lightened.

1.8.11 Scanning Mode

This feature provides you with normal-speed reading and high-speed reading. High-speed reading is useful when reading text or line art that do not require continuous tones. Use the normal-speed reading is for images that require quality of 8 bits/pixel/color.

1.9 MAIN COMPONENTS

To simplify maintenance and repair, the main components of the GT-8500/ES-1000C have been designed for easy removal and replacement. The main components are:

- ❏ B028 MAIN board: Main control circuit
- ❏ B027 PSB/B027 PSE board: Power supply circuit
- ❏ B028 I/F board: Interface board
- ❏ Carriage assembly (scanner head)
- ❏ Lower case with scanner mechanism
- ❏ Upper case
- ❏ Document cover

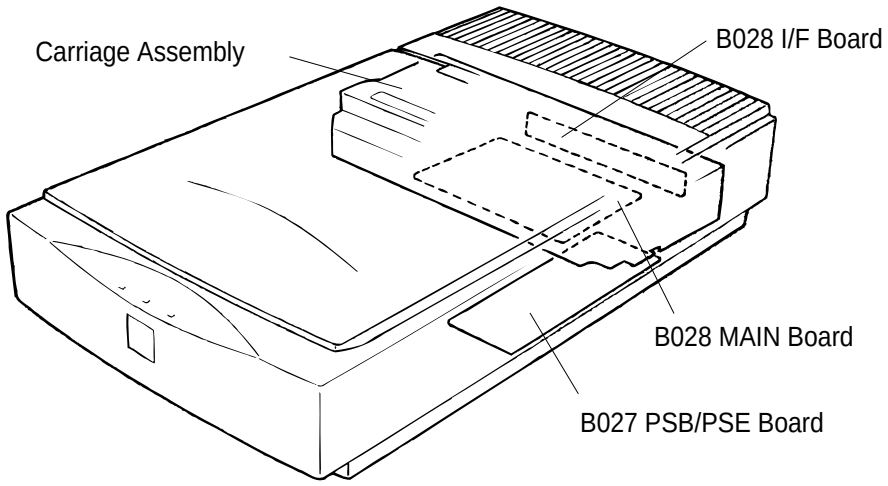

Figure 1-18. Component Layout

1.9.1 B028 MAIN Contol Board

The B028 MAIN board is the main circuit board in the scanner, containing a logic circuit and scanner engine driver circuit. The HD6413003 CPU (location IC15) is used, and the following memory ICs and gate array are assigned to the memory space:

- Memory ICs
  - 1M-bit program ROM : IC2
  - 1M-bit PSRAM : IC1/ 8/ 9
- Gate Arrays
  - E02A14 : IC7
  - E02A15 : IC6
- Drivers
  - CR motor (stepping motor) driver (TA789P) : IC10/11

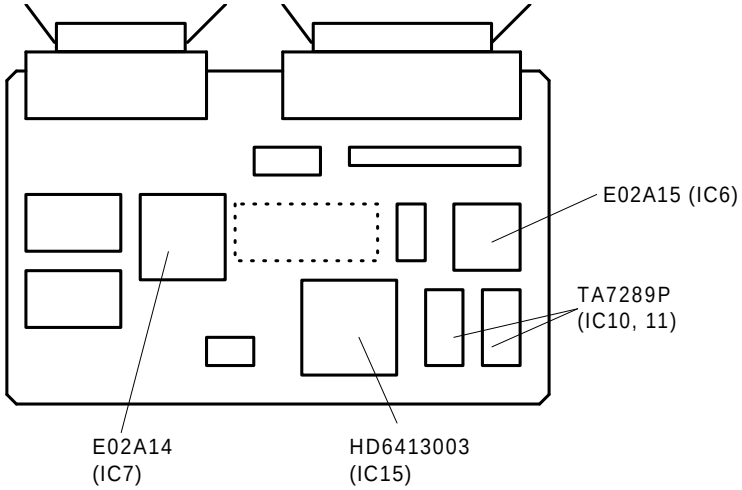

Figure 1-19. B028 MAIN Board

1.9.2 B027 PSB/PSE Power Supply Board

The power supply unit consists of a switching regulator circuit, which converts the AC line voltage to the DC voltages (for example, +24 VDC, +5 VDC, +12 VDC, and –12 VDC) used by the scanner. The B027 PSB board uses a 120 V input type, and the B027 PSE board uses a 220/240 V input type.
The B027 PSE board is same as the GT-9000/ES-1200C. The B027 PSB for GT-8500/ES-1000C is not same as GT-9000/ES-1200C. Diffrent point is as follows:

B027 PSB for GT-9000/ES-12000C : R5 value 10K/2W
B027 PSB for GT-8500/ES-1000C : R5 value 43K/2W

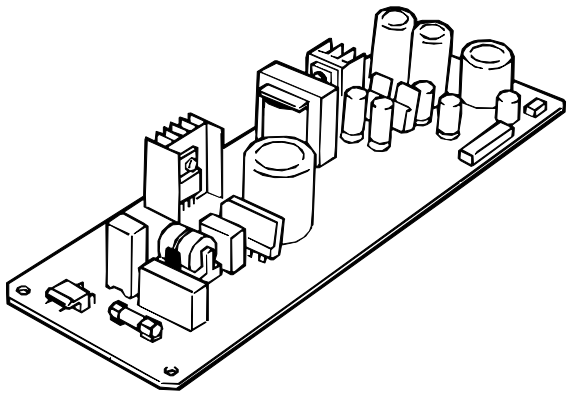

Figure 1-20. B027 PSB/PSE Board

1.9.3 B028 I/F Board

The B028 I/F board contains interface circuit, connectors for SCSI and optional unit and terminator switch and SCSI ID switch.

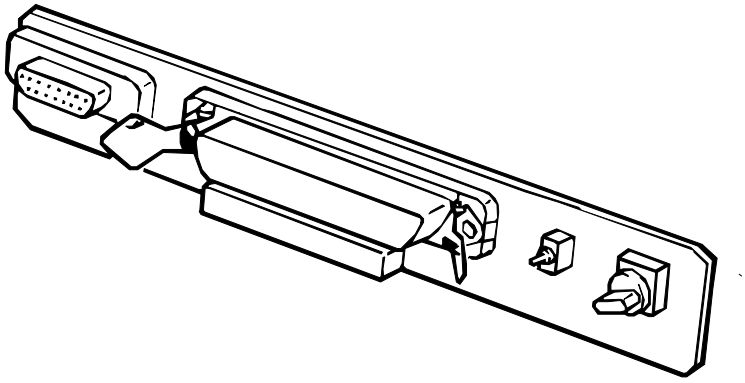

Figure 1-21. B028 I/F Board

1.9.4 Carriage Assembly (Scanner Head)

The carriage assembly (scanner head) is a 400 dpi CCD (charge coupled device) line sensor. This unit has OP amplifier. It send analog data to the main controller board. The carriage assembly also contains the RGB noble-gas fluorescent lamps.

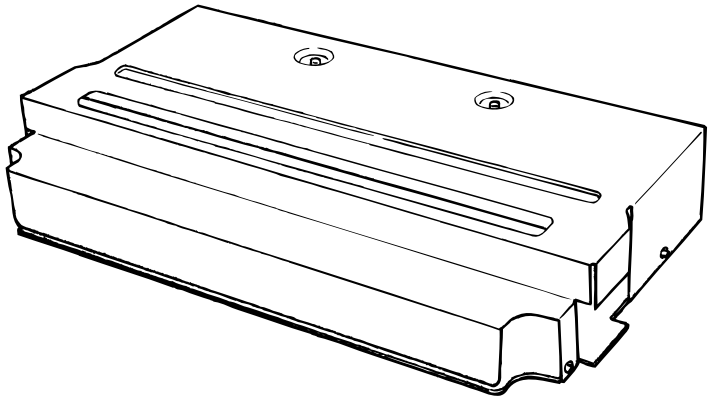

Figure 1-22. Carriage Assembly

1.9.5 Lower Case with Scanner Mechanism

The lower case includes the scanner mechanism components. Among these components are the carriage motor, the carriage mechanism, the home position sensor, and the scanner head.

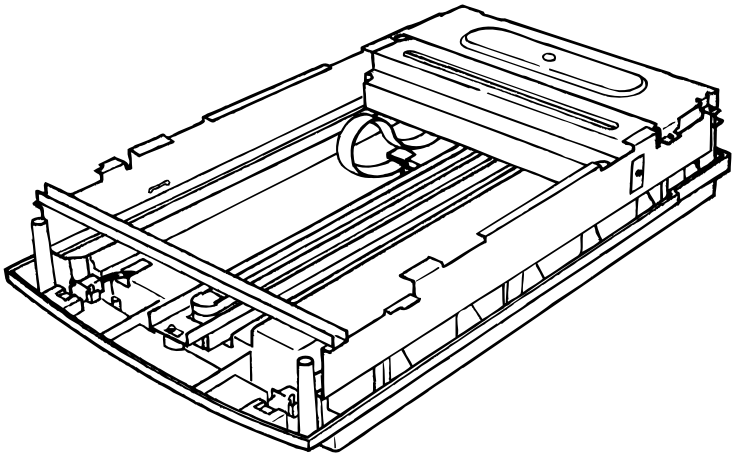

Figure 1-23. Lower Case with Scanner Mechanism

1.9.4 Upper Case

The upper case includes the document glass.

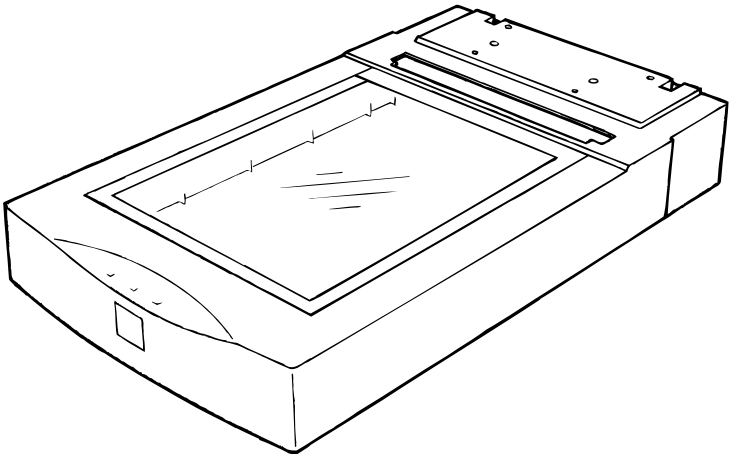

Figure 1-24. Upper Case

Chapter 2 Operating Principles

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2.1 ENGINE OPERATIONS

This section describes the functions and operating principles of the GT-8500/ES-1000C engine. The engine contains a CCD image sensor with a reading resolution of 400 dpi. The engine consists of two main sections: the sensor head and the carriage-movement mechanism.

2.1.1 Scanner Head Operations

The scanner head (carriage assembly) is comprised of the CCD image sensor and the light source used to enable reading. Figure 2-1 shows a cross-section of the scanner head.

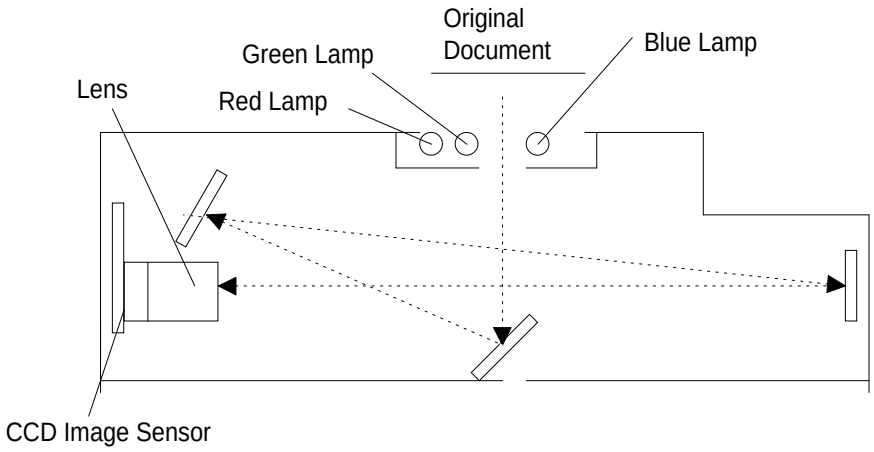


Figure 2-1. Cross-section of the Scanner Head

The light source is made up of three noble-gas fluorescent lamps — green, red, and blue. To read a color original, the three primary colors (red, green, blue) must be read individually. If the image is to be reproduced on a CRT, the individual readings are reconstituted on the display.

To read individual colors, the scanner illuminates the original document separately with each color of light. The green lamp is the light source for reading the green component; the red lamp is for reading the red component; the blue lamp is for reading the blue component. The operation of the CCD image sensor is divided into the three blocks shown and described below.

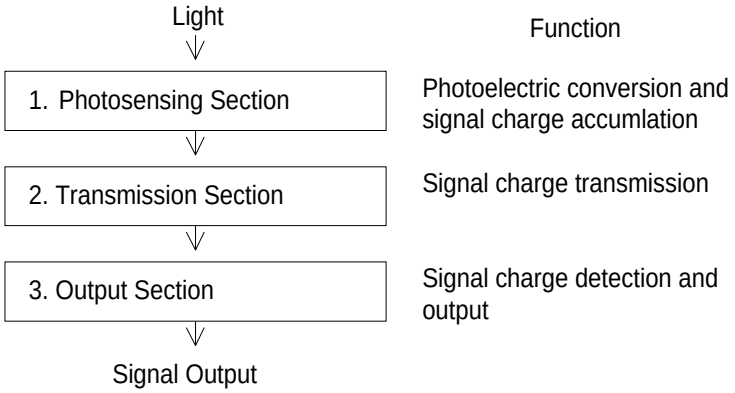
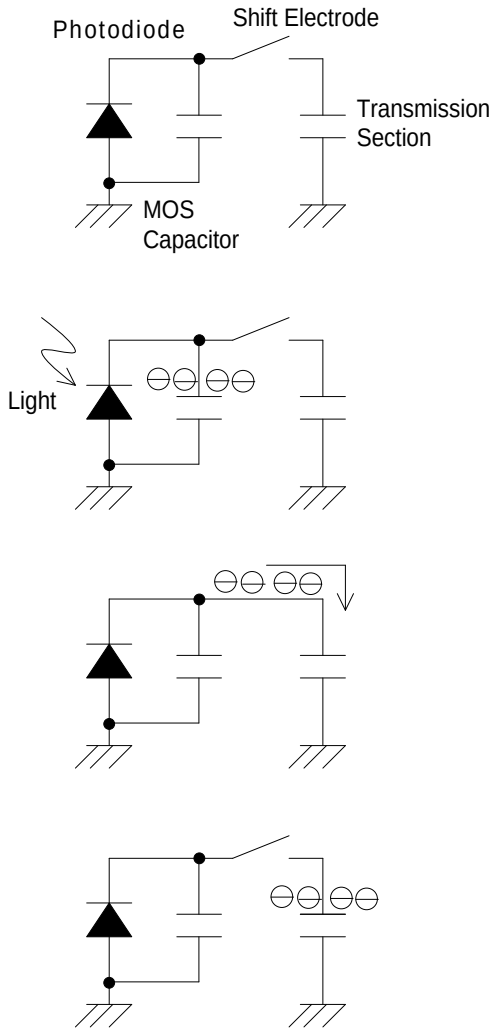


Figure 2-2. Functions of Image Sensor Mechanism

Figure 2-2 shows the relationship of these three blocks. Light reflected from the original document strikes the photosensitive section (①), where photoelectric conversion takes place; a signal charge accumulates that is proportional to the received light energy. The transmission section (②) transmits the accumulated signal to the output section (③). The output section outputs the received signal charge in the form of an electrical signal.

Photosensitive Section

The photosensitive section converts the light energy into electrical signals and accumulates the resulting signal charge over a short term. The description below explains the process of photoelectrical conversion to change the incoming light energy into an accumulated signal charge.



The equivalent circuit at left shows the operating principles of the photosensitive section. The circuit consists of a photodiode, a MOS capacitor, and a shift electrode. (The transmission section, which follows the photosensitive section, also is illustrated simply in terms of capacitance.)

Light reflected from the original document impacts the photodiode, which converts the energy into a corresponding amount of electric current. The resulting electric current causes the MOS capacitor to accumulate electrons in numbers proportional to the strength of the originally received light.

When the shift electrode goes on, the electrons accumulated in the MOS capacitor are released.

The shift electrode then goes off, which completes the transfer of the signal-charge to the transmission section.

Figure 2-3. Operation of the Photosensitive Section

The above photosensor sections are arranged in parallel rows, where the number of units in each horizontal row is equivalent to the maximum number of pixels per line plus α (dummy).

Figure 2-4 illustrates this arrangement.

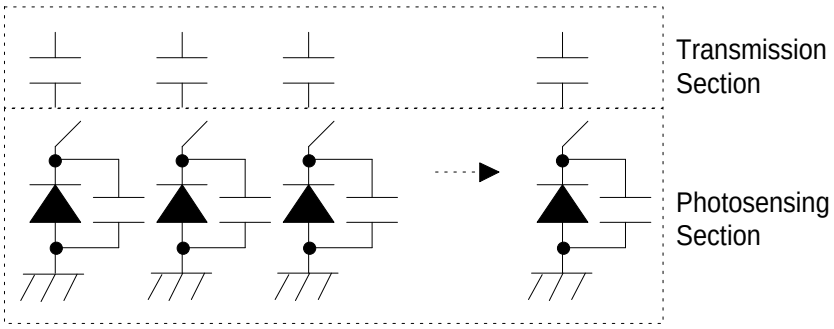
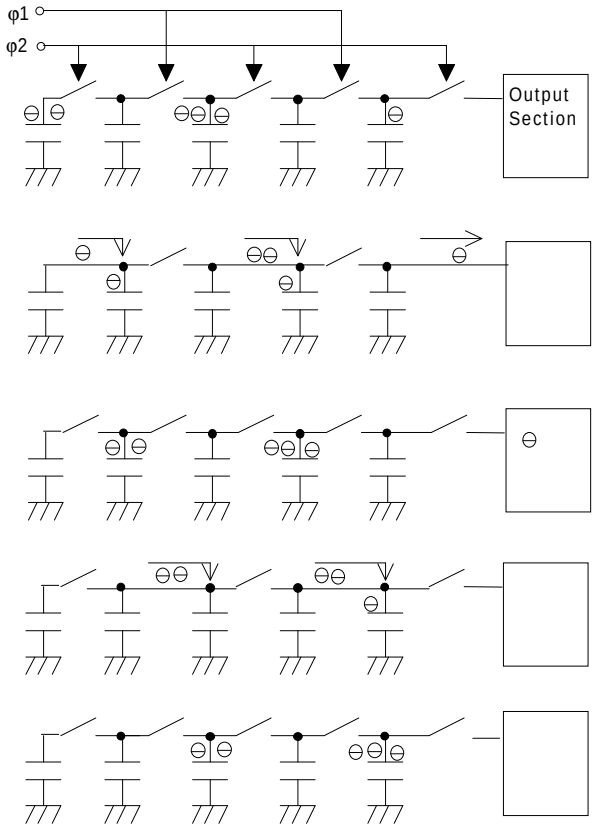


Figure 2-4. Arrangement of Photosensors

Transmission Section

This section receives the signal charge from the photosensitive section and transfers it to the output section. The transmission section contains two capacitors for each photodiode in the photosensitive section.

There is only one output section, which means that the signal charge for each pixel must be sent separately to the output section. This operation is illustrated in the diagram and explained below.



The diagram at left is a simple illustration of the transmission section. f1 and f2 are transmission pulses. The photoelectrically converted signal charges are stored in the capacitors.

When transmission pulse f2 goes ON, signal charges move to the capacitor at their right. The charge that exists in the right-most capacitor is transmitted to the output section and then to the main board.

When transmission pulse f2 goes OFF, the condition of the section becomes stable.

When transmission pulse f1 goes ON, charges again move to the capacitor at their right.

When transmission pulse f1 goes OFF, the condition of the section again becomes stable. By continual repetition of these operations, signal charges for all pixels are transmitted to the output section.

Figure 2-5. Operations of the Transmission Section

Output Section

The output section receives signal charges from the transmission section and sends them out of the unit (i.e., to the main board). The section must receive a reset signal from the main board after outputting the signal for each pixel.

2.1.2 Carriage Operations

Because photosensor elements are aligned and have a one-to-one correspondence with a horizontal row of pixels, no mechanical operation is required for the main scan (one horizontal reading of the original document). To read more than a single line, however, vertical movement (sub-scanning) is also necessary. This requires mechanical movement of the scanner head. In other words, scanning is performed by reading one line at a time, moving in the vertical direction. The operation is illustrated in Figure 2-6.

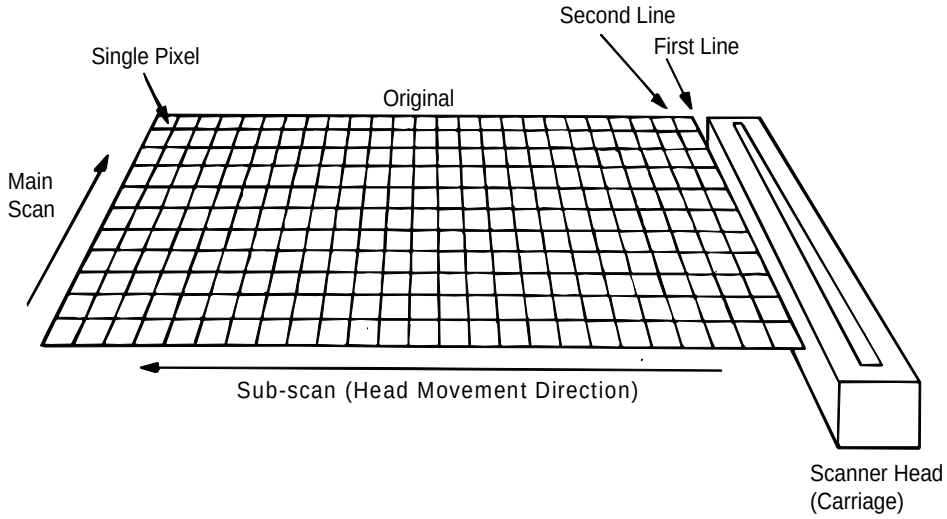


Figure 2-6. Reading of an Original Document

The carriage mechanism moves the scanner head. A timing belt is inserted into the base of the carriage. The carriage motor (a stepping motor) drives the timing belt by means of the carriage pulley; the carriage moves back and forth along the rail, carrying the scanner head with it. A home-position sensor detects when the carriage is in the home position.

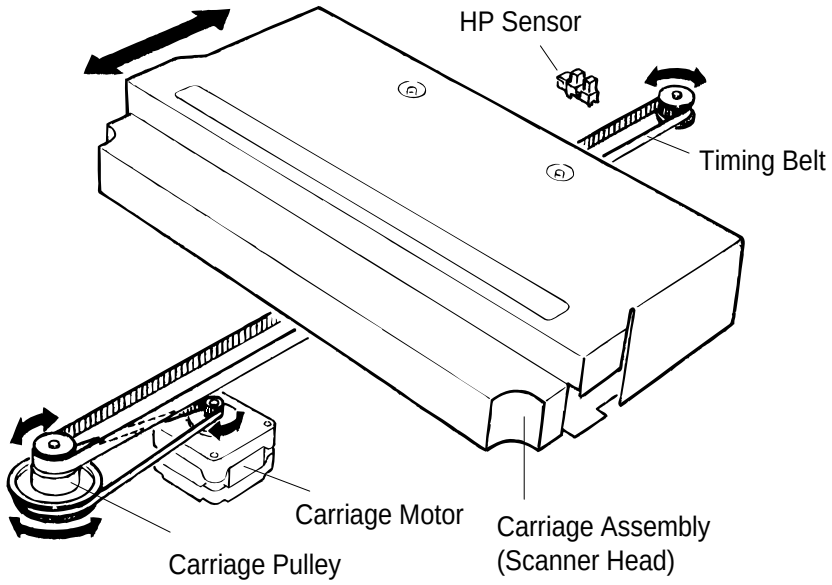


Figure 2-7. Carriage Operation

2.2 POWER SUPPLY OPERATIONS

The scanner can be powered by either of two power supply boards: the 120 V B027 PSB board or the 220/240 V B027 PSE board. The only difference in the way these boards operate is in the primary circuitry. These power boards output the DC voltage necessary to drive the scanner control circuits and carriage drive mechanism. Table 2-1 shows the input voltages and fuse ratings for these boards.

Table 2-1. Power Supply Boards

Board	Rated Input Voltage Range (VAC)	Fuse F1 Ratings	Output Voltages
B027 PSB	100 - 120	2.5 A / 125 V	+24 VDC/ 1.0 A +5 VDC/ 1.0 A ± 12 VDC/ 0.1 A
	85 - 138		
B027 PSE	220 - 240	1.25 A / 250 V	
	187 - 276		

2.2.1 Power Supply Overview

The power supply board has two power output lines that supply power to the various control circuits and drive mechanisms. Table 2-2 lists the parts of the scanner that run off these four DC output supply voltages.

Table 2-2. Power Supply Output Voltages and Applications

Output Supply Voltage (DC)	Applications
+24 V	Carriage motor drive Fluorescent lights
+5 V	B028 MAIN logic board circuitry Carriage home position sensor Control panel LEDs
+12 V	CCD sensor drive Amplifier
–12 V	Amplifier

2.2.2 Supply Circuit Operations

Figure 2-8 shows the power supply circuitry in block diagram form. AC power feeds into the scanner from the external power source. A filter circuit removes the noise. The AC voltage then undergoes full-wave rectification and is smoothed to produce the direct current supply voltage. This voltage is fed through a switching circuit and secondary smoothing circuit to produce a +24 VDC, +12 VDC, and –12 VDC supply. A +24 V line voltage detector circuit is connected to the switching circuit. This feedback control arrangement ensures that the +24 VDC supply is kept regulated.

The +12 VDC and –12 VDC are regulated by local regulator ICs.

The +5 VDC supply is created by feeding the +24 VDC line through the +5 VDC power supply circuit. This circuit further steps down the +24 VDC voltage and outputs a stabilized +5 VDC supply.

There are two main features of the power supply circuit. First, the power supply switch is in the secondary circuitry. When this switch is turned off, the switching circuit is de-energized and output of the +24 VDC, +12 VDC, and –12 VDC supply stops. However, since the switch is in the secondary circuitry, while the scanner remains plugged into the external AC supply, current continues to flow in the primary circuitry, whether the power supply switch is turned off or on. For this reason, before you perform any maintenance work, you must unplug the scanner from the external AC power outlet.

Second, there are three circuits to protect the supply circuitry and avoid danger. The +5 VDC line contains a voltage overload protection circuit. The +5 V voltage overload protection circuit cuts the supply if the voltage reaches or exceeds +7 VDC. It stops the switching circuit operation, which stops the output of the +24 VDC line.

The +24 VDC line has a voltage overload protection circuit and a voltage drop protection circuit. The +24 V voltage overload protection circuit cuts the supply if the voltage reaches or exceeds +30 VDC. It stops the switching circuit operation, which stops the output of the +24 VDC line. The voltage drop protection circuit protects the scanner from such damage as might occur from short circuiting in the secondary circuitry of the +24 VDC line. If a voltage drop is detected, it stops the switching circuit operation, which stops the output of the +24 VDC line.

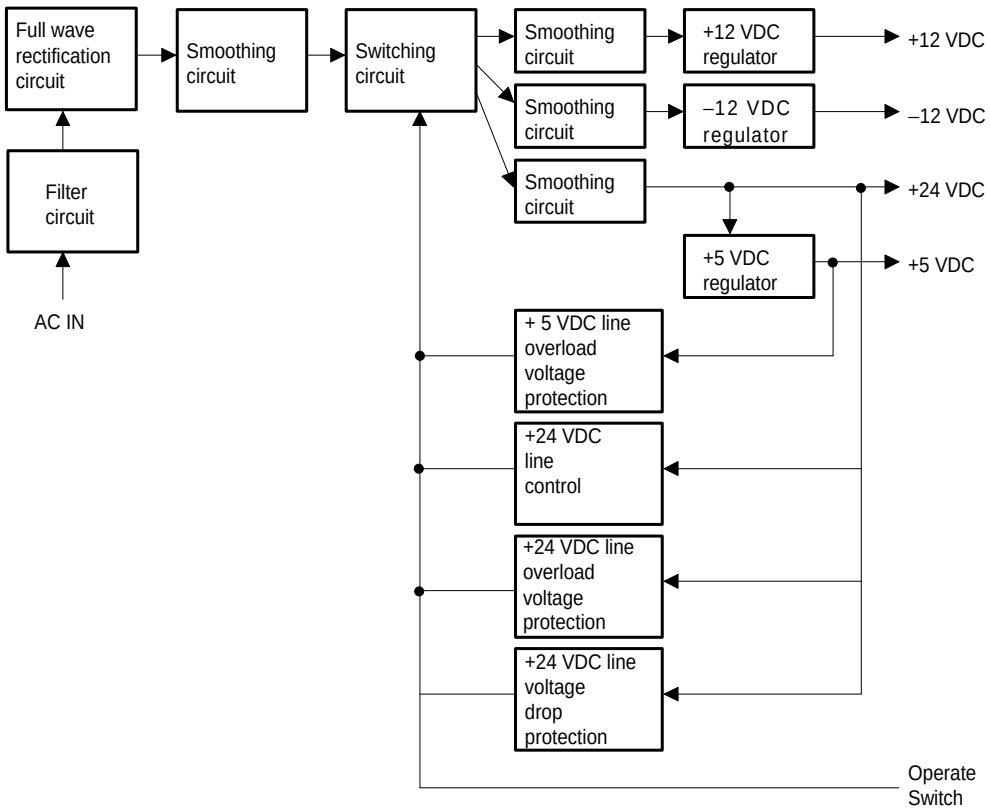


Figure 2-8. Power Supply Circuit Block Diagram

2.3 CONTROL CIRCUITS

The scanner's control circuits are implemented using a total of five boards.

2.3.1 Control Circuit Outline

The scanner CPU is an 16-bit, single-chip HD6413003. To simplify the circuitry, the circuits for correcting the image data signals are collected into three gate arrays. Figure 2-9 is a block diagram of the control circuitry.

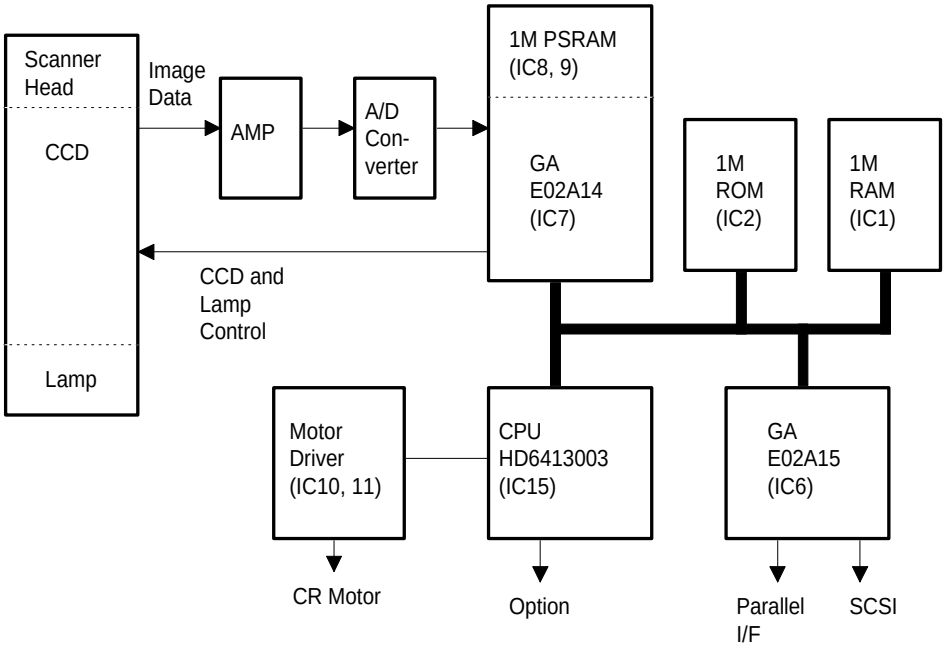


Figure 2-9. Control Circuit Block Diagram

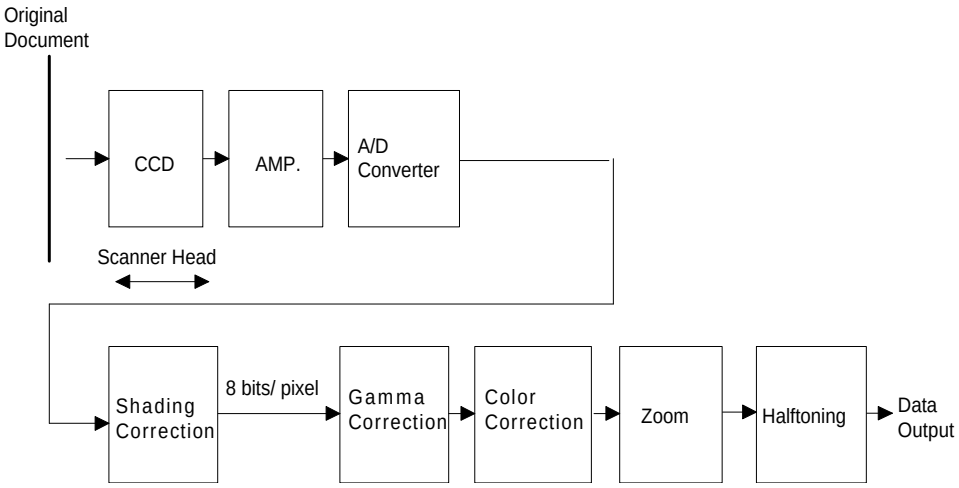


Figure 2-10. Sequence of Operations

Figure 2-10 shows the sequence of operations, starting from the point where image data is input into the GT-8500/ES-1000C, and ending with the output of image data to a computer.

1. The lamps light, and the scanner reads the white standard attached to the back surface of the document glass.
2. The lamps go out (so that there is no reflection), and the scanner reads the black standard.
3. The lamps light. Light reflected from the document is read by the CCD sensors.
4. The data that has been read in is amplified.
5. The amplified analog image data is converted to 10-bit digital data by the 10-bit A/D converter.
6. Shading correction is applied to the 10-bit digital data. The white and black standards [read in steps 1 and 2, above] determine the shading correction.

Shading Correction

The image data sent out by the sensors is derived by direct photoelectric conversion of the reflected light that impacts the sensors. This data must be further converted before it can be output from the device (e.g., before it can be used for reproducing the image on a CRT). The use of white and black standards in performing this type of conversion is referred to as "shading correction." The correction value is determined using the following expression:

(image data - black standard)/(white standard - black standard)

In other words, image data is calculated in terms of its proportional relation to white data.
This scanner changes the data format from 10 bits to 8 bits after making the shading correction.

7. ***Gamma correction (explained in Section 1.8.10), color correction (explained in Section 1.8.7), zoom correction (explained in Section 1.8.3), and halftoning (explained in Section 1.8.6) are performed, based on commands sent from the computer.***
8. ***Image data is output to the computer or other external device.***

Table 2-3 lists the functions of the scanner's main elements.

Table 2-3. Functions of Main Elements

Element	Location	Function
HD5413003 CPU	IC15	The CPU, which operates at 8 MHz, controls scanner operations.
E02A14 Gate Array	IC7	This gate array performs the following functions: Fluorescent lamp control CCD sensor control Control of the A/D converter Shading correction Gamma correction Color correction Zoom Halftoning The gate array is connected to two external 1M RAMs.
E02A15 Gate Array	IC6	This gate array performs the following functions: Bidirectional parallel interface control SCSI control Panel LEDs control
1M ROM	IC2	Program ROM
1M PSRAM	IC1	Working area of CPU
TA789P	IC10, 11	Carriage motor driver

2.3.2 Reset Circuit

Figure 2-11 shows the reset circuit used to reset the controls. Immediately after power on and power off, the +5 VDC line voltage drops, and the reset IC (IC12, M51953BFP) outputs the reset signal from pin 6 (OUT port). INIT signals sent through the parallel interface by an external device are also input to gate array E02A15 (pin 56, INIT port) to output the reset signal to reset the scanner. When the RESET button is pressed, the RESW signal is input to gate array E05A15 (pin 39, RESW port) to output the reset signal also.

2.3.3 Home-Position Sensor Circuit

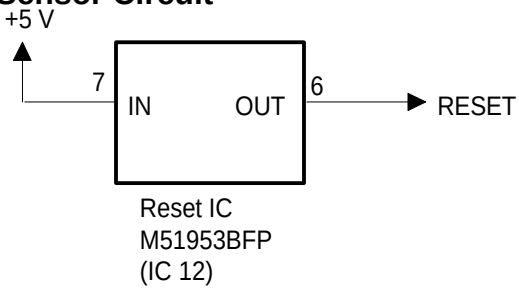


Figure 2-11. Block Diagram for Reset Circuit

The home-position sensor detects whether the carriage is in the home position. This sensor establishes the standard carriage-drive location. Figure 2-11 is a block diagram of the sensor circuitry. When the carriage is in the home position, the sensor outputs a HIGH signal to the HD6413003 CPU (pin 91, P75).

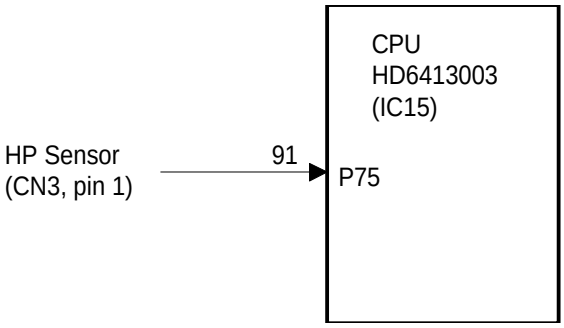


Figure 2-12. Block Diagram for Home Position Sensor

2.3.4 Carriage Motor Drive Circuit

A constant current drives the carriage motor, a stepping motor that requires changes in the excitation status to generate rotation.

Table 2-4 indicates the relationship between the input and output excitation phase data of the TA7289P motor driver. Table 2-5 indicates the excitation sequence required to rotate the motor, and Figure 2-14 shows the motor's internal wiring. Note that the motor can be rotated in reverse by reversing the excitation sequence given in Table 2-5.

There are 16 drive speeds (including stopped). The drive speed is established by the drive current, which is determined by the combination of 1, 2, 4, and 8.

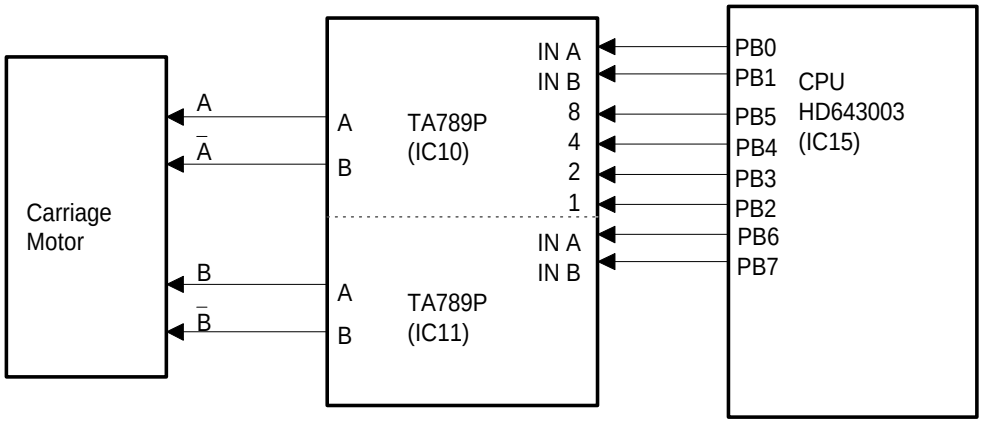


Figure 2-13. Block Diagram of Carriage Motor Drive Circuit

Table 2-4. Inputs and Outputs of the TA7289P Motor Driver

Input		Output	
IN A	IN B	A	B
H	L	H	L
L	H	L	H

Table 2-5. Excitation Sequence

Step	$\overline{A}$	B	A	$\overline{B}$
1	–	–	+	+
2	+	–	–	+
3	+	+	–	–
4	–	+	+	–

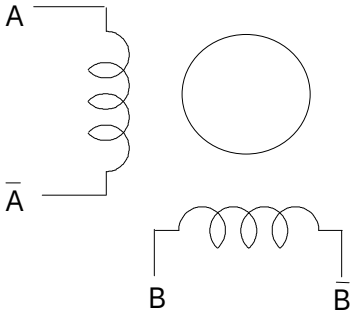


Figure 2-14. Internal Wiring of the Motor

2.3.5 Image Sensor Drive Circuit

Figure 2-15 is a block diagram of the image-sensor drive circuit. Gate array E02A14 controls image sensor operations. The sensor receives the following control signals: the SH signal, which drives the main sensor's shift electrode; transmission pulse CLK, which transmits the signal charges (described as $\phi 1$ and $\phi 2$, in Section 2.1.1); and the RS reset signal, which resets the image sensor's output section following the reading of each pixel. The image sensor receives these control signals, and outputs the image data as signal V. The process is illustrated in Figure 2-16.

The image data output by the image sensor is in the form of an analog signal. This signal is passed through an amplifying circuit.

The analog signal output from the amplifier is passed into the 10-bit A/D converter and converted into 10-bit digital data. This data is sent to gate array E02A14EA (IC7). Details of subsequent image processing may be found in Section 2.3.1.

The original document must be illuminated to be read. The scanner uses fluorescent lamps for this purpose. These lamps are also controlled by gate array E02A14. The gate array provides switching in order to maintain the proper radiation intensity.

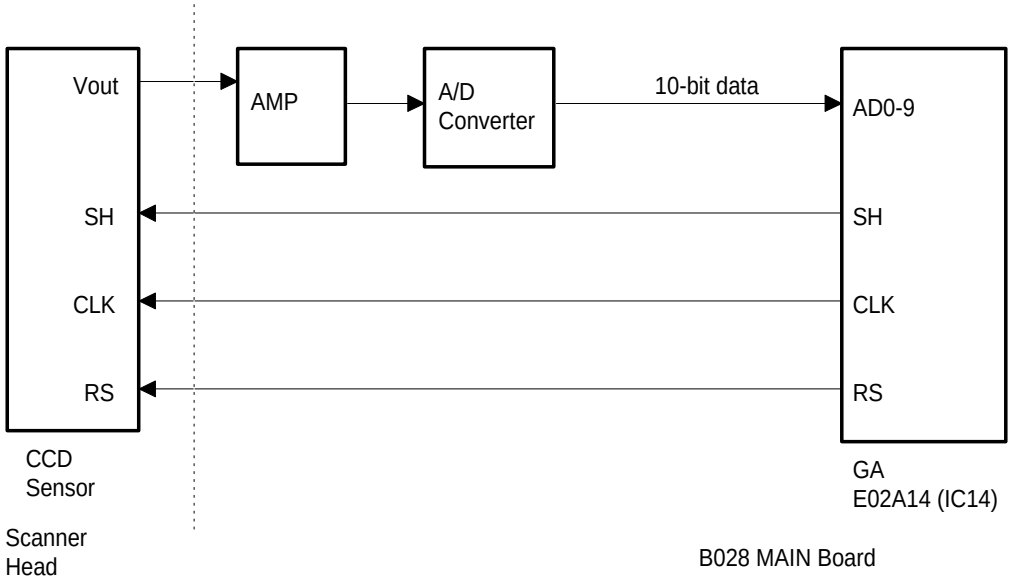


Figure 2-15. Image Sensor Drive Circuit

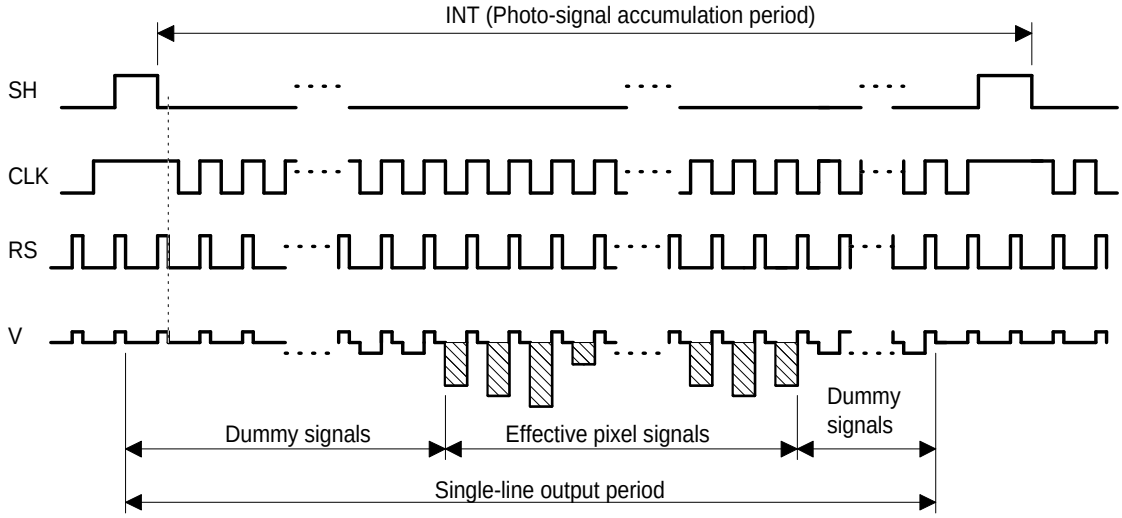


Figure 2-16. Image Sensor Control Process

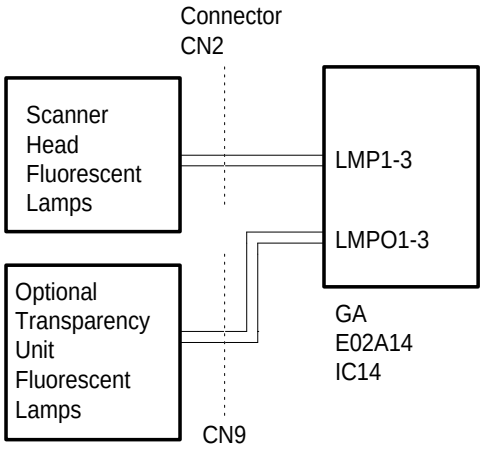


Figure 2-17. Lamp Control Circuit Block Diagram

Chapter 3 Disassembly and Assembly

Table of Contents

List of Figures

List of Tables

3.1 BEFORE BEGINNING DISASSEMBLY OR ASSEMBLY

This section describes the precautions to take during disassembly or assembly, the tools required, and the small parts used in the scanner.

3.1.1 Precautions

WARNING

Before disassembling or assembling the scanner, disconnect the power supply cable from the external AC power socket. Failure to do so risks personal injury. The OPERATE ***button for the scanner is wired into the secondary circuitry. As a result, the printer still remains live with current flowing even this switch is off.***

Carefully read the following before beginning disassembly or assembly work.

Before disassembling the machine or checking operation, first loosen the thumbscrew at the rear of the unit. If you are returning the unit to a customer, attach the thumb screw.

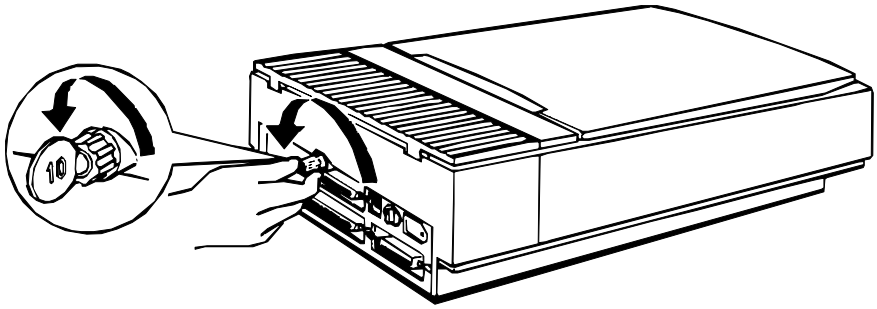


Figure 3-1. Loosening the Transportation Screw

3.1.2 Tools

Use the tools listed in Table 3-1 for disassembly and assembly.

Table 3-1. Tools

Name	Commercially Available?	Part No.
Phillips screwdriver	Yes	B743800200
Tweezers	Yes	B641000100
Round-nose pliers	Yes	B740400100
Regular screwdriver	Yes	B743000100

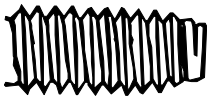
3.1.3 Small Parts

In the following sections, abbreviations are used for small parts, such as screws and washers. Tables 3-2 and 3-3 list these abbreviations.

Table 3-2. Abbreviations Used for Screw

Abbreviation	Part Name
CP screw	Cross-recessed Pan head screw
CBS-tite screw	Cross-recessed Binding head S-tite screw
CBB-tite screw	Cross-recessed Binding head B-tite screw
CBP-tite screw	Cross-recessed Binding head P-tite screw
CCS-tite screw	Cross-recessed Cup head S-tite screw
CCB-tite screw	Cross-recessed Cup head B-tite screw
CP (S-P1) screw	Cross-recessed Pan head screw with Spring washer and Plain washer 1

Table 3-3. Screw Types and Abbreviations

Head		Body	Washer (assembled)
Top	Side		
Cross-recessed 	Binding  Pan  Cup 	Normal — S-tite  P-tite  B-tite 	S-P1 

3.1.4 Service Shipping Checklist

Before returning the scanner to the customer, use the checklist below to ensure that it is ready for return.

Table 3-4. Service Shipping Checklist

Category	Component	Item to Check	Is Check Required?
Operation	Scanner head	Do all 3 fluorescent lights switch on normally?	☐ Checked, ☐ Not necessary
	Carriage mechanism	Is movement smooth?	☐ Checked, ☐ Not necessary
	Self-test	Normal? (☐ Page sequence, ☐ Monochrome)	☐ Checked, ☐ Not necessary
	Imaging feeding	Is image feed performed normally by utility software?	☐ Checked, ☐ Not necessary
Function enhancement	ROM version	The ROM version is _____.	☐ Checked, ☐ Not necessary
Cleaning		Is the document cover clean?	☐ Checked, ☐ Not necessary
		Is the inside of the unit free of dust?	☐ Checked, ☐ Not necessary
		Is the outside of the unit clean?	☐ Checked, ☐ Not necessary
Return shipping condition		Is the thumbscrew attached?	☐ Checked, ☐ Not necessary
		Was the document cover installed?	☐ Checked, ☐ Not necessary
Separate items		Power cord	☐ Checked, ☐ Not necessary

3.2 DISASSEMBLY AND ASSEMBLY

This section describes how to disassemble and assemble the main components of the scanner. When the procedure for installing a component in the scanner is simply the reverse of the procedure for removing that component from the printer, no installation description is given.

3.2.1 Replacing the ROM

1. Remove the CBS-tite (M3 × 6) screw fixing the ROM cover to the bottom plate.
2. Remove the ROM cover.
3. Replace the ROM.

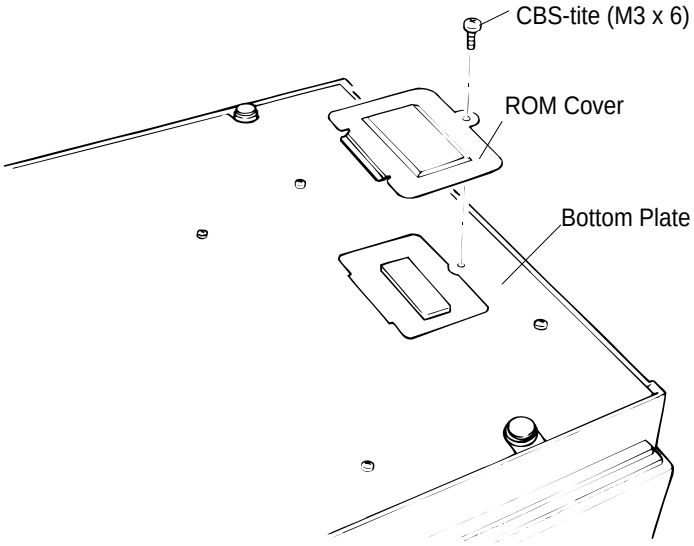


Figure 3-2. Replacing the ROM

3.2.2 Removing the Upper Case

1. Open the document cover, and remove the document cover.
2. Remove the 2 cosmetic (M4 × 3.4) screws and 2 CBP-tite (M3 × 12) screws fixing the upper case.
3. Remove the upper case.
4. Disconnect the connector on the LED board.

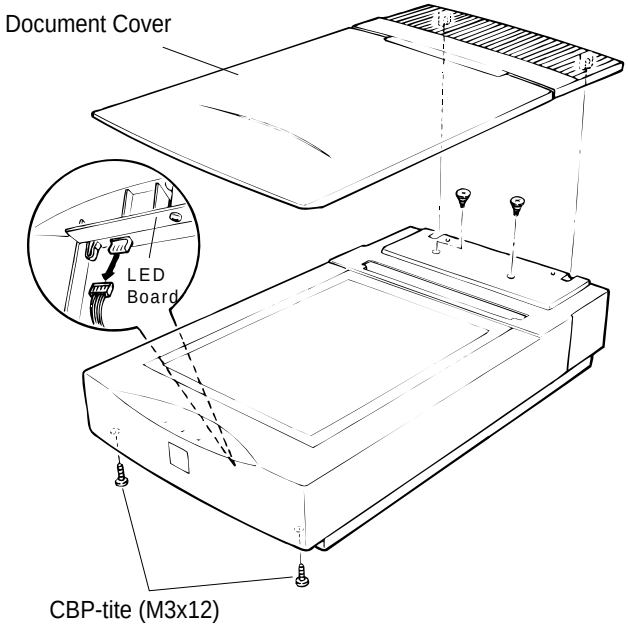


Figure 3-3. Removing the Upper Case

ASSEMBLY POINTS

The following figures illustrate the methods to attach the glass.

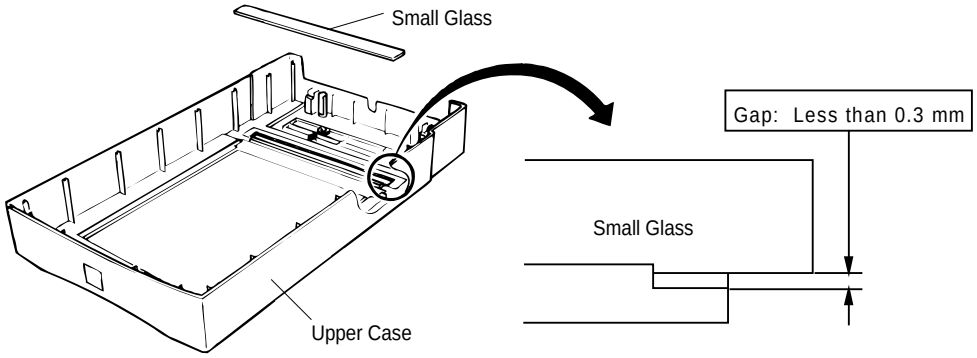


Figure 3-4. Fixing Small Glass

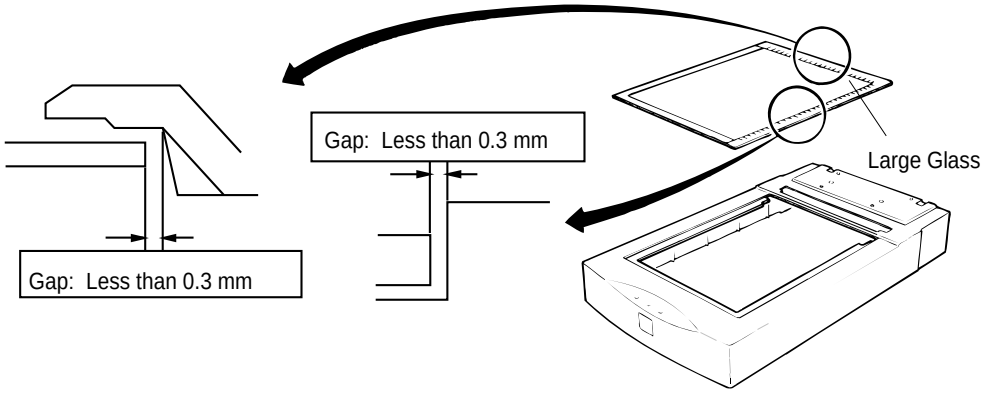


Figure 3-5. Fixing Large Glass

3.2.3 Removing the Bottom Plate

1. Remove the document cover. (Refer to Section 3.2.2.)
2. Remove 4 CBS-tite (M3 × 6) screws and 5 CBP-tite (M3 × 12) screws.
3. Remove the bottom plate.

CAUTION

Turn the main unit over onto a soft cloth, so that the glass will not be damaged.

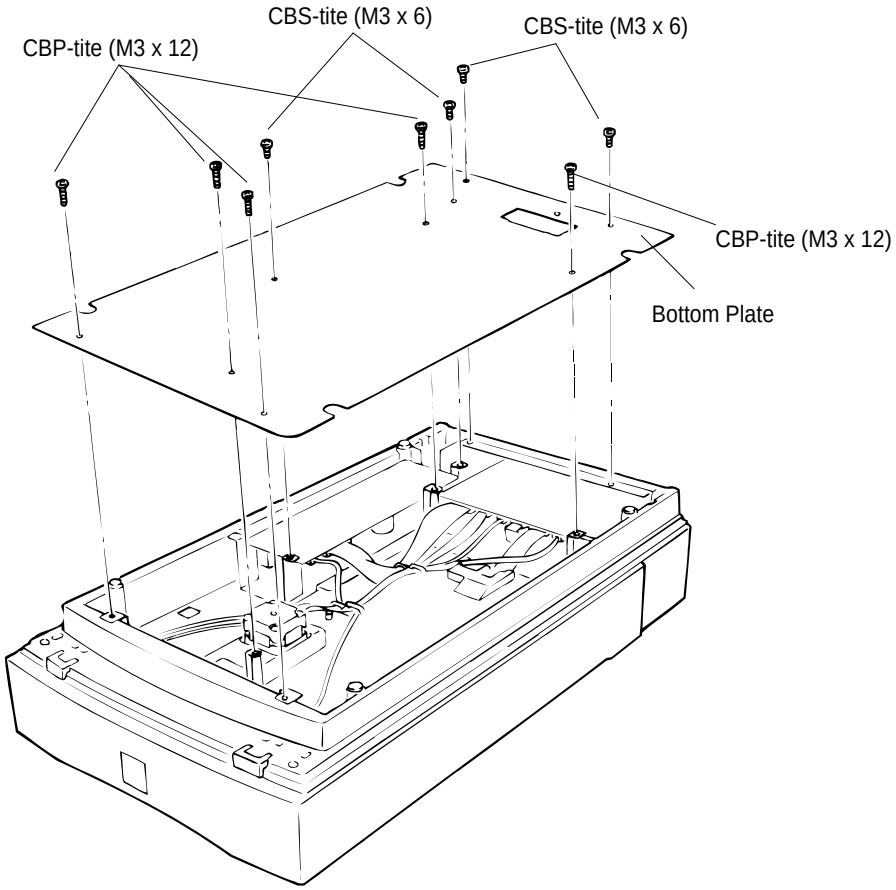


Figure 3-6. Removing the Bottom Plate

3.2.4 Removing the Carriage Assembly

1. Remove the bottom plate. (Refer to Section 3.2.3)
2. Remove flat cables CN4 and CN2 on the B028 MAIN board.
3. Remove the document cover and upper case. (Refer to Section 3.2.2.)
4. Remove the ferrite core from the tab in the lower case.
5. Remove the CP (S-P1) (M3 × 6) screw and remove the spring.
6. Remove the pulley holder with timing belt from the center rail.
7. Lift up the carriage assembly.

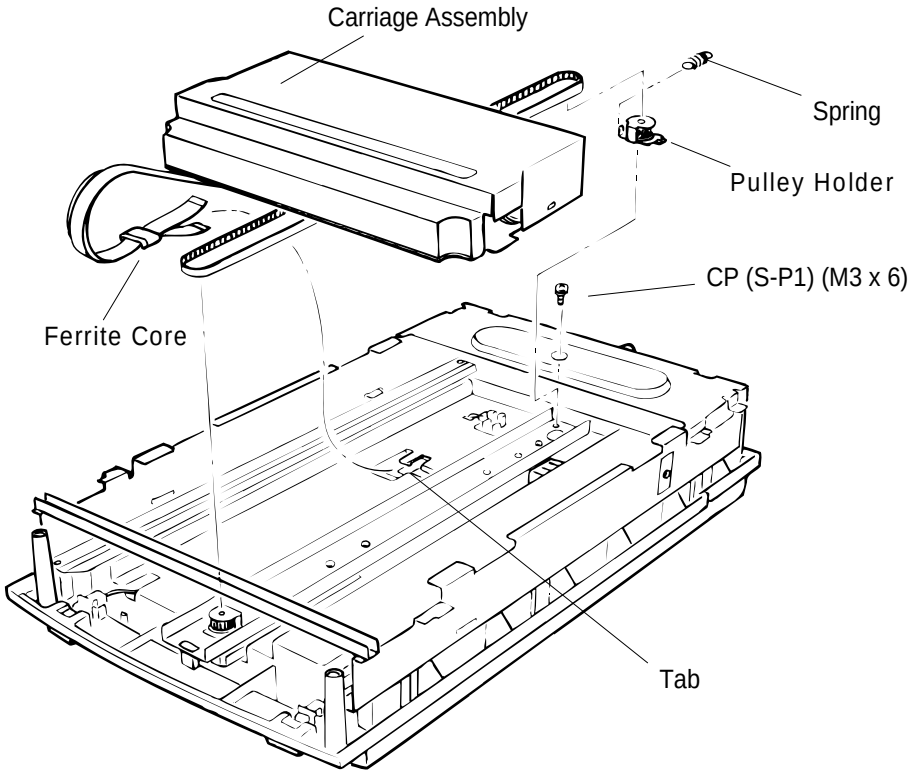


Figure 3-7. Removing the Carriage Assembly

3.2.5 Removing the B027 PSB/PSE Power Supply Board

1. Remove the bottom plate. (Refer to Section 3.2.3.)
2. Remove 1 CBB-tite (M3 × 14) screw, 2 CBP-tite (M3 × 12) screws, and 2 CBS-tite (M3 × 6) screws.
4. Disconnect the 3 cables on the board, and then remove the board.

CAUTION

Turn the main unit over onto a soft cloth so that the glass will not be damaged.

ASSEMBLY POINT

When you connect the cable to connector CN2 of the B027 PSB/PSE board, align the white stripe on the cable with pin 1 of CN2.

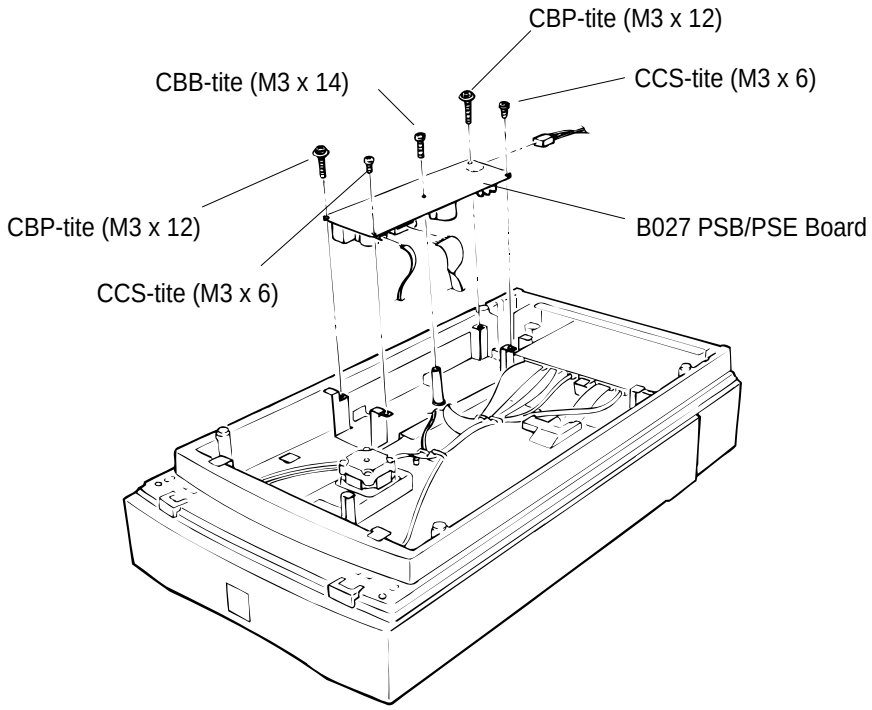


Figure 3-8. Removing the B027 PSB/PSE Board

3.2.6 Removing the B028 MAIN Control Board and B028 I/F Board

1. Remove the bottom plate. (Refer to Section 3.2.3.)
2. Disconnect connectors CN1, 2, 3, 4, 6, 7, and 8.
3. Remove 2 CBP-tite (M3 × 12) screws.
4. Remove 2 CBS-tite (M3 × 6) screws.
5. Remove the B028 MAIN board, along with the B028 I/F board.

ASSEMBLY POINT

When you connect the cable to connector CN1 of the B028 MAIN board, align the white stripe on the cable with pin 11 of CN1.

When you connect the cable to connector CN6 of the B028 MAIN board, align the red stripe on the cable with pin 4 of CN6.

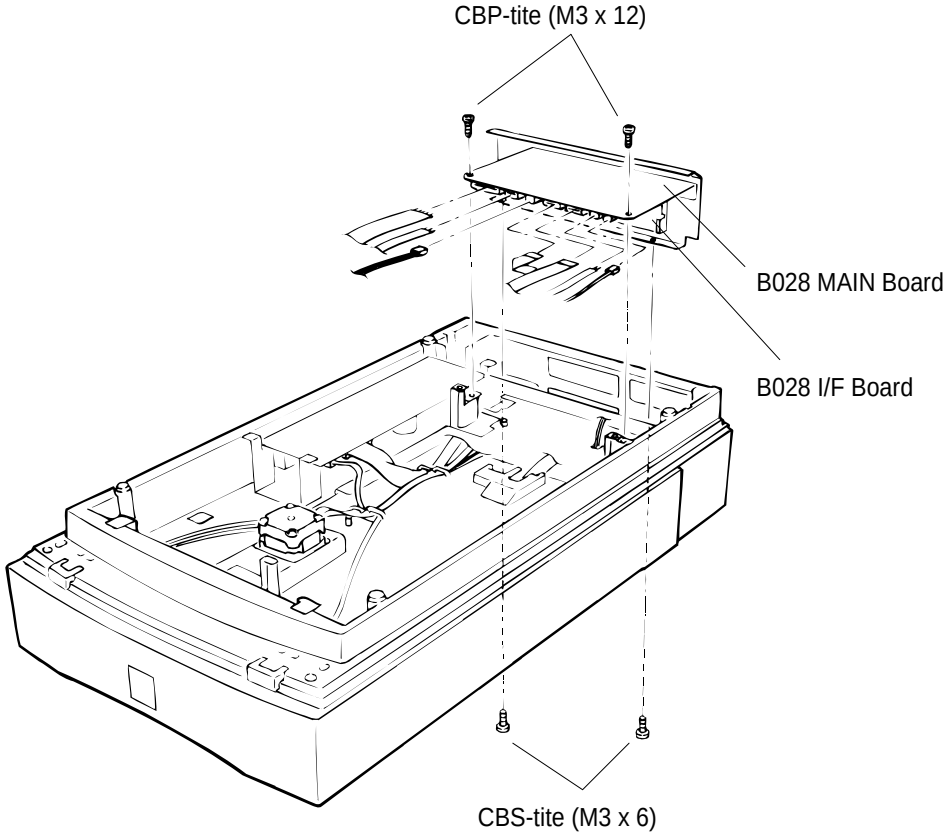


Figure 3-9. Removing the B028 MAIN and B028 I/F Boards

6. Disconnect CN9 on the B028 MAIN board.
7. Remove 2 CP (M3 × 6) screws and 2 connector screws.
8. Remove the B028 I/F board.
9. Remove 4 CP (M3 × 6) screws.
10. Remove the B028 MAIN board.

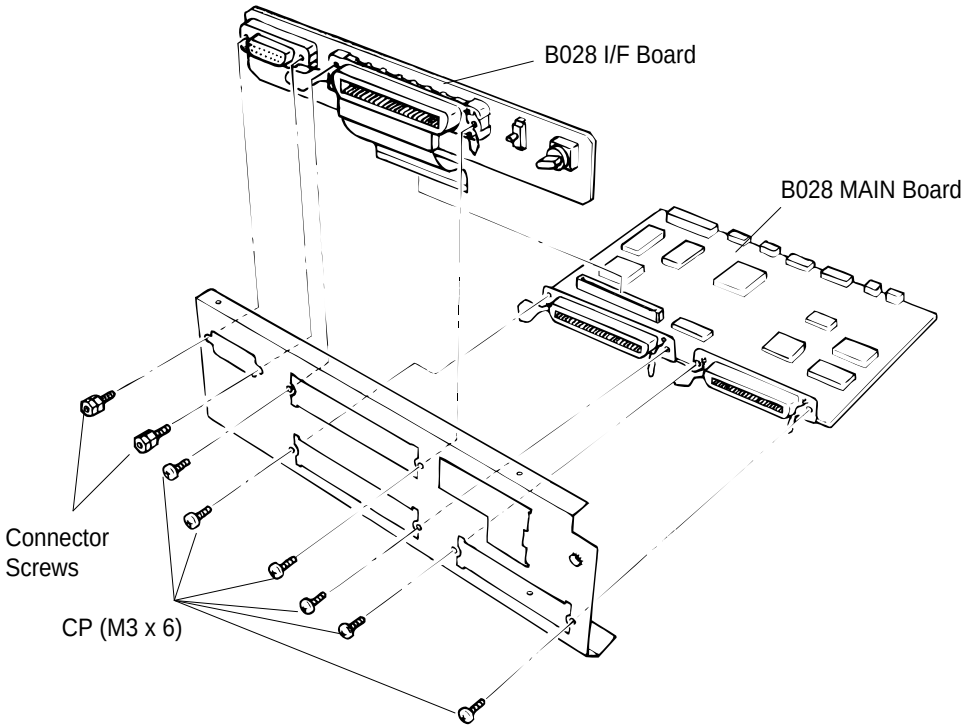


Figure 3-10. Removing the B028 MAIN and B028 I/F Board

3.2.7 Removing the Center Rail and CR Motor

1. Remove the bottom plate. (Refer to Section 3.2.3.)
2. Disconnect connectors CN2, 4, and 6 on the B028 MAIN board.
3. Remove 2 CBS-tite (M3 × 6) screws.

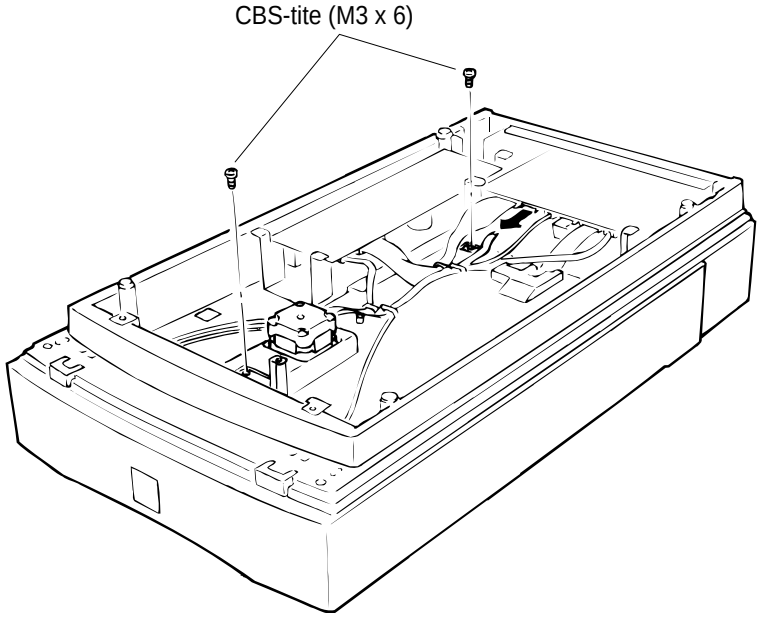


Figure 3-11. Removing 2 Screws

4. Remove the document cover and the upper case. (Refer to Section 3.2.2.)
5. Remove the carriage assembly. (Refer to Section 3.2.4.)
6. Remove 2 CBP-tite (M3 × 12) screws.
7. Remove the center rail.

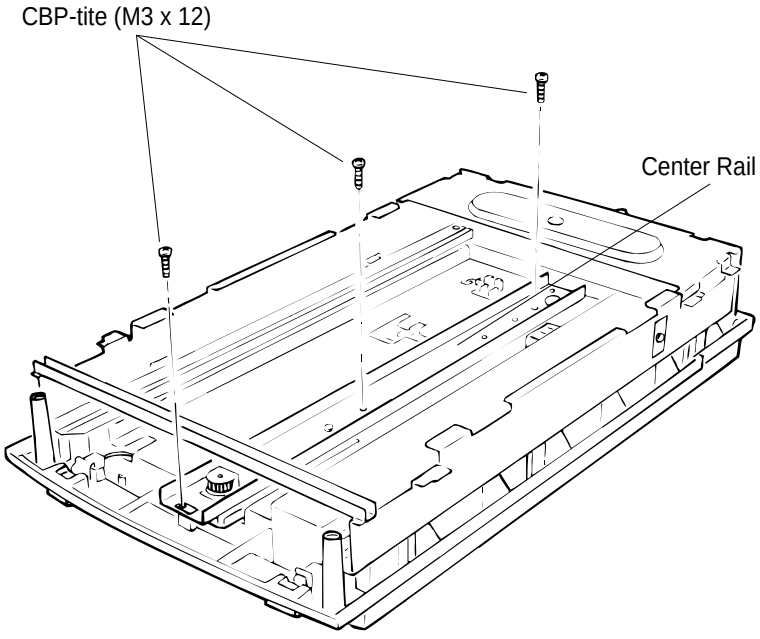


Figure 3-12. Removing the Center Rail

8. Remove 3 CBS-tite (M4 × 6) screws.
9. Remove the motor frame.

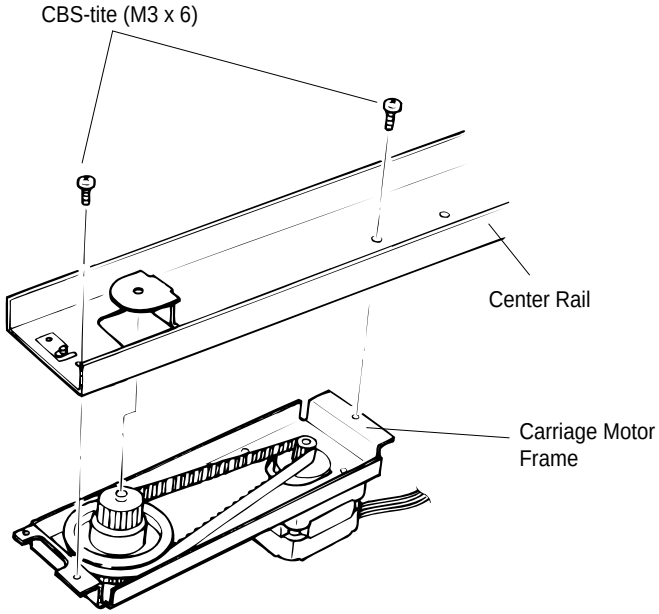


Figure 3-13. Removing the CR Motor

10. Remove 2 CP (M3 × 6) screws.
11. Remove the CR motor.

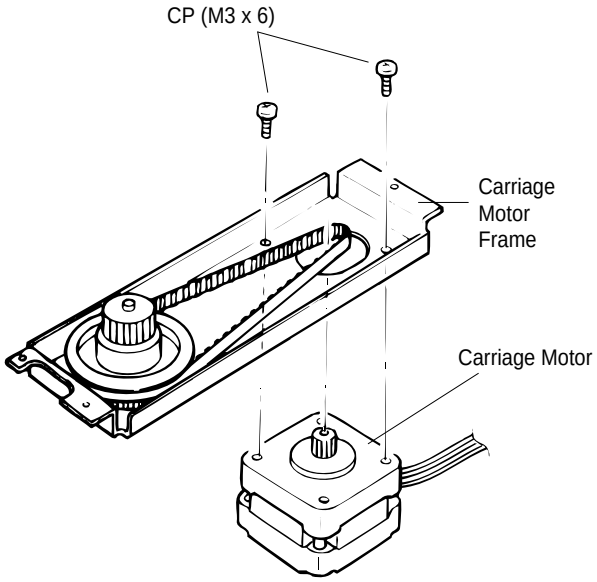


Figure 3-14. Removing the CR Motor

ASSEMBLY POINT

Pull the carriage motor so that motor belt is stretched the motor belt when carrige motor screws fixed.

3.2.8 Removing the HP Sensor

1. Remove the upper case. (Refer to Section 3.2.2.)
2. Remove the tab holding the HP sensor and disconnect the connector from the HP sensor.

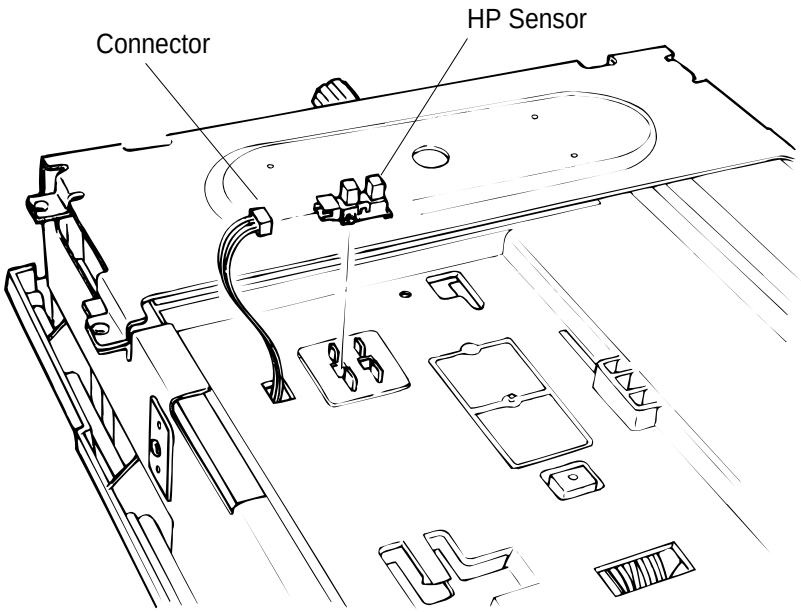


Figure 3-15. Removing the HP Sensor

3.2.9 Removing the LED Board

1. Remove the document cover and the upper case. (Refer to Section 3.2.2.)
2. Disconnect the connector on the LED board..
3. Remove the LED board.

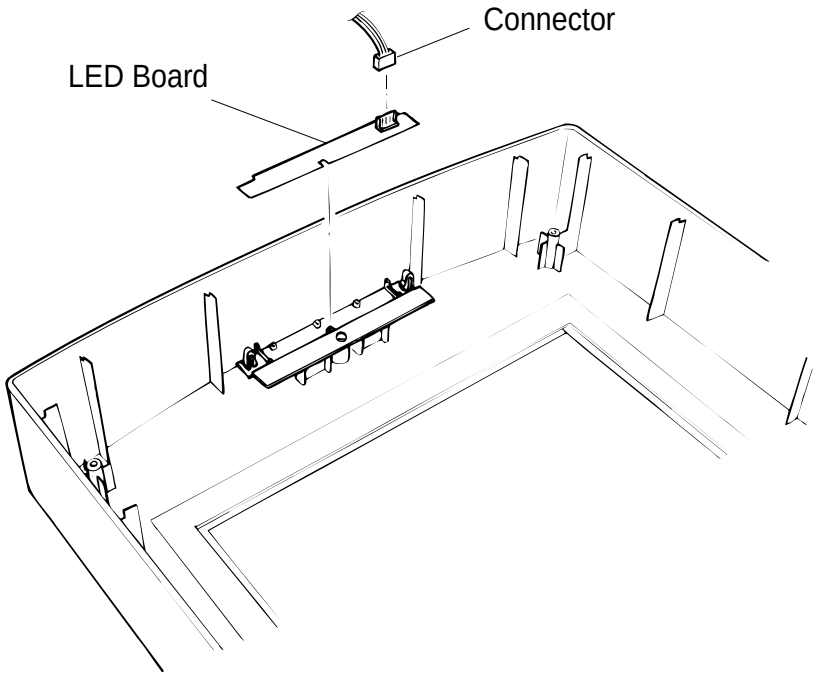


Figure 3-16. Removing the LED Board

3.2.10 Disassembling the Carriage Assembly

1. Remove the document cover and the upper case. (Refer to Section 3.2.2.)
2. Remove the bottom plate. (Refer to Section 3.2.3.)
3. Remove the carriage assembly. (Refer to Section 3.2.4.)
4. Remove the CR cover.
5. Remove the inverter board, and disconnect all the connectors on the inverter board.
6. Remove the lamp.

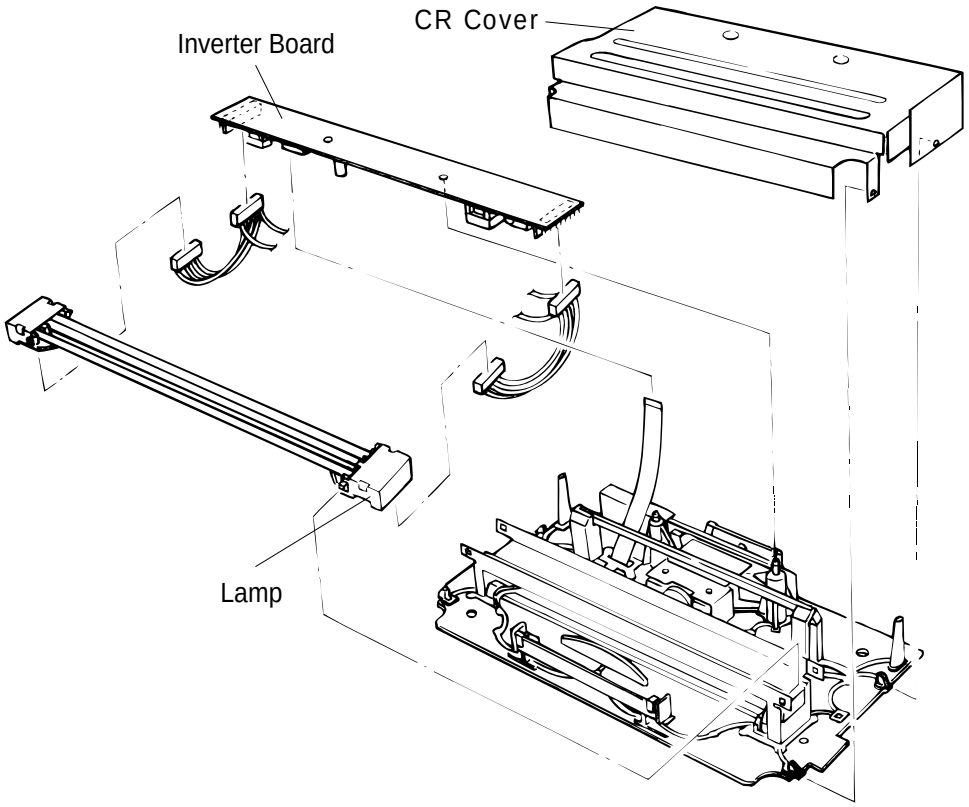


Figure 3-17. Disassemble the Carriage Assembly

ASSEMBLY POINT

Attach the short FFC to long FFC using double-sided tape after replacing either the short FFC or long FFC.

Chapter 4 Adjustments

No Adjustment is required in this product.

Chapter 5 Troubleshooting

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5.1 OVERVIEW

The GT-8500/ ES-1000C has a sophisticated, built-in self-diagnostic function that reduces troubleshooting time by identifying failed components. The following tables show motor resistance ratings and sensor test points.

Table 5-1. Motor Coil Resistance

Motor	Resistance
Carriage motor	Coil resistance 9.0 Ω ± 10% (25° C, 77° F)

Table 5-2. Sensor Status

Sensor	Test Point	Signal Level	Status
HP sensor	CN3/ pin 1	H (5 V)	At home position (HP)
		L (GND)	Away from HP

5.2 SELF-DIAGNOSTIC FUNCTION

This section describes the self-diagnostic function, in which the scanner controller automatically checks the operating conditions of each component. If any abnormality is detected, the scanner displays an error message using the LEDs. Table 5-3 lists the messages that tell you if service is required.

Table 5-3. Error Displays

Error Display		Error	Cause
READY LED	ERROR LED		
ON	ON	Command error	● An invalid command has been received. ● An invalid parameter has been received.
OFF	BLINKING	Interface error	● Communication protocols are wrong. ● The interface connection is broken or the connector is unplugged. ● The host computer does not respond to the scanner for 30 seconds or more.
BLINKING	BLINKING	Fatal error	● The fluorescent lamp is broken or requires replacement. ● The transportation screw has not been removed, and the carriage does not move. ● A paper jam or cover open was detected in the optional automatic document feeder during scanning. ● The optional transparency unit is opened during scanning.
OFF	OFF	Option error	● An error related to the option is detected, such as a paper end or cover open.

5.3 TROUBLESHOOTING

This section describes how to troubleshoot abnormal operations and repair the unit.

5.3.1 Troubleshooting Abnormal Operations

The table below tells how to identify malfunctions by symptom, determine their cause, and resolve them. Each entry in the table below refers you to a more detailed troubleshooting table.

Table 5-4. Symptoms and Reference Table

Symptom	Problem	See Table
The unit does not operate when power is turned on.	OPERATE LED does not light.	5-5
	Unit does not begin initialization.	5-6
The error message FATAL ERROR is displayed, and the problem is not corrected by switching power off and then on again.	Carriage does not move.	5-7
	The carriage moves and crashes into the back or front side frame before the error is displayed.	5-8
	Lamps do not light.	5-9
	Lamps light before the error is displayed.	5-10
The scanner does not read the image cleanly.	The scanner does not read the image clearly.	5-11
The error message INTERFACE ERROR is displayed.	Error using the bidirectional parallel interface.	5-12
	Error using the SCSI.	5-13

Table 5-5. OPERATE LED Does Not Light

Cause	Step	Checkpoint	Finding	Solution
Connector CN1 on the B027 PSB/PSE board may be disconnected.	1	Verify whether connector CN1 on the B027 PSB/ PSE board has been disconnected?	Yes	Connect CN1 on B027 PSB/PSE board.
Connector CN3 on the B027 PSB/PSE board may be disconnected.	2	Check whether connector CN3 on the B027 PSB/ PSE board has been disconnected?	Yes	Connect CN3 on B027 PSB/PSE board.
OPERATE button may be bad.	3	Disconnect connector CN3 on the B027 PSB/PSE board and check the OPERATE button using a multimeter. Is the button OK?	No	Replace the OPERATE button.
The fuse on the B027 PSB/PSE board may have blown.	4	Has the fuse blown on the B027 PSB/PSE board?	Yes	Replace the fuse.
The B027 PSB/PSE board may be dead.	5	With the power ON, is there an output of +5 VDC between pins 7 (+) and 5 (–) for CN3 on B027 PSB/PSE board?	No	Replace the B027 PSB/PSE board
The CR motor coils are shorted.	6	Disconnect CN6 on the B028 MAIN board and use a multimeter to check the coil resistance between pins 2 and 4 and between pins 1 and 3 (2 points total) on the disconnected cable side. Pin 2 — Pin 4 Pin 1 — Pin 3 Are any coils of CR motor shorted?	Yes	Replace the CR motor and follow the steps below to check the driver.
		If any coil is shorted, check the CR motor driver circuit using the following procedure: 1. Set the multimeter to check resistance. 2. Place the (–) terminal of the multimeter on pins 1, 2, 3, and 4 of connector CN6 on the B028 MAIN board. 3. Place the (+) terminal on pin 6 of connector CN1 on the B028 MAIN board (GND). With the power off, does the multimeter detect “∞”?	No	Replace the CR motor and B028 MAIN board at the same time.

Table 5-5. OPERATE LED Does Not Light (Continued)

Cause	Step	Checkpoint	Finding	Solution
Inverter board in the scanner head may be dead.	7	Disconnect connector CN2 on the B028 MAIN board and power on. Does the OPERATE LED come on?	Yes	Replace the inverter board in the scanner head.
Scanner head may be dead.	8	Disconnect connector CN4 on the B028 MAIN board and power on. Does the OPERATE LED come on?	Yes	Replace the scanner head.
B028 MAIN board may be dead.	9	—	—	Replace the B028 MAIN board.

Table 5-6. Unit Does Not Initialize

Cause	Step	Checkpoint	Finding	Solution
B028 MAIN board may be dead.	1	—	—	Replace the B028 MAIN board

Table 5-7. Carriage Does Not Move

Cause	Step	Checkpoint	Finding	Solution
The B027 PSB/PSE board may be dead.	1	With power on, is there an output of +24 VDC between pin 1 (+) and pin 3 (–) for CN3 on B027 PSB/PSE board?	No	Replace the B027 PSB/PSE board
The carriage mechanism is defective.	2	Turn off the scanner and try to move the carriage manually. Does the carriage move smoothly?	No	Check the carriage mechanism, and replace or reassemble the affected parts.
The CR motor is defective.	3	Dissconnect CN6 on the B028 MAIN board and use a multimeter to check the coil resistance between pins 2 and 4 and between pins 1 and 3 (2 points total) on the disconnected cable side. Pin 2 - Pin 4 Pin 1 - Pin 3 Are the resistances for the two points above approximately 9.0 ohms?	No	Replace the CR motor. If any coil is shorted, follow the steps below to check the driver.
		If any coil is shorted, check the CR motor driver circuit using the following procedure: 1. Set the multimeter to check resistance. 2. Place the (–) terminal of the multimeter on pins 1, 2, 3, and 4 of connector CN6 on the B028 MAIN board. 3. Place the (+) terminal on pin 6 of connector CN1 on the B028 MAIN board (GND). With the power off, does the multimeter detect “∞”?	No	Replace the CR motor and B028 MAIN board at the same time.
The B028 MAIN board may be dead.	4	—	—	Replace the B028 MAIN board.

Table 5-8. Carriage Moves and Crashes into Frame

Cause	Step	Checkpoint	Finding	Solution
HP sensor may be bad.	1	—	—	Replace the HP sensor

Table 5-9. Lamps Do Not Light

Cause	Step	Checkpoint	Finding	Solution
Connector CN2 on the B028 MAIN board may be disconnected.	1	Is connector CN2 on the B028 MAIN board disconnected?	Yes	Connect CN2 on the B028 MAIN board.
A connector on the inverter board in the scanner head may be disconnected.	2	Are any connectors on the inverter board disconnected?	Yes	Connect the connector on inverter board.
Lamps may be dead.	3	Does the scanner work after you replace the lamps?	Yes	Scanner OK.
The inverter board in the scanner head may be dead.	4	Does the scanner work after you replace the inverter board?	Yes	Scanner OK.
The B028 MAIN board may be dead.	5	—	—	Replace the B028 MAIN board.

Table 5-10. Lamps Light before the Error is Displayed

Cause	Step	Checkpoint	Finding	Solution
Connector CN4 on the B028 MAIN board may be disconnected.	1	Check whether connector CN4 on the B028 MAIN board is disconnected?	Yes	Connect CN4 on the B028 MAIN board.
A connector on the CCD board in the scanner head may be disconnected.	2	Are all connectors on the CCD board connected?	No	Connect the connector on the CCD board.
The B027 PSB/PSE board may be dead.	3	With the power on, is there an output of +12 VDC between pin 9 (+) and pin 10 (–) and –12 VDC between pin 11 and pin 10 for CN3 on B027 PSB/PSE board?	No	Replace the B027 PSB/PSE board.
The scanner head may be dead.	4	Does the scanner work after you replace the scanner head?	Yes	Scanner OK.
The B028 MAIN board may be dead.	5	—	—	Replace the B028 MAIN board.

Table 5-11. Image Unclear

Cause	Step	Checkpoint	Finding	Solution
The document glass may be dirty.	1	Does the scanner work after you clean the glass inside and outside?	Yes	Scanner OK.
The scanner head may be dead.	2	Does the scanner work after you replace the scanner head?	Yes	Scanner OK.
The B028 MAIN board may be dead.	3	—	—	Replace the B028 MAIN board.

Table 5-12. Interface Error (Parallel)

Cause	Step	Checkpoint	Finding	Solution
The parallel interface cable may be bad.	1	Does the scanner work after you replace the interface cable?	Yes	Scanner OK.
The B028 MAIN board may be dead.	2	—	—	Replace the B028 MAIN board.

Table 5-13. Interface Error (SCSI)

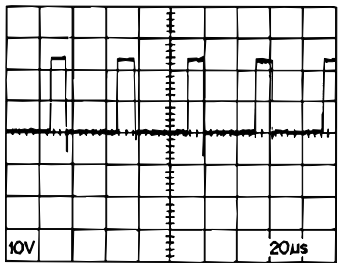
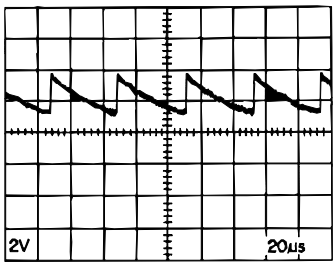
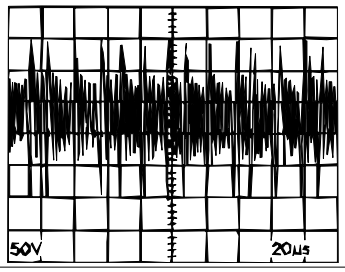
Cause	Step	Checkpoint	Finding	Solution
The terminator settings may be incorrect.	1	Check the settings and user's guide. Are the settings OK?	No	Change the terminator settings.
The SCSI ID settings may be incorrect.	2	Check the settings and user's guide. Are the settings OK?	No	Change the SCSI ID settings.
The SCSI cable may be bad.	3	Does the scanner work OK after you replace the interface cable?	Yes	Scanner OK.
The B028 MAIN board may be dead.	4	—	—	Replace the B028 MAIN board.

5.4 REPAIR OF THE POWER SUPPLY BOARD

This section provides instructions for repairing a defective power supply board. Servicers who do not repair to the component level (including all servicers in the U.S.) can ignore this section.

This table describes various problems, likely causes, checkpoints, and solutions. The checkpoint column provides proper waveforms, resistance values, and other values to be checked to evaluate the operation of any component that might be bad. Check these values and take the appropriate action.

Table 5-14. Repair of the Power Supply Board

Condition	Cause	Checkpoint	Action
+5 VDC is not output.	IC51 is bad.	Check oscillating waveforms and chopping waveforms.  	Replace IC51.
+24 VDC is not output.	Switching FET Q1 is bad.	Check chopping waveform of switching FET Q1 between pins 2 and 4 of transformer T1. 	Replace FET Q1.
+12 VDC is not output.	Regulator IC52 is bad.	—	Replace IC52.
–12 VDC is not oputput.	Regulator IC53 is bad.	—	Replace IC53.

5.5 REPAIR OF THE MAIN CONTROL BOARD

This section provides instructions for repairing a defective main board. It describes various problems, likely causes, checkpoints, and solutions. The checkpoint column provides proper waveforms, resistance values, and other values to checked to evaluate the operation of any component that might be bad. Check these values and take the appropriate action.

Table 5-15. Repair of the Main Control Board

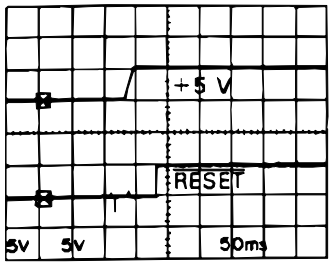
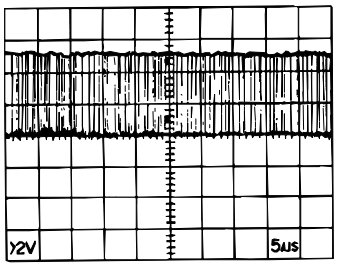
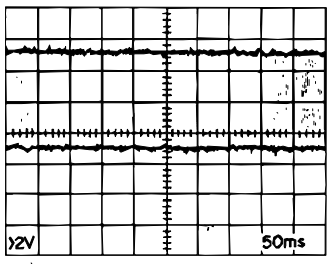
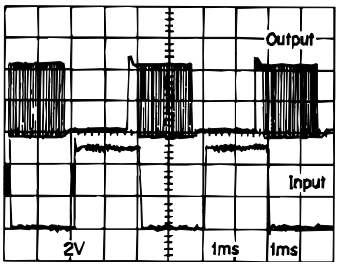
Problem	Condition	Cause	Checkpoint	Action
No operation at all.	CPU does not operate.	Reset circuit does not operate.	Check the +5 VDC voltage at the output of IC12 (pin 6). 	Replace IC12.
		ROM selection is not carried out correctly.	Is pin 30 of IC6 correctly changing from HIGH/LOW? 	Replace IC6.
		Defective RAM.		Replace IC1.
		Defective CPU.	Check the waveform at pin 74 of IC15 (CPU). 	If oscillation is detected, replace the CPU; other-wise replace CR2.

Table 5-15. Repair of the Main Control Board (Continued)

Problem	Condition	Cause	Checkpoint	Solution
Fatal error is displayed.	CR motor does not run.	Defective IC10 and 11.	Check the input of pins 3 and 8 of IC10/11. 	Replace IC10 and 11.
	The carriage does not stop at the home position.	Defective IC15.	Does the input of pin 91 of IC15 go from LOW to HIGH when the carriage enters home position?	If signal changes from LOW to HIGH, replace IC15.
	The fluorescent lamp does not light.	Defective IC7.	Check switching of pins 95, 96, and 97 of IC7.	Replace IC7.
	White standard cannot be read.	Defective IC7.	Is IC7 outputting the sensor drive signal?	Replace IC7.
		Defective IC14.	Check I/O of amp IC14.	Replace IC14.
The scanner does not read the image cleanly.	—	Defective image processing gate array.	—	Sequentially replace IC7.
Interface error is displayed.	Defective parallel interface circuit.	Defective gate array IC6.	—	Replace IC6.
	Defective SCSI circuit.	Defective gate array IC6.	—	Replace IC6.

Chapter 6 Maintenance

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6.1 MAINTENANCE

Appropriate cleaning is required to maintain the device in optimal condition over a long period and to prevent problems. Use a neutral cleaning agent to remove external dirt, and use a vacuum cleaner to remove dust and other debris. Be sure that the document cover glass is free of dirt; dirt on the glass can have a particularly bad influence on the reading quality. If the glass is dirty, clean it with a dry, soft cloth.

CAUTION

Do not use thinner, trichlene, or ketones, since these may cause deterioration of plastic and rubber parts.

6.2 LUBRICATION

The scanner must be lubricated properly when it is disassembled for component replacement, or if mechnical noise exceeds a certain level. EPSON recommends only the lubricant listed in table below for this scanner. It has been tested extensively and found to comply with the requirements of the scanner mechanism. The figure on the next page shows the lubrication points.

Table 6-1. Recomended Lubricants

Type	Name	Quantity	Part No.	Availability
Grease	G-20	40 g	B702000001	E
Grease	G-26	40 g	B702600001	E

Note: E = EPSON exclusive product (not commercially available)

Table 6-2. Lubrication Points

Ref. No. in Figure 6-1	Lubrication Point	Lubricant
(1)	Contact portion of the shaft of CR motor frame and the CR driven pulley.	G26
(2)	Contact portion of the center rail and the roller of carriage aseembly.	G20

CAUTION

Do not apply too much lubricant because it may create stains or cause the mechanism to malfunction.

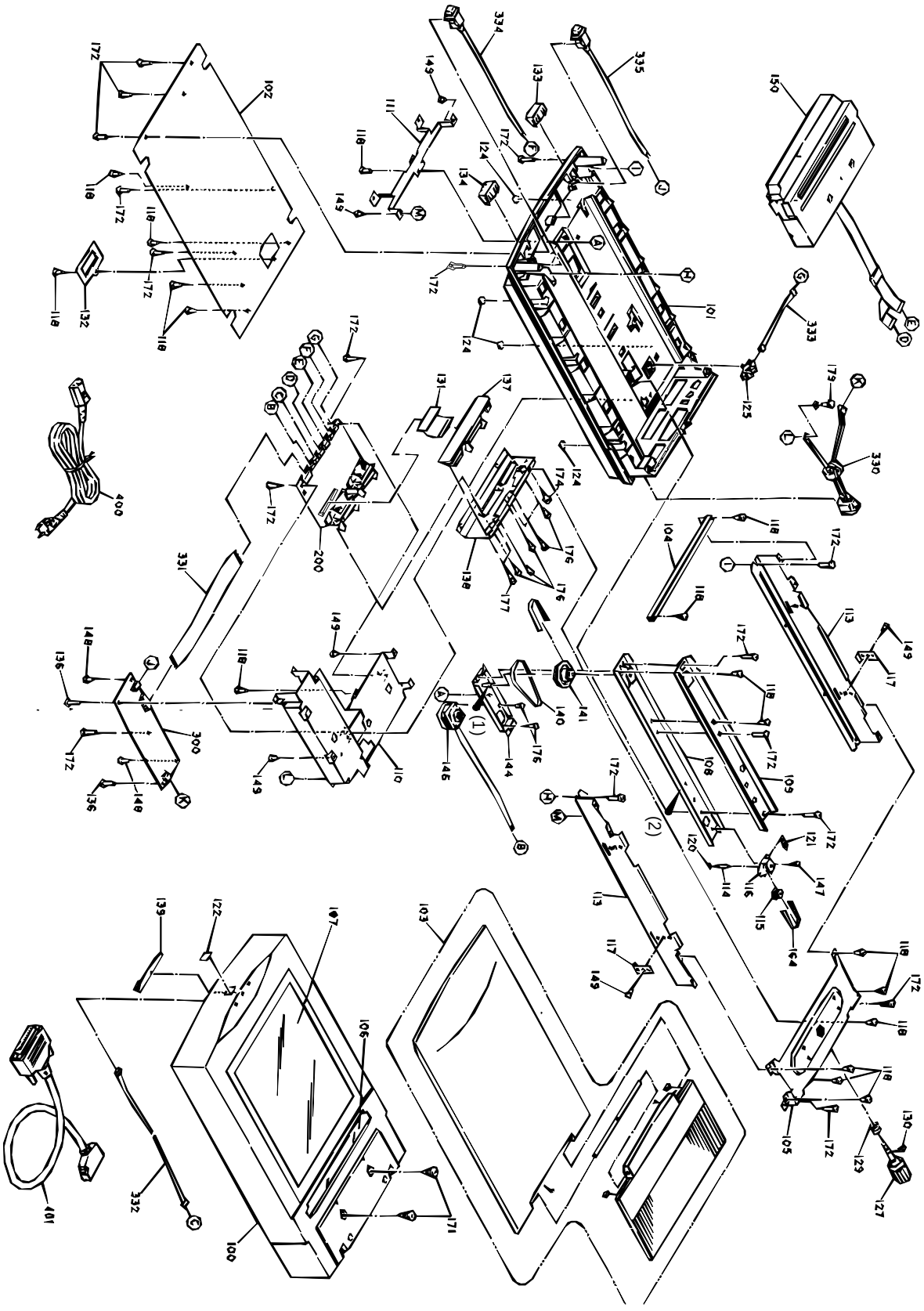

Figure 6-1. Lubrication Points

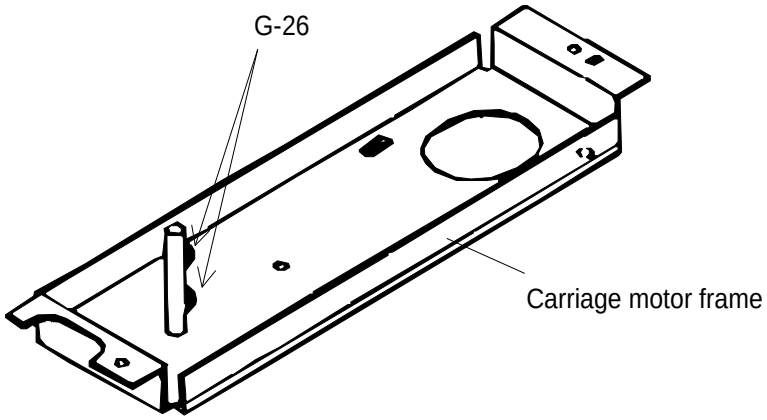

Figure 6-2. Lubrication Method 1

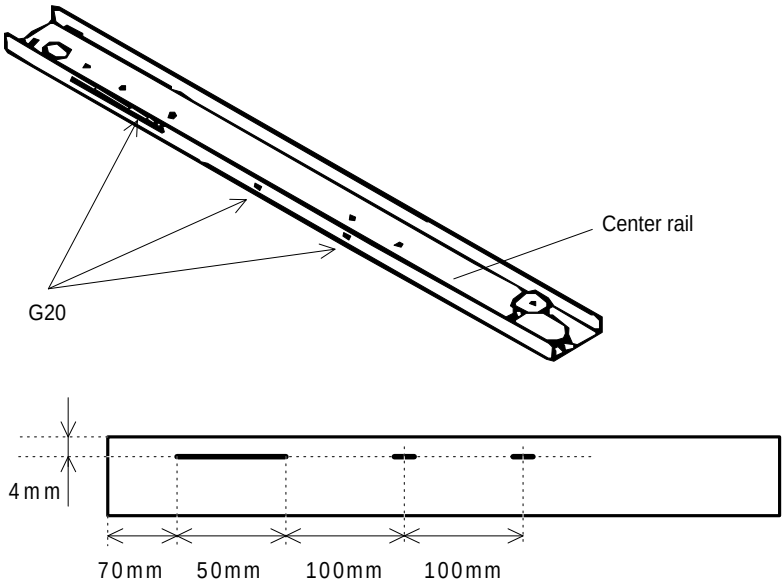

Figure 6-3. Lubrication Method 2

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A.1 CONNECTOR PIN ASSIGNMENTS

Figure A-1 illustrates the interconnection of the primary components. Table A-1 summarizes the description and sizes of the connectors.

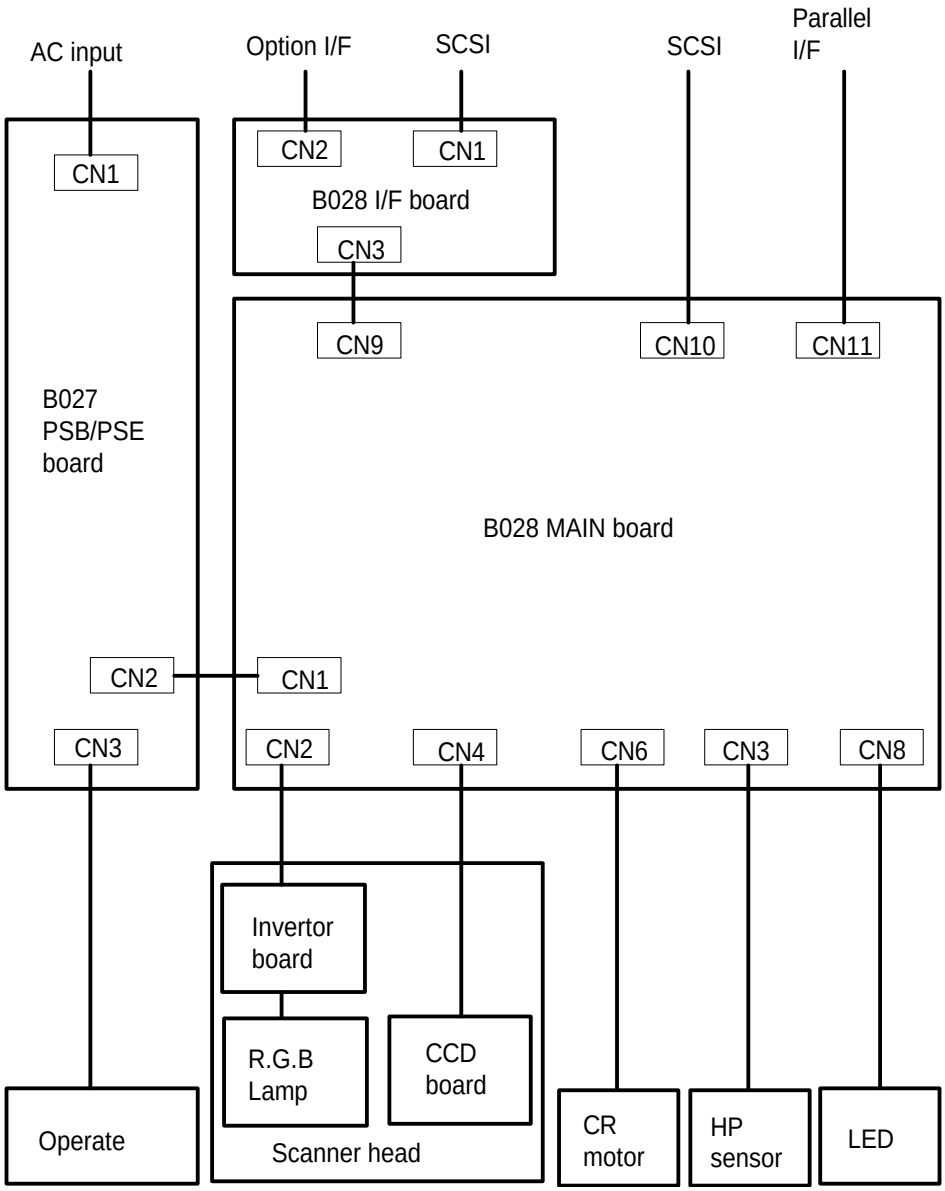

Figure A-1. Cable Connections

Table A-1. Board Connector Summary

Connector	Description	Pins	Reference
B028 MAIN Control Circuit Board			
CN1	Connector for B027 PSB/PSE board	11 pins	Table A-2
CN2	Connector for carriage assembly inverter	10 pins	Table A-3
CN3	Connector for HP sensor	3 pins	Table A-4
CN4	Connector for CCD sensor for carriage assembly	12 pins	Table A-5
CN6	Connector for CR motor	4 pins	Table A-6
CN7	Connector for RESET button	2 pins	Table A-7
CN8	LED board	4 pins	Table A-8
CN9	Connector for B027 I/F board	40 pins	Table A-9
CN10	Connector for SCSI	50 pins	Table 1-6
CN11	Connector for parallel interface	36 pins	Table 1-2
B027 PSB/PSE Power Supply Board			
CN1	Connector for AC power input	2 pins	—
CN2	Connector for B028 MAIN board	11 pins	—
CN3	Connector for OPERATE button	2 pins	—
B028 I/F Board			
CN1	Connector for SCSI	40 pins	—
CN2	Connector for option	15 pins	—
CN3	Connector for B028 MAIN board	50 pins	—

Table A-2. CN1 Pin Assignments

Pin No.	Signal Name	I/O	Description
1, 2	+24	—	+24 VDC
3-6	GND	—	Ground
7,8	+5	—	+5 VDC
9	+12	—	+12 VDC
10	AG	—	Analog GND
11	–12	—	–12 VDC

Table A-3. CN2 Pin Assignments

Pin No.	Signal Name	I/O	Description
1, 2	+24	—	+24 VDC
3, 4	GND	—	GND
5	LMP2	O	LMP2 lamp control
6	LMP3	O	LMP3 lamp control
7	LMP1	O	LMP1 lamp control
8-10	GND	—	Ground

Table A-4. CN3 Pin Assignments

Pin No.	Signal Name	I/O	Description
1	HP	I	HP signal
2	GND	—	GND
3	+5	—	+5 VDC

Table A-5. CN4 Pin Assignments

Pin No.	Signal Name	I/O	Description
1	+12	—	+12 VDC
2	Vin	I	Image data
3	+12	—	+12 VDC
4	SH	O	SH signal for CCD control
5	–12	—	–12 VDC
6	CLAMP	O	CLAMP signal for CCD control
7	GND	—	GND
8	GND	—	GND
9	GND	—	GND
10	RS	O	RS signal for CCD control
11	GND	—	GND
12	CLK	—	CLK signal for CCD control

Table A-6. CN6 Pin Assignments

Pin No.	Signal Name	I/O	Description
1	B	O	Carriage motor phase B
2	$\overline{A}$	O	Carriage motor phase $\overline{A}$
3	$\overline{B}$	O	Carriage motor phase $\overline{B}$
4	$\overline{A}$	O	Carriage motor phase $\overline{A}$

Table A-7. CN7 Pin Assignments

Pin No.	Signal Name	I/O	Description
1	GND	—	GND
2	RSSW	I	RESET button ON

Table A-8. CN8 Pin Assignments

Pin No.	Signal Name	I/O	Description
1	ERROR	O	ERROR LED
2	READY	O	READY LED
3	POWER	O	POWER LED
4	+5	—	+5 VDC

Table A-9. CN9 Pin Assignments

Pin No.	Signal Name	I/O	Description
1	ID2	I	SCSI ID switch
2	ID4	I	SCSI ID switch
3	ID1	I	SCSI ID switch
4	ID8	I	SCSI ID switch
5	GND	—	GND
6	TERMPWR	—	Terminator power (+5 VDC)
7	SD0	I/O	SD0 signal for SCSI
8	SD1	I/O	SD1 signal for SCSI
9	SD2	I/O	SD2 signal for SCSI
10	SD3	I/O	SD3 signal for SCSI
11	SD4	I/O	SD4 signal for SCSI
12	SD5	I/O	SD5 signal for SCSI
13	SD6	I/O	SD6 signal for SCSI
14	SD7	I/O	SD7 signal for SCSI
15	SDP	I/O	SDP signal for SCSI
16	TERMPWR	—	Terminator power (+5 VDC)
17	SATN	I	ATN signal for SCSI
18	SBSY	I/O	BSY signal for SCSI
19	SACK	I	ACK signal for SCSI
20	SRST	I	RST signal for SCSI
21	SMSG	O	MSG signal for SCSI
22	SSEL	I/O	SEL signal for SCSI
23	SCD	S/D	C/D signal for SCSI
24	SREQ	O	REQ signal for SCSI
25	SIO	O	I/O signal for SCSI
26	GND	—	GND
27	IN1	I	Option switch 1
28	TXD	O	Transmitted data
29	IN2	I	Option switch 2
30	SCK	O	Option clock
31	IN3(B)	O	Blue lamp control
32	LOD	O	Option control
33	IN4(G)	O	Green lamp control
34	SEL	O	Select signal
35	IN5(R)	O	Red lamp control
36	+5	—	+5 VDC
37	+5	—	+5 VDC
38	GND	—	GND
39	+24	—	+24 VDC
40	+24	—	+24 VDC

A.2 CIRCUIT DIAGRAMS

Figure A-2. B028 MAIN Circuit Diagram

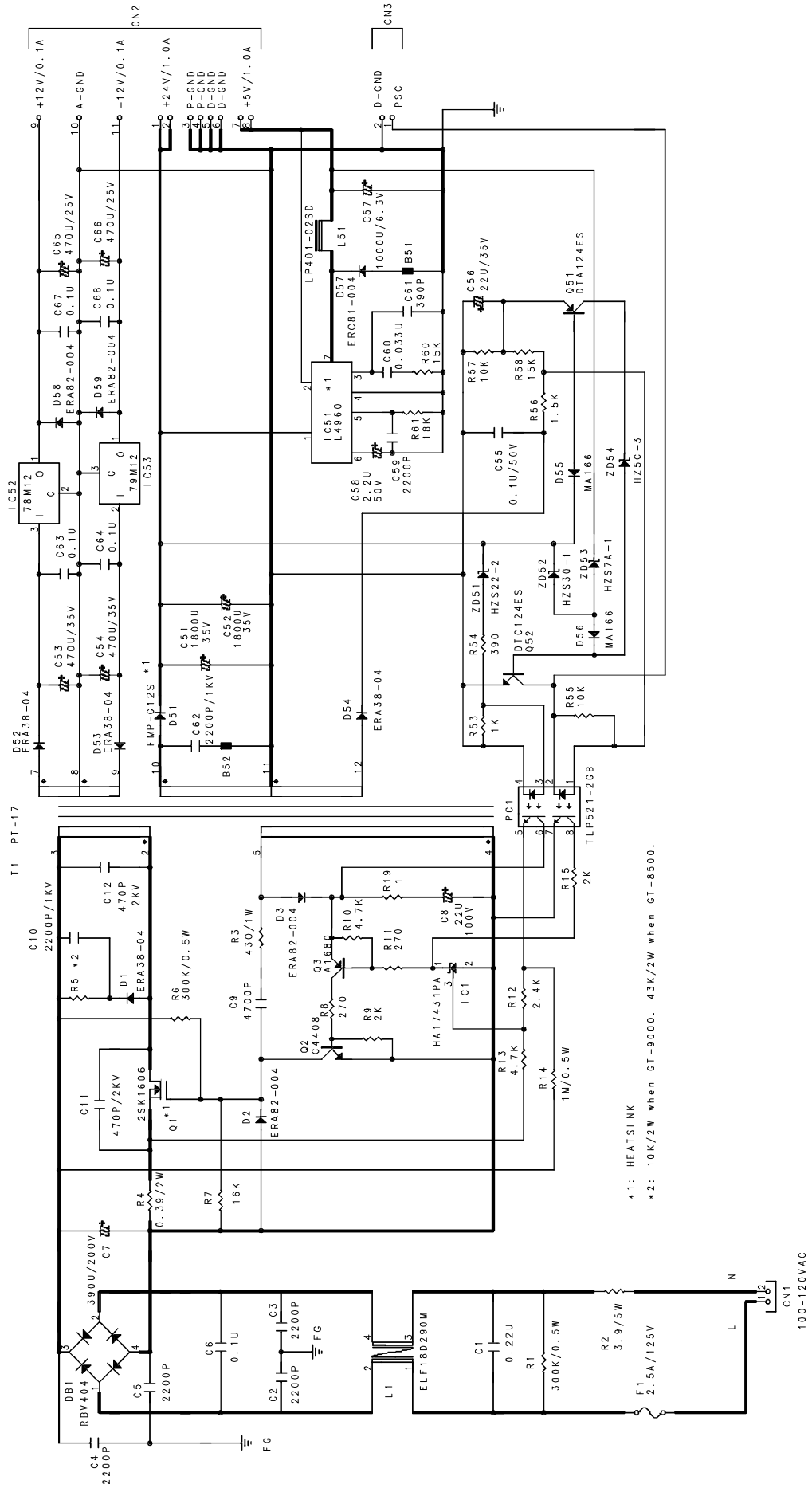

Figure A-3. B027 PSB Circuit Diagram

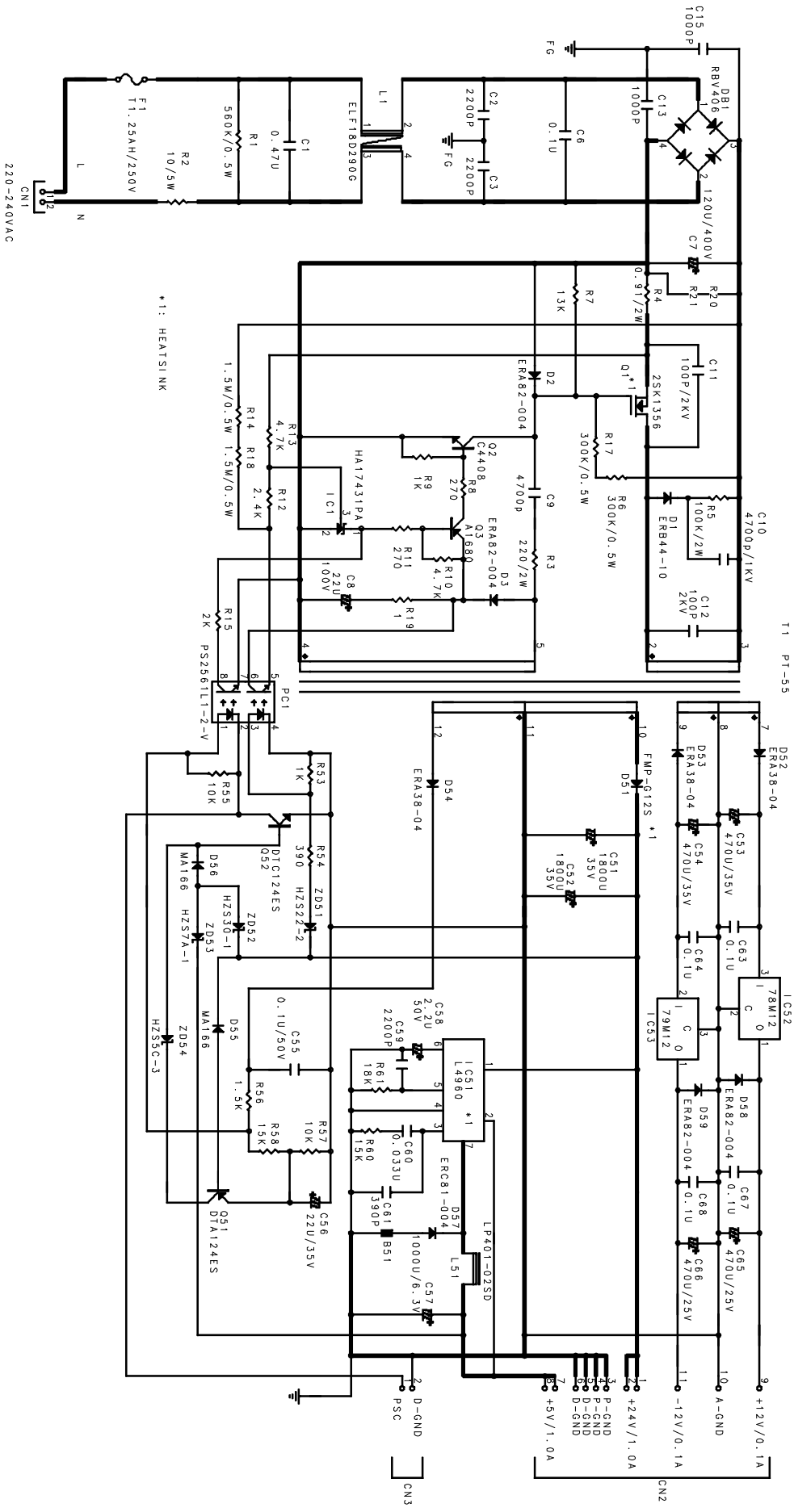

Figure A-4. B027 PSE Circuit Diagram

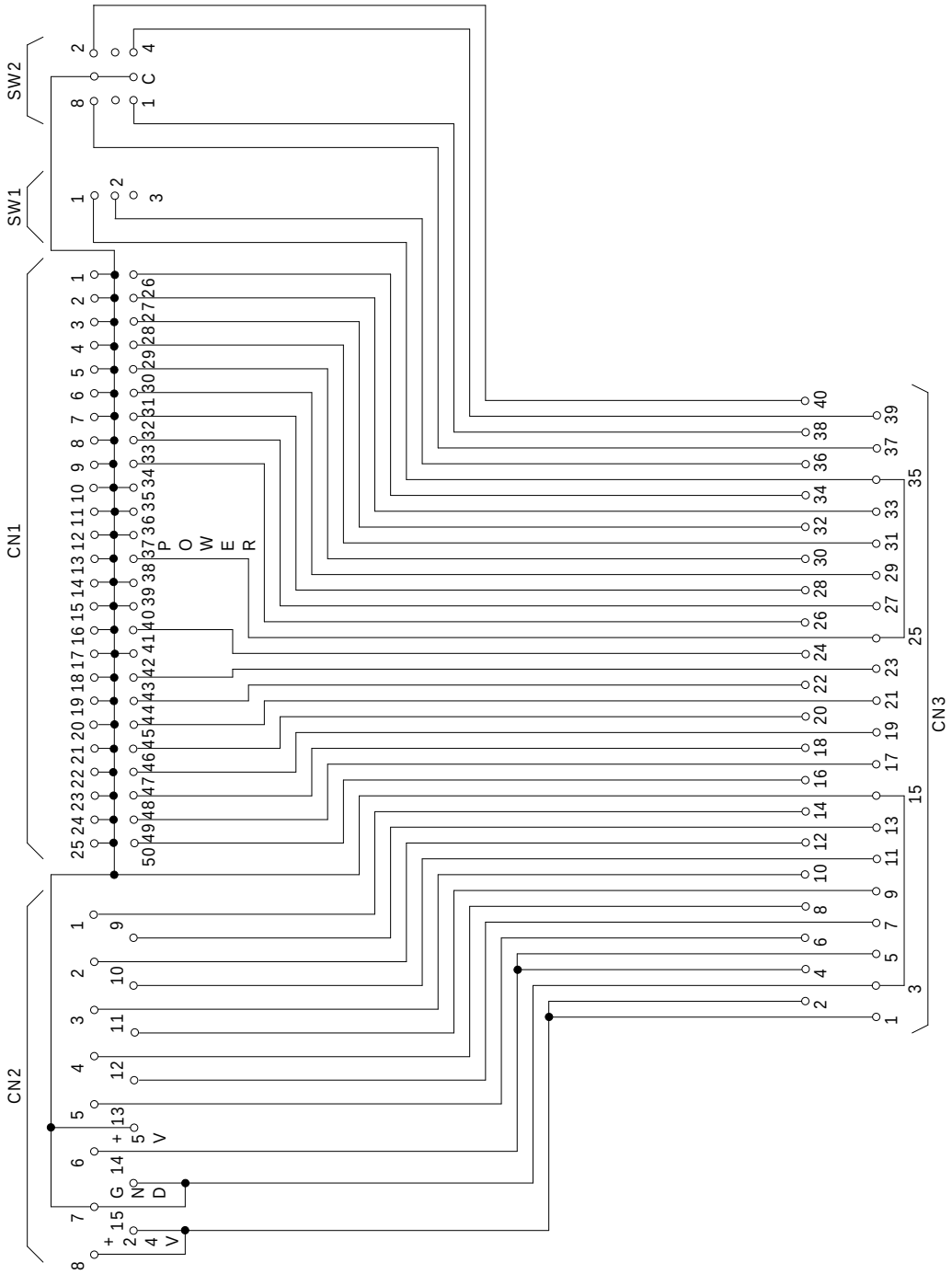

Figure A-5. B028 I/F Circuit Diagram

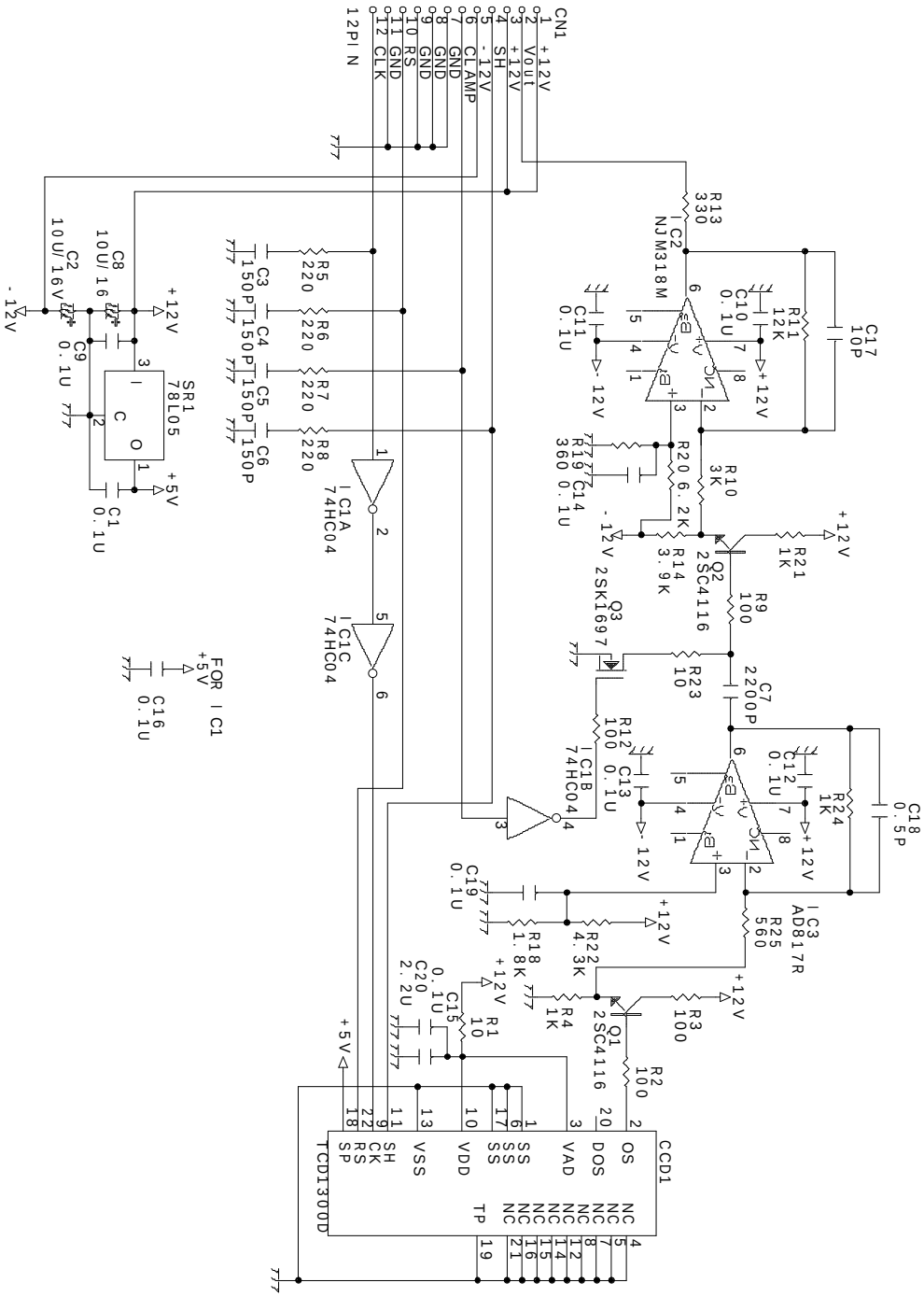

Figure A-6. B028 ISN (CCD) Circuit Diagram

A.3 CIRCUIT BOARD COMPONENT LAYOUTS

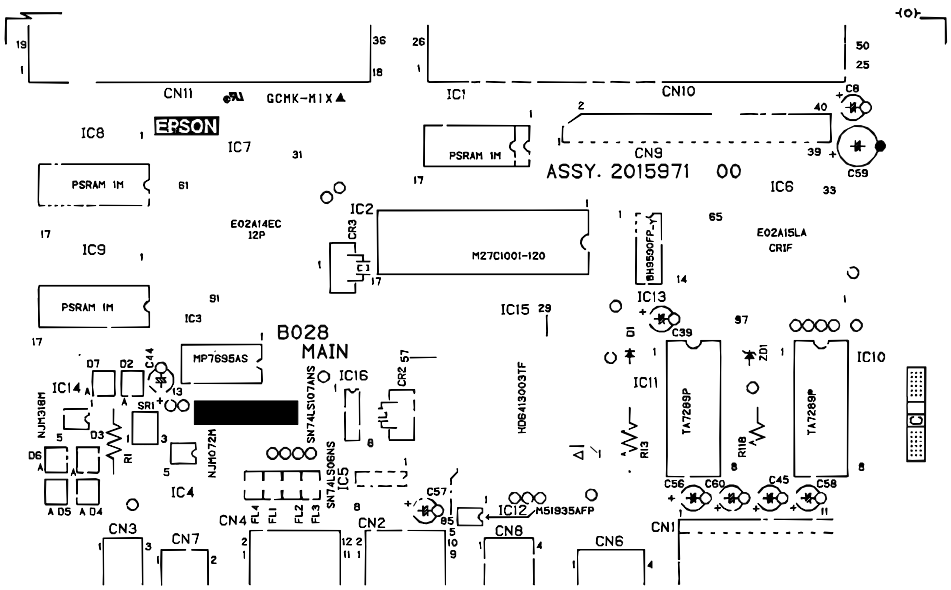

Figure A-7. B028 MAIN Component Layout (Front)

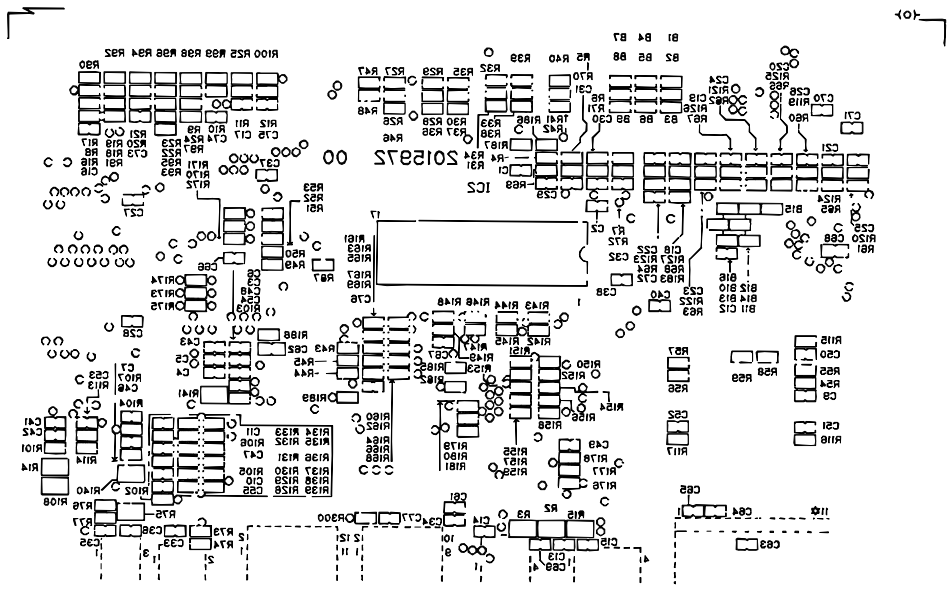

Figure A-8. B028 MAIN Component Layout (Rear)

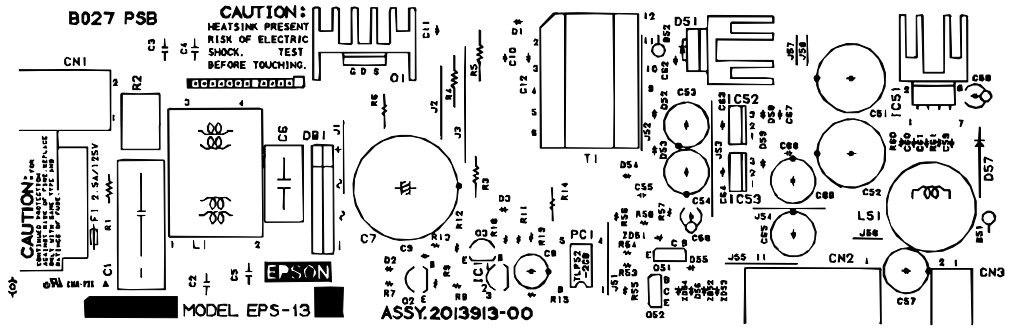

Figure A-9. B027 PSB Component Layout

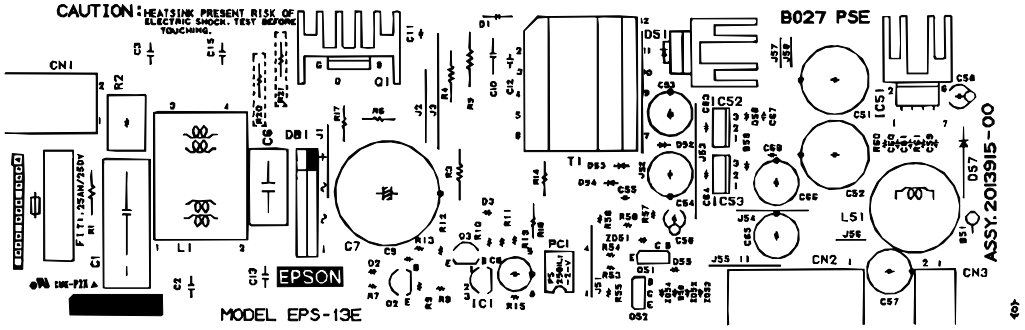

Figure A-10. B027 PSE Component Layout

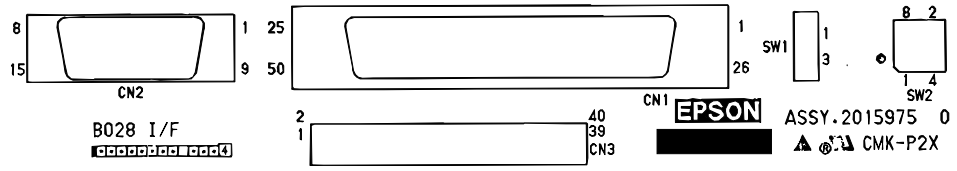

Figure A-11. B028 I/F Component Layout

A.4 EXPLODED DIAGRAMS

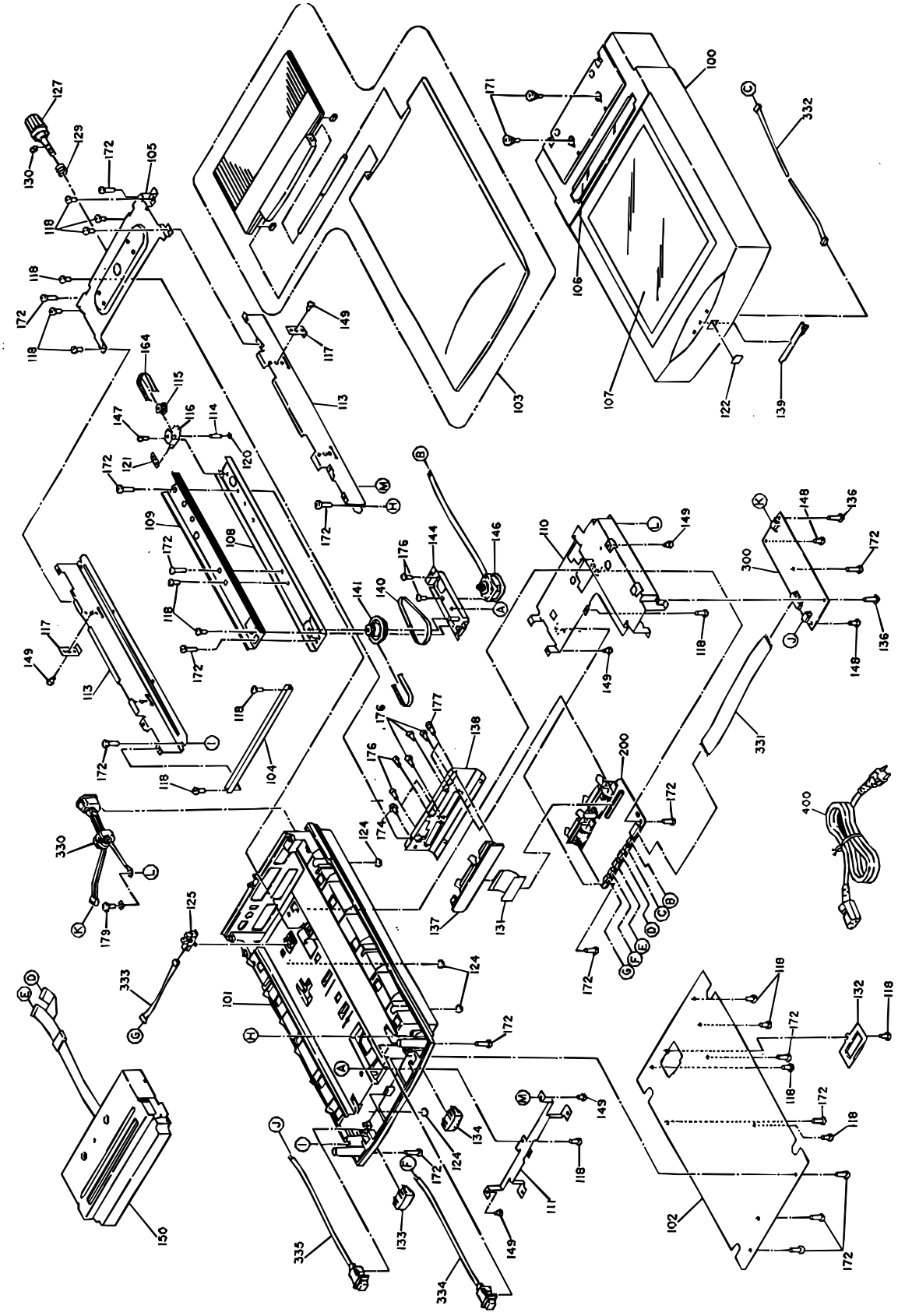

Figure A-12. Exploded Diagram

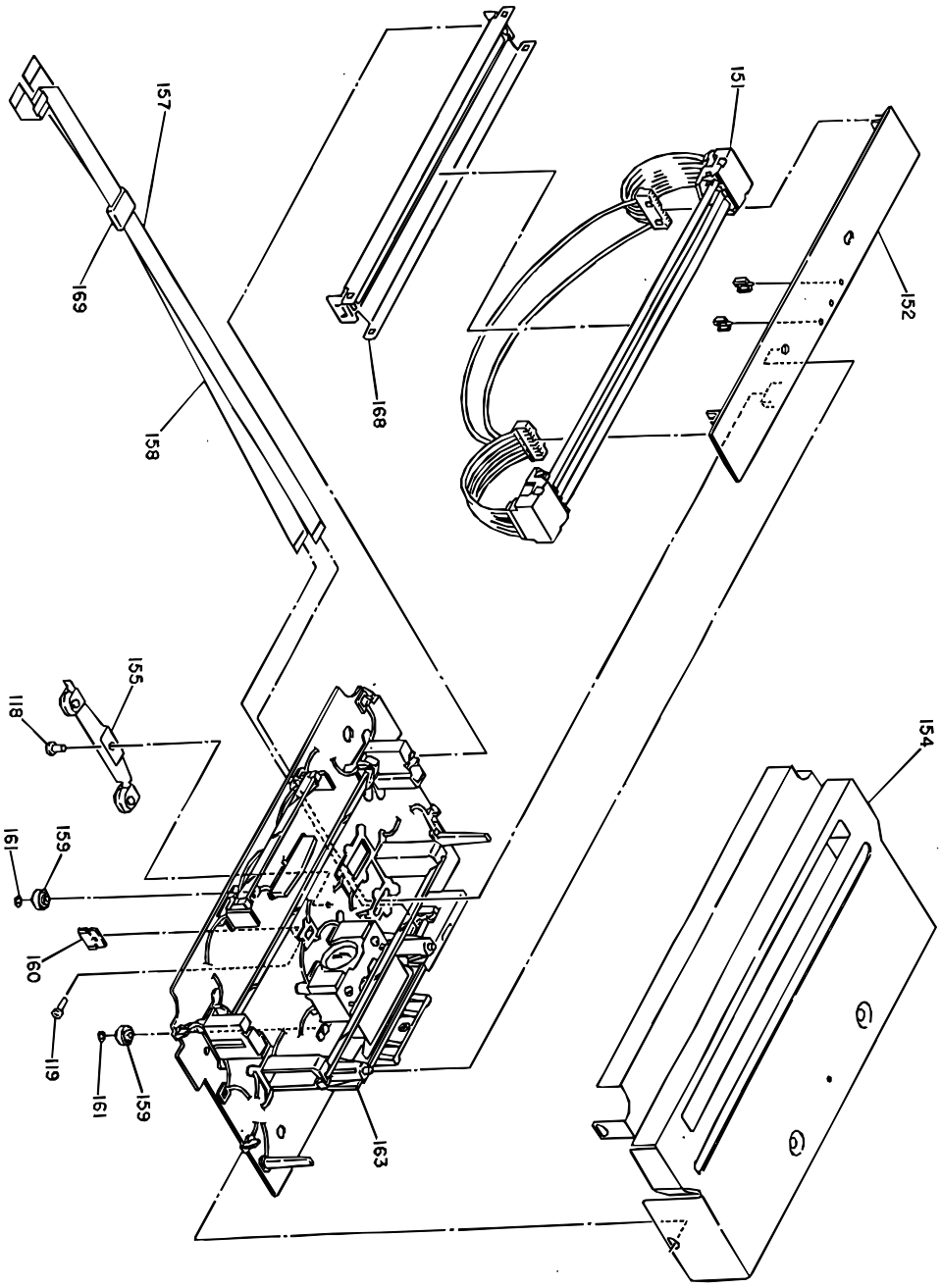

Figure A-13. Exploded Diagram

Table A-10. Part No. Reference Table

Ref. No.	Description	PPL Name
100	UPPER HOUSING	HOUSING ASSY., UPPER
101	LOWER HOUSING	HOUSING SUB ASSY., LOWER
102	BOTTOM PLATE	PLATE, BOTTOM
103	DOCUMENT COVER	COVER ASSY., DOCUMENT
104	FRONT FRAME	FRAME FRONT
105	REAR FRAME	FRAME, REAR
106	SMALL GLASS	GLASS, SMALL
107	LARGE GLASS	GLASS ASSY., LARGE
108	CENTER RAIL	RAIL, MIDDLE
109	RAIL COVER	COVER, RAIL
110	REAR SHIELD PLATE	SHIELD PLATE, REAR
111	FRONT SHIELD PLATE	SHIELD PLATE, FRONT
113	SIDE FRAME	FRAME ASSY., SIDE
114	DRIVEN PULLEY SHAFT	SHAFT, PULLEY, DRIVEN
115	DRIVE PULLEY	DRIVE PULLEY
116	DRIVEN PULLEY HOLDER	HOLDER, PULLEY, DRIVEN
117	CR STOPPER	STOPPER, CR
118	CBS SCREW (M3 × 6)	C.B.S SCREW (M3 ´ 6)
119	CP SCREW (M3 × 8)	C.P. SCREW (M3 ´ 8)
120	RETAINING RING	RETAINING RING
121	EXTENSION SPRING (939 g)	EXTENSION SPRING, 939
122	LOGO PLATE	LOGO PLATE
124	FOOT	FOOT
125	HP SENSOR	DETECTOR, HP
127	THUMB SCREW (Transportation Screw)	THUMB SCREW, 5 × 10, F/NI
129	COMPRESSION SPRING (250 g)	COMPRESSION SPRING, 250
130	RETAINING E-RING (4 mm)	RETAINING RING TYPE-E (4)
131	CABLE	CABLE, IF
132	ROM COVER	COVER, ROM
133	RESET BUTTON KEYTOP	KEYTOP, RESET SWITCH
134	POWER BUTTON KEYTOP	KEYTOP, POWER SWITCH
136	CBB SCREW (M3 × 14)	C.B.B SCREW (M3 × 14)
137	B028 I/F BOARD	BOARD ASSY., INTERFACE
138	I/F COVER PLATE	COVER, I/F PLATE
139	LED BOARD	POWER SUPPLY., LED
140	MOTOR BELT	TIMING BELT, MOTOR
141	DRIVE PULLEY	PULLEY, DRIVE
144	MOTOR FRAME	FRAME ASSY., MOTOR
146	CR MOTOR	MOTOR CR
147	CBSP SCREW (M3 × 6)	C.B.S.P SCREW (M3 ´ 6)
148	CPSPS SCREW (M3 × 6)	C.P.S.P.S SCREW (M3 ´ 6)
149	CB SCREW (M3 × 3)	C.B SCREW (M3 ´ 3)

Table A-10. Part No. Reference Table (Continued)

Ref. No.	Description	PPL Name
150	CARRIAGE ASSEMBLY (Scanner Head)	CARRIAGE ASSY.
151	LAMP	LAMP ASSY.
152	INVERTER BOARD	BOARD ASSY., INVERTOR
154	CR COVER	COVER ASSY, CR
155	ROLLER HOLDER	HOLDER ASSY., ROLLER
157	INVERTER CABLE (FFC)	CABLE, INVERTOR
158	SENSOR CABLE (FFC)	CABLE, SENSOR
159	CARRIAGE ROLLER	ROLLER, CARRIAGE
160	BELT CLAMP	CLAMP BELT
161	RETAINING E-RING (2.3 mm)	RETAINING RING TYPE-E (2.3)
163	CARRIAGE BASE	CARRIAGE ASSY., BASE
164	TIMING BELT	TIMING BELT
168	LAMP COVER	COVER, LAMP
169	FERRITE CORE	FERRITE CORE
171	DOCUMENT COVER SCREW	METAL FITTING COVER DOCUMENT
172	CBP-TITE SCREW (M3 × 12)	C.B.P-TITE SCREW (M3 ´ 12)
174	CPS(O) SCREW (M3 × 6)	C.P.S.(O) SCREW (M3 ´ 6)
176	CP SCREW (M3 × 6)	C.P. SCREW (M3 ´ 6)
177	ADF CONNECTOR SCREW	SCREW, CONNECTOR, ADF
179	CB(O) SCREW (M4 × 8)	C.B.(O). SCREW (M4 ´ 8)
200	B028 MAIN BOARD	BOARD ASSY., MAIN
300	B027 PSB/PSE BOARD	BOARD ASSY., POWER SUPPLY
330	CABLE	HARNESS
331	CABLE	HARNESS
332	CABLE	HARNESS
333	CABLE	HARNESS
334	OPERATE BUTTON	SWITCH, OPERATE
335	RESET BUTTON	SWITCH, RESET
400	AC CABLE	POWER CABLE