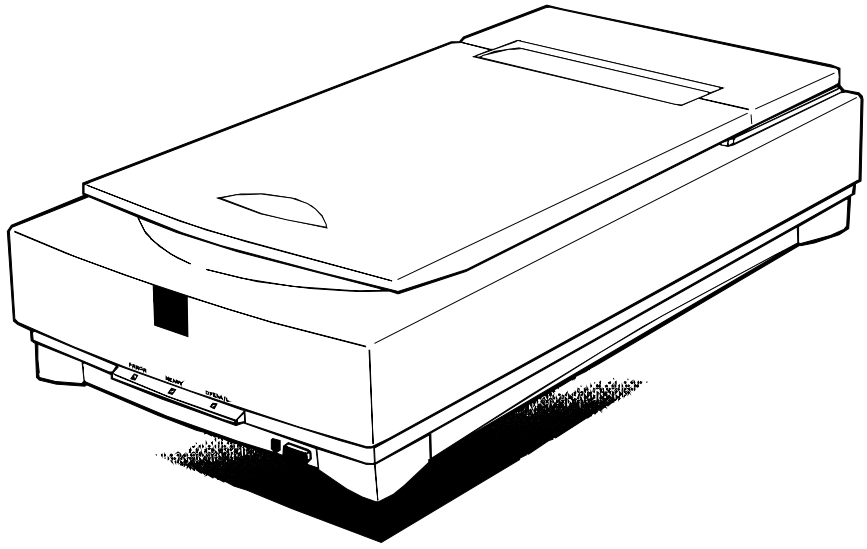
EPSON COLOR IMAGE SCANNER

GT-9500

SERVICE MANUAL



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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.

The above notwithstanding SEIKO EPSON can assume no responsibility for any errors in this manual or the consequence thereof.

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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.

PREFACE

This manual describes functions, theory of electrical and mechanical operations, maintenance, and repair of GT-9500 / Expression 636.
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 scanner.

CHAPTER 2. OPERATING PRINCIPLES

Describes the theory of scanner 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.

REVISION SHEET

Revision	Issue Date	Revision Page	
A	August 23, 1996	-	1st issue

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Chapter 1 Product Description

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1.1 FEATURES

The GT-9500/Expression 636 is the high-resolution (600 dpi) color image scanner for A4 and letter-size sheets. Its main features are:

❑ High resolution:	600 dpi	
❑ High image quality:	12-bit A/D (optical density 3.0)	
❑ High speed (600 dpi, draft mode):	Line-art	Approx. 5.5 ms/line
	256 gray levels	Approx. 5.5 ms/line
	Full color	Approx. 8 ms/line
❑ Accurate reading position:	± 0.5 mm (accuracy of origin point)	
❑ New command level:	ESC/I-B6 (B5+AAS) AAS (automatic area segmentation), for better handling of images containing text	
❑ Light source with no warm up:	Xe-Gas cold cathode fluorescent lamp	

Figure 1-1 shows an external view of GT-9500/Expression 636, and Table 1-1 lists optional units available.

Table 1-1. Optional Units

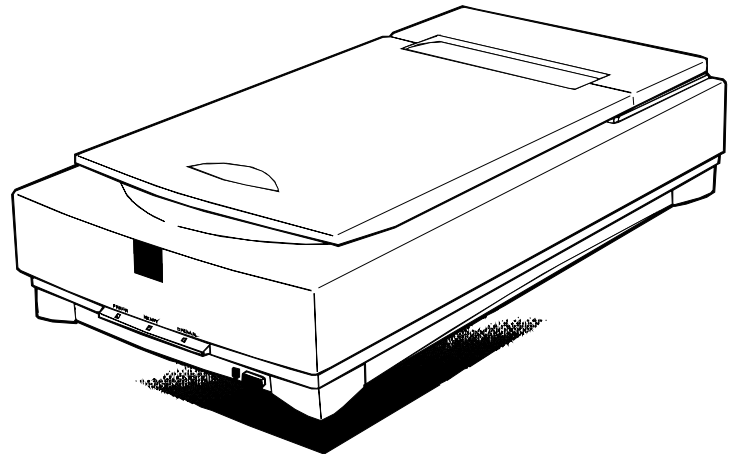

Figure 1-1. External View

Model	Description
B813001	Automatic document feeder (ADF) for GT-9000/Expression 636
B813011	Automatic document feeder (ADF) for ES-1200C
B81307*	Transparency unit

* The number represented by the asterisk varies by country

1.2 SPECIFICATIONS

1.2.1 General Specifications

This section provides specifications for the GT-9500/Expression 636.

Product type:	Flatbed color image scanner	
Sub-scanning method:	Movement of the reading head	
Photoelectric device:	Color CCD line sensor	
Maximum reading area:	216 × 297 mm (8.5" × 11.7") Either a full A4 or letter- size page	
Maximum effective picture elements:	5096 × 7020 pixels (600 dpi)	
Scanning resolution:	Main Sub	600 dpi 600 dpi
Output resolution:	50 - 2400 dpi (in 1 dpi steps)	
Scanning speed: (A4, 600 dpi, draft mode)	Line art 256 gray levels Full color	approx. 5.5 ms/line approx. 5.5 ms/line approx. 8 ms/line (line/byte sequence)
Color separation:	Using the CCD as a color filter	
Command level:	ESC/I-B6 (B5, AAS)	
Zoom:	50 - 200 % (in 1% steps)	
Gray scale:	8 bits/pixel (input 12 bits/pixel, output 8 bits/pixel)	
Gamma correction types:	Two CRT levels (A, B) Three print levels (A, B, C) One user-defined level	
Color correction types:	Impact dot printer Thermal transfer printer Ink-jet printer CRT display User-defined	
Brightness:	7 levels	
Line art:	Fixed threshold TET (Text Enhanced Technology)	
Digital halftoning: (bi-level, quad-level)	Error diffusion Dither (resident) Dither (user-defined)	3 modes (A, B, C) 4 modes (A, B, C, D) 2 modes (A, B)
Interface (resident):	Bidirectional parallel interface SCSI (50/50-pin connectors)	
Light source:	Xe-Gas cold cathode fluorescent lamp	

1.2.2 Electric Specifications

Rated voltage:	100 - 120 VAC (100 V model) 220 - 240 VAC (200 V model)
Input voltage:	100-120 VAC ±10% 220-240 VAC ± 10%
Rated current:	0.8 A (100 V model) 0.4 A (200 V model)
Rated frequency range:	50 - 60 Hz
Input frequency range:	49.5 - 60.5 Hz
Power consumption:	Approx. 25 W (self test mode without optional unit) Max. 50 W (with optional unit)
Insulation resistance:	10 M Ω at 500 VDC (between AC line and chassis)
Dielectric strength:	1.5K VAC, minute (200 V model) 1.2K VAC, minute (100 V model) (between AC line and chassis)

1.2.3 Safety, EMC

Safety regulations:	100 V model	UL1950 (+D3) CSA 22.2 NO.950(+D3)
	200 V model	EN60950 (TÜV) EN60950 Nordic Deviation (NEMKO, FIMKO, DEMKO, SEMKO)
EMI:	100 V model	FCC 15B Class B : USA CSA 108.8 class B: Canada EN55022 (CISPR Pub 22) class B
EMS:	200 V model	EN 60555-2,-3 IEC 801-2,-3, -4

1.2.4 Resistance to Electric Noise

Static electricity:	Panel	10 KV
	Metal	7 KV / 150 pF, 150 Ω

1.2.5 Environmental Conditions

Temperature:	Operating	5 ° to 35 ° C (41_ to 95 _ F)
	Storage	-25 ° to 60 ° C (-13_ to 140_ F)
Humidity:	Operating	10 to 80 % (no condensation)
	Storage	10 to 80 % (No condensation)

1.2.6 Reliability

Main unit:	MCBF = 100,000 cycles

1.2.7 Operating Conditions

Dust:	Ordinary office or home conditions. Keep away from areas with extreme dust.
Illumination:	Operation under direct sunlight or near a strong light source is not guaranteed and should be avoided.

1.2.8 Specifications for Original

Reflective type:	The source document should have a smooth surface, such as a printed page or a photograph.
Transparency type:	Reverse film
With transparency unit:	Negative film

1.2.9 Page Size

Dimensions:	216 mm (H) × 297 mm (W) 8.5" (H) x 11.7" (W)

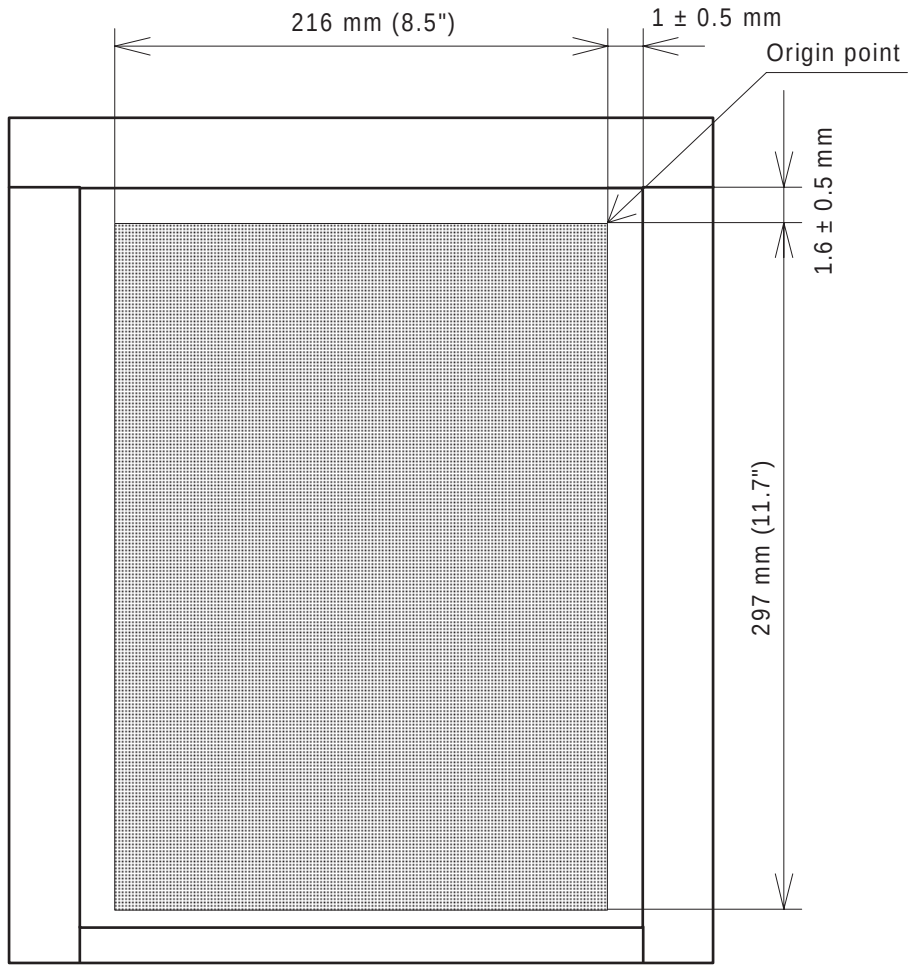

Figure 1-2. Maximum Size of Original for Scanning

1.3 INTERFACE

The GT-9500/Expression 636 is equipped with the following external interfaces:

❏ Bidirectional parallel interface

❏ SCSI (Small Computer System Interface)

1.3.1 Bidirectional Parallel Interface

Data format:	8-bit parallel
Handshaking:	BUSY, ACK handshaking
Signal level:	TTL level
Connector type:	36-pin
Data transmission timing:	See Figures 1-3 and 1-4.

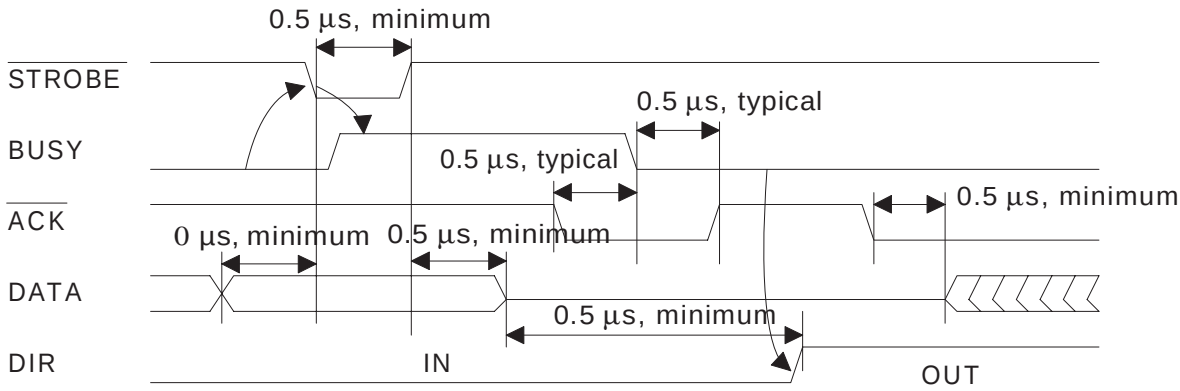

Figure 1-3. Data Transmission Timing (Host to Scanner)

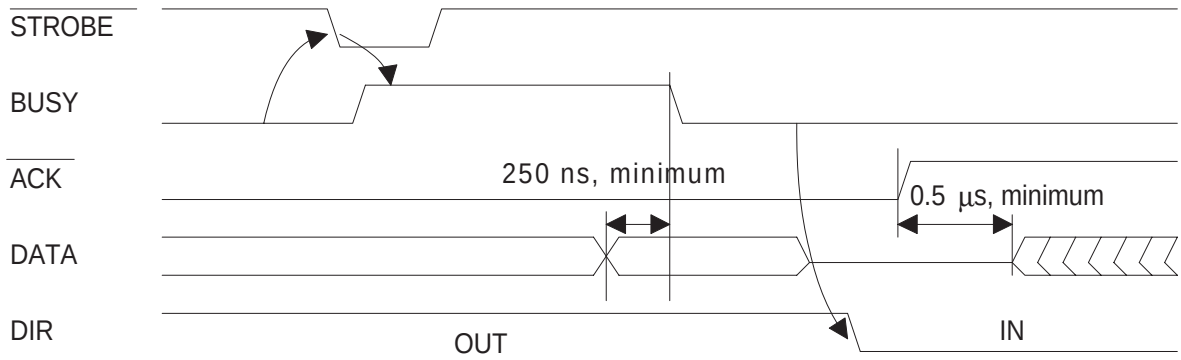

Figure 1-4. Data Transmission Timing (Scanner to Host)

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

Pin No.	Signal Name	I/O	Description
1	$\overline{\text{STROBE}}$	I	Data strobe pulse
2 - 9	DATA 0 - 8	I/O	8-bit data bus
10	$\overline{\text{ACK}}$	O	Acknowledge signal
11	BUSY	O	Scanner busy signal
12 - 15	NC	_	Not used
16	GND	_	Ground
17	C_GND	_	Frame Ground
18	NC	_	Not used
19 - 30	GND, Ground	_	Ground
31	INIT	I	Scanner reset signal. The pulse width at the receiving terminal must be longer than 50 μs.
32	NC	_	Not used
33	GND	_	Ground
34,35	NC	_	Not used
36	DIR	I	Direction

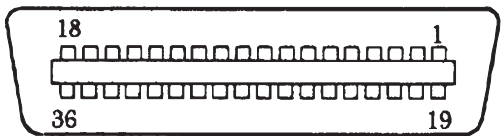

Figure 1-5. Connector Pin Assignments for Bidirectional Parallel Interface

1.3.2 SCSI

This section describes the SCSI interface for the GT-9500/Expression 636.

1.3.2.1 Basic Specifications

Any items not included in this specification conform with the ANSI standard X3.131-1986.

Function: The following functions are available, which are included in the X3.131-1986 specification.

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

Note: *The LUN (Logical Unit Number) is fixed at* **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

Electric specification: Conforms to ANSI standard X3.131-1986.

Connector type: 50/50-pin connector

Terminator: Internal terminator

Switch control of active or inactive.
(SW=ON: Terminator available)

SCSI ID: The SCSI ID is set with a rotary switch on the rear panel.
Set the switch number to correspond to the available SCSI address. The switch can be set from 0 to 7.
The middle position between 7 and * is reserved for origin adjustment. (Refer to Chapter 4.)
* is GT-9000/ES-1200C emulation mode. (ID = 2, fixed)

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	Confirms scanner for operation
Request Sense	03H	Requests sense data *1
Receive	08H	Data transmission from target to initiator
Send	0AH	Data transmission from initiator to target
Inquiry	12H	Requests information from SCSI device *2

Notes: *1* *Only the extension sense data format is supported for sense data returned by the Request Sense 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 byte:

*[00H, 00H, 00H, 'EPSON', 20H, 20H, 20H, 'SCANNER', 20H, 20H 'GT-xxxx',20H,' ****', 00H, 00H, 00H, FFH]*

Where: *'GT-xxxx' indicates the product name.*

*'****' indicates the 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	0	0	0	0	0	0	0
Check Condition	R	0	0	0	0	0	1	0
Busy	R	0	0	0	1	0	0	0

Notes: *All other codes are reserved.*

'R' means reserved bit.

1.3.2.4 SCSI Messages

Table 1-5. SCSI Interface Messages

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 Connector Information

Table 1-6. SCSI Pin Assignments

Pin No.	Signal	I/O	Description
1 - 12, 14 - 25, 35 - 37, 39, 40, 42	GND	_	Signal ground
13	NC	_	Not used
26 - 33	DB0 - DB7	I/O	Data bus 0 - 7
34	DBP	I/O	Data bus parity
38	TERMPWR	_	Terminal power
41	ATN	I	Attention
43	BSY	I/O	Busy
4	ACK	I	Acknowledge
45	RST	I	Reset
46	MSG	O	Message
47	SEL	I/O	Select
48	C/D	O	Command/data
49	REQ	O	Request
50	I/O	O	Input / output

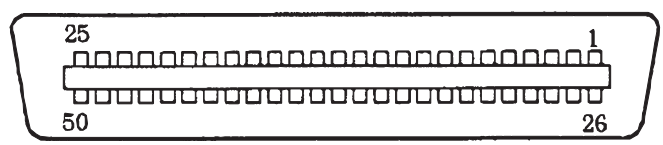

Figure 1-6. Connector Pin Assignments for SCSI

1.4 COMMANDS

This section describes data transmission protocols between the host computer and the scanner.

1.4.1 Control Codes for Handshaking Procedure

This section describes the types of control codes used for handshaking.

Control Code without Parameters

1. The host computer sends a control code.
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.)

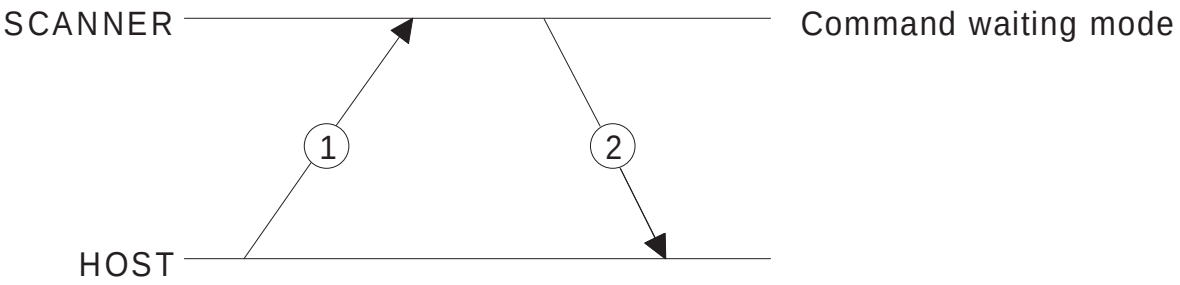

Figure 1-7. Control Code without Parameters

Control codes with parameters

1. The host computer sends a control code.
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.)

3. If the host receives **ACK**, it sends the parameters.
4. Response from the scanner.

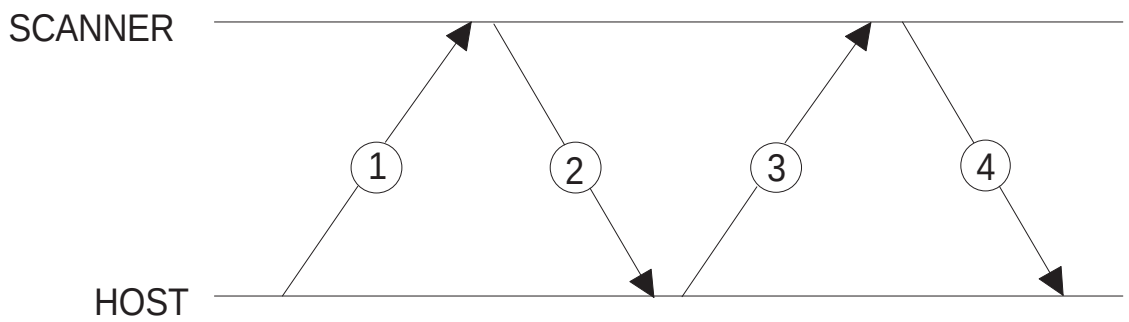

Figure 1-8. Control Code with Parameters

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

1.4.2 Data Block Handshaking Procedure

This section describes the data block handshaking procedure.

Requesting Scanner Data

1. The host computer sends a control code.
2. The scanner responds by sending a data block.

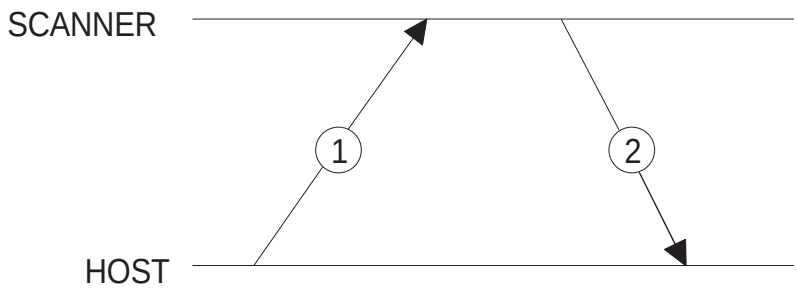

Figure 1-9. Scanner Data Request

Reading Monochrome Image Data

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

1. The host computer sends the control code. (Refer to **ESC G**.)
2. The scanner responds with a data block.
3. The host computer responds:

   ACK (06H): Continue to send more data
   CAN (18H): Abort

4. The scanner sends the last data block.

Note: *1. The host computer should not send back an* **ACK** *(06H) code after receiving the last data block..*
2. The order of image data for color line sequences or byte sequences is specified by **ESC C**.

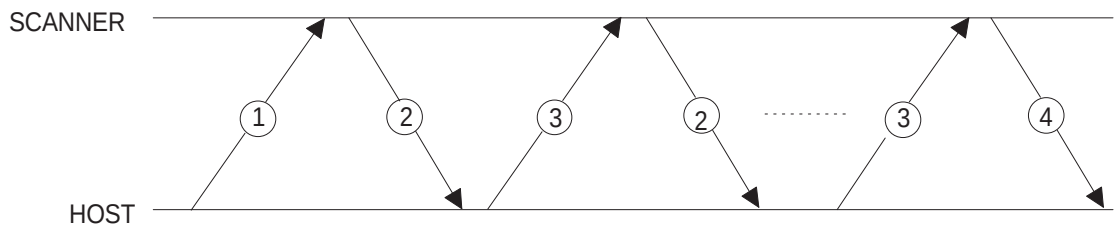

Figure 1-10. Reading Monochrome Image Data

Reading Color in the Page Sequence Mode

1. The host computer sends a control code.
2. The scanner responds by sending a data block.
3. The host computer responds:

   ACK (06H): Continue to send more data
   CAN (18H): Abort

4. The scanner sends the last data block.

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

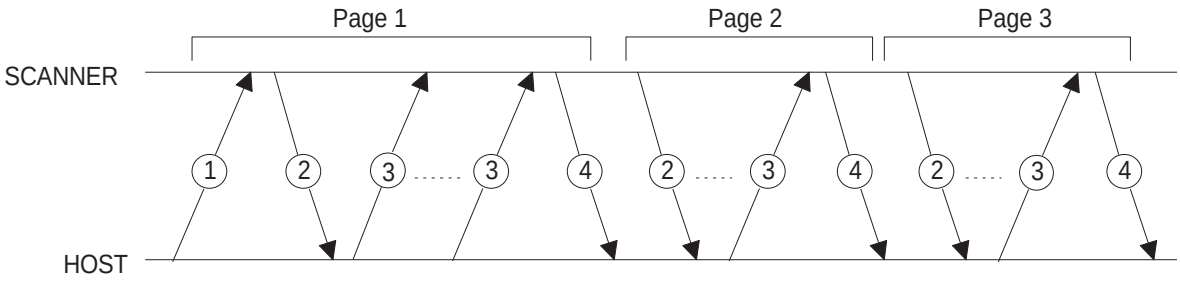

Figure 1-11. Reading Color in Page Sequence Mode

Transferring Image Data in Line Sequence Mode

1. The host computer sends a control code.
2. The scanner sends a data block (the first block of color data).
3. The scanner sends another data block (the second block of color data).
4. The scanner sends another data block (the third block of color data).
5. The host computer responds:

   ACK (06H): Continue sending more data
   CAN (18H): Abort

6. The scanner sends the last data block.

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

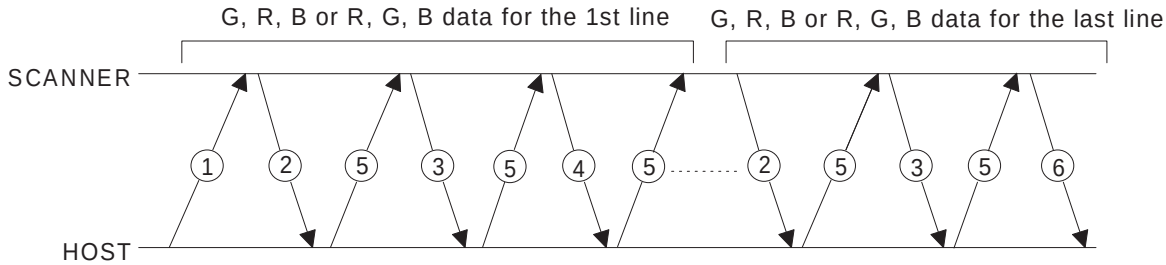

Figure 1-12. Image Data Transfer in the Line Sequence Mode

Transferring Image Data in the Line Sequence Mode (Block Transfer Mode)

1. The host computer sends a control code.
2. The scanner sends a data block (G or R).
3. The scanner sends another data block (R or G).
4. The scanner sends the third data block (Blue).
5. The host computer responds:

   ACK (06H): Continue sending more data
   CAN (18H): Abort

6. The scanner sends the last data block.

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

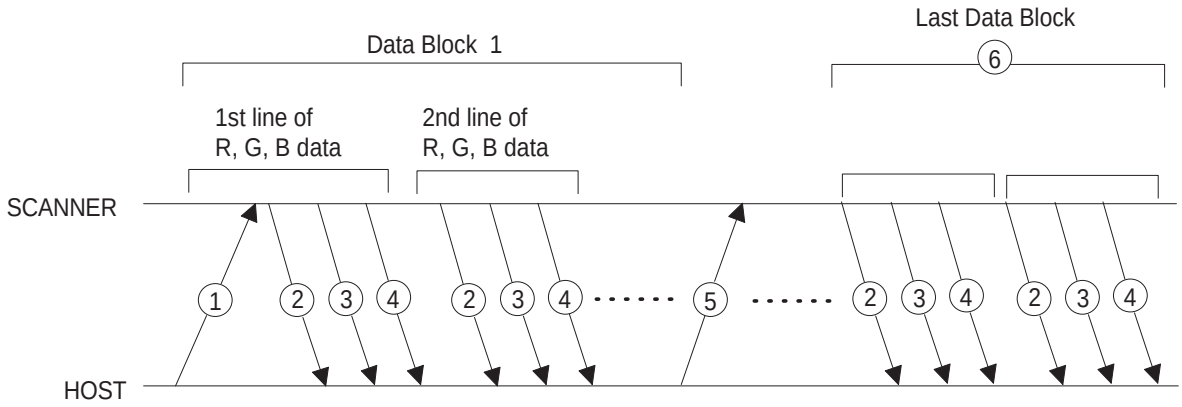

Figure 1-13. Image Data Transfer in the Line Sequence Mode (Block Transfer Mode)

Transferring Image Data in Byte Sequence Mode

1. The host computer sends the control code.
2. The scanner sends a data block (R, G, B 1 block of data).
3. The host computer responds:

   ACK (06H): Continue sending more data
   CAN (18H): Abort

4. The scanner sends the last data block.

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

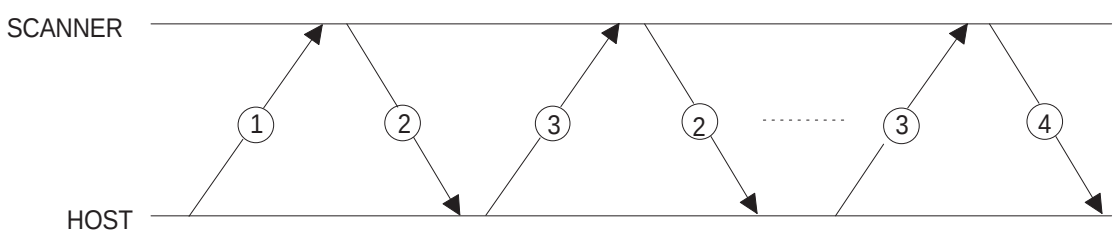

Figure 1-14. Image Data Transfer in Byte Sequence Mode

1.4.3 Structure of a Data Block

This section describes two data block structures.

❑ Line Data Structure Including 4 bytes for the information block and 1 line of the image data.

❑ Block Data Structure

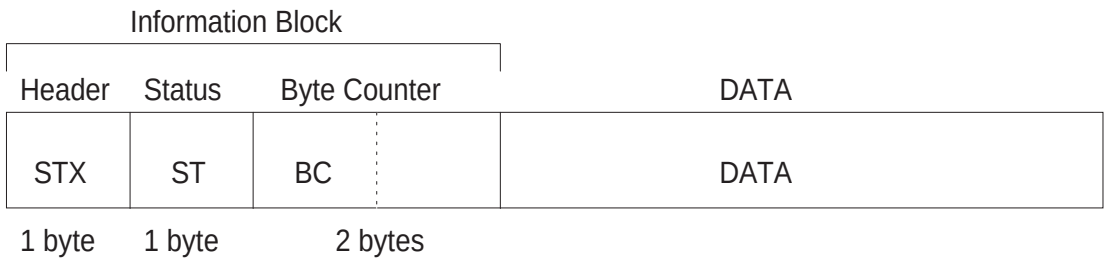

Figure 1-15. Line Data Structure

Including 6 bytes for the information block and *n* lines of the image data, where *n* is indicated in the line counter of the information block.

Note:

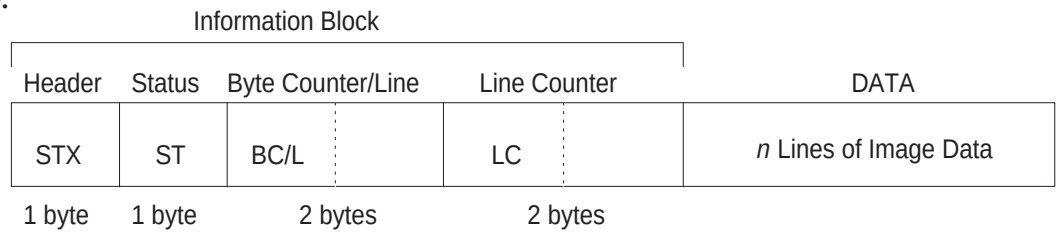

Figure 1-16. Block Data Structure

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

1.4.3.1 Line Data Structure

Information Block

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

Status: Refer to Section 1.4.4.

Byte Counter: The byte counter indicates the number of bytes of data that follow the information block. The byte counter consists of 2 bytes, and the following bytes precede the higher bytes.

Data

Data is either image data or information data that corresponds to the command, such as **ESC I**, **ESC S**, etc. The data has the length indicated by the byte counter.

Color data order: Refer to command **ESC C**.

1.4.3.2 Block Data Structure

Information Block

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

Status: Refer to Section 1.4.4.

Byte Counter/Line: The byte counter/line indicates the number of bytes of image data in each line in the main scanning direction.

Line Counter: The line counter indicates the number of lines of image data for each color.

Note:
1. *The block data structure is available when the executing the 'Set Line Counter' command. (Refer to command* **ESC d**.*)*
2. *For Color Line Sequence mode, image data is arranged in the order green, red, and blue. So, if* **n** *lines of the color data are included in the data block, the line counter indicates* **3 x n**.
3. *The byte counter/line and 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.

Color data order: Refer to command **ESC C**.

1.4.4 Format of a Status Byte

The status byte has the format below:

1. Status indicates the current condition of the scanner (ready, error, etc.).
2. The status byte accompanies the information block for the data block.
3. The scanner returns status information to the host computer when requested by the status request command **ESC F**.

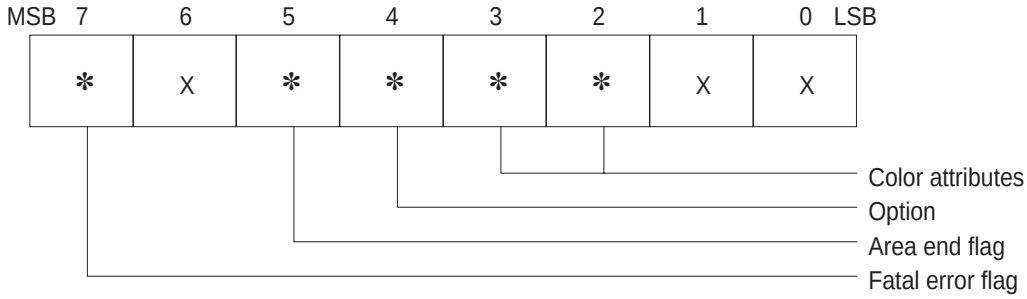

Figure 1-17. Status Byte

The Meaning of Each Status Bit

Bit 7: Fatal error flag. Set to **1** when a system error has occurred.

Bit 6: Reserved (always **0**).

Bit 5: Area end flag.
For reading in color page mode, set to **1** in the last data block of each page of color.
For reading in monochrome mode, color line mode, or color byte mode, set to **1** in the last data block.

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

Bit 3: Color attribute 1. See the following table.

Bit 2: Color attribute 2. See the following table.

Bit 1: Reserved (always **0**).

Bit 0: Reserved (always **0**).

Table 1-7. Color Attributes

Mode Type		Bit 3 (Attribute 1)	Bit 2 (Attribute 2)
Monochrome Mode (**ESC C 0**)		0	0
Line Sequence Mode (**ESC C 1**)	Green	0	1
	Red	1	0
	Blue	1	1
Byte Sequence Mode (**ESC C 3**)		0	1
Block Data Transfer Mode		0	1

1.4.5 Notes for SCSI

The data block from the scanner consists of two parts: an information block and data. The information block includes a byte counter word, which indicates the byte length for the data block. For SCSI, the data length should be set in the CDB (Command Descriptor Block) field by the initiator (host). The information block and the data are sent separately. The initiator (host) receives the information block, detects the length of the data bytes, then it receives the data.

1. The host sends the **ESC G** code, etc.
2. The scanner responds with the information block (4 or 6 bytes).
3. The scanner sends the data.
4. The host computer responds:

   ACK (06H)

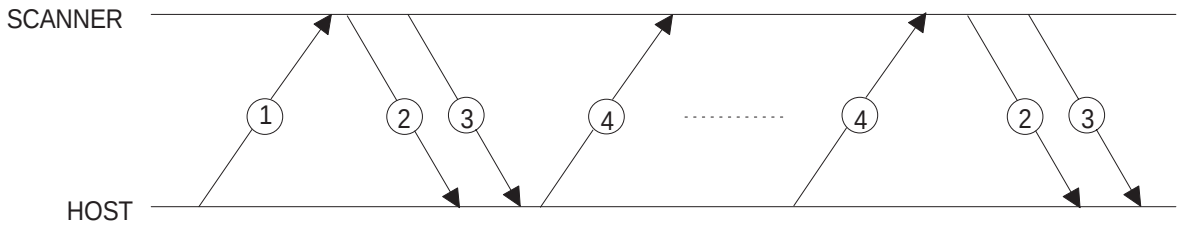

Figure 1-18. Notes for SCSI

1.5 Buttons and Indicators

The GT-9500/Expression 636 has the following buttons, switches, and indicators:

Buttons and Switches

OPERATE	Turns power on and off. At power on, the scanner is reset.	
RESET	Initializes the scanner.	
ROTARY SWITCH	0-7:	SCSI ID
	The middle position between 7 and * :	
		Reserved for origin adjustment. (Refer to Chapter 4.)
	* :	ESC I/-B5 (GT-9000/ES-1200C) emulation mode (ID = 2 , fixed)
TERMINATOR	ON:	Terminator ON (default)
	OFF:	Terminator OFF

Indicators (LEDs)

OPERATE (Green)	This LED indicates while the OPERATE button is on.
READY (Green)	This LED comes on when the scanner is ready to receive data. Blinks in the combination with the ERROR LED when an error occurs.
ERROR (Red)	This LED indicates that the scanner is in an error condition. (Refer to Section 1.5.2.)

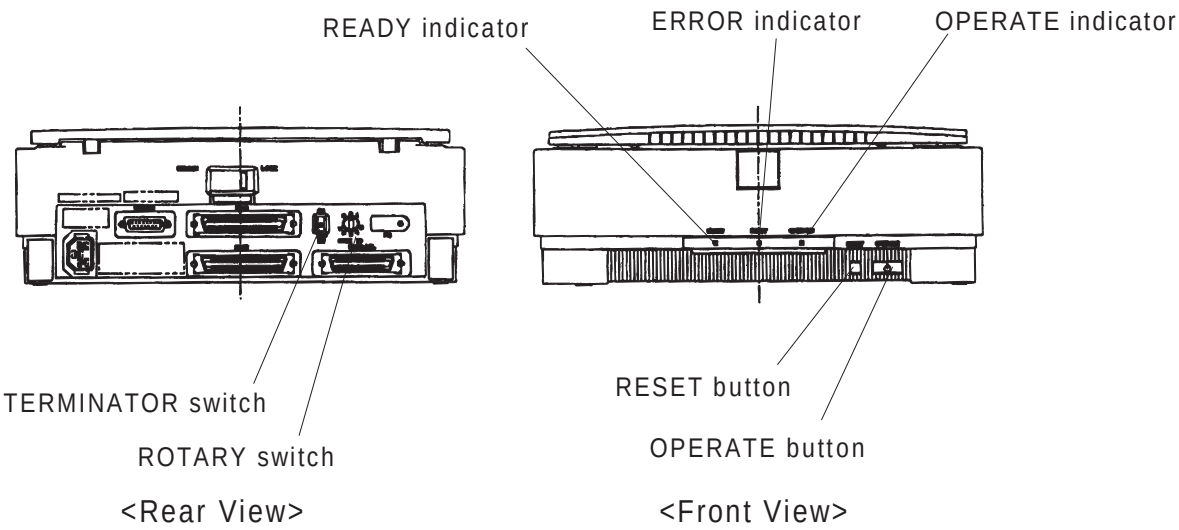

Figure 1-19. Location of Buttons and Indicators

1.6 Errors

When an error occurs, the scanner displays a message using the indicators to identify the error.

Command Error

Cause:	An unidentified command was detected.
Scanner Response:	The scanner ignores the wrong command or parameter. (Therefore, the current setting or default value remains effective.) The scanner sends a **NACK** code and waits for the next command or parameter.
Indicators:	READY LED comes ON ERROR LED comes ON
Remedy:	The error is cleared when the scanner receives a correct command.

Interface Error

Cause:	A wrong procedure is detected in the interface communication. With SCSI, transmission is frozen for more than 30 seconds, except in the BUS FREE phase.
Scanner Response:	The lamp goes off and the scanner stops operation.
Indicators:	READY LED goes OFF ERROR LED blinks
Remedy:	Turn the scanner off and then back on. Press the RESET button. Set the INIT signal in the parallel interface active. Set the RESET signal in SCSI active.
Acceptable commands:	None.

Fatal Error

Cause:	1. The lamp may be broken. 2. Power may have been turned on before the carriage was unlocked. 3. System breakdown.
Scanner Response:	The lamp goes off and the scanner stops operation. Bit 7 of the status byte is set.
Indicators:	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. Set the INIT signal in the parallel interface active. Set the RESET signal in SCSI active.
Acceptable commands:	**ESC F**, **ESC f**, **ESC @**

Option Error

In case of option unit is installed.

Cause:	1. Unit cover open 2. Paper empty
Scanner Response:	Bit 7 of the status byte is set.
Indicators:	READY LED blinks ERROR LED blinks
Remedy:	Remove the error condition.

1.7 FUNCTIONS

This section describes the functions of the GT-9500/Expression 636.

1.7.1 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 ($2 \times 2 \times 2$); 2 bits/pixel can represent 64 colors ($4 \times 4 \times 4$). Eight bits/pixel (providing a total of 24 bits for each pixel) can represent more than 16 million different colors.

Table 1-8. 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. Many microcomputer displays and printers cannot support such tonalities. To achieve optimal results with these devices, normalize a 1 bit/pixel format together with halftoning mode. The **ESC D** command sets the data format.

1.7.2 Output Resolution

The output resolution determines how many pixels, or dots, are used for reproducing an image. Resolution is measured in units of dpi (dots per inch). This scanner has 29 settings: 50, 60, 72, 75, 80, 90, 100, 120, 133, 144, 150, 160, 175, 180, 200, 216, 240, 300, 320, 360, 400, 480, 600, 800, 900, 1200, 1600, 1800, and 2400 dpi. 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 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, 1800, 2400 dpi
Facsimile transmissions:	100, 200, 300, 400 dpi

1.7.3 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.

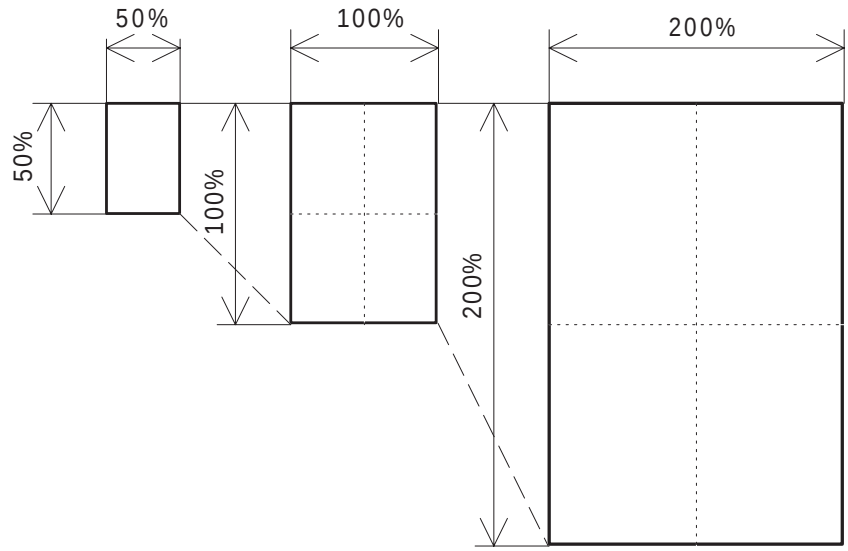

Figure 1-20. Zoom Function

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 an 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 the 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; therefore, you should avoid this practice. The zoom function is set by the **ESC H** command. The default setting is 100 % (for both the main scan and sub scan).

1.7.4 Reading Area

This function allows you to limit the scan to a specified portion of the document. You 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.

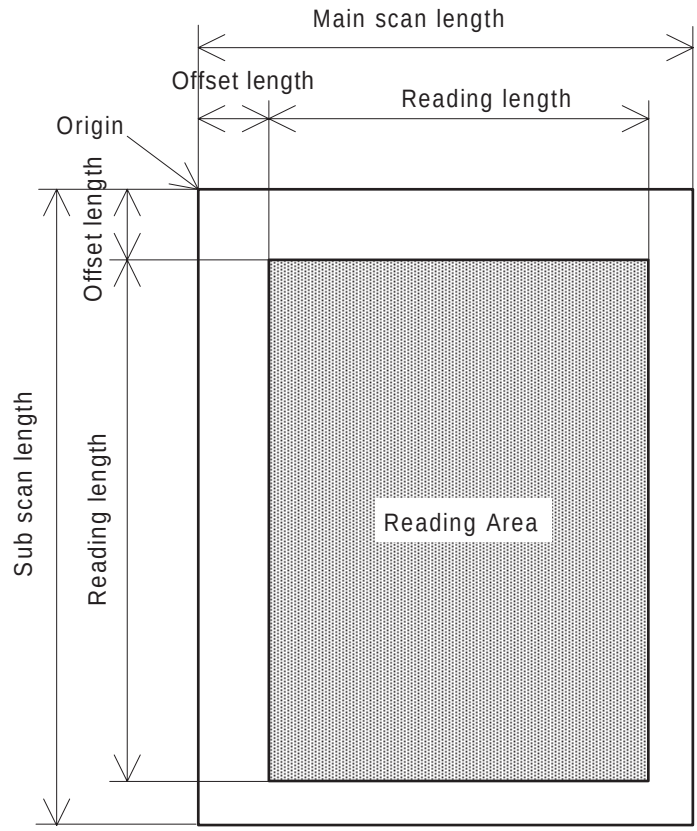

Figure 1-21. Reading Area

1.7.5 Color Mode

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 scanner scans the document once in monochrome. In standard monochrome scanning, all green, red, and blue lights are used 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.

1.7.6 Digital Halftoning

Generally, 1 bit/pixel and 2 bits/pixel formats cannot be used to express continuous image tones. Halftoning mode processes this scanned image data so that the data output in these formats simulates continuous tones when displayed or printed. Halftoning mode is suitable for continuous tone images (such as photographs) and for output devices that cannot handle multi-bus data for each pixel. Halftoning mode is not suitable for images requiring sharp definitions (such as line art or 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 can choose one of the following modes: TET mode, three halftoning modes, four resident dither patterns, and two user-defined dither modes. When you choose a halftoning mode, the scanner provides a scanned image with continuous tones for comparison to adjust the pixels. When you choose a dither mode, the scanner uses a regular pattern for the same purpose. Each mode is outlined below:

TET (Text Enhanced Technology) Mode

In this mode, text is contrasted with any background color in the original to be scanned. This technique allows text to be read clearly. This mode is available only when monochrome reading mode is specified.

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 having 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.

Notes:
1. *When using halftoning mode, read the image at actual size, and then enlarge or reduce it to the desired size using the zoom function.*
2. *This setting is available only when* **ESC D** *01H or 02H is specified.*
3. *The disable halftone mode and TET mode are available only when* **ESC D** *01H is specified.*

1.7.7 Color Correction

The color correction function can operate only when the scanner is in color line sequence mode, in 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). Some printers add black to increase the definition. Printer colors also may vary with 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 color ink jet printers.

1.7.8 Brightness

The scanner lets you choose one of seven scanning brightness levels. The centrer setting is the normal one. Darker settings are appropriate for line art and for faint original images; use lighter settings when the original image is dark. You can set brightness independently of other functions. The following graph shows the differences between brightness settings when the gamma correction is set to CRT display A.

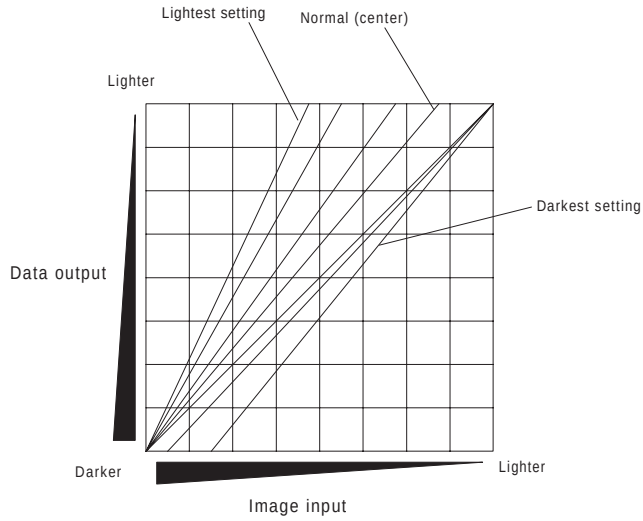

Figure 1-22. Brightness

1.7.9 Sharpness

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).

1.7.10 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 the following figure for a graphical representation of the five gamma correction settings. You can set gamma correction independently of other scanner functions. An overview of the five gamma correction settings is explained is this section.

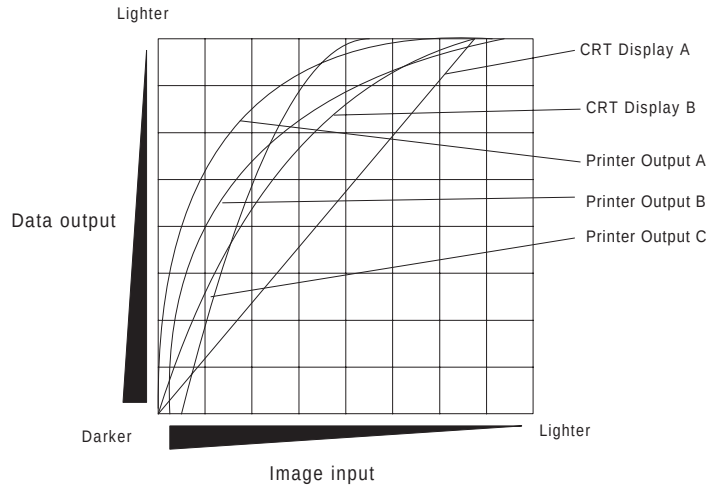

Figure 1-23. Gamma Correction

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) which 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 =1.8.

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 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.

1.7.11 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 does not require continuous tones. Use normal speed reading for images that require a quality of 8 bits/pixel/color.

1.7.12 AAS (Auto Area Segmentation) Mode

This function separates the text area from the imaging area and proccesses these areas differently during scanning. This technique provides better text and imaging quality. AAS mode is especially suitable for image files from sources such as fax data, magazine articles, etc. In AAS mode, text is scanned in one bit/pixel format, and image are is scanned using halftoning.

The scanner switches the data format for scanning to 16 gray levels (4 bits/pixel) and separates the scanned data into 16 gray level data blocks. By referring to the number of black pixels and maximum differences in tone, the scanner decides whether the block is a text area or an image area. Then, the scanner reproduces the data block in 2 grays.

1.8 MAIN COMPONENTS

To simplify maintenance and repair, the main components of the GT-9500/Expression 636 have been designed for easy removal and replacement. The main components are:

- ❏ B035 MAIN Board: Main control circuit
- ❏ B035 PSB/PSE/PSH Board: Power supply circuit
- ❏ B035 ISN Board: Imaging sensor circuit
- ❏ B035 I/F Board: Interface connector circuit
- ❏ Scanner Head
- ❏ Carriage Mechanism
- ❏ Housing: Upper /lower case, etc
- ❏ Document Cover

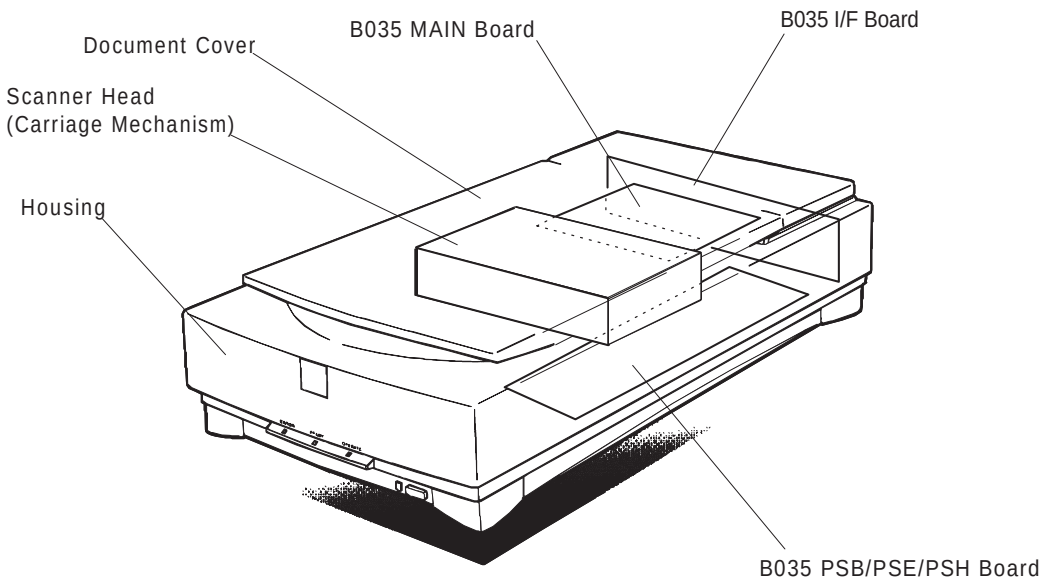

Figure 1-24. GT-9500/Expression 636 Component Layout

1.8.1 B035 MAIN Control Circuit

The B035 MAIN board is the control circuit board in the scanner, containing a logic circuit and carriage motor driver circuit. The 16-bit CPU M37720S1BFP is used at 20 MHz clock.

1.8.2 B035 PSB/PSE/PSH Power Supply Circuit

The power supply circuit unit consists of a switching regulator circuit, which converts the AC line voltage to DC voltages (for example, +24 V,+15 V and +5 V) used by the scanner. The B035 PSB board uses a 120 V input type, the B035 PSE board uses a 220/240 V input type and B035 PSH board uses 100-120/220-240 V input type.

1.8.3 B035 ISN Board

The B035 ISN board consists of CCD controller and A/D converter.

1.8.4 B035 I/F Board

The B035 I/F board contains the interface circuit, SCSI connectors, optional unit and termination switches, and SCSI ID switch. This board is based on B027 I/F Board. B035 I/F Board is added one capacitor between Pin 14 and Pin 15 on CN2. So, B027 I/F (Part's No. 2023385-xx) is only compatible with B035 I/F Board.

1.8.5 Scanner Head

The scanner head consists of a 600 dpi color CCD sensor, light source, and the inverter circuit for the light source.

1.8.6 Carriage Mechanism

The carriage mechanism consists of scanner head, lead screw, carriage motor and carriage home position sensor.

1.8.7 Housing

The housing consists of the upper case and lower case. They hold the B035 MAIN, B035 PSB/PSE/PSH, B035 ISN boards, as well as the carriage mechanism.

1.8.8 Document Cover

The document cover flattens the document on the scanner glass and prevents external light from leaking in.

Chapter 2 Operating Principles

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2.1 ENGINE OPERATIONS

This section describes the functions and operating principles of the GT-9500/Expression 636 engine. The engine contains a CCD image sensor with a reading resolution of 600 dpi. The engine consists of the scanner head and the carriage mechanism.

2.1.1 Scanner Head Operations

The scanner head (carriage assembly) consists of the color CCD image sensor, the lamp (light source), lens, and mirrors. Figure 2-1 shows a cross-section of the scanner head.

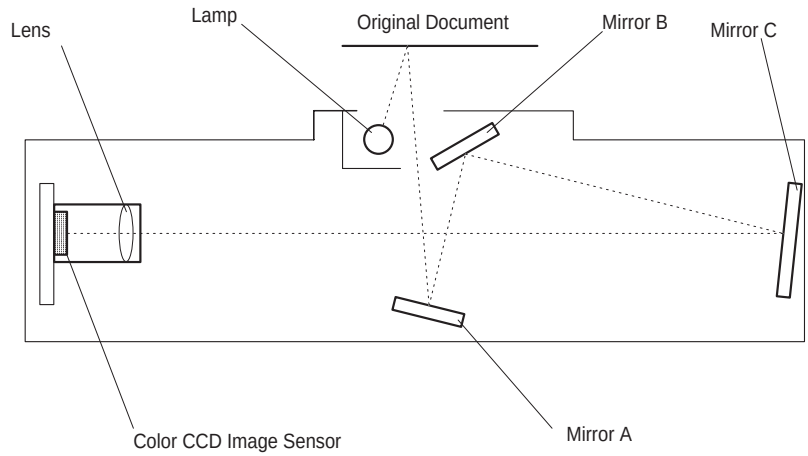


Figure 2-1. Cross-Section of the Scanner Head

The light source is a white fluorescent lamp. To read a color document, the CCD sensor must read each of the three primary colors (red, green, blue; R, G, and B). If the image is to be reproduced on a CRT, these individual readings are reconstituted on the display. Because the color CCD has a sensor for each of the three colors (R, G, and B) on it, the CCD is able to read these colors at same time. The color CCD sensor consists of three blocks, as shown below:

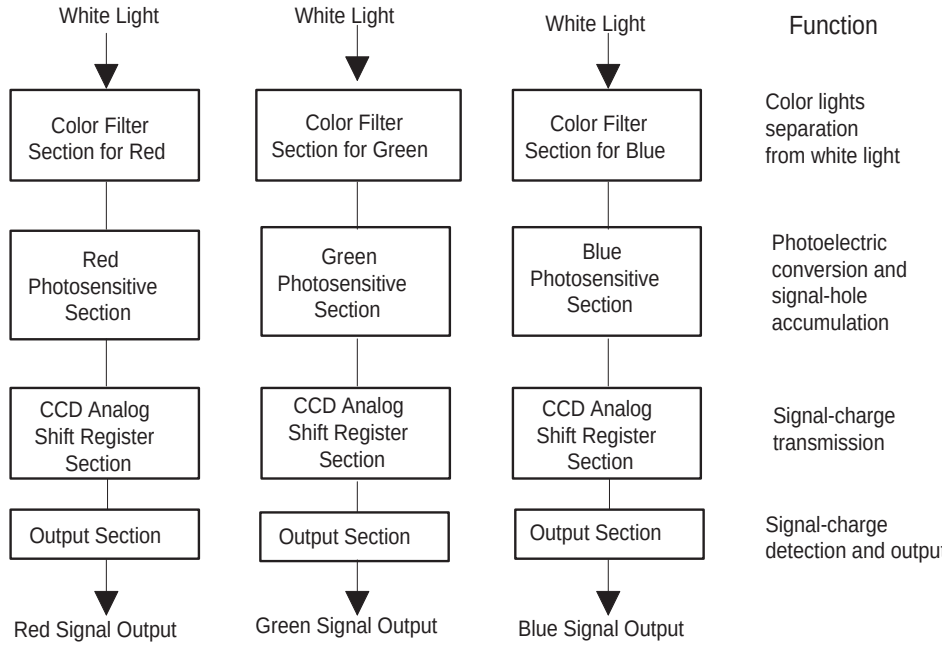


Figure 2-2. Function of CCD Sensor Blocks

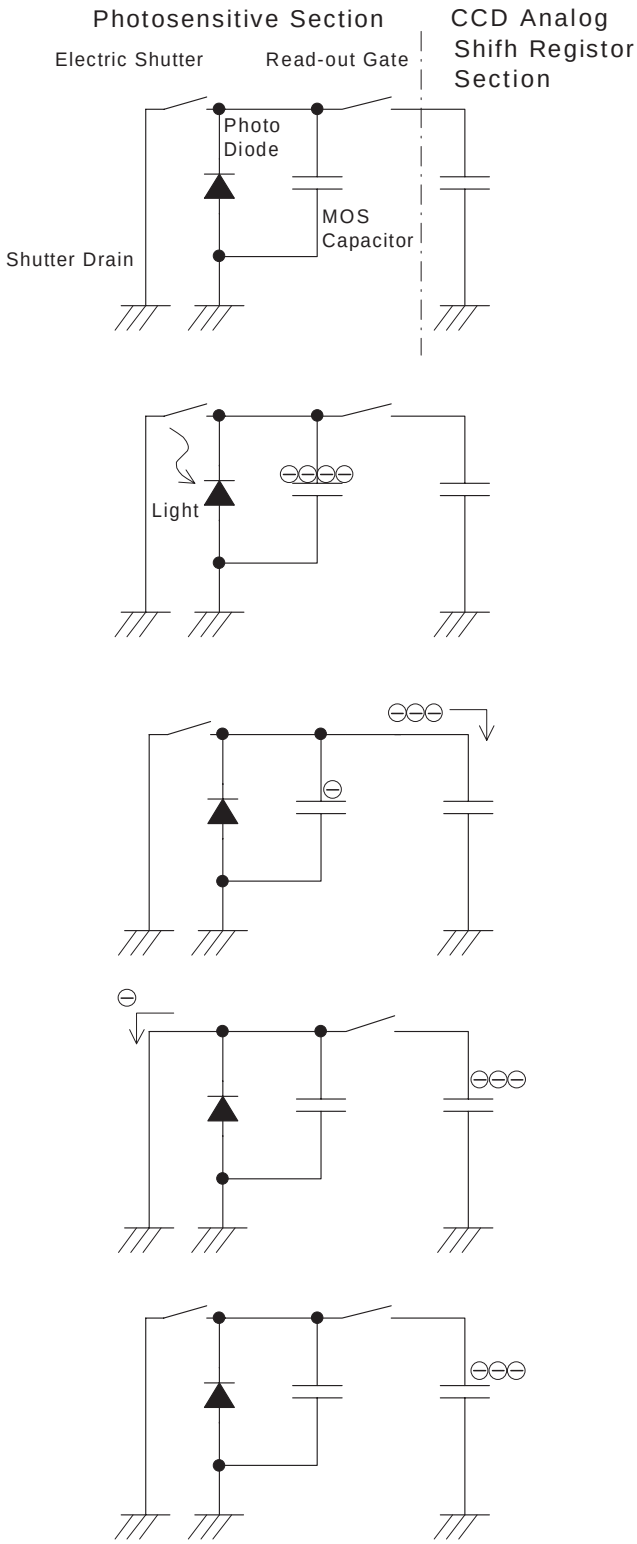
Figure 2-2 illustrates the relationship between these four blocks. Light reflected from an original document is separated into the three colors (R, G, B) by the filters. The separated light strikes the photosensitive section for each individual color, where photoelectric conversion takes place. A signal charge accumulates for the received light energy. The CCD shift register section transmits this received signal charge in the form of orderly serial electric signals. The output section outputs the received signal charge in the form of an electric signal.

Color Filter Section

Since the light source is white light, the primary colors (R, G, and B) are mixed in the source. The color filter area on each color's photosensitive section passes the desired color's light and rejects the undesired color's light from the white light.

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 photoelectric conversion to change the imaging light energy into an accumulated signal charge.



The equivalent circuit diagram at left shows the operating principles of the photosensitive section. The circuit consists of photodiode, MOS capacitor, read-out gate, electric shutter, and shutter drain. (The CCD analog resistor 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 electric charge.

When the read-out gate goes on, the electric charge accumulated in the MOS capacitor is shifted to CCD analog shift register section.

The electric shutter can control the sensor signal storage time independently of the read-out gate pulse period. When the sensor is being used in such a way that the read-out period is extremely long, the electric charge of the sensor signal may overflow. Using the shutter function allows the signal to be obtained without the electric charge overflowing.

The electric charge is translated in the shift register section when the read-out gate goes off.

Figure 2-3. Operations of the Photosensitive Section

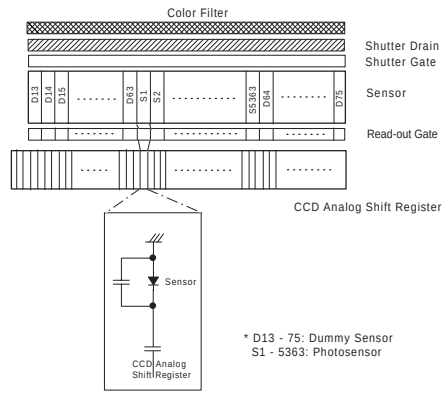


Figure 2-4. Arrangement of Photosensors

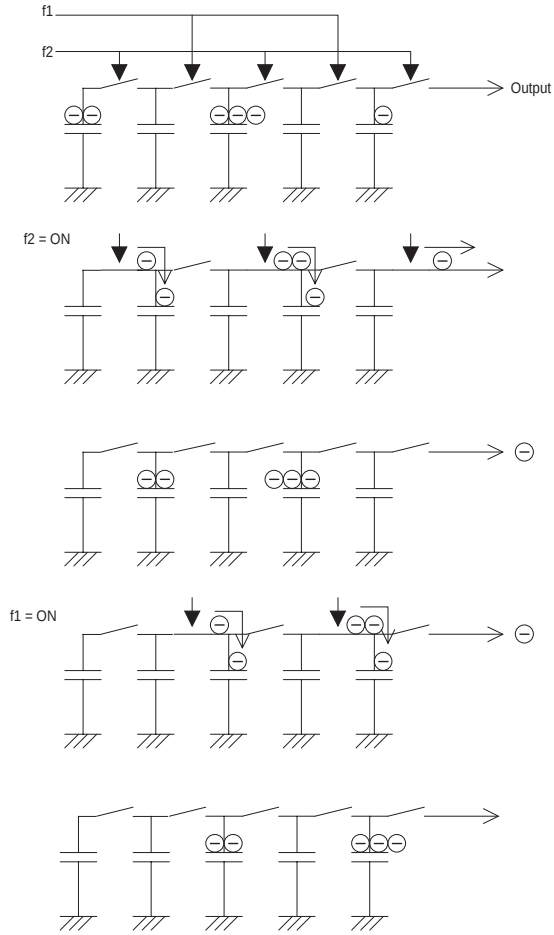
The photosensor sections are arranged in parallel rows in each color (R, G, and B). The number of 7units in each horizontal row is equivalent to the maximum number (5363) of pixels per line and 75 dummy sensors.

CCD Shift Register

This section receives the electric charge from the photosensitive section and transfers it to the main board. The shift register contains two capacitors for each photosensor 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. The operation is illustrated in the diagram and explained below.

The diagram at left is a simple model of the shift register section. ϕ 1 and ϕ 2 are transmission clock pulses. The converted photoelectric signal charges are stored in the capacitors of the shift register.

When clock ϕ 2 goes ON, the signal charges move toward the right, and the charge in the right-most capacitor is output to the main board.



When clock ϕ 2 goes OFF, the condition of the shift register section becomes stable again.

When clock ϕ 1 goes ON, the signal charges move toward the right again.

When clock ϕ 1 goes OFF, the condition of the shift register section becomes stable again.

By repeating these operations continually, the charges for all pixels are output to the main board.

Figure 2-5. Operations of the Shift Register Section

Output Section

The out put section receives signal charges from the sift resister 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 for each color, no mechanical operation is required for the main scan (which is one horizontal reading of the original document). To read more than a signal 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 shown in the figure below.

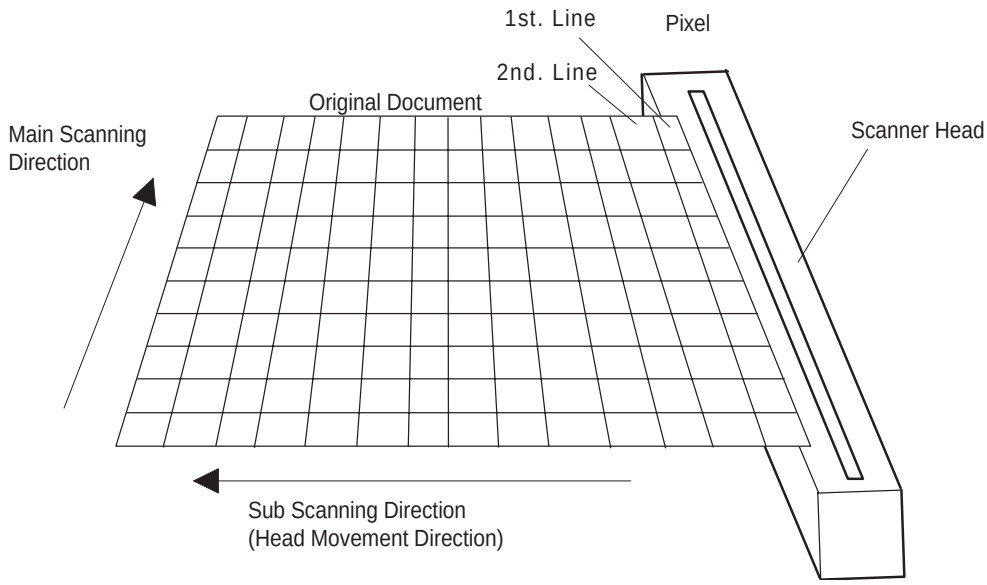


Figure 2-6. Reading of an Original Document

The carriage mechanism moves the scanner head in the scanning area. The carriage mechanism consists of the carriage assembly (scanner head), a carriage motor, an HP (carriage home position) sensor, a carriage drive pulley, a carriage driven pulley, and a timing belt. The carriage motor is an HB-type stepping motor, allowing the motor to move the carriage assembly smoothly and stop it anytime and anywhere on the timing belt. The HP sensor detects the home position of the carriage assembly. The home position is the reference point used to position the carriage assembly on the scanning area.

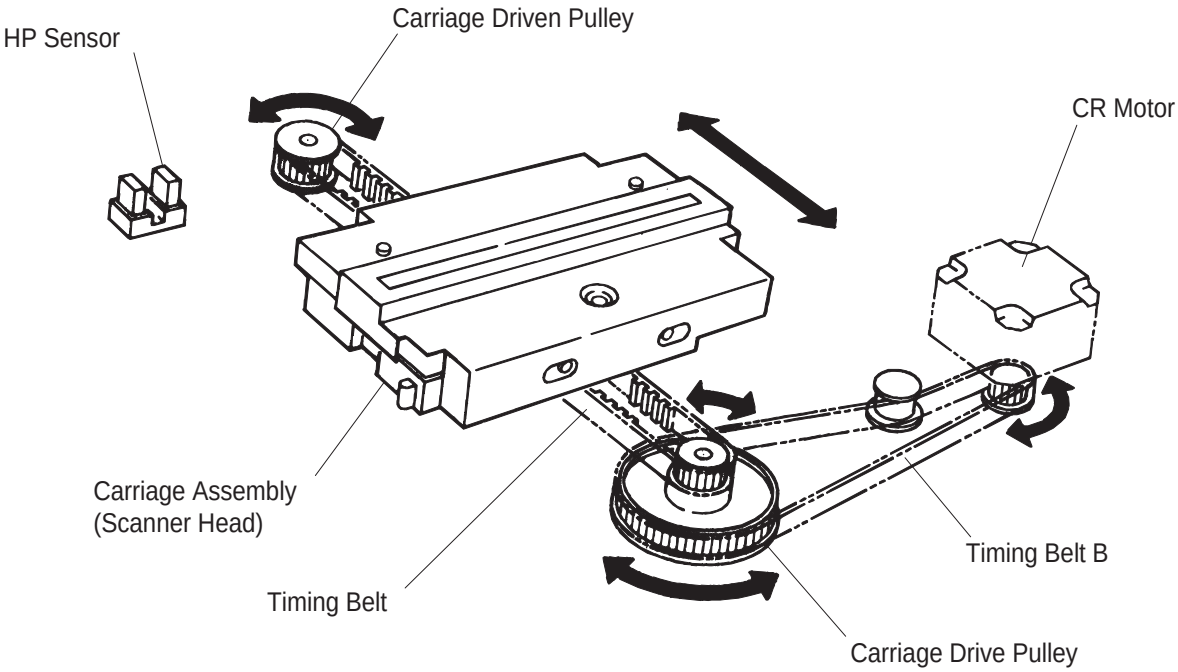


Figure 2-7. Carriage Mechanism

2.2 POWER SUPPLY OPERATIONS

The scanner can be powered by either of three power supply boards: B035 PSB board, B035 PSE board and B035 PSH 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, the lamp, 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 Ratings	Output Voltages
B035 PSB	100-120 ± 10 %	2.5 A / 125 V	+24 V / 0.85 A +15 V / 0.2 A +5 V / 0.7 A
B035 PSE	220-240 ± 10 %	1.25 A / 250 V	
B035 PSH	100-120/220-240 ± 10 %	T1.6AH / 250 V, T1.6 A / 250V	

2.2.1 Power Supply Overview

The power supply board has three power output lines that supply power to the various control circuits, lamp, and carriage drive mechanism. Table 2-2 lists the DC output supply voltages of the scanner.

Table 2-2. Power Supply Output Voltages and Applications

Output Supply Voltage (DC)	Applications
+24 V	❒ Carriage motor drive ❒ Fluorescent lamp
+15 V (+12 V)	❒ CCD sensor drive / amplifier
+5 V	❒ B035 MAIN logic board circuit ❒ Carriage home position sensor ❒ LEDs

2.2.2 Supply Circuit Operations

AC power is fed into the scanner from an external power source, and the AC line filter removes the line noise. Then, the AC voltage undergoes full-wave rectification and is smoothed to produce the direct current supply voltage. This voltage is fed through an RCC (ringing choke converter), switching circuit, and secondary smoothing circuit to produce the +24 VDC, +15 VDC, and +5 VDC supplies. The power switch (Operate button) is in the secondary circuit. When the power switch is turned OFF, the power supply circuit goes into a standby condition. The +24 VDC is under +3 V, and the others are almost 0 V.

The +15 VDC and +5 VDC are created by feeding the +24 VDC line through each regulator IC, and the +15 VDC is brought down to +12 VDC with the regulator IC in the B035 MAIN board to make it suitable for the CCD sensor and amplifier. The power supply circuit diagram is shown on the next page.

+24 VDC Line Voltage Drop Protection

If the +24 VDC line drops under +18 V, a signal is sent to the primary switching circuit using Zener diodes ZD51 and ZD81 - 83 and by photocoupler PC1. Then the switching circuit brings the secondary voltage up to +24 V.

+24 VDC Line Over Voltage Protection

If the +24 VDC line goes over +35 V, a signal is sent to stop the primary switching circuit using Zener diode ZD52, transistor Q82, and photocoupler PC1.

+5 VDC Line Over Voltage Protection

If the +5 VDC line goes over +11 V, a signal is sent to stop the primary switching circuit using Zener diode ZD53, transistor Q82 and photocoupler PC1.

+15 VDC Line Over Voltage Protection

If the +15 VDC line goes over +22 V, a signal is sent to stop the primary switching circuit using Zener diode ZD84, transistor Q82 and photocoupler PC1.

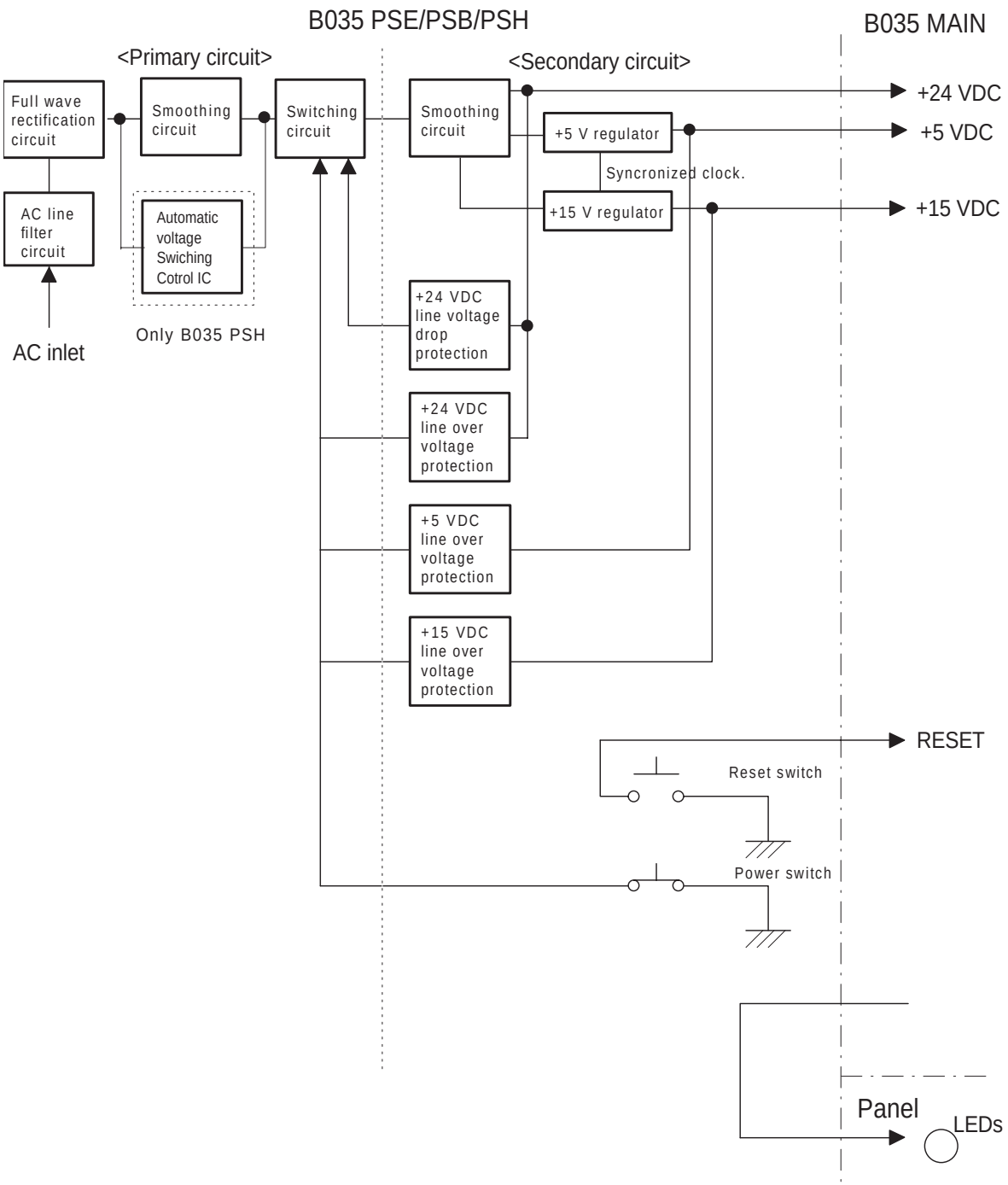


Figure 2-8. Power Supply Circuit Block Diagram

2.3 CONTROL CIRCUIT

The control circuit consists of the B035 MAIN board, B035 ISN board, B035 I/F board and the inverter circuit for the light source.

2.3.1 Control Circuit Overview

The scanner CPU is a 16-bit , single chip M37721S2BFP, which operates at 20 MHz. To simplify the circuitry, the circuits for correcting the image data signals are collected into four gate arrays. The circuit diagram is shown below.

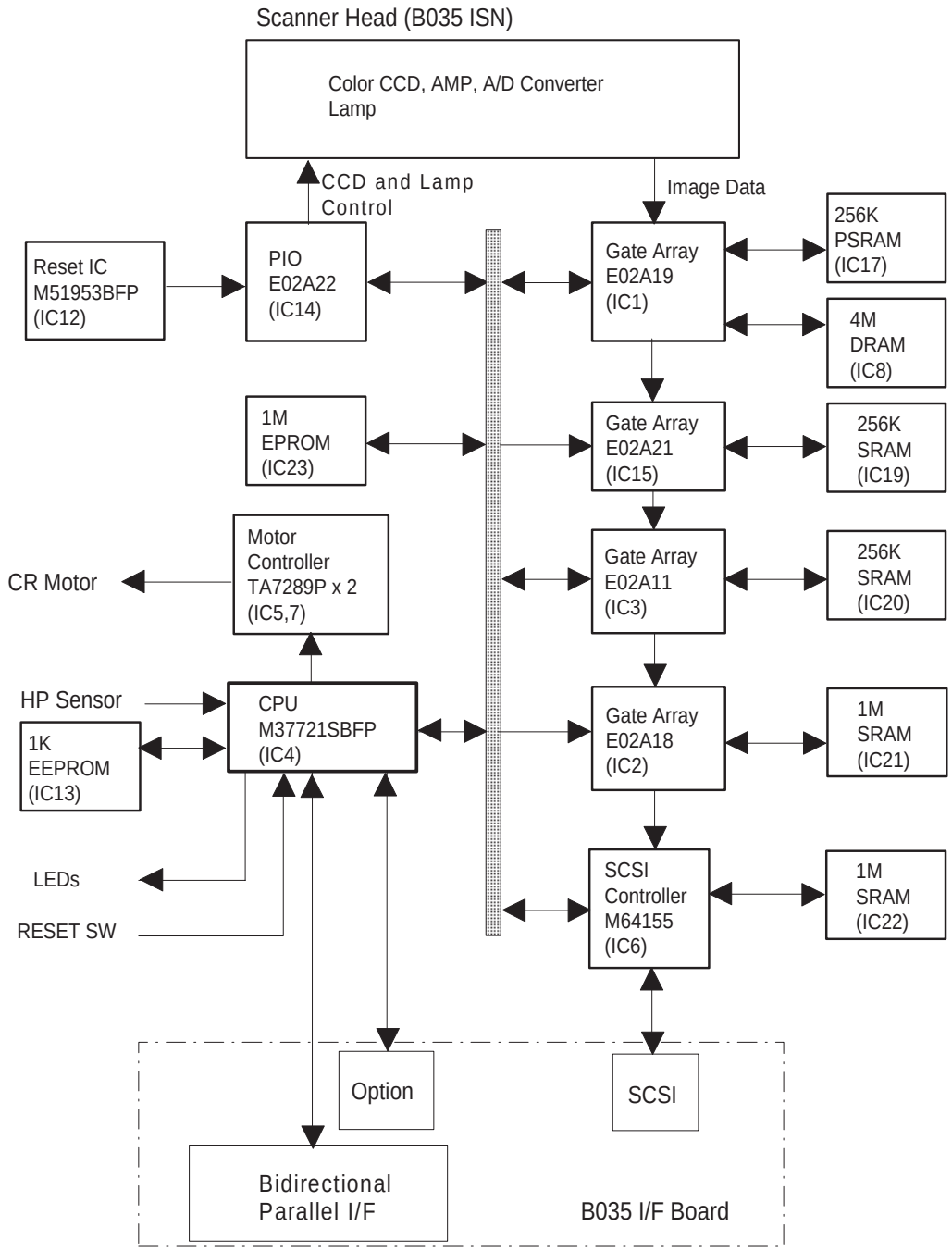


Figure 2-9. Control Circuit Block Diagram

2.3.1.1 Control Circuit Operation

This section provides an overview of the scanner's control circuit operation, starting from the point where image data is input into the scanner, and ending with the output of the image data to a computer. A block diagram of the operation is shown below.

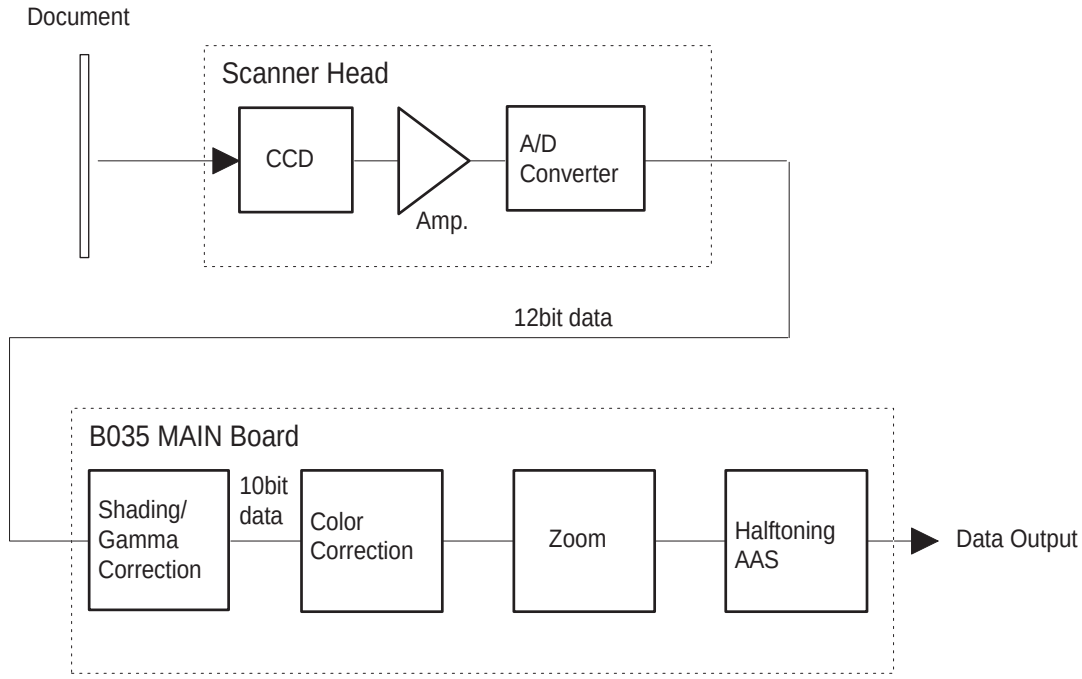


Figure 2-10. Diagram of GT-9500/Expression 636 Operation

1. The light source (lamp) lights, and the scanner reads the white standard attached to the black surface of the document glass.
2. The black standard has been installed in gate array IC1.
3. The lamp lights. Light reflected from the document is read by the color CCD.
4. The data that has been read is amplified.
5. The amplified analog image data is converted to 12-bit digital data by the ADC (A/D converter). The amplifiers and ADC are located in the scanner head. The scanner head sends 12-bit digital data to B035 MAIN board.
6. Shading correction is applied to the 12-bit 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 from direct photoelectric conversion of the reflected light that has impacted the sensors. This data must be converted further 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 the white data. This scanner changes the data format from 12-bit data to 10-bit data after making the shading correction.

7. Gamma correction (explained in Section 1.7.10), color correction (explained in Section 1.7.7), zoom correction (explained in Section 1.7.3), halftoning (explained in Section 1.7.6) and AAS (explained in Section 1.7.12) are performed, based on commands sent from the computer.
8. Image data is output to the computer or another external device.

Table 2-3. Functions of Main Elements of Logic Board

Element	Location	Function
M37721S2BFP CPU	IC4	The CPU, which operates at 20 MHz, controls scanner operations. The CPU is connected to an EEPROM and an EPROM.
E02A19 Gate Array	IC1	This gate array performs the following functions: ❒ Shading correction ❒ Gamma correction ❒ CCD sensor control ❒ A/D converter control ❒ Light source control ❒ Motor driver timing control The gate array is connected to a 256Kbit PSRAM and a 4Mbit DRAM.
E02A21 Gate Array	IC15	This gate array performs the following function: ❒ Color correction The gate array is connected to a 256Kbit SRAM.
E02A11 Gate Array	IC3	This gate array performs the following function: ❒ Zooming The gate array is connected to a 256Kbit SRAM.
E02A18 Gate Array	IC2	This gate array performs the following functions: ❒ Halftoning ❒ AAS The gate array is connected to a 1Mbit SRAM.
E02A22 Gate Array	IC14	This gate array performs the following functions: ❒ Assistance of CPU Parallel I/O control Memory control Quantity of light source correction ❒ Power on reset signal generation ❒ Clock signal generation
M64155	IC6	SCSI controller
TA7289P	IC5,7	CR motor controller

2.3.2 Reset Circuit

Immediately after power on and off, the +5 VDC line voltage drops, and the reset IC (IC12) outputs the reset signal from pin 6. This reset signal is then input to pin 52 (PON) of gate array E02A22 (IC14), and it supplies the reset signal to the CPU and other peripheral devices connected to pin 6. INIT signals sent through the parallel interface by an external device are also input into pin 48 of gate array E02A22 to output the reset signal to reset the scanner. When the RESET button is pressed, the RSW signal is input into pin 54 of gate array E02A22 to produce a reset signal also. The reset block diagram is shown below.

2.3.3 Home Position Sensor Circuit

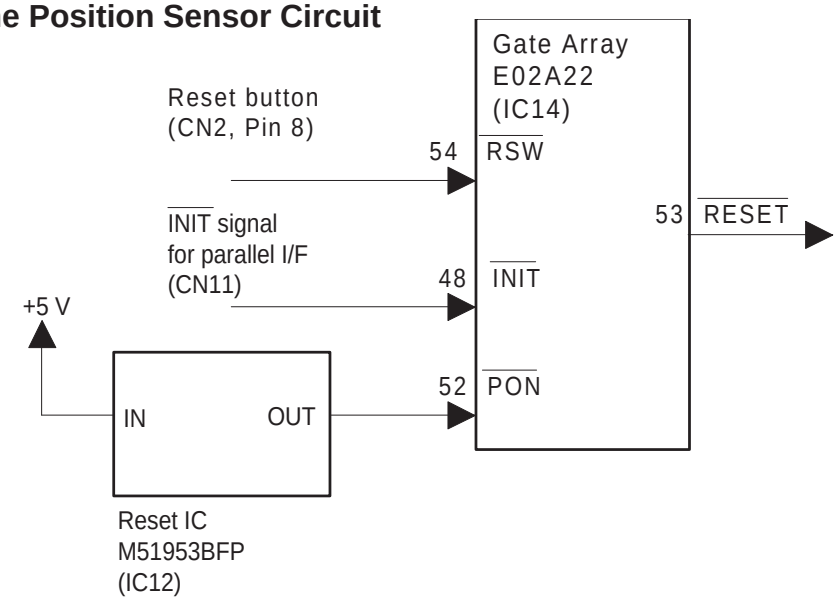


Figure 2-11. Block Diagram of Reset Circuit

The home-position sensor detects whether the carriage (scanner head) is in the home position or not. This sensor establishes the standard carriage-drive location. When the carriage is in the home position, the sensor outputs a HIGH signal to pin 21 (P103/TC) of M37721S2BFP CPU. The home-position sensor circuit block diagram is shown below.

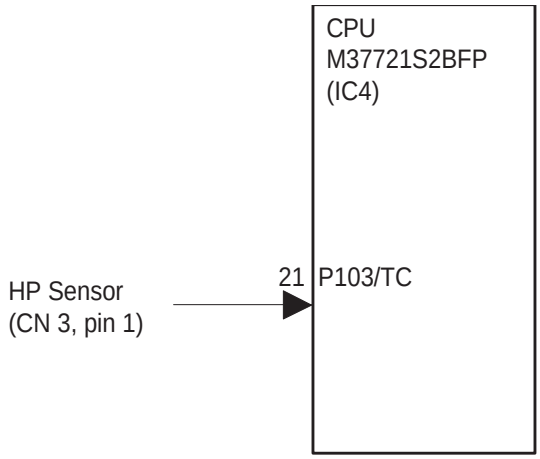


Figure 2-12. Block Diagram of Home-Position Sensor Circuit

2.3.4 Carriage Motor Driver Circuit

The TA7289P carriage motor (CR motor) driver IC (IC5, 7) outputs a constant current to drive the carriage motor. Gate array E02A19 (IC1) generates the motor driver timing signal (MINT) and sends it to the M37721S2BFP CPU to synchronize carriage movement with CCD driving. Referring to MINT, the M37721S2BFP CPU sends motor drive pulses to the stepping motor, which requires changes in the excitation status to generate rotation via the stepping motor driver ICs.

The INA and INB from the CPU (pins 44, 45, 46, and 47) determine the excitation phase of the motor. The 8-bit parallel data (1, 2, 4, and 8 × 2) from the CPU (pins 50 - 57) determine the drive current of the motor. The internal wiring of motor and carriage motor driver circuit block diagram are shown below.

The excitation sequence of carriage motor is shown in the table below.

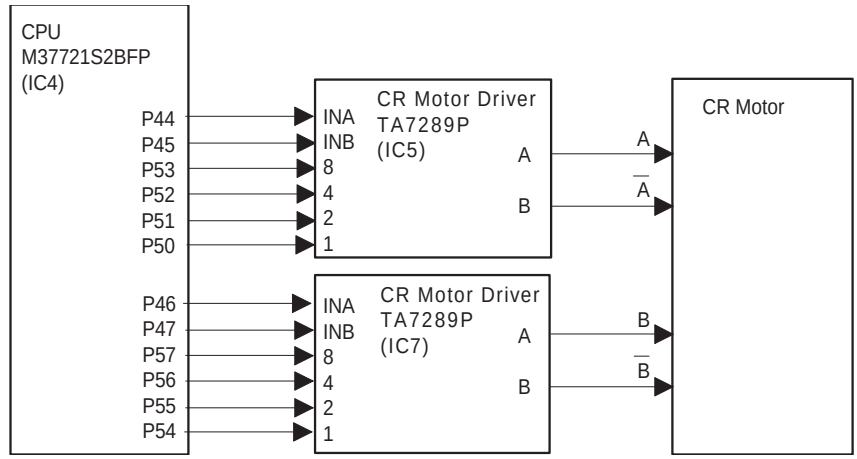


Figure 2-13. Block Diagram of Carriage Motor Driver Circuit

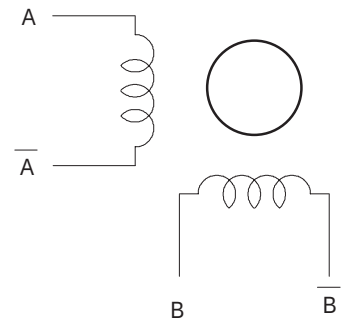


Figure 2-14. Internal Wiring of the Motor

Table 2-4. Excitation Sequence

Step	$\overline{B}$	$\overline{A}$	B	A
1	+	+	-	-
2	-	+	+	-
3	-	+	+	-
4	+	-	-	+
5	+	+	-	-

2.3.5 Color CCD Driver Circuit

Gate array E02A19 (IC1) controls the color CCD operation and light source operation. The CCD receives the following control signals: the RGR, RGG, and RGB signals, which drive the main sensor's shift electrode for each color (R,G and B); transmission pulses CK1 and CK2, which transmit the signal charge (and which are labeled ϕ 1 and ϕ 2 in Section 2.1.1); the RST reset signal, which resets the CCD output section following the reading of each pixel; the STR, STG, and STB shutter signals (which are described for each color in Section 2.1.1). The CCD receives these control signals and outputs the image data as signals VOR, VOG, and VOB.

In monochrome image reading, the R.G.B. data are mixed to make a pixel.

The color CCD driver circuit diagram is shown below.

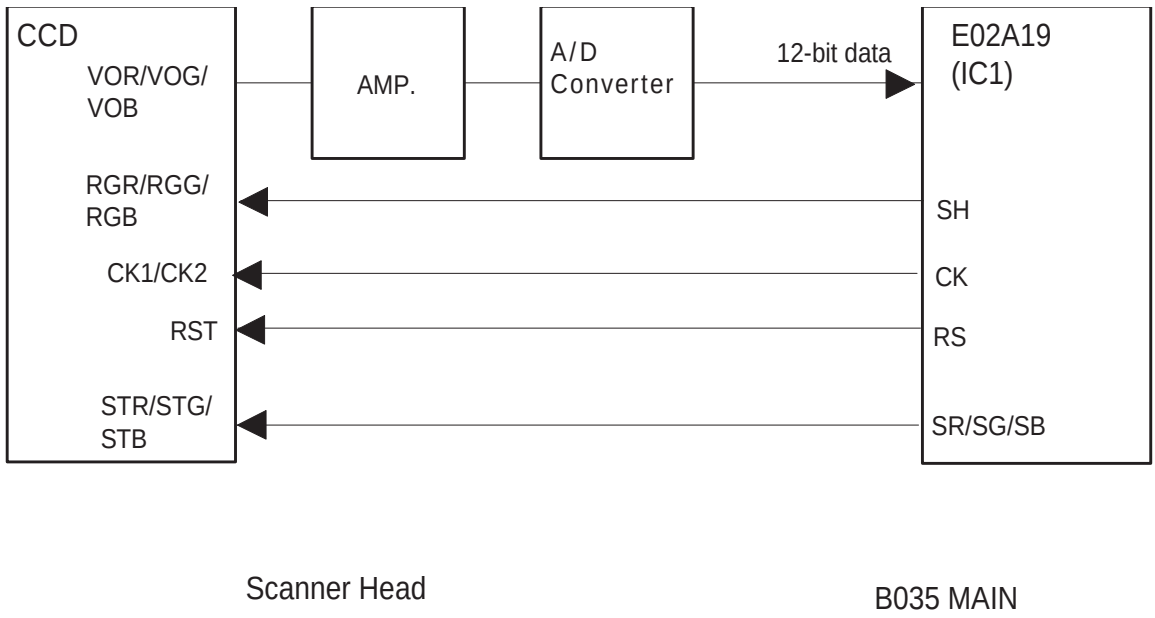


Figure 2-15. Color CCD Driver Circuit Block Diagram

And, the process is illustrated below.

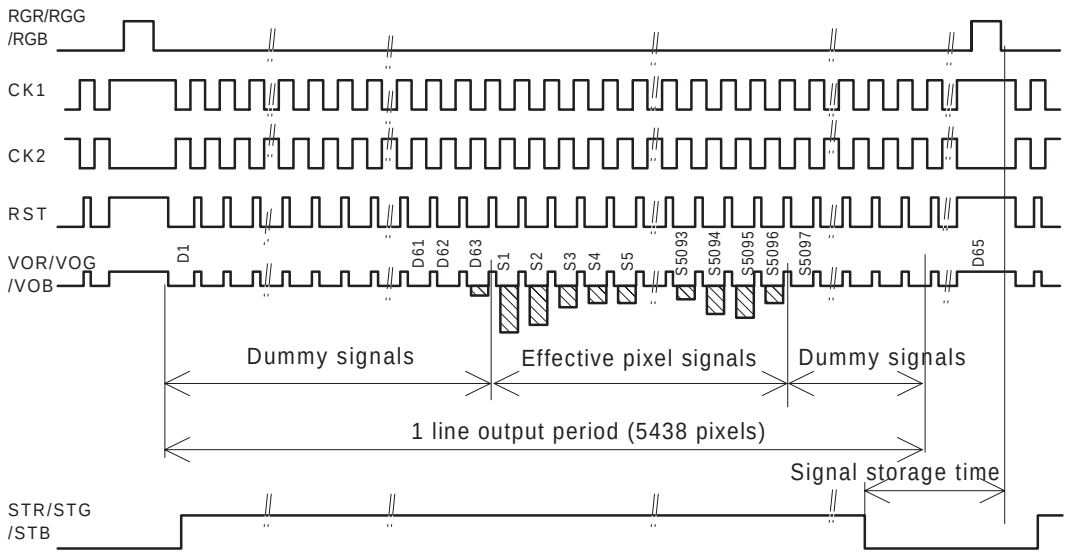


Figure 2-16. Image Sensor Control Process

The image data from the CCD is in the form of an analog signal. This signal is passed through amplifying circuits. The analog signal output from the amplifiers is passed into the A/D converter and converted into 12-bit digital data. This data is sent to gate array E02A19 (IC1). Details of subsequent image processing may be found in Section 2.3.1.1.

The original document must be illuminated to be read. The scanner uses only one fluorescent lamp for this purpose. And the color CCD detects the image for each color (R, G, and B). The lamp is also controlled by gate array E02A19 (LON, pin 1) via an inverter circuit.
This scanner equips the function of light radiation intensity correction. Referring of image data from CCD, gate array E02A22 (IC14) controls the gain of amplifiers on the scanner head to prevent from decreasing of light radiation intensity.

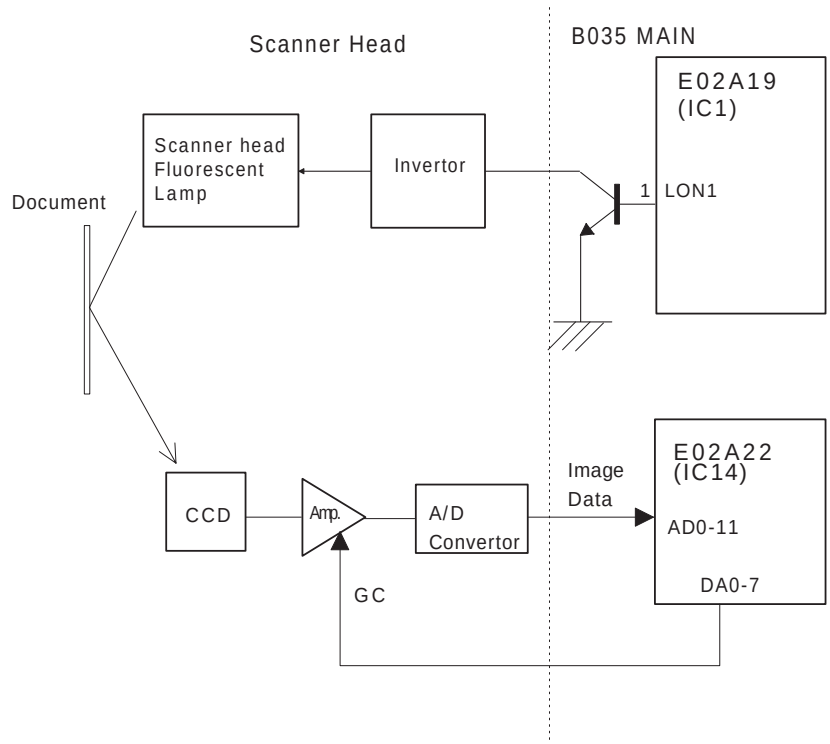


Figure 2-17. Light Source Control Circuit Block Diagram

2.4 OPTIONAL TRANSPARENCY UNIT (B81307*)

This section describes the operating principles of the scanner's optional transparency unit. This unit is almost identical to the B81306* model transparency unit. The main difference is the light source (lamp). The light source for the B81306* consists of three colors of light for red, green, and blue (RGB). The light source for the B81307* model transparency unit consists of one white Xe-Gas cathode fluorescent lamp, which is just same as that for the GT-9500/Expression 636 scanner.

*Note: * varies, depending on the country*

2.4.1 Carriage Movement Mechanism

To create a transparency, the unit moves the carriage, containing the light source. The carriage movement mechanism consists of the lamp, carriage assembly, carriage motor assembly, gear/lead screw, roller, and carriage home position sensor. The mechanism is almost identical to that used in the B31306*. (Refer to Section 2.1 of B81306* Service Manual.)

2.4.2 Circuit Operation Overview

The control circuit for the transparency unit consists of the main control circuit board and the inventer circuit board. The main circuit board drives the carriage motor. This carriage motor is synchronized with the scanner's carriage motor. The inverter drives the light source, which is the white Xe-Gas cathode fluorescent lamp. This circuit requires +5 VDC (for logic) and +24 VDC (for the inventer and carriage motor). These power voltages are supplied by the scanner via the B027 I/F board. The transparency unit contains a photodiode on the inverter circuit board. Using this transparency unit, the output of photo-diode near by the lamp is fed back to the scanner head amplifiers instead of CCD output, and correct the gain of amplifiers for the light radiation intensity.

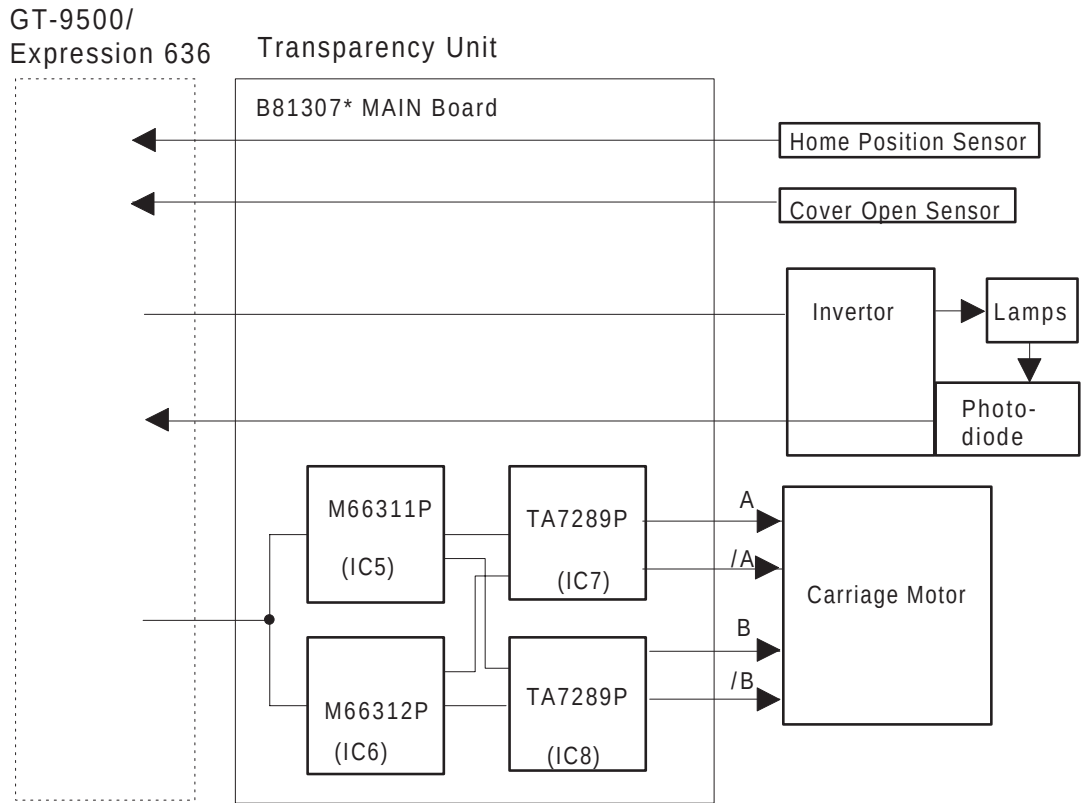


Figure 2-18. B81307* MAIN Ciruit Block Diagram

Chapter 3 Disassembly and Assembly

Table of Contents

List of Figures

List of Tables

3.1 OVERVIEW

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 for Disassembly

Carefully read the following before beginning disassembly or assembly work.

⚠ 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 circuit. As a result, the scanner still remains live with current flowing even after this switch is OFF.

Before disassembling the scanner or checking operation, first unlock the carriage unit by moving the lock lever at the rear of the scanner to UNLOCK.

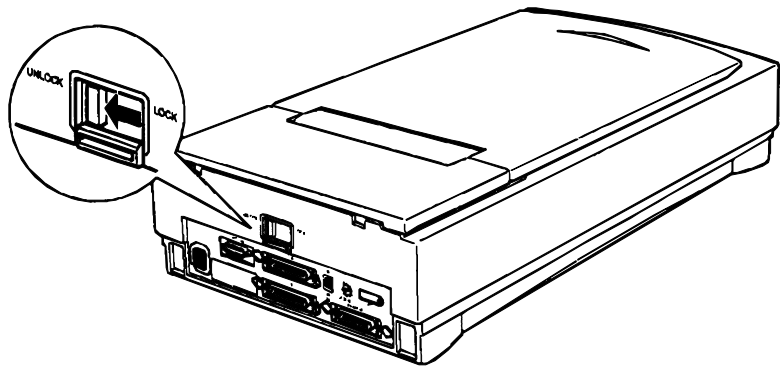


Figure 3-1. Unlocking the Lock Lever

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.
Origin adjustment tool	No	103285300
Phillips screwdriver no. 2	Yes	B743800200
Tweezers	Yes	B741000100
Round-nose pliers	Yes	B740400100

3.1.3 Service Check After Repair

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

Table 3-2. Service Shipping Checklist

Category	Component	Item to Check	Is Check Required?
Mechanical operation OK?	Scanner head	Does the fluorescent light switch on normally?	❒ Checked, ❒ Not necessary
	Carriage mechanism	Is movement smooth?	❒ Checked, ❒ Not necessary
	Self-test	Normal? (❒ Page sequence, ❒ Monochrome)	❒ Checked, ❒ Not necessary
	Image feeding	Is image feed performed normally by utility software?	❒ Checked, ❒ Not necessary
Upgrade?	ROM version	The ROM version is _____.	❒ Checked, ❒ Not necessary
Cleaning requireed?		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
Ready for return shipment?		Is the carriage locked completely?	❒ Checked, ❒ Not necessary
		Is the document cover installed?	❒ Checked, ❒ Not necessary
Separate items included?		Power cable included?	❒ Checked, ❒ Not necessary

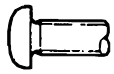
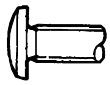
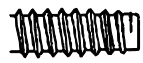
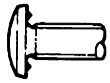
3.1.4 Specifications for Screws

In the following sections, abbreviations are used for small parts, such as screws.

Table 3-3. Abbreviations Used for Screw

Abbreviation	Part Name
CB screw	Cross-recessed Bind head
CBS screw	Cross-recessed Bind head S-tite screw
CBB screw	Cross-recessed Bind head B-tite screw
CP screw	Cross-recessed Pan head screw
CB(O) screw	Cross-recessed Bind head screw with washer

Table 3-4. Screw Types and Abbreviations

Head		Body	Washer (assembled)
Top	Side		
Cross-recessed 	Pan head 	Normal —	(O) 
	Bind head 	B-tite 	
	 (with Notch)	S-tite 	
		A-LAMITITE 	

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, no installation description is given.

3.2.1 Removing the Upper Housing Assembly

1. Remove the document cover from the scanner.
2. Remove 2 upper housing fixing screws and 2 CBB (3 × 12) screws attaching the upper housing assembly to the lower housing.
3. Remove the upper housing assembly by lifting upward.

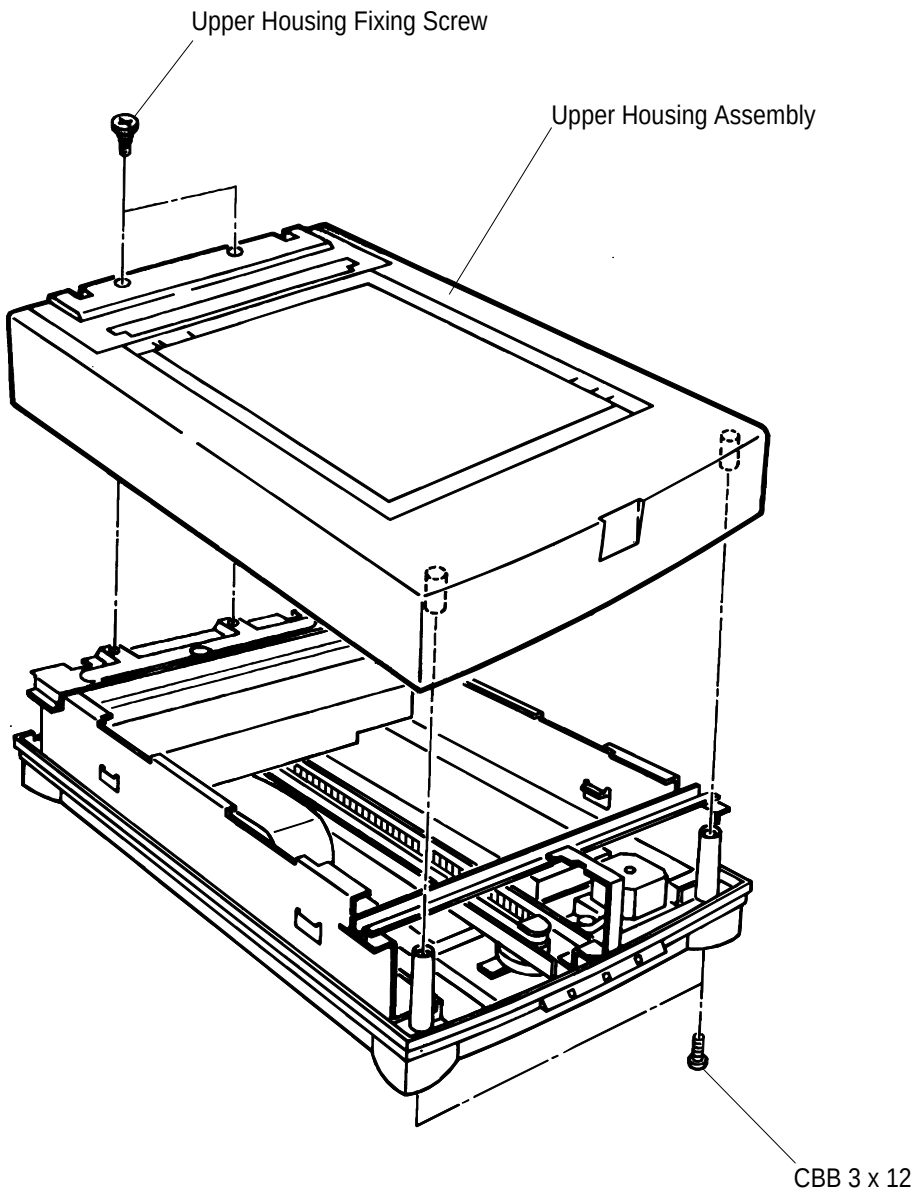


Figure 3-2. Removing the Upper Housing Assembly

3.2.2 Replacing the ROM

1. Remove the upper housing assembly. (Refer to Section 3.2.1.)
2. Remove the ROM by lifting upward with a chip extractor.

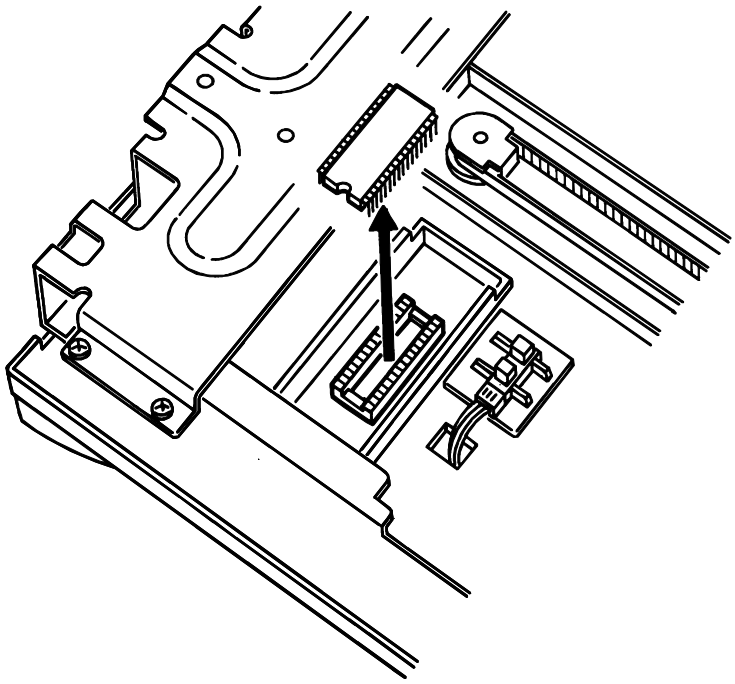


Figure 3-3. Replacing the ROM

3.2.3 Removing the LED Board

1. Remove the upper housing assembly. (Refer to Section 3.2.1.)
2. Disconnect the LED harness from the LED board.
3. Release the hooks of LED board attaching the board to lower hpsing.
4. Remove the LED board from the lower housing.

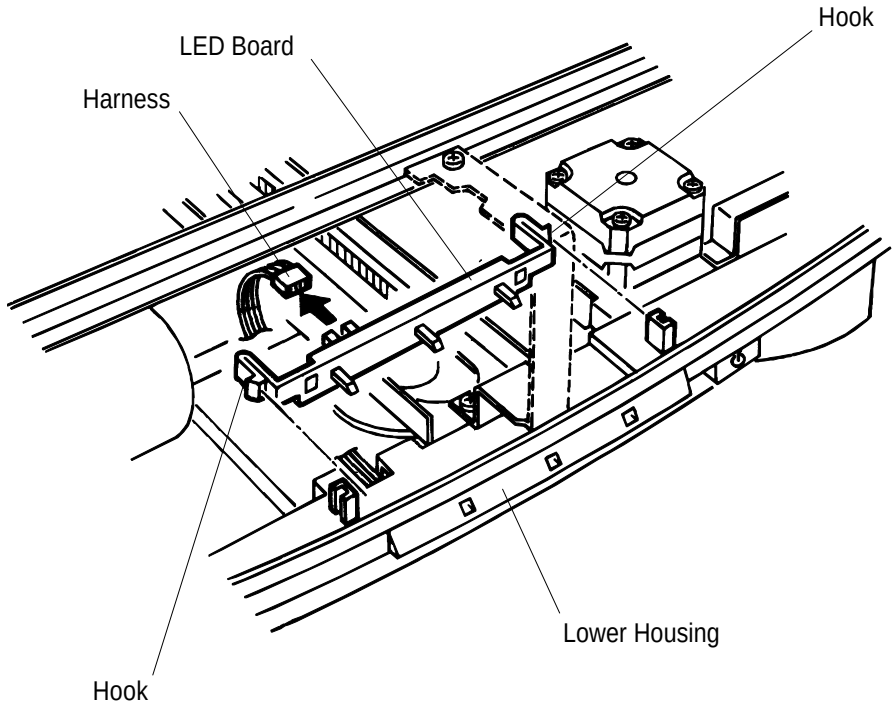


Figure 3-4. Removing the LED Board

3.2.4 Removing the Bottom Plate

1. Remove 3 CBS (M3 × 6) screws and 16 CBB (3 × 12) screws attaching the bottom plate to the lower housing.
2. Remove the bottom plate from the lower housing.

DISASSEMBLY/ASSEMBLY POINT

When attach the bottom plate to lower housing, do not to warp the plate.

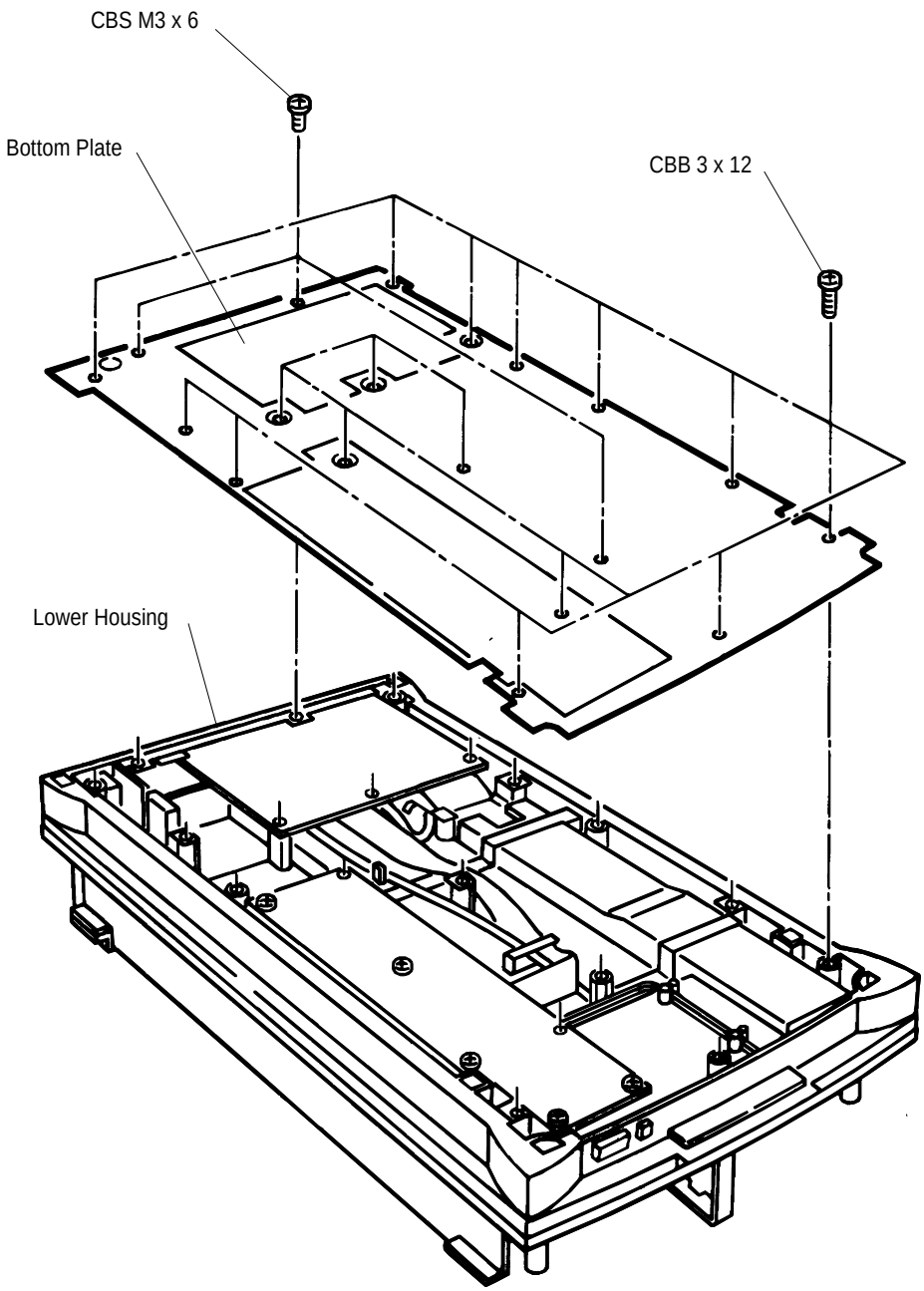


Figure 3-5. Removing the Bottom Plate

3.2.5 Removing the B035 PSB/PSE/PSH Power Supply Board

1. Remove the bottom plate. (Refer to Section 3.2.4.)
2. Disconnect the harnesses for the B035 PSB/PSE/PSH board, LED board and AC cable by the connectors.
3. Remove 2 CBB (3×8) screws and 3 CBB (3×12) screws attaching the B035 PSB/PSE/PSH board to the lower housing.
4. Remove the B035 PSB/PSE/PSH board from the lower housing.

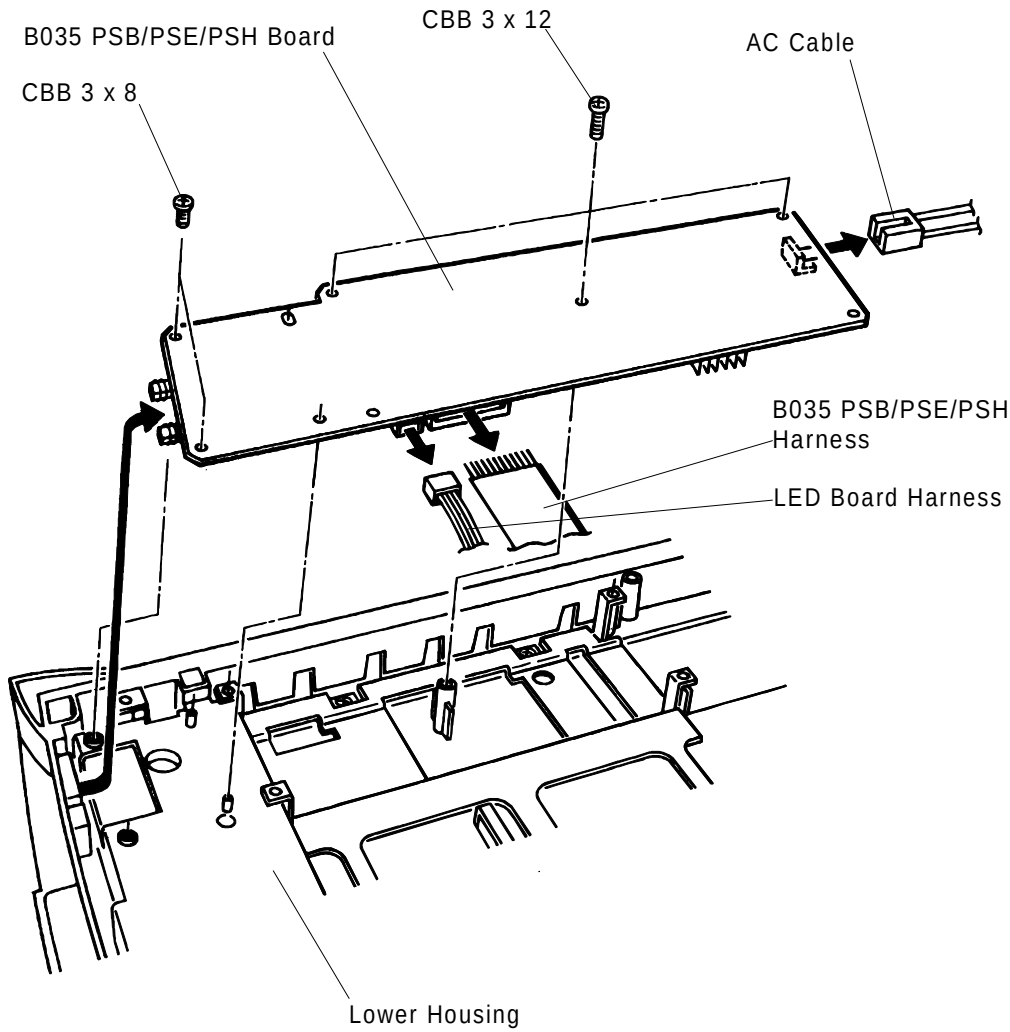


Figure 3-6. Removing the B035 PSB/PSE/PSH Power Supply Board

3.2.6 Removing the B035 MAIN Board and B035 I/F Board

1. Remove the bottom plate. (Refer to Section 3.2.4.)
2. Remove 1 CBB (3 × 12) screw attaching the harness shield plate to the lower housing; then remove the harness shield plate.
3. Disconnect connectors CN1, CN2, CN3, and CN6 from the B035 MAIN board.
4. Remove 2 CBS (M3 × 6) screws attaching the B035 MAIN and B035 I/F boards to the rear of frame assembly.
5. Remove the B035 MAIN board and B035 I/F board.

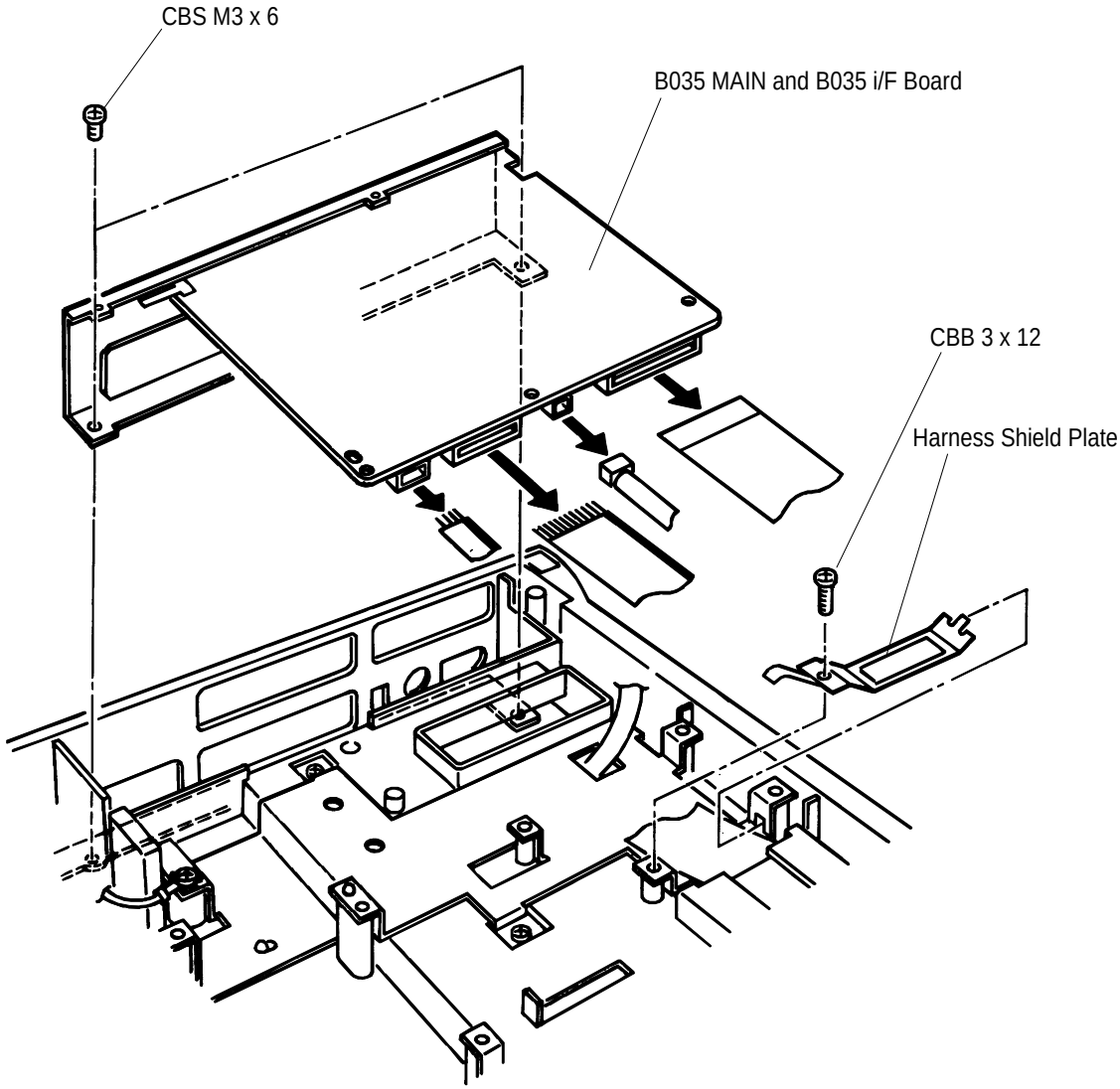


Figure 3-7. Removing the B035 MAIN and B035 I/F Board

⚠ CAUTION

❒ ***If the carriage assembly is locked, unlock it and move it to the front manually. Otherwise, you cannot remove the MAIN board and B027 I/F board, because the carriage assembly covers the B035 MAIN board and B027 I/F board.***

6. Disconnect the harness of B035 I/F Board from CN5 on the B035 MAIN board.
7. Remove 6 CP (M3 × 6) screws and 2 connector screws attaching the B035 I/F board to the B035 MAIN board via the interface plate cover.
8. Remove the B035 I/F board from the B035 MAIN board.

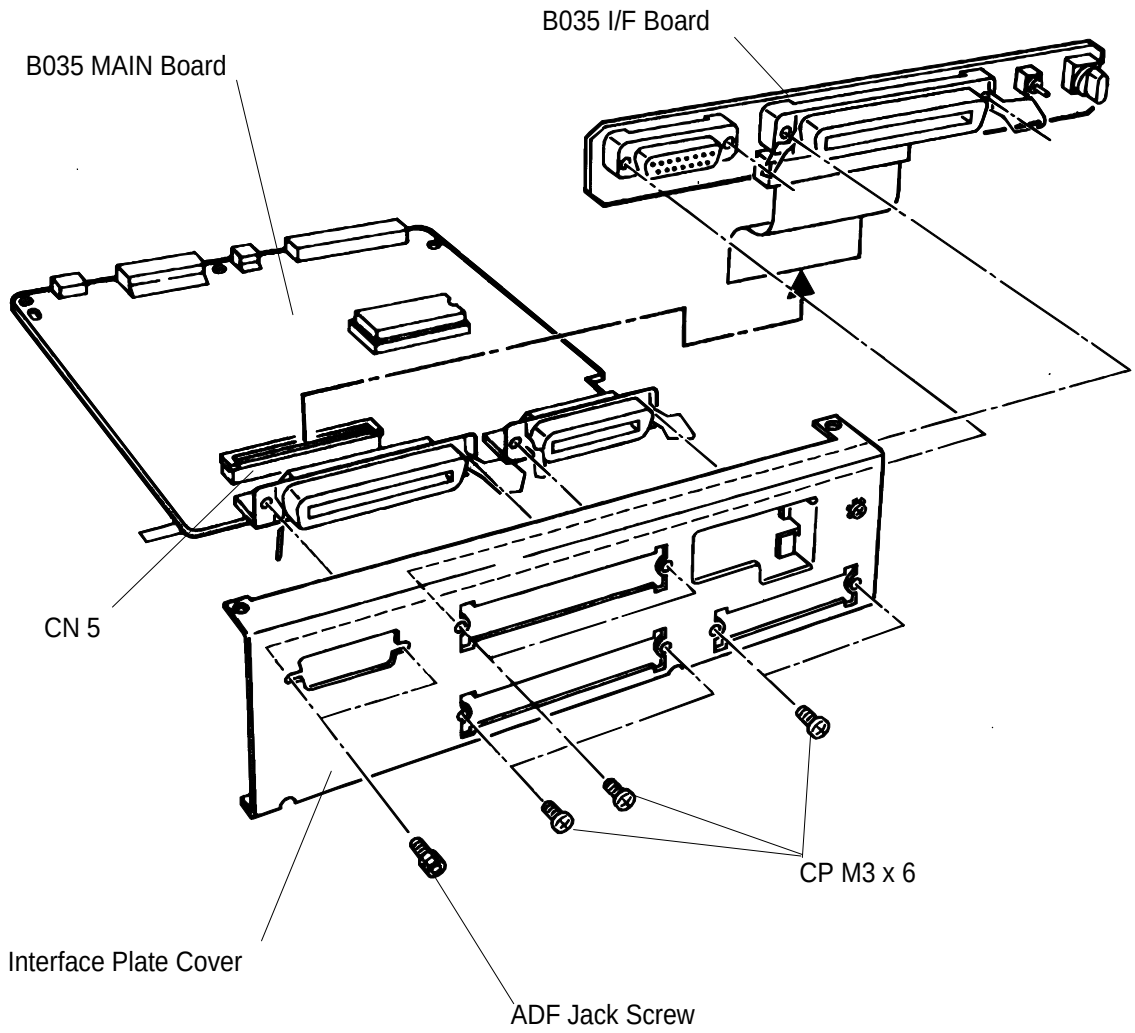


Figure 3-8. Removing the B035 I/F Board

3.2.7 Removing the HP Sensor

1. Remove the bottom plate. (Refer to Section 3.2.4.)
2. Remove the B035 MAIN and B035 I/F board. (Refer to Section 3.2.6.)
3. Remove 2 CBS (M3 × 6) screws and 2 CBS (M3 × 3) screws attaching the rear shield plate to the scanner frames, and remove the CB(O) (M4 × 8) screw attaching the grounding wire for the power cable to the MAIN board base plate.

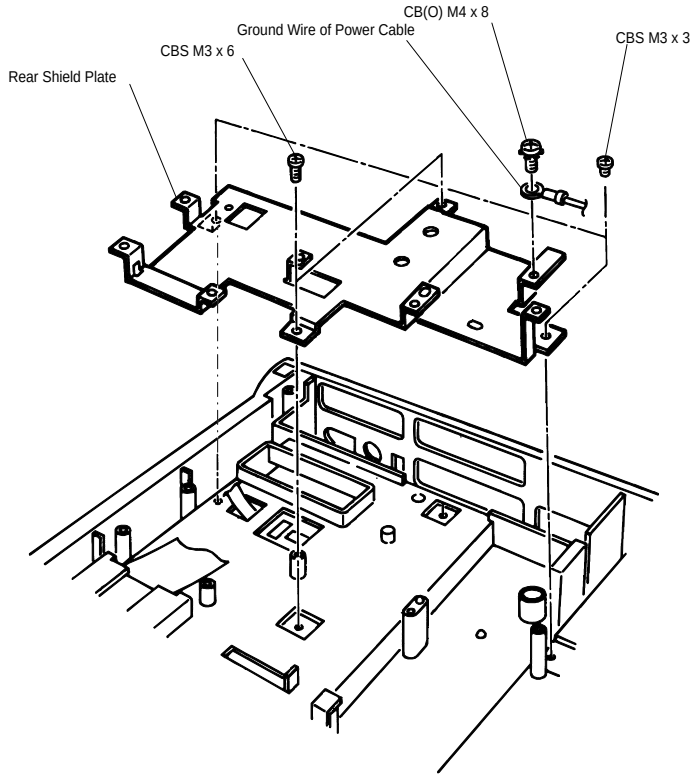


Figure 3-9. Removing the MAIN Board Base Plate

4. Remove the MAIN board base plate.
5. Release the hooks that attach the HP sensor to the lower housing; then remove the sensor from the lower housing.

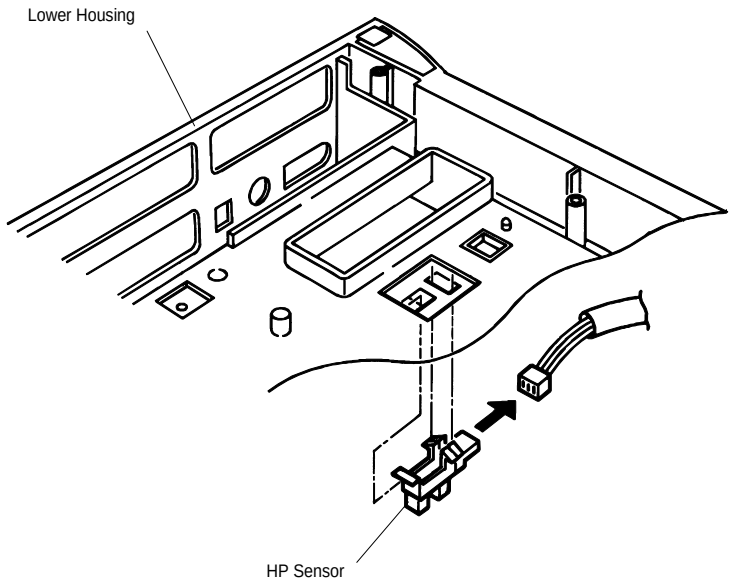


Figure 3-10. Removing the HP Sensor

3.2.8 Removing the Carriage Assembly

1. Remove the upper housing assembly. (Refer to Section 3.2.1.)
2. Remove the bottom plate. (Refer to Section 3.2.4.)
3. Release the harness of carriage assembly by CN1 of B035 MAIN. (Refer to Section 3.2.6.)
4. Remove the extension spring 600 from the carriage driven pulley holder.
5. Remove the CBS (M3 $\times$ 6) screw attaching the carriage driven pulley holder to the center rail; then release the tension in the carriage timing belt.
6. Remove the carriage assembly from the scanner by lifiting upward.

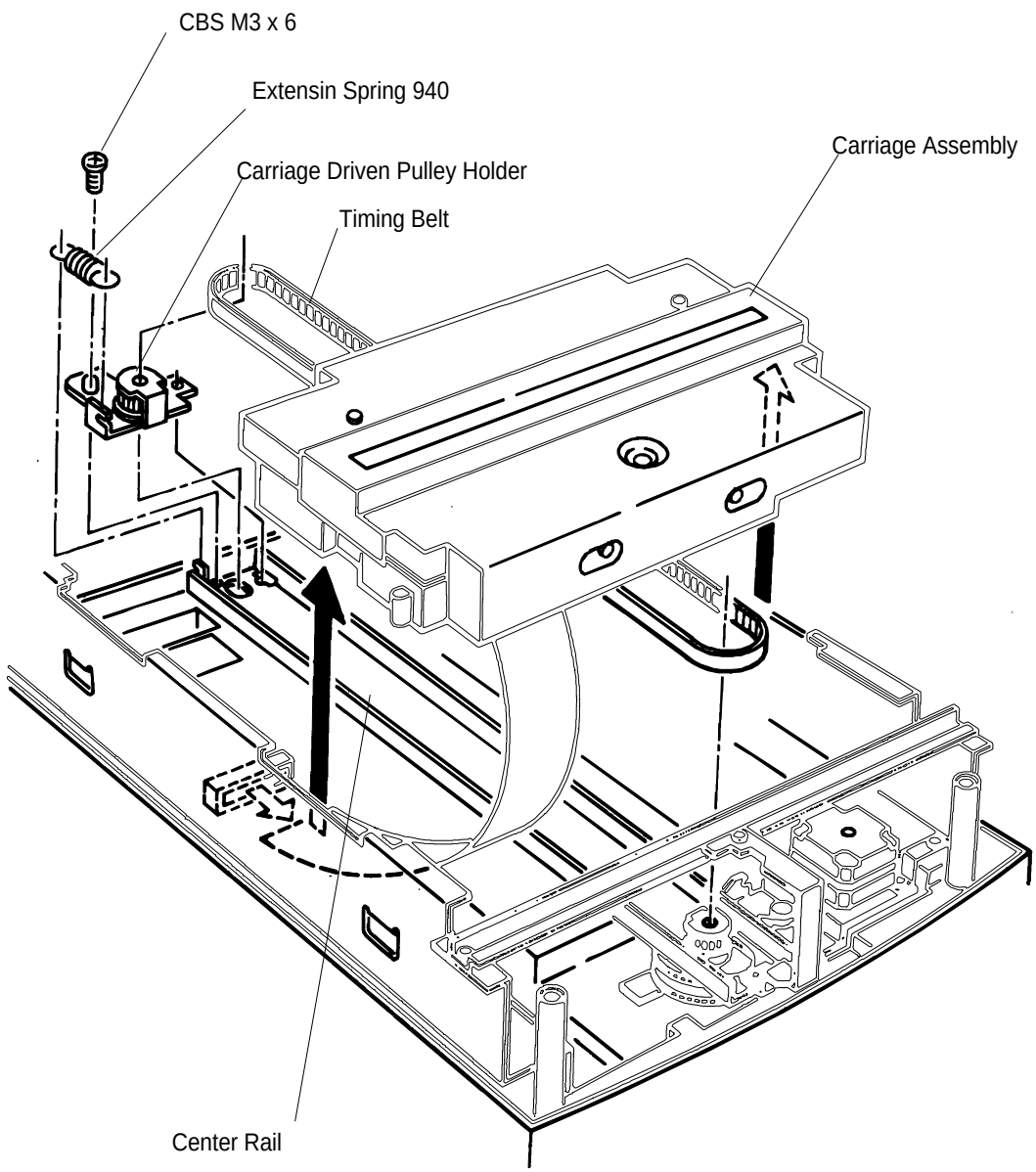


Figure 3-11. Removing the Carriage Assembly

3.2.9 Removing the Center Rail and CR Motor

1. Remove the upper housing assembly. (Refer to Section 3.2.1.)
2. Remove the bottom plate. (Refer to Section 3.2.4.)
3. Remove the B035 MAIN board and B035 I/F board. (Refer to Section 3.2.6.)
4. Remove 4 CBS (M3 × 6) screws and the spacer nut attaching the rear shield plates from below to center rail.

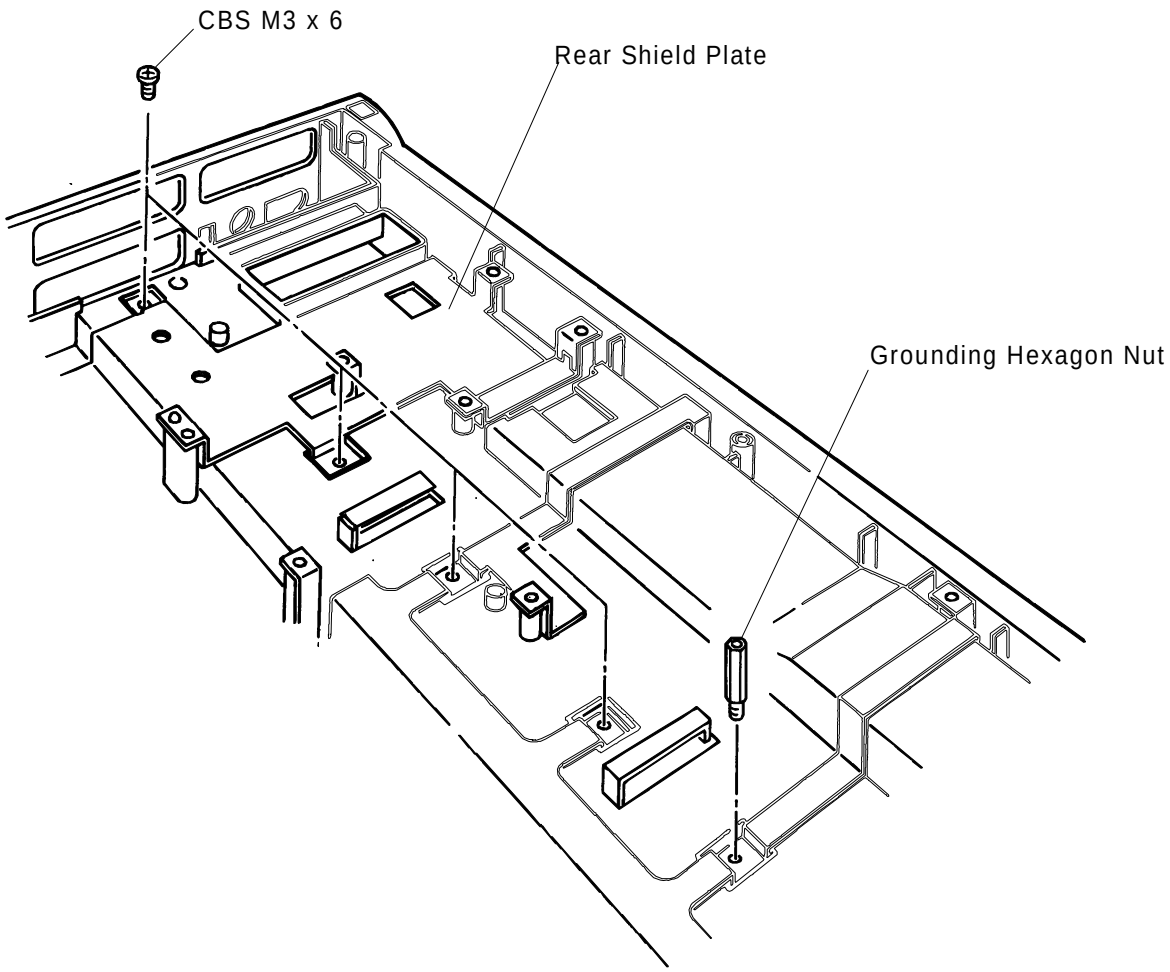


Figure 3-12. Removing CBS Screws and the Spacer Nut

5. Remove the carriage assembly. (Refer to Section 3.2.8.)
6. Remove 3 CBB (3 × 12) screws attaching the center rail to the lower housing and the CBS (M3 × 6) screw attaching the center rail to CR motor frame assembly; then remove the center rail.
7. Remove 2 CBS (M3 × 6) screws attaching the front grounding plate between front frame and CR motor assembly; then remove the front grounding plate.
8. Remove 3 CBB (3 × 12) screws attaching the CR motor assembly to the lower housing; then remove the CR motor assembly.

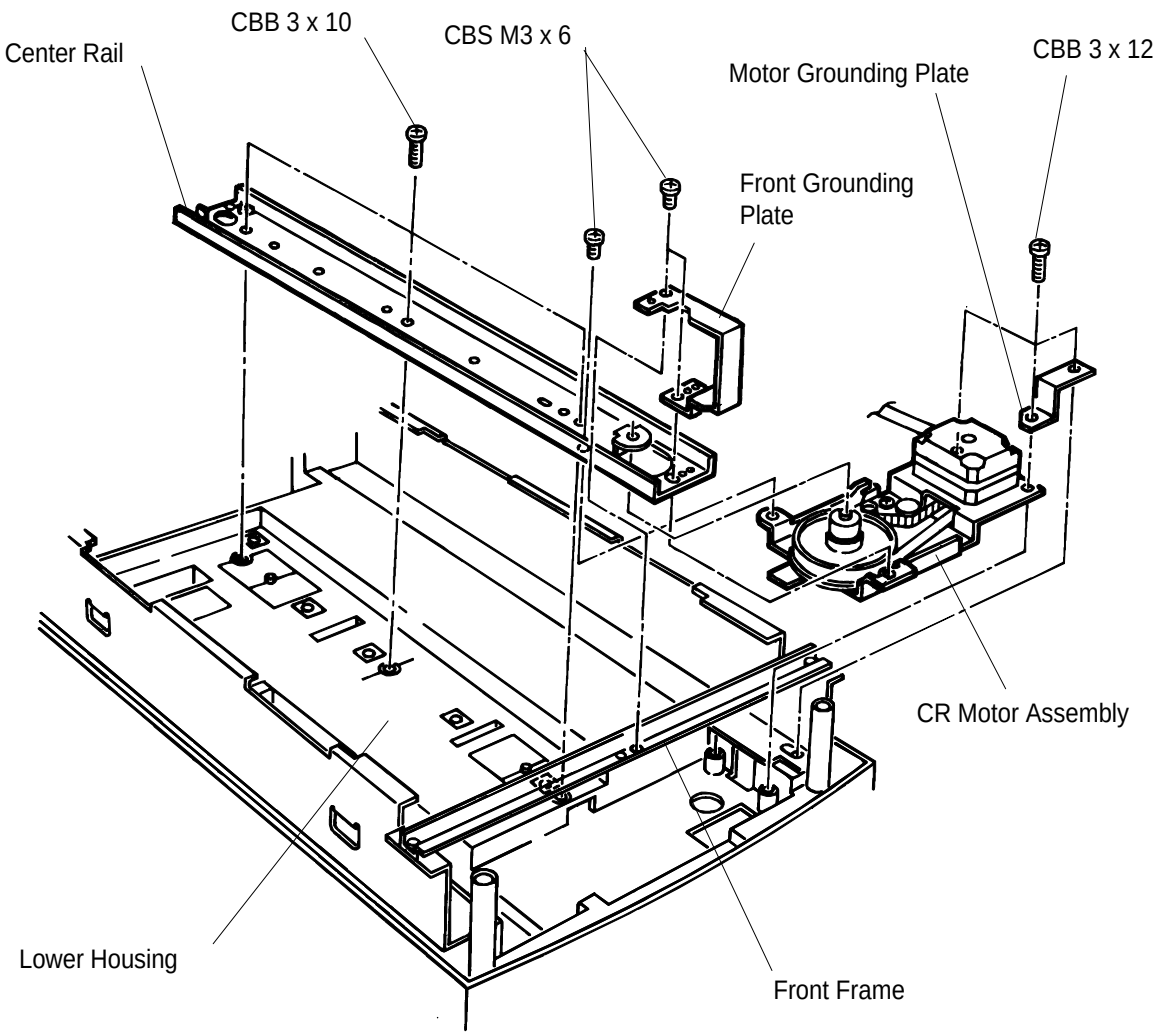


Figure 3-13. Removing Center Rail and CR Motor Assembly

9. Release the CBS (M3 × 6) screw attaching the tension lever assembly to CR motor frame assembly, and swing the lever toward out side to release the tension in timing belt B. Then remove the timing belt B between drive pulley and CR motor pulley.
10. Remove 3 CR dumper shfts and 3 plain bashers, and remove the CR motor from the CR motor frame.

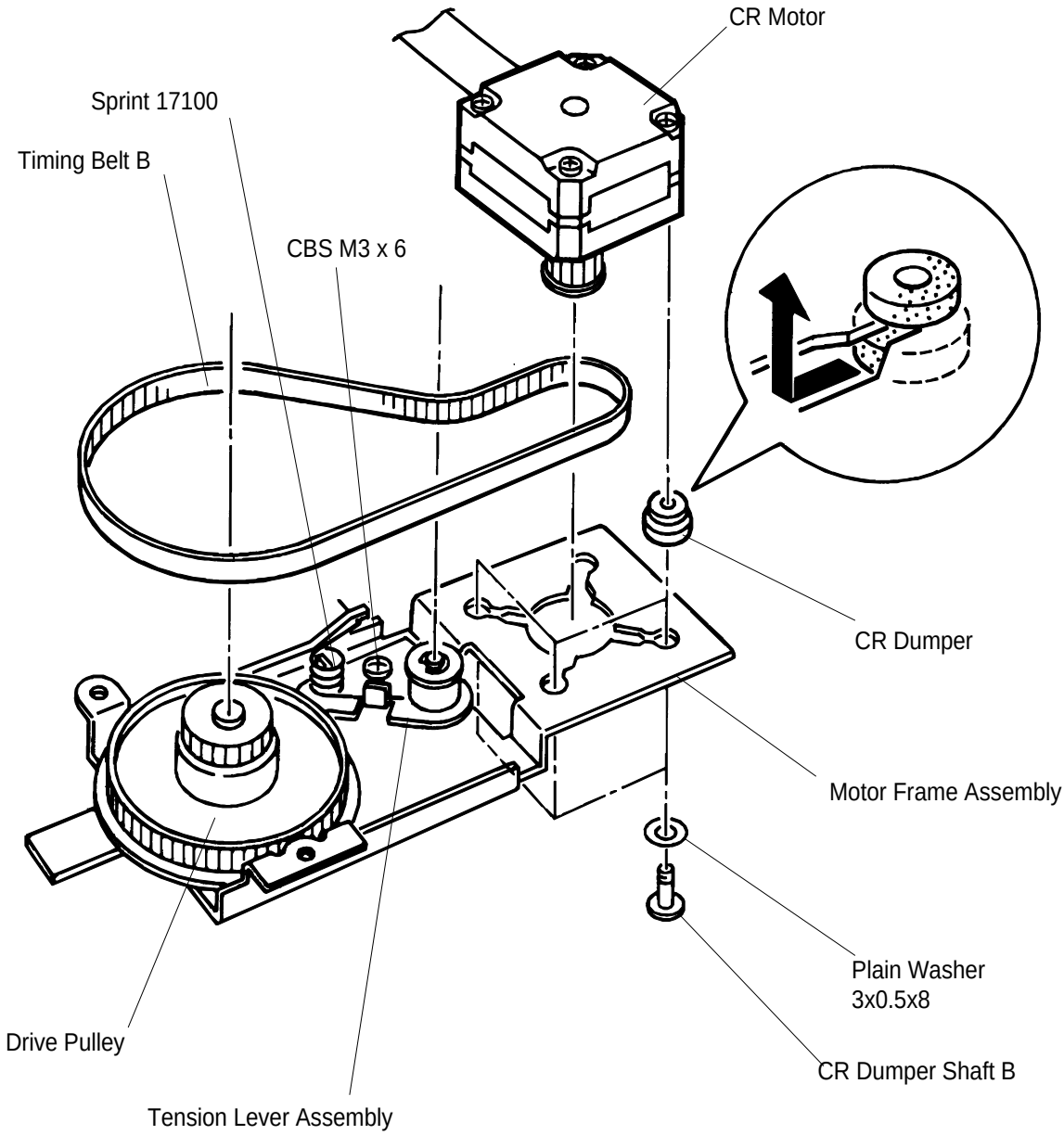


Figure 3-14. Removing the CR Motor

3.2.10 Removing the Lamp Assembly

1. Remove the carriage assembly. (Refer to Section 3.2.8.)
2. Remove 3 CB(O) (M3 × 6) screws attaching the CR cover to the carriage assembly, and remove CR cover.
3. Remove 2 CB (M3 × 6) screws attaching the inverter board to the carriage assembly, and disconnect the harness for the lamp assembly from the connector on the inverter board.
4. Remove the lamp assembly from the carriage.

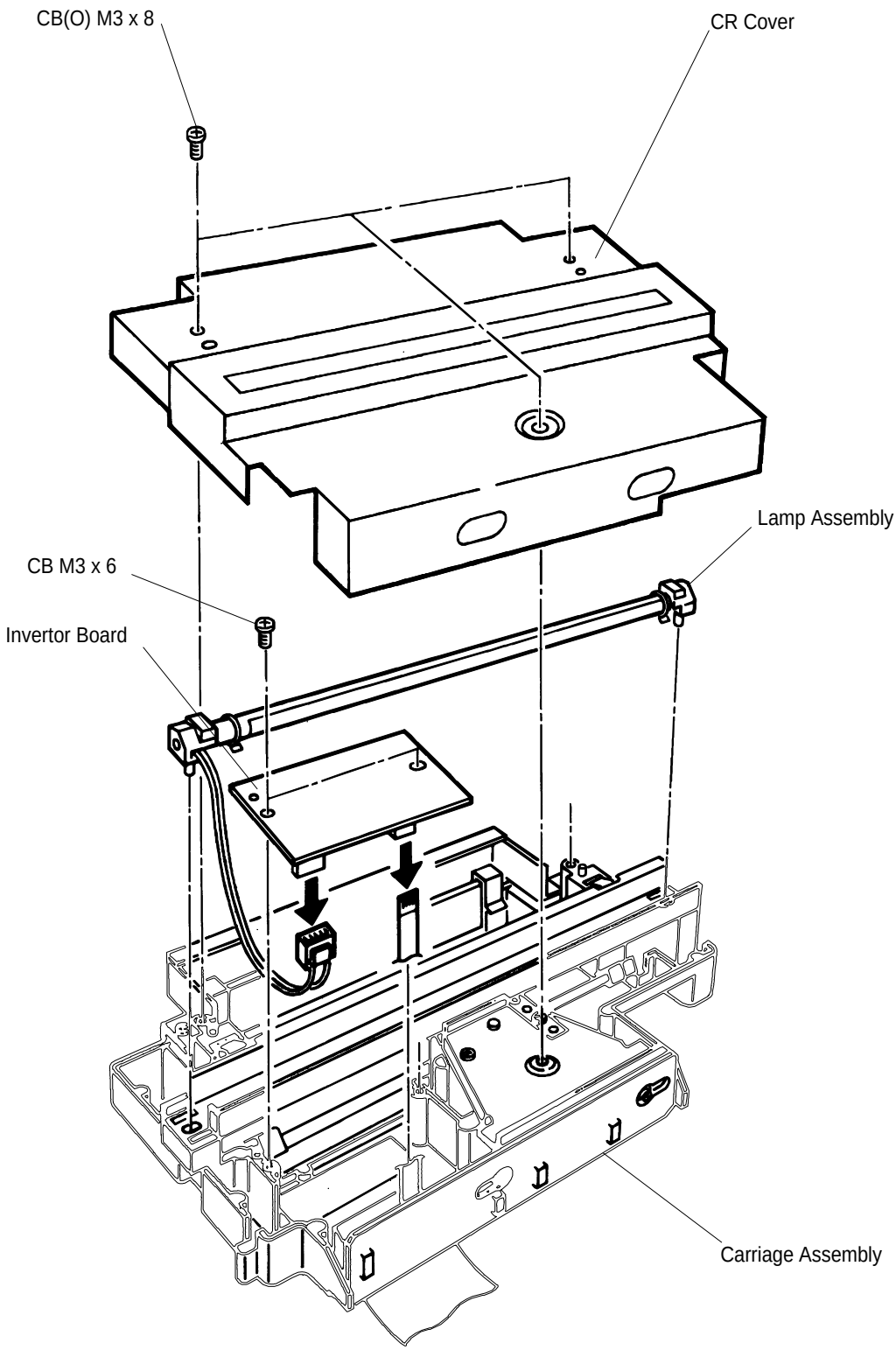


Figure 3-15. Removing the Lamp Assembly

3.3 DISASSEMBLY AND ASSEMBLY OF TRANSPARENCY UNIT

The transparency unit B81307* is exclusive use for GT-9500 / Expression 636. But, the components of this unit are the same as those of B81306*. The only difference is that the this unit equips one light source, on the other hand, B81306* equip the several light sources. So, the details of disassembly and assembly procedures for the unit are referred from the service manual of B81306*.

*Note: * The number represented by the asterisk varies by country*

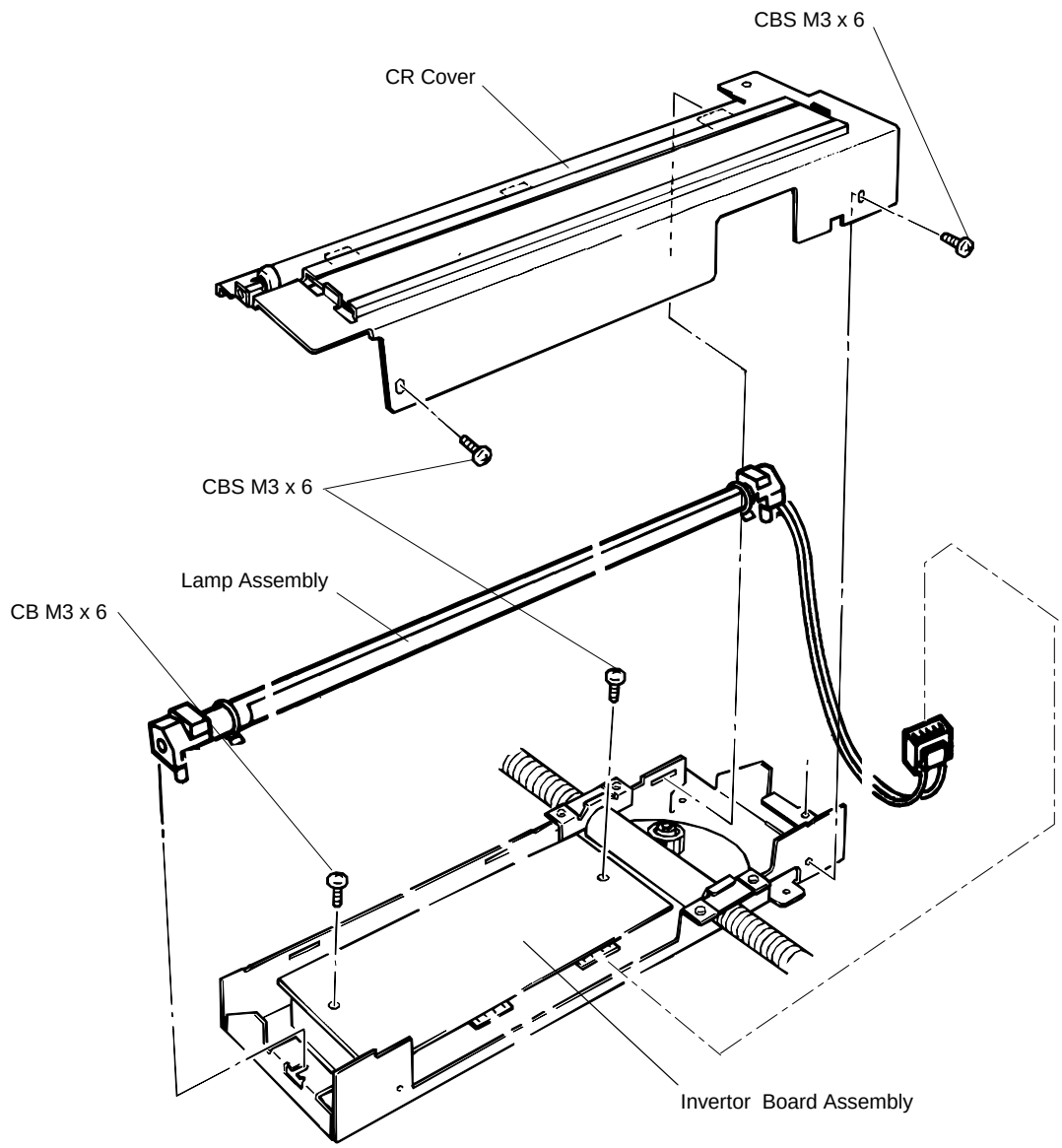


Figure 3-16. Removing the Lamp Assembly of Transparency Unit

Chapter 4 Adjustments

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4.1 Origin Adjustment

This scanner provides a high-performance, high-resolution color CCD sensor for scanning. This sensor also is necessary to control positioning of main and sub scanning directions correctly. The following origin adjustment is required to keep scanning accurate.

1. Place the origin adjustment tool on the right corner of the document glass, fitting the tool edge to main scan scale correctly as shown in the illustration below.

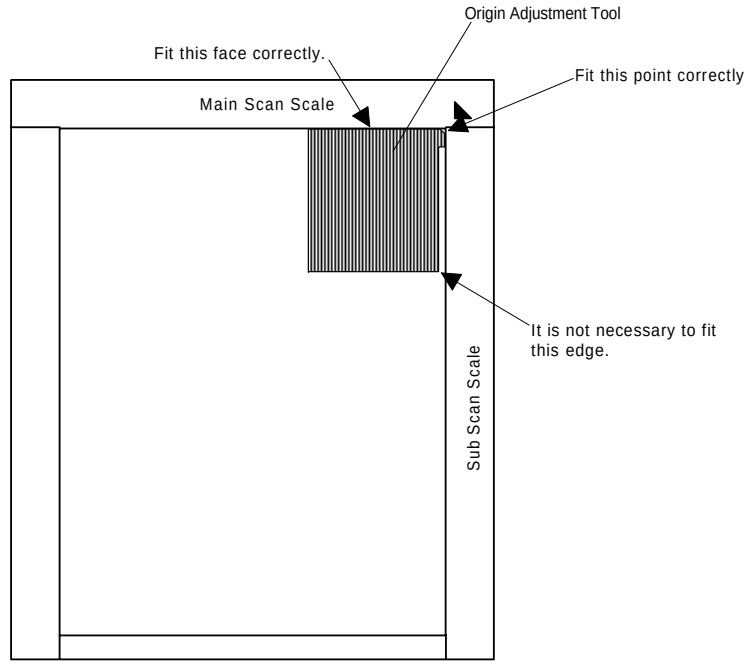

Figure 4-1. Adjustment Tool Position

Note: The white dot side of the tool is set toward glass side.

2. Set the **ID** switch to the middle position between **7** and ***** in the rear of scanner .
3. Hold down the **RESET** button during power on until the LEDs starting blinking.
4. When READY LED and OPERATE LED turn on, power off the scanner once.
5. Set the **ID** switch to **2** or the original setting again.

Note: 1. If you replace the B035 MAIN board or the HP sensor, you must also perform this adjustment.
2. To save the adjustment data in the EEPROM on the B035 MAIN board, you must power off the scanner at once after the adjustment.
3. If ERROR LED is light on or blinking during the adjustment, please retry to perform the adjustment.

Chapter 5 Troubleshooting

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5.1 OVERVIEW

The GT-9500/Expression 636 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 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 for each component. If any abnormality is detected, the scanner displays an error message using the LEDs. The following table lists the messages that show you if service is required.

Table 5-3. Error Displays

Error Display		Error	Cause
READY LED	ERROR LED		
On	On	Command Error	Scanner detects an unidentified command.
Off	Blinks	Interface Error	❒Scanner detects a wrong procedure from the interface communication. ❒With SCSI interface, transmission is frozen for more than 30 seconds, except in the bus free phase.
Blinks	Blinks	Fatal Error	❒The lamp is broken. ❒Power is on while the carriage is locked. ❒System breakdown.

5.3 TROUBLESHOOTING

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

5.3.1 Troubleshooting Abnormal Operations

The table below shows 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 indication is displayed.	5-8
	Light source (lamp) does not light.	5-9
	Lamp lights before the error is displayed.	5-10
Poor quality image output.	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	Result	Solution
CN1 on the B035 PSB/PSE/PSH board may be disconnected.	1	Is CN1 disconnected?	Yes	Connect CN1 on the B035 PSB/PSE/PSH board.
CN2 on the B035 PSB/PSE/PSH board may be disconnected.	2	Is CN2 disconnected?	Yes	Connect CN2 on the B035 PSB/PSE/PSH board.
CN3 on the B035 PSB/PSE board may be disconnected.	3	Is CN3 disconnected?	Yes	Connect CN3 on the B035 PSB/PSE/PSH board.
OPERATE button may be defective.	4	Disconnect CN3 on the B035 PSB/PSE board, and check the OPERATE button using a multimeter. Is the button is normal?	No	Replace SW1.
The fuse on the B035 PSB/PSE/PSH board may be defective.	5	Has the fuse blown on the B035 PSB/PSE/PSH board?	Yes	Replace the fuse.
The B035 PSB/PSE/PSH board may be defective.	6	Is there an output of +5 VDC between: pin 5 or 6 (+), and pin 3 or 4 (–) (total 2 points) for CN2 on the B035 PSB/PSE/PSH with the power on?	No	Replace the B035 PSB/PSE/PSH board.
LED may be defective.	7		Yes	Replace the LED board.
The CR motor coils may be shorted.	8	Disconnect CN6 on the B035 MAIN board and use a multimeter to check the coil resistance between: pins 2 and 4, or pins 1 and 3 (2 points total) on the disconnected cable side.	Yes	Replace the CR motor and follow the steps below to check the driver circuit.
	9	If any coil is shorted, check the CR motor driver circuit using the following procedure: 1.Set the multimeter to resistance check mode. 2.Place the (–) terminal of the multimeter on pins 1, 2, 3, and 4 of connector CN6 on the B035 MAIN board. 3.Place the (+) terminal on GND (pin 10, 11, or 12 of connector CN2 on the B035 MAIN board. Does the multimeter detect " ∝ " with the power off?	No	Replace the CR motor and B035 MAIN board at the same time.

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

Cause	Step	Checkpoint	Result	Solution
Inverter board in the scanner head may be defective.	10	Disconnect connector CN1 on the B035 MAIN board and power on. Does the OPERATE LED come on?	Yes	Replace the inverter board in the scanner head.
Scanner head may be defective.	11		No	Replace the scanner head.
B035 MAIN board may be defective.	12	————————————	——	Replace the B035 MAIN board.

Table 5-6. Unit Does Not Begin Initialization

Cause	Step	Checkpoint	Result	Solution
B035 MAIN board may be defective.	1	————————————	——	Replace the B035 MAIN board.

Table 5-7. Carriage Does Not Move

Cause	Step	Checkpoint	Result	Solution
The B035 PSB/PSE/PSH board may be defective.	1	Is there an output of +24 VDC between pin 1 or 2 (+) and pin 3 (–) for CN2 on the B035 PSB/PSE/PSH board with power on?	No	Replace the B035 PSB/PSE/PSH board.
The carriage mechanism may be 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 may be defective.		Disconnect CN6 on the B035 MAIN board and use a multimeter to check the coil resistance between: pins 2 and 4, or pins 1 and 3 (2 points total) on the disconnected cable side. Pin 2 - Pin 4 Pin 1 - Pin 3 Are the resistances of the two points above approximately 9 Ω ?	No	Replace the CR motor. If any coil is shorted, follow the steps below to check the driver.
	3	If any coil is shorted, check the CR motor driver circuit using the following procedure: 1.Set the multimeter to resistance check mode. 2.Place the (–) terminal of the multimeter on pin 1, 2, 3 and 4 of connector CN6 on the B035 MAIN board. 3.Place the (+) terminal on GND (pin 10, 11, or 12 of connector CN2 on the B035 MAIN board. Does the multimeter detect " ∝ " with the power off?	No	Replace the CR motor and B035 MAIN board at the same time.
B035 MAIN board may be defective.	4	————————————————	——	Replace the B035 MAIN board.

Table 5-8. Carriage Moves and Crashes into Frame

Cause	Step	Checkpoint	Result	Solution
Carriage may be still locked.	1	Check whether the carriage is unlocked or not.	Yes	Unlock the carriage.
HP sensor may be defective.	2	————————————————	——	Replace the HP sensor.

Table 5-9. Light Source (Lamp) Does Not Light

Cause	Step	Checkpoint	Result	Solution
CN1 on the B035 MAIN board may be disconnected.	1	Is CN1 disconnected?	Yes	Connect CN1 on the B035 MAIN board.
The connector for the inverter board in the scanner head may be disconnected.	2	Is the connector for the inverter board disconnected?	Yes	Connect the inverter board connector.
Lamp may be defective.	3	Does the scanner work well again after you replace the lamp?	Yes	————————————
The inverter board in the scanner head may be defective.	4	Does the scanner work well after you replace the inverter board?	Yes	————————————
The B035 MAIN board may be defective.	5	————————————	——	Replace the B035 MAIN board.

Table 5-10. Lamp Lights Before the Error is Displayed

Cause	Step	Checkpoint	Result	Solution
Carriage may be still locked.	1	Check whether the carriage is unlocked or not.	Yes	Unlock the carriage.
The connector on the CCD board in the scanner head may be disconnected.	2	Is the connector on the CCD board connected?	No	Connect the connector on B035 ISN board.
The B035 PSB/PSE/PSH board may be defective.	3	Is there an output of +15 VDC between pins 1 or 2 (+) and 3 (–) for CN2 on the B035 PSB/PSE board?	No	Replace the B035 PSB/PSE/PSH board.
The scanner head may be defective.	4	Does the scanner work well again after you replace the scanner head?	Yes	————————————
The B035 MAIN board may be defective.	5	————————————	——	Replace the B035 MAIN board.

Table 5-11. Image Unclear

Cause	Step	Checkpoint	Result	Solution
The document glass may be dirty.	1	Does the scanner work well again after you clean the glass inside and outside?	Yes	————————————
The scanner head may be defective.	2	Does the scanner work after you replace the scanner head?	Yes	————————————
The B035 MAIN board may be defective.	3	————————————	——	Replace the B035 MAIN board.

Table 5-12. Interface Error (Parallel)

Cause	Step	Checkpoint	Result	Solution
The parallel interface cable may be defective.	1	Does the scanner work after you replace the interface cable?	Yes	————————————
The B035 MAIN board may be defective.	2	————————————	——	Replace the B035 MAIN board.

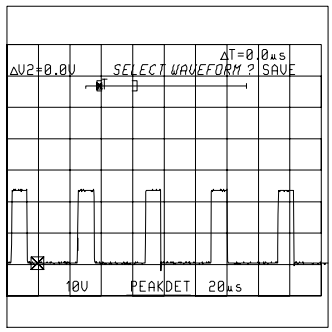
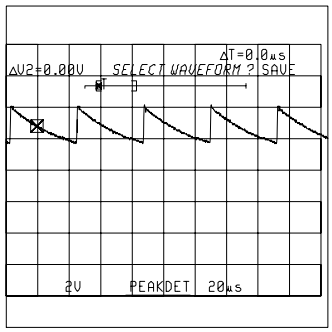
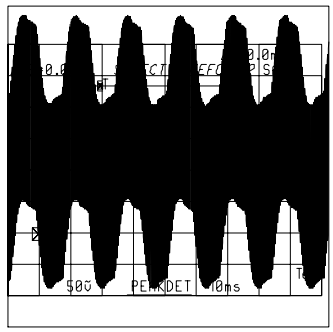
Table 5-13. Interface Error (SCSI)

Cause	Step	Checkpoint	Result	Solution
The terminal settings may be wrong.	1	Check the settings and user's guide. Are the settings correct?	No	Change the terminal settings.
The SCSI ID setting may be wrong.	2	Check the setting and user's guide. Is the setting correctly?	No	Change the SCSI ID setting.
The SCSI cable may be defective.	3	Does the scanner work well again after you replace the interface cable?	Yes	————————————
The B035 MAIN board may be defective.	4	————————————	——	Replace the B035 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 check to evaluate the operation of any components that might be defective. Check these value and take the appropriate action.

Table 5-14. Repair of the Power Supply Board

Condition	Cause	Checkpoint	Action
+5 VDC is not output.	Regulator IC51 is defective.	Check oscillating waveform (pin 5) and chopping waveform (pin 7). Waveform-1 (pin 7):  Waveform-2 (pin 5):  	Replace IC51.
+24 VDC is not output.	Switching FET (Q1) is defective.	Check drain waveform of switching FET Q1. Waveform-3  	Replace FET Q1.
+15 VDC is not output.	Regulator IC81 is defective.	(Refer to IC51, because the procedure and waveforms to check IC81 are just same as for IC51.)	Replace IC81.

5.5 REPAIR OF THE MAIN CONTROL BOARD

This section provides instructions to repair a defective main board. Servicers who do not repair to the component level (including all servicers in the U.S.) can ignore this section. The table describes various problems, likely causes, checkpoints, and solutions. The checkpoint column provides proper waveforms, resistance values, and other values to check to evaluate the operation of any components that might be defective. Check these value and take the appropriate action.

Table 5-15. Repair of the Main Control Board

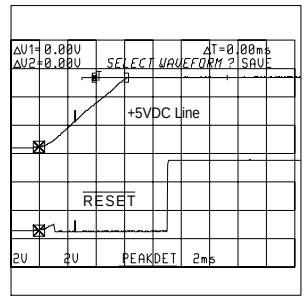
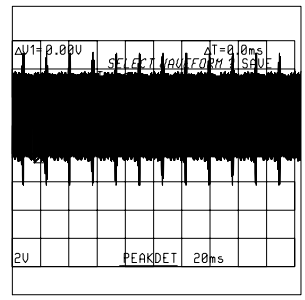
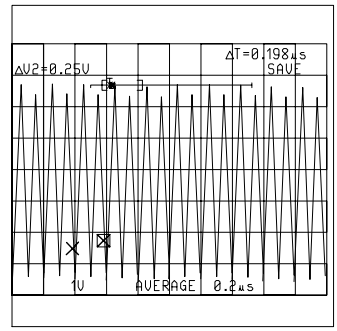
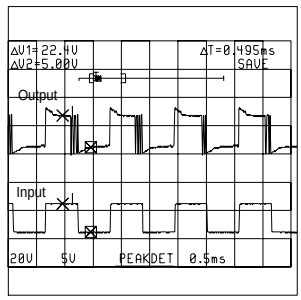
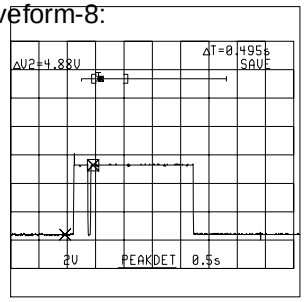
Problem	Condition	Cause	Checkpoint	Action
No operation at all.	CPU does not operate.	Reset circuit does not operate.	Check the +5 VDC voltage and the reset signal of IC12 (pin 6) at power on. Waveform-4: 	Replace IC12. Otherwise, replace B035 MAIN board.
		ROM selection is not carried out correctly.	Is pin 26 of IC14 correctly changing from HIGH/LOW? Waveform-5: 	Replace IC14. Otherwise, replace B035 MAIN board.
		CPU is defective.	Check the waveform at pin 37 of IC4 (CPU). Waveform-6: 	Replace B035 MAIN board

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

Problem	Condition	Cause	Checkpoint	Action
Fatal error is displayed.	CR motor does not move.	IC5, IC7 are defective.	Check the input for pin 3 (Input) and pin 8 (Output) of IC5, IC7. Waveform-7: 	Replace IC5, IC8. Otherwise, replace the B035 MAIN board.
	Carriage does not stop at home position.	IC4 (CPU) or HP sensor is defective.	Does the input for pin 21 of IC4 go from LOW to HIGH when the carriage is in the home-position?	Replace the B035 MAIN board. Otherwise, replace HP sensor.
	The lamp does not light.	IC1 is defective.	Check pin 1 of IC 1. Waveform-8: 	Replace IC1. Otherwise replace the B035 MAIN board.
		Inverter circuit board is defective.	Does IC1 output lamp drive signal (pin 1 of IC1)?	Replace inverter circuit board.
	White standard cannot be read.	IC1 is defective.	Does IC1 output CCD sensor drive signal (pin 117 of IC1)?	Replace IC1. Otherwise, replace B035 MAIN board.
The scanner does not read the image.		Image processing gate arrays defective.	————————————————	Replace IC1, IC15, IC3, and IC2. Otherwise, replace the B035 MAIN board.

Interface error is displayed.	Parallel I/F	IC14 is defective.	————————————————	Replace IC14. Otherwise, replace main board.
	SCSI	IC6 is defective.	————————————————	Replace IC6. Otherwise, replace main board.

Chapter 6 Maintenance

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6.1 MAINTENANCE

This scanner requires appropriate cleaning 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 glass is free of dirt; dirt on the glass can have a particularly bad affect on the reading quality. If the glass is dirty, clean it with a dry, soft cloth.

CAUTION

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

6.2 LUBRICATION

Lubricate the scanner properly when you disassemble it for component replacement, or if mechanical noise exceeds a certain level. EPSON recommends only the lubricants listed in table below for this scanner. They have 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. Recommended Lubricants

Type	Name	Quantity	Part No.	Availability
Grease	G-20	40 g	B702000001	E
Grease	G-44	40 g	103155100	E

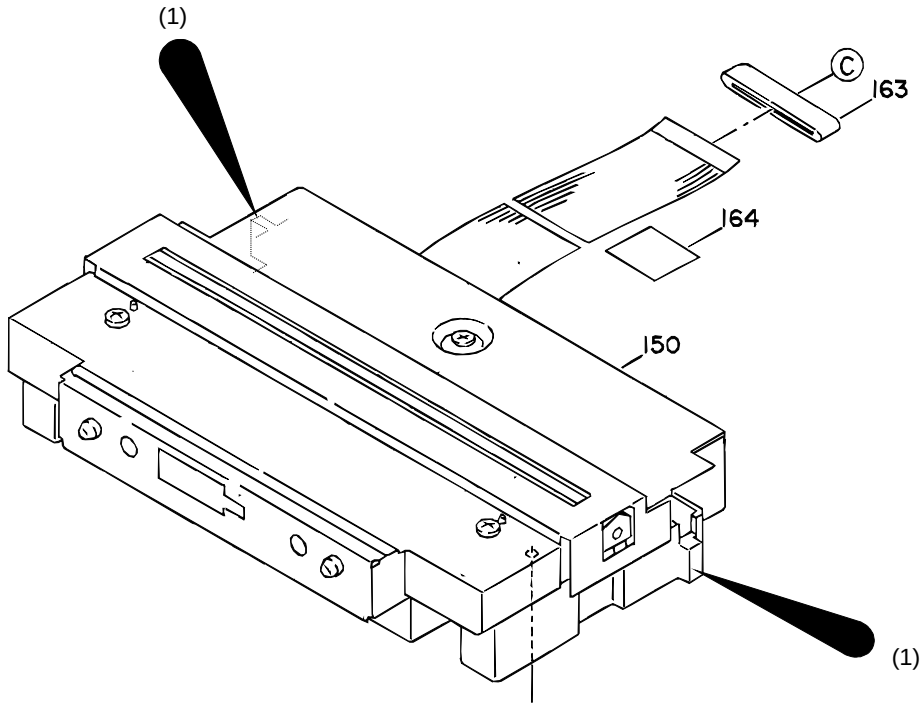
Note: E = EPSON exclusive product (not commercially available)

Table 6-2. Lubrication Points

Reference No. in Figure 6-1	Lubrication Point	Lubricant (See Figures 6-1.)
(1)	Surfaces of the left / right side carriage unit that contact with side frames.	G-20 (3 mg)
(2)	Surface of the center rail that contact with the CR metal rollers.	G-44

CAUTION

❒ ***Do not apply too much lubricant, because it may create stains or cause the mechanism to malfunction.***
❒ ***Do not apply lubricant to the surface of center rail that contact with plastic CR rollers.***



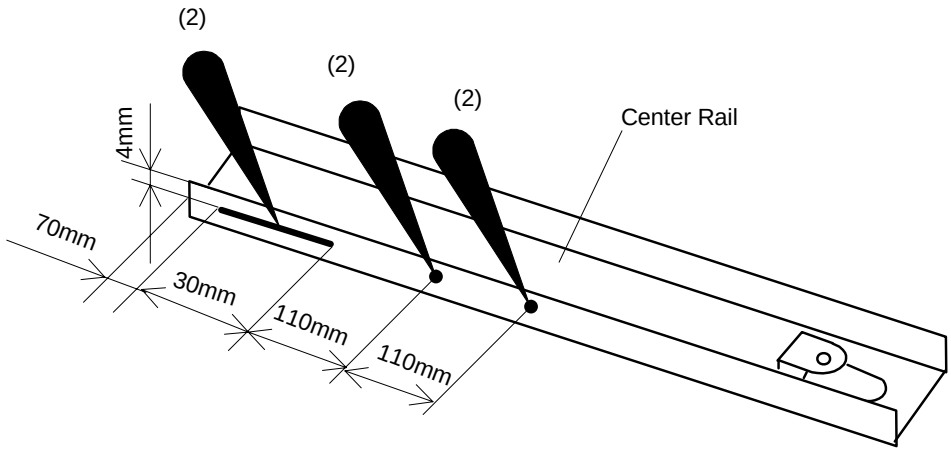


Figure 6-1. Lubrication Points

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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.

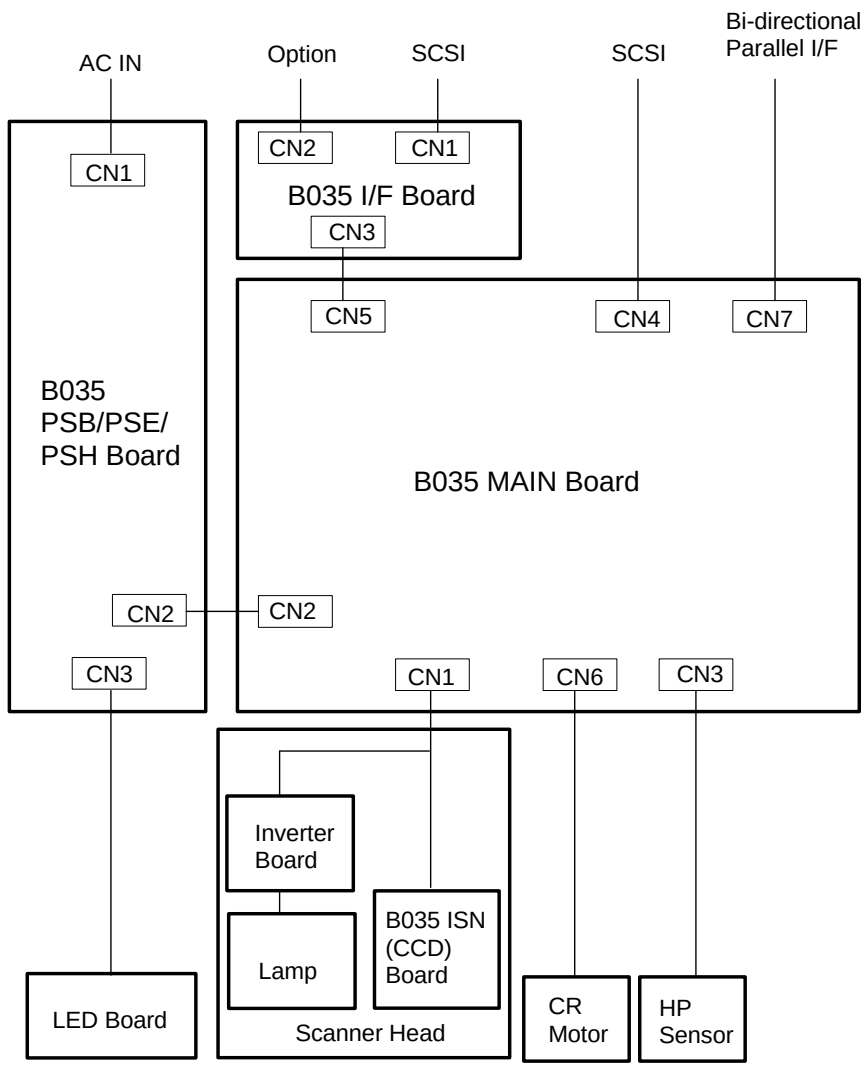

Figure A-1. Cable Connections

Table A-1. Board Connector Summary

Connector	Description	Pins	Reference
B035 MAIN Control Circuit Board			
CN1	Connector for CCD sensor for carriage assembly	37-pin	Table A-2
CN2	Connector for B035 PSB/PSE/PSH board	12-pin	Table A-3
CN3	Connector for HP sensor	3-pin	Table A-4
CN4	Connector for SCSI	50-pin	Table 1-6
CN5	Connector for B035 I/F board	40-pin	Table A-5
CN6	Connector for CR motor	4-pin	Table A-6
CN7	Connector for parallel interface	36-pin	Table 1-2
B035 PSB/PSE/PSH Power Supply Board			
CN1	Connector for AC power input	2-pin	—
CN2	Connector for B035 MAIN board	12-pin	—
CN3	Connector for LED board	4-pin	—
B027 I/F Board			
CN1	Connector for SCSI	40-pin	—
CN2	Connector for option	15-pin	—
CN3	Connector for B035 MAIN board	50-pin	—

Table A-2. CN1 Pin Assignments

Pin No.	Signal Name	I/O	Description
1 - 2	+24	—	+24 VDC
3	LON		
4 - 5	GP	—	Ground
6	—	—	Not Used
7	GND	—	Ground
8	+5	—	+5 VDC
9	GND	—	Ground
10	+12	—	+12 VDC
11	TPU		Output switching signal between photodiode of transparency unit (TPU) and CCD sensor
12	GC	O	Gain control for CCD
13	GND	—	Ground
14	CP2	O	A/D clamp pulse 2
15	AD	O	A/D converter clock
16	MX0	O	A/D multiplex 0
17	MX1	O	A/D multiplex 1
18	SH	O	A/D sampling and holding
19	CP1	O	A/D clamp pulse 1
20	SHB	O	Blue shutter of CCD
21	SHG	O	Green shutter of CCD
22	SHR	O	Red shutter of CCD
23	RST	O	Reset
24	CK1	O	Clock 1
25	TG	O	CCD shift pulse
26	AD0	I	Video data bit 0
27	AD1	I	Video data bit 1
28	AD2	I	Video data bit 2
29	AD3	I	Video data bit 3
30	AD4	I	Video data bit 4
31	AD5	I	Video data bit 5
32	AD6	I	Video data bit 6
33	AD7	I	Video data bit 7
34	AD8	I	Video data bit 8
35	AD9	I	Video data bit 9
36	AD10	I	Video data bit 10
37	AD11	I	Video data bit 11

Table A-3. CN2 Pin Assignments

Pin No.	Signal Name	I/O	Description
1,2	+24	—	+24 VDC
3,4	GP	—	Ground
5,6	+5	—	+5 VDC
7	+15	—	+15 VDC
8	RESET	O	Reset
9	ERROR	O	ERROR LED
10,12	GND	—	Ground
11	READY	O	READY LED

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. CN5 Pin Assignments

Pin No.	Signal Name	I/O	Description
1	P61	I	SCSI ID switch
2	P62	I	SCSI ID switch
3	P63	I	SCSI ID switch
4	P64	I	SCSI ID switch
5	EN	I	SCSI terminator enable
6	+5	—	+5 VDC
7	DBP	I/O	DBP signal for SCSI
8	DB7	I/O	DB7 signal for SCSI
9	DB6	I/O	DB6 signal for SCSI
10	DB5	I/O	DB5 signal for SCSI
11	DB4	I/O	DB4 signal for SCSI
12	DB3	I/O	DB3 signal for SCSI
13	DB2	I/O	DB2 signal for SCSI
14	DB1	I/O	DB1 signal for SCSI
15	DB0	I/O	DB0 signal for SCSI
16	POWER	—	Terminator power (+5 VDC)
17	$\overline{\text{ATN}}$	I	ATN signal for SCSI
18	$\overline{\text{BSY}}$	I/O	BSY signal for SCSI
19	$\overline{\text{ACK}}$	I	ACK signal for SCSI
20	$\overline{\text{RST}}$	I	RST signal for SCSI
21	$\overline{\text{MSG}}$	O	MSG signal for SCSI
22	$\overline{\text{SEL}}$	I/O	SEL signal for SCSI
23	$\overline{\text{CD}}$	S/D	C/D signal for SCSI
24	$\overline{\text{REQ}}$	O	REQ signal for SCSI
25	$\overline{\text{IO}}$	O	I/O signal for SCSI
26	GND	—	GND
27	P71	I	Option switch 1
28	TXD	O	Transmitted data
29	P72	I	Option switch 2
30	SCK	O	Option clock
31	P73(B)	O	Blue lamp control
32	$\overline{\text{LOD}}$	O	Option control
33	P75(G)	O	Green lamp control
34	P70(S)	O	Select signal
35	P74(R)	O	Red lamp control
36,37	+5	—	+5 VDC
38	GND	—	GND
39,40	+24	—	+24 VDC

Table A-6. CN6 Pin Assignments

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

A.2 CIRCUIT DIAGRAMS

Figure A-2. B035 MAIN Board Circuit Diagram

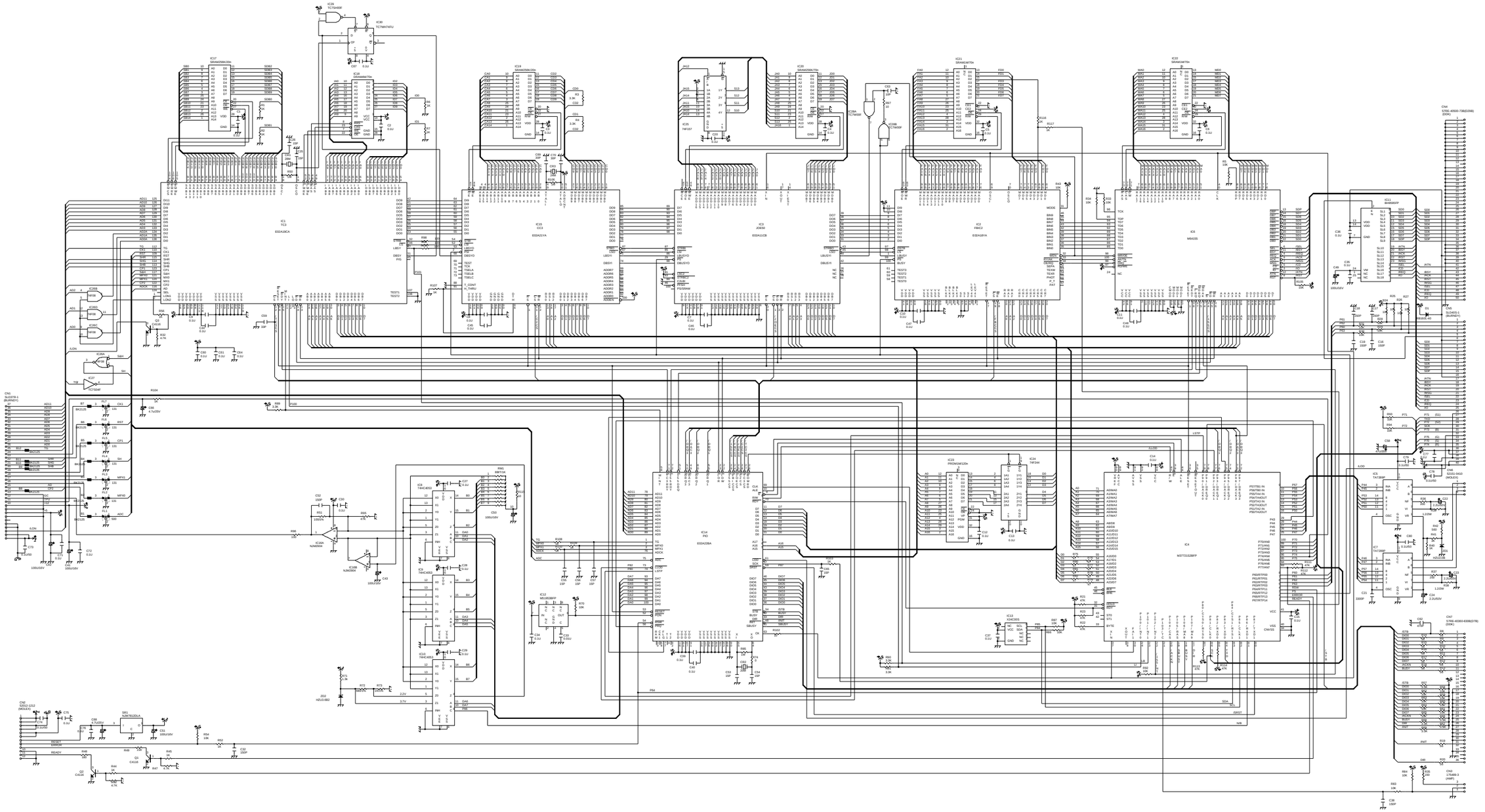

Figure A-2. B035 MAIN Board Circuit Diagram

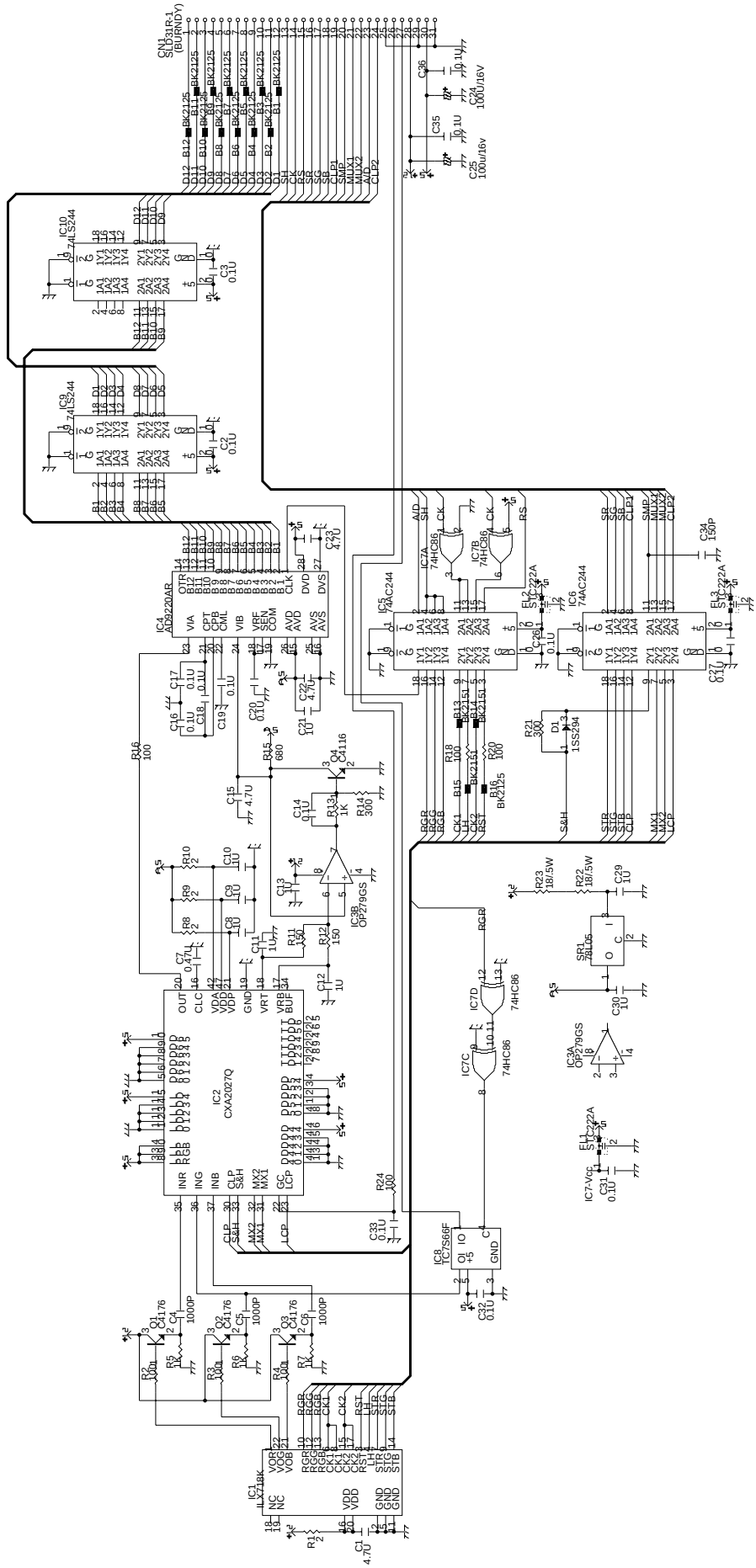

Figure A-3. B035 ISN Board Circuit Diagram

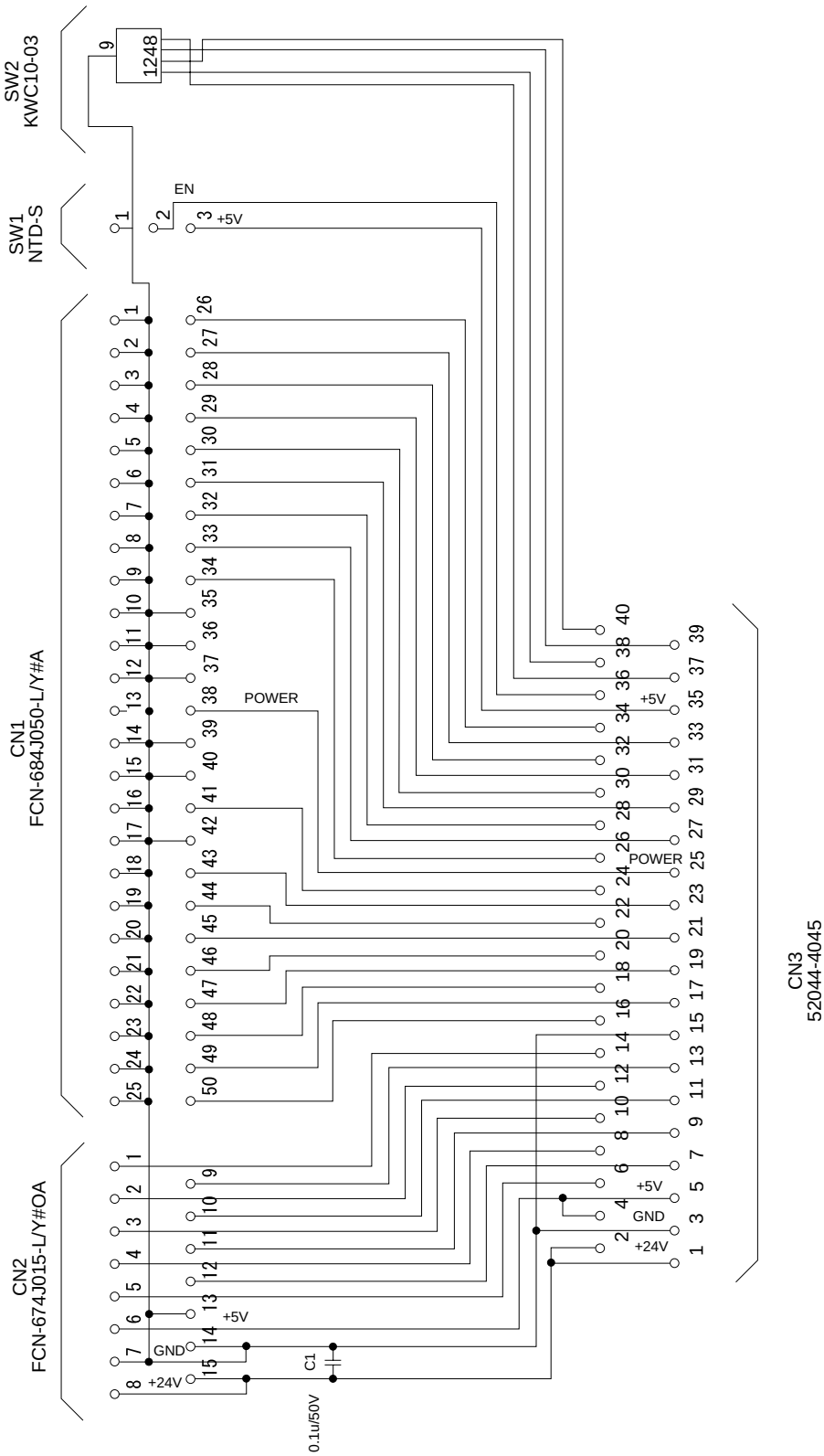

Figure A-4. B035 I/F Board Circuit Diagram

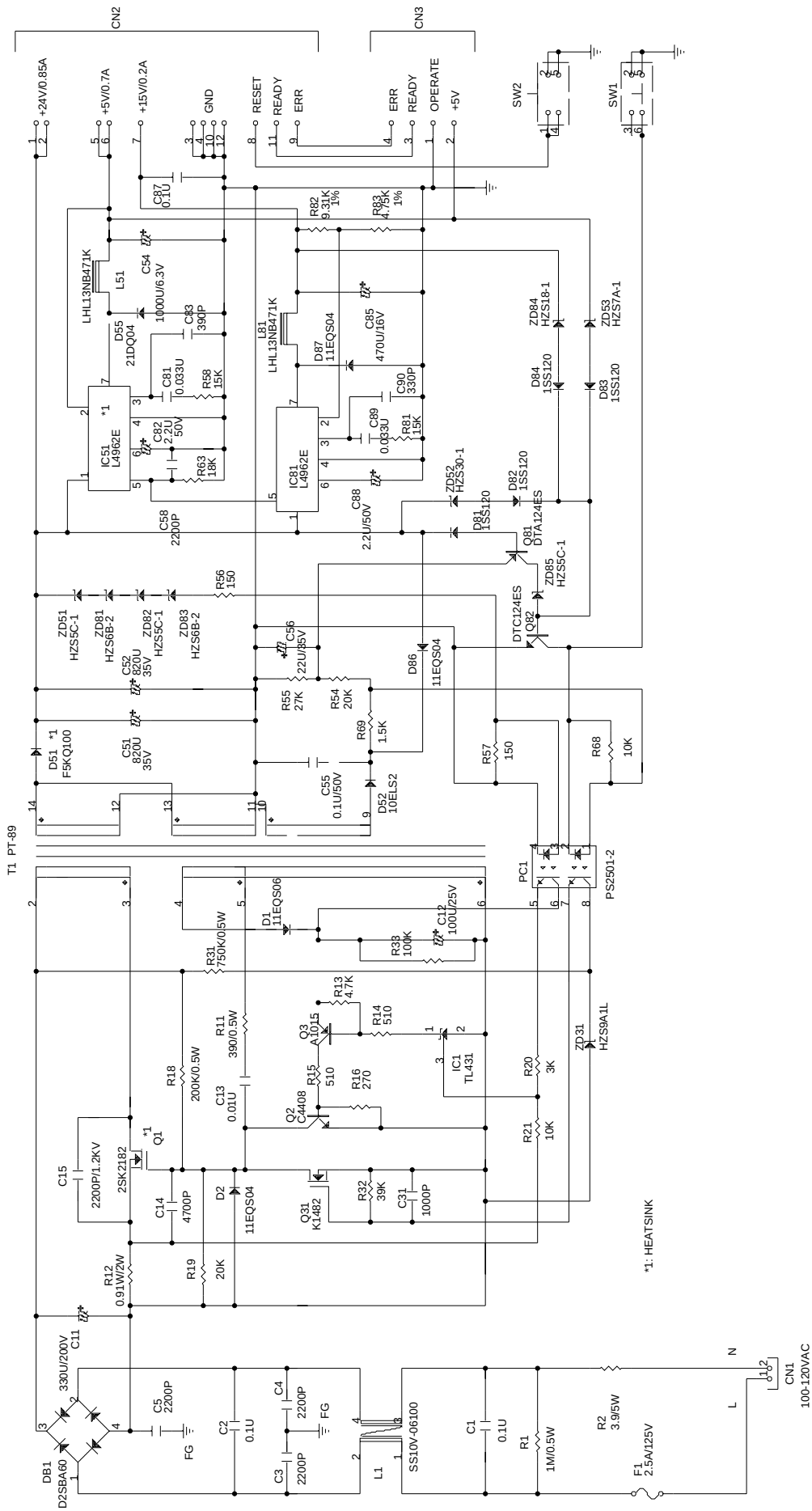

Figure A-5. B035 PSB Board Circuit Diagram (100-120 VAC)

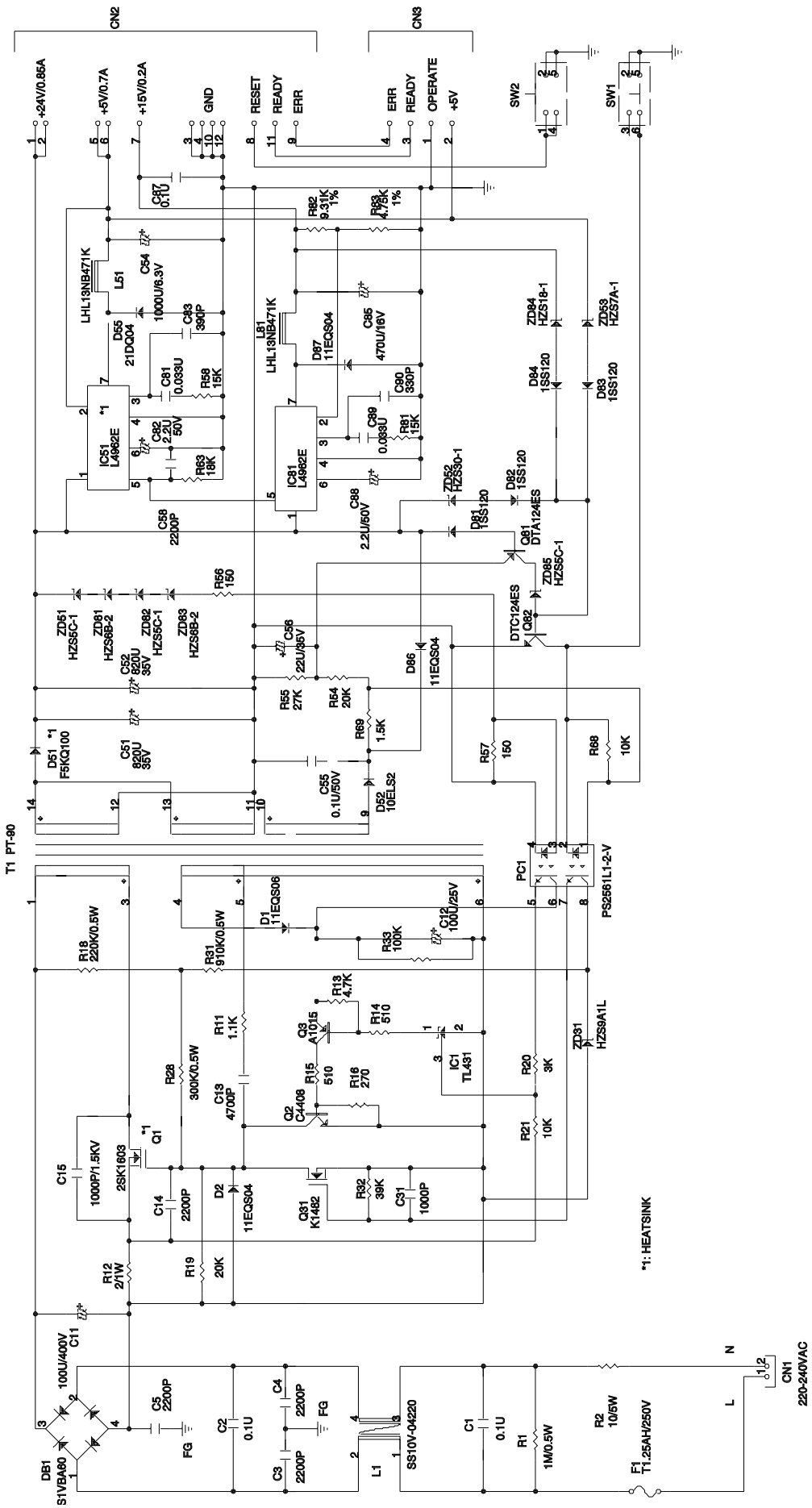

Figure A-6. B035 PSE Board Circuit Diagram (220-240 VAC)

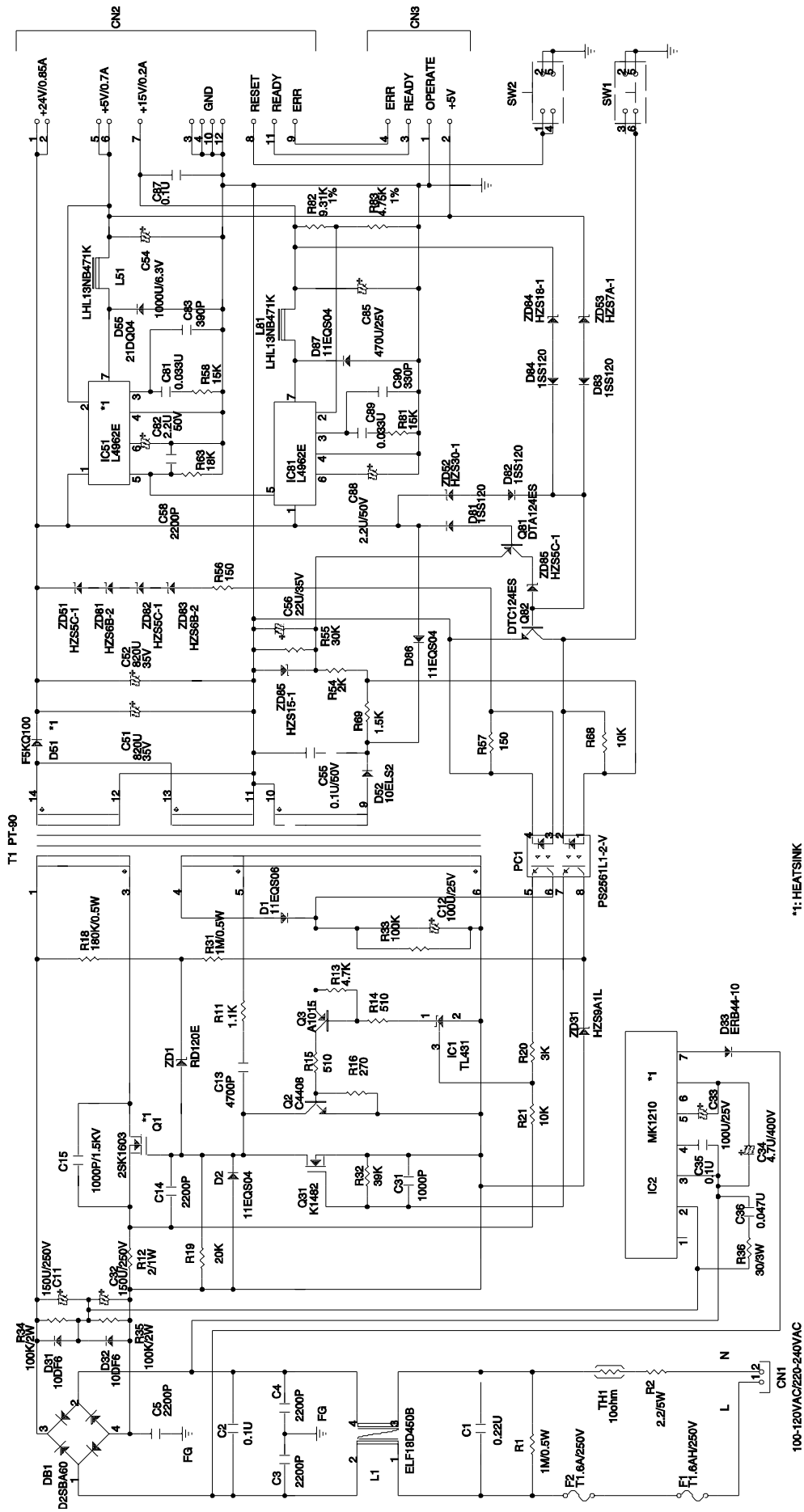

Figure A-7. B035 PSH Board Circuit Diagram (100-120 V / 220-240 VAC)

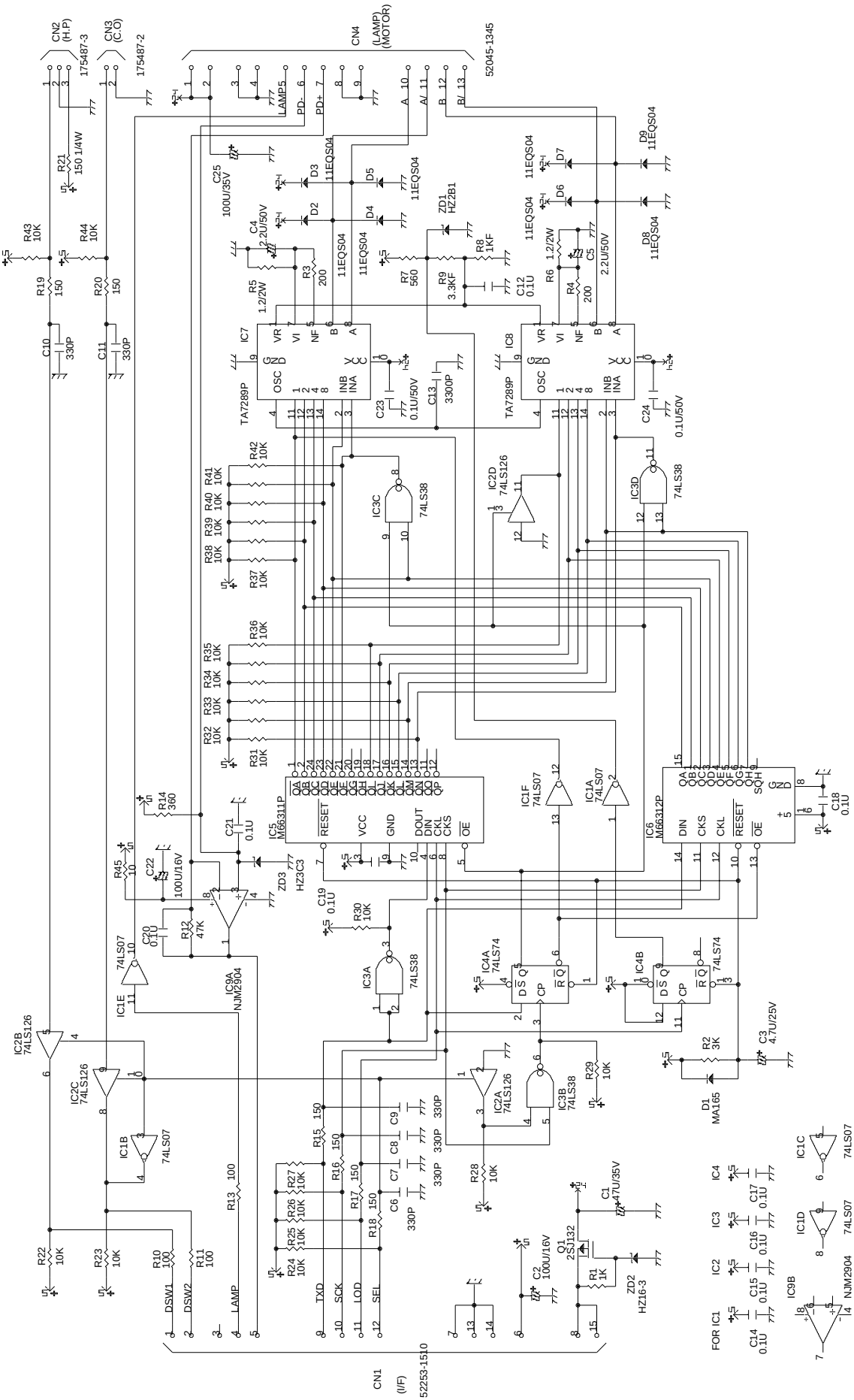

Figure A-8. B81307* MAIN Board Circuit Diagram (Optional Transparency Unit TPU)

A.3 CIRCUIT BOARD COMPONENT LAYOUTS

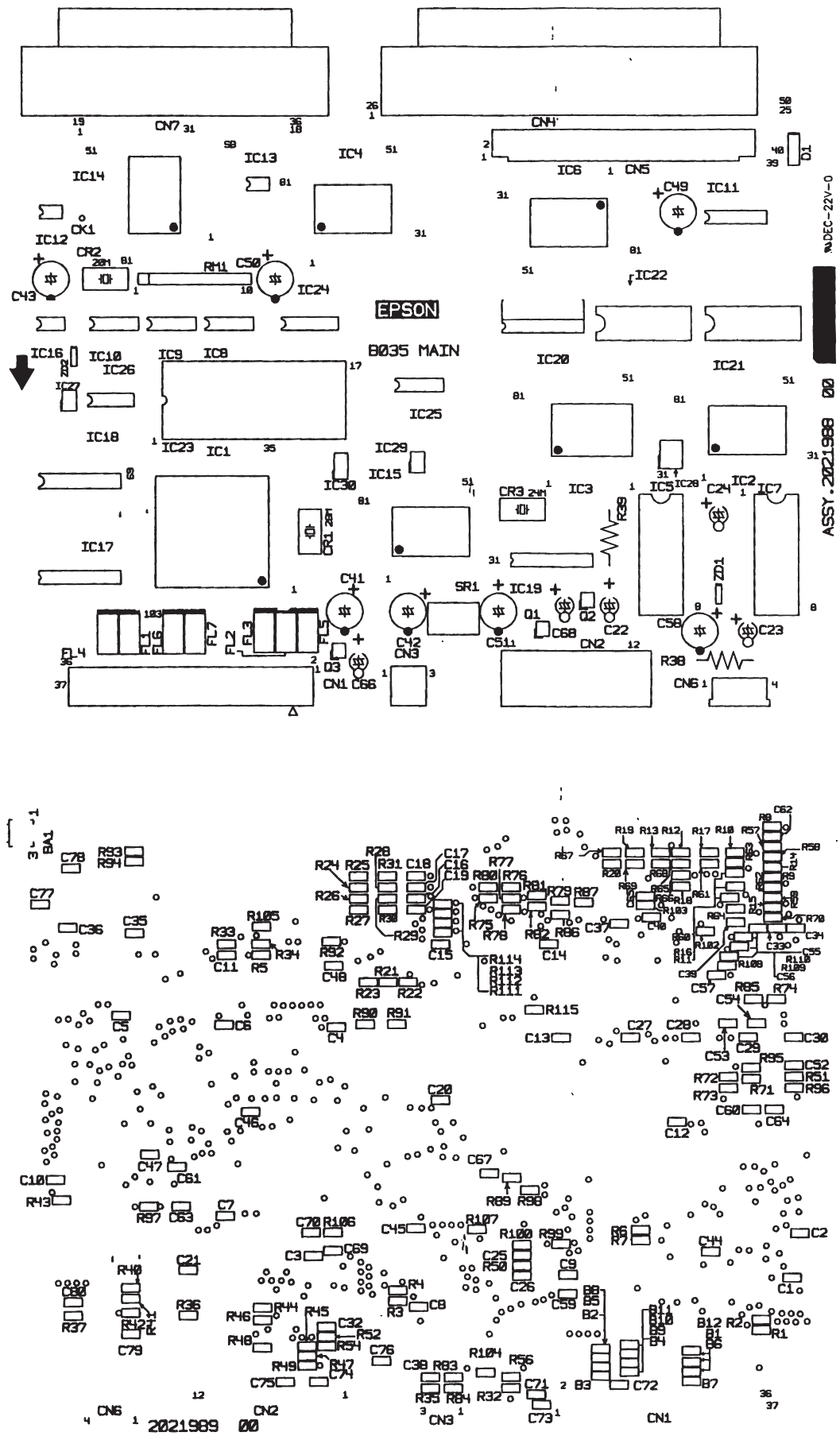

Figure A-9. B035 MAIN Board Component Layout

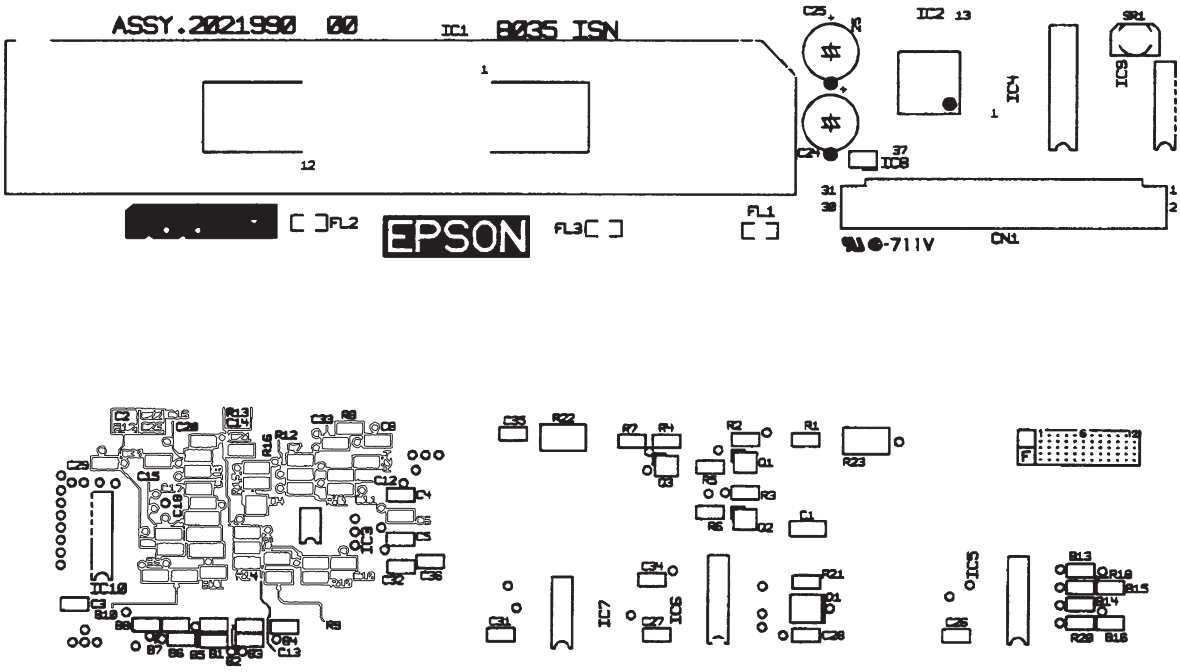

Figure A-10. B035 ISN Board Component Layout

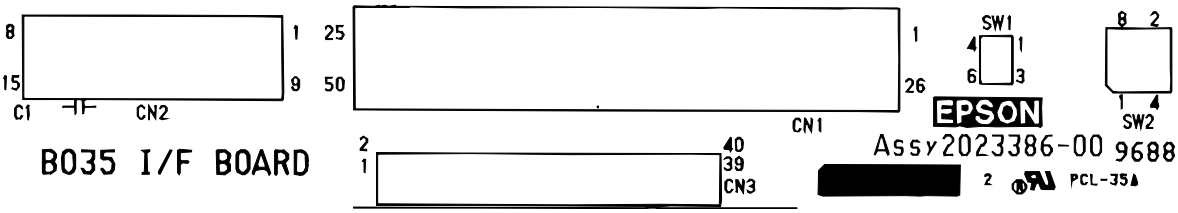

Figure A-11. B035 I/F Board Component Layout

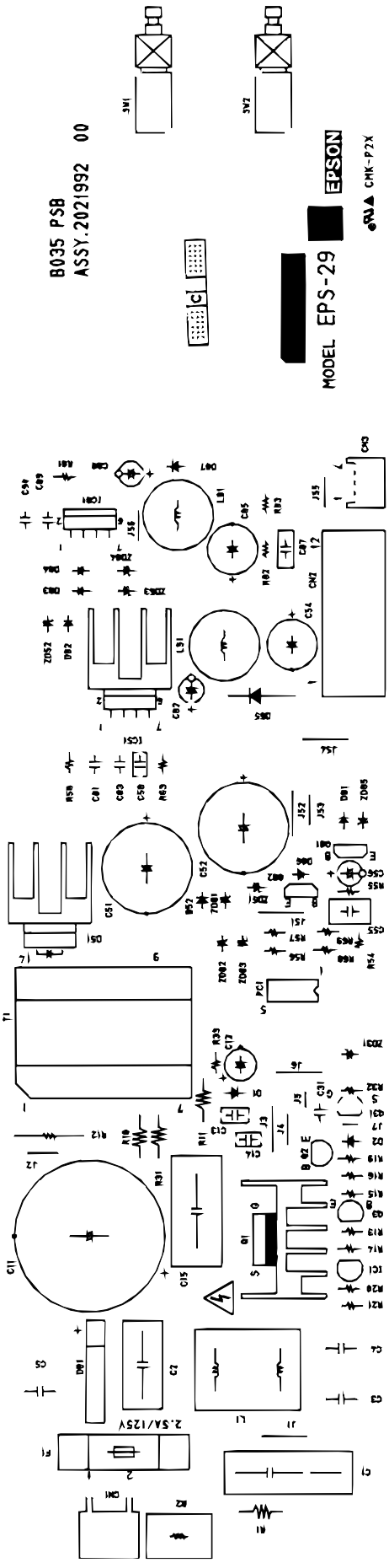

Figure A-12. B035 PSB Board Component Layout

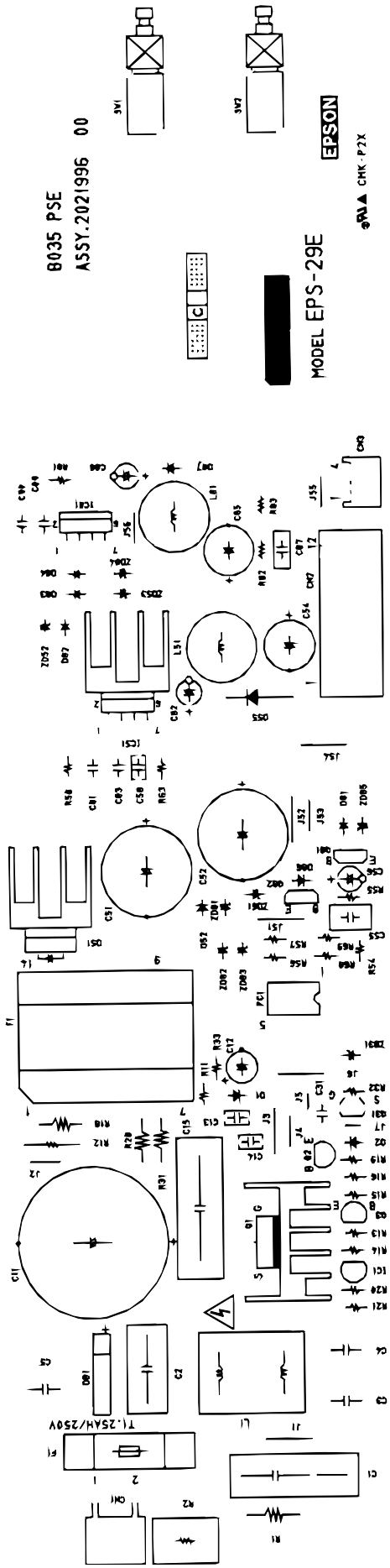

Figure A-13. B035 PSE Board Component Layout

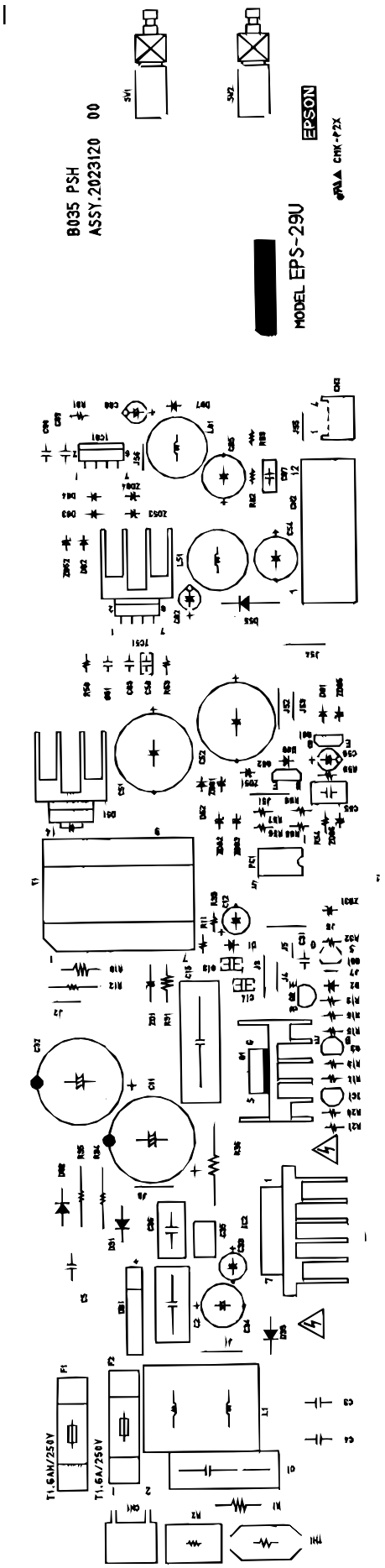

Figure A-14. B035 PSH Board Component Layout

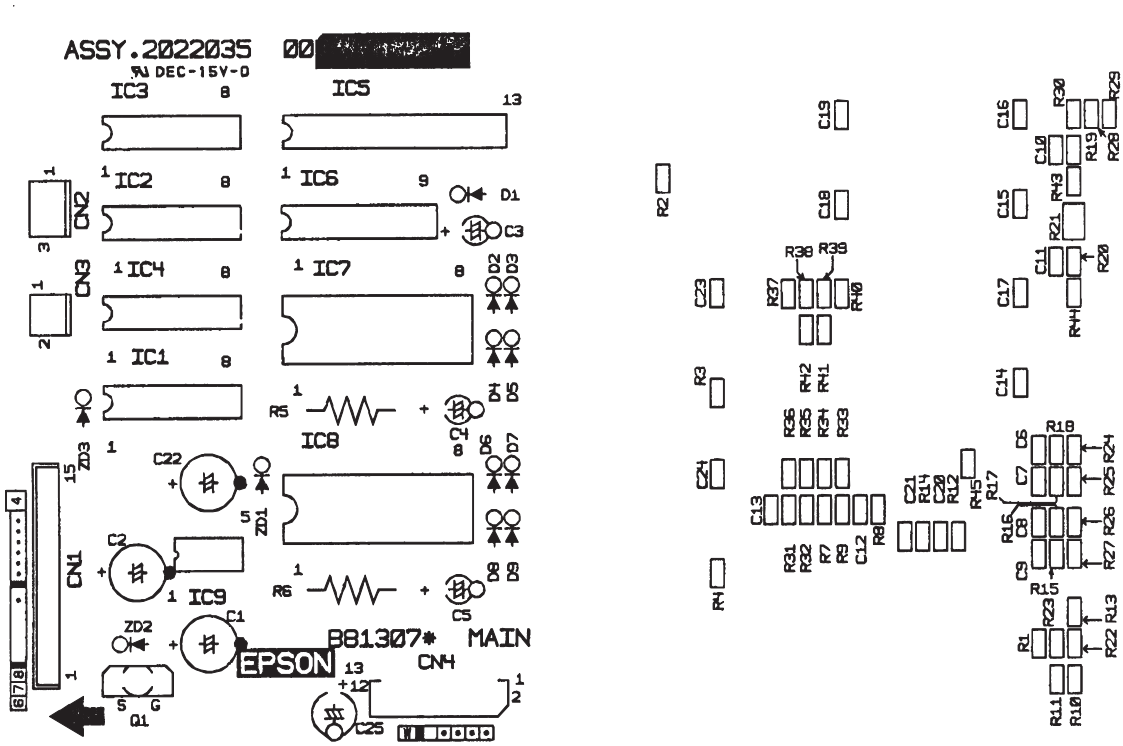

Figure A-15. B81307* MAIN Board Component Layout

A.4 EXPLODED DIAGRAMS

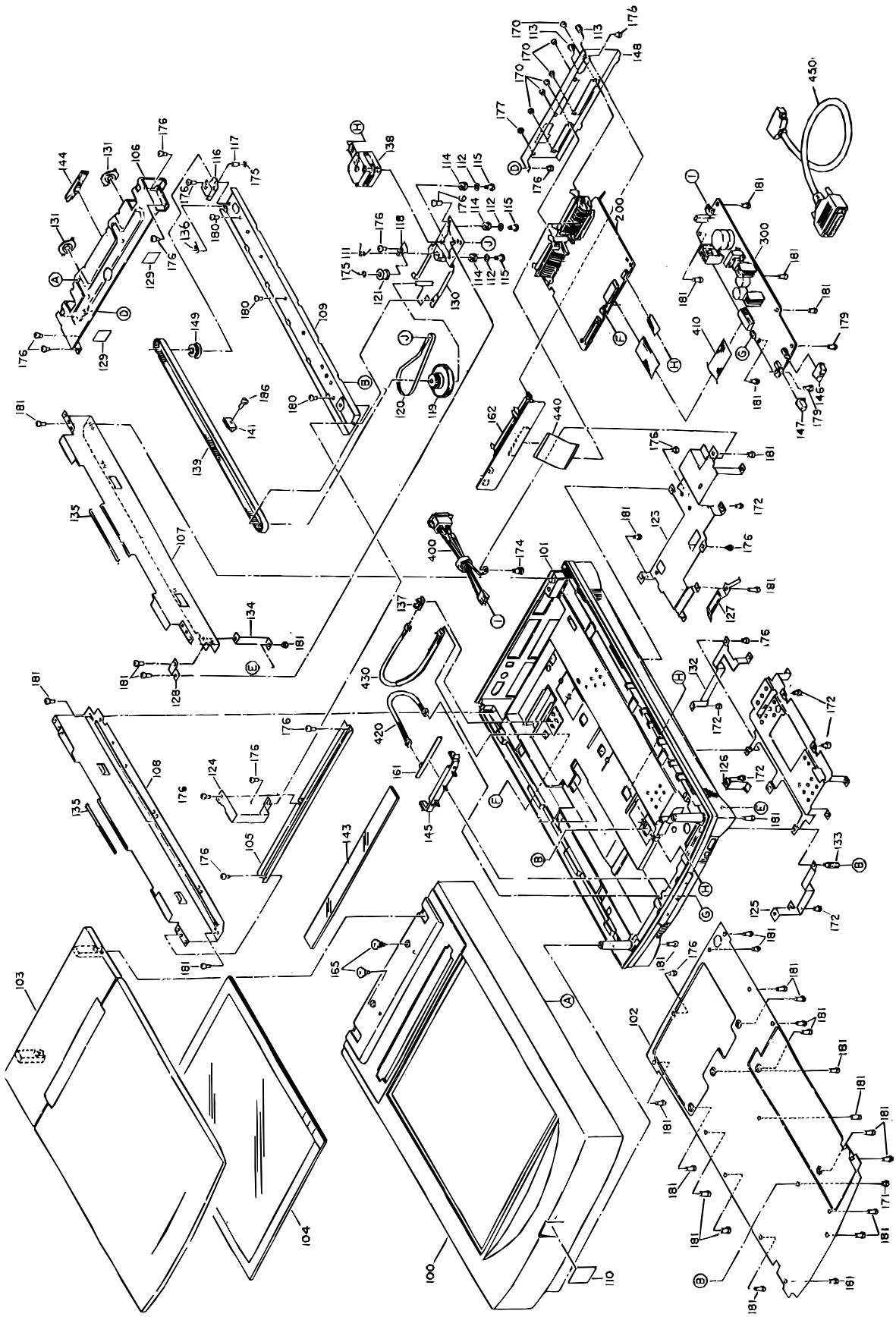

Figure A-16. Exploded Diagram (1)

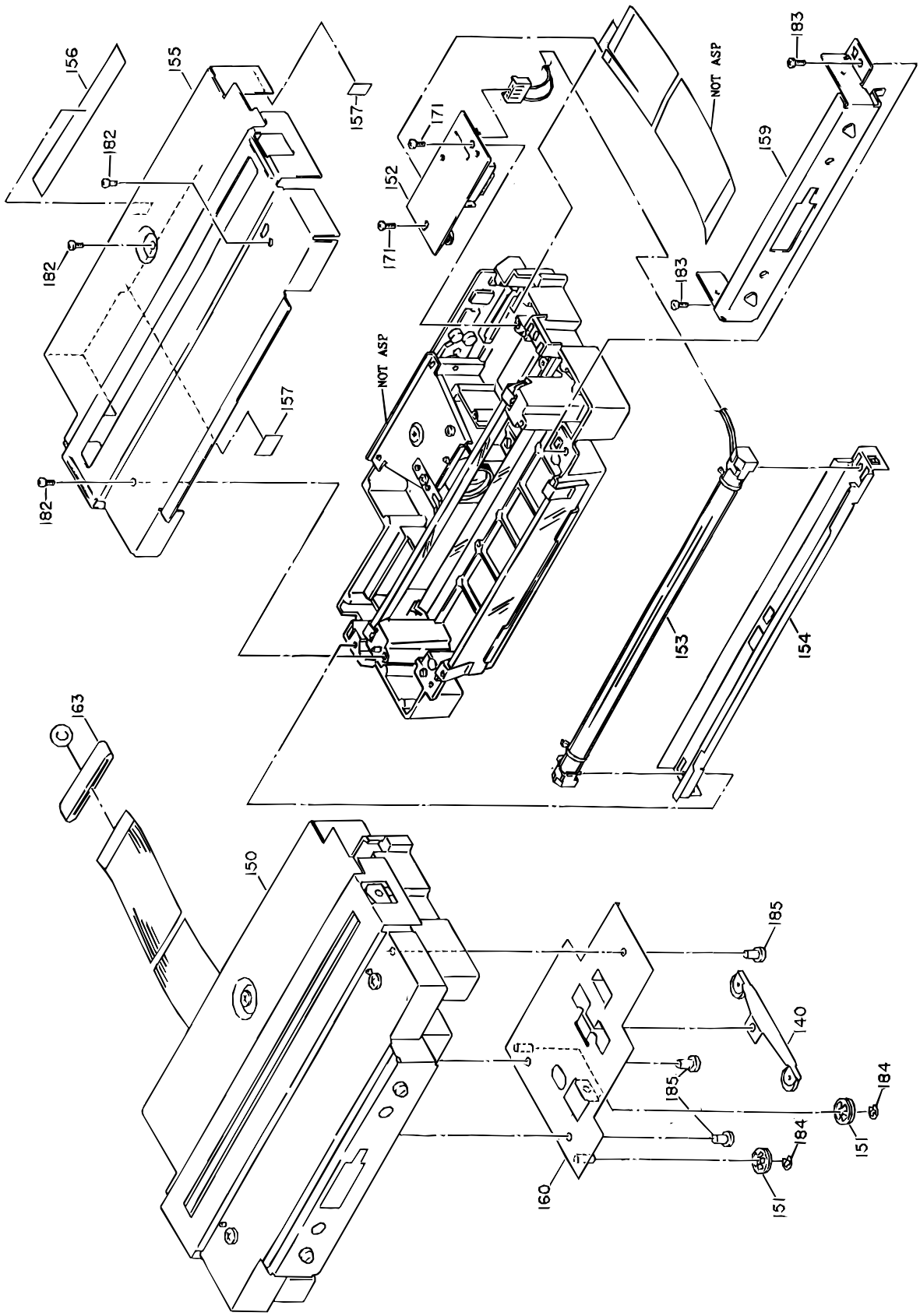

Figure A-17. Exploded Diagram (2)

Table A-7. Part Number 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	LARGE GLASS ASSEMBLY	GLASS ASSY, LARGE
105	FRONT FRAME	FRAME FRONT
106	REAR FRAME	FRAME, REAR
107	LEFT SIDE FRAME	FLAME ASSY, SIDE, L
108	RIGHT SIDE FRAME	FLAME ASSY, SIDE, R
109	CENTER RAIL	RAIL ASSY, CENTER
110	LOGO PLATE (For GT-9500)	LOGO PLATE
110	LOGO PLATE B (For Expression 636)	LOGO PLATE; B
111	TORSION SPRING 17100	TORSION SPRING, 17100
112	PLAIN WASHER $3 \times 0.5 \times 8$ F/Zn	PLAIN WASHER $3 \times 0.5 \times 8$ F/Zn
113	CONNECTOR SCREW	SCREW, CONNECTOR, ADF
114	CR DUMPER	DUMPER, CR
115	CR DUMPER SHAFT B	SHAFT, DUMPER, CR; B
116	DRIVEN PULLEY HOLDER	HOLDER, PULLEY, DRIVEN
117	DRIVEN PULLEY SHAFT	SHAFT, DRIVEN, PULLEY
118	TENSION LEVER ASSEMBLY	LEVER ASSY., TENSION
119	DRIVE PULLEY	PULLEY, DRIVE
120	TIMING BELT B	TIMING BELT; B
121	TENSION ROLLER	ROLLER, TENSION
122	POWER SUPPLY SHIELD PLATE	SHIELD PLATE, POWER SUPPLY
123	REAR SHIELD PLATE	SHIELD PLATE, REAR
124	FRONT GROUNDING PLATE	GROUNDING PLATE, FRONT
125	POWER SUPPLY GROUNDING PALTE	GROUNDING PLATE, POWER SUPPLY
126	BOTTOM GROUNDING PLATE	GROUNDING PLATE, BOTTOM
127	FFC GROUNDING PLATE	GROUNDING PLATE, FFC
128	MOTOR GROUNDING PLATE	GROUNDING PLATE, MOTOR
129	REAR FRAME SHEET	SHEET, FRAME, REAR
130	MOTOR FRAME	FRAME ASSY., MOTOR
131	REAR FRAME SLEEVE	SLEEVE, FRAME, REAR
132	POWER SUPPLY GROUNDING PALTE B	GROUNDING PLATE, POWER SUPPLY; B
133	GROUND HEXAGON NUT	HEXAGON NUT, GROUND
134	FRAME GROUNDING PLATE	GROUNDING PLATE, FREME
135	PROTECT FRAME SHEET	SHEET, FRAME, PROTECT
136	SPRING 600	EXTENSION SPRING, 600
137	HP SENSOR	DETECTOR, HP
138	CR MOTOR	MOTOR ASSY., CR
139	TIMING BELT	TIMING BELT
140	ROLLER HOLDER ASSEMBLY	HOLDER ASST., ROLLER
141	TIMING BELT CLUMP	CLUMP, TIMING BELT
143	SMALL GRASS	GLASS, SMALL
144	LOCK LEVER	LEVER, LOCK
145	OPTICAL PLATE	OPTICAL PLATE
146	POWER SWITCH KEYTOP	KEYTOP, POWER SWITCH
147	RESET SWITCH KEYTOP	KEYTOP, RESET SWITCH

Table A-7. Part Number Reference Table (Continued)

Ref. No.	Description	PPL Name
148	I/F COVER PLATE	COVER, I/F PLATE
149	DRIVE PULLEY	PULLEY, DRIVE
150	CARRIAGE ASSEMBLY (Scanner Head)	CARRIAGE ASSY.
151	CARRIAGE ROLLER C	ROLLER, CARRIAGE; C
152	INVERTER BOARD	BOARD ASSY., INVERTOR
153	LAMP	LAMP ASSY.
154	LAMP COVER	COVER, LAMP
155	CR COVER	COVER, CR
156	CARRIAGE COVER SHEET	SHEET, COVER, CARRIAGE
157	CARRIAGE COVER SHEET 2	SHEET, COVER, CARRIAGE; 2
159	MOUNT PLATE COVER	COVER, MOUNT PLATE
160	SUB CARRIAGE BASE ASSEMBLY	CARRIAGE SUB ASSY., BASE
161	LED BOARD ASSEMBLY	BOARD ASSY., LED
162	B027 I/F BOARD	BOARD, ASSY., I/F
163	LARGE FERITE CORE	FERITE CORE, LARGE
165	DOCUMENT COVER FITTING METAL	METAL FITTING COVER DOCUMENT
170	CP SCREW (M3 × 6)	C.P. SCREW (M3 × 6)
171	CB SCREW (M3 × 6)	C.B. SCREW (M3 × 6)
172	CB SCREW (M3 × 3)	C.B. SCREW (M3 × 3)
173	CPSP SCREW (M3 × 6)	C.P.S.P. SCREW (M3 × 6)
174	CB(O) SCREW (M4 × 8)	C.B.(O). SCREW (M4 × 8)
175	RETAINING RING TYPE-(3)	RETAINING RING TYPE-(3)
176	CBS SCREW (M3 × 6)	C.B.S SCREW (M3 × 6)
177	CPS(O) SCREW (M3 × 6)	C.P.S.(O) SCREW (M3 × 6)
178	CPSPS SCREW (M3 × 6)	C.P.S.P.S SCREW (M3 × 6)
179	CBB SCREW (M3 × 8)	C.B.B SCREW (M3 × 8)
180	CBB SCREW (M3 × 10)	C.B.B SCREW (M3 × 10)
181	CBB SCREW (M3 × 12)	C.B.B SCREW (M3 × 12)
182	CB(O) SCREW (M3 × 6)	C.B.(O). SCREW (M3 × 6)
183	CBS SCREW (M3 × 8)	C.B.S SCREW (M3 × 8)
184	RETAINING RING TYPE-E (2.3)	RETAINING RING TYPE-E (2.3)
185	CB(O) SCREW (M3 × 8)	C.B.(O). SCREW (M3 × 8)
186	CBS SCREW (M3 × 8)	C.B.S SCREW (M3 × 8)
200	MAIN BOARD ASSEMBLY	BOARD ASSY., MAIN
300	POWER SUPPLY BOARD	BOARD ASSY., POWER SUPPLY
400	AC INLET	HARNESS
410	CABLE	HARNESS
420	CABLE	HARNESS
430	CABLE	HARNESS
440	INTERFACE CABLE	CABLE, IF
460	POWER CABLE	POWER CABLE

A.5 CASE OUTLINE DRAWING

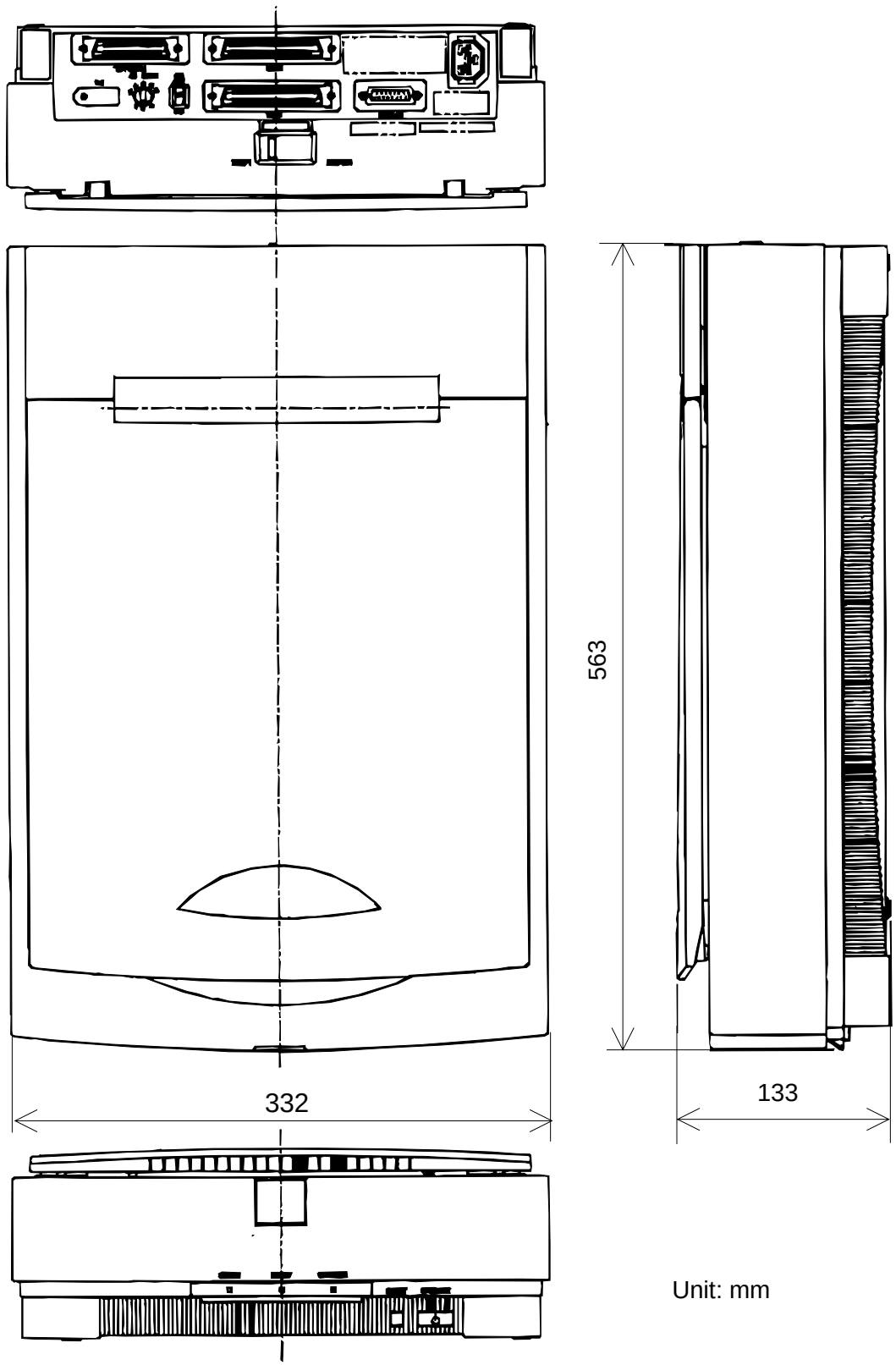

Figure A-18. GT-9500/Expression 636 Case Outline Drawing